

[54] **ENCAPSULATED PLASTIC SNOW SKI**

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[56] **References Cited**

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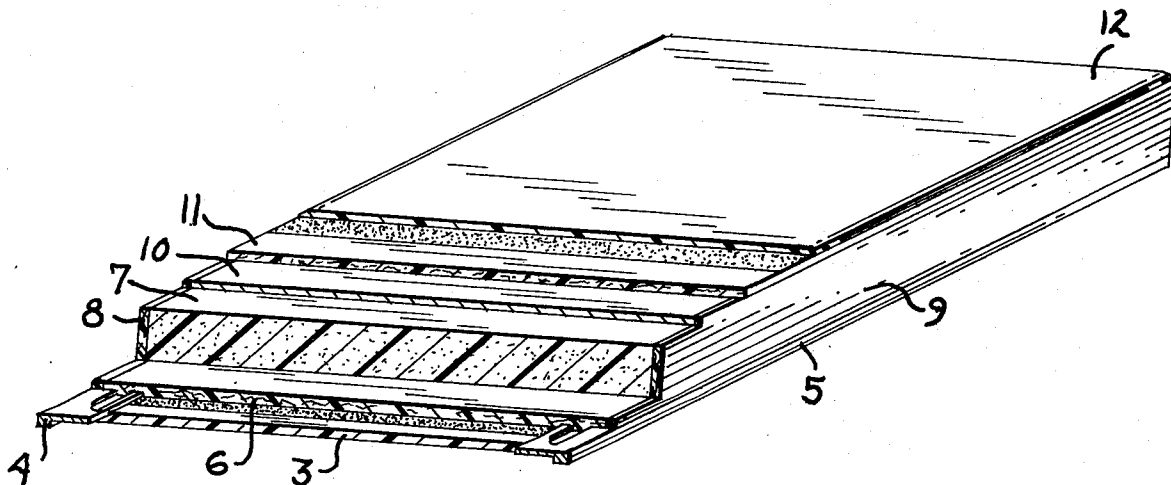
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[57] **ABSTRACT**

A rugged, flexible snow ski having a lightweight core (e.g., polyurethane foam) encapsulated within a shell made of a tough, resilient thermoplastic which has been reinforced with glass fibers. The ski can be manufactured by hot pressing a ski assembly which comprises a high-density polyethylene running surface, steel edges, a preformed polyurethane foam core interposed between upper and lower sheets of glass fiber reinforced thermoplastic and bounded on each side by sheets of glass fiber reinforced thermoplastic, all topped by a decorative plastic cover sheet. During the hot pressing, the four glass reinforced plastic sheets which surround the core are fused together to form a shell which encapsulates the foam core, and the entire ski assembly is firmly bonded together to form a unitized structure.

