Jan. 17, 1961 E. E. JOINER ET AL 2,968,106

LIGHTWEIGHT HEELS

Filed Oct. 1, 1958

Fig. 1

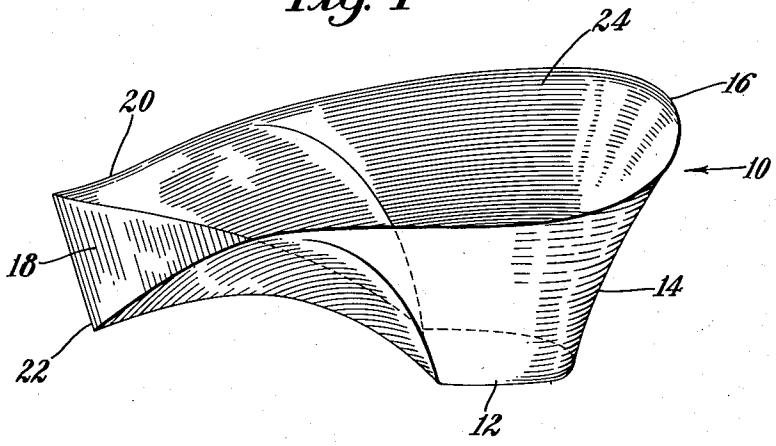


Fig. 2

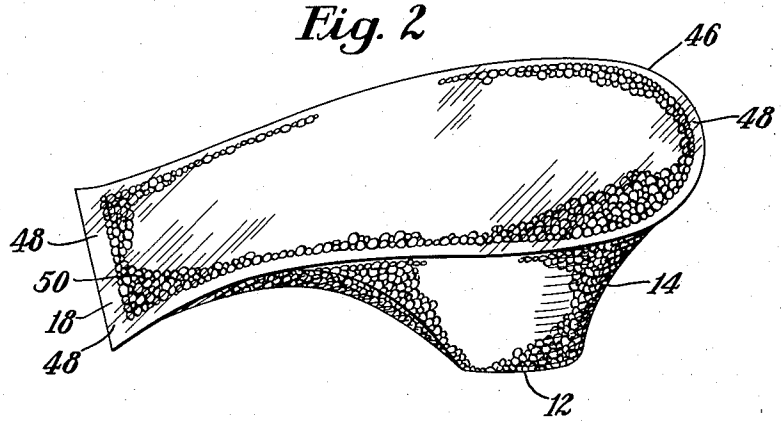
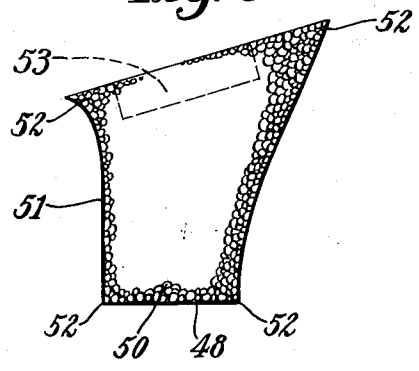


Fig. 3



Inventors
Edgar E. Joiner
John P. Szumski
By their Attorney
Benjamin C. Pillard

United States Patent Office 2,968,106
Patented Jan. 17, 1961

2,968,106

LIGHTWEIGHT HEELS

Edgar E. Joiner, Andover, and John P. Szumski, Marblehead, Mass., assignors to Fred W. Mears Heel Company, Inc., Lawrence, Mass., a corporation of Massachusetts

Filed Oct. 1, 1958, Ser. No. 764,541

6 Claims. (Cl. 36—34)

This invention relates to a lightweight plastic heel.

The wider tread heel, such as a wedge or Cuban type used in the casual style slip-lasted shoe, is usually made of wood and covered. The wood heel requires special quality raw stock and involves turning difficulties and a substantial number of rejects. The plastic heel is gradually replacing the conventional wooden heel for high thin heels in women's shoes for reasons of strength, styling and cost, but there has been little adaptation of the plastic heel for the low-heeled casual or novelty shoe. In the low heeled shoe, the heel receives a compressive force only, rather than a bending force, as encountered in a high thin heel. This is because a greater portion of the weight is distributed on the heel than on the ball and toes of the foot. To carry this compressive force, a solid heel is preferred. Forming such a heel of solid plastic would require a relatively large quantity of expensive raw material. The solid plastic heel would also be heavier than the customary wood heel. Heretofore also, plastic heels have been made in expensive molds which represent a considerable overhead.

