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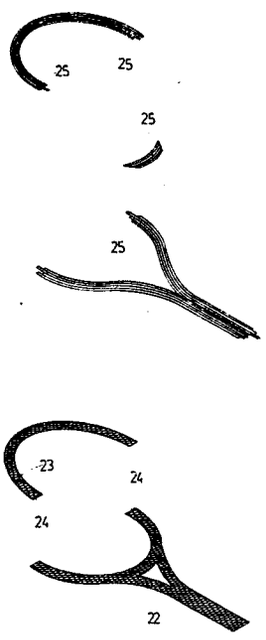
(71) Applicant: **Lo, Kun Nan, No. 7-1 Lane 246 Chung Hsan Road Sec 3, Tan Tzu Hsiang Taipei Hsien (TW)**

(72) Inventor: **Lo, Kun Nan, No. 7-1 Lane 246 Chung Hsan Road Sec 3, Tan Tzu Hsiang Taipei Hsien (TW)**

(74) Representative: **Parker, Jeffrey et al, Frank B. Dehn & Co. Imperial House 15-19 Kingsway, London, WC2B 6UZ (GB)**

(54) Method for making fiber sheet reinforced wood racket.

(57) For reinforcing a wooden racket, uncured resin impregnated carbon fiber sheets with the fiber thereof being arranged in cross-ply pattern are tailored to adapt to the flat shape of respective portion of a wooden racket. Each fiber of the carbon fiber sheets 22 or 23 is oriented at an angle ranging from ± 25°c - ± 45° with respect to a longitudinal axis of a racket. A further thermoset resin impregnated carbon fiber sheet with the fiber thereof being arranged in cross-ply pattern are tailored to the desired length to supplement the weaker portion of the wooden racket. Each fiber of further carbon fiber sheet 25 is oriented at an angle ranging from 0° - ± 90° with respect to the longitudinal axis of the racket. By means of heat sealing, the above two sheets are bonded to form a fiber laminate for reinforcing the wood racket.



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METHOD FOR MAKING FIBER SHEET REINFORCED WOOD RACKET

The present invention is related to composite sheet material, particularly a thermoset resin impregnated fiber reinforced plastics skin for a wooden racket.

It is well known that the playing characteristics of a game racket such as a tennis racket, including the design and the material from which the frame of the racket is constructed, for example, a tennis racket which is constructed with a wooden frame has good torsional stiffness characteristics enabling the player to maintain touch control during strong play, especially when the ball is hit off-center. On the other hand, metal rackets generally have better bending stiffness characteristics than wood rackets, thereby enabling the player to hit the ball with a considerable degree of power and often without feeling the vibrational stress. Thus, in the past, the choice of a racket having a metal frame required the player to sacrifice the torsional characteristics of wood rackets while the choice of a racket having a wood frame meant the loss of the better bending characteristics of the metal rackets. It has been attempted to bond a fiber reinforced plastics skin on each of the opposing faces of the wooden frame to combine the best properties of wood and metal racket.

A conventional method for manufacturing the fiber reinforced plastics skin is illustrated in Fig. 1; the fiber reinforced plastics skin 10 is formed by press punching a cured fiber sheet according to the outline of the wooden

frame. Then, the respective fiber reinforced plastics skin is adhered to the surface of the wooden frame. It is no doubt that some reinforcement might be achieved in this way. Yet inherent effect possessed by the reinforced material is not completely manifested. Further it is not economical to adhere same thickness of the fiber reinforced plastics skin to each portion of the racket frame. Another drawback is that since before tailoring the reinforced fiber sheet has been cured so that the orientation of the fiber has been fixed and can not be pre-arranged to meet the desired angle. Besides, after press punching, very high percentage of the precured reinforcing fiber sheet will be left unused, hence increasing the production cost.

