March 2, 1965 R. W. ROGERS 3,171,407

ORTHOPEDIC FOOT BRACE

Filed Nov. 30, 1962 2 Sheets-Sheet 1

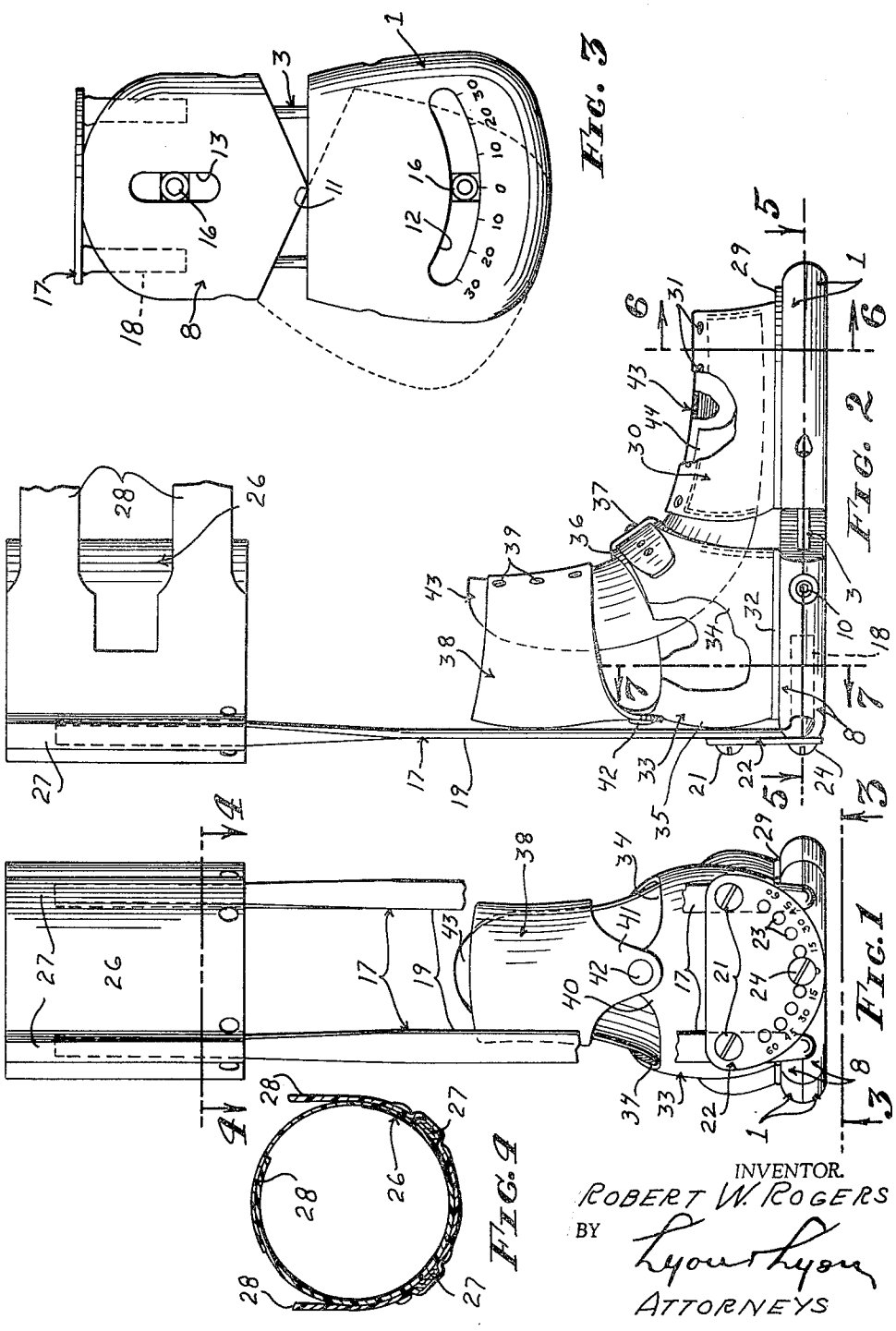


FIG. 3

FIG. 2

FIG. 1

FIG. 4

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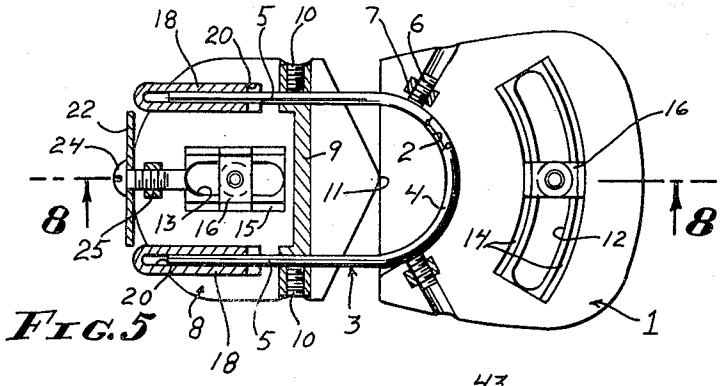


FIG. 5

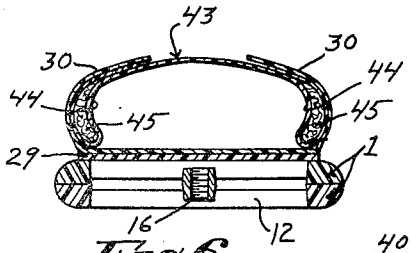


FIG. 6

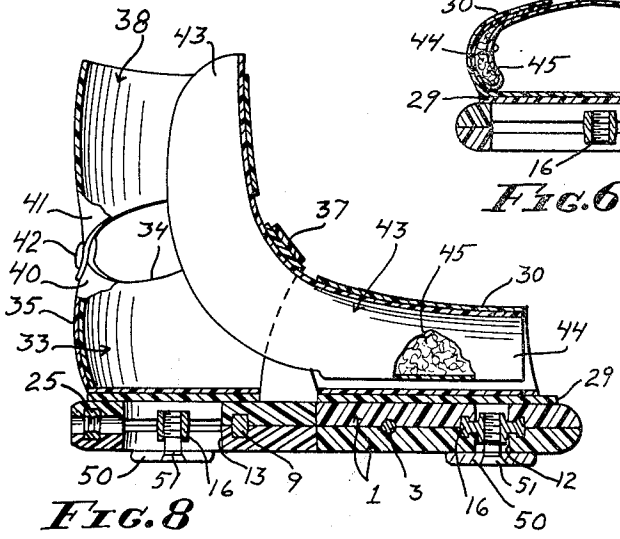


FIG. 8

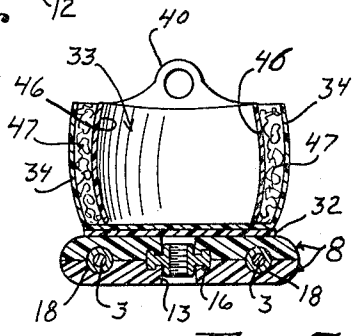


FIG. 7

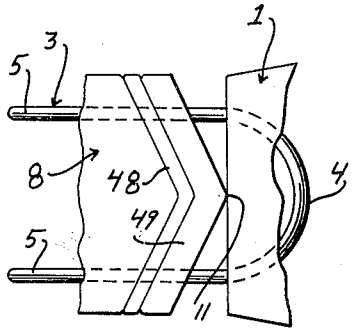


FIG. 9

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3,171,407

ORTHOPEDIC FOOT BRACE

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Filed Nov. 30, 1962, Ser. No. 241,279
10 Claims. (Cl. 128—80)

The present invention relates to improvements in orthopedic devices for the treatment of congenital and acquired deformities in infants' feet, such as clubfoot, forefoot adductus and abductus, metatarsus varus, forefoot pronation and suppination, varus and valgus deformities of the heel, forefoot equinus, equinus ankle, talipes equino varus, or any combination of the fore-named deformities.

