

United States Patent

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[56]

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[54] **FOOTWEAR**
4 Claims, 6 Drawing Figs.

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 30, 32, 2.5

ABSTRACT: A sandal having a sole and a band member integrally molded from synthetic resinous material having a foamy interior and a nonfoamy exterior. The specific gravity of the sole is lower than the specific gravity of the band member.

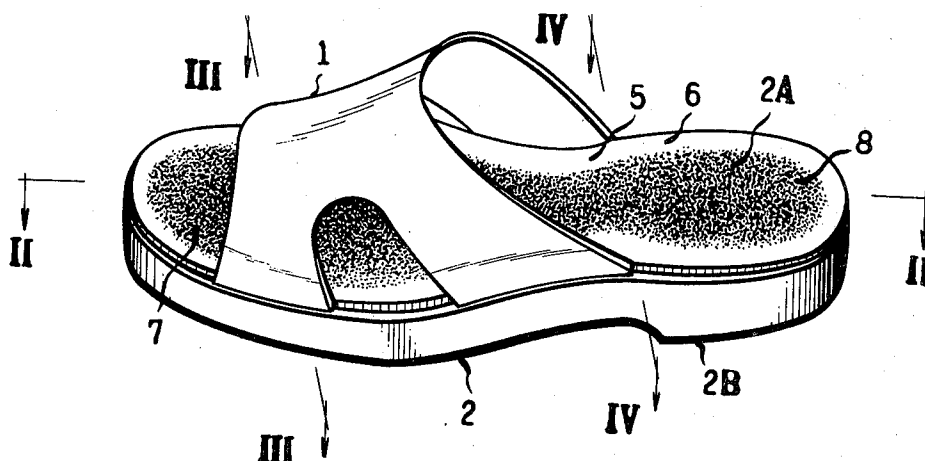


FIG. 1

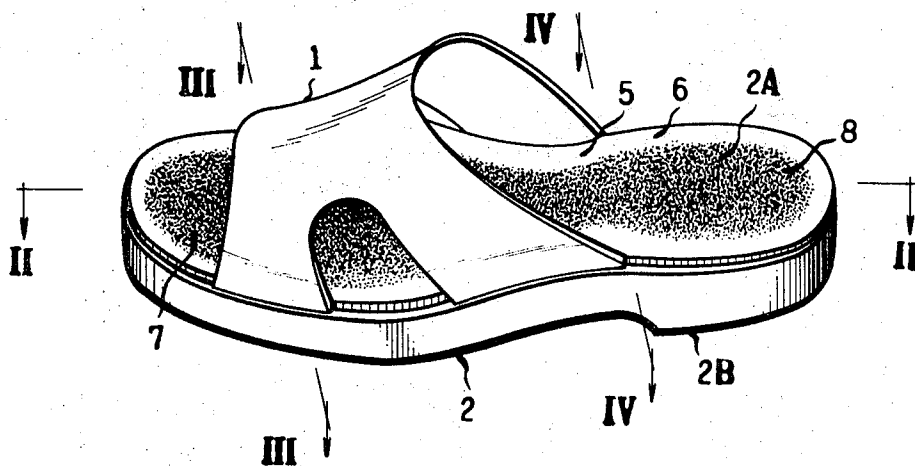


FIG. 2

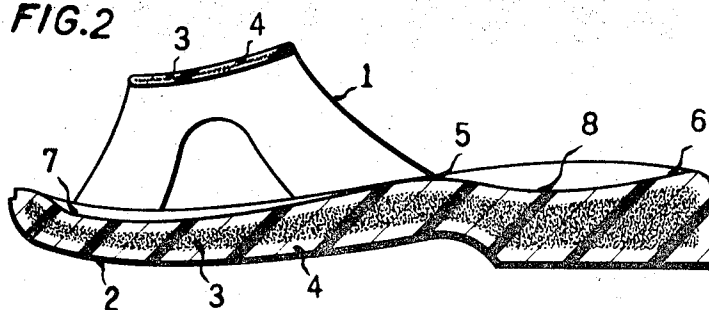


FIG. 3

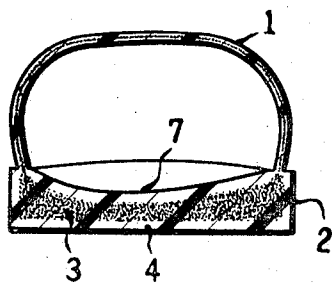


FIG. 4

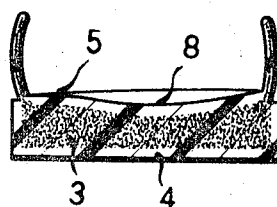


FIG. 5

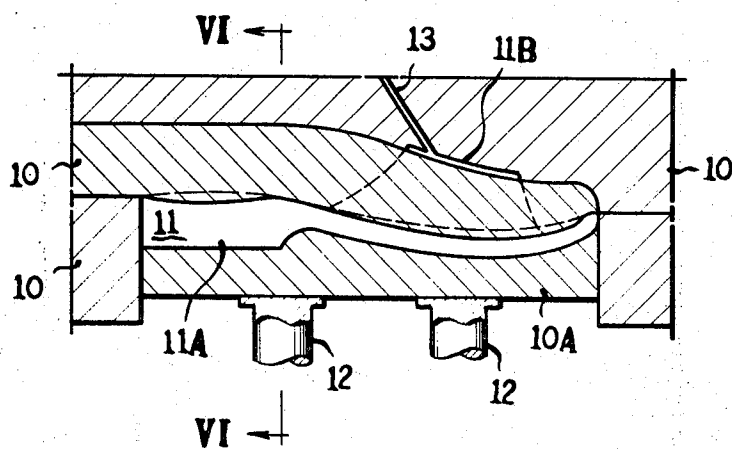
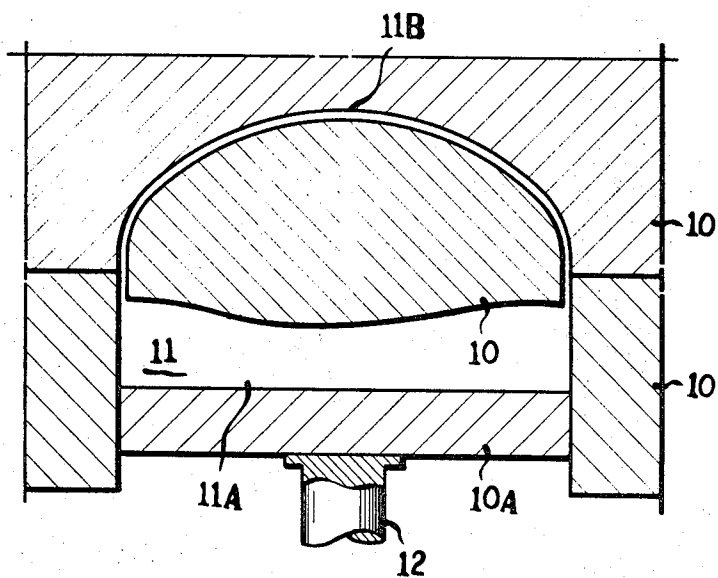


FIG. 6



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FOOTWEAR

The present invention relates to an improvement of footwear such as sandal, slipper or the like integrally formed of synthetic resinous material.

A main object of the present invention is to provide a footwear comprising a foamy interior portion adapted for providing resiliency and a nonfoamy outer layer integral therewith adapted for providing durability and resistance against deformation of the footwear, and especially the specific gravity of said foamy interior in a sole member of the footwear being lower than that of a band member of the footwear.

The further object of the present invention exists in providing the footwear of which band member and sole member are integrally and inseparably molded from synthetic resinous material in a manner to be provided with a foamy interior suitable resiliency and comfort, and an integral nonfoamy outer layer suitable for durability and resistance against deformation of the footwear, and especially foamy interior of the sole member of the footwear being lower, in specific gravity thereof, than foamy interior of the band member of the footwear.

Still further objects and advantages of the present invention will appear from the following disclosure of a preferred form of embodiment thereof taken in connection with the attached drawings, in which:

FIG. 1 is a perspective view of the sandal according to the present invention;

FIG. 2 is a longitudinal sectional view of the sandal taken along the line II-II in FIG. 1;

FIG. 3 is a transversal sectional view of the sandal taken along the line III-III in FIG. 1;

FIG. 4 is a transversal sectional view of the sandal taken along the line IV-IV in FIG. 1;

FIG. 5 is a longitudinal sectional view of an apparatus available for producing the sandal of the present invention; and

FIG. 6 is an enlarged transversal sectional view of the apparatus taken along the line VI-VI in FIG. 5.

Referring to the drawings, illustrated therein is an improved sandal according to the present invention. Be molded from synthetic resinous material said sandal of which composition will be hereinafter described in detail.

