



# UNITED STATES PATENT OFFICE

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## FOOT BALANCING MEANS

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6 Claims. (Cl. 36—71)

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The present invention relates generally to shoes, and more particularly to means for and a method of achieving foot balance and correct position within a shoe.

The invention relates to the subject matter of my previously issued Patents No. 2,238,366 of April 15, 1941, and No. 2,252,936 of August 19, 1941, and constitutes extensions to and improvements upon the art disclosed therein. Therefore, a principal object of the present invention is to provide improved means for and a method of supporting and balancing a foot within a modern shoe having a raised heel which are applicable alike to the "normal" foot and to the foot having an arch structure which is congenitally weak or which may have been unduly weakened by habitual use of the foot in an unnatural position.

As stated in the above-mentioned patents, I hold to the theory that there is a single primary bone arch in the normal human foot. This primary arch I conceive as extending from the posterior portion of the plantar region of the os calcis to the anterior plantar portion of the first metatarsal, these two areas being the main bearing contacts with the ground or floor. Intermediate these main bearing areas but laterally of a line connecting them, there exists another important bearing contact with the ground or floor, viz., the plantar protuberance adjacent the posterior end of the fifth metatarsal. This latter contact is secondary in weight transmitting function to the two first-mentioned contacts, but it aids materially in balancing the foot owing to its lateral location relative to the main ground or floor contacting elements.

The single arch theory, in controversion to a multiple arch theory held by many authorities, contemplates the interlocked bones of the tarsus as integral keying elements of a single arch rather than constituting a system of three or four separate substantially parallel arches. Thus, as can be readily understood, the complete foot arch may be considered to extend not only longitudinally from the posterior portion of the os calcis to the anterior portion of the first metatarsal, but also laterally inwardly and upwardly from a curved line extending through the posterior portion of the os calcis, the posterior enlargement or base of the fifth metatarsal, and the anterior enlargement or head of the first metatarsal. In other words, the bones of the tarsus particularly, the cuboid, the three cuneiforms and the scaphoid form an interlocked network of bones which functions as a load bearing unit when properly locked together.

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Normally, a proper keying or locking action is instigated by pressure on the plantar protuberance of the fifth metatarsal and moves progressively upwardly and inwardly through the cuboid and the remaining enumerated bones of the tarsus until the weight is transferred almost entirely to the first metatarsal. As the foot rolls forward in a walking motion, the pressure on the plantar protuberance of the fifth metatarsal is reduced, but the locking action of the fifth metatarsal is maintained by pressure contact of the forepart of this bone on the walking surface. The fourth, third and second metatarsals act primarily as auxiliary braces spanning out from the tarsus to assist in the general balance of the foot.

Unfortunately, modern shoe construction is not adapted to support all of the important points of bearing contact as nature apparently intended that they should be supported, and the result has been notably to weaken the whole arch structure to the point where, in some individuals, even a return to normal foot contact with a bearing surface does not enable the weakened arch structure to perform normally. A foot thus weakened will be subjected to much discomfort during and after prolonged periods of use.

It is apparent, then, that, in many cases, the employment of remedies as disclosed in my two previously mentioned patents, while providing appropriate bearing surfaces to insure normal foot support, is not enough to render maximum comfort to those who possess abnormally weakened arches or, for that matter, arches which are congenitally weak. It has been found, however, that by combining certain remedial constructions of my existing patents above enumerated with accompanying nominal support of substantially the entire metatarsal region, bone and muscle fatigue may be greatly reduced. Therefore, in extension of the principal object above recited, it is an object of the present invention to provide means for and a method of supporting a foot within a shoe to reduce muscle fatigue and relieve the strain on the ligaments.

Another object is to provide a device for insertion within a shoe adapted to cooperate therewith in providing appropriately disposed bearing contact areas for principal contacts of a foot and at the same time to provide support for substantially the entire metatarsal region of the foot.

Another object is to provide a device for insertion within a shoe adapted to provide appropriate support at both ends of a fifth metatarsal, thereby to enable a locking action to be instigated and maintained.

Other objects and advantages will be apparent

from the following description, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a side view of a shoe sole having a raised heel, the present invention being assembled in operative relation therewith, the bones of a foot being shown in dotted lines;

Fig. 2 is a top plan view of the shoe sole assembly and foot bones of Fig. 1;

Fig. 3 is a sectional elevation of the assembly of Fig. 1 taken generally along the line 3—3 of Fig. 2;

Fig. 4 is a sectional elevation of the assembly of Fig. 1 taken generally along the line 4—4 of Fig. 2;

Fig. 5 is a sectional elevation of the assembly of Fig. 1 taken generally along the line 5—5 of Fig. 2;

Fig. 6 is a top plan view of an element of the device comprising the subject matter of the present invention, a modified form being indicated in dotted lines;

Fig. 7 is a top plan view of another element of the device comprising the subject matter of the present invention; and

Fig. 8 is a top plan view of still another element of the device comprising the subject matter of the present invention.

