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(54) **SHUTTLECOCK FOR BADMINTON**

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VOLANT DE BADMINTON

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(73) Proprietor: **MIZUNO CORPORATION**
Osaka-shi
Osaka 541-8538 (JP)

(72) Inventors:
- **OGAWA, Masao**
  Osaka-shi
  Osaka 559-8510 (JP)
- **TONOMURA, Yutaka**
  Osaka-shi
  Osaka 559-8510 (JP)
- **YOSHIDA, Satoshi**
  Osaka-shi
  Osaka 559-8510 (JP)
- **TAKENAKA, Toshimasa**
  Osaka-shi
  Osaka 559-8510 (JP)

(74) Representative: **Prüfer & Partner GbR**
European Patent Attorneys
Sohnckestrasse 12
81479 München (DE)

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EP 2 236 176 B1

Description

TECHNICAL FIELD

[0001] The present invention relates to a shuttlecock for badminton, and more specifically, it relates to a shuttlecock for badminton having excellent durability.

BACKGROUND ART

[0002] In general, a shuttlecock (natural shuttlecock) employing feathers of a waterfowl as the feathers thereof and a shuttlecock (artificial shuttlecock) employing feathers artificially prepared from nylon resin or the like are known as shuttlecocks for badminton. The artificial shuttlecock includes a shuttlecock whose feathers consist of a skirtlike integrally molded product made of resin or the like and a shuttlecock employing a plurality of independent artificial feathers similarly to the natural shuttlecock.

[0003] Fig. 30 is a schematic side elevational view showing a natural shuttlecock. Fig. 31 is a partially fragmented schematic sectional view showing an overlapping state of feathers of the natural shuttlecock. The natural shuttlecock is described with reference to Figs. 30 and 31.

[0004] As shown in Fig. 30, a natural shuttlecock 101 consists of a hemispherical base body 102, a plurality of feathers 103 consisting of feathers of a waterfowl connected to a planar surface of base body 102 and a binding thread for fixing shafts of plurality of natural feathers 103 to each other. Feathers 103 consist of shafts 107 and feather body portions 105. The positions of annularly arranged plurality of feathers 103 are so decided that feather body portions 105 partially overlap with each other and the extensional directions of feather body portions 105 intersect with each other on individual feathers 103 (so an angle of torsion is formed), as shown in Fig. 31.

[0005] In the aforementioned artificial shuttlecock employing the plurality of artificial feathers, the appearance itself is similar to that of aforementioned natural shuttlecock 101.

[0006] A natural shuttlecock is more high-priced than a shuttlecock employing artificial feathers, since it takes time to obtain such natural feathers of constant quality. Therefore, artificial shuttlecocks each employing a plurality of independent artificial feathers, employing low-priced artificial feathers having stable quality, are proposed (refer to Japanese Patent Laying-Open No. 57-37464 (Patent Document 1) and Japanese Patent Laying-Open No. 53-40335 (Patent Document 2), for example).

[0007] Patent Document 1 discloses an artificial feather for an artificial shuttlecock manufactured by preparing a feather portion from nonwoven fabric and integrally forming a stem portion coupled to the feather portion by injection molding and an artificial shuttlecock employing the artificial feather. Patent Document 2 discloses an artificial feather for a shuttlecock manufactured by bonding a feather portion and a stem portion having a reinforcing member of high-strength fiber to each other with an adhesive.

[0008] In view of stabilizing flight while preventing breakage of a stem portion, a structure of providing a notch on a feather portion and winding a thread around the stem portion on the notch is also proposed (refer to Japanese Utility Model Laying-Open No. 59-26676 (Patent Document 3), for example).

[0009] Another shuttlecock with a thread wound around the stem portion of the feathers is disclosed in Japanese patent application JP 36-19067 B1 (Patent Document 4).

Patent Document 1: Japanese Patent Laying-Open No. 57-37464
Patent Document 2: Japanese Patent Laying-Open No. 53-40335
Patent Document 3: Japanese Utility Model Laying-Open No. 59-26676
Patent Document 4: Japanese Patent Application JP 36-19067 B1

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0010] In an artificial shuttlecock employing the artificial feather for a shuttlecock disclosed in the aforementioned Patent Document 1 or Patent Document 2, however, feather body portions of artificial feathers may have interlaced (the stacked state (arrangement) of the artificial feathers may have been locally replaced) according to an experiment made by the inventor when the shuttlecock has been used in practice, since the strength of the artificial feathers is low as compared with that of natural feathers. This interlacement of the feather body portions is described with reference to Fig. 32. Fig. 32 is a partially fragmented schematic sectional view for illustrating a state where feather body portions of artificial feathers interlace with each other. Fig. 32 corresponds to Fig. 31.

[0011] When a conventional artificial shuttlecock is used, the order of stacking of feather body portions 5 may have

been replaced (may have interlaced) as shown at an interlacing portion 150 of Fig. 32, since the strength of artificial feathers 3 is low as compared with that of natural feathers. It has follows that, when such interlacement takes place, the shuttlecock hit with a racket does not normally revolve and flight characteristics thereof remarkably deteriorate. Also in the artificial shuttlecock disclosed in Patent Document 3, the aforementioned problem of interlacement of feather body portions conceivably takes place in a similar manner. Deterioration of flight characteristics resulting from such interlacement of feather body portions or the like has been particularly remarkable in the aforementioned artificial shuttlecock as compared with the natural shuttlecock.

[0012] The present invention has been proposed in order to solve the aforementioned problem, and an object of the present invention is to provide a shuttlecock for badminton capable of maintaining initial flight performance over a long period of time.

MEANS FOR SOLVING THE PROBLEMS

[0013] A shuttlecock for badminton according to the present invention includes a hemispherical base body and a plurality of artificial feathers. The plurality of artificial feathers include feather portions and shafts connected to the feather portions. The plurality of artificial feathers are fixed to the base body, to be annularly arranged and to partially overlap with each other. Welding portions fixing overlapping parts of the feather portions are formed by at least partially melting and thereafter solidifying mutually overlapping parts in the feather portions of the artificial feathers.

[0014] Thus, a stacked state and the shape of the artificial feathers can be maintained in the initial states by forming the welding portions functioning as stacked state fixing portions, also in the case of employing the artificial feathers whose shafts are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. Therefore, the flight performance of the shuttlecock can be inhibited from deterioration resulting from replacement of the stacked state of the artificial feathers or deformation of the artificial feathers.

[0015] The welding portions, fixing adjacent artificial feathers to each other in order to maintain the stacked state of the plurality of artificial feathers, function also as reinforcing members. Therefore, the strength of the shuttlecock so improves that the durability of the shuttlecock can be improved as a result.

[0016] Further, the welding portions can be formed without performing prearrangement or the like of an adhesive or the like, by at least partially melting-resolidifying stacked parts of the artificial feathers. Therefore, manufacturing steps for the shuttlecock can be simplified.

[0017] Another shuttlecock for badminton according to the present invention includes a hemispherical base body and a plurality of artificial feathers. The plurality of artificial feathers include feather portions and shafts connected to the feather portions. The plurality of artificial feathers are fixed to the base body, so that the same are annularly arranged and adjacent feather portions partially overlap with each other. Bonding portions prepared by at least partially connecting mutually overlapping parts in the feather portions with a bonding layer are formed.

[0018] Thus, a stacked state and the shape of the artificial feathers can be maintained in the initial states by forming the bonding portions functioning as stacked state fixing portions, also in the case of employing the artificial feathers whose shafts are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. Therefore, the flight performance of the shuttlecock can be inhibited from deterioration resulting from replacement of the stacked state of the artificial feathers or deformation of the artificial feathers.

[0019] The bonding portions, fixing adjacent artificial feathers to each other in order to maintain the stacked state of the plurality of artificial feathers, function also as reinforcing members. Therefore, the strength of the shuttlecock so improves that the durability of the shuttlecock can be improved as a result.

