

Nov. 7, 1972

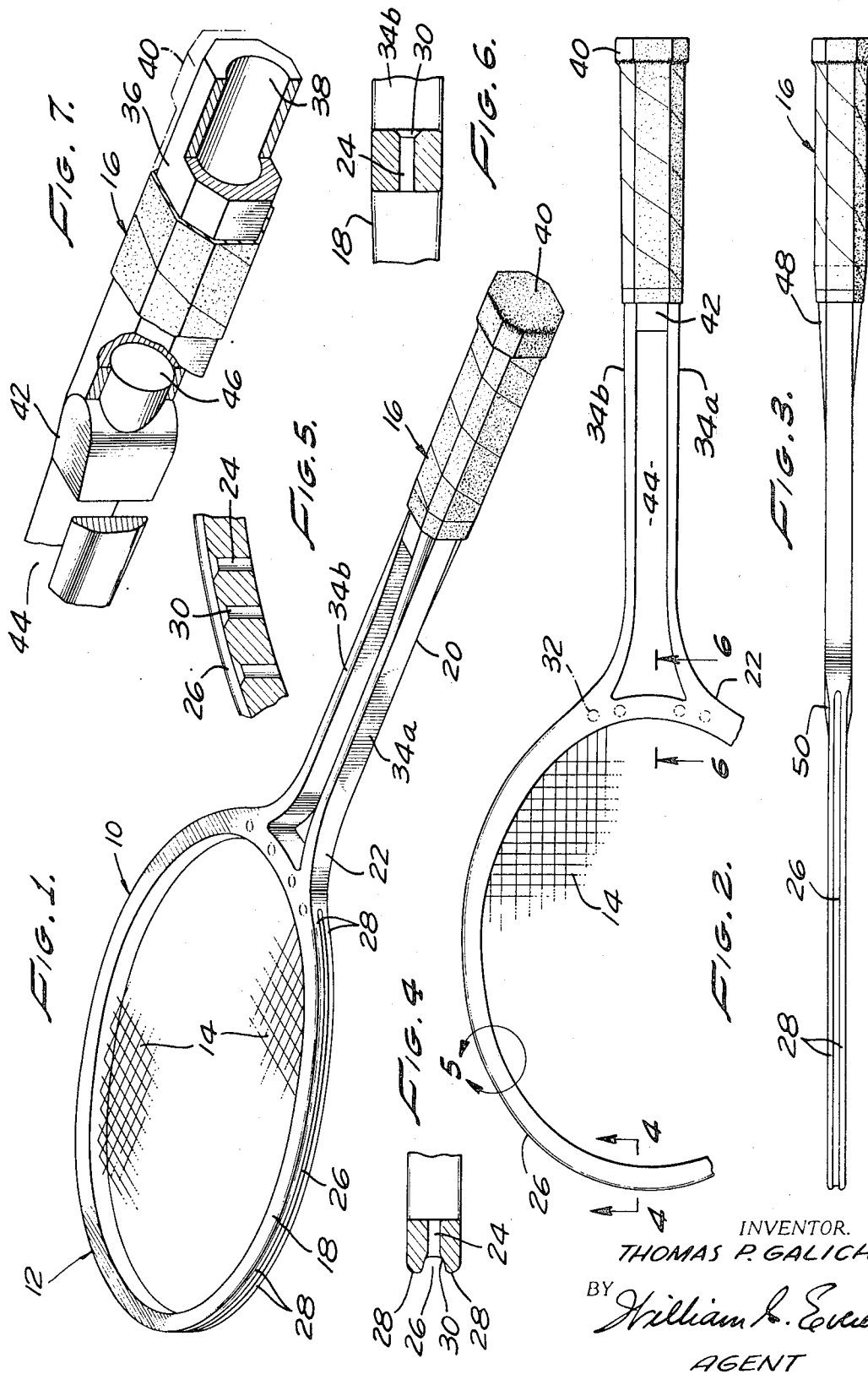
T. P. GALICH

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TENNIS RACKET

Filed March 4, 1971

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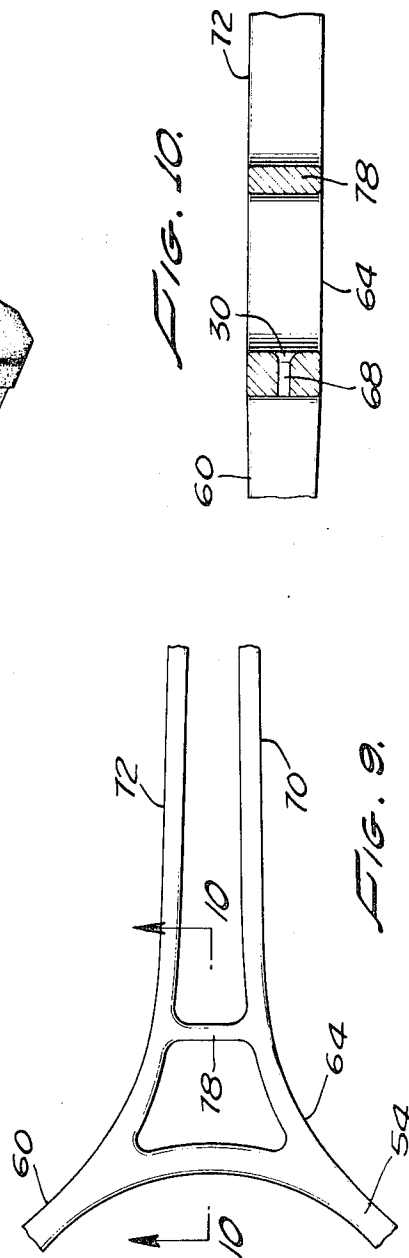
