

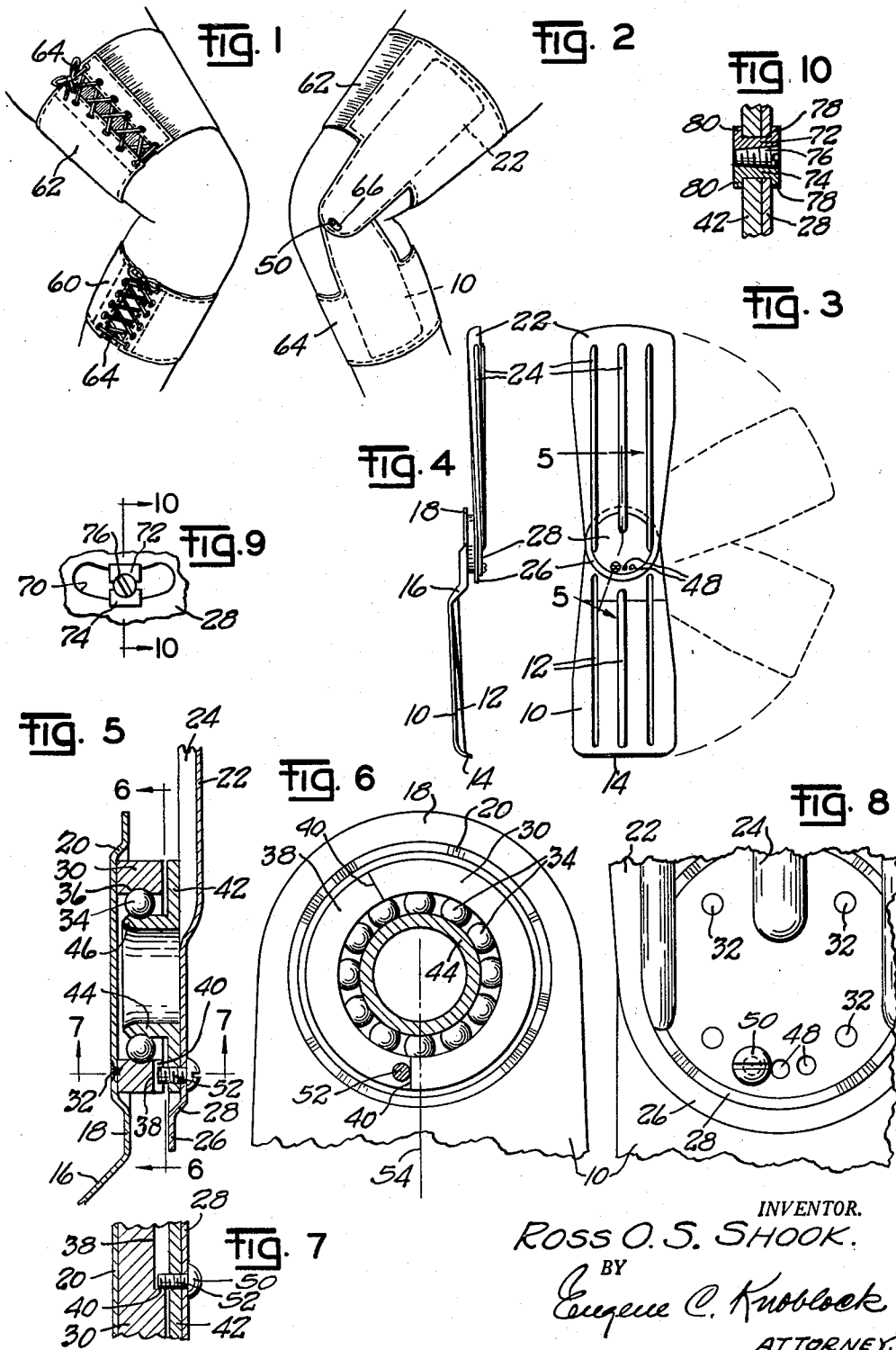
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KNEE BRACE

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2,959,168

KNEE BRACE

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4 Claims. (Cl. 128—80)

This invention relates to improvements in knee braces, and more particularly to improvements in knee braces of the type disclosed in my Patents No. 2,532,955, dated December 5, 1950, and No. 2,637,575, dated May 5, 1953, and in the patent to P. G. Stahly No. 2,746,051, dated May 22, 1956.

