Oct. 23, 1934. J. A. PINAUD 1,977,695

HEEL

Filed June 10, 1933

Fig. 1.

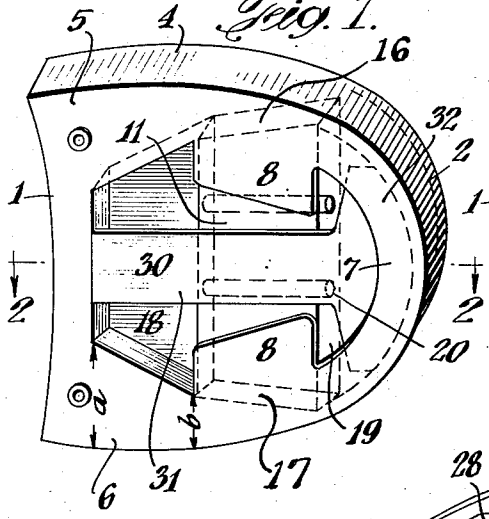


Fig. 2.

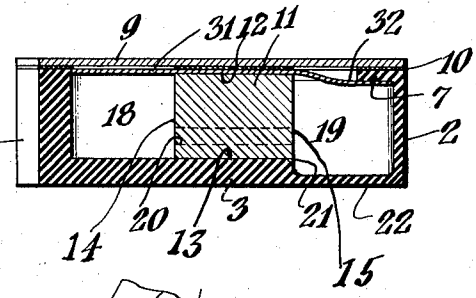


Fig. 3.

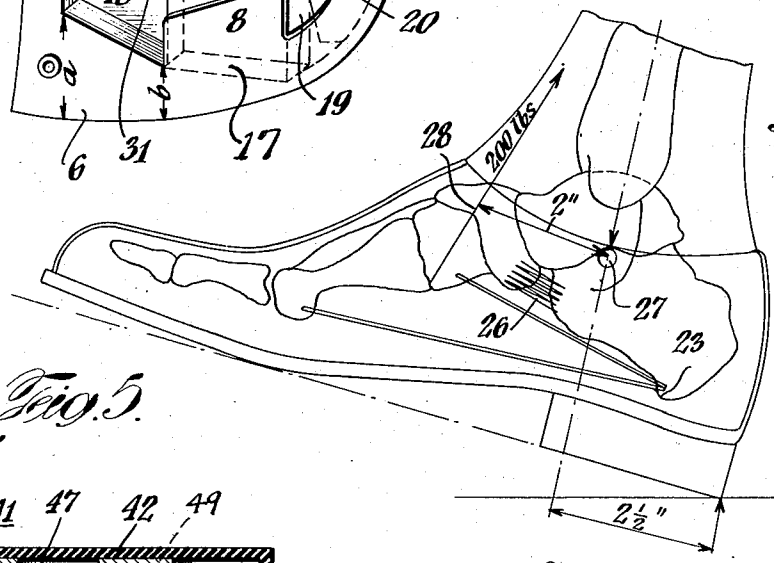


Fig. 5.

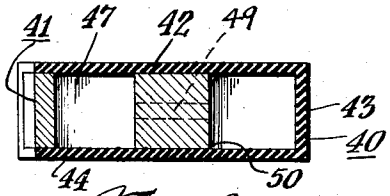


Fig. 6.

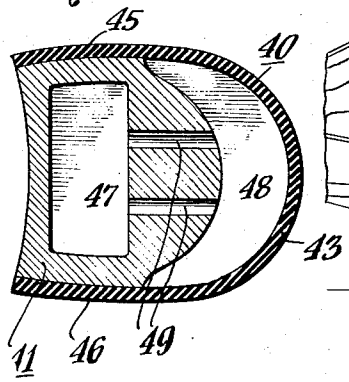
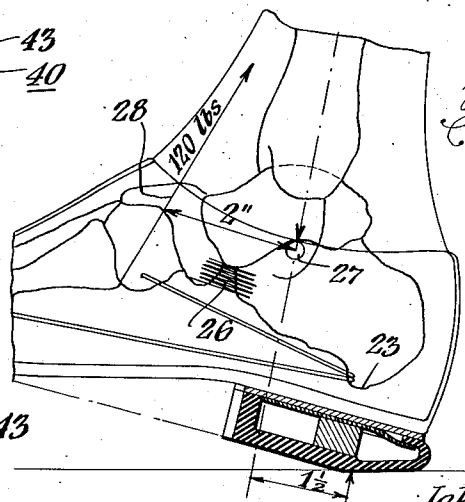


Fig. 4.



