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B. C. MAXWELL

2,034,243

SHOE

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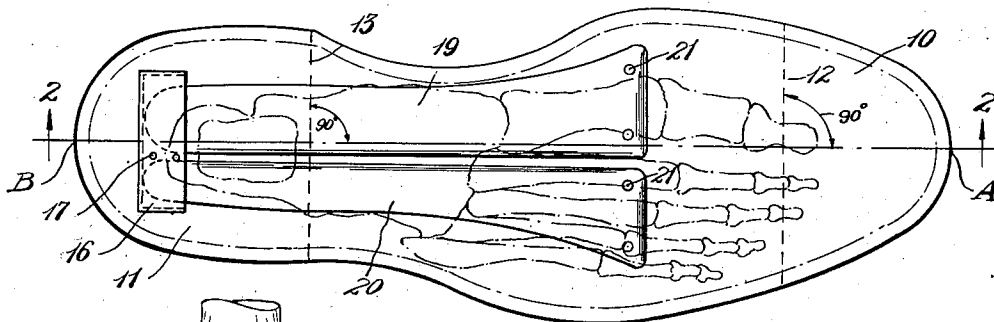


FIG. 1

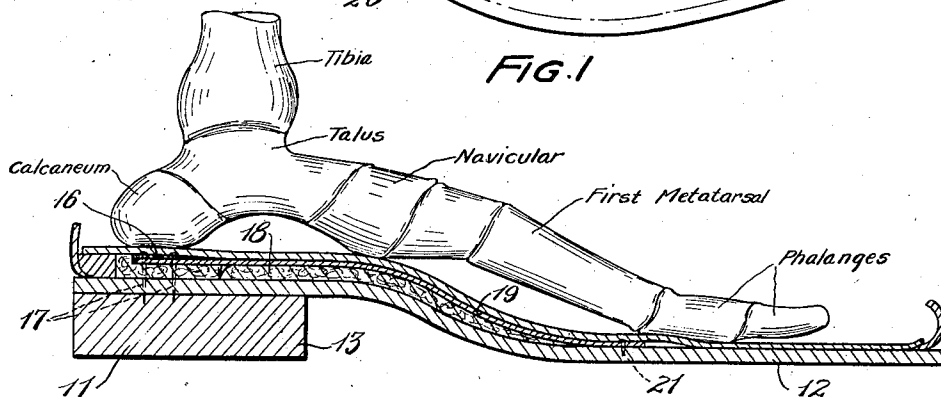


FIG. 2

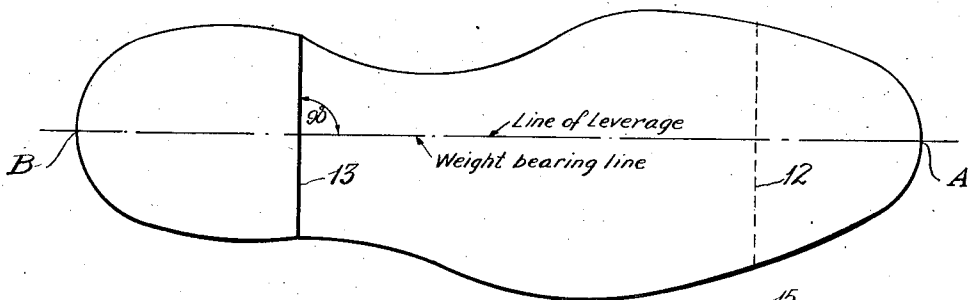


FIG. 3

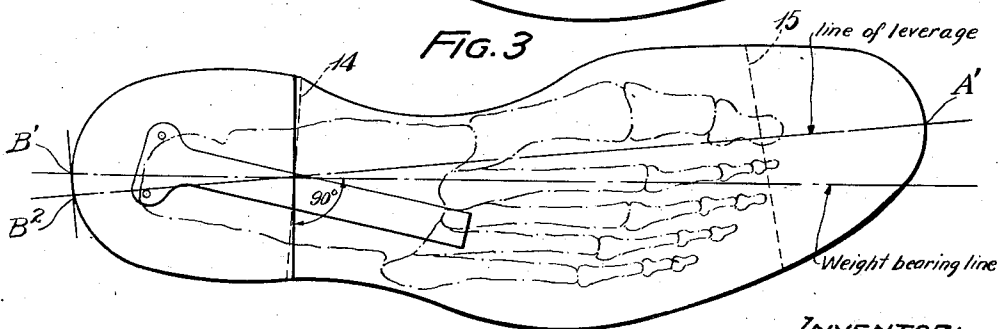


FIG. 4

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SHOE

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6 Claims. (Cl. 36-8.5)

This invention relates to a shoe constructed for use upon the foot of modern civilized man.

