May 13, 1958 V. R. BENNETT ET AL 2,834,339

POSITIVE PRESSURE BREATHING APPARATUS

Filed Dec. 14, 1955 2 Sheets-Sheet 1

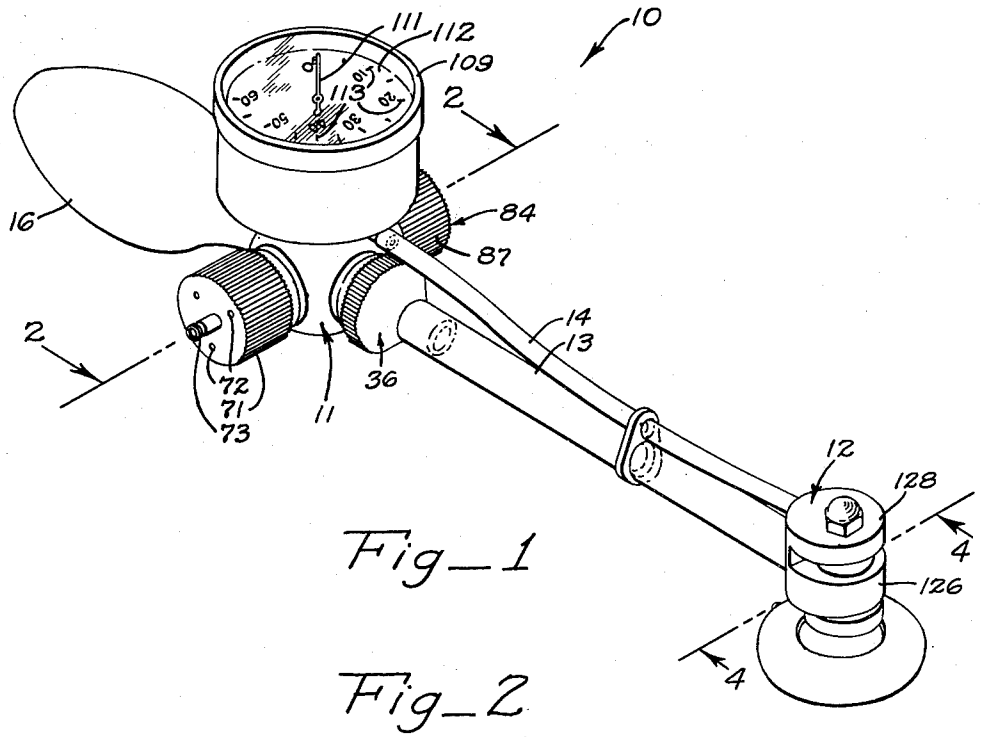

Fig_1

Fig_2

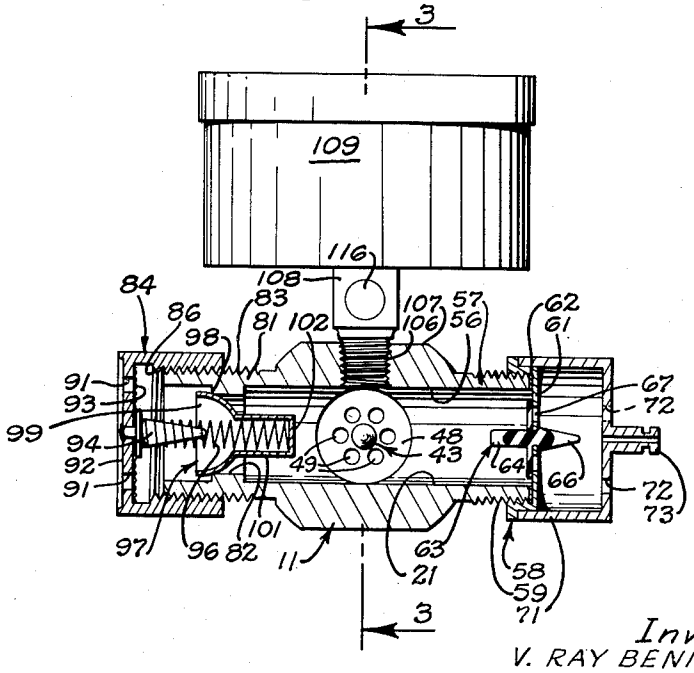

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Fig_3

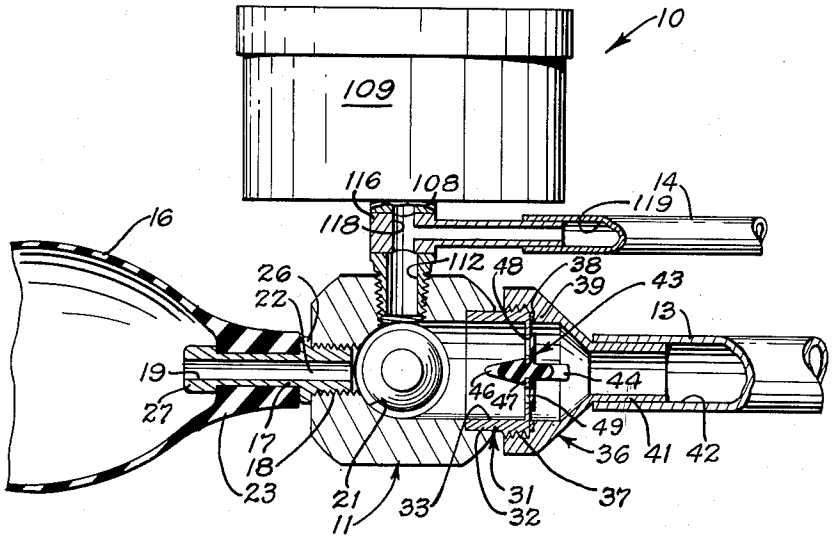


Fig_4

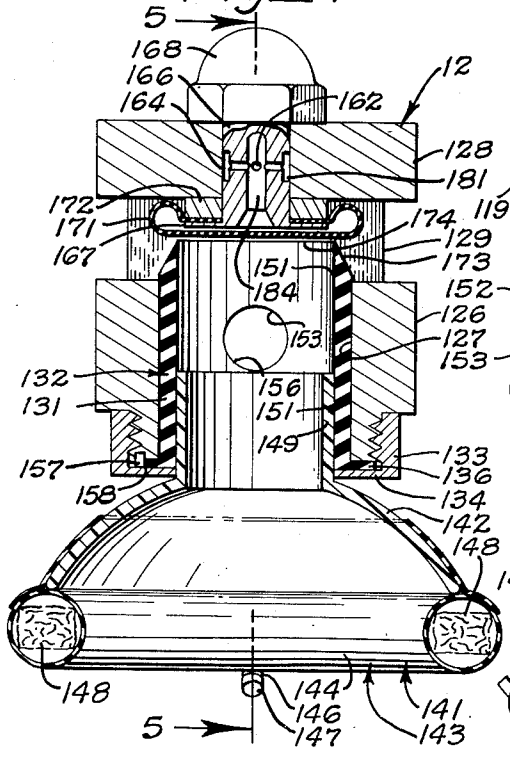
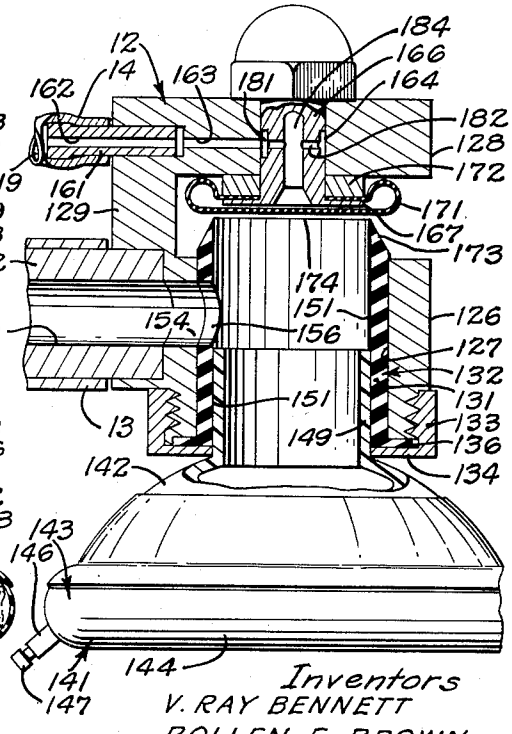


Fig_5



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POSITIVE PRESSURE BREATHING APPARATUS

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Application December 14, 1955, Serial No. 553,009

6 Claims. (Cl. 128—29)

The invention relates to kinesitherapy, and more particularly to positive pressure breathing apparatus for administering artificial respiration to infants.

One of the problems with which obstertricians frequently are confronted arises when a newly-born infant fails to start breathing and is not responsive to the stimuli commonly employed under such circumstances to induce commencement of the respiratory process. Occasionally, an infant is delivered who starts breathing, but so imperfectly that the prospects of survival are seriously jeopardized. These conditions are usually caused by complete or partial atelectasis, i. e., defective expansion of the pulmonary alveoli, and require that artificial respiration be administered promptly.

