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W. RUETTING
LEG BRACE KNEE JOINT

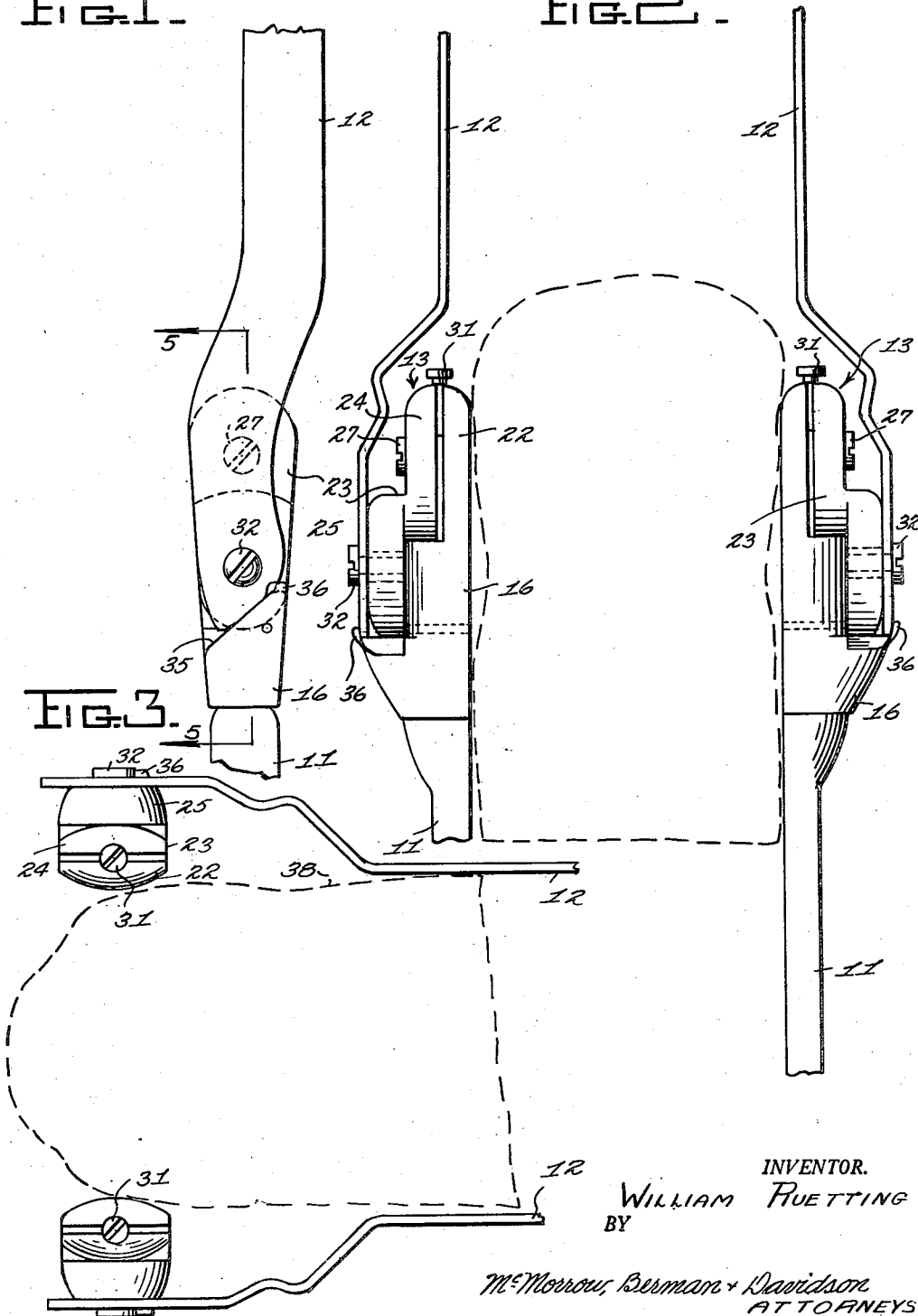
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2 Sheets-Sheet 1

FIG. 1.

FIG. 2.



