

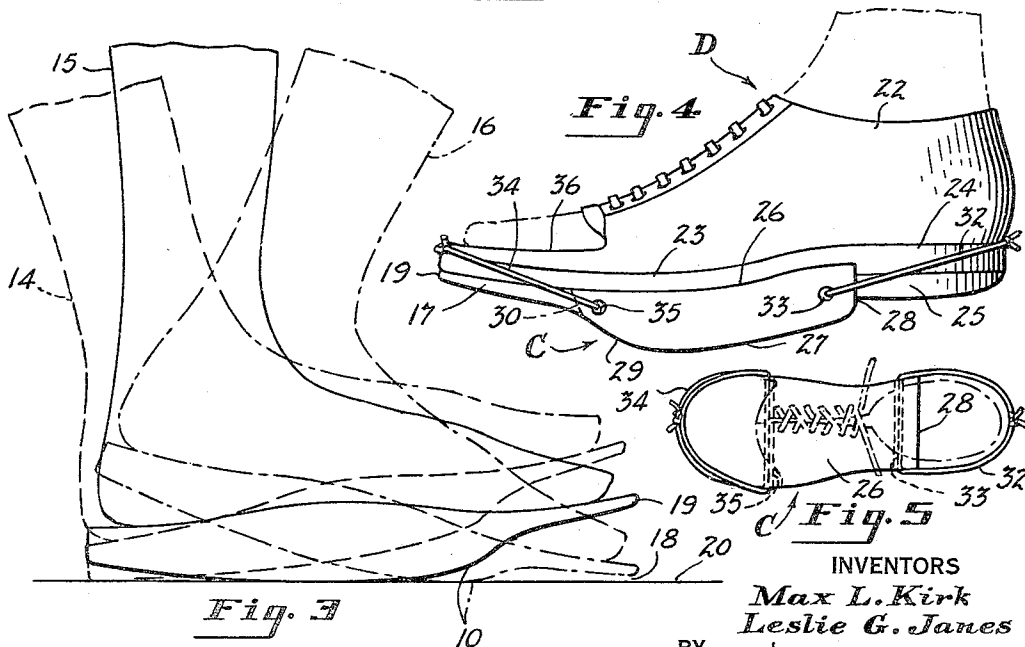
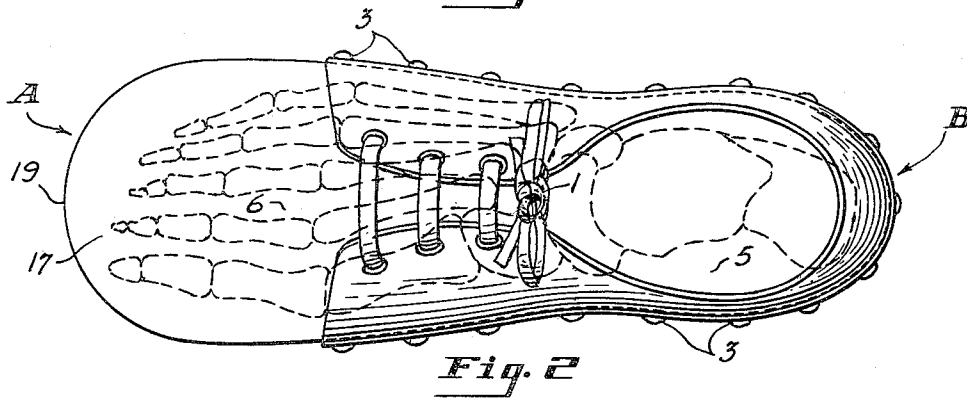
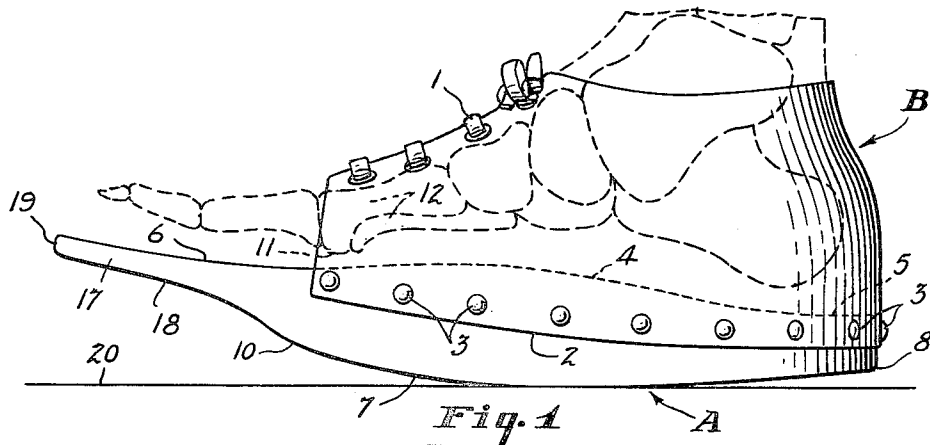
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M. L. KIRK ET AL

