

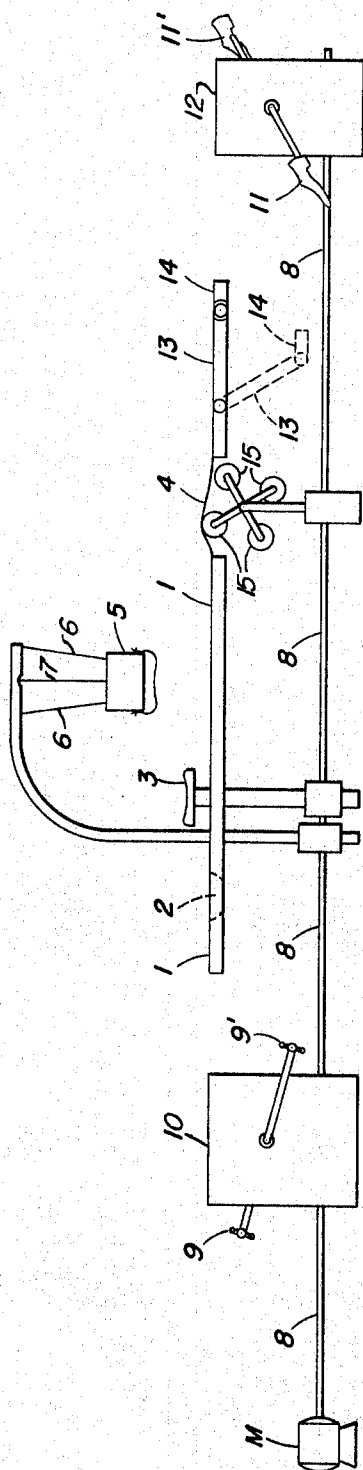
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RESUSCITATOR

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RESUSCITATOR

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This invention relates to apparatus for the administration of artificial resuscitation to restore breathing to persons temporarily incapable of breathing adequately without assistance. In particularly preferred embodiments, this invention relates to a device which is capable of administering artificial resuscitation and also of performing other useful functions, including administration of physical therapy to partially paralyzed persons, swimming instruction, weight-reduction and others.

With respect to artificial respiration, or resuscitation, a number of methods have been proposed at various times for assisting persons who need assistance in breathing. One of these is the Sylvester method, which involves alternately lifting the shoulders of a prone patient to allow the lungs to expand and fill with air, and then releasing the shoulders and applying pressure to the patient's back in the lung area, in order to deflate the lungs and expel carbon dioxide, along with foreign matter if present. This method has been highly effective, and is frequently recommended for modern first-aid practice.

Another method, used by electrical linemen, has been called the "pole-top" method, because it is suitable for use at the top of a power-line pole. This method consists in alternately embracing and compressing the patient's abdomen, and releasing the same, while the patient is in an upright position. The effect of the alternate compression and release is that, on compression the contents of the abdominal cavity press upwardly on the diaphragm, which in turn exerts an upward pressure on the contents of the chest cavity, tending to collapse the lungs. When the abdominal pressure is released, the diaphragm is allowed to drop, and the pressure in the chest cavity is reduced, thereby causing air to enter and expand the lungs.

Both of the above methods for artificial resuscitation suffered from certain disadvantages, not the least of which was the fact that they could be applied only by the direct physical manipulation of the patient's body by one skilled in their application. It is well known that artificial respiration must sometimes be applied for protracted periods—sometimes many hours—before the patient is capable of breathing unassisted, and it can be only a matter of speculation how many patients have been lost because the endurance of the person administering artificial respiration was exhausted.

Another method of artificial respiration that has been used is the well-known "iron lung." This apparatus was capable of continually applying artificial respiration over long periods of time without the exertion of physical effort by the operator, but was subject to other disadvantages that detracted from its usefulness as a resuscitation apparatus for first-aid use or the like. In particular, the "iron-lung" type of respirator encloses major portions of the patient's body making it impossible to treat injuries in these areas, and has no provision for evacuating foreign matter, for example water, from the patient's lungs.

It is an object of this invention, therefore, to provide an improved apparatus for resuscitation and artificial respiration. Another object is to provide an apparatus capable of applying artificial respiration over protracted periods without requiring physical exertion on the part of the one administering the same. Still another object is to provide an apparatus which leaves the major portion

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of the patient's body accessible for treatment of injuries simultaneously with the administration of artificial respiration. Another object still is to provide apparatus of the character described, which provides for the removal of foreign matter from the patient's lungs. Still another object is to provide such apparatus, which is also useful for other purposes such as physical therapy, exercise, weight-removal and the like. Other objects and advantages will become apparent from the following more complete description and claims.

