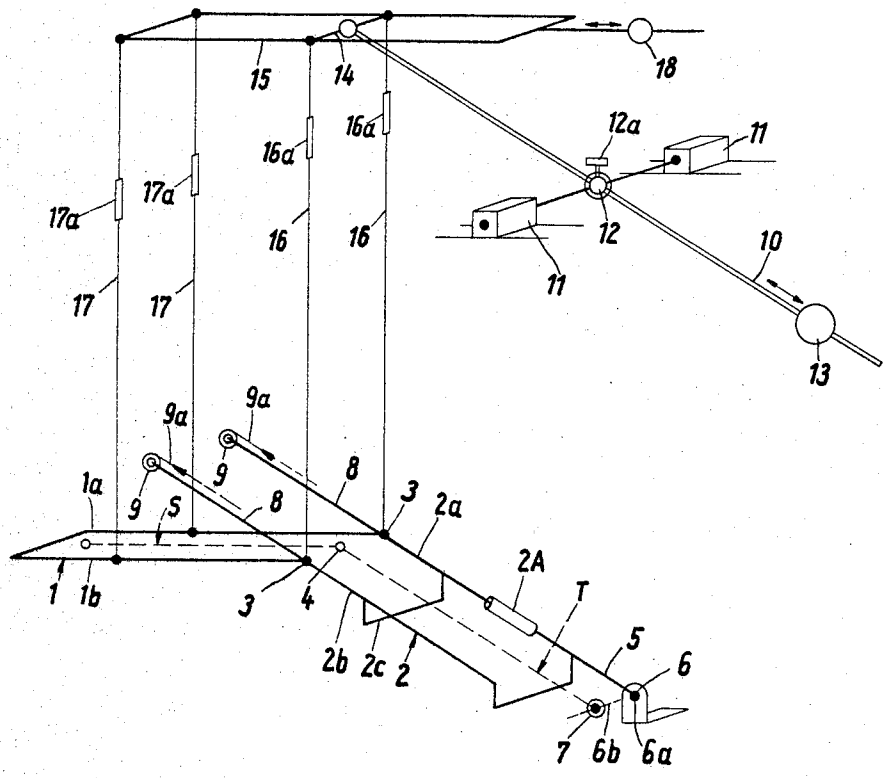
Feb. 11, 1969 H. STRECKFUSS 3,426,753

SURGICAL OR ORTHOPEDIC SPLINT HAVING MEANS FOR EXERCISING UNINJURED LEG PORTIONS TO PREVENT MUSCULAR ATROPHY AND JOINT STIFFNESS

Filed Sept. 21, 1966



Inventor:

HANS STRECKFUSS

BY Michael S. Striker

his ATTORNEY

United States Patent Office 3,426,753
Patented Feb. 11, 1969

3,426,753

SURGICAL OR ORTHOPEDIC SPLINT HAVING MEANS FOR EXERCISING UNINJURED LEG PORTIONS TO PREVENT MUSCULAR ATROPHY AND JOINT STIFFNESS

Hans Streckfuss, Tannenweg 47, Kunsell uber Fulda, Germany

Filed Sept. 21, 1966, Ser. No. 580,952
Claims priority, application Germany, Sept. 22, 1965, S 24,415
U.S. Cl. 128—85 10 Claims
Int. Cl. A61f 5/04, 5/37; A61h 1/02

The present invention relates to surgical or orthopedic splints. More particularly, the invention relates to improvements in splints of the type which can support, reinforce and/or otherwise brace the thigh and the shin of a patient's leg.

When a leg is injured or damaged as a result of broken bone or bones, stiff joints, bone dystrophy or other diseases, localized treatment of affected leg portion or portions constitutes but one phase of proper therapy because it is equally important to insure satisfactory functioning of unaffected leg portions. Total immobilization of a leg will cause muscular atrophy and stiffening of joints. Consequently, a satisfactory leg splint must be designed in such a way that it can properly immobilize all damaged portions of the leg but allows for substantially unimpeded articulation and other functioning of unaffected or undamaged leg portions. This insures more rapid healing because movements of leg muscles promote circulation of blood.

Accordingly, it is an important object of the present invention to provide a surgical or orthopedic leg splint which can properly immobilize and protect damaged portions of a patient's shin or thigh but will allow for unimpeded functioning and active or passive exercising of uninjured or undamaged leg portions.

Another object of the invention is to provide a leg splint which can be readily adjusted so that it can be used on shorter or longer legs and that it can be used for treatment of different types of leg injuries and diseases.

A further object of the invention is to provide a leg splint which enables a patient to exercise a hip joint or knee joint with a greater or lesser effort and which is provided with means for accurately selecting the exact magnitude of such effort.

An additional object of the invention is to provide a leg splint which can be readily installed on a normal bed, on a hospital bed or on any other structure capable of supporting a patient in supine or dorsal position.

A concomitant object of the invention is to provide a leg splint which can be manipulated by the patient so that the patient can exercise his or her leg without assistance and with a minimal effort.

Still another object of the invention is to provide a leg splint which occupies relatively little room, which is assembled of a small number of simple parts, and which can be readily transported to different locales of use.

