Dec. 3, 1940. R. M. McMILLIN 2,223,570

APPARATUS FOR PRODUCING ARTIFICIAL RESPIRATION

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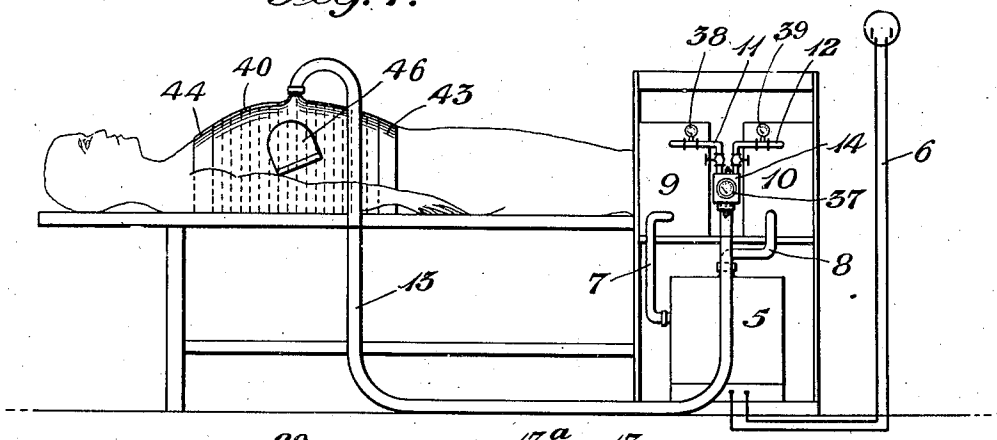
Fig. 1.



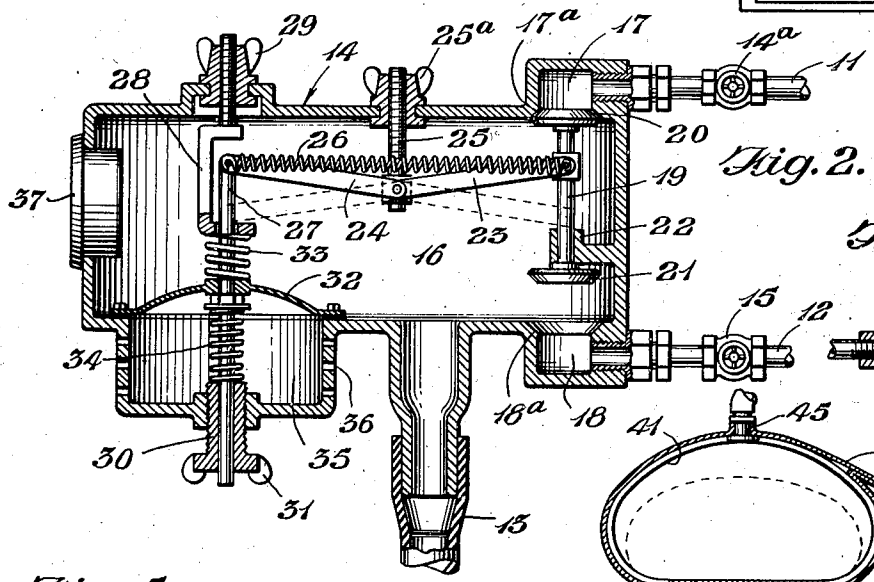
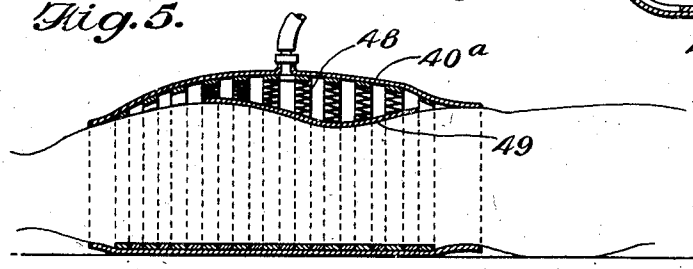


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.



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APPARATUS FOR PRODUCING ARTIFICIAL RESPIRATION

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3 Claims. (Cl. 128—29)

This invention relates to apparatus for producing artificial respiration, or "artificial lung," wherein a hood or casing is placed over the intermediate body portion of a patient with a space between the body and hood in which sub and super atmospheric pressure is alternately established to induce or promote breathing.

