

Aug. 11, 1942.

H. T. KRAFT

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PUMP

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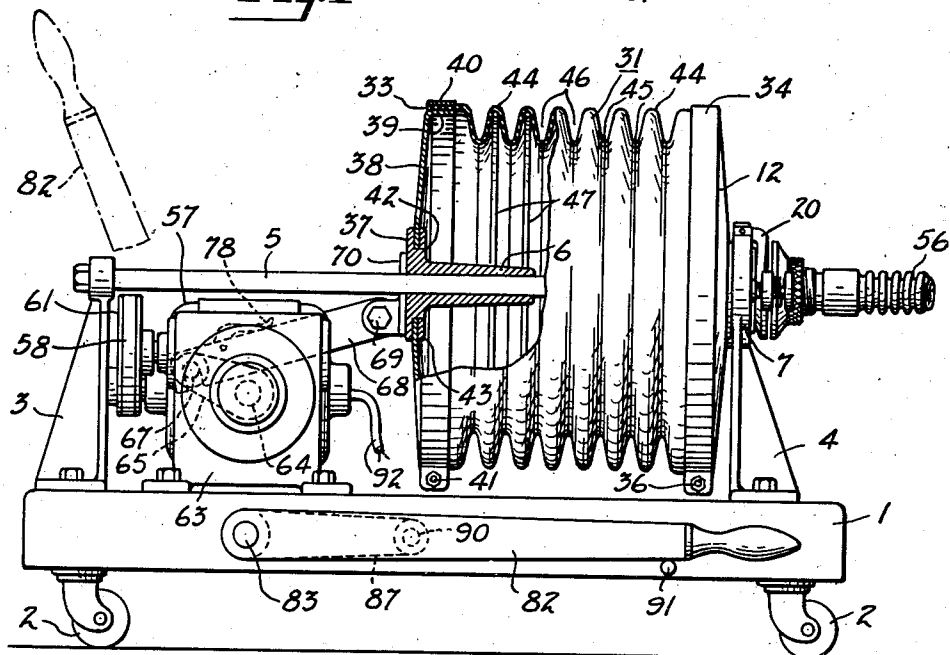
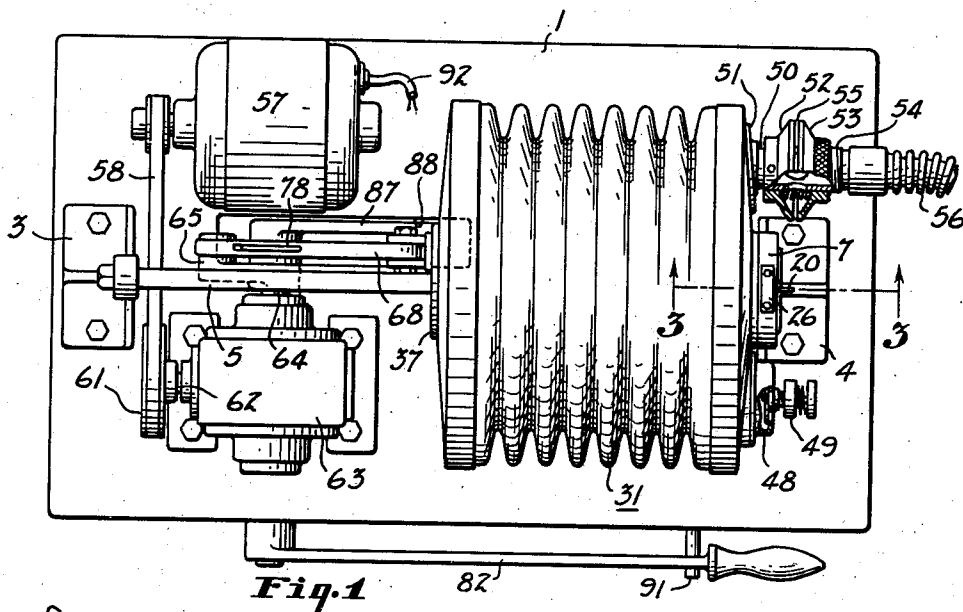


