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(71) Applicant: **Yonex Kabushiki Kaisha**
Joint-stock company of Japan
Tokyo 113-8543 (JP)

(72) Inventors:
- **Ogawa, Naoto**
  Nagaoka-shi, Niigata, 949-5123 (JP)
- **Saito, Shinji**
  Nagaoka-shi, Niigata, 949-5123 (JP)
- **Iwasawa, Tomoya**
  Tokyo, 113-8543 (JP)

(74) Representative: **Heine, Christian Klaus**
KNH Patentanwälte
Kahlhöfer Neumann Rößler Heine
Postfach 10 33 63
40024 Düsseldorf (DE)

(54) Racket

(57) A racket (1) including: a handle (20); an annular frame (11) having a plurality of through holes (13), and a groove section (111) provided on an outer peripheral face (11a) of the frame along a circumferential direction of the frame; a shaft (30) connecting the handle and the frame; and a string (12) that passes through the through hole to the outside of the frame, and that is folded back on the groove section, wherein when either one of a longitudinal direction (121) of the racket and a width direction (122) perpendicular to the longitudinal direction on a hitting surface of the racket is defined as a first direction, a depth of a position at which the string is folded back at a second position in the first direction is smaller or less than a depth of a position at which the string is folded back at a first position in the first direction, the first position being located on the outer peripheral face of the frame, the second position being located on the outer peripheral face of the frame and outside of the first position in the first direction.

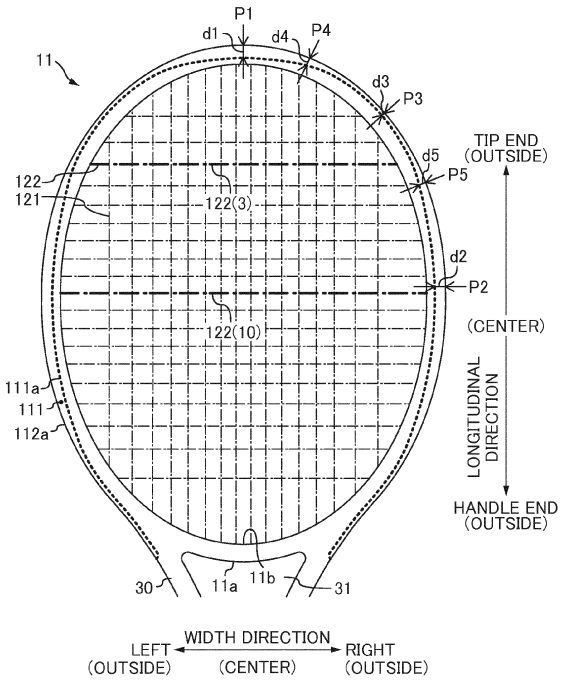

FIG. 3

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Description

Technical Field

[0001] The invention relates to a racket used in tennis and the like.

Background

[0002] As a racket used in tennis and the like, there are known ones including: a handle which a player grips; a frame inside which a string is strung; and a shaft connects the handle and the frame. Generally, on the outer peripheral face of the frame, a groove section is provided along the circumferential direction of the frame and in the middle in the thickness direction (a direction perpendicular to a hitting surface). In addition, along the circumferential direction of the frame, the frame has a plurality of through holes through which a string passes. The openings of the through holes are formed in the groove section. When stringing the string in the frame, the following processes are repeated: the string passes from the inside to the outside of the frame through a through hole; the string is folded back along the groove section of the frame; and the string passes through the next through hole. Then, in the frame, the portions of the string (longitudinal strings) along the longitudinal direction of the racket are strung at intervals in the width direction intersecting with the longitudinal direction. Also, the portions of the string (transverse strings) along the width direction are strung at intervals in the longitudinal direction so as to intersect the longitudinal strings. Thus, the net-like hitting surface is formed in the frame (for example, see Patent Literature 1).

Citation List

[Patent Literature]

[0003] [Patent Literature 1] Japanese Patent Application Laid-open Publication No. 6-269514

Summary of the Invention

Technical Problem

[0004] The sweet spot, which has a high rebound performance of a ball and vibrates less when hitting a ball, can be enlarged by increasing the lengths of longitudinal strings and transverse strings and by reducing the difference between the lengths of longitudinal strings arranged in the width direction and/or the difference between the lengths of transverse strings arranged in the longitudinal direction. However, if the frame has an annular shape such as an elliptical shape, the string is folded back along the outer peripheral face (the groove section) of the curved frame. Therefore, longitudinal strings and transverse strings passing the ends of the frame are shorter in length than longitudinal strings and transverse strings passing the center of the frame.

[0005] The invention has been made in view of the above issue, and an advantage thereof is to enlarge the sweet spot of a racket without changing the shape of the frame.

Solution to the Problem

[0006] An aspect of the invention to achieve the above advantage is a racket including: a handle; an annular frame having a plurality of through holes, and a groove section provided on an outer peripheral face of the frame along a circumferential direction of the frame; a shaft connecting the handle and the frame; and a string that passes through the through hole to the outside of the frame, and that is folded back on the groove section, wherein when either one of a longitudinal direction of the racket and a width direction perpendicular to the longitudinal direction on a hitting surface of the racket is defined as a first direction, a depth of a position at which the string is folded back at a second position in the first direction is smaller or less than a depth of a position at which the string is folded back at a first position in the first direction, the first position being located on the outer peripheral face of the frame, the second position being located on the outer peripheral face of the frame and outside of the first position in the first direction.

[0007] Other features of this invention will become apparent from the description in this specification and the attached drawings.

Effects of the Invention

[0008] With a racket according to the invention, it is possible to enlarge the sweet spot of a racket without changing the shape of the frame.

Brief Description of the Drawings

[0009]

FIG. 1 is a plan view and a side view of a tennis racket.

FIG. 2A is a cross-sectional view of a frame in the thickness direction, and FIG. 2B is a diagram showing how the string is strung in the frame.

FIG. 3 is a diagram of a groove section provided in the frame of the present embodiment.

FIG. 4 is a diagram of a groove section provided in the frame of a comparative example.

FIG. 5 is a diagram of the frame and the groove section of a modified example.

Mode for Carrying Out the Invention

Overview

[0010] From the description in the detailed description of the invention and the accompanied drawings, at least the following matters will be apparent.

[0011] A racket including:

a handle;
an annular frame having

a plurality of through holes, and
a groove section provided on an outer peripheral face of the frame along a circumferential direction of the frame;

a shaft connecting the handle and the frame; and
a string

that passes through the through hole to the outside of the frame, and
that is folded back on the groove section,

wherein

when either one of a longitudinal direction of the racket and a width direction perpendicular to the longitudinal direction on a hitting surface of the racket is defined as a first direction,

a depth of a position at which the string is folded back at a second position in the first direction is smaller or less than a depth of a position at which the string is folded back at a first position in the first direction,
the first position being located on the outer peripheral face of the frame,
the second position being located on the outer peripheral face of the frame and outside of the first position in the first direction.

[0012] With such a racket, it is possible that, without changing the shape of the annular frame, the length of the string on any outer end of the frame (the second position) in the first direction becomes more equal to the length of the string at the center of the frame (the first position) in the first direction. As a result, sweet spot can be enlarged.