The invention includes among its objects:

To provide an artificial lung of such construction as will permit the patient or user to assume different or varying postures while using the lung;

To provide apparatus of this type wherein a relatively high or fine degree of control may be exercised over the artificial breathing action, so as to obtain the most efficient respiration in accordance with the individual characteristics of the patient or user of the lung;

To provide adjustable automatic regulation for the pressure and suction phases of the apparatus;

To provide an artificial lung which is not only more comfortable to the user, but which is so constructed as to permit an attendant or nurse to gain access to the interior of the lung while the latter is in use; and,

To generally improve apparatus of this class.

The foregoing and other objects and advantages will become apparent in view of the following description taken in conjunction with the drawing, wherein:

Fig. 1 is a view in elevation of apparatus embodying features of the present invention;

Fig. 2 is a substantially central sectional view of an automatic control and regulating unit forming part of the apparatus;

Fig. 3 is a detailed sectional view showing one of the valves in the air lines leading to the said control unit;

Fig. 4 is a substantially central cross section of the lung proper; and,

Fig. 5 is a longitudinal sectional view of a modified type of lung.

Referring to the drawing in detail, and particularly to Fig. 1, an air pump is generally indicated at 5, and is shown as of the electrically operated type and accordingly is provided with leads 6 adapted to be connected to or plugged into a suitable source of current supply. The pump is connected through pipes 7 and 8 with a suction or vacuum tank 9 and a pressure tank 10.

The tanks 9 and 10 communicate through pipes 11 and 12 with a main flexible hose or air line connection 13 through an automatic control and regulating unit generally indicated at 14 and shown more or less in detail in Fig. 2. The pipe lines 11 and 12 are provided with orifice valves 14a and 15, for a purpose which will be hereinafter specified.

Referring now particularly to Fig. 2, it will be noted that the housing for the unit 14 provides a closed pressure chamber 16, and the pipe lines 11 and 12 communicate with this chamber through valve ports 17 and 18, respectively, formed with valve seats 17a and 18a. A reciprocating valve guide stem 19 is provided and has at opposite ends thereof closure members or valves proper 20 and 21. The stem or rod 19 is mounted for sliding movement in a guide bracket 22, which may be projected from the end wall of the main housing. Automatic valve actuating mechanism is provided and in the example shown comprises links 23 and 24, stem 25 adjustable through nut 25a, spring 26 and guide rod 27. The rod 27 is mounted to reciprocate in upper guide bracket 28, which is adjustable through the medium of guide 29, and a lower bearing or bushing 30, which is adjustable through medium of nut 31. A valve actuating diaphragm 32 is provided and the rod 27 is connected to said diaphragm, tension springs 33 and 34 being disposed on said rod above and below the diaphragm. The tension of springs 33 and 34 may be adjusted through the medium of wing nuts 29 and 31, respectively. Below the diaphragm, is a vent chamber 35, the wall of which is provided with one or more air vents 36. The links 23 and 24 are pivotally connected at their inner ends to the lower end of the stem or rod 25, while the outer or remote ends of said links are pivotally connected to the valve stem or guide 19 and the diaphragm connecting rod 27.

A gauge 37 is preferably mounted in operative communication with the chamber 16, to indicate at all times the pressure in said chamber. It is also preferred to provide gauges 38 and 39 in the pipe lines 11 and 12 respectively, so as to give a visible indication of the pressures in said lines during operation of the apparatus.

The control mechanism just described operates as follows:

The valves 20 and 21 move in unison, their position as shown indicating that the pressure or compression phase is being carried out, the valve 21 clearing the pressure port 18 and valve 20 closing the suction port 17. When pressure builds up in the chamber 16 and consequently in the line 13 to the lung proper, to be described, the diaphragm 32 will be depressed past dead center, at which time the spring 26 will also move past dead center or below the pivotal axis of the

links 23 and 24, thereby automatically throwing the valve 21 against the seat 18a and unseating the valve 20 from the seat 17a. The suction phase will then commence, and suction will then build up in the chamber 16 and main conduit or line 13 until a certain predetermined sub-atmospheric pressure is reached, at which time the diaphragm 32 and valves 20 and 21 will be returned to the respective positions shown in the drawing. By adjusting the tension of the springs 33 and 34, the throw of the diaphragm 32 may be accurately regulated to obtain the most effective respiratory action for the patient being treated.