[0020] The bonding portions for maintaining the stacked state of the artificial feathers can be easily formed by arranging the bonding layer on a prescribed position and arranging the plurality of artificial feathers to partially overlap with each other. Therefore, manufacturing steps for the shuttlecock can be simplified.

[0021] Still another shuttlecock according to the present invention includes a hemispherical base body, a plurality of artificial feathers, and a cordlike body. The plurality of artificial feathers include feather portions and shafts connected to the feather portions. The plurality of artificial feathers are fixed to the base body, so that the same are annularly arranged and adjacent feather portions partially overlap with each other. The cordlike body regulates relative movement or modification of the feather portions in the plurality of artificial feathers.

[0022] Thus, the stacked manner of the artificial feathers can be maintained in the initial state by arranging the cordlike body functioning as a member maintaining the stacked state of the artificial feathers also in the case of employing the artificial feathers whose shafts are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. Therefore, the flight performance of the shuttlecock can be inhibited from deterioration resulting from replacement of the stacked state of the artificial feathers or the like.

[0023] A further shuttlecock for badminton according to the present invention includes a hemispherical base body, a plurality of artificial feathers and a stacked state fixing portion. The plurality of artificial feathers include feather portions and shafts connected to the feather portions. The plurality of artificial feathers are fixed to the base body, so that the

same are annularly arranged and adjacent feather portions partially overlap with each other. The stacked state fixing portion is employed for maintaining a stacked state of the artificial feathers.

[0024] Thus, the stacked state of the artificial feathers can be maintained in the initial state by forming the stacked state fixing portion also in the case of employing the artificial feathers whose shafts are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock, whereby the flight performance of the shuttlecock can be inhibited from deterioration resulting from replacement of the stacked state of the artificial feathers or the like. Further, it follows that the stacked state fixing portion relatively fixes the positions of adjacent artificial feathers in order to maintain the stacked state of the plurality of artificial feathers, whereby the same functions also as a reinforcing member. Therefore, the strength of the shuttlecock so improves that the durability of the shuttlecock can be improved as a result.

EFFECTS OF THE INVENTION

[0025] Thus, according to the present invention, the order of stacking, the arrangement, the shape etc. of the artificial feathers can be inhibited from changing by forming the stacked state fixing portion, whereby a shuttlecock for badminton employing artificial feathers, having flight performance and durability equivalent to those of a shuttlecock employing feathers of a waterfowl can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a schematic side elevational view showing a first embodiment of a shuttlecock according to the present invention.

Fig. 2 is a partially fragmented schematic sectional view showing a welding/fixing portion of the shuttlecock shown in Fig. 1.

Fig. 3 is a partially fragmented schematic sectional view showing a modification of the first embodiment of the shuttlecock according to the present invention shown in Figs. 1 and 2.

Fig. 4 is a schematic side elevational view showing another modification of the first embodiment of the shuttlecock according to the present invention shown in Figs. 1 and 2.

Fig. 5 is a schematic top plan view of the shuttlecock shown in Fig. 4.

Fig. 6 is a schematic diagram for illustrating a modification of the welding/fixing portion in the first embodiment of the shuttlecock according to the present invention.

Fig. 7 is a schematic diagram for illustrating another modification of the welding/fixing portion in the first embodiment of the shuttlecock according to the present invention.

Fig. 8 is a schematic diagram for illustrating still another modification of the welding/fixing portion in the first embodiment of the shuttlecock according to the present invention.

Fig. 9 is a schematic diagram for illustrating a further modification of the welding/fixing portion in the first embodiment of the shuttlecock according to the present invention.

Fig. 10 is a schematic diagram for illustrating a further modification of the welding/fixing portion in the first embodiment of the shuttlecock according to the present invention.

Fig. 11 is a schematic top plan view showing the structure of an artificial feather for a shuttlecock constituting the shuttlecock shown in Figs. 1 and 2.

Fig. 12 is a schematic sectional view taken along the line XII-XII in Fig. 11.

Fig. 13 is a schematic sectional view taken along the line XIII-XIII in Fig. 11.

Fig. 14 is a schematic sectional view taken along the line XIV-XIV in Fig. 11.

Fig. 15 is a schematic sectional view taken along the line XV-XV in Fig. 11.

Fig. 16 is a schematic side elevational view showing a second embodiment of the shuttlecock according to the present invention.

Fig. 17 is a partially fragmented schematic sectional view showing a bonding/fixing portion of the shuttlecock shown in Fig. 16 fixed by a bonding member.

Fig. 18 is a schematic side elevational view showing a third embodiment of the shuttlecock according to the present invention.

Fig. 19 is a schematic top plan view of the shuttlecock shown in Fig. 18.

Fig. 20 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 18 where an intermediate thread is arranged.

Fig. 21 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 18 where an inner thread is arranged.

Fig. 22 is a schematic side elevational view showing a modification of the third embodiment of the shuttlecock according to the present invention shown in Figs. 18 and 19.
Fig. 23 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 22 where an outer thread is set.
Fig. 24 is a schematic side elevational view showing a fourth embodiment of the shuttlecock according to the present invention.
Fig. 25 is a schematic side elevational view showing a modification of the fourth embodiment of the shuttlecock shown in Fig. 24.
Fig. 26 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 25 where a fixing thread is arranged.
Fig. 27 is a schematic top plan view showing a fifth embodiment of the shuttlecock according to the present invention.
Fig. 28 is a schematic top plan view showing the structure of an artificial feather for a shuttlecock constituting the shuttlecock shown in Fig. 27.
Fig. 29 is a schematic top plan view showing a modification of the fifth embodiment of the shuttlecock according to the present invention shown in Fig. 27.
Fig. 30 is a schematic side elevational view showing a natural shuttlecock.
Fig. 31 is a partially fragmented schematic sectional view showing an overlapping state of feathers of the natural shuttlecock.
Fig. 32 is a partially fragmented schematic sectional view for illustrating a state where feather body portions of artificial feathers interlace with each other.

DESCRIPTION OF THE REFERENCE SIGNS

[0027] 1, 101 shuttlecock, 2, 102 base body, 3 artificial feather, 5, 105 feather body portion, 7, 107 shaft, 8 stem portion, 9 sheetlike member, 10 fixed shaft portion, 12 protruding portion, 15 intermediate thread, 17 inner thread, 19 outer thread, 21 fixing thread, 31 bonding/fixing portion, 33 bonding member, 41 welding/fixing portion, 43 reinforcing member, 50 extensional portion, 103 natural feather, 150 interlacing portion

BEST MODES FOR CARRYING OUT THE INVENTION

[0028] Embodiments and Examples of the present invention are now described with reference to the drawings. In the following drawings, identical or corresponding portions are denoted by the same reference numerals, and redundant description is not repeated.

(First Embodiment)

[0029] Fig. 1 is a schematic side elevational view showing a first embodiment of a shuttlecock according to the present invention. Fig. 2 is a partially fragmented schematic sectional view showing a welding/fixing portion of the shuttlecock shown in Fig. 1. The first embodiment of the shuttlecock according to the present invention is described with reference to Figs. 1 and 2.

[0030] Referring to Figs. 1 and 2, a shuttlecock 1 according to the present invention consists of a hemispherical base body 2 and a plurality of artificial feathers 3 for a shuttlecock connected to a planar surface of base body 2, and is further provided with welding/fixing portions 41 for maintaining a stacked state of the plurality of artificial feathers. Base body 2 is made of cork, for example. Plurality of (e.g. 16) artificial feathers 3 are annularly connected to the planar surface of base body 2. As understood from Figs. 1 and 2, plurality of artificial feathers 3 are so arranged that the intervals therebetween enlarge (the inner diameter of a cylindrical portion formed by plurality of artificial feathers 3 enlarges as separating from base body 2) as separating from base body 3. Further, stem portions 8 (see Fig. 11) of plurality of artificial feathers 3 are fixed to each other by a binding thread such as a cotton thread. Welding/fixing portions 41, each having an elliptical plane shape, are formed by partially melting and resolidifying stacked feather body portions 5 with a welder or the like. In other words, materials constituting feather body portions 5 are partially melted/solidified to be fixed to each other in welding/fixing portions 41. The plane shape of welding/fixing portions 41 can be brought into an arbitrary shape, as described later.

[0031] Thus, the flight performance of shuttlecock 1 can be inhibited from deterioration resulting from replacement of the stacked state of artificial feathers 3 or deformation or artificial feathers 3. In shuttlecock 1 shown in Figs. 8 and 2, it is not necessary to carry out a step of previously arranging an adhesive or the like on the surfaces of feather body portions 5 in manufacturing steps therefor, whereby the manufacturing steps can be further simplified.

[0032] Fig. 3 is a partially fragmented schematic sectional view showing a modification of the first embodiment of the shuttlecock according to the present invention shown in Figs. 1 and 2. The modification of the first embodiment of the

shuttlecock according to the present invention is described with reference to Fig. 3.

[0033] While a shuttlecock 1 shown in Fig. 3 basically has a structure similar to that of shuttlecock 1 shown in Figs. 1 and 2, the structure of and a manufacturing method for each welding/fixing portion 41 are different. In other words, shuttlecock 1 shown in Fig. 3 is in such a state that a reinforcing member 43 is arranged between stacked feather body portions 5 in welding/fixing portion 41. This reinforcing member 43 is formed by arranging a resin segment of polypropylene or the like on the stacked parts of corresponding feather body portions 5 and heating and resolidifying the same with feather body portions 5, for reinforcing welding/fixing portion 41. For example, a resin sheet of polypropylene having a quadrangular shape of 4 mm by 4 mm and a thickness of 200 μm or the like can be employed as reinforcing member 43. The strength of welding/fixing portion 41 can be improved by arranging such reinforcing member 43. Consequently, the durability of shuttlecock 1 can be improved.

[0034] While arbitrary resin can be employed as aforementioned reinforcing member 43, a film of polypropylene (PP) or the like can be employed, for example. Feather body portions 5 and the polypropylene film as reinforcing member 43 can be welded by holding such a film between previously stacked feather body portions 5 and heating this portion with a welder or the like.

[0035] A material different from the material constituting feather body portions 5 and lower in melting point than the material constituting feather body portions 5 is preferably employed for such reinforcing member 43. Thus, welding/fixing portion 41 can be formed in a state relatively reducing the quantity of heat applied to welding/fixing portion 41. In this case, the material constituting feather body portions 5 itself is not completely melted, but it follows that welding/fixing portion 41 is formed by melting and resolidification of reinforcing member 43.

[0036] As a method of forming such welding/fixing portion 41, the following method can be employed, for example: In other words, a film of a prescribed size (a quadrangular film having a size of about 4 mm by 4 mm, for example) is prepared as reinforcing member 43, and this film is temporarily fastened to prescribed positions of feather body portions 5. A remarkably small quantity of adhesive or tackifier, for example, can be employed for this temporary fastening. Then, stacked parts in a three-layer structure of a feather body portion 5, reinforcing member 43 and another feather body portion 5 are pressed and heated with a hand-type ultrasonic welder or the like. Thus, welding/fixing portion 41 can be formed.

[0037] Such reinforcing member 43 is extremely lightweight such that the mass thereof about 0.04 g in a case of employing the aforementioned polypropylene film, for example. Therefore, reinforcing member 43 hardly influences the mass balance of the shuttlecock.

[0038] Fig. 4 is a schematic side elevational view showing another modification of the first embodiment of the shuttlecock according to the present invention shown in Figs. 1 and 2. Fig. 5 is a schematic top plan view of the shuttlecock shown in Fig. 4. Another modification of the first embodiment of the shuttlecock according to the present invention is described with reference to Figs. 4 and 5.

[0039] While a shuttlecock 1 shown in Figs. 4 and 5 basically has a structure similar to that of shuttlecock 1 shown in Figs. 1 and 2, an inner thread 17 for preventing feather portions of artificial feathers 3 from bending (curling) inward is arranged in addition to welding/fixing portions 41.

[0040] Inner thread 17 encircles shafts of artificial feathers 3. Inner thread 17 is arranged to reach the shafts of adjacent artificial feathers 3 from inner peripheral sides of annularly arranged plurality of artificial feathers 3 and to successively encircle the shafts. Thus, inner thread 17 is arranged along the inner peripheral sides of annularly arranged artificial feathers 3, as understood from Figs. 4 and 5. Therefore, feather body portions of artificial feathers 3 can be inhibited from bending toward the inner peripheral sides (the sides where inner thread 17 is positioned) in use of shuttlecock 1. Consequently, occurrence of such a problem that the characteristics of shuttlecock 1 such as air resistance remarkably change can be more reliably suppressed.

[0041] Figs. 6 to 10 are schematic diagrams for illustrating modifications of each welding/fixing portion in the first embodiment of the shuttlecock according to the present invention shown in Figs. 1 and 2. The modifications of each welding/fixing portion 41 of shuttlecock 1 according to the present invention are now described.

[0042] A welding/fixing portion 41 of a shuttlecock shown in Fig. 6 has a quadrangular plane shape. Corner portions are rounded in welding/fixing portion 41. Welding/fixing portion 41 in artificial feathers 3 is arranged on regions of feather body portions 5, each having a length L0 in a direction along shafts 7, closer to a base body 2 (not shown) from central portions in the direction along shafts 7. The length L1 of the regions where welding/fixing portion 41 is arranged in the direction along shafts 7 is preferably set to at least 40 % and not more than 65 %, more preferably at least 40 % and not more than 50 % of aforementioned length L0. Welding/fixing portion 41 is at least partially formed on regions closer to shafts 7 than intermediate points between shafts 7 and end portions (portions, most separating from shafts 7, of outer peripheral parts of feather body portions 6 opposed to shafts 7 in Fig. 6) of feather body portions 5. In other words, consider a central axis 22 of one of shafts 7 shown in Fig. 6 and a line segment 23, parallel to central axis 22, passing through an end portion of corresponding feather body portion 5 most separating from shaft 7 in the width direction. When defining a line segment 24, parallel to central axis 22, passing through an intermediate point between central axis 22 and line segment 23, welding/fixing portion 41 is preferably at least partially positioned in a region of feather body portion

5 held between line segment 24 and shaft 7.

[0043] A welding/fixing portion 41 of a shuttlecock shown in Fig. 7 has a rectangular (or linear) plane shape. Welding/fixing portion 41 extends in a direction along shafts 7. When such a shape is employed, an overlapping state of feather body portions 5 can be maintained as to a wide range in the direction along shafts 7.

[0044] A welding/fixing portion 41 of a shuttlecock shown in Fig. 8 has a triangular plane shape. One side of the outer periphery of welding/fixing portion 41 extends in a direction along shafts 7, and a corner portion of welding/fixing portion 41 opposed to the side extending in the direction along shafts 7 is arranged on a position closer to a base body 2 (not shown) than a central portion of this side. Such a shape is so employed that an effect of dispersing a load applied to welding/fixing portion 41 can be attained.

[0045] A welding/fixing portion 41 of a shuttlecock shown in Fig. 9 is constituted of a plurality of dotlike fixing portions. While each fixing portion has a circular plane shape, another arbitrary shape may alternatively be employed. Regions where the fixing portions are arranged may be rectangular or elliptical regions extending in a direction along shafts 7. Thus, an overlapping state of feather body portions 5 can be maintained as to wide regions (regions where the dotlike fixing portions are distributed) in a state reducing the area (total area of the dotlike fixing portions) of actually welded portions.

[0046] A welding/fixing portion 41 of a shuttlecock shown in Fig. 10 is constituted of two quadrangular fixing portions. While each fixing portion has a quadrangular plane shape, another arbitrary shape (circular, elliptical or polygonal, for example) may alternatively be employed. The sizes of the individual fixing portions may not be rendered identical to each other, but fixing portions different in size from each other may be plurally arranged by two or at least three. Such a shape is so employed that, even if one of the individual fixing portions comes off, for example, the remaining fixing portion functions and the shape of the shuttlecock can be maintained. It is also possible to arrange welding/fixing portion 41 in wide ranges of feather body portions 5 while suppressing increase in mass of the shuttlecock.

[0047] The aforementioned shapes of welding/fixing portions 41 are illustrative, and each welding/fixing portion 41 can be brought into another arbitrary shape. The conditions of the regions where welding/fixing portion 41 is arranged as described in Fig. 6 are also applicable to welding/fixing portions 41 shown in Figs. 7 to 10.

[0048] The structure of each artificial feather 3 constituting shuttlecock 1 shown in Figs. 1 and 2 is now described. Fig. 11 is a schematic plan view showing the structure of the artificial feather for a shuttlecock constituting the shuttlecock shown in Figs. 1 and 2. Fig. 12 is a schematic sectional view taken along the line XII-XII in Fig. 11. Fig. 13 is a schematic sectional view taken along the line XIII-XIII in Fig. 11. Fig. 14 is a schematic sectional view taken along the line XIV-XIV in Fig. 11. Fig. 15 is a schematic sectional view taken along the line XV-XV in Fig. 11.

[0049] Referring to Figs. 11 to 15, artificial feather 3 constituting shuttlecock 1 shown in Figs. 1 and 2 consists of feather body portion 5 and shaft 7 connected to feather body portion 5. Shaft 7 consists of stem portion 8 arranged to protrude from feather body portion 5 and a fixed shaft portion 10 connected to feather body portion 5 at a substantially central portion of feather body portion 5. Stem portion 8 and fixed shaft portion 10 are arranged to extend on the same line, and constitute one continuous shaft 7.

[0050] A protruding portion 12 held in a state embedded in stem portion 8 is connected to feather body portion 5. Feather body portion 5 and protruding portion 12 constitute one sheetlike member 9.

[0051] In shaft 7, the diameter thereof gradually reduces from the base (the right end portion in Fig. 12 or an end portion of stem portion 8 opposite to the side connected with fixed shaft portion 10) toward the forward end portion (the left end portion in Fig. 12 or an end portion of fixed shaft portion 10 opposite to the side connected with stem portion 8), as shown in Fig. 12. The sectional shape of shaft 7 in a direction intersecting with (a direction orthogonal to) the extensional direction is quadrangular, more specifically rhomboid, as shown in Figs. 13 to 15. The sectional shape of shaft 7 is not restricted to the aforementioned quadrangular shape, but an arbitrary shape can be employed. For example, it is also possible to employ such an elliptical shape or the like that the length in a direction (the vertical direction in Fig. 13) intersecting with the extensional direction of sheetlike member 9 is larger than the length in the extensional direction (the transverse direction in Fig. 13) of this sheetlike member as the sectional shape of shaft 7.

[0052] As shown in Figs. 12 and 13 as to shaft 7, sheetlike member 9 is in a state embedded in shaft 7 (a state where sheetlike member 9 is embedded to have an annular sectional shape in shaft 7) on the base side of shaft 7. However, sheetlike member 9 is in a state exposed on the surface of shaft 7 (sheetlike member 9 is in a state brought into contact with and fixed to the surface of shaft 7) as directed toward the forward end portion of shaft 7, as shown in Figs. 14 and 15.

[0053] The arrangement of sheetlike member 9 in shaft 7 is not restricted to the state where sheetlike member 9 is embedded in shaft 7 on the base side of shaft 7 and sheetlike member 9 is the state exposed on the surface of shaft 7 on a central portion and the side of the forward end portion of shaft 7 as shown in Figs. 11 to 15, but may be in another mode. For example, sheetlike member 9 may be in such a state that the same is embedded in shaft 7 on the base side and the central portion of shaft 7 while sheetlike member 9 is exposed on the surface of shaft 7 on the side of the forward end portion of shaft 7. Alternatively, sheetlike member 9 may be in a state embedded in shaft 7 in all portions of the base side, the central portion and the side of the forward end portion of shaft 7.

[0054] A method of manufacturing shuttlecock 1 and each artificial feather 3 for a shuttlecock shown in Figs. 1, 2 and

11 to 15 are now briefly described. First, the method of manufacturing artificial feather 3 for a shuttlecock according to the present invention shown in Fig. 11 is described.

[0055] In this method of manufacturing artificial feather 3, a nonwoven fabric preparation step (S10) is first carried out. While a sheetlike member having an arbitrary shape can be employed as nonwoven fabric prepared in this step (S10), nonwoven fabric having a substantially quadrangular plane shape whose four corners are roundly formed may be prepared, for example. The thickness of this nonwoven fabric can be properly selected in consideration of air resistance and mass balance of formed artificial feather 3. Further, nonwoven fabric consisting of chemical fiber such as polyester fiber or acrylic fiber can be employed as the nonwoven fabric. For example, that having a surface density of at least 10 g/m^2 and not more than 90 g/m^2 can be employed as the nonwoven fabric. Further, that of polyester fiber having a surface density of at least 30 g/m^2 and not more than 80 g/m^2 and a thickness of at least 0.07 mm and not more than 0.13 mm can also be employed as the nonwoven fabric, for example. As nonwoven fabric of polyester fiber, that preferably having a surface density of at least 40 g/m^2 and not more than 60 g/m^2 and a thickness of at least 0.08 mm and not more than 0.12 mm, more preferably having a surface density of at least 40 g/m^2 and not more than 50 g/m^2 an a thickness of at least 0.09 mm and not more than 0.11 mm may be employed.

[0056] In place of the nonwoven fabric, silk fabric, natural fiber of cotton or the like, cellulose fiber (the so-called paper) or that prepared by coating such a material with resin or the like may be employed. In place of the nonwoven fabric, further, it is also possible to employ a resin film (whose thickness is at least 50 μm and not more than 100 μm) such as a polyamide resin film, a polyester resin film or a PET film. Further, a material prepared by forming a coating layer on the surface of the aforementioned arbitrary nonwoven fabric may be employed as the nonwoven fabric. A method of laminating (coextrusion-molding) a resin film on nonwoven fabric, for example, can be employed as a method of forming the coating layer. The coating layer of the resin film or the like may be formed on one surface of the nonwoven fabric, or may be formed on each surface. The coating layer may be formed only on a specific portion of one surface or each surface.

[0057] Then, a step (S20) of arranging the nonwoven fabric in a mold is carried out. In this step (S20), the nonwoven fabric prepared in the aforementioned step (S 10) is arranged in the mold for forming shaft 7 by injection molding or the like, for example.

[0058] Then, a mold setting step (S30) is carried out. More specifically, the mold in which the nonwoven fabric is arranged is arranged in a state where resin constituting shaft 7 is injectable into the inner portion, and temperature conditions etc. for the mold are adjusted.

[0059] Then, a resin injection step (S40) is carried out. More specifically, the resin is injected into the mold from a resin injection hole provided on the mold. Consequently, shaft 7 is formed in a state in contact with and fixed to sheetlike member 9 consisting of the nonwoven fabric in the mold.

[0060] Then, a posttreatment step (S50) is carried out. More specifically, sheetlike member 9 to which shaft 7 is connected, fixed and bonded is taken out from the mold. At this time, the section of shaft 7 is in the state shown in Figs. 13 to 15. In other words, shaft 7 is connected with sheetlike member 9 substantially over the total length thereof. In shaft 7, sheetlike member 9 is in the state embedded in shaft 7 on the base side of shaft 7, as described above. As directed toward the side of the forward end of shaft 7, on the other hand, sheetlike member 9 enters the state exposed on the surface of shaft 7. Particularly on the side of the forward end of shaft 7, sheetlike member 9 is in a state fixed to the surface of shaft 7. Such a structure can be implemented through the shape of a groove for forming shaft 7 in the mold and the arrangement of the nonwoven fabric for forming sheetlike member 9. Then, unnecessary portions (portions other than a portion to form feather body portion 5) of the aforementioned nonwoven fabric are cut and removed in the aforementioned posttreatment step (S50). Consequently, artificial feather 3 shown in Fig. 11 can be obtained.

[0061] The method of manufacturing shuttlecock 1 shown in Fig. 1 is now described. In the method of manufacturing shuttlecock 1 shown in Fig. 1, a preparation step (S100) is first carried out. In this preparation step (S100), components of shuttlecock 1 such as base body 2 and artificial feathers 3 of shuttlecock 1 are prepared. A well-known arbitrary method can be employed as a method of manufacturing base body 2. The aforementioned manufacturing method can be employed as the method of manufacturing artificial feathers 3.

[0062] Then, an assembling step (S200) is carried out. In this assembling step (S200), aforementioned artificial feathers 3 are plurally connected to the planar surface portion of base body 2. Artificial feathers 3 are annularly arranged as shown in Figs. 1 and 2. Stem portions 8 of plurality of artificial feathers 3 are fixed to each other with the binding thread of cotton or the like.

[0063] In the aforementioned assembling step (S200), welding/fixing portions 41 are formed with a welder or the like as to overlapping regions in feather body portions 5 of artificial feather 3, in order to further maintain the stacked state of artificial feathers 3. Thus, shuttlecock 1 shown in Figs. 1 and 2 can be manufactured.

(Second Embodiment)

[0064] Fig. 16 is a schematic side elevational view showing a second embodiment of the shuttlecock according to the

present invention. Fig. 17 is a partially fragmented schematic sectional view showing a bonding/fixing portion of the shuttlecock shown in Fig. 16 fixed by a bonding member. The second embodiment of the shuttlecock according to the present invention is described with reference to Figs. 16 and 17.

[0065] As shown in Figs. 16 and 17, a shuttlecock 1 basically has a structure similar to that of shuttlecock 1 shown in Figs. 1 and 2, while the same is different in a point that not welding/fixing portions 41 but bonding/fixing portions 31 are formed as a mechanism for maintaining a stacked state of artificial feathers 3. In other words, bonding/fixing portions 31 arranging a bonding member 33 between stacked feather body portions 5 are formed on stacked parts of feather body portions 5 of annularly arranged artificial feathers 3 on sides closer to a base body 2 than central portions of feather body portions 5, as shown in Fig. 16. In each bonding/fixing portion 31, stacked feather body portions 5 are bonded/fixed to each other through bonding member 33, as shown in Fig. 17. Also in this case, effects similar to those of shuttlecock 1 shown in Figs. 1 and 2 can be attained.

[0066] The plane shape of each of aforementioned bonding/fixing portions 31 can be brought into an arbitrary shape (the shape shown in each of Figs. 6 to 10, for example), similarly to each welding/fixing portion 41 in the first embodiment. While a method of manufacturing shuttlecock 1 shown in Figs. 16 and 17 is basically similar to the method of manufacturing the shuttlecock shown in Figs. 1 and 2, each bonding/fixing portion 31 is formed by arranging bonding member 33 on prescribed positions of artificial feathers 3 and bonding/fixing artificial feathers 3 to each other with bonding member 33, in place of forming each welding/fixing portion 41 in the aforementioned assembling step (S200). Thus, the shuttlecock shown in Figs. 16 and 17 can be obtained.

(Third Embodiment)

[0067] Fig. 18 is a schematic side elevational view showing a third embodiment of the shuttlecock according to the present invention. Fig. 19 is a schematic top plan view of the shuttlecock shown in Fig. 18. Fig. 20 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 18 where an intermediate thread is arranged. Fig. 21 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 18 where an inner thread is arranged. The third embodiment of the shuttlecock according to the present invention is described with reference to Figs. 18 to 21.

[0068] While a shuttlecock 1 shown in Figs. 18 to 21 basically has a structure similar to that of shuttlecock 1 shown in Fig. 15, a fixing method for fixing stacked parts (overlapping parts) in feather body portions 5 of artificial feathers 3 is different. In other words, an intermediate thread 15 and an inner thread 17 are employed in order to maintain a stacked state of plurality of artificial feathers 3. Intermediate thread 15 and inner thread 17 are so arranged as to regulate the positional relation between plurality of artificial feathers 3, as described later. The arrangement of intermediate thread 15 and inner thread 17 is now specifically described with reference to Figs. 20 and 21.

[0069] As shown in Fig. 20, intermediate thread 15 encircles shafts 7 of artificial feathers 3, and is so arranged as to pass through regions where feather body portions 5 of adjacent artificial feathers 3 are opposed to each other (to pass through the spaces between stacked feather body portions 5) in parts of feather body portions 5 in a stacked state in adjacent artificial feathers 3. Intermediate thread 15 passes through the spaces between stacked feather body portions 5 on the parts where feather body portions 5 are thus stacked, whereby occurrence of such a problem that the order of stacking of feather body portions 5 is replaced (the order of stacking of feather body portions 5 is replaced by an impact of hitting with a racket, for example) during use of the shuttlecock can be suppressed.

[0070] As shown in Fig. 21, inner thread 17 encircles shafts 7 of artificial feathers 3, similarly to intermediate thread 15 shown in Fig. 20. Inner thread 17 is so arranged as to reach shafts 7 of adjacent other artificial feathers 3 from inner peripheral sides of annularly arranged plurality of artificial feathers 3 and to successively encircle shafts 7. Thus, inner thread 17 is arranged along inner peripheral sides of annularly arranged artificial feathers 3, as understood from Figs. 19 and 21. Therefore, feather body portions 5 of artificial feathers 3 can be inhibited from bending toward the inner peripheral sides (the sides where inner thread 17 is positioned) in the use of shuttlecock 1. Consequently, occurrence of such a problem that the characteristics of shuttlecock 1 such as air resistance remarkably change can be suppressed.

[0071] Aforementioned intermediate thread 15 and inner thread 17 are circumferentially arranged to fix all of annularly arranged plurality of artificial feathers 3 to each other, as shown in Figs. 18 and 19. An operator sews intermediate thread 15 and inner thread 17 with a needle or the like, for example, so that the same can be brought into the arrangement shown in Figs. 18 to 21. Sewing start end portions and sewing finish end portions of circumferentially arranged intermediate thread 15 and inner thread 17 are connected with each other, and the remaining portions of the threads are cut and removed in the vicinity of the knots. Protective layers are preferably formed on the knots by applying an adhesive or the like. Such protective layers are so formed that the knots can be prevented from coming loose when shuttlecock 1 is hit with a racket.

[0072] While an arbitrary material such as cotton or resin can be employed for intermediate thread 15 and inner thread 17, threads of polyester are preferably employed. Further, those as lightweight as possible are preferably employed as intermediate thread 15 and inner thread 17, in order to influence the center of gravity etc. of shuttlecock 1 as slightly as

possible. For example, polyester threads No. 50 may be employed as the employed threads. In this case, the mass of the thread used as intermediate thread 15 is about 0.02 g. If the mass is at about this level, the flight performance is conceivably hardly influenced, although the position of the center of gravity of shuttlecock 1 is slightly influenced.

[0073] While intermediate thread 15 and inner thread 17 may be arranged on positions different in distance from base body 2 from each other as shown in Figs. 18 and 19, intermediate thread 15 and inner thread 17 may alternatively be arranged on positions substantially identical in distance from base body 2 to each other. In a case of fixing the order of stacking of artificial feathers 3 and utilizing intermediate thread 15 and inner thread 17 also as strength members, however, the distances of intermediate thread 15 and inner thread 17 from base body 2 are preferably different from each other. In consideration of prevention of inward bending (curling) of feather body portions 5 of artificial feathers 3, it is more effective to arrange inner thread 17 on a position more separating from base body 2 than intermediate thread 15.

[0074] While a method of manufacturing shuttlecock 1 shown in Figs. 18 to 21 is basically similar to the method of manufacturing the shuttlecock shown in Figs. 1 and 2, a step of arranging intermediate thread 15 and inner thread 17 is carried out in place of forming welding/fixing portions 41 in the aforementioned assembling step (S200). Intermediate thread 15 and inner thread 17 may be arranged by the sewing operation of the operator, for example. While an arbitrary material can be employed for inner thread 17 and intermediate thread 15, cotton or resin such as polyester can be employed as the material as described above, for example. Thus, shuttlecock 1 shown in Figs. 18 and 19 can be manufactured.

[0075] Fig. 22 is a schematic side elevational view showing a modification of the third embodiment of the shuttlecock according to the present invention shown in Figs. 18 and 19. Fig. 23 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 22 where an outer thread is set. The modification of the third embodiment of shuttlecock 1 according to the present invention is described with reference to Figs. 22 and 23.

[0076] While a shuttlecock 1 shown in Figs. 22 and 23 basically has a structure similar to that of shuttlecock 1 shown in Figs. 18 and 19, the same is different in a point that an outer thread 19 is further set in addition to an intermediate thread 15 and an inner thread 17, in order to hold a stacked state and the shape of artificial feathers 3. In other words, outer thread 19 encircles shafts 7 of artificial feathers 3 as understood from Fig. 23, and is arranged to encircle shafts 7 of adjacent artificial feathers 3 again through outer peripheral sides of artificial feathers 3 as shown in Fig. 22 or the like. Thus, occurrence of such a problem that feather body portions 5 of artificial feathers 3 bend toward the outer peripheral sides can be suppressed.

[0077] A thread identical in material and thickness to aforementioned intermediate thread 15 or the like can be employed as outer thread 19. Outer thread 19 is also set by a method such as a sewing operation by an operator, similarly to aforementioned intermediate thread 15 or the like.

(Fourth Embodiment)

[0078] Fig. 24 is a schematic side elevational view showing a fourth embodiment of the shuttlecock according to the present invention. The fourth embodiment of the shuttlecock according to the present invention is described with reference to Fig. 24.

[0079] While a shuttlecock 1 shown in Fig. 24 basically has a structure similar to that of shuttlecock 1 shown in Figs. 1 and 2, the structure of a member for maintaining a stacked state of artificial feathers 3 is different. In other words, while welding/fixing portions 41 have been formed in order to maintain the stacked state and the shape of feather body portions 5 of artificial feathers 3 in shuttlecock 1 shown in Figs. 1 and 2, a plurality of artificial feathers 3 are in a state circumferentially sewn together with a fixing thread 21 on positions of feather body portions 5 closer to a base body 2 in shuttlecock 1 shown in Fig. 24. The stacked state of artificial feathers 3 can be easily maintained by sewing plurality of artificial feathers 3 together with such fixing thread 21. Consequently, effects similar to those of shuttlecock 1 shown in Figs. 1 and 2 can be attained.

[0080] Fig. 25 is a schematic side elevational view showing a modification of the fourth embodiment of the shuttlecock shown in Fig. 24. Fig. 26 is a partially fragmented schematic sectional view showing the structure of a portion of the shuttlecock shown in Fig. 25 where a fixing thread is arranged. The modification of the fourth embodiment of the shuttlecock according to the present invention is described with reference to Figs. 25 and 26.

[0081] Referring to Figs. 25 and 26, the modification of the fourth embodiment of the shuttlecock according to the present invention basically has a structure similar to that of shuttlecock 1 shown in Fig. 24, while the arrangement of fixing threads 21 is different. In other words, each fixing thread 21 sews each pair of stacked feather body portions 5 together to extend in a direction along the extensional direction of shafts 7 in parts of feather body portions 5 in a stacked state as to adjacent artificial feathers 3. The region on which fixing thread 21 is sewn extends to be substantially along the extensional direction of shafts 7. Also in this case, the stacked state of feather body portions 5 of artificial feathers 3 can be maintained in shuttlecock 1.

(Fifth Embodiment)

[0082] Fig. 27 is a schematic top plan view showing a fifth embodiment of the shuttlecock according to the present invention. Fig. 28 is a schematic plan view showing the structure of each artificial feather for a shuttlecock constituting the shuttlecock shown in Fig. 27. The fifth embodiment of the shuttlecock according to the present invention is described with reference to Figs. 27 and 28.

[0083] Referring to Figs. 27 and 28, a shuttlecock 1 basically has a structure similar to that of the shuttlecock shown in Figs. 1 and 2, while the shape of each artificial feather 3 and the arrangement of welding/fixing portions 41 for adjacent artificial feathers 3 are different from those of the shuttlecock shown in Figs. 1 and 2. In other words, each artificial feather 3 constituting shuttlecock 1 in this embodiment basically has a structure similar to that of artificial feather 3 shown in Fig. 11, while the shape of a feather body portion 5 is different. More specifically, an extensional portion 50 protruding toward an outer peripheral side is formed on feather body portion 5 in artificial feather 3 constituting shuttlecock 1 shown in Fig. 27, as shown in Fig. 28. Extensional portion 50 extends in a direction separating from a shaft 7 (specifically a direction intersecting with shaft 7, more specifically a direction orthogonal to shaft 7). In shuttlecock 1 shown in Fig. 27, extensional portions 50 of artificial feathers 3 extend up to positions beyond shafts 7 of other artificial feathers 3 on inner peripheral sides of adjacent other artificial feathers 3. On the positions beyond shafts 7, extensional portions 50 and feather body portions 5 of other artificial feathers 3 are connected/fixed to each other by welding/fixing portions 41. In each welding/fixing portion 41, a reinforcing member 43 may be arranged between extensional portion 50 and feather body portion 5 of another artificial feather 3, as shown in Fig. 3. The plane shape of welding/fixing portion 41 may be brought into an arbitrary shape shown in any of Figs. 8 to 10, for example.

[0084] As to the arrangement of welding/fixing portions 41, welding/fixing portions 41 are at least partially formed on regions closer to shafts 7 than intermediate points between shafts 7 and end portions (portions, most separating from shafts 7, of outer peripheral portions of the feather body portions opposed to shafts 7 in Fig. 27) of feather body portions 5 (see Fig. 28) in a width direction which is a direction perpendicular to shafts 7 (see Fig. 28) of artificial feathers 3. In other words, consider a central axis 22 of any shaft 7 shown in Fig. 27 and a line segment 23, parallel to central axis 22, passing through the end portion of the feather body portion most separating from shaft 7 in the width direction. When defining a line segment 24, parallel to central axis 22, passing through an intermediate point between central axis 22 and line segment 23, welding/fixing portion 41 is preferably at least partially positioned in a region of feather body portion 5 held between line segment 24 and shaft 7. The outer peripheral portions of the aforementioned feather body portions opposed to shafts 7 denote outer peripheral portions of regions not including extensional portions 50 in feather body portions 5.

[0085] Also in such a structure, a stacked state of feather body portions 5 of artificial feathers 5 can be maintained, similarly to shuttlecock 1 shown in Fig. 1. Further, welding/fixing portions 41 are arranged on the positions beyond shafts 7 of adjacent other artificial feathers 3, whereby the degree of freedom in the shape of artificial feathers 3 and the degree of freedom in the arrangement of welding/fixing portions 41 more enlarge as compared with the case where welded/fixed contents 41 are arranged in front of shafts 7 of other artificial feathers 3 as shown in Fig. 1. When the structure shown in Fig. 27 is employed, therefore, the angle of torsion of artificial feathers 3 can be maintained at a prescribed magnitude also on sides closer to forward ends from the centers of feather body portions 5 (sides of end portions in a direction separating from a base body 2). Further, welding/fixing portions 41 are formed on extensional portions 50 protruding from the outer peripheries of feather body portions 5, whereby the angle (angle of torsion) formed by feather body portions 5 as viewed from the extensional direction of shafts 7 can be sufficiently enlarged as to adjacent artificial feathers 3. In other words, a shape close to the shape of a natural shuttlecock can be implemented.

[0086] The shape of each extensional portion 50 is not restricted to the shape shown in Fig. 28, but can alternatively be brought into another arbitrary shape. For example, the width of a forward end portion (end portion in the direction separating from shaft 7) of each extensional portion 50 may be larger than the width of the remaining portion in extensional portion 50, in order to sufficiently enlarge the size of welding/fixing portion 41. As such a structure that a portion on one side is larger than a portion on another side as a whole (the width of the portion on one side is larger than the width of the portion on another side in a direction intersecting with shaft 7) as viewed from shaft 7 in each feather body portion 5, a part of the portion on one side extending up to a position beyond shaft 7 of adjacent another artificial feather 3 may be employed as extensional portion 50. Further, welding/fixing portions 41 may be arranged on positions not beyond shafts 7, similarly to shuttlecock 1 shown in Fig. 1.

[0087] Fig. 29 is a schematic top plan view showing a modification of the fifth embodiment of the shuttlecock according to the present invention shown in Fig. 27. The modification of the fifth embodiment of shuttlecock 1 according to the present invention is described with reference to Fig. 29.

[0088] While a shuttlecock 1 shown in Fig. 29 basically has a structure similar to that of shuttlecock 1 shown in Fig. 27, the same is different in a point that an inner thread 17 is set. Inner thread 17 can be arranged similarly to inner thread 17 set on shuttlecock 1 shown in Figs. 4 and 5. Thus, feather body portions of artificial feathers 3 can be inhibited from bending toward inner peripheral sides (sides where inner thread 17 is positioned), in addition to effects according to

shuttlecock 1 shown in Fig. 27. Consequently, occurrence of such a problem that the characteristics of shuttlecock 1 such as air resistance remarkably change can be more reliably suppressed. While Fig.

[0089] 29 has shown the example of applying inner thread 17 to shuttlecock 1 shown in Fig. 27, intermediate thread 15 shown in Fig. 18 etc. and outer thread 19 or the like shown in Fig. 22 may be set on shuttlecock 1 shown in Fig. 27. Intermediate thread 15, inner thread 17 and outer thread 19 may be applied to shuttlecock 1 shown in Fig. 27 in an arbitrary combination.

[0090] While welding/fixing portions 41 have been formed in shuttlecocks 1 shown in Figs. 27 and 29 as fixing portions for extensional portions 50 and feather body portions 5 of other artificial feathers 3, bonding/fixing portions 31 employing bonding member 33 shown in Fig. 17 may alternatively be formed as the fixing portions.

[0091] Characteristic structures of the present invention are now enumerated, although the same partially overlap with the aforementioned embodiments.

[0092] A shuttlecock 1 for badminton according to the present invention includes a hemispherical base body 2 and a plurality of artificial feathers 3. Plurality of artificial feathers 3 include feather portions and shafts 7 connected to the feather portions. Plurality of artificial feathers 3 are fixed to base body 2, to be annularly arranged and to partially overlap with each other. Welding/fixing portions 41 as welding portions fixing the overlapping parts of the feather portions are formed by at least partially melting and thereafter solidifying the mutually overlapping parts of the feather portions of artificial feathers 3.

[0093] Thus, a stacked state and the shape of artificial feathers 3 can be maintained in the initial states by forming welding/fixing portions 41 functioning as the welding portions, also in the case of employing artificial feathers 3 whose shafts 7 are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. Therefore, the flight performance of shuttlecock 1 can be inhibited from deterioration resulting from replacement of the stacked state of artificial feathers 3 or deformation of artificial feathers 3.

[0094] Welding/fixing portions 41, fixing adjacent artificial feathers 3 to each other in order to maintain the stacked state of plurality of artificial feathers 3, function also as strength members. Therefore, the strength of shuttlecock 1 so improves that the durability of shuttlecock 1 can be improved as a result.

[0095] Further, welding/fixing portions 41 can be formed without performing prearrangement or the like of an adhesive or the like, by at least partially melting·resolidifying the stacked parts of artificial feathers 3. Therefore, manufacturing steps for shuttlecock 1 can be simplified.

[0096] In aforementioned shuttlecock 1 for badminton, each welding/fixing portion 41 may be at least partially formed on regions closer to shafts 7 than intermediate points between shafts 7 and end portions of the feather portions in a width direction which is a direction perpendicular to shafts 7 of the feather portions, as shown in Fig. 6 or 27. More specifically, each welding/fixing portion 41 is preferably at least partially formed in the region held between line segment 24 and shaft 7 shown in Fig. 6 in feather body portion 5 when no extensional portion 50 shown in Fig. 26 is formed on feather body portion 5 as shown in Fig. 6 or the like. When extensional portions 50 are formed on feather body portions 5 as shown in Fig. 27, each welding/fixing portion 41 formed on each extensional portion 50 is preferably at least partially positioned on the region held between line segment 24 and shaft 7 shown in Fig. 27 in feather body portion 5. Welding/fixing portion 41 is more preferably formed in the region held between shaft 7 and line segment 24. In this case, it follows that the part of the feather portion outward beyond welding/fixing portion 41 has a sufficient width in artificial feather 3, and the angle of torsion of artificial feather 3 can be maintained.

[0097] In aforementioned shuttlecock 1 for badminton, welding/fixing portions 41 may include a reinforcing member 43 positioned between feather body portions 5 on mutually overlapping parts in adjacent feather body portions 5 and fixed to feather body portions 5. In this case, the strength of welding/fixing portions 41 can be sufficiently increased by arranging reinforcing member 43, even if the thickness of the stacked parts of artificial feathers 3 is small.

[0098] In aforementioned shuttlecock 1 for badminton, reinforcing member 43 may be melted and thereafter solidified to be fixed to said feather body portions 5.

[0099] In aforementioned shuttlecock 1 for badminton, the plane shape of welding/fixing portions 41 may be one selected from a group consisting of a polygonal shape, a circular shape, an oval shape and an elliptical shape. In shuttlecock 1 for badminton, the plane shape of welding/fixing portions 41 may be a quadrangular shape, a trapezoidal shape, a triangular shape, a polygonal shape of at least a pentagonal shape or another arbitrary shape. In welding/fixing portions 41 whose plane shape is polygonal, corner portions may be curved. The oval shape denotes such a shape (a shape similar to that of a track for athletics) that semicircles are connected to two opposed sides of a rectangle, and includes such a shape that the aforementioned rectangle is bent.

[0100] In aforementioned shuttlecock 1 for badminton, each welding/fixing portion 41 may consist of a plurality of welding portion parts. In aforementioned shuttlecock 1 for badminton, each welding/fixing portion 41 may consist of a plurality of dotlike welding portion parts.

[0101] Aforementioned shuttlecock 1 for badminton may further include a cordlike body (an intermediate thread 15, an inner thread 17 and an outer thread 19) regulating relative movement or deformation of feather body portions 5 in plurality of artificial feathers 3. In this case, the stacked state of plurality of artificial feathers 3 can be reliably maintained

by regulating relative movement or deformation of artificial feathers 3 with the cordlike body (intermediate thread 15, inner thread 17 and outer thread 19). Further, an extremely thin thread (a thread of cotton or a thread of resin such as polyester, for example) or the like can be utilized as the cordlike body, whereby a cordlike body having small mass or a small occupied volume can be employed. Therefore, changes in the position of the center of gravity or balance of shuttlecock 1 can be reduced to the utmost.

[0102] In aforementioned shuttlecock 1 for badminton, the cordlike body includes inner thread 17 as another cord member encircling respective shafts 7 (preferably fixed shaft portions 10) of plurality of artificial feathers 3 and arranged on inner peripheral sides of feather body portions 5 of annularly arranged plurality of artificial feathers 3. In this case, it follows that inner thread 17 is arranged along the inner peripheral sides of plurality of artificial feathers 3, whereby inner thread 17 can inhibit feather body portions 5 of artificial feathers 3 from bending toward the inner peripheral sides while shuttlecock 1 is used. Therefore, the flight performance of shuttlecock 1 can be prevented from changing due to bending of the feather portions. Consequently, the flight performance of shuttlecock 1 employing artificial feathers 3 can be stabilized, and the durability thereof can be improved.

[0103] In aforementioned shuttlecock 1 for badminton, the feather portions (more specifically, feather body portions 5 constituting the feather portions) of artificial feathers 3 may include extensional portions 50 protruding outward from outer peripheral portions of the feather portions and extending up to positions overlapping with the feather portions of annularly arranged other artificial feathers 3 (more specifically, feather body portions 5 of other artificial feathers 3), as shown in Figs. 27 to 29. Welding/fixing portions 40 may be formed on extensional portions 50. In this case, the stacked state and the shape of artificial feathers 3 can be maintained in the initial states, and the degree of freedom in deformation of artificial feathers 3 can be enlarged. Therefore, an angle of torsion close to the angle of torsion of feathers in a natural shuttlecock can be implemented while ensuring durability, whereby the flight performance can be approximated to that of the natural shuttlecock.

[0104] In aforementioned shuttlecock 1 for badminton, extensional portions 50 may extend from the outer peripheral portions of the feather portions up to positions beyond shafts 7 of other artificial feathers, as shown in Fig. 27 or 29. Welding/fixing portions 41 may be formed on the positions beyond shafts 7 of other artificial feathers 3 in extensional portions 50.

[0105] In aforementioned shuttlecock 1 for badminton, the feather portions of artificial feathers 3 may include extensional portions 50 extending up to positions beyond shafts 7 of annularly arranged other artificial feathers. Welding/fixing portions 41 may be formed on the positions beyond shafts 7 of other artificial feathers 3 in extensional portions 50. In this case, the angle of torsion of adjacent artificial feathers 3 can be sufficiently enlarged to an extent similar to the angle of torsion in a natural shuttlecock.

[0106] Another shuttlecock 1 for badminton according to the present invention includes a hemispherical base body 2 and a plurality of artificial feathers 3. Plurality of artificial feathers 3 include feather portions and shafts 7 connected to the feather portions. Plurality of artificial feathers 3 are fixed to base body 2 so that the same are annularly arranged and adjacent feather portions partially overlap with each other. Bonding/fixing portions 31 as bonding portions connecting at least partially connecting mutually overlapping parts in the feather portions of artificial feathers 3 with a bonding layer (bonding member 33) are formed.

[0107] Thus, a stacked state and the shape of artificial feathers 3 can be maintained in the initial states by forming bonding/fixing portions 31 also in the case of employing artificial feathers 3 whose shafts 7 are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. Therefore, the flight performance of shuttlecock 1 can be inhibited from deterioration resulting from replacement of the stacked state of artificial feathers 3 or deformation of artificial feathers 3.

[0108] Bonding/fixing portions 31, fixing adjacent artificial feathers 3 to each other in order to maintain the stacked state of plurality of artificial feathers 3, function also as strength members. Therefore, the strength of shuttlecock 1 so improves that the durability of shuttlecock 1 can be improved as a result.

[0109] Bonding/fixing portions 31 for maintaining the stacked state of artificial feathers 3 can be easily formed by arranging bonding member 33 on a prescribed position and arranging plurality of artificial feathers 3 to partially overlap with each other. Therefore, manufacturing steps for shuttlecock 1 can be simplified.

[0110] In aforementioned shuttlecock 1 for badminton, bonding/fixing portions 31 may be at least partially formed on regions closer to shafts 7 than intermediate points between shafts 7 and end portions of the feather portions in a width direction which is a direction perpendicular to shafts 7 of the feather portions. In this case, it follows that portions of the feather portions outward beyond bonding/fixing portions 31 have a sufficient extent in artificial feathers 3, and the angle of torsion of artificial feathers 3 can be maintained.

[0111] In aforementioned shuttlecock 1 for badminton, the feather portions (more specifically, feather body portions 5 constituting the feather portions) of artificial feathers 3 may include extensional portions 50 protruding outward from outer peripheral portions of the feather portions and extending up to positions overlapping with the feather portions of annularly arranged other artificial feathers 3 (more specifically, feather body portions 5 of other artificial feathers 3), as shown in Figs. 27 to 29. In this case, an angle of torsion close to the angle of torsion of feathers in a natural shuttlecock

can be implemented while ensuring durability, whereby the flight performance can be approximated to that of the natural shuttlecock.

[0112] In aforementioned shuttlecock 1 for badminton, extensional portions 50 may extend from the outer peripheral portions of the feather portions up to positions beyond shafts 7 of other artificial feathers, as shown in Fig. 27 or 29. Bonding/fixing portions 31 may be formed on the positions beyond shafts 7 of other artificial feathers 3 in extensional portions 50.

[0113] In aforementioned shuttlecock 1 for badminton, the feather portions of artificial feathers 3 may include extensional portions 50 extending up to positions beyond shafts 7 of annularly arranged other artificial feathers. Bonding/fixing portions 31 may be formed on the positions beyond shafts 7 of other artificial feathers 3 in extensional portions 50. In this case, the angle of torsion of adjacent artificial feathers 3 can be sufficiently enlarged to an extent similar to the angle of torsion in a natural shuttlecock.

[0114] Still another shuttlecock for badminton according to the present invention includes a hemispherical base body 2, a plurality of artificial feathers 3 and a cordlike body (at least any one of an intermediate thread 15, an inner thread 17 and an outer thread 19). Plurality of artificial feathers 3 include feather portions and shafts 7 connected to the feather portions. Plurality of artificial feathers 3 are fixed to base body 2 so that the same are annularly arranged and adjacent feather portions partially overlap with each other. The cordlike body (intermediate thread 15, inner thread 17 and outer thread 19) regulates relative movement or deformation of the feather portions in plurality of artificial feathers 3.

[0115] Thus, a stacked state and the shape of artificial feathers 3 can be maintained in the initial states by arranging intermediate thread 15 or inner thread 17 as the cordlike body, also in the case of employing artificial feathers 3 whose shafts 7 are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. For example, intermediate thread 15 is so arranged between the stacked parts of artificial feathers 3 that the order of stacking of artificial feathers 3 can be prevented from replacement. Further, inner thread 17 is so arranged along inner peripheral sides of plurality of artificial feathers 3 that inner thread 17 can prevent the feather portions of artificial feathers 3 from bending toward the inner peripheral sides while shuttlecock 1 is used. Therefore, the flight performance of shuttlecock 1 can be inhibited from deterioration resulting from replacement of the stacked state of artificial feathers 3 or deformation of artificial feathers 3.

[0116] Intermediate thread 15 and inner thread 17 as the cordlike body, fixing shafts 7 of adjacent artificial feathers 3 to each other in order to maintain the stacked state of plurality of artificial feathers 3, function also as strength members. Therefore, the strength of shuttlecock 1 so improves that the durability of shuttlecock 1 can be improved as a result. Further, an extremely thin thread or the like can be utilized as the cordlike body, whereby changes in the position of the center of gravity, balance, the total mass or the like of shuttlecock 1 resulting from arrangement of intermediate thread 15 or inner thread 17 can be reduced to the utmost.

[0117] In aforementioned shuttlecock 1 for badminton, the cordlike body may constitute sewn parts (parts fixed by a fixing thread 21) by at least partially sewing mutually overlapping parts in the feather portions of artificial feathers 3. In this case, the order of stacking or the arrangement of artificial feathers 3 can be inhibited from changing by mutually sewing artificial feathers 3 (sewing the same with fixing thread 21). In other words, the stacked state of plurality of artificial feathers 3 can be reliably maintained.

[0118] In aforementioned shuttlecock 1 for badminton, the sewn parts (parts fixed by fixing thread 21