The main object of the invention is to provide a shoe in which the human foot may function and develop as nature intends it to do.

A further object is to provide a shoe embodying in its construction principles of mechanics conforming to the mechanics of the human foot and enabling the foot to function in the shoe at a mechanical advantage.

A further object is to provide a shoe that meets the functional demands of the human foot and permits the stress of body weight to pass unrestricted and unrestrained and without deformation of the foot over the natural weight-bearing line of the foot; that is, a shoe so formed that the line of leverage of the shoe coincides with the structural line of leverage of the foot.

A further object is to provide a shoe wherein there is a balance reinforcement of the line of leverage of the shoe.

A still further object is to provide a shoe so constructed that it promotes health and comfort for the wearer and provides for long service and thus economy in use.

Further and additional objects and advantages will become apparent hereinafter as the following description proceeds.

Before proceeding with a detailed description of the invention it is thought desirable, in order to more clearly bring out the advance in the art made by the invention and to clearly show the advantages inherent therein, to set-forth a brief resumé of the development and structure of the human foot.

The human foot, during the age when man walked on all fours and lived in trees, was short, the toes were long and the anterior part of the foot was broad, while the outer four metatarsals with their phalanges extended lateralwardly fan-like and the first metatarsal with its phalanges extended medialwardly thumblike. The feet toed in, the soles tended to face inwardly toward each other and the body weight rested mainly upon the lateral or outer part of the foot. This type of foot was suitable for the habits of early man, but it was not suitable for the two footed terrestrial man with a vertically supported body and it was necessary for nature to create a different type of foot.

The new type of foot, as now possessed by civilized man, is relatively long and slender, the outer four metatarsals with their phalanges and the first metatarsal with its phalanges having moved toward a definitely determined weight-bearing

line with the toes comparatively short in length. The new type foot presents an arched form for strength and resiliency, toes out for body balance and for locomotion and places its sole horizontal to the ground for stability.

The most important function of the foot is to assist in locomotion of the body and for that purpose the new type foot is designed to serve as a lever for lifting and propelling the body, hence the weight-bearing line or line of leverage has constantly appeared as the outstanding and determining factor in the development of the foot.

The natural weight-bearing line, the line of leverage, of the foot is definitely determined by the hinge-like movement of the ankle joint, by the direction of the superior surface of the talus, and by the direction indicated by the head of the talus, all of which coincide with the line that extends from the posterior point of the heel to a point between the heads of the first and second metatarsal bones. This line determines the normal distribution of body weight throughout the foot and the position of the foot when standing or walking and the location of the proper line of leverage of the shoe.

It is to be observed that the line of leverage is constructed out of the heaviest and strongest material of the foot, that it is straight and resilient, and that it is surrounded by structures designed to preserve its integrity and stability. This is shown by the fact that the soft tissues and bones on the inner side of the foot are more numerous and more massive and stronger than those on the outer side; the phalanges and metatarsals decreasing in size from the first to the fifth, with those on the outer side showing unmistakable signs of degeneration, while the navicular is more massive than the cuboid and the stress resisting surfaces of the talo-calcaneo-navicular joint are larger than those of the cuboidal-calcaneal joint.

For the most part the long bones of the foot extend parallel to the long axis of the foot. Each toe lies approximately in line with its associated metatarsal, while the long axis of the upper articulating surface of the talus lies in and parallel to a line which extends forward to a point between the heads of the first and second metatarsals and which marks the normal weight-bearing line of the foot, as pointed out above.