[0013] In such a racket, the position at which the string is folded back on the outer peripheral face of the frame may become shallower in depth as it goes from a center of the frame to an end in the first direction.

[0014] With such a racket, it is possible to reduce the difference in length between strings arranged in a direction intersecting with the first direction. This makes it possible to reduce the differences caused by different hitting positions in the frame of the rebound performance of a ball and the feel, which results in enlarging the sweet spot.

[0015] In such a racket, the frame may have substantially an elliptical shape, and a position in an end in the longitudinal direction on the outer peripheral face of the frame at which the string is folded back at a center in the width direction may be deeper in depth than a position in an end in the width direction on the outer peripheral face of the frame at which the string is folded back at a center in the longitudinal direction.

[0016] With such a racket, the sweet spot can be further enlarged while preventing the strength deterioration of the frame. This also allows the racket to rebound a ball more and to vibrate less.

Racket 1

[0017] An embodiment of a tennis racket will be described below as an example of a racket according to the invention.

[0018] FIG. 1 is a plan view and a side view of a tennis racket (hereinafter referred to as a racket 1). The left one is the plan view and the right one is a side view. FIG. 2A is a cross-sectional view of a frame 11 in the thickness direction, and FIG. 2B is a diagram showing how a string 12 is strung in the frame 11. The racket 1 includes: a head 10 which hits a ball; a handle 20 which a player grips to hold the racket 1; and a shaft 30 connects the head 10 and the handle 20 in an integrated manner. For the purpose of illustration, of the longitudinal sides of the racket 1, the side of the head 10 is called as a tip-end side, and the side of the handle 20 is called as a handle-end side. On the hitting surface of the racket 1 (that is, on the plane along the hitting surface), a direction perpendicular to the longitudinal direction is called as a width direction. A direction perpendicular to the hitting surface of the racket 1 is called as a thickness direction.

[0019] The head 10 includes: the frame 11 with an elliptical shape extending in the longitudinal direction of the racket 1; and the string 12 strung inside the frame 11. The frame 11 is made by shaping into an elliptical shape, for example, a hollow rod which is made of fiber reinforced resin and the like. It should be noted that the frame 11 may not be hollow and the inside of the frame 11 may be filled with foamed material. As shown in FIG. 2A, in the outer peripheral face 11a of the frame 11, a groove section 111 is provided along the circumferential direction of the frame 11 and the groove section 111 has the middle in the thickness direction which is concave compared to the both side sections 112. In addition, the frame 11 has a plurality of string holes 13 (corresponding to through holes) along the circumferential direction of the frame 11; the string holes 13 extend through from the inner peripheral face 11b to the outer peripheral face 11a and are for inserting the string 12.

[0020] As shown in FIG. 2B, the opening of each string hole 13 is provided on the groove section 111. In order to protect the string 12 and to dampen vibrations caused

by hitting a ball, the string 12 is strung in the frame 11 through a grommet 40. The grommet 40 includes: A plurality of tube sections 41; and a strip-shaped base section 42 which connects the plurality of tube sections 41 to each other and has communicating holes 43 which communicate the hollow of each tube section 41. The tip end of each of the tube section 41 is placed into the string hole 13 from the side of the outer peripheral face 11a of the frame 11. Then, the base section 42 is embedded in the groove section 111 of the frame 11. In this way, the grommet 40 is placed in the outer peripheral face 11a of the frame 11. In the base section 42 of the grommet 40, a groove section 44 extending from one end of the base section 42 to the other end is provided in the middle of the thickness direction; the openings of the communicating holes 43 are provided in the groove section 44. The thickness of the base section 42 (the thickness from the surface on which the tube section 41 is placed to the bottom surface of the groove section 44) is uniform.

[0021] Thus, when stringing the string 12 in the frame 11, the string 12 passes from the inside of the frame 11 to the outside through one of the tube sections 41 (the string holes 13) of the grommet 40, and the string 12 is folded back on the groove section 44 of the grommet 40. In other words, through the groove section 44 of the base section 42 of the grommet 40, the string 12 is folded back on the groove section 111 of the frame 11. Thereafter, the string 12 is inserted into the next tube section 41 (string hole 13). This process is repeated. Thus, a plurality of "longitudinal strings 121", which are the portions of the string 12 extending in the longitudinal direction, are strung inside the frame 11 at intervals in the width direction. A plurality of "transverse strings 122", which are the portions of the string 12 extending in the width direction, are strung at intervals in the longitudinal direction so as to intersect the longitudinal strings 121. Thus, a net-like hitting surface is formed.

[0022] The shaft 30 branches into two sections toward the tip end in longitudinal direction as seen from the thickness direction, as shown in the left diagram of FIG. 1. So, an opening 31 extending in the thickness direction is formed by the branched portions and the handle end of the frame 11. However, this invention is not limited thereto. A racket may have an unbranched shaft 30.

Groove Section 111 of Frame 11

[0023] FIG. 3 is a diagram of the groove section 111 provided in the frame 11 of the present embodiment. FIG. 4 is a diagram of the groove section 111' provided in the frame 11' of a comparative example. In each of these diagrams, of the outer peripheral face 11a of the frame 11, a solid line indicates the shape (the outer peripheral edge) of the top surface 112a of both side sections in the thickness direction (see FIG. 2A) as seen from the thickness direction. Another solid line indicates the shape (the inner peripheral edge) of the inner peripheral face 11b of the frame 11 as seen from the thickness direction. A dotted line indicates the shape of the bottom surface 111a of the groove section as seen from the thickness direction.

[0024] The width of the frame 11 of the present embodiment (the thickness from the inner peripheral edge to the outer peripheral edge) is substantially uniform through the entire circumference of the frame 11. Of the outer peripheral face 11a of the frame 11, in other portions in the longitudinal direction except the handle end, that is, in other portions except the portions connecting to the shaft 30 and the portion facing the opening 31, the groove section 111 is provided continuously along the circumferential direction of the frame 11; the groove section 111 is a section on which the string 12 passing through the string holes 13 to the outside of the frame 11 is folded back. The depth of the groove section 111 differs in place. Note that the depth of the groove section 111 means the length from the bottom surface 111a of the groove section to the outer peripheral edge in the direction perpendicular to the bottom surface 111a. The groove section 111 is substantially symmetric about the line along the longitudinal direction passing the center of the frame 11 in the width direction, and is substantially symmetric about the line along the width direction passing the center of the frame 11 in the longitudinal direction.

[0025] The depth of the groove section 111 will be described concretely below. The portion of the groove section 111 of the frame 11 provided on the tip end (hereinafter referred to as "the top") in the longitudinal direction, in other words, the groove section 111 within a range in which longitudinal strings 121 are folded back, gradually becomes shallower in depth as it goes from the center to the outside (left or right) in the width direction. For example, in the top of the frame 11, the depth d1 of the groove section 111 at the center P1 in the width direction is deepest. The depth d4 of the groove section 111 at the point P4 outside (to the right of) the center P1 in the width direction is shallower than the depth d1 at the center P1. The depth d3 of the groove section 111 at the point P3 outside the point P4 in the width direction is further shallower than the depth d4 at the point P4 (d1 > d4 > d3).

