Description

Field Of The Invention

The present invention relates to a tennis racket, comprising a frame with a handle portion and a pair of curved beam portions which extend along a predetermined path to define an oval head, and having a configuration which increases the stiffness of the racket and its playability.

Description Of The Prior Art

The force applied by a ball to a strung racket bends the racket primarily along a plane disposed perpendicularly to its strung surface (primary mode bending). As the frame cross-section deviates from the longitudinal axis, the cross-section will have a tendency to twist upon ball impact. This twisting or torsional movement increases as the distance from the longitudinal center line of the racket increases. The bending causes deflection of the racket which reduces the power and accuracy that a player may impart to the ball.

The prior art tennis rackets designed to minimize the bending described above usually include a frame with an increased height. These rackets have increased stiffness in the normal bending mode; but they do not significantly reduce the twisting of the two side frame portions that occur.

GB-A 12 146 discloses a tennis racket having an oval head defined by a frame of two portions of wood attached together the one forming the outer frame being of a simple piece of wood and the other forming the internal part composed of a wooden lath coiled several times upon itself. These two parts constitute the frame and the holder for a wedge block, which is fixed between the handle pieces. The wide upper part of this block presses against the internal frame. The frame varies in width between the top of the oval head portion and the handle portion.

The tennis racket according to EP 0 340 127 A1 is constructed in such a way that the height of the stringing portions starting from an intermediate length thereof and above the cross piece increases the center of these stringing portions and then decreases to the top of the oval head.

WO 89/06558 also discloses a tennis racket of the above wherein cross-sectional height of the head decreases continuously from a point located at an interval from the heart-shaped portion of the racket towards said heart-shaped portions and towards the top of the head. The height then increases towards the handle portion of the racket.

The width of the tennis racket as disclosed in EP 0 176 021 and as build-up in a similar manner as the above known rackets remains constant over the whole length of the racket with the exception of the width of the handle portion. However, this racket has a varying frame height as measured in the direction normal to the plane of stringing with a maximum height at the cross members thereof.

The tennis racket of the present invention overcomes the disadvantages of prior rackets with the features of claims 1 to 7 respectively. It has a configuration which increases stiffness in the primary mode and resists the torsional deformation of the head of the racket. This increased stiffness provides a more stable and accurate strung surface during impact between a ball and the racket.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the present invention, a racket includes a handle portion, a pair of arm portions, a frame cross piece portion which extends between the arm portions, and a pair of curved stringing portions. The curved stringing portions and the frame cross piece define an oval head or hoop which supports the racket stringing. The racket is symmetric with respect to its longitudinal axis which extends along the middle of the racket. Corresponding arm and stringing portions lie on opposite sides of this longitudinal axis and define a pair of beam portions which meet at the top of the racket.

Each beam has a generally oval cross-section with a longitudinal or major axis and a minor axis. The minor axis lies in the plane of a strung surface; and the major axis extends perpendicularly to it. The height and width of each beam (as measured along the major and minor axis of the beam's cross-section) varies along the length of the beam, beginning with a first predetermined width at the bottom of the beam, tapering outwardly and increasing in size to a maximum width and height proximate the end of the arm portion (proximate to the beam's inflection point), and tapering inwardly and decreasing in size to the top of the racket. Thus, the portion of the beam which receives the greatest twisting moment, i.e., the section proximate to the frame cross piece portion, has an increased width and height which allows the beam to resist twisting.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of this invention, one should now refer to the embodiment illustrated in greater detail in the accompanying drawings and described below by way of an example of the invention. In the drawings:

FIG. 1 is a top plan view of the tennis racket of the present invention;
FIG. 2 is a side elevation view of the racket of FIG. 1;
FIG. 3 is a cross sectional view taken along line 3-3 in FIG. 1;
FIG. 4 is a cross sectional view taken along line 4-4 in FIG. 1;
FIG. 5 is a cross sectional view taken along line 5-5 in FIG. 1;
FIG. 6 is a cross sectional view taken along line 6-6 in FIG. 1;
FIG. 7 is a cross sectional view taken along line 7-7 in FIG. 1;
FIG. 8 is a cross sectional view taken along line 8-8 in FIG. 1;
FIG. 9 is a cross sectional view taken along line 9-9 in FIG. 1;
FIG. 10 is a cross sectional view taken along line 10-10 in FIG. 1;
FIG. 11 is a cross-sectional view taken along line 11-11 in FIG. 1;
FIG. 12 is a cross sectional view taken along line 12-12 in FIG. 1.

While the following disclosure describes the invention in connection with one embodiment, one should understand that the invention is not limited to this embodiment. Furthermore, one should understand that the drawings are not to scale and that graphic symbols, diagrammatic representation and fragmentary views may, in part, illustrate the embodiment. In certain instances, the disclosure may not include details which are not necessary for an understanding of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS AND AN EMBODIMENT

Turning now to the drawings, FIG. 1 shows a tennis racket 20 in accordance with the present invention. The racket 20 includes a frame which is a one piece, integrally molded unit made of graphite and kevlar fibers and resin or any other light-weight material of high strength and rigidity. This frame generally includes a handle portion 21, a pair of arm portions 22 and 23, a frame cross piece portion 24 which extends between the arm portions, and a pair of curved stringing portions 25 and 26.

The curved stringing portions 25 and 26 and the frame cross piece portion 24 define an oval head or hoop which supports the racket stringing. Leather wrapping (not shown) or wrapping made from any other suitable material covers a substantial length of the handle portion 21 and allows a player to securely grasp the racket.

The racket 20 is symmetric with respect to a longitudinal axis which extends along the middle of the racket from the bottom end of the handle portion 21 to the top of the racket. The arm portion 22 and the stringing portion 25 lie on one side of this longitudinal axis and define a first beam portion. The arm portion 23 and the stringing portion 26 lie on the opposite side and define a second beam portion. These beam portions extend from the handle portion 21 (at X, See Fig. 2) and meet at the top of the racket on the racket's longitudinal axis.

Each beam portion has a generally oval cross-section (See FIGS. 3-12) with a longitudinal or major axis and a minor axis. The minor axis extends in the plane of the strung surface; and the major axis lies on a perpendicular to it. The height and width of each beam (as measured along the major and minor axis of the beam's cross-section) vary along the length of the beam, beginning with a first predetermined width at the bottom of the beam, tapering outwardly and increasing in size to a maximum width and height proximate the end of the arm portion (proximate to the beam's inflection point), and tapering inwardly and decreasing in size to the top of the racket 20. Thus, the portion of the beam which receives the greatest twisting moment, i.e., the section proximate to the frame cross piece portion where the frame cross piece portion and an arm portion merges, has an increased width and height which allows the beam to resist twisting.

Each beam portion defines a groove 27 which extends longitudinally of each beam portion on the outward side of the beam. It also defines a plurality of through holes (not shown) spaced apart at predetermined distances. Similarly, the frame cross piece portion 24 defines a plurality of through holes (not shown) spaced apart at predetermined distances. Stringing 28 extends through these holes and along the groove 27 of the beam portions and portion 24 and lies in a predetermined pattern, defining a strung surface.

The racket 20 is a light-weight racket, advantageously within the range of 276 to 291 g. (9.74 - 10.26 ozs.) (the weights given include 14 g. of string (0,49 oz). It has a high center of percussion (disposed proximate the geometric center of the strung surface) and a high center of gravity with the weight distributed according to the teachings of U.S. Patent No. Re. 31.419 reissued to Frolow on October 18, 1983. The applicants incorporate the disclosure of that patent to the present disclosure by this reference.