Fig. 2

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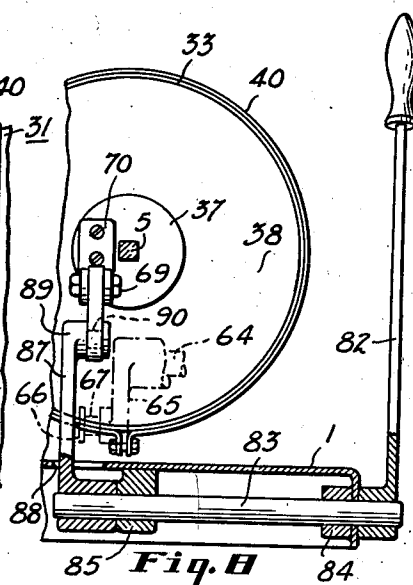
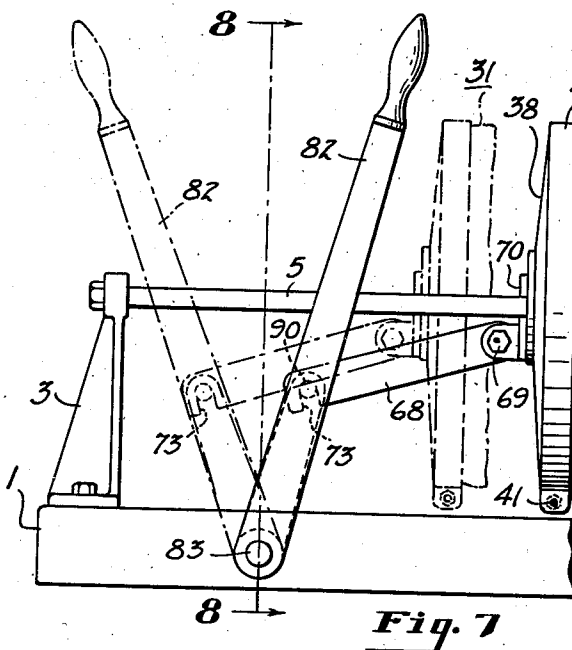
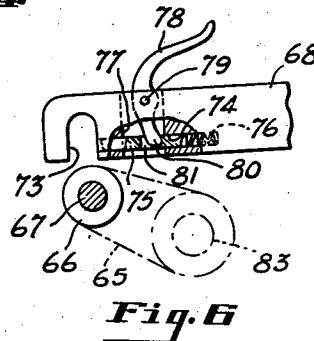
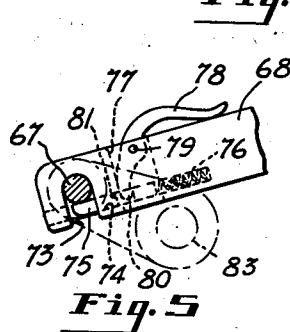
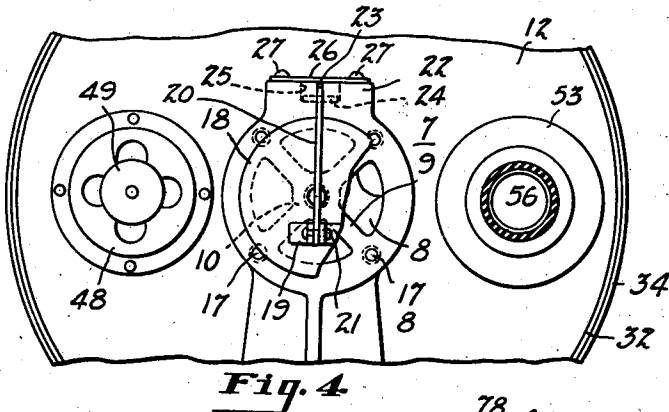
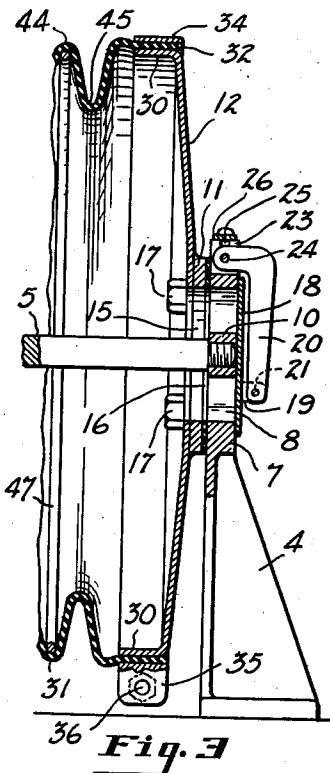
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7 Claims. (Cl. 60—62.6)

This invention relates to pumps and more particularly to air pumps used in connection with vaso-therapy and for the promotion of artificial respiration in the treatment of respiratory diseases and ailments.

