

April 29, 1958

C. D. DAVIS ET AL
PHYSIOTHERAPY DEVICE

2,832,336

Filed June 23, 1955

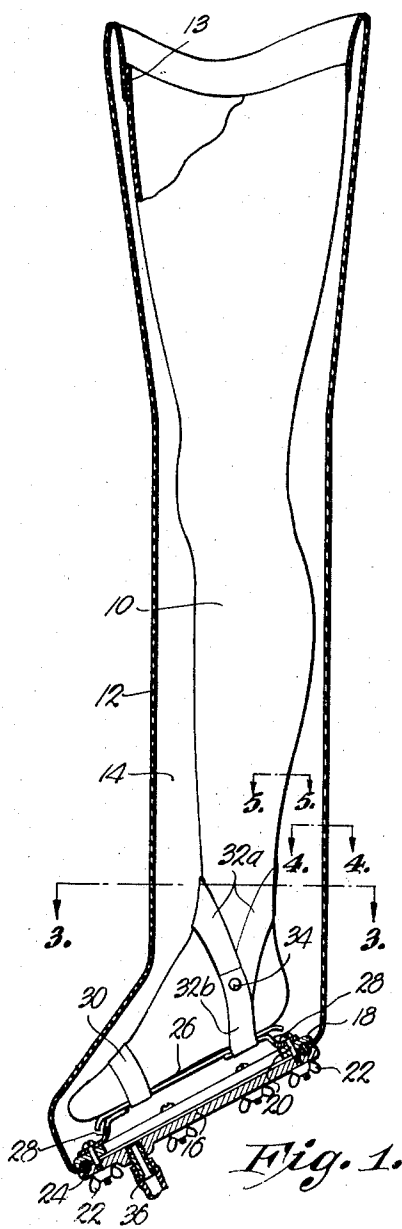


Fig. 1.

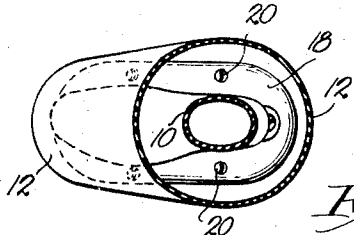


Fig. 3.

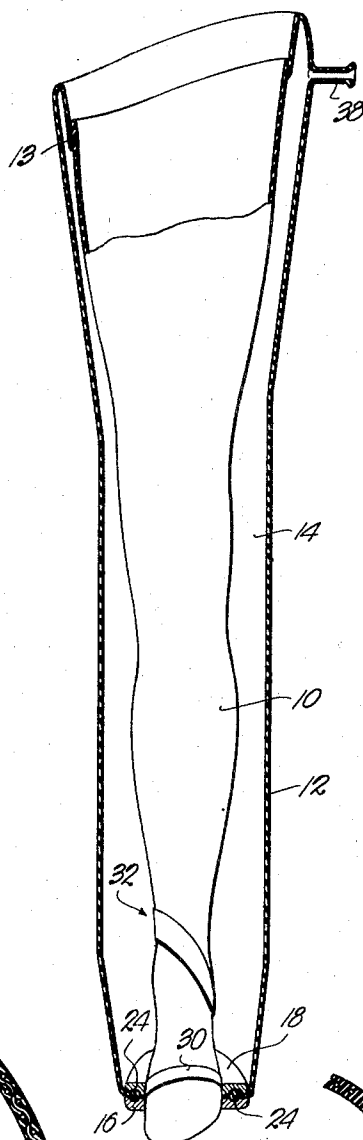


Fig. 2.

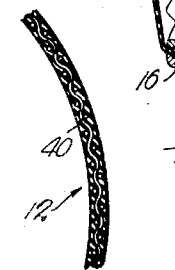


Fig. 4.

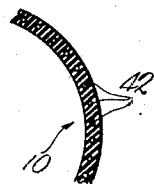


Fig. 5.

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PHYSIOTHERAPY DEVICE

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Application June 23, 1955, Serial No. 517,532

3 Claims. (Cl. 128—38)

The present invention relates in general to the treatment of muscular disorders resulting from poliomyelitis, rheumatism, arthritis, etc., and it deals more particularly with the construction of an improved physiotherapy appliance for treating the affected limb.

