United States Patent

[11] 3,568,671

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[21] Appl. No. **837,035**
[22] Filed **June 27, 1969**
[45] Patented **Mar. 9, 1971**

[54] **SPLINT CONSTRUCTION**
9 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **128/87,** 128/88, 128/89
[51] **Int. Cl.** **A61f 5/04**
[50] **Field of Search** 128/87, 83, 84, 85, 86, 88, 89, 93, 133

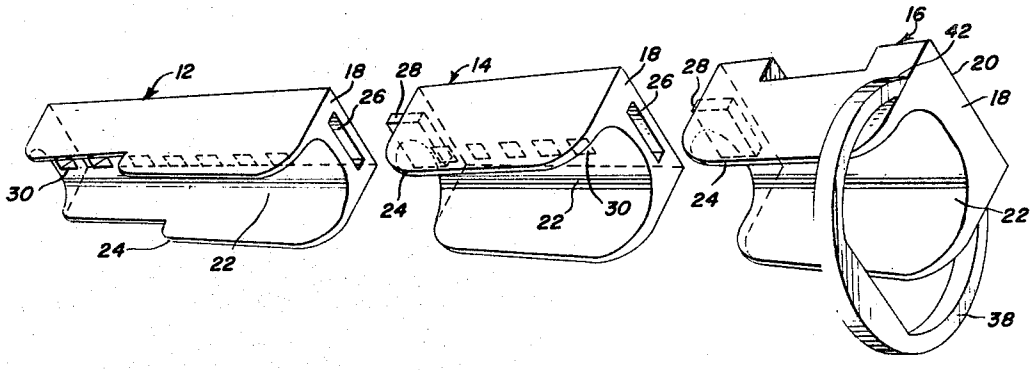
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ABSTRACT: A splint formed of three tapered segments joined end-to-end. Each segment has a flat-bottomed base and a concave limb-receiving portion. The distal and medial segments have a row of spaced apertures capable of selectively receiving an upright foot or hand piece for adjustable longitudinal positioning. The proximal ends of each segment are apertured to receive the free ends of a split ring which serves to bear against the axillary or perineal area of the patient during traction. The segments may be used singly or in combination.



