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Meyer

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[54] **LAMINATE STRUCTURE FOR WATER SKIS**

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[52] **U.S. Cl.** ..... **9/310 A,** 280/11.13 L

[51] **Int. Cl.** **A63c 15/00**

[58] **Field of Search** ..... 9/310, 6, 310 A, 9/310 R; 280/11.13 L

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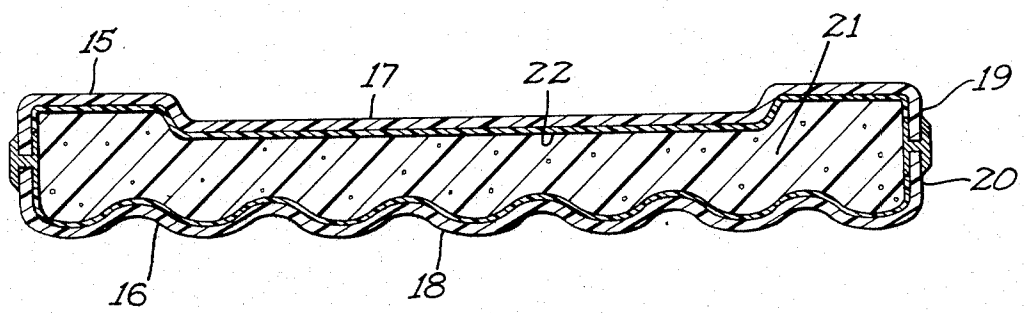
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Assistant Examiner—Paul E. Sauberer
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[57] **ABSTRACT**

A water ski structure prepared from a pair of generally U-shaped shells, each fabricated from a synthetic resin film and arranged to be retained together along mating edges of the legs of said U-shaped shells to form a structure with a top surface, a bottom surface, and side wall segments defining and confining a core structure therewithin. The shells are reinforced with fibrous reinforcement secured to the inner surfaces of said shell, and a frothed synthetic resin is disposed within the core structure substantially filling the volume thereof. The frothed synthetic resin is selected so as to be bondable to the reinforced inner surface of the shells. In order to join the side wall segments together, it is preferred that generally H-shaped beads are utilized so as to secure and join the side wall segments of the shells together to form a composite side wall structure.

