

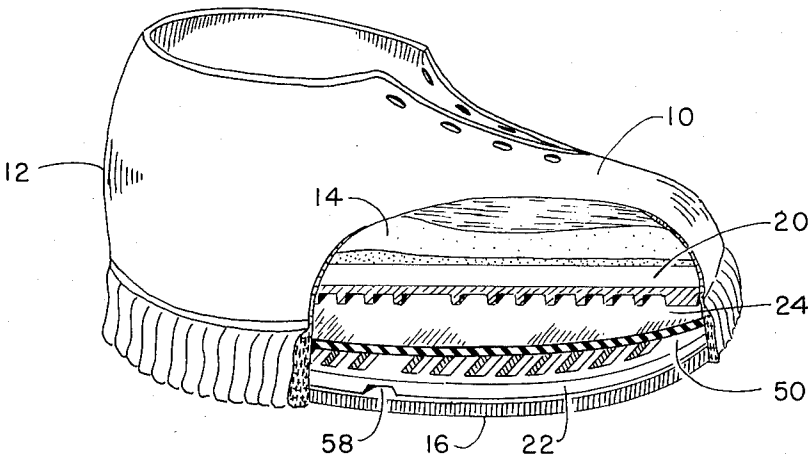
[54] SHOE SOLE STRUCTURE
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[22] Filed: Apr. 9, 1973
[21] Appl. No.: 348,901
[52] U.S. Cl. 36/28, 36/30 R
[51] Int. Cl. A43b 13/18
[58] Field of Search 36/30 R, 31, 30 A, 32 R,
36/28

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Primary Examiner—Patrick D. Lawson

[57] ABSTRACT
A cushioning structure for footwear is interposed between the insole of the shoe and the ground-engaging sole and includes upper and lower sheets having a plurality of complementary and aligned protrusions and openings therebetween, the sheets being separated by an elastic diaphragm which will yieldingly resist the movement of the protrusions into the openings when the sole is compressed against the upper part of the shoe.