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SHEET 1 OF 2

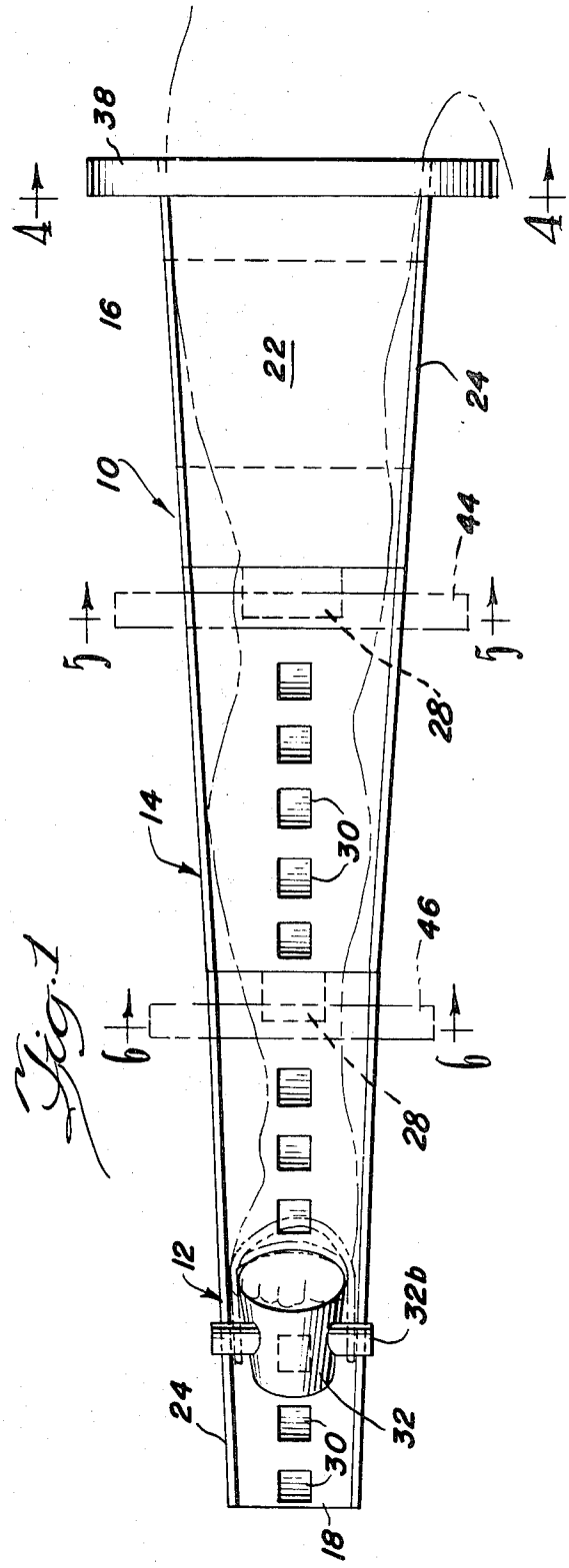


Fig. 1

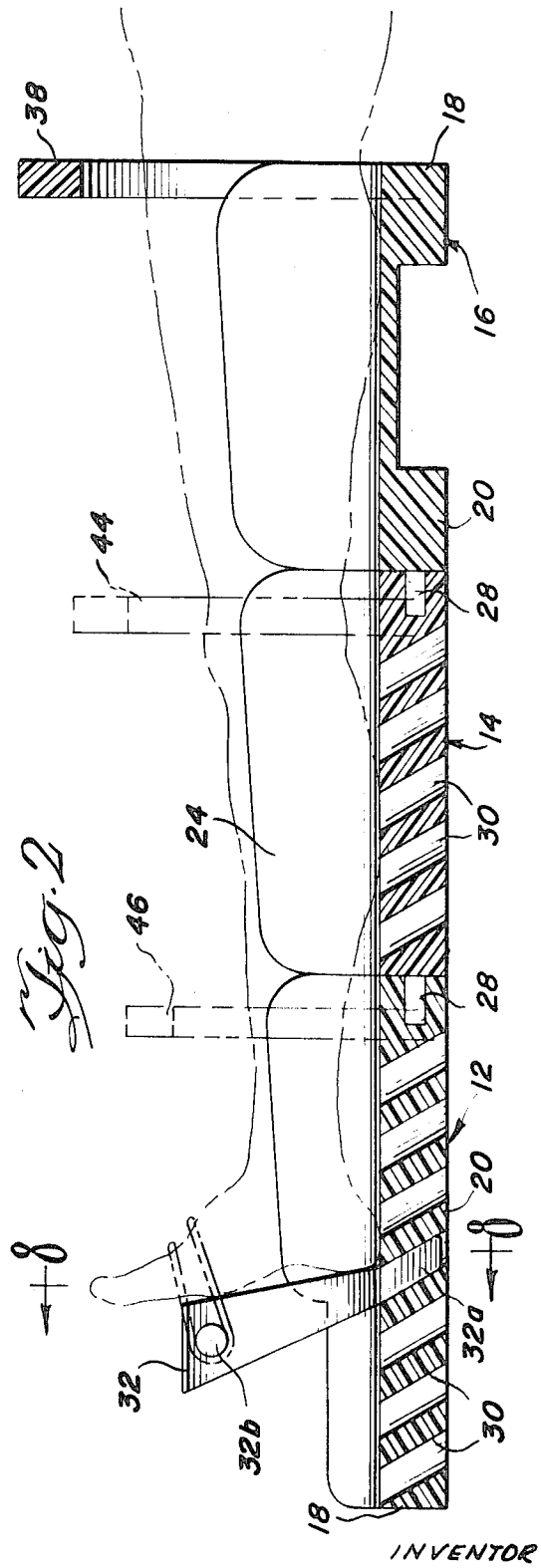


Fig. 2

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PATENTED MAR 9 1971

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SHEET 2 OF 2

SPLINT CONSTRUCTION

BACKGROUND–SUMMARY–DRAWINGS

This invention relates to a surgical-medical splint and, more particularly, to a splint which is capable of holding an injured limb in an absolutely stable and immobile attitude for treatment or surgery, which is adjustable for all sizes of patients, and which permits ready application of traction.