[0026] Similarly, The portions of the groove section 111 of the frame 11 provided on the ends (hereinafter referred to as "sides") in the width direction, in other words, the portions of the groove section 111 within a range in which transverse strings 122 are folded back, gradually become shallower in depth as they go from the center to the outside (the tip end or the handle end) in the longitudinal direction. For example, in the right side of the frame 11, the depth d2 of the groove section 111 at the longitudinal center P2 is deepest. The depth d5 of the groove section 111 at the point P5 outside (to the tip end of) the center P2 in the longitudinal direction is shallower than the depth d2 at the center P2. The depth d3 of the groove section 111 at the point P3 longitudinally outside the point P5 is further shallower than the depth d5 at the point P5 (d2>d5>d3). It should be noted that, in the present embodiment, the depth d1 of the groove section 111 of the

top of the frame 11 at the center P1 in the width direction is equal to the depth d2 of the groove section 111 of the sides of the frame 11 at the longitudinal center P2.

[0027] On the other hand, in the frame 11' of the comparative example shown in FIG. 4, unlike the frame 11 of the present embodiment, the groove section 111' is uniform in depth. Specifically, in the top of the frame 11, the depth d1 of the groove section 111 at the center P1 in the width direction is equal to the depth d3 of the groove section 111 at the outer end P3 in the width direction. Also, in the right side of the frame 11, the depth d2 of the groove section 111 at the longitudinal center P2 is equal to the depth d3 of the groove section 111 at the longitudinal outer end P3 (d1=d2=d3). In the comparative example, the elements except for the depth of the groove section 111' of the frame 11', such as the range in which the groove section 111' is formed and the shape of the outer peripheral edge and the inner peripheral edge, are the same as those of the frame 11 of the present embodiment.

[0028] The sweet spot, which has a high rebound performance of a ball and vibrates less when hitting a ball, can be enlarged by increasing the lengths of the longitudinal strings 121 and the transverse strings 122 and by reducing the difference between the lengths of the longitudinal strings 121 arranged in the width direction and/or the difference between the lengths of the transverse strings 122 arranged in the longitudinal direction. As shown in FIG. 4, the length (La) of one longitudinal string 121 means the length in the longitudinal direction from the point on the handle-end side at which the longitudinal string 121 is folded back to the point on the tip-end side at which the longitudinal string 121 is folded back (to the bottom surface 111a of groove section; more precisely, to the bottom surface of the groove section 44 in the base section 42 of the grommet 40). Also, the length (Lb) of one transverse string 122 means the length in the width direction from the point on the left side at which the transverse string 122 is folded back to the point on the right side at which the transverse string 122 is folded back. Therefore, in a case where the outer peripheral edge has an elliptical (annular) shape as seen from the thickness direction as in the frame 11 of the present embodiment and the frame 11' of the comparative example, if the groove section 111 has constant depth as in the frame 11' of the comparative example, the string 12 is folded back along the bottom surface 111a' of the groove section, which is greatly curved in the same manner as the outer peripheral edge of the frame 11'. Thus, the longitudinal strings 121 passing both ends of the frame 11' in the width direction are shorter in length than the longitudinal strings 121 passing the center, and the transverse strings 122 passing both ends of the frame 11' in the longitudinal direction are shorter in length than the transverse strings 122 passing the center. Therefore, in the frame 11' of the comparative example, only the center serves as the sweet spot, whose area is not sufficiently large.

[0029] As opposed thereto, in the frame 11 of the present embodiment, on the outer peripheral face 11a of the top of the frame 11, compared to the portion of the groove section 111 at a certain position (e.g. P1) in the width direction, the portion of the groove section 111 is smaller or less in depth at a position (e.g. P3) outside of the certain position (e.g. P1) in the width direction. Therefore, in the present embodiment, the groove section 111 of the top of the frame 11 extending in the width direction has a lower degree of curving than the outer peripheral edge and the inner peripheral edge of the top of the elliptical frame 11. This groove section 111 also has a lower degree of curving than the groove section 111' of the top of the frame 11' of the comparative example extending in the width direction. That is, the bottom surface 111a of the groove section provided in the top of the frame 11 of the present embodiment is an arc-shaped surface the shape of which is closer to straight line.

[0030] The string 12 is folded back on the groove section 111 provided on the outer peripheral face 11a of the frame 11 through the base section 42 of the grommet 40, and the base section 42 of the grommet is uniform in thickness. Thus, on the outer peripheral face 11a of the top of the frame 11, compared to a certain position (e.g. P1, corresponding to the first position) in the width direction (corresponding to the first direction), the depth of the position where the string 12 is folded back is smaller or less at a position (e.g. P3) outside of the certain position (P1) in the width direction. Not that "the depth at the position where the string 12 is folded back" when stringing the string 12 through the grommet 40 means the distance from the bottom surface of the base section 42 of the grommet 40 to the outer peripheral edge in the direction perpendicular to the bottom surface.

[0031] Similarly, on the outer peripheral face 11a of the sides of the frame 11, compared to the portion of the groove section 111 at a certain position (e.g. P2) in the longitudinal direction, the portion of the groove section 111 is smaller or less in depth at a position (e.g. P3) outside of the certain position (e.g. P2) in the longitudinal direction. Therefore, in the present embodiment, the groove section 111 of the sides of the frame 11 extending in the longitudinal direction has a lower degree of curving than the outer peripheral edge and the inner peripheral edge of the sides of the elliptical frame 11. This groove section 111 also has a lower degree of curving than the groove section 111' of the sides of the frame 11' of the comparative example extending in the longitudinal direction. The bottom surface 111a of the groove section provided in the sides of the frame 11 of the present embodiment is an arc-shaped surface the shape of which is closer to straight line. That is, on the outer peripheral face 11a of the sides of the frame 11, compared to the depth of the position where the string 12 is folded back at a certain position (e.g. P2, corresponding to the first position) in the longitudinal direction (corresponding to the first direction), the depth of the position where the string 12 is folded back at a position (e.g. P3, corresponding to

the second position) outside of the certain position (e.g. P2) in the longitudinal direction is smaller or less.

[0032] Therefore, in the top of the frame 11 of the present embodiment, the portions of the bottom surface 111a of the groove section which are located on the outer ends in the width direction (the positions at which the longitudinal strings 121 are folded back) are located closer to the outer peripheral edge compared to the frame 11' of the comparative example. Similarly, in the sides of the frame 11 of the present embodiment, the portions of the bottom surface 111a of the groove section which are located on the longitudinal outer ends (the positions at which the transverse strings 122 are folded back) are located closer to the outer peripheral edge compared to the frame 11' of the comparative example. Therefore, in the frame 11 of the present embodiment, the longitudinal strings 121 passing the outer ends of the frame 11 in the width direction can be longer than in the frame 11' of the comparative example. Also, in the frame 11 of the present embodiment, compared to the frame 11' of the comparative example, it is possible to reduce the difference in length between the longitudinal strings 121 passing the outer ends of the frame 11 in the width direction and the longitudinal strings 121 passing the center. Also, the transverse strings 122 passing the outer ends of the frame 11 in the longitudinal direction can be longer. And, it is possible to reduce the difference in length between the transverse strings 122 passing the outer ends of the frame 11 in the longitudinal direction and the transverse strings 122 passing the center. Therefore, even when hitting a ball with a region far from the center of the frame 11, the difference is small from when hitting a ball with the central region. This improves the rebound performance of a ball and allows the racket to vibrate less when hitting a ball (achieves the same feel). That is, sweet spot can be enlarged.