The valves 14a and 15 have a particular function to perform, these valves controlling the speed and time of the suction and pressure intervals. In other words, by varying the orifice openings controlled by these valves, the time lengths of the suction and compression intervals as well as the speed of the latter may be regulated in the suction and compression lines 11 and 12, without varying the motor speed as in certain conventional types of apparatus.

The lung proper, in its preferred form, comprises a casing 40 of suitable resilient or flexible material, such as rubber, composition rubber and fabric, or the like which is held in expanded or hood-shaped position through the medium of stays or hoops 41. Suitable means are preferably provided to maintain the hoops or stays in fixed spaced relation, such means in the form shown comprising a backing strip 42, preferably of material having sufficient body to hold the hoops in position while at the same time permitting a limited amount of bending or flexing of the lung. This strip also forms a support or brace for the patient. In the instance shown, the strip 42 is made of relatively hard or solid rubber having the hoops embedded therein. The opposite ends of the lung may be sealed to the patient's body through the medium of suitable tape or the like as indicated at 43 and 44. The line 13 communicates with the lung through a sealed connector such as the coupling 45 constructed to permit more or less free rotation of the hose coupling.

With this type of resilient lung, the patient may either lie down on a table or other support, as is customary in the conventional rigid type of lung, or the patient may adopt varying postures, such as a sitting, or partially reclining position; or the patient may stand and walk within the limits of the conduit 13.

Means are provided whereby access may be had to the interior of the lung or hood without breaking the seal of the latter, such, for instance, as where a nurse or attendant desires to wash the patient. Such means in the form shown comprises a flexible sleeve 46, note particularly Figs. 1 and 4, having its outer end normally sealed by a cap 47. The sleeve 46 may be joined in sealed relation or vulcanized to the casing or hood 40 or it may be made integral therewith.

Whenever it is desired to gain access to the interior of the lung, the cap 47 may be removed or partially removed and the arm of the attendant inserted in the sleeve 46 and the end of the sleeve taped or otherwise sealed to the arm, whereupon the operation of the apparatus may be resumed, or the sleeve may be applied without disturbing the normal operation of the apparatus.

Fig. 5 shows a type of lung wherein springs are utilized for exhausting air from the patient's lungs. In this instance, the casing or hood is indicated at 40a and is provided with a plurality of springs 48 having their lower ends seated on a backing member or analogous strip 49. The remaining parts of the lung may be constructed as in Fig. 1, the difference in this instance being that the springs automatically expel the air instead of depending upon air pressure as in the form first described. This type of lung requires much less air to produce the same pressure difference on the abdomen, the excess air space being smaller. Also, lighter material may be used for the casing, since the area exposed to pressure is reduced.

It is preferred that the pump 5 have sufficient surplus capacity on both the compression and depression strokes to take care of maximum requirements, and that constant pressure regulating valves be provided to maintain a constant pressure in tank 10 and sub-atmospheric pressure in tank 9, such pressure being registered by gauges 38 and 39. As will be understood, the pump 5 supplies fresh air to the pressure tank and thus to the lung and skin of the patient.

It will be seen from the foregoing that I have provided respiratory apparatus having certain important advantages not only as to control but also as to use and which facilitates both the most efficient or effective breathing of the patient and comfort of the latter.

It will be understood that the foregoing description and illustration in the drawing is more or less illustrative, and that certain changes in construction, design and operation may be adopted within the scope of the invention as defined by the appended claims.

I claim:

1. In apparatus for inducing artificial respiration, an artificial lung in the form of a flexible casing adapted to be applied over a portion of the body of a patient, means sealing the upper and lower portions of said casing to the patient's body, a series of annular supporting members in said casing maintaining the latter distended from at least a portion of the patient's body, and means maintaining said supporting members in spaced relation along the length of the casing.

2. In apparatus for inducing artificial respiration, an artificial lung in the form of a flexible casing adapted to be applied over a portion of the body of a patient, means sealing the upper and lower ends of said casing to the patient's body, a series of hoops in said casing maintaining the latter distended from at least a portion of the patient's body, and means having a limited amount of flexibility extending along the back of the casing for holding said hoops in spaced relation along the length of the casing.

3. In apparatus for inducing artificial respiration, an artificial lung in the form of a casing adapted to be applied over a portion of the body of a patient, means maintaining said casing distended providing an air space between the body of the patient and wall of the casing, spring means in said casing adapted to compress the patient's abdomen and cause the patient to exhale, and means for creating suction in said casing to compress said springs and permit the patient to inhale.

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