Countless types of limb splints and splint kits have been devised, ranging from a simple pair of slats with wrapping bandages to extremely complex and costly devices for use in the operating room. Typically, splints have been designed to fulfill but a single predominant goal. For example, one type of splint is designed specifically for traction (see, e.g., U.S. Pat. No. 2,302,868). Other splints have been designed principally to permit longitudinal adjustability (see, e.g., U.S. Pat. Nos. 2,593,546; 2,440,964; and 2,138,975). Other types have been designed for platform stability (see, e.g., U.S. Pat. Nos 2,984,239; 2,700,383; and 237,775). Finally, certain splints have been designed primarily for use during surgery and are thus quite complex and costly (see, e.g., U.S. Pat. No. 2,829,640). These specific splints usually have achieved their intended goal with some degree of success, but this success has come at the expense of other equally important goals. For example, an extremely complex splint designed for use during surgery is typically useless under emergency field conditions, or as part of first aid equipment. On the other hand, a splint which is lightweight, portable and inexpensive is normally unable to provide for many sophisticated functions such as traction and surgical stability.

The splint structure contemplated by the present invention fulfills all of these desirable goals and more, and yet is uncomplicated, inexpensive and very portable. The splint of the present invention may be used effectively during any stage of the treatment process, from emergency first aid in the field all the way to the operating or event the recovery room. The splint is longitudinally adjustable so that it may serve equally well with injured arms or legs, whether a child's or an adult's. The splint provides for the application of traction in a unique manner, without undue movement of the injured limb. The splint is extremely stable, and will hold the injured limb absolutely immobile, whether in the field, in a moving vehicle, or on the operating table. The splint is constructed without moving parts, requires no special expertise to use, and may be packaged in a small volume as part of a first aid kit. Finally, with appropriate selection of strong but lightweight material, such as inexpensive plastic, the splint may even be disposable.

To achieve the foregoing beneficial advantages there is provided, in accordance with the invention, a splint which is preferably comprised of three tapered segments joinable end-to-end to provide a single splint structure of uniformly varying width. Each of the splint segments includes a flat-bottomed base to which is affixed a concave limb-receiving portion. Although the limb-receiving portion may be V-shaped or rectangular in cross section, it is preferably curved to approximate the anatomical contours of the limb. The flat bottom of the base renders the entire splint structure extremely stable, while the limb-receiving portion provides lateral stability for the limb itself within the splint.

An annular ring provides a bearing surface for the axillary or perineal region of the patient during traction. Rings of this type may be provided in different sizes and may be adapted for attachment to the proximal end of any of the splint segments. In its preferred form, the traction ring is split so that its free ends may be attached to the base of the proximal splint segment. Thus, the ring may be passed about the patient's limb and affixed to the splint while the limb is firmly in place in the splint.

The splint also includes one or more hand or foot pieces which are selectively positionable along the length of the splint by means of a longitudinal row of spaced apertures, thus permitting a wide range of size adjustability. If an injured adult leg is to be treated, the splint is assembled using all three segments. In the case of a child's leg or an adult's arm, it may be desirable to use only the distal and medial segments. For pediatric injuries, the distal segment alone may be used.