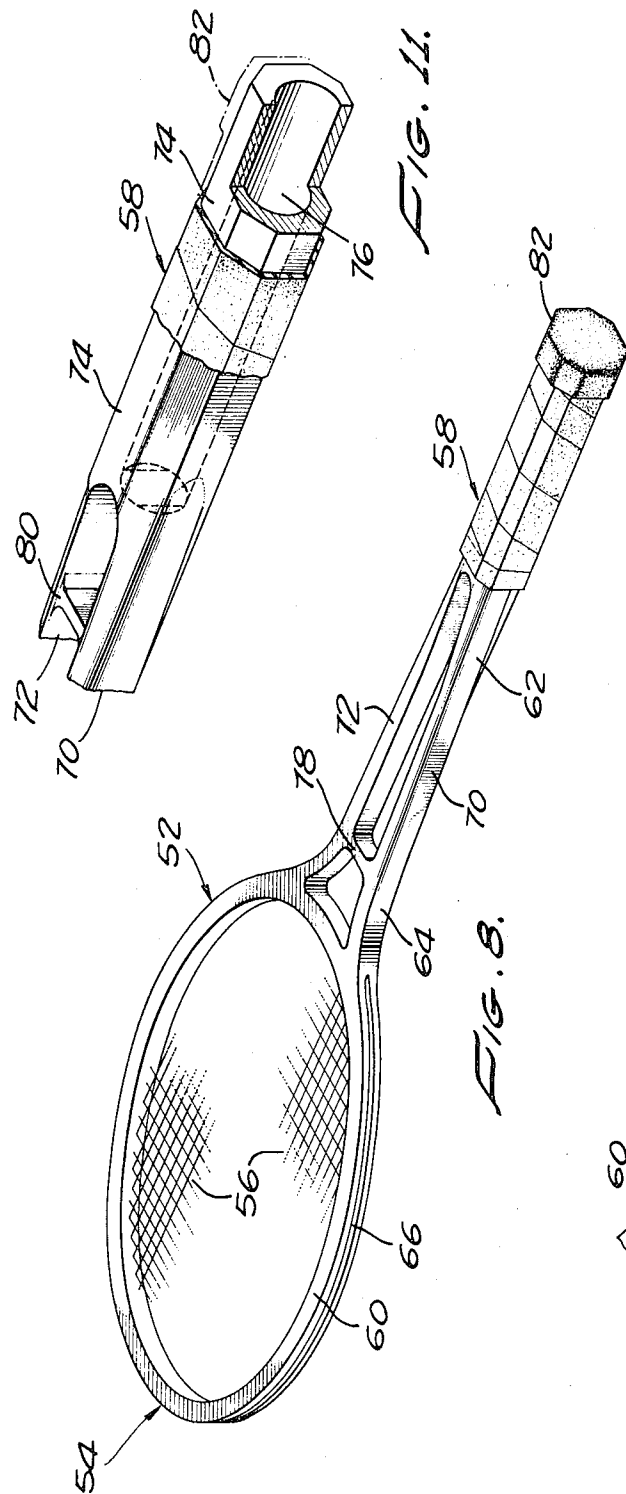
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4 Sheets-Sheet 2



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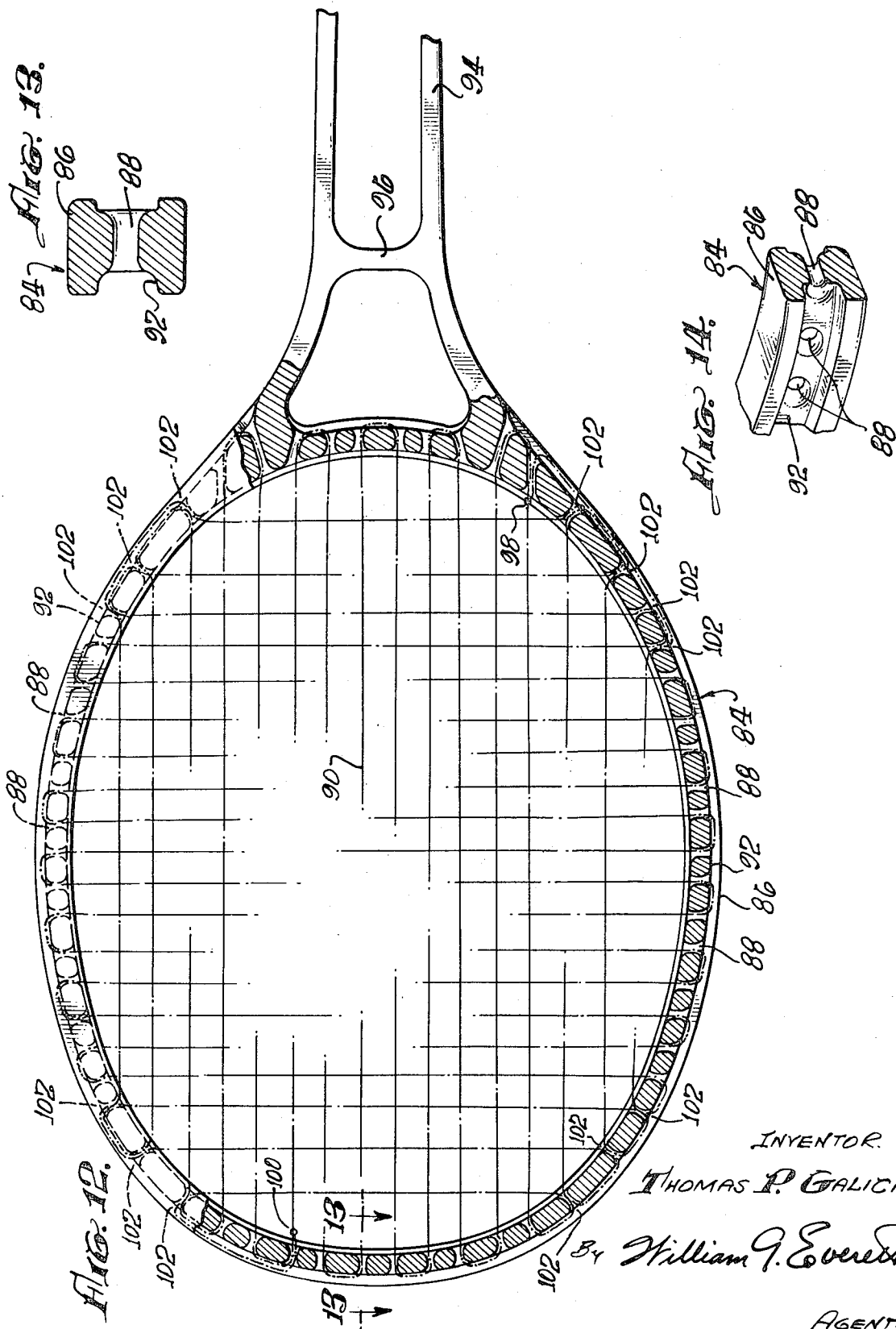
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4 Sheets-Sheet 3