The sandal comprises a band member 1 and a sole member 2 having a unique upper surface 2A and a heel 2B, said band member and sole member being simultaneously and integrally molded in one operation and step by means of a mold or apparatus which will be hereinafter described.

Said sandal including the band member and sole member is, as shown in FIGS. 2 to 4, molded so as to form an integral unit of a uniquely formed synthetic resinous material having a foamy interior 3 and a nonfoamy outer layer 4 surrounding said foamy interior.

As a consequence of said unique structure, the foamy interior portion of the resinous material provides a highly resilient and pliable cushiony effect, thereby effecting the comfort in use, while the nonfoamy (relatively firm) outer layer resists against deformation of the sandal caused by the user's own weight. In addition, said nonfoamy outer layer being integral over the band member and sole member facilitates the firm and integral connection of the sole member and band member, further is provided with a water insulation ability for preventing water saturation. And as a result of the existence of the bubblelike foamy portion in the foamy layer, there may be contained air in said foamy layer, thereby reducing the weight of the sandal. And especially, it is hereby pointed out as the specific feature of the present invention that specific gravity of the sole member is different from that of the band member, that is, the former is lower than the latter by approximately 0.2 to 0.4 (specific gravity).

The following tables show examples of the specific gravities of the sandals produced according to the present invention, in which table A shows examples of having used vinyl chloride as the material thereof and table B shows those of having used ethylenevinyl acetate copolymer as the material thereof:

2

TABLE A

	No. 1	No. 2	No. 3	No. 4
Specific gravity of the sandal.....	0.697	0.609	0.655	0.655
Specific gravity of the band member.....	0.919	0.912	0.920	0.954
Specific gravity of the sole member.....	0.651	0.542	0.616	0.606
Difference between gravities of band member and sole member.....	0.268	0.370	0.303	0.348

TABLE B

	No. 5	No. 6	No. 7	No. 8
Specific gravity of the sandal.....	0.518	0.572	0.474	0.602
Specific gravity of the band member.....	0.793	0.778	0.714	0.750
Specific gravity of the sole member.....	0.444	0.515	0.432	0.443
Difference between gravities of band member and sole member.....	0.349	0.263	0.282	0.307

Since the specific gravity of the sole member to occupy 80 percent of the whole weight of the sandal is lower than that of the band member, whatever the gravity of the band member may be in its specific gravity higher, for example, being 0.954 as shown in the example No. 4 in table A, the whole specific gravity of the sandal will never be more than 0.655, whereby the sandal or footwear produced according to the present invention facilitates reduction of its whole weight and also the band member being liable to be damaged can be reinforced by higher specific gravity thereof.

According to the present invention, the upper surface 2A of the sole member is provided with a curved shape in conformity with figure of the user's sole in order to provide the user with the comfort to wear.

In FIGS. 1 to 4, a portion 5 of the surface 2A corresponding to the plantar of the user's sole and an edge 6 of said upper surface 2A are gently elevated and another portions of the upper surface being formed by gently sloped concaves 7 and 8. The aforesaid elevated portions and concaves are integrally connected to each other through the gently curved face.

By the above-described construction user's sole can be brought into perfect snug-fit contact with the upper surface of the sole member and accordingly the wearer can easily walk without slippage and fatigue, with extremely improved wearing comfort.

FIGS. 5 and 6 show an embodiment of an apparatus available for producing the sandal according to the present invention. The apparatus is assembled with a number of mold pieces 10 and provided with a molding chamber 11 formed in a profile in conformity with outer figure of the sandal to be manufactured. A movable mold piece 10A comprising a lower surface of a space 11A adapted for producing said sole is connected to plungers 12 constructed to be driven upwardly and downwardly by means of suitable power source (not shown).

Through an inlet 13 a molten synthetic resinous material to be after described is discharged into the molding chamber 11 and secondly the movable mold piece 10A is downwardly moved for the predetermined measure by plunger so as to expand the capacity of the space 11A. As a result of it, the specific gravity of the sole member will be lowered by expanding capacity of the space 11A. In such a case, the molten synthetic resin material existing within a space 11B adapted for producing the band member will be rapidly cooled and hardened rather than the molten material existing within the space 11A by surrounding mold piece because of small clearance of the space 11B, thereby preventing the inflow of the material into the expanded space 11A and obtaining the aforementioned different specific gravities of band member and sole member of the sandal.

It will be understood that the desired specific gravities of band member and sole member such as shown in examples of tables A and B are easily obtained by the step for adjusting momentum of the mold piece 10A.