16 Claims, 9 Drawing Figures



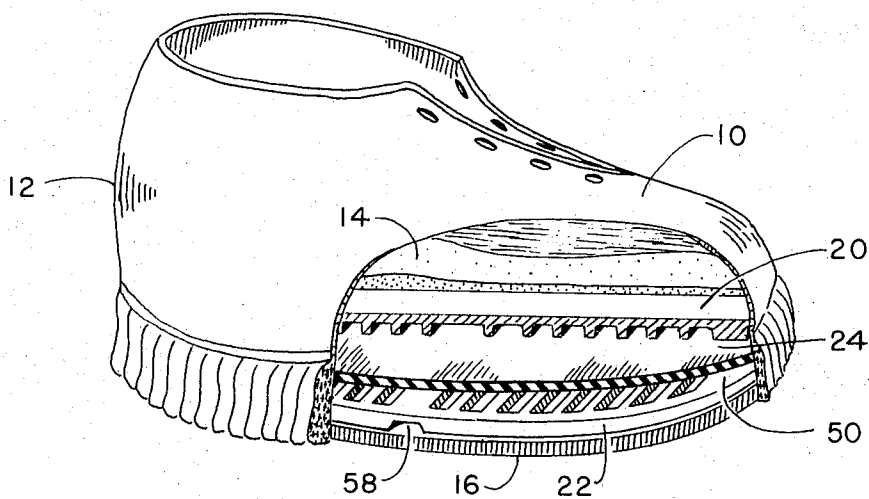


FIG. 1

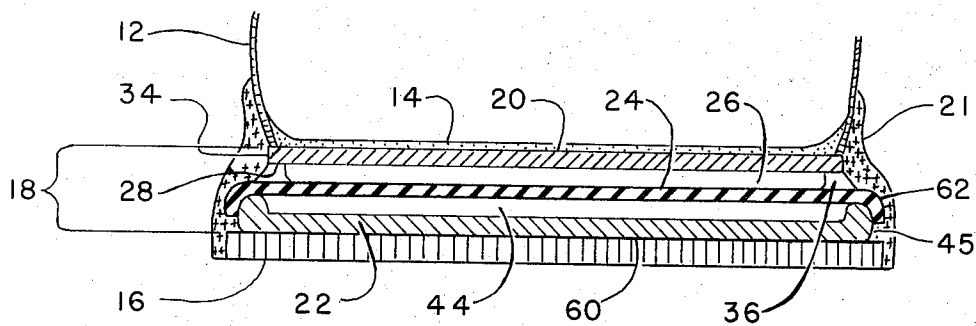


FIG. 2

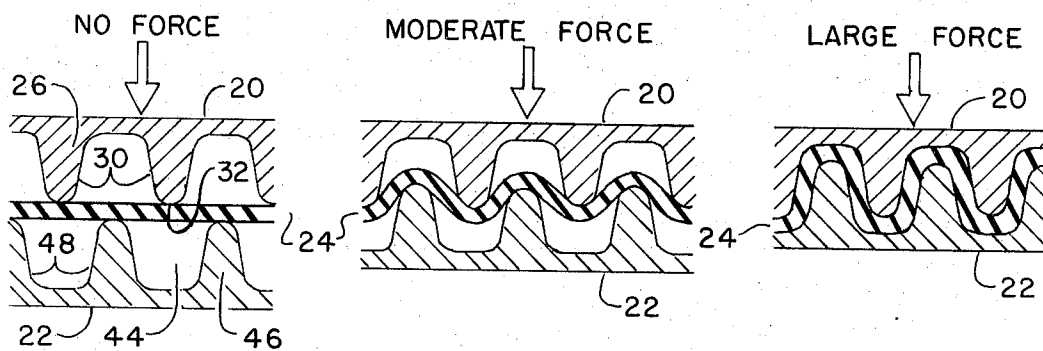


