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BLADDER STRUCTURES USEFUL IN THERAPEUTIC TREATMENT

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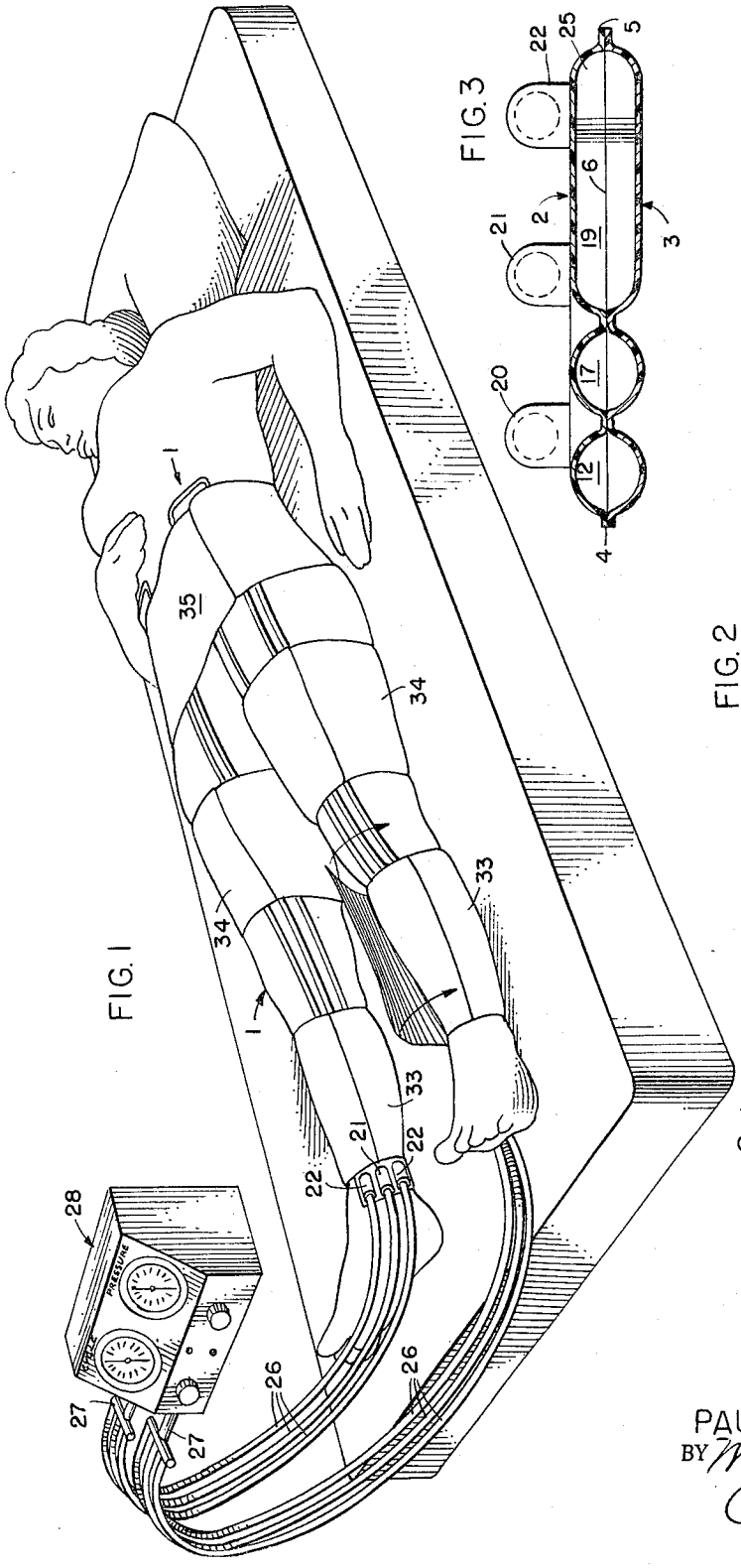

