Feb. 24, 1953 H. C. STEIN 2,629,189

MULTIPLE ACTING HEEL FOR SHOES

Filed July 5, 1951

FIG. 1.

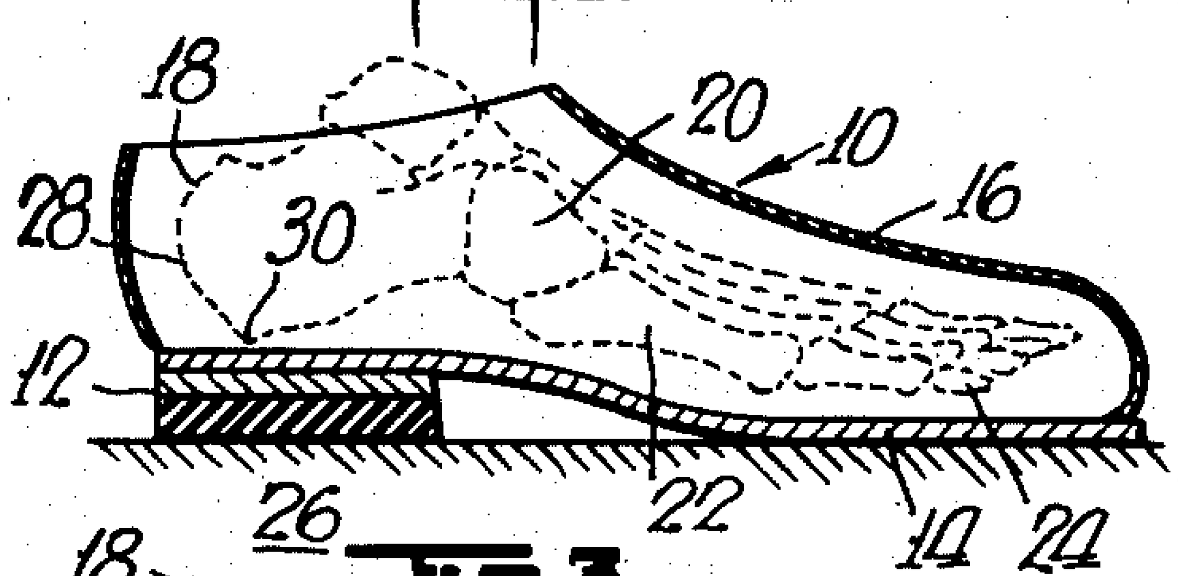


FIG. 2.

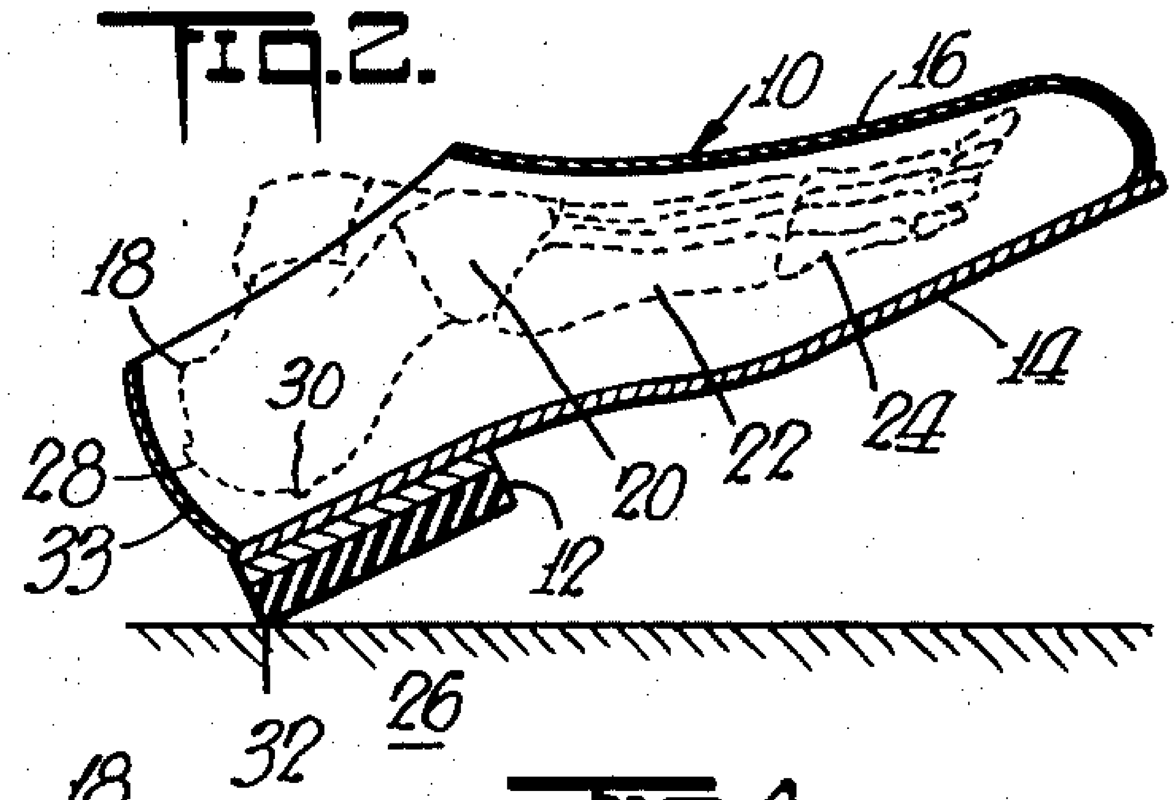


FIG. 3.

