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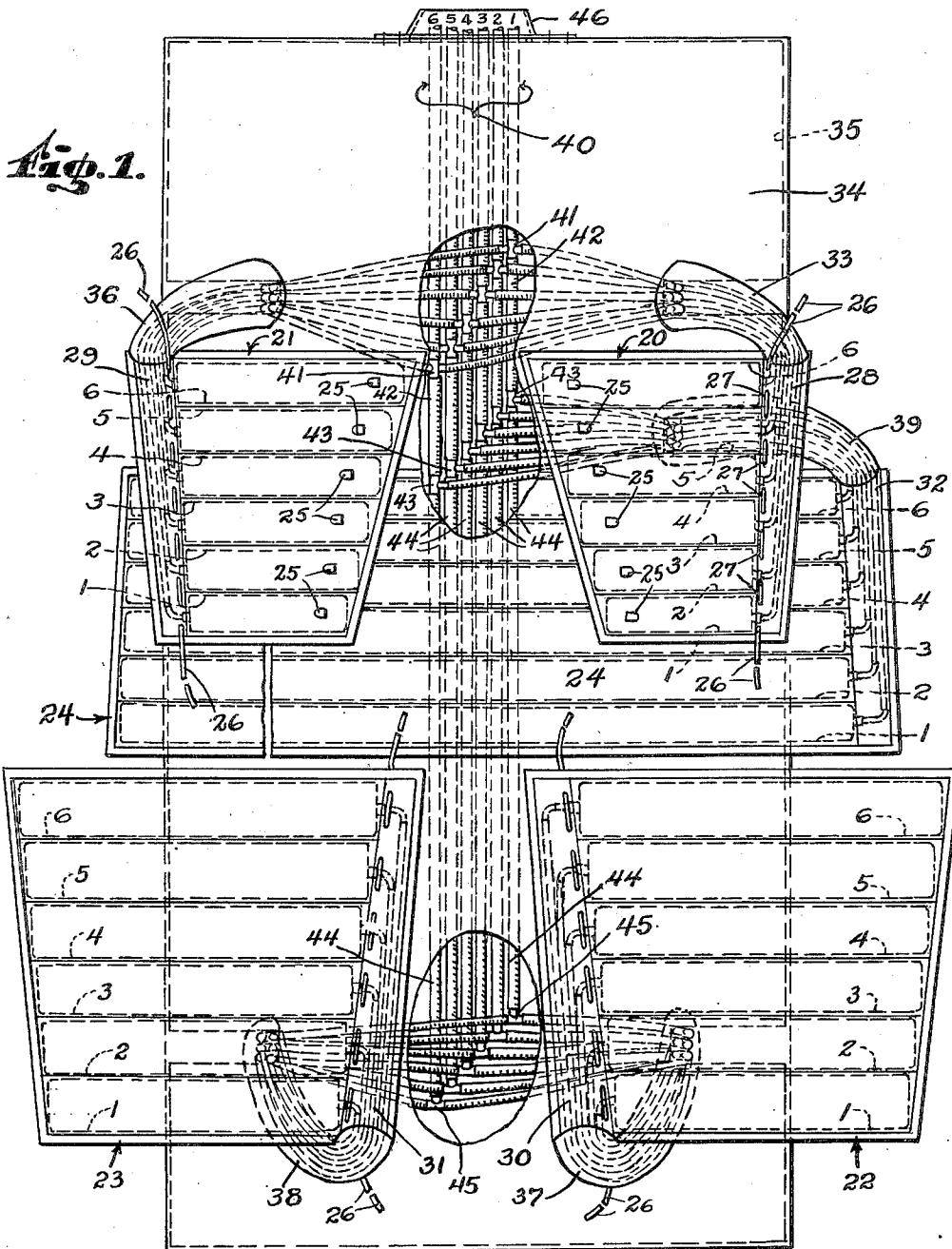
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THERAPEUTIC DEVICE AND METHOD OF CONSTRUCTING SAME