[0033] As a concrete example, consider the following case: the depth of the groove section 111' of the frame 11' in the comparative example is 3mm (a constant); the depth of the groove section 111 of both sides of the frame 11 in the present embodiment at the longitudinal center (e.g. P2 in FIG. 3) is 6mm; the depth of the groove section 111 at the longitudinal outer end (e.g. P3 in FIG. 3) is 1mm; and the depth of the groove section 111 becomes gradually shallower from the center toward the outer end in the longitudinal direction. In the frame 11' of the comparative example of this case, when the length of the transverse string (the 10th transverse string 122(10) from the tip end) passing the center of the frame 11' in the longitudinal direction is defined as "100%", the length of the transverse string (the third transverse string 122(3) from the tip end) passing the tip-end portion of the frame 11' in the longitudinal direction becomes "85%". As opposed thereto, in the frame 11 of the present embodiment, when the length of the transverse string 122(10) passing the center of the frame 11 in the longitudinal direction is defined as "100%", the length of the transverse string 122(3) passing the tip-end portion of the frame 11 in the longitudinal direction becomes "89%". From this, it will be seen that, compared to the frame 11' of the comparative example, the frame 11 of the present embodiment makes it possible to reduce the difference between the lengths of the transverse strings 122 arranged in the longitudinal direction.

[0034] Further, with the racket 1 of the present embodiment, the sweet spot can be enlarged without changing the elliptical shape of the frame 11. The frame 11 of the present embodiment has an accurate elliptical shape. However, the invention is not limited thereto. For example, the frame 11 may be substantially elliptical, may have perfect circular shape, or may have a shape close to rectangle. However, compared to a frame whose shape is close to rectangle, a frame having an elliptical or perfect circular shape obtains more the effect caused by making the lengths of the longitudinal strings 121 close to each other or by making the lengths of the transverse strings 122 close to each other. Also, a frame having an elliptical or perfect circular shape can reduce air resistance caused when swinging the racket.

[0035] The difference between the lengths of the longitudinal strings 121 arranged in the width direction and/or the difference between the lengths of the transverse strings 122 arranged in the longitudinal direction are reduced across wide range as the depth of the groove section 111 of the top of the frame 11 at the center in the width direction is increased and/or as the depth of the groove section 111 of the sides of the frame 11 at the center in the longitudinal direction is increased. However, if the groove section 111 is considerably deep in depth, the thickness from the inner peripheral face 11b (inner peripheral edge) of the frame 11 to the bottom surface 111a of the groove section becomes small, which results in deterioration of the strength of the frame 11. Therefore, it is preferable that the depth of the groove section 111 is decided in the light of this fact.

[0036] In the racket 1 of the present embodiment, the groove section 111 is provided on the outer peripheral face 11a of the frame 11 and is not provided on the inner peripheral face 11b. The lengths of the longitudinal strings 121 and the transverse strings 122, which affects enlargement of the sweet spot, are a distance in the longitudinal direction or in the width direction from one-end side point of the folding back of the string 12 to other-end side point of the folding back of the string 12. So, even if the groove section is provided on the inner peripheral face 11b of the frame 11, the groove section does not contribute enlargement of the sweet spot. Further, providing the groove section 111 on the outer peripheral face 11a of the frame 11 makes a manufacturing process of the frame 11 easier than providing a groove section on the inner peripheral face 11b (for example, a mold for shaping the frame 11 into an ellipse is easy to be manufactured). Furthermore, compared to the case in which the groove section 111 is provided on the inner peripheral face 11b of the frame 11, providing the groove section 111 on the outer peripheral face 11a makes it possible

to reduce stress concentration when hitting a ball, and can increase the strength of the frame 11.

[0037] In the racket 1 of the present embodiment, in the top of the frame 11, the portions of the groove section 111 at the outer ends in the width direction are shallower than the portion of the groove section 111 at the center; the thickness and the strength from the inner peripheral edge to the bottom surface 111a of the groove section increase. Similarly, in the sides of the frame 11, the portions of the groove section 111 at the outer ends in the longitudinal direction are shallower than the portion of the groove section 111 at the center; the thickness and the strength from the inner peripheral edge to the bottom surface 111a of the groove section increase. Thus, when hitting a ball, the frame 11 is likely to be curved inwardly in the longitudinal direction and in the width direction (the side which the ball hits is defined as the inside). That is, the frame 11 is likely to deform so as to rap the ball. This makes it possible to increase the contact area between the ball and the hitting surface (string 12), which results in improvement of control and spin.

[0038] If the frame 11 has an elliptical (annular) shape, when the groove section 111' is uniform in depth as in the frame 11' of the comparative example, the longitudinal strings 121 become shorter as they pass through either outer portion of the frame 11 in the width direction, and the transverse strings 122 become shorter as they pass through either outer portion of the frame 11 in the longitudinal direction. Thus, in the racket 1 of the present embodiment, the portions of the groove section 111 which are located on the outer peripheral face 11a of the frame 11, that is, the portions where the string 12 is folded back, are shallower in depth as they go outwards from the center in the longitudinal direction or the width direction of the frame 11. That is, in the top of the frame 11, the portion of the groove section 111 (the positions at which the string 12 is folded back) becomes shallower in depth as it goes outwards in the width direction. Also, in side of the frame 11, the portions of the groove section 111 (the positions at which the string 12 is folded back) become shallower in depth as they go outwards in the longitudinal direction. This makes it possible to reduce the difference between the lengths of longitudinal strings 121 arranged in the width direction and/or the difference between the lengths of transverse strings 122 arranged in the longitudinal direction while increasing the lengths of the longitudinal strings 121 and the transverse strings 122. This makes it possible to reduce the differences caused by different hitting positions in the frame 11 of the rebound performance of a ball or the feel, which results in enlarging the sweet spot.

[0039] Further, it is preferable that the groove section 111 varies gradually in depth without varying in steps in depth of the groove section 111, in other words, without steps in the bottom surface 111a of the groove section. This makes it possible to prevent stress when hitting a ball from concentrating into steps provided in the bottom surface 111a of the groove section and to increase the strength of the frame 11. This also makes it possible to prevent change of the feel produced only when a ball hits a corresponding portion within the frame 11 to the steps provided in the bottom surface 111a of the groove section.

Modified Example

[0040] In the abovementioned embodiment, the base section 42 of the grommet 40 is uniform in thickness. However, the invention is not limited thereto. For example, on the outer peripheral face 11a of the top of the frame 11, the portions of the base section 42 of the grommet 40 provided in the outside in the width direction may be thicker than the portions of the base section 42 of the grommet 40 provided in the center in the width direction. Similarly, on the outer peripheral face 11a of the sides of the frame 11, the portions of the base section 42 of the grommet 40 provided in the outside in the longitudinal direction may be thicker in thickness than the portions of the base section 42 of the grommet 40 provided in the center in the longitudinal direction.