In the treatment of poliomyelitis, for example, it is known that manipulation of the limb and alternate application of heat and cold will provide a stimulating effect to the muscles and nerves which assists the return to normal function. However, a single treatment can require as much as eight hours and the constant manual manipulation and application of hot and cold towels over this period naturally is a most laborious process, not to mention the messiness involved in handling of the wet towels. The primary object of our invention is to reduce this labor and otherwise minimize the difficulties of treatment.

More particularly, one of the objects is to provide an appliance by which the affected member may easily be subjected to controlled heating or controlled cooling (or alternate heating and cooling) without the handling of moist towels or any other messiness.

Another object is to provide a device of the character indicated which is relatively simple and economical; which may easily be cleaned and sterilized; which can be used not only in the hospital but in the doctor's office or even in the patient's home; and which when not in use requires little storage space.

Still another object is to provide an appliance by means of which the affected limb may be subjected to variable pressure stimulation if desired.

A feature of the invention resides in the provision of a double-walled enclosure for the affected member. Assuming this to be the patient's leg, the enclosure comprises (1) an elastic stocking of rubber or like material, preferably of such length as to receive the entire leg and (2) a boot surrounding the stocking and connected thereto to provide around the stocking-covered leg a unitary chamber for the circulation of liquid or gas at the desired temperature and pressure, whereby the entire affected area is treated.

A further object of the invention is to provide a double-walled enclosure of the character indicated wherein the outer wall (e. g., the boot) is made in whole or in large part of flexible pliant material capable of being rolled or folded, but which is relatively non-elastic or non-stretchable whereby in the normal use of the device it will retain a predetermined exterior shape. Another object is to provide the outer wall with a removable closure by means of which access may readily be had to the circulating chamber for cleaning purposes.

Where the device is to be used for pressure treatment of the affected member and the pressure is alternated between predetermined high and low values there is a tendency for the elastic stocking to walk up and down the patient's limb; additionally, there is a tendency for the pressure to expel the stocking-covered limb from the boot,

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and it is still another object of the invention to overcome these problems.

Other and further objects, together with the features of novelty whereby the objects are achieved will appear in the course of the following description of the invention. For convenience it will be described with reference to a form of a device suitable for treatment of the patient's leg, but it should be understood that this is merely exemplary, it being obvious that treatment of another part of the body (e. g., the arms) may be carried out with only such modification in the shape of the parts as is dictated by the shape of the alternate body-portion to be treated.

In the drawings which form a part of the specification and are to be read in conjunction therewith and in which like reference numerals indicate like parts in the various views:

Fig. 1 is a longitudinal view of our improved physiotherapy device showing same partly in cross section;

Fig. 2 is a longitudinal cross section of the device taken at 90° from that shown in Fig. 1;

Fig. 3 is a transverse cross section taken along the line 3—3 of Fig. 1 in the direction of the arrows;

Fig. 4 is an enlarged cross section taken along the line 4—4 of Fig. 1; and

Fig. 5 is an enlarged cross section taken along the line 5—5 of Fig. 1.

Referring more particularly to the drawings, our device employs an inner stocking member 10 and an outer boot member 12, the two being joined together at the top and the boot normally being closed at the bottom to form a confined fluid space 14 entirely surrounding the stocking.

The stocking and boot are made essentially of rubber, either natural or synthetic, so as to be impervious to the fluid contained in the space 14. The physical character of the inner and outer walls of the fluid space differ as will be explained presently, but it should be understood that both are flexible and pliable. The outer wall of boot 12 is doubled back upon itself at the top and bonded to the upper extremity of the stocking, as by cementing or vulcanizing, to form a circumferentially continuous joint 13 spaced slightly below the top of the assembly. As indicated, the stocking is molded or preformed to a shape complementary to that of the leg to be treated, and it preferably is of a length to encase the leg all the way to its juncture with the body.

