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C. L. INVIDIATO
LEG AND ANKLE BRACE

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2 Sheets-Sheet 1

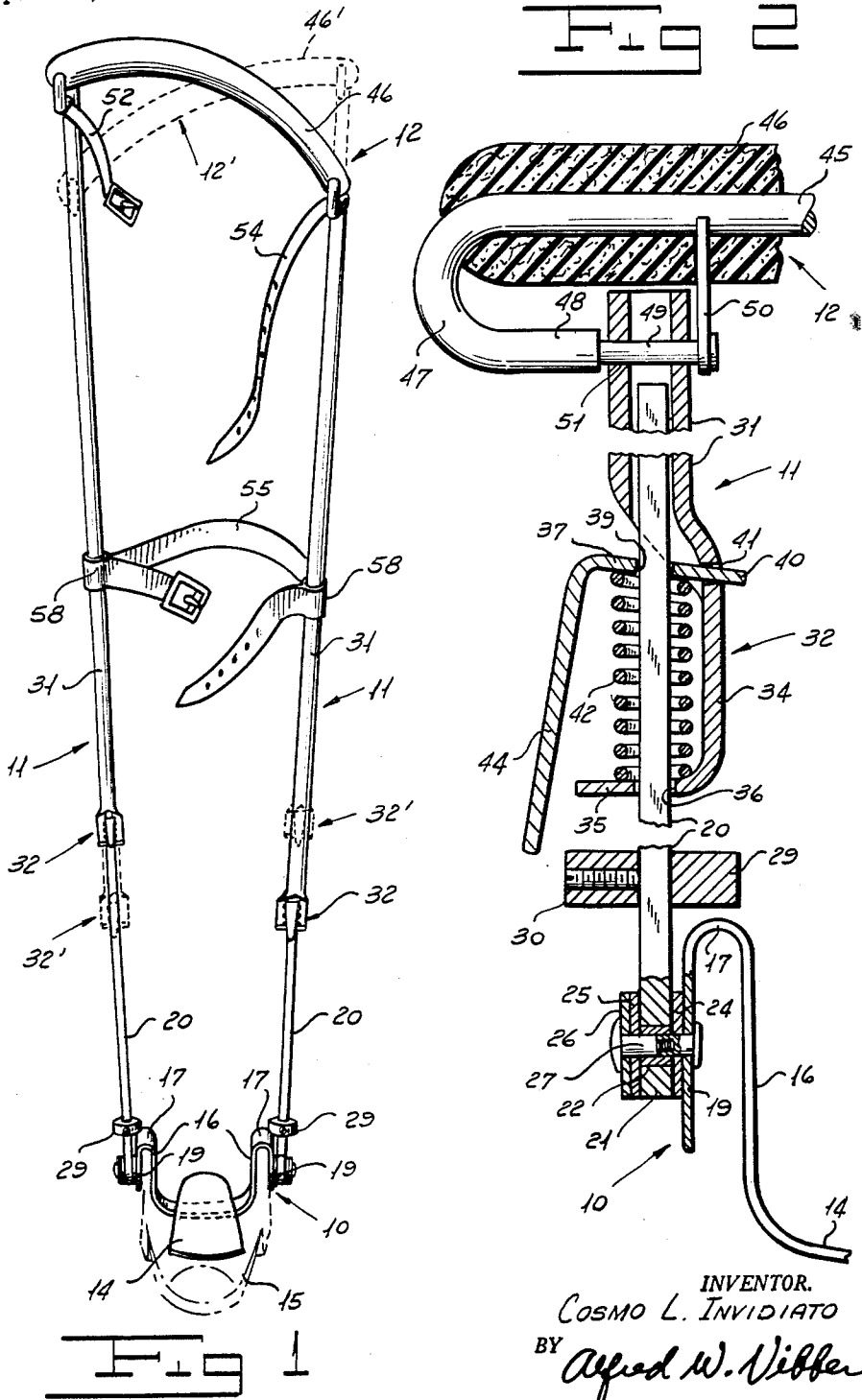


FIG 2

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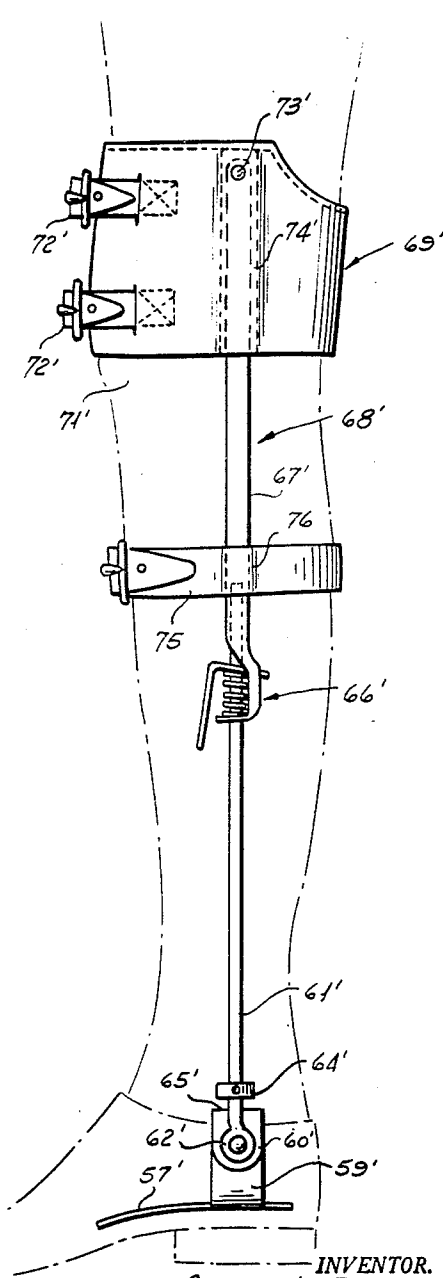
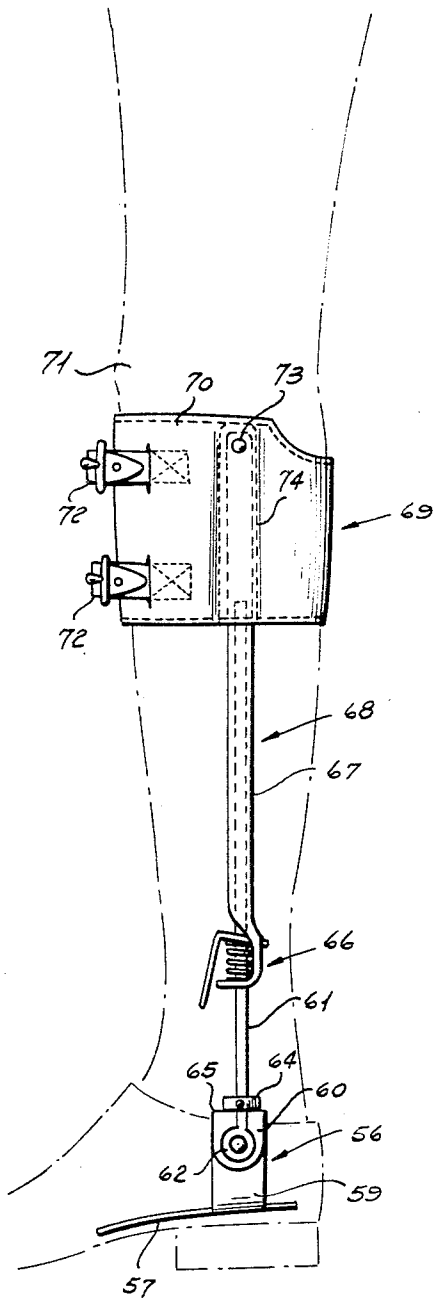
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2 Sheets-Sheet 2

Fig 3

Fig 4



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LEG AND ANKLE BRACE

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7 Claims. (Cl. 128—80)

This invention relates to a surgical brace which is easily adaptable without structural change for use with a variety of ailments of the leg, including those of the thigh, knee, and ankle.