[0041] Compared to the case in which only the depth of the groove section 111 of the frame 11 varies, this makes it possible to further reduce the difference between the lengths of longitudinal strings 121 arranged in the width direction and also to further reduce the difference between the lengths of transverse strings 122 arranged in the longitudinal direction. Further, a thick portion of the base section 42 of the grommet 40 is located far from the frame 11 which is highly rigid, so that elastic deformation of the grommet 40 easily to occur. Thus, when a ball impacts the hitting surface, if an force toward the inside of the frame 11 is produced at the positions where the string 12 is folded back, the force can be absorbed by the thick grommet 40 (the base section 42). Thus, though the portions of the string passing in the outer ends in the width direction or in the longitudinal of the frame 11 are slightly shorter than the portions of the string passing in the center, the thick grommet 40 (the base section 42) has a high vibration damping capacity. Therefore, even when a player hits a ball with a region far from the center of the frame 11, the player can experience the feel nearly as much as when hitting a ball with a region of the center. That is, the sweet spot can be enlarged.

[0042] It should be noted that, if the base section 42 of the grommet 40 varies in thickness, the groove section 111 of the frame 11 may be uniform in depth. In other words, adjusting the thickness of the base section 42 of the grommet 40 may achieve the followings: on the outer peripheral face 11a of the frame 11, compared to a certain position in the longitudinal direction, the depth of the position where the string 12 is folded back is shallower at a position outside of the certain position in the longitudinal direction; on the outer peripheral face 11a of the frame 11, compared to a certain position in the width direction, the depth of the position where the string 12 is folded

back is shallower at a position outside of the certain position in the width direction.

[0043] FIG. 5 is a diagram of the frame 11 and the groove section 111 of the modified example. The frame 1 of the racket 1 in the abovementioned embodiment has an elliptical shape. However, the invention is not limited thereto. For example, as shown in FIG. 5, the frame 1 may have substantially an elliptical shape in which the tip end and the handle end in the longitudinal direction have a lower degree of curving than those of an ellipse.

[0044] Further, in the racket 1 of the abovementioned embodiment, the depth (d1) of the point (P1 in FIG. 3) of the groove section 111 of the top of the frame 11 at the center in the width direction is equal to the depth (d2) of the point (P2 in FIG. 3) of the groove section 111 of the sides of the frame 11 at the center in the longitudinal direction. However, the invention is not limited thereto. The groove section 111 may vary in depth. As mentioned above, the difference between the lengths of longitudinal strings 121 arranged in the width direction and/or the difference between the lengths of transverse strings 122 arranged in the longitudinal direction can be reduced as the depth of the groove section 111 of the top of the frame 11 at the center in the width direction is increased and/or as the depth of the groove section 111 of the sides of the frame 11 at the center in the longitudinal direction is increased. This reduces the thickness of the frame 11 from the inner peripheral face 11a to the bottom surface 111a of the groove section, which results in deterioration of the strength of the frame 11. However, if the frame 11 is substantially in an elliptical shape (including a perfect elliptical shape), the frame 11 is strong and difficult to deform because the top of the frame 11 is smaller in size than the sides. Further, since longitudinal strings 121 are longer than transverse strings 122, reducing the difference between the lengths of longitudinal strings 121 arranged in the width direction is more effective than reducing the difference between the lengths of transverse strings 122 arranged in the longitudinal direction. That is, it is possible to further enlarge the sweet spot; also this allows the racket to rebound a ball more and to vibrate less.

[0045] As shown in FIG. 6, it is preferable that, in the frame 11 having substantially an elliptical shape, the depth (D+α) of the point (P1 in FIG. 5) of the groove section 111 of the outer peripheral face 11a of the top (the end in the longitudinal direction) at the center in the width direction be deeper than the depth (D) of the point (P2 in FIG. 5) of the groove section 111 of the outer peripheral face 11a of either side (either end in the width direction) at the center in the longitudinal direction. That is, it is preferable the depth at the position where the string 12 is folded back on the outer peripheral face 11a of the top of the frame 11 at the center in the width direction is deeper than the depth at the position where the string 12 is folded back on the outer peripheral face 11a of the sides of the frame 11 at the center in the longitudinal direction. As a result, the sweet spot can be further enlarged while preventing the strength deterioration of the frame 11. This also allows the racket to rebound a ball more and to vibrate less.

[0046] In the racket 1 of the abovementioned embodiment, all portions of the groove section 111 located in the top and both sides of the frame 11 become shallower in depth as they go from the center to the outer ends. However, the invention is not limited thereto. For example, at least one portion of the groove section 111 located in the top and both sides of the frame 11 may be different in depth. Further, in the racket 1 of the abovementioned embodiment, the groove section 111 is not provided in the handle end (the portion facing the opening 30) of the frame 11 in the longitudinal direction. However, the invention is not limited thereto. For example, the groove section 111 may be provided in the handle end and the groove section 111 may be shallower in depth as it goes from the center in the width direction to the outer ends. Furthermore, in the racket 1 of the abovementioned embodiment, the groove section 111 varies gradually in depth. However, the invention is not limited thereto. For example, the groove section 111 may vary in depth by providing steps in the bottom surface 111a of the groove section.

Other Embodiments

[0047] It should be noted that the aforementioned embodiment is for facilitating understanding of the invention, and are not limiting of the invention, and are not to be interpreted as limiting the invention. The invention can of course be altered and improved without departing from the gist thereof, and equivalents are intended to be embraced therein.

[0048] For example, in the abovementioned embodiment, a tennis racket is taken as an example of a racket associated with the invention. However, the invention is not limited thereto. For example, the invention may be applied to a squash racket, a badminton racket and the like. Also, in the abovementioned embodiment, the racket 1 in the frame 11 of which the string 12 is strung is taken as an example of a racket associated with the invention. However, the invention is not limited thereto. A racket in which the string 12 is not strung may also be employed.

Reference Signs List

[0049] 1 racket, 10 head, 11 frame, 111 groove section , 12 string, 13 string hole (through hole), 20 handle, 30 shaft, 31 opening, 40 grommet, 41 tube section, 42 base section, 43 communicating hole, 44 groove section,

Claims

1. A racket comprising:

a handle;
an annular frame having

a plurality of through holes, and
a groove section provided on an outer peripheral face of the frame along a circumferential direction of the frame;

a shaft connecting the handle and the frame; and
a string

that passes through the through hole to the outside of the frame, and
that is folded back on the groove section,

wherein

when either one of a longitudinal direction of the racket and a width direction perpendicular to the longitudinal direction on a hitting surface of the racket is defined as a first direction,

a depth of a position at which the string is folded back at a second position in the first direction is smaller or less than a depth of a position at which the string is folded back at a first position in the first direction,
the first position being located on the outer peripheral face of the frame,
the second position being located on the outer peripheral face of the frame and outside of the first position in the first direction.

2. A racket according to claim 1, wherein
the position at which the string is folded back on the outer peripheral face of the frame becomes shallower in depth as it goes from a center of the frame to an end in the first direction.

3. A racket according to claim 1 or 2, wherein
the frame has substantially an elliptical shape, and
a position in an end in the longitudinal direction on the outer peripheral face of the frame at which the string is folded back at a center in the width direction is deeper in depth than a position in an end in the width direction on the outer peripheral face of the frame at which the string is folded back at a center in the longitudinal direction.

