

[54] RACKET

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[22] Filed: June 14, 1974

[21] Appl. No.: 479,688

[52] U.S. Cl. 273/73 E; 273/67 R; 273/73 H

[51] Int. Cl.² A63B 49/12; A63B 51/12

[58] Field of Search 273/73 E, 73 C, 73 D, 73 H, 273/67 R

2,034,444	3/1936	Rauch et al.	273/73 E
2,145,785	1/1939	Aubert	273/73 E
3,702,189	11/1972	Galich	273/73 H X
3,724,850	4/1973	Steven	273/73 E

FOREIGN PATENTS OR APPLICATIONS

320,183	10/1929	United Kingdom	273/73 E
566,130	12/1944	United Kingdom	273/73 D
1,089,675	9/1960	Germany	273/73 D

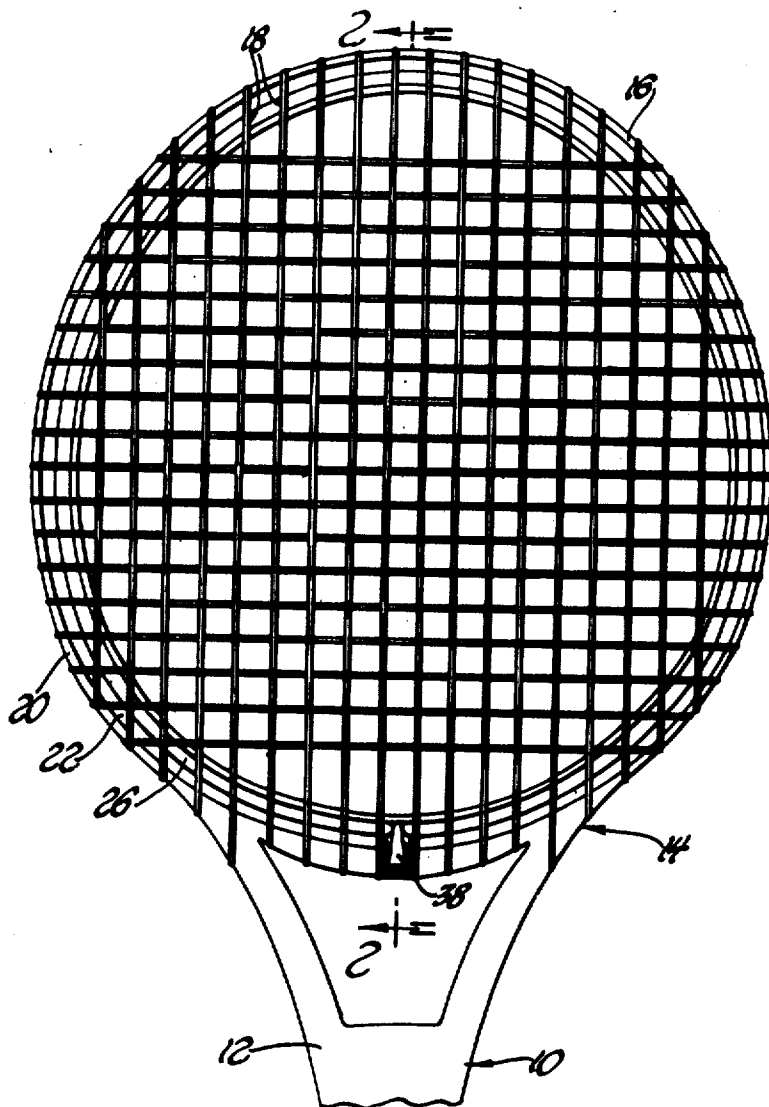
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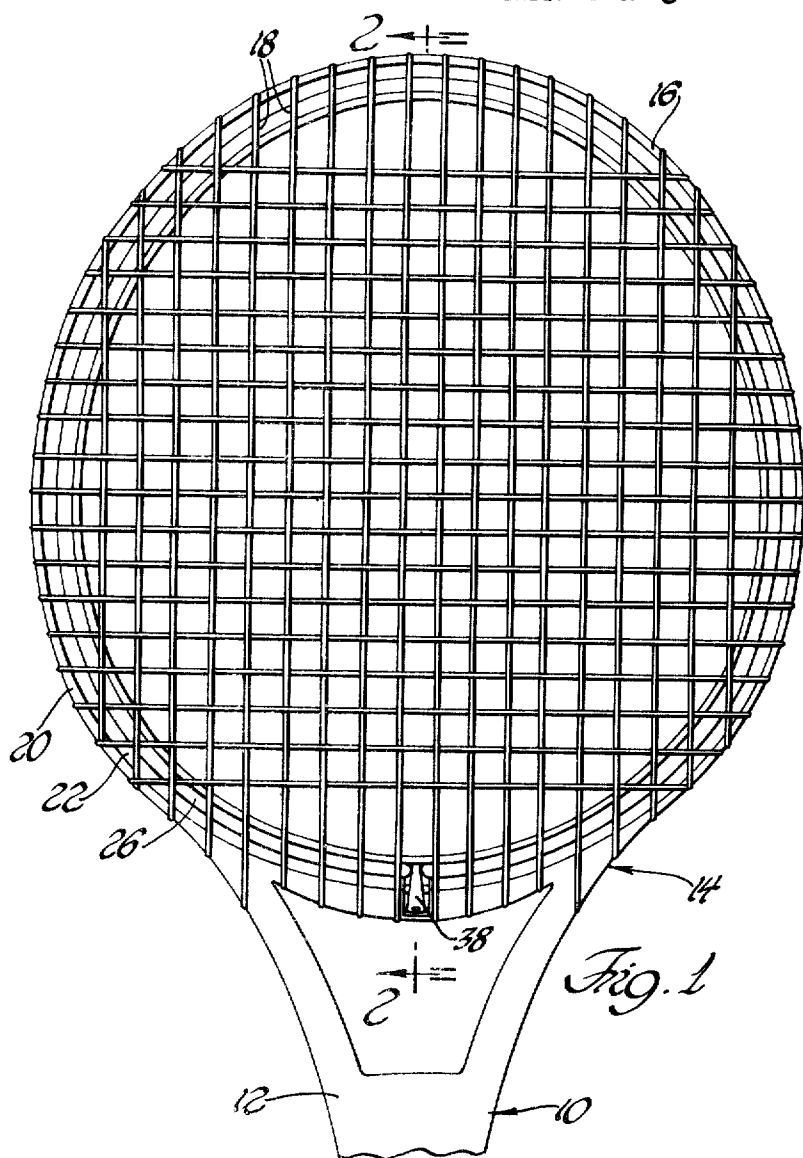
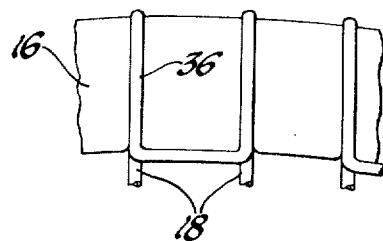
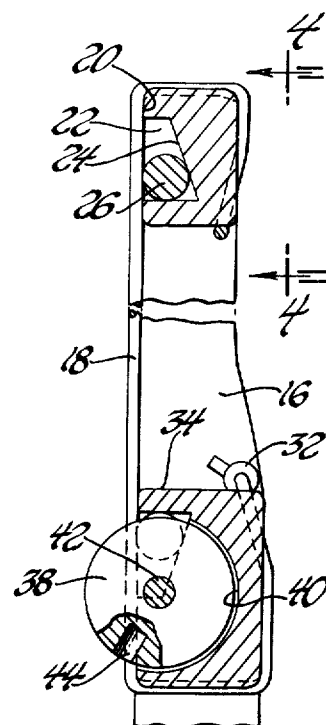
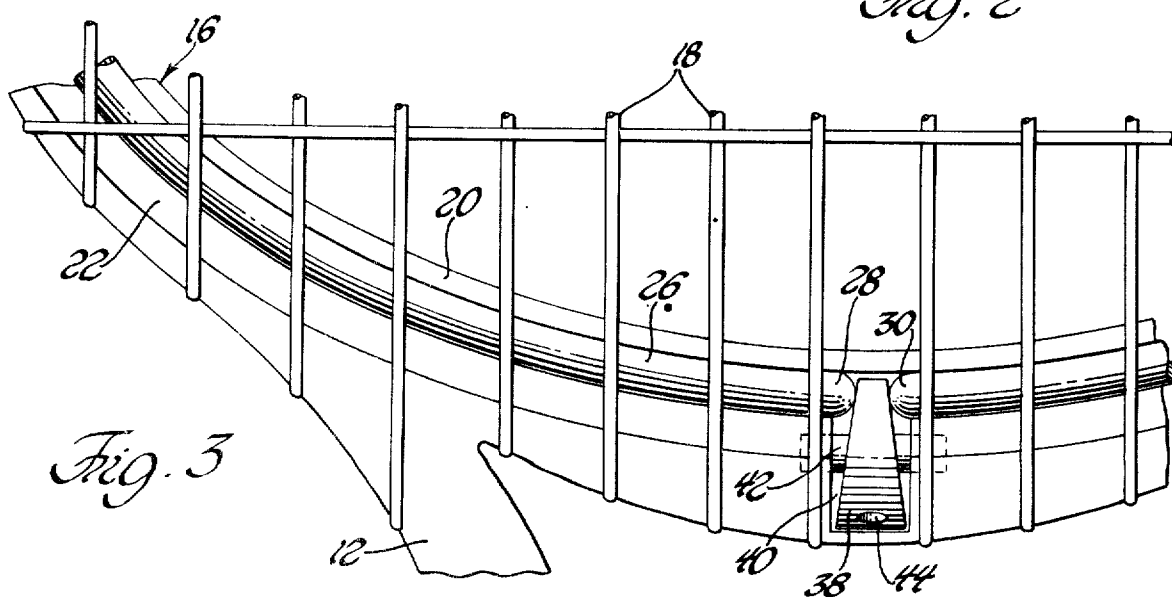
[57] ABSTRACT