However, resuscitation to attain expansion of the lungs of an infant who exerts no respiratory effort at birth, or who is unable by his own effort to expand his lungs, is a form of treatment which in itself presents difficulties, requiring of the practitioner the highest degree of judgment and skill. Aid to the infant who has breathed spontaneously, but has partial atelectasis and respiratory distress, is likewise a difficult problem. The cause of these difficulties lies largely in the delicacy of an infant's lung tissue, and the consequent susceptibility of the lung to injury as a consequence of overdistension if inflated at pressures in excess of a maximum safe value.

Nevertheless, positive internal pressures in excess of 25 cm. of water are necessary to expand an infant's atelectatic lung—in fact, it has been ascertained that a newborn infant, in struggling for a breath, can produce an inflating pressure greater than 40 cm. of water. In some isolated cases, it has been found necessary to inflate at even higher pressure to overcome the factors resisting expansion of the human lung at birth. Not only must the natural elasticity of the lung tissue be overcome, but also the resistance offered by certain structures of the upper respiratory passageways, the thoracic cage, and the abdominal viscera. Actual practice has demonstrated that pressures in excess of 50 cm. of water must frequently be resorted to, in order to achieve uniform expansion of an infant's atelectatic lung.

Fortunately, however, extent of distension is proportional to both the magnitude of the internal pressure and the duration of the period throughout which the pressure is maintained. This phenomenon makes entirely feasible the application of internal pressures adequate to insure lung expansion provided such pressures are applied for short intervals. During clinical practice, pressures ranging as high as 60 cm. of water have been employed, but in order to assure against damaging the lungs, great care was exercised to permit such pressures to prevail for only very short intervals, of the order of from 0.2 to 0.6 seconds.

The factors of optimum pressure and time, however, are subject to considerable variation, depending upon the age, condition and other data pertaining to the individual case. Tidal flow, or volume of air required for each full respiratory cycle, and the respiratory pattern, or rate

of both inhalation and exhalation, are matters for which no fixed, universally applicable figures can be set, but must be determined by the physician in charge of the individual case.

It is an object of the present invention to provide an improved and simplified apparatus for administering artificial respiration.

Another object is to provide apparatus particularly adapted for use in administering artificial respiration therapy to infants.

Another object is to provide artificial respiration apparatus capable of administering air or other gas intermittently and at the same pressure during the pressure phase of successive cycles.

Another object is to provide apparatus of the character described whereby the pressure at which gas is supplied to the patient is at all times under the complete control of the administering technician, and is instantly variable, as charging conditions of the patient may dictate.

Another object of the invention is to provide apparatus for administering artificial respiration to an infant which is adapted to be applied to, and to be maintained in operative association with, the infant by one hand of the attending physician, and which is fully operable by the physician's other hand, so that both the infant and the apparatus are at all times under the physician's full observation and control, thus enabling him to remain completely sensitive to any symptomatic variations that the infant may exhibit and instantly to alter the manner in which he operates the apparatus in accordance with such changing conditions.

Another object is to provide artificial respiration apparatus as described, which is characterized by extreme accuracy in causing air to be administered at precisely the same pressure throughout the pressure phase of successive cycles.

Another object is to provide a control regulator so designed and so situated that it is instantly operable by thumb of the physician's hand by which the device is being operated, and without interrupting the continuity of such operation.

Another abnormal condition frequently encountered by obstericians immediately following a delivery, and likewise occasionally confronting pediatricians in the care of older children, is an oxygen deficiency of the tissues and the arterial blood. This anoxic condition likewise is responsive to artificial respiration, particularly if air or other gases having a high oxygen content are administered. Another object of the present invention, therefore, is to provide positive pressure breathing apparatus having incorporated therein means for introducing oxygen or other gases to the air administered by the device.

The invention possesses other objects and valuable features, some of which, with those enumerated, will be set forth in the following description of the preferred embodiments of the invention illustrated in the drawings accompanying and forming part of the specification. It is to be understood that variation may be made in the said drawings and description without departing from the scope of the invention as defined by the appended claims.

Referring to the drawings:

Figure 1 is a perspective of positive pressure breathing apparatus incorporating the principles of the present invention.

Figure 2 is a transverse section along the line 2—2 of Fig. 1.

Figure 3 is a fragmentary longitudinal section along the line 3—3 of Figure 2.

Figure 4 is a transverse section along the line 4—4 of Fig. 1.

Figure 5 is a fragmentary longitudinal section along the line 5—5 of Fig. 4.