The first moment of inertia (torque, first moment = weight x balance point) of the racket 20 is the same as or approximately the first moment of inertia of a conventional racket. Similarly, the second moment of inertia is the same as or approximately that of a conventional racket. In addition, the racket 20 has a small tip deflection (e.g., approximately 2,79 mm (0.11 inch) as compared to approximately 7,87 mm (0.31 inch) for a conventional racket).

By the way of a specific example, a tennis racket made of graphite and kevlar fibres and resin, has an overall length of 682,3 mm (26.862 inch) and a strung surface with a 260 mm (10.235 inch) width and a 345 mm (13.60 inch) length. It weighs 283 g. (9.98 ozs.) (this weight includes 14 g. (0.49 oz) for string); its center of gravity lies approximately 375

mm (14.76 inch) from the bottom end; and its center of percussion lies approximately 498 mm (19.6 inch) from the bottom end. This tennis racket has a first moment of inertia of approximately 10,600 points (283 grams x 37.5 cm) and a second moment of inertia of 2,875 - 2,975 oz/in.^{2} (525.84 - 544.13 kg/cm^2).

The following table shows the frame height and frame width along the ungrooved outer profile of the frame beginning with position zero at the top of the racket (positions in table shown as numbered circles in FIG. 2):

Position*	Frame Height (h)		Ungrooved Frame Width (w)	
	[mm]	[inch]	[mm]	[inch]
0	27,43	1.080	10,66	.420
1	27,43	1.080	10,66	.420
2	28,07	1.105	10,82	.426
3	28,70	1.130	11,02	.434
4	29,34	1.155	11,30	.445
5	29,97	1.180	11,63	.458
6	30,60	1.205	12,34	.486
7	31,24	1.230	12,92	.509
8	31,87	1.255	13,36	.526
9	32,51	1.280	13,61	.536
10	33,14	1.305	13,71	.540
11	33,78	1.330	13,76	.542
12	34,41	1.355	13,89	.547
13	35,05	1.380	14,14	.557
14	35,68	1.405	14,47	.570
15	36,32	1.430	14,90	.587
16	36,95	1.455	15,41	.607
17	37,59	1.480	-	-
18	38,22	1.505	-	-
19	36,32	1.430	14,78	.582
20	34,41	1.355	14,37	.566
21	32,51	1.280	13,99	.551
22	30,60	1.205	13,61	.536
23	28,70	1.130	-	-
24	26,79	1.055	-	-

* Cumulative arc length as measured along the ungrooved outer profile of the racket frame.

The tip deflection of this racket is 2,79 mm (0.11 inch). (Typically, the tip deflection of a conventional racket is approximately 7,87 mm (0,31 inch)).

Claims

1. A tennis racket comprising a frame with a handle portion (21), a pair of curved beam portions which extend along a predetermined path to define an oval head, and a cross piece portion (24) which extends between the beam

mm (14.76 inch) from the bottom end; and its center of percussion lies approximately 498 mm (19.6 inch) from the bottom end. This tennis racket has a first moment of inertia of approximately 10,600 points (283 grams x 37.5 cm) and a second moment of inertia of 2,875 - 2,975 oz/in.^{2} (525.84 - 544.13 kg/cm^2).

The following table shows the frame height and frame width along the ungrooved outer profile of the frame beginning with position zero at the top of the racket (positions in table shown as numbered circles in FIG. 2):

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3	28,70	1.130	11,02	.434
4	29,34	1.155	11,30	.445
5	29,97	1.180	11,63	.458
6	30,60	1.205	12,34	.486
7	31,24	1.230	12,92	.509
8	31,87	1.255	13,36	.526
9	32,51	1.280	13,61	.536
10	33,14	1.305	13,71	.540
11	33,78	1.330	13,76	.542
12	34,41	1.355	13,89	.547
13	35,05	1.380	14,14	.557
14	35,68	1.405	14,47	.570
15	36,32	1.430	14,90	.587
16	36,95	1.455	15,41	.607
17	37,59	1.480	-	-
18	38,22	1.505	-	-
19	36,32	1.430	14,78	.582
20	34,41	1.355	14,37	.566
21	32,51	1.280	13,99	.551
22	30,60	1.205	13,61	.536
23	28,70	1.130	-	-
24	26,79	1.055	-	-

* Cumulative arc length as measured along the ungrooved outer profile of the racket frame.

