

[54] **INFLATABLE PROFILE WITH HIGH PNEUMATIC RIGIDITY**

[75] Inventor: **Gildas Hatton**, Paris, France

[73] Assignee: **Aerazur Constructions Aeronautiques Anciens Etablissements Claude Ethatten**, Issy-Les-Moulineaux, France

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[58] Field of Search **128/78, 87, DIG. 20, 83, 128/84; 2/DIG. 3, 2.1**

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Primary Examiner—Richard A. Gaudet

Assistant Examiner—J. Yasko

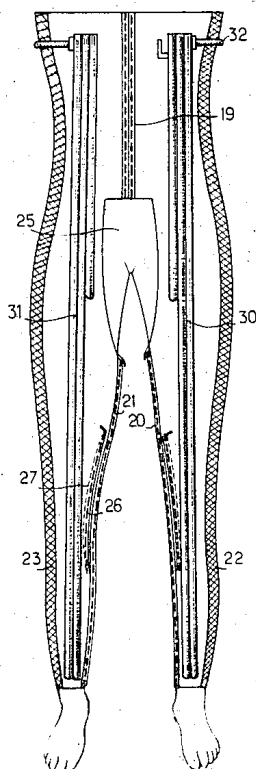
Attorney, Agent, or Firm—William Anthony Drucker