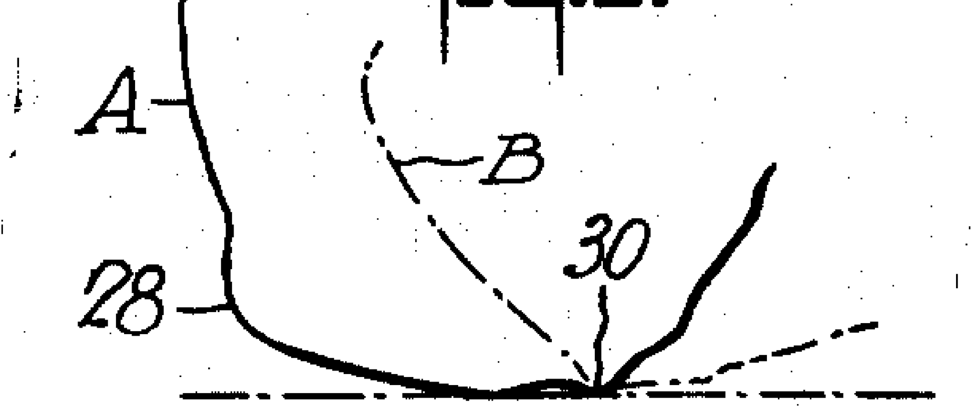


FIG. 4.

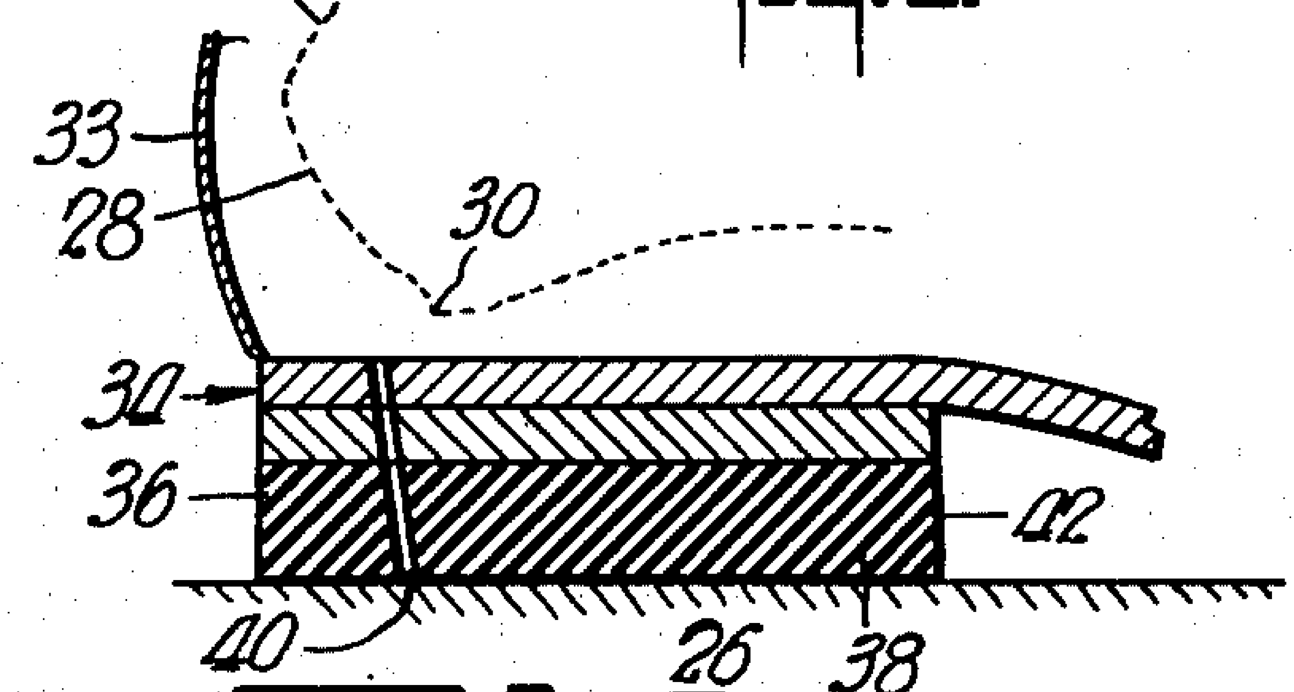


FIG. 5.

