

[54] **LOCKING KNEE JOINT FOR ORTHOPEDIC
LEG BRACE**

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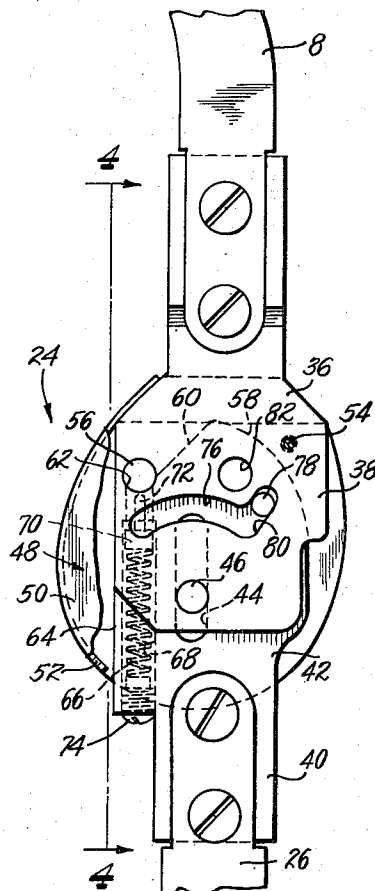
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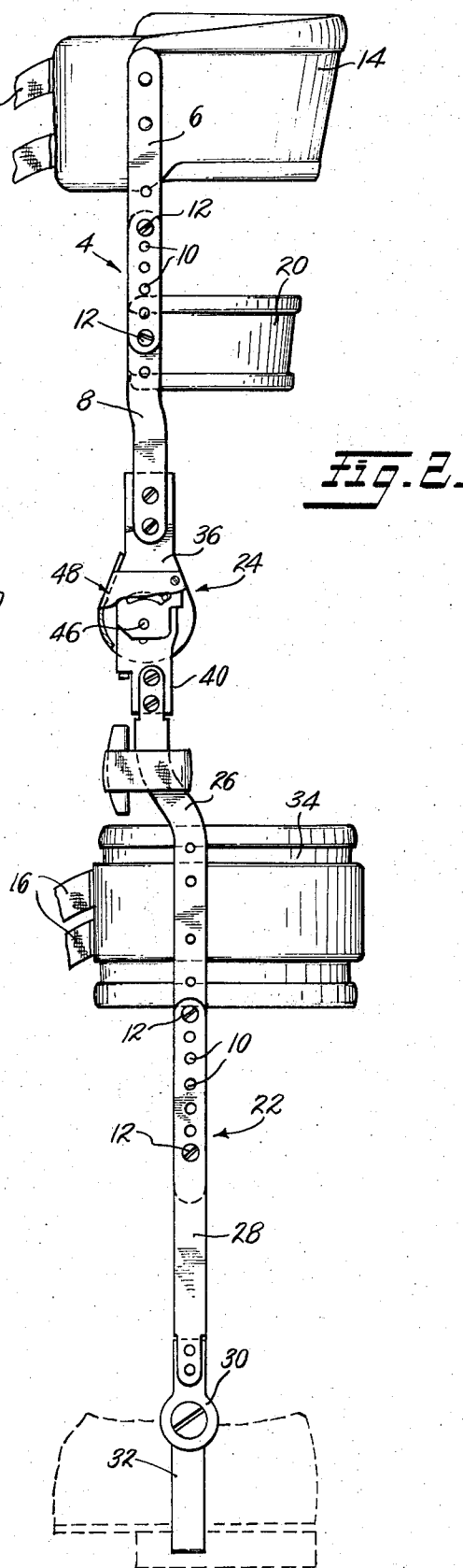
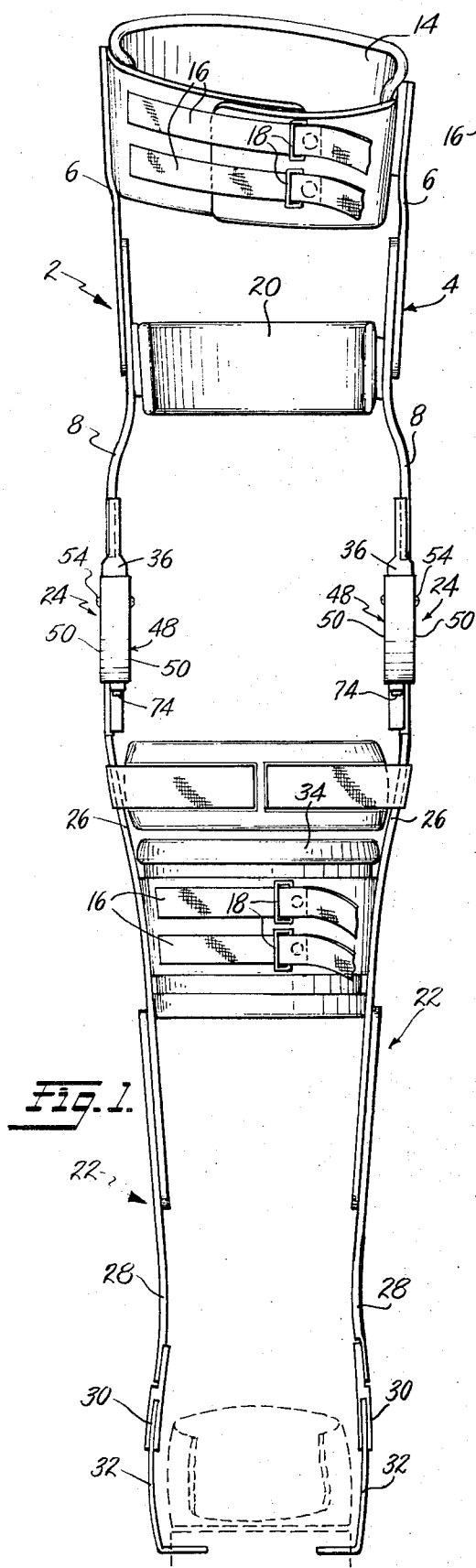
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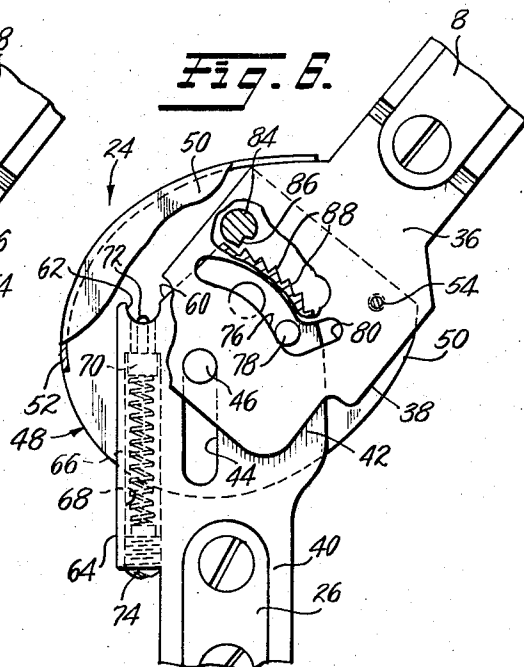