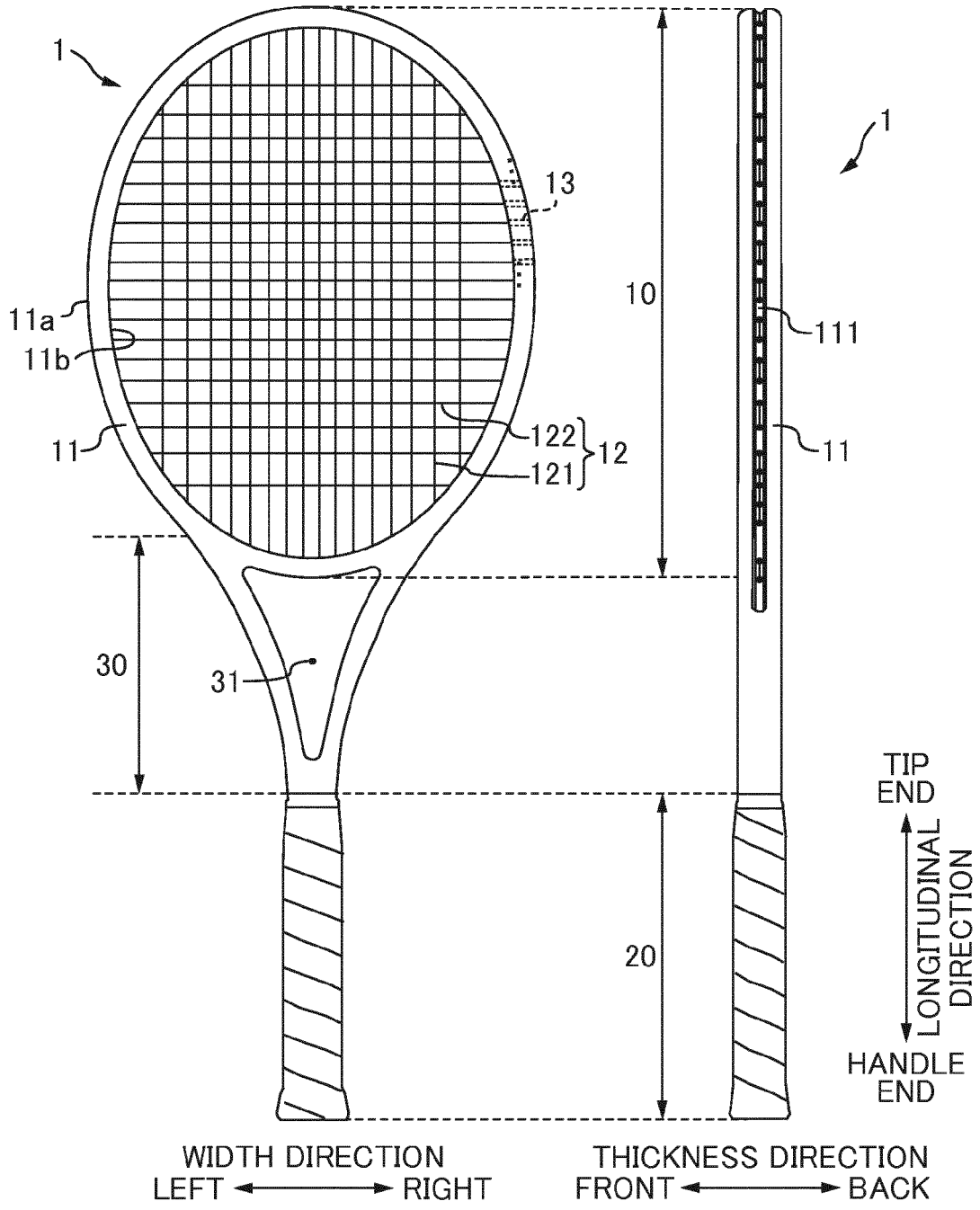
1
13
11a
11b
11
122
121
12
10
30
31
20
1
111
11
TIP END
LONGITUDINAL DIRECTION
HANDLE END
WIDTH DIRECTION
LEFT
RIGHT
THICKNESS DIRECTION
FRONT
BACK

FIG. 1

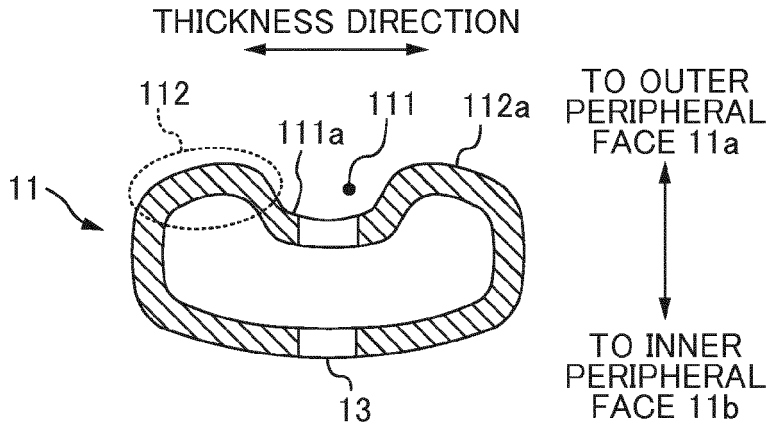
THICKNESS DIRECTION
112
111
112a
111a
11
TO OUTER PERIPHERAL FACE 11a
TO INNER PERIPHERAL FACE 11b
13

FIG. 2A

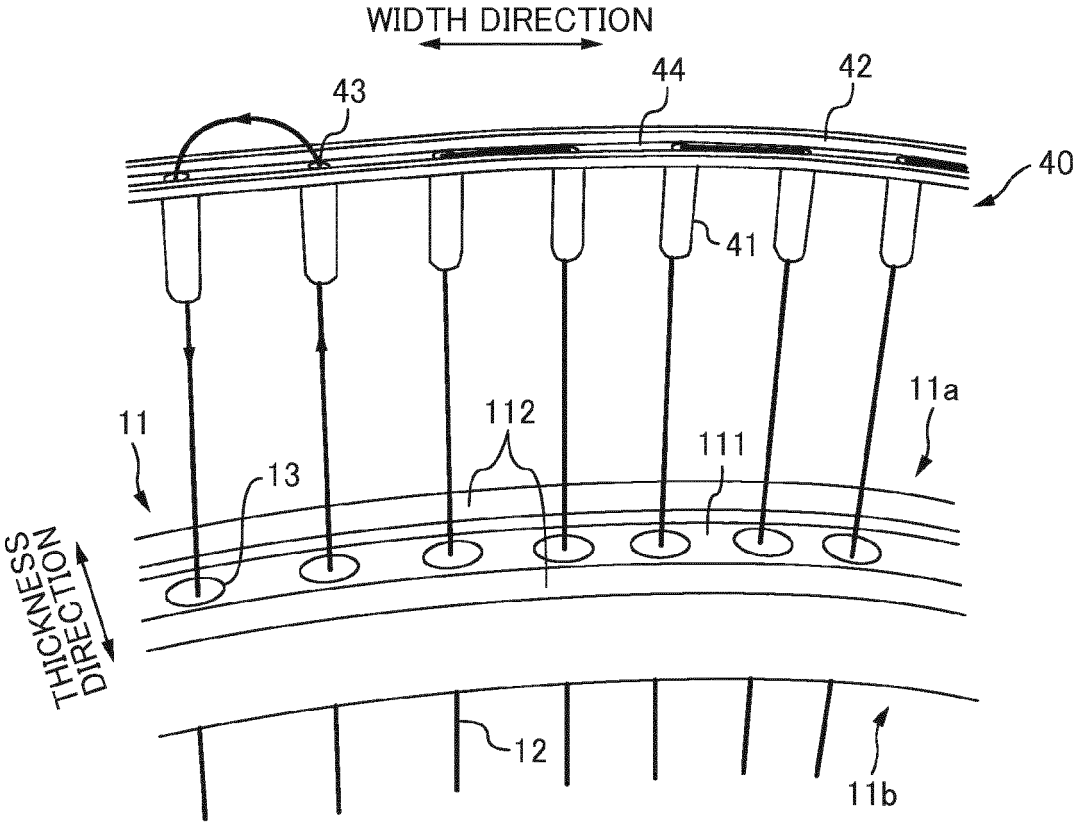
WIDTH DIRECTION
43
44
42
40
41
11a
11
112
111
13
THICKNESS DIRECTION
12
11b