For the purpose of facilitating illustration and description herein, an embodiment of the present invention has been chosen in the form of a manually operable respirator 10 comprising a pressure housing 11 and a manifold housing 12 interconnected by a main pressure tube 13 and an auxiliary pressure tube 14. Since the tubes 13 and 14 constitute the sole means interconnecting the housings 11 and 12, flexibility and consequent ease of manipulation is imparted to the entire device by using tubing of suitable flexible material such as any one of a wide variety of plastics presently available upon the open market. However, the material selected for the tubes 13 and 14, as well as for the remainder of the apparatus, should be impervious to the materials and temperatures apt to be encountered in clinical practice and in sterilizing the equipment.

A manually operable pneumatic bulb 16 is connected to the pressure housing 11 by a tube or nipple 17 (Fig. 3) having a threaded connection with the housing as indicated at 18. The bore 19 of the nipple 17 communicates with the pressure chamber 21 within the housing 11 through a passage 22 thereof. The neck 23 of the bulb 16 is relatively thick as compared with the wall thickness of the remainder of the bulb, to provide a relatively inflexible portion adapted to seat between flanges 26 and 27 of the nipple in such a manner that the pressure housing 11 may receive physical support from the bulb when the latter is grasped in a hand of an operator, and also that the neck 23 establishes a substantially air-tight seal with the nipple 17. The bulb 16 is of a size and shape adapting the same to be grasped comfortably in one hand, so that the operator, by alternately squeezing and releasing pressure upon the bulb 16, can cause air to be forced from the bulb into the chamber 21, and from the chamber into the bulb, respectively. The bulb 16 is of such a nature that upon release of external, squeezing pressure thereupon, the inherent resiliency of the material of which the bulb is made will cause the bulb 16 to spring back to normal, bulbous form from the collapsed form to which it was deformed by manual, squeezing pressure.

The main pressure tube 13 is connected to the housing 11 by a tubular fitting 31 whose shank 32 is rigidly affixed to the housing 11 in such a manner that its relatively large bore 33 communicates with the housing's chamber 21. A tubular cap 36 of tubular frusto-conical form is removably secured to the exterior of the fitting 31 by threads 37, a gasket 38 being interposed between the outer end of the fitting 31 and an internal flange 39 of the cap. A tubular nipple 41 on the outer, smaller end of the cap 36 is fitted to the bore 42 of the main pressure tube 13 to secure the tube 13 to the cap 36 and thereby establish communication between the bore 42 of the tube 13 and the pressure chamber 21. However, flow of gas between the chamber 21 and the bore 42 is uni-directional only, being controlled by a check valve 43 of thin, highly flexible rubber or like material. This valve 43 is integral with a stem 44 whose inner end is formed with a tapered head 46 adapted to be forced through a central hole 47 in a plate 48 integral with the fitting 31 and extending across the bore 33 thereof. Thus mounted on the fitting 31, the valve 43 is adapted to prevent flow into the chamber 21 through holes 49 in the plate 48 which provide the only means of communication between the chamber 21 and the bore 42 of the tube 13. However, upon creation of higher pressure within the chamber 21 than that existing within the tube 13, the relatively large size and number of the holes 49, and the extreme flexibility of the thin valve 43, permit flow from the pressure chamber 21 to the tube 13 with so little resistance that pressure drop resulting therefrom is negligible.

Air is admitted to the chamber 21 through the bore 56

of a nipple 57 integral with and extending laterally from the pressure chamber 11. A fitting 58 removably secured to the nipple 57 by threads 59 includes an apertured plate 61 extending across the bore 56 at the outer end of the nipple. A gasket 62 is interposed between the plate 61 and the outer end of the nipple 57. A check valve 63 similar in form to the check valve 43 previously described, is similarly mounted by its stem 64 and tapered head 66 on the plate 61, but in this instance upon the inner face of the plate 61 so as to permit gas to flow into the chamber 21 through the ports 67 of the plate 61 when pressure less than atmospheric exists within the chamber 21. However, when pressure higher than atmospheric exists within the chamber 21, the valve 63 seals the ports 67 against outward flow therethrough.

A cap 71 is press fitted to the outer circumferential wall of the fitting 58 and encloses the apertured plate 61 and the protruding tapered head 66 of the valve stem 64. The cap 71 is provided with a plurality of air inlet holes 72 and a tubular nipple 73 which provides convenient means for connecting a source of oxygen (not shown) to the apparatus in such a manner that oxygen can be supplied to the interior of the cap 71. Accordingly the cap 71 functions as an accumulator for supplying to the intake ports 67 a mixture of oxygen and air in any desired proportions, or of air at atmospheric pressure, as the condition of the individual under treatment may require.