FIG. 3A

FIG. 3B

FIG. 3C

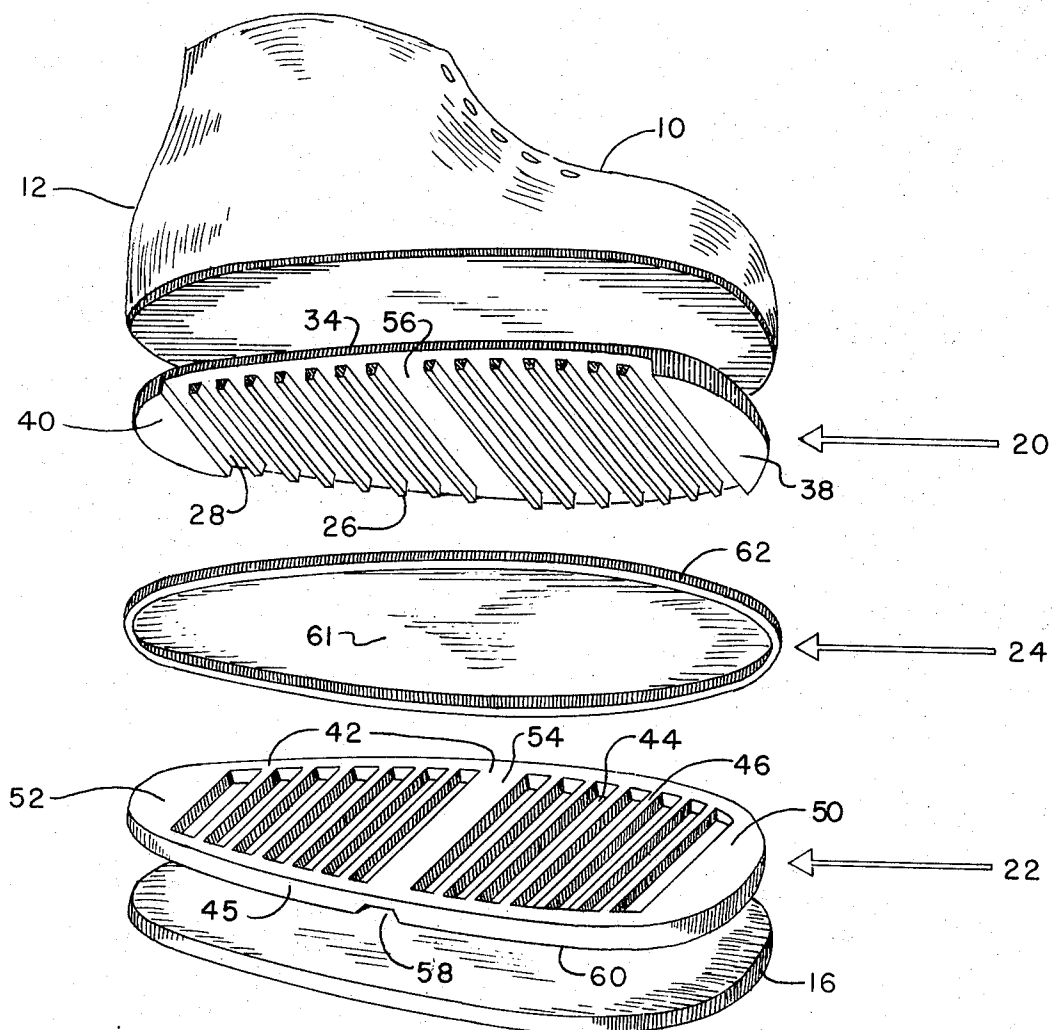


FIG. 4.

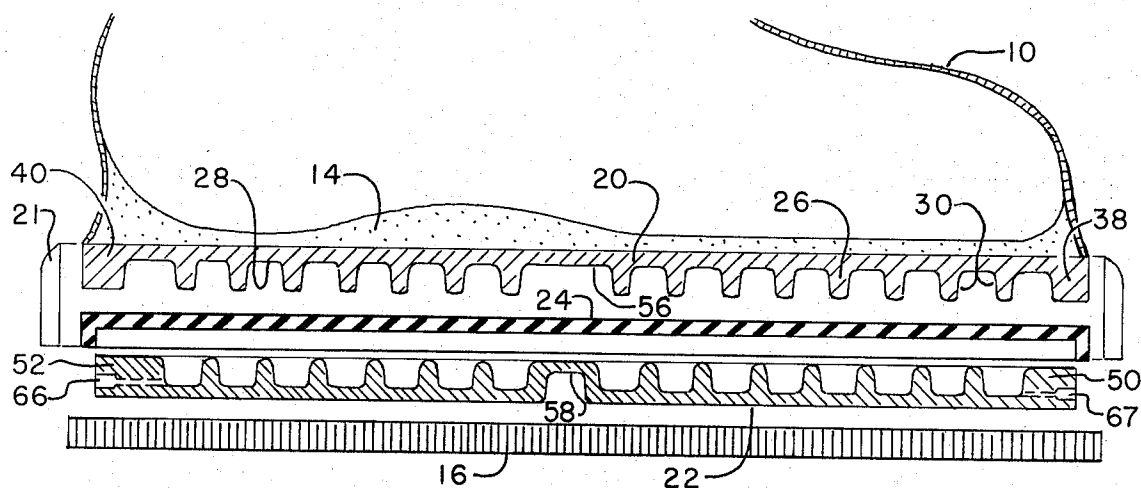


FIG. 5.

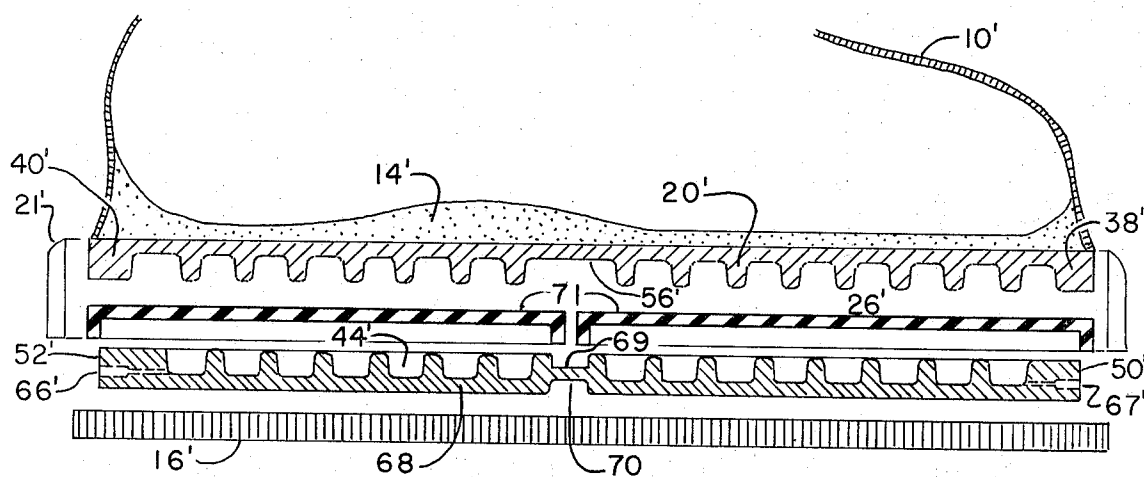


FIG. 6.

