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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improved Sandal

I, TATSUO FUKUOKA, a Japanese Citizen of No. 25, 4-Ban, 2-chome, Shin-Minami-Fukushima, Tokushima City, Tokushima Prefecture, Japan, do hereby declare the invention for which I pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improvement of sandal, and more particularly to a low cost but comfortable improved sandal formed of synthetic resin material.

Up to the present, sandals of conventional types have been formed of a highly resilient material that provides excellent cushioning effect but which is liable to be easily deformed during use thereof, or another type of sandal has been made of a relatively hard, unyielding material being durable but uncomfortable to put on. However, as far as the inventor is aware, there has heretofore been no sandal having both durability along with the desired resiliency and comfort in use.

Accordingly, a main object of the present invention is to provide a novel sandal, a main body and a band of which are integrally molded of synthetic resin material having a foamy interior to provide resiliency and comfort, and having an integral outer portion which is non-foamy to provide durability and resistance to deformation.

A further object of the present invention is to provide a new sandal having improved water-insulation for avoiding saturation by water.

A further object of the present invention is to provide a novel sandal which can be manufactured easily and economically.

A further object of the present invention is to provide a new sandal, a body of which is equipped with a unique upper surface to further provide enhanced comfort in use.

Still further objects and advantages of the present invention will appear from the follow-

ing disclosure of a preferred form of embodiment thereof taken in connection with the attached drawings, in which:—

Figure 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 line II—II in Fig. 1;

Fig. 3 is a transverse sectional view of the sandal taken along line III—III in Fig. 1;

Fig. 4 is a transverse sectional view of the sandal taken along line IV—IV in Fig. 1; and

Fig. 5 is a transverse sectional view of the sandal taken along line V—V in Fig. 1.

Referring to the drawings, illustrated therein is a novel improved sandal according to the present invention. Said sandal is molded of synthetic resin material, the composition of which will be hereinafter described in detail.

The sandal comprises a band member 1 and a body member 2 including a top base portion 2A and a sole portion 2B with or without a heel 2C, and those members are simultaneously integrally molded in one operation by means of a suitable injection mold (not shown). Though said injection mold consists of a stationary half-mold and another movable half-mold facing thereto, providing a molding profile of the sandal in co-operation with each other, it will be understood that other suitable means of molding can be employed and the invention is not to be limited to said injection mold.

As will be hereinafter described in greater detail, and as best appears in Fig. 2 and Fig. 5, the sandal including the band member 1 and the body member 2 is molded as an integral unit of a uniquely-formed synthetic resin material wherein the interior composition includes a multitude of hollow, bubble-like resilient foam elements as designated by the numeral 3, and wherein the outer, sur-

rounding portion or layer 10 is substantially devoid of said foam elements.

As a consequence of said novel structural composition, the foamy interior portion of the resinous material provides a highly resilient and pliable cushion for providing the comfort in use, while the relatively firm non-foamy surrounding layer minimizes deformation of the sandal caused by the weight of a user thereof.

In addition, said non-foamy outer layer may be provided with a water insulation for avoiding saturation by water and to form a strong connection between the main base member and the band member 1, and as a result of the existence of the bubble-like 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 of the body member 2, namely the upper surface of the top base portion 2A of the sandal is formed in a specific shape as described hereinafter in order to further provide the user with comfort in wear. The upper surface of the body member is formed in a curved shape in conformity with the form of the user's sole.

As best seen in Fig. 2, a longitudinal sectional view of the body member, the form comprises a gently sloped concave 4 in the front portion, an intermediate gently elevated portion 9, and a rear concave curve 5 relatively abrupt as compared with the front concave portion.

When seen in the transverse section as illustrated in Figs. 3, 4 and 5, the foam of the upper surface of the body member comprises a front portion A having an approximately horizontal surface (see Fig. 3), an intermediate concave portion B having the deepest bottom portion 6 positioned slightly nearer towards the other sandal of the pair with respect to the transversal mid-portion (see Fig. 4) and a rear concave portion C having the deepest bottom portion 7 (see Fig. 5).

The proportion of the area of the front concave portion 4 to that of the rear concave portion 5 is 53—56% to 47—44%, the left to right curved portions 8 and 8' on the opposite side of the deepest portion of the intermediate portion B being 35—38% to 65—62% in proportion. These proportions serve to prevent the foot of the user from slipping sideways due to the weight of the user, thereby enhancing stable wearing comfort.

When a sandal having the above-described construction is worn by the user, the sole of his foot can be brought into perfect snug-fitting 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 be-

ing ensured against removal of the band from the sandal due to the unbalanced loading.

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

In a sandal of the present invention, a transverse soft protrusion 11 as shown in Fig. 2 may be formed in the front portion of the upper surface of the body member 2, if so desired. More particularly, the protrusion 11 is so positioned that it may be brought in contact with the recessed toe base portion in the foot sole whereby the snug-fitting contact between the sandal and the foot is enhanced. Due to this, the foot is prevented from being detached off the sandal even when, for example, the foot is dragged in walking. In order to permit the protrusion 11 to attain greater flexibility, it may be formed with hollow interior.

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 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 alkyl 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 thermoplastics 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 thermoplasticized 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 to 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.

WHAT I CLAIM IS:—

1. A sandal comprising a body member and a band member which are integrally and

simultaneously molded of synthetic resin material having a foamy interior for resilience, and having a non-foamy integral outer portion for providing durability and resistance to deformation.

2. A sandal as claimed in Claim 1 wherein said upper surface of the body member is formed in a curved shape in conformity with the form of the user's sole.

3. A sandal as claimed in Claim 1 wherein the upper surface of the body member as seen in the longitudinal section comprises a gently sloped concave curve in the front portion thereof and a rear concave curve more abrupt and involving a smaller area than said front concave curve, and when seen in transverse section said upper surface comprises a front portion having an approximately horizontal surface, an intermediate concave portion having the deepest bottom portion positioned slightly nearer towards the other sandal of a pair with respect to the transverse mid-portion and a rear concave portion having the deepest bottom portion.

4. A sandal as claimed in Claims 1 and 3 wherein a transverse soft protrusion is formed in the front portion of said upper surface of said body member so as to be brought in contact with the recessed toe base portion in the foot sole of the user when said sandal is worn.

5. A sandal as claimed in any one of Claims 1 to 4 wherein said synthetic resin material is formed by a method comprising: charging a mass of expandable granules of thermoplastic resinous material 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.

- 5 6. A sandal substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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