

Jan. 26, 1943.

P. G. McCOLLAM

2,309,470

RESPIRATOR -

Filed Nov. 28, 1940

3 Sheets-Sheet 1

Fig. 1.

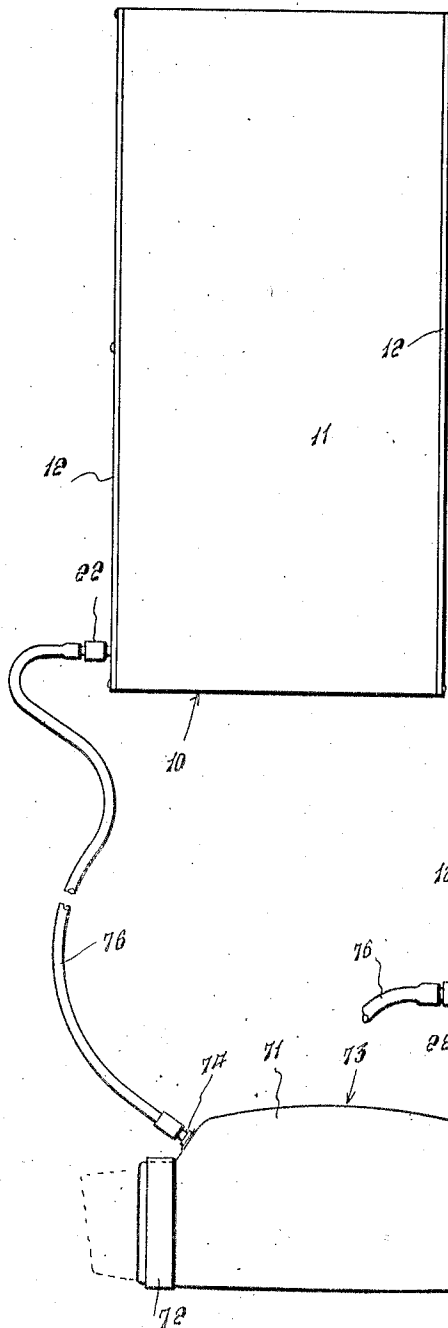
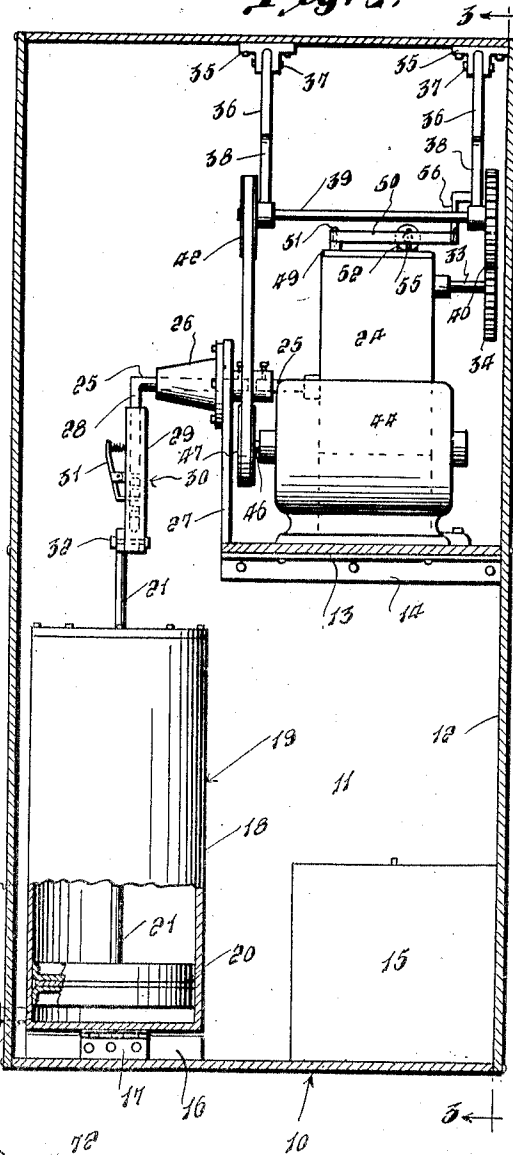


Fig. 2.