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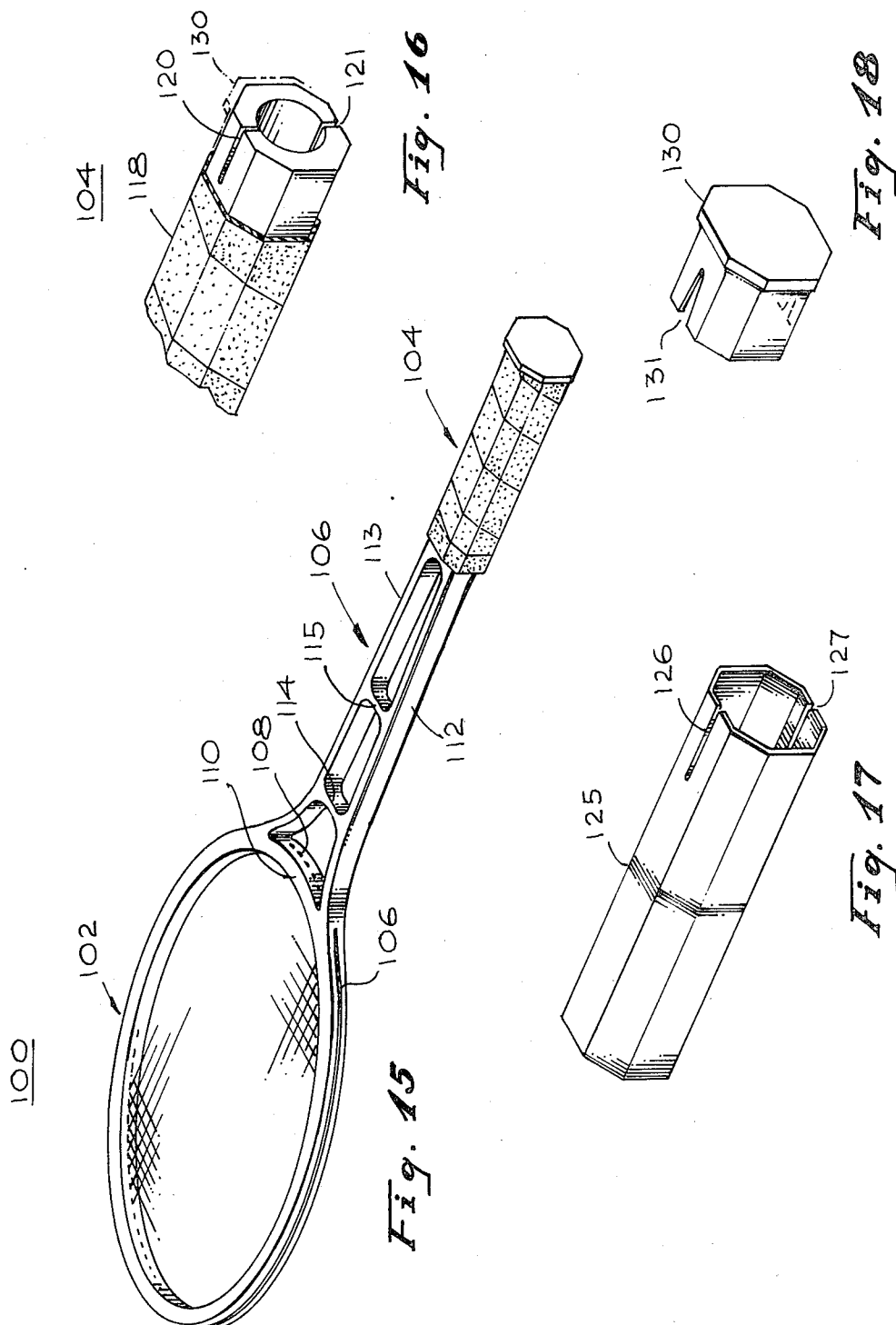
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3,702,189

TENNIS RACKET

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Continuation-in-part of application Ser. No. 863,868, Oct. 6, 1969, which is a continuation-in-part of application Ser. No. 770,467, Oct. 7, 1968, which in turn is a continuation-in-part of application Ser. No. 680,683, Nov. 6, 1967, now abandoned. This application Mar. 4, 1971, Ser. No. 121,016

Int. Cl. A63b 49/08, 49/12

U.S. Cl. 273—73 J

5 Claims

ABSTRACT OF THE DISCLOSURE

The invention in certain embodiments provides a one piece tennis racket cast in a permanent mold from nonferrous materials including magnesium alloys. The frame of the racket in one embodiment includes a head portion having radially disposed holes cast in planar alignment with each other and communicating with an annular groove into which the stringing or netting is nested and protected from damage. In another embodiment, the head portion includes a plurality of openings disposed in parallel alignment and arranged in a predetermined cross-sectional configuration so as to provide continuous contact for the stringing or netting. The frame also includes a handle portion with the center or shaft region being formed into twin or bifurcated arms which diverge in a neck portion adjacent to the head portion. In still another embodiment the unit is forged from a nonferrous metal, preferably aluminum or an aluminum alloy, with bridging reinforcing elements for added strength and protection against acoustic fatigue.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates generally to tennis rackets and the like and more particularly to rackets of this type having a one piece frame cast from nonferrous materials.