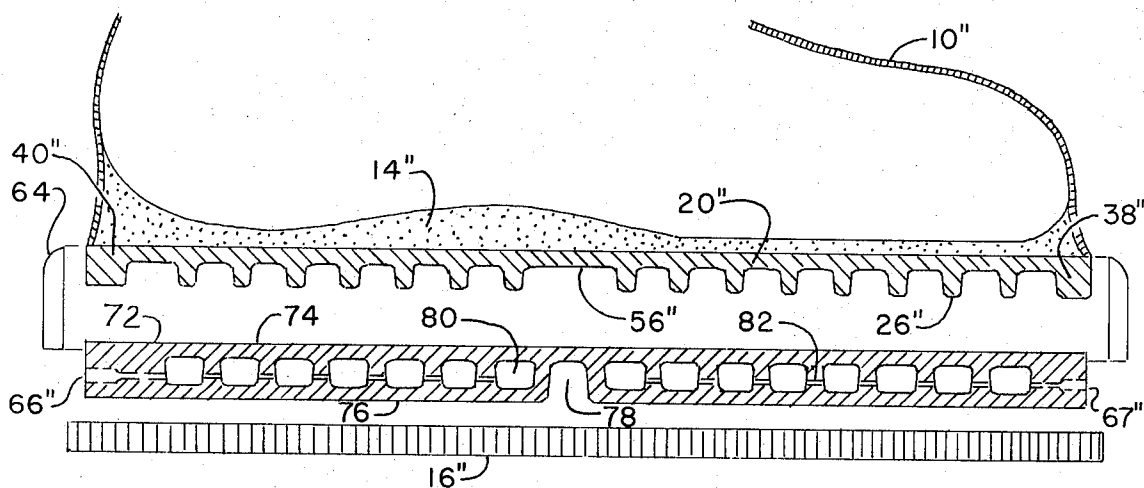


FIG. 7.

SHOE SOLE STRUCTURE

BACKGROUND OF THE INVENTION

The present invention generally relates to footwear and more particularly relates to a novel and improved cushioning sole separating the insole from the ground-engaging sole of the shoe.

Numerous attempts have been made to design cushioning soles for footwear in order to prevent the feet from tiring particularly after standing or walking over extended periods of time. In accordance with the present invention, it is desirable to provide for a more efficient, controlled absorption of the compressive forces generated in standing, walking, running and the like.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a cushioning sole for footwear which efficiently absorbs compressive forces applied thereto in minimizing foot fatigue.

It is another object of the present invention to provide a cushioning sole for footwear which efficiently absorbs compressive forces, which minimizes foot fatigue, and also provides a certain rebound action which allows a person to walk or run with less effort.

It is another object of the present invention to provide a laminated sole structure for footwear incorporating improved cushioning characteristics to minimize foot fatigue.

It is another object of the present invention to provide a cushioning structure for footwear which yieldingly resists the movement of protrusions in the structure into aligned complementary openings in the structure to thereby absorb compressive forces applied to the sole of the footwear.

It is another object of the present invention to provide a cushioning structure for footwear having spaced flexible sheets, one having protrusions directed toward the other sheet and the other having complementary openings aligned with the protrusions on the first sheet and including an elastic diaphragm or membrane between the two sheets whereby compression of the sheets will cause the protrusions to be forced against the elastic diaphragm pressing the diaphragm into the aligned openings to absorb the force.

