United States Patent

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[54] **SANDAL**
4 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **36/11.5, 36/32**
[51] **Int. Cl.** **A43b 3/12, A43b 13/06**
[50] **Field of Search** 36/11.5, 32, 25

[56] **References Cited**
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ABSTRACT: The present invention relates to an improvement of sandal, and more particularly to a comfortable improved sandal which is to be integrally formed of thermoplastic synthetic resin material.

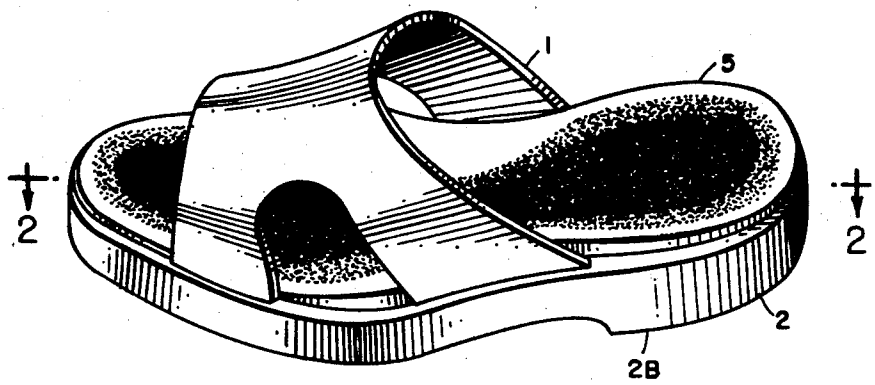

FIG. 1

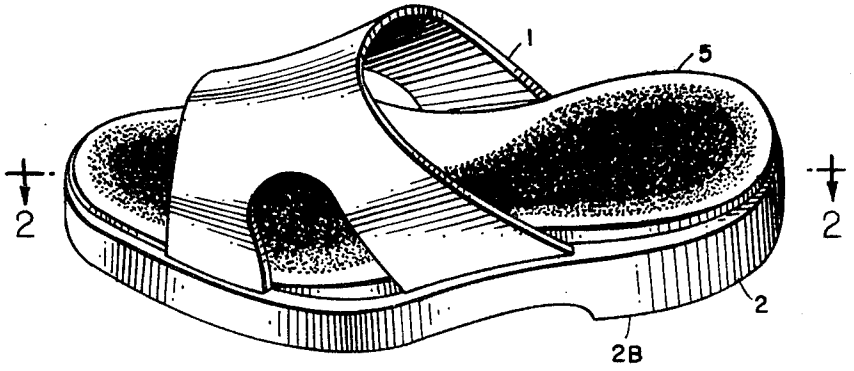

FIG. 2

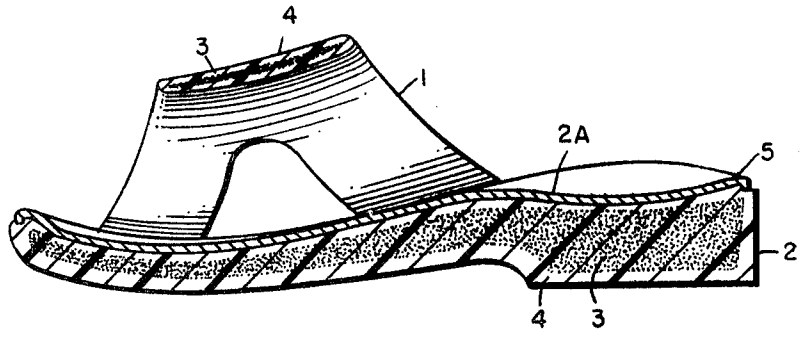

FIG. 3

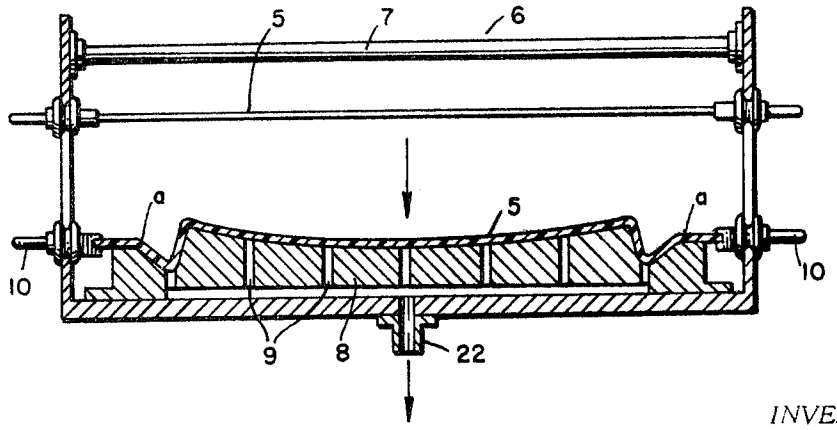

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FIG. 4

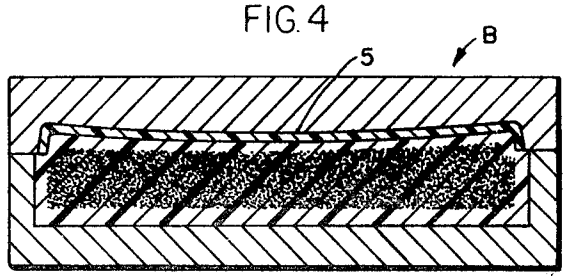


FIG. 5

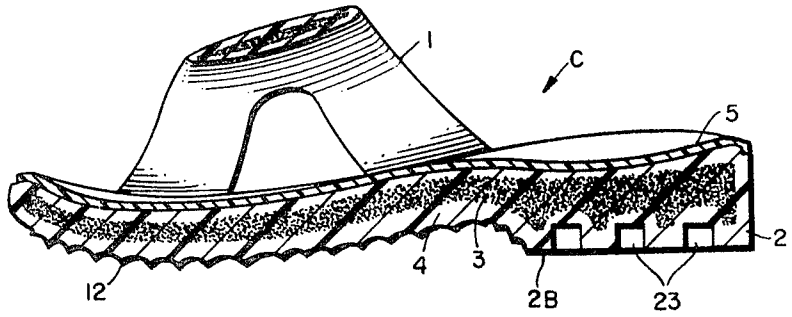


FIG. 6

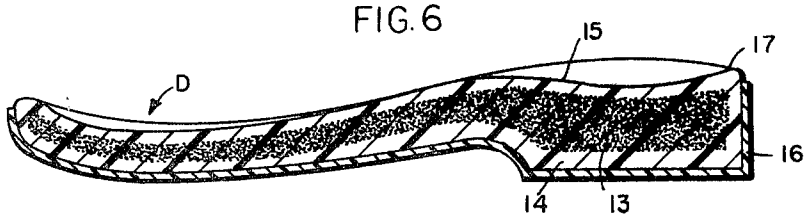
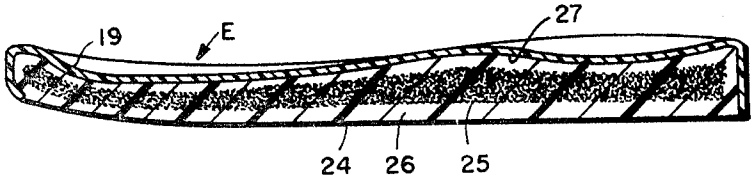


FIG. 7



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SANDAL

In general, the one sandal of the conventional type formed of highly resilient material provides the utmost excellent cushioning effect but being liable to be too much deformed during use thereof, further in addition another typed sandal made of comparatively hard and unyielding material being rich of durable but uncomfortable to put on. However, as far as the inventor is aware, there has heretofore been found no sandal having both advantages of durability, desirable resiliency and comfort to wear.

On the other hand, in order to provide the sandal with comfort and durability it is desirable that band member of the sandal is equipped with high softness and body member or sole of the sandal has suitable hardness enough to keep up outer profile of the sandal. In the said manner, in the sandal to be integrally and simultaneously molded of thermoplastic synthetic resin material, said two different demands are to be simultaneously satisfied, but up to the present has not been substantially settled the subject matter corresponding to said demands.