Broadly, this invention contemplates an apparatus for manipulation of the human body, comprising in combination means for intermittently lifting the shoulders of a prone patient, thereby removing body weight from the chest, and means for intermittently applying pressure to the back of said patient, thereby augmenting the normal tendency of body weight to collapse the lungs of said patient and expel air therefrom, said lifting means and said pressure means being synchronized to render said pressure means operative to apply pressure only at times when said lifting means is inoperative to lift the shoulders of said patient.

In a particularly desirable embodiment, this invention contemplates an apparatus for manipulation of the human body, comprising in combination table means for supporting the body of a patient in a prone position, reciprocating support means for intermittently lifting the shoulders of said patient vertically away from said table, thereby removing the pressure of said patient's upper body weight from the chest area and permitting entry of air into the lungs of said patient, and reciprocating pressure means for applying pressure to said patient's back when said support means is in position to allow said patient's full weight to rest on said table and for relieving said pressure when said support means is in position to lift the shoulders of said patient away from said table.

This invention also contemplates an apparatus for manipulation of the human body, comprising in combination means for supporting a patient in prone position, and means for intermittently applying pressure to the abdomen of said patient.

The preferred means for applying pressure to the prone patient's abdomen, as will be more fully described hereinafter with reference to the drawings, comprises a plurality of generally cylindrical rollers arranged in parallel spaced relationship about a central axis parallel with the axes of said rollers, means for causing the rollers to revolve in planetary fashion about the central axis while remaining free to revolve about their own respective axes, and flexible cover means for permitting said rollers to exert a kneading action on a portion of the body in contact with the cover means, while preventing direct contact between said rollers and said body portion.

The flexible cover is not essential to the function of the machine, but is highly desirable because it minimizes any chance of injuring the patient or the operator by the rollers.

Referring now to the figure, FIG. 1 is a side elevation of a preferred form of apparatus according to this invention.

When the apparatus according to this invention is used for the administration of artificial respiration, the patient is placed on table 1 in a prone position, with his face over face aperture 2, and the upper part of his chest—i.e. the area of the armpits and clavicles, supported by lifting means represented by cradle 3, and his abdomen resting on flexible cover 4. The patient's legs are supported by the portion of table 1 extending beyond cover 4. To accommodate individual patients whose sizes and proportions differ, adjustment means are preferably provided, suitable for varying the distances between face aperture

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2, cradle 3, and cover 4 with its underlying roller means. The adjustment means, not shown, may be provided in a variety of ways as will be obvious to those skilled in the art. A convenient way of providing for this adjustment is to make the various sections of the table in the form of separate telescoping units with means (motor-driven if desired) for driving the various sections of the apparatus independently to the right or left as viewed in FIG. 1, thereby extending or retracting the telescoping sections to place the various parts of the apparatus in the respective positions required for the patient being treated.

With the patient in prone position on the table and the various component sections adjusted to conform to his requirements, pressure means, represented by weight 5, is brought into play. In the embodiment as shown in FIG. 1, weight 5 is supported by fixed cables 6 and operating cable 7. Fixed cables 6 limit the extent of downward travel of weight 5, precluding any possibility of injuring the patient when the full pressure of weight 5 is applied. Operating cable 7 is connected to drive means (not shown in FIG. 1) operative to continuously reciprocate weight 5 from a lower position determined by the length of fixed cables 6 to an upper position in which the weight is still in contact with the patient's back, but exerts no substantial pressure thereon. The vertical distance traveled by the weight means may be varied if desired to suit the requirements of individual patients, but a distance of 2½-3 inches normally accommodates the needs of all individuals.

Preferably also, the distance between weight 5 and table 1 is also made adjustable, to accommodate patients of varying dimensions. That is to say, a vertical travel of 2½-3 inches is suitable for practically all patients, but the height above the table at which the vertical travel begins and ends may have to be adjusted, depending on whether the patient is deep- or shallow-chested. Various means for providing such adjustment will readily occur to those skilled in the art. For example, the height of the table may be raised or lowered to the necessary degree, or the cable-support member may be made adjustable as to height.