In the early human foot the line of leverage extended along the outer side of the foot, but in the modern human foot the line of leverage extends more nearly adjacent to the inner side of the foot, such line having shifted medialwardly as the foot became narrower and assumed

a position with the sole horizontal to the ground. A shifting of the line of leverage medialwardly moved the base of support to a position more directly under the body weight and reduced the essential width of the inner side of the foot, thereby gaining an advantage in supporting, lifting and propelling the body and in permitting the feet freely to pass each other during locomotion. In the modern foot the line of leverage extends from the heel to between the ends of the first and second metatarsal bones, as already explained herein.

The construction of the new type shoe herein described is based upon the new interpretation of the foot of civilized man above set forth, which interpretation is now generally accepted by scientists everywhere; but the construction of most shoes now worn is based upon the interpretation of the foot of uncivilized man, which has been wrongly considered the normal foot of civilized man.

Substantially all types of shoes now worn by civilized man are not adapted to the modern foot, although many are well adapted to the arboreal human foot. The ordinary shoe causes the foot to toe in and tends to make the sole to face inwardly, thus shifting the weight-bearing line or the line of leverage to the outer side of the foot. The ordinary shoe swings the forepart of the foot inwardly and elevates the inner side, thus tending to throw the body weight regularly upon the weak and less resilient outer side of the foot. Such shoes bend and shorten the foot and compress the foot on the inner side, thus reducing resiliency and disarranging the foot structure. They spread and weaken the joints on the outer side of the foot and thereby destroy the strength and efficiency of the foot. They bend the forepart inwardly from under the weight bearing line and thereby cause the weight to move diagonally across the forepart of the foot onto the heads of the lateral and weaker metatarsals.

As the foot straightens and stiffens during its use, shoes built according to modern practice receive strong outward-downward pressure from the foot at the lateral anterior and posterior parts and strong inward-downward pressure at the inner middle part. These unnatural bending and twisting pressures the foot exerts against the shoe strain all the joints of the foot and lead to outward turning of the ankle, to calluses beneath the heads of the middle and outer metatarsals, to corns on the outer side of the little toe, contracted and overlapping toes, sagging arches, and bunions; and they further lead to a destructive wearing and running down of the heel of the shoe on the outer side, bagging of the shoe at its middle inner side, and to a stretching outwardly of the upper anterior part of the shoe.

The constructions employed in modern shoes are based upon erroneous conceptions of the structural and functional makeup of the foot of civilized man. They are based upon the belief that the foot normally bends medialwardly from heel to toe; that the sole tends to face inwardly; that the body weight passes from the heel to the head of the fifth metatarsal bone and thence to the head of the first metatarsal bone; and that the foot should be set to point straight ahead when standing or walking.

In order to remove all of the above named disadvantages present in shoe construction, the present invention contemplates a shoe that has its strongest part coinciding with the actual and

structural line of leverage or weight-bearing line of the foot.

A shoe constructed according to the present invention has the sole placed horizontally to the ground and the most anterior part of its sole and the most posterior part of its heel lying in the line of leverage, thus permitting the shoe to function as a straight and stable lever.

The heel is bisected by the line of leverage and the breast of the heel extends at right angles to the line of leverage, thus permitting the heel to function as a balanced portion of the line of leverage. The posterior edge of the toe-cap and the anterior edge of the spring shank extend at right angles to the line of leverage, thus causing the shoe to break transversely and perpendicularly to the weight-bearing line and across the ball of the foot and permitting the metatarsophalangeal and the phalangeal joints to move over a transverse axis.

The shoe of the present invention further includes a shank construction which forms a balanced reinforcement for the line of leverage of the shoe. The shank is preferably a twin shank and consists of two parts of unequal strength placed parallel to each other and to the line of leverage of the shoe, each part being curved at its outer margin to correspond to the curve of the shoe and curved upwardly to correspond to the curve of the shank of the shoe. The weaker part of the twin shank member is located at the outer side of the shoe and the stronger part is located at the inner side of the shoe beneath and parallel to the line of leverage of the shoe and the weight-bearing line of the foot, which arrangement corresponds to the relative supporting strength of the parts of the foot.

Referring to the accompanying drawing:

Figure 1 is a plan view of the sole of a shoe constructed in accordance with the present invention, the skeleton of a foot being indicated thereon in order to more clearly bring out the reasons for the construction;

Fig. 2 is a longitudinal sectional view taken substantially on line 2—2 of Fig. 1, looking in the direction of the arrows, said line 2—2 of Fig. 1 coinciding with the line of leverage of the shoe and the weight-bearing line of the foot.