Many individuals suffer from a condition known as "over-extension" in which the knee joint fails to function properly. Such condition can arise as the result of physical injury or as the result of diseases, such as poliomyelitis. The condition of over-extension is one in which the knee joint swings past center or past normal substantial alignment of the lower leg portion with the thigh when the lower leg portion is moved toward a straightened or fully extended position. The condition of over-extension impairs normal walking and movement of the individual and constitutes a crippling condition.

It is the primary object of this invention to provide a knee brace which will function to accommodate normal swinging of the knee joint between straight or extended position and bent or flexed condition, and which will limit movement of the knee joint at any selected extended position.

A further object is to provide a device of this character which is adjustable to vary the range through which a knee joint may be flexed and to vary the limits of flexing movement thereof according to the requirements of the wearer and to meet varying or different conditions of over-extension of the knee joint and to vary the limits of extension from time to time as healing of injuries progresses or other physical conditions change to make feasible such adjustment.

A further object is to provide a device of this character with means for varying the extent of movement of a knee joint toward fully extended position and adjustable to accommodate a slight over-center adjustment in over-extended direction to prevent collapse of the knee joint in a rear bending direction and thereby permit support of the weight of the user in substantially normal walking function and relation in cases where the user suffers a crippled condition entailing over-extension which prevents him from walking normally or naturally.

Other objects will be apparent from the following specification.

In the drawing:

Fig. 1 is a perspective view showing a knee brace made in accordance with this invention applied to the thigh and lower leg of a person;

Fig. 2 is a perspective view of the knee brace viewed from the opposite side compared to Fig. 1;

Fig. 3 is an elevational view of the bracing portion of the device, illustrating the same in extended position in full lines and in flexed position in dotted lines;

Fig. 4 is an edge view of the construction illustrated in Fig. 3;

Fig. 5 is an enlarged fragmentary sectional view taken on line 5—5 of Fig. 3;

Fig. 6 is a sectional view taken on line 6—6 of Fig. 5;

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Fig. 7 is a fragmentary detail sectional view taken on line 7—7 of Fig. 5;

Fig. 8 is an enlarged fragmentary face view similar to Fig. 3.

5 Fig. 9 is a fragmentary detail view of a modification of the device; and

Fig. 10 is a sectional view taken on line 10—10 of Fig. 9.

Referring to the drawing which illustrates the preferred embodiment of the invention, the numeral 10 designates a lower plate which is curved transversely and which is preferably provided with a plurality of longitudinally extending concavo-convex ribs 12 serving to reinforce and strengthen the same. The plate 10 may have a bent transversely extending flange 14 at its end to increase and enhance the rigidity thereof. The portion of plate 10 opposite the end at which flange 14 is formed is preferably offset at 16 which separates the main portion of said plate provided with the corrugations 12 from an end portion 18. The end portion 18 is preferably cupped to a shallow depth at 20, the concave surface of which cup portion projects in the same direction as the transversely concave surface of the portion of the plate provided with the longitudinal ribs 12.

25 A second plate 22, which is transversely curved and longitudinally ribbed or corrugated at 24, has an end portion 26 thereof provided with a shallow cup-shaped recess 28. The plates 10 and 22 are arranged with their portions 18 and 26 in overlapping relation and their cup-shaped portions 20 and 28 are substantially of the same diameter and are arranged concentrically with their concave surfaces confronting each other.

The plates 10 and 22 are preferably formed of metal although they may be formed of any rigid material which is of thin cross-sectional dimension. The cup-shaped parts 20 and 28 carry bearing race members concentrically of the shallow cup offsets thereof. The bearing race members may be of any suitable construction and, as here illustrated, the part 20 carries a ring 30 which may be spot welded or otherwise secured thereto, as at a plurality of points 32. The ring 30 provides an outer race member for a plurality of spherical bearing elements 34, for which purpose its inner periphery may be provided with a circumferential groove 36. The face of the ring 30 opposite the face which is welded to the plate portion 20 is of reduced thickness at 38 for a portion thereof preferably slightly less than 180 degrees, thereby providing a pair of shoulders 40 at opposite ends of said reduced part 38.