Weight 5, or whatever pressure means is used for the purpose should be so situated as to apply pressure to the area of the back which overlies the lungs—i.e. approximately half-way between the shoulder line and the waist. To achieve this positioning, the position of weight 5 should also be adjustable from left to right as viewed in FIG. 1.

The reciprocating motions of the lifting means (as cradle 3) and the pressure means (as weight 5) are synchronized in such manner that both are up, and both down, at the same time. Thus when the lifting means raises the upper part of the patient's chest, it relieves from the rib cage the pressure normally exerted by the patient's body weight, and at this point in the cycle, weight 5 is also in its upper position, where it exerts substantially no pressure on the patient's back, and the patient's lungs expand and become filled with air. On the other hand, when the lifting means are in the lower position, the chest rests solidly on the table, and the pressure means compresses the rib cage between itself and the table (to the extent permitted by fixed cables 6), thereby compressing the lungs and expelling the contents thereof (whether spent air and carbon dioxide, or foreign matter such as water).

The synchronization of the lifting means and the pressure means is most conveniently achieved by operating them from a common power source, for example an electric motor, by way of a drive shaft, e.g. square shaft 8, which extends longitudinally for the full length of the apparatus. The use of a square (or other non-round) shaft is advantageous in that the power take-off for the various working parts can be permitted to slide on the shaft in making the positional adjustments referred to above, without otherwise disturbing the drive mechanisms.

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The combination of the lifting means with the pressure means, as described to this point, may be used alone, and will effectively apply artificial respiration to a patient over as long a period as required, without exercise of manual effort by the operator.

For more complete evacuation and subsequent refilling of the lungs, however, it is advantageous to employ the abdominal pressure means comprising the flexible cover 4 together with its associated arrangement of planetary rollers 15. As previously described in connection with the "pole-top" method, air can be forced out of the lungs by compressing the abdominal internal organs, forcing the diaphragm upward and thereby exerting a pressure on the lungs from below. Upon release of the pressure on the abdomen, the organs settle back in their accustomed position, the diaphragm subsides, and the pressure on the lungs is relieved, allowing atmospheric pressure to refill them with air. The abdominal pressure means represented by cover 4 and its associated elements applies intermittent abdominal pressure to the prone patient to achieve the same result. It too, even though used alone, will effectively apply artificial respiration over prolonged periods, without physical effort on the part of the operator.

Although both the Sylvester and the "pole-top" methods are effective means of applying artificial respiration, a more complete evacuation and subsequent filling of the lungs is achieved when both are employed in combination, for this reason: When the pole-top method is used alone, not all of the pressure generated by the upward displacement of the diaphragm is effective to exhaust the lungs, because part of the necessary volume adjustment is taken up in expanding the patient's chest before any air is displaced from the lungs. Conversely, when the diaphragm subsides, the chest tends to collapse, rather than making the entire volume adjustment by inspiration of air.

Similarly, when artificial respiration is applied by means which affect only the chest, as the Sylvester method or the use of only the lifting means and the pressure means of the device according to this invention, part of the effect of applying pressure to the lungs is lost by being exerted in forcing the diaphragm downward, and when the pressure is relieved, the diaphragm returns to its normal position, thereby partially off-setting the reduction of pressure in the chest cavity which is being depended on to induce the lungs to be refilled by atmospheric pressure.

When both types of artificial respiration method are applied simultaneously and properly synchronized, however, these losses in effectiveness are prevented. Thus, when pressure is applied to the back, and simultaneously to the abdomen, the abdominal pressure forces the diaphragm upward, and the back pressure, instead of being partially lost by forcing the diaphragm down, is completely utilized in forcing air out of the lungs. On the other half of the cycle, when pressure is relieved from the abdomen and from the chest cavity simultaneously, the diaphragm subsides at the same time the chest cavity is expanding, thus providing optimum conditions for inspiration of air into the lungs.

As illustrated in FIG. 1, the preferred form of apparatus according to this invention also comprises certain additional elements, namely hand grips 9 and 9' together with hand-grip drive 10 (which is a conventional gear drive taking its power from shaft 8), as well as foot members 11 and 11', which may be in the form of shoes as illustrated, or merely pedals similar to the pedals of a bicycle, and foot-member drive 12, which is also a conventional gear drive taking its power from shaft 8.