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UNITED STATES PATENT OFFICE

1,977,695

HEEL

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17 Claims. (Cl. 36—35)

This invention relates to improvements in shoe heels, and more particularly to a shoe heel having an anteriorly displaced rear supporting edge.

Hitherto, it has been proposed to alleviate foot troubles and other bodily ailments associated with or having their origin in maladjustments of the muscles and bones of the feet by providing resilient heel members. The underlying theory has been that such maladjustments and troubles were due to impacts transmitted from the heel to the foot and leg muscles. The solution of the problem was considered to lie in absorbing such impacts and not transmitting them to the leg and foot muscles.

As a result of such theories, many patents have been granted on various kinds of resilient heels without, however, apparently arriving at a true solution of the problem.

As a result of an extended study of foot troubles, and more particularly those grouped under the generic heading of "weak foot", and of a number of experiments with shoes of various types and their component parts, an improved novel heel construction has been devised. This heel is adapted to impart to a foot a support approximating that of soft yielding ground to a bare foot. The support simulates a natural condition and does not impose undue strains on the foot with the concomitant derangements of the foot ligaments and associated leg muscles, due to the fact that the anterior muscles are normally exercised.

It is an object of this invention to provide an improved heel adapted for use in the treatment and prevention of "weak foot."

It is a further object of this invention to provide a heel having a supporting edge anteriorly of the back of the heel.

It is another object of this invention to provide an improved heel having an anteriorly displaced impact receiving edge and with a masking rear portion providing a conventional appearance to the heel but offering substantially no support to the foot when it is put down in walking.

These and other desirable objects and advantages of the present invention will be described in the accompanying specification and illustrated in the drawing, a certain preferred embodiment being shown by way of example only, for since the underlying principles may be embodied in other specific constructions, it it not intended to be limited to the one here shown, except as such limitations are clearly imposed by the appended claims.

In the drawing, like numerals refer to similar parts throughout the several views, of which

Fig. 1 is a top elevation, partly in plan view of an improved heel with the cover removed;

Fig. 2 is a longitudinal vertical section of a heel of the improved construction;

Fig. 3 is a skeleton view of a foot and shoe having a solid heel, shown at the moment of impact;

Fig. 4 is a view similar to Fig. 3, the shoe being provided with an improved heel embodying the concepts of the present invention;

Fig. 5 is a vertical section of a modified form of heel made according to the principles of the invention; and

Fig. 6 is a horizontal section through the heel shown in Fig. 5.

In the form shown in Figs. 1, 2 and 4, the heel comprises a front or breast portion 1, a rear or back portion 2, a bottom 3, and sides 4. These members are preferably integrally molded and form a substantially cup shaped construction, having an interior depression coextensive with the inside of the walls.

The breast of the heel may be of substantial thickness, of the order of ¼ inch, while the side portions 5 and 6 immediately adjacent the breast portion may taper rearwardly from a thickness of about ¾ inch at *a*, to a thickness of about three-eighths at *b*. These dimensions may, of course, be varied to suit any particular design of heel and to meet desired strengths.

At the rear curved portion 2 of the heel, the wall thickness is preferably reduced to about one-half or less than that of the wall of the breast portion for the purpose of providing a freely collapsible rear portion, having substantially no impact resistance, the function of which portion will be discussed more in detail hereinafter. A top flange portion 7 integral with member 2 and the rear of sides 4, is provided with flaps 8 lying preferably in the transverse median section of the heel. The portions 7 and 8 are of substantially the same thickness as section 2 although they may be made of thinner material without materially affecting the function to be subserved.

It will be noted that the upper surfaces of heel members 1, 5, 6, 7 and 8 form a continuous bearing surface of substantial area which is adapted to support a cover plate or closure 9, juxtaposed thereto and configured to the outer edges thereof. The closure 9 may be made of any suitable material such as sheet rubber, or sheet metal, and is hermetically sealed to the body portion of the

heel by vulcanizing or by a suitable cement, indicated generally at 10.

If desired, in order to assist in the attachment of the top wall or closure 9 to the body portion of the heel, a sheet metal insert, indicated by 30, may be provided. This insert is generally T-shaped and comprises a shank 31 and a cross-piece 32 having a curved outer edge to fit the curved rear wall 2. It will be noted that the cross-piece 32 which is inserted under the lip or flange 7 holds the latter up against the closure 9 when it is pressed against the body portion during either the cementing or vulcanizing operation above mentioned.

