

March 26, 1935.

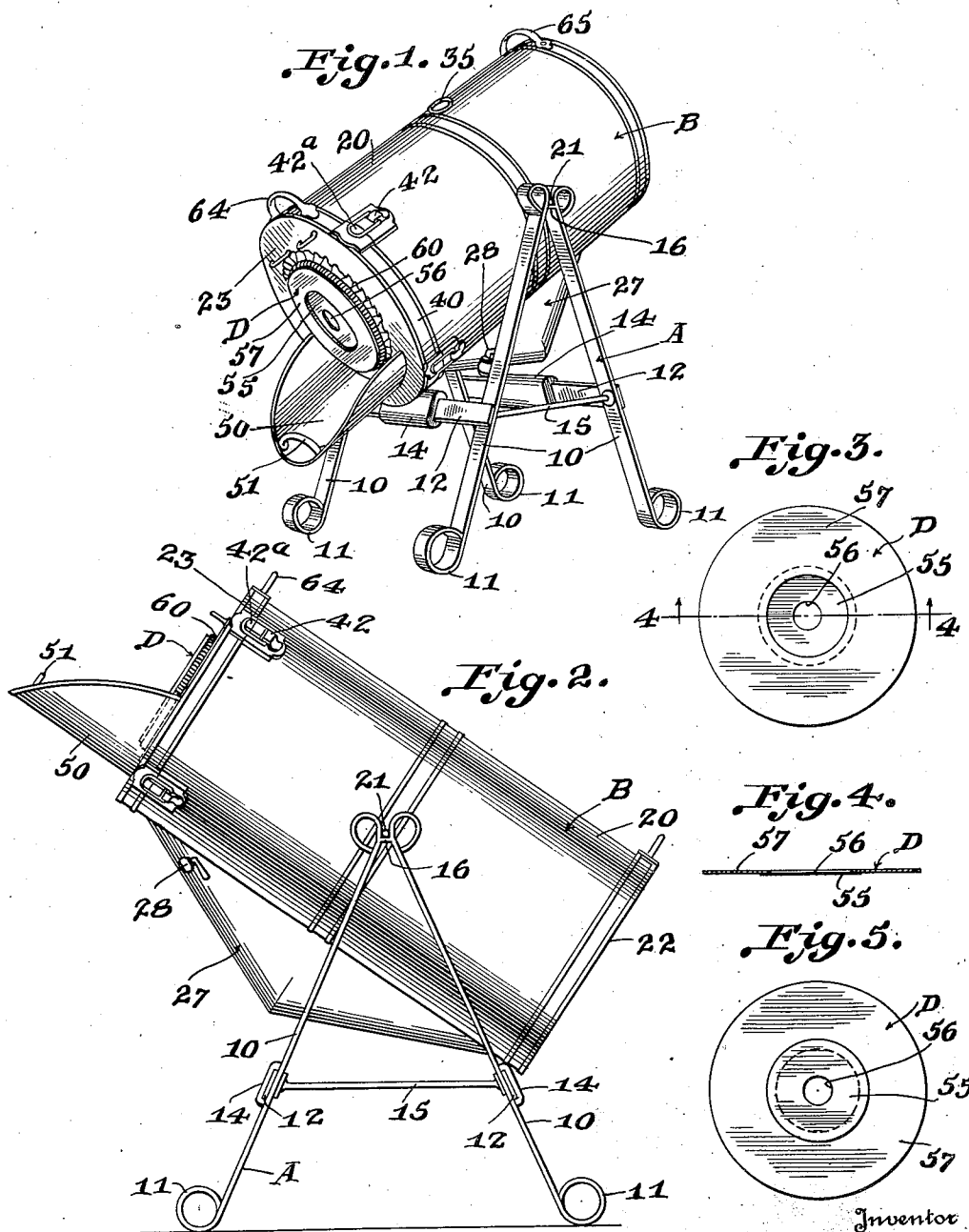
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RESUSCITATION APPARATUS

Filed Feb. 21, 1933

3 Sheets-Sheet 1



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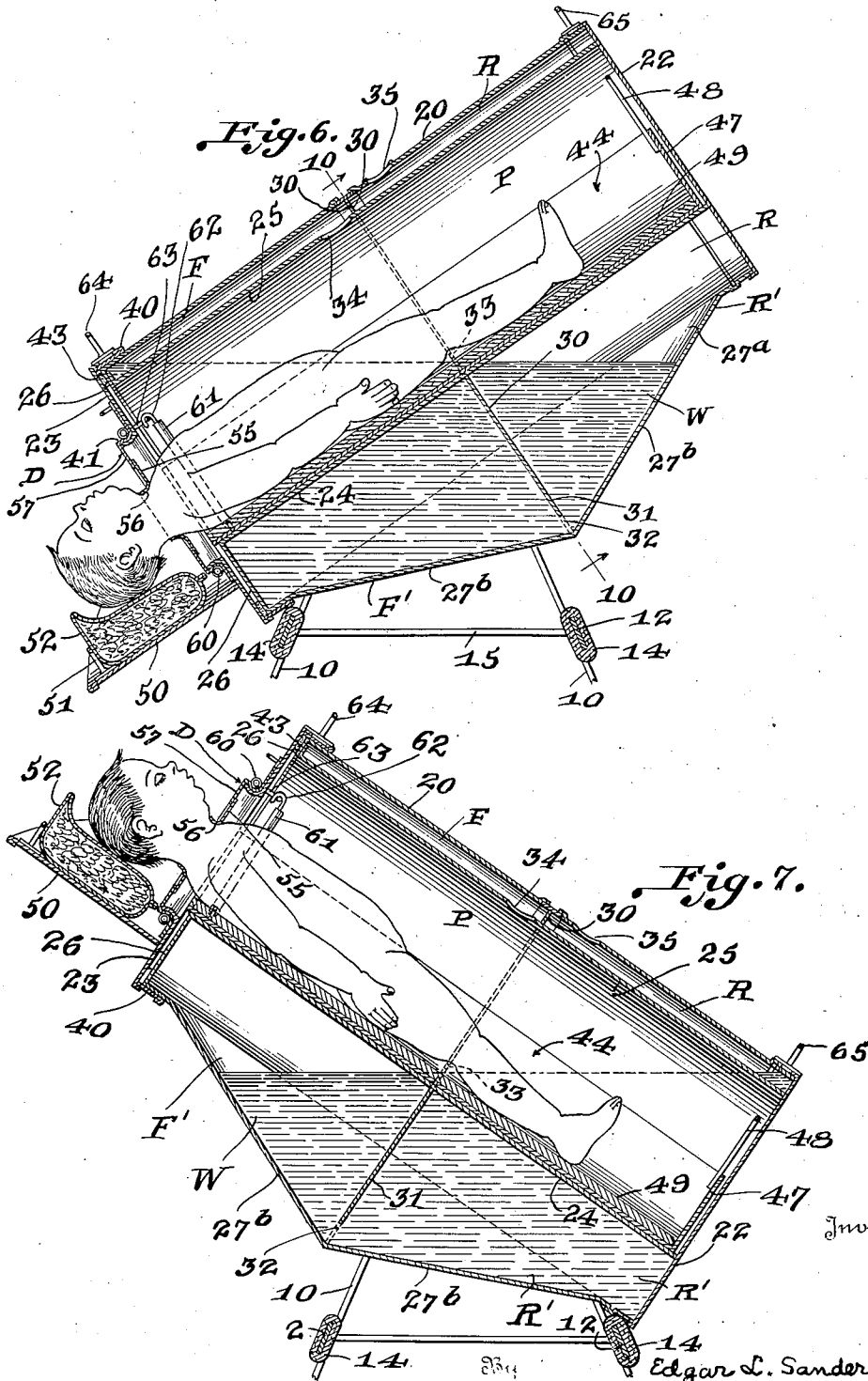
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RESUSCITATION APPARATUS