In treating abnormal foot conditions in infants, responsive correction can be achieved by rotating or pivoting the appropriate muscular-skeletal elements about one or more axes and maintaining portions of the limb in progressively improved, predetermined positions until a satisfactory correction is achieved. For example, the clubfoot patient generally requires three distinctly separate phases of treatment: First, the straightening of the metatarsals of the forefoot from a varus (inward) condition towards more normal alignment. Second, the stabilization of the heel which may be in a varus or valgus condition. Third, the lifting up of the entire drooping foot by correction of the equinus element. With approximately twenty-six bones interacting within the foot and ankle, the severity and combination of attitudes required to effect proper orthopedic treatment varies considerably with the individual.

While the true three-phased clubfoot problem represents a smaller percentage of the overall foot deformities encountered in infants, it is inherently the most complicated of those commonly diagnosed by pediatricians and orthopedists, therefore a major challenge to treatment. However, a substantial percentage of infants are born with mild to severe deformities, often stated as "one-third clubfoot" or "two-thirds clubfoot," or other muscular-skeletal abnormalities not specifically related to clubfoot, but which are receptive to the same treatment techniques. Preferably, therefore, orthopedic devices destined for treatment of infantile foot deformities should have a wide latitude of motion, adjustment, and adaptability.

Conventional treatment of the component phases of clubfoot, its offshoot deformities, and many variant foot problems usually necessitates the application of cumbersome, sometimes numerous, plaster casts on infants, often followed-up by special orthopedic braces and shoes. In the more severe cases, where surgery is required, post-operative retention of the afflicted limb along normal axes of alignment again necessitates the use of the currently available plaster casts, special orthopedic braces, and shoes until recovery is complete.

Plaster of Paris casts, while quite satisfactory for the immobilization of lower extremity fractures in adults, prove extremely heavy, physiologically irritating, and awkward for infants. Since growth requirements and correctional adjustments may require several cast changes, the application proves especially time-consuming to the physician, and mutually reproachable by the parent and infant. Application of the cast is usually messy, and requires assistance, either in preparing the casting material or controlling the patient, thereby adding to costs. Further, the electric cast cutters universally used to modify or remove plaster casts, create a noise and vibration that is almost cruelly fearsome to infants.

Orthopedic shoes, like plaster casts, are rigid; and, accordingly, must be remade or replaced when major adjustments are prescribed. If an adduction-abduction splint is to be attached to the shoes, as is often the case

in practice, another pair of shoes or the services of a bracemaker must be obtained, in addition. It follows, then, that while the conventional devices correct phases of the overall problem in varying degrees, they lack multi-directional adjustability, and are therefore relegated to a relatively limited, single-function treatment.

With the background problem as outlined above in view, the principal objects of this invention are:

First, to provide an orthopedic device which has a wide range of adjustability and adaptability and which is easily manipulated, thereby to provide an orthopedic device which aids materially in the correction of a wide variety of abnormal foot conditions.

Second, to provide an orthopedic device which incorporates novel means, and which permits ready and quick adjustment to the rapidly growing infant's foot and foreleg.

Third, to provide an orthopedic device which is readily and quickly removed for frequent cleansing and inspection of the affected limb.

Fourth, to provide an orthopedic device which incorporates a heel unit and a forefoot unit, and connecting means which not only permits ready lengthening of the device but also permits relative displacement of the heel unit and forefoot unit about three axes to meet various corrective requirements.

Fifth, to provide an orthopedic device which enables the physician to make the variously required angular adjustments in small increments, as the treatment progresses, to ensure proper growth and development of the affected limb.

Sixth, to provide an orthopedic device which incorporates a novel boot structure capable of expansion as the foot and foreleg grows, and which is provided with pockets to receive padding so as to ensure full, complete, and comfortable support at all times.

Seventh, to provide an orthopedic device the components of which are simple and inexpensive, and several of which are interchangeable as well as capable of use on either the right or left foot, so as to reduce materially the manufacturing and distribution costs.

