

[54] **TENNIS RACKET**
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[52] **U.S. Cl.**..... **273/73 C; 273/73 D; 273/73 F; 273/73 H**
[51] **Int. Cl.²**..... **A63B 49/02; A63B 51/08**
[58] **Field of Search**.... **273/26 A, 26 R, 29 R, 29 A, 273/67 R, 73 R, 73 C, 73 L, 76, 95 R**

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[57] **ABSTRACT**
A tennis racket is formed with a frame having a generally square head and a stem depending therefrom. The racket is strung so that each string length spanning the head extends perpendicularly from the lengths of the head portions from which it is supported to provide a ball striking matrix of equal length and equally tensioned string reaches. In one embodiment, the frame is formed of a single length of extruded metal while in another, the frame is molded in two segments which are joined along the medial thickness plane of the racket.

8 Claims, 10 Drawing Figures

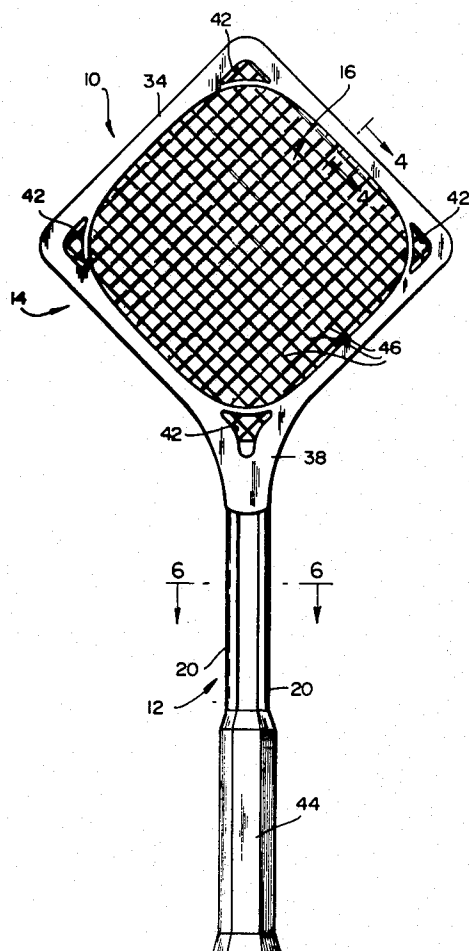


FIG. 1

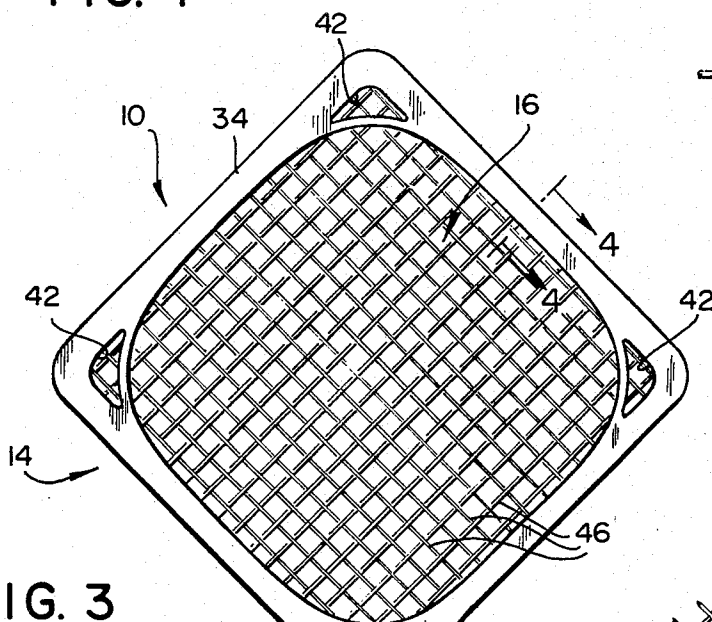


FIG. 3

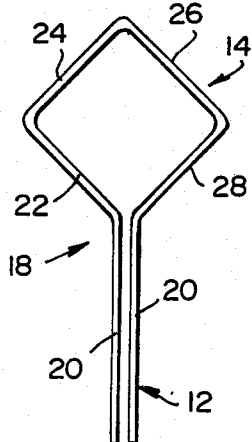
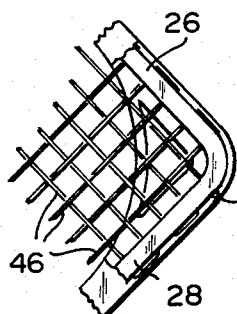