It is an object of the invention to provide a pump of this character which operates in a uniform and even manner so that the alternations of pressure induced thereby upon a patient receiving treatment will be of the character most suited for the treatment prescribed.

Another object is to provide an air pump which may be moved about from place to place so as to permit its use successively in connection with a number of patients in different rooms or wards of a hospital or similar institution.

Another object is to provide an air pump for use in connection with therapeutic devices which is provided with power actuated drive means in combination with hand actuating means, so that either may be used independently of the other. More particularly the invention aims to provide a drive arrangement of this character in which the pump may be rapidly disconnected from either the motor actuated drive means or the hand actuated drive means and reconnected to the other, so that there is no suspension in the treatment being given a patient during change.

The invention also aims to provide improvements in the manner of supporting a bellows type pump, improvements in the valve structure, and improvements in the construction and arrangement of the flexible bellows. Other objects and advantages will become apparent from the following detailed description of a suitable embodiment of the invention made in connection with the accompanying drawings in which like parts throughout the several views are indicated by the same numerals of reference.

Figure 1 is a top plan view of the pump showing the same mounted on a supporting structure, together with drive means for the pump;

Fig. 2 is a side elevational view, partly in section and with partly broken away, showing the pump apparatus of Fig. 1;

Fig. 3 is a sectional detail taken substantially on the line 3—3 of Fig. 1 and enlarged with respect thereto;

Fig. 4 is an elevational detail, partly in section and with parts broken away, showing one end of the pump;

Fig. 5 is a diagrammatic detail with parts removed showing the connection for the link and motor driven crank;

Fig. 6 is a view similar to Fig. 5, showing the link and crank disconnected;

Fig. 7 is a diagrammatic elevational view showing the pump actuating link connected to the manual drive; and

Fig. 8 is a sectional detail with parts broken away, taken substantially on the line 8—8 of Fig. 7.

The pump is mounted on a supporting structure which includes a base 1 which may be constructed of wood, but is preferably made of metal such as cast iron or steel. This base is provided with caster wheels 2 which permit movement of the pump from room to room or patient to patient, as required. Also, the pump may be moved on the casters along with the patient so that the patient may receive the vacuum treatments while in transit. At opposite ends of the base 1, pedestals 3 and 4 are secured thereto in spaced apart relation. Extending between and secured to the pedestals is a sliding rod or bar 5 on which is slidably mounted a hub or sleeve 6. Preferably, the rod 5 is of square section and is received in a square opening in the hub 6 so as to prevent rotation of the hub on the rod, see Fig. 8.

The pedestal 4 has an enlarged flat head 7 which is preferably of circular form, as shown in Fig. 4. A number of apertures 8 are formed through the head to provide air or gas passages, as will later appear. Portions of the head 7 between the apertures 8 form legs 9 of a spider structure, having a central part 10 into which is threaded or otherwise secured one end of the slide rod 5.

Disposed against one face of the head 7 is hub portion 11 of a fixed or stationary end member 12. An opening 15 in the hub 11 is aligned or communicates with the openings 8 in the head to permit the passage of air or gas from one side of the end member 12 to the other. Preferably, a soft gasket 16, also apertured, is interposed between the head and hub 11 to provide a gas-tight connection therebetween when securing bolts 17 which extend through holes in the hub 11 and are threaded into the head 7 are tightened.

Disposed against the outside of the head 7 and across the openings 8 is a flap or cover 18. The periphery of this cover seats against the marginal portions of the head 7 so as to completely cover the apertures 8 and seal the same against the flow of air into the bellows of the pump. Any suitable material may be used to form the flap or cover, although a thin metal plate is to be preferred. As shown in Fig. 4, the cover 18 is cir-

cular, being concentric to the circular periphery of the head 7.

Bracket 19 is formed or secured to the cover 18 below the center thereof and is bifurcated to receive the lower end of an L-shaped arm or link 20 to which the bracket is pivoted at 21. On the top portion of the head 7 is formed a boss 22 having a slot or groove 23 which receives the upper end of the link 20. A pin 24 extends through the end of the link 20 and is seated in a socket or recess 25 formed in the boss 22 at right angles to the link receiving slot 23, thus forming a pivotal connection for the link. A keeper or plate element 26 is disposed across the tops of the slots 23 and 25 and is secured to the boss 22 by screws 27. This keeper retains the upper end of the link 20 in the slot 23, there being sufficient clearance under the keeper to permit pivotal movement of the link in the slot.