Eighth, to provide an orthopedic device which incorporates means for ready attachment and detachament of accessory braces and tie bars.

Ninth, to provide an orthopedic device wherein rough, sharp, or projecting portions are minimized to reduce the probability of damage to sheets, bedding, and furniture.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

FIGURE 1 is a rear view of the orthopedic device;

FIGURE 2 is a side view thereof;

FIGURE 3 is a bottom view thereof taken substantially from 3—3 of FIGURE 1;

FIGURE 4 is a transverse sectional view taken through 4—4 of FIGURE 1;

FIGURE 5 is a longitudinal sectional view taken through 5—5 of FIGURE 2;

FIGURE 6 is a transverse sectional view taken through 6—6 of FIGURE 2;

FIGURE 7 is a transverse sectional view taken through 7—7 of FIGURE 2;

FIGURE 8 is a longitudinal sectional view taken through 8—8 of FIGURE 5;

FIGURE 9 is a fragmentary bottom view.

The orthopedic device includes a pair of identical forefoot plates 1, preferably molded of plastic material. The confronting surfaces of the two plates define a semi-circular channel 2 intersecting the rearward ends of the plates at two laterally spaced points. The rear edges of the plates 1 are straight, whereas the side edges diverge

therefrom and then curve laterally inwardly to form the toe extremities of the plates. The confronting surfaces of the plates 1 may be cemented together, or may be removably attached to each other by conventional fastening means, not shown.

The semicircular channel 2 receives a U-shaped connecting bar 3. The connecting bar 3 includes a semicircular end 4 and parallel legs 5. The forefoot plates 1 are capable of limited arcuate movement about the center of the semicircular end 4 of the connecting bar 3, and may be locked in any position relative to the connecting bar 3 by means of recessed set screws 6 and cooperating screw-threaded inserts 7, shown best in FIGURE 5.

A pair of identical heel plates 8 is also provided. The confronting surfaces of the heel plates 8 define a cross channel, enlarged at its lateral extremities, which receives a transversely extending insert bar 9. The heel plates 8 also define longitudinally-extending, parallel channels which align with cross holes near the extremities of the insert bar 9 and receive the legs 5 of the connecting bar 3.

The extremities of the insert bar 9 are provided with recessed set screws 10. The heel plates 8 are adapted to slide longitudinally with respect to the connecting bar 3 and be locked in any adjusted position by the set screws 10.

The forward ends of the heel plates 8 define a central apex 11 which may bear against the rear edges of the forefoot plates 1 and define the center of curvature of the channel 2 and semicircular end 4 of the connecting bar 3. The edges of the heel plates 8 diverge from each other laterally from the apex 11 and rearwardly from the forefoot plates 1. The heel plates 8 form essentially parallel lateral sides which merge into an essentially semicircular rear or heel edge.

Formed in each forefoot plate 1 is an arcuate slot 12. The center of curvature of the arcuate slot 12 coincides with the center of curvature of the semicircular end 4 of the connecting bar 3. The heel plates 8 define a central, longitudinally-extending slot 13. The side margins of the slots 12 and 13 form guide tracks 14 and 15, respectively. The slots and their guide tracks receive slide nuts 16 having vertical screw-threaded bores.

The heel plates 8 are adapted to be attached to a pair of brace bars 17. The brace bars are L-shaped and comprise tubular ends 18 and flattened vertical portions 19. The longitudinal channels formed in the heel plates 8, which receive the legs 5 of the connecting bar 3, are counterbored to form sockets 20 which receive the tubular ends 18. The tubular ends in turn receive the extremities of the legs 5 to provide maximum longitudinal or axial adjustment of the heel plates 8 relative to the connecting bar 3.

Secured to the vertical portions 19 of the brace bars 17 by screws 21 is a semicircular, angular adjustment plate 22. The arcuate side of the adjustment plate 22 is provided with an arcuate row of perforations 23, any one of which may receive a screw 24 which screw-threads into an insert 25 located between the heel plates 8 in coincidence with their longitudinal axis.