Another and longer tubular nipple 81 (Fig. 2) is formed integrally with the housing 11, extending laterally therefrom in position opposite the nipple 57, with its bore 82 communicating with the pressure chamber 21. Running threads 83 are formed on the exterior of the nipple 81, for the reception thereon of a cap 84 whose internal threads 86 engage the threads 83 in such a manner that the cap 84 can be adjusted axially by turning the cap on the nipple 81. The parts are so proportioned and arranged that while an operator supports the housing 11 by grasping the bulb 16 in his right hand, he can extend the thumb of that hand (see Fig. 1) into engagement with the exterior cylindrical surface 87 of the cap 84 and rotate the same and thereby effect axial adjustment of the cap toward or away from the housing 11 wtihout requiring the use of his left hand, which is thus left free to hold the manifold housing 12. Suitable knurling, preferably in the form of parallel, closely spaced and relatively sharp ridges may be provided on the surface 87 of the cap 84, to facilitate such manipulation of the cap.

A plurality of outlet ports 91 are provided in the end 92 of the cap, and a screen 93 is secured within the cap 84 in position extending across the ports 91. A pin 94 rigid with the end 92 of the cap 84 and extending axially from the interior surface thereof, provides support for the outer end of a coiled compression spring 96, the inner end of which engages a relief valve 97, in such a manner that the spring 96 serves the dual purpose of yieldingly pressing the valve 97 toward an annular seat 98 encircling the bore 82 of the nipple, and of retaining the valve 97 in coaxial relationship with the bore 82. The body 99 of the valve 97 is of substantially hemispherical form, and is provided with a tubular socket portion 101 extending axially from the body portion 99 in a direction perpendicular to the flat side of the hemisphere defined by the body portion. The distal end 102 of the socket 101 is closed, and the spring 96 imposes its yielding pressure against the inner surface of the socket end 102. Hence, the pressure of the spring 96 is exerted against the valve 97 at such a location and in such a direction that the force of the spring retains the axis of the socket 101 in substantially coaxial relation with the bore 82, and the flat side of the hemisphere defined by the body 99 of the valve substantially parallel to the plane of the annular valve seat 98. Thus it may be seen that the configuration of the valve 97 and the

manner in which the spring **96** is applied thereto, assure proper alignment of the valve **97** with respect to the seat **98**, thus avoiding the necessity of providing guiding means for slidable engagement by the valve to preserve alignment of the same.

A tapped hole **106** is provided in the top **107** of the housing for the reception of the threaded tubular stem **108** of a pressure gauge **109**. Since the internal mechanism of the pressure gauge forms no portion of the present invention, it need not be illustrated or described herein, and it will suffice for the purposes of the present disclosure to explain that its indicating hand **111** (Fig. 1) is subject to movement with respect to a dial plate **112** in proportional response to variation of pressure within the chamber **21**, and that since the type of service for which the resuscitator **10** of the invention is intended requires the generation of quite low pressures, the gauge **109** is highly sensitive, and the calibrations **113** on the dial plate cover a band of low pressures, for example, of the order of from 0 to 60 centimeters of water. It will be appreciated, therefore, that the spring **96** of the relief valve **97** should likewise be so designed that when the cap **84** is adjusted to its innermost position on the nipple **81**, the spring will yield and permit the valve **97** to move off its seat **98** when the gas pressure within the chamber **21** exceeds that which corresponds to the calibration **113** of highest numerical value. It will be readily understood, therefore, that the cap **84** can easily and rapidly be adjusted to permit the relief valve **97** to open when the gas pressure within the chamber **21** exceeds any selected value within the range of pressures to which the calibrations **113** are appropriate.

The stem **108** of the pressure gauge **109** is transversely drilled (Fig. 3) to receive a small tubular nipple **116** whose bore **118** communicates with the bore **112** of the stem **108**. The auxiliary pressure tube **14** is fitted tightly onto the nipple **116**, thus constantly maintaining communication between the chamber **21** and the bore **119** of the auxiliary pressure tube **14**.

By referring now to Figures 4 and 5, it will be seen that the manifold housing **12** comprises a tubular body **126** whose bore **127** extends vertically, and an upper horizontal plate **128** extending over the upper end of the bore **127**, the axis of the bore **127** being perpendicular to the general plane of the plate **128**. A connecting portion **129** integral with both the body **126** and the plate **128**, rigidly maintains the plate spaced above the upper end of the body **126**. The tubular shank **131** of a bushing **132** is fitted to the bore **127**, within which the shank **131** is retained by a collar **133** threaded onto the lower end of the body **126** and including a flange **134** engaging the outer face of an end flange **136** integral with the shank **131** of the bushing **132**.