In accordance with the present invention a method for manufacturing a thermoset resin impregnated fiber reinforced plastics skin for a wooden racket comprises steps of: tailoring a first uncured thermoset resin impregnated fiber sheet with the fiber thereof being arranged in cross-ply pattern, each fiber oriented at an angle ranging from $\pm 25^{\circ}$ - $\pm 45^{\circ}$ with respect to a longitudinal axis of a racket, into the flat shape of respective portion of the racket; tailoring a second uncured thermoset resin impregnated fiber sheets with the fiber thereof being arranged in cross-ply pattern, each fiber oriented at an angle ranging from 0° - $\pm 90^{\circ}$ with respect to the longitudinal axis of the racket, to the proper portion of the first fiber sheet; and bonding the first

tailored fiber sheet with the second tailored fiber sheet by curing to form a predesigned laminated racket reinforced plastics skin.

It is an object of the present invention to provide a method for producing a fiber laminate for reinforcing a wooden racket, in which each fiber of the fiber laminate has definite orientation to manifest the effect of reinforcement.

Another object of the present invention is to provide a method for producing a fiber laminate, in which before tailoring to adapt to the shape of the frame, the resin impregnated fiber is not yet cured so that the resin impregnated fiber sheet is very easily and economically cut and laminated to the mold.

These and other objects will be apparent by illustrating a preferred embodiment with reference to the following drawings, in which:

Fig. 1 is a schematic view illustrating a prior method for manufacturing fiber reinforced layer for racket frame;

Fig. 2 is a schematic elevational view of a preferred embodiment manufactured by a method according to the present invention; and

Fig. 3 is a schematically exploded view illustrating respective layer of a fiber laminate produced by a method according to the present invention.

As shown in Fig. 2, when starting to manufacture a fiber laminate, a first uncured thermoset resin impregnated carbon fiber sheet 26 is firstly tailored into a semi-annular shaped layer 23 and a substantially Y-shaped layer 22 which includes a throat portion and a shaft portion corresponding to the respective portion of a wooden racket frame. Each fiber of the semi-annular shaped layer 23 is arranged in cross-ply pattern and the orientation of each fiber is at an angle ranging from $\pm 25^{\circ}$ - $\pm 45^{\circ}$, with respect to a longitudinal axis of a racket. The orientation of the fiber of the Y-shaped layer 22 is identical to that of the semi-annular shaped layer 23 and the fibers of both layers are overlapped at their juncture 24. Thereafter, several uncured resin impregnated carbon fiber strips 25 with different length which have their fiber oriented at an angle ranging from 0° - 90°, with respect to the longitudinal axis of the wooden racket, are separately adhered to the necessary part of the surface of the Y-shaped layer 22 and the semi-annular shaped layer 23. Since each layer is an as yet uncured resin impregnated carbon fiber sheet, the number of layers of the laminate can be varied to cater to the need, and the center of gravity of the whole frame can be adjusted by means of adding additional weight to the Y-shaped layer 22 or to the same annular shaped layer 23. Additionally, the throat portion which is most commonly subjected to the largest impact, can be reinforced by a further layer of strip-shaped carbon fiber sheet to meet this need. Finally, placing the

uncured laminate in the mold cavity 21 of the lower mold 20 and subsequently a upper mold thereupon with heat treatment together with applying pressure, a unique pre-designed laminated racket reinforcing sheet is then formed.

With the invention thus explained, it is apparent that various modifications might be made within the spirit of the scope of the invention, it is intended that the invention be defined only as indicated in the appended claims.

CLAIMS:

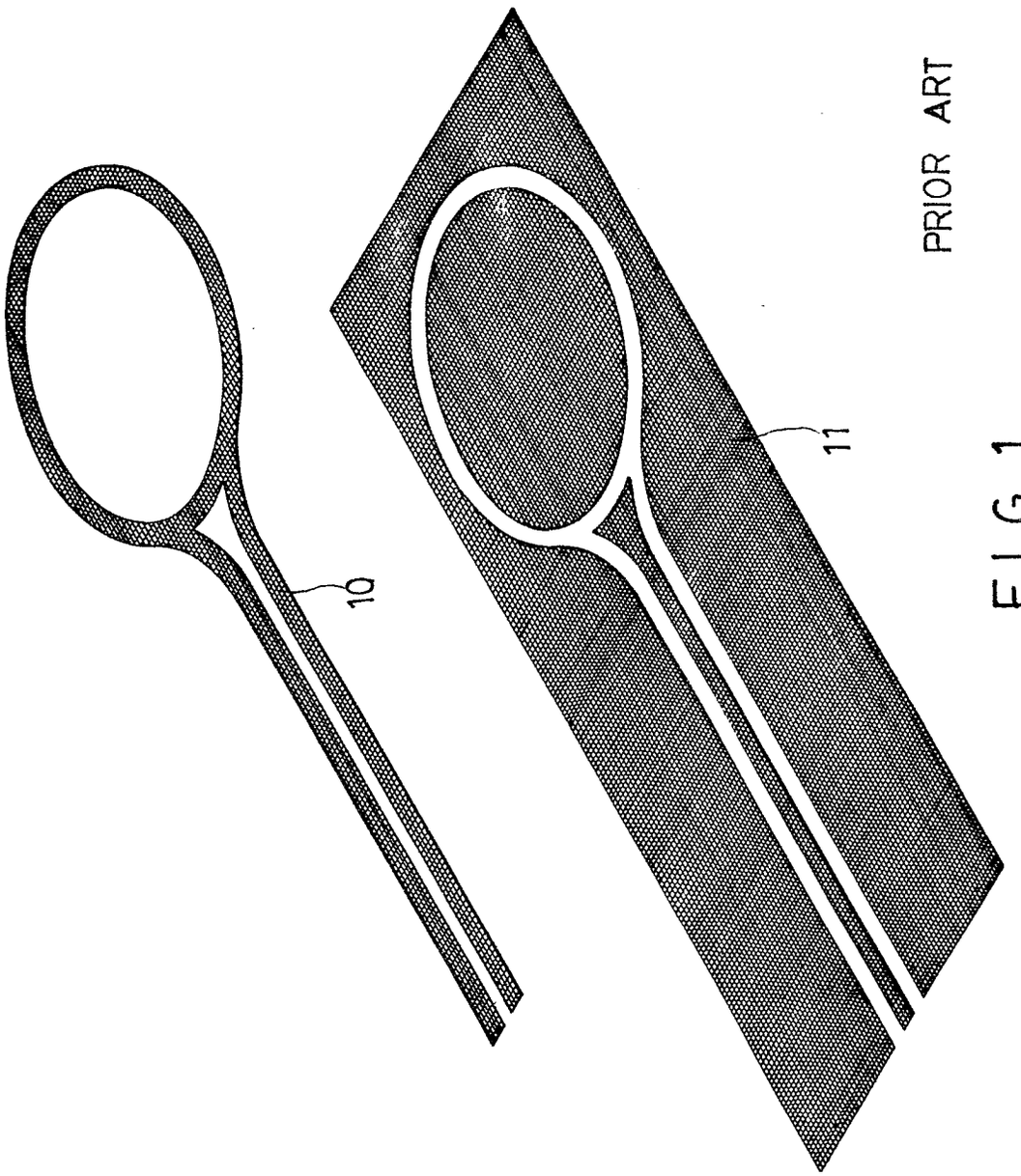
1. A method for manufacturing a thermoset resin impregnated fiber reinforced plastics skin for a wooden racket including, the steps of tailoring a first thermoset resin impregnated fiber sheet(26) with the fiber thereof being arranged in cross-ply pattern and oriented at first predetermined angles, tailoring a second thermoset resin impregnated fiber sheet(25) with the fiber thereof being arranged in cross-ply pattern and oriented at second predetermined angles, and bonding the first and second tailored fiber sheets(25, 26) characterized in that either said first and second resin impregnated fiber sheet(25, 26) is tailored before the resin is cured ; said first and second tailored resin impregnated fiber sheets are laminated and cured in a mold(20).

2. A method as claimed in Claim 1, wherein said first and second tailored resin impregnated fiber sheets(25, 26) are laminated in alternate layers.