This patent application is a continuation-in-part of my copending application for United States Letters Patent Ser. No. 863,868, filed Oct. 6, 1969, entitled Tennis Racket, now abandoned, which was a continuation-in-part of my application Ser. No. 770,467, filed Oct. 7, 1968, now abandoned, which was a continuation-in-part of my application Ser. No. 680,683, filed Nov. 6, 1967, now abandoned.

(2) Description of the prior art

Tennis rackets and the like, being commonplace, are widely known. Perhaps only the more expensive professional models are not readily available at the local sporting goods store. But, until recently, both these along with the more common variety were constructed with a wood frame, usually laminated and contoured in various ways to achieve sufficient strength at light weights. The problem to be solved with the wooden frame racket concerned not only the wind resistance stemming from the relatively bulky handle but also how to make the racket strong enough to prevent fracture or cracking from the more severe impacts, whether generated by proper or faulty contact, presumably during a game.

More recent developments utilize light weight tubular steel and seemingly provide the necessary added strength and at the same time the desired lower resistance to wind and motion. But the tubular steel racket requires, in addition to welded joints, a non-conventional method for stringing that requires special gear to do the job. More-

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over, string breakage has become a new problem with tubular steel rackets which tend to have relatively sharp edges which cut into the stringing causing the failure.

SUMMARY OF THE INVENTION

These disadvantages of the wooden and tubular steel rackets are alleviated in the one piece nonferrous metal rackets of the present invention. By casting a frame from a magnesium alloy, such as type AZ91C, as disclosed below, a racket of great strength, desired weight, having intimate and continuous contact with the stringing to eliminate breakage, and sufficiently rigid and of remarkably low resistance to motion emerges. I have found that the racket of my invention can be subjected to severe impacts without fracture and that more of the shock of such impact is absorbed and less is transmitted up the arm to the user's elbow. This shock absorbing capacity of the present invention is of much importance to the professional player.

Even cast metal rackets of the prior art, such as cast aluminum units for example, have not been able to present the desired combination of light weight and strength. It is virtually impossible to cast a device such as a tennis racket from aluminum without the necessity of forming the structural members with sufficient thickness that the result is impractical or undesirable for use as a tennis racket. The increased thickness of structural members adds sufficient weight and presents such wind resistance when the device is in use that it is not satisfactory as a tennis racket.

According to one arrangement of the invention, there is provided a racket for playing tennis and the like comprising, in combination, cast frame means of magnesium alloy having a head portion, a handle portion, and a neck portion coupling the head portion to the handle portion; netting means mounted on the head portion; and hand grip means mounted on the handle portion at the outer end thereof for facilitating the user in grasping the racket to manipulate same to impart a force on the object to be struck when such object comes in contact with the netting means.

In another aspect of the invention, there is provided a tennis racket cast from nonferrous materials in a permanent mold, the frame of the racket including openings sand cast therein and having a cross-sectional configuration adapted to provide continuous contact for the netting operatively disposed on the racket.

In still another particular embodiment of the invention, a tennis racket or like device is forged from a nonferrous material, preferably aluminum or an aluminum alloy, in a one-piece unit having thin, streamlined, generally parallel shaft portions extending between the handle and the head of the racket with selectively positioned bridge portions of similar streamlined configuration extending between the shaft portions and integrally forged therewith to provide increased strength in the shaft portion and to eliminate or minimize harmonic vibrations therein while reducing resistance to wind motion. A particular advantage of such a structural configuration, apart from the reduced frontal area, improved esthetic appearance and lighter weight, is the increased strength of the device. Besides being stronger than previously known configurations of corresponding devices, my invention is not subject to failure from acoustic fatigue which is entirely eliminated by virtue of the present design.

Moreover, in accordance with particular aspects of the invention, the handle of the racket is fashioned in a manner which admits of particular facility in wrapping the hand grip. In addition, sizing of the handle is easily effected without the need to change the mold design or size by virtue of the addition of a spacing cylinder of selected

thickness over the handle in a manner to cooperate with the end-locking arrangement for the hand grip.

It is therefore the primary objective and purpose of the invention to provide an improved tennis racket or the like.

It is another object of the invention to provide a racket of the type described utilizing a one piece frame formed from nonferrous materials.

It is still another object of the invention to provide a tennis racket or the like of the type described having a sand-cast frame of magnesium alloy.

It is yet another object of the invention to provide a tennis racket or the like of the type described having a one piece, cast frame with a hollow handle and bifurcated shaft to minimize resistance due to wind and motion.

Another object of the invention is to provide a tennis racket or the like of the type described having radially directed openings in the head to receive the netting, said openings all lying in the same plane.

Yet another object of the invention is to provide a tennis racket or the like of the type described wherein planar openings communicate with a protective annular groove which encircles substantially all of the head of the racket and into which groove the strands of netting are individually stowed between the openings through which the particular strands weave in and out.

Still another object of the invention is to provide a tennis racket or the like of the type described wherein symmetrically disposed openings may be provided in the racket for weight reduction without impairing the strength or rigidity thereof.

Another object of the invention is to provide a tennis racket or the like of the type described having a one piece, cast frame of nonferrous material having a cored handle coextending from a bifurcated shaft, both portions of which are integrally connected to the other by a transversely disposed cross bar whereby resistance to wind motion is minimized and rigidity is maximized.

Yet another object of the invention is to provide a tennis racket of the type described having a one piece frame of nonferrous materials and a plurality of openings disposed in planar alignment in the frame, the plurality of contoured openings having a cross-sectional configuration adapted to provide continuous supporting for the netting where same makes contact with the frame.

It is another object of the invention to provide a tennis racket or the like of the type described that is strong and compact, of a desired weight, is virtually unbreakable, and of reduced frontal area to minimize adverse effects due to wind and motion.

BRIEF DESCRIPTION OF THE DRAWING

Other objects, features and advantages of the invention will appear and be brought out more fully in the following detailed description, reference being had to the accompanying drawing wherein:

FIG. 1 is a perspective view of an improved tennis racket or the like according to the invention.