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SURGICAL SPLINT

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INVENTORS  
**Max L. Kirk**  
**Leslie G. Jones**  
 BY **Evans + McCoy**  
 ATTORNEYS

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## SURGICAL SPLINT

Max L. Kirk, Euclid, and Leslie G. Janes, Cleveland, Ohio

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5 Claims. (Cl. 36—8.5)

This invention relates to surgical splints for use by those having foot injuries, more particularly to a splint for supporting a foot to permit walking without flexing of the metatarsophalangeal joint or of the joints of the foot anterior to the metatarsal joint.

In the treatment of injuries or diseases of the foot requiring immobilization of certain joints, particularly the metatarsophalangeal joint and other joints in the toes or anterior portions of the foot, various devices have been employed to relieve the forward portions of the foot from pressure or load due to walking. The devices heretofore known, although of some utility, have not been fully satisfactory. One of the chief objections to the devices heretofore known is the interference with normal attitudes, elevations and walking movements of the foot.

It is, therefore, one of the principal objects of the present invention to provide a splint of the character mentioned which has a minimum interference with normal positions and walking movements of the wearer's foot. More specifically, it is sought to provide such a splint which, while eliminating flexing of the metatarsophalangeal joint of the foot, provides a rocking motion of the foot in which supporting contact is made with the ground along a line which shifts or moves progressively forward from a point underlying the heel to a point underlying the ball of the wearer's foot.

Another object is to provide a support splint of such character which raises the heel of the wearer substantially no higher off the ground than a normal shoe so as to obtain normal ground engagement by the heel of the wearer at the start of a step.

Another object is to provide a rigid foot supporting splint for use in combination with a conventional shoe to support a foot for rocking motion in the taking of a normal step while eliminating flexing of the metatarsophalangeal and other joints of the foot.

A further object is to provide an improved fastening means for securing a rocker block against the underside of a conventional shoe so as to provide substantially normal comfort and walking action.

Still other objects and advantages pertain to certain novel features of construction and combinations of parts apparent in the following detailed description of the invention. This description is made in connection with the accompanying drawings forming a part of the specification. Like parts throughout the several views are indicated by the same letters and numerals of reference.

In the drawings:

Figure 1 is a side elevational view, partly diagrammatic, showing the foot support or splint of the present invention;

Fig. 2 is a plan view, partly diagrammatic, of the foot support;

Fig. 3 is a diagram showing different relative positions of the support and a foot resting thereon in the course of a normal step;

Fig. 4 is a side elevation, partly diagrammatic, showing a modification comprising a shoe and supporting rocker

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block combination incorporating the principles of the invention; and

Fig. 5 is a plan view reduced in scale, of the rocker block shown in Fig. 4, the shoe of the combination being shown in broken lines.

The surgical splint or support of the present invention is embodied in a rigid member or block positioned under the instep of the wearer's foot and having a convex bottom or ground engaging surface which permits rocker action during a normal step. The rear portion of the block is of such a height that the heel of the wearer, at the inception of a step, is supported at normal height above the ground. The forward end of the block or splint terminates beneath the ball of the wearer's foot or preferably is relieved forwardly of the ball of the foot so that the walking load or pressure is not applied to the toes of the wearer in the taking of a normal step.