The tip deflection of this racket is 2,79 mm (0.11 inch). (Typically, the tip deflection of a conventional racket is approximately 7,87 mm (0,31 inch)).

Claims

1. A tennis racket comprising a frame with a handle portion (21), a pair of curved beam portions which extend along a predetermined path to define an oval head, and a cross piece portion (24) which extends between the beam

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portions, each beam portion including an arm portion (22, 23) and a stringing portion (25, 26), the stringing portions (25, 26) and the cross piece portions (24) defining a generally triangular throat; each beam portion (22, 25, 23, 26) extending from the handle portion (21) to the top of the racket and varying in width along its length; each beam portion (22, 25; 23, 26) increasing in width from the handle portion (21) to the cross piece portion (24), having a maximum width proximate the cross piece portion (24), and decreasing in width from the cross piece portion (24) to the top of the oval.

2. The tennis racket of claim 1, wherein said frame includes a cross piece portion (24) which extends between the beam portions (22, 25; 23, 26) at the bottom of the oval head, said beam portions having a maximum width adjacent the cross piece portion (24).

3. The tennis racket of claim 2, wherein each beam portion (22, 25, 23, 26) varies in height along its length and has a maximum height adjacent the cross piece portion (24).

4. The tennis racket of claim 3, wherein each of said beam tapers outwardly, increasing in height and width from the handle portion (21) to the cross piece portion (24) and decreasing in height and width from the cross piece portion (24) to the top of the racket.

5. The tennis racket of claim 4, wherein the frame is a one piece integrally molded unit.

6. The tennis racket of claim 5, wherein said frame is made out of graphite and KEVLAR fibres and resin.

7. A tennis racket comprising a frame with a handle portion (21), a pair of curved beam portions (22, 25; 23, 26), and a cross piece portion (24) which extends between said beam portions (22, 25; 23, 26), each of said beam portions including an arm portion (22, 23) and a stringing portion (25, 26), the stringing portions (25, 26) of said beam portions and the cross piece portion (24) defining an oval head; the arm portions (22, 23) and the cross piece portion (24) defining a generally triangular throat; each beam portion (22, 25; 23, 26) extending from the handle portion (21) to the top of the racket (20) and varying in width and height along its length; each beam portion (22, 25; 23, 26) increasing in width and height from the handle portion (21) to the cross piece portion (24), having a maximum width and height adjacent the cross piece portion (24) and decreasing in width and height from the cross piece portion (24) to the top of the oval.

8. The tennis racket of claim 7, wherein each of said beam portions taper outwardly, increasing in height and width from the handle portion (21) to the cross piece portion (24) and decreasing in height and width from the cross piece portion (24) to the top of the racket (20).

9. The tennis racket of claim 8, wherein the frame is a one piece integrally molded unit.

10. The tennis racket of claim 9, wherein said frame is made out of graphite and KEVLAR fibres and resin.

Patentansprüche

1. Tennisschläger mit einem Rahmen, der einen Griffabschnitt (21), ein Paar gewölbter Rahmenabschnitte, die sich längs eines bestimmten Weges erstrecken, um einen ovalen Kopf zu definieren, und ein Querstück (24) umfaßt, das sich zwischen den Rahmenabschnitten erstreckt, wobei jeder Rahmenabschnitt einen Armabschnitt (22, 23) und einen Saitenabschnitt (25, 26) einschließt, wobei die Saitenabschnitte (25, 26) und das Querstück (24) einen im wesentlichen dreieckförmigen Hals definieren, sich jeder Rahmenabschnitt (22, 25; 23, 26) von dem Griffabschnitt (21) zum Kopf des Schlägers erstreckt und über seine Länge in der Breite variiert, und wobei jeder Rahmenabschnitt (22, 25; 23, 26) in seiner Breite von dem Griffabschnitt (21) zu dem Querstück (24) zunimmt im Bereich des Querstückes (24) eine maximale Breite aufweist und von dem Querstück (24) zum Kopf des Ovals in seiner Breite abnimmt.