Fig. 3 is a plan view of the sole of a shoe or the bottom of a shoe last constructed in accordance with the present invention, and

Fig. 4 is a plan view of the sole of a shoe of ordinary construction, or the bottom of the last for making it, the line of leverage of the shoe being shown thereon and also a line which would coincide with the weight-bearing line of a foot.

The weight-bearing line of the foot of civilized man passes from the heel to between the heads of the first and second metatarsal bones and coincides with the line of motion of the ankle joint when one is walking, the stress of body weight following the weight-bearing line; the weight-bearing line of the foot, indicated in skeleton form in Fig. 1, coincides with line 2—2 of said figure. It will be noted that the line of leverage of the shoe (the weight-bearing line of the foot, as indicated by line 2—2 of Fig. 1) passes through the most forward point A of the sole 10 of the shoe and the most rearward point B of the heel 11 thereof. It will also be noted that the line of leverage of the shoe, line 2—2 of Fig. 1, perpendicularly intersects the dotted line which indicates the posterior edge of the toe-cap 12 and bisects the anterior line or breast 13 of the heel and that such line of leverage lies more

closely adjacent to the inner side of the foot than to the outer side of the foot.

Fig. 3 indicates the sole of a shoe made in accordance with the present invention, or the bottom of the last for making the same, and clearly indicates the coincidence of the actual or structural weight-bearing line of the foot with the line of leverage of the shoe, and the fact that such line extends through the extreme end points of the toe and heel of the shoe and perpendicularly bisects the anterior end or breast of the heel and perpendicularly intersects the posterior end of the toe-cap.

In Fig. 4 there is illustrated the sole of an ordinary shoe, or the bottom of the last for making such a shoe. It will be noted that the line of leverage of the shoe does not extend through the extreme end points A' and B' of the shoe, but only through the point A' and through a point B² located toward the outer side of the heel from the point B'. The dot and dash line 14 of Fig. 4 represents the front edge or breast of the heel and it will be noted that said line does not intersect the line of leverage of the shoe at right angles thereto, but extends across the shoe from the inner side diagonally rearward toward the outer side. In other words, the front of the heel faces toward the outer side of the shoe.

It will further be noted in the shoe or last shown in Fig. 4 that the line 15 representing the posterior end of the toe-cap likewise is not perpendicularly intersected by the line of leverage of the shoe, but extends transversely thereof from the outer side of the shoe diagonally and rearwardly toward the inner side thereof, that is, the toe of the shoe faces inwardly and in a direction opposite to the direction in which the breast of the heel faces.

This form of construction is such that the foot is abnormally twisted or deformed, since the heel is made to face in one direction, while the inwardly curved toe of the shoe twists the foot so that it will face in an inward and different direction. For these reasons the ordinarily constructed shoe does not allow the foot of civilized man to function in the manner in which nature intends it to do, but subjects it to an unnatural twisting and cramping which is highly injurious to the foot and shoe when bearing body weight, there being a conflict between the structural line of leverage of the shoe and the structural line of leverage of the foot.

It will be noted in the shoe shown in Fig. 4 that the weight-bearing line of the foot passes from the most rearward point B' of the heel forwardly and through a point adjacent the toe of the shoe, but lying rearwardly of the point A' and on the outer side of the shoe. When a person wears the ordinarily constructed shoe, such as shown in Fig. 4, the natural weight-bearing line of the foot, being as indicated in the drawing, and the line of leverage, being angularly disposed and not coinciding therewith, the foot attempts to adapt itself to such line of leverage, but cannot and, therefore, there is a constant inclination of the stress of body weight to follow the weight-bearing line of the foot with the result that the weaker outer side of the foot is subjected or forced to assume a duty for which it was not intended, while the shoe is forced over toward the outer side thereof, resulting in quickly wearing out the outer side of the upper part of the shoe in addition to subjecting the foot to harmful stresses, causing overlapped toes, falling arches, bunions and other disturbances of the foot and

numerous reflex disturbances in other parts of the body.