As shown in Fig. 3, the pivot pin 24 is to the left of the cover or plate 18 so that the latter is normally held flatwise against the end of the head 7 by gravity to seal the passages 8 and prevent the flow of air into the bellows there-through. Upon an increase of air pressure within the bellows, the cover 18 is forced outwardly or away from the head 7, permitting the escape of air or gas through the apertures 8.

Stationary end member 12 extends radially from the hub 11 and may be integral therewith if desired. Preferably, the end member is slightly dished, having a concavo-convex form to impart rigidity thereto, and has a peripheral axially extending flange 30 of circular form. The bellows, indicated generally at 31, is in the form of an annular band having approximately circular ends 32 and 33. The end 32 is disposed about and embraces the circular flange 30 on the end member 12 and is held in place by a band 34 of steel or similar strong material which is split and provided with ears 35, which may be drawn together by a nut and bolt 36 so as to tighten the band around the bellows and squeeze the ends 32 of the latter against the flange 30, thus forming a strong air-tight seal.

One end of the sleeve 6 is formed with a circular collar or flange 37 which receives end member 38 of the bellows, which is constructed or formed similarly to the end member 12 and has a peripheral circular flange 39 corresponding to the flange 30. Circular edge portion 33 of the bellows 31 is disposed about the circular flange 39 of the end member 38 and secured or retained by a band 40 of steel or similar material which corresponds to the band 34 and is provided with a tightening nut and bolt 41. Desirably, the end member 38 may be formed with a central aperture which is received over a shoulder 42 of the flange 37 and is held in place by a retaining ring 43.

Any suitable air or gas tight flexible material may be used for the bellows 31. It has been found, however, that rubber is most satisfactory and the bellows shown is constructed of such material, suitably compounded and cured. Preferably, the bellows is formed by molding operation and is provided with a succession of folds or bands 44 and 45, each of which is of circumferential extent and define annular grooves 46. The folds 44 and 45 permit the bellows to be drawn out longitudinally or compressed together by movement of the end member 38 without objectionable distortion of the rubber material forming the bellows.

Internally of the bellows a series of reinforcing

rings 47 are disposed in the folds 44, being separated by the material of the bellows on the opposite sides of the annular grooves 46. The rings 44 are annular in extent or approximately so, and serve to support the bellows, thus preventing collapse of the same during expansion and contraction. When the present device is used for the purpose of partially evacuating a therapeutic device the decrease in air pressure within the bellows 31 results in the imposition of a great atmospheric force on the bellows which is withstood largely by the rings 47. Thus, these rings retain the folds 44 and 45 of the bellows in their correct relative position with respect to one another and also prevent collapse of the bellows which would otherwise interfere with proper functioning of the pump.

A cup 48 is formed or secured on the end member 12 and carries a safety valve indicated generally at 49 which is arranged to admit air or gas from the atmosphere into the bellows chamber in the event that the amount of vacuum created therein should become excessive. The particular form of the valve 49 forms no part of the present invention and it may be of conventional construction. Also attached to the stationary head 12 is a conduit 50 through which air or gas is pumped by actuation of the bellows. This conduit may be secured to the end member 12 by means of a reinforcing or attaching plate 51, and adjustable air or gas escape valve is carried by the conduit 50 and comprises a fixed cup 52 and an adjustable cup 53, the latter being threadedly received by threaded portion 54 of the conduit 50. Apertures through the conduit 50 communicate with an annular space between the cups 52 and 53 and this annular space communicates with the atmosphere through annular slot or groove 55 between the peripheries of the cups 52 and 53. By rotation of the cup 53 on the threads 54 the width of the annular slot 55 may be adjusted so as to vary the resistance to the flow of air or gas into or out of the conduit 50 therethrough. In this manner the degree or amount of vacuum induced by the pump may be adjusted to suit the requirements of the particular treatment prescribed. On the end of the conduit 50 is secured a flexible hose 56 which is of air or gas tight construction and connects the pump to the therapeutic device being used.

An electric motor 57 for actuating the pump is mounted or secured on the base 1 adjacent the pedestal 3 and by means of a flexible chain or belt 58 drives pulley 61 mounted on a shaft 62 journaled in a housing 63 also secured on the base 1 adjacent the pedestal 3. Through suitable reduction gearing, not shown, the shaft 62 drives a shaft 64, also journaled in the housing 63, and rotatable at a much slower rate of speed than the shaft 62 and motor 57 around an axis disposed at approximately a right angle relative to the direction of reciprocation of the end member 38 on the shaft 5. A crank arm 65 is secured on the end of the shaft 64 and carries a crank pin 66 having a reduced diameter portion 67.