Filed April 10, 1942

4 Sheets-Sheet 1



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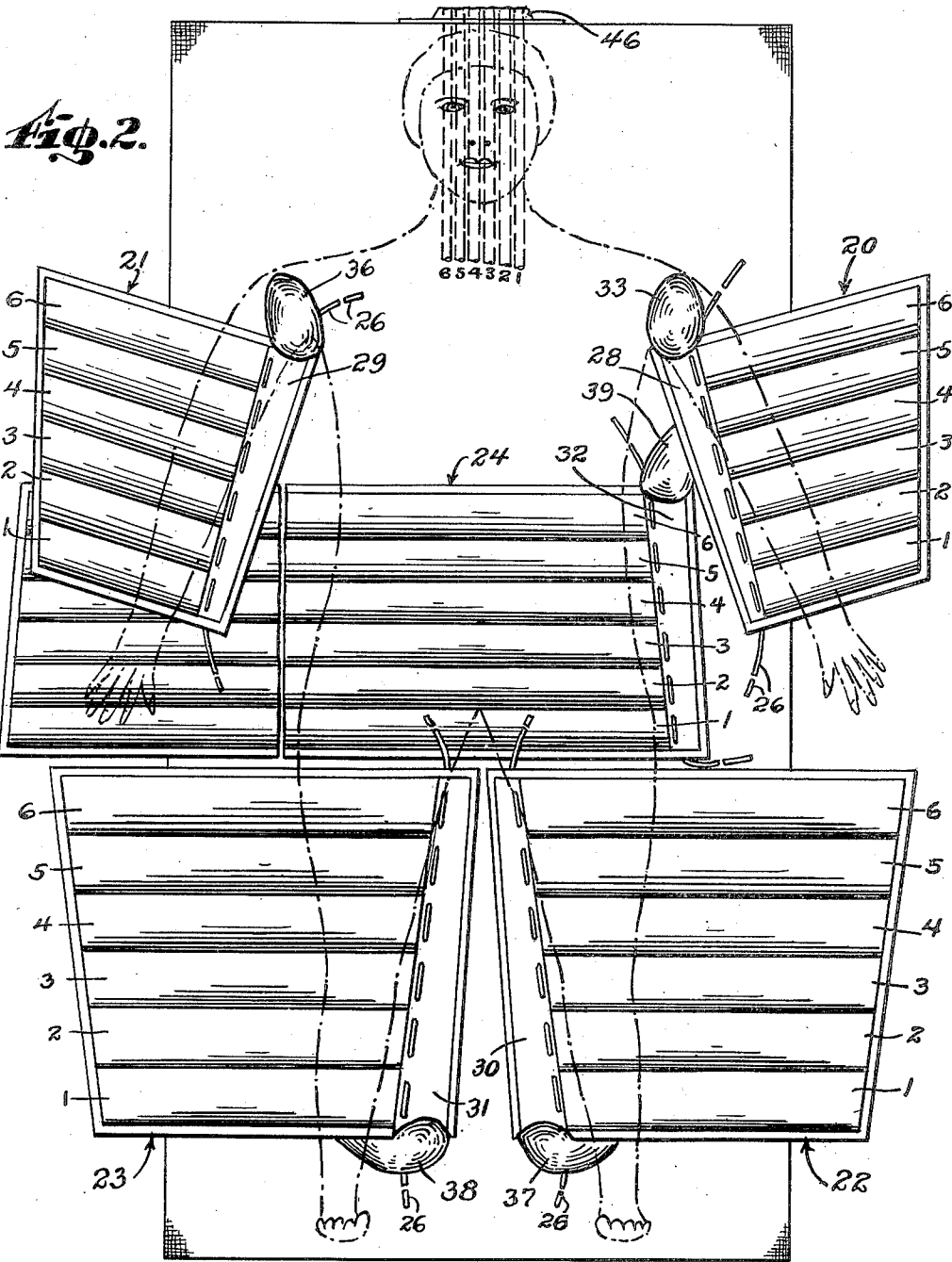
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THERAPEUTIC DEVICE AND METHOD OF CONSTRUCTING SAME