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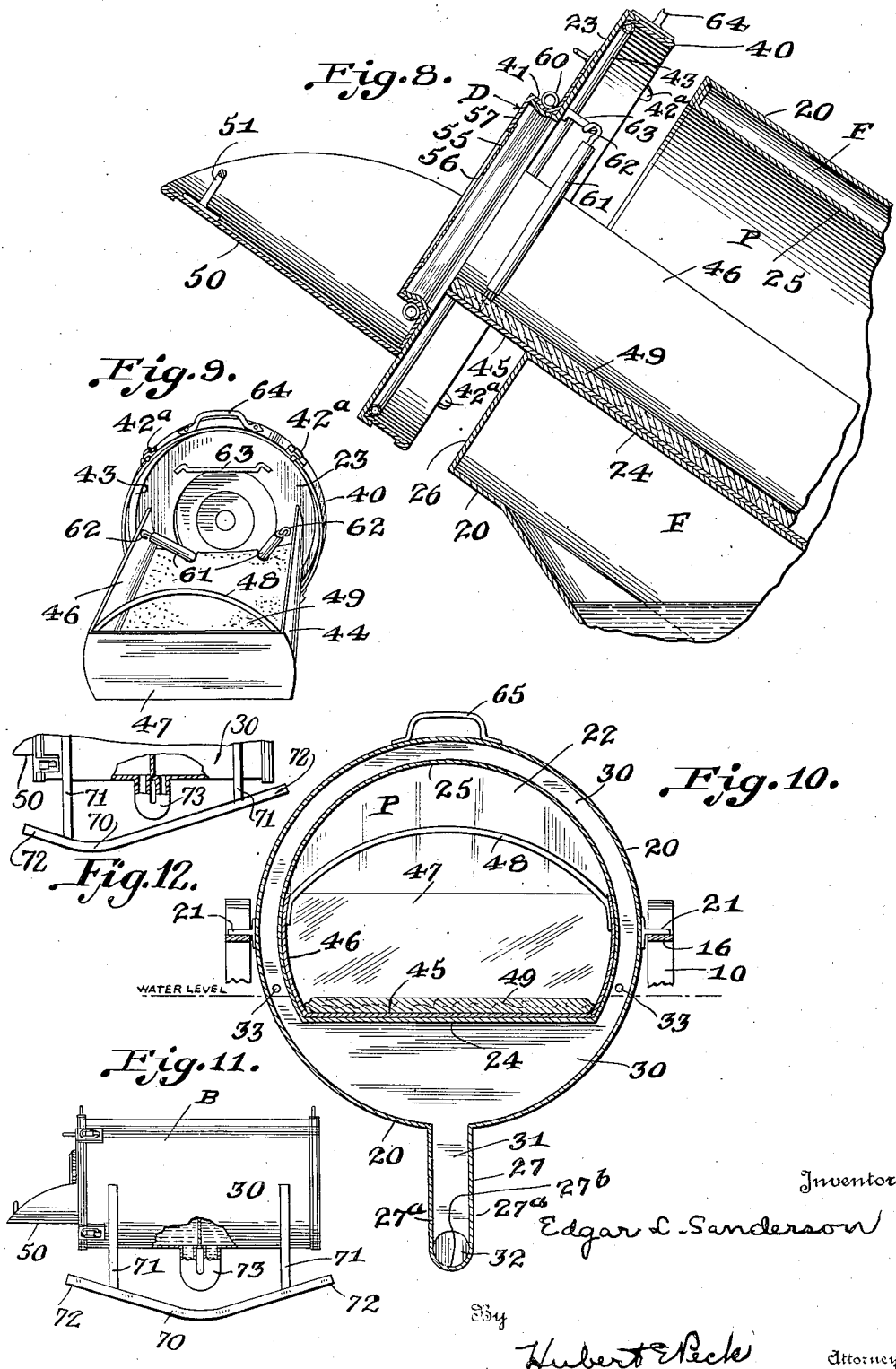
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RESUSCITATION APPARATUS

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UNITED STATES PATENT OFFICE

1,995,583

RESUSCITATION APPARATUS

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Application February 21, 1933, Serial No. 657,859

18 Claims. (Cl. 128—30)

This invention relates to certain improvements in resuscitation apparatus; and the nature and objects of the invention will be readily recognized and understood by those skilled in the arts to which it pertains in the light of the following explanation and detailed description of the preferred method and the steps thereof from among equivalent or other steps within the scope of my invention, and from the detailed description of the accompanying drawings illustrating what I at present consider to be the preferred embodiments or mechanical expressions of apparatus of my invention for carrying out the method, from among various other forms, arrangements, combinations and constructions of which such apparatus is capable within the spirit and scope of the invention.

My invention is primarily directed to that branch of the art of resuscitation in which a person whose normal and natural respiration functioning has ceased or is impaired through any of a variety of causes, such as suffocation, strangulation, asphyxiation and such like, is subjected to those forms of artificial respiration utilizing the principle of the alternate application of increased and decreased air pressure, or plus and minus atmospheric pressure, externally to the chest or body to cause the respiratory organs to function in simulation of the natural and normal breathing acts. Experience with such forms of artificial respiration and the apparatus for carrying them out, in which the body of the patient is in a recumbent position at rest, has demonstrated the fact that in many cases in order to obtain or induce the breathing acts, it is necessary to apply pressures of sufficient magnitude as to cause danger of injury to the lungs of the patient with resulting possibility of hemorrhages.

One of the main objects of my invention is the provision of a method of resuscitation by artificial respiration in which the breathing acts can be induced in a patient by the application of alternate increased or plus atmospheric pressures and decreased or minus atmospheric pressures on the exterior of the chest or body of the patient, but of relatively small magnitude and within a pressure range such that the possibility of any injury to the patient or his respiratory organs is substantially eliminated, through the utilization of movements of the body of the patient in synchronization with the pressure applications, so as to aid the artificial functioning of the lungs by such body movements and permit

of relatively low pressure applications externally to produce the breathing acts.

