Oct. 28, 1969 B. R. NASON 3,475,035

POLYCARBONATE PLASTIC SKIS

Filed Feb. 17, 1967

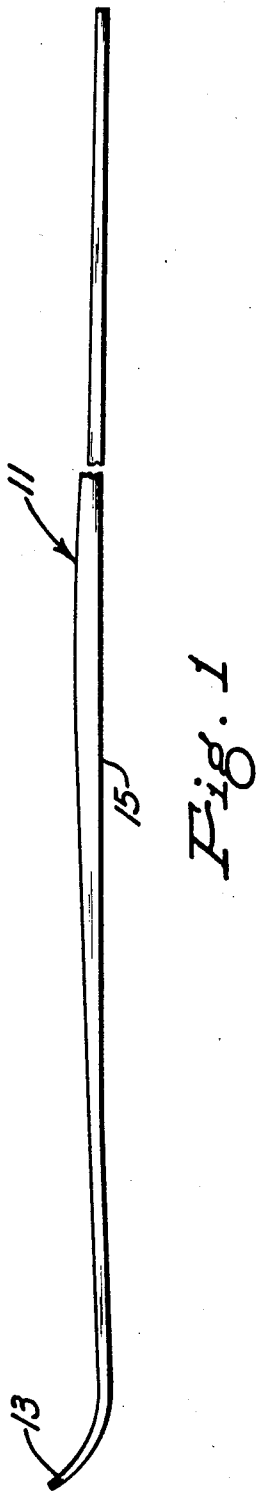


Fig. 1

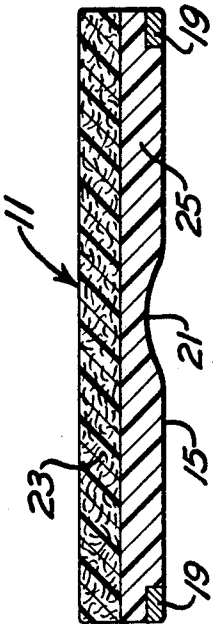


Fig. 3

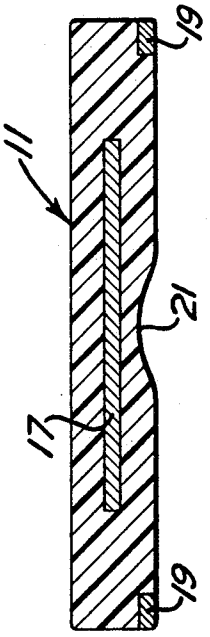


Fig. 2

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POLYCARBONATE PLASTIC SKIS

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U.S. Cl. 280—11.13 6 Claims

ABSTRACT OF THE DISCLOSURE

A ski is fabricated from a polycarbonate plastic having incorporated therein a polyolefin. The ski has improved impact resistance, resilience, lightness and sliding contact on snow.

This invention relates to skis, and more particularly to plastic skis of polycarbonate.

It has been heretofore known to provide skis from a variety of materials; the most basic of these materials being wood. In the preparation of wooden skis, various types of wood such as ash, oak, birch, spruce or hickory either alone or in combination are used. These skis are generally made up of many laminae in order to provide the proper flexing action. In order to impart the proper slipperiness to the running surface of the ski, it has generally become the practice to provide the bottom surface with a layer of a polyolefin polymer such as polyethylene or polypropylene. To this surface, a coating of wax may, if desired, be applied.

Various metals such as aluminum and magnesium have been used in the preparation of skis. These are generally combined with other materials including wood, plastics, and the like. All of the heretofore known types of skis are complex structurally because of the attempt to achieve the most optimum flexing action in combination with a surface which permits the least drag.

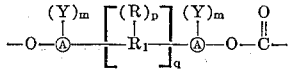
It is an object of this invention to provide an improved ski of simplified structure. It is another object of this invention to provide a lightweight ski which is easily manufactured. It is another object of this invention to provide a ski of polycarbonate plastic.

The foregoing objects and others which will become apparent from the following description and the accompanying drawing are accomplished in accordance with the invention generally speaking by providing a ski of a polycarbonate plastic, the polycarbonate plastic having incorporated therein from about 3 to about 7% of a polyolefin resin at least in the vicinity of the running surface.