A main object of the present invention is to provide a new and comfortable sandal according to which said subject matter has been substantially settled.

Described further in detail, a main object of the present invention is to provide a novel sandal of which band member is provided with a desirable resiliency and softness so as to provide the sandal with durability and resistance in relation to deformation thereof.

A further object of the present invention is to provide a novel sandal of which body member and a band member are integrally and simultaneously formed of thermoplastic synthetic resin material having a foamy interior portion to provide resiliency and comfort, and having a nonfoamy outer layer to provide durability and resistance against deformation thereof.

A further object of the present invention is to provide a new sandal of which body member is equipped with a unique upper surface to further increase enhanced comfort to wear.

Still further objects and advantages of the present invention will become apparent from the following disclosure of preferred examples selected from embodiments 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 diagrammatic sectional view of a part of device available for producing a hardening and reinforcing cover of said sandal according to the present invention;

FIG. 4 is an enlarged sectional view of a part of split mold available for producing the sandal according to the present invention;

FIG. 5 is a longitudinal sectional view showing the other embodiment of the sandal according to the present invention;

FIG. 6 is a longitudinal sectional view of an embodiment in which the present invention is applied to a lower sole; and

FIG. 7 is a longitudinal sectional view of another embodiment in which the present invention is applied to an upper sole.

Referring to the drawings 1 and 2, illustrated therein is an improved sandal according to the present invention. Said sandal is molded of thermoplastic synthetic resin material and the construction thereof will be hereinafter described in detail.

The sandal consists of a band member 1 and a body member 2 with or without a heel 2A which are integrally and simultaneously molded in one step by means of the specific process to be later illustrated.

As will be hereinafter described in greater detail, and as appears in FIGS. 1 and 2, the sandal provided with band member 1 and a body member 2 is molded as an integral unit of uniquely formed synthetic resin material wherein the interior composition thereof includes a multitude of hollow, bubblelike resilient foam elements as designated by the numeral 3, and wherein the outer surrounding layer 4 is substantially devoid of said foam elements.

As a consequence of said novel structure, the foamy interior portion of the resinous material provides a highly resilient and pliable cushion sufficient to comfort in use, while comparatively firm nonfoamy outer layer 4 minimizes deformation of the sandal caused by the weight of the user.

In addition, further said nonfoamy outer layer may be provided with a water-insulation for avoiding the saturation of water and strongly connected between the band member and the body member, and as a result of the existence of the bubblelike foam elements, the foam elements include air therein so that the weight of the sandal can be reduced.

In accordance with the present invention the upper surface 2A of the body member is formed in a curved shape in conformity with the form of the user's sole in order to further provide the user with comfort to wear.

When a sandal having the above-described construction is worn by the user, his sole can be brought into perfect snag-fit contact with the upper surface of the body member and accordingly the sandal is subjected to a well-balanced natural load with the result that uneven wear of the sole can be eliminated, the foot of the user being ensured against the removal from the band of the sandal by the unbalanced loading.

As an outstanding advantage of the invention, the user can walk naturally without slippage and fatigue with extremely improved wearing comfort.

Further, the sandal of the present invention, as shown in FIG. 2, provides a hardening and reinforcing cover member 5 which is made of relatively hard and nonfoamy synthetic resin material and which is inseparably mounted on the upper surface and lateral surfaces of said body member 2, whereby said body member 2 of the sandal may be made more harder than the band portion, though those of said sandal are integrally molded. So that the sandal having the desirable hardness and resiliency sufficient to comfort is easily obtainable. Said cover member 5 is previously (initially) formed by means of a device to be later described and is inseparably and simultaneously adhered to the body member by means of split mold wherein the sandal is to be molded.