The foregoing and other features of the invention will be more fully understood by considering the remainder of the specification and the claims, together with illustrative reference to the drawings, in which:

FIG. 1 is a top plan view of a splint constructed in accordance with the invention;

FIG. 2 is a sectional side elevation thereof;

FIG. 3 is an exploded perspective view thereof;

FIG. 4 is a cross-sectional view taken on the line 4–4 of FIG. 1;

FIG. 5 is a cross-sectional view taken on the line 5–5 of FIG. 1;

FIG. 6 is a cross-sectional view taken on the line 6–6 of FIG. 1;

FIG. 7 is a view similar to that of FIG. 5, showing a modified form of traction ring construction;

FIG. 8 is a sectional view taken on the line 8–8 of FIG. 2;

FIG. 9 is a side sectional elevation of the distal portion of a distal splint segment showing one form of hand piece;

FIG. 10 is a cross-sectional view taken on the line 10–10 of FIG. 9;

FIG. 11 is a top plan view of the distal portion of a distal splint segment showing another form of hand piece; and

FIG. 12 is a cross-sectional view taken on the line 12–12 of

DESCRIPTION OF EXEMPLARY EMBODIMENT

With specific reference to FIGS. 1, 2 and 3, there is shown a splint 10 constructed in accordance with the present invention. (It will be noted that, in FIGS. 1 and 2, a representation of an adult human leg is indicated by the broken lines.) The splint 10 comprises a distal splint segment 12, a medial splint segment 14 and a proximal splint segment 16. Each of the segments 12, 14 and 16 includes a base 18 having a flat bottom 20, and a concave limb-receiving portion 22. As illustrated, the limb-receiving portion 22 is integral with the base and consists of a pair of sidewalls 24 which, together with the base 18, define a smooth, arcuate interior surface. The limb-receiving portion 22 might also be a separate unit adapted for attachment to the base 18, and might take a variety of other cross-sectional shapes, as for example rectangular or V-shaped. Preferably, however, the limb-receiving portion 22 is formed as an integral unit with the base 18 and has an arcuate cross section (best shown in FIGS. 4—8) which conforms generally to the anatomical contours of the limb.

As can be seen, the flat bottom 20 of the base 18 provides an extremely stable bearing surface for the splint 10. Thus, the splint 10 with an injured limb in place may be placed on an operating table, on the floor of an ambulance or on the ground, without tilting, tipping or other undue movement. The sidewalls 24 which define the limb-receiving portion 22 serve to maintain the limb in a stable attitude within the splint. It will be noted that the sidewalls 24 in the distal portion of the distal segment 12 are slightly cut away. This permits more detailed attention to be given to the injured hand or foot at the distal portion of the splint 10 and also provides better access for affixing the hand or foot to a hand or foot piece. If the splint 10 is constructed of suitably strong but lightweight and relatively soft materials, such as plastic or aluminum, the sidewalls 24 may be further cut away at any desired point to provide for better access during surgery or other treatment.

As best shown in FIG. 3, the distal, medial and proximal segments 12, 14 and 16 respectively are joinable end-to-end to provide the single splint structure 10. For this purpose, the distal segment 12 is provided with a slot 26 in its base at the proximal end thereof, and the medial segment 14 has at its distal end a correspondingly sized tab 28. Similarly, the medial segment 14 includes a slot 26 at its proximal end, which mates with a tab 28 at the distal end of the proximal segment 16. The slots 26 and mating tabs 28 may be tapered for tight fit.

Because of the relatively large interfacing surfaces at the ends of the splint segments 12, 14 and 16, the splint structure 10 will be very stable longitudinally, particularly when the injured limb is under traction.

The distal segment 12 and the medial segment 14 include a row of apertures 30 formed in the bases 18 of the segments. The apertures 30 are spaced in regular fashion along the approximate longitudinal center line of the segments 12 and 14. As best seen in FIGS. 2 and 9, the apertures 30 serve to receive and hold a foot piece 32 (FIG. 2) or a hand piece 34 (FIG. 9). As illustrated in FIGS. 2 and 8, the foot piece 32 includes a lug 32*a* which is shaped to mate with the apertures 30. The inclined attitude of the apertures 30 and the lug 32*a* serves to enhance the holding of the foot piece 32. Thus, when the lug 32*a* is inserted into one of the apertures 30 the foot piece 32 is maintained firmly in an upstanding position with respect to the base 18. The foot piece 32 also includes a cross bar 32*b* which may be used as a convenient point of attachment to bind the foot firmly to the foot piece.