2. Tennisschläger nach Anspruch 1, wobei der Rahmen ein Querstück (24) einschließt, das sich am Boden des ovalen Kopfes zwischen den Rahmenabschnitten (22, 25; 23, 26) erstreckt, wobei die Rahmenabschnitte neben dem Querstück (24) maximale Breite aufweisen.

3. Tennisschläger nach Anspruch 2, wobei jeder Rahmenabschnitt (22, 25: 23, 26) längs seiner Länge in der Höhe variiert und im Bereich des Querstückes (24) eine maximale Höhe aufweist.

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4. Tennisschläger nach Anspruch 3, wobei sich jeder Rahmenabschnitt nach außen verjüngt, vom Griffabschnitt (21) zu dem Querstück (24) in seiner Höhe und seiner Breite zunimmt und vom Querstück (24) zu dem Kopf des Schlägers in seiner Höhe und seiner Breite abnimmt.

5. Tennisschläger nach Anspruch 4, wobei der Rahmen eine einteilig geformte Einheit ist.

6. Tennisschläger nach Anspruch 5, wobei der Rahmen aus Graphit, KEVLAR-Fasern und Kunstharz besteht.

7. Tennisschläger, bestehend aus einem Rahmen mit einem Griffabschnitt (21), einem Paar gewölbter Rahmenabschnitte (22, 25; 23, 26) und einem Querstück (24), welches sich zwischen den Rahmenabschnitten (22, 25; 23, 26) erstreckt, wobei jeder der Rahmenabschnitte einen Armabschnitt (22, 23) und einen Saitenabschnitt (25, 26) umfaßt, die Saitenabschnitte (25, 26) der Rahmenabschnitte und das Querstück (24) einen ovalen Kopf definieren, die Armabschnitte (22, 23) und das Querstück (24) einen allgemein dreieckigen Hals definieren, sich jeder Rahmenabschnitt (22, 25; 23, 26) von dem Griffabschnitt (21) zum Kopfende des Schlägers (20) erstreckt und längs seiner Länge in seiner Breite und seiner Höhe variiert, und wobei jeder Rahmenabschnitt (22, 25; 23, 26) in seiner Breite und in seiner Höhe von dem Griffabschnitt (21) zu dem Querstück (24) zunimmt, im Bereich des Querstückes (24) maximale Höhe und Breite aufweist und in seiner Höhe und seiner Breite von dem Querstück (24) zu dem Kopf des Ovals abnimmt.

8. Tennisschläger nach Anspruch 7, wobei sich jeder der Rahmenabschnitte nach außen verjüngt, vom Griffabschnitt (21) zu dem Querstück (24) in seiner Höhe und seiner Breite zunimmt und vom Querstück (24) zu dem Kopfende des Schlägers (20) in seiner Höhe und seiner Breite abnimmt.