The method of my invention in attaining the foregoing general object and results, is essentially characterized by tilting or rocking movement of the body of the patient while in a recumbent position, either on its back or on its stomach, to alternately raise and lower the head so as to alternately cause the abdominal organs to slide or move in the body from and toward the diaphragm and lungs and thus compress and expand the lungs as the decreased or minus pressures and increased or plus pressures, respectively are applied externally to the body of the patient.

Another general object of the invention is the provision of apparatus for use in carrying out and practicing the method of resuscitation by artificial respiration of my invention, which apparatus is generally characterized by a horizontally disposed and vertically rockable or tiltable body receiving compartment in which the patient is placed with his head on the exterior of the compartment and in which the air pressure on the body is increased and decreased as the compartment is rocked or tilted to lower and raise, respectively, the head end thereof, to thereby synchronize the abdominal organ movements toward and from the lungs with the pressures variations.

A further object of the invention resides in the provision of such apparatus in which the means for increasing and decreasing the air pressures within the body receiving compartment is actuated and controlled by rocking or tilting the compartment; and further in so arranging and designing such means that the proper and required pressures are automatically insured by the rocking of the compartment.

Another object and characteristic of the invention is found in the provision for manual rocking operation of the body receiving chamber to raise and lower the head end thereof at a rate to result in the required rate of breathing being induced in the patient by the artificial respiration; and further in the provision of a type and character of chamber pressure varying means by which the required and proper rate of tilting is clearly indicated to the operator.

The invention holds as a further object the provision of such a resuscitating apparatus in which mechanical devices such as pumps, compressors and operating mechanisms can be eliminated and an exceedingly structurally simple, efficient and troubleproof apparatus pro-

duced, through the provision of a design and arrangement in which the body receiving compartment is formed in a casing or container that includes and carries a body of liquid and a system of air chambers and passages by which movement of the liquid body as the casing is rocked or tilted results in alternately exhausting or sucking air from the compartment to reduce the pressure therein, and forcing air thereinto to increase the compartment pressure.

A further feature and characteristic of my invention resides in the arrangement of liquid and air passages by which the movement of the liquid and air in the operation of the apparatus is definitely controlled as to rate and resulting positive and negative pressures produced in the body receiving compartment, so that the resulting breathing rate of the artificial respiration induced in the patient is thereby definitely automatically determined without relying upon the skill or judgment of the operator.

Another object and feature of the invention resides in the design and arrangement by which the liquid means is utilized as a medium for maintaining the desired temperature in the body receiving compartment; and further where water is employed as the liquid in the arrangement by which the air drawn from and forced into the body receiving compartment is warmed and humidified by the body of water in the operation of the apparatus.

A further feature of the invention is presented by the design and arrangement of the body supporting tray or pallet by which the body is placed in and removed from the pressure compartment, and in the arrangement of the removable end closure and the manner of sealing and locking the same in compartment closing position.

Another object of the invention is to provide an efficient sealing diaphragm for the compartment end closure through which the neck of the patient extends and which diaphragm is so constructed as to form an efficient seal around the patient's neck without discomfort or tendency to strangle or choke the patient; and further to provide an efficient and readily operated arrangement for removably sealing the diaphragm on and across the end closure head opening.

A further object and feature of the invention is the provision of a relatively simple arrangement for releasably maintaining the body of the patient in the required position on the body supporting structure within the body receiving compartment against displacement during the tilting or rocking of the body, while permitting the body to stretch or elongate and compress or shorten from the shoulders under the action of its own weight, to thereby aid in the expansion and compression of the lungs of the patient in inducing the artificial respiration.

With the foregoing general objects, features and results in view, as well as certain others which will be readily apparent from the following explanation, the invention consists in certain novel steps and their equivalent of the method, and in certain novel features in construction and in combination and arrangements of elements making up the apparatus, all as will be more fully explained and specified hereinafter.

Referring to the accompanying drawings:

Fig. 1 is a perspective view of one form of resuscitating apparatus embodying features of the invention and for carrying out my method of resuscitation, showing the patient receiving compartment forming container or body structure in

position for tilting the patient's body with head lowered and feet elevated.

Fig. 2 is a view in side elevation of the resuscitating apparatus of Fig. 1, but showing the body receiving container rocked to position the patient's body with head elevated and feet lowered.

Fig. 3 is a plan view of a form of rubber sealing diaphragm for fitting over the head of and sealing around the patient's neck, and for sealing the head end opening of the body receiving compartment.

Fig. 4 is a transverse section taken on the line 4-4, of Fig. 3.

Fig. 5 is a plan view of the reverse side of the diaphragm front that is shown in Fig. 3.

Fig. 6 is a vertical longitudinal section through the body receiving container of the apparatus of Fig. 2 in head lowered position, and more or less diagrammatically showing a patient in position therein held against displacement and with the neck sealing diaphragm in its operative secured position sealed around the neck of the patient.

Fig. 7 is a view similar to Fig. 6, but with the body container and body therein rocked to head raising and feet lowering position.

Fig. 8 is a vertical longitudinal view of the head end of the body-receiving container with the patient supporting tray or pallet and removable end closure and head rest carried thereby, in position partially removed from the body-receiving compartment of the container.

Fig. 9 is a perspective view taken from the rear of the removable body supporting pallet and container end closure unit, completely removed from the container body-receiving compartment, and showing the flexible holders for the patient's body in their detached shoulder receiving position.

Fig. 10 is a vertical transverse section, taken as on the line 10-10, of Fig. 6, with the liquid removed from the liquid and air chambers, but with the approximate liquid level with the container in its maximum tilted positions in relation to the pressure relief ports in the chamber dividing wall indicated by legend.

Fig. 11 is a view in side elevation of a modified form of tilting or rocking mounting for the body receiving container, and of a modified form of liquid transfer and air sealing passage between the liquid and air chambers of the container, portions of the walls thereof being broken away to clearly disclose the arrangement.

Fig. 12 is a view in side elevation of the tilting or rocking mounting of Fig. 11 with the radii of curvature of the rockers changed to compensate for the added weight at the head end of the apparatus.

I have presented herewith purely by way of example and not in every respect by way of limitation, embodiments of apparatus of my invention for efficiently practicing and applying the method of resuscitation by artificial respiration in accordance with the method of my invention. The novel method disclosed may be carried out and practiced by other forms and embodiments of apparatus within the spirit and scope of my invention, and such other forms and embodiments are contemplated by and included within the range of equivalents and the scope to which the broad features and principles of my invention, in both apparatus and method, as disclosed herein, are legally entitled.

One form and embodiment of apparatus incorporating the principles and certain features of the invention, and capable of carrying out the

method of resuscitation of my invention, is disclosed in Figs. 1 and 2, in connection with certain other figures of the accompanying drawings, to which reference will be made in detail hereinafter. This illustrated form of resuscitating apparatus is now being successfully used in practicing the method, particularly in the resuscitation of new-born babies in cases of strangulation, suffocation and the like, but it is to be clearly understood that the invention, as to either method or apparatus, is in no sense limited or restricted to such cases, and is generally applicable, as is contemplated and intended, for the resuscitation of patients of any age, children as well as adults. The form of the apparatus as illustrated in Figs. 1 to 10, is designed primarily for use in practicing the method on new-born or young babies, although equally adapted to children and adults, and such use has been here selected for purposes of explanation primarily because the dangers of patient injury from the conditions of high body pressures encountered with known resuscitating methods and apparatus, are greatly increased in the case of a new-born or young baby.