10 Claims, 5 Drawing Figures



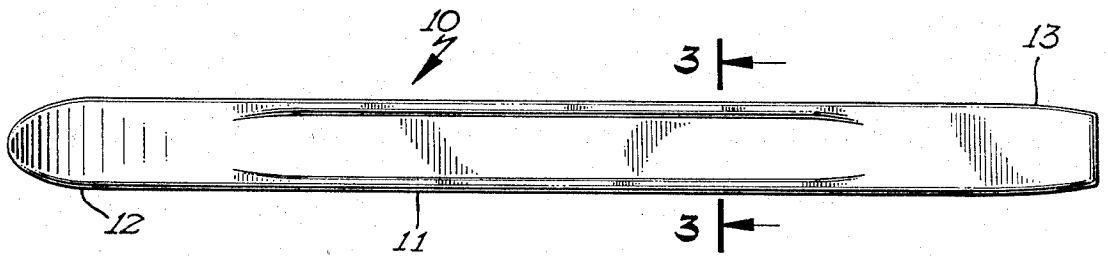


FIG 1

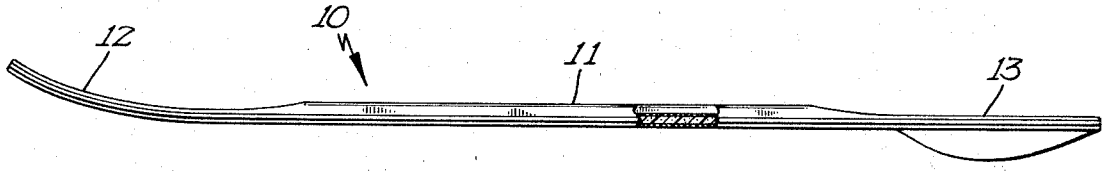


FIG 2

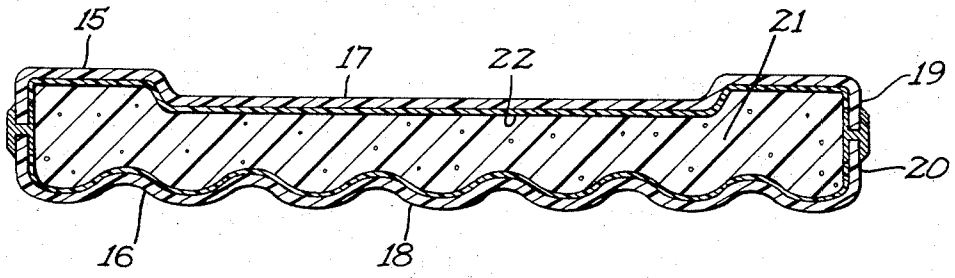


FIG 3

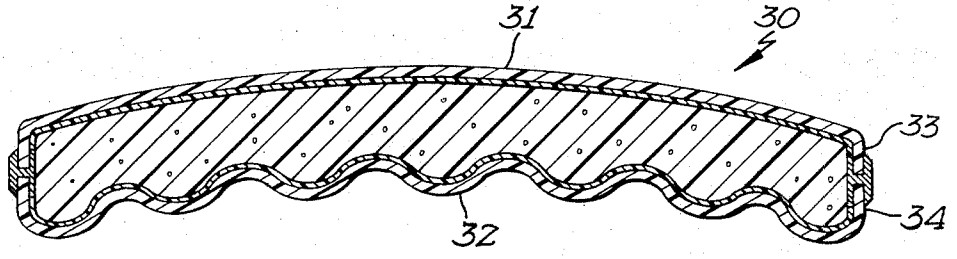


FIG 4

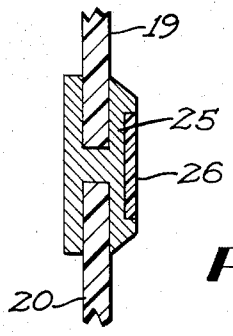


FIG 5

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LAMINATE STRUCTURE FOR WATER SKIS

BACKGROUND OF THE INVENTION

The present invention relates generally to an improved water ski structure, and more specifically to a composite water ski structure which is rigid, durable, and light in weight. In the past, it has been traditional to fabricate water skis from a laminated wood structure, or from a resin structure which is generally uniform in its cross-sectional makeup. While these structures function reasonably well for their intended purposes, they were nevertheless undesirable from the standpoint of being either extremely heavy or dense, or, if light in weight, somewhat flimsy and non-durable. The concept of the present invention provides a composite structure which is extremely light in weight, but which is designed so as to be both rigid and durable, and consistent with the requirements of the normal functions of water skis.

In the past, various structures have been proposed for water skis, including the structure of U. S. Pat. No. 3,428,979, Paul C. Johnson, which patent is assigned to the assignee of the present invention. In this concept, a particular water contacting surface is disclosed and claimed which is desirable for use in a variety of structures, including water ski structures. The concept of the present invention is particularly adapted for the production of such structures on an extremely economical basis.

SUMMARY OF THE INVENTION

The present invention provides for an improved water ski structure which comprises essentially a pair of generally U-shaped shells fabricated from a synthetic resin film and arranged to be retained together along mating edges of the legs of said U-shaped shell. This arrangement defines and confines a core structure between the individual shell members, and for purposes of rigidity, fibrous means are secured to the inner surface of the shells, and serve to reinforce and render the shell structure more rigid. A frothed synthetic resinous substance is utilized to fill the core structure, the frothed foam being selected so as to be "bondable" to the surface of the shells so as to provide a "composite laminate sandwich" which is rigid, durable, and highly suited for use as a water ski structure.

If desired, the reinforcing materials may be applied in a "programmed" fashion so as to provide a greater density of reinforcement adjacent the ares of extensive stress. Such a technique is readily available in the art, and no unusual application requirements exist.

In another concept of the invention, the rudder means or "skeg" of the ski is integral with the bottom surface. Thus, additional rigidity is possible. Also, the structure set forth in U. S. Pat. No. 3,428,979, described hereinabove, is highly adapted for enhancing the rigidity of the overall composite structure.

If desired, an extruded H-channel may be utilized to bond the edges of the side wall segments together so as to complete the closure of the unit. This channel member may be fabricated from aluminum or the like, and may also be provided with an elastomer-type coating along the outer face in order to provide a cushion edge for the unit.

Therefore, it is an object of the present invention to provide an improved water ski structure fabricated from a composite laminate utilizing a pair of generally U-shaped shells fabricated from a synthetic resin film, the shells being arranged to be retained together to form a core structure therewithin, the core structure being filled with a frothed synthetic resin which is bondable to the surfaces of the shells.

It is yet a further object of the present invention to provide a composite laminate ski structure which is rigid, durable, and light in weight, the structure being provided with reinforcing fibers at predetermined positions along the extent of the structure so as to optimize and otherwise enhance the reinforcement of the composite structure.

Other and further objects of the present invention will become apparent to those skilled in the art upon a study of the following specification, appended claims, and accompanying drawing.