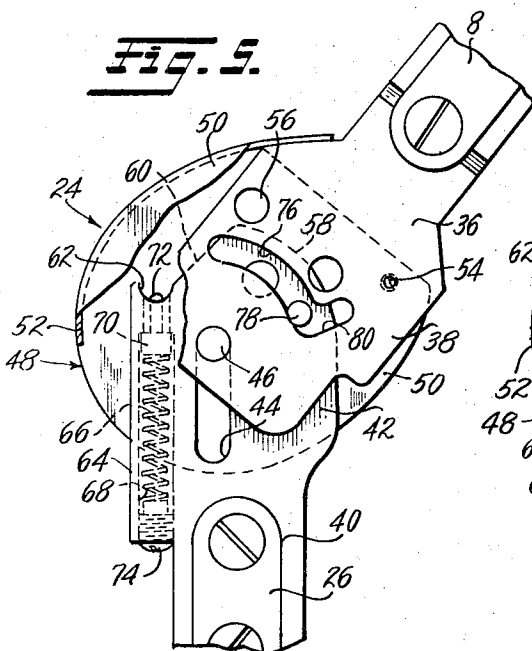
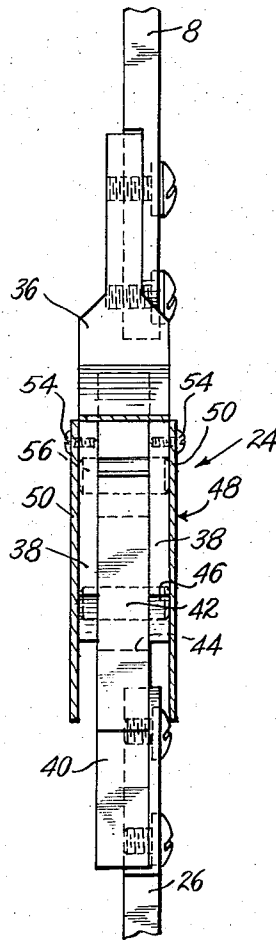
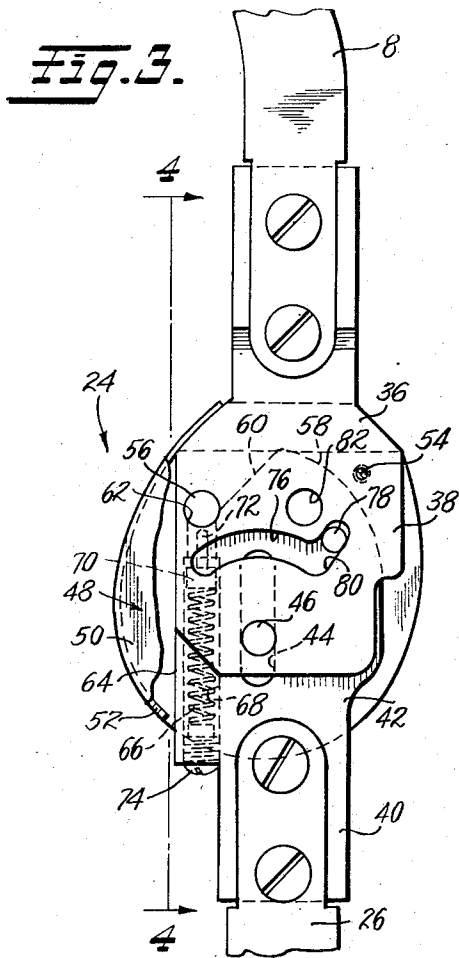
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[57] **ABSTRACT**
A pivoted knee joint for an orthopedic leg brace provides for both pivoting and relative sliding movement. When the user's weight is placed on the braced leg and the leg is substantially straight, the joint is locked against pivoting but is freely pivotable when the leg is lifted. If the weight of the user is placed on the leg while the leg is partially bent at the knee, the joint locks against pivoting to prevent collapse of the user.