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4 Sheets-Sheet 2



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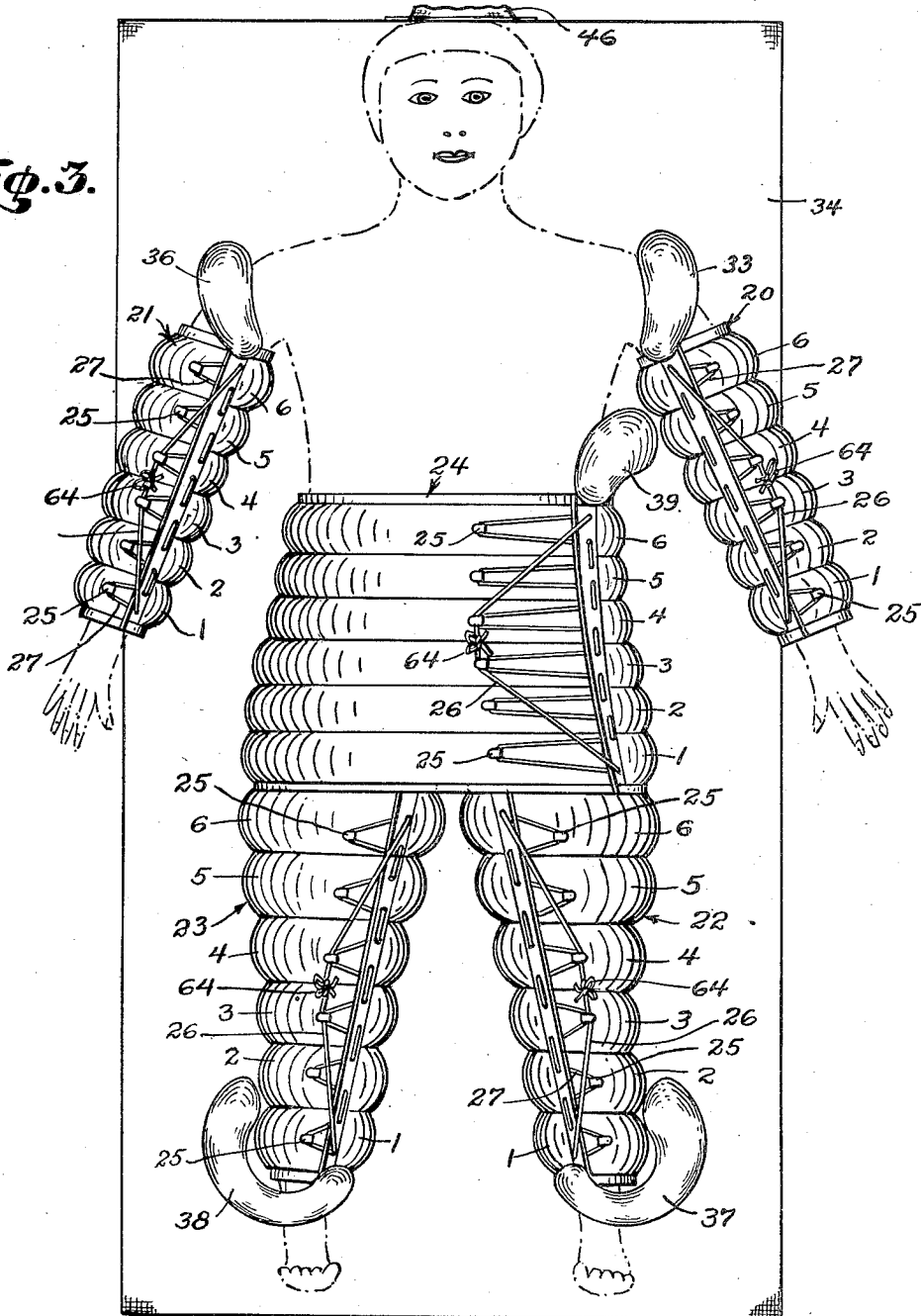
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*Fig. 3.*



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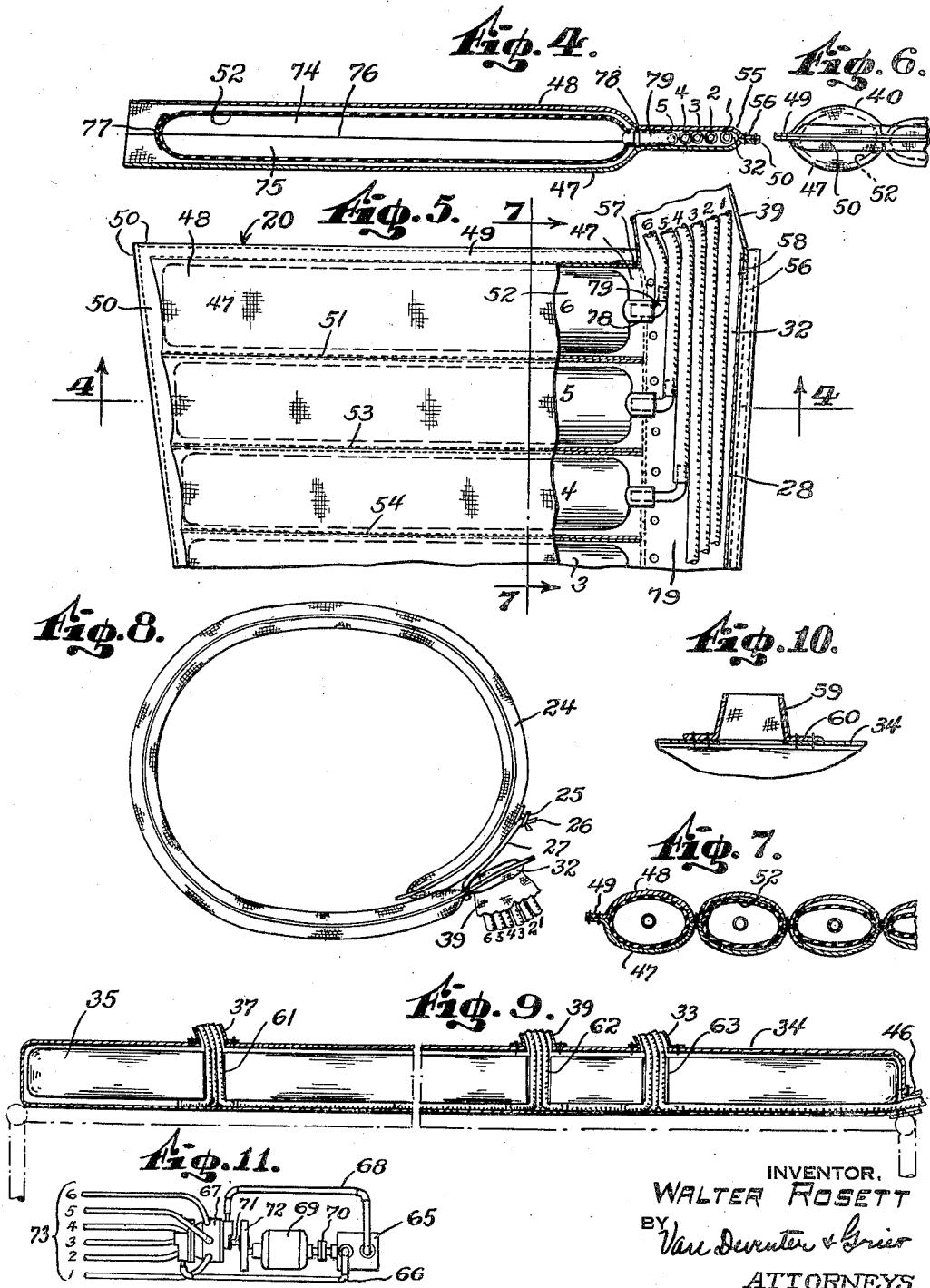
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THERAPEUTIC DEVICE AND METHOD OF CONSTRUCTING SAME