The bottom of the boot has a removable closure comprising a generally oval metal plate 16 and a ring 18 of matching contour. These normally are clamped together by means of bolts 20 extending through registering apertures in the two members and having wing nuts 22 on their threaded ends exteriorly of the plate. The sole of the rubber boot 12 is made with an opening for receiving this closure and about the opening there is an integral continuous bead 24. The confronting faces of plate 16 and ring 18 are provided with opposed grooves which together form a continuous annular channel for receiving and gripping the bead 24 when the wing nuts 22 are tightened, thereby to afford a leak-proof seal between the closure plate 16 and the boot 12.

Insertion of a patient's leg in our device can easily be effected by first rolling the top of the double-walled leg portion outwardly and downwardly as far as it will go in order to facilitate introducing the patient's foot into the bottom of the stocking. Then said double-walled portion is unrolled upwardly along the limb to final position. The bottom of the patient's foot is adapted to rest against a seat 26 as shown; this comprises an elongate plate spaced from the closure 16 by means of a pair of supporting brackets 28 secured to the underside of the plate at its

opposite ends, the brackets being apertured to receive opposed bolts 20.

It is desirable that the patient's foot be anchored and for this purpose the sole of the stocking can be cemented or otherwise bonded to plate 26. Alternatively, this may be accomplished by means of one or more tie-down tapes extending from the rest plate 26 to the toe, ankle or thigh region of the stocking; by way of example, we have shown a toe strap 30 and an ankle strap 32, both of which conveniently can be made of fabric tape or like non-elastic strip stock. They are secured to the plate, the former being a circular band extending under the forward portion of the plate and over the toe of the stocking to form a stirrup; the latter can comprise a short section 32a and a longer section 32b adapted to be detachably connected thereto by a separable fastener 34 after being positioned about the ankle as shown.

In the use of our device, the heated or cooled treating medium which may be water or air, for example, is introduced into the space 14 through an inlet nipple 36 and can be discharged through an outlet nipple 38. The latter is located near the upper end of space 14 and the former is located near the lower end—conveniently in the closure plate 16 as shown—in order that there can be circulation of the treating medium along the full length of the leg. In other words, the entire affected area is subjected to the heating or cooling effect of the treating medium although the medium is kept out of contact with the leg by means of the stocking 10.

If desired, a continuous flow of fluid from the inlet 36 to the outlet 38 may be established in which case we prefer that the temperature of the inflowing fluid be controlled automatically and maintained at the desired temperature by means of a conventional thermostat associated with the supply source. Alternatively, the space 14 may be charged with fluid and after an interval drained and recharged, this process being repeated periodically as needed.

The rubber of which stocking 10 is made preferably is relatively thin (for example, like that employed in conventional surgical gloves) to assist in the transfer of heat therethrough, and the stocking should of course fit snugly about the affected member without tightly binding same so as to impede circulation. Boot 12 on the other hand should be relatively non-stretchable, though flexible and pliant, in order to resist radial distending of the outer wall when the device is in use. Particularly is this true if the treating medium is under substantial applied pressure or if, although applied pressure is small, the medium is water or some other liquid which due to its own weight tends to cause bulging of the outer wall. With this in mind, we prefer to make the outer wall thicker and less elastic than the inner wall. Alternatively, the outer wall may be made of rubberized textile fabric, that is to say, rubber which has fabric 40 imbedded therein as shown in Fig. 4 or cemented to one face of the rubber wall; in either case the longitudinal and circumferential cords of the fabric will resist stretching of the wall in any direction while leaving it still flexible and pliant. The fabric reinforcement may extend the full length of our device, but if the device is to be used in a generally upright position as shown and only for circulating hot or cold water in the chamber 14, the fabric can be confined to the lower region about the calf and ankle, for this obviously is the region in which the effect of the hydrostatic head is most pronounced.