The shoe of the present invention, as previously stated, also includes a novel shank construction and one that cooperates with the other parts of the shoe in the normal movements of the foot and assists in preserving the integrity and stability of the line of leverage of the shoe and the actual or structural weight bearing line of the foot.

It is constructed preferably of spring steel and consists of two parts, a twin shank member built into the shank of the shoe and a receiving member built into the heel of the shoe.

Referring to Figs. 1 and 2, the receiving member is indicated at 16 and comprises a strip of metal or other suitable material flanged at its rear and sides and secured in position by suitable securing means 17 arranged intermediate its ends and extending through a suitable shock absorbing pad 13 arranged beneath the twin shank member.

The twin shank member is formed of two elements or parts which may be integrally connected or which may be separate from one another, the latter construction being that illustrated in the drawing. The twin shank member shown in Fig. 1 comprises an element or part 19 lying adjacent the inner side of the shoe and the element or part 20 lying adjacent the outer side of the shoe. The elements 19 and 20 are preferably, but not necessarily, secured at their forward ends by suitable means 21 extending into the sole of the shoe, while their rear ends pass beneath and into the receiving member 16, it being loosely positioned therein whereby the shank elements may adapt themselves to the normal flexure of the shoe. It will be noted that both shank elements 19 and 20 extend parallel to the line of leverage of the shoe and the weight-bearing line of the foot and intersect line 13 of the front or breast of the heel at right angles thereto, while a line passing through their forward ends is parallel to the line 12 at the rear of the toe-cap. The element 19 on the inner side of the shoe is stronger than the element 20, since the weight-bearing line of the foot lies above and the line of leverage of the shoe passes through or adjacent the element 19.

As previously stated, the two parts of the twin shank member may be connected together structurally at either or both ends, and one or both ends may be securely attached to the shoe, although it is preferable that it be constructed of two separate parts with only the anterior ends securely attached to the shoe, wherefore both parts are permitted to operate independently or in unison as the normal movements of the foot may direct.

The movements of the twin shank member, of course, are facilitated since the posterior end thereof is received in the receiving member in such manner as will permit free, but limited, movement of the shank member in all directions without injury to essential parts of the shoe. When the twin shank member consists of two separate elements or parts, as illustrated, the receiving member, it will be noted, is so constructed as to present two side by side chambers designed to receive the two posterior ends respectively, since the securing member 17 separates the receiving member into the two chambers and thus prevents overlapping of the ends of the shank elements or parts. Of course, when the twin shank member is structurally united at the posterior end, only one chamber is provided in

the receiving member. It will be noted that the flange along the rear edge of the receiving member forms a posterior wall or abutment with which engages the posterior end of the twin shank member when it lengthens under the stress of body weight. The rear end of the twin shank member extends to a point near the rear margin of the heel, while the front end of the member extends forwardly to a point near, but rearwardly of the position of the first metatarsophalangeal joint. These two points represent the weight-bearing points of the member.

A resilient cushion-like member 18 is arranged beneath the twin shank member and between the two weight bearing points and acts as a shock absorber for the stress of body weight imparted to the twin shank member and thus supports the latter and helps to preserve the shape of the shoe. The member 18 acts to absorb the weight applied to the breast of the heel and thus to prevent the toe and heel of the shoe from tilting upwardly.

It is understood that when reference is made herein to the weight-bearing line or line of leverage of the foot, sometimes referred to by scientists as the physiological or functional axis of the foot, it is meant that line upon which the greatest stress of body weight is received and which normally extends from the center of the posterior border of the heel to between the heads of the first and second metatarsal bones including the long axis of the talus. Naturally the weight of the body is imparted to some extent to all parts of the foot, but only the heel and the part marked by the treads of the first and second metatarsal bones regularly and directly bear body weight through contact with the ground or other supporting surface. Thus the structural line of leverage of the foot includes the long (longitudinal) axis of the talus and passes from the posterior border of the heel to and between the heads of the first and second metatarsal bones and normally functions over an approximately vertical plane. It is also understood that when reference is made herein to the weight-bearing line or line of leverage of the shoe, which may be referred to as the functional axis of the shoe, it is meant that line which corresponds to and which normally coincides with a similarly designated line of the foot. It is substantially a straight line and functions as such, for only a straight lever can serve efficiently. Thus the structural line of leverage of the shoe passes from the posterior border of the heel to and through the space in the shoe that is provided for the heads of the first and second metatarsal bones, following the space for the long axis of the talus, and normally functions over a vertical plane coinciding with that of the structural line of leverage of the foot.