It is an object of the present invention to provide a new plastic heel which is light, crush-resistant and shock-absorbent, and which is unusually adaptable to decorative ideas which may be incorporated in the course of manufacture. It is a particular object of the invention to provide a wedge style heel having a thin tapered shank end which is strongly reinforced and a smooth heel-seat area conforming accurately to a shoe upper.

According to a method of making the present heel, there is provided a tough outer skin or shell of a thermoplastic resin, pre-molded to give the desired external shape and size. In this shell is deposited a quantity of expandable fluid resin, preferably a fluid mixture comprising particles of an expandable thermoplastic resin, a liquid thermosetting resin and a curing agent for the thermosetting resin. The resin is caused to expand to fill the entire cavity of the shell with solidified expanded resin conforming faithfully to the shape of the shell. The preferred mixture when cured and cooled fills the main body of the shell with a light, crush-resistant thick-walled cellular material, while thermosetting resin reinforces the portions of the heel having thin cross sections, particularly the shank region, and bonds the expanded resin mass to the inner wall surfaces of the shell.

This invention will be described further in reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a wedge heel shell for use in the present invention;

Fig. 2 is a top view of a completed wedge heel filled with expanded and cured resin; and

Fig. 3 is a side view of another style of heel as made by the present invention.

The shell 10 (see Fig. 1) forming part of the present heel is formed of relatively thin sheet plastic presenting an exterior surface shaped to correspond to the shape of a conventional heel, e.g. a wedge heel. The heel shell 10 comprises a flat portion 12 for attaching a heel lift,

a curved rear portion 14 having an upper edge 16 corresponding to the shape of the outer edge of the heel seat of a shoe upper, and a shank portion 18 extending forward with its upper edge 20 shaped complementary to the outer edge of the shank portion of a shoe upper and with its forward end 22 terminating in a line. As shown in the drawing the upper edge 20 of the shank portion slopes downward from the forward edge of the heel seat to a relatively narrow wedge at the forward edge of the shank portion. The interior of the shell 10 provides a cavity 24 deepest at the rear of the heel seat portion and tapering to a thin wedge at the forward end 22 of the shank portion of the heel. The shell 10 is usually formed by molding a thermoplastic resin sheet. Conventional molding procedure such as vacuum molding may be used to form the resin sheet. The details of the process are so well known that no description of the steps is needed. A variety of thermoplastic resin sheet materials such as styrene copolymers, cellulose acetate, polyvinyl chloride, vinyl chloride-vinyl acetate copolymers, cellulose acetate-butyrate and polyacrylates and methacrylates may be used. Preferably the shell 10 is molded from a sheet of thin, high impact styrene polymer. Such a polymer is Styron 475, available from Dow Chemical Co. A shell 10 molded from this material is chip and shock resistant, and may be colored or otherwise decorated for use without a covering.

The thin walls of the shell 10 are flexible and must be supported to prevent distortion in the steps of expanding the resin within the shell. A smooth surface is disposed to cooperate with the upper edge of the shell 10 for molding the upper surface of the expanding resin in the shell 10 to a shape for cooperation with the bottom of the heel end of a shoe upper. Alternatively, a sheet of material such as paper, leather, etc., may be disposed to cooperate with the upper edge of the shell 10 to mold the upper surface of the expanding resin in the shell. On expansion and curing of the resin in the cavity this sheet will be firmly adhered to the upper surface of the expanded resin.

Various expandable resin materials may be used to fill the shell. It is preferred to use a resin material in the present invention which expands at a temperature below the softening temperature of the resin shell, and is adhesive to the walls of that shell. Suitable resins known per se include the expandable styrene polymer, mixtures of particles of expandable styrene polymers and thermosetting resins, and foamable polyurethane resins. These expandable resin materials include an agent which liberates a gaseous material on heating or reaction to cause the expansion.