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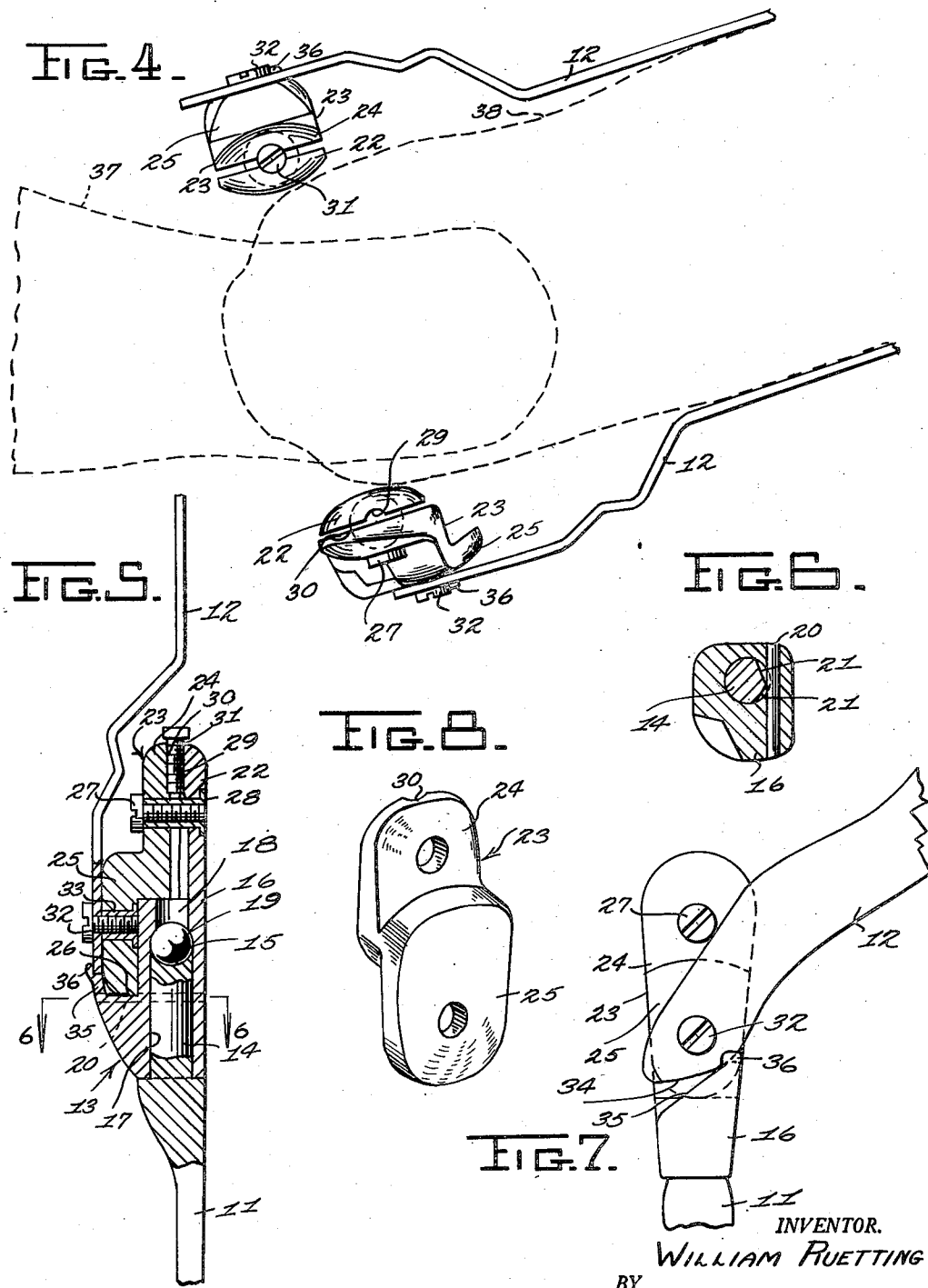
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LEG BRACE KNEE JOINT

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3 Claims. (Cl. 128—80)

1

This invention relates to orthopedic appliances, and more particularly to knee joints for leg braces.

A main object of the invention is to provide a novel and improved leg brace having knee joints adapted to permit bending of the wearer's knee and natural turning of the lower leg and foot around a vertical axis relative to the upper leg, whereby normal functioning of the muscles of the lower leg is allowed, and whereby the leg brace may be worn without discomfort or soreness.