FIG. 3 diagrammatically shows said device available for molding the cover member. Referring to the FIG. 3, a vacuum-typed molding device 6 has a heating member 7 at internal upper portion thereof and a mold 8 at integral lower portion thereof. Said mold 8 is equipped with a number of sucking holes 9 connected to a vacuum pump (not shown) through a common pipe 22 (manifold) and is provided with an upper surface formed in a shape in conformity with profile of the user's sole. Designated by the numerals 10 are supporting members for bearing a film 5' which is to be molded into the cover member, said supporting members each being mounted to sidewall of the device 6, in such manner that supporting members facing to each other are movable towards the vertical direction.

In said device, after the film 5' supported by the supporting member 10 within the device 6 is softened by heating with the heater 7, the film 5' is moved downwardly up to the upper surface of the mold 8 by means of the supporting member 10, and the vacuum pump (not shown) then operated. So that the film 5' can be easily formed in shape in conformity with the upper surface of the mold or the profile of the user's sole. Useless edges (a) of the film 5' will be then cut out, after that finished product of the cover member 5 is placed on the upper wall of a molding chamber of a split mold B which is available for molding the sandal as shown in FIG. 4.

It will be understood that the cover member 5 is simultaneously and inseparably adhered to upper surface and lateral surfaces of the body member 2 of the sandal when the sandal is molded by means of the split mold B. Thus, the sandal having a soft band member adapted to provide comfort and a relatively hard body member adapted for durability will be easily obtainable.

Another embodiment of the invention is shown in FIG. 5. In the embodiment a sandal C is the same construction with that as shown in FIGS. 1 and 2, but the body member 2 thereof is somewhat different therefrom in construction thereof. The lower portion of the nonfoamy outer layer 4' in the body member 2 is relatively thicker than the upper portion thereof, whereby said thicker lower portion is to protect the body member from shock and increase durability of the sandal. Further, in the embodiment said body member 2 provides a heel 2B which has a plurality of transversal recesses 23 and a sole equipped with an uneven bottom surface 12 so as to increase cushioning effect and to avoid slipping thereof.

Further, as shown in FIGS. 6 and 7, the present invention may be applied to a lower sole D and an upper sole E which are to be separately produced and after that to be combined into one body.

Referring to FIG. 6, the body member 17 of the lower sole D also comprises a foamy interior portion 13 adapted for resiliency, a nonfoamy outer layer 14 for providing durability and resistance against deformation and a unique upper surface 15 which is formed with the profile in conformity with figure of user's sole. On the back surface and the lateral surfaces of the body member 17 a cover member 16 made of the relatively hard and nonfoamy thermoplastic synthetic resin material is inseparably mounted, so that the lower sole D can also effect the same advantages with those as shown in the above.

In FIG. 7, the body member 24 of the upper sole E also comprises a foamy interior portion 25, a nonfoamy outer layer 26 and a unique upper surface 27 similar to the above written body member 17 in FIG. 6, together with a cover member 19. The embodiment also provides suitable resiliency and hardness so as to provide the user with comfort to wear.

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 foamed 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 $Ar{-}CR{=}CH_2$ 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 a-methyl styrene, ar-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 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. Crosslinked 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 mole 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 sandal comprising a band member and a body member which are integrally molded of thermoplastic synthetic resin material so as to form a foamy interior portion and a nonfoamy outer layer, the upper surface of the body member being formed in a curved shape in conformity with the profile of the user's sole, and a cover member made of a relatively hard, nonfoamy thermoplastic synthetic resin material secured to the upper and lateral surfaces of the body member, the body member including a heel having a plurality of transversal recesses, the lower portion of the nonfoamy outer layer of the body member being relatively thicker than the upper portion thereof.

2. A sandal having a body member and a band member which are integrally formed of thermoplastic synthetic resin material, each of the body and band members having a foamy interior adapted for providing resiliency and comfort and a nonfoamy outer layer integrally formed therewith and surrounding said foamy interior for providing durability and resistence against deformation, and a hardening and reinforcing cover member secured to at least two surfaces among the upper, lateral and lower surfaces of the body member for protecting the body member.

3. The sandal of claim 2 wherein the cover member is secured to the upper surface and lateral surface of the body member.

4. The sandal of claim 2 wherein the cover member is secured to the lower surface and lateral surface of the body member.