Under such conditions of minimum pressure, tie-down straps such as 30 and 32 also may ordinarily be dispensed with. However, these or some alternative means for holding the patient's leg in place are needed if substantial pressure is to be applied to the affected member, as may be done by partially or completely blocking the outlet nipple 38 and introducing the treating fluid under pressure through nipple 36. If the pressure is to be alternated in such a fashion as to tend to cause the

stocking 10 to walk up and down the leg of the patient, we prefer to deal with this problem by making the stocking relatively non-elastic in a longitudinal direction. This can be accomplished by imbedding circumferentially spaced longitudinal cords 42 in the rubber as shown in Fig. 5 or by cementing said cords to the exterior surface of the stocking; they will of course resist stretching of the stocking in a longitudinal direction while leaving it circumferentially elastic and free to respond to changes in the radial pressure applied to the limb.

Where longitudinal cords 42 are employed, we prefer to dispense with tie down straps such as 30 and 32, and in lieu thereof anchor the lower extremities of the cords to the rest member 26. The member may for example be molded of plastic and have some of all of the cords embedded therein, an arrangement which permits the application of very considerable fluid pressures without any danger of expelling the patient's leg or subjecting it to longitudinal strain.

When our device is not in use, the leg portion thereof can be rolled or folded into a compact package so that little storage space is required. For the purpose of cleaning the device, closure plate 16 can be removed from the opening in the bottom of boot 12 by loosening wing nuts 22; and the stocking 10 can be withdrawn from the boot (by turning it inside out) to permit sterilization thereof separately from the boot.

From the foregoing it will be seen that our invention is one well adapted to attain all of the ends and objects hereinbefore set forth, together with other advantages which are obvious and which are inherent to the device.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the appended claims.

Inasmuch as many possible embodiments of the invention may be made without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. In a physiotherapy device for treatment of the limb of a patient, a unitary stocking for receiving the limb from the extremity thereof to its juncture with the body, said stocking being of a shape complementary to the exterior shape of the limb and comprising a fluid impervious membrane, a boot having its open end joined circumferentially with the open end of said stocking, said stocking being within said boot so it is wholly encompassed thereby, said boot being larger than the contained stocking to form with the exterior of the stocking a chamber extending the full length of the stocking, said boot having a fluid inlet communicating with said chamber at one end of the stocking and a fluid outlet communicating with the chamber at the other end of the stocking, the leg portion of said boot being formed of flexible material which is relatively non-elastic and the leg portion of said stocking being formed of rubber with integral cords extending longitudinally of the stocking whereby said stocking is relatively non-elastic in a longitudinal direction and relatively elastic in a circumferential direction.

2. In a physiotherapy device for treatment of the limb of a patient, a unitary stocking for receiving the limb, said stocking being of a shape complementary to the exterior shape of the limb and comprising a fluid-impervious membrane, a boot having its open end joined circumferentially with the open end of said stocking, said stocking being within said boot so it is wholly encompassed thereby, means connecting the closed end of the stocking to the closed end of said boot to retain the two in close proximity, said means comprising a relatively non-elastic strap around the ankle portion of said stocking with its ends connected to the sole of the boot, said boot being larger than the contained stocking to form with the

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exterior of the stocking a chamber extending the full length of the stocking, said boot having a fluid inlet communicating with said chamber at one end of the stocking and a fluid outlet communicating with a chamber at the other end of the stocking, said stocking is formed of rubber with integral cords extending longitudinally of the stocking whereby it is relatively non-elastic in a longitudinal direction and relatively elastic in a circumferential direction.

3. In a physiotherapy device for treatment of the leg of a patient, a unitary stocking for receiving said leg, said stocking being of a shape complementary to the exterior shape of the leg and comprising a fluid impervious membrane, a boot having an opening in the sole portion thereof, a removable closure for said opening, means detachably securing said closure in said opening and sealing the margin thereof to the margin of the opening, said boot being open at the end opposite said closure and said last end being joined circumferentially with the open end of said stocking, said stocking being within said boot so that the foot portion thereof is in juxtaposition to said

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closure, said boot being larger than the contained stocking to form with the exterior of the stocking a chamber extending the full length of the stocking, said boot having a fluid inlet communicating with said chamber at one end of the stocking and a fluid outlet communicating with the chamber at the other end of the stocking, said stocking is formed of rubber with integral cords extending longitudinally of the stocking whereby the stocking is relatively non-elastic in a longitudinal direction and relatively elastic in a circumferential direction.

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