If desired, a transverse supporting member 11 is molded in the heel casing before the application of the cover 9. This member may comprise a substantially rectangular block of wood, relatively hard rubber, or any other suitable substantially non-yielding material, having a top 12, a bottom 13, sides 14, 15, and ends 16 and 17. Where wood is used, the member may be molded in situ, or cemented in place, while if rubber is used, the compound may be suitably disposed in a mold and vulcanized in place.

The transverse member 11, just described, preferably divides the hollow interior of the heel into two separate sealed chambers 18 and 19, which may be made intercommunicating by means of large passages 20 formed in the device. The bottom rear edge 21 of the insert 11 is adapted to serve as the impact-receiving section of the heel due to the high degree of flexibility of the rear tread section 22 and the back wall 2 of the heel. The large passages 20 serve to freely pass the air compressed in the false rear chamber 19 into the front chamber 18.

The transverse member 11, as intimated above, is so disposed in the heel as to bring its rear lower edge 21 substantially in the median vertical plane of the planter tubercles 23 of the os calcis or calcaneus, Figs. 3 and 4, thereby permitting the effective downward thrust of the heel to be received in that plane, as indicated in Fig. 4, instead of at the rear of the shoe heel, as shown in Fig. 3.

The novel effects of the improved heel, above described, can be best appreciated by reference to the skeletons of the foot bones and tibia, schematically illustrated in Figs. 3 and 4 and shown in conjunction with associated shoes having a heel of conventional construction (Fig. 3) and one involving the novel concepts of the present invention (Fig. 4).

In these figures an average body weight of 160 pounds has been assumed, together with an average distance of 2½ inches from the median vertical plane of the tibia to the rear of the shoe heel. These figures are assumed for purposes of explanation only, as it is self-evident that body weights and foot sizes vary within wide limits.

Referring now to Fig. 3, it will be noted that if a weight of 160 pounds is applied at the rear edge of the heel, as in walking, the resulting moment about the ankle axis 27 will be 160 pounds by 2½ inches, or substantially 400 inch-pounds. Assuming a distance of 2 inches from the ankle axis 27 to the nearest part of the tibialis anterior 28, it will be seen that the effective pull on this muscle, at the moment of impact, required to balance, will be substantially 200 pounds.

Referring now to Fig. 4, and assuming like conditions, with the exception that the impact edge of the heel is now displaced anteriorly by 1 inch, it will be seen that the impact moment will be 240 inch-pounds (160/1½) and that the effective pull of the anterior muscle will be but 120 pounds $\left(\frac{240}{2}\right)$.

As weak foot is but a condition involving strain of the plantar ligaments, and particularly ligament 26, and as the effective force applied to these members is a function of the pull exerted by the anterior muscles, it will be seen that the anterior displacement of the impact edge by 1 inch, under the conditions noted, involves a reduction of the effective force applied to the plantar ligaments. This reduction is very important when it is considered that in walking, such impacts occur at every step, and that energy is required to resist them, resulting in tiring of the body generally, and overloading the plantar ligaments specifically, which results in progressive weakening of the foot and "weak foot" with its attendant troubles.

It should be noted that the collapsible rear portion is made with thin walls 2 and 22 and of such material as to offer substantially no resistance when the heel is put down in walking. In order to obtain the fullest advantage from the present invention substantially the total force of the impact when the heel is put down must be taken at the rear edge 21 which is located directly under the plantar tubercles of the os calcis. The reason for this is obvious since any additional support provided at the false rear portion acts through an increased leverage about the center of the ankle bone.

In other words the false or masking portion on the rear of the heel is not intended to affect the operation of the heel, but is provided solely for the purpose of lending attractiveness and style to the heel, causing it to appear as an ordinary conventional heel. In one type of heel according to the invention the total resistance force exerted by the false rear portion was found to be about 4 or 5 pounds. This force was due both to the deformation of the material in walls 2 and 22 and compression of the air in the chambers 18 and 19.

It has been found by actual use that although the masking or false rear portion is made thin, it will stand up in use for long periods of time. Furthermore, the heel is entirely sealed around the outside thereof so that it is impossible for any water or dirt to get into the interior.

It will be further noted that the upper wall 9 performs an important function in lending support to the thin curved rear wall 2, holding it in position and preventing it from bending outward when the heel is in use.

Referring now to Figs. 5 and 6 which show a modified form of heel utilizing the same principles of operation, the heel comprises a rubber outer section 40 and a plug 41 inserted from the front thereof. The outer or body section is provided with a cavity, opening from the front, making comparatively thin walls. The cavity is bounded by an upper wall 42, a curved back wall 43, side walls 45 and 46, and bottom wall 44. The plug 41 may be provided with a recess 47 extending from the top wall 42 to the bottom wall 44. A plurality of large passages 49 may connect the recess 47 and the recess 48 left in the rear of the heel.