FIGURE 1 is a side elevation of a preferred form of ski; FIGURE 2 is a cross-sectional configuration of one embodiment of a ski in accordance with this invention; FIGURE 3 is a cross-sectional configuration of a second embodiment of a ski in accordance with this invention.

It has been found that a ski prepared from a polycarbonate plastic having incorporated therein from 3 to 7% of a polyolefin gives the desired properties with regard to resilience, durability, lightness, and excellent sliding contact with the snow.

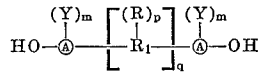
The polycarbonate resin material of this invention comprises a linear polymer comprising recurring structural units of the formula

I 

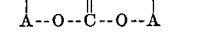
where R is a monovalent hydrocarbon radical; R_1 is selected from the group consisting of an alkylene and an alkylidene residue; A is the residue of an aromatic nucleus; Y is a chemical constituent selected from the group consisting of (a) inorganic atoms (b) inorganic radicals and (c) organic radicals; *m* is a whole number equal to

from 0 to a maximum determined by the number of replaceable nuclear hydrogens substituted on the aromatic hydrocarbon residue A; *p* is a whole number equal to from 0 to a maximum determined by the number of replaceable hydrogens on R_1; and *q* is a whole number equal to from 0 to 1 inclusive.

One method of preparing these resins comprises effecting reaction between (1) a dihydroxydiaryl compound of the formula

II 

and (2) a diaryl carbonate of the formula

III 

where R is a monovalent hydrocarbon radical; R_1 is selected from the group consisting of an alkylene and an alkylidene residue; A is the residue of an aromatic nucleus; Y and Z are chemical substituents selected from the group consisting of (a) inorganic atoms (b) inorganic radicals and (c) organic radicals, (a), (b) and (c) being inert to and unaffected by the reactants and by the reaction of the dihydroxydiaryl compound and the diaryl carbonate; *m* and *n* are whole numbers equal to from 0 to a maximum equivalent to the number of replaceable nuclear hydrogens substituted on the aromatic hydrocarbon residue A; *p* is a whole number equal to from 0 to a maximum determined by the number of replaceable hydrogens on the alkylene or alkylidene residue; and *q* is a whole number equal to from 0 to 1 inclusive.

In the above formula for the dihydroxydiaryl compound (hereinafter employed as a designation for the compound defined in Formula II), the inert substituents designated by Y on each aromatic hydrocarbon residue may be the same or different, and R's may also be the same or different; the number of Y's on each respective aromatic hydrocarbon nucleus residue A may also be varied if desired so that a symmetrical or an unsymmetrical compound be formed. The Z's in the diaryl carbonate defined by Formula III may also be the same or different, and the number of substituents represented by Z may be the same on each aromatic nucleus A, or may vary depending upon the degree of substitution desired on each aromatic residue A.

Among the monovalent hydrocarbon radicals which R may represent are, for instance, alkyl radicals (e.g., methyl, ethyl, propyl, isopropyl, butyl, decyl, etc.), aryl radicals (e.g., phenyl, naphthyl, biphenyl, tolyl, xylyl, ethylphenyl, etc.), aralkyl radicals (e.g., benzyl, phenylethyl, etc.), cycloaliphatic radicals (e.g., cyclopentyl, cyclohexyl, etc.), as well as monovalent hydrocarbon radicals containing inert substituents thereon, for instance, halogens (e.g., chlorine, bromine, fluorine, etc.) Among the aromatic nuclei which A may represent are, for instance, the aromatic hydrocarbon residues based on benzene, biphenyl, naphthalene, anthracene, etc. The final configuration of this aromatic hydrocarbon residue in the molecule is determined by the nuclearly-substituted hydroxyl groups, together with any nuclearly-substituted hydrogen atoms and the number of inert substituents represented by either Y or Z.

Examples of R_1 as an alkylene or alkylidene residue are, for instance, methylene, ethylene, propylene, propylidene, isopropylidene butylene, butylidene isobutylidene, amylene, isoamylene, amylidene, isoamylidene, etc. When *l* is zero, the valence requirements of the carbon skeleton of the alkylene or alkylidene residue are completely satisfied with hydrogens. When *p* is greater than zero, hydrogens fulfill the valence requirements of the carbon skeleton not satisfied by the R's.