Surgical braces are frequently required in the treatment of a variety of ailments of the leg, the brace subjecting the leg to selected tensions and/or bracing it at the desired locations, usually while allowing the patient to walk. Some leg injuries may require the entire leg, from thigh to foot, to be placed in moderate traction while allowing a selected range of motion of the ankle. Other injuries may require that the ankle be locked from pivotal motion. Still other leg injuries may require a moderate traction on the leg from above the knee to the foot, with perhaps a restraint of the knee from bending, with or without allowable motion of the ankle. Further, the injury may be confined to the ankle, which alone should then be held from motion by the brace.

Braces have been devised in the past for specific application to legs which have sustained one or more of the above injuries. In the main, such braces have been more or less specifically made for the particular injury and patient, and have been heavy, cumbersome, and not readily adjustable. Thus, it was difficult for a surgical-brace manufacturer or supplier to have on hand at all times a brace which would fit at least a majority of patients and fill the needs for a variety of leg injuries. This has been particularly true in surgical braces having an ankle-bracing function in which the shoe, in effect, became an integral part of the brace. Such braces could not usually be sold as finished articles, because the shoe had to fit the patient and the assembly of the brace with the shoe usually had to be made for each particular patient. If a complete combination of shoes and other brace parts were made up for stock, twice as many (lefts and rights) braces as there were sizes, styles, and colors of shoes would have to be carried in stock.

The surgical brace of the present invention provides a simple, economical brace which is readily adjustable for use with the right or left leg without structural change, either in the brace parts or in the patient's shoe. The lower part of the present brace fits within the patient's shoe and acts as an at least partial insole therefor, preferably being of such size relative to the shoe as to fit a considerable range of shoes of various sizes, and to be received in either the right or left shoe. The brace is readily adjustable as to the total height thereof, and thus the upper leg-embracing part may engage the leg below the knee, above the knee, or in one embodiment illustrated, at the thigh of the patient, and may exert a selected degree of tension on the leg between the foot and the upper leg-engaging part of the brace. A relatively small part of the brace is visible when it is worn on a trousered leg.

The pivotal axis between the upper and lower brace parts lies close to and generally vertically below the pivotal axis of the ankle of the wearer, so that there is

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no tendency of the brace to impede the turning of the foot at the ankle other than the selectively operated stop device of the brace whereby the ankle may be locked in one position or may be allowed a predetermined range of pivoting. The pivotal connection between the upper and lower brace parts is such that the ease of turning of the parts is substantially unchanged even though the contour of the brace as a whole is appreciably changed, as when it is changed from a "right" to a "left" for one particular patient, or is altered by adjustment of its height to fit a different-sized patient.

The invention has among its objects the provision of a simple, compact, and light brace which is readily adjusted to fit patients of various sizes, is readily adaptable without structural change to fit the right or left leg and foot of a patient, and is capable of immediate use by persons having an appreciable range of foot sizes.

A further object of the invention resides in the provision of a surgical brace of the above-described character wherein the lower, foot-engaging portion of the brace removably fits within the patient's shoe, such lower portion of the brace preferably being of such size as to fit a reasonable range of shoe sizes and to fit within right- and left-hand shoes, and wherein the pivotal axis between the upper and lower parts of the brace lies close to the pivotal axis of the ankle of the wearer.

Yet another object of the invention resides in the provision, in a leg and ankle brace of the type indicated, of a simple and easily adjusted thigh-engaging member and of its connection to the upper ends of the vertical brace members, whereby the attitude of the thigh-engaging member, and thus the contour of the brace as a whole, may readily be changed to allow it to fit with a right or left leg.

Still another object of the invention lies in the provision in the indicated type of surgical brace of means selectively locking the ankle from pivotal movement or for allowing the pivoting thereof throughout a selected range.

Further objects and objects relating to details and economies of construction, manufacture, assembly, and use will more definitely appear from the detailed description to follow.