Briefly stated, one feature of my invention resides in the provision of a surgical or orthopedic leg splint which can be used by patents in dorsal position. The splint comprises a support which may be affixed to a bed or forms a self-supporting unit, a first brace adapted to be applied to a patient's thigh and having an end portion articulately joined with the support, preferably by means of a universal joint in registry with the hip joint of the patient, a second brace adapted to be applied to the shin, first pivot means articulately connecting the braces to each other in registry with the knee joint, a first two-armed balance beam fulcrumed in the support at a level above the hip joint, a first counterweight provided on one arm of the

first beam, a second two-armed balance beam, second pivot means connecting the second beam with the other arm of the first beam at a level above the knee joint, a second counterweight provided on one arm of the second beam, first connector means connecting the first and second pivot means, and second connector means connecting the second brace with the other arm of the second beam.

The splint preferably comprises means for varying the length of at least one connector means, for varying the length of at least one brace, and/or for varying the length of at least one balance beam, particularly the length of the first beam between its fulcrum and the second pivot means.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved leg splint itself, however, both as to its construction and the mode of manipulating the same, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of a specific embodiment with reference to the accompanying drawing.

The single illustration of the drawing is a diagrammatic perspective view of a leg splint which embodies my invention.

Referring to the drawing in detail, the leg of a patient is indicated diagrammatically by broken lines. The patient is assumed to rest in supine position so that the thigh T is inclined upwardly and that the shin S is substantially horizontal. The knee- and hip joints are respectively indicated at **4** and **7**.

The improved surgical or orthopedic splint comprises two leg-engaging sections **1** and **2** (hereinafter called braces for short) which are respectively applied to the shin S and thigh T. As shown, the brace **2** may resemble a trough having two elongated rails **2***a*, **2***b* connected by U-shaped rungs **2***c*. The rail **2***a* has an extension or end portion **5** which is articulately coupled with a bracket **6** by means of a universal joint **6***a*. The joint **6***a* should permit angular movements of the brace **2** about at least two mutually inclined intersecting axes including a horizontal axis **6***b* which passes through the hip joint **7** and preferably a vertical axis. The arrangement is normally such that the extension **5** can be readily detached from the bracket **6**. This bracket can be secured to or forms an integral part of a bed frame, a chair wherein the patient can rest in setting or partly or fully reclining position, or any other similar support.

The brace **1** can straddle the shin S and comprises two elongated rails **1***a*, **1***b* which are articulately connected with the rails **2***a*, **2***b* by pivot means **3**. The common axis of the pivot means **3** passes through the knee joint **4**.

If the thigh T is to be subjected to traction (for example, to reset a broken femur), the necessary stretching force can be furnished by tensioning means including one or two springs **9***a* provided in spring housings **9** at the free ends of extensions or end portions **8** forming part of the rails **2***a*, **2***b* and projecting beyond the knee joint **4**. The housings **9** are preferably detachable and the splint can be furnished with two or more sets of housings **9** each containing a spring **9***a* of different strength so that the physician, the nurse or the patient himself can select an optimum stretching force. Similar spring housings and springs (not shown) are preferably provided at the left-hand ends of the rails **1***a*, **1***b*.

The splint further comprises a pair of two-armed balance beams **10** and **15** which respectively cooperate with the braces **2** and **1**. The beam **10** is fulcrumed at **12** between a pair of aligned bearings **11** forming part of a support or frame which can be provided with its own ground-contacting means or is secured to the bed, to a side wall or to the ceiling of a room. The fulcrum **12** is located

at a level exactly or almost exactly above the hip joint 7. One arm of the beam 10 carries a longitudinally adjustable counterweight 13 and its other arm is articulately connected with the second balance beam 15 by means of pivot means 14 located exactly or almost exactly above the knee joint 4. The pivot means 14 constitutes a second fulcrum and defines a horizontal pivot axis for the beam 15.

Wires, rigid stays or similar connectors 16 connect the pivot means 14 with the pivot means 3. The left-hand arm of the balance beam 10 (between the fulcrum 12 and pivot means 14) is preferably of adjustable length so that the splint can be readily adjusted in accordance with the length of the thigh T. For example, the beam 10 may comprise two or more telescopically connected sections or the entire beam 10 may be shifted lengthwise so that the length of one of its arms at one side of the fulcrum 12 increases at the expense of the other arm, or vice versa. In such splints, the fulcrum 12 may be provided with adjusting means e.g. a lock screw 12*a* which holds the beam 10 in selected position of adjustment.

The left-hand arm of the beam 15 is coupled to the brace 1 by one, two or more preferably rigid wires, stays or analogous connectors 17. The other arm of the beam 15 carries a longitudinally adjustable counterweight 18.