3. A method as claimed in Claim 1, wherein said first predetermined angles ranges from $\pm 25^{\circ}$ to $\pm 45^{\circ}$ and said second predetermined angles ranges from 0° to $\pm 90^{\circ}$.

4. A method of manufacturing a wooden racket of the kind including the step of bonding a shaped skin of fibre reinforced plastics to the wooden frame of the racket to improve its characteristics, characterised in that the shaped skin is formed by the steps of tailoring to the shape of the racket a first uncured fibre impregnated thermosettable resin sheet (26) with the fibres thereof arranged in cross-ply array and oriented at first predetermined angles, tailoring to the shape

of the racket a second uncured fibre impregnated thermosettable resin sheet (25) with the fibres thereof arranged in cross-ply array and oriented at second predetermined angles, bonding together the first and second uncured sheets (25,26), and curing the bonded sheets in a mould (20) to form a laminated shaped skin.



PRIOR ART

FIG. 1

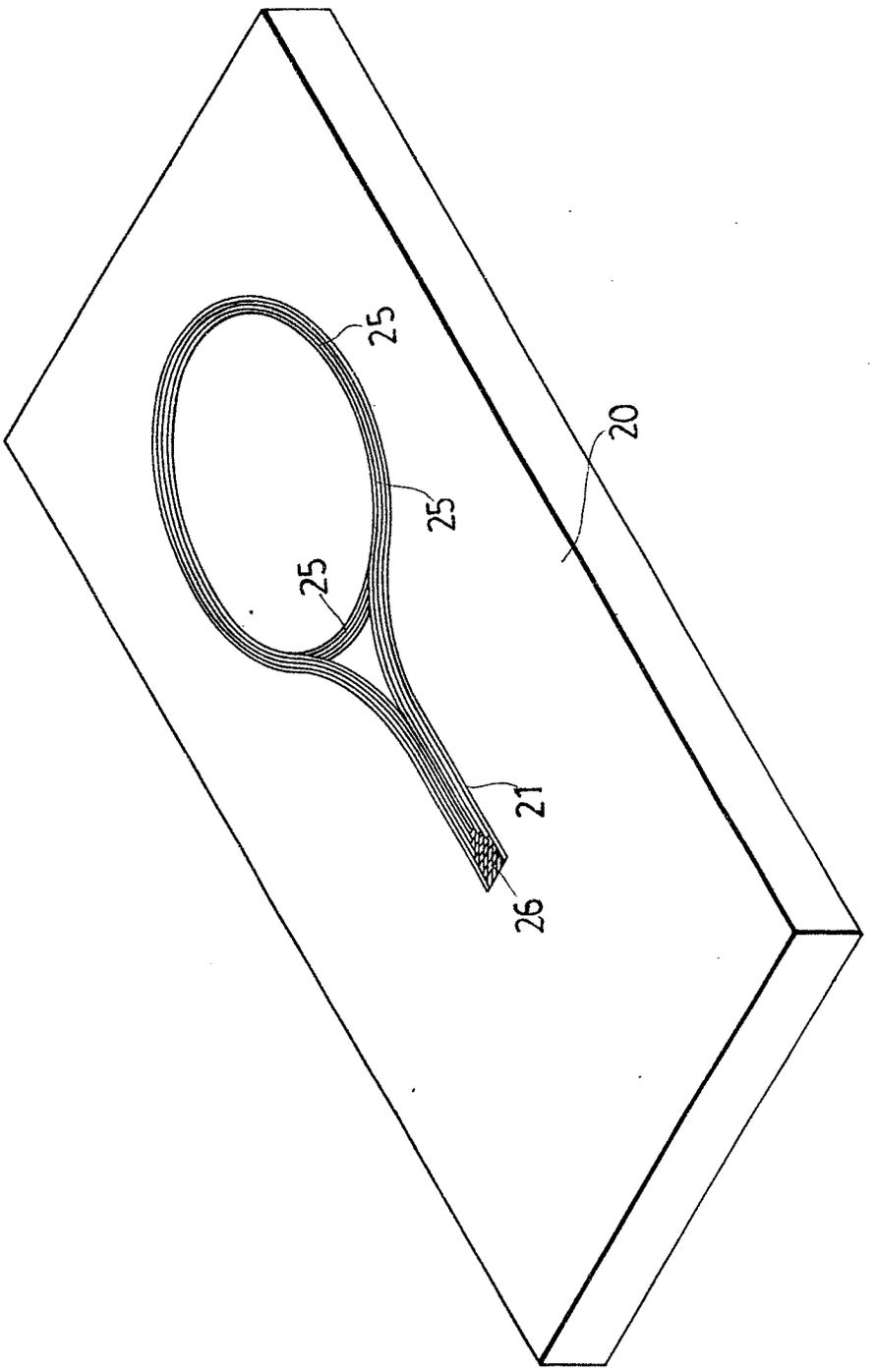


FIG. 2

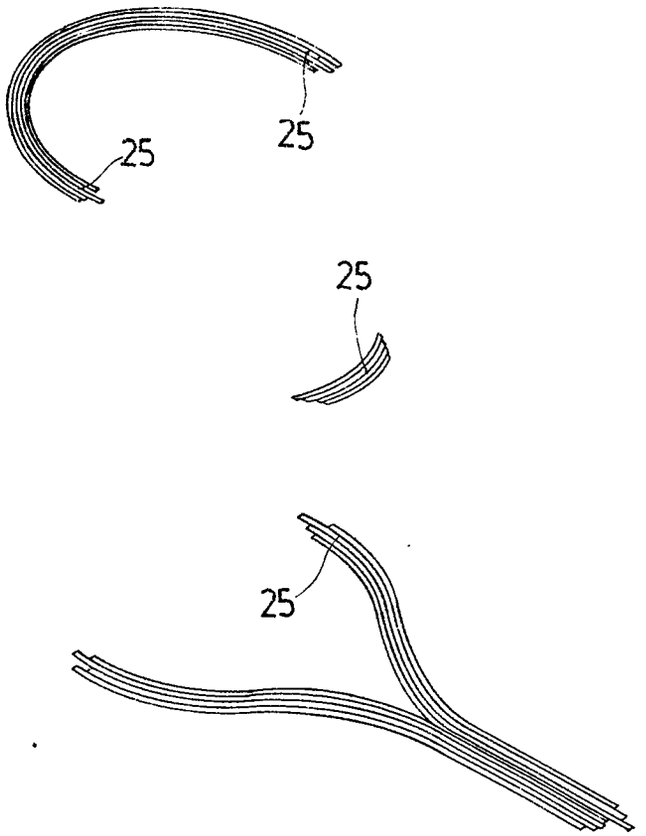


FIG. 3

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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
	---		A 63 B 49/10