Referring now to Figs. 1 and 2 of the drawings in particular, a resuscitating apparatus of the invention there shown happens to include a supporting frame structure or stand A, on which is suitably mounted and supported for vertical rocking or tilting, the patient-receiving and holding container B. For instance, the container-supporting structure or stand A, can, as in the example hereof, comprise the spaced and opposite pairs of legs 10 converged and connected at their upper ends, and formed of strip or band metal with the lower, diverged ends rolled or curved upwardly to provide the supporting feet 11. Suitable cross braces 12 connect and maintain the opposite pairs of legs 10 in fixed relation, such braces being located intermediate the upper and lower ends of the legs. Preferably each pair of legs 10 is provided with an inter-brace or cross bar 15 to strengthen and give rigidity to the supporting structure.

Each of the cross braces 12 is provided, in the example hereof, with a suitable bumper, preferably of a yielding and sound deadening material, positioned thereon to be engaged by the adjacent end of container B thereabove, when such end is rocked downwardly. The bumpers 14, thus form stops limiting and determining the extent of downward movement of the adjacent ends, respectively, of container B, and hence define the maximum degree of tilt or inclination that can be given the patient container.

The upper ends of each pair of supporting legs are converged and connected by a suitable spacing member 16 horizontally disposed there between and below the extreme upper ends of the legs. A space is thus formed between the upper ends of each pair of supporting legs to removably receive the opposite side container pivots 21 by which the container B is rockably supported on stand A, the members 16 forming bearing supports for such pivots, as will be clear by reference to Figs. 2 and 10 of the drawings in particular. While the supporting stand A as above described provides a relatively simple and efficient portable supporting structure for the particular form of apparatus of the present example, the invention is in no sense limited thereto, or to any particular form, arrangement or construction of the structure or means for rockably supporting the patient body supporting and receiving container B, as any suitable or desired supporting arrangement

can be provided to meet the exigencies or preferences of any form of my resuscitating apparatus, or of the form of the instant example.

The container B for receiving and supporting the patient's body in carrying out and subjecting the patient to, the method of resuscitation of my invention, in the particular example hereof is of general cylindrical form externally, although not so limited, and is provided with the diametrically opposite, horizontally disposed and axially aligned pivots or outwardly projecting stub shafts 21, by which the container is pivotally mounted for vertical rocking or tilting on and between the upper ends of the opposite, spaced pairs of legs 10, or other supporting means. In the example here given, the pivots 21 are located centrally of the length, and of the width or diameter of the container, and removably seat on the members 16 between the upper ends of the spaced pairs of legs 10, respectively, to removably support the container B for free vertical tilting on the pivots 21 as an axis, to alternately raise and lower the opposite ends of and alternately tilt or incline the container longitudinally in opposite directions. If desired, the pivots for the container B may be located to secure a more perfect balance and compensate for weight variations along the length or longitudinal axis of the container.

The container B, in this instance, includes the outer cylindrical wall 20, with particular reference here to Figs. 6, 7, and 10 of the drawings, having one end thereof closed by the end closure wall 22, forming the foot end of the container, and the opposite end normally closed by the removable end closure or cover 23, forming the head end of the container. A patient body-receiving compartment P, is formed within and longitudinally of the container from end to end thereof and accessible through the head end normally closed by cover 23, by an inner wall structure formed and fixed within the container B, spaced inwardly completely there around from the outer cylindrical wall 20 thereof. For example, such inner wall structure can include the substantially flat, horizontally disposed patient supporting bottom wall or floor 24, spaced above the lower side of outer cylindrical wall 20, and along its opposite edges from the adjacent sides of the outer wall, together with the curved upper wall 25, concentric with outer cylindrical wall 20 but spaced a distance inwardly therefrom, as will be clear by reference to Fig. 10 of the drawings in particular. A space is thus formed between the outer wall 20 and the inner walls 24—25, completely around and surrounding the body receiving compartment P.

In order to permanently close the head end of the space between the inner and outer spaced walls of container B, an end wall 26, referring particularly to Figs. 6, 7, and 8, is secured in position between and across the ends of the outer wall 20 and inner walls 24—25, around the end opening of the body receiving compartment P, such end wall 26 conforming in shape to the cross-sectional shape of the space between the inner and outer container walls, as will be readily apparent. Thus, the space between the inner and outer walls of the container is closed at the foot end thereof by the end wall 22, and at the head end by the wall 26.

A relatively narrow, width depending well formed by a downward extension of the space between the inner and outer walls of container B, is provided by a well forming or trough struc-

ture 27, which depends or extends downwardly from the lower or under side of the outer wall 20, and is disposed longitudinally and centrally of the under side of the container B. Such trough structure 27 can be formed, as in the example hereof, of the spaced, depending side walls 27a, and the longitudinal edge or end walls 27b, sloping or inclined upwardly from the central or lowermost portion of structure 27, toward the head and foot ends, respectively, of the container where they merge into and join the outer wall 20 of the container B. (See Figs. 6, 7, and 10.) A depending well is thus formed having its greatest depth at the central portion of the structure 27, and of the length of the container B, which well opens through the lower side of the container outer wall 20 into, and forms a downward extension of the space between the inner and outer container walls, but of relatively narrow width with respect to the diameter of the container (see Fig. 10), and extending longitudinally and centrally thereof for a substantial portion of the length of the container B. (See Fig. 6.)

A pet cock or suitable drain valve 28, shown in Figs. 1 and 2 of the drawings, is provided in the specific example hereof, in one of the side walls 27a adjacent the head end of the container and in proximity to the outer wall 20, that is, in the upper portion of wall 27a and opening into the shallow head end of the well formed by the trough structure 27. The purpose of such valve 28 and of the hereinbefore described well formed by the structure 27 will be described and explained hereinafter.

The space within the container formed between the outer wall 20 and the inner wall structure 24-25, is formed and divided into two chambers, a forward chamber F, and a rear chamber R, by a dividing wall or partition 30 which is secured therebetween and connecting outer wall 20 and inner walls 24-25, centrally of the length and intermediate the head and foot ends of the container, as clearly shown by Figs. 6 and 7 of the drawings. The wall or partition 30 conforms, of course, to the cross sectional shape of the space between the inner and outer walls of the container surrounding the compartment P, and extends completely across and between the floor wall 24 of the body receiving compartment P, and the opposite lower side portion of the outer cylindrical wall 20, as will be clear by reference to Fig. 10 of the drawings in particular.