As hereinabove mentioned, the method of manufacturing the synthetic resin material featured in the present invention is not only of critical importance, but is a highly complex and specialized process, as will now be described.

A number of various thermoplastic resinous materials which can be expanded or formed may be used to form the novel foamed material utilized in the present invention. However, and without intending to be restricted thereto, the invention is particularly adapted to be formed of granules or beads of polystyrene. Said polystyrene particles may be in an essentially linear or in a cross-linked form, as being generally representative of expandable thermoplastic resinous materials and as being especially representative of alkenyl aromatic compounds which contain at least one alkenyl aromatic compound having the general formula $\text{Ar}-\text{CR}=\text{CH}_2$ wherein Ar is an aromatic compound and R is selected from the group consisting of a hydrogen atom and a methyl radical. Expandable thermoplastic copolymers of styrene and polymers and copolymers of α -methyl styrene, α -methyl styrene or vinyltoluene, mono- and di-chlorostyrene, including copolymers containing small amounts of such materials as divinylbenzene may frequently be utilized with benefits commensurate with those which are derivable from employment of polystyrene. Often this may also be the case with other expandable thermoplastic resinous materials including various copolymers of vinylidene chloride which are frequently generically described as being sarans and thermoplastic resinous materials which may be comprised of polymers and copolymers of methyl methacrylate, ethyl acrylate and other derivatives of acrylic acid such as their homopolymers and copolymers of methyl methacrylate and vinylidene chloride; polymers and copolymers of vinyl acetate and vinyl butyral and the like; and various thermoplastic or thermoplastified derivatives of cellulose including cellulose nitrate and cellulose acetate. Cross-linked materials usually have greater thermal stability and frequently tend to produce stronger, less heat-sensitive foam structures.

The blowing agents employed for the expandable thermoplastic resinous material may be those which are commonly utilized including dichlorodifluoromethane, carbon dioxide, pentane and other low-boiling hydrocarbons or other suitable materials such as heat sensitive gas-generating agents and the like. Conventional amounts of the blowing agent may be incorporated in the discrete particles of thermoplastic resinous material to render it suitably expandable. Thus, an incorporated amount of dichlorodifluoromethane between about 5 and 15 percent by weight may be found to be a satisfactory and efficient amount in many expandable thermoplastic resinous materials, particularly polystyrene and many other alkenyl aromatic Thermoplastic resinous materials.

To form the foamed material, the preferred method comprises charging a mass of said granules into the dischargeable injection chamber of an injection-molding apparatus; then, in intermittent molding cycles, forcing said mass under pressure sequentially in and through a first cold zone in said chamber wherein a portion of said mass is compacted in solid granular form while being maintained at a temperature beneath its foaming temperature; a second heated zone adjacent to the first zone in said chamber wherein a portion of said mass is heated to a flowable condition under the application of an adequate quantity of heat to cause it to attain a foaming temperature; the solid compacted portion of the mass in the first zone continuously maintaining the heated portion of said mass in the second zone to restrain substantial foaming therein throughout said intermittent cycles; and a discharge zone in said chamber from which a portion of said heated mass is injected to fill a retractable mold form having an enlargeable cavity wherein the injected mass is initially exteriorly cooled against the mold form to form a solidified surface layer while being maintained under pressure; and finally relieving the pressure and enlarging the mold form to permit the central, relatively uncooled heated mass to expand and force the solidified surface layer against the enlarged confining limits of the mold form to form said sandwich construction molded foam structure.

While the present invention has been illustrated and described herein with respect to a preferred embodiment, it is not desired to limit the invention only to the embodiment, but the invention should be considered to include all the substitutes, modifications and equivalents which are encompassed within the essential part of the invention to be set forth in the scope of the underwritten claims and within the scope of the spirit exhibited in the intention of the inventor.

I claim:

1. A footwear comprising a band member and a sole member both of which are integrally and inseparably molded from synthetic resinous material having foamy interior, said sole member of which specific gravity being lower than that of the band member with the difference approximately 0.2 to 0.4.

2. A footwear as claimed in claim 1, wherein said specific gravity of the band member is approximately 0.70 to 0.96 while that of the sole member being approximately 0.40 to 0.66.

3. A footwear as claimed in claim 1, wherein said foamy interior is provided with a relatively firm and nonfoamy outer layer integral therewith around thereof.

4. A footwear as claimed in claims 1, 2 or 3, wherein said sole member is provided with a unique upper surface formed with a shape in conformity with profile of the user's sole.

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