The upper ends of the brace bars 17 are joined to a leg band 26 having vertically extending pockets 27, which receive the upper ends of the brace bars 17. The leg band 26 is provided with straps 28 having conventional buckles, not shown.

The upper surface of the uppermost forefoot plate 1 receives a thin forefoot sole 29 which may be cemented or otherwise secured thereto. Attached to the side margins, and if desired covering the sole 29, is a forefoot band 30, the extremities of which curve upwardly and toward each other, and are provided with perforations 31 to receive laces, not shown. If desired, the forefoot sole 29 may be omitted, and the midportion of the forefoot band 30 may be attached directly to the uppermost forefoot plate 1.

The uppermost heel plate 8 receives a thin heel sole 32 to which is secured a heel band 33 shaped to form side portions 34 and a heel portion 35. The side portions 34 terminates in strap elements 36 adapted to be joined by a buckle 37, or other conventional fastening means. The heel sole 32 may be omitted, and the band 33 may be joined directly to the uppermost heel plate 8.

Above the heel band 33 there is located a split ankle band 38, the confronting extremities of which are provided with perforations 39 to receive laces, not shown. The heel portion 35 of the heel band 33 is provided with an upwardly extending tab 40, and the back portion of the ankle band 38 is provided with a downwardly extending tab 41. The tabs 40 and 41 are joined by a snap 42, or other conventional fastening means.

Fitted within the upper and forward portions of the forefoot band 30, heel band 33, and ankle band 38 is a flexible tongue 43, which underlies the buckle 37 and the laces utilized to adjust the forefoot band 30 and ankle band 38.

The tongue 43 is essentially T-shaped to form lateral extensions 44 located within the forefoot band 30. The extremities of the lateral extensions 44 are joined to the extremities of the forefoot band 30 near the perforations 31, as shown best in FIGURE 6, and then extend laterally from each other and downward toward the forefoot plates 1; then fold upon themselves and merge into the central or longitudinal portion of the tongue 43.

The folded lateral extensions of the tongue 43 form side pockets which receive padding 45. The side portions 34 of the heel band 33 are provided with liners 46, as shown best in FIGURE 7, to form side pockets which receive padding 47.

V-shaped adapter blocks 48 and 49 of various widths are adapted to be interposed between the forefoot plates 1 and the heel plates 8, as shown best in FIGURE 9.

Operation of the orthopedic device is as follows:

By reason of the semicircular channel 2 and corresponding semicircular end 4 of the connecting bar 3, the forefoot plates 1 may be pivoted about the apex 11 into angular relation with the heel plates 8, as indicated by dotted lines in FIGURE 3.

By reason of the fact that the forward edges of the heel plates 8 recede from the rearward edges of the forefoot plates 1, portions of the legs 5 of the connecting bar 3 are exposed. Additional portions may be exposed by moving the heel plates 8 away from the forefoot plates 1.

The exposed portions of the connecting bar 3 may be bent upwardly or downwardly, or one may be bent upwardly and the other bent downwardly, so as to displace the forefoot plates 1 about two additional axes with respect to the heel plates 8. By reason of the fact that the forefoot plates 1 may be adjusted about three axes with respect to the heel plates 8, the forefoot and heel plates may be adjusted to meet a wide variety of conditions.

With respect particularly to lateral, pivotal movement of the forefoot plates 1, adjustment about this axis may be accomplished in small increments, and the forefoot plates 1 may be locked in their various adjusted positions by the set screws 6. In addition, longitudinal spacing of the forefoot plates 1 and heel plates 8 may be made in small increments to accommodate for growth of the foot, and may be locked in any of their relatively adjusted positions by the set screws 10.

By means of the angular adjustment plate 22, the heel plates 8 may be angularly located with respect to the brace bars 17; that is, both the heel plates 8 and forefoot plates 1 may be pivoted about their common longitudinal axis.