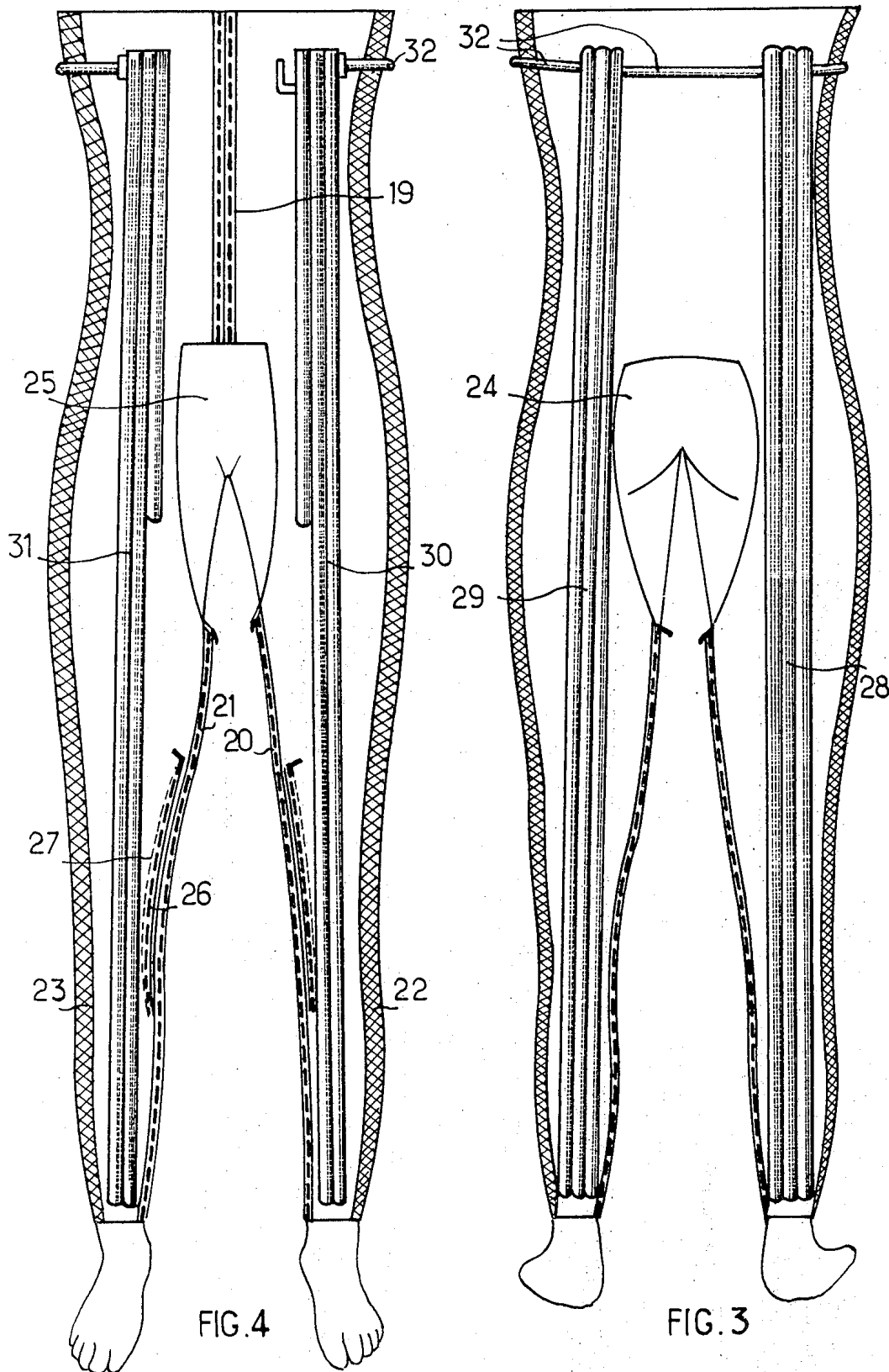
[57] **ABSTRACT**

An inflatable shaped structure comprising an assembly of pneumatic tubular elements, characterized by the combination of a number of inflatable tubes made from elastic material and a fabric casing forming adjacent elongated cells which contain the tubes, each pair of adjacent cells having plane sides joined by stitching along at least one generator to the vicinity of a continuous wall which closes the cells.

Its application to orthopaedic clothing.

9 Claims, 4 Drawing Figures





INFLATABLE PROFILE WITH HIGH PNEUMATIC RIGIDITY

The object of the present invention is to obtain an inflatable shaped structure with a particularly high pneumatic rigidity, which makes it suitable for use in certain applications where metal structures would normally be used.

The structure of the invention is shaped only on one side, which enables it to make continuous contact with a body of predetermined form. In particular, it can act as a support for certain parts of the human body, which parts are held firmly but without constricting the patient.

Some pneumatic mattresses are made of two layers of fabric water-proofed with latex and stuck together along parallel lines in order to form several inflatable cylinders.

Such a structure will only support relatively weak inflation pressures, of the order of 200 g/cm² (2.84 pounds per square inch) for example, and provides no continuous plane surface.

The structure of the invention can support inflation pressures which may reach, for example, several kg/cm² (1 kg/cm² = 14.2 pounds per square inch).

It is mainly characterized by the combination of a number of cubes of rubber or other elastic material and a fabric casing forming adjacent elongated cells which contain the tubes, each pair of adjacent cells having plane sides joined by stitching along at least one generator to the vicinity of a continuous wall which closes the cells.

In a preferred mode of execution the cells are in the form of square-section pipes, closed on one side by a sheet of fabric to which they are stitched, and at least one second line of stitching joins adjacent cells on the opposite side, forming plane sides in mutual contact between the cells, which act as braces after inflation.

Although the invention will be more particularly described in the sequel by reference to its application to an orthopaedic costume, it should be well understood that the structure above can be used for a wide variety of purposes.

The invention will be better understood with the help of the following description.

In the following drawings:

FIG. 1 is a perspective view, with a transverse section, of a shape conforming to a preferred mode of execution of the invention;

FIG. 2 is a section of a leg dressed in an orthopaedic costume using such a shape;

FIG. 3 is a back view of such a costume, and

FIG. 4 is the front view.

FIG. 1 shows a part of an elongated section comprising, by way of example, three latex tubes 1-3 contained in a fabric casing.

The latter consists of a plane side 4 and three parts 5-7 forming pipes. The parts 5-7 are stitched to the side 4 at 8, 9, 10, 11, 12 and 13. They also are stitched to each other, on the one hand in the vicinity of the side 4 (at 10 and 11, for example), and on the other hand at their opposite side (at 14 and 15, for example). This results in the adjacent plane sides of the pipes being in mutual contact and acting as braces.

Zip fasteners, not shown, may be provided to allow the tubes to be threaded in the casing, previously sewn

so as to be an integral part of the assembly to which they are applied.