A further object of the invention is to provide an improved leg brace having a knee joint arranged to allow the turning of the foot of the wearer around a vertical axis relative to the upper leg when the knee is bent, in accordance with the natural flexing of the leg muscles, the improved knee joint being very simple in construction, dependable in operation, and allowing the wearer of the leg brace to enjoy substantially normal use of his legs without soreness by rubbing portions of the wearer's legs against the brace.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a side elevational view of the intermediate portion of an improved leg brace, showing the improved knee joint structure of the present invention;

Figure 2 is a front elevational view of the intermediate portion of the leg brace of Figure 1, showing both of the improved knee joint structures employed in the side portions of the leg brace;

Figure 3 is a top plan view of the jointed portions of the leg brace, the brace being shown in straight bending position with the segments of the knee joint members locked against relative rotation;

Figure 4 is a top plan view similar to Figure 3, but showing the knee joint elements in angled knee-bending position, corresponding to a turned position of the wearer's foot around a vertical axis, the segments of one of the knee joint members being shown in unlocked position;

Figure 5 is a vertical cross-sectional view taken on line 5—5 of Figure 1;

Figure 6 is a cross-sectional view taken on line 6—6 of Figure 5;

Figure 7 is a view similar to Figure 1, but showing the knee joint in bent position;

Figure 8 is an enlarged perspective detail view of the offset link member employed in the knee joint of Figures 1 to 7.

Referring to the drawings, and more particularly to Figure 2, the leg brace comprises opposed lower bar members 11, 11 adapted to be

2

strapped to opposite sides of the wearer's leg below the knee, and upper bar members 12, 12 adapted to be strapped to opposite sides of the wearer's leg above the knee. The respective upper bar members 12 are connected to the respective lower bar members 11 at opposite sides of the wearer's knee by respective symmetrically-opposed knee joint structures indicated generally at 13, 13.

Referring now to Figures 5 and 6, it will be seen that each lower bar member 11 is formed at its top end with a vertical cylindrical stud 14 which is spherically recessed at 15. Designated at 16 is a bracket member formed with a vertical bore 17 in which stud 14 is received, the upper end of the bore being reduced in diameter, as shown at 18; and being formed with a spherical seat below bore portion 18, in which is positioned a ball bearing 19 against which the spherical seat element 15 of stud 14 abuts. Stud 14 is retained in bore 17 by a horizontal pin 20 extending transversely through bracket member 16 which is received in a groove formed in stud 14, said groove having oppositely-angled inner wall surfaces 21, 21 defining clearances whereby vertical stud 14 may rotate through small angles around the vertical axis of bore 17, permitting corresponding angular rotation of lower bar member 11 with respect to bracket member 16.

Each bracket member 16 is formed with a vertically-rising arm 22 at the inner side thereof. Designated at 23 is a link member having a vertical upper arm 24 and a vertical lower arm 25 outwardly offset with respect to upper arm 24, and arranged, as shown in Figure 5, with the upper arm 24 parallel to arm 22, and the lower arm 25 disposed in a groove 26 formed in the outer lower portion of bracket member 16. Upper arm 24 is pivotally secured to arm 22 by a horizontal bolt 27 threaded into a flanged sleeve 28 carried by arm 22, the head of the bolt 27 bearing on the outer end of the sleeve 28 and overlying the outer surface of arm 24. The opposing inner surfaces of arms 22 and 24 are formed with complementary registrable threaded vertical grooves 29 and 30 adapted to receive a vertical bolt 31 which may be employed to lock the arms 22 and 24 against relative rotation around the axis defined by bolt 27, as shown in Figure 5. The lower end portion of the upper bar member 12 is pivotally secured outwardly to arm 25 of bracket member 23 by a horizontal bolt 32 which is threaded into a flanged sleeve 33 carried by arm 25. The bottom edge of bar member 12 is inclined, as shown at 34, and cooperates with an inclined rib 35, forming the outer wall of groove 26, to limit counterclockwise rotation around the axis of bolt 32 of bar member 12 with respect to bracket member 16, as viewed in Figures 1 and 7. The upper end of rib 35 is formed with an outwardly-offset upstanding lug

3

36 disposed adjacent the lower marginal portion of bar member 12 and acting as a guide element for maintaining the lower portion of bar member 12 in a vertical plane at all times.