FIG. 2B

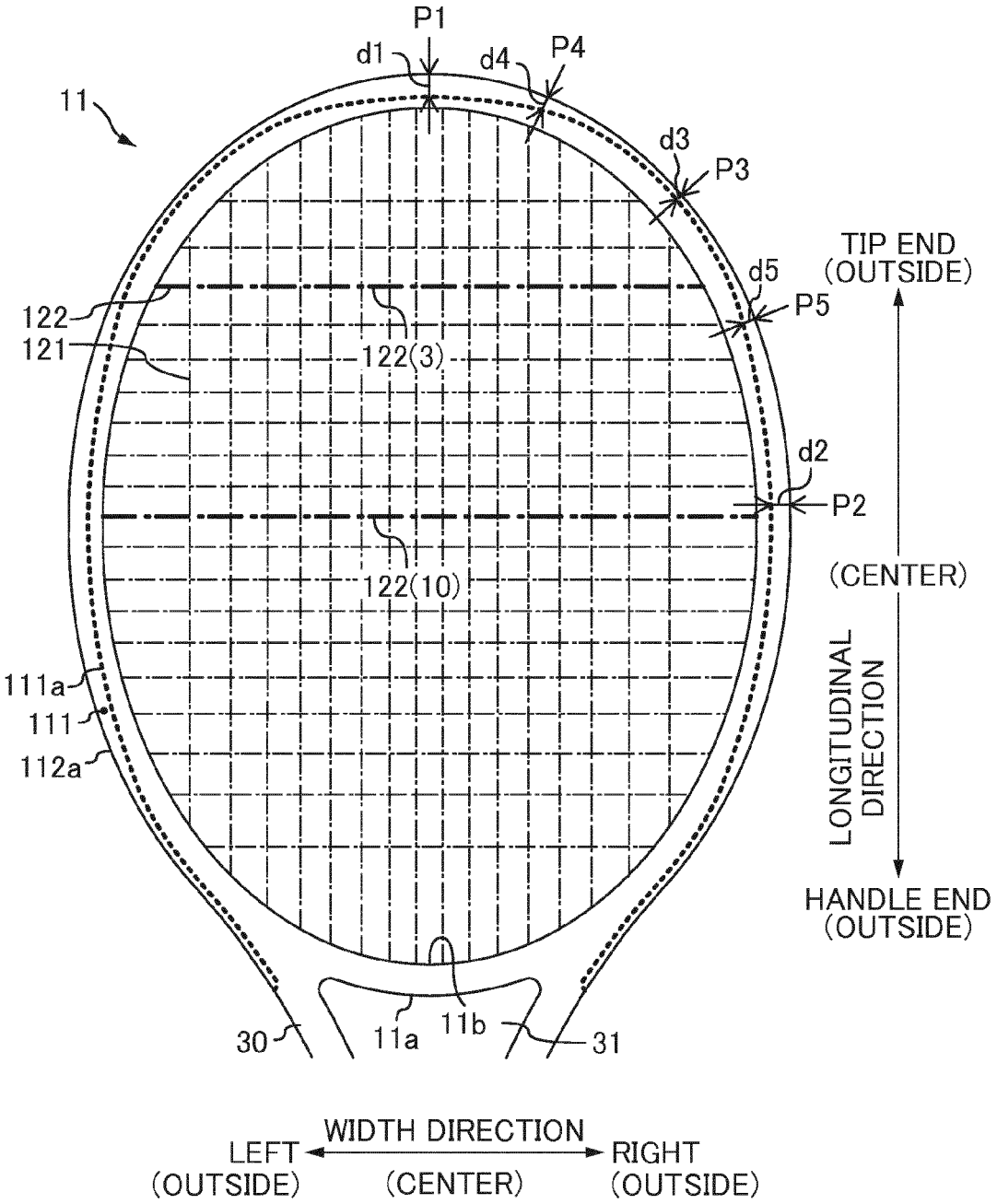
P1
d1
d4
P4
11
d3
P3
TIP END
(OUTSIDE)
d5
P5
122
121
122(3)
d2
P2
(CENTER)
122(10)
111a
111
112a
LONGITUDINAL
DIRECTION
HANDLE END
(OUTSIDE)
30
11a
11b
31
WIDTH DIRECTION
LEFT
(OUTSIDE)
(CENTER)
RIGHT
(OUTSIDE)