By way of example, FIG. 2 shows a leg 16 of an orthopaedic costume in which each leg is provided with two sections 17 and 18. The section 17 comprises three tubes and is intended for application to the back of the patient's leg, while the section 18, with only two tubes, is applied to the front part of the leg.

It can be seen that the sections 17 and 18 form an integral part of the leg of the costume, the fabric wall 16 closing the pipes of the two structures. In this connection, the circumferential wall of each tubular cell has a length which upon inflation of the inflatable tubes 1, 2 and 3 minimizes any tightening of the fabric 16 enclosing the lower extremity. Yet because of the adjacent wall structure in contact relation one with the other as well as the spaced stitching 8, 9, 10, 11, 12 and 13 securing the tubular wall structures to the fabric 16 they do indeed form the needed, in integral, bracing means.

When the tubes are inflated they completely fill the interior space of the pipes, slightly rounding their exterior walls, and the adjoining walls stretch and become rigid. Each section thus forms a homogeneous structure in which the stretched adjoining walls act as stiffening braces, and has considerable rigidity.

The rigidity is very much greater than would be the case if the tubes were completely separated from each other.

In the application described here, it is indispensable that the adjoining walls of the pipes be joined by at least two lines of stitching in order to form stiffening braces after inflation.

However, in other applications where less rigidity is needed a single line of stitching will suffice to prevent the tubes from separating during inflation.

The fabric used is an aerated linen and preferably fireproofed. The structure is then permeable to air, which is important in the case of an orthopaedic costume. It is clearly much lighter and more flexible than a metal or plastic frame, yet possesses sufficient rigidity to replace them in most cases.

The orthopaedic costume shown in FIGS. 3 and 4, made from a light strong fabric, aerated and preferably fireproof, consists of a garment fitted around the legs and the body up to a certain height. It is supported by shoulder-straps or other means, not shown, and can be put on easily thanks to zip fasteners 19, 20 and 21 (FIG. 4) or other quick fastenings, so positioned that it can be laid flat when the fasteners are open: the user can then lie on the costume and put it on unaided.

Suitably positioned lacings 22, 23 allow adjustment for differing body sizes, so as to fit closely without impeding the circulation.

Two openings, posterior 24, and anterior 25, are provided so that the femoral artery will not come under any pressure, which would cause serious problems in the case of prolonged wearing of the costume.

A gusset 26, freed by a zip fastener 27, gives fullness to the garment at knee level to allow the wearer to sit down when the strengthening sections are deflated.

The tubular sections or pipes are visible at 28 and 29 (rear view, FIG. 3) and at 30 and 31 (front view, FIG. 4).

In the preferred form described, these sections follow closely the anterior and posterior axes along the legs and thighs and rise to the level of the hips.

at a variable height according to the case being treated. This arrangement is not limitative; nor is the number of tubes which comprise each tubular section. The anterior tubular sections FIG. 4 are shown with three tubes in their upper part and two tubes in their lower part. It may be preferable in some cases to prolong the third tube to the bottom of the section.

The tubes are closed at either end, as is the casing, and are joined to each other and to the tubes of the other sections of the costume by a flexible tube 32 (FIGS. 3 and 4).

A feeding device (not shown) comprises preferably a micro-valve, a striker and a valve fixed to the tube 32.

A bottle of carbonic gas or a compressor with a pressure-reducer may be joined to the valve to ensure inflation.

When the user has no such source available, he operates the striker which opens a cartridge of carbonic gas (not shown), which may also be joined to the valve. The microvalve is to allow decompression.

The inflation pressure needed to ensure bodily support for an adult is of the order of 2 bars or 29.4 pounds per square inch.

The costume thus inflated exerts a light pressure on the members, which suppresses hypotension.

It goes without saying that the number and the size of the tubes, and the different details of the realization described, are not limitative.

It is advisable to note here that, in the costume described and shown, a continuous and sensibly uniform support is given along the length of the patient's body, with the result that his bones are put under pressure and the body support is effected normally by bone pressure.