The connectors 16, 17 are preferably of adjustable length to allow for variations in the distance between the balance beams 15 and brace 1. The means for adjusting the length of these connectors may include turnbuckles 16*a*, 17*a* or analogous devices. Also, the braces 1 and 2 are preferably adjustable in length and each of the joints, pivot means and fulcra 3, 6*a*, 12, 14 is preferably of the type which offers a minimal resistance to relative movement between the parts 1–2, 2–6, 10–11 and 10–15. The same holds true for pivots at the ends of the connectors 16, 17. The length of the braces 1, 2 can be varied by assembling their rails 1*a*, 1*b*, 2*a*, 2*b* of telescoped rail sections or in any other conventional way. The drawing merely shows an adjusting device for the rail 2*a* including sleeve 2A receiving the ends of two coaxial rail sections. These sections can be shifted toward or away from each other and with reference to the sleeve 2A to thereby select a desired length of the rail 2*a*. The rails 1*a*, 1*b*, 2*b* may be provided with analogous adjusting means.

The counterweights 13 and 18 can be moved to such positions that they fully balance the weight of the braces 2 and 1 and/or the weight of leg portions T and S. Also, such counterweights may be moved to an infinite number of additional positions each of which corresponds to a different weight which must be overcome by muscles to articulate the leg about the joint 4 and/or 7. The leg may be articulated actively by its muscles or passively by means of suitable handles, drawstrings or other motion transmitting means (not shown) connected to the balance beam 10 and/or 15.

The thigh T can be articulated about the hip joint 7 between a fully horizontal and a nearly or fully vertical position (i.e., through an angle of up to 90 degrees). The shin S can be moved about the knee joint 4 through an angle of up to about 135 degrees. Means may be provided to arrest the brace 1 and/or 2 in any desired position of inclination.

Due to the fact that the joint 6*a* allows for angular movements of the brace 2 about two or more axes, the patient may assume a dorsal recumbent position, a dorsal rigid posture or a dorsal inertia posture in which the body is turned to either side from a recumbent position or a rigid posture. The joint 6*a* may be a ball joint or any other suitable universal joint. The leg can be held in an inertia posture by shortening one each of the wires or stays 16, 17 by means of the respective turnbuckle 16*a* or 17*a* and/or by adjustment of the bearings 11 and fulcrum 12. Also, the balance beam 10 is preferably turnable about its own axis to change the position of inclination of the pivot means 14. The beam 10 can be held in selected angular position by the screw 12*a*. Such adjustments in the inclination of the pivot means 14 might be necessary if the patient decides to move or is moved from a dorsal recumbent position or dorsal rigid posture to a dorsal inertia posture or vice versa.

By proper positioning of the counterweights 13 and 18, the person in charge (or the patient himself) can select the exact weight which the muscles must overcome in order to articulate the thigh and/or the shin. The extent of adjustments in the position of counterweights 13, 18 is preferably such that the leg portions of the patient may be made weightless or that the effort necessary to set the leg portions in motion exceeds the effort which is needed to compensate for the weight of the thigh and/or shin. Each of the two counterweights may be adjusted independently of the other.

The improved splint does not impede passive or active articulation of the knee joint and/or hip joint. The joint 6*a* enables the patient to spread the legs, to change to and from an inertia posture, and/or to lift or lower the leg. The springs 9*a* and their housings 9 enable the person in charge to select a desired traction for the thigh, and the non-illustrated springs and spring housings on the brace 1 can produce the desired stretching force in the event of broken bones in the shin.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is:

1. A surgical or orthopedic leg splint, particularly for use by patients in dorsal position, comprising a support; a first brace adapted to be applied to a patient's thigh and having an end portion articulately joined with said support in alignment with the hip joint; a second brace adapted to be applied to the shin; first pivot means articulately connecting said braces to each other in registry with the knee joint; a first two-armed balance beam fulcrumed in said support at a level above the hip joint; a first counterweight provided on one arm of said first beam; a second two-armed balance beam; second pivot means connecting said second beam with the other arm of said first beam at a level above the knee joint; a second counterweight provided on one arm of said second beam; first connector means connecting said first and second pivot means; and second connector means connecting said second brace with the other arm of said second beam.

2. A leg splint as set forth in claim 1, further comprising means for adjusting the length of at least one of said connector means.

3. A leg splint as set forth in claim 1, further comprising means for adjusting the length of at least one of said braces.

4. A leg splint as set forth in claim 1, further comprising means for varying the length of the other arm of said first beam between the fulcrum of said first beam and said second pivot means.

5. A leg splint as set forth in claim 1, wherein said first balance beam and said second pivot means are turnable about the axis of said first beam.

6. A leg splint as set forth in claim 1, further comprising means for applying tension to the leg, at least at one of said braces.

7. A leg splint as set forth in claim 6, wherein said one brace comprises an extension and said tensioning means is operatively connected with said extension.

8. A leg splint as set forth in claim 1, wherein said counterweights are adjustable in the longitudinal direction tion of the respective balance beams.

9. A leg splint as set forth in claim 1, wherein the joint

between said support and said first brace is a universal joint.

10. A leg splint as set forth in claim **1**, wherein each of said connector means comprises a plurality of parallel stays.

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RICHARD A. GAUDET, *Primary Examiner.*

ROLAND L. FRINKS, *Assistant Examiner.*

U.S. Cl. X.R.

128—25, 88; 272—80