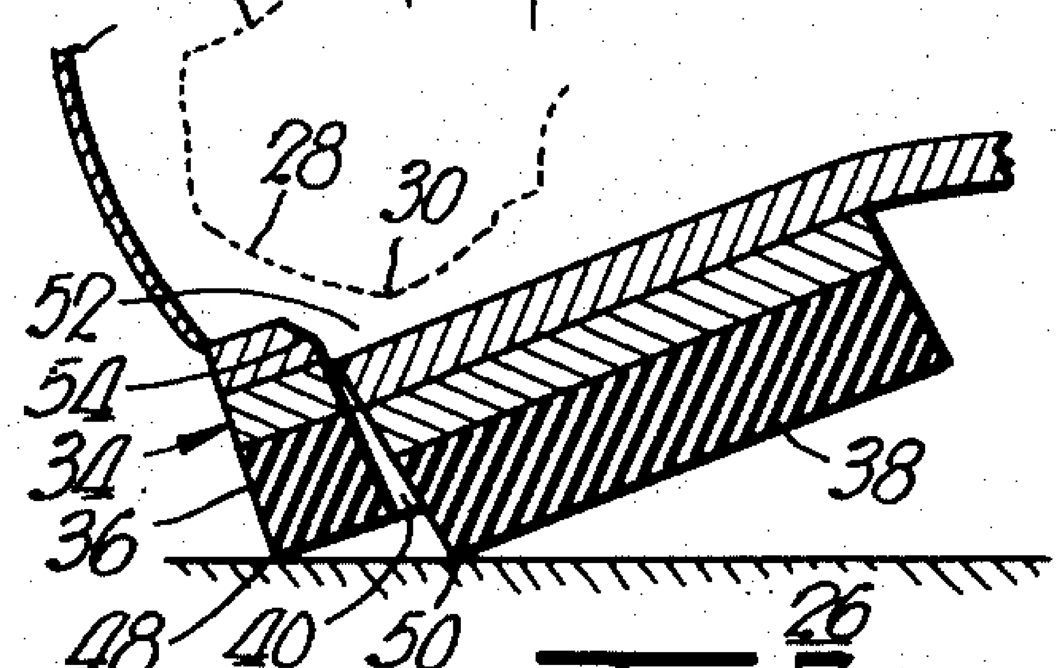


FIG. 6.

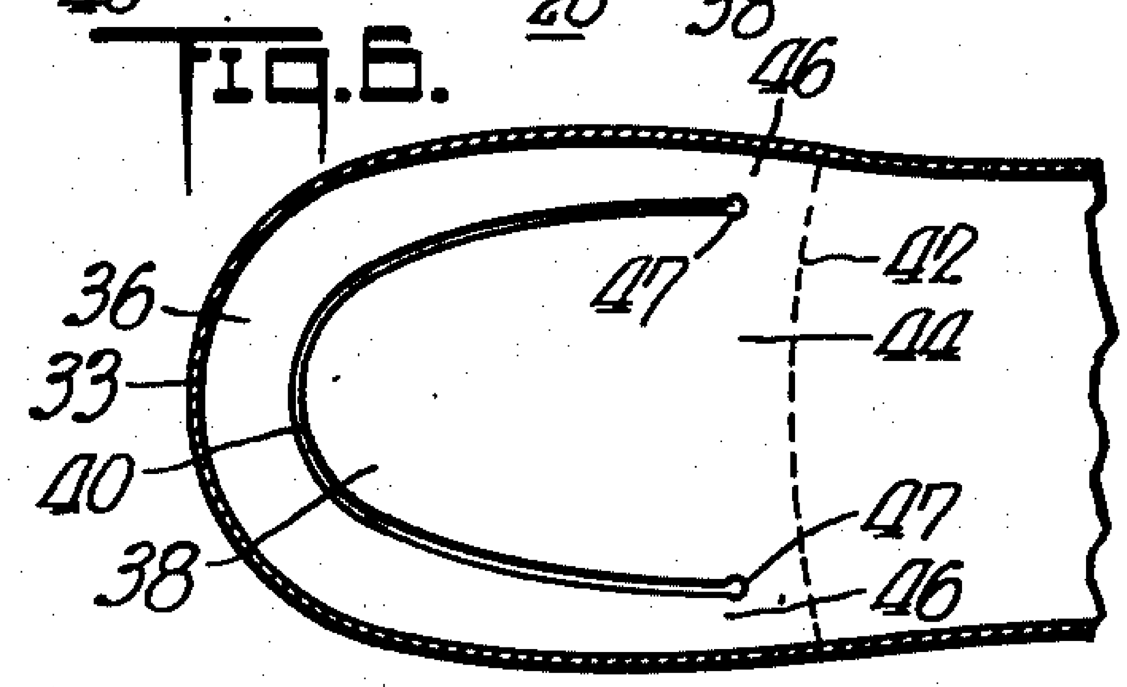


FIG. 7.

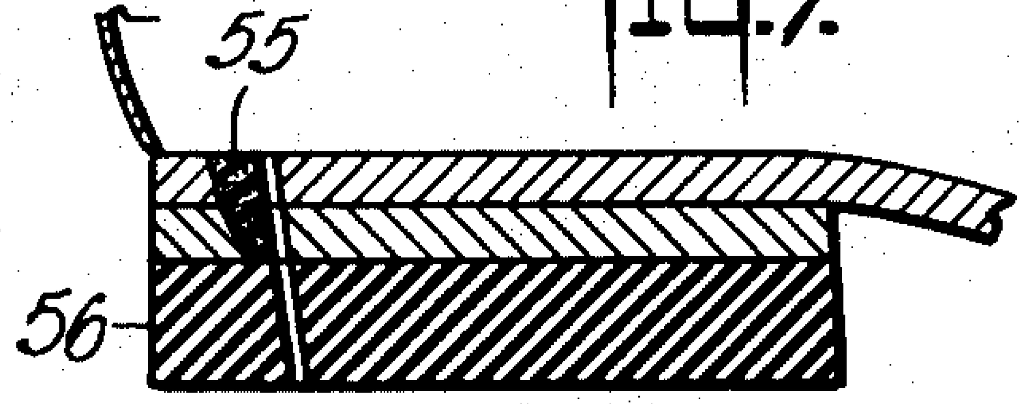


FIG. 8.