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4 Sheets-Sheet 4



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# UNITED STATES PATENT OFFICE

2,361,242

## THERAPEUTIC DEVICE AND METHOD OF CONSTRUCTING SAME

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11 Claims. (Cl. 128—299)

This invention relates to improvements in therapeutic devices and method of constructing same, and has for a principal object the provision of a therapeutic device wherein the method of construction is simplified and adapted for mass production.

The invention is directed toward the construction of devices for relieving, to a certain extent, the work of the human heart, where such relief is necessary, by propelling the venous blood of the body surface from the limbs and from the torso toward the heart; and also for increasing the general nutrition of the body, in cases where this is desirable, by a systematic kneading of the tissues and consequent enhancement of circulation of the lymphatic fluids.

Primarily, the device comprises a pneumatic suit or garment adapted to be applied to the limbs of the patient being treated. In its preferred form, the pneumatic suit or garment includes a fabric structure having formed therein a series of laterally disposed pockets, each of which is provided with a fluid-tight flexible bag.

Connections are provided between a source of air pressure which is admitted to said bags in such a manner as to inflate the bags one after another in groups so as to cause the exertion of waves of pressure from the extremities of the limbs and from the lower portion of the torso of the patient toward the region of the heart. After each bag is inflated, it is immediately subjected to a source of sub-atmospheric pressure to accelerate the removal of the air therefrom and thereby to accentuate the effect.

It is convenient to utilize a compressor of the rotary type which furnishes both air under pressure and the subatmospheric pressures for operating the garment. Suitable valve mechanism is provided for supplying pressure to said bags in the order desired and at the rate desired, and also for subjecting said bags to said sub-atmospheric pressures for rapidly deflating said bags.

In the form herein shown and described, a plurality of sections are provided for surrounding the torso and the limbs of the patient. For example, there are preferably five such sections; two to embrace the arms of the patient; two to embrace the legs of the patient; and one to embrace the torso.

Since each section includes a plurality of inflatable bags, each of which must be connected to the source of pressure (via said distributing valve), for example by means of rubber tubes, the tubes would be bulky and more or less unwieldy. However, in the preferred form herein

shown and described, these tubes for supplying air and vacuum to the bags, are enclosed in the body of a mattress and are led out from the mattress to the various sections through tubular casings provided for the purpose. The mattress not only serves as a carrier for the tubes, but also serves as a support for the person being treated. In other words, said person is reclining on the mattress while being treated, and is therefore in a state of repose, which is therefore conducive to the best results.

Although any type of mattress is suitable for carrying out the invention, it has been found preferable to utilize a pneumatic mattress which is enclosed in a fabric cover or casing. This is particularly convenient because the pneumatic mattress may be deflated and the whole device folded into a substantially small compass.

One object of the invention is the provision of a pneumatic suit or garment in combination with a mattress wherein the tubes communicating with the air bags in the suit are enclosed within the body of the mattress.

A further object of the invention is the provision of novel means for quickly adjusting the sections to the size of the body members of the person being treated.

A further object of the invention is the provision in a therapeutic suit or the like, of limb or torso embracing members provided with novel means for quickly adjusting said sections to fit the body members of the person being treated.

Other objects and advantages of the invention will be apparent to those skilled in the art upon a perusal of the following description of the embodiment herein illustrated and described.

In the drawings—

Figure 1 is a plan of the device showing the torso and body member embracing sections spread out flat. In this figure the arm embracing members are turned with the exterior surface uppermost to show details of the fastening device.

