(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 223 882**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **85201947.0**

(51) Int. Cl.⁴: **A63B 49/00**

(22) Date of filing: **22.11.85**

(43) Date of publication of application:
03.06.87 Bulletin 87/23

(84) Designated Contracting States:
AT CH DE FR GB IT LI LU NL SE

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(54) Strung sports racket with tension transmitting devices.

(57) Sports rackets having strings 19 supported by tension transmitting devices 27 positioned between the string sections or chords and an outward facing head frame 17 surface. Tension is transmitted between connecting string sections by the tension transmitting devices. Such transmission of tension allows strain energy to be stored in additional string sections instead of only those directly contacted by a ball or other impacting object. One form of the tension transmitting device is an independent rocker member that receives and supports the string as it wraps over the outer surface of the racket head.

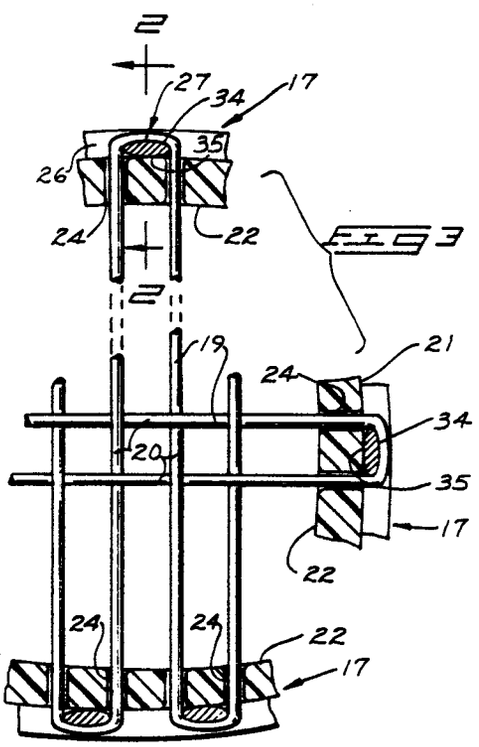

Fig 3

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Strung Sports Racket Having String Tension Transmitting Device

Field of the Invention

This invention relates to transmission of tension among the various strings of a strung sports racket upon impact with a ball or other playing object.

Background

Most conventional sports rackets have strings which are each effectively anchored as they pass across the head or face opening to the next string hole. String elasticity, static string tension, frame stiffness, strung area geometry, and balance are all factors known to affect power, control, comfort and equipment performance. Many shapes, sizes, material, string tension, weights, even grips have been tried to improve the various games.

There remains a need for optimizing power and control features of a strung racket while minimizing the complexity of mechanisms for achieving such results. It is also desirable to incorporate simple, yet effective, features in a strung racket that will produce a higher coefficient of restitution - (increased power for the same exertion), lower stress in the racket frame during the hit (lower magnitude vibrations), and lower peak tension in the strings during the hit. It is further desirable to provide improved performance by balancing forces applied to the hit object by providing even dynamic string tension which approaches that of a uniform membrane, reducing edge effects on off-center hits, and producing a longer dwell time thereby providing better control and larger string deflection for additional power.

Brief Description of the Drawings

Preferred forms of the present invention are shown in the accompanying drawings in which:

Fig. 1 is a view of a tennis racket with portions broken away to illustrate features of the present invention;

Fig. 2 is an enlarged sectional view taken through a portion of the racket head frame and taken along line 2-2 in Fig. 3;

Fig. 3 is a fragmented view illustrating a portion of a string arrangement and portions of a racket including features of the present invention; and

Fig. 4 is a pictorial view of a rocker device with a portion thereof broken away.

Detailed Description of the Preferred Embodiment

The present invention can be incorporated in any size or geometry sports racket made from any common material. For purposes of this application, an exemplary configuration is that of a mid-sized tennis racket, made from graphite fiber impregnated resin.

The exemplary racket is shown at 10 in Fig. 1 of the drawings. The racket 10 includes an elongated handle 11 extending from a handgrip 12 along a shaft 13 to a throat 14. The throat 14 is secured or integral with a head frame 17.

The head frame 17 is planar with the handle 11 and defines a string opening 18. A string 19 may be threaded through the head frame 17 in a criss-cross fashion of individual string chords 20. This woven pattern defines a planar racket face for impact with a ball or other playing object. It is preferable that the string incorporated for use with the present invention be a single strand of gut or conventional synthetic string material. The string can be tied at opposed ends to the head frame in any conventional manner.