Connecting rod or link 68 extends between the crank and movable end member 38, being pivotally secured at 69 to a bracket 70 mounted on the exposed end of the sleeve 6. The crank end of the link 68 is formed with a transverse slot or notch 73 which receives the reduced diameter portion 67 of the crank 66, the shoulders formed by the large diameter portions of the crank serving to prevent the end of the link from slipping off the reduced diameter portion 67. Slidably

mounted in a groove 74 formed in the link 68 is a latch 75 which is movable across the open end of the notch 73, as shown in Fig. 5, thus retaining the crank pin in the notch. A helical compression spring 76 is disposed in the groove or bore 74 between the end thereof and the inner end of the latch 75 so as to normally urge the latch outwardly into pin locking position. A slot 77 is formed in the link 68 and in communication with the groove or bore 74. In this slot is mounted a lever 78 which is pivoted at 79 and has an extension portion 80 receivable in a recess or opening 81 formed in the latch 75. When the lever 78 is drawn upwardly so as to turn on the pivot 79, the extension portion 80 of the lever draws the latch 75 from beneath the crank 66, releasing the latter from the notch 73 so that the same upwardly pressure which is employed in releasing the latch serves to raise the link 68 away from the crank, as shown in Fig. 6.

In normal operation of the device the crank arm 65 is rotated by the motor 57 so as to reciprocate the link or connecting rod 68, thus imparting reciprocatory movement to the end member 38 on the rod 5 and alternately expanding and contracting the bellows 31. In case of emergency the pump of the present invention can be manually operated. Although this can be accomplished by grasping the link 68 after releasing the same and forcing the end member 38 back and forth on the rod 5, the manual operation can be effected by means of a hand lever 82 secured on a shaft 83 rotatably mounted in journals 84 and 85 secured to the underside of the frame 1. An arm 87 is secured on the inner end of the shaft 83 and when in operative position extends upwardly therefrom through an aperture 88 formed in the base 1.

The end of the arm 87 carries a crank 89 which is similar to the crank 66 and has a reduced diameter portion 90 which is receivable in the notch 73 of the link 68.

Normally the hand lever 82 is disposed in a substantially horizontal position along one side of the base 1 and rests on a suitable support pin 91. When it is desired to convert the pump from motor driven to manual operation, the operator or attendant raises the hand lever 82 from the horizontal position shown in Fig. 2 to an upright position such as indicated by the broken lines of that figure. Simultaneously with this movement of the hand lever, the link 68 is released from the motor driven crank 66 in the manner previously described and with the quick release latch 75 still withdrawn from across the opening of the notch 73, the latter is disposed over the crank 89 of the arm 87. As soon as this connection is made the lever 78 is released so that the spring 76 forces the latch 75 across the opening of the notch 73, thus locking the crank 89 in the motion. Manual operation of the pump may be then effected by reciprocating the hand lever 82 between the full line and broken line positions indicated in Fig. 7. It is preferable to move the motor driven crank 66 either manually or otherwise to its lowermost position when manually operating the pump. As shown in Fig. 8, the reduced diameter portion 90 of the crank 89 on the lever 87 is reciprocable in the plane of rotation of the reduced diameter portion 67 of the crank 66 on the arm 65. The arms 87 and 65 carrying the cranks are offset from one another and from the plane in which the reduced diameter portions of the cranks move, so that the crank 66 does not interfere with the movement of the

crank 87 during manual operation of the pump.

When it is desired to keep the pump in substantially continuous operation while moving a patient from one part of the building to another, a long extension cord or similar arrangement may be provided to furnish power to the motor 57 through the electrical conductors indicated at 92.

When it becomes necessary or desirable to change from manual operation to motor driven operation, the procedure is reversed, the link 68 being first released from the crank 89, after which the hand lever 82 is lowered and the link 68 connected to the motor driven crank 66.

The features of the present invention which permit the pump to be easily and quickly converted from manual operation to motor driven operation and from motor driven operation to manual operation are very important in vacuum therapy. When undergoing treatment of this character it is important that there be no interruption or lapse of the alternations of pressure and vacuum imposed upon the patient. This is particularly true in the case of devices for inducing artificial respiration. It is to be further observed that the present invention provides a vacuum pump having a very simple construction so that the same may be readily repaired in case of breakage and so that the attendant or operator in charge of the same may keep the machine in efficient working order at all times.