FIG. 2

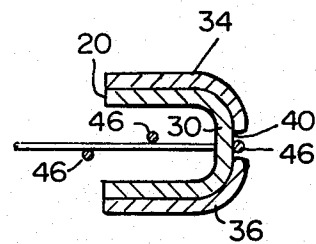


FIG. 4

FIG. 5

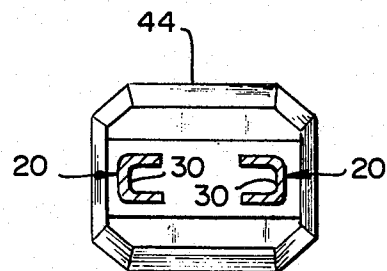
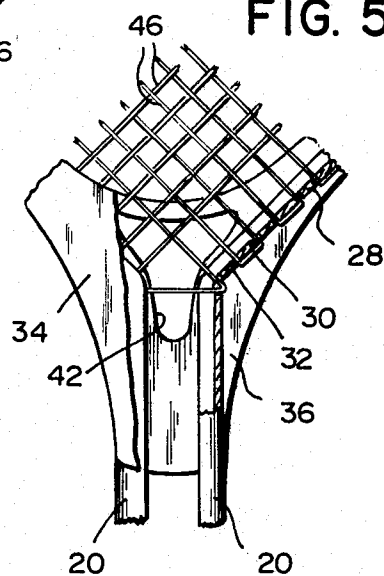


