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Foures

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[54] **RESPIRATOR ACTUATING MECHANISM**

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[51] **Int. Cl.²** **F01B 31/04**

[58] **Field of Search** 417/429, 539; 92/13.1, 92/13.7, 172

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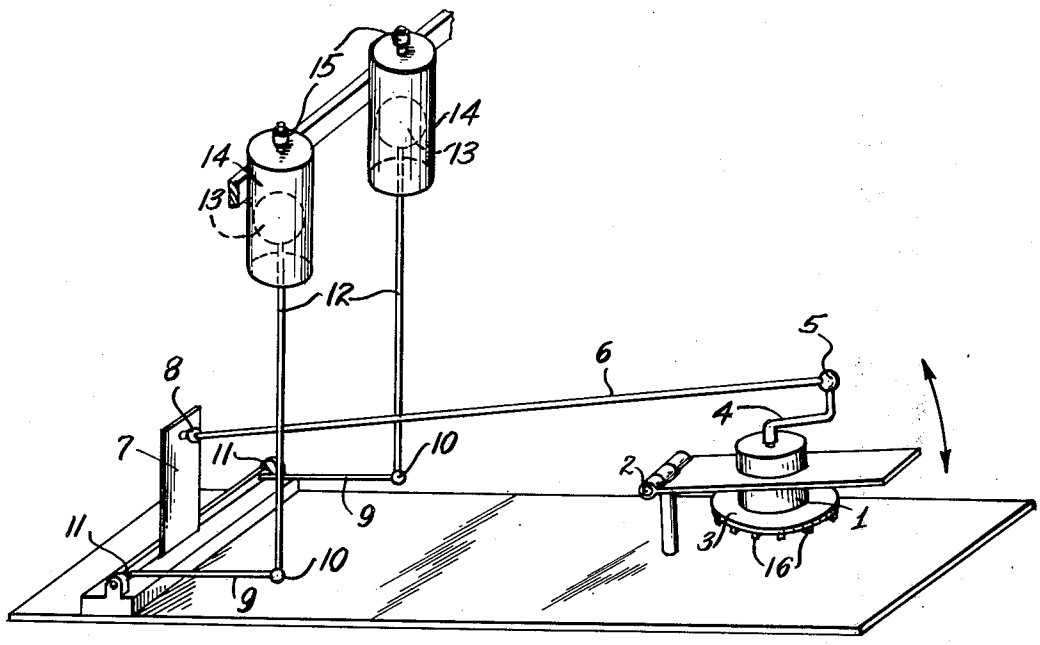
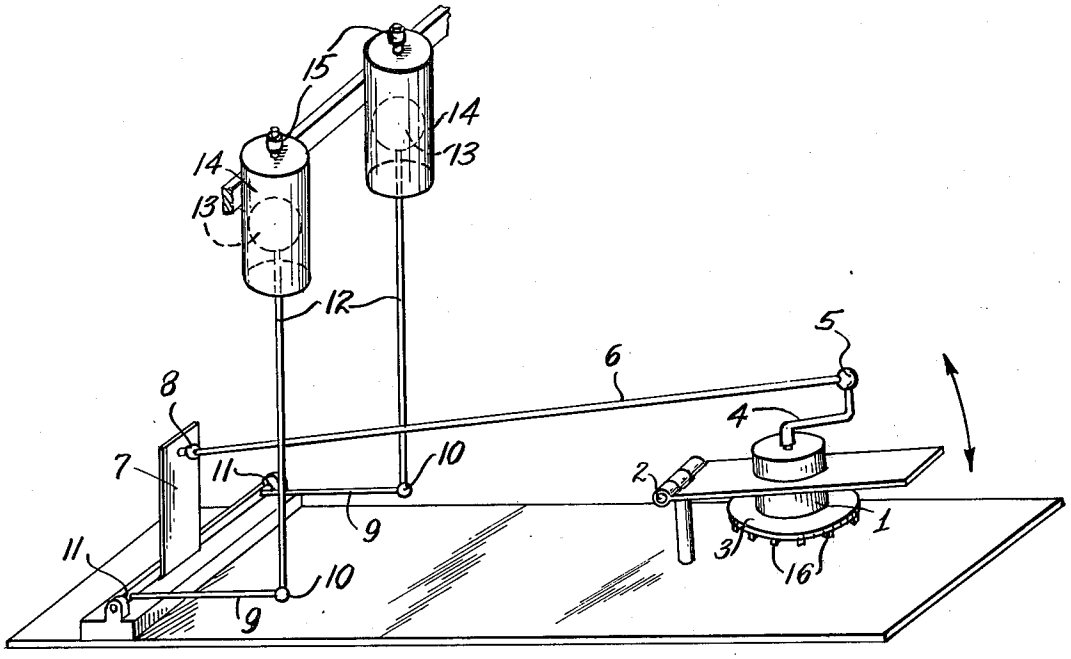
[57] **ABSTRACT**

Device for actuating a respirator comprises two pumps for producing alternate inhalations and exhalations, a variable speed motor for driving said pumps 180° out of phase, and adjustable linkage means for altering the stroke imparted to said pumps by said motor.

7 Claims, 1 Drawing Figure

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RESPIRATOR ACTUATING MECHANISM

SUMMARY OF THE INVENTION

This invention relates to program controlled apparatus for inducing respiration in a fixed cycle.