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Fig. 3.

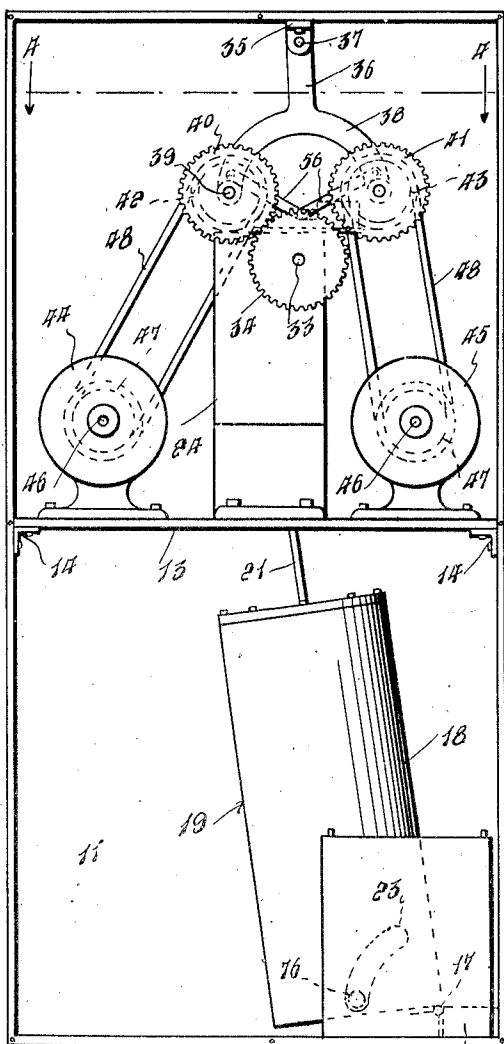


Fig. 4.

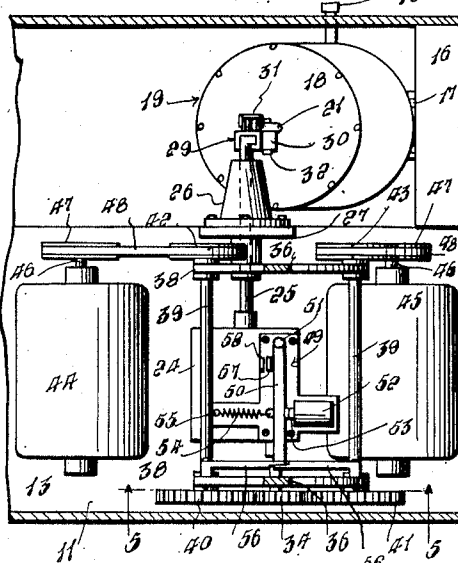


Fig. 5.

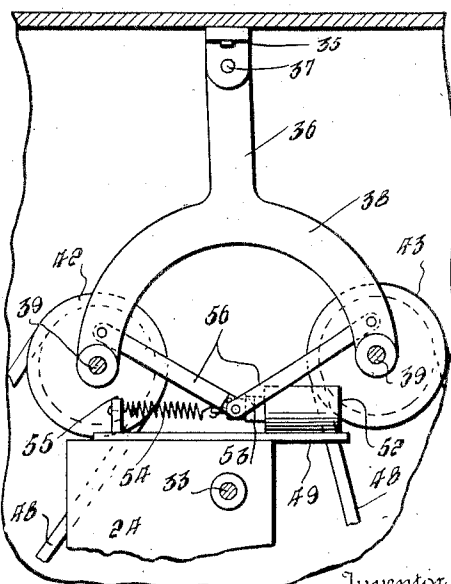
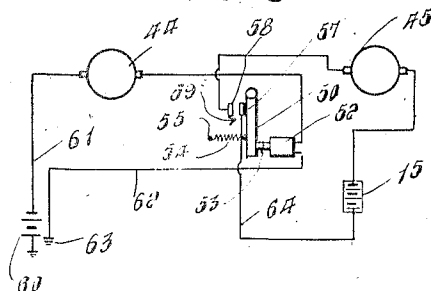


Fig. 9.