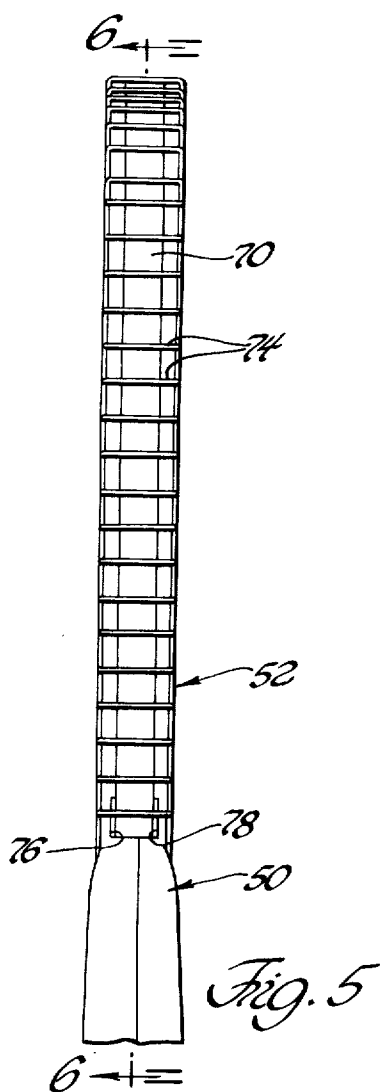
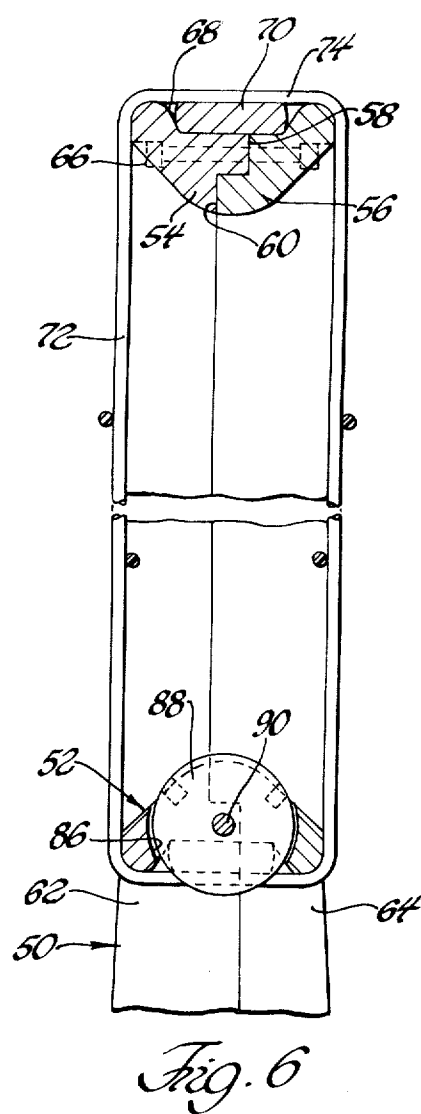
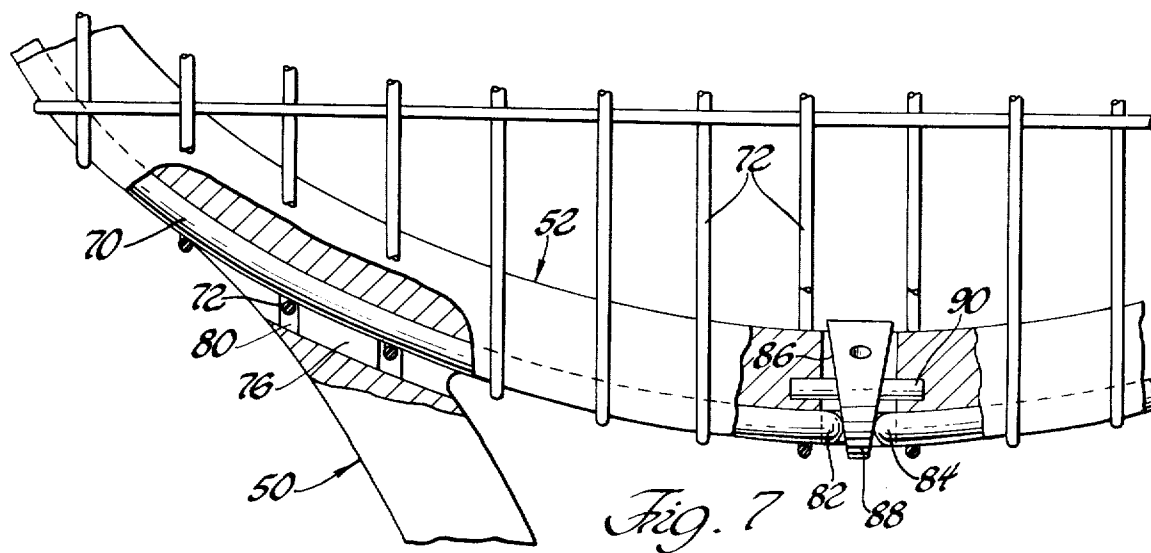
A racket including a string tensioning system symmetrically disposed about the racket frame so as to impose substantially equal string tension forces throughout the length of the frame.