The bushing **132** provides means for releasably attaching a facial mask **141** in operative arrangement upon the manifold housing **12**. The mask **141** preferably is constructed in accordance with the general principles of that forming the subject matter of U. S. Patent No. 2,540,567, issued to me on February 6, 1951, since it includes a plastic, funnel-shaped body portion **142** to the outer peripheral edge of which is secured a resiliently yieldable cuff **143** in the form of an inflatable pneumatic annulus tube **144** adapted to be gently inflated through a tubular stem **146** into which a headed pin **147** is insertable to retain inflating air within the tube. A cushion **148** of soft textured sponge rubber loosely disposed within the tube **144** prevents complete collapse of the latter when pressure is exerted thereagainst in any localized area, as by a prominent cheek bone or sharp chin configuration. Hence, the cuff **143** is adapted to conform to facial features of a child to provide a substantially air-tight seal encircling the mouth and nose, without discomfort to the patient.

A tubular nipple **149** integral with the body portion **142** is dimensioned to fit into the bore **151** of the bushing **132** sufficiently tightly to retain the mask **141** in, with the interior of the mask in communication with the bore **151** of the bushing against accidental displacement therefrom, and yet to permit the mask to be amply and easily detached from the manifold housing. This ready detachability of the mask **141** permits selection of a particular mask from an assortment of different sized masks to meet the requirements of an individual patient. Secure retention of a selected mask in operative relation to the manifold housing **12** against accidental displacement, without impairment of the ready removability of a mask when circumstances require so doing, is attained, in part, by forming the bushing **132** of a suitable grade of hard rubber, which is dimensionally stable, non-absorbent, and inert to the chemicals and temperature required for sterilization.

A nipple **152** rigid with the manifold housing **12** extends laterally therefrom, with its bore **153** in communication with the bore **151** of the bushing **132** through a lateral passage **154** in the side wall of the housing **12** and an aperture **156** in the shank **131** of the bushing **132**. A dowel pin **157** (Fig. 4) extending from the bottom face of the housing **126** seats within a notch **158** in the flange **136** of the bushing **132**, to assure alignment of the aperture **156** with the passage **154**. The main pressure tube **13** is fitted onto the nipple **152**, thus providing a continuous passage between the pressure chamber **21** and the interior of the face mask **141** attached to the manifold housing **12**, which passage is obstructed by only the check valve **43**. As above pointed out, this check valve **43** permits substantially unrestricted flow outwardly of the pressure chamber **21** and prevents reversal of flow from the tube **13** into the chamber **21**.

The auxiliary pressure tube **14** is connected to a nipple **161** rigid with and extending laterally from an edge of the plate **128** with its bore **162** communicating with a passage **163** within the plate. The passage **163** extends into a cylindrical opening **164** extending through the plate **128** in axial alignment with the bore **127** of the body **126** of the manifold housing **12**. A tubular stem **166** fitted to the opening **164** extends through the plate **128** to dispose a flange **167** integral with one end of the stem in position between the plate **128** and the body portion **126** of the housing **12**. A nut **168** is threaded onto the opposite end of the stem **166** in position to be tightened against the outer face of the plate **128**.

A hollow bulb **171** of highly flexible, resilient, impervious material (e. g. natural rubber or rubber-like material) is supported on the stem **166**, whose flange **167** is disposed inside the bulb **171** (see Figs. 4 and 5). The peripheral edge of the bulb **171** is clamped between the flange **167** and a collar **172** encircling the stem, when the nut **168** is tightened. Thus, it may be seen that the bulb **171** is mounted in position above the bushing **132**, which extends above the upper end of the body **126** and is preferably beveled as indicated at **173** to form a relatively thin valve seat **174** encircling the bore **151** of the bushing **132** and adapted to be engaged by the bulb **171** in such manner that the upper end of the bushing is effectively closed when the bulb **171** is expanded into engagement with the seat **174**. When the bulb **171** is unstressed, however, it is lifted off the seat **174**, as illustrated in Figs. 4 and 5, thus leaving the bore of the bushing **132** and the interior of the face mask **141** open to the atmosphere with little or no restriction.

Expansion of the bulb **171** into closing relation with the seat **174** is effected in response to rise in pressure within the pressure chamber **21**, since the passage **163** leads into an annular passage **181** in the outer surface of the stem **166**, and radial holes **182** lead from the passage **181** into a bore **184** formed in one end of the stem **166** and communicating with the interior of the bulb **171**. Thus it will be understood that the bulb **171** and valve seat **174** co-operate to function as an exhalation valve structure whose operation resembles that of the

exhalation valve disclosed in U. S. Patent No. 2,648,331 issued to me on Aug. 11, 1953.