FIG. 1

FIG. 3

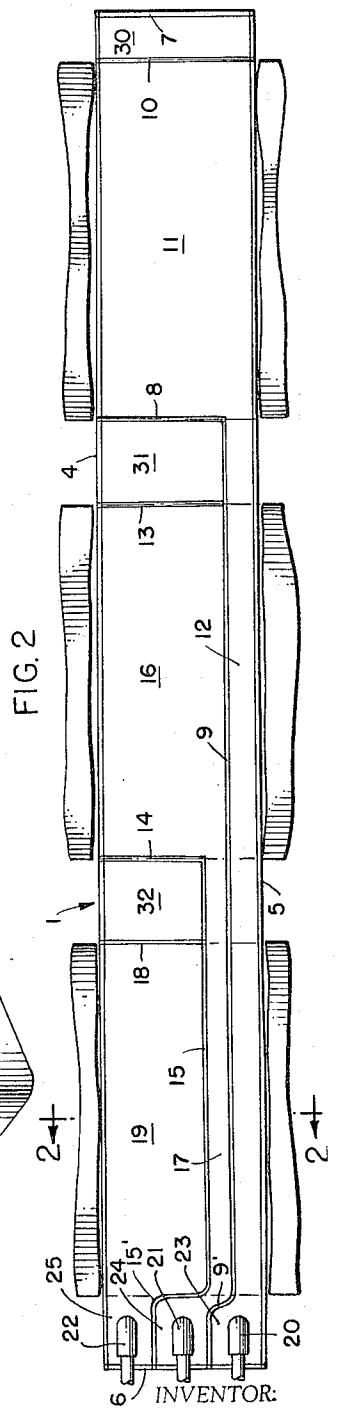

FIG. 2

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BLADDER STRUCTURES USEFUL IN THERAPEUTIC TREATMENT

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This invention in general pertains to inflatable bladder structures and more particularly pertains to inflatable bladder structures especially made for therapeutic treatments, e.g., for applying external pressure to areas of the human body such as the extremities and/or abdomen to improve circulation of body fluids.

Bedridden patients or patients with chronic circulatory ailments often develop venous stasis, the stagnation of blood in the veins. Venous stasis is a primary cause of phlebothrombosis, which is a particularly dangerous condition in that phlebothrombi often break up into emboli which lodge in the lung as they move toward the central portion of the circulatory system. It is desirable, therefore, to prevent phlebothrombosis, as the risk of pulmonary embolism is thereby substantially reduced.

It is an object of this invention to provide inflatable bladder structures useful in applying external pressure to parts of human body.

Another object is to provide bladder structures in which a bladder entity is adapted to apply external pressures to several portions of the human body.

Another object is to provide bladder structures of the character described which are readily applied by a therapist or other person to the human body for therapeutic treatment.

A further object is to provide bladder structures wherein one size of bladder structure is suitable for therapeutic use on patients of varying sizes.

A specific object is to provide bladder structures adapted to be used for application of intermittent pulses of minimal pressure to the lower extremities and abdomen of the human body.

These objects and advantages of the invention, as well as others hereafter described or made apparent to those skilled in the art, are achieved by the invention more particularly described in the following specification taken in conjunction with the drawings, in which:

FIG. 1 is a perspective view of a prone patient and a preferred form of the therapeutic device of the invention embodying a preferred form of the bladder structure of the invention applied to the lower extremities and abdomen;

FIG. 2 is a top plan view of the preferred bladder embodiment of FIG. 1 plus fragments of wraps or bandages adapted to be wrapped around the patient and the applied bladder; and

FIG. 3 is a sectional view taken on section 2—2 of FIG. 2 with the bladder in the inflated state.

Briefly, the bladders of the invention comprise two superposed, elongated layers or strips of flexible films which are preferably heat-sealable and which may be elastic. The layers are joined together, preferably by heat-sealed seams, to form two or more inflatable bladder cavities spaced longitudinally in the layers or strips. These cavities are connected to an air pressure supply means. Each bladder may have its own air pressure supply.

The connections or couplings for the air pressure hoses of the air supply means are preferably juxtapositioned at or adajacent one end of the elongated bladder

structure. The bladder cavities are communicated with a respective coupling by longitudinally extending air passages formed by joining together the superposed layers or strips, again preferably by heat-sealing, to define separate, longitudinally extended air passages between said layers or strips opening into the respective cavities.