There are several known types of such apparatus. Some of them use cams actuating rubber bellows. These do not provide an entirely satisfactory method for dividing up the cycle. Moreover, the rubber bellows have a flexibility which impairs the alveolar ventilation in difficult cases.

Other devices are controlled by electromagnetic connecting rods and clutches but these fail to exactly define the starting moment. In effect, the clutches slip to a certain extent in dependence upon the state of the clutch surfaces. Other devices operate by inflating expansible chambers (balloons for example) by means of gas under pressure. Weights or springs then compress these chambers. The present invention has the object of overcoming all these disadvantages by permitting a continuous regularity in the ventilation while decreasing the compression and expansion of inert volumes.

It has the effect of eliminating dead spaces in the ventilation which is particularly valuable in infantile ventilation. The apparatus also has the advantage of dividing up the respiratory cycle with great precision.

The apparatus according to the present invention comprises a variable speed motor controlling a mechanical assembly which actuates at least two pumps having spherical pistons, one for inhalation and one for exhalation, operating continuously and 180° out of phase. Valves are used to distribute the ventilation in accordance with the selected respiratory cycle and are program controlled.

A preferred embodiment of the invention will now be described with reference to the accompanying drawing which is a schematic assembly view of the apparatus as a whole.

As shown in the drawing, an electrical variable-speed motor **1**, adjusted to the respiratory rhythm of the patient or to one selected by the physician, is mounted on a support pivotally attached at **2** to the base of apparatus. It is equipped with a program disc **3** at one end of its shaft and a crank **4** at its other end, which crank carries a ball and socket joint **5** attached to a connecting rod **6** which transmits the movement of the motor to a swinging member **7** through a ball and socket joint **8**. The variation in the movement of the ball and socket joint **8** is dependent on the position of the motor support on the sector on which it turns. It may be electrically or manually positioned and locked in the selected position.

The swinging member **7** is fixed to two arms **9** each carrying at one end a pivotal joint **10**. Pivots **11** permit an alternating angular rotation of the assembly comprising the swinging member **7** and the arms **9**, said pivots being fixed to the framework of the apparatus.

The pivotal joints **10** of the two arms **9** are attached to piston rods **12** which carry the spherical pistons **13**, the shape of which avoids any disadvantage resulting from a change in the angular position of the rods which carry them, so that these changes in angle due to movement of the arms **9** does not prevent the ability of the pistons to stay in sealing contact with the walls of the pump chambers **14**.

The more closely the position of the motor approaches the vertical the more the stroke of the connecting rod **6** decreases. Moreover, the alternating rectilinear motion of the pistons **13** also decreases and the cyclic movement of the pistons takes place closer to the head end of the pump cylinders. This particular position of the various components of the apparatus is chosen for small ventilations. For larger ventilations the converse takes place. In order to increase the volume between the piston and the bottom of the pump the stroke of the connecting rod **6** is increased by bringing the motor to the horizontal position shown by the drawing.

The ventilation is distributed by means of valves **15** controlled by a program disc **3** during the respiratory cycle. Various electrical or fluid control points are provided on the periphery of the disc. The selection of the cycle is made by a switch on a control panel. This means of controlling the respiratory cycle makes it possible to obtain diverse functions such as self-initiated respiration, various warnings, etc.

By appropriately controlling the valves it is possible to set up the apparatus for self-initiated respiration without stopping the mechanical assembly.

A digital counter for the frequency is mounted on the motor shaft. A pressure responsive device having a memory awaits the moment at which the programming device is in a position to start inhalation in order to deliver a respiratory cycle to the patient. The choice of various phases in the action of said respiratory cycle may be adjusted by an operator or by electrical signals received from auxiliary apparatus carrying out continuous physiological analyses.

The assembly of the apparatus may be constructed on a modular 19 inch base to facilitate its integration with a monitoring and indicating panel.

The present invention may be used in any medical or other service requiring respiratory assistance and particularly in the case where prolonged respiratory assistance is necessary.

What is claimed is:

1. Apparatus for providing respiratory assistance, said apparatus comprising a support carrying a variable speed electric motor connected to actuate spherical pistons in two pumps through appropriate linkage, one pump being connected to provide inhalation and the other exhalation, said motor carrying a crank at one end of its shaft which actuates said linkage, and said linkage comprising a connecting rod driven by said crank which transmits motion to a swinging member carrying projecting means, to which rods carrying the spherical pistons are connected, said motor being pivotally mounted on its support to swing about an axis parallel to but spaced from the axis of rotation of said swinging member, so that a change in the angular position of said motor varies the stroke of the connecting rod and consequently the stroke of the two pistons.

2. Apparatus as claimed in claim **1** in which the crank is connected to the connecting rod by a ball and socket joint.

3. Apparatus as claimed in claim **1** in which the connecting rod is connected to the swinging member by a ball and socket joint.

4. Apparatus as claimed in claim **1** in which the swinging member is mounted on pivot means supported on the framework of the apparatus so that said swinging member may oscillate through an angle of rotation.

5. Apparatus as claimed in claim 1 in which said projecting means comprise arms which carry pivotal joints at their ends which are connected to the piston rods.

6. Apparatus according to claim 1 in which the two pumps are continuously operated 180° out of phase.

7. Apparatus as claimed in claim 1 in which said motor is mounted to swing between a first position causing a maximum piston stroke and a second position causing a minimum piston stroke, and said linkage actuates said pistons over a path of travel nearer the head ends of said pumps when said motor is in said second position than when said motor is in said first position, thereby decreasing the dead time for each stroke.

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