As shown in FIGS. 9 and 10, the handpiece 34 likewise includes a lug 34*a* which is shaped to mate with the apertures 30. The handpiece 34 also includes a curved rest portion 34*b* which serves to support the wrist and lower portion of the arm as well as the hand. An alternative form of handpiece 36 is illustrated in FIGS. 11 and 12. The handpiece 36, like the handpiece 34, includes a lug 36*a* for mating with the apertures 30, and further includes a slotted grip portion 36*b* which is useful for binding the hand to the hand piece. The hand piece 34 may be used for both pronation and supination, while the hand piece 36 will be most suitably employed for pronation.

As can be seen, the spaced row of apertures 30 which are sized to receive the lugs 32*a*, 34*a* and 36*a* permit a wide range of longitudinal adjustability for the splint 10. In use, the injured limb is placed in the splint 10 and an aperture 30 is selected which is one or two spaces toward the distal end of the splint from the extremity of the injured limb. The appropriate hand or foot piece is then inserted in that aperture, and the hand or foot is firmly bound to the piece, thus extending the limb. The limb may be further immobilized by using tape in conjunction with the sidewalls 24, or by wrapping bandages about the entire splint.

When the injured limb is a child's leg, or perhaps an adult's arm, it may be necessary to use only the distal segment 12 and the medial segment 14. Similarly, the distal segment 12 may be used alone, for example in connection with an infant's limb or, in certain circumstances, it may be desirable to use the proximal and medial segments 16 and 14 without the distal segment 12.

As can be seen from FIG. 1, and from the cross-sectional views of FIGS. 4, 5 and 6, the splint segments 12, 14 and 16 are uniformly tapered, decreasing in width in the distal direction, so as to be capable of forming a single splint structure 10 which is widest at its proximal end and narrowest at its distal end. This, of course, corresponds generally to the tapered shape of a human limb.

As best illustrated in FIG. 3, the proximal splint segment 16 includes an annular ring 38 which is useful if traction is to be applied to the injured limb. The ring 38, which may be formed of the same material as the other components of the splint 10, is split, leaving a pair of free ends 40. The free ends 40 of the ring 38 are shaped to mate with corresponding apertures 42 in the base 18 of the proximal segment 16. The function of the ring 38 is to bear against the axilla or perineum of the patient when traction is applied. For example, if it were desired to place the leg shown by the broken lines in FIG. 1 in traction, the leg would first be placed in the splint 10 and bound relatively loosely to the foot piece 32. During this operation, the ring 38 would not be in place. The ring 38 would then be carefully placed over the injured limb, and its free ends 40 would be inserted into the apertures 42 in the base 18 of the proximal segment 16. This step may be more easily accomplished if the ring 38 is made of slightly resilient material, such as plastic. The foot is then unbound from the foot piece 32 and the foot piece moved to an aperture 30 which is further toward the distal end of the splint 10. The physician then applies traction and binds the foot tightly to the foot piece 32. When this is accomplished, the leg will be in substantial extension, and the ring 38 will press firmly against the perineal area and the outer portion of the hip, thus maintaining the splint 10 in a stable position.

As can be seen, this method of applying traction is essentially self-contained, in that neither the splint 10 nor the patient need be separately anchored. The external line of stabilizing force runs from the foot piece 32 through the splint segments 12, 14 and 16 to the traction ring 38, which is firmly anchored against the patient's body. The internal line of stabilizing force is from the foot piece 32 through the leg bones and into the body. Inasmuch as the common end points for each line of force are the foot piece 32 and the body, there is no resultant force which tends to move either the splint 10 or the patient. Thus, particularly when the limb is under traction, the splint 10 acts as though it were a part of the patient's body and moves with the body, with no relative motion between the limb and the splint.

Additional smaller sized rings 44 and 46 (illustrated respectively in FIGS. 5 and 6) may be provided for use at the proximal ends of the medial segment 14 and the distal segment 12 respectively, as shown in FIGS. 1 and 2. For example, the ring 44 illustrated in FIG. 5 could, with the provision of suitable apertures at the proximal end of the medial segment 14, be used as a traction ring for the axillary area of an adult with an injured arm. Similarly, the ring 46 illustrated in FIG. 6 could, through the provision of suitable apertures in the proximal end of the distal segment 12, be used as a perineal traction ring for an infant's leg.