X	US-A-4 031 181 (SCHAEFER) *Column 2, lines 59-64; column 5, lines 10-14; column 6, line 57 - column 7, line 45; figures 1,2,11*	1-4	

X	EP-A-0 055 184 (GUYOT) *Page 3, lines 11-34; page 7, line 31 - page 8, line 2; page 10, lines 13-24; page 12, lines 17-25; figures 1,4*	1-4	

X	GB-A-2 043 460 (HASEGAWA) *Page 1, line 104 - page 2, line 61; figures 1,2,6,7*	1,2,4	

A		3	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

Y	FR-A-2 057 942 (SNAUWAERT) *Page 1, line 38 - page 2, line 10; figure*	1,2,4	A 63 B

A		3	

Y	FR-A-2 258 874 (EXXON CO.) *Page 1, lines 17-34; page 3, line 24 - page 4, line 14; page 5, lines 6-24; figure 5*	1,2,4	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-12-1982	GERMANO A.G.

CATEGORY OF CITED DOCUMENTS

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D : document cited in the application
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EUROPEAN SEARCH REPORT

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Application number

EP 82 30 4940

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	GB-A- 400 305 (AUER) *Claim 1*	1,2,4	
A	FR-A-2 380 038 (DUNLOP)		
A	US-A-2 878 020 (ROBINSON)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

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THE HAGUE	28-12-1982	GERMANO A.G.

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