The wall or partition 30 is also extended down into and centrally of the length of, the well formed by the trough structure 27, a depending extension wall or partition 31 (see Figs. 6, 7, and 10) from wall 30 being provided for this purpose. This well dividing wall 31 is in downward continuation of the wall or partition 30 thereabove, and extends between and connects the side walls 27a of structure 27, so as to divide the well formed by such trough structure, into a forward chamber F' and a rear chamber R' in continuation of and communicating at their upper ends with chambers F and R, respectively, of the container B. (See Figs. 6 and 7.) The lower end of the wall 31, is however, formed with, or to provide, a port or passage 32, referring to Figs. 6, 7, and 10, therethrough placing the chambers F' and R' in communication at, in the specific example hereof, the deepest point of the well, although the invention is not so limited as will be explained hereinafter. This port or passage 32 provides for restricted

and controlled fluid or liquid flow between the chambers F' and R'.

The wall or partition 30 is, in this instance, provided with the ports or openings 33 (see particularly Fig. 10) therethrough at opposite sides of the inner wall 25, and in the specific example hereof, spaced a distance above the level of the patient supporting floor 24 of compartment P. These ports 33 provide for displacement of air and liquid between the chambers F and R in the operation of the apparatus, and their area and relative positioning in partition 30 controls certain factors, and is dependent upon certain others, in the operation and functioning of the apparatus, as will be later referred to herein.

The forward and rear chambers are placed in communication with each other for air passage or displacement alternately from one to the other by the ports 33 in the partition wall 30, and are also placed in communication with the patient receiving compartment P, through the port or opening 34, referring now to Figs. 6 and 7 of the drawings, provided in the upper side of the inner wall 25 in the forward chamber F adjacent the partition wall 30. The chambers F and R, are also placed in communication with the exterior of the container B by the port or opening 35 formed through the upper side of outer wall 20 and opening into the rear chamber R adjacent the partition wall 30, in the particular example hereof. This outer wall port 35 also provides a filling opening through which the chambers F-F' and R-R' are charged with the required quantity of liquid, such as the body of water W shown in Figs. 6 and 7, necessary to the proper operation and functioning of the apparatus.

The removable head end closure in the form of the slip-cover 23, includes the peripheral flange 40, referring particularly to Fig. 8 of the drawings, which removably fits over and around the exterior of outer wall 20 of container B at the head end thereof, and the central aperture or opening therethrough defined by the outwardly extending neck flange 41 surrounding such opening; the neck flange 41 being preferably formed to provide an external groove therearound. The cover 23 is fitted over and against the head end of container B, with its neck opening in communication with and opening into the open end of the patient compartment P, and is removably locked and secured in position by the draw bolts 42, or other suitable locking and securing means, carried on the exterior of container B and operatively engaging and cooperating with suitable lugs or projection 42a fixed on cover flange 40. (See Figs. 1 and 2.) A sealing gasket 43 (see Figs. 6 and 8), which is preferably as in the example hereof, in the form of a rubber or the like material tube, is secured around the inner side of cover 23 adjacent flange 40, for sealing engagement with the container end wall 26 when the cover is in secured position on the head end of the container, to prevent leakage or passage of air from the compartment P to the exterior of the container.

The apparatus includes a patient receiving tray or pallet 44 (see Fig. 9 in particular), which is secured to and forms a unit with cover 23, and by which the patient to be treated is placed in and removed from compartment P, as well as being supported and maintained in position in compartment P thereby, during treatment. For instance, such tray or pallet can, as in the form hereof, include the bottom wall 45, the vertical,

upstanding opposite longitudinal side walls 46, and the end wall 47, the bottom and side walls being secured to the cover 23 at their forward ends. The forward end of bottom wall 45 is secured across the central opening in cover 23 above the lower side thereof and at such a level that with the cover in position on the head end of container B, such bottom wall slidably rests and is supported upon the floor 24 of compartment P (see Figs. 6 and 8); while the width of wall 45 and the shape of side walls 46 is preferably such as to conform to the width and side wall shape of compartment P. (See Fig. 10.) The length of the patient receiving tray 44 is preferably substantially that of the internal length of compartment P, so that the end wall 47 of tray 44 is adjacent container end wall 22, in mounted position of the tray in the compartment. A suitable handle 48 is preferably provided on the inner or foot end of tray 44, while a pad 49 is usually advisable in the tray over bottom wall 45. The cover 23 and tray or pallet can be formed and provided as separate units, if so desired, or found expedient, and the invention is not limited to the unit arrangement and mounting thereof as specifically shown in the example hereof.

On the exterior or outer side of the cover 23, a preferably concave or the like support 50 is secured extending horizontally forwardly therefrom and below the cover neck opening and the level of the tray or pallet bottom wall 45, for receiving and holding the head of the patient on the exterior of container B. The outer end of this head support 50 can be provided with the handle 51, while a pillow or cushion 52 (see Figs. 6 and 7) is preferably provided to receive and position the head of the patient.

The patient is placed in a recumbent position, either on his stomach or on his back, in the tray or pallet 44 with his head at the outer side of cover 23 and his neck extending through the central aperture of the cover, as shown by Figs. 6 and 7 of the drawings. With the cover tray unit holding the patient placed in position on and in container B, and the compartment P, it is necessary to properly seal the cover opening around the neck of the patient to close off the compartment P from the atmosphere through such cover opening. I carry out such sealing of the cover neck opening in the example of the present apparatus by means of a rubber or equivalent material diaphragm D, which I have illustrated in detail in Figs. 3, 4, and 5, of the drawings. Such diaphragm D includes the central portion 55 of relatively thin rubber having the central aperture or head and neck opening 56, and the surrounding main body portion of the diaphragm formed by the relatively thick rubber or the like material 57. Such diaphragm can be formed of a separate thick section 57 and thin central section 55 and cemented or secured together in any other suitable manner, as in the example hereof, or the diaphragm can be formed of a single piece of material having the thin central portion integral with the outer thick portion.

Such a diaphragm D, or its equivalent is secured over and across the central aperture or head and neck opening of the cover 23, being suitably removably fastened over and around the neck flange 41 by the elastic ring or annular band 60. Such diaphragm securing ring 60, in accordance with a feature of my invention is formed by a coil spring having its ends secured together to provide the endless band form of ring, and with

the diaphragm turned down over and around neck flange 41, such coil spring is expanded and forced down over and around neck flange 41 into the external groove around such flange (see Fig. 8), to thus firmly secure and removably bind the diaphragm in position.

With the diaphragm D so mounted and secured, the head and neck opening 56 thereof is stretched to a sufficient size to pass the head of a patient outwardly therethrough until the diaphragm opening receives and fits around the neck of the patient. As the opening 56 is normally of less diameter than that of the neck of the patient received therein, the thin elastic portion 55 tightly fits and bears against the neck under sealing tension, but due to its thin character, without sufficient binding force to tend to choke or strangle the patient. The outer thick portion provides the relatively heavy material for binding over the neck flange by spring 60, to thus resist wear and tear, and also reduces the area of thin material over the opening in cover 23 to resist pressure variations in the compartment P, and reduce tendency of the diaphragm to bulge outwardly and collapse inwardly under plus and minus pressures in the patient compartment P.