Operation

Since the resuscitator **11** of the invention is of small size and of simple and light weight construction, it is well adapted to be included among the instruments with which an obstetrician may be equipped when attending a birth. A small, readily portable hand case (not shown) can conveniently accommodate the resuscitator **11** and an assortment of interchangeable face masks **141** of various sizes as well as a catheter tube and a supply of adapters whereby the catheter tube can be attached to the bushing **132** in place of a face mask in the event that the circumstances of an individual are not conducive to the satisfactory use of a mask.

Assuming, however, that the circumstances involving a child requiring artificial respiration permit the use of a mask, the attending physician will select from the assortment of masks available the particular mask **141** best suited to the size of the child's facial features. After the selected mask **141** is attached to the manifold housing **12** by inserting the mask's nipple **141** into the bushing **132**, the physician should hold the manifold housing in one hand and support the pressure housing **11** by grapsing the bulb **16** in his other hand. The instrument **10** should then be placed in operative association with the child by seating the mask **141** over his nose and mouth, whereupon artificial respiration may immediately be started by simply squeezing the bulb **16**. This will force air into the pressure chamber **21**, whence it flows due to the pressure differential thus established, past the check valve **43**, through the main pressure tube **13** and into the manifold housing **12**.

Simultaneously with flow of air through the main pressure tube **13**, air flows also through the auxiliary pressure tube **14**, inflating the bulb **171** and closing the upper end of the bushing **132** and thereby preventing escape of air from the pressure housing **12** except through the mask **141** and thence to the child's pulmonary system. Air is thus forced into the lungs of the child at the pressure for which the pressure regulating cap **84** is set. This will force the lungs to expand against the natural resiliency of the child's entire thoracic cage.

At the expiration of a suitable time interval, the physician should release his squeezing pressure upon the bulb, which will, due to its own inherent resiliency, expand to its normal, unstressed configuration, and in doing so create a partial vacuum within the bulb **16** and the pressure chamber **21**. Flow of air to the mask **141** will thereupon cease, the check valve **43** will close and thereby prevent reversal of flow in the main pressure tube **13**. However, sufficient flow reversal will occur within the auxiliary pressure tube to relieve the pressure within the bulb **171** which then retracts to its unstressed form, and thus effects opening the upper end of the bushing **132** to the atmosphere. Thus, pressure within the mask **141** is permitted to drop instantly to that of the ambient atmosphere, whereupon the child is enabled to exhale through the muscular effort involved in normal breathing, and/or under the influence of the inherent, natural resiliency of the thoracic cage. In the event that the child is incapable of exerting the said muscular effort, the resiliency of the thoracic cage will induce exhalation of a sufficient volume of air to meet temporary requirements and permit continued use of the resuscitator **10**.

At the expiration of a suitable time interval after termination of exhalation, the bulb should again be squeezed, thus starting another cycle of operation, which should be continually repeated for as long a period as the condition of the child may require.

The rhythm according to which the instrument **10** is operated is a highly critical matter and one which is to be determined by the judgment of the attending physician. It will depend upon such factors as the age and condition of the child, and since it is beyond the scope of the present disclosure to enter into the details thereof, it will presently suffice to set forth the following illustrative examples of the time duration of the inhalation-exhalation cycles that proved beneficial in the administration of artificial respiration to a premature infant and to a full term infant:

	Premature Infant	Full Term Infant
Respiratory rate (cycles per minute)	50–70	40–60
Tidal Volume, c. c. per breath:		
Average	5–17	18–25
Peak	25–50	40–50
Time of inspiration	0/3–0/6	0/5–0/6
Pressure Exerted (in cm. of water):		
Average	13–30	14–28
Peak	30–50	20–46

The respiratory pattern, i. e., the time duration of the full cycle, as well as of the several constituent parts thereof (inspiration, pause, expiration, pause) is at all times under the full control of the operator, and it is in this regard that the small, compact nature of the instrument **10**, the manner of its application to the infant, and the manner of its operation are particularly important. Being applied directly to the infant, the instrument is at all times within the field of vision of the operator without his having to remove his attention from the infant. The operator's hand by which the mask **142** is applied to the child's face is fully sensitive to any movements that the child may make. It is readily understandable, therefore, that application of the apparatus to the child, and actual operation of the apparatus, do not in any way distract the operator's attention from the child, thus permitting him to remain keenly observant of, and sensitive to, any changes in the child's condition and responses that may develop.

In cases involving the correction of atelectasis, it has been found advisable to employ relatively high pressures over short time intervals, rather than hesitant, lower pressure which more often result in incomplete and non-uniform expansion. Subsequently to initial expansion, lower pressures must be employed to avoid damage to the already expanded lung. In any case, the pressure should be ample to effect expansion, but extreme care must be exercised to avoid exceeding a safe maximum, to avoid rupture of the lung tissues.