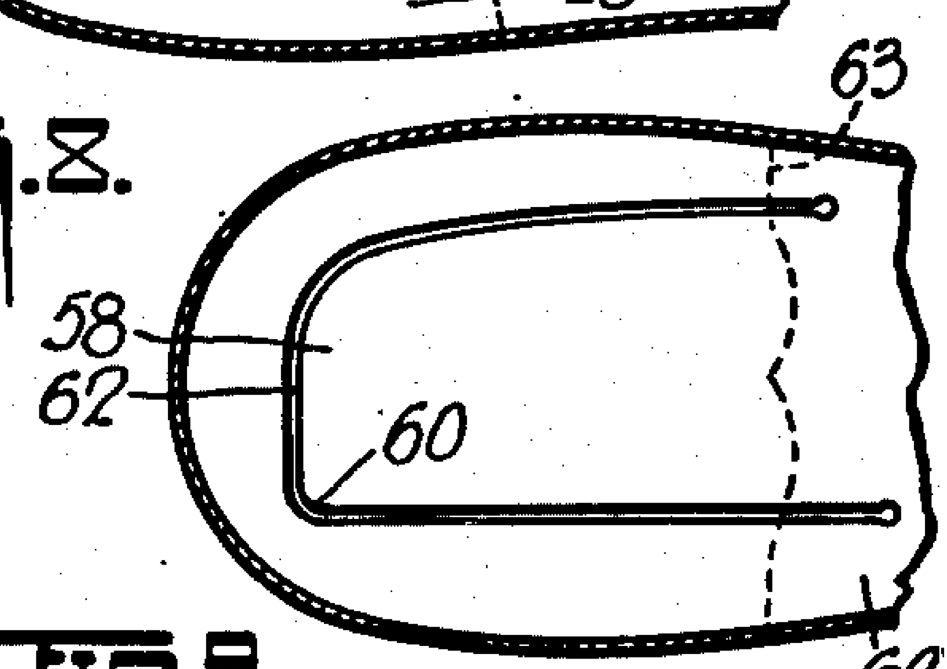


FIG. 10.

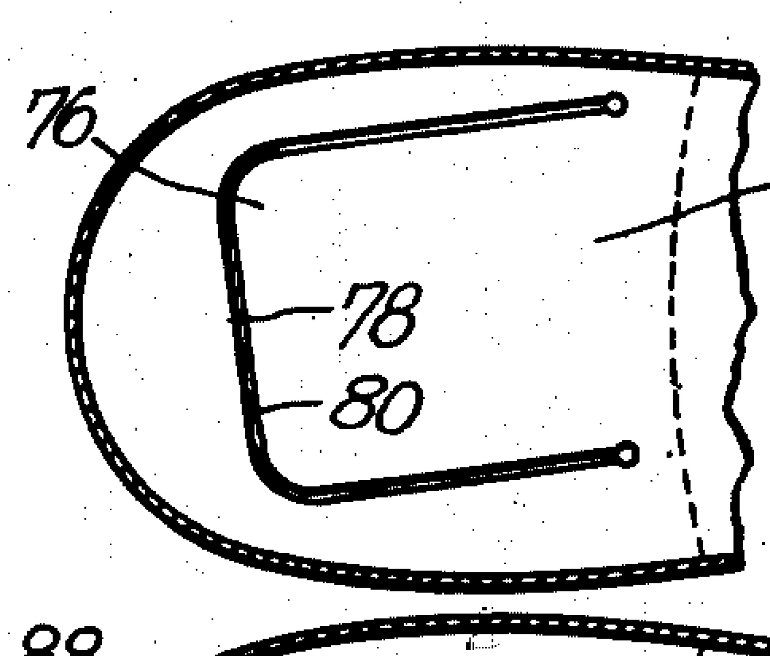


FIG. 11.

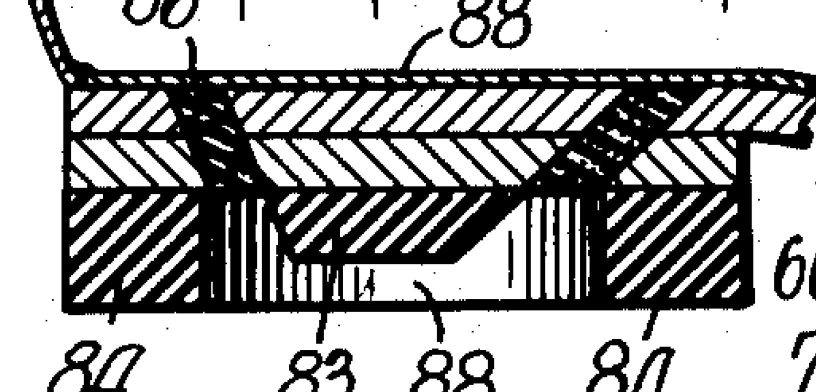


FIG. 9.