FIG. 3

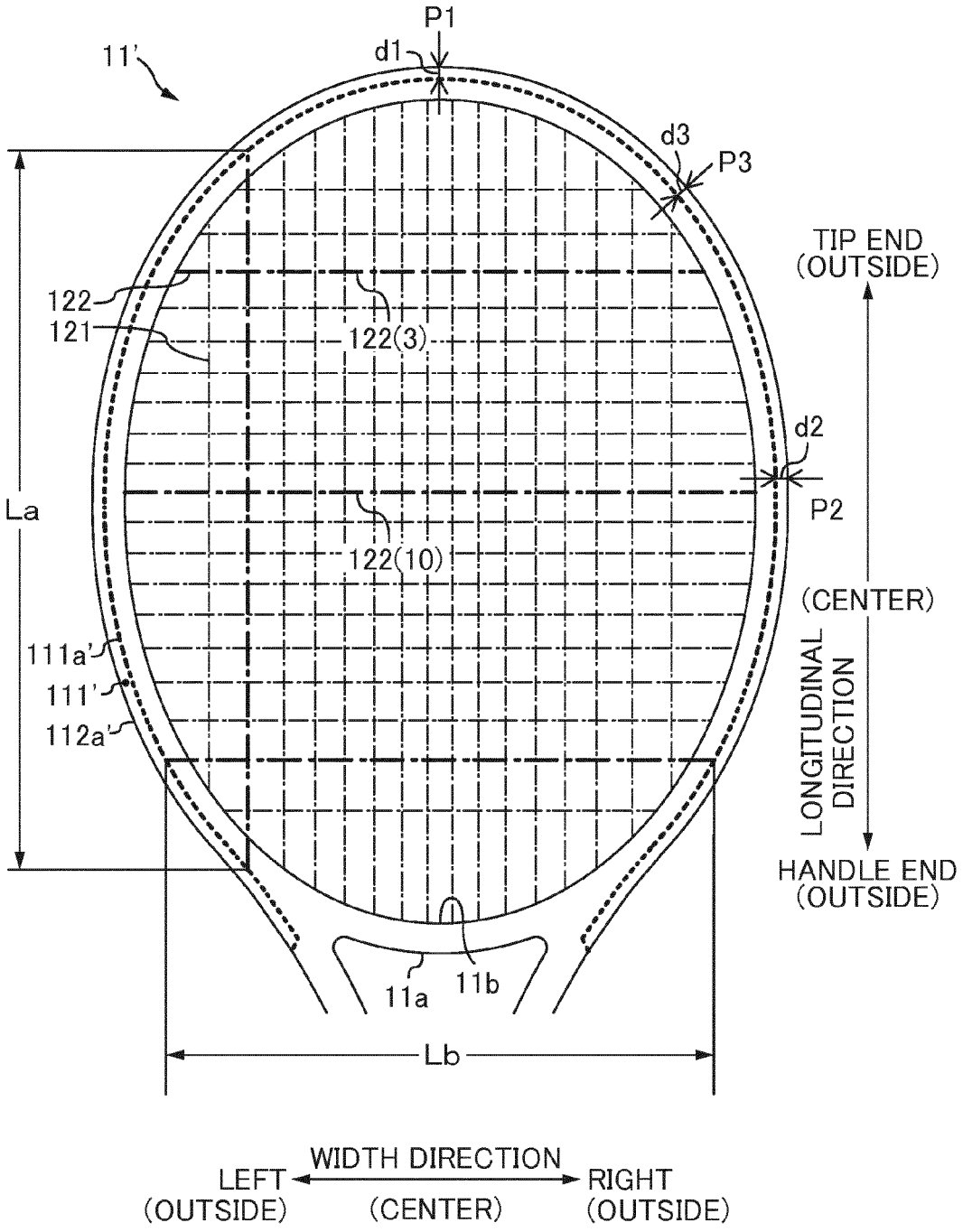
P1
11'
d1
d3
P3
TIP END
(OUTSIDE)
122
121
122(3)
d2
La
P2
122(10)
(CENTER)
111a'
111'
112a'
LONGITUDINAL
DIRECTION
HANDLE END
(OUTSIDE)
11a
11b
Lb
WIDTH DIRECTION
LEFT
(OUTSIDE)
(CENTER)
RIGHT
(OUTSIDE)

FIG. 4

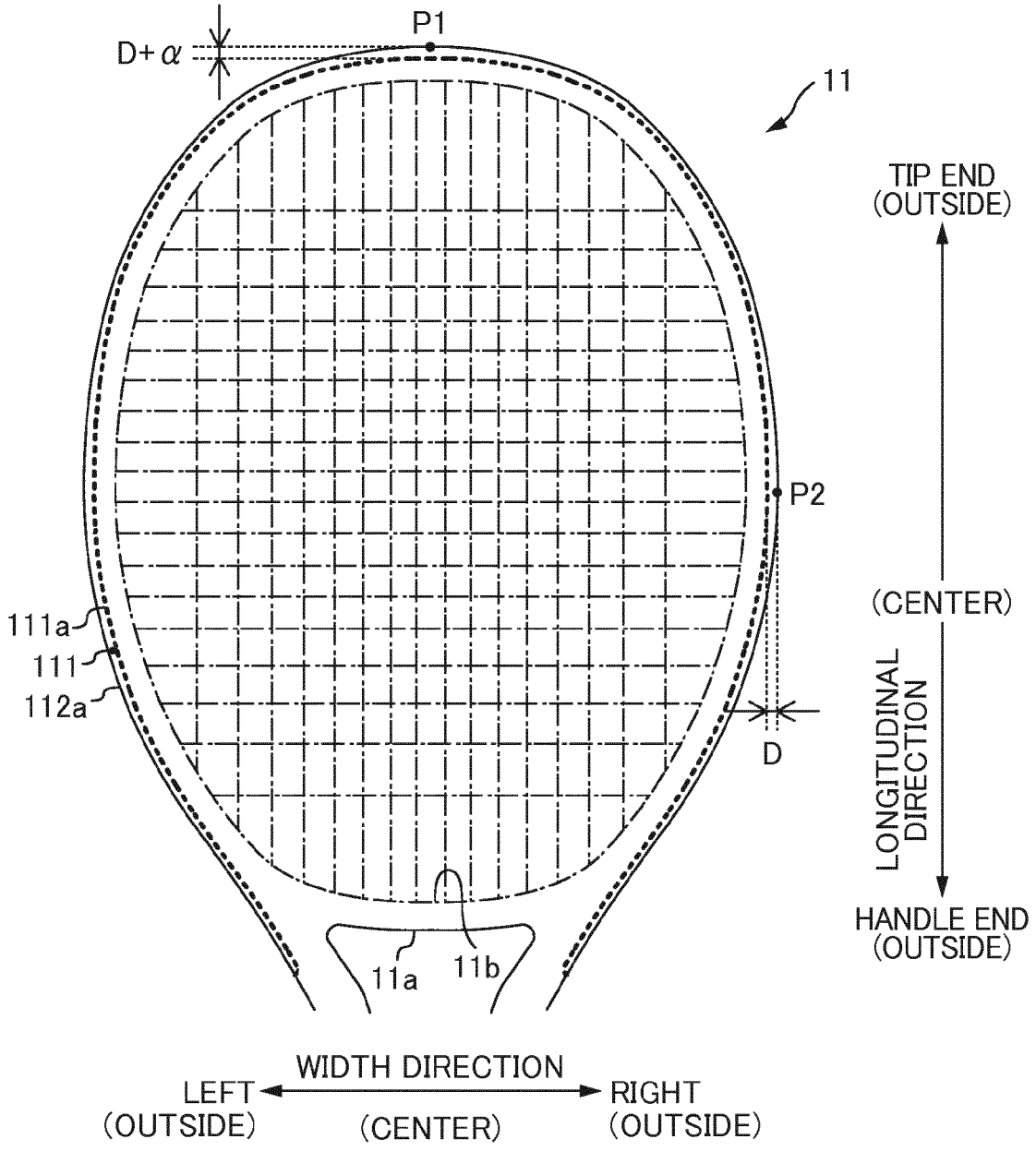
P1
D+α
11
TIP END
(OUTSIDE)
P2
111a
111
112a
D
(CENTER)
LONGITUDINAL
DIRECTION
HANDLE END
(OUTSIDE)
11a
11b
WIDTH DIRECTION
LEFT
(OUTSIDE)
(CENTER)
RIGHT
(OUTSIDE)

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 7836

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 260 208 A1 (ROSSIGNOL SA [FR]) 16 March 1988 (1988-03-16) * column 1, paragraph 30 - paragraph 59 * * column 3, line 6 - line 31; figure 2 *	1-3	INV. A63B49/02 A63B49/00
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A63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 May 2014	Lundblad, Hampus

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20-05-2014

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