In this connection, it should be observed that whereas the selection of the actual pressure at which air is to be forced into the child's lungs is a matter requiring the judgment of the operator, the relief valve **97**, spring **96** and relief pressure regulating cap **84** are so designed and arranged that once the operator has decided just what pressure should be employed, the cap is easily within the reach of the thumb of the hand within which the bulb **16** is held, and can be almost instantly adjusted to attain the desired pressure during each succeeding application of squeezing pressure to the bulb **16**, with little or no interruption of the rhythm of the breathing pattern being followed.

The immediate proximity of the exhalation port defined by the valve seat **174** to the point of attachment of the mask **141** to the pressure housing **12** is worthy of note, since it reduces to a minimum the length of the passages containing exhaled air which must be re-breathed before fresh air reaches the child's lungs during the next successive operation of the apparatus, and thus reduces to a minimum the volume of previously breathed air that the infant must inhale at the inception of each inspiratory portion of the breathing cycle.

Having thus described our invention, that which is believed to be new and for which protection is desired by United States Letters Patent, is:

1. Positive pressure breathing apparatus comprising a

manually supportable bulb compressible to expel air therefrom, a housing connected to the bulb for support therefrom and having a chamber communicating with the interior of the bulb, said housing having inlet and outlet ports communicating with said chamber, check valves associated with said ports, a flexible delivery tube secured to the housing with its bore communicating with said outlet port, a face mask secured to the delivery tube with the interior of the tube in communication with the bore of the tube, means defining an exhalation port adjacent said mask and in communication with the interior of the same, valve means operatively associated with said exhalation port, and means operative in response to fluctuation of pressure within said chamber for controlling said valve.

2. Positive pressure breathing apparatus comprising a manually supportable bulb compressible to expel air therefrom, a housing connected to the bulb for support therefrom and having a chamber communicating with the interior of the bulb, said housing having inlet and outlet ports communicating with said chamber, check valves associated with said ports, a flexible delivery tube secured to the housing with its bore communicating with said outlet port, a face mask secured to the delivery tube with the interior of the tube in communication with the bore of the tube, means defining an exhalation port adjacent said mask and in communication with the interior of the same, a valve mounted for movement into a position in closing relation with said exhalation port, and means operative in response to increase in pressure within said chamber for moving the valve into said port closing position.

3. Positive pressure breathing apparatus comprising a manually supportable bulb compressible to expel air therefrom, a housing connected to the bulb for support therefrom and having a chamber communicating with the interior of the bulb, said housing having inlet and outlet ports communicating with said chamber, check valves associated with said ports, a hollow manifold housing, a flexible tube establishing communication between the interior of said manifold housing and a patient's respiratory system, said manifold housing having an exhalation port leading from the interior thereof to the atmosphere, an inflatable bulb valve, and means establishing communication between said chamber and the interior of said bulb valve, and means mounting said bulb valve exteriorly of said housing in position to close said exhalation port in response to increase of pressure within the chamber.

4. Positive pressure breathing apparatus comprising a

pneumatic bulb adapted to be grasped in a hand of an operator, means for supplying to the bulb gas to be administered to a patient, a housing having therein a chamber in communication with the interior of the bulb to receive a charge of the gas upon compression of the bulb, means for establishing communication between the chamber and the patient's respiratory system, an extension on said housing having a bore leading from said chamber, a valve seat encircling said bore; a cap threadedly engaged with said extension and rotatable with respect to the same by a digit of the operator's hand grasping the bulb, a valve in operative association with said seat and including a substantially hemispherical head of larger diameter than the seat and a socket extending radially from the head, and a spring having one end bearing against an interior surface of the cap and the other end seated within said socket to press the head yieldably against the seat and thereby to retain the valve in coaxial alignment with the seat.

5. Positive pressure breathing apparatus comprising manually controllable means adapted when actuated to expel air therefrom; means presenting a chamber in communication with said manually controllable means and provided with inlet and outlet ports; a check valve operably associated with each of said ports respectively; means for administering gas to the respiratory system of a human being; pneumatic conduit means coupling said outlet port with said gas administering means, said inlet port being adapted for coupling with a source of said gas; means presenting an exhalation port communicating with said gas administering means; valve means operably associated with said exhalation port; and control means operably coupled with said valve means and automatically operative in response to fluctuation of gas pressure within said chamber for controlling said valve means.

6. In apparatus as set forth in claim 5, wherein said control means is automatically operative in response to an increase in gas pressure within said chamber for actuating said valve means to close said exhalation port.

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