My invention is clearly defined in the appended claims. Where parts are for clarity and convenience referred to on the basis of their oriented position shown in the accompanying drawings, no limitation as to the positioning of the brace, except as it relates to the leg of the patient, is to be implied, since it will be understood that the leg of the patient with the brace of the invention thereon may be disposed in any position. Also, in both the description and the claims, parts at times may be identified by specific names for clarity and convenience, but such nomenclature is to be understood as having the broadest meaning consistent with the context and with the concept of my invention as distinguished from the pertinent prior art. The best forms in which I have contemplated applying my invention are illustrated in the accompanying drawings forming a part of this specification, in which:

Fig. 1 is a view in front elevation of a first embodiment of the brace of the invention in the position it assumes when applied to the right leg of a patient, the leg not being shown, a portion of the shoe with which the brace cooperates being shown in dotted lines. The upper, thigh-engaging member of the brace is shown in dotted lines in the position it assumes when the contour of the brace is altered to fit the left leg of the patient.

Fig. 2 is an enlarged fragmentary view of a side portion of the brace of Fig. 1 partially in vertical section in a direction transverse to the plane of the paper in Fig. 1 and partially in elevation, certain of the parts being broken through to shorten them, the foot-engaging portion of the brace being shown fragmentarily.

Fig. 3 is a view in side elevation of a second embodiment of the brace of the invention, the leg to which the brace is applied and a portion of the shoe on such leg being shown in dotted lines, the brace being shown adjusted to extend from the foot to a location below the knee.

Fig. 4 is a view in side elevation of the second embodiment of the brace modified by being extended so that its upper leg-embracing part engages the leg above the knee and by the addition of a knee-restraining strap thereto.

In both illustrative embodiments, the brace of the invention employs a lower, stirrup-like, foot-engaging member and an upper, leg-parallel brace member pivotally connected thereto. Preferably, the upper brace part includes two selectively extensible elongated members, positioned one on each side of the leg. The stirrup-like, lower brace member, taken with the shoe, provides a means whereby the foot may serve as a terminal point for traction. Various leg-engaging brace-securing means may be disposed on the upper brace member to maintain the two elongated members parallel to the leg, to impose stiffening of the knee if desired, and to form the other terminus for traction, when such is desired.

In the embodiment of Figs. 1 and 2, the lower, foot-engaging member is designated as a whole by the character 10. Such member, which is generally of U shape in front elevation, has a central, at least partial insole-forming generally flat portion 14 which fits within the shoe 15, as shown. On each side of portion 14, there rises the flange portion 16 of part 10 in close contact with the inner side surface of the upper of the shoe, the flanges then being folded outwardly from the upper folded edge 17 to lie above the upper edge of the shoe and downwardly at 19 to form depending ears outwardly of the shoe upper.

Pivotally connected to each of the ears 19 is the generally vertical rod 20, which is preferably square in section. One rod 20, as shown, lies alongside each side of the leg, and forms a lower section of the extensible upper brace member 11. The annular, lower end 21 of each rod 20 has a central passage therethrough. Pivotal connection to ear 19 is effected by the two-part stud 27 extending through the ear 19 and the end 21 of the rod, there being a nylon bushing 22 snugly fitting within the hole in part 21 and inner and outer nylon washers 24 and 25 at the sides of member 21. A metal washer 26 overlies the outer nylon washer. The described pivotal connection is such that the parts remain reasonably tight and anti-rattling at all times while not preventing the easy turning of lower brace part 10 with respect to the upper brace part 11 of which rods 20 are a part. Further, the yieldability of nylon allows the alignment of the parts to be somewhat changed, as when the brace is changed in contour, without incurring any undue binding of the parts.

A vertically adjustable collar 29 is positioned on at least one of rods 20 and preferably on each of rods 20 as shown, the collar being of such diameter that its inner edge at least partially overlies the upper folded edge 17 of each of the depending ears 19. When the collar 29, which is provided with a rod-engaging set screw 30, is adjusted on the rod so as to engage the central portion of edge 17, as shown in Fig. 1, part 10 of the brace is effectively locked from any pivotal movement with respect to the upper part 11 of the brace. The raising of the collar 29 on the rod and the locking of it at various heights above portion 17 of the lower brace member allows such lower brace member to turn angularly through the desired angular range.