50 The plate part 28 has welded or otherwise fixedly secured thereto concentrically thereof an annular member 42 which is substantially of L-shape in cross-section, being characterized by an inner tubular portion 44 having a reduced thickness end portion 46 providing an inner race member for confining the spherical bearing members 34, said part 46 preferably being flared at its mouth to confine the spherical bearing members 34. A series of close spaced apertures 48, equispaced from the perimeter of the cup-shaped member 28, are formed in that member and extend through the flat portion 42 of the inner race at a position confronting the inner surface of the opposite bearing ring 30. The apertures 48 are formed substantially centrally of the plate 22, that is, are preferably formed substantially symmetrically relative to the longitudinal center line of that plate and are located adjacent the plate 10 in the extended position of plates 10 and 22. A screw 50 has a threaded shank 52 screw-threaded in any selected one of the apertures 48 to project past the inner face of the part of the ring 30 of greatest thickness and to terminate short of the reduced thickness portion 38 and between the shoulders 40 of the ring 30, as seen in Figs. 5 and 7.

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One of the shoulders 40 of the ring 30 will be located near the center line of the plate 10, as illustrated at the bottom in Fig. 6. This shoulder is preferably so located that the reduced thickness part 38 of the ring 30 will be located at one side of the center line 54 of the plate 10.

It will be apparent that the extent to which plates 10 and 22 may swing toward straight position from a flexed position, as illustrated in dotted lines in Fig. 3, may be varied by selecting the aperture 48 within which the screw 52 is inserted. By this means a wide range of conditions of different users or wearers may be accommodated insofar as the range of flexing of the knee and the degree of over-extension or under-extension of the knee joint which the user requires are concerned.

It will be understood that the plates 10 and 22 mount transversely projecting webs 60 and 62, respectively, which are so arranged and constructed as to be anchored to the plates and project laterally from the free or swinging end portions thereof to pass around the lower leg and thigh portions, respectively, of the leg of a wearer. Laces 64 may be passed through eyelets in the webs 60 and 62 to secure the webs in place upon the leg. The securing webs 60, 62 and the laces 64 thereof will preferably extend for a substantial portion of the longitudinal dimension of the plates 10 and 22, so that the anchorage of the appliance to the leg afforded thereby will be such that the plates 10 and 22 will be held firmly alongside the lower leg portion and the thigh, and no free play between the leg and the appliance will be possible. The web will preferably be associated with suitable padding or facing material, which may be of fabric, leather, plastic sheet material, or the like, and will serve to protect against direct contact of the metal or other material of the plates 10 and 22 with the skin of the wearer and may also provide protection against direct contact of the edges of the metal parts with the garments of the wearer. In this connection it will be understood that the appliance may be applied directly to the wearer's leg, in which event its use is substantially concealed by the wearer's garments, such as trouser legs, or, if desired, it may be worn externally relative to the garments of the wearer.

When the device is mounted upon the wearer's leg, it will be understood that the same will be so located that the center about which the plates 10 and 22 swing will be positioned alongside the knee joint at such position as to flex freely with flexure of the limb without restraining movement of the limb and without material movement of the plates 10 and 22 relative to the parts of the limb to which they are secured by the webs 60 and 62, so that chafing is avoided. After the appliance is mounted upon the limb, the limit of extension desired can be determined and the screw 52 can be inserted in the proper aperture 48 to limit the extension at the desired point. In cases where a covering is applied over the portion 26 of the plate 22, suitable openings, such as a slot 66, may be provided therein to receive the screw 52 and permit access thereto for insertion and removal. It may also be mentioned that, while the screw 52 is here illustrated in Figs. 5 and 7 as being provided with a rounded head, it will be understood that the screw head may be flat to be received in a counter bored opening whereby it lies substantially flush with the plate part 28, so as to avoid the possibility of injury to clothing and of discomfort or injury to the person if his other limb strikes the appliance.

The provision of multiple points of adjustment of the stop or screw 52, that is, a plurality of openings 48, is of use to accommodate an appliance to meet varying or different physical conditions of over-extension of the user. Also, it makes possible limiting of extension of the leg to a permissible degree or extent after injury, and also permits progressive increase of that degree of extension as healing of the injury occurs.

In addition to serving the function of limiting the degree of extension of the knee joint, the device serves

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the further purpose of protecting the knee against injury from blows applied to the side of the leg, as in instances where athletes are subject to body contact with opponents and wear the appliance to protect against blows or contact at the side of the knee.