The head frame includes an outer surface 21 that is oriented perpendicularly to the planar racket opening. An inner surface 22 of the frame 17 defines the opening configuration. String is threaded through the head frame between surfaces 21 and 22 through string holes 24.

Conventional string holes are formed through the racket head frame in substantially radial orientations. The string, however, is oriented in chord lengths that are preferably longitudinal and transverse with respect to the handle. The strings therefore are tightened against conventionally formed hole peripheries at vertices of angles formed between the radial holes and the transverse or longitudinal strings. This produces a binding or anchoring effect on the string chords.

String holes 24 are arranged to be coaxial with the strings passing through them and are preferably arranged in two groups. A first or longitudinal group of string holes 24 are formed through the racket head frame along parallel longitudinal axes and spaced across the head frame to receive string portions forming the longitudinal chords. A second group of string holes are formed up the sides of the head frame between surfaces 21 and 22. The second group of holes are also parallel to one

another and spaced along the head length in transverse orientation to the longitudinal string chords. The particular orientation of the string chords can vary.

String holes 24 are preferably of sufficient size to loosely receive the string chords. The chord segments can thus be centered within the holes without touching or rubbing against the head frame material between the outer and inner surfaces 21 and 22. The string chords 20 are therefore loosely received rather than anchored in the holes 24.

The head frame 17 may be provided with an annular channel 25 extending about its outer periphery. The base of channel 25 serves as the outwardly facing head frame surface 21 for purposes of this description. The surface 21 is advantageously situated between channel walls 26 as shown in Fig. 2.

Important features of the present invention are embodied in a tension transmitting means generally shown at 27. The tension transmitting means can be provided in the form of individual rockers 28 as shown in Figs. 2 through 4. Tension transmitting means 27 is intended to transmit tension from one string chord to an adjacent chord using a rocking action.

A preferred rocker means 28 is shown in detail in Fig. 4. It includes a top surface 34 and bottom surface 35. The bottom surface is advantageously convex, preferably cylindrical. Surfaces 34 and 35 extend between smoothly curved ends 36. A groove or recess 37 may be formed along the top surface 34 to receive and orient a string in perpendicular orientation to the preferably cylindrical configuration of the bottom surface 35. Convex side walls 38 may extend between the bottom surface 35 and top surface 34, as best shown in Figs. 2 and 4.

The lengths of the individual rockers are such that string cords draped over the top surfaces 34 and guided over ends 36 through adjacent string holes 24 can be centered precisely within the string holes 24. Contact is made with the racket frame only by way of rockers 28. This effectively eliminates frictional contact between the string cords and the frame head. The actual length dimension between rocker ends 36 is less than the distance between centers of adjacent parallel string holes 24 by approximately the diameter of the string being used.

The bottom surfaces 35 of each rocker is arranged to be received with its longitudinal axis perpendicular to the racket opening or face. Contact between the rocker surfaces and the outer head frame surface exists along approximately parallel tangential lines of contact perpendicular to the planer face of the racket.

Orientation of the rocker surfaces to the racket face is important in three ways. Firstly, the tangential lines of contact provide rolling or rocking motion thus reducing friction between the two surfaces to a mimimum, even with considerable tension being applied to one or both of the two adjacent string chords. Secondly, the tangential line contact, versus point contact, enables the rockers to withstand the high Hertzian stresses developed at the contact interface. Thirdly, the lines of contact are preferably oriented perpendicular to the planer string opening to provide high frictional resistance against sliding when the racket is impacted by a ball or other object. If rockers 28 slide along the lines of contact then one of the convex side walls 38 of rockers 28 will come into contact with an adjacent channel wall 26. Convex walls 38 are preferably semi-spherical and contact the channel wall at only a single tangential point. Such contact will prevent further sliding motion of the rocker with mimimal effect upon the rocking capability of the rockers.

Figs. 1 and 3 indicate the preferred use of a plurality of rockers positioned between the string and outer head frame surface 21 at all string holes about the racket head frame. This arrangement supports all string chords in a tension transmitting and substantially friction free manner.

It is preferable that the individual rockers be formed of a substantially rigid material such as aluminum or other lightweight, yet high strength, material. High strength plastic, such as graphite-filled polyamide may also be used, as can any material which provides the necessary rigidity and can withstand the high Hertizan stresses developed along the contact surfaces.

It is possible for an existing sports racket to be retrofitted with rockers between adjacent string segments to provide the roll tension transmitting capability. The rockers would function especially well in conjunction with a racket having oversized string holes or holes redrilled to loosely receive the strings coaxially therein.