A wide range of adjustments of the shoe elements comprising the forefoot band 30, heel band 33, and

angular band 38 may be made; and the leg band 26 may be expanded to accommodate the growth of the foot and foreleg of the patient. In addition, the padding 45 and 47, which may be placed in the side pockets, enables the forefoot band 30 and heel band 33 to accommodate comfortably the corresponding portions of the patient's foot.

Many times it is necessary that the orthopedic device be used in pairs. It is not, however, necessary to provide left and right devices, as the same device may be used on either foot. When the orthopedic device is used in pairs, it is often necessary that the two feet of the patient be interconnected by cross bars 50, indicated in FIGURE 8. These cross bars are attached by screws 51 to the slide nuts 16.

Relative angular adjustment of the two orthopedic devices thus used is readily accomplished by the screws 51 which, when loosened, permit lateral movement of one slide nut 16 in the slot 12 and longitudinal movement of the other slide nut 16 in the slot 13.

Inasmuch as each pair of heel plates 8 and forefoot plates 1 are identical, only two molds are required for their manufacture. If the pairs of heel or forefoot plates are cemented or otherwise permanently joined together, the connecting bar 3 is permanently retained in the forefoot plates 1. If desired, however, the pairs of forefoot or heel plates may be removably attached to each other, as by screws, so that the connecting bar 3 may be removed and may in fact be a low cost, expendable item.

While it is not necessary in all conditions that the heel plates 8 and forefoot plates 1 be in contact with each other, it may be desirable to avoid excessive spacing. In this case, the V-shaped adapter blocks 48 and 49 of various widths may be interposed between the forefoot plates 1 and the heel plates 8, and, in effect, form extensions of heel plates, as shown in FIGURE 9.

While a particular embodiment of this invention has been shown and described, it is not intended to limit the same to the exact details of the construction set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

What is claimed is:

1. An orthopedic device, comprising:
(*a*) a U-shaped connecting bar having a semicircular end and essentially parallel legs;
(*b*) a forefoot plate structure having a semicircular guideway fitted on the semicircular end of said connecting bar for angular adjustment thereabout;
(*c*) a heel plate structure having guideways slidably receiving said legs for axial adjustment thereon;
(*d*) means for securing said plate structures to said connecting bar;
(*e*) and means for attachment of said plate structure to the foot of a patient.

2. An orthopedic device, comprising:
(*a*) a U-shaped connecting bar having a semicircular end and essentially parallel legs;
(*b*) a forefoot plate structure having a semicircular guideway fitted on the semicircular end of said connecting bar for angular adjustment thereabout;
(*c*) a heel plate structure having guideways slidably receiving said legs for axial adjustment thereon;
(*d*) said connecting bar disposing the ends of said plate structures in confronting relation, and the confronting end of at least one of said plate structures being beveled to permit relative angular displacement;
(*e*) means for securing said plate structures to said connecting bar;
(*f*) and means for attachment of said plate structure to the foot of a patient.

3. An orthopedic device, comprising:
(*a*) a U-shaped connecting bar having a semicircular end and essentially parallel legs;
(*b*) a forefoot plate structure having a semicircular guideway fitted on the semicircular end of said connecting bar for angular adjustment thereabout;
(*c*) a heel plate structure having guideways slidably receiving said legs for axial adjustment thereon;
(*d*) said connecting bar disposing the ends of said plate structures in confronting relation, and the confronting end of at least one of said plate structures being beveled to permit relative angular displacement;
(*e*) V-shaped spacer elements fitted on the legs of said connecting bar between said plate structures;
(*f*) means for securing said plate structures to said connecting bar;
(*g*) and means for attachment of said plate structure to the foot of a patient.

4. An orthopedic device, comprising:
(*a*) a U-shaped connecting bar having a semicircular end and essentially parallel legs;
(*b*) a forefoot plate structure having a semicircular guideway fitted on the semicircular end of said connecting bar for angular adjustment thereabout;
(*c*) a heel plate structure having guideways slidably receiving said legs for axial adjustment thereon;
(*d*) said connecting bar disposing the ends of said plate structures in confronting relation, and the confronting end of at least one of said plate structures being beveled to permit relative angular displacement;
(*e*) said forefoot plate structure having an arcuate guide slot therein and said heel plate structure having a longitudinally extending guide slot therein;
(*f*) slide nuts in said slots;
(*g*) a pair of cross bars joined to a pair of said forefoot and heel plate structures by said slide nuts;
(*h*) and means for attachment of said plate structure to the foot of a patient.