Since the line of leverage or weight-bearing line is the most important feature of the foot of civilized man, as before stated, it becomes the most important feature of a shoe designed for that foot, and since the heel of the foot first receives, supports, and directs the body weight in its forward movement over the foot, as in walking, it constitutes the most important part of the weight-bearing line of the foot. Likewise, since the sole or tread of the heel of the shoe first receives, supports, and directs the body weight in its forward movement over the shoe, the heel constitutes the most important part of the weight-bearing line of the shoe, and the tread constitutes the most important part of the

heel of the shoe. Thus in order that the heel of the foot might function normally and that the heel of the shoe might function efficiently, the invention herein disclosed provides that the heel of the shoe shall be set in structural alignment with the weight-bearing line or line of leverage of the shoe, and that the tread of said heel shall be divided by said line into two parts of like design, so that the parts of the tread, one on either side of the line of leverage or weight-bearing line, may present bearing surfaces or tread-ways having equal balancing effect on the movement of body weight over the coinciding weight-bearing lines or lines of leverage of the foot and shoe.

Although a preferred form of the invention has been illustrated and described herein, it should be understood that the invention is susceptible of various modifications and adaptations within the scope of the appended claims.

Having thus described my invention, I claim:

1. A shoe comprising a sole, a heel secured thereto, a reinforcing shank member extending from above the heel to a point forwardly of the shoe shank, said shank member having a plurality of separately functioning elements of different strength, the strongest of said elements being located adjacent the inner side of the shoe and including the line of leverage of the shoe, and means located above the heel and into which the rear ends of said elements extend and have limited movement therein.

2. A shoe comprising a reinforcing shank member, a sole and a heel secured thereto, and a toe-cap, said shoe having a structural line of leverage forming a straight line connecting the extreme tip of the toe portion of said sole and the extreme tip of the rounded heel portion thereof and passing through a point in the middle third of the space across the sole at the ball of said shoe, said line of leverage extending at right angles to the breast of the heel of the shoe, and to the posterior border of the toe-cap of the shoe, and to the anterior border of the reinforcing shank member of the shoe.

3. A shoe comprising a reinforcing shank member, and a sole and a heel secured thereto, said shoe having a structural line of leverage forming a straight line connecting the extreme tip of the toe portion of said shoe and the extreme tip of the rounded heel portion thereof and passing through a point in the middle third of the space across the sole at the ball of said shoe, said line of leverage extending at right angles to the breast of the heel and at right angles to the anterior border of the reinforcing shank member of said shoe.

4. A shoe comprising a reinforcing shank member, a sole and a heel secured thereto, and a toe cap, said shoe having a structural line of leverage forming a straight line connecting the extreme tip of the toe portion of said sole and the extreme tip of the rounded heel portion thereof, said line of leverage extending at right angles to the breast of the heel of said shoe and to the anterior border of the reinforcing shank member of said shoe, and perpendicularly intersecting the posterior border of the toe cap of said shoe at a point more closely adjacent to the inner side of said sole than to the outer side thereof.

5. A shoe comprising a sole and a heel secured thereto, and a toe cap, said shoe having a structural line of leverage forming a straight line connecting the extreme tip of the toe portion of

5 said sole and the extreme tip of the rounded heel portion thereof, and including the middle longitudinal line of the heel portion of said sole and the longitudinal bisecting line of said heel and perpendicularly intersecting the posterior border of the toe cap of said shoe at a point more closely adjacent to the inner side of said sole than to the outer side thereof.

10 6. A shoe comprising a sole and a heel secured thereto, a reenforcing shank member, and a toe cap, said shoe having a structural line of lever-

age forming a straight line that includes the medial longitudinal line of the heel portion of said sole and the forwardmost point of the toe portion of said sole, and perpendicularly intersects the posterior border of said toe cap at a point more closely adjacent to the inner side of said sole than to the outer side thereof, said shank member extending forwardly from above the heel portion of said sole and being included in said line of leverage. 5

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