Rackets according to this invention are preferably strung with relatively long, continuous strings which are passed through the frame and over tension transmitting means 27. The relatively long continuous strings supported by the tensioning means allows the string tension to be uniformly distributed over a relatively large or entire area of the racket. This greater distribution of strain energy reduces localized high stresses which otherwise occur in conventional string rackets. The total amount of elongation or strain developed in the strings is accordingly increased because of the longer effective string length over which the tension is distributed. This provides several very beneficial advantages.

One advantage is the higher initial tension which can be used to string the racket. This higher static string tension can be used with less risk of string breakage because of the more even distribution of tension throughout the racket face. The overall deflection of the racket face will also be greater than with conventional rackets wherein only a relatively small percentage of the strings share the peak loading at impact. The even distribution of strain and increased overall deflection of the string face provide a smaller restoring angle for impacts occurring near the racket frame thus providing increased velocity. This increases the preferred hitting area or "sweet zone" of the racket. The relative change in tension during impact is also less, thus reducing the apparent difference in control between hard and soft hits, and giving the player a wider range of available hits. Greater deflection also provides an overall longer dwell time during impact which improves control and power transmission to the ball. The ball also sees a more evenly balanced force profile when hit, especially near the frame of the racket. This improves control considerably when compared to conventional rackets which exprience abnormally high string tensions near the frame due to the relatively shorter string lengths. The invention also allows more energy to be transmitted to the ball thus reducing the levels of shock and vibration experience by the player.

The invention is also advantageous in reducing friction and wear. Wear at the crisscross string intersections is reduced because the tension forcing the overlapping strings together is substantially reduced thus decreasing the frictional forces proportionately. This lower friction at the string intersections complements the minimal friction associated with the tension transmitting action of rockers 28.

Stringing of the racket may be accomplished in substantially the usual manner, with rockers 28 inserted as stringing progresses. One rocker is placed between the string and outer head frame surface 21 at each wrap where the string passes through one hole and extends over the outer surface to be received through the next adjacent hole.

An important advantage of the present invention over other rackets employing pulley systems or saddle string mounts is the basic simplicity of the structure. It further allows the weight of the racket head to be maintained at a relatively low value. Prior art apparatus added to a conventional racket head significantly increase the head weight and adversely affect racket valance and performance. Other advantages are the small size and external positioning of the tension transmitting means so that there is no interference or intrusion into the string opening 18. This is a important since anything extending into the opening 18 will effectively diminish the opening size or decrease the effective string length.

Claims

1. A sports racket comprising:
an elongated handle;
a head frame at an end of the handle defining a planar string opening;
wherein the head frame includes an outward facing surface substantially perpendicular to the planar string opening and an inside surface defining the opening;
a first group of substantially parallel first string holes formed through the head frame oriented in a first direction and adapted for loosely receiving at least one racket string therethrough;
a second group of substantially parallel second string holes formed through the head frame oriented transversely with respect to the first direction and adapted to loosely receive at least one racket string therethrough; and
rocker means positionable between two string holes; the rocker means being rigid in a plane parallel to the string holes; and adapted for contacting the outward facing surface of the head frame along a rocking line of contact perpendicular to the string holes and parallel to a plane tangential to the outward facing surface; said rocker means having a string receiving surface thereon adapted to receive and guide a racket string through the string holes.

2. The sports racket as claimed by claim 1 wherein the rocker means is an elongated rigid body having:
a substantially cylindrical bottom rocking surface for rocking engagement with the outward facing surface of the head frame; and
a top surface opposite the bottom rocking surface having a string receiving recess formed therein.

3. The sports racket as claimed by claim 2 wherein the outward facing surface is situated at the base of a channel formed about the frame head for loosely receiving the rocker means therein.

4. The sports racket of claim 3 wherein the rocker means are oriented with the axis of the bottom cylindrical rocking surface oriented transversely to the planar string opening of the head frame.

5. The sports racket as claimed by claim 4 wherein the rigid body of the rocker means includes convex side walls joining the substantially cylindrical rocking surface and the string receiving surface.

6. A string tension transmitting device for a stringed racket having a racket head frame defining a substantially planar string opening and having an outward facing frame surface substantially perpendicular to the planar string opening and with a plurality of string holes formed through the head frame from the outward surface into the opening, the device comprising:
a rocker body having a top side and a bottom side, and being substantially rigid in a plane passing through said top and bottom sides;
string receiving means on the top side of the rocker body for receiving a portion of string therein and for guiding the string through two string holes in the racket head;
rocker surface means formed on the bottom side of the body for rocking engagement with the outward facing head frame surface of the racket head along a line of contact perpendicular to the plane of the planar string opening and parallel with a plane tangential to the outward facing frame surface.