It is still another object of the present invention to provide an improved cushioning structure adapted to be incorporated between the upper portion and ground-engaging sole of footwear wherein the cushioning structure has an upper flexible sheet with downwardly directed protrusions, a lower sheet with upwardly opening indentations aligned with the protrusions and an elastic diaphragm separating the upper sheet from the lower sheet whereby forces applied against the upper or lower sheets will cause the protrusions on the upper sheet to force the diaphragm into the indentation in the lower sheet to absorb the forces.

In attaining the foregoing and other objects of the present invention, a laminated structure having spaced surfaces separated by an elastic membrane and air pockets is included between the upper portion of a shoe and the ground-engaging sole to absorb compressive forces applied to the sole. The compressive forces are absorbed by limited movement of the spaced surfaces toward each other forcing the elastic membrane into the air pockets in yieldingly resisting the movement. More specifically, in a preferred embodiment the laminated cushioning structure includes facing upper

and lower sheets of flexible material, one sheet having a plurality of protrusions directed toward the other sheet and the other sheet having a plurality of aligned complementary indentations opening toward the one sheet with an elastic membrane separating the two sheets in yieldingly resisting and limiting movement of the protrusions into the aligned indentations dependent upon the compressive force applied against one of the sheets. The resistance to the movement of the protrusions against the elastic membrane in pressing the elastic membrane into the indentations is primarily dependent upon the elasticity of the diaphragm but can further be regulated by the pressure of the air in the pockets formed between the indentations and the elastic membrane to modify the resistance to the movement of the membrane into the indentations.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, advantages and capabilities of the present invention will become more apparent as the description proceeds taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a partially-sectioned perspective view with parts broken away of a shoe incorporating the sole structure of the present invention,

FIG. 2 is an enlarged fragmentary vertical section taken through the shoe of FIG. 1,

FIGS. 3A through 3C are enlarged fragmentary operational views showing the cooperation of the laminations of the sole structure of the present invention in absorbing forces,

FIG. 4 is an exploded view showing the various laminations in the sole structure and their relation to the shoe,

FIG. 5 is a fragmentary exploded partially-sectioned side elevation showing a second embodiment of the sole structure of the present invention,

FIG. 6 is an exploded side elevation similar to FIG. 5 showing still another embodiment of the sole structure of the present invention, and

FIG. 7 is an exploded side elevation similar to FIG. 5 showing still another embodiment of the sole structure of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, a shoe 10 is shown having an upper portion 12, an insole 14, and a ground-engaging or wearing sole 16 with the intermediate or laminated cushioning structure 18 of the present invention interposed between the insole 14 and the ground-engaging sole 16 and enclosed therein by an outer surrounding closure portion 21.

The laminated characteristics of the intermediate structure 18 are best seen in FIG. 2 to include an upper sheet 20, a lower sheet 22, and an intermediate membrane or diaphragm 24 separating the upper and lower sheets. The upper sheet 20, as shown in FIG. 4, comprises a substantially oval planar sheet of flexible material, such as a 40-60 shore rubber or rubber-like material conforming in configuration to the insole 14 of the shoe. The upper sheet 20 has a plurality of longitudinally spaced transversely extending elongated protrusions or ribs 26 arranged in closely spaced, parallel relation to one another and extending downwardly from the lower surface 28 of the sheet 20. The protrusions 26 are best seen in FIG. 4 and in the operational views

of FIGS. 3A through 3C to be somewhat rectangular in transverse cross-section having slightly downwardly and inwardly tapering side surfaces 30 and a convex bottom surface 32. The elongated transversely extending protrusions 26 terminate at locations spaced slightly inwardly from side edges 34 of the upper sheet and define passages 36 therebetween which open adjacent to the side edges of the upper sheet. As will be explained more fully later, the protrusions 26 are adapted to cooperate with the lower sheet 22 and the diaphragm 24 in absorbing compressive forces applied to the sole of the shoe. The rounded toe and heel portions of the upper sheet 20 are solid defining reinforcing curved end sections 38 and 40 respectively which more than double the thickness on the upper sheet at these locations, best seen in FIG. 4.