The invention also includes provision for holding the patient against displacement from proper position in the container B during rocking thereof, while permitting the patient's body to elongate and compress under the action of its own weight. Such feature is expressed and carried out in the apparatus of the present example, by flexible members or straps 61 which are passed under the arm pits of the patient and secured at their opposite ends to the cover and tray unit. For instance, such members can take the form of coil springs covered by any suitable, soft, yielding material such as rubber, and secured at their lower ends for swinging movement to the forward end of tray bottom wall 45 in spaced relation so as to receive the body of a patient therebetween. The upper or free ends of members 61 are provided with hooks 62 which are removably hooked over and on a rod member 63 horizontally disposed across the inner side of cover 23 above the central aperture or head opening therein. (See Fig. 9.) The body holding position of members 61 passed under the arm pits of a patient and secured to rod 63, is shown in Figs. 6 and 7, while the unhooked, body releasing position thereof is shown in Fig. 9. In their attached position the flexible members 61 are of themselves laterally yieldable, but possibility of undue binding is eliminated by the mounting of hooks 62 for lateral sliding movement on rod 63. However, various other fastening members may be employed within the scope of my invention, such as straps and buckles, and the like.

Preferably, the container B is provided with suitable hand holds or handles by which it can be manually rocked or tilted with facility. For instance, a forward handle 64 can be provided on the upper side edge or flange 40 of the cover 23, and a similar handle 65 on the opposite end of container B at the upper side thereof. By mounting the forward handle 64 on the cover 23, it serves the further function of aiding in the withdrawal and insertion of the cover and patient tray unit 23-44, from and into the container compartment P.

Now, to condition the resuscitating apparatus of the hereinbefore described example, for operation in carrying out my method of resuscitation, it is first charged with a body of liquid, preferably

water of a suitable temperature. The container B is rocked or tilted to raise the head end thereof to the maximum, as determined by the opposite or foot end striking the bumper 14 on stand A, as shown in Figs. 2 and 7 of the drawings. Pet cock or drain valve 28 (see Fig. 2) is then opened, and with the container held in such tilted position, water, preferably warmed to a desirable temperature, is poured into the container through the opening 35 until there is a flow from the open cock 28; whereupon the cock is closed. The desired body of water W is thus placed in chambers F—F' and R—R', surrounding compartment P, and to a level such as indicated in Fig. 7. In such tilted position of the container B, the level of the body of water W is below the ports or openings 33 in the partition wall 30 between chambers F' and R, the distance below being non-essential and depending upon other factors, such as size of chambers, positioning of such ports and the quantity of liquid used.

The cover and tray unit 23—44 being removed from container B, the patient to be treated is placed in a recumbent position flat on his back or on his stomach (depending upon the type of case to be treated) in the tray with his head resting on support 50 and cushion 52, and the diaphragm D forming a sealing fit around the patient's neck. The flexible members 61 are then secured extending beneath the patient's arm pits and the upper end hooks 62 are removably secured over rod 63. This position of a patient is clearly shown in Figs. 6 and 7. The cover and tray unit with the patient thereon is slid into the compartment P of container B, and the cover 23 is then locked in position by the draw bolts or the like 42. The body of the patient is thus disposed in compartment P, which compartment is sealed by cover 23 and diaphragm D, around the patient's neck from the atmosphere except through ports 35, 34, and 33, while the patient's head is disposed at the exterior of the container B.

The operator then starts functioning of the apparatus to apply the method of the invention in resuscitating the patient. Assume the container B in the head lowered position of Fig. 6 with the patient's feet elevated. In such position the body of water W, is in the position indicated substantially occupying the forward chambers F and F'. The patient's body is in a position to have caused the body to compress toward the lungs and the abdominal organs have slid toward the diaphragm and tended to compress the lungs to cause exhalation or expulsion of the air therefrom in simulation of such normal breathing act of the lungs. During the movement of the container B, in rocking from the opposite, head elevated position, the shift in the body of water W has caused the establishment of plus or increased pressure within compartment P acting on the chest and abdomen to aid the action of the abdominal organs and body compression to thereby completely expel air from the lungs.

At the completion of the head lowering and lung compressing-exhalation step, the pressure in compartment P, has been reduced to normal atmospheric pressure, by pressure relief through ports 34, 33, and 35, and the operator then rocks the container B to elevate the head and lower the feet of the patient into the body tilted position of Fig. 7. The abdominal organs with the body in such position slide downwardly toward the feet pulling the diaphragm of the patient from the lungs creating a suction or reduced

pressure in the chest, so that the lungs can more readily expand and fill with air in simulation of the normal inhalation act of breathing.

During and by the rocking or tilting of the container from the head lowered position of Fig. 6 to the head elevated position of Fig. 7, the body of liquid W, moves and is displaced from chambers F—F', at the head end of container B, toward and into the chambers R—R' at the foot end. This displacement forces air outwardly from chamber R through port 35 and results in an expansion or suction in chamber F with resulting suction and withdrawal of air from compartment P to change the pressure condition therein from a plus to a minus or reduced pressure acting on the patient's body therein. The minus reduced pressure of the compartment P acting on the chest and abdomen of the patient, together with the action on the lungs by the elongating movement of the body and the movement of the abdominal organs and diaphragm, produces or causes the lungs to expand and fill with air in simulation of the inhalation act of the breathing function.

The water or liquid body is of course, retarded and must accomplish its displacement through port 32 at the lower end of wall 31 in the well formed by trough 27, and by bubbling and flowing through ports 33 during any period in which the level is above ports 33. After the displacement of the liquid to its new location in chambers R—R', the ports 33 are above the liquid level and the air pressure is relieved and equalized there-through, and hence the compartment P pressure is brought to normal or atmospheric pressure. The container B is then tilted back into the reverse position by the operator, with the water displacement causing compression of air in chamber F' and in compartment P to establish increased or plus pressure acting on the body in cooperation with its head down, inclined position, to induce the act of exhalation by the patient's respiratory organs. The operator then continues the rocking of container B to alternately tilt the patient's body to raise and lower the head and induce the artificial respiration for the period of time which may be necessary to resuscitate the patient.

The apparatus of the example hereof is featured by the fact that the water in displacing from one position to the other in the container, together with the air bubbling through ports 33 is audible, which serves as a clear signal and indication to the operator when to rock the container to the reverse direction, because such audible noises cease when the atmospheric pressure condition is reestablished in compartment P and displacement of the liquid body has been consummated, following either a plus pressure (exhalation) or a minus pressure (inhalation) condition in such compartment. Thus, the area of ports 32 and 33 determines the period of time for liquid displacement and normal pressure return, so that, in accordance with the invention, the ports 32 and 33 are designed of such an area that the normal breathing rate, for example a rate of 12 to 15 times per minute, is induced in the patient by rocking container B to the reverse position immediately after the cessation of the noise of liquid displacement following a rocking movement from one body tilted position to the reverse body tilted position. In the present example the area of port 32 is greater than the areas of ports 33 to allow a relatively quicker transfer of liquid to accumulate an air pressure

in compartment P due to the relatively slower transfer rate through the smaller area ports 33. In this manner the rate of rocking required for inducing the desired rate of artificial respiration is determined and the operator is not called upon to exercise any particular skill or judgment, but merely follows the rate audibly indicated.