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Fig. 6.

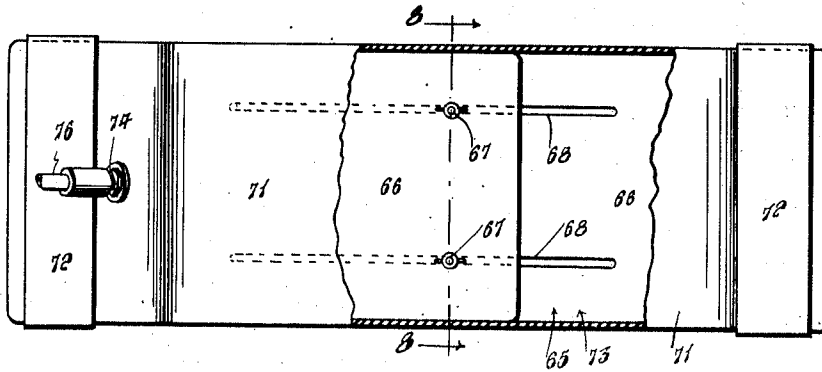


Fig. 7.

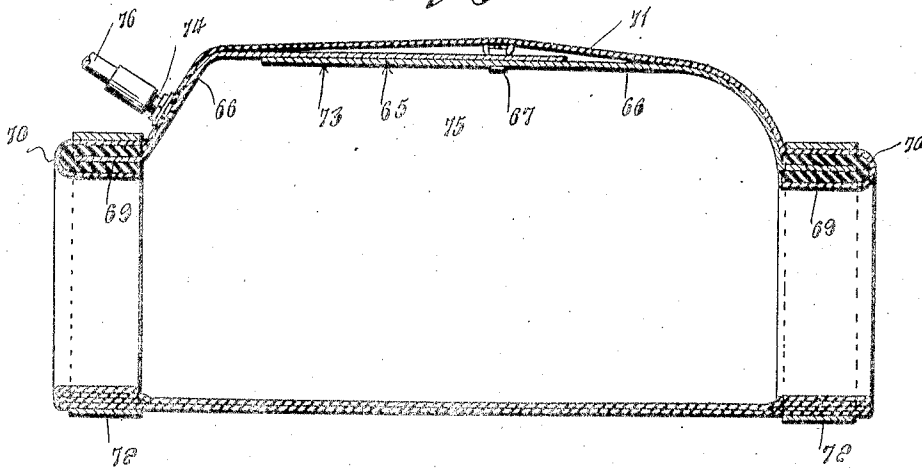
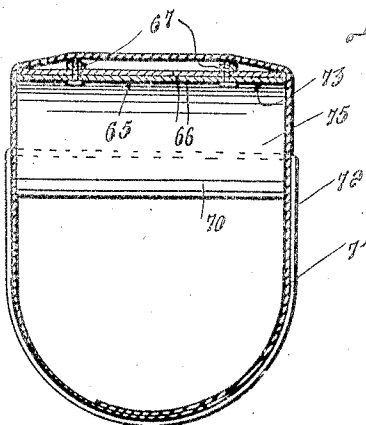


Fig. 8.



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UNITED STATES PATENT OFFICE

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RESPIRATOR

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Application November 28, 1940, Serial No. 367,654

1 Claim. (Cl. 172-239)

This invention relates to an improved respirator and more particularly to a respirator so designed that it will cause the patient to expand and contract the abdomen and chest to thereby artificially compel breathing.

It is a particular aim of the invention to provide an apparatus of simple construction capable of being readily applied to a patient for artificially causing breathing, said apparatus being so constructed that it can be used while a patient is lying prone, sitting upright, standing or walking within a limited area.