The lower sheet 22, as best seen in FIG. 4, also comprises a substantially oval planar sheet, slightly larger than the upper sheet 20, conforming in configuration to the insole 14 of the shoe and preferably being composed of the same flexible material as the upper sheet. The upper face 42 of the lower sheet 22 contains a plurality of longitudinally spaced transversely extending elongated indentations or recesses 44 which terminate at locations spaced inwardly from the side edges 45 of the lower sheet so as to be closed at both ends. The indentations are vertically aligned with the protrusions 26 on the upper sheet and define partition ridges 46 therebetween. The indentations 44 can be seen in FIGS. 3A through 3C to also be substantially rectangular in transverse cross-section having downwardly and inwardly convergent sides 48 so as to substantially conform in cross-sectional configuration to the protrusions 26 on the upper sheet. It is to be pointed out that the width of the indentations 44 is substantially greater than the width of the protrusions 26 for a reason which will become clear later. The rounded toe and heel portions of the lower sheet 22 are solid, as with the upper sheet, defining reinforcing curved end sections 50 and 52 respectively which are aligned with and substantially correspond in size with the curved end sections 38 and 40 respectively on the upper sheet to give solid support at these locations.

It can be seen best in FIGS. 1 and 4 that at the approximate longitudinal center of the lower sheet 22, the indentations 44 are interrupted providing a flat blank surface 54 corresponding with a similar flat blank surface 56 in the upper sheet 20 where the protrusions 26 are interrupted. These flattened locations on the upper and lower sheet correspond with the major flex point of the sole where it is desirable that the protrusions and indentations be interrupted. So that the lower sheet 22 is not unusually thick at the major flex point thereby impeding the flexural characteristics of the lower sheet, a transversely extending downwardly opening groove 58 is provided in the lower surface 60 of the lower sheet whereby the thickness of the lower sheet at the major flex point is thin and readily flexible.

The elastic membrane or diaphragm 24 which separates the upper and lower sheets 20 and 22 respectively can be seen in FIG. 4 to comprise a substantially planar oval-shaped body 61 also conforming in shape to the insole 14 of the shoe 10. The diaphragm 24 is composed of an elastic material, such as natural rubber, so that it will flex and expand with movement of the protrusions 26 of the upper sheet 20 into the indentations 44 of the lower sheet 22, as shown clearly in FIGS. 3B

and 3C. The elastic diaphragm 24 is slightly larger than the lower sheet and has an integral downturned rim or flange 62 along its perimeter which is adapted to fit downwardly over the peripheral edge of the lower sheet 22 to positively position the diaphragm on the lower sheet. Additionally, the diaphragm is bonded with a rubber adhesive to the lower sheet around the perimeter, and across the middle to surface 54, to positively seal and position the diaphragm on the lower sheet. Similarly, the upper sheet can be bonded to the diaphragm at desired locations and to the lower surface of the insole 14 to secure the entire laminated structure 18 to the insole. Furthermore, the ground-engaging sole 16 is bonded to the bottom surface 60 of the lower sheet whereby the entire sole structure is securely integrated. To better interconnect the elements of the sole and cushioning structure and to provide a watertight seal to protect the sole from the ambient environment, the closure 21 is defined by an elastomeric material which is molded or otherwise affixed to the shoe around the peripheral edges of the sole so as to interconnect and enclose the various layers of the sole, cushioning structure and the shoe as seen best in FIG. 2.

The operation of the laminated sole structure is best illustrated in FIGS. 3A through 3C, with FIG. 3A showing the upper and lower sheets and the elastic diaphragm 24 separating the sheets when no compressive force is applied to the ground-engaging sole. It can there be seen that the diaphragm 24 is maintained in a flat planar orientation supporting the protrusions 26 of the upper sheet in spaced relation from the indentations 44 in the lower sheet. When a moderate compressive force is applied to the ground-engaging sole, FIG. 3B, the protrusions 26 on the upper sheet are pushed into the underlying indentations 44 in the lower sheet, causing the elastic diaphragm 24 to stretch and thereby be deformed and pressed into the indentations. The yielding resistive force of the diaphragm absorbs the compressive force applied to the sole and thereby creates a cushioning effect. If a large force is applied to the ground-engaging sole, FIG. 3C, the protrusions will be depressed further into the indentations possibly forcing the diaphragm into continuous engagement with the side and bottom walls of the indentations. To accommodate such a force, the cross-sectional area of the indentations is greater in width than the protrusions by approximately twice the thickness of the elastic diaphragm.