8 Claims, 6 Drawing Figures







LOCKING KNEE JOINT FOR ORTHOPEDIC LEG BRACE

BACKGROUND OF THE INVENTION

This invention is in the field of orthopedic leg braces and relates particularly to the pivot joint at the knee of the brace.

Persons needing and using orthopedic leg braces usually do not have sufficient muscular control and strength to hold the leg straight and rigid in supporting the weight of the user on that leg particularly while walking. Efforts have been made heretofore to provide a leg brace wherein a pivoted knee joint locks against pivotal movement when the weight of the user is placed on that leg. However, such devices have been quite complicated in structure and in many cases not truly reliable. Those of complicated structure were subject to malfunction and excessive wear in addition to being relatively expensive to produce.

SUMMARY OF THE INVENTION

The present invention is a pivot joint for an orthopedic leg brace of extremely simple construction since it involves essentially no relatively movable parts other than the two leg members that are pivotally joined. The joint provides for both pivotal and relative sliding movement between the upper and lower leg members such that when the user's leg is lifted, as in walking, the weight of the lower leg portion causes the two members to slide relative to each other and the lower leg portion becomes pendulously pivotal relative to the upper portion. When the upper and lower leg members are nearly in alignment and the weight of the user is placed on that leg, the upper leg member slides downwardly relative to the lower member a small amount and interengaging means on the two members lock the members against pivotal movement, thus ensuring that the user's leg will not collapse or fold when weight is placed thereon. Means are also provided to urge the leg members apart when weight is relieved therefrom to ensure a return to a freely pivotal condition and one form of the invention provides a further safety feature whereby in the event the user loses balance or inadvertently places weight on his or her braced leg while the knee is bent, limited sliding movement between the members takes place to lock the brace against further pivotal movement and thus prevent the user's falling by collapse of his or her bent leg.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of an orthopedic leg brace embodying the present invention;

FIG. 2 is a side elevational view of the device of FIG. 1 with certain parts broken away;

FIG. 3 is a side view, on an enlarged scale, of one of the joints employed in the brace of FIG. 1 and with parts thereof broken away;

FIG. 4 is a vertical sectional view taken along the line 4-4 of FIG. 3;

FIG. 5 is a view similar to FIG. 3 but showing the parts in different relative positions; and

FIG. 6 is a view similar to FIG. 5 of a modified form of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, the leg brace shown comprises laterally spaced upper leg members 2 and 4 adapted to extend along the thigh portion of a user's leg. Each leg member comprises an upper bar 6 and a lower bar 8 each being provided with a plurality of openings 10 whereby the bar members may be longitudinally adjusted and held in longitudinally adjusted position by suitable fasteners 12 to adjust the device to the length desired for a particular user. An upper band structure 14 is secured to the upper bar members 6 and is provided with straps 16 and buckles 18 whereby it may be secured to the upper thigh of the user. As shown, a further cradle pad 20 is secured to the upper leg members to assist in holding the device in fixed relation to the user's thigh. At their lower ends the bar members 8 are pivotally and slidably joined to lower leg members 22 by pivot joints 24 which will be further described in greater detail. The lower leg members 22 comprise upper bar members 26 and lower bar members 28 adjustably secured together in the same manner as described with reference to the upper leg bar members 6 and 8 to be adjustable to accommodate the particular length of leg found on the user. At their lower ends the lower leg members 22 are pivotally joined, at pivot joint 30, to a clamp device 32 usually fixed to a special shoe which is customarily part of the apparatus. The pivot joint 30 corresponds to the user's ankle and the lower leg member 22 has fixed thereto an encircling clamp pad device 32, also supplied with straps and buckles similar to the upper pad member 14. The structure thus far described may be considered more or less conventional, the novelty residing in the pivot joints 24 which will now be described in greater detail. As shown, there is a pivot joint 24 on each of the inner and outer leg bar members but since each pivot joint is similar to the other, being merely a mirror image thereof, a detailed description of one will suffice.

Referring now to FIGS. 3 to 5, the upper leg bar member 8 has secured thereto a bracket structure 36 in the form of a yoke having spaced side plates 38. The lower leg bar member 26 has a bracket structure 40 fixed to its upper end and defining a single plate-like member 42 slidably received between the side plates 38 of the upper bracket 36. The plate 42 is provided with an elongated slot 55 therein, which slot extends in the direction of the length of the lower leg member, as clearly shown in the drawings. A transverse pin 46 extends through the spaced plates 38 and extends slidably through the slot 55. Preferably, the pin 46, and other transverse pins to be described later, are loosely positioned in aligned openings in the plates 38 and normally held therein by a cover member 48 having side plates 50 lying against the outer surfaces of the plates 38 and a front web portion 52. The cover member 48 is secured to the upper bracket 36 by screws 54 but may be readily removed when access to the inner mechanism is desired.