DESCRIPTION OF THE DRAWING

FIG. **1** is a top plan view of a water ski structure prepared in accordance with the present invention, and being fabricated from the composite laminate structure described herein;

FIG. **2** is a side elevational view of the water ski structure of FIG. **1**, with portions thereof being shown in section;

FIG. **3** is a vertical sectional view of the water ski structure of FIG. **1**, and being taken along the line and in the direction of the arrows **3—3** of FIG. **1**;

FIG. **4** is a view similar to FIG. **3**, however showing a water ski structure with an optional concave cross-section to maximize the rigidity and stability of the structure; and

FIG. **5** is a detail sectional view of the edging structure which may be utilized to retain the shell members of the laminate together in edge-to-edge relationship.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Particular attention is now directed to FIGS. **1, 2** and **3** wherein the water ski structure of the present invention is shown in substantial detail. Specifically, the structure **10** includes a central segment **11**, a forward or tip segment **12**, along with a trailing or rear portion **13**. As is appreciated, the structure is generally continuous from the tip end to the trailing end, and the individual segments are utilized for purposes of describing the various features of each of the individual segments. The cross-section of the structure is shown in greatest detail in FIG. **3**, the structure being fabricated from a composite laminate including an upper or top shell member **15**, a bottom shell member **16**, each shell member having a generally U-shaped configuration, and arranged to be retained together along the mating edges of the legs of the U-shaped shells. When retained together, these shells cooperate to form a structure with a top surface such as the top surface **17**, a bottom surface such as the bottom surface **18**, and side wall segments such as the upper segment **19**, and the lower segment **20**. These side wall segments cooperate to form a composite side wall structure when held and retained together as hereinafter described. The individual U-shaped shells, when joined together, confine a core structure therewithin, such as the core area **21**, and the volume of this core is filled with a frothed synthetic resin so as to substantially fill the volume thereof. In order to enhance the rigidity of the structure, the inner surface of the individual shells **15** and **16** is covered

with a fiberglass reinforcing material such as is illustrated at **22.** For purposes of enhancing the strength-to-weight features of the system, the reinforcement is generally programmed so as to be heavier in the center area of the ski, where the greater forces are applied when in use, this reinforcing tapering in density at the extreme tip and rear segments.

Turning now to the details of the generally U-shaped shells **15** and **16,** these shells are preferably prepared from a synthetic resin material such as, for example, an acrylic or other thermoplastic sheet material which may be vacuum formed. Vacuum formed or vacuum formable plastic sheet material is commercially available, and one material which has been found particularly desirable is that certain acrylic-vinyl copolymer material available from American Cyanamide Corp. of New York, N. Y., under the code name "Acrylite." A similar material, available from the same source, and incorporating reinforcing fibers is commercially available under the code name "Rigidite." This material presents a generally smooth surface, and is sufficiently tough, rigid, and durable so as to be suitable for the purpose of forming the composite laminate structure for the water skis of the present invention. The thermoplastic skin structure preferably has a thickness of between about 5 and 100 mils, however, generally speaking, thicknesses between about 5 and 90 mils are preferred. The shell structure, or skin structure, is chemically compatible with the substance utilized to bond the reinforcing material to the inner side of the shell. For example, the acrylic-vinyl copolymer as mentioned hereinabove is normally compatible with the polyester base adhesives in common use, and this material may be conveniently sprayed onto the inner surface of the individual shell structures. Furthermore, acrylic-vinyl copolymer materials are compatible, forming strong bonds, with a wide variety of commercially available polyester base adhesives, particularly those containing an acrylic monomer. Also, as has been indicated, the structure provides for convenient in-situ forming of the rudder, keel or "skeg" of the water ski. Thus, the structure is not detachable in the manner as is frequently found on water skis presently available in the market.

The foam core, such as the core **21** is preferably prepared from a foam-in-place resin based upon the polyurethane system. One example of a workable material of polyurethane base is tolylene diisocyanate together with a polyol. Polyethers, polyesters, or other materials containing hydroxyl groups may be employed as well. Polyethers such as propylene or ethylene oxide derivatives are also of value.

The basic polymer unit is formed as follows:

$$HOR_1OH + OCN\text{-}R_2\text{-}NCO \rightarrow$$
$$\text{-}R_1OOCNH\text{-}R_2\text{-}NHCOOR_1\text{-}$$

wherein R_1 represents an alkyl group containing from 2 to 4 carbon atoms, and wherein R_2 represents an aryl group. These reactions are straightforward, and combinations of ingredients as set forth in the above formulation are commercially available.

Polyurethane foams are utilized for two reasons; the first being that they are compatible with and bond to the polyester coating on the interior of the shell members **15** and **16,** and additionally because the cell structure is of the closed-cell variety. Therefore, in the event the surface is ruptured or perforated for one reason or another, the ski structure will not absorb water during periods of continuous immersional use.