A preferred resin mixture is a combination comprising particles of an expandable thermoplastic resin, preferably polystyrene beads, a liquid thermosetting resin, and a curing agent for the thermosetting resin. The polystyrene beads expand from the blowing agents contained therein, pushing the mixture outward to fill the shell 10 and conform to the molding surface. At thinner cross sections of the cavity defined by the shell, e.g. the upper edges 16 and 20 of the shell 10 and adjacent the shank edge 22 of the heel, the expanded polystyrene particles cannot penetrate and the fluid thermosetting resin free from expanded particles is forced into the thin narrow cross sections where it cures to a strong rigid condition. The thermosetting resin also bonds strongly to the walls of the shell 10 to hold the expanded mass and the shell in unitary relation. The expanded beads are themselves overlaid with the fluid resin where it cures to form a thicker walled cellular structure. The resultant mass is very light, resilient and an excellent shock absorbent for walking vibrations.

The expandable polystyrene beads preferably employed

are known per se and comprise a base of styrene polymer with a gaseous material or a volatile organic liquid which is non-solvent for the polymer absorbed therein, and homogeneously dispersed throughout the beads. However, upon heating, the liquid volatilizes or the gas expands and in a closed mold expands the styrene polymer into a cellular structure. Such expandable polystyrene beads are disclosed in United States Letters Patent No. 2,744,291, granted May 8, 1956, in the name of Fritz Stastny, No. 2,816,827, granted December 17, 1957, in the name of Murray H. Roth, and Nos. 2,848,427 and 2,848,428, granted August 19, 1958, in the name of Louis C. Rubens. The beads range in diameter from 1–3 mm. with those of the smaller dimension averaging about 1.4 mm. and those of the larger about 2.8 mm.

The preferred thermosetting resin is a polyepoxide which binds together the polystyrene beads and the cellular mass to the walls of the heel shell. The polyepoxide is a resinous glycidyl polyether of a member of a group consisting of polyhydric phenols, polyhydric alcohols, and mixtures of these. The polyepoxides are complex resinous materials and may be produced by the reaction of polyhydric phenols with a polyfunctional chlorohydrin such as epichlorohydrin and glycerol dichlorohydrin. The preparation of epoxide resin is shown in United States Patents Nos. 2,506,486 to Bender et al., granted May 2, 1950, and 2,589,245 to Greenlee, granted March 18, 1952.

The epoxide resins used in the present invention are liquid at room temperature with a viscosity at 25° C. of from about 3600 to 15,000 cps. The range of epoxy equivalence is from about 170 to 210 and the molecular weight is between 340 and 400. Such epoxy resins are commercially available as Epon 828 or 820, made by the Chemical Division, Shell Oil Co., and Araldite 6005, made by the Ciba Company, Inc.

The epoxide resins are curable to a hard, strong state by the action of a catalyst, such as the aliphatic primary or secondary amines, having a molecular weight of at least 100. Included in such amines are ethylene diamine, triethylene tetramine, and dimethylamino propylamine.

A modifying agent which may be a high boiling alcohol may be used to secure uniformity of reaction.

The proportion of thermosetting resin relative to the beads is preferably high enough to ensure completely filling the cavity of the shell with cellular resinous mixtures and to deposit a reinforcing layer of the thermosetting resin on the inner surfaces of the shell, against the mold cover and concentrated in the thinner cross sections of the tapered shank end of the wedge heel. Suitably there will be used from about one to about two parts by weight of expandable beads to one part by weight of the thermosetting resin.

The mixing procedure employed, where polyepoxide resin is used involves heating the epoxide resin from 150° to 190° F., preferably from 180° to 190° F., adding the polystyrene beads at room temperature, and quickly stirring the mixture to ensure uniformly wetting the exterior surfaces of the beads with the epoxide resin. The curing agent, also at room temperature, is stirred vigorously into the combination, and finally the modifier is added and the entire mixture stirred to uniform condition.

The warm resin mixture is deposited in the cavity 24 of the preformed heel shell as in Fig. 1, which has been trimmed. The epoxide resin curing reaction generates sufficient heat to increase the temperature of the mixture to cause expansion of the polystyrene beads. This requires a compact body of a substantial quantity of the resin mixture so that the heat generated will not escape too rapidly. If there is too rapid a transfer of the heat from the reaction, the mixture will not attain a high enough temperature to cause the uniform expansion of the polystyrene beads by the volatilization of the organic liquid included in the beads.