When arms 22 and 24 are locked against relative rotation by locking screw 31, upper bar member 12 may pivot only around horizontal bolt 32. When the locking screws 31 are employed at both sides of the leg brace, as shown in Figure 2, pivoting of the upper bar members 12, 12 may take place only around the common horizontal axis defined by bolts 32, 32. Under these conditions, turning around a vertical axis of either foot of the wearer of the brace during knee-bend conditions is substantially prevented, since the lower leg portions 11 are prevented from turning around vertical axes to the upper leg portions by the locking effect provided by screws 31. By removing one of the locking screws 31, as shown in Figure 4, a slight degree of turning movement of the lower leg portion around a vertical axis is permitted, since the unlocked brace knee joint is thereby provided with a swingable link connection of its upper bar member 12 to its lower bar member 11 instead of having merely a purely pivotal connection therewith. This is shown in Figure 4, wherein the unlocked link member 23, at the lower portion of the figure, is shown rotated around a horizontal axis with respect to its adjoining bracket arm 22, due to the slightly-turned position of the wearer's foot around a vertical axis, shown in dotted view at 37, relative to the upper leg portion, shown in dotted view at 38. When both locking screws 31, 31 are removed, turning movements around vertical axes of each foot and lower leg with respect to each upper leg of the wearer are substantially unrestrained during knee bending and other leg conditions, both link members 23, 23 being now free to pivot around horizontal axes with respect to their associated bracket members 16, 16. Under these latter conditions, the brace-knee joints 13, 13 allow the feet to be turned naturally around vertical axes under the operation of the leg muscles when the knees are bent.

When a person makes a normal knee bend, that is, allows his body to descend by allowing both knees to bend, the weight of his body tends to cause his knees to swing outwardly away from each other while his feet pivot outwardly to a much lesser degree.

Since the link members 23, 23 tend to rotate in opposite directions as a result of the normally opposite turning movements of the foot and lower leg portions around vertical axes during knee bends (the locking screws 31 being removed), the bracket members 16, 16 also rotate in opposite directions around their vertical studs 14 since oppositely-directed horizontal torques are applied to the respective bracket members by the respective bar members 12, 12. The required amount of rotation of the bracket members 16, 16 around their studs 14 is allowed by the provision of the mutually inclined clearance surfaces 21, 21 in the rear walls of the horizontal retaining pin-receiving grooves formed in the studs.

The grooves 30 and 29 in the arms 24 and 22 may be employed as passages for conveying lubricant to the bearing balls 19.

Although a specific embodiment of an improved knee joint for leg braces has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled

4

in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A flexible leg brace knee joint comprising a pair of upper bar members arranged to be secured on opposite sides of the wearer's leg above the knee, a pair of substantially vertical lower bar members arranged to be secured on opposite sides of the wearer's leg below the knee, vertically extending pivot means on the upper ends of the lower bar members, respective bracket members rotatably secured on said pivot means for rotation around the respective vertical axes of the lower bar members, and respective link bars connecting the top ends of the respective bracket members to the lower ends of the respective upper bar members, whereby rotation of the lower leg portion around its rotational axis relative to the upper leg portion may take place with the leg in knee-bending position.

2. A flexible leg brace knee joint comprising a pair of upper bar members arranged to be secured on opposite sides of the wearer's leg above the knee, a pair of substantially vertical lower bar members arranged to be secured on opposite sides of the wearer's leg below the knee, vertically extending pivot means on the upper ends of the lower bar members, respective bracket members rotatably secured on said pivot means for rotation around the respective vertical axes of the lower bar members, respective link bars connecting the respective bracket members to the lower ends of the respective upper bar members, whereby rotation of the lower leg portion around its rotational axis relative to the upper leg portion may take place with the leg in knee-bending position, and means for at times selectively locking the respective link bars against rotation around said rotational axis with respect to the respective bracket members.

3. A flexible leg brace knee joint comprising a pair of upper bar members arranged to be secured on opposite sides of the wearer's leg above the knee, a pair of lower bar members arranged to be secured on opposite sides of the wearer's leg below the knee, a vertically extending bearing member on each of one of said pairs of bar members, a bracket member rotatably mounted on the bearing member, and respective outwardly offset link bars, the inner and outer portions of the link bars being respectively pivoted to said bracket member and to the other of said bar members for rotation about a horizontal axis, whereby the bars are permitted to move relative to one another about their respective horizontal axes and to rotate about the vertical bearing member when the knee is bent.

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