FIG. 2 is a top plan view of the racket shown in FIG. 1.

FIG. 3 is a side elevational view of the racket shown in FIG. 1.

FIG. 4 is an enlarged cross-sectional view of the head portion of the racket shown in FIG. 1 taken along a line 4—4 of FIG. 2.

FIG. 5 is an enlarged partial view of the head portion encircled by an arrow identified in FIG. 2 by a reference numeral 5, the top half in the partial view being removed to facilitate the description thereof.

FIG. 6 is an enlarged cross-sectional view of the neck portion of the racket shown in FIG. 1 taken along a line 6—6 in FIG. 2.

FIG. 7 is an enlarged perspective view of the handle portion of the racket shown in FIG. 1 with fragments removed to reveal structural details for descriptive purposes.

FIG. 8 is a perspective view of a second embodiment of the invention.

FIG. 9 is an enlarged top plan view of the preferred tennis racket of FIG. 8 showing the neck portion thereof.

FIG. 10 is a further enlarged partial cross-sectional view of the neck portion of FIG. 9 taken along a line 10—10.

FIG. 11 is an enlarged perspective view of another embodiment of the handle portion of the tennis rackets shown in FIGS. 1 and 8, part of the handle portion being removed for facilitating a description thereof.

FIG. 12 is an enlarged plan view of yet another embodiment having portions of the frame removed to expose in cross-sectional configuration the plurality of openings disposed in planar alignment in the frame for operatively receiving the netting in continuous contact relationship.

FIG. 13 is an enlarged cross-sectional view taken along the line 13—13 in FIG. 12.

FIG. 14 is an enlarged perspective view of a portion of the frame shown in FIG. 12.

FIG. 15 is a perspective view of still another embodiment of the invention.

FIG. 16 is a view of the handle portion of the arrangement of FIG. 15, with a part of the hand grip broken away.

FIG. 17 is a perspective view of a particular element used as part of the handle portion of various arrangements in accordance with the invention.

FIG. 18 is a perspective view of an end cap element which may be employed in arrangements in accordance with the invention.

Referring to the drawing, shown there in perspective at FIG. 1 is a tennis racket 10 according to the invention formed from nonferrous materials. It should be mentioned at the outset that the invention is not necessarily restricted to rackets as now used in the playing of tennis, the choice here being only for descriptive purposes.

In FIG. 1, the racket 10 comprises a single piece frame 12 of cast magnesium alloy, a netting 14 strung on the frame 12 in the manner to be described, and a hand grip 16 by which the user may grasp the racket for its intended and other purposes.

The frame 12 further includes an open oval region or head portion 18 and a shaft or handle portion 20 which coextends from the head portion 18 at a yoke or neck portion 22.

As best seen in FIGS. 1 and 2, the frame 12 extends in ring-like fashion around the open oval region to form the head portion 18. FIG. 4 shows a cross-sectional element of the head portion 18 of the preferred embodiment to be substantially rectilinear. If desired, a curvilinear cross-sectional configuration, not shown, may be used to form the head portion 18.

For mounting the netting 14, which may be of catgut or any other suitable material including synthetic materials such as nylon, a plurality of openings 24 is cast in the head portion 18. The openings 24 preferably are radially disposed toward the center of and in the plane of the netting 14. In another embodiment described and claimed below, a different arrangement of openings is provided.

An elongated annular groove 26 is provided in the outer surface 28 of the head portion 18 and communicates with the outer end of each of the openings 24 except in the region of the yoke 22. The groove 26 serves both as a means for weight and balance control as well as protective means to shield the strands of netting 14 which weave in and out of the openings 24. To further prevent damage to the netting 14 at the points where the strands enter or emerge from the openings 24, either or both ends of the openings 24 may be countersunk or rounded as shown by a reference numeral 30 in FIGS. 4, 5 and 6. In the area where the strands of netting 14 enter the openings 24 at an angle other than substantially in axial alignment with the respective opening 24, removal of

sharp edges as by rounding as indicated by the reference numeral 30 is provided.

Where additional reduction in weight is desired, one or more symmetrically arranged openings may be provided in the head portion 18 in the region of the yoke 22 as illustrated by the openings 32 shown in dashed delineation in FIG. 2. It should be pointed out that the openings 32 may be sized and positioned accordingly as weight reduction and balance control dictate, preferably at the mid-point between adjacent openings 24, reference FIGS. 2 and 6.

The handle portion 20 is considered for the moment as separate and apart from the head portion solely for facilitating a thorough description of the invention. The handle portion 20 comprises spaced apart parallel arms 34a and 34b which merge at one end to form a slightly enlarged and faintly discernible eight-sided coextending member 36 through which an opening 38 is axially disposed, reference FIG. 7.

As shown in FIGS. 1, 2, 3 and 7, a cap 40 is provided on the outer end of the member 36. The cap 40 is secured to the member 36 by the hand grip 16 which may be made from leather in a tape form and spiral wrapped from the cap 40 towards the spaced apart arms 34a and 34b. If desired, other commercially available hand grips may be used.

A plug 42 is provided and disposed in the space depicted by a reference numeral 44 to seal off the opening 38 which, as stated above, extends axially through the member 36 to the space 44. If desired, the plug 42 may include a cylindrical protrusion 46 suitably sized to be received in the opening 38 as shown in FIG. 7.

The hand grip 16 preferably extends partially over the plug 42 as shown in FIGS. 1 and 2 and terminates at a predetermined distance along the handle portion 20, preferably along the taper depicted by a reference numeral 48 in FIG. 3 to further retain the plug 42 in position. If desired, identifying markings as to source, etc. may be provided on the plug 42.

The frame 12 as stated supra, is a one piece magnesium alloy sand casting. The mold, not shown, is suitably detailed as shown in FIGS. 2 and 3 to include tapers 48 and 50 and cored to provide for the opening 38, the space 44 intermediate the arms 34a and 34b and the head portion 18, and the groove 26. The openings 24 and, where used, the openings 32 are preferably drilled in the head portion 18 prior to machine polishing of the frame 12. Removal of sharp edges as depicted by the reference numeral 30 may precede the machine polishing stage.