As also indicated in FIG. 1, the lower (right-hand) portion of the table, which is the portion normally carrying the weight of the patient's thighs down to below the knee, is articulated, and bifurcated, so that the patient's legs may be supported individually in either straight-out or bent position.

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These last-named features, namely the hand grips, the foot members, and the articulated portion of the table, are not brought into play for the purpose of administering artificial respiration. For purposes of resuscitation, the hand-grips and the foot-members are not engaged at all, and may be moved out of the way, while the articulated portions of the table are locked in the fully-extended position, providing a plane surface for supporting the legs.

When employing the device of this invention for swimming instruction, the hand-grips and the foot members are employed. The hand-grips guide the hands in vertical circular paths, and the foot members guide the feet in vertical circular paths. The hand-grips and the foot-members are geared to revolve at the same angular speed, i.e. at the same number of revolutions per minute, and so fixed on their respective shafts that when the right hand grip is at its point farthest from the patient, the left foot member is at its farthest point, while the left hand grip and the right foot member are at the closest points in their respective paths. Once adjusted to this relationship, the hand grips and the foot-members will remain synchronized indefinitely, because they are driven from a common shaft (shaft 8), and geared to the same angular velocity.

When the apparatus of this invention is used for this purpose, the legs are alternately flexed and extended, and the articulated portions of the table are then operated, by means of conventional gear drives, which also take their power from shaft 8, so as to reciprocate in synchronization with the foot members, the right-hand thigh-support 13 being in the dropped position shown, at the point in the cycle when right foot member 11 is in its forward position, causing the right leg to be flexed.

Each of the articulated thigh supports is provided with an articulated knee-support, which is pivotally connected at the lower end of the thigh support and connected to the thigh support and to the table by linkages which cause it to remain substantially horizontal, whatever the position of the thigh support. In FIG. 1, the left knee support 14 is shown connected to the lower end of left thigh support 13.

The hand-grip, foot-member, thigh-support and knee-support features may be employed without the respiration features, namely the cradle, weight 5 and the abdominal pressure means, for swimming instruction, exercise, physical therapy or the like. When used for swimming instruction, however, it is advantageous to put the respiration features into operation as well, because, in addition to teaching the necessary coordination of muscular movement of the limbs, this manner of operation also helps the subject become accustomed to breathing in time with his stroke. When operating in this manner, it is preferred to so synchronize the respiration means with the hand grips, that the subject is forced to inhale when one arm (generally the right arm) is in the retracted position at the end of its stroke. This corresponds with the breath timing employed, for example, in the crawl strokes.

The abdominal pressure means of the apparatus according to this invention may, if desired, be employed to apply intermittent pressure and kneading to any desired portion of the body for weight-reduction or muscle-toning purposes.

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While this invention has been described with reference to certain preferred embodiments and illustrated by means of certain drawings, these are illustrative only, and the invention is not to be construed as limited, except as set forth in the appended claims.

I claim:

1. Apparatus for manipulation of the human body, comprising in combination means for intermittently lifting the shoulders of a prone patient, thereby removing body weight from the chest, and means for intermittently applying pressure to the back of said patient in the area overlying the lungs, thereby augmenting the normal tendency of body weight to collapse the lungs of said patient and expel air therefrom, said lifting means and said pressure means being synchronized to render said pressure means operative to apply pressure only at times when said lifting means is inoperative to lift the shoulders of said patient, and roller means for intermittently applying pressure to the abdomen of said patient, said roller means being synchronized with said shoulder-lifting means and said back-pressure means to apply pressure to the abdomen of said patient when said shoulder-lifting means is inoperative and said back-pressure means is operative, and to release said pressure to the abdomen when said shoulder-lifting means is operative and said back-pressure means is inoperative.

2. Apparatus for manipulation of the human body comprising in combination means for guiding the hands of a prone subject alternately in circular, generally vertical paths, means for guiding the feet of said subject in circular, generally vertical paths, drive means for causing said hand-guiding means and said foot-guiding means to travel in said circular paths and respiration-inducing means for intermittently applying pressure to said patient's body and forcing said patient to breath at a predetermined point in the cycle of said movements of said hand- and foot-guiding means.

3. Apparatus according to claim 2, wherein said hand-guiding means and said foot-guiding means are so synchronized that said subject's right arm and left leg are simultaneously retracted and simultaneously extended, and said subject's left arm and right leg are simultaneously retracted and simultaneously extended.

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