

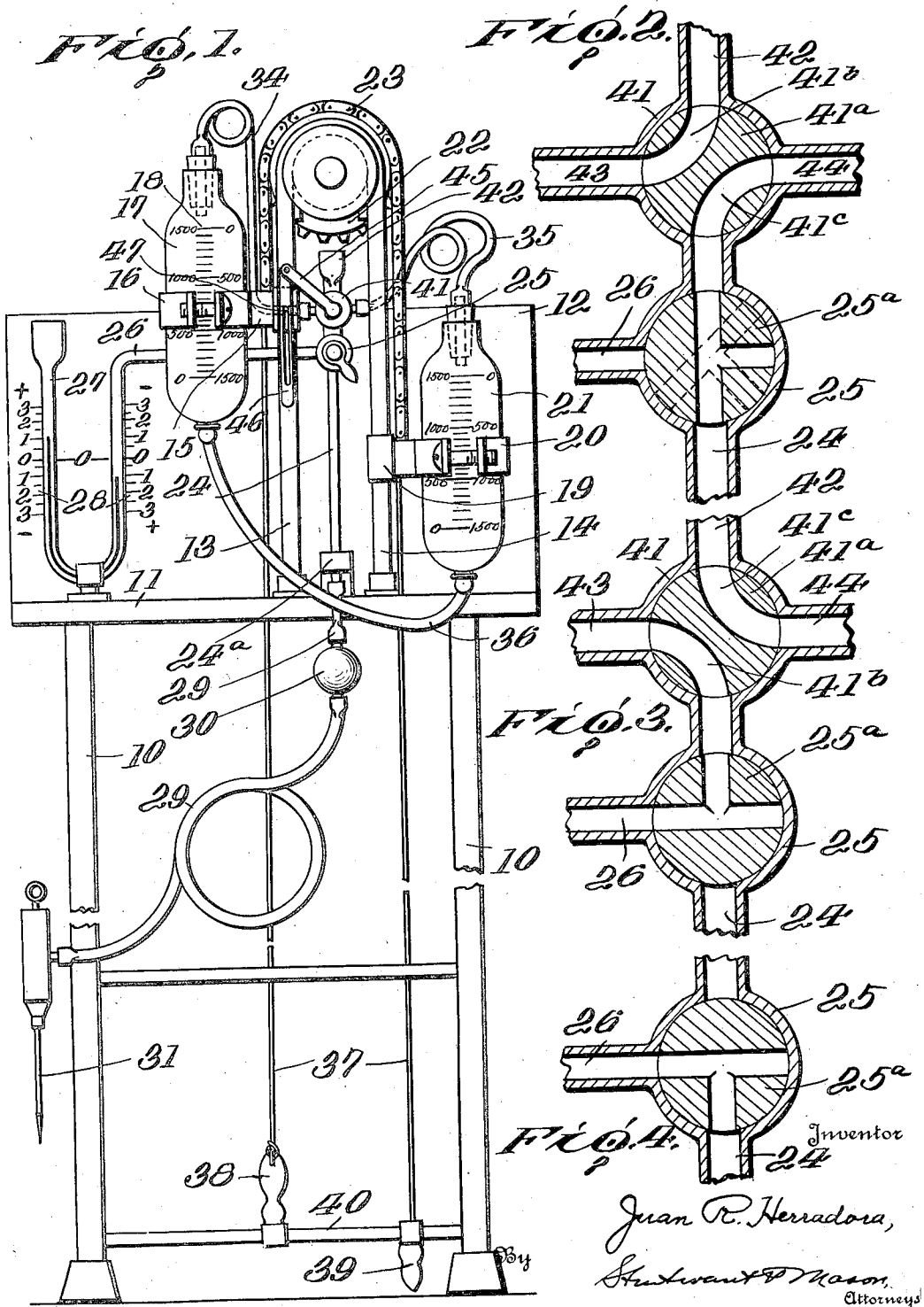
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APPARATUS FOR ARTIFICIAL PNEUMOTHORAX

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APPARATUS FOR ARTIFICIAL PNEUMOTHORAX

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This invention relates to an apparatus for performing the operation of artificial pneumothorax with filtered gases.

One of the objects of this invention is to improve such apparatus so that it is self-setting at each operation for the performance of the following operation.

Other objects are to improve the construction of such mechanism, so that the maintenance of absolutely sterile conditions is facilitated; and to permit the necessary actuation of the device with ease and certainty.

One form of execution of this invention is illustrated on the accompany drawings, in which:

Figure 1 is a front view of the apparatus.

Figs. 2, 3 and 4 are sectional views through the control valve employed.