The preferred magnesium alloy for sand casting the frame 12 is known commercially as AZ91C. Other alloys, such as AZ63A or AZ92A may be used, their properties as to strength and ductility being somewhat less favorable than that of AZ91C. For more detailed information on the characteristics of these magnesium alloys, reference is made to Federal Specification QQ-M-56b, dated Oct. 24, 1960.

The frame 12, when cast with magnesium alloy AZ91C, is tempered to what is a T6 condition by a solution heat treatment process followed by an aging heat treatment. The complete schedule for solution heat treatment and artificial aging is set forth at p. 2 et seq of Bulletin No. DM35b entitled Heat Treating of Magnesium Sand and Permanent Mold Castings, published by The Dow Chemical Company of Midland, Mich.

It is to be noted that the arms 34a and 34b are geometrically deep, as seen in FIG. 3, relative to their thickness as seen in FIG. 2. I have found that this arrangement provides more than adequate strength and rigidity in the direction orthogonal to the netting 14 while at the same time, as a result of the spaced apart arms 34a and 34b, the actual and/or relative wind resistance is drastically reduced.

Referring now to FIG. 8, shown there in perspective is

a second embodiment of a tennis racket 52 according to the invention comprising a single piece frame 54 of cast magnesium alloy, a netting 56 strung on the frame 54 and a hand grip 58.

The frame 54 further includes an open oval region or head portion 60 and a shaft or handle portion 62 which coextends from the head portion 60 at a yoke or neck portion 64. The frame 54 extends in ring-like fashion around an open oval region to form the head portion 60 in the manner as described above with respect to head portion 18. The cross-sectional configuration of the head portion 60 may be rectilinear, such as is shown in FIGS. 4 and 6 to describe the head portion 18; a curvilinear configuration may also be used if desired.

An elongated annular groove 66 having cast openings 68, reference FIG. 10, similar to the openings 24 shown in FIGS. 4, 5 and 6, is provided on the head portion 60 to receive the netting 56 as described above in conjunction with FIG. 1. Removal of rough or sharp edges, common when casting the frame, may be achieved if desired by conventional machining operations as depicted by the reference numeral 30, reference FIGS. 4, 5, 6 and 10.

The handle portion 62 comprises spaced apart arms 70 and 72 which merge at one end to form a slightly enlarged and faintly discernible eight-sided coextending grip member 74 through which an opening or core 76 is axially disposed, reference FIG. 11.

As best seen in FIGS. 8 and 9, a rib member 78 is provided and integrally coupled to the arms 70 and 72 at a substantially perpendicular direction thereto. To provide added lateral rigidity, the arms 70 and 72 may diverge outwardly from each other from the junction of the rib member 78 and towards the head portion 60. In the preferred embodiment, this divergence increases gradually at a predetermined rate so that the arms 70 and 72 appear, in the neck portion 64, to be an integral part of the head portion 60.

If desired, a second rib member 80, reference FIG. 11, may be provided on the handle portion 62 of the racket 52 or on the handle portion 20 of the racket 10 of FIGS. 8 and 1 respectively. The rib member 80 may be similar in all respects as to form and construction as the rib member 78 described above. Further, the rib member 80 may be positioned, as preferred, near the inner end of the opening 76. The hand grip 58, when completely installed may extend up the grip member 74 to a point substantially near or just below the second rib member 80, according to the over-all appearance to be achieved. A cap 82 may also be provided to complete the hand grip 58.

Referring now to FIG. 12, shown there in a partial enlarged plan view is a third embodiment of a tennis racket 84 according to the invention. The racket 84 comprises a one-piece frame 86 having a plurality of openings 88 disposed in planar alignment for receiving a grid network of strings 90 in tensioned relationship. The strings 90 may be similar in all respects to the nettings 14 and 56 of FIGS. 1 and 2 and of FIG. 8 respectively.

It should be pointed out that the openings 88 may be provided in the frame 86 at the time the racket 84 is cast. For example, a permanent type mold, not shown, may be used to cast the frame 86; in that event, such a mold may be provided with sand cores arranged in a predetermined configuration so as to produce the plurality of openings 88. In addition, the sand cores which produce the openings 88 may in turn be fixed relative to each other and appear essentially as a network of varied shaped spokes interconnected between an inner and outer flat ring, the latter of which may serve to form a groove 92 which communicates with all of the openings 88 except those in the region nearest the handle and neck portions, 94 and 96 respectively.

The grid network of strings 90 may be formed from a single length of catgut or any other suitable material,

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which to be more specific, may start at a reference numeral 98 and terminate at another reference numeral 100. Stated differently, when starting from the reference numeral 98, it will be seen in FIG. 12 that the frame 86 is first strung in the longitudinal direction and then in a transverse direction to form the grid network of strings 90 with the terminating tie point being the reference numeral 100. With such an arrangement only the openings 88 which are further identified by a reference numeral 102 would receive two instead of one of the strings forming the grid network 90. Other points of origin and termination may be used if desired.

It should be pointed out that the openings 88 vary widely as best seen in FIG. 12. The precise configuration of each of the openings 88 is dependent upon the size of the grid network of strings 90 as well as upon the sizes of the material used to form the grid. In any case, each of the openings 88 is contoured accordingly to eliminate any sharp or sudden changes in curvature in the region between each opening 88 and the groove 92 and thereby provide an intimate or constant contact support for the strings 90.

The frame 86 further includes the handle portion 94 and the neck portion 96, each of which is respectively similar to the handle portion 62 and the neck portion 64 as described in conjunction with FIG. 8. The groove 92 communicating with most of the openings 88 is also shown in FIGS. 13 and 14. If desired, a similar groove may be provided along the inner edge of the frame 86 opposite the groove 92. The groove 92, as do the grooves 26 and 66 of FIGS. 1 and 8 respectively, serves to protect the strings 90 from fracture or damage as well as to provide an additional means for weight and balance control. The handle portion 94 may comprise the handle portion 62 and a hand grip strings 90 from fracture or damage as well as to provide an additional means for weight and balance control. The handle portion 94 may comprise the handle portion 62 and a hand grip 58 as described in conjunction with FIG. 8.