Referring to the drawings, the bladder element **1** comprises a pair of superposed, elongated, flexible strips **2**, **3**, preferably composed of heat-sealable, flexible thermoplastic resin films such as polyvinyl chloride, polyethylene, polyvinylidene chloride or the like. The strips **2**, **3** are joined together by a series of seams defining longitudinally shaped bladder cavities and longitudinally extending air passages. In the case of heat-sealable films, the seams are preferably formed by heat-sealing, although other means for forming substantially air-tight seams may be used. Examples of the latter are seams formed by vulcanization of vulcanizable films of the synthetic or natural rubber group, and seams formed by application of adhesive compositions or adhesive strips.

In the bladder of FIGS. 1–3, the strips **2**, **3** have substantially air-tight seams comprising longitudinal edge seams **4** and **5** and transverse end seams **6** and **7**. The cavity embraced by said seams is further sub-divided by additional, substantially air-tight seams into longitudinally shaped bladder cavities and longitudinally extending air passages. Cross seam **8** extends from seam **4** toward seam **5** but terminates somewhat short thereof. The end of cross seam **8** is joined with the end of longitudinal seam **9**. There may also be a cross seam **10** spaced somewhat inwardly of end seam **7** and extending between seams **4** and **5**. The cavity between seams **4**, **5**, **8** and **10** forms an inflatable bladder cavity **11** communicating at a corner thereof with the longitudinally extending air passage **12** defined by seams **5**, **9** and **6**.

A cross seam **13** extending between seams **4** and **9** may be provided near, but spaced from, cross seam **8**. Another cross seam **14** extends from seam **4** toward seam **9** but terminates somewhat short thereof. A longitudinal seam **15** extends substantially parallel to and spaced inwardly from seam **9** from the end of seam **14** to seam **6**. Seams **4**, **9**, **13** and **14** define a bladder cavity **16** communicated at a corner thereof with the air passage **17** defined by seams **6**, **9** and **15**.

A cross seam **18** may be provided near, but spaced from, cross seam **14**. It extends between seams **4** and **15**. Seams **4**, **6**, **15** and **18** define a bladder cavity **19**.

The air supply connections for inflating or pulsatingly inflating and deflating the bladder cavities **11**, **16** and **18** are preferably separate connections, although a single connection feeding a manifold connected to the bladder cavities and/or their respective air supply passages may be used, though to lesser advantage. In the illustrated, preferred form, the bladder structure has at an axial end thereof three juxtapositioned elbow couplings **20**, **21** and **22** which extend into and are tightly sealed in the strip **2**. In order to equally space these couplings, the seams **9** and **15** are deflected as shown for segments **9'** and **15'** thereof, thereby providing enlarged air passage chambers **23** and **24** at the ends of air passages **12** and **17**, respectively. The chamber **25** comprises the entire air passage between coupling **22** and the bladder cavity **19**.

As seen in FIG. 1, the couplings each are connected by a flexible hose **26** to a manifold **27** of an air supply device **28**. The latter may supply constant air pressure or, preferably, pulsations of air pressure of minimal pressure whereby the bladder cavities **11**, **16** and **19** are expanded and contracted by the air pulsations.

The bladder structure illustrated includes segments **20**, **31** and **32** circumscribed by seams which isolate these seg-

ments from the inflatable portions. Hence, these segments are not inflatable.

In a bladder structure for thereapeutic use on the lower extremities and abdomen, bladder cavity **19** is positioned at the calf portion of the leg; bladder cavity **16**, at the thigh portion, and bladder cavity **11**, in the abdominal area. Segments **31** and **32**, respectively, separate the calf and thigh bladder cavities **19** and **16** and the thigh and abdomen cavities **19** and **11** whereas segment **30** constitutes a tab-like element adapted to protrude from the edge of the abdominal wrap or bandage, hereafter described.