In the embodiment of Figs. 1 through 3, the rocker support or block, indicated generally at A, is formed of a suitable rigid material such as wood and extends substantially the full length of the wearer's foot, the bones of the latter being indicated in broken lines. The block A somewhat resembles a shoe in plan form but may be made symmetric, as shown, for optional use for either the right or the left foot. A leather or canvas upper B of low-cut style embraces the foot of the wearer to secure the block A in place. The forward edges of the upper are connected and drawn together about the wearer's foot as by lacing 1. Lower edge 2 of the upper is continuous about the sides and rear of the block A, being secured to the latter as by spaced tacks 3. The upper B is discontinuous over the toes of the wearer to accommodate any surgical dressing that may be applied and to eliminate constraint and pressure on the wearer's toes. A suitable protective cup or shield (not shown) may be used over the wearer's toes on the forward portion of the foot support or splint.

The top surface of the splint or rocker block A includes a central convex portion 4 which underlies and supports the arch of the wearer's foot. This arch supporting convex portion of the top surface is continuous with a flat or a slightly concave heel supporting portion 5 at the rear of the block and also with a flat or, as shown, preferably slightly concave portion 6 at the forward or anterior portion of the block. The ogee curvature or shape of the upper surface portions 4, 5 and 6 are uniform across the entire width of the block and are generated as by a substantially straight line transverse to block moving longitudinally of the latter over a path corresponding to the ogee outline shown. In forming the support the block of wood from which it is made is shaped in profile by cutting as on a band saw to the desired contour, or by passing the block across the face of a rotary cutting tool over the desired relatively curved path in accordance with conventional woodworking or mill practice. Band sawing is also employed in cutting the shaped block to the desired plan form.

The bottom surface of the block A includes a central rocker or ground engaging convex portion 7 generally underlying the upper central convex portion 4 of the top surface. The convex rocker portion 7 extends rearwardly in a continuous curve substantially to the heel corner indicated at 8. Although it is preferable for the bottom surface of the block to be thus convexly curved substantially to the rear corner of the heel, as shown, it is satisfactory if the ground engaging surface includes a rear flat portion underlying some or even the major portion of the heel of the wearer. However, the convexly curved rocker portion extends at least from the front portion of the wearer's heel forwardly under the arch or instep of the wearer's foot and to a point such as

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indicated at 10, slightly in advance of anterior heads 11 of metatarsal bones 12 of the wearer's foot.

The ground engaging curved rocker surface extends across substantially the full width of the block A and is generated as by a straight transverse line moving in a continuous curve from one end of the rocker to the other. Thus, in the preferred arrangement, both the top and the bottom surfaces of the block are convexly curved longitudinally. In the taking of a normal step the weight of the wearer is concentrated along a transverse line contact which shifts progressively forward from a point on the heel portion of the block which point underlies the breast of the wearer's heel substantially to the point 10, the latter point constituting substantially the limit of rocking movement contact at which the wearer raises the support or splint from the ground and carries it forward for the next step.

This rocking motion of the support is indicated diagrammatically in Fig. 3 wherein the initial contact of the heel with the ground or supporting surface is indicated by broken lines 14. An intermediate or standing position is indicated by solid lines 15 and the limit of movement where the wearer raises his foot from the ground is indicated by broken lines 16.

Forward of the rigid rocker portion of the splint is a rigid relatively thin toe supporting portion 17 which may be integral with the rocker portion. The top surface portion 6 is continuous onto the toe supporting portion 17, the underside of the toe portion 17 being relieved or cut away and formed with a concave surface 18 which may be joined by a continuous curve to the convex surface portion 7 of the rocker.

Thus, in profile, the support block or splint A is formed with ogee curves on both top and bottom surfaces. It is of greatest height or thickness at the central portion which underlies the instep or arch of the wearer's foot. From this relatively thick central portion the block tapers to both the heel and toe portions, the toe portion 17 being only of sufficient thickness to provide the structural strength requisite to resist bending and breakage in use. The relief of the underside of the toe portion 17 has the effect of eliminating objectionable contact or pressure between the toe portion and the ground during the taking of a normal step. In Fig. 3, for example, a clearance 18 is indicated between tip 19 of the toe portion 17 and ground line 20, this position of the toe portion 17 representing the limit of movement of the toe portion in a normal step.