In the embodiment of the invention shown in FIG. 15 a particular structural configuration is depicted which is designed to take advantage of the manner of application of the racket. The structural configuration of FIG. 15 is forged in a single piece from a metal comprising aluminum or aluminum alloy. A preferred material is an aluminum alloy designated as 6061-T6 aluminum which provides a particularly desirable combination of tensile strength and ductility. This material also possesses the desirable properties which avoid stress corrosion and hydrogen embrittlement that may be encountered in other materials.

As shown in FIG. 15, the racket 100 comprises a head portion 102, a handle grip or butt portion 104 and a shaft portion 106. The head portion of the racket is provided with radially directed openings arranged in planar alignment in the manner as described. About the main portion of the racket, these openings communicate at their outer ends with an annular groove which extends around the head portion from one side of the handle shaft portion to the other. This arrangement, together with the openings 108 along the base 110 of the head portion 102, serves to permit the stringing of the racket in a conventional manner, as already described in detail in connection with the arrangement of FIG. 12.

Forging of the racket of FIG. 15 permits the provision of a thinner face with respect to all of the structural members of the racket, thus affording less wind resistance when the racket is in use. This also permits a lighter racket, since the desired strength is achieved with the use of less metal.

The shaft portion 106 is shown comprising a pair of substantially parallel arms 112, 113 which are spaced apart with openings between them to permit air passage during use of the racket. Increased structural strength and rigidity is afforded in the racket shown in 15 by a

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pair of bridging structural elements 114 and 115 spaced approximately as shown in the figure. The bridging elements 114, 115 are forged integrally with the remainder of the racket 100 and maintain the two arm portions 112, 113 in rigidly affixed juxtaposition. If desired, additional such bridging elements may be provided, preferably substantially equally spaced apart along the extent of the parallel arms between the hand grip portion 104 and the head portion 102. With the rigidity afforded by the structure comprising the arms 112, 113 and the bridging elements such as 114, 115, the racket may be fabricated with substantially thinner frontal area, thus reducing wind resistance. Such a reduction in the thickness of the various elements just mentioned, however, would not be possible with any effectiveness if the racket of FIG. 15 were formed by any other means than by forging as a one-piece integral unit. The provision of the bridging elements 114, 115 (in particular the addition of the element 115 approximately midway between the hand grip portion 104 and the bridging element 114) advantageously serves to eliminate or effectively dampen the harmonic vibrations which tend to occur in structures of this nature during use, thus effectively eliminating the problem of acoustic fatigue as a cause of failure of the unit. As a result, rackets corresponding to a particular embodiment of FIG. 15 are exceedingly strong and rugged, while being light weight and easy to handle because of the reduced wind resistance, as compared with other rackets of the prior art. As a further advantage, the design affords a particularly esthetic appearance in keeping with modern design trends, being streamlined and slim in appearance and especially pleasing to the eye.

FIGS. 16, 17 and 18 depict specific features of a preferred hand grip construction which presents particular advantages for the fabrication and the maintenance of rackets in accordance with the invention. FIG. 16 is a section of the hand grip portion 104 with the covering strap 118 partially broken away to show the details of construction underneath. The hand grip portion of the racket is prepared in accordance with the arrangement shown in FIG. 11, but in addition a pair of slots 120, 121 are cut in two diametrically opposed faces of the butt of the racket. These slots serve the purpose of receiving the end of the strap which is used to wrap the hand grip portion 104, effectively retaining the end of the strap against its coming loose during use of the racket. Only one of the slots 120, 121 is actually used for engaging the end of the strap 118, two such slots being provided to facilitate the ease with which the strap may be inserted in one or the other.

FIG. 17 depicts a hexagonal tube element 125 which is provided in accordance with an aspect of the invention to facilitate the sizing of the racket handle for various hand grip sizes. The tube 125 is also provided with a pair of diametrically opposed slots 126 and 127 which should match the position of the slots 120, 121 in the butt end of the racket when the tube 125 is slipped over the hand grip portion 104 in proper position.

FIG. 18 shows an end cap 130 also having a pair of diametrically opposed slots such as 131 which are to be aligned with the slots 126, 127 and 120, 121 when the end cap is placed in position over the butt end of the racket 100.

In covering the butt end 104 of the racket 100 in order to provide a suitable hand grip for the user, the racket is first sized to fit into one of five different preselected sizes. Each of the five different sizes is developed without any need for changing the tooling required for the forming of the racket 100. For example, a 4 $\frac{3}{8}$ inch circumference is developed by first placing the butt of the racket 100 in an acid tank to remove approximately .030 inch of the thickness from the handle by acid etching. This can easily be done in large quantities by the use of a jig in which the various rackets are mounted. For a 4 $\frac{1}{2}$ inch circumference, the butt of the racket is wrapped with tape in the

manner illustrated in FIG. 16. For a 4% circumference, the tube 125 of FIG. 17 is slipped over the hand grip portion 104. A tub 125 having a wall thickness of .030 inch and fabricated of extruded plastic of a dimension such as to fit tightly over the hand grip portion 104 of the racket 100 would be utilized for the 4% inch size. For a 4¾ inch size, a cylinder tube 125 having a wall thickness of .060 inch is employed. The 4% inch circumference handle is achieved by using a tube 125 of .060 inch wall thickness and adding an extra wrapping of tape.