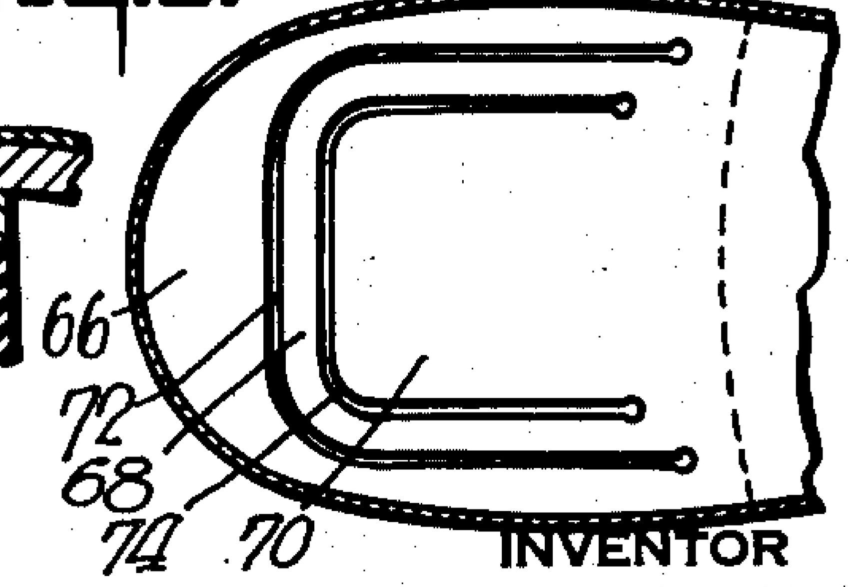
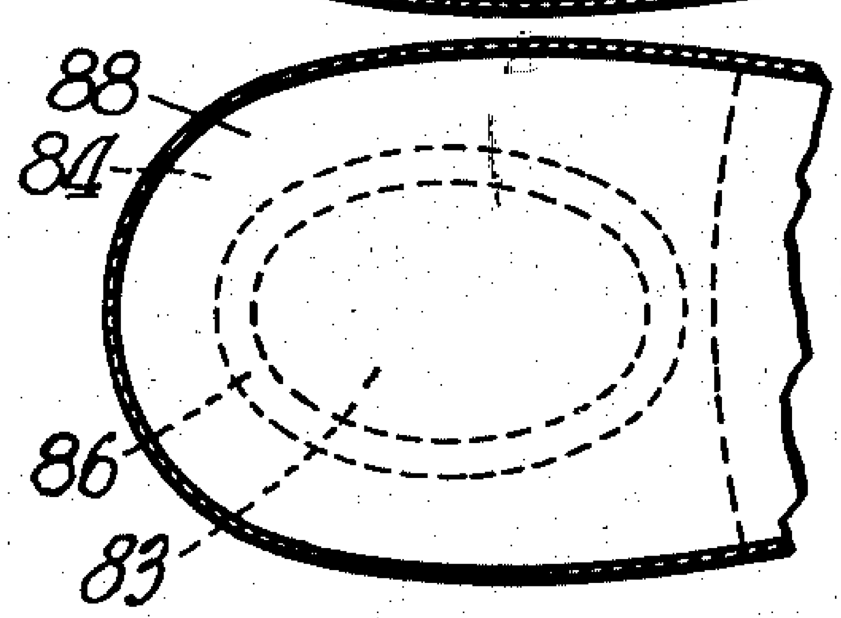


FIG. 12.



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MULTIPLE ACTING HEEL FOR SHOES

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4 Claims. (Cl. 36—8.5)

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This invention relates to footwear and more particularly to a shoe provided with multiple heel elements for supporting different parts of the foot during forward motion.

When a person walks unshod, and the extended foot makes initial contact with the ground, the weight of the body is transmitted to the surfaces of the heel bone, or the os calcis, which acts as a pivot as it rolls over the ground. However, when the foot is encased in a conventional shoe the foot is anchored and the os calcis cannot rotate with respect to the shoe. As a result when the shoe strikes the ground during walking the foot pivots about the lower posterior margin of the shoe heel. This posterior margin of the conventional shoe heel extends back a distance from the os calcis which forms a substantial rigid straight lever or splint. The rigid lever prevents the os calcis from performing its natural movement when the foot contacts the ground, causing an irregular and uncentralized wear of the shoe heel, and more important it creates extra work and strain on the foot and leg during walking.

Accordingly, it is a principal object of my invention to avoid these disadvantages by interrupting the rigid lever in the conventional heel between the os calcis and the posterior margin of the shoe heel, enabling the heel bone to simulate its natural action as occurs when walking unshod.

A further object of my invention is to retain the advantages of the conventional shoe by providing a fixed outer and a hinged inner heel. The outer heel functions as a support for the body when standing, and as an anchorage for the foot when the shoe contacts the ground during walking. The inner heel is a hinged support for the pivoting os calcis during walking.

Still further objects of my invention are to provide a resilient connection between the inner and outer heels to cushion the body from shock during walking; to provide a greater distribution of the body weight on the surfaces of the os calcis; to prevent the foot from sliding to and fro in the shoe on the os calcis; and to reduce the strain on the muscles, bones and joints of the foot and leg.