5 Claims, 13 Drawing Figures



SHEET 1 OF 3





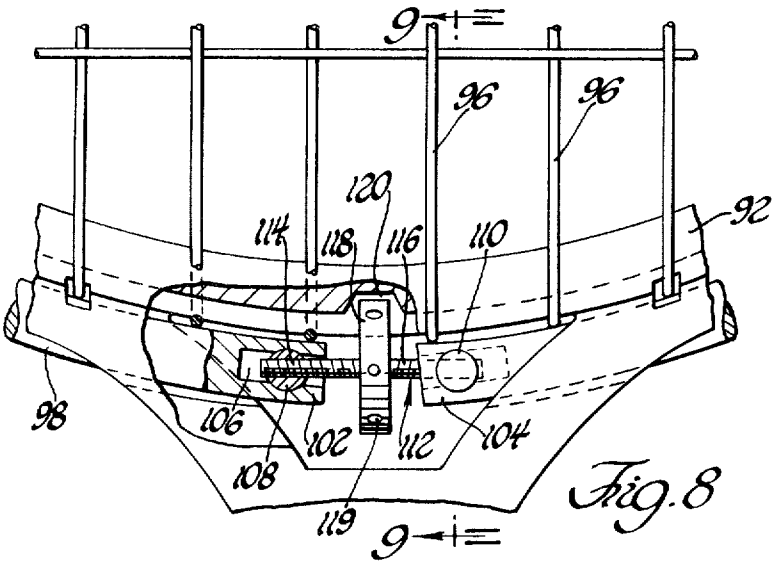


Fig. 8

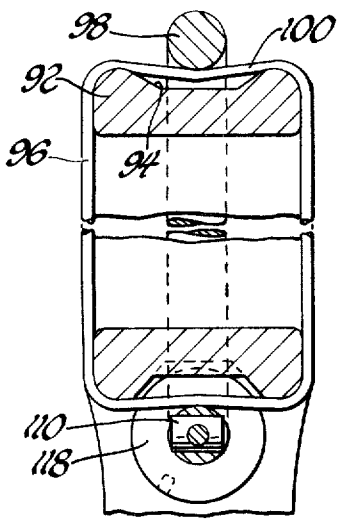


Fig. 9

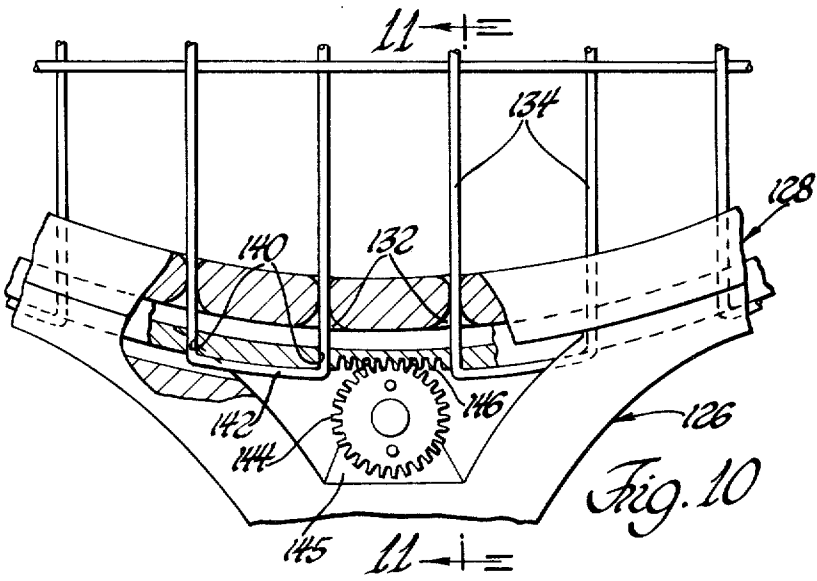


Fig. 10

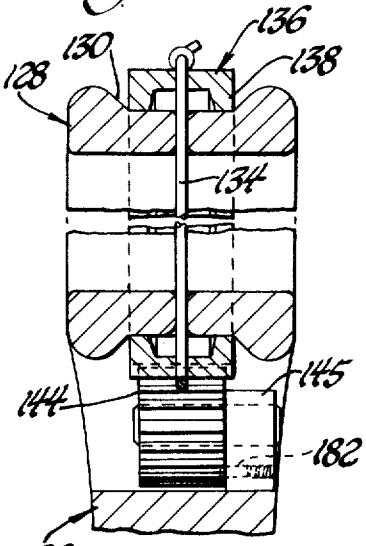


Fig. 11

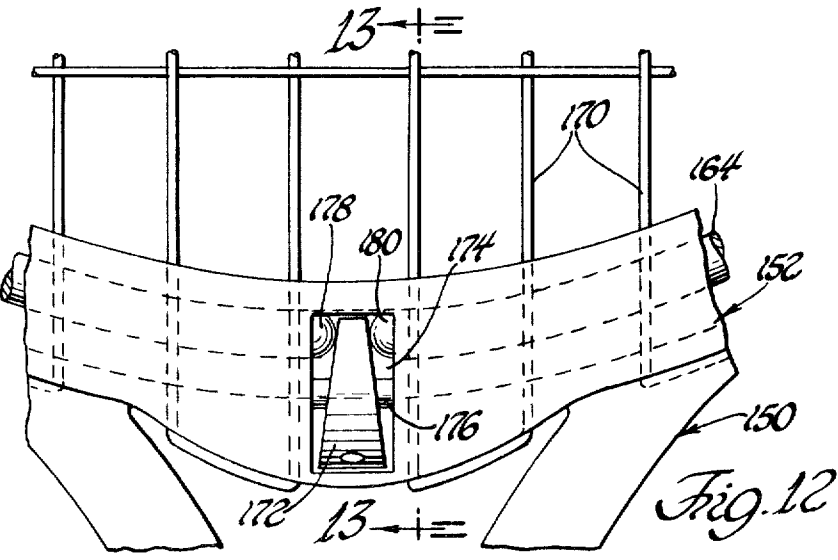


Fig. 12

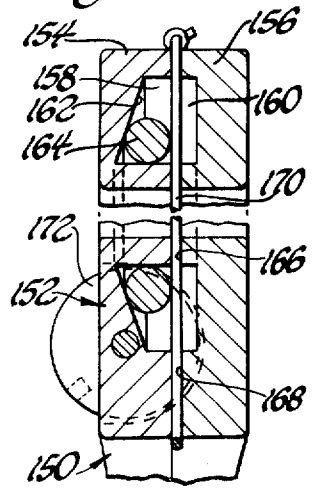


Fig. 13

RACKET

BACKGROUND OF THE INVENTION

1. Field of the Invention

Depending on the user's requirement, typically a tennis racket is strung at the time of purchase to a predetermined tension, e.g. in the range of 58 to 62 pounds, and thereafter no controlled adjustment of the string tension can be made. From day to day, variations in string tension are occasioned by changes in atmospheric conditions such as temperature and humidity. Further, in the normal course of racket use the strings become progressively looser. Particularly with better players, racket strings become sufficiently loose as to require racket restringing to reestablish the string tension at the proper level. Thus, to be certain of having a racket with the proper string tautness, a more experienced player may carry several rackets for use during a match.

2. Description of the Prior Art

The symmetrical string tensioning system of the present invention is to be contrasted with an asymmetrical tensioning mechanism such as shown in Aubert U.S. Pat. Nos. 2,145,785 and 2,193,526. In the Aubert patents the tension device is disposed proximate that half of the racket frame closest to the racket handle and, further, the cross-section of that half of the racket frame is reduced in size relative to the upper half of the frame. Thus, Aubert's arrangement is such that the cross-sectional strength of the upper half of the racket frame is greater than that of the lower half. With the Aubert approach, it is apparent that string tensioning and other forces imposed on the racket will be unequally distributed about the racket frame due to its asymmetric construction.