5. An orthopedic device, comprising:
(*a*) a U-shaped connecting bar having a semicircular end and essentially parallel legs;
(*b*) a forefoot plate structure having a semicircular guideway fitted on the semicircular end of said connecting bar for angular adjustment thereabout;
(*c*) a heel plate structure having guideways slidably receiving said legs for axial adjustment thereon;
(*d*) said heel plate structure having brace-receiving sockets intersecting the heel extremity thereof;
(*e*) upwardly extending brace rods having horizontal portions fitting said sockets;
(*f*) means interconnecting said heel plate structure and said rods to dispose said heel plate at various tilted angles with respect to said brace rods;
(*g*) a leg band connected to the upper ends of said brace rods;
(*h*) and means for attachment of said plate structure to the foot of a patient.

6. An orthopedic device, comprising:
(*a*) a heel plate structure having a pair of sockets extending therein from the heel end thereof;
(*b*) upwardly extending brace rods having horizontal portions fitting said sockets;
(*c*) means interconnecting said heel plate structure and said rods to dispose said heel plate at various tilted angles with respect to said brace rods;
(*d*) a leg band connected to the upper ends of said brace rods;
(*e*) and means for attachment of said plate structure to the foot of a patient.

7. An orthopedic device, comprising:
(*a*) a U-shaped connecting bar having a semicircular end and essentially parallel legs;
(*b*) a forefoot plate structure having a semicircular guideway fitted on the semicircular end of said connecting bar for angular adjustment thereabout;
(*c*) a heel plate structure having guideways slidably receiving said legs for axial adjustment thereon;

(*d*) a forefoot band means secured to said forefoot plate structure;
(*e*) a heel band means secured to said heel plate structure;
(*f*) an ankle band means connected with said heel band means;
(*g*) and a tongue secured to said forefoot band means and extending through said band means from between the distal ends of said ankle band and said forefoot band.

8. An orthopedic device, comprising:
(*a*) a forefoot plate structure;
(*b*) a heel plate structure;
(*c*) adjustable means connecting said structures;
(*d*) a forefoot band means secured to said forefoot plate structure;
(*e*) a heel band means secured to said heel plate structure;
(*f*) an ankle band means connected with said heel band means;
(*g*) a tongue secured to said forefoot band means and extending through said band means from between the distal ends of said ankle band and said forefoot band;
(*h*) means forming pockets in the opposite sides of said forefoot band means;
(*i*) means forming pockets in the opposite sides of said heel band means;
(*j*) and padding in said pockets.

9. An orthopedic device, comprising:
(*a*) a forefoot plate structure;
(*b*) a heel plate structure;
(*c*) adjustable means connecting said structures;
(*d*) a forefoot band means secured to said forefoot plate structure;

(*e*) a heel band means secured to said heel plate structure;
(*f*) an ankle band means connected with said heel band means;
(*g*) and an essentially T-shaped tongue having lateral extremities secured in said forefoot band means to form side pockets for reception of padding, and a central extension projecting through said heel band means and ankle band means.

10. An orthopedic device, comprising:
(*a*) a forefoot plate structure;
(*b*) a heel plate structure;
(*c*) said plate structures having confronting edges in bearing contact in coincidence with a common longitudinal axis through said plate structures, and spaced from each other laterally of said bearing contact to permit relative pivotal movement about an axis perpendicular to said longitudinal axis;
(*d*) bendable connecting means joining said plate structures laterally of said bearing contact, to permit relative twisting of said plate structures;
(*e*) means for locking said connecting means with respect to said plate structures to dispose said plate structures in various angular and twisted relations;
(*f*) and means for attachment of said plate structure to the foot of a patient.

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