A further transverse pin or detent 56 extends between the plates 38 and the periphery of the bracket plate 42 is formed to define an arcuate edge portion 58, a generally straight edge portion 60 and a semi-circular socket or notch 62 at the upper end of a lateral enlargement 64. When the lower leg member is drawn downwardly by gravity or the like, the slot 44 slides down-

wardly over pin 46 until the lower leg member hangs on the pin 46 by the upper end of slot 44 and the parts are then in the position of FIG. 5. When the pin 46 is thus at the upper end of slot 44, the further pin 56 clears both the surface 60 and the arcuate edge surface 58 and the upper and lower leg members may freely pivot relative to each other, as is clearly evident from FIG. 5. With the parts in the relative positions shown in FIG. 5, assume that the upper leg is dropped to more nearly vertical position, as in walking, the lower leg portion, being pendulous, will remain generally upright and the pin or detent 56 will appear to move to the left, as seen in FIG. 5, over the straight edge surface 60. Under these conditions, if the weight of the user is placed on the leg having the brace, the upper leg portion will tend to slide downwardly on the lower leg portion with pin 46 moving downwardly in slot 44. The pin 56 will then engage surface 60 and tend to forcibly swing the upper and lower leg members into longitudinal alignment with the pin 56 sliding downwardly on surface 60 until it seats in the semicircular slot 62, as shown in FIG. 3. Under these conditions, it is apparent that the leg members are locked against pivotal movement. When the user's weight is lifted slightly, a compression spring 66 in a bore 68 of extension 64 acts on a headed plunger 70 to project its pin portion 72 upwardly into socket 62 and thus ensure that the pin 56 is lifted out of the socket to assist in causing longitudinal movement of the parts toward a free pivoting position. The socket 62 is preferably at least a full semi-circular socket and thus tends to grip the pin 66 snugly and gravity alone acting on the lower leg members and the user's lower leg might not be sufficient to unseat the pin 56 from socket 62. The bore 68 is closed at its lower end by a threaded plug member 74 against which the spring 66 reacts and which plug may be adjusted to regulate the force exerted by spring 66. Obviously, the spring 66 may be easily compressed when the weight of the user is placed on the braced leg but is sufficiently strong to ensure unseating of the pin 56.

It will be obvious from FIG. 5 that when the parts are in the position shown in that figure, the upper leg portion may be swung more nearly horizontal and the lower leg portion can freely and pendulously pivot about the pin 46, the pin 56 merely swinging downwardly spaced a slight distance from the arcuate surface 58.

To further ensure locking of the leg brace when the members are substantially in alignment at least one of the spaced plates 38 is provided with an arcuate slot 76 concentric to the pin 46 and extending throughout about the angular range shown in the drawings. A third pin 78 extends through the plate 42 and slidably projects into slot 76 but is quite loose therein, being of a diameter somewhat less than the width of the arcuate slot 76. When the parts are in the relative position of FIG. 5, it is apparent that the leg members may freely pivot about the axis of pin 46 with the pin 78 merely sliding along the slot 76, the ends of the latter, however, serving as stops to limit the relative pivotal movement of the leg members. The slot 76, at one end, is provided with a generally radially extending slot portion 80 extending generally radial to the pin 46. When the user's leg is substantially straight, as shown in FIG. 3, and the weight of the user is not on the leg having the brace, the pin 78 will remain adjacent or on the bottom edge of the slot 76 and pin 56 will be spaced above the

socket 62. However, when the weight of the user is placed on that leg, the upper leg portion moves downwardly relative to the lower leg portion to the locked position of FIG. 3 wherein the pin 56 is seated in socket 62 and the end portion 80 of slot 76 moves downwardly to embrace the pin 78 and thus serve as a further lock against pivotal movement of the parts. In this condition, all three pins, 46, 56 and 78, serve to key the upper and lower leg members against pivotal movement. The direction of extent of the end portion 80 of slot 76 assists the surface 60 in directing the parts to the locked position shown in FIG. 3.

The spaced plates 38 and the plate 42 therebetween are provided with further openings which are in axial alignment when the parts are in the position of FIG. 3, those aligned openings being identified in FIG. 3 by the numeral 82. Such openings perform no function in the described operation of the device but are provided so that the user may selectively position a locking pin in those aligned openings to thus convert the leg brace to a single rigid brace, incapable of pivotal movement at any time. Thus, the user may selectively employ the described leg brace as a pivoted brace that is self-locking when the user's weight is thereon or as a rigid brace extending throughout the length of the leg.