The principles of the present invention may be utilized in various ways, numerous modifications and alterations being contemplated, substitution of parts and changes in construction being resorted to as desired, it being understood that the embodiments shown in the drawings and described above are given merely for purposes of explanation and illustration without intending to limit the scope of the claims to the specific details disclosed.

What I claim is:

1. An air pump for therapeutic apparatus comprising a base, spaced pedestals on the base, an opening through one of the pedestals and a spider structure in the opening, a rod extending between the pedestals and connected to the spider structure, a pair of end members disposed in confronting relation to one another about the rod, a flexible sleeve-like bellows disposed about the rod, and means securing the ends thereof to the end members, an elongated hub on one end member and slidably embracing the rod for movement along the latter, a central opening in the other end member, and means securing said other end member to said one pedestal with the openings in register, valve means supported across the opening in the pedestal to restrict the flow of air therethrough and through said other end member, and means for reciprocating said one end member on the rod.

2. In therapeutic pump apparatus, a supporting structure, a bellows and means mounting the same on the structure, including a member movable relative to the structure to expand and contract the bellows, a rotatable crank mounted on the structure and having a pin movable in a circular path, power means on the structure for rotating the crank, an arm pivoted on the structure for reciprocable movement and having a pin movable over an arcuate path intersecting the circular path, manual means for reciprocating the arm, link means connected to the movable member and having latch means for op-

tionally connecting the link means to the crank pin or the arm pin.

3. Gas pump structure comprising a supporting pedestal having at one end a head formed with a gas outlet aperture, a rigid end member of generally circular form and larger than said head secured to the latter and solely supported thereby, said end member having an aperture aligned with the aperture in the head, valve means associated with the aligned apertures to regulate the flow of gas therethrough, a spider disposed across one of the apertures, a bellows having one end thereof attached to the end member and supported thereby, and a slide rod for supporting the other end of the bellows and having one end secured to and supported by the spider.

4. Gas pump structure comprising a supporting pedestal having at one end a head formed with a gas outlet aperture, a rigid end member of generally circular form and larger than said head secured to the latter and solely supported thereby, said end member having an aperture aligned with the aperture in the head, a spider disposed across one of the apertures, a bellows having one end thereof attached to the end member and supported thereby, a slide rod for supporting the other end of the bellows and having one end secured to and supported by the spider, a cover and means mounting the cover across one of the apertures for movement by the pressure of gas flowing through the apertures to displace the cover from across the aperture.

5. A gas pump comprising a base and a pair of spaced pedestals mounted thereon, one of said pedestals having a head formed with a gas passage aperture, a spider across said aperture, a slide rod extending between the spider and the other pedestal, a bellows disposed about the rod, a pair of rigid members secured to the ends of the bellows for expanding and contracting the bellows, one of the end members having a hub slidable on the rod and the other end member

being larger than the pedestal head and centrally secured to the latter, said other end member being supported solely by the head and having a gas passage aperture aligned with the head aperture, valve means associated with the aligned apertures to regulate the flow of gas therethrough, and means for sliding said one end member back and forth along the rod.

6. In a therapeutic air pump having a supporting structure and a bellows mounted thereon, a movable member actuable to expand and contract the bellows, a rotatable crank and an electric motor for actuating the same on the structure, a manually actuable reciprocable hand lever on the structure, a link having one end pivotally connected to said member, and a quick release latch being alternatively connectable to the crank for actuation of the bellows by the motor, or to the hand lever for manual actuation of the bellows.

7. An air pump unit for therapeutic apparatus comprising a supporting structure, a bellows carried by the structure and having a movable member actuable for expanding and contracting the bellows, an electric motor mounted on the structure, a crank connected to the motor to be rotated thereby in a circular path, a second crank and means supporting the same on the structure for movement over a path in substantially the same plane as the motor rotated crank, manually actuable lever means connected to the second crank for actuating the same, a link connected at one end to the movable member of the bellows, and a quick release latch on the other end of the link, said latch being alternatively connectable to the motor driven crank for actuation of the bellows by the motor, or to the second crank for actuation of the bellows manually, the path of each crank including a portion beyond the path of the other crank and to which the same can be moved to avoid interference between the cranks.

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