A molding surface is disposed to cooperate with the edges of the shell, thus defining a closed chamber. The mixture expands 200 to 300% into a cellular mass filling the enclosed area. The internal pressure generated by the expanding beads forces the epoxide resin outward from the center of the mass toward the perimeter of the shell 46 squeezing it from the beads into the thin, tapered cross section of the shank end 18 and against the inner surfaces of the shell where it accumulates and cures into a strong, rigid layer of resin 48, reinforcing those areas to which it adheres. The beads themselves expand into a cellular structure 50, with each cellular body surrounded by a film of the cured epoxide resin 48, thus forming a thicker walled cellular structure. The upper surface against the molding surface also presents a smooth surface rich in hardened epoxide resin which will fit neatly against the heel engaging surface of the combining upper.

The entire process from placing the resin mixture in the heel shell may require a matter of two to twenty minutes. The time and degree of bead expansion may be controlled to some extent by the pre-heat temperature of the epoxide resin and the temperature of the containing shell.

Although this invention has been described in reference to a wedge style heel with a thin tapered shank portion (which is admirably adapted to the benefits of the reinforcing resin), it is to be understood that the invention is not limited to any particular style, shape or size of heel. A shell 51 of a more conventional style heel form is shown in Fig. 3 where the thin areas at the corners 52 of both the heel seat engaging surface and the heel base where the lift is attached are strengthened by the thermosetting resin. For nailing purposes it is desirable to include a nailable insert, for example of wood or fiber, in a heel of conventional type. This may be in the form of a dowel extending the height of the heel. However, it has been found (see Fig. 3) that a flat nailable insert member 53 presenting an upper surface of appropriate size and shape to receive heel attaching nails in a determined pattern and having outer dimensions allowing it to move freely in the shell may be incorporated by depositing expandable resin material in the heel shell 51 and merely placing the nailable member 53, which may be of wood, fiber or other nailable material, in the heel shell above deposited expandable resin material. In order that the insert member may be properly located in the upper surface of the finished heel, it has been found desirable that, when placed in the shell, it rest on the body of deposited resin with its edges capable of movement without binding against the heel shell walls. Where larger insert members are used in a heel of upwardly increasing cross section, it may be desirable to allow the resin partially to expand and raise the upper surface of the resin in the shell to a level having greater cross section before placing the insert member on the resin surface. The resin material is then caused to expand and lifts the nailable member 53 on its upper surface, finally forcing the member against the molding surface and flowing up around the sides of the member to embed it firmly in place. This modification is particularly effective where the expandable material is a mixture of expandable thermoplastic resin particles and liquid thermosetting resin, since the body of non-liquid thermoplastic particles exerts positive lifting action on the member and the thermoplastic resin wets and bonds to the member and fills in even fine crevices around the member. After the resin is cured, the heel seat engaging surface may be "concaved" using conventional machinery.

The following example is given to aid in understanding the present invention but it is to be understood that the invention is not restricted to the specific composition and procedure described below.

Example

A resin mixture was prepared using the following proportions:

	Parts by weight
Polystyrene beads containing volatile liquid for expansion	120
Epoxide resin	100
Curing agent (diethylene triamine)	20
High boiling alcohol	10

The epoxide resin was a glycidyl polyether, liquid at room temperature with a viscosity at 70° F. of 8,000 cps. and at 170° F. of 80 cps., and a specific gravity at 25° C. of 1.2. It had a reactivity range of epoxy equivalent of 173–179. The expandable polystyrene beads had a range in diameter of from 1 to 1.5 mm. with an average of about 1.4 mm.

The epoxide resin was heated to about 170° F. and the polystyrene beads, at room temperature, were added and stirred in rapidly so as to insure uniform wetting of the exterior surfaces of the beads with the liquid resin, thereby allowing the beads in expanding to be reinforced by films of the thermosetting, hard, epoxide resin which forms a thicker-walled cellular structure. The curing agent, at room temperature, was then stirred vigorously into the combination and finally the alcohol was added and the entire mixture stirred into uniform condition.