In this form it should be noted that the rearmost part of the lower rear edge of the plug 50 provides the impact receiving edge which is located directly under the plantar tubercles of the os calcis. The passages 49 are preferably large

to permit free passage of the air, compressed in the chamber 48, into the chamber 47. In some cases the chamber 47 may be eliminated, together with the passages 49, the plug 41 being then made solid.

It will be noted that the lower rear impact receiving edge 50 of the insert 41 is curved in this form. This may be desirable in many instances where persons walk on the "outside" of the heel. In fact, most people in walking come down on their heels slightly to the outside. When contact is made on the outer edge of the heel a transverse couple is formed, the weight of the body tending to evert the foot, that is to turn the ankle inwardly. This force is also opposed by the tibialis anterior, and is lessened when the heel is made narrower.

It will also be noted that with the curved edge 50 and with the creasing of the lower corner of back wall 43 when the heel first meets the ground, there is a very materially larger linear portion around the back of the heel which gives way in bending. For instance the linear portion, referring to Fig. 6, could be measured from the point where the curved edge 50 of insert 41 engages the outer edge 43 or wall 46 and then extends all the way around the back edge 43 to the part of wall 45 to where the other end of the curved edge 50 meets the wall 45. It will be noted that this linear length is more than the linear length shown in Figs. 1 and 2 of the opening 19. In the straight rear wall of supporting member 11, Figs. 1 and 2, the bending of the wall 2 and the wall 22 has a limited length of bending in comparison to that in the structure in Fig. 6. It has been found that when the juncture point of the back of the supporting member with the sides of the collapsible portion are not too sharp or too close to the back edge of the heel, the wear of the heel at that corner is decreased. In Fig. 6 it may be possible to vary the linear length for bending of the wall 43 by changing the rear shape of edge 50. For instance, there may be a greater distance from the very rearmost point of wall 43 to the point where that wall engages the side end of rear wall 50, as indicated in the lower portion of Fig. 6, than the distance between the rearmost edge 43 to a point where the wall 43 joins the other vertical edge of the rear edge 50 in wall 45 as indicated by the upper portion of Fig. 6. These distances may be varied as desired and for the purpose of obtaining the greatest wear.

The plug 41 may be of any desired material, such as rubber, fiber or wood, and may be secured in place in any desired way, such as by cementing or vulcanizing.

The operation and advantages of this heel will be apparent from the discussion above.

In order to more fully appreciate the operation of the invention the following should be borne in mind. In walking, when heel contact has been made, a pull must be exerted by the anterior muscles to prevent the instant drop of the forefoot under the influence of the body weight. Otherwise a severe shock would be experienced when the forefoot reached the ground. The application of the anterior muscular force retards the descent of the forefoot gradually so that no shock is felt. This explains why it is not necessary to interpose shock absorbing material between the heel of the foot and the ground. Otherwise it would not be practicable to walk on hard leather shoe heels.

The anterior muscular force necessary to retard the descent of the forefoot at the rate at which it is actually done is about equal to the force necessary to maintain the forefoot in the raised position. These considerations justify the application of the muscular forces of 120 and 200 lbs., as described above.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In a heel structure for a shoe or the like, a weight-sustaining body portion having its rear, lower supporting edge substantially under the plantar tubercles of the os calcis and a false, freely collapsible rear portion imparting a conventional outline to the heel but offering substantially no support when the foot is put down.

2. A heel comprising a forward body portion and a rear portion having substantially all of its volume hollow, said hollow rear portion being bounded by a top wall, a bottom wall and a curved back wall, said rear portion being freely collapsible, and offering no substantial support when the heel is put down with the forefoot raised, the rear edge of said body portion providing substantially the entire support and being disposed below the plantar tubercles of the os calcis.

3. A heel for attachment to a shoe or the like, comprising a supporting body portion having an overhanging projecting rear portion, the lower back part of said body portion presenting an edge adapted to be disposed below the os calcis, and a false rear portion completing the heel and being disposed in back of said body portion and under said overhanging projecting rear portion to provide a conventional outline to said heel.

4. A heel for attachment to a shoe or the like, comprising a collapsible portion at the rear end thereof, an intermediate weight-supporting portion of relatively small flexibility the rear edge of which is positioned beneath the plantar tubercles of the os calcis and a front portion of flexibility greater than the weight-supporting portion.