Figure 2 is a view similar to Figure 1 wherein the embracing members have been turned over in their normal positions, and positioned in respect to a patient to facilitate the applying of the embracing members to the body;

Figure 3 is a view similar to Figure 2, wherein the embracing members are adjusted to fit the arms, legs and torso of the patient;

Figure 4 is a sectional elevation of one of the pockets formed in the embracing members, as seen along the line 4—4 of Figure 5;

Figure 5 is a fragmentary view of one of the embracing members showing the bag pockets formed therein, the bags mounted in said pockets, and details of connection between the supply tubes and the bags;

Figure 6 is a fragmentary view of the arrangement shown in Figure 5, as seen from the left side thereof;

Figure 7 is a sectional elevation, as seen along the lines 7—7 of Figure 5;

Figure 8 is an end view of the torso embracing member, with the torso omitted;

Figure 9 is a sectional elevation taken through the mattress lengthwise, showing the supply tubes and the take-offs therefrom for feeding the various embracing members;

Figure 10 is a fragmentary view showing a conical reinforcing member through which branch supply tubes may run; and

Figure 11 is a diagrammatic representation of a rotary compressor for supplying air under pressure and sub-atmospheric pressures to the distributor valve and connections extending from the distributor valve and corresponding in number to the supply tubes embodied in said device.

Referring first to Figure 1, the device includes arm embracing members 20 and 21, leg embracing members 22 and 23, and a torso embracing member 24. These members may be made of any flexible material, but fabric has been found to be preferable because it lends itself easily to having a series of pockets sewed in, as will presently be described, for containing the inflatable bags. The inflatable bags which will presently be described in detail, may be formed of any desired flexible fluid-tight medium, or it is deemed preferable to form these bags of rubber.

The embracing members may include any desired number of bags. However, for the sake of simplicity, there is herein shown six rubber bags in each embracing member. These bags are numbered from 1 to 6 in each embracing member, number 1 in each instance being at the point most remote from the heart.

The arm embracing members 20 and 21, in Figure 1, are reversed so that the means for securing the same to the patient's body member may be seen. This consists of a series of hooks 25 spaced apart from one edge of the embracing member, and a series of eyelets spaced from the opposite edge of the embracing member through which a lace 26 extends. This forms loops 27 which may be placed in engagement with the hooks 25 when the embracing member is placed around a body member. After engaging the loops 27 with the hooks 25, the ends of the lace 26 may be pulled to take up the slack and thereby a good fit on the body member is very quickly obtained, following which the ends of the lace may be tied to maintain the embracing member on the body member.

It will be noted that the pockets formed in the body embracing members extend laterally. In addition to these lateral pockets, each embracing member has a longitudinal pocket designated by the numeral 28 in the member 20, a pocket 29 in the member 21, a pocket 30 in the member 22, a pocket 31 in the member 23, and a pocket 32 in the member 24. These pockets are provided to enable the bags to be inserted in the horizontal pockets, to contain the tube connections of the bags, and to contain the feeder tubes through which air may enter or leave the bags.

These feeder tubes, where they leave the em-

bracing members, are provided with tubular covers which embrace the feeder tubes; for example, the feeder tubes for the embracing member 20 are enclosed in a tubular member 33, one end of the tubular member being joined to the embracing member, and the other end being connected to the cover 34 of the mattress 35 where the feeder tubes enter said mattress.

The feeder tubes for the embracing member 21 are embraced by a tubular member 36, one end of which is connected to the embracing member 21, and the other end of which is connected to the cover 34 of the mattress.

The feeder tubes for the embracing member 22 are enclosed by a tubular member 37, one end of which is secured to the embracing member 22, and the other to the cover 34.

The feeder tubes for the embracing member 23 are likewise embraced by a tubular member 38, one end of which is connected to the embracing member 23, and the other to the mattress.

The feeder tubes for the torso embracing member 24 are also embraced by a tubular member 39, one end of which is secured to the embracing member 24 and the mattress cover 34.

The feeder tubes above referred to are in fact branches of main feeder tubes 40 which are concealed within the body of the mattress 35. These main feeder tubes include branches which feed off to the feeder tubes above described. For example, the main feeder tube 1 is provided with an X fitting 41, to which branch feeder tube 1 for the number 1 bags in the embracing members 20 and 21 are secured.

Also secured to this fitting is an extension 42 of main feeder tube 1. This extension includes a T fitting 43 to which the feeder tube for the number 1 bag in the torso embracing member 24 is attached. Also attached to the T fitting is a further extension 44 of the main feeder tube which extends to a point near the bottom end of the mattress and terminates in a T fitting 45. The T fitting 45 is connected to number 1 branch feeder tubes which supply air to the number 1 bags in the leg embracing members 22 and 23.

The arrangement just described is repeated for each of the remaining five main feeder tubes and need not here be explained in detail, especially in view of the fact that the X and T fittings are clearly shown in Figure 1 of the drawings.

As stated above, the mattress may be of any desired material; however, it is preferable to have a pneumatic mattress provided with a fabric cover, both from the standpoint of weight and portability and from the angle of the patient's comfort.

The mattress 35 may be provided with a reinforcing grommet 46 through which the main feeder tubes 40 enter the mattress.