FIG. 6

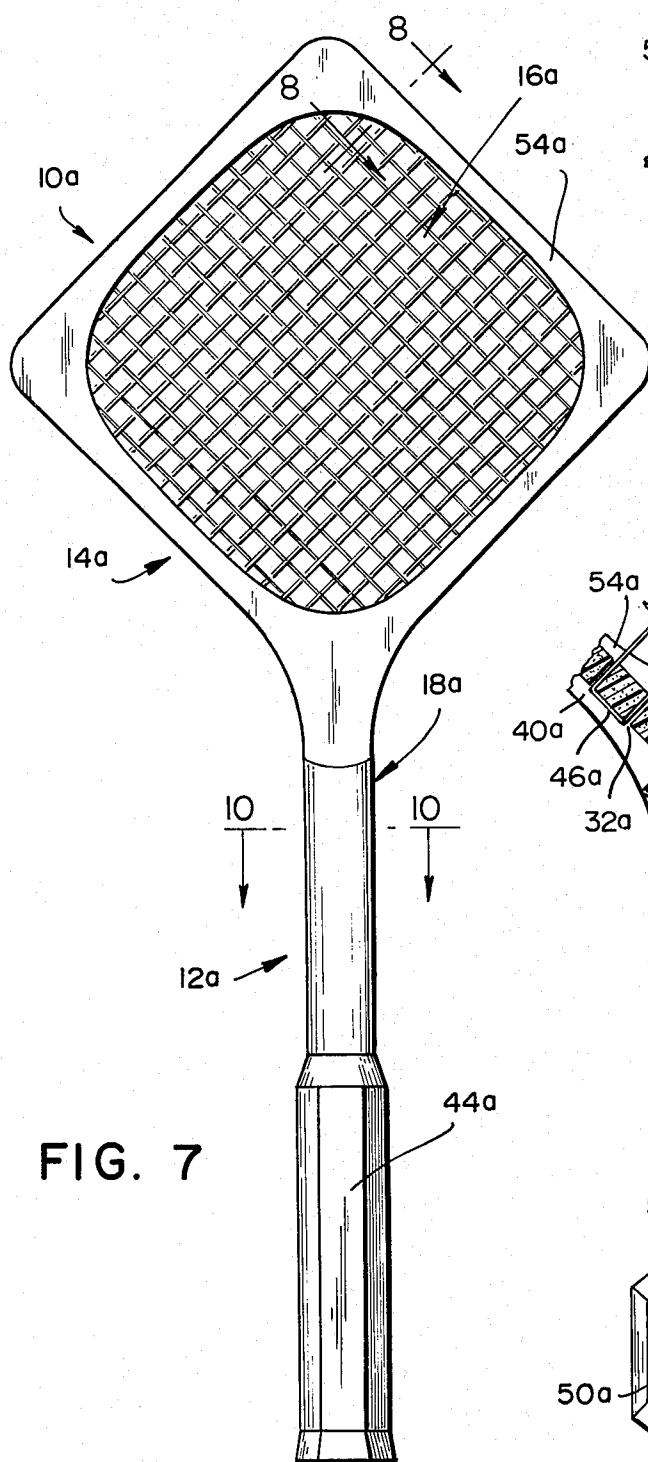


FIG. 7

FIG. 8

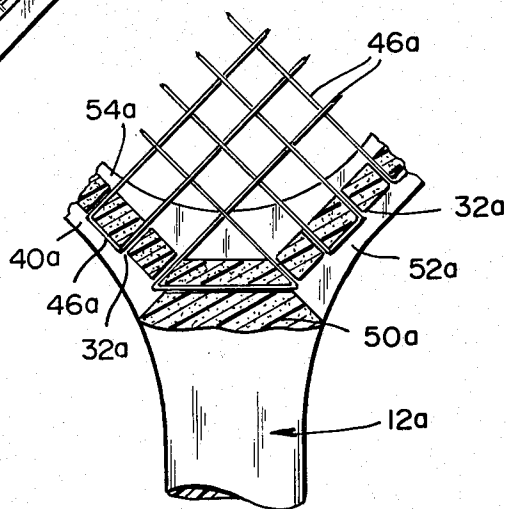
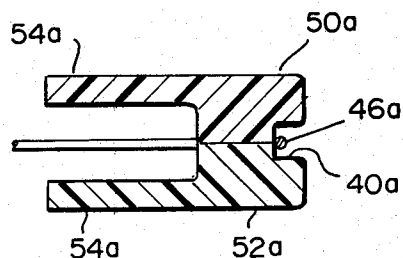


FIG. 9

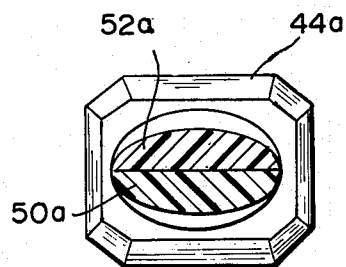


FIG. 10

TENNIS RACKET

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to tennis rackets and, more particularly to tennis rackets having a ball striking zone which provides substantially uniform ball rebound characteristics over its available surface.

2. Brief Description of the Prior Art

The tennis enthusiast is well aware of the large variety of various types of tennis rackets sold to date. Each of the varieties had drawbacks and, the player usually selected the type of racket which was best suited to meet his individual needs, i.e. the one which had the bearable disadvantages.

Although wood rackets maintained a degree of control as its basic playing characteristic, well made wood rackets were relatively costly and, even these were susceptible to bow warpage. Wood racket warpage, if not progressed to the extent of rendering the racket entirely unacceptable for use, affected the tension in strings thereby altering the playing characteristics. A further drawback with the use of wood rackets was that changes in humidity affected both playing characteristics and susceptibility to warpage. Fatigue splintering was also a common problem.

With regard to the playing characteristics of wood rackets, it has been found that they were generally stiff and failed to satisfactorily flex upon ball contact. This, of course, resulted in a transmittal of ball impact shock and/or axial torque through the handle and to the player, repeated effects of which manifested itself in the common ailment of players, tennis-elbow, i.e. tendonitis.