5. In a heel, an outer shell having side walls, a back wall, top and bottom walls, said shell having a recess opening from its front wall, an insert in said recess having its rear edge adapted to be disposed under the plantar tubercles of the os calcis and leaving a hollow freely collapsible rear portion to the heel.

6. In a heel, an outer shell having side walls, a back wall, top and bottom walls, said shell having a recess opening from its front wall, an insert in said recess having its rear edge adapted to be disposed under the plantar tubercles of the os calcis and leaving a hollow freely collapsible rear portion to the heel, said insert having a forward recess and conduit means communicating with said hollow rear portion.

7. A rubber heel including a forward section and a rear section having integral bottom side and end portions, and an integral rigid weight-supporting transverse member of substantial width having its upper face in substantially the same plane as the top of the heel, the said member being disposed between the sides and in contact with the bottom and defining forward and rear chambers.

8. A rubber heel including, in combination, a hollow body portion and a cover hermetically se-

cured thereto, a rigid member of substantial width disposed within the said body and transversely thereof whereby to form two chambers, and means in the solid member connecting the chambers in fluid communication.

9. A heel comprising a body having forward and rear chambers, a weight-supporting member between said chambers, means freely passing fluid between said chambers, the rear and bottom walls of said rear chamber being freely collapsible.

10. In a heel structure for a shoe or the like, a weight-sustaining body portion having its rear, lower supporting edge substantially under the plantar tubercles of the os calcis, and a false, freely collapsible rear portion imparting a conventional outline to the heel but offering substantially no support when the foot is put down with the sole upraised, said rear portion having its walls relatively thin and of substantially uniform thickness with the ground engaging wall being somewhat thicker.

11. A heel comprising a body having a forward and rear chambers, a weight-supporting member between said chambers, means for allowing fluid to pass freely between said chambers, the rear and bottom walls of said rear chamber being freely collapsible, said rear portion having its walls relatively thin and of substantially uniform thickness with the ground engaging wall being somewhat thicker.

12. A heel comprising a body having a hollow portion at the rear thereof, a weight-supporting member forming a wall of said hollow portion, the rear and bottom walls of said hollow chamber being freely collapsible, the top edge of the rear wall having a flange thereon which is substantially at right angles to the rear wall of said rear portion and extending inward and adapted to engage the shoe or the cover therefor.

13. A heel comprising a body having a forward and a rear chamber, a weight-supporting member positioned between said chambers, the rear and bottom walls of said rear chamber being freely collapsible, the top of said rear wall having a flange extending inwardly and substantially at right angles therefrom and adapted to engage the shoe or a covering body over the top of said heel.

14. A heel comprising a body having a hollow portion at the rear thereof, a weight-supporting member forming a wall of said hollow portion, the rear and bottom walls of said hollow chamber being freely collapsible, the top edge of said rear portion having a flange thereon which extends inwardly substantially at right angles thereto and adapted to engage the shoe or the cover therefor, and a semi-rigid supporting member for engaging a portion of said flange for maintaining the same in contact with the shoe or the cover therefor.

15. A heel comprising a body having a hollow portion at the rear thereof, a weight-supporting member forming a wall of said hollow portion, the rear and bottom walls of said hollow chamber being freely collapsible, the top edge of said rear portion having a flange thereon which extends substantially at right angles thereto and adapted to engage the shoe or the cover therefor, and a slightly flexible metal member supported by the weight-supporting member and engaging the under side of a majority portion of the area of said flange for maintaining said flange in contact with the shoe or the cover therefor.

16. A rubber heel including, in combination a body having a forward and a rear hollow chamber, a weight-supporting member between said chambers, the walls of said rear chamber being relatively thin and of substantially uniform thickness with the ground engaging portion being somewhat thicker, a flange at the upper end of the rear wall and extending at substantially right angles thereto toward the center of the heel for engaging a shoe, and a supporting member for holding said flange in engagement with said shoe.

17. A rubber heel comprising a front hollow chamber, a rear hollow chamber, a relatively rigid supporting member between said chambers, the rear lower supporting edge positioned substantially under the plantar tubercles of the os calcis, said supporting member having one or more conduits connecting said chambers, the walls of said rear chamber being relatively thin and substantially of uniform thickness with the wall engaging the ground being somewhat thicker than the upright wall, a flange engaging the rear wall and extending inwardly thereof at substantially right angles for engagement with a shoe or a cover over the heel, and a metal member for engaging the under side of some of the area of said flange for supporting said flange against the shoe, said metal member being primarily supported by said relatively rigid supporting member.

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