This apparatus for the operation of artificial pneumothorax is composed of two displacement vessels which are connected adjacent their bottoms for the movement of the displacement liquid. In the practice of the operation, one of the vessels, being filled with displacement liquid, is elevated above the other, so that the liquid may run by gravity into the lower vessel and force the gas initially in the lower vessel to pass through conduits including a gas filter to the injecting needle. A valve is provided to control the flow of the gas. When the operation has been completed by the injection of the desired quantity of gas, the remaining liquid in the upper bottle is permitted to flow into the lower one, with a free escape of the air in the lower bottle. The positions of the bottles are then reversed so that the lower bottle (now filled with displacement liquid), is raised above the level of the bottle which formerly was uppermost; and the device is now ready for a further injection of air by displacement from the now upper to the now lower bottle. This injection is supervised by the attendant by observing the scales located upon the bottles which indicate the volume of gas which has been displaced, and the pressures prevailing in the pleural space may be supervised at varying intervals by a manometer.

It will be understood that it is customary to perform this operation with filtered air:

although any filtered gas having the proper medical qualities may be used, and any such injection medium is comprehended by the term "gas" in this specification and its claims. The displacement liquid employed may be water, or any other suitable substance.

On the drawings, a stand 10 supports a table 11 having a guard back 12. A frame comprising the two vertical columns 13 and 14 which are connected at the top is fastened rigidly to the table and back. A holder or sliding carriage 15 is located for movement along the column 13 in a vertical direction and includes a clamp member 16 which supports a vessel 17 which preferably is of transparent material such as glass, and is provided with an indicating scale 18 at its front. A similar sliding carriage 19 with a clamp 20 is movable on the column 14 and supports a similar vessel 21. These vessels are of the same size and of about 1500 cc. calibrated capacity each, the scales on each being marked from top to bottom and from bottom to top.

A sprocket 22 is journaled at the top of the frame and carries a chain 23 which is connected at its respective ends to the two carriers 15 and 19, so that when one vessel is raised, the other is lowered; and vice versa.

A conduit 24 is rigidly mounted upon the table by a supporting bracket 24a and is practically located between the columns 14, 14 for greater protection. Adjacent its top, this conduit is provided with a three-way valve 25 which controls the passage through the conduit 24 and a branch tube 26 which leads to a monometer which is shown as a U-tube 27 rigidly fastened to the table and back and having the scales 28 by which the position of the liquid column in the manometer may be read, whereby to determine the pressure existing at any moment in the pleural space. A flexible tube 29 is in communication with the discharge conduit 24 at the lower end of the latter, and is provided with a filtering ampule 30 filled with a suitable filter material such as medicated cotton to filter the gas passing through the tube 29 on its way to the injection needle 31.

At its upper end, the discharge conduit 24 is provided with a further valve 41 and a cup

42, the latter being filled with a filtering material similar to that employed in the ampule 30, for the purpose of filtering the gas or air prior to its entry into the respective vessel 17, 21. The valve 41 is an automatic valve to control the connection of the respective vessels 17, 21 with the discharge conduit 24. As shown in Figs. 2 and 3, the valve casing 41 is provided with a plug 41a which has two passages 41b, 41c therein. The valve casing 41 likewise has its side tubes 43, 44 which are connected respectively by the flexible tubes 34 and 35 with the tops of the respective vessels 17, 21. This valve 41 is a "four-way" valve, and is competent of establishing communication as shown in Figs. 2 and 3. In the position of Fig. 2, the passage 41b places the cup 42 in communication with the tube 43 and tube 34 and thereby with the upper part of the vessel 17, so that air may flow into this vessel to fill it as the displacement liquid leaves it. The passage 41c on the other hand places the upper part of the vessel 21, by the tubes 35, 44, in communication with the discharge conduit 24 through the valve 25. When the parts have been moved to the position shown in Fig. 3, the upper part of the vessel 17 is placed in communication by its tube 34 and 43 with the discharge conduit 24: while the other vessel 21 may receive air through its tubes 35, 44 from the cup 42.

This positioning of the valve body 41a is accomplished automatically during the operation of raising and lowering the respective vessels with their sliding carriages. The valve body 41a is provided with a handle 45 which is pivoted at its free end to a slotted link 46. A pin 47 on the sliding carriage 15 is engaged permanently in the slot of the link 46.

The bottoms of the vessels are placed in communication with each other by a flexible conduit 36 for the displacement liquid, so that the liquid is free to flow from one vessel to the other so long as there is a difference in level in the two vessels, and so long as an escape is provided for the gas located at the top of the vessel having the lower level.

A means is provided for lifting and lowering the respective bottles which is illustrated as comprising the cables 37 which extend downwardly through holes in the table 11, and are connected to the respective pedals 38, 39 which are journaled on a cross-bar 40 of the stand 10.