Among the inert substituents which Y and Z may represent are, for instance, halogens (e.g., chlorine, bromine, fluorine, etc.); organoxy radicals of the formula OW, where W is a monovalent hydrocarbon radical similar to those recited for R; and monovalent hydrocarbon radicals of the type represented by R. Other inert substituents included within the scope of Y and Z, such as the nitro group, may be substituted on the aromatic nuclear residue A without departing from the scope of the invention.

In the above formula, *m* and *n* may be zero whereby the aromatic nuclear residue A will be unsubstituted except for the hydroxyl group in regard to Formula II, or else there may be a plurality of substitutions of inert substituents on the aromatic nuclear residues depending upon the number of nuclearly bonded hydrogens remaining on A, taking into consideration the presence of the hydroxyl group in Formula II. Where *q* is zero, the aromatic nuclei will be directly joined without the presence of an alkylene or an alkylidene bridge.

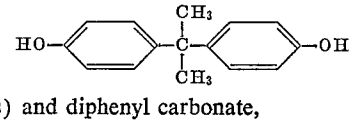
The position of the hydroxyl groups, Y and Z on the aromatic nuclear residue A, may be varied in the ortho, meta or para positions, and the groupings may be in a vicinal, asymmetrical, or symmetrical relationship, where two or more of the nuclearly-bonded hydrogens of the aromatic hydrocarbon residue are substituted with, for instance, Y, the hydroxyl group in Formula II.

One method of preparing a polycarbonate resin linear polymer is given in the following example:

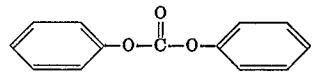
EXAMPLE 1

This example is illustrative of the reaction of equimolar ratios of technical grades of bisphenol-A and diphenyl carbonate.

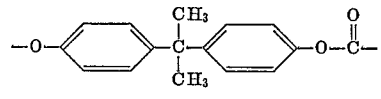
Equimolar ratios of bisphenol-A,

IV 

(114 parts) and diphenyl carbonate,

V 

(107 parts), were charged to an oil bath heated reactor equipped with a stirrer, an inert gas inlet, a condenser-receiver system connected to a vacuum means for creating subatmospheric pressure. Nitrogen was slowly allowed to enter the reactor system to which vacuum was gradually applied. Initial distillation of phenol began when the bath temperature reached 185–190° C. (after ½ hour of heating) and continued rapidly for 1–1.5 hours at this temperature and a pressure of 10 mm. during which time most of the phenol was evolved. The temperature of the heating bath was then slowly raised to 290° C. under the nitrogen-reduced pressure system (about 10 mm.) and held at this point for about 5 additional hours during which time the viscosity of the reaction mixture increased. Long fibers could be drawn from the hot melt. The carbonate resin product (melting point 280–300° C.) comprised recurring units of the formula



The resin had an intrinsic viscosity of 0.355 as determined in p-dioxane at a temperature of 30.3+0.1° C. using an Ostwald discometer, hereafter referred to as "p-dioxane 30.3+0.1° C."

Further examples of polycarbonate resins prepared from di(monohydroxyl aryl)alkanes are found in U.S. Patents Nos. 2,964,794, 2,950,266, 3,028,365, 3,153,008, 3,187,065 and 3,215,668.

In the preparation of a ski in accordance with this invention, a polyolefin is blended with a polycarbonate by any suitable technique such as, for example, by intimately dispersing the two plastics in powder or pellet form and then extruding them to form a pellet of the blended material or by mixing the two in the melted form on suitable equipment such as Banbury mixers and the like.

In the simplest form of the invention, a mixture of polycarbonate and polyolefin is injection molded into a suitable mold having the desired configuration to form a ski of uniform composition throughout. For example, to prepare a ski 6 feet long a mold having a cavity 6 feet long and in the shape of a ski would be utilized. A ski thus prepared of the material stated above provides the necessary flexing action to prevent chattering even at high speeds. The polyolefin incorporated into the polycarbonate permits the running surface to inherently have the desired properties in order to decrease the friction when in engagement with snow. Further, the bottom surface has a much higher resistance to rocks and other hazards to skis than the conventional bottom surfaces. There is the additional advantage that the surface will not peel or scrape off. If desired, an additional layer of polyethylene, polypropylene or polytetrafluorethylene may be laminated to the bottom surface of the ski, however, this is not necessary.