A modification of the construction is illustrated in Figs. 9 and 10 which is designed to provide increased selectivity of adjustment of the device. In this construction the parts 28 and 42 are provided with an elongated arcuate set of slots 70 of desired length located substantially similarly to the location of the apertures 48 of the previous construction. A stop is provided for adjustment at any selected position in these elongated slots 70 and, as here illustrated, is formed of a pair of complementary parts 72 and 74 and wedge means 76 therebetween for separating the same and urging them against the opposite walls of the slot 70. The wedging means 76 is here illustrated as a tapered screw receivable in a socket defined by concave confronting tapered screw-threaded recesses in the inner faces of the parts 72 and 74. The parts 72 and 74 are provided with flanges 78 and 80 which overlie the faces of the legs 28 and 42, respectively, at the margins of the slots 70 and thus are held in proper relation to receive and accommodate the screw 76 and prevent separation and release of the parts. It will be apparent that by tightening the screw 76, the stop consisting of the parts 72 and 74 may be locked in the slots 70 at any desired position along the length thereof, and similarly that by a release of the screw 76 the stop can be disengaged from its frictional contact in the slot to accommodate longitudinal sliding thereof within the slots 70.

While the preferred embodiment of the invention has been illustrated and described, it will be understood that changes in the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A knee brace comprising a pair of rigid plates having adjacent end portions arranged in spaced overlapping relation, means pivotally connecting said overlapping plate end portions, means carried by each plate for detachably mounting said plate in predetermined positions on the adjacent portion of the leg of a user with the pivot means alongside the knee whereby said brace and knee flex in unison, and means carried by said overlapping plate end portions and positioned therebetween for limiting the angular extent of the pivotal movement of said plates, said pivot means constituting a bearing having a pair of confronting relatively rotatable annular parts, one of said parts having a reduced thickness arcuate portion defining a recess facing the other part and having spaced abutments, and said limiting means constituting said abutments and a stop member fixedly carried by the other part and projecting into said recess.

2. A knee brace comprising a pair of rigid plates having adjacent end portions arranged in spaced overlapping relation, means pivotally connecting said overlapping plate end portions, means carried by each plate for detachably mounting said plate in predetermined position on the adjacent portion of the leg of a user with the pivot means alongside the knee whereby said brace and knee flex in unison, and means carried by said overlapping plate end portions and positioned therebetween for limiting the angular extent of the pivotal movement of said plates, said pivot means constituting a bearing having a pair of confronting relatively rotatable annular parts, one of said parts having a reduced thickness arcuate portion defining a recess facing the other part and having spaced abutments, the other part having a plurality of apertures, and a stop removably mounted in one of said apertures and projecting into and terminating in said recess spaced from said other part, said abutments and stop constituting said limiting means.

3. A knee brace comprising a pair of rigid plates hav-

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ing adjacent end portions arranged in spaced overlapping relation, means pivotally connecting said overlapping plate end portions, means carried by each plate for detachably mounting said plate in predetermined position on the adjacent portion of the leg of a user with the pivot means alongside the knee whereby said brace and knee flex in unison, means carried by said overlapping plate end portions and positioned therebetween for limiting the angular extent of the pivotal movement of said plates, said pivot means constituting a bearing having a pair of confronting relatively rotatable annular parts, one of said parts having an elongated arcuate interruption in the face thereof confronting the other part, said interruption defining spaced abutments, and a stop member fixedly carried by the other part and projecting into said interruption and engageable with said abutments to define said limiting means.

4. A knee brace comprising a pair of rigid plates having adjacent end portions arranged in spaced overlapping relation, means pivotally connecting said overlapping plate end portions, means carried by each plate for detachably mounting said plate in predetermined position on the adjacent portion of the leg of a user with the pivot means alongside the knee whereby said brace and knee flex in unison, means carried by said overlapping plate end portions and positioned therebetween for limiting the angular extent of the pivotal movement of said plates, said

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pivot means constituting a bearing having a pair of confronting relatively rotatable annular parts, one of said parts having an elongated arcuate interruption in the face thereof confronting the other part, said interruption defining spaced abutments, an elongated slot formed in the other part in position to register with said interruption, a stop seated in said slot and projecting into said interruption, and means for locking said stop in selected position in said slot, said stop and abutments constituting said pivot limiting means.

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