7. The device as claimed by claim 6 wherein the top surface includes a string receiving groove and the bottom rocker surface is substantially cylindrical about an axis oriented substantially perpendicular to the string receiving groove.

8. The device as claimed by claim 8 wherein the top and bottom surfaces are elongated and joined at curved ends over which a string extends.

9. A strung sports racket, comprising:
an elongated handle;
a head frame at an end of the handle forming a planar string opening along a racket face; the head frame including an outward facing surface perpendicular to the planar string opening, and an inward facing surface defining the planar string opening;
a plurality of string holes defined by hole walls extending through the head frame in the plane of the the string opening;
at least one string threaded through at least a portion of the string holes and extending across the string opening to form chord sections in a criss-cross pattern spanning at least portions of the string opening; and
a plurality of tension transmitting rocker means interposed between the string and the outward facing surface of the head frame; the rocker means each having a rocker surface engaging the outward facing surface of the head frame, and a string engaging surface spaced apart from the rocker surface in opposing and substantially rigid relationship thereto; the rocker surfaces engaging the outward facing surface in rocking relationship thereto along lines of contact substantially perpendicular to the planar string opening; for rocking in response to differences in string section tension.

10. The sports racket as claimed by claim 9 wherein the outward facing surface is situated at the base of a channel formed about the frame head for loosely receiving the rocker means with the longitudinal axis of the rocking surface oriented substantially perpendicular to the planar string opening.

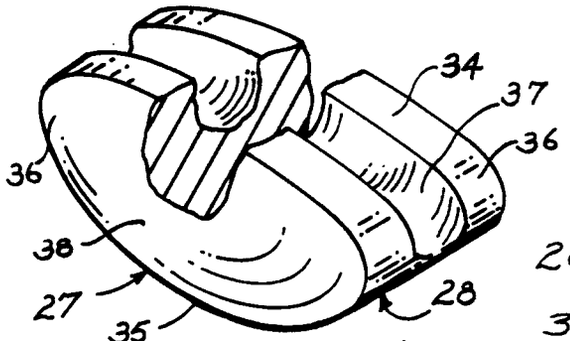
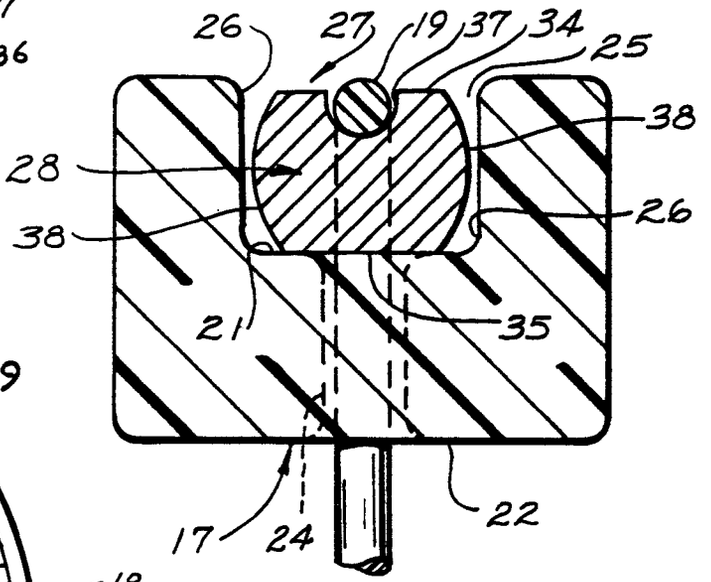