In particular cases where it would be useful, a ground support could nevertheless be provided.

I claim:

1. An inflatable shaped structure comprising an assembly of pneumatic tubular elements, characterized by the combination of a number of parallel inflatable tubes made from gas tight elastic material and a fabric casing forming adjacent elongated cells which contain the tubes, each pair of adjacent cells having plane sides joined along at least one side to the vicinity of a continuous wall which closes the cells characterized in that the cells have the form of square-section pipes, closed on one side by a sheet of air permeable fabric to which they are stitched, and by at least a second line of stitching which joins adjacent cells on the opposite side, forming plane sides in mutual contact between the cells, which act as braces after inflation.

2. An orthopedic brace of high pneumatic rigidity comprising:

tubular wall structures of light, strong fabric for close-fitting wrap-around disposition with each lower extremity having a plurality of contiguous, tubular cells closed at their ends and extending lengthwise of each extremity;

each said cell having radially extending sidewalls in contact with like sidewalls of each adjacent cell;

means securing each said sidewall to said fabric to form elongated braces some of which are of double fabric thickness and all of which extend parallel to the long axes of said tubular wall structures; and

means including gas-impervious wall structure for inflating said tubular cells to a pressure which pro-

duces rigidity of said tubular wall without increase in inward pressure upon said extremities sufficient to impede blood circulation.

3. The orthopedic brace of claim 2 in which said tubular cells are each of generally rectangular shape before inflation.

4. The orthopedic brace of claim 2 in which said tubular cells are each of generally rectangular shape before inflation, said fabric of said tubular enclosures forming corresponding wall portions of each said cell, and means securing each said sidewall to said fabric of said tubular enclosures.

5. An orthopedic brace of high pneumatic rigidity for an extremity of the body, comprising:

enclosing means of a light, strong, fabric for close contour-fitting of said extremity;

tubular wall structure of light, strong, fabric having a plurality of contiguous, tubular cells closed at their ends and extending lengthwise of said extremity;

an elastic tube coextensive in length with and disposed within each said cell;

each said cell having a sidewall in contact with a like sidewall of each adjacent cell to form a plurality of elongated braces of double fabric thickness; and means for inflating said elastic tubes to a pressure which produces rigidity of said tubular wall structures without increase in circumferential pressure upon said extremity.

6. An orthopedic bracing costume of high pneumatic rigidity adapted for use with at least one of the lower extremities, comprising:

extremity enclosing means; adapted for close contour-fitting;

tubular wall structures, on the outer surface of said enclosing means, at least one of which is adapted to be disposed in front of and another of which is adapted to be disposed behind the knee;

each said tubular wall structure being a dimensionally stable fabric casing having therein at least a pair of elastic inflatable tubular cells closed at both ends and extending lengthwise of said extremity;

each said cell having radially extending sidewalls in contact with the sidewalls of an adjacent cell; and

means including gas-impervious wall structure for inflating said tubular cells to a pressure which produces rigidity of said tubular wall structures without increase in inward pressure upon said extremities sufficient to impede blood circulation.

7. An orthopedic bracing costume of high pneumatic rigidity adapted for use with at least one of the lower extremities, comprising:

extremity enclosing means of flexible sheet material adapted for close contour-fitting;

tubular wall structures of flexible sheet material on the outer surface of said enclosing means, at least one of which is adapted to be disposed in front of and another of which is adapted to be disposed behind the knee;

each said tubular wall structure having therein at least two tubular cells closed at both ends and extending lengthwise of said extremity;

each said cell having a radially extending sidewall in contact with a like sidewall of an adjacent cell; and

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means including gas-impervious wall structure for inflating said tubular cells to a pressure which produces rigidity of said tubular wall structures without increase of inward pressure upon said extremities sufficient to impede blood circulation.

8. The orthopedic bracing costume of claim 7 in which said enclosing means in the region of the crotch

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have openings somewhat greater than the regions in which the femoral arteries surface in avoidance of restrictive pressure upon said arteries.

9. A costume according to claim 7 in which the flexible sheet material of the extremity enclosing means is permeable to body fluids and vapors.

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