In the process of finishing the wrapping of the hand grip portion 104, the end of the strap 118 is slipped into one of the slots 120 or 121. It will also extend through the slot 126 or 127 if the tube 125 is employed. The end cap 130 of FIG. 18 is then slid over the butt of the hand grip portion 104 with its slot 131 engaging the end of the strap 118 which extends through the other slots in the butt of the racket and the tube 125 (if employed). The strap 118 is then wrapped in spiral fashion about the hand grip portion 104, beginning at the end cap 130 and extending from the very bottom portion thereof to the other end of the hand grip portion 104. In this manner, the free end of the strap 104 extending through the slot 120 or 121 is securely anchored and covered by its own wrap so that there is never any problem of it coming loose during use of the racket. The cylindrical portion of the end cap 130 is also wrapped securely in place by the strap 118. At the other end of the hand grip portion 104, the strap is secured by tape or by a string binding. Additionally, the strap may be covered with one or more layers of tape, also wound in spiral fashion, to retain the entire hand grip configuration in proper position.

Thus, there is shown and described a racket suitable for tennis and similar games wherein the entire device is fabricated as an integral unit. In one particular embodiment, the frame is cast from a nonferrous material such as magnesium alloy type AZ91C. In another embodiment, the device is fabricated by forging as an integral unit from aluminum or an aluminum alloy, preferably 6061-T6 aluminum. A particular structural configuration is provided for the frame in which the radically directed openings arranged in planar alignment communicating at the outer ends with an annular groove serve to facilitate the winding of the racket in the manner which is conventional with the well known wooden frame rackets while serving to maintain the racket strings recessed for protection during use. The particular structural arrangements disclosed herein are extremely light in weight, strong and durable by virtue of the reinforcements provided as described which provide a number of openings within the shaft portions and prevent structural fatigue from developing during use.

It should be emphasized with respect to the forged aluminum embodiment of the invention that the fabrication of the annular groove extending substantially around the head portion of the racket is particularly important. It has heretofore been customary in the fabrication of curved parts having recesses along the plane of the arcuate portion to form the part of two or more pieces which together develop the desired recessed configuration and to thereafter weld the pieces together. This is not desirable in the present invention because of the inherent weakness introduced in the frame structure by such a fabrication step, plus the added complexity of such a fabrication process over that presently employed. The major objective of developing the fabrication process for the present invention is to achieve as the end result a unitary, one piece racket frame complete with head, neck and handle portions which do not have any joint or junction anywhere to introduce stress concentration points or lines or to detract from the slender, streamlined appearance of the racket which both presents the most pleasing visual and esthetic effect as well as functionally improving the racket from the standpoint of weight, strength, and wind resistance. In accordance with

that objective, and in order to develop the groove about the head portion for providing protection for the net strings as they are woven about the head portion of the frame, I utilize a profiling step in the fabrication process which forms the groove after the frame is forged. This is accomplished automatically by a profiling machine indexed to perform the profiling step on a plurality of the frames at the same time. Further finishing, smoothing, polishing, and the like follow the forging and profiling steps.

Although there have been described above specific arrangements of a tennis racket in accordance with the invention for the purpose of illustrating the manner in which the invention may be used to advantage, it will be appreciated that the invention is not limited thereto. Accordingly, any and all modifications, variations or equivalent arrangements which may occur to those skilled in the art should be considered to be within the scope of the invention.

What is claimed is:

1. A racket for tennis or the like comprising:

a one piece frame formed of a lightweight nonferrous metal and having a head portion, a handle portion, and a neck portion coupling the head portion to the handle portion;

netting means mounted on said head portion;

the handle portion including a hand grip member at the outer end thereof of generally cylindrical shape with a hollow core extending inwardly from the outer end and generally aligned with the longitudinal axis of the hand grip member; and

hand grip means mounted on the hand grip member for enabling the user to grasp the racket and manipulate same in utilization; said handle portion also including a pair of spaced apart bifurcated arms co-extending between the hand grip member and the head portion and diverging slightly at the neck portion for integral coupling with the head portion, said bifurcated arms being symmetrically disposed relative to the longitudinal axis of the hand grip member; said racket further including a cap operatively disposed over the outer end of the handle portion for sealing off said core, and a plug adapted for operative mounting in the space between said bifurcated arms at the outer end of said arms, said plug including a cylindrical protrusion insertably and removably receivable in said core at the end opposite that covered by said cap, said hand grip means being operatively mounted on said cap at the sides thereof, over said hand grip member, and onto a predetermined portion of said plug.

2. A racket for tennis or the like comprising:

a one piece frame formed of a lightweight nonferrous metal and having a head portion, a handle portion, and a neck portion coupling the head portion to the handle portion;

netting means mounted on said head portion;

the handle portion including a hand grip member at the outer end thereof of generally cylindrical shape with a hollow core extending inwardly from the outer end and generally aligned with the longitudinal axis of the hand grip member; and

hand grip means mounted on the hand grip member for enabling the user to grasp the racket and manipulate same in utilization; said handle portion further including a pair of spaced apart bifurcated arms co-extending between the hand grip member and the head portion and diverging slightly at the neck portion for integral coupling with the head portion, said bifurcated arms being symmetrically disposed relative to the longitudinal axis of the hand grip member; said hand grip member being generally octagonal in cross-section about its outer surface, having a cylindrically shaped hollow core extending

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from the outer end thereof and being slotted in planar fashion through two opposite faces extending longitudinally inward from the outer end thereof; said racket further including an end cap also generally octagonal in cross-section and having a pair of planar slots extending through opposite faces thereof for matching the slots in the hand grip member when the end cap is slipped over the end of said member, the mating slots in said juxtaposition being adapted to receive one end of the hand grip means and locking said end therein when the hand grip means is wrapped about the hand grip member over the octagonal cross-section portion of the end cap.

3. A racket in accordance with claim 2 wherein the hand grip member further includes hand grip sizing means for adjustably adapting the circumference of the hand grip means in various predetermined selected sizes.

4. A racket in accordance with claim 3 wherein said sizing means comprises a generally octagonally shaped sleeve configured to fit over the hand grip member when slipped thereon for increasing the circumference of the hand grip member and sleeve combination by a preselected amount.

5. A racket in accordance with claim 4 wherein said sizing means includes a pair of co-planar slots extending

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longitudinally from one end thereof for matching the slots of the hand grip member and the end cap for receiving one end of the hand grip means therein.

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