Referring now to Figure 5, which shows a fragmentary view of the arm embracing member 20, showing details of construction, the embracing member formed of a fold of fabric forming walls 47 and 48. The edges of 47 may be turned over the wall 48, for example to form a hem 49, which hem may be double stitched, as shown. The edge 50 may be stitched as shown to reinforce the same, and the bottom edge of the embracing member 20 may be finished off like the top edge with a hem similar to the hem 49.

Spaced apart from the hem 49 is a row of double stitching 51, forming therebetween a pocket into which an inflatable rubber bag 52 may be inserted. This is marked bag number 6,

as it is bag 6 with reference to the branch feeder tubes.

Spaced apart from the double row of stitching 51 is a second double row of stitching 53, forming therebetween a pocket which is adapted to contain bag 5.

Spaced apart from the stitching 53 is a double row of stitching 54, forming therebetween a pocket for containing the inflatable bag 4.

By this construction any desired number of pockets may be formed in the embracing member very easily, as compared to devices of the prior art, in view of the fact that it is not necessary to have the stitching fluid-tight because the air is entirely confined to the inflatable bags 1 to 6 (where six are used).

Referring to Figure 4, a strip 55 is double stitched to the bottom wall 47 to form a hem designated by the numeral 56. This strip, together with the portion of the wall 47 therebelow, forms a chamber 32 above referred to, through which inflatable bags may be inserted in the pockets formed in the embracing member and also adapted to contain the branch feeder tubes 1 to 6.

The tubular member 39, above referred to as having one end secured to the embracing member 20, is stitched to the embracing member along seams 57 and 58. The other end of the tubular member 39 is secured to a reinforcing grommet 59, which is in turn secured to the cover 34 of the mattress by means of a double row of stitching 60. This reinforcing grommet protects the cover against any undue strains tending to tear the same as the members are moved around.

Figure 6 shows the walls 47 and 48 of the embracing member distended when the bag 52 is inflated.

Figure 7 is similar to Figure 6, except that it shows a sectional elevation of the device when the end bag is inflated and the other bags are being deflated.

Referring to Figure 8, the torso embracing member 24 is shown as it would be adjusted to a torso of a given size. The hooks 25 are shown as engaged by the loops 27 of the laces 26. Also the wall which includes the pocket 32 is shown with the branch feeder tubes extending therein, the tubular member 39 being cut away to show said tubes.

Referring now to Figure 9, the mattress 35 is shown as a pneumatic mattress having a plurality of holes or tufts 61, 62 and 63 formed therein. These holes or tufts are normally formed in the mattress to let air pass there-through. However, in the present arrangement at least some of these holes or tufts are utilized to allow the feeder tubes to pass through the mattress. These feeder tubes enter the mattress at one end through the grommet 46, previously described, and branch off at various points with branch feeder tubes, for example the feeder tubes passing upwardly through the vent 63 extending into the tubular member 33 and lead into the pocket 28 of the embracing member 20 for controlling the air bags carried in the embracing member 20. Likewise, branch feeder tubes passing through the opening 62 in the mattress extend into the sleeve 39 and thence into the pocket 32 for feeding the bags in the torso embracing member 24.

Other branch feeder tubes extend through the opening 61 in the mattress, thence into the sleeve member 37 and into the pocket 30 to control the air bags in the leg embracing member 22. The

cover or ticking 34 on the mattress covers the main feeder tubes which are preferably positioned below and in contact with the mattress 35.

Referring now to Figure 2, which shows the device ready to be applied to the patient, it will be noted that the arm embracing members 20 and 21 have been turned over to the right and left respectively, so as to be in the proper position to receive the patient's arms. The torso embracing member 24 and the leg embracing members 22 and 23 are shifted over into the proper positions to receive the torso and the legs of the patient.

The patient is now placed on the mattress. The arm embracing members are then folded around the arms, and the loops 27 are placed in engagement with the hooks 25, after which the ends of the laces 26 may be pulled endwise, thereby quickly adjusting the arm embracing members into intimate contact with the entire surfaces of the arms embraced.

Following this, the ends of the laces 26 are brought together and tied into a bow-knot 64. The tubular casing 33, enclosing the branch feed pipes, loops over the patient's left shoulder and is therefore not in the way and uncomfortable.

Likewise, the tubular member 36 embracing the feeder pipes for the right arm, of the arm embracing member 21, loops over the patient's right shoulder.

Next, the leg embracing member 22 is applied to the patient's left leg by engaging the loops 27 with the hooks 25 in the same manner, drawing the ends of the lace 26 taut to cause the member to snugly embrace the leg, after which the lace is tied into a bowknot 64.

The tubular casing 37 enclosing the feeder pipes for the embracing member 22 loops upwardly over the patient's ankle and is therefore out of the way and forms no impediment.

Next, the embracing member 23 is applied in the same manner to the patient's right leg. The tubular member 38 embracing the feeder pipes for the embracing member 23 loops upwardly over the patient's right ankle.