A sheet of thin, high impact polystyrene in the color desired for the finished heel was vacuum molded in the conventional manner into a shell with the exterior configuration of a heel with a thin tapered shank end.

The above mixture was deposited while still warm in the deeper end of the cavity 24 of the heel shell in quantity to fill the shell about one-third full. A molding surface was clamped tightly in place, and the shell then set aside for 10 minutes to allow the resin to expand and cure exothermically. At the end of this interval, there was obtained a firm, solid, unitary heel structure with reinforced walls and shank end and a smooth, even heel-seat attaching surface ready for assembly with a slip-lasted upper. This colored heel needed no finishing beyond attaching the protective heel lift.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. As an article of manufacture, a heel for a shoe comprising the combination of a thin flexible thermoplastic resin shell, said shell presenting an exterior surface in the shape of a heel, and a body of a cellular resin filling said shell and adhering to and reinforcing the walls of said shell to form a lightweight unitary heel structure.

2. As an article of manufacture, a heel for a shoe comprising the combination of a resin shell of thin sheet tough, flexible thermoplastic resin, said shell presenting an exterior surface in the shape of a heel, and a resinous body filling said shell and adhering to and reinforcing the flexible walls of said shell to form a lightweight unitary heel structure, said resinous body comprising particles of fine cellular thermoplastic resin surrounded by and embedded in a cured thermosetting resin.

3. As an article of manufacture, a heel for a shoe comprising the combination of a resin shell of thin sheet tough, flexible thermoplastic resin, said shell presenting an exterior surface in the shape of a heel, and a resinous body filling said shell and adhering to and reinforcing the flexible walls of said shell to form a lightweight unitary heel structure, said resinous body comprising particles of fine cellular polystyrene surrounded by and embedded in a continuous phase of cured resinous glycidyl polyether.

4. As an article of manufacture, a heel for a shoe comprising the combination of a resin shell of thin sheet tough, flexible thermoplastic resin, said shell presenting an exterior surface in the shape of a heel comprising a flat portion for attaching a heel lift, a curved rear portion having an upper edge corresponding to the shape of the outer edge of the heel seat of a shoe and a shank portion extending forward with its upper edge shaped complementary to the outer edge of the shank portion of a shoe upper and tapering to a relatively thin cross section at the forward edge of the shank portion, and a resinous body filling said shell and adhering to and reinforcing the flexible walls of said shell to form a lightweight unitary heel structure, said body comprising particles of fine cellular polystyrene resin surrounded by and embedded in a continuous phase of cured resinous glycidyl polyether, portions of said resinous body in thin cross sections of said shell comprising cured resinous glycidyl polyether substantially free from said particles of cellular polystyrene resin.

5. A heel adapted for attachment to a shoe by nailing, comprising a hollow, thin, flexible thermoplastic resin shell presenting an exterior in the shape of a heel, a body of cellular resin adhering to the flexible walls of said shell, and a nailable insert member in said shell at least partially embedded in said cellular resin, said member presenting an upper surface of size and shape to extend outside the heel attaching nailing pattern.

6. A heel adapted for attachment to a shoe by nailing, comprising a hollow, thin, tough, flexible thermoplastic resin shell presenting an exterior in the shape of a heel, a mass of crush-resistant cellular resin adhering to the flexible walls of and filling said shell, and a nailable insert member in said shell at least partially embedded in and adhesively secured by said mass of resin, said cellular resin mass comprising fine cellular thermoplastic resin bodies surrounded by and embedded in a continuous phase of cured thermosetting resin constituting a thick walled cellular structure, and said insert member presenting an upper surface of size and shape to extend outside the heel attaching nailing pattern.

References Cited in the file of this patent

UNITED STATES PATENTS

1,336,194	Burger	Apr. 6, 1920
1,609,918	Perugia	Dec. 7, 1926
1,710,378	Owen	Apr. 23, 1929
1,781,931	Owen	Nov. 18, 1930
2,871,583	Cooper et al.	Feb. 3, 1959

FOREIGN PATENTS

484,627	Great Britain	May 9, 1938