It is apparent that the shape of the support block or splint of the present invention facilitates economical manufacture in large or small quantities by conventional machines such as are available in standard woodworking mills.

In Figs. 4 and 5 is illustrated a modification wherein a rocker block C is used in combination with a conventional shoe D, preferably of the low cut or oxford type, to form a surgical splint or foot support. The shoe comprises an upper 22, a sole 23, and a heel 24. The latter may include the customary rubber lift indicated at 25.

The block C is formed with an upper surface 26, preferably of ogee or compound curvature, receivable against the underside of the sole 23 of the shoe in underlying relation to the instep and sole of the wearer's foot. The surface 26 may be of the same curvature across the entire width of the block C permitting the shaping of the block by a band saw or rotary straight edged cutting tool as mentioned in connection with the preceding figures. In this block-shoe combination a convex supporting surface for the instep of the wearer's foot is provided by the shoe D and corresponds to the upper convex face 4 of the embodiment first described.

The block C is formed with a bottom or ground engaging face 27 which is curved longitudinally in the provision of a convex rocker. This rocker surface 27 extends substantially from rear end face 28 of the block

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forwardly in a continuous curve to a point 29 underlying or slightly anterior to the metatarsophalangeal joint of the wearer's foot. The point 29 of the rocker block C corresponds to the bearing limit point 10 previously described in connection with Figs. 1 through 3. The block C may terminate slightly ahead of the ground contact limit 29, as, for example, along the broken line indicated at 30, or, preferably, may be formed with the integral forwardly extending toe portion 17 as previously described in Figs. 1 through 3.

The bottom surface, including the ground engaging face 27 of the rocker block, is of the same curvature or shape across the entire width of the block facilitating manufacture by the straight edge rotary cutter method or the band saw method previously mentioned. These blocks are made for right and left shoes although, if desired, they may be symmetric in plan form for use with either rights or lefts. Fig. 5 shows, in full lines, the plan form of a block for use with a left shoe, a block for a right shoe being reversed in form. In this view the shoe is shown in broken lines.

In attaching the rocker block C to the shoe or oxford D the rear end face 28 of the block is seated against the forward face of the shoe heel 24. A metal wire 32 received through a transverse drill hole 33 in the rear of the block C is passed around the rear of the shoe and drawn tight as by twisting the wire ends together to hold the block snugly against the shoe heel. This heel wire is received in the angle between the heel component 24 and the shoe upper 22 thereby preventing dislodgment of the wire in use.

A metal wire 34 is received through a transverse drill hole 35 in the forward end of block C and is passed forwardly around the toe of the shoe and drawn tight as by twisting the wire ends. This toe wire 34 is received in the angle between the sole 23 and the toe portion of the shoe upper 22 thereby preventing dislodgment of the wire in use. The front retaining wire 34, being disposed at an angle to the shoe sole 23, draws the latter snugly against the top face of the toe extension 17 of the rocker block. In the event that the toe extension is omitted or removed as by cutting along the line 30, the front wire 34 braces the toe portion of the shoe D to resist objectionable deflection or bending of the shoe which might otherwise result in undesirable flexing of the toes or metatarsophalangeal joints. If desired, the toe portion of the shoe upper 22 may be removed or cut away as along the lines indicated at 36 to relieve pressure on the injured portions of the wearer's foot.

In accordance with the patent statutes the principles of the present invention may be utilized to various ways, numerous modifications and alterations being contemplated, substitution of parts and changes in construction being resorted to as desired, it being understood that the articles shown in the drawings and described above are given merely for purposes of explanation and illustration without intending to limit the scope of the claims to the specific details disclosed.

What we claim and desire to secure by Letters Patent of the United States is:

1. A surgical splint for supporting a human foot comprising a rigid member extending the full length of the foot in underlying relation thereto, the member having an upwardly directed convex top surface for receiving the wearer's foot and a downwardly directed bottom surface which includes a portion for engaging the ground and a forward toe portion, the ground engaging surface portion being generated by a line transverse to the member moving longitudinally of the member from the heel of the wearer to the metatarsophalangeal joint of the wearer and being convex throughout the major portion of the length of the member rearwardly of the metatarsophalangeal joint of the wearer's foot to provide rocker action in the taking of a normal step, the toe portion of the bottom surface being spaced above the

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ground throughout the taking of a normal step, and means for retaining the rigid member on the foot of the wearer.