The operation of the artificial pneumothorax may be accomplished with this apparatus as follows:

When the bottles are in the position of Fig. 1, i. e., with the left hand vessel 17 raised and containing substantially all of the displacement liquid, and the right hand vessel 21 lowered and filled with the gas to be injected, the valve body 41a being in the po-

sition in Fig. 2, and with the three-way valve 25 presenting its valve body in the position shown in dotted lines in Fig. 2, the attendant inserts the injection needle 31 into the patient's thorax. The three-way valve 25 is then moved to the position shown in full lines in Fig. 2. The displacement liquid in the vessel 17 now flows through the common displacement liquid conduit 36 into the vessel 21, and forces the gas to the upper portion of this vessel to pass through the tubes 35 and 44, the passage 41c, the valve body 25a, the discharge conduit 24, the filtering ampule 30 and the flexible duct 29 to the injecting device 31. The pressure of the gas thus passing can be measured by the manometer 27 by turning the valve 25a to a position such as shown in Fig. 3: while the pressure prevailing in the interpleural space may be determined by moving the valve body 25a into the position shown in Fig. 4. The volume of gas injected is determined by the downward movement of the displacement liquid in the vessel 17 or the upward movement of this liquid in the vessel 21 and may be read easily from the scales provided upon each of these bottles. When the attendant desires to discontinue the injection, the valve body 25a may again be turned to the dotted line position and the injecting needle 31 withdrawn.

In order to reset the mechanism for a further operation, the valve 25 is again opened to permit the escape of air from the vessel 21 until the displacement liquid has come to the same level in the two vessels 17 and 21, being at the lowest graduation in the vessel 17 and at the highest graduation in the vessel 21. The pedal 38 is then operated to raise the vessel 21 and lower the vessel 17. During the downward movement of the carriage 15 with its vessel 17, the pin 47 slides freely in the slot of the link 46: when the pin finally encounters the bottom of this slot it drops downward upon the link and moves the valve handle 45 so that the valve body 41a is moved from the position of Fig. 2 to that shown in Fig. 3. This movement occurs during the latter stage of the carriage movements and causes the disconnection of the vessel which formerly was delivering gas to the conduit 24 and the reconnection of the other vessel, while at the same time connecting the vessel now full of displacement liquid with the cup 42 so that it may draw in a further supply of gas for use during the next operation. With the substitution of a sterile injecting needle 31 the device is again ready for service, for a new operation.

When this new operation has been completed, the pedal 39 is operated so that the vessel 17 is restored to its uppermost position while the vessel 21 is lowered. During the first part of the upward movement of the carriage 15, the pin 47 again moves freely

in the slotted link 46, but toward the close of this movement it encounters the end of the slot and moves the link 46 upwardly, to move the handle 45 of the valve body 41a back into the position shown in Fig. 1, thereby reestablishing the former connections of the vessels 17 and 21 with the atmosphere and with the discharge tube 24, respectively.

It will be seen that the device is very simple and automatic in its functions: and that the delivering of gas for one operation of artificial pneumothorax causes the substantial resetting of the apparatus for the succeeding operation, and that the various parts may be maintained clean. The use of the pedals avoids the necessity of contact even with the gloved hand, and the three-way valve 25 may be operated and handled by a sterile clip, thereby giving the surgeon sufficient opportunity to keep his gloves out of contact with an instrument that is not bacteriologically sterile or aseptic: while at the same time the portions of the apparatus which are in contact with air or gas may be maintained clean: and the gas itself filtered on its way to service.

The manometer 27 has its scale 28 divided into sections with a zero line substantially midway of each scale. The readings may be taken on either arm, and it is preferred to designate the readings above and below the zero line as "plus" or "positive" and "minus" or "negative", respectively, on the left hand arm, while the readings on the right hand arm are of course reverse. These scales are divided according to any desirable standard as for example, in pounds per square inch or kilos per square centimeter, or in terms of inches of mercury or water of according to any other accepted standard for such measure.

The manometer 27 is preferably placed in communication with the interpleural space of the patient at varying intervals during the operation by turning the valve 25 to the position shown in Fig. 4, so that the absolute pressure prevailing in the space may be determined.

It is obvious that the invention is not limited to the specific forms illustrated and described, but that it may be modified within the scope of the appended claims.

I claim:

1. In a gas injecting apparatus, a support, two vessels, a liquid conduit connecting the bottoms of said vessels so that a liquid permanently contained in the apparatus and at a higher level in one vessel may flow through said conduit to establish a uniform level in said vessel, a four-way valve on said support, discharge conduits for connecting the tops of the vessels with said valve, a pair of vertical slide-ways fixed on said support, carriages movable on said slide-ways for holding said vessels upright while permitting them to be

raised and lowered with said carriages on said slide-ways, means for connecting said carriages so that one is raised as the other is lowered, an injection conduit leading from said four-way valve to the injecting device, a gas inlet means for said valve, and means operated by the movement of the said carriages to actuate said valve to connect one of said discharge conduits to said gas inlet means.

2. An apparatus as in claim 1, in which said connecting means comprises a pulley mounted on said support and a chain passing over said pulley and connected at its ends to said carriages.

In testimony whereof, I affix my signature.
JUAN RAFAEL HERRADORA.