3 Claims, 3 Drawing Figures



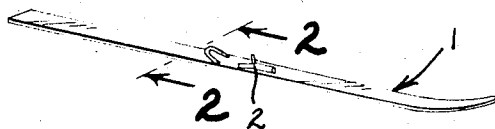


FIG. 1

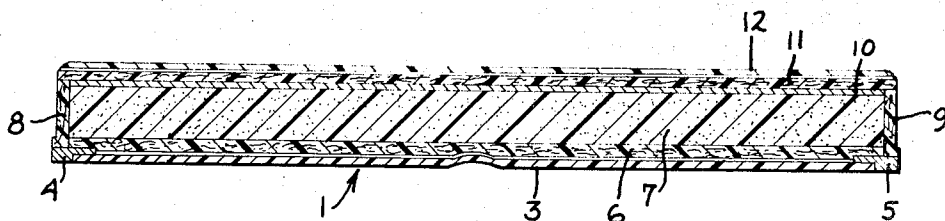


FIG. 2

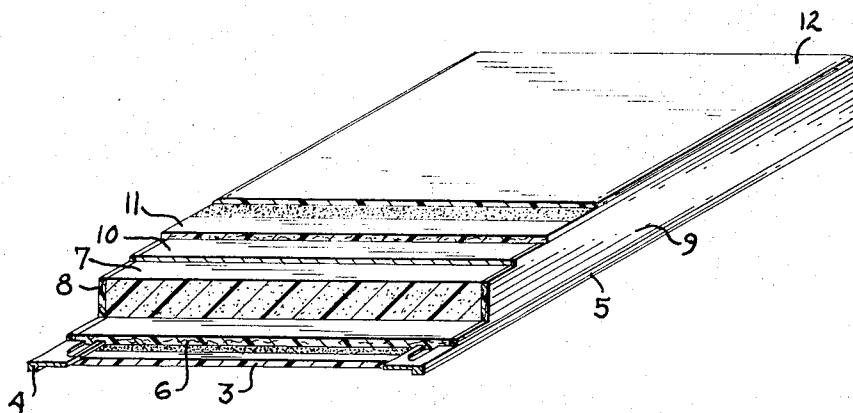


FIG. 3

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ENCAPSULATED PLASTIC SNOW SKI

BACKGROUND OF THE INVENTION

Snow skis have been made from a variety of materials including wood, plastic, metal, and various combinations of the foregoing.

In manufacturing skis, ski manufacturers seek to develop skis which are rugged, have the proper degree of flexibility for the intended end use (e.g., as a slalom ski, downhill ski, etc.), have a minimum weight consistent with performance and stability requirements, have a long life and the like. In addition, ski manufacturers seek to achieve these properties using construction materials and techniques which lend themselves to mass production and minimum costs.

In the past, many manufacturers have produced laminated skis by gluing together under pressure a plurality of wooden or plastic parts (e.g., thin sheets of unidirectional glass fiber reinforced polyester). However, delamination or failure of the glue lines has been a continued problem in the ski industry. In addition, the flat sheets of unidirectional glass fiber reinforced polyester which are often used in making such skis have a memory. When such sheets are flexed and the forces are then removed, the sheet tends to abandon its flexed position and return to its original flat position. As a result, when such flat sheets are bent during ski fabrication to form the nose or toe of the ski and to impart camber to the ski, there is a tendency for the ski to flatten out over long periods of time as a result of the memory of the unidirectional glass reinforced polyester sheet.

In attempts to produce skis of improved quality, ski manufacturers have turned in increasing numbers to the use of plastics, particularly in conjunction with new fabrication techniques. According to one such technique a foamed ski core is wound or wrapped with glass filaments which are then coated or impregnated with a suitable resin which is thereafter cured or hardened in place. Metal edges and appropriate decorative top surfaces are then bonded to this structure by known techniques.

More recently, snow skis have been made by laminating a sandwich made of a high-density polyethylene running surface, a wooden core covered with glass fibers or glass fabric which has been impregnated with an uncured resin, and a decorative plastic top sheet. During lamination, the uncured resin is cured in place to form a box-tube around the wooden core.

SUMMARY OF THE INVENTION

The present invention is an improvement in plastic snow skis.

Briefly described, the snow skis of the present invention can be made by thermopressing (i.e., made by heating and pressing) an assembly comprising from bottom to top a plastic running surface (e.g., high-density polyethylene), steel running edges, a bottom sheet of glass reinforced thermoplastic, a lightweight core (e.g., foamed plastic), left and right sidewalls of glass reinforced thermoplastic, a top sheet of glass reinforced thermoplastic, and finally a decorative plastic cover sheet. During thermopressing, the top and bottom glass reinforced thermoplastic sheets are bonded to the left and right glass reinforced sides by fusion, thereby encapsulating the lightweight core in a glass fiber reinforced shell. Simultaneously, the decorative plastic top sheet, the running surface, and the steel edges are bonded together to form a unitized ski which is unusually light in weight (e.g., 9 lbs. for 210-centimeter skis).

Among other desirable properties, the shells of the snow skis produced by this invention have a memory which is its shape as formed (i.e., ski shaped) and does not have the same tendency to flatten with time as is the case with certain prior art skis.

THE DRAWINGS

FIG. 1 is a perspective view of a snow ski.

FIG. 2 is a cross section of the ski of FIG. 1 taken along the lines 2—2 in the direction of the arrows.

FIG. 3 is a fragmentary isometric view of the section shown in FIG. 2 with portions of each element of the ski broken away in step fashion to show in more detail the construction of the ski.

DETAILED DESCRIPTION

The present invention is directed to an improved process for making plastic snow skis and to the resulting snow skis.

THE SNOW SKIS

The following description is made with reference to the drawings in which FIG. 1 illustrates a snow ski, generally designated by the numeral 1, having mounted thereon a suitable ski binding 2.