Referring specifically to the drawing, FIGURE 1 represents a side elevation of a ski **11** having an up-turned toe portion **13** and a bottom or running surface **15**. The ski in accordance with FIGURE 1 can be a unitary structure prepared as above by injection molding or it can be made up of a plurality of laminae. These laminae may be of the same material. In this method of preparation the laminae can be positioned within a compression type mold having the desired configuration. The mold is closed and heat and pressure applied. The polycarbonate olefin blend at a suitable temperature of from about 150–250° C. will firmly unite the laminate to each other. In another method of preparation, the plurality of laminae may be adhered to each other by the use of any suitable adhesive material.

FIGURE 2 is a cross-sectional configuration of one embodiment in accordance with this invention. Ski **11** has incorporated therein a reinforcing means **17** which substantially runs the length of the ski. This reinforcing means may be of wood, metal or the like, and is provided to render the ski somewhat more rigid. While the reinforcing means is shown as a single flat member, it is to be understood that it can have a variety of forms such as a rod or rods, a mesh or the like. The ski **11** is further provided with metallic running edges **19** as is customarily found on most skis to improve the "grip" particularly on turns and also with one or more guiding grooves **21** which run substantially the length of the ski except for the up-turned toe portion **13**.

FIGURE 3 represents still another embodiment in accordance with this invention. This embodiment also includes running edges **19** and guiding grooves **21**. Ski **11** is made up of a plurality of laminae. The bottom or running edge **15** is prepared from a polycarbonate plastic having incorporated therein 3 to 7% of a polyolefin. The upper surface which does not engage the snow is prepared from a polycarbonate having incorporated therein from about 3 to 7% of a polyolefin and from about 3% to about 35% by weight of glass fibers arranged in random distribution. The upper portion **23** is for the purpose of providing a material of somewhat higher flexing modulus than that of the polycarbonate having only polyolefin incorporated therein.

The skis in accordance with FIGURES 2 and 3 can be prepared by conventional molding techniques. In the preparation of a ski in accordance with FIGURE 2, the reinforcing means **17** can be positioned within a mold and the polycarbonate-olefin material injected around the reinforcing means to thereby substantially completely fill the mold cavity. Further, the ski can be prepared by the laminating process wherein the polycarbonate-olefin ma-

terial is positioned around the reinforcing means and caused to adhere to itself and the reinforcing means by use of suitable adhesives or by heat and pressure. The same is true with regard to FIGURE 3. For example, the upper portion **23** can be first prepared in a suitable mold by injection molding techniques. The lower portion **25** may also be prepared in the same manner and then the two bonded to each other by heat and pressure or the use of adhesives. The metal running edges **19** can further be molded directly in the ski by positioning the metal edges in the mold and then causing the molten polycarbonate-olefin blend to surround the metallic inserts on the two contiguous edges. Further, in place of metal edges, the edges **19** may be made of polyurethane plastic such as those disclosed in U.S. Patents Nos. 3,214,411 and 3,233,-025. In a similar technique, either the top portion **23** or bottom portion **25** may be injection molded and then positioned in a suitable mold. The opposite portion can be injection molded directly into the first formed part. It is thus seen that the skis in accordance with this invention are much more readily prepared than those presently being manufactured.

Although the invention has been described in considerable detail for the purpose of illustration, it is to be understood that variations can be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A ski having a bottom surface and a top surface, said bottom surface and top surface forming a main portion and an up-turned toe portion of said ski, said bottom surface having a groove running longitudinally the length of said main portion, said ski being fabricated from a polycarbonate plastic having incorporated therein from about 3% to about 7% of a polyolefin.

2. The ski of claim **1** wherein a reinforcing element is incorporated into said ski.

3. The ski of claim **1**, the bottom surface of which has metallic edges running the length thereof.

4. The ski of claim **1** wherein the polycarbonate plastic is an aromatic polycarbonate.

5. The ski of claim **1** wherein the polycarbonate plastic is based on bisphenol-A.

6. A ski having a bottom surface and a top surface, said bottom and top surface forming a main portion and an up-turned toe portion of said ski, said bottom surface having a groove running longitudinally the length of said main portion and polyurethane edges running the length thereof, said ski being fabricated from a polycarbonate plastic having incorporated therein from about 3% to about 7% of a polyolefin.

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