Referring to the drawing more particularly by means of reference numerals, there is shown a shoe sole assembly 10 including an outer sole 12, an inner sole 14, and a heel 16. Upon the upper surface of the inner sole 14, there is superimposed an insert 18 constructed in accordance with the teachings of the present invention.

The insert 18 is of generally elongated configuration and comprises, in the depicted embodiment, three insert elements 20, 22 and 24 of cork composition or similar resilient material. The insert elements 20, 22 and 24 may be cut from sheet stock of the parent material and are preferably shaped to the respective outlines clearly shown in Figs. 6, 7 and 8.

The element 20 is adapted to occupy a position intermediate the ends of the inner sole 14 and has its lateral edges shaped to conform to respective adjacent portions of the side edges of the inner sole 14 (Fig. 7). The upper surface of the element 20 is beveled forwardly and rearwardly so as to leave flat an area 26 of generally trapezoidal shape, the bevels descending uniformly therefrom to form fore and aft feather-edged transition portions 28 and 30.

The element 22, like the element 20, has its lateral edges shaped to conform to respective adjacent portions of the side edges of the inner sole 14 (Fig. 8). It also has an area 32 of uniform thickness extending between fore and aft feather-edged transition portions 34 and 36. The element 22 overlies the element 20 and extends forwardly and rearwardly thereof, as best shown in Fig. 2.

The element 24, shaped as clearly shown in Fig. 6, conforms to the shape of the inner sole 14 along only an adjacent portion of the inner edge thereof, it being apparent from Fig. 2 that the outer edge of the element 24 does not extend to the outer edge of the inner sole 14. An area 38 of uniform thickness is thus bounded by a single continuous feather-edged portion 40 which extends around three sides of the element 24. The element 24 is superimposed upon the element 22. The dotted lines in Fig. 6 illustrate a modified shape for the indicated portion.

The various elements which together comprise the insert 18 are appropriately cemented one to

another to form a single unit, and it is clear that the shapes of the individual elements as well as the number thereof may be varied to provide an insert 18 which is adapted to render needed foot support of the type contemplated in the present invention. The composite insert 18 may be molded as a unitary structure after determining foot requirements or as a blank. However, the composite construction illustrated is preferred.

In use, the insert 18 is disposed in a shoe against the inner sole 14 either beneath or above a sock lining (not shown). It is apparent from Figs. 1 and 2 that, in this position, the rearwardly situated transition portions 36 and 40 of the elements 22 and 24, respectively, are adapted to support the anterior portion of an os calcis 42 and to serve as a stop to prevent a foot from sliding forwardly in the shoe. It is likewise apparent that the shape and disposition of the element 20 are effective to elevate a portion of the surface 32 of the element 22 so as to provide an appropriately disposed bearing surface for the plantar protuberance 44 of the fifth metatarsal 46 whereby the aforementioned ability of the latter to instigate a locking action of the tarsal bones 48, 50, 52, 54 and 56 may be maintained. These attributes, however, have been previously achieved through the disclosures of my two patents above-mentioned and it is, therefore, in the ability of the presently disclosed structure to provide additional further benefits that the present invention resides. Thus, it is seen further, that the elements 20 and 22 cooperate to provide an elevated support for the head 58 of the fifth metatarsal 46, thereby to maintain the aforementioned locking action as the foot rolls forward in a walking motion. Also, the three elements 20, 22 and 24 cooperate to provide an appropriately raised and shaped surface to support the remaining metatarsal region, including the first, second, third and fourth metatarsal bones 60, 62, 64 and 66, respectively, against abnormal depression. The forepart of the element 22 also supports the phalangeal bones of the second, third, fourth and fifth digits. It will be noted that the head of the first metatarsal, as well as the phalanges of the first digit, are permitted to rest upon the inner sole 14 which, of course, functions as a base or index surface, but the first metatarsal is supported by the forepart of the elements 22 and 24 just rearwardly of the head thereof.

Clearly, there has been provided a device and method which fulfill the objects and advantages sought therefor. It is to be understood that the foregoing description and the accompanying drawing have been given by way of illustration and example, and not for purposes of limitation, the invention being limited only by the claims which follow.