FIG. 6 illustrates a further embodiment of the invention wherein the parts are all identical to those described with reference to FIGS. 3-5 except for the following differences:

Whereas the pin 56 of FIGS. 3-5 may be loosely contained in openings in the plates 38, the corresponding pin 84 of FIG. 6 is rigidly fixed in the plates 38 against pivotal movement therein and it is formed to define a detent nose portion 86. The arcuate surface 58 of FIGS. 3-5 is shown therein as a smooth edge surface whereas the corresponding edge of FIG. 6 is provided with detent or ratchet teeth 88. In normal use of the brace of FIG. 6, the detent nose 86 is spaced outwardly from the teeth 88 so that the parts do not engage or interfere with each other during normal pivotal movement of the parts. However, if the user's leg is in such position that the parts are pivoted to the relative position shown in FIG. 6 and if the user loses his or her balance or for some other reason places weight on the braced leg, the looseness of pin 78 in the slot 76 permits sufficient downward movement of the upper leg portion relative to the lower leg portion to bring the detent nose 86 into engagement with one of the teeth 88 and thus lock the pivot joint against further pivotal movement in a direction which could result in complete collapse of the user's leg and his falling to the ground. Thus, the brace structure supports the user until his or her balance can be regained.

While the proper operation of the present invention depends in part upon the described sliding of the parts, it must be remembered that a person's leg is not of rigidly fixed length, the knee and ankle joints permit enough shortening and lengthening movement to provide the necessary relatively small movements for the described device to operate properly.

Although a limited number of specific embodiments of the invention have been shown, the same are merely illustrative of the principles involved and other embodiments may be resorted to. For example, the basic principles of the invention may be practiced by eliminating the arcuate slot 76 and pin 78, particularly where the user has considerable strength in his leg.

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I claim:

1. A joint between upper and lower portions of an orthopedic knee brace, said portions having laterally spaced elongated members adapted to receive a user's knee therebetween and means for securing said brace to a leg of the wearer with the wearer's knee between said members, comprising:

at least one elongated lower member having a longitudinal slot therethrough adjacent the upper end thereof;

the corresponding elongated upper member having a first transverse pin adjacent its lower end slidably positioned in said longitudinal slot;

cooperating means on said members guiding said members for only relative pivotal movement about the axis of said pin and only when said pin is at the upper end of said slot and permitting substantial downward movement of said pin in said slot only when said members are substantially longitudinally aligned; and

interengageable means on said leg members, movable into engagement when said pin moves downwardly in said slot, to hold said leg members against relative pivoting in either direction.

2. A joint as described in claim 1 including resilient means urging said interengageable means to disengage.

3. A joint as defined in claim 2 wherein said interengageable means includes a longitudinally facing socket on one of said members and detent means on the other member seatable in said socket, said resilient means comprising a spring pressed plunger extending into said socket from the bottom thereof.

4. A joint as defined in claim 1 wherein said cooper-

ating means include, an arcuate slot in said upper member, concentric to said first transverse pin and a second transverse pin on said lower member, slidable in said slot; said slot having a generally radial slot portion at one end thereof extending generally upwardly from said second transverse pin when said members are substantially longitudinally aligned.

5. A joint as defined in claim 3 including a surface portion on said one member for guiding said detent means into said socket.

6. A joint as defined in claim 4 wherein the lower end of said upper member comprises laterally spaced plate portions and the upper end of said lower member comprises a single plate portion slidably and rotatably received between said spaced plate portions; said first transverse pin extending between said spaced plate portions and said arcuate slot being formed in at least one of said spaced plate portions.

7. A joint as defined in claim 1 wherein said members are respectively provided with openings therethrough that are in alignment when said members are longitudinally aligned whereby a locking member may be selectively positioned in said aligned openings to lock said members against relative movement.

8. A joint as defined in claim 1 including cooperating locking means on said members positioned to be freely movable past each other when said members pivot about each other with said first transverse pin at the upper end of said longitudinal slot but being brought into locking engagement when said first transverse pin moves a small distance downwardly in said longitudinal slot during relative pivoting of said members.

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