The utilization of metal rackets provided more flexibility and reduced, to some extent, shock transmission. An additional advantage inherent in metal rackets was that the tendency to warp did not manifest itself. Such rackets therefore provided a longer useful life and eliminated maintenance procedures such as the use of presses to retard warpage in wood rackets.

A further problem which has been found in prior tennis rackets was that since essentially all rackets had an ellipsoidal bow shape across which the racket striking matrix was strung, successive string reaches were of varying lengths and usually were not uniformly prestressed. Ideal rebound characteristics were obtained when the ball was struck at the center of the striking matrix. If a ball was struck off center, shorter string lengths contacted the ball thereby altering the rebound characteristics.

SUMMARY OF THE INVENTION

The present invention provides for a tennis racket having a square head section and with each length of the string extending perpendicularly between two parallel head frame sides. Intersecting string segments extend substantially perpendicular to a second pair of head frame sides. Adjacent string lengths are uniformly spaced apart and the intersecting string segments to provide a ball striking matrix wherein each string segment is of the same length and equally tensioned to provide uniform response characteristics over its entire available surface.

In one embodiment, the racket frame is bent from a single length of metal channel with the head diagonal

coaxial with a depending handle stem. A pair of gusset casings may be secured to opposite faces of the head for reinforcement.

In an alternate embodiment, the frame is molded in two segments which are subsequently joined along the medial thickness plane to form a composite frame.

From the above summary it will be appreciated that it is an object of the present invention to provide a tennis racket of the general character described which is so constructed that it is not subject to any of the aforementioned disadvantages.

It is a further object of the present invention to provide a tennis racket of the general character described which is practical, lends itself to economical mass production fabrication techniques and is low in initial cost.

A still further object of the present invention is to provide a tennis racket of the general character described wherein response characteristics are substantially uniform over the entire available ball striking surface.

Yet another object of the present invention is to provide a tennis racket of the general character described which includes a ball striking surface formed of a matrix of spaced equal length string segments.

A further object of the present invention is to provide a tennis racket of the general character described wherein a frame is reinforced at the racket head by a pair of gusset casings.

Yet a further object of the present invention is to provide a tennis racket of the general character described wherein the string lengths forming a ball striking matrix are equally prestressed and of the same length to provide substantially uniform rebound characteristics over the entire available ball striking surface area.

Another object of the present invention is to provide a tennis racket of the general character described wherein a frame is fabricated of two segments joined along the medial thickness plane of the racket.

Other objects in part will be obvious and in part will be pointed out hereinafter.

With these ends in view, the invention finds embodiment in certain combinations of elements and arrangements of parts by which the said objects and certain other objects are hereinafter attained, all as fully described with reference to the accompanying drawings and the scope of which is more particularly pointed out and indicated in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings in which are shown some of the various exemplary embodiments of the invention,

FIG. 1 is an elevation view of a tennis racket constructed in accordance with and embodying the invention and having a generally square head and a depending stem;

FIG. 2 is a reduced scale elevation view of an extruded metal channel bent to the configuration of the tennis racket and forming the frame thereof;

FIG. 3 is an enlarged fragmentary illustration of a corner of the tennis racket head and with portions broken away for clarity to better illustrate a pair of gusset casings which reinforce the frame;

FIG. 4 is an enlarged sectional view through the racket head, the same being taken substantially along the line 4-4 of FIG. 1 with portions thereof deleted for clarity to better illustrate the frame channel and casings;

FIG. 5 is an enlarged fragmentary illustration of the throat of the racket as shown in FIG. 1 with portions broken away to illustrate both the casings and the manner in which the racket is strung;

FIG. 6 is an enlarged sectional illustration, the same being taken substantially along the line 6—6 of FIG. 1 and through the frame portions which form the racket stem;

FIG. 7 is an elevational view, similar to that of FIG. 1, showing an alternate embodiment of the tennis racket wherein the frame is formed of two sections;

FIG. 8 is an enlarged sectional view through a portion of the frame forming the racket head, the same being taken substantially along the line 8—8 of FIG. 7;

FIG. 9 is an enlarged fragmentary illustration of the throat of the tennis racket as shown in FIG. 7 with portions thereof broken away for clarity and;

FIG. 10 is an enlarged sectional view of the racket stem, the same being taken substantially along the line 10—10 of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The reference numeral 10 denotes generally a tennis racket constructed in accordance with and embodying the invention. The racket 10 includes a generally upright stem 12 extending to an enlarged generally square head 14 which includes a peripherally encased ball striking zone 16.