The torso embracing member 24 is next applied, utilizing the loops and the hooks in the same manner and tying the lace 26 into a bowknot 64, as was done with the other members.

The tubular member 39 extends from the mattress cover 34, looping upwardly to the torso embracing member between the patient's left side and the left arm.

#### Operation

A rotary compressor 55, referring to Figure 11, has its discharge port connected by a pipe 66 to one end of a distributor valve 67, and its suction port connected by a pipe 68 to the other end of the distributor valve 67.

A motor 69 is connected in driving relation to the compressor by a cardin joint 70. The motor 69 is also connected to the distributor valve shaft 71 through suitable gearing 72. The distributor valve has a plurality of main feeder pipes 73. These pipes are numbered 1 to 6 to correspond with the feeder pipes 40 (Figure 1) which are also numbered 1 to 6.

The rotor (not shown) of the distributor valve includes a port connected to the pressure end of the distributor valve so as to receive pressure delivered thereto by the pipe 66. As the rotor turns, ports within the body of the valve forming the termini of the main feeder pipes 1 to 6, are successively placed in engagement with said port on the rotor and thereby the bags, also numbered 1 to 6, are inflated.

Positioned on the distributor valve rotor, so as to follow the pressure port above described, is a suctional vacuum port which spans a plurality of said termini ports, with the result that each bag after it has been inflated is immediately deflated. Now, since the bags are successively inflated and deflated, a series of waves of pressure are exerted in the flesh of the patient, and the motion of these waves is from the extremities of the limbs and from the lower portion of the torso toward the region of the heart.

Referring to Figure 3, bags number 1 on both of the legs of the patient, both of the arms of the patient, and on the torso of the patient, are inflated simultaneously. Immediately afterwards, all number 2 bags in the arms, legs and torso sections are inflated and all of the number 1 bags in these sections are subjected to the suction pressure of the pump and rapidly deflated. Next, the number 3 bags in the various sections are inflated and the number 2 bags are rapidly deflated.

This continues throughout the sections, and finally after the number 6 bags are inflated, the number 1 bags are again inflated and the number 6 bags are deflated; and the process is repeated.

As these inflating and deflating actions occur much more rapidly than can be described, waves of pressure are actually exerted in the body members embraced by the embracing members.

The distributor valve may be driven at any desired speed, depending upon the rate at which it is desired to apply the waves of pressure. For example, the rotor of the valve may be driven at a rate of from 15 to 20 revolutions per minute.

When the patient has been treated for the desired length of time, the bowknots 64 may be untied, thereby releasing the tension of the loops 27, thus permitting the loops to be quickly disengaged from the hooks 25, so that the embracing members may be spread out flat, as shown in Figure 2, thereby releasing the patient.

While only six bags are shown and described in each embracing member, it is obvious that any other desired number of bags may be employed without departing from the spirit of the invention.

Referring to Figures 4 and 5, it will be noted that the rubber bag 52 is constructed of an upper sheet of rubber 74 and a lower sheet 75 vulcanized together along the line 76 and reinforced by a rubber strip 77.

A tubular portion 78 is vulcanized to the bag at one end, and this tubular portion carries a metallic elbow 79. The bags may be made in different lengths, in accordance with the lengths of the pockets which they occupy in the various embracing members 20 to 24.

It will be obvious that the fabric pockets containing the inflatable bags limit or define the maximum distention of the bags when they are inflated.

Although the mattress 35 is herein shown and described as a pneumatic mattress, it is obvious that the feeder pipes may be enclosed in any other type of mattress.

The embodiment of the device herein shown and described is a preferred form of the invention, but it is obvious that many changes may be made in the arrangements herein shown and described without departing from the spirit of the invention as set forth in the following claims.

What is claimed is:

1. In a therapeutic device, the combination of a fabric member having a plurality of parallel

pockets formed therein, the open ends of which terminate in another pocket angular therewith, an inflatable bag in each of said first pockets, a feeder tube secured to each of said bags, all of said feeder tubes being disposed in said second-mentioned pocket, and a tubular member embracing said feeder tubes where they leave said second-mentioned pocket, said tubular member being secured to said fabric member.

2. In a therapeutic device, in combination, a fabric member having a plurality of parallel pockets formed therein, the open ends of which terminate in another pocket angular therewith, an inflatable bag in each of said first pockets, said bags being formed of rubber or the like, an angular elbow secured to each of said bags, a feeder tube secured to each of said elbows, all of said feeder tubes being disposed in said second-mentioned pocket, and a tubular member embracing said feeder tubes where they leave said second-mentioned pocket, said tubular member being secured to said fabric member.

3. In a therapeutic device, in combination, a fabric member having a plurality of pockets sewn therein, said member being adapted to be placed in embracing relation with at least a portion of the human body, inflatable bags in each of said pockets, fastening means on said member for securing the latter in said embracing relation, a mattress forming a support for said body, said mattress having a fabric casing thereon, feeder tubes extending via said mattress from one edge thereof to said bags, said tubes within the body of the mattress lying between its under-surface and its fabric cover, and means connected to said feeder tubes for inflating and deflating said bags successively to exert a series of waves of pressure in an embraced portion of said body.