An alternative form of traction ring 50 is illustrated in FIG. 7. As shown therein, the ring 50 is actually comprised of two separate curved pieces which are not joined across the top as in the case of the ring 44 shown in FIG. 5. With either type of ring, however, there is great advantage over prior forms of traction circles, inasmuch as the patient's limb need not be carefully guided through the circle, with attendant risk of further injury. Instead, the ring may be placed about the limb after the limb is in place on the splint.

As indicated above, the splint components may be made of any suitable materials, keeping in mind the desired specifications of strength, low cost and lightweight. Sizes of the individual components may vary; however, it has been found that a proximal segment 16 about 1 foot long coupled with a medial segment 14 also about 1 foot long and a distal segment 12 about 16 inches long provides a splint having the necessary flexibility to accommodate various sizes of limbs. In such a system, the proximal segment 16 tapers from 8 inches wide at its proximal end to 6 ½inches wide at its distal end with the medial segment 14 being 5 inches wide at its distal end and the distal segment having a width at its distal end of 4 inches.

Although an embodiment constructed in accordance with the present invention has been described with the requisite particularity, the disclosure is of course only exemplary. Consequently, numerous changes in details of construction, in size, configuration and arrangement of components and materials, and in modes of application will be apparent to those familiar with the art and may be resorted to without departing from the scope of the invention as set forth in the following claims:

I claim:

1. A splint comprising: a proximal segment, a medial segment and a distal segment, said segments being detachably joined end-to-end to form a single splint structure; an annular axillary/perineal ring detachably attached near the proximal end of at least said proximal segment; and a foot/hand piece detachably positioned at a selected point along said splint structure, means along said splint structure adapted to receive and position said foot/hand piece in selected positions along the length of the splint, each of said segments including a flat-bottomed base portion and a concave limb-receiving portion.

2. A splint according to claim 1, wherein at least said distal segment includes a series of spaced apertures arrayed longitudinally along said segment for receiving said foot/hand piece.

3. A splint according to claim 1, wherein each of said segments is adapted, near its proximal end, to receive said ring and hold said ring in a plane essentially normal to said base.

4. A splint according to claim 1, wherein said segments are formed of plastic material.

5. A splint according to claim 1, wherein the widths of said segments uniformly taper such that the proximal end of said proximal segment is the widest and the distal end of said distal segment is the narrowest.

6. A splint comprising: at least a proximal segment and a distal segment, said segments being detachably joined end-to-end to form a single splint structure; a ring detachably attached at the proximal end of said splint for encircling the injured limb and bearing against the axillary or perineal area of the patient; and a foot/hand piece detachably positioned at a selected point along said splint structure, means along said splint structure adapted to receive and position said foot/hand piece in selected positions along the length of the splint, each of said segments including a flat-bottomed base portion and a concave limb-receiving portion.

7. A splint comprising a plurality of tapered segments, said segments being joined end-to-end to form a splint structure having a uniformly decreasing width from its proximal end to its distal end; and a foot/hand piece detachably positioned at a selected point along said splint structure, means along said splint structure adapted to receive and position said foot/hand piece in selected positions along the length of the splint, each of said segments including a flat-bottomed base portion and a concave limb-receiving portion.

8. A splint comprising: a flat-bottomed base portion; a concave limb-receiving portion attached to said base portion; a row of apertures formed in said base portion and spaced longitudinally therealong, a foot/hand piece having a lug received in one of said apertures and the other of said apertures adapted to selectively receive and hold said lug in selected positions along the length of the splint, and a split axillary/perineal ring having free ends attached to opposite sides of said base near the proximal end thereof.

9. A splint according to claim 8, wherein said ring is sufficiently resilient to permit said free ends to clear an injured limb in place in said limb-receiving portion during attachment of said ring to said base.