The stem 12 and head 14 are formed of a skeletal frame 18 preferably bent from a metal channel 20 of generally U-shaped transverse cross-sectional configuration and oriented such that the open channel surfaces face each other. From an observation of FIG. 2 it will be seen that in the stem 12, the channel 20 extends as two parallel terminal elements.

The head 14 is constructed of four equal continuous lengths of the channel 20 each forming a side 22, 24, 26 and 28 each oriented perpendicularly to intersecting sides.

It will be appreciated that to facilitate stringing of the racket 10 a base wall 30 of the channel includes a plurality of equidistantly spaced apertures 32 in the channel sides forming the square head 14. The head 14 is oriented in a diamond configuration with respect to the stem 12 such that the stem axis is coincident with a diagonal passing between opposed corners of the head. Each aperture 32 is of a size suitable to accept a racket string which is strung across the ball striking zone 16 in a manner to be subsequently described. To prevent string wear, the apertures 32 may be oversized and suitable bushings or grommets (not shown) may be seated therein.

In order to reinforce the racket frame 18 against the fatigue of competitive playing, a pair of front and rear gusset casings 34, 36 are provided. Each casing is generally of a square configuration to conform with and overlap the frame 18 at the head 14. It will be appreciated that to facilitate such reinforcement, the corners of the casings are provided with gusset webs and, in addition, the throat area of the frame is strengthened with a depending neck web 38.

From an observation of FIG. 4 it can be observed that the casings 34, 36 are provided with inturned (toward the channel 20) peripheral edges which overlap the channel base wall 30. Such peripheral edges do not, however, abut one another and thereby provide a groove 40 (see FIG. 4) within which loops of the string

are protectively seated. Since the casings 34, 36 overlap the channel 20, the web portions thereof which overlie the string reaches will be sufficiently spaced from the strings to permit string flexure upon ball impact without contacting the casings.

As shown in FIG. 1, the casings 34, 36 may be provided with openings 42 at the gusset corners to both reduce wind resistance and weight. Because both the channel 20 and the casings 34, 36 are of metal, e.g. aluminum, magnesium, steel, etc., the casings 34, 36 may be secured to the channel with any of the conventional bonding modes, e.g. welding, riveting, etc.

With reference to FIG. 5, it will be appreciated that the casings 34, 36 include, at the neck web 38, suitable notches along their inturned peripheral edges to accommodate the channel terminal elements which extend to form the stem 12. It will be further observed from FIGS. 1 and 6 that these stem forming elements are seated in a handle 44 which serves to lock the channel in position thus rigidifying the frame while at the same time providing a gripping surface for manipulation.

As previously mentioned, the head 14 is formed of four equal length channel lengths constituting the sides 22, 24, 26 and 28 with intersecting sides perpendicularly oriented to thus form the substantially square ball striking zone 16. The base wall 30 of the channel 20 includes a plurality of equidistantly spaced apart apertures 32 for receiving and accommodating a string 46.

The tennis racket 10 is strung with any conventional stringing material, e.g. gut or nylon, to provide a uniform response within the entire available ball striking zone 16, even if a ball is struck off center. The stringing of the racket can be accomplished through the use of conventional techniques.