I accomplish these and other objects and obtain my new results as will be apparent from the device described in the following specification, particularly pointed out in the claims, and illustrated in the accompanying drawing, in which—

Fig. 1 is a diagrammatical cross-sectional elevation view of the heel portion of a conventional right shoe in a standing position showing the bone structure of the foot positioned therein viewed from its lateral aspect;

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Fig. 2 is a similar view of the conventional shoe when the leg is extended forward and the posterior margin of the shoe heel initially engages the ground, and the heel of the foot is resting against the counter of the shoe after sliding;

Fig. 3 is an enlarged partial diagrammatical elevation view of the heel bone of the right foot showing the os calcis in the initial position and the final position shown in dotted lines during the rolling action when walking unshod with the soft pad omitted;

Fig. 4 is an enlarged cross-sectional elevation view of the rear of a right shoe in a standing position embodying my novel multiple shoe heel construction;

Fig. 5 is a similar view of my multiple shoe heel showing the extended foot in a walking position, corresponding to the position shown in Fig. 2;

Fig. 6 is a top plan view of the multiple heel illustrated in Fig. 4;

Fig. 7 is an enlarged cross-sectional elevation view of the rear of a modification provided with a cushion insert in the outer heel element;

Fig. 8 is an enlarged top plan view of the rear of a right shoe showing a further modification wherein the inner heel element is forwardly hinged;

Fig. 9 is an enlarged partial top plan view of the rear of a right shoe showing another modification in which a plurality of inner heel elements are provided;

Fig. 10 is an enlarged top plan view of the rear of a shoe showing still another modification in which the posterior edge of the inner heel element is formed on an oblique line normal to a plane passing approximately through the great toe of the foot;

Fig. 11 is an enlarged cross-sectional elevation view of the rear of a right shoe showing still another modification provided with a floating inner heel element; and

Fig. 12 shows a top view of the multiple shoe heel shown in Fig. 11.

In the drawing reference numeral **10** designates a conventional shoe having a heel **12**, sole **14** and an upper **16**. Positioned within the shoe as shown in Fig. 1 are illustrated some of the bones of the foot, namely, the os calcis or heel bone **18**, cuboid **20**, metatarsals **22** and phalanges **24**.

In order to understand applicant's invention it is necessary to consider the movement of the bones of the foot when walking unshod. Fig. 3 illustrates the position of the os calcis bone in the initial and final position upon contact of the foot with the ground 26 after the motion has been initiated, in which A indicates the position of the os calcis when the foot is normally extended forward and the pressure on the os calcis is created upon contact with the ground, at substantially two points, namely, on the slightly convex postero-inferior surface 28 and the medial tubercle 30. This is the position of the os calcis as the foot initially contacts the ground, and it is the most stable position in that the foot is well balanced with the weight of the body distributed on at least two points on the os calcis. If the length of stride is increased the foot will be supported solely on the rounded postero-inferior surface 28. The stability of the support accordingly decreases when the maximum length of stride is approached. If the length of stride is a minimum, the point of initial contact and shock will be only on the medial tubercle 30.

Reconsidering the initial position A as the body moves forward, the weight of the body is shifted to the medial tubercle 30, which thereafter acts as a fulcrum, and the foot rolls on the medial tubercle until the foot is flat on the ground, as indicated by the os calcis in position B. In the average adult foot the medial tubercle is in the form of a ridge measuring about ¾ inch in width and about ⅜ inch in length. At position B the foot is in the same position as in standing, and the weight of the body is transmitted through the os calcis and directed solely on the medial tubercle. Thus, the medial tubercle in acting as a pivot for the foot during the stride forward causes a forward motion of the foot. In the adult foot the distance of this forward motion, or roll on the os calcis is about ½ inch to ¾ inch.

With the above bio-mechanics of the unshod foot in mind, consider the same foot movement with the foot shod in the conventional shoe as in Fig. 1, where the foot is shown in a standing position and the metatarsals 22 and phalanges 24 are bearing against the sole 14 of the shoe. The weight of the body is transmitted to the shoe heel 12 through the medial tubercle 30, similar to position B of Fig. 3.

During forward motion in the conventional shoe the foot is extended forwardly in a manner previously described and illustrated in Fig. 2, and the lower hind margin of the shoe heel is anchored at 32 to the ground. The metatarsals 22 and the phalanges 24, which must necessarily contact the upper 16 of the shoe when the foot is initially lifted off the ground, resist the counter-pressure created by the contact of the shoe with the ground. Because the foot is tightly embraced by the shoe the foot remains supported on the medial tubercle although the foot may slide rearwardly depending on the longitudinal clearance present between shoe and foot. The point of pivot for the foot is now at the lower hind margin of the shoe heel and remains there until the foot is rotated to the original position as in Fig. 1. The distance from the point of pivot 32 on the ground and the medial tubercle forms a substantially rigid lever, which since the foot is tightly embraced in the shoe, in effect forms a rigid extension of the foot. As the center of gravity of the body must pass through the point of contact of the foot, which in the conventional shoe is the medial tubercle, a moment is created around the pivot point 32, which the bones of the foot tend to balance by pressure against the upper of the shoe. This counter-balancing action by the foot bones against the shoe upper causes a rubbing action against the skin and a strain in the bones and muscles of the foot and the fore leg, resulting in fatigue and heat due to friction. The longer the lever the higher the foot must be lifted which also increases the force exerted by the bones of the foot and muscles of the leg.

The moment created by the lever in the conventional shoe heel also causes a greater force to be applied to the medial tubercle as the shoe pivots on the ground, increasing the likelihood of local pressure and friction on the medial tubercle ultimately causing organic changes in the tissue.