In order to create an expansion and contraction pulsation in the body parts on which the bladder cavities **11**, **16** and **19** are positioned, these body parts and the bladder portions thereon are encased by a firmly applied envelope or casing. Such envelope or casing may be the wrappings or bandages **33**, **34** and **35** of cloth or other suitable material. The wrappings **33** are wrapped firmly about the calves and portion of bladder structure embraced by bladder cavity **19** with the bladder structure in a state of total deflation or partial inflation. The wrapping is firmly secured by adhesive tape, pins, clips, etc., to form a firm envelope or casing without undue pressure. Similarly, wrappings **34** and **35** are wrapped and secured firmly about the thighs and lower abdomen, respectively, and the bladder cavities **16** and **11**. The patient is then ready for the therapeutic treatment, in which the expansion of the bladder cavities under increased air pressure causes the bladder and the wrappings therearound to compress inwardly the body parts around which they are applied. When the bladder is allowed to deflate, the pressures on the body parts lessen. If desired, the bladder structure **1** and/or the wrappings **33–35** may be attached to the person's skin with adhesive tape or the like to maintain them in the applied position, and the bladder structure **1** and wrappings may be secured together by pressure sensitive tape or the like. The wrappings **33–35** should be substantially inelastic.

A further advantage of the invention is that the bladder structure **1**, when totally deflated, lies flat and can be folded and stored in a small space. The bladder and wrappings further are applied readily and quickly at the pressure points most effective for the therapeutic result desired.

While the previous description and the drawings refer primarily to the application of the therapeutic devices of the invention to the lower extremities and abdomen, the generic concepts illustrated thereby can be used for other similar therapeutic treatments of the forearms, upper arms and other parts of the human body. The invention further may be used on animals. The devices of the invention may be used with success in substantially any therapeutic pressure applications and are especially suited in the application of selective and sequential pressure pulses to parts of the human body on which such treatment is beneficial. For treatment of the extremities only, the bladder cavity **11** and the air passage **12** may be eliminated in the bladder structure made for such treatment.

The invention is hereby claimed as follows:

1. A bladder structure comprising superposed, elongated, flexible films joined together by substantially air tight seams defining a plurality of inflatable bladder cavities between said films and spaced longitudinally in said bladder structure, and also defining a plurality of narrow, elongated air passages extending longitudinally from an end of said bladder structure to and each communicating with a different one of said bladder cavities spaced longitudinally from said end.

2. A bladder structure comprising superposed, elongated, flexible films joined together by substantially air tight seams defining a plurality of inflatable bladder cavities between said films and spaced longitudinally in said bladder structure, and also defining a plurality of narrow, elongated air passages extending longitudinally from an end of said bladder structure to and each communicating with one of said bladder cavities spaced longitudinally from said end, and hose couplings corresponding in number to the number of said bladder cavities and tightly seated in one of said films at said end of said bladder structure, there being one longitudinally extending air passage defined by said seams for each of said bladder cavities, and each coupling communicating with one of said air passages.

3. A bladder structure comprising superposed, elongated, flexible, thermoplastic resin films joined together by substantially air tight seams defining a plurality of inflatable bladder cavities between said films and spaced longitudinally in said bladder structure, and also defining a plurality of narrow, elongated air passages extending longitudinally from an end of said bladder structure to and each communicating with a different one of said bladder cavities spaced longitudinally from said end.

4. A bladder structure comprising superposed, elongated, flexible films joined together by substantially air tight seams defining three inflatable bladder cavities between said films and spaced longitudinally in said bladder structure, and also defining next to a longitudinal edge of said films a pair of juxtapositioned, elongated, parallel, narrow air passages extending longitudinally from an end of said bladder structure to and communicating respectively with the two of said three bladder cavities most remotely spaced from said end, and means including air hose couplings seated tightly in one of said films for supplying air to said air passages and said bladder cavity nearest said end.

5. A bladder structure as claimed in claim **4** wherein said air passage nearest said edge is the longest air passage and communicates with the bladder cavity most remote from said end of said bladder structure, the seam of said longest passage further from said longitudinal edge also being a longitudinal seam defining a side of the bladder cavity next remote from said end and also a longitudinal seam of the next adjacent air passage, and the other longitudinal seam defining said next adjacent passage also defining a side of the bladder cavity closest to said end of said bladder structure.

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