The racket may be strung of a single length of suitable string 46 and thus only two string tie down points will be required. In stringing, initially, a knot 48 is formed adjacent one end of the string 46 (see FIG. 3) and the opposite end and remaining portions of the string may be strung through an aperture 32 in one of the sides, e.g. the side 28. The string is then pulled through a registered aperture in the opposite, parallel side, e.g. the side 24. The string 46 is pulled taut spanning the distance between the opposite parallel sides 28, 24. It will be appreciated that at the side 24, the string is looped to the next adjacent aperture with such loop seated within the groove 40 formed between the casings 34, 36. Stringing is continued across to a registered aperture in the first side 28. Registration of the apertures in parallel sides is such that successive string lengths extending across two parallel sides are, themselves, parallel and perpendicularly oriented to the two sides from which they are supported. After the string 46 has passed through the final aperture 32 in an aperture series along two parallel sides, it is suitably rerouted to span between the adjacent pair of parallel sides which are perpendicular to the first pair. A suitable rerouting arrangement is illustrated in FIG. 5. It will also be appreciated that intersecting string lengths spanning between different pairs of sides may be alternately lapped over one and under the next as shown to form a composite ball striking lattice or matrix.

With the particular construction of the present square head tennis racket 10, it is readily observed that the string elements spanning the ball striking zone 16 and forming the ball striking matrix are not only all of the same length, but in addition thereto, may be all equally prestressed to the desired playing tension dur-

ing the stringing operation.

The skeletal frame 18 could be constructed of various alternate transverse cross sectional configurations other than the channel configuration shown, e.g. of tubing such as that employed and illustrated in U.S. Pat. No. 3,568,290.

As mentioned heretofore, frame elements forming the stem 12 include two parallel depending elements which are seated in the handle 44. The handle 44 may be molded of one piece construction and suitably wrapped with a grip material, e.g. leather, or may be formed of two mating half sections within each of which one of the frame elements would be seated. If desired, the handle may be mounted at the time of sale.

In an alternate embodiment illustrated in FIGS. 7 through 10 and wherein like numerals denote like components previously described, however bearing the suffix *a*, the numeral 10*a* denotes generally a tennis racket embodying the invention. In a manner similar to that of the previous embodiment, the racket 10*a* includes a stem 12*a* and a generally square head 14*a* within which a ball striking zone 16*a* is formed.

In essence, the racket 10*a* embodies a square head in a manner similar to that of the previous embodiment. With this aspect in view, the racket 10*a* provides equal length string segments in a ball striking matrix and which segments are uniformly prestressed to thereby provide substantially uniform ball rebound characteristics over the entire available surface area of the ball striking zone 16*a*.

The racket head 14*a* and stem 12*a* are constructed of a frame 18*a* which, however, differs substantially from the construction of the previous embodiment. The frame 18*a* is molded of two segments, 50*a* and 52*a*, each of which includes, in one piece, both the head 14*a* and the stem 12*a*. Each segment is bonded or fused to the registered opposite segment along the medial thickness plane (the plane of the strings) of the composite racket.

A suitable grip 44*a*, preferable of one piece construction, is employed at the free end of the stem 12*a* to both facilitate manipulation of the racket and to further serve to secure the frame segments. Optionally, the grip itself may be molded in one piece construction with one or both segments.

In the head 14*a* of each of the frame segments 50*a*, 52*a* a transverse channel forming the string aperture may be provided. When the frame segments are in registry, the channels will also be in registry to provide a string passage 32*a*. If the ball striking matrix does not lie in the medial thickness plane of the strings the apertures 32*a* may be separately postformed in only one of the segments, e.g. the segment 50*a*.

Since each of the frame segments 50*a*, 52*a* are of one piece unitary construction, the head reinforcement provided by the casing employed in the previous embodiment is supplanted by overlapping gusset flanges 54*a*. The flanges 54*a* are suitably spaced from the plane of the strings to permit unobstructed string flexure. Furthermore, the flanges 54*a* are webbed at the head corners for additional reinforcement.

The frame of the racket 10*a* of this alternate embodiment may be molded of any metal, e.g. aluminum, steel, magnesium, etc., or a thermoplastic, e.g. acrylonitrile-butadiene-styrene, polyamides, polycarbonates, etc., with or without fiber glass or other reinforcement, or may even be laminated. To assemble the racket, the frame segments 50*a*, 52*a* are registered and

bonded together. The mating segments are secured through conventional techniques suitable for joining the materials from which they are molded.