As shown in FIG. 5, the sole structure best illustrated in FIGS. 1 through 4 can be modified by incorporating a valve 66 into the heel section 52, and a valve 67 into the toe section 50 of the lower sheet 22 in a manner such that air pressure can be adjusted in the air pockets created between the diaphragm 24 and the lower sheet 22 to increase or decrease the yielding resistance to movement of the protrusions and diaphragm into the indentations. In a preferred arrangement, the valves are of the self-sealing type, such as used on basketballs, footballs and the like, and are incorporated into the reinforced sections at the heel and toe of the lower sheet 22. It will be readily appreciated that the cushioning effect of the structure 18 can be appreciably altered by the compression of air into the front and rear air pockets, so that many degrees of yielding resistance are achieved.

FIG. 6 shows a modification of the structure shown in FIG. 5 with like parts having been given like reference numerals with a prime suffix. In the embodiment of FIG. 6, the upper portion 10' of the shoe along with the insole 14', the upper sheet 20', and the ground-engaging sole 16' would be identical to the corresponding components of the embodiment shown in FIG. 5. However, a lower sheet 68 used in the embodiment shown in FIG. 6 is different from the lower sheet 22 of the embodiment in FIG. 5 in that the flat blank surface 54 across the longitudinal center of the lower sheet of FIG. 5 has been recessed defining an upwardly opening groove 69 immediately above a downwardly opening groove 70. In the embodiment of FIG. 6, a pair of diaphragms 71 fit downwardly over the front and rear portions of lower sheet with a downturned flange around the perimeter of each diaphragm adapted to seat in the upwardly opening groove 69 of the lower sheet. In this manner, an air pocket is established in the front as well as the rear portion of the structure and air valves 66' and 67' corresponding to the valves 66 and 67 respectively shown in FIG. 5 can be provided in the lower sheet so that air can be compressed into the air chambers to modify the resistance to the movement of the diaphragms 71 into the indentations 44' in the lower sheet.

With reference to FIG. 7, another modification to the arrangement shown in FIG. 5 is shown with like parts being given like reference numerals with a double prime suffix. In the embodiment shown in FIG. 7, the upper sheet 20'' would be identical to the upper sheet 20 disclosed in the first described embodiment. The lower sheet 72 would again be substantially oval in configuration to conform with the insole 14'' of the shoe 10''; however, in this embodiment, the lower sheet 72 would be substantially planar with a flat upper surface 74 and a flat lower surface 76 wherein the lower surface is interrupted at its longitudinal center by a downwardly opening groove 78, similar to the groove 58 provided in the lower sheet 22 of the first described embodiment so as to provide the desirable flexing characteristics at the maximum flex point in the lower sheet. In this embodiment, the lower sheet 72 is provided with closed elongated longitudinally spaced channel-like cavities 80 extending transversely of the sole. The portions of the lower sheet 72 which overlie the channel-like cavities 80, thereby establishing flexible membranes, replace the diaphragm 24 of the first described embodiment so as to be depressable by the protrusions 26'' on the upper sheet and thereby serve to absorb compressive forces applied to the sole. Again, the components of the sole cushioning structure would be suitably integrated by bonding adjacent components and sealing the entire assemblage by interconnecting the components with a peripheral elastic band 64. Also, the lower sheet 72 could include air valves 66'' and 67'', and apertures 82 interconnecting the cavities 80 to form air pockets in the front and rear portions of the lower sheet, so that air could be compressed into the cavities to regulate the cushioning effect.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details of structure may be made without departing from the spirit thereof.

What is claimed is:

1. In a shoe having an upper foot-enclosing portion and a ground-engaging sole, the improvement comprising an intermediate cushioning structure between said upper portion and said ground-engaging sole, said intermediate structure having a first sheet, a plurality of spaced male protrusions extending away from a face of said first sheet, a second sheet substantially parallel to said first sheet having a plurality of openings therein aligned with said protrusions, and an elastic membrane between said first and second sheets to yieldingly resist movement of said protrusions into the aligned openings when a compressive force is applied to the shoe sole.