In addition, by creating a point of pivot 32 for the foot outside of the foot and laterally spaced from the medial tubercle, there is a shift of the center of gravity from a line which would normally extend through the leg bones, through a new line posterior thereof. This action results in an increased bending force on the leg bones and a corresponding strain on the leg bones and muscles.

As the os calcis is unable to roll in the conventional shoe heel, as it does on the ground when walking unshod, the entire weight of the body and shock due to walking is always concentrated on the medial tubercle surface which is relatively small in area. This action causes thinning of the protective fat pad of the heel, localized ligamentitis, periostitis, bursae, and spur formations, and other painful disturbances.

The sliding action of the foot in the conventional shoe on the medial tubercle until the foot reaches the counter 33, and forward when the foot is brought down also causes a disadvantageous rubbing action and heats the foot through the friction created.

I have discovered that I can eliminate the above disadvantages of the conventional shoe by constructing the multiple heel 34, one form of which is shown in Figs. 4, 5 and 6. The multiple heel 34 comprises an outer or peripheral heel element 36, and an inner or central heel element 38 for supporting the os calcis. The inner and outer heel elements are spaced sufficiently apart to permit relative movement therebetween by a slit 40 extending through the entire shoe, viz, heel and sole. The slit 40 extends longitudinally on each side of and transversely across the shoe adjacent the rear margin to form a movable flap-like U-shaped structure which supports the medial tubercle as is shown in Fig. 6. Looking inside the shoe as appears in Fig. 6 the slit 40 extends longitudinally forward terminating short of the forward edge 42 of the heel providing an integrally attached hinged portion 44 about which the inner heel element 38 may flex, and a connecting portion 46 on each side to the outer heel element 36 for supporting the flexing action. Apertures 47 may be provided at the end of the slit to prevent tearing.

To obtain a water-tight construction and prevent the seepage of moisture and entry of foreign matter into the shoe through the slit, I may provide a flexible material that is positioned in the slit to act as a seal as will be later described with respect to Fig. 11.

In operation and following through the same movement as with the conventional shoe described with respect to Fig. 2, when the fore leg of the user having a shoe with the multiple heel 34 is extended forward after forward movement has been initiated, the outer heel element 36 strikes the ground at its rear margin 48 and performs its function as an anchorage means preventing the foot from slipping, see Fig. 5.

Immediately thereafter the outer heel element 36 flexes under the weight of the body until the inner heel element 38 contacts the ground at its rear margin 50. During this action there may also be a slight flexing of the inner heel element 38. The weight of the body is transitted through the leg bone, to the os calcis, and the medial tubercle which bears on the inner heel element 38. A pivotal action of the foot with respect to the ground occurs at the lower rear margin 50 of the inner heel element 38.

The foregoing pivot point 50 of the shoe at the inner heel element is substantially vertically aligned with the leg bone through the medial tubercle. Consequently the long lever is eliminated, which is present in the conventional shoe, relieving the muscles and bones of the leg and foot from strain and fatigue. Not only are the muscles and bones of the foot and leg benefited by the elimination of the long lever extension of the foot during movement, but benefit also occurs when starting of forward motion from a standing position, as the foot must roll back slightly to enable the leg to be lifted off the ground. Additionally, the contact of the outer heel element 36 with the ground at 48 forms a steadying or balancing action with the pivotal action of the inner heel element 38 at 50.

A pocket 52 is formed between the inner and outer heel elements when the outer heel rides up in relation to the inner heel. This pocket accommodates the os calcis, with the upper edge 54 of the outer heel element engaging the rounded postero-inferior surface 28. A two point support for the os calcis is thus provided, similar to that which occurs in the unshod foot, with the major weight of the body being absorbed by the medial tubercle and the remainder absorbed by the postero-inferior surface 28 which acts to balance the force on the medial tubercle.

The upper edge 54 of the outer heel element, in addition to serving as a support to balance the weight of the body, functions to prevent the sliding action of the medial tubercle on the shoe, thus avoiding the rubbing action and the injuries to the bone and tissues resulting therefrom.

The slit 40 may extend transversely through the entire shoe at the heel and preferably along an oblique line as shown in Figs. 4, 5 and 6. The oblique line provides a greater supporting surface at the upper edge 54 of the outer heel for the postero-inferior surface 28 of the os calcis. The slit should be sufficiently wide to permit unrestricted movement of the inner heel element.

The resiliency of the inner heel element provides a cushioning effect on the foot minimizing the shock from the engagement of the outer shoe heel with the ground. The inner heel element absorbs the main shock caused by contact with the ground and takes more of the wear reducing the so called "worn down at the heel" appearance that would normally occur at the outer heel element 36 or in the conventional shoe heel 12.

In Fig. 7 I have placed an insert 55, made of any suitable resilient material, in the outer heel element 56 along the upper forward edge to provide a cushion for the os calcis when engaged by the postero-inferior surface 28 and give greater support and comfort to the os calcis.

In Figs. 8, 9 and 10 I have provided different modifications of my novel multiple heel in which the configuration of the inner heel element may be varied. In Fig. 8 the inner heel element 58 has a sharp corner at its rear outer edge 60 to provide a straight edge for improved footing on the ground. The slit 62 may extend forward on each side beyond the leading edge 63 of the inner heel element so that the inner heel will be attached at the sole 64 of the shoe, in contrast to Fig. 6 where the inner heel 38 is attached within the heel itself. The slit 62 may vary in length on each side to provide more or less resiliency on a particular side of the shoe if this result is found desirable.