4. In a therapeutic device, in combination, a plurality of flexible members each having a plurality of pockets formed therein and adapted to be placed in embracing relation with portions of the human body, inflatable bags in each of said pockets, fastening means carried on each of said members for securing them in said embracing relations, a mattress to support said patient, means connecting said members to said mattress, a plurality of feeder tubes connected to said bags and extending into the body of said mattress via said last-mentioned means, extensions on said feeder tubes extending through one wall of said mattress, and means connected to said extensions for inflating and deflating said bags successively for exerting in the embraced portions of said body a series of waves of pressure.

5. The invention according to claim 4, in which said mattress is comprised of a pneumatic core having a plurality of openings extending therethrough, said core being covered by a fabric casing, and said feeder tubes extending from the bottom of said core via said openings to said flexible members.

6. In a therapeutic device, in combination, a plurality of flexible members each having a plurality of pockets formed therein, said members comprising a torso embracing member and limb embracing members adapted to be placed in embracing relations with a patient's torso and limbs, inflatable bags in each of said pockets, fastening means carried on said members for securing them in embracing relations with said torso and said limbs, a mattress having a fabric casing, flexible means connecting said mattress to said casing, a plurality of feeder tubes connected to said



inflatable bags and extending into the body of said mattress via said last-mentioned means, extensions of said feeder tubes extending through one wall of said casing, and means connected to said extensions for inflating and deflating the bags in said members successively and in definite time relation with each other for exerting in the embraced torso and limbs series of waves of pressure tending to accelerate the circulation of venous blood therein towards the heart.

7. In a therapeutic device, in combination, a plurality of flexible members each having a plurality of pockets formed therein, said members comprising a torso embracing member, limb embracing members adapted to be placed in embracing relations with a patient's torso and limbs, inflatable bags in each of said pockets, each of said bags having a feeder tube secured thereto, a mattress having a fabric cover, fabric tubular members connecting said flexible members to said casing, said feeder tubes passing through said tubular members and into the body of said mattress and extending through the body of said mattress to one side wall thereof, fastening means carried by said members for securing the latter in said embracing relations with said torso and said limbs, and means connected to said feeder tubes and adapted to inflate and deflate said bags in said members, the periods of inflation and deflation being timed to exert in the embraced torso and limbs series of waves of pressure tending to systematically knead the tissues and thereby enhance the circulation of the lymphatic fluids therein.

8. In a therapeutic device, in combination, a mattress having a fabric cover, a plurality of feeder tubes extending from one side of said mattress along the bottom thereof within said casing, a plurality of fabric members each having a plurality of parallel pockets formed therein, said members comprising a torso embracing member and limb embracing members adapted to be placed in embracing relation with a patient's torso and limbs, inflatable bags in each of said pockets, each of said bags having a branch feeder tube connected thereto, said branch feeder tubes extending into said mattress and being connected to said feeder tubes, fastening means carried on said members for securing them in said embracing relations with said torso and said limbs, and means connected to said feeder tubes and adapted

to inflate and deflate said bags in said members, the periods of inflation and deflation being timed to exert in the embraced torso and limbs series of waves of pressure tending to systematically knead the tissues and stimulate the circulation of venous blood toward the heart.

9. In a therapeutic device, in combination, a mattress having a fabric cover, a plurality of feeder tubes extending from one side of said mattress along the bottom thereof within said casing, a plurality of fabric members each having a plurality of parallel pockets formed therein, said members comprising a torso embracing member and arm and leg embracing members adapted to be placed in embracing relations with a patient's torso and arms and legs, inflatable bags in each of said pockets, each of said bags having a branch feeder tube connected thereto, said branch feeder tubes extending into said mattress at points normally above the patient's right shoulder from the right arm embracing member, above the patient's left shoulder from the left arm embracing member, near the calf of the patient's right leg from the right leg embracing member, near the calf of the patient's left leg from the left leg embracing member, and between the patient's left side and left arm from the torso embracing member, and being connected to said feeder tubes, fastening means mounted on said members for securing them in said embracing relations with said torso and said arms and legs, and means connected to said feeder tubes and adapted to inflate and deflate said bags in said members, the periods of inflation and deflation being timed to exert in the embraced torso and arms and legs series of waves of pressure tending to systematically knead the tissues and stimulate the circulation of venous blood toward the heart.

10. The invention according to claim 8, in which said one side of said mattress is provided with a flanged reinforcing member through which said feeder tubes extend to a point outside of the mattress.

11. The invention according to claim 9, in which the mattress is formed of an inflatable rubber core having a plurality of transverse openings formed therein through which said branch feeder tubes leading from said embracing members pass from the top of the mattress to the bottom thereof.

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