2. In a shoe having an upper foot-enclosing portion and a ground-engaging sole, the improvement comprising an intermediate cushioning structure between said upper portion and said ground-engaging sole, said intermediate structure having elongated upper and lower sheets, one of said sheets having a plurality of spaced male protrusions directed toward the other sheet and the other sheet having a plurality of spaced female indentations opening toward said one sheet and aligned with said protrusions, and an elastic diaphragm between said upper and lower sheets to yieldingly resist movement of said protrusions into the aligned indentations when a compressive force is applied to the shoe sole.

3. In the shoe of claim 2, wherein said one sheet overlies the diaphragm so that the male protrusions are directed downwardly and wherein said other sheet underlies the diaphragm so that the indentations open upwardly.

4. In the shoe of claim 2, further including an elastic band extending peripherally around the intermediate structure to connect the upper and lower sheets on opposite sides of the diaphragm.

5. In the shoe of claim 3, wherein said upper sheet is generally planar and wherein said male protrusions comprise elongated ribs extending transversely of the upper sheet.

6. In the shoe of claim 5, wherein said ribs define elongated channels therebetween, each of said channels opening at the sides of the upper sheet.

7. In the shoe of claim 3, wherein said lower sheet is generally planar and wherein said female indentations comprise elongated recesses extending transversely of the lower sheet.

8. In the shoe of claim 7, wherein said recesses terminate at spaced locations from the sides of the lower sheet so that each recess is closed at both ends.

9. In the shoe of claim 7, wherein said upper sheet is generally planar and wherein said male protrusions comprise elongated ribs extending transversely of the upper sheet, and wherein said recesses are at least as long as said ribs.

10. In the shoe of claim 9, wherein said diaphragm is generally planar and has a downturned flange along its perimeter, and wherein said flange is adapted to peripherally engage the sides of the lower sheet.

11. In the shoe of claim 10, wherein each of said upper and lower sheets are composed of flexible material.

12. In the shoe of claim 1, wherein said elastic sheet encloses said channels defining a plurality of closed compartments, and further including means for allowing air to be compressed into said closed compartments

to increase the resistance to the protrusions forcing the elastic sheet into the channels.

13. In the shoe of claim 12, wherein said means for allowing air to be compressed into said closed compartments includes valve means in said second sheet providing selected fluid communication with one of said closed chambers and apertures means in said second sheet communicating with adjacent closed compartments to allow compressed air to be introduced through said valve means to flow into the respective compartments.

14. In the shoe of claim 1, wherein said elastic sheet is integral with said second sheet.

15. In a shoe having an upper foot enclosing portion, an insole defining a bottom foot engaging surface of the upper portion and a ground-engaging sole, the improvement comprising an intermediate structure having a flexible generally planar upper sheet conforming in configuration to the configuration of the insole, adhesive means bonding the upper sheet to the insole, said upper sheet having a plurality of longitudinally spaced transversely extending ribs of substantially rectangular transverse cross-section depending therefrom and defining passages therebetween which open at each end through the sides of the upper sheet, a flexible generally planar lower sheet conforming in configuration to the upper sheet, said lower sheet having a plu-

rality of longitudinally spaced transversely extending upwardly opening recesses of substantially rectangular transverse cross-section, said recesses having a larger cross-sectional size than said ribs and being vertically aligned with said ribs, each of said recesses having closed ends so as to define segregated compartments, adhesive means bonding the lower sheet to the ground-engaging sole, an elastic generally planar diaphragm conforming in configuration to the upper sheet, said diaphragm having a peripheral downturned flange and being disposed between said upper sheet and said lower sheet so that said flange peripherally engages the lower sheet and so that when a compressive force is applied to the shoe sole the diaphragm will yieldingly resist movement of said ribs into said recesses, and an elastic band extending peripherally around said intermediate structure as well as said inner sole and said ground-engaging sole to operably connect said intermediate structure to the insole and ground-engaging sole.

16. In the shoe of claim 15, further including valve means in said lower sheet communicating with one of said compartments and apertures means in said lower sheet communicating with adjacent compartments whereby air can be compressed into the compartments to increase the resistance to movement of the ribs into the compartments.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,834,046 Dated September 10, 1974

Inventor(s) Donald M. Fowler

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Description of the Preferred Embodiment:

Column 6, line 41, cancel "protrusions"

Signed and sealed this 5th day of November 1974.

(SEAL)
Attest:

MCCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents