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### (54) RACKET

(57) A face of a racket includes a plurality of first longitudinal threads 30a, a plurality of second longitudinal threads 30b, and a plurality of transverse threads. The first longitudinal threads 30a and the second longitudinal threads 30b are arranged alternately from a center of the face toward outside in a width direction of the racket. A material of each first longitudinal thread 30a is different

from a material of each second longitudinal thread 30b. A tension of the first longitudinal thread 30a may be different from a tension of the second longitudinal thread 30b. Preferably, a ratio (N1/N2) of a number N1 of the first longitudinal threads to a number N2 of the second longitudinal threads is greater than or equal to 2/8, but less than or equal to 8/2.

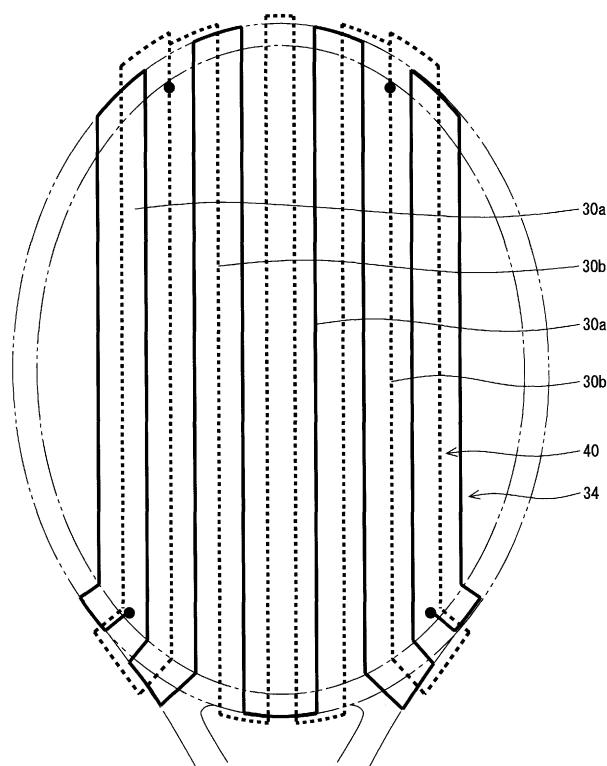


FIG. 7

**Description****CROSS-REFERENCE TO RELATED APPLICATION**

5 [0001] This application claims priority to and the benefit of Japanese Patent Application No. 2020-032943, filed on February 28, 2020, the entire disclosure of which is incorporated herein by reference.

**BACKGROUND OF THE INVENTION**10 **Field of the Invention**

[0002] The present invention relates to rackets for use in, for example, tennis.

15 **Description of the Related Art**

[0003] A tennis racket includes a frame and a string. In the past, natural gut was primarily used as the string. Natural gut is made of sheep intestine. In recent years, mainstream strings are synthetic resin strings. Synthetic resin strings have excellent durability. A string made of a resin composition whose base material is polyester or nylon is widely used. Japanese Laid-Open Patent Application Publication No. 2009-226107 discloses a string in which polyester is used.

20 [0004] Natural gut has excellent hitting feeling and rebound performance. However, natural gut is inferior in terms of spin performance and control performance.

[0005] A nylon string has excellent hitting feeling and rebound performance. However, a nylon string is inferior in terms of spin performance and control performance.

25 [0006] A polyester string has excellent spin performance and control performance. However, a polyester string is inferior in terms of hitting feeling and rebound performance.

[0007] A main string and a cross string that are made of different materials from each other can be both used in a tennis racket. The tennis racket in which the main and cross strings are used can have both the advantages of the material of the main string and the advantages of the material of the cross string. However, although contribution of the main string to the performance of the racket is great, contribution of the cross string to the performance of the racket is small. Therefore, the advantages of the material of the cross string are not fully exerted.

30 [0008] A string can be stretched on the frame of a tennis racket in such a manner that a high-tension region and a low-tension region are formed on the string. The tennis racket with the string stretched in this manner can have both the advantages of the high-tension region and the advantages of the low-tension region. However, when the tennis racket is used repeatedly, the tension in the high-tension region decreases gradually, and the tension in the low-tension region increases gradually. After such changes in the tension have occurred, the tennis racket can no longer have both the advantages of the high-tension region and the advantages of the low-tension region.

35 [0009] An object of the present invention is to provide a racket that has excellent balance in various performances.

**SUMMARY OF THE INVENTION**

40 [0010] A racket according to the present invention includes: a head; and a face whose contour is formed by the head. The face includes a plurality of first longitudinal threads, a plurality of second longitudinal threads, and a plurality of transverse threads. Specifications of each first longitudinal thread are different from specifications of each second longitudinal thread.

45 [0011] The racket according to the present invention has advantages derived from the first longitudinal threads and advantages derived from the second longitudinal threads.

[0012] Preferably, a material of the first longitudinal thread is different from a material of the second longitudinal thread.

[0013] The material of the first longitudinal thread may be a resin composition whose base material is a polyester, and the material of the second longitudinal thread may be a resin composition whose base material is a nylon.

50 [0014] The material of the first longitudinal thread may be a resin composition whose base material is a polyester, and the material of the second longitudinal thread may be natural gut.

[0015] The material of the first longitudinal thread may be a resin composition whose base material is a nylon, and the material of the second longitudinal thread may be natural gut.

55 [0016] An elongation rate E1 of the first longitudinal thread may be different from an elongation rate E2 of the second longitudinal thread. Preferably, a ratio (E1/E2) of the elongation rate E1 of the first longitudinal thread to the elongation rate E2 of the second longitudinal thread is less than or equal to 48/52, or is greater than or equal to 52/48.

[0017] A tension T1 of the first longitudinal thread may be different from a tension T2 of the second longitudinal thread. Preferably, a ratio (T1/T2) of the tension T1 of the first longitudinal thread to the tension T2 of the second longitudinal

thread is less than or equal to 48/52, or is greater than or equal to 52/48.

[0018] Preferably, a ratio (N1/N2) of a number N1 of the first longitudinal threads to a number N2 of the second longitudinal threads is greater than or equal to 2/8, but less than or equal to 8/2.

[0019] Preferably, each of the first longitudinal threads is adjacent to one or two of the second longitudinal threads, and each of the second longitudinal threads is adjacent to one or two of the first longitudinal threads.

[0020] Preferably, the first longitudinal threads and the second longitudinal threads are arranged alternately from a center of the face toward outside in a width direction of the racket.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a front view of a racket according to one embodiment of the present invention.

FIG. 2 is an enlarged exploded view of a part of the racket of FIG. 1.

FIG. 3 is an enlarged view of a part of a face of the racket of FIG. 1.

FIG. 4 is a schematic diagram showing a first main string of the racket of FIG. 1.

FIG. 5 is a schematic diagram showing a second main string of the racket of FIG. 1.

FIG. 6 is a schematic diagram showing a cross string of the racket of FIG. 1.

FIG. 7 is a schematic diagram showing the first main string and the second main string of the racket of FIG. 1.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Hereinafter, the present invention is described in detail based on preferred embodiments with appropriate reference to the accompanying drawings.

[0023] FIG. 1 shows a tennis racket 2. The tennis racket 2 includes a frame 4, a grip 6, an end cap 8, a grommet 10, and a face 12. The tennis racket 2 can be used in regulation-ball tennis. In FIG. 1, an arrow X represents the width direction of the tennis racket 2, and an arrow Y represents the axial direction of the tennis racket 2.

[0024] The frame 4 includes a head 14, two throats 16, and a shaft 18. The head 14 forms the contour of the face 12. The front shape of the head 14 is substantially an ellipse. The major axis direction of the ellipse coincides with the axial direction Y of the tennis racket 2. The minor axis direction of the ellipse coincides with the width direction X of the tennis racket 2. One end of each throat 16 is continuous with the head 14. At the vicinity of the other end thereof, the throat 16 merges with the other throat 16. The throats 16 extend from the head 14 to the shaft 18. The shaft 18 extends from the location where the two throats 16 merge together. The shaft 18 is formed so as to be continuous with, and integrated with, the throats 16. A portion of the head 14, the portion being positioned between the two throats 16, is a yoke 20.

[0025] The frame 4 is hollow. The material of the frame 4 is a fiber reinforced resin. In the present embodiment, the matrix resin of the fiber reinforced resin is a thermosetting resin. The thermosetting resin is typically an epoxy resin. The fibers of the fiber reinforced resin are typically carbon fibers. The fibers are filament fibers.

[0026] As shown in FIG. 2, the head 14 includes a grommet groove 22. The grommet groove 22 is recessed from the outer peripheral surface of the head 14. As shown in FIG. 1, the grommet groove 22 is formed over substantially the entire periphery of the head 14, except the yoke 20.

[0027] The head 14 further includes a plurality of holes 24. Each hole 24 extends through the head 14. The plurality of holes 24 are arranged over substantially the entire periphery of the head 14.

[0028] The grip 6 is formed by a tape wound around the shaft 18. The grip 6 suppresses a slip between a hand of a player and the tennis racket 2 when the tennis racket 2 is swung. The end cap 8 is attached to the end of the grip 6.

[0029] As shown in FIG. 2, the grommet 10 includes a base 26 and a plurality of pipes 28. The base 26 is belt-shaped. Each pipe 28 is formed so as to be integrated with the base 26. The pipes 28 rise from the base 26.

[0030] The material of the grommet 10 is typically a synthetic resin that is softer than the frame 4. The racket 2 may include a plurality of grommets 10. Each grommet 10 may be spaced apart from its adjacent grommet(s) 10. The number of pipes 28 of each grommet 10 may be one.

[0031] The grommet 10 is attached to the head 14. In a state where the grommet 10 is attached to the head 14, the base 26 is accommodated in the grommet groove 22. The base 26 may partly protrude from the grommet groove 22. In the state where the grommet 10 is attached to the head 14, the pipes 28 extend through the respective holes 24. Each pipe 28 is passed through a corresponding one of the holes 24.

[0032] FIG. 3 is an enlarged view of a part of the face 12 of the tennis racket 2 of FIG. 1. As shown in FIG. 3, the face 12 includes a plurality of first longitudinal threads 30a, a plurality of second longitudinal threads 30b, and a plurality of transverse threads 32. Each first longitudinal thread 30a is stretched on the head 14 along the axial direction (Y-direction). Each first longitudinal thread 30a crosses the plurality of transverse threads 32. Each second longitudinal thread 30b is stretched on the head 14 along the axial direction (Y-direction). Each second longitudinal thread 30b crosses the plurality

of transverse threads 32. Each transverse thread 32 is stretched on the head 14 along the width direction (X-direction). Each transverse thread 32 crosses the plurality of longitudinal threads. The face 12 generally extends along an X-Y plane.

String

[0033] The tennis racket 2 includes a first main string. FIG. 4 shows a first main string 34. The first main string 34 is stretched on the head 14 in a zigzag manner. The first main string 34 is passed through the plurality of holes 24 (see FIG. 2). In other words, the first main string 34 is passed through the plurality of pipes 28. One end 36 of the first main string 34 forms a knot. The other end 38 of the first main string 34 also forms a knot. The plurality of first longitudinal threads 30a are formed by the first main string 34. In the present embodiment, eight first longitudinal threads 30a are formed by one first main string 34. These first longitudinal threads 30a are arranged symmetrically with respect to the center of the head 14 in the width direction. The tennis racket 2 may include a plurality of first main strings 34.

[0034] The tennis racket 2 includes a second main string. FIG. 5 shows a second main string 40. For the sake of convenience of illustration, the second main string 40 is shown as a dotted line in FIG. 5. The second main string 40 is stretched on the head 14 in a zigzag manner. The second main string 40 is passed through the plurality of holes 24 (see FIG. 2). In other words, the second main string 40 is passed through the plurality of pipes 28. One end 42 of the second main string 40 forms a knot. The other end 44 of the second main string 40 also forms a knot. The plurality of second longitudinal threads 30b are formed by the second main string 40. In the present embodiment, eight second longitudinal threads 30b are formed by one second main string 40. These second longitudinal threads 30b are arranged symmetrically with respect to the center of the head 14 in the width direction. The tennis racket 2 may include a plurality of second main strings 40.

[0035] The tennis racket 2 includes a cross string. FIG. 6 shows a cross string 46. The cross string 46 is stretched on the head 14 in a zigzag manner. The cross string 46 is passed through the plurality of holes 24 (see FIG. 2). In other words, the cross string 46 is passed through the plurality of pipes 28. One end 48 of the cross string 46 forms a knot. The other end 50 of the cross string 46 also forms a knot. The plurality of transverse threads 32 are formed by the cross string 46. In the present embodiment, nineteen transverse threads 32 are formed by one cross string 46. The tennis racket 2 may include a plurality of cross strings 46. The cross string 46 may be integrated with the first main string 34 (see FIG. 4). The cross string 46 may be integrated with the second main string 40 (see FIG. 5).

[0036] FIG. 7 shows the first main string 34 and the second main string 40. As previously mentioned, in the present embodiment, eight first longitudinal threads 30a are formed by the first main string 34, and eight second longitudinal threads 30b are formed by the second main string 40. Therefore, the number of longitudinal threads is 16. Holes 24 for passing the first main string 34 therethrough are selected, and also, holes 24 for passing the second main string 40 therethrough are selected. Therefore, on the face 12, the second longitudinal threads 30b do not overlap the first longitudinal threads 30a. The first longitudinal threads 30a and the second longitudinal threads 30b are arranged alternately from the center of the face 12 toward the outside in the width direction.

[Specifications of Longitudinal Threads]

[0037] The specifications of each first longitudinal thread 30a are different from the specifications of each second longitudinal thread 30b. Therefore, the tennis racket 2 can have both the advantages of the first longitudinal thread 30a and the advantages of the second longitudinal thread 30b.

[1. Difference in Material]

[0038] A typical difference in specifications between the first longitudinal thread 30a and the second longitudinal thread 30b is a difference in material. One example difference in material is that the first longitudinal thread 30a is formed by using a resin composition and the second longitudinal thread 30b is formed by using a different resin composition. Examples of such a difference in resin composition include a difference in base material polymer, a difference in additive agent, and a difference in additive agent amount. Another example difference in material is that one longitudinal thread is formed by using a resin composition and the other longitudinal thread is made of natural gut.

[1.1 Polyester and Nylon]

[0039] The material of the first longitudinal thread 30a may be a resin composition whose base material is a polyester, and the material of the second longitudinal thread 30b may be a resin composition whose base material is a nylon. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is small. The first longitudinal thread 30a can contribute to spin performance and control performance. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is great. The second longitudinal

thread 30b can contribute to rebound performance and hitting feeling. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. Alternatively, the material of the second longitudinal thread 30b may be a resin composition whose base material is a polyester, and the material of the first longitudinal thread 30a may be a resin composition whose base material is a nylon.

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[1.2 Polyester and Natural Gut]

**[0040]** The material of the first longitudinal thread 30a may be a resin composition whose base material is a polyester, and the material of the second longitudinal thread 30b may be natural gut. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is small. The first longitudinal thread 30a can contribute to spin performance and control performance. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is great. The second longitudinal thread 30b can contribute to rebound performance and hitting feeling. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. Alternatively, the material of the second longitudinal thread 30b may be a resin composition whose base material is a polyester, and the material of the first longitudinal thread 30a may be natural gut.

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[1.3 Nylon and Natural Gut]

**[0041]** The material of the first longitudinal thread 30a may be a resin composition whose base material is a nylon, and the material of the second longitudinal thread 30b may be natural gut. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is relatively small. The first longitudinal thread 30a can contribute to spin performance and control performance. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is relatively great. The second longitudinal thread 30b can contribute to rebound performance and hitting feeling. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. Alternatively, the material of the second longitudinal thread 30b may be a resin composition whose base material is a nylon, and the material of the first longitudinal thread 30a may be natural gut.

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[1.4 Grade]

**[0042]** The grade of the base material of the first longitudinal thread 30a may be different from the grade of the base material of the second longitudinal thread 30b. For example, the material of the first longitudinal thread 30a may be a resin composition whose base material is a polyester, and the material of the second longitudinal thread 30b may be a resin composition whose base material is a different polyester. The polyester of the first longitudinal thread 30a and the polyester of the second longitudinal thread 30b may be different from each other in terms of, for example, the raw material, components, molecular weight, crystallization degree, thermal history, and/or machining history. The material of the first longitudinal thread 30a may be a resin composition whose base material is a nylon, and the material of the second longitudinal thread 30b may be a resin composition whose base material is a different nylon. The nylon of the first longitudinal thread 30a and the nylon of the second longitudinal thread 30b may be different from each other in terms of, for example, the raw material, components, molecular weight, crystallization degree, thermal history, and/or machining history.

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[2. Elongation Rate]

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**[0043]** Each of the above-described differences in material would result in a difference in elongation rate. An elongation rate E1 of the first longitudinal thread 30a and an elongation rate E2 of the second longitudinal thread 30b are elongation rates when these threads are tensioned to a stress of 200 MPa. These elongation rates are measured by a tensile test machine. The test machine includes a pair of chucks. A string is wound around each chuck. Test conditions are as indicated below.

Test machine: SHIMADZU AG-Xplus 5kN

Chuck: SHIMADZU 5kN air capstan type, 343-23325-30

Inter-chuck distance: 210 mm

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Inter-gauge mark distance: 150 mm

Tensile speed: 1 mm/sec

Plotting interval: 100 msec

Ambient temperature: 25°C

[0044] The measurement is performed three times for each string, and the median value is used as a representative value.

5 [2.1 E1 < E2]

[0045] The elongation rate E1 of the first longitudinal thread 30a may be less than the elongation rate E2 of the second longitudinal thread 30b. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is small. The first longitudinal thread 30a can contribute to spin performance and control performance. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is great. The second longitudinal thread 30b can contribute to rebound performance and hitting feeling. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. In light of this, a ratio (E1/E2) is preferably less than or equal to 48/52, more preferably less than or equal to 45/55, and particularly preferably less than or equal to 43/57.

10 [2.2 E1 > E2]

[0046] The elongation rate E1 of the first longitudinal thread 30a may be greater than the elongation rate E2 of the second longitudinal thread 30b. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is great. The first longitudinal thread 30a can contribute to rebound performance and hitting feeling. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is small. The second longitudinal thread 30b can contribute to spin performance and control performance. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. In light of this, the ratio (E1/E2) is preferably greater than or equal to 52/48, more preferably greater than or equal to 55/45, and particularly preferably greater than or equal to 57/43.

15 [3. Difference in Tension]

[0047] Another example difference in specifications between the first longitudinal thread 30a and the second longitudinal thread 30b is a difference in tension. The strings are tensioned, and in the tensioned state, the strings are stretched on the head 14. A worker can adjust a tension T1 of the first longitudinal thread 30a and a tension T2 of the second longitudinal thread 30b. The first main string 34 and the second main string 40 are not integrated together. Therefore, decrease in the tension of the first longitudinal thread 30a does not cause increase in the tension of the second longitudinal thread 30b. Also, decrease in the tension of the second longitudinal thread 30b does not cause increase in the tension of the first longitudinal thread 30a. Even when the tennis racket 2 is used repeatedly, a difference in tension between the first longitudinal thread 30a and the second longitudinal thread 30b can be kept.

20 [3.1 T1 > T2]

[0048] The tension T1 of the first longitudinal thread 30a when it is stretched on the head 14 may be greater than the tension T2 of the second longitudinal thread 30b when it is stretched on the head 14. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is small. The first longitudinal thread 30a can contribute to spin performance and control performance. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is great. The second longitudinal thread 30b can contribute to rebound performance and hitting feeling. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. In light of this, the ratio (T1/T2) is preferably greater than or equal to 52/48, more preferably greater than or equal to 55/45, and particularly preferably greater than or equal to 57/43.

25 [3.2 T1 < T2]

[0049] The tension T1 of the first longitudinal thread 30a when it is stretched on the head 14 may be less than the tension T2 of the second longitudinal thread 30b when it is stretched on the head 14. In this case, the amount of deformation of the first longitudinal thread 30a upon impact with a ball is great. The first longitudinal thread 30a can contribute to rebound performance and hitting feeling. On the other hand, in this case, the amount of deformation of the second longitudinal thread 30b upon impact with a ball is small. The second longitudinal thread 30b can contribute to spin performance and control performance. The tennis racket 2 thus configured is well-balanced in spin performance, control performance, rebound performance, and hitting feeling. In light of this, the ratio (T1/T2) is preferably less than or equal to 48/52, more preferably less than or equal to 45/55, and particularly preferably less than or equal to 43/57.

[0050] The material of the first longitudinal thread 30a may be different from the material of the second longitudinal

thread 30b, and in addition thereto, the tension T1 of the first longitudinal thread 30a may be different from the tension T2 of the second longitudinal thread 30b.

[Other Examples of Difference in Specifications]

**[0051]** The thickness of the first longitudinal thread 30a may be different from the thickness of the second longitudinal thread 30b. The sectional shape of the first longitudinal thread 30a may be different from the sectional shape of the second longitudinal thread 30b. The surface roughness of the first longitudinal thread 30a may be different from the surface roughness of the second longitudinal thread 30b.

[N1/N2]

**[0052]** On the face 12, the ratio of the number (N1) of first longitudinal threads 30a to the number (N2) of second longitudinal threads 30b (i.e.,  $N1/N2$ ) is preferably greater than or equal to 2/8, but less than or equal to 8/2. The tennis racket 2 having the ratio ( $N1/N2$ ) of greater than or equal to 2/8 sufficiently exerts the advantages derived from the first longitudinal threads 30a. In light of this, the ratio ( $N1/N2$ ) is more preferably greater than or equal to 3/7, and particularly preferably greater than or equal to 4/6. The tennis racket 2 having the ratio ( $N1/N2$ ) of less than or equal to 8/2 sufficiently exerts the advantages derived from the second longitudinal threads 30b. In light of this, the ratio ( $N1/N2$ ) is more preferably less than or equal to 7/3, and particularly preferably less than or equal to 6/4. In the embodiment shown in FIG. 7, the number N1 is 8, and the number N2 is 8. That is, the ratio ( $N1/N2$ ) is 1.0.

[Arrangement]

**[0053]** Each first longitudinal thread 30a is preferably adjacent to one or two second longitudinal threads 30b. Each second longitudinal thread 30b is preferably adjacent to one or two first longitudinal threads 30a. The tennis racket 2 thus configured can have both the advantages of the first longitudinal threads 30a and the advantages of the second longitudinal threads 30b. When the first and second longitudinal threads are thus adjacent to each other, no other longitudinal thread is present between these longitudinal threads.

**[0054]** As previously described, in the embodiment shown in FIG. 7, the first longitudinal threads 30a and the second longitudinal threads 30b are arranged alternately from the center of the face 12 toward the outside in the width direction. Therefore, the tennis racket 2 can sufficiently have both the advantages of the first longitudinal threads 30a and the advantages of the second longitudinal threads 30b.

**[0055]** In the embodiment shown in FIG. 7, one or two longitudinal threads whose amount of deformation upon impact with a ball is great are present between two longitudinal threads whose amount of deformation upon impact with a ball is small. In other words, the distance between the two longitudinal threads whose amount of deformation upon impact with a ball is small is sufficiently great. Therefore, the longitudinal threads whose amount of deformation upon impact with a ball is small can sufficiently bite into the ball. That is, the tennis racket 2 has excellent spin performance.

[Specifications of Transverse Thread]

**[0056]** The specifications of each transverse thread 32 may be the same as the specifications of each first longitudinal thread 30a. The specifications of each transverse thread 32 may be the same as the specifications of each second longitudinal thread 30b.

**[0057]** The specifications of the transverse thread 32 may be different from both the specifications of the first longitudinal thread 30a and the specifications of the second longitudinal thread 30b. The tennis racket 2 may include two types of transverse threads 32 having different specifications from each other.

## EXAMPLES

[Example 1]

**[0058]** A tennis racket having the structure as shown in FIGS. 1 to 7 was produced. In the tennis racket, the material of the first longitudinal thread is a resin composition whose base material is a polyester; the material of the second longitudinal thread is a resin composition whose base material is a nylon; and the material of the transverse thread is a resin composition whose base material is a polyester. The tension of the first longitudinal thread is 50 pound-force (lbf); the tension of the second longitudinal thread is 50 pound-force; and the tension of the transverse thread is 50 pound-force.

[Examples 2 to 8 and Comparative Examples 1 to 6]

**[0059]** Tennis rackets of Examples 2 to 8 and Comparative Examples 1 to 6 were obtained in the same manner as Example 1, except that the specifications of the threads were varied as shown in Tables 1 to 3 below.

**[Evaluation]**

**[0060]** Players did a rally by using each tennis racket. The players evaluated the rebound performance (flight), spin performance, hitting feeling, and control performance of each racket. The evaluation results are shown in Tables 1 to 3 below. In Tables 1 to 3, the greater the numerical value, the higher the evaluation.

**[0061]** Table 1: Evaluation Results.

		Example 1	Example 2	Example 3	Example 4
15	First longitudinal thread				
	Material	polyester	polyester	polyester	nylon
20	Tension (lbf)	50	50	50	50
25	Second longitudinal thread				
	Material	nylon	nylon	natural	natural
30	Tension (lbf)	50	50	50	50
35	Transverse thread				
	Material	polyester	nylon	polyester	nylon
40	Tension (lbf)	50	50	50	50
45	Rebound	6	8	7	10
50	Spin	8	7	8	3
55	Hitting feeling	6	8	7	10
	Control	8	7	8	5
	Overall Evaluation	7.0	7.5	7.5	7.0

Table 2: Evaluation Results.

	Comparative Example 1	Example 5	Example 6	Example 7	Example 8
15	First longitudinal thread				
20	Material	polyester	polyester	polyester	polyester
25	Tension (lbf)	50	55	60	60
30	Second longitudinal thread				
35	Material	polyester	polyester	nylon	nylon
40	Tension (lbf)	50	45	40	40
45	Transverse thread				
50	Material	polyester	polyester	polyester	nylon
55	Tension (lbf)	50	50	50	50
	Rebound	4	6	5	7
	Spin	7	9	10	8
	Hitting feeling	4	5	5	7
	Control	8	8	9	8
	Overall Evaluation	5.8	7.0	7.3	7.5

Table 3: Evaluation Results.

	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6
5	First longitudinal thread Material Tension (lbf)	polyester 50	nylon 50	nylon 50	polyester 60
10	Second longitudinal thread Material Tension (lbf)	polyester 50	nylon 50	nylon 50	polyester 60
15	Transverse thread Material Tension (lbf)	nylon 50	polyester 50	nylon 50	polyester 50
20	Rebound	6	7	9	2
25	Spin	6	5	3	8
30	Hitting feeling	6	8	9	2
35	Control	7	6	4	7
40	Overall Evaluation	6.3	6.5	6.3	4.8
					5.8

**[0062]** It is clear from Tables 1 to 3 that the tennis racket in each Example is well-balanced in various performances. These evaluation results clearly indicate that the present invention is superior.

**[0063]** The racket according to the present invention can be used in various sports, such as soft tennis, squash, and badminton.

**[0064]** The above descriptions are merely illustrative examples, and various modifications can be made without departing from the principles of the present invention.

## Claims

1. A racket including:

a head; and

a face whose contour is formed by the head, wherein

the face includes a plurality of first longitudinal threads, a plurality of second longitudinal threads, and a plurality of transverse threads, and

specifications of each first longitudinal thread are different from specifications of each second longitudinal thread.

2. The racket according to claim 1, wherein

a material of the first longitudinal thread is different from a material of the second longitudinal thread.

3. The racket according to claim 2, wherein

the material of the first longitudinal thread is a resin composition whose base material is a polyester, and the material of the second longitudinal thread is a resin composition whose base material is a nylon.

4. The racket according to claim 2, wherein  
the material of the first longitudinal thread is a resin composition whose base material is a polyester, and  
the material of the second longitudinal thread is natural gut.
5. The racket according to claim 2, wherein  
the material of the first longitudinal thread is a resin composition whose base material is a nylon, and  
the material of the second longitudinal thread is natural gut.
6. The racket according to any one of claims 1 to 6, wherein  
10 an elongation rate E1 of the first longitudinal thread is different from an elongation rate E2 of the second longitudinal thread.
7. The racket according to claim 6, wherein  
a ratio (E1/E2) of the elongation rate E1 of the first longitudinal thread to the elongation rate E2 of the second  
15 longitudinal thread is less than or equal to 48/52, or is greater than or equal to 52/48.
8. The racket according to any one of claims 1 to 7, wherein  
a tension T1 of the first longitudinal thread is different from a tension T2 of the second longitudinal thread.
9. The racket according to claim 8, wherein  
20 a ratio (T1/T2) of the tension T1 of the first longitudinal thread to the tension T2 of the second longitudinal thread is  
less than or equal to 48/52, or is greater than or equal to 52/48.
10. The racket according to any one of claims 1 to 9, wherein  
25 a ratio (N1/N2) of a number N1 of the first longitudinal threads to a number N2 of the second longitudinal threads  
is greater than or equal to 2/8, but less than or equal to 8/2.
11. The racket according to any one of claims 1 to 10, wherein  
each of the first longitudinal threads is adjacent to one or two of the second longitudinal threads, and  
30 each of the second longitudinal threads is adjacent to one or two of the first longitudinal threads.
12. The racket according to claim 11, wherein  
the first longitudinal threads and the second longitudinal threads are arranged alternately from a center of the face  
toward outside in a width direction of the racket.

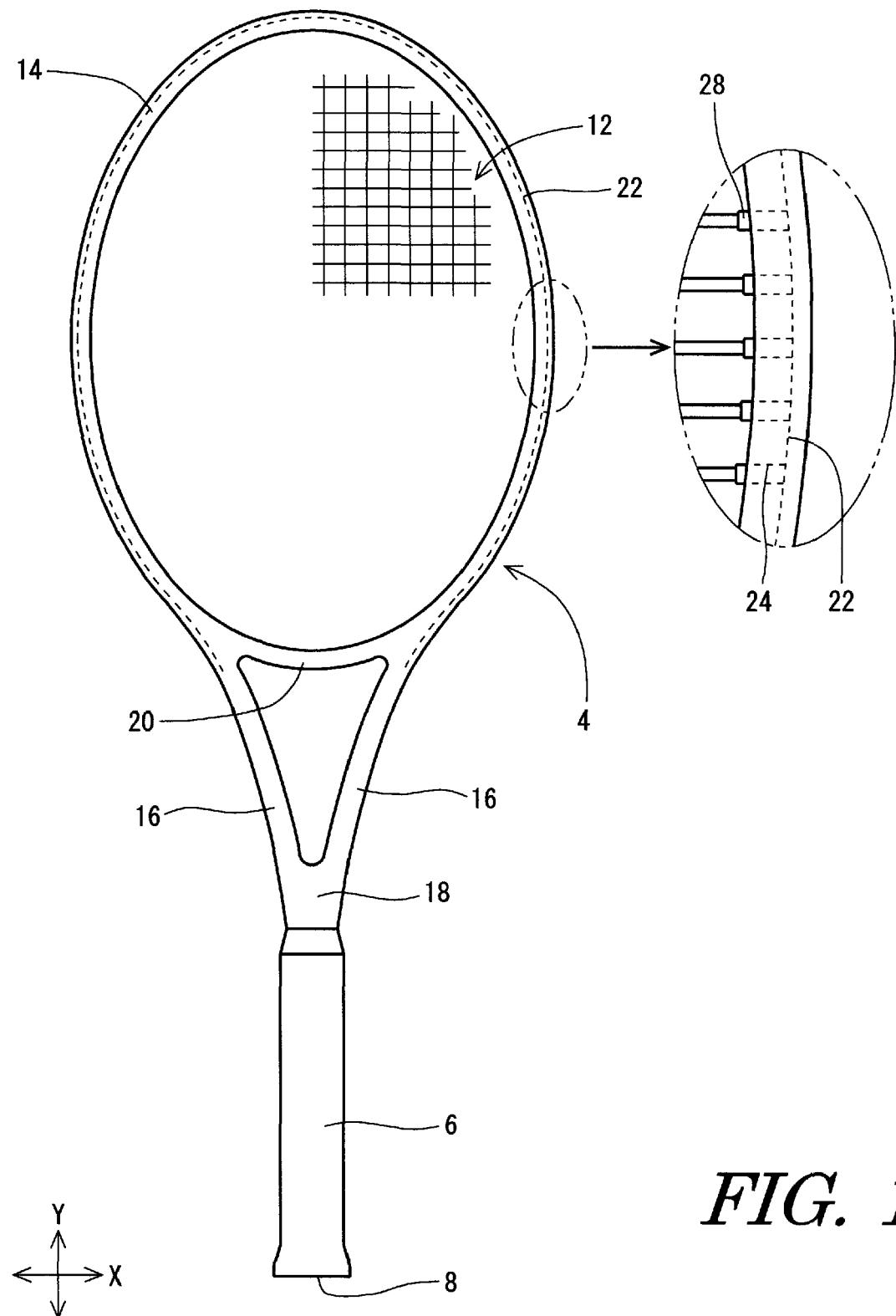
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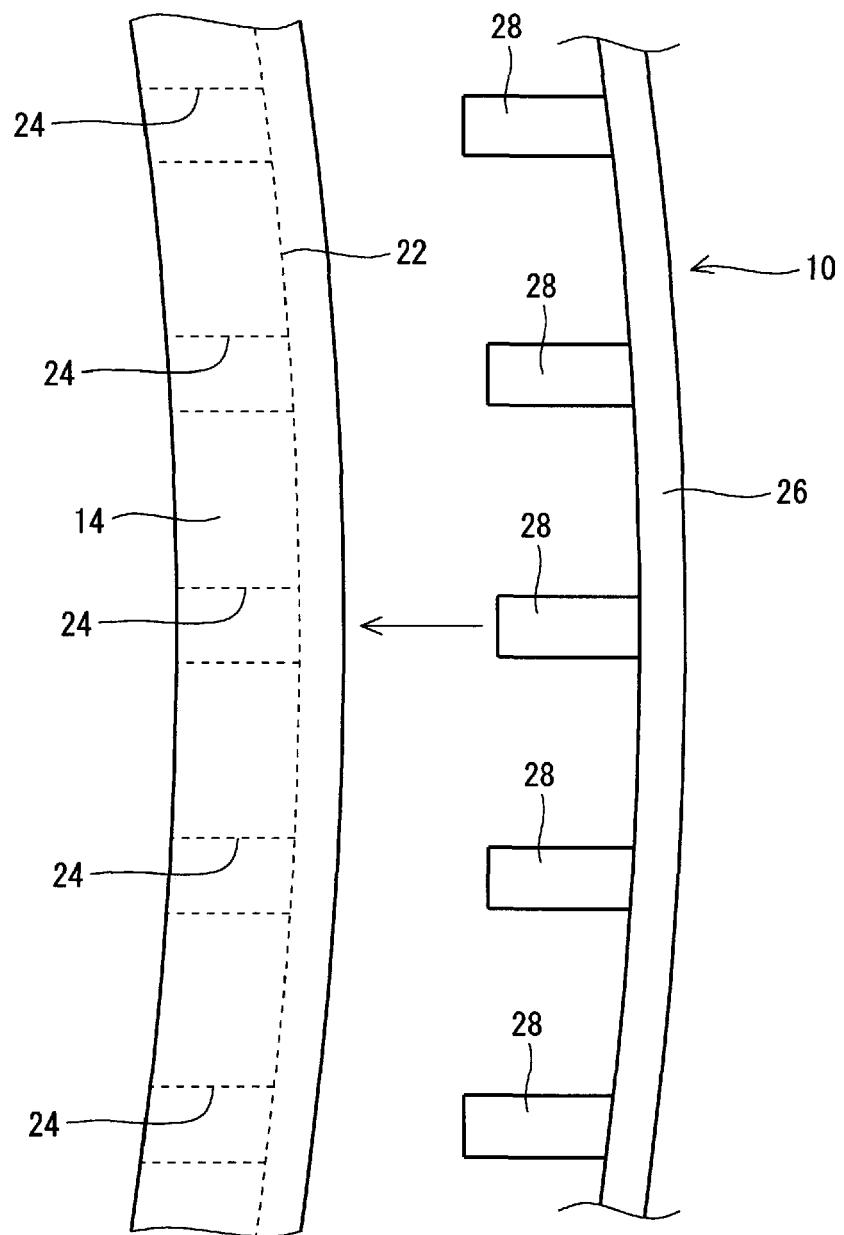
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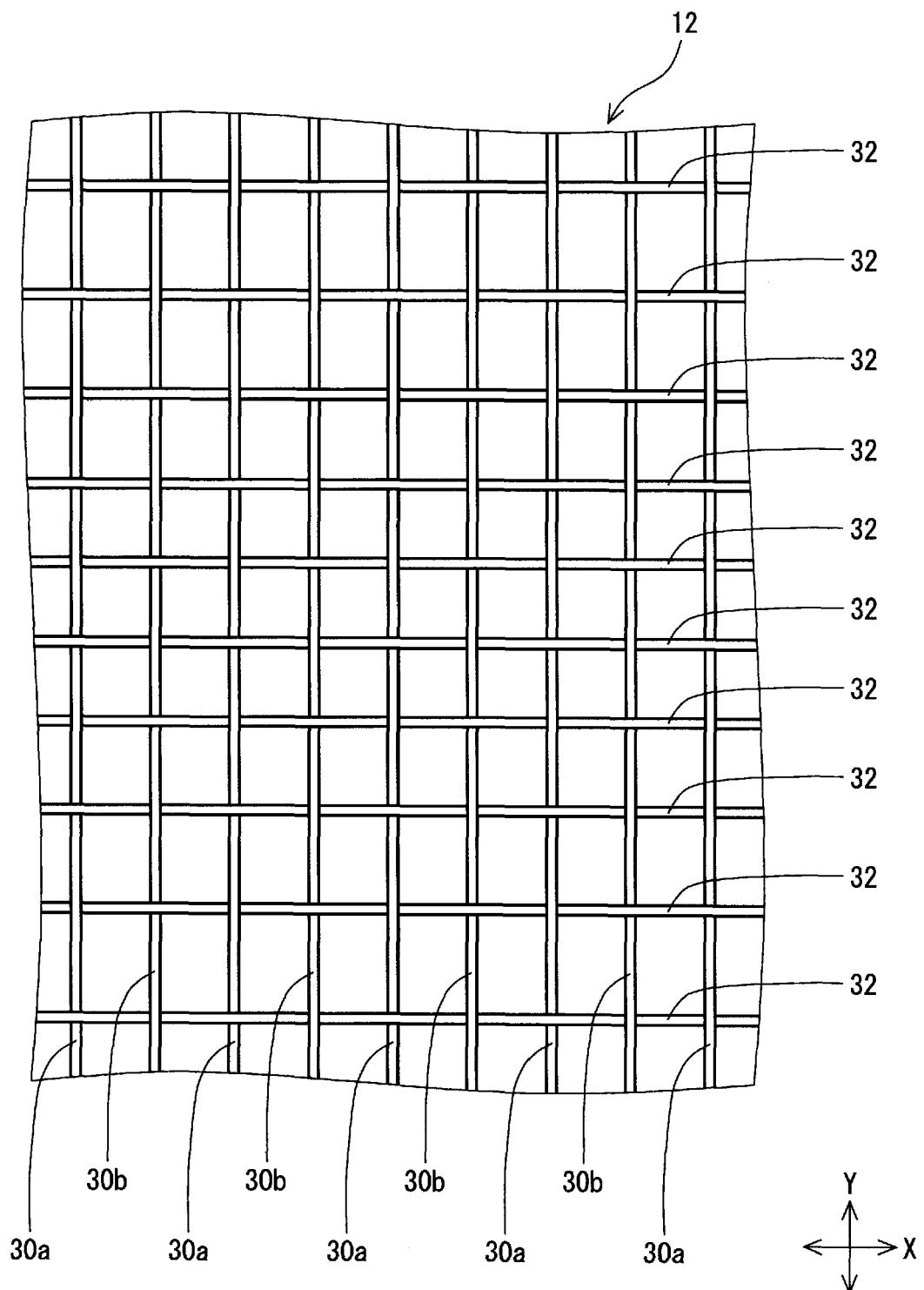
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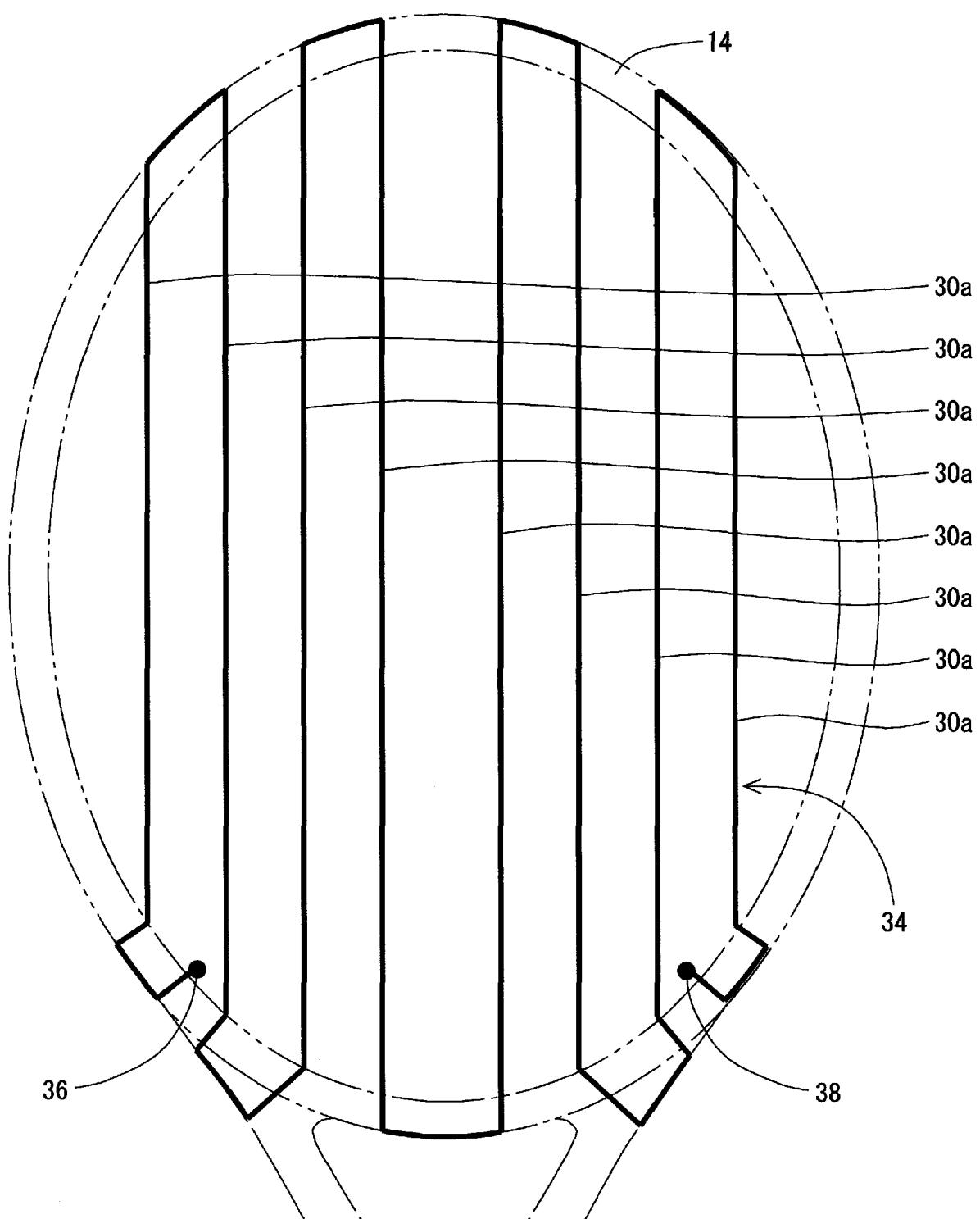
*FIG. 1*



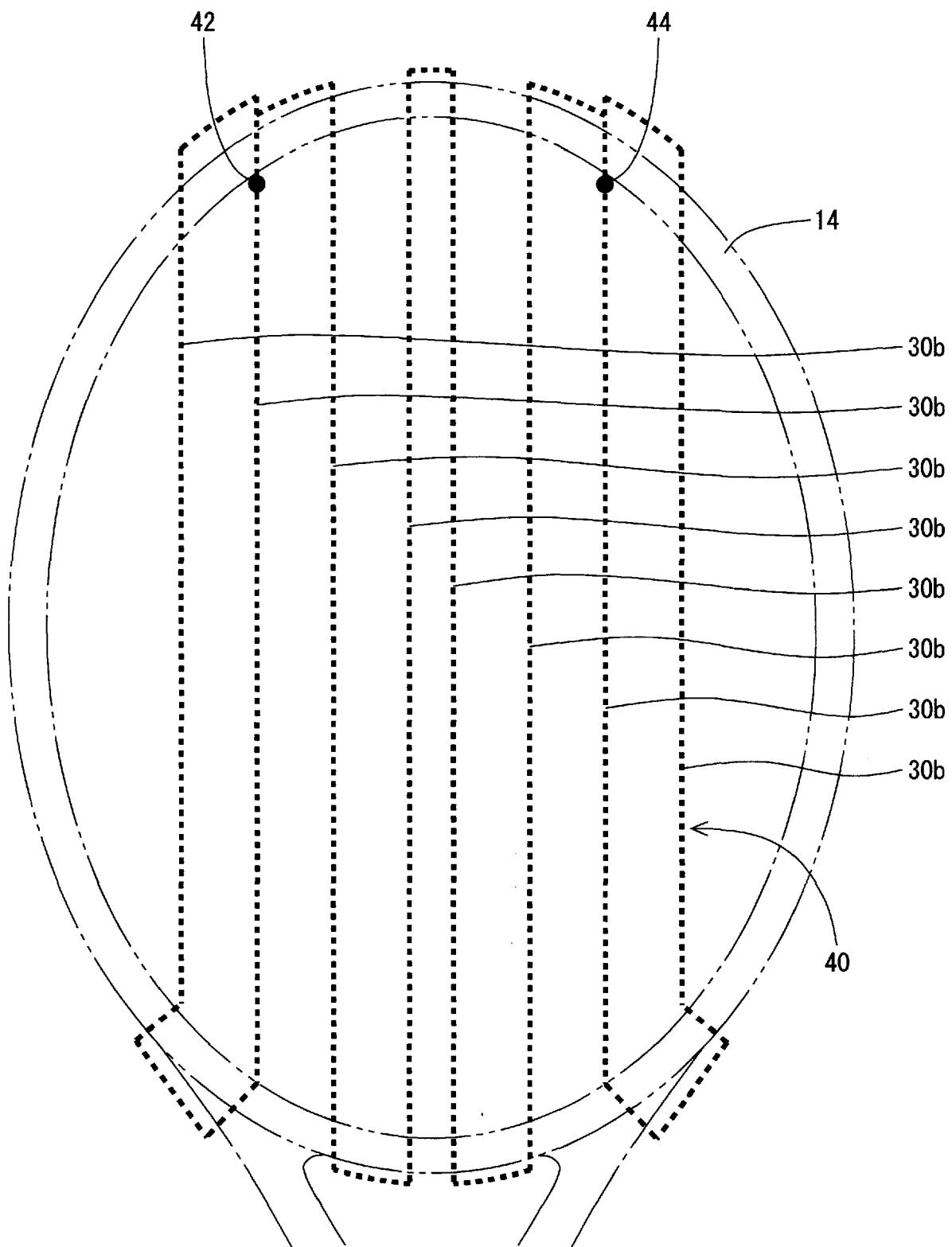
*FIG. 2*



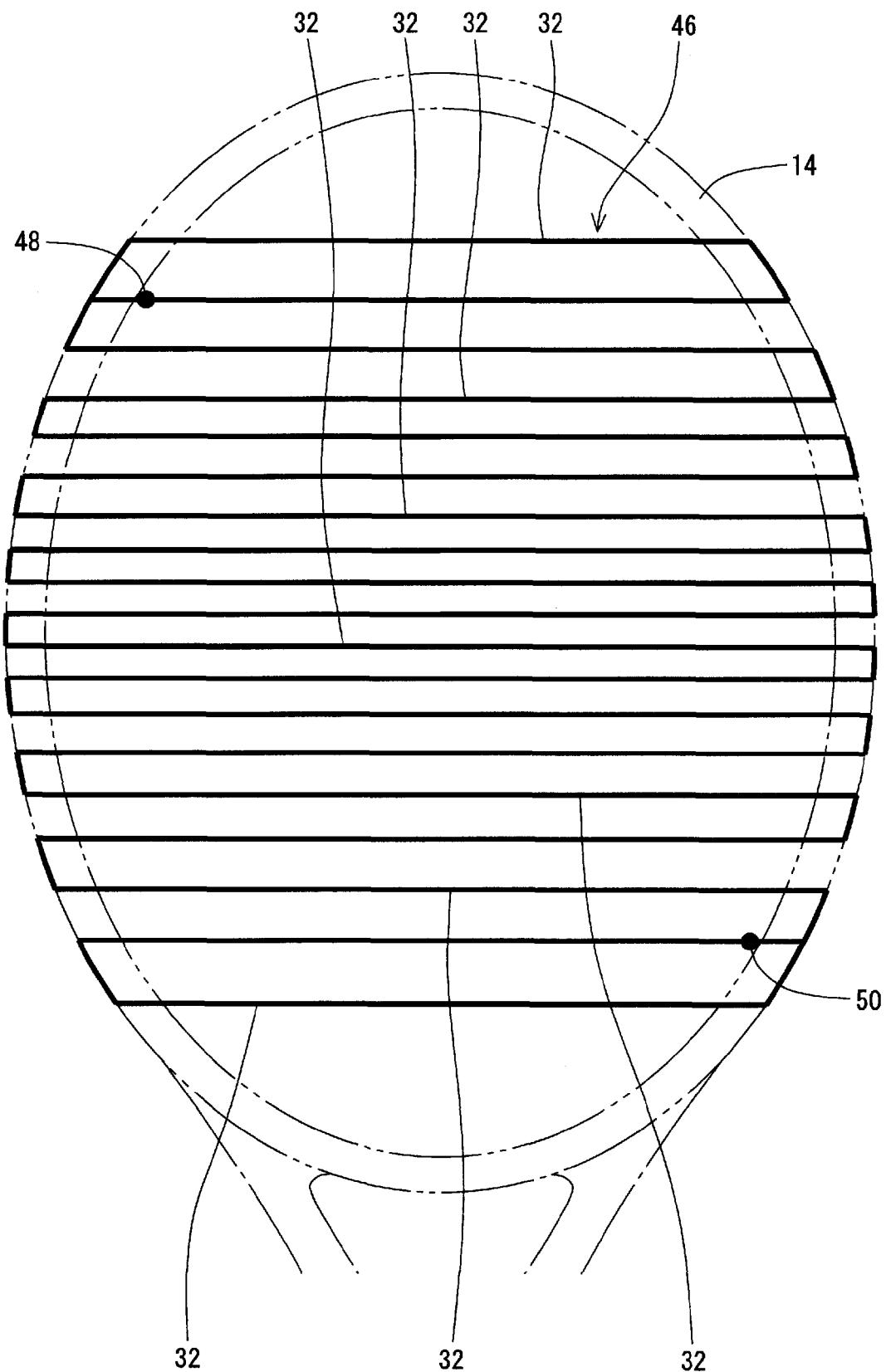
*FIG. 3*



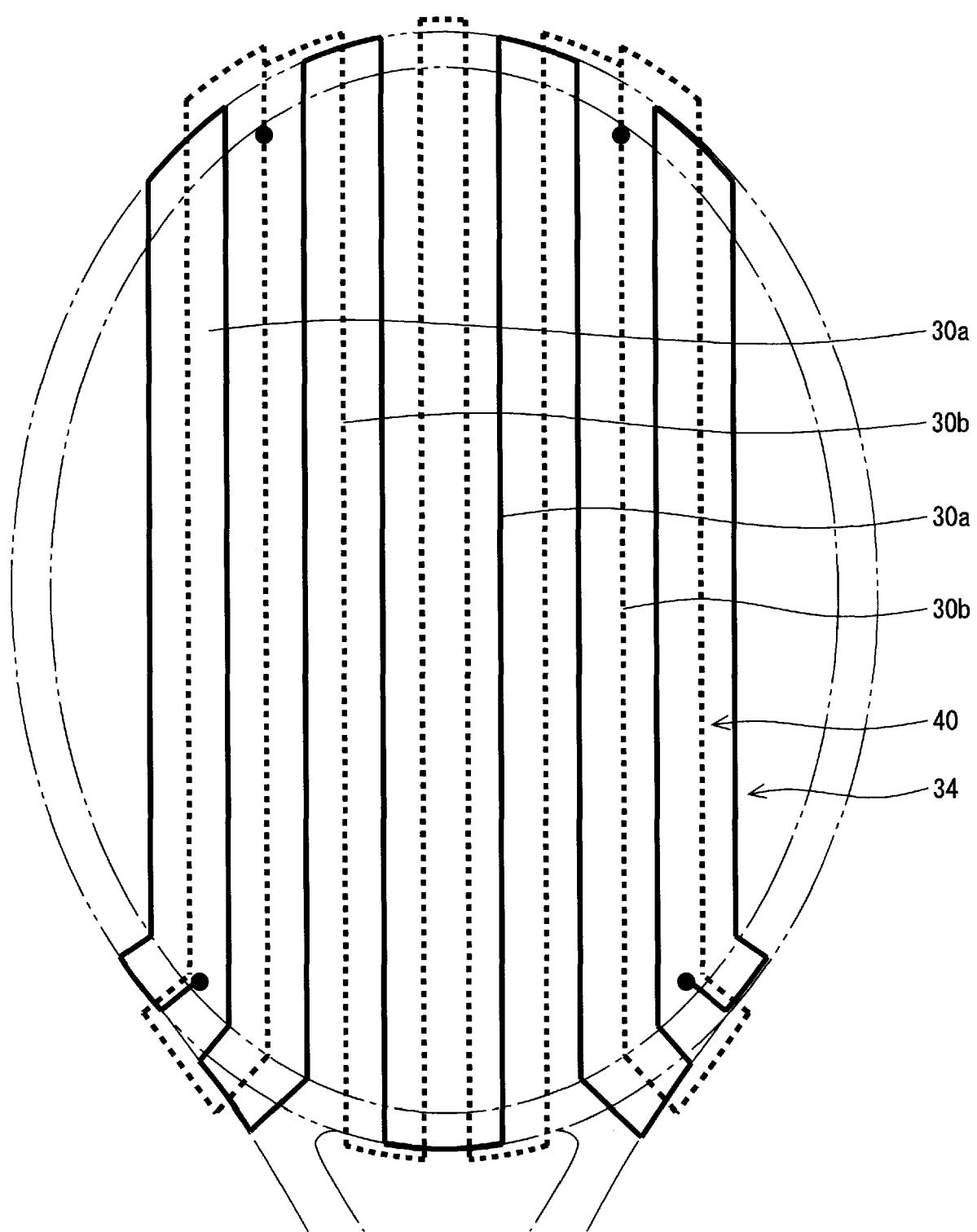
*FIG. 4*



*FIG. 5*



*FIG. 6*



*FIG. 7*



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Application Number

EP 21 15 8488

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