2. A surgical splint for supporting a human foot comprising a member for extending the full length of the foot in underlying relation thereto to prevent flexing of the foot joints, the member including a rigid forward portion for underlying the phalangeal bones of the foot and a rigid rocker portion rigidly connected to the forward portion, said rocker portion having a ground engaging surface as wide as the foot and convexly curved continuously from the rear of the foot to a point beneath the metatarsophalangeal joint so that in walking the weight of the wearer is concentrated along a ground engaging line transverse to the foot which moves progressively forward over said curved surface during each normal step, the rigid forward portion of the member being maintained spaced above the ground during a normal step to relieve the phalanges of the foot of load, the rigidity of the forward portion in relation to the rocker portion preventing flexing of said joint in the event said forward portion contacts the ground in an abnormal step, and means for retaining the rigid member on the foot of the wearer.

3. A surgical splint for supporting a human foot comprising a rigid member for underlying the full width of the wearer's foot and means for retaining the rigid member on the foot of the wearer, said member having a bottom surface which engages the supporting surface in a line contact and which imparts a rocker action to the member during the taking of a normal step by the wearer, said bottom surface including a curved portion which is generated by a straight line transverse to the member moving longitudinally thereof from the heel of the wearer to the metatarsophalangeal joint of the wearer, the weight of the wearer being concentrated during a normal step on said line contact between the curved surface of said member and the supporting surface, which line contact shifts progressively forward along said curved surface from a point underlying the breast of the wearer's heel to a bearing limit area underlying the metatarsophalangeal joint of the wearer's foot during such normal step, said curved bottom surface including a portion at said bearing limit area having a greater curvature than the bottom surface extending rearwardly from the bearing limit area so that as a normal step is completed the forward movement rate of the line contact reduces at the metatarsophalangeal joint.

4. A surgical splint for supporting a human foot comprising a rigid member for underlying the wearer's foot, said member having a ground engaging bottom surface which is substantially coextensive in width with the wearer's foot, the ground engaging surface including a curved portion which is generated by a straight line

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transverse to the member moving longitudinally of the member over a path which curves continuously from one point underlying the breast of the wearer's heel to a bearing limit point underlying the metatarsophalangeal joint of the wearer's foot to provide a rocker action during normal walking in which the weight of the wearer is concentrated along a line which travels forwardly over said curved surface progressively from the one point under the breast of the wearer's heel to said joint of the wearer's foot in the course of a normal step, said ground engaging surface including a portion at said bearing limit point having a greater curvature than another portion of the ground engaging surface extending rearwardly from said first named portion so that as a normal step is completed the rate of forward travel of said weight concentrating line decreases providing an increasing tilting action at the bearing limit point, and means for retaining the rigid member on the foot of the wearer.

5. A surgical splint for supporting a human foot comprising a rigid member for underlying the wearer's foot, said member having a ground engaging bottom surface which is coextensive in width with the wearer's foot, the ground engaging surface including a curved portion which is generated by a straight line transverse to the member moving longitudinally of the member over a path which curves continuously from one point underlying the breast of the wearer's heel to a point underlying the metatarsophalangeal joint of the wearer's foot to provide a rocker action during normal walking in which the weight of the wearer is concentrated along a line which travels over said curved surface progressively from the one point under the breast of the wearer's heel to said joint of the wearer's foot in the course of a normal step, said member also including a toe supporting forward portion having a concave bottom surface anterior to the ground engaging surface portion, the anterior surface portion being maintained in spaced relation above the ground surface during the taking of a normal step by said weight concentration to relieve that portion of the wearer's foot anterior to said joint of load, the forward portion of the member underlying said anterior portion of the foot being rigid with that portion of the member having the rocker surface to prevent flexing of the metatarsophalangeal joint in the event of the application of a load to said forward portion of the member, and means for retaining the rigid member on the foot of the wearer.

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