As has been previously indicated, the foam core preferably has a density of between about 10 and 20 pounds per cubic foot, however a preferred density for most structures is generally at the lower end of this range, such as between 10 pounds per cubic foot and 13 pounds per cubic foot, with 12 pounds per cubic foot being considered optimum. This foam density is sufficient so as to provide an overall structure which forms a useful adhesive bond to the chopped fiberglass or fiberglass roving, and is also sufficiently cohesive so as to form a unit structure. Volumes to be formed from a given input of resin are readily predictable.

As has been previously indicated, the vacuum formed and fiberglass coated shells are joined together along a continuous edge, preferably utilizing an extruded structure having a H configuraion to receive the two halves. Aluminum is a preferred material for this structure, although plastic resinous substances may be utilized if desired. The configuration of the H-shaped structure is shown on an enlarged scale in FIG. **5,** wherein the H-shaped member **25** is utilized to secure the edges of the shells together, such as the edges **19** and **20.** In the event it is deemed desirable to provide an edging or the like, an elastomeric edging may be bonded to the exposed face of the member **25,** such as at **26.**

Attention is now directed to FIG. **4** of the drawing wherein a modified configuration is **1**llustrated. The structure in FIG. **4** shows the cross-section of a water ski generally designated **30,** the ski **30** comprising the pair of generally U-shaped shells **31** and **32** joined together at their respective edges, such as at the edge zones **33** and **34.** The structure of the ski **30** is substantially the same as the structure of the ski **10** with the exception of the generally concave cross-section of the ski bottom, together with the matching convex arrangement for the top surface. This design of a concave ski will serve to maximize the rigidity of the overall structure and will enhance stability. Consequently, the present invention provides a simple and desirable means for forming the composite laminates as required.

In order to tailor the cross-section to the required strength for the structure, it is anticipated that the cross-section may be contoured so as to provide a center section of the ski with a heavier cross-sectional mass than the ends, thus providing increased strength along the areas where the binding devices are normally applied. This increased strength will enhance the holding capabilities of the unit for the binding elements, and will also provide the added strength, where required.

The present arrangement provides an extremely economic arrangement for the fabrication of water skis which are rigid, durable, and light in weight. The fabrication arrangement permits the utilization of low cost molds and tooling available in the thermoforming processes for the skin structures which skins, in turn, provide molds for the reinforcing frothed synthetic resin material.

I claim:

1. In a water ski structure:

a. a pair of generally U-shaped shells fabricated from a film of synthetic resin and arranged to be retained together along mating edges of the legs of said U-shaped shells to form an enclosure shell structure with a top surface, a bottom surface, and side wall

segments defining and confining a core structure therewithin;

b. fibrous means secured to and reinforcing said shell structure along the inner surface thereof;

c. means joining said side wall segments of said shell structure together along the edges thereof to form a composite side wall structure;

d. a frothed synthetic resin foam structure disposed within said shell structure and substantially filling the volume thereof to form a core structure, and being adherently bonded to the inner surfaces of said shell structure; and

e. said shell and core structure comprising an elongated ski member having a center segment disposed between a tip end segment and a trailing segment, whrein each of said center and trailing segments have a substantially uniform thickness and width, and wherein said tip end segment tapers inwardly toward a pointed tip, and wherein said center segment has a significantly greater cross-sectional density than said tip and trailing segments.

2. The water ski structure as defined in claim **1** being particularly characterized in that said core structure is a frothed resin is a closed-cell resin adhesively bonded to the inner walls of said shell structure.

3. The water ski structure as defined in claim **2** being particularly characterized in that said frothed synthetic resin has a density ranging from between **10** pounds and **20** pounds per cubic foot.

4. The water ski structure as defined in claim **2** being particularly characterized in that said frothed synthetic resin has a density ranging from between 10 pounds and 13 pounds per cubic foot.

5. The water ski structure as defined in claim **1** being particularly characterized in that said structure comprises an elongated ski member having a center segment disposed between a tip end segment and a trailing segment, and wherein said fiberous reinforcing means are arranged in a substantially greater density along said center segment than along said tip and trailing segments.

6. The water ski structure as defined in claim **5** being particularly characterized in that said fiberous reinforcing means is arranged along the surface of said shell in a density pattern which is at its greatest density at the center, and tapers outwardly toward the tip ends thereof.

7. The water ski structure as defined in claim **1** being particularly characterized in that said shells are fabricated from an acrylic-vinyl copolymer.

8. The water ski structure as defined in claim **1** being particularly characterized in that said bottom surface has a rudder means formed integrally therewith.

9. The water ski structure as defined in claim **1** being particularly characterized in that said means joining the side walls of said shell structure together comprise a generally H-shaped structure for receiving said side wall segments therewithin.

10. The water ski structure as defined in claim **9** being particularly characterized in that said H-shaped member is provided with a soft elastomeric coating on the outer surface thereof.

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