SUMMARY OF THE INVENTION

The present invention is directed to a string tensioning system which may be adapted to various types of rackets and which will permit a player to adjust the tension or tautness of a string surface. More specifically, the string tensioning system of this invention is disposed about a racket frame such that substantially equal string tensioning and other forces are symmetrically distributed around the racket frame. The system is so constructed and arranged that the racket frame has a constant cross-sectional shape substantially throughout its length. According to the present invention, the string tensioning system results in substantially equal and opposite tensioning forces being applied to the opposite ends of each string element in such a way that relatively little movement of the tensioning mechanism is necessary to vary the tension of each string element.

While illustrated as applied to a tennis racket, it is to be understood that the invention is also applicable to other types of rackets, e.g. squash and badminton.

Reference is now made to the drawings and the following detailed description where several modifications of the invention are shown and described.

FIG. 1 shows a tennis racket embodying one modification of the present invention;

FIG. 2 is a sectional view through the racket head along line 2—2 of FIG. 1;

FIG. 3 is an enlargement of a portion of the racket head showing the tensioning mechanism in greater detail.

FIG. 4 is a view along line 4—4 of FIG. 2;

FIG. 5 represents a second modification of the invention;

FIG. 6 is a sectional view of the racket frame along line 6—6 of FIG. 5;

FIG. 7 is an enlarged view of a section of the racket head frame of the modification of FIG. 5;

FIGS. 8 and 9 represent a third variation of the subject invention;

FIGS. 10 and 11 represent a fourth modification of the subject invention; and

FIGS. 12 and 13 represent a fifth modification of the present invention.

Reference is now made to the first modification of the present invention shown in FIGS. 1 through 4. A tennis racket is indicated generally at 10. The upper end of a racket shaft is indicated at 12 from which extends a racket head indicated generally at 14 and which includes an enlarged frame member 16 about which is strung a plurality of string elements 18 interwoven so as to provide ball-engaging surfaces on either face of the racket head.

It is to be understood that a handle or grip, not shown, is disposed at the other end of shaft 12. It is an important aspect of the subject invention that the frame member 16 be subject to substantially equal tensioning forces throughout its length. Accordingly, in all modifications of the invention, both the racket frame and the tensioning system are symmetrically related and, more specifically, the tensioning system is generally coextensive with the frame length or perimeter.

Furthermore, it is basic to the present invention to provide a string tensioning system enabling the use of a frame having a substantially identical transverse cross-section throughout its length, and particularly that part of the frame length beyond the juncture with the racket shaft.

More specific reference is now made to the tensioning mechanism and racket construction of the modification shown in FIGS. 1 through 4. Frame 16 includes a face 20 extending substantially throughout the length of the frame in which an annular recess 22 is provided. Recess 22 includes a cam or sloping face 24 at the innermost portion thereof such that the recess tapers or narrows as it approaches the radially outer edge of the frame. Recess 22 extends substantially throughout the length of frame 16.

An annular rod member 26 is adapted to be disposed within frame recess 22 and terminates in a pair of proximally disposed ends 28 and 30.

String elements 18 are anchored to the frame member 16 as best seen in FIGS. 2 and 4. In this modification of the invention one string element is anchored through a knot 32 to the inner face 34 of frame 16 from which it extends radially outwardly and transversely around the frame so as to include an end portion which extends transversely across recess 22 in abutting engagement with member 26. As best seen in FIG. 4, each string element is wrapped about the frame member so as to terminate in a U-shaped loop 36 which forms the beginning of the next string element which thereby again traverses face 20 of the frame.

As seen in FIG. 2, it will be noted that the plane of string elements 18 is offset from the median plane of the racket frame.

As initially assembled, annular rod member 26 is disposed in the radially innermost or widest portion of re-

cess 22 as shown in FIGS. 2 and 3. A circular cam member 38 is disposed within a recess 40 formed in frame 16 and is rotatably supported through a shaft 42. As best seen in FIG. 3, cam 38 is doubly tapered throughout its length so as to progress from a narrow to a wide width. Cam 38 includes at least one radially outwardly opening hole 44 to receive a suitable tool which is inserted therein to rotate the cam.

Again referring to FIG. 3, as noted, the annular rod member 26 is disposed in the deepest or radially innermost portion of recess 22. In this position, the narrowest portion of cam 38 abuttingly engages the rod ends 28 and 30.