The upper section 31 of each upper brace member 11 is made in the form of a tube accurately receiving and guiding the upper end of rod 20 so that each of parts 11 may be markedly extended or contracted as desired. Member 11 is held at the desired length by the lock member 32, shown in detail in Fig. 2. At the lower

end of tube 31, a part of its side wall is continued in a somewhat laterally diverted position 34 and terminates in the horizontally directed end 35. End 35 is provided with a square rod-receiving opening 36 aligned with the passage or the opening in the tube 31. A locking member having the generally horizontal portion 37 with the square rod-receiving opening 39 is disposed below the end of tube 31. The rear of portion 37 is provided with a tang 40 loosely received in the opening 41 in portion 34. A compression coil spring 42 is positioned between the upper surface of part 35 and the lower surface of part 37 of the lock.

Member 37 may be released from effective clamping contact with rod 20 by pressing the handle member 44 to the right to swing member 37 counterclockwise (Fig. 2). It will be seen that the brace member 11 may be extended without manipulation of lock 32 simply by pulling tube 31 relative to rod 20, since the spring 42 yields to allow member 37 momentarily to loosen on the rod. The lock, however, positively prevents member 11 from shortening unless the member 37 of the lock is released by handle 44.

The brace shown in Figs. 1 and 2 is desired for imposing moderate traction on the leg from the foot to the thigh. Positioned on the upper ends of the tubes 31 is the substantially rigid generally semi-circular thigh-engaging ischium ring or member 12 composed of the rodlike core-member 45 provided with the generally tubular padding 46. Each forward end of core 45 is bent downwardly at 47 and rearwardly at 48, the rear end of the downward-bent portion of the core being reduced in diameter at 49 and received in a passage 51 through the upper end of tube 31. The free end of portion 49 is braced to the core by the member 50. A thigh-engaging strap composed of opposite portions 52 and 54 completes the thigh-engaging member. The brace may also include a further strap 55 attached to tubes 31 by loops 53, such strap being vertically adjustable on the tubes so that it may overlie the knee or other portions of the leg, as desired.

It will be seen that the brace of Figs. 1 and 2 may readily be adjusted as to length as a whole and that it may easily be changed in contour, by raising or lowering one end of the ischium ring with respect to the other end thereof, to fit either the right or the left leg of the patient. When, for example, the brace shown in full lines in Fig. 1 is changed to the contour shown in dotted lines, the locks 32 then occupy the respective positions 32', and thigh-engaging member 12 occupies position 12', the pivotal connection between the upper ends of tubes 31 and parts 49 readily allowing such change of attitude of member 12 (12'), the described pivotal connection between parts 10 and 11 functioning satisfactorily regardless of lateral deviations of members 11 as a result of the change of contour of the brace.

The embodiment of the brace of the invention shown in Figs. 3 and 4 engages the leg, respectively, below the knee and above the knee. In these two figures, the same reference characters are employed to designate the same parts, with the exception that a prime (') is employed with each such character in Fig. 4.

The insole portion of the lower, foot-engaging member 56 is designated 57. The side flanges 59 of the U-shaped member 56 rise, as before, along the inside of the shoe, cross the shoe uppers at the folded edge 65, and are bent downwardly outwardly of the shoe upper to form ears 60. The annular, lower end 62 of each of rods 61, forming a lower section of the upper brace member, is pivotally connected to its ear 60 by a connection such as shown in Fig. 2. The upper, generally vertical side members 68 of the brace, of which rods 61 are a part, are composed of the above-mentioned rod 61, the lower section, and the upper tube 67, the upper section, there being a lock 66 similar to that in Figs. 1 and 2 between them. Rods 61 may be square in section, if de-

sired, and the passages in tubes 67 guidingly receiving the rods also square.

In Fig. 3 the brace is shown applied to a leg, the ankle of which must be held from pivotal motion. Accordingly, the stop collar 64 is shown tightly in engagement with the surface 65 of the ear 60, so that brace portions 56 and 67 are, in effect, rigid. Portions 67 are maintained fixed with respect to the lower leg by means of the leg-embracing portion 69, the lower edge 70 of which engages the leg somewhat below the knee 71. Straps 72 maintain member 69 tightly in engagement with the leg. The upper ends of tube 67 are somewhat loosely received in vertical pockets 74 along the outside of member 69, being pivotally connected thereto at the upper end by the pin 73.