A cross-sectional view of the ski is shown in FIG. 2. The details of construction are as follows. A running surface 3, typically of high-density polyethylene, is embraced and protected along either edge by L-shaped steel edges 4 and 5. Immediately above the running surface are one or more bottom sheets of glass fiber reinforced thermoplastic 6. Next is a lightweight core 7 (usually a foamed plastic) which is embraced on the left and right by glass fiber reinforced thermoplastic sidewalls 8 and 9. Optionally, a sheet of metal 10 is placed above the core 7. On top of this entire assembly are one or more top sheets of glass reinforced thermoplastic 11 which are overlaid with a decorative plastic sheet 12.

If desired, the top, bottom and sidewalls (11, 6, 8 and 9 respectively) can be formed in more or less than the four separate pieces as shown and it is only necessary that the lightweight core 7 be surrounded or enclosed within or by at least two separate sheets of glass reinforced thermoplastic which will, as a result of thermopressing, fusibly bond together to encapsulate the core 7. By way of example, sidewalls 8 and 9 and bottom 6 can be formed in a U-shape from a single sheet of glass fiber reinforced thermoplastic by hot stamping.

The details of construction of the snow skis of this invention are shown more clearly in FIG. 3.

MATERIALS OF CONSTRUCTION

The running surface 3 of the skis can be of any conventional plastic known to the ski art. Polyethylene, particularly high-density polyethylene known in the art as P-Tex, is particularly useful. Such material is commercially available in semirigid or rolled form. If desired, an additional sheet of glass reinforced thermoplastic of the type used to encapsulate the core 7 can be used as the running surface, or the separate running surface 3, as such, can be omitted entirely and the exposed surface of thermoplastic 6 can function as the running surface. However, the use of a separate running surface 3 as shown in FIGS. 2 and 3 is preferred.

The top decorative sheet 12 is optional and can be of any conventional plastic material used for this purpose in the ski industry. Phenolic and aminoplast decorative sheets are particularly useful. Decorative plastic sheets of either phenol-formaldehyde resin or melamine-formaldehyde resin have proven to be particularly abrasion resistant and colorfast. Also, top sheet 12 can be omitted entirely, or replaced by paint or an additional sheet or layer of the glass reinforced thermoplastic used to encapsulate the core 7.

Metal edges 4 and 5 are desirably perforated or have an irregular shaped (e.g., serrated or corrugated) ski-engaging surface to enable them to become firmly attached to and integral with the finished snow ski during thermopressing (i.e., they are locked into the ski). During thermopressing, the thermoplastic used to encapsulate core 7 will flow into and around such irregular shapes or perforations to thereby mechanically lock the edges to the encapsulated core when the soft hot plastic has cooled and hardened.

Reinforcing element 10 may be omitted entirely, although its use in the center section of the ski is preferred. One pur-

pose of reinforcing element 10 is to reinforce the ski at the points where the binding 2 is attached. Aluminum is a suitable material of construction.

The lightweight core 7 can be any lightweight material (e.g., foamed or filled plastic) that can be shaped or preformed to the desired shape (e.g., ski shaped) and will function satisfactorily under the conditions of thermopressing. Although wood or a wood-filled plastic can be used to form the core, the use of a metal or plastic core (i.e., a wood-free core) is preferred. Suitable core materials include foamed plastics, paper and metal honeycombs, and the like, ordinarily having a bulk density of less than 50 pounds per cubic foot, generally less than 20 pounds per cubic foot, and preferably less than 10 pounds per cubic foot (e.g., 4-8 pounds per cubic foot). One of the primary functions of the core 7 is to provide a core around which a thermoplastic shell (i.e., the ski-defining surfaces) can be formed by thermopressing together the sheets of glass fiber reinforced thermoplastic 6, 8, 9 and 11. Under some conditions, it is even possible to use a lightweight plastic core (e.g., styrofoam) which loses its structural identity or shape under the conditions of thermopressing but is, nonetheless, capable of temporarily supporting elements 6, 8, 9 and 11 until they have fused together under the conditions of thermopressing to encapsulate the core. However, for normal use we prefer to use a lightweight plastic which does not lose its structural identity or integrity during thermopressing. Polyurethane foam, particularly polyurethane foam reinforced with glass fibers is preferred. One especially preferred core material is polyurethane foam which has been filled or extended with small diameter glass bubbles (e.g., 50-75 microns in diameter) and reinforced with glass fibers (e.g., continuous roving). Although the core has been shown in FIGS. 2 and 3 as having a rectangular cross section (i.e., four sides), other shaped cores can be used (e.g., oval). However, the use of four-sided cores as shown in FIG. 2 and 3 is preferred.