Still another aim of the invention is to provide a respirator apparatus including a pump adapted to be driven by an electric motor and equipped with a primary and secondary motor connected to separate sources of electric current and so arranged that in case of failure of electric current to the primary motor, a gear connected to and driven by the secondary motor will be automatically moved into position for operating the pump and the circuit to the secondary motor will be closed for energizing it thus providing means to insure uninterrupted operation of the apparatus.

Other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, which illustrate a preferred embodiment thereof, and wherein—

Figure 1 is a side elevational view of the apparatus, shown applied,

Figure 2 is a vertical sectional view, partly in elevation and on an enlarged scale and showing the operating mechanism of the apparatus,

Figure 3 is a vertical sectional view taken substantially along the plane of the line 3—3 of Figure 2,

Figure 4 is a horizontal sectional view taken substantially along the plane of the line 4—4 of Figure 3,

Figure 5 is an enlarged vertical sectional view taken substantially along the plane of the line 5—5 of Figure 4,

Figure 6 is a top plan view partly in section of the portion of the apparatus which is applied to the patient,

Figure 7 is a longitudinal vertical sectional view of the same,

Figure 8 is a transverse vertical sectional view taken substantially along the plane of the line 8—8 of Figure 6, and

Figure 9 is a diagrammatic view of the electric circuit of the electric motors.

Referring more particularly to the drawings, 55

wherein like reference characters designate like or corresponding parts throughout the different views, 10 designates generally the respirator apparatus comprising the invention and which includes a casing or housing 11 having opposed removable walls 12. The housing 11 is provided with a platform or floor 13, intermediate of its top and bottom, which extends from one of the sides 12 to adjacent the center of the housing 11 and which is supported by angle members 14. A storage battery 15 is mounted in the bottom of the housing 11 beneath the floor 13.

In the other side of the bottom portion of the housing 11 is secured a block 16 to which is connected one leaf of a hinge 17, the other leaf of which is fastened to the bottom of a cylinder 18 which forms a part of an air pump, designated generally 19, and which is hingedly mounted by means of the hinge 17 within the housing 11, for a purpose which will hereinafter become apparent. As best seen in Figure 2, a piston 20 is slidably mounted in the cylinder 18 and is provided with a piston rod 21 which extends upwardly therefrom and through the upper end of the cylinder 18. A pipe 22 communicates with the lower portion of the cylinder 18, beneath the piston 20, and projects therefrom through an arcuately shaped slot 23 in one of the sides 12.

A gear housing 24 is mounted on and fastened to the floor 13 and projects upwardly therefrom. A shaft 25 has one end extending into the gear housing 24 and has its intermediate portion journaled in a bearing 26 supported by a standard 27 which, in turn, is secured to and supported by the floor 13. The opposite end 28 of the shaft 25 is bent at a right angle, beyond the bearing 26, and carries a sleeve 29, which combines therewith to form a crank arm 30. A spring latch 31 is mounted on the sleeve 29 and has one end extending therethrough for selectively engaging apertures or recesses, not shown, in the portion 28 for varying the length of the crank arm 30. The free end of the sleeve 29 is pivotally connected by a pin 32 to the free end of the piston rod 21 for reciprocating the piston 20 when the shaft 25 and its crank arm 30 are revolved. It will be obvious that the length of the telescoping crank arm 30 can be varied for varying the length of the stroke of the piston 20. The pump 19 is hingedly mounted to permit it to rock as the crank arm 30 revolves to swing with the piston rod 21 and the arcuately shaped slot 23 is shaped so that the pipe 22 can swing with the cylinder 18.