It is also to be noted that the combined area of the ports 33 can be provided by a single port in wall 30, or can be divided into a greater number of ports than the two here shown.

By the use of water of a desired temperature, to provide the liquid body W, the compartment P, is warmed through the inner wall structure 24-25, and also by the air intimately mixing with the water during tilting and flowing to and from compartment P through port 34. Also, a humidification of the air in compartment P to which the body of the patient is subjected, is secured by the air bubbling through the water in its flow to and from chambers F and R, through ports 33. Thus, a desired humid condition can be maintained in the body receiving compartment P, together with a desired air temperature therein.

The formation and arrangement of the trough structure 27 to provide the liquid well, together with the partition or wall 31 dividing the same into the chambers F' and R' in communication through port 32, provides in effect a liquid seal or trap to prevent leakage or escape of the air from and between chambers F and R during operation of the apparatus. For instance, in either of the positions shown in Figs. 6 and 7, a sufficient body of liquid is maintained between the chambers to prevent passage of air therethrough and through port 32 from one chamber to the other. If the port 32 is raised a sufficient distance in the wall 31, air will bubble back through the water and release the pressure condition which it is desired to establish for the required period of time in compartment P. The apparatus of this example here given is so designed that the port 32 is just low enough to prevent such back bubbling of air and obtain the full value of the difference in water level pressure, while allowing the pressures established in compartment P to be gradually released by air bubbling through the small ports 33 in the chamber partition wall 30.

The method of resuscitation by inducing artificial respiration in the patient, in accordance with my invention, thus includes the alternate tilting or rocking of the patient while maintaining the patient's body in a flat, unbending position on his back, or stomach so as to cause the abdominal organs to move in the body to force the diaphragm toward the lungs to compress them from below when the head is lowered (exhalation); and when the head is raised and the feet lowered to cause the abdominal organs to pull the diaphragm from the lungs and causing a suction or lowered pressure in the chest (inhalation). And, simultaneously and in synchronization with the alternate tilting of the body the method provides the application of pressure externally to the chest and abdomen of the patients, positive pressure when the body is tilted to head lowered position and negative or reduced pressures when the body is tilted to head elevated position. In this manner, by utilizing the action of the abdominal organs under gravity response, and of the tendency of the body to elongate and compress, a material aid to the compressing (exhalation) and expanding (inhalation) functioning of the lungs in performing the breathing

act is obtained, and it is then only necessary to employ relatively low or light pressure applications externally to induce the natural breathing acts by the respiratory organs. With this method employing light pressure, the possibility of injury to the lungs and other organs of the patient is practically eliminated.

The form of apparatus as disclosed in Figs. 1 to 10 of the accompanying drawings, is designed primarily for the smaller types of the apparatus particularly intended for treating new-born or young babies, but the apparatus can be built in larger sizes for adults or children and of equally efficient operation and results. However, in Fig. 11 of the drawings I have disclosed a form of mounting for the rockable or tiltable patient body receiving container B, which is well and efficiently adapted for the larger or adult sizes of the apparatus.

Referring to Fig. 11 such form of mounting includes a pair of spaced longitudinally disposed rockers 70, of which only one is shown here as they are identical in design and mounting, each secured to the lower ends of a pair of spaced depending legs or struts 71 which are fixed at their upper ends adjacent the opposite ends, respectively, of container B. The container B is thus rockably supported on rockers 70, and each of the rockers is so designed and formed as to present the intermediate curved portion terminating at opposite ends in the substantially straight upwardly inclined portions 72, which determine the degree to which the container can be tilted in either direction in operation of the apparatus. A further feature of this mounting is the formation of the curved intermediate portions of the rockers to have a radius of curvature, or varying radii of curvature, and to be so located along the rocker length with respect to container B, as to compensate for the greater weight of the apparatus at the head end thereof with a patient in the container. By such arrangement of the rockers, or by a positioning thereof under the container with respect to the center of gravity of the apparatus, the operator can smoothly and easily rock and alternately tilt the container B as required to obtain its functioning as hereinbefore explained.

In Fig. 11, I have also presented a modified arrangement of liquid seal or trap between the chambers F-F', and R-R', which can be employed in place of the well forming trough structure 27, hereinbefore described. For instance, the trough structure and well are eliminated and a U-pipe or trap 73 is mounted depending from the under side of outer wall 20 with one leg opening into the container at the forward side of partition 30, and the other leg opening into the container at the rear side of partition 30. The partition 30 extends downwardly to the lower side of wall 20, and liquid thus fills U-pipe 73 and forms a liquid seal for the purpose hereinbefore described.

What I claim is:—

1. In apparatus for resuscitation by artificial respiration, in combination, means for supporting a patient in a recumbent position and for alternately bodily rocking the patient to head lowered and feet raised and to head raised and feet lowered positions, and means for increasing the external pressure on the patient's chest during rocking to head lowered position and for decreasing the external chest pressure during rocking of the patient's body to head raised position.
2. In apparatus for resuscitation by artificial

respiration, in combination, means for supporting a patient in a recumbent position and for alternately bodily tilting the patient to an inclined body position with head lowered and feet raised and to an inclined position with head raised and feet lowered, and means controlled and actuated by operation of said first mentioned means for increasing the external pressure on the patient's chest during tilting of the body to head lowered position and for decreasing the external pressure on the chest during tilting of the body to head raised position.

3. In apparatus for resuscitation by artificial respiration, in combination, means for alternately bodily tilting a patient to an inclined body position with head lowered and feet raised and to an inclined body position with head raised and feet lowered, means limiting the degree of alternate tilting of the body by said means, and means for increasing the external pressure on the patient's chest during tilting to head lowered position and for decreasing the external chest pressure during tilting of the patient's body to head raised position.

4. In apparatus for resuscitation by artificial respiration, in combination, means providing a compartment for receiving and enclosing the body of a patient with his head at the exterior of said compartment, said means operative to alternately bodily tilt the patient to an inclined body position with head lowered and feet raised, and to an inclined body position with head raised and feet lowered, and means for increasing the air pressure acting on the body in said compartment during tilting of the body to head lowered position and for decreasing the pressure in the compartment during tilting of the body to head raised position.

5. In apparatus for resuscitation by artificial respiration, in combination, means providing a compartment for receiving and enclosing the body of a patient with his head at the exterior of the compartment, said means operative to alternately bodily tilt the patient to an inclined body position with head lowered and feet raised and to an inclined body position with head raised and feet lowered, and means actuated and controlled by the operation of said first mentioned means to increase the pressure in said compartment during tilting of the body to head lowered position and for decreasing the pressure in the compartment during tilting of the body to head raised position.