The shell which surrounds core 7 can be formed of separate elements 6, 8, 9 and 11 or their equivalent (e.g., a U-shaped bottom and side member, and a top piece). These elements can be made of any thermoplastic which possesses the physical properties needed for ski construction. However, for use in this invention, it is necessary that the thermoplastic which is selected for encapsulating core 7 be one wherein the two or more separate elements can be fused together by thermopressing (e.g., pressing at 350° F. and 100 p.s.i.g.) to form in situ a shell around the core. Normally, and most preferably, this thermoplastic will be reinforced with glass fibers, preferably those which are not unidirectionally oriented. However, the use of glass reinforcing is not essential with all thermoplastics. Suitable thermoplastics include but are not limited to polypropylene, styrene-acrylonitrile copolymers, poly (vinyl chloride), and the like. Some particularly useful materials for this purpose are those sold under the trademark Azdel (products of GRTL, Inc.). These materials are thermoplastic sheets reinforced with large amounts (e.g., 40 percent by volume) of randomly oriented glass fibers. Azdel A-201 (based on a styrene-acrylonitrile copolymer) is espe-

cially useful.

METHOD OF CONSTRUCTION

Snow skis produced according to this invention can be made by thermopressing all of the elements shown in FIGS. 2 and 3 in a mold. Each of the individual elements is formed to the desired shape and then positioned within the mold in the order shown in FIGS. 2 and 3. When using glass reinforced sheets of an acrylonitrile-styrene copolymer to form the sidewalls of the shell, a melamine-formaldehyde decorative plastic top sheet, and high-density polyethylene as the running surface, it is necessary to pretreat, precoat or dope the bonding surfaces of the polyethylene running surface and the decorative top sheet with a suitable adhesive (e.g., by heating P-Tex and coating it with a suitable adhesive while hot).

Although the temperature and pressure of thermopressing can vary considerably, it is normally convenient to use temperatures of 250°-550° F. (e.g., 300°-400° F.) at elevated pressures (e.g., 50-500 p.s.i.g.). The time of thermopressing will vary with the plastics used, temperature and pressure. We have made skis by heating the necessary ski forming elements in a box mold under a molding pressure of about 100 p.s.i.g. to a desired molding or encapsulating temperature (e.g., 350° F.) and then water cooling the mold in a total time of about 10 minutes.

The channel groove in the center of running surface 3 can be pressed or molded into the plastic as the ski is formed and does not need to be machined in.

The toe end of the ski 1 can be sealed or encapsulated by either: (a) continuing the sidewalls 8 and 9 around the tip or toe; or by having the sidewalls taper down to a point short of the toe or tip of ski 1, allowing the top and bottom sheets 6 and 11 to extend forward beyond the fore end of core 7 and fusibly bonding top and bottom sheets 6 and 11 to each other. Similar techniques can be used to finish off the heel of the ski (e.g., an end or crosspiece of reinforced thermoplastic can be fusibly bonded to elements 6, 8, 9 and 11).

Advantages of the present skis include: strength and durability; ease of construction; the ski has a memory of its own; it can be completely sealed or encapsulated; and nose and tail inserts can be eliminated. Flexibility can be controlled by adding extra layers or partial layers of reinforced thermoplastic.

What is claimed is:

1. In a plastic snow ski, the improvement which comprises a lightweight, plastic foam core within a plastic shell encapsulating said core, said shell being formed in situ by thermopressing said shell in a mold to bond together separate sheets of rigid or semirigid thermoplastic.

2. Snow skis of claim 1 wherein said thermoplastic sheets are of glass fiber reinforced copolymer of styrene and acrylonitrile.

3. Snow skis of claim 2 wherein said core is polyurethane foam reinforced with glass fibers and filled with glass bubbles, and having a bulk density of less than 10 pounds per cubic foot.

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