FIG 4

FIG 2



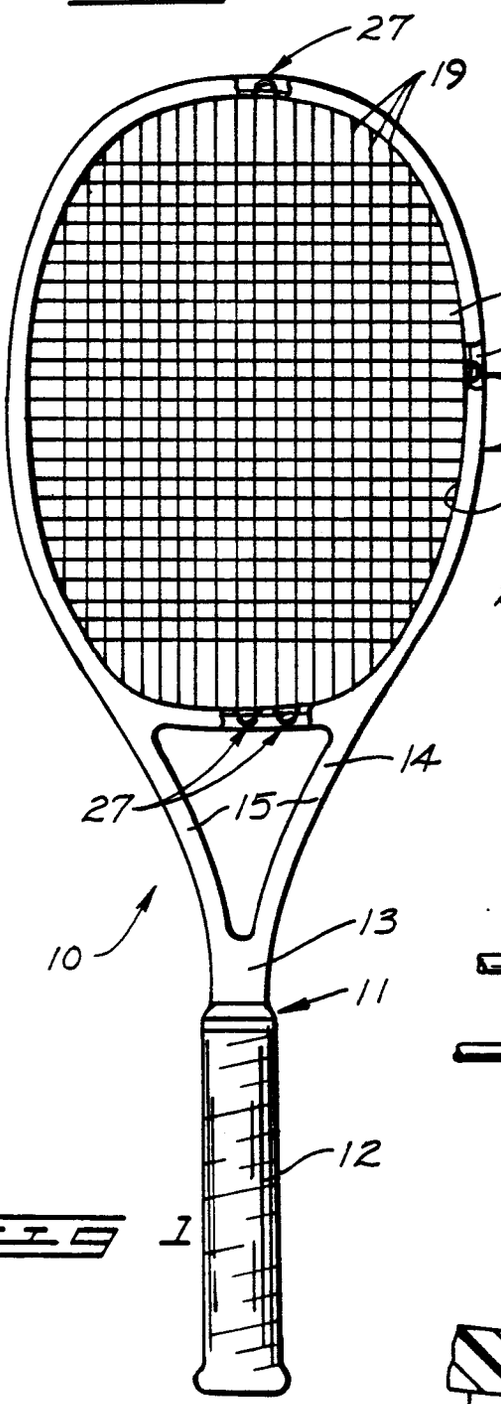


FIG 1

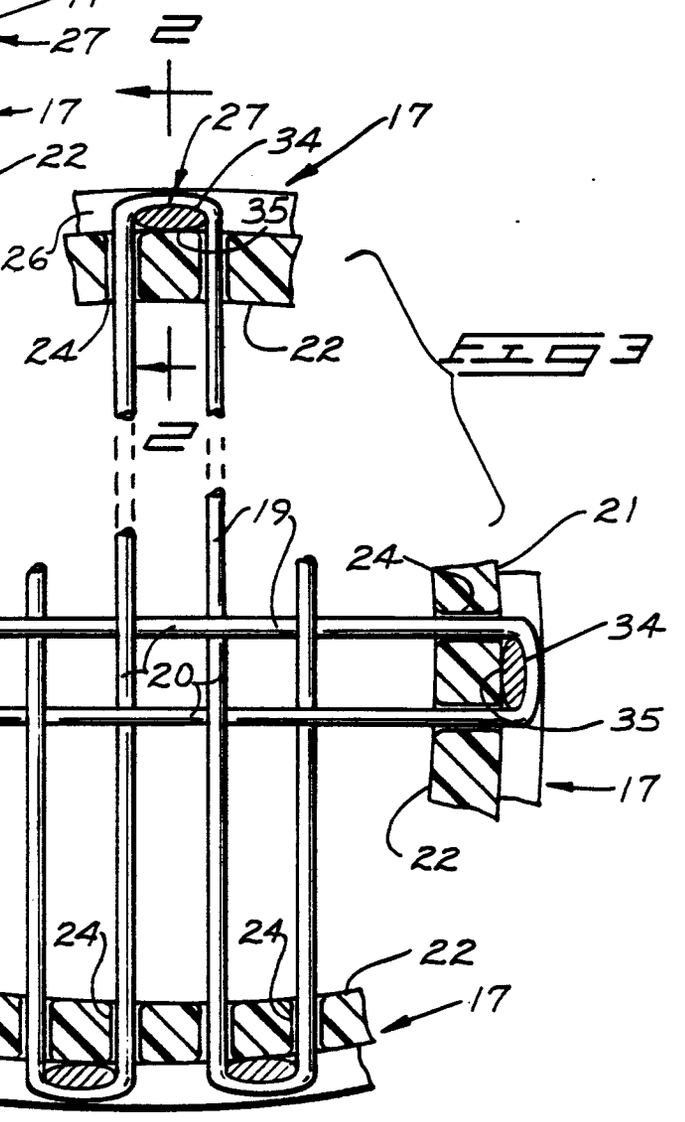


FIG 3

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 85 20 1947

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.4)
X	US-A-1 542 177 (R. ROSE) * Figures 1,5; page 1, line 109 - page 2, line 15 *	1,2,9, 10	A 63 B 49/00
A		6	
X	US-A-4 462 592 (R. LEGGER et al.) * Column 2, lines 24-36; figures *	1	
A		2-4,6	
A	US-A-3 567 225 (J. HOLLIS)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	DE-A-2 611 970 (H. BAUSCH)		A 63 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-08-1986	VEREECKE A.

CATEGORY OF CITED DOCUMENTS

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