Without departing from the invention, certain modifications of head shape are easily envisioned which would still achieve substantially uniform string lengths in each of the courses of string reaches forming the striking matrix. Among such modifications of head shape would be any polygon with opposite sides equal and parallel, e.g. a parallelogram, a hexagon, etc. or even a head with one or more pairs of curved parallel sides.

It should be appreciated that although the invention has been illustratively described as a tennis racket, the advantages of the invention are well adapted for use in other sports wherein a racket is employed to propel a projectile.

Thus it will be seen that there is provided a racket which achieves the various objects of the invention and which is well suited to meet the conditions of practical use.

As various changes might be made in the tennis racket as above set forth, it is to be understood that all matters herein described or shown in the accompanying drawings is to be interpreted as illustrative and not in the limiting sense.

Having thus described the invention, there is claimed as new and desired to be secured by letters patent:

1. A racket suitable for use in propelling a game projectile by striking the projectile, said racket comprising a frame including a head and a manipulating stem, string means forming a projectile striking matrix in the head, the head including means providing substantially uniform response characteristics over the striking matrix, said uniform response means including a first pair of substantially straight parallel sides and a second pair of substantially straight parallel sides in said head, each of the sides of the second pair of sides being substantially equal in length to the sides of the first pair, a first series of string reaches spanning between the first pair of sides, and a second series of string reaches spanning between the second pair of sides, all of the string reaches in the first series being of equal length and parallel to one another, all of the string reaches in the second series being of equal length and parallel to one another, and the stem having handle means for facilitating the movement of the racket to various positions and for impelling the striking matrix against the projectile to propel the projectile during game play, the axis of the stem being coincident with a diagonal of the head, whereby effective striking response characteristics will be substantially constant regardless of the point of contact on the striking matrix.

2. A racket constructed in accordance with claim 1 wherein the frame is of one piece metal construction, the racket further including at least one casing, the casing peripherally overlapping the frame at the head and including brace means for frame reinforcement, and means securing the casing to the frame, whereby the racket is capable of withstanding the stress fatigues of competitive playing.

3. A racket constructed in accordance with claim 2 wherein the sides of the first and second pairs intersect one another at mutual terminal ends, and the casing includes a gusset web registered with the intersecting ends.

4. A racket constructed in accordance with claim 2 wherein the head and the stem are joined at a juncture

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and the casing includes a depending gusset throat web formed in registry with the juncture.

5. A racket constructed in accordance with claim 1 wherein the frame further comprises two segments, each of the segments being formed of one piece construction, the two segments being in registry and joined at the medial thickness plane of the composite racket.

6. A racket constructed in accordance with claim 1 wherein the first pair of sides are perpendicularly oriented with respect to the second pair of sides.

7. A racket constructed in accordance with claim 1 wherein the frame comprises a metal channel of generally U-shaped transverse cross-sectional configuration with open channel surfaces facing each other in the head.

8. A racket suitable for use in propelling a game projectile, said racket comprising a frame including a head and a manipulating stem, string means lying within a string plane and forming a projectile striking matrix in the head, the head including means providing substantially uniform response characteristics over the striking matrix, said uniform response means including a first pair of parallel sides and a second pair of parallel sides in said head, each of the sides of the second pair being

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substantially equal in length to the sides of the first pair, a first series of string reaches spanning between the first pair of sides, and a second series of string reaches spanning between the second pair of sides, all of the string reaches in the first series being of equal length and parallel to one another, all of the string reaches in the second series being of equal length and parallel to one another, and the stem having handle means for facilitating the movement of the racket to various positions and for impelling the striking matrix against the projectile to propel the projectile during game play, the racket further including a casing, the casing peripherally overlapping the frame at the head and including brace means for frame reinforcement, the brace means comprising a gusset web overlapping the striking matrix adjacent each intersection of the sides of the first and second pairs, all of said gusset webs being spaced from the string plane to permit unobstructed string movement and to maintain equal effective lengths of the string reaches of each series, whereby effective striking response characteristics will be substantially constant regardless of the point of contact on the striking matrix.

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