In Fig. 9 I provide an outer heel element 66 and a plurality of inner heel elements 68 and 70, which may be concentrically positioned and separated by respective slits 72 and 74. By extending the slits 72 and 74 for different lengths, each heel element may have a different resiliency and produce a cushioning effect for the os calcis in a manner shown in Fig. 5 or Fig. 7. The inner heel elements 68 and 70 may each have the same configuration or may vary in design.

A study of the bones of the foot will show that the medial tubercle is a ridge-like formation, as previously described, and extends along a line oblique to the longitudinal centerline of the foot, but substantially normal to a plane passing through the great toe. In this manner the unshod foot pivots on the medial tubercle in the plane containing the large toe and the weight of the body when shifted is distributed along the axis of function between the medial tubercle and the ball of the great toe. I have simulated this natural action by my construction in Fig. 10 in which the inner heel element 76 is cut at a bias with the rear edge 78 formed along an oblique line substantially parallel to the medial tubercle and the slit 80 formed to provide a hinge 82 along a line parallel to the rear edge 78. When the foot pivots on the inner heel element 76 the force due to the weight of the body will be distributed to the great toe along a line normal to the hinge and the rear edge 78.

Whereas in Figs. 6 and 9 the inner and outer heel elements may be integrally attached within the heel, and in Fig. 8 the integral attaching means may be the sole 64, I may provide as in Fig. 11 an inner heel element 83 as a separate unit resiliently mounted within the outer heel element 84 by a resilient material 86, such as a gum rubber or the like. In place of a resilient material, I may use a flexible spring or spring biased hinge for connecting together the inner and outer heel elements.

To provide a surface with greater comfort to the heel of the foot, I may use in the various modifications described above a flexible innersole 88, shown in Fig. 11, which covers the inner and outer heel elements. The innersole 88 need not be fixed to the outer heel to permit relative movement between the heel elements.

The resilient material 86, as previously mentioned, may be positioned between the inner and outer heel elements of the various prior modifications as a sealing means to avoid the entrance in the shoe of moisture and foreign matter.

The inner heel element 83 may be slightly reduced in thickness as compared with the outer heel element to space the under surface of the inner heel element from the ground as at 88 thus providing some resiliency for the os calcis when the foot is in a standing position.

By providing my novel multiple shoe heel having a heel element within a heel element flexibly mounted one with respect to the other, I can substantially support the medial tubercle on the inner heel element and the soft fat pad of the heel on the outer heel element while walking, and simulate the natural action of the foot when walking unshod. The inner and outer heel elements when flexed form a pocket for the os calcis when walking and prevents the foot from sliding to and fro on the inner sole and irritating the medial tubercle and the surrounding tissues.

The upper forward edge of the outer heel element supports the postero-inferior surface of the os calcis relieving the medial tubercle of the entire weight of the body and distributing the stress. In addition, the outer heel furnishes an additional point of support for the os calcis in a manner similar to the foot when walking unshod, which adds to the stability of the foot when walking. The same balancing action occurs on the lower rear edges of the inner and outer heel elements when they engage the ground forming multiple points of contact.

In providing an inner heel element for supporting the medial tubercle on which the foot may pivot, I can materially reduce the length of the rigid lever heretofore present in a shoe having a conventional heel. Consequently, I reduce the strain on the metatarsal and phalangeal bones, as well as reduce the strain on the leg bones and muscles during the action when initiating movement and when the extended foot contacts the ground. The foot need not be lifted as high for clearance as with the conventional heel and thus energy is expended.

The particular configuration of the inner and outer heel elements may be varied to give the desired effect. By providing a posterior margin of the inner heel element normal to a plane containing the big toe, the natural hinge action of the medial tubercle in the unshod foot is imitated.

A plurality of inner or outer heel elements may be provided to give a varying degree of resiliency which will cushion the os calcis and absorb the shock of walking, in a manner similar to a cushion insert. The inner and outer heel elements can be connected integrally through the heel or sole, or may be made as separate elements with a supplemental resilient connecting means.

I have thus described my invention, but I desire it understood that it is not confined to the particular forms or uses shown and described, the same being merely illustrative, and that the invention may be carried out in other ways without departing from the spirit of my invention, and, therefore, I claim broadly the right to employ all equivalent instrumentalities coming within the scope of the appended claims, and by means of which, objects of my invention are attained and new results accomplished, as it is obvious that the particular embodiments herein shown and described are only some of the many that can be employed to attain these objects and accomplish these results.

I claim:

1. A shoe for the foot comprising innersole, outersole, and heel sections positioned at the posterior region of the shoe for supporting the medial tubercle of the os calcis, said sections divided to form a fixed peripheral portion and a central movable portion the latter of which is positioned directly under the medial tubercle, said movable portion moving with respect to the fixed peripheral portion when the body weight is shifted during motion of the foot in normal gait.

2. The shoe of claim 1, wherein the central movable portion is shaped in the form of a tongue, the fixed distal end of which is integral with the shoe.

3. The shoe of claim 1, wherein the fixed peripheral portion completely encircles the movable portion.

4. The shoe of claim 1, wherein a flexible material is positioned between the fixed peripheral portion and the movable central portion to permit sealing of the two portions during movement.

HARRY CHARLES STEIN.

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