In Fig. 4 the same brace as shown in Fig. 3 is depicted, but extended so that leg-embracing member 69' lies slightly above the knee 71'. It will be assumed that such mounting of the brace is desired to treat a condition in which the knee is to be held substantially stiff but a desired degree of pivotal movement is to be given the ankle. The intermediate strap 75 connected to tubes 67' through the medium of tubular pockets 76 in conjunction with member 69' holds the knee substantially from flexing. Stop collar 64' is in this instance locked a predetermined height above surface 65' of the lower brace member so that the lower brace member 56 and thus the ankle are permitted to turn throughout the desired angular range with respect to the upper brace member 68 and the lower leg, respectively.

I claim as new the following:

1. A surgical brace for a leg, comprising in combination at least one elongated upper brace member adapted to lie along a side of the leg, means connected to the upper brace member for embracing, and fastening said upper brace member to, the leg, a lower brace member having a broad base portion in the form of an insole for a shoe, a laterally thin upright member rising from and connected to a side edge of the base portion and having a main portion adapted to lie inwardly of the upper side portion of the shoe of the wearer, and means pivotally connecting the lower end of the upper brace member to the upright member adjacent the upper end thereof to allow the free pivoting of the lower brace member with respect to the upper brace member, the upright member having an outwardly and then downwardly extending portion attached to the main portion thereof, the main portion and the downwardly extending outer portion of the upright member being spaced from each other to receive therebetween the upper side portion of the shoe of the wearer, and the upper brace member being pivotally connected to the downwardly extending outer portion of the upright member.

2. A surgical brace as defined in claim 1, wherein there are two generally similar upright members, the main portions of said upright members being generally parallel and connected to opposite sides of the insole, wherein the outwardly extending portions of the respective upright members are oppositely directed, the main portion of each upright member and its downwardly extending outer portion receiving the upper edge portion of the respective side of the shoe therebetween, and there are two upper brace members adapted to be positioned on opposite sides of the leg, each upper brace member being pivotally connected at its lower end to the respective upright member adjacent the upper end of the latter.

3. A surgical brace for a leg, comprising in combination a pair of spaced parallel elongated upper brace members the lower ends of which are adapted to lie along opposite sides of the lower part of the leg, means detachably connecting the upper ends of the upper brace members together and for embracing, and fastening said upper brace members to, the leg, a lower brace member in the form of a removable insole for a shoe, said lower brace member having a toe and a heel portion, the

lower brace member having upstanding ear portions on opposite sides thereof generally in a location close to the pivotal axis of the ankle of the wearer, and means connecting the lower ends of the upper brace members to their respective upstanding portions of the lower brace member, said last named means comprising means allowing the free pivoting of the lower brace member with respect to the upper brace members, and an adjustable stop means at the joint between at least one of the upper brace members and the lower brace member including a collar slidable along the lower end of the upper brace member and cooperating with the upper surface of the confronting ear portion of the lower brace member, and means to secure the collar in a selected position longitudinally of the upper brace member.

4. A surgical brace for a leg, comprising in combination a pair of spaced parallel elongated extensible upper brace members the lower ends of which are adapted to lie along opposite sides of the lower part of the leg, means including a thigh engaging member connecting the upper ends of the upper brace members together and for embracing, and fastening said upper brace members to, the leg, each upper brace member having a plurality of telescopically mounted sections, means for locking such sections together against contraction, an elongated lower brace member in the form of a removable insole for a shoe, said lower brace member having a toe and a heel portion at opposite ends thereof, the lower brace member having upwardly and then outwardly and downwardly extending flange portions on opposite sides thereof generally in a location close to and generally vertically aligned with the pivotal axis of the ankle of the wearer, the upwardly and downwardly extending parts of the respective flanges being spaced from each other to receive therebetween the upper sides of the shoe of the wearer, means connecting the lower end of each of the lower sections of the upper brace members to the respective one of the downwardly extending parts of the flanges of the lower brace member along an axis below the pivotal axis of the ankle of the wearer, a collar slidable along the lower end of at least one of the lower sections of the upper brace members, said collar cooperating with the upper surface of the confronting ear portion of the lower brace member, and means to secure the collar in a selected position longitudinally of the upper brace member whereby the lower brace member may be locked from pivotal movement in a horizontal position or may be allowed to pivot with respect to the upper brace members throughout a selected angular range.