In order to increase the tension of the string elements, a tool is inserted in cam hole 44 and the cam rotated so that the progressively thicker portions of the cam move the ends of the rod element away from the tapered cam faces to increase the effective length of the rod element. Inasmuch as the rod element is constrained within recess 22 by string elements 18, the annular rod member is caused to move radially outwardly toward the narrow end of recess 22, thereby applying a tensioning force to the end portions of each string element. Since the end portions of each string element 18 engage rod member 26, approximately half as much radial movement of the rod member is required as compared to the case where only one end portion of each string element was directly tensioned by the system.

Reference is now made to the modification of the invention shown in FIGS. 5 through 7. In this modification the shaft 50 and frame 52 are formed of a split or two-part construction which is particularly adapted to a metal-type racket. As best seen in FIG. 6, the frame is formed by two frame sections 54 and 56 having abutting faces 58 and 60. Frame sections 54 and 56 and their corresponding shaft portions 62 and 64 are most preferably diecast members although a stamped construction is also usable. Any suitable means, such as rivets 66, may be used to secure the frame sections together to form a unitary frame construction. The radially outer faces of frame sections 54 and 56 are formed to provide a common recess 68 within which is disposed a flat strip member 70.

In this modification string elements 72 are wrapped about the frame element so as to include end portions 74 extending transversely across recess 68 to abuttingly retain strip member 70 within the recess. In this arrangement as well as in the modification shown in FIGS. 8 and 9, two sets of strings are provided one on each side of the median plane of the frame.

As seen in FIGS. 5 and 7, the frame sections 54 and 56 are formed so as to provide slots or recesses 76 and 78 through which strip member 70 can extend at the juncture of the frame and shaft. Transverse recesses 80 are also formed at the juncture of the frame and the upper end of the shaft to permit string element 72 to pass therethrough.

Strip member 70 includes a pair of proximately disposed end portions 82 and 84 which terminate within a recess 86 formed in the frame. A double tapered cam member 88 is rotatably supported within frame recess 86 upon a shaft member 90. As in the modification of FIGS. 1 through 4, when assembled the narrowest portion of cam member 88 abuttingly engages end portions 82 and 90 of strip member 70. Inasmuch as the strip member 70 is retained in abutting relationship with frame recess 68 by string element end portions 74, as

cam 88 is rotated and the thicker portion thereof brought into engagement with strip end portions 82 and 90, the effective length of strip member 70 is increased. The effect of the outwardly linear movement of strip end portions 82 and 84 is to impart equal and opposite radial tensioning forces to each end of each string elements 72.

In the modifications of FIGS. 1 through 4 and 5 through 7, the string elements are wrapped about the frame member so as to retain the respective members 26 and 70 to the frame. A further modification of the invention is shown in FIGS. 8 and 9 in which a frame member 92 is provided with a recess 94 formed in the radially outer face thereof. String elements 96 are once again wrapped about the frame member 92 so as to extend transversely of the frame recess 94. In this case, however, a rod member 98 extends about frame member 92 in alignment with recess 94 and abuttingly engages the transversely extending end portions 100 of each string element.

Rod member 98 terminates in a pair of proximately disposed end portions 102 and 104 each of which terminates in inwardly opening recesses 106 within which are pivotally mounted a pair of internally threaded journals 108 and 110 adapted to receive a shaft 112 having oppositely threaded portions 114 and 116. A knob or wheel 118 is fixed to shaft 112 and is adapted to project within a recess 120 formed in frame 92. In order to increase the tension of string elements 96, wheel 118 is rotated through a suitable tool inserted in hole 119 so as to draw the end portions 102 and 104 of rod member 98 toward each other thereby shortening the effective length of the rod member and depressing string element end portions 100 within frame recess 94.

A further modification of the invention is shown in FIGS. 10 and 11 wherein the racket shaft and frame are indicated generally at 126 and 128. In this case, frame 128 is formed with a recess 130 in its radially outer face. Radial holes 132 are formed in the median plane of frame 128 and through which string elements 134 extend. An integral or continuous annular ring member 136 includes a pair of radially inwardly extending leg portions 138 to slidably support ring 136 within recess 130. Ring member 136 also includes a plurality of radially extending holes 140 formed therein and adapted initially to be radially aligned in spaced relation to frame holes 132 and through which holes the end portions of each string element extend.

Referring particularly to FIG. 10, an adjacent pair of string elements 134 extend radially through aligned holes 132 and 140 of frame 128 and ring 136 and are interconnected by a circumferentially extending string section 142. Thus, the ends of the string elements 134 are fixed or anchored to ring 136.