What is claimed is:

1. A device for insertion in a shoe for supporting selected portions only of a foot at predetermined different elevations above an insole comprising means for supporting the anterior portion of the os calcis of a foot at one elevation, means for supporting both the base and the forepart of the fifth metatarsal at another elevation, and means for supporting the portion of the sole of a foot adjacent the inner edge thereof and extending from beneath the anterior portion of the os calcis to the anterior portion of the first metatarsal at elevations which vary in magnitude between the one elevation and the other elevation aforementioned.

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2. A device for supporting selected portions of a foot comprising means for supporting the anterior portion of the os calcis of a foot, means for supporting both the base and the forepart of the fifth metatarsal, and means for supporting the portion of the sole of a foot adjacent the inner edge thereof and extending from the anterior portion of the os calcis to the anterior portion of the first metatarsal, said supporting device being of appropriate size and shape to permit the head of the first metatarsal and the posterior portion of the os calcis to be supported by the insole of a shoe with which said device is associated, said supporting device extending to immediately behind the head of the first metatarsal for lending support to the posterior portion of the first metatarsal and extending to the full extent of the phalanges of the second through the fifth digits for support thereof.

3. A device of non-uniform thickness for supporting portions of a foot comprising means for supporting the entire sole thereof with the exceptions of a portion rearwardly of the anterior portion of the os calcis and a portion forwardly of the posterior portion of the first metatarsal and inwardly of the second digit, said device having its maximum thickness in the general area adapted to underlie the joints of the first through the fourth metatarsal with the first through the third cuneiforms and the cuboid, respectively, said device having an intermediate thickness adapted to underlie at least a portion of the scaphoid, said device having sloping transition portions adjacent edges thereof beyond which the aforesaid unsupported portions of a foot are adapted to extend.

4. A device for insertion in a shoe and adapted to cooperate therewith in supporting a foot comprising an elongated insert adapted to be disposed on an inner sole of the shoe, said insert having side edges shaped to conform to part only of the side edges of the insole, said device being shorter than the insole and adapted to occupy a position in spaced relation to the rear end of the insole to permit a portion of the sole of a foot rearwardly of the anterior portion of the os calcis to rest upon the inner sole of the shoe, said device having a forwardly disposed portion of less width than the corresponding portion of the insole, said portion of less width having an inner edge adapted to occupy a position in lateral spaced relation to the corresponding inner edge portion of the insole to permit a portion of the sole of a foot forwardly of the posterior portion of the first metatarsal and inwardly of the second digit to rest upon the inner sole of the shoe, said device being of non-uniform vertical thickness for supporting selected elements of foot structure including the head of the fifth metatarsal different distances above

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the inner sole of the shoe, said device having sloping transition portions adjacent edges thereof beyond which said inner sole of the shoe is adapted to extend.

5. A device for insertion in a shoe and adapted to cooperate therewith in supporting a foot comprising an elongated insert of non-uniform thickness adapted to be disposed on an inner sole of the shoe and shaped to conform to portions only of the side edges thereof, said device being further appropriately sized and shaped to permit a portion of the sole of the foot rearwardly of the anterior portion of the os calcis and a portion of the sole of the foot forwardly of the posterior portion of the first metatarsal and inwardly of the second digit to rest upon the inner sole of the shoe, said device having an area of maximum thickness adapted to underlie portions of each of the first through the fourth metatarsals, the three cuneiforms, and the cuboid, said device having an area of intermediate thickness adapted to underlie a portion of the scaphoid, said device having an area of varying thickness less than said intermediate thickness adapted to underlie the anterior heads of the second through the fifth metatarsals and the phalanges of the second through the fourth digits.

6. A device for insertion in a shoe and adapted to cooperate therewith in supporting a foot comprising an elongated insert of non-uniform thickness adapted to be disposed on an inner sole of the shoe and shaped to conform to portions only of the side edges thereof, said device being further appropriately sized and shaped to permit a portion of the sole of the foot rearwardly of the anterior portion of the os calcis and a portion of the sole of the foot forwardly of the posterior portion of the first metatarsal and inwardly of the second digit to rest upon the inner sole of the shoe, said device providing elevated support for all other portions of a sole of a foot, said device being of laminated construction and having varying numbers of laminations in different areas thereof, each lamination having sloping transition portions adjacent edges thereof beyond which said inner sole is adapted to extend.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

Number	Name	Date
1,550,715	Stout	Aug. 25, 1925
2,238,366	Leydecker	Apr. 15, 1941
2,252,936	Leydecker	Aug. 19, 1941