A shaft 33 is journaled in the upper portion

of the gear housing 24 and has one end projecting from the side thereof opposite to the side from which the shaft 25 projects, and the exposed end of the shaft 33 is provided with a gear wheel 34. A pair of brackets 35 are secured to the top of the housing 11 and depend therefrom and are arranged transversely of the housing 11 and in alinement with one another. A hanger 35 is pivotally connected at its upper end by means of a pin 37 to each of the brackets 35. The hangers 35 are provided with yoke shaped bifurcated lower ends 33. Shafts 39 are journaled, adjacent their ends, in the complementary ends of the yoke shaped portions 38. Gear wheels 40 and 41 are keyed to corresponding ends of the shafts 39 and pulleys 42 and 43, having V-shaped grooves, are connected, respectively, to the opposite ends of said shafts 33. Electric motors 44 and 45 are fastened to the upper side of the floor 13, one on either side of the gear housing 24 and are each provided with driven shafts 46 having pulleys 47, which are likewise provided with V-shaped grooves. Pulley 47 of the motor 44 is connected by a belt 48 to the pulley 42 and the pulley 47 of the motor 45 is similarly connected by a belt 49 to the pulley 43. The belts 48 are likewise V-shaped in cross section to fit the grooves of the pulleys 42, 43 and 47.

Referring particularly to Figures 4 and 5, a plate 49 of insulating material is fastened to the top of the gear housing 24 and a lever 50 is pivotally connected at 51 at one end thereof to one end of the plate 49. An electromagnet 52 is secured to the plate 49 and is provided with an armature 53 which is fastened to one side of the lever 50, intermediate of its ends. A contractile coil spring 54 is fastened at one end to the opposite side of the complementary portion of the lever 50 and is anchored at 55 at its opposite end to a portion of the plate 49 which is remotely disposed relatively to the electromagnet 52. A pair of links 56 are pivotally connected at their adjacent ends to the free end of the lever 50 and are pivotally connected at their opposite ends to the ends of the yoke shaped portion 33, which is disposed adjacent the gears 40 and 41. An electric contact 57 is carried by the lever 50 for engaging a fixed contact 58 mounted on the plate 49 and combining with the contact 57 to form a switch, designated generally 59. The contact 57 is insulated from the lever 50 in any suitable manner as by means of a block of insulating material interposed therebetween.

As best seen in the diagrammatic view, Figure 9, the electric motor 44, which is the primary motor, is adapted to be connected to a suitable source of electric current 60, such as conventional house current, by means of an electric wire 61 which leads therefrom to the motor 44 and by the wiring 62 which leads from the motor 44 to a ground 63. The wiring 62 is also connected to the electromagnet 52 so that the electromagnet 52 and the motor 44 will be simultaneously energized or deenergized. The switch 59 is connected in the circuit 64 to the secondary electric motor 45 and to the battery 15.

Referring particularly to Figures 6, 7 and 8, an arch shaped member, designated generally 65, is formed of sections 66 having overlapping ends which are connected by fastenings 67. One of the sections 66 is also provided with slots 68 through which the fastenings 67 extend, and

by means of which the arch shaped member 65 may be extended or retracted. The arch shaped member 65 is provided with downwardly offset remote ends 69 which are disposed in folded strips of cushioning material such as the sponge rubber strips 70. As best seen in Figure 1, the arch shaped member 65 is adapted to be disposed over the chest and abdomen of a patient with one end thereof resting on the collar-bone and the other end resting on the pelvis, and the cushioning strips 70 are provided for cushioning the ends 69. A sheet of air-tight material such as rubber, designated 71, is disposed over the arch shaped member 65 and is wrapped around the body of the patient with the side edges thereof preferably turned under and back upon themselves and around the cushioning strips 70. Elastic straps 72 are applied around the folded side edges of the sheet 71 for detachably securing the body engaging member, designated generally 73 and comprising the member 65 and the sheet 71, to the body of the patient, as illustrated in Figure 1.

A pipe connection 74 opens into the space 75 between the abdomen and chest of the patient and the arch shaped member 65 and projects from the body engaging member 73. A hose 76 is attached at one end to the outer end of the pipe connection 74 and at its opposite end to the outer end of the pipe 22.