A gear element 144 is rotatably supported on a trunion member 145 formed or otherwise mounted on racket shaft 126. Ring member 136 includes a rack portion 146 formed in the outer face thereof and adapted to coact with gear element 144. In order to increase the tension of the string elements 134, gear element 144 is rotated by a suitable tool, not shown, so as to move ring element 136 circumferentially relative to frame member 128 and thereby imparting equal and opposite tensioning forces to each end of each string element.

A still further modification of the invention is shown in FIGS. 12 and 13, wherein shaft and frame sections are indicated generally at 150 and 152. As in the modification shown in FIGS. 5 through 7, a split or two-part frame and shaft construction is utilized. Frame sections 154 and 156 include internal recessed portions 158 and 160 which are in open communication with each other. Recess portion 158 formed in frame section 154 includes a sloping wall section 162 which inclines from its radially innermost end toward the median plane of the frame at its radially outer end. Recess 160 of frame section 156 is generally of rectangular cross-section.

An annular rod member 164 is disposed within the common recess defined by the internal frame recesses 158 and 160. Frame members 154 and 156 are formed so as to provide two sets of spaced and radially aligned holes 166 and 168 formed in the median plane of the frame and through which string elements 170 extend. As assembled, rod 164 is disposed within the radially innermost or widest portion of recess 158 and retained therein by string elements 170.

A double tapered cam element 172 is disposed within a frame recess 174 and rotatably supported therein by a shaft element 176. Here again, rod 164 terminates in a pair of proximately disposed end portions 178 and 180 which initially abuttingly engage the narrowest portion of the cam element. To increase the tension on the string elements, cam element 172 is rotated to bring a progressively thicker portion thereof into engagement with the end portions 178 and 180 of rod element 164 increasing the effective length of the rod element and causing the same to move radially outwardly along the sloped wall 162 of recess 158 and thereby exert equal and opposite tension forces on each end of each string element 170.

In all modifications of the invention, it is anticipated that there is sufficient friction in the tension adjusting system to maintain the strings at any adjusted tension. However, should it be found in practice that the strings tend to loosen once the tension is set or varied, it is within the scope of the invention to provide any suitable means for locking the rotatable came, wheels or gear members to retain them in an adjusted position. By way of an example, and referring to FIG. 11, a spring biased detent member 182 can be disposed in shaft trunion 145 and which detent is adapted to coact with suitable notches formed in the adjacent face of gear element 144.

The embodiments of the present invention in which an exclusive property or privilege is claimed are defined as follows:

1. A racket of the type including a shaft, an enlarged closed frame extending from one end of said shaft, a plurality of string elements stretched about the frame to form open-weave ball engaging surfaces, said frame member including at least one substantially continuous surface extending throughout the length of the frame, and means for mechanically adjusting the tension of said string elements, said tension adjusting means including:

- a. an integral, non-stretchable member of constant

cross-section supported upon and extending substantially entirely about the length of said frame surface and including a pair of end portions;

- b. each string element including a pair of longitudinally spaced end portions each operatively connected to said member; and
- c. adjustable mechanical means mounted upon said frame and coacting with the pair of end portions of said member for moving said end portions to thereby uniformly adjust the tension of each string element.

2. A racket as set forth in claim 1 in which the adjustable means comprises a cam element rotatably supported upon said frame and in operative engagement with the end portions of said member, rotation of said cam element changing the effective length of said member.

3. A racket of the type including a shaft, an enlarged closed frame extending from one end of said shaft, a plurality of string elements stretched about the frame to form open-weave ball engaging surfaces, each string element including a pair of longitudinally spaced end portions proximate said frame, and means for mechanically adjusting the tension of said string elements, said tension adjusting means including:

- a. a circular ring member supported upon and extending about the length of said frame;
- b. the end portions of each string element operatively connected to said ring member; and
- c. means for rotating said ring member relative to said frame to vary the tension of each string element.

4. A racket as set forth in claim 3 in which said frame includes a first set of openings through which the end portions of each string element extend, a second set of openings formed in said ring said second set of openings being radially spaced from and initially aligned with said first set of openings, the end portions of each string element extending through said second set of openings and being fixed relative to the ring.

5. A racket of the type including a shaft, an enlarged closed frame extending from one end of said shaft, a plurality of string elements stretched about the frame to form open-weave ball engaging surfaces, and means for mechanically adjusting the tension of said string elements, said tension adjusting means including:

- a. a recess formed in said frame and extending substantially throughout the length thereof;
- b. said recess including a cam surface;
- c. an integral member of constant cross-section at least partially disposed within said recess and extending substantially throughout the length thereof;
- d. each string element including a pair of longitudinally spaced end portions retaining said member against said cam surface;
- e. adjustable mechanical means mounted upon said frame and adapted to move said member relative to said cam surface to adjust the tension of each string element.

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