6. In apparatus for resuscitation by artificial respiration, in combination, a container structure providing a compartment therewithin for receiving and enclosing the body of a patient in a recumbent position with the patient's head at the exterior of said compartment, means removably sealing the head end of the compartment and providing a sealing fit around the neck of the patient, the said container structure mounted for alternately longitudinally bodily tilting the patient to an inclined body position with the head lowered and feet raised and an inclined body position with the head raised and feet lowered, and means for increasing the normal air pressure in said container during tilting of the patient's body to head lowered position and for decreasing the normal compartment pressure during tilting of the body to head raised position.

7. In apparatus for resuscitation by artificial respiration, in combination, a container structure having double walls providing an inner compartment longitudinally thereof and a closed

space surrounding said compartment, the said inner compartment adapted to receive the body of a patient in recumbent position with the head of the patient at the exterior of the compartment, means removably sealing the head end of the compartment and providing a sealing fit around the neck of a patient positioned in said compartment, said container structure mounted for alternately longitudinally bodily tilting the patient to an inclined body position with head lowered and feet raised and to an inclined body position with head raised and feet lowered, a body of liquid in the lower portion of the space around said compartment displaceable therein by the alternate tilting of the container structure, and the container structure formed with ports therein placing said space in communication with the compartment and with atmosphere whereby tilting of the container to patient head lowered position displaces the liquid body to cause increase in air pressure in the compartment and tilting of the container to head raised position displaces the liquid to cause decrease in the air pressure in the compartment.

8. In apparatus for resuscitation by artificial respiration, a container structure providing a compartment longitudinally thereof for receiving the body of a patient in a recumbent position with the patient's head at the exterior of the container, means sealing the head end of the compartment from the atmosphere, said container structure including chambers at the outer side of said compartment having ports placing such chambers in communication with the compartment and with the atmosphere, a body of liquid in the lower portion of said chambers and displaceable between the chambers, said container structure mounted for alternately longitudinally bodily tilting the patient to an inclined body position with head lowered and feet raised and to an inclined body position with head raised and feet lowered, said liquid body displaced by said container tilting to cause increase in pressure in the compartment during tilting to head lowered position and decrease in the compartment pressure during tilting to head raised position.

9. In apparatus for resuscitation by artificial respiration, in combination, a container structure providing a compartment for receiving the body of a patient in recumbent position with the head of the patient at the exterior of the container, means for sealing the head end of the compartment around the neck of the patient, said container structure rockable to bodily longitudinally alternately tilt the patient to an inclined body position with head lowered and feet raised and to an inclined body position with head raised and feet lowered, and means carried by and rockable with said container structure, including air chambers in communication with said compartment and a body of liquid in said chambers displaceable therein by rocking of the container to cause increase in the normal chamber pressure during body tilting to head lowered position and decrease in the normal chamber pressure during body tilting to head raised position.

10. In apparatus for resuscitation by artificial respiration in combination, a container structure providing a compartment for receiving the body of a patient with the head of the patient at the exterior of the container, means for sealing the head end of the compartment around the neck of the patient, said container structure rockable to bodily longitudinally tilt the patient to an inclined body position with head lowered and feet raised

and to an inclined body position with head raised and feet lowered, means carried by and rockable with said container structure for increasing the normal air pressure in the compartment during tilting of the body to head lowered position and for decreasing the normal air pressure in the compartment during tilting to head raised position and said pressure varying means providing for pressure relief and return to normal pressure in the compartment upon termination of body tilting and prior to rocking of the container structure to the opposite tilted position.

11. In apparatus for resuscitation by artificial respiration, in combination, a container structure providing a compartment for receiving the body of a patient with the head of the patient at the exterior of the container, means for sealing the head end of the compartment around the neck of the patient, said container structure rockable to bodily longitudinally tilt the patient to an inclined body position with head lowered and feet raised and to an inclined body position with head raised and feet lowered, means carried by and rockable with said container structure, including air chambers separated by a partition wall and in communication with said compartment, and a body of liquid in said chambers displaceable through said wall as the container is rocked to cause increase in the normal compartment pressure during tilting to head lowered position and to cause decrease in normal compartment pressure during tilting to head raised position, and the said chamber partition wall including pressure relief ports whereby the pressure condition established by displacement of said liquid returns to normal upon termination of the tilting movement in one direction.

12. In apparatus for resuscitation by artificial respiration, a container structure providing a compartment for receiving the body of a patient with the patient's head on the exterior of the compartment, an end closure for the head end of said compartment having an aperture for fitting over the patient's head and through which the neck of the patient extends, said closure having an outwardly extended flange defining said aperture, a flexible sheet material diaphragm formed with a relatively thin central portion of reduced thickness with respect to the surrounding material of the diaphragm and having a central aperture expanded around and in sealing engagement with the neck of the patient, said diaphragm extended over and around said cover flange, and a yielding ring member removably stretched over and engaged around said flange and diaphragm thereon to secure the diaphragm in attached position.

13. In resuscitating apparatus, a container structure providing a compartment for receiving the body of a patient, said container structure mounted on rocker members for rocking movement to alternately bodily tilt the patient's body

to inclined position with head down and feet raised and to inclined position with head raised and feet lowered, stop means limiting the degree of inclination to which the body can be rocked in either direction, and the said rocker means formed and mounted to compensate for the increased weight of the body at the head end thereof to normally maintain the container structure balanced in substantially horizontal position.

14. In apparatus for resuscitation by artificial respiration, in combination, means for bodily tilting a patient while in a recumbent position alternately to inclined body positions with the head lowered and feet raised and with the head raised and feet lowered, means for holding the body of the patient in recumbent position against bodily displacement during tilting but with the body free to compress and elongate under its own weight as alternately tilted, and means for decreasing the external pressure on the chest of the patient during bodily tilting to head raised position.

15. In apparatus for resuscitation by artificial respiration, in combination, means for bodily tilting a patient while in a recumbent position alternately to inclined body positions with the head lowered and with the head raised, and means for decreasing the external pressure on the chest of the patient in bodily tilted and head raised position.

16. In apparatus for producing artificial respiration, in combination, means for alternately bodily tilting a patient while in a recumbent position to inclined body positions with the head raised and with the head lowered, and means synchronized with the tilting of the body by said first means for varying the external pressure on the chest of the patient.

17. In apparatus for producing artificial respiration, in combination, means for alternately bodily moving a patient while in a recumbent position to inclined body positions with the head lowered and with the head raised, and means controlled by such alternate body movements to increase the external pressure on the patient's chest for the head lowered position and to decrease such external pressure for the head raised position.

18. In apparatus for producing artificial respiration, a structure providing a compartment for receiving the body of a patient in a recumbent position, rocker members on which said structure is mounted for rocking movement to alternately bodily tilt the patient's body to inclined positions with head lowered and with head raised, means synchronized with the tilting of the body for varying the external pressure on a patient in said compartment and stop means limiting the degree of inclination to which the body can be rocked in either direction.

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