9. Tennisschläger nach Anspruch 8, wobei der Rahmen eine einstückig geformte Einheit ist.

10. Tennisschläger nach Anspruch 9, wobei der Rahmen aus Graphit, KEVLAR-Fasern und Kunstharz hergestellt ist.

Revendications

1. Raquette de tennis comprenant un cadre dont une partie est un manche (21), deux parties sont des profilés courbés qui s'étendent lelong d'une courbe prédéterminée pour définir une tête ovale, et dont une partie (24) est une pièce en croix qui s'étend entre les parties qui forment les profilés, chaque profilé comprenant une partie qui est un bras (22, 23) et une partie comprenant des cordes (25, 26), les parties (25, 26) comprenant des cordes et les parties (24) qui sont une pièce en croix définissant une gorge généralement triangulaire; chaque profilé (22, 25; 23, 26) s'étendant à partir de la partie qui est un manche (21) jusqu'à la partie supérieure de la raquette et variant en largeur lelong de sa longueur; la largeur de chaque profilé (22, 25; 23, 26) augmentant à partir de la partie qui est un manche (21) jusqu'à la partie (24) qui est une pièce en croix, atteignant une largeur maximale à proximité de la partie (24) qui est une pièce en croix, et diminuant en largeur à partir de la partie (24) qui est une pièce en croix jusqu'à la partie supérieure de l'ovale.

2. Raquette de tennis selon la revendication 1, dans laquelle ledit cadre inclut une partie (24) qui est une pièce en croix qui s'étend entre les profilés (22, 25; 23, 26) au bas de la tête ovale, lesdits profilés ayant une largeur maximale dans la région près de la partie (24) qui est une pièce en croix.

3. Raquette de tennis selon la revendication 2, dans laquelle chaque partie qui forme un profile, (22, 25; 23, 26) varie en hauteur lelong de sa longueur et a une hauteur maximale dans la région près de la partie (24) qui est une pièce en croix.

4. Raquette de tennis selon la revendication 3, dans laquelle chacun des profilés s'amincit vers l'extérieur, augmentant en hauteur et en largeur à partir de la partie qui est un manche (21) jusqu'à la partie (24) qui est une pièce en croix et diminuant en hauteur et en largeur à partir de la partie (24) qui est une pièce en croix jusqu'à la partie supérieure de la raquette.

5. Raquette de tennis selon la revendication 4, dans laquelle le cadre forme une unité entièrement moulue d'une pièce.

6. Raquette de tennis selon la revendication 5, dans laquelle le cadre est fait de graphite, de fibres KEVLAR et de résine.

7. Raquette de tennis comprenant un cadre dont une partie est un manche (21), deux parties (22, 25; 23, 26) sont des profilés courbés, et une partie (24) est une pièce en croix qui s'étend entre lesdites parties qui sont des profilés

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(22, 25; 23, 26), chaque profilé incluant une partie qui est un bras (22, 23) et une partie qui sont des cordes (25, 26), les parties qui forment les cordes (25, 26) desdites parties qui sont des profilés et la partie (24) qui est une pièce en croix définissant une tête ovale; les parties qui forment un bras (22, 23) et la partie (24) qui est une pièce en croix définissant une gorge généralement triangulaire; chaque profilé (22, 25; 23, 26) s'étendant à partir de la partie qui est un manche (21) jusqu'à la partie supérieure de la raquette (20) et variant en largeur et en hauteur lelong de sa longueur; chaque partie qui est un profilé (22, 25; 23, 26) augmentant en largeur et en hauteur à partir de la partie qui est un manche (21) jusqu'à la partie (24) qui est une pièce en croix, ayant une largeur et une hauteur maximale dans la région près de la partie (24) qui est une pièce en croix et diminuant en largeur et en hauteur à partir de la pièce (24) qui est une pièce en croix jusqu'à la partie supérieure de l'ovale.

8. Raquette de tennis selon la revendication 7, dans laquelle chacun des profilés s'amincit vers l'extérieur, augmentant en hauteur et en largeur à partir de la partie qui est un manche (21) jusqu'à la partie (24) qui est une pièce en croix et diminuant en hauteur et en largeur à partir de la partie (24) qui est une pièce en croix jusqu'à la partie supérieure de la raquette.

9. Raquette de tennis selon la revendication 8, dans laquelle le cadre forme une unité entièrement moulue d'une pièce.

10. Raquette de tennis selon la revendication 9, dans laquelle le cadre est fait de graphite, de fibres KEVLAR et de résine.

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