5. A surgical brace for a leg, comprising in combination a pair of spaced parallel extensible elongated upper brace members the lower ends of which are adapted to lie along opposite sides of the lower part of the leg, means connecting the upper brace members together and for embracing, and fastening said upper brace members to, the leg, each upper brace member having a plurality of telescopically mounted sections, means for locking such sections together against contraction, a lower brace member in the form of an insole for a shoe, said lower brace member having a heel end and a toe end, and means connecting the lower section of each of the upper brace members to the respective one of the opposite sides of the lower brace member along an axis close to and in substantial vertical alignment with the pivotal axis of the ankle of the wearer, each of the connections between the upper and lower brace members including resilient bearing means allowing the free pivoting of the lower brace member with respect to the respective upper brace member, the last named means being so constructed and arranged that the angularity of the upper brace members laterally of the lower brace member may be changed appreciably without materially altering the freedom of turning of the pivotal connections.

6. A surgical brace for a leg, comprising in combina-

tion a pair of spaced parallel elongated extensible upper brace members the lower ends of which are adapted to lie along opposite sides of the lower part of the leg, means including a thigh engaging member connecting the upper ends of the upper brace members together and for embracing, and fastening said upper brace members to, the leg, each upper brace member having a plurality of telescopically mounted sections, means for locking such sections together against contraction, an elongated lower brace member in the form of a removable insole for a shoe, said lower brace member having a toe and a heel portion at opposite ends thereof, the lower brace member having upwardly and then outwardly and downwardly extending flange portions on opposite sides thereof generally in a location close to and generally vertically aligned with the pivotal axis of the ankle of the wearer, the upwardly and downwardly extending parts of the respective flanges being spaced from each other to receive therebetween the upper sides of the shoe of the wearer, means connecting the lower end of each of the lower sections of the upper brace members to the respective one of the downwardly extending parts of the flanges of the lower brace member along an axis below the pivotal axis of the ankle of the wearer, the last named means each comprising aligned bores through the lower end of the lower section and the downwardly extending part of the flange, a pivot pin extending through such bores, a resilient plastic bearing sleeve on the pin within the bore in the section, and means retaining the pin in place.

7. A surgical brace for a leg, comprising in combination a pair of spaced parallel elongated extensible upper brace members the lower ends of which are adapted to lie along opposite sides of the lower part of the leg, means including a thigh engaging member connecting the upper ends of the upper brace members together and for embracing, and fastening said upper brace members to, the leg, each upper brace member having a plurality of telescopically mounted sections, means for locking such sections together against contraction, an elongated lower brace member in the form of a removable insole for a shoe, said lower brace member having a toe and a heel portion at opposite ends thereof, the lower brace member having upwardly and then outwardly and downwardly extending flange portions on opposite sides thereof gen-

erally in a location close to and generally vertically aligned with the pivotal axis of the ankle of the wearer, the upwardly and downwardly extending parts of the respective flanges being spaced from each other to receive therebetween the upper sides of the shoe of the wearer, means connecting the lower end of each of the lower sections of the upper brace members to the respective one of the downwardly extending parts of the flanges of the lower brace member along an axis below the pivotal axis of the ankle of the wearer, the last named means each comprising aligned bores through the lower end of the lower section and the downwardly extending part of the flange, a pivot pin extending through such bores, a resilient plastic bearing sleeve on the pin within the bore in the section, resilient plastic bearing washers between the section and the depending part of the flange and outwardly of the section, and means retaining the pin in place, compressing the washers and urging the section against the depending part of the flange, a collar slidable along the lower end of at least one of the lower sections of the upper brace members, said collar cooperating with the upper surface of the confronting ear portion of the lower brace member, and means to secure the collar in a selected position longitudinally of the upper brace member whereby the lower brace member may be locked from pivotal movement in a horizontal position or may be allowed to pivot with respect to the upper brace members throughout a selected angular range.

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