Assuming that the body engaging member 73 has been applied to a patient, as illustrated in Figure 1, and as previously described, and that the circuit formed by the wires 61 and 62 is connected to a source of electric current, as for example an electrical outlet box, the current flowing through the wires 61 and 62 will energize the motor 44 and the electromagnet 52. The electromagnet 52 when energized will attract the armature 53 to swing the lever 50 toward the armature 53 and against the action of the spring 54 to thereby open the switch 59 to the motor 45. This movement of the lever 50 will rock the hangers 35 to move the gear 40 into engagement with the gear 34 and at the same time move the gear 41 out of engagement with the gear 34. The gear 40 being driven by the motor 44 will drive the gear 34 and its shaft 33 which is connected by suitable reduction gearing, not shown, disposed within the gear housing 24, to the shaft 25 for driving this shaft to revolve the crank arm 30. The rotation of the crank arm 30 will reciprocate the piston 20, as previously described. The reduction gearing, not shown, is provided so that the shaft 25 and its crank arm 30 will revolve very slowly and on the upstroke of the piston 20 air will be drawn from the space 75 thereby creating a partial vacuum therein and causing the abdomen and chest of the patient to be artificially expanded so that air will be drawn into the lungs of the patient. On the downstroke of the piston 20 air will be forced into the space 75 to cause the patient's chest to be artificially contracted to exhale the air from the lungs of the patient. It will thus be seen that on the upstroke the patient will be caused to inhale and on the downstroke of the piston 20 to exhale to thereby artificially promote natural breathing of the patient. It will be obvious that the patient while being thus treated may lie down, stand or sit or walk about within a limited area depending upon the length of the hose 76.

Should the electric current by which the motor 44 is driven fail for any reason, the electromagnet

52 will be promptly deenergized permitting the spring 54 to move the lever 50 away from the electromagnet 52 to thereby close the switch 59 for closing the circuit from the battery 15 to the motor 45 and at the same time swing the hangers 36 to the left, as seen in Figures 3 and 5, to move the gear wheel 40 out of mesh with the gear wheel 34 and to move the gear wheel 41 into mesh with the gear wheel 34. As the gear wheel 41 is driven by the motor 45 it will thus begin immediately to drive the shafts 33 and 25 to continue the operation of the pump 19 without sufficient interruption to affect the patient. The motor 45 will continue to operate the pump 19 until current to the motor 44 and the electromagnet 52 is resumed when the change over, first pointed out, will be repeated to break the circuit to the motor 45 by opening the switch 59 and by moving the gear 40 into mesh with gear 34 and gear 41 out of mesh therewith by swinging the hangers 36 to the right. The belts 48 are arranged so that they will be correctly tensioned when the gears 40 and 41, which they drive, are in mesh with the gear 34.

Various modifications and changes are contemplated and may obviously be resorted to, as only a preferred embodiment of the invention has been disclosed.

I claim as my invention:

An operating mechanism for driving a driven member, comprising a housing, a shaft journaled in said housing and having a crank arm on one

end thereof adapted to be connected to a driven member, a second shaft connected to said first mentioned shaft, bearing means for journaling said second shaft, a gear keyed to said second shaft, a depending hanger pivotally mounted in said housing and having a yoke shaped depending end, shafts journaled in the ends of said yoke shaped end, a gear keyed to each of said last mentioned shafts, a pulley keyed to each of said last mentioned shafts, two motors mounted in the housing and having driven shafts provided with pulleys, belts each connecting one of the first mentioned and one of the last mentioned pulleys, one of said motors being connected to a suitable source of electric current, electro-magnetic means connected in circuit with said motor, means attracted by said electromagnetic means and connected to said hanger for moving it to bring the gear, connected to the shaft driven by said last mentioned motor, into mesh with said first mentioned gear, a battery connected to the other motor, a normally open switch disposed in the circuit from the battery to said last referred to motor, and spring means for moving the hanger in the opposite direction, when said electromagnetic means is deenergized, for closing said switch and for moving the other of said last mentioned gears into mesh with said first mentioned gear and for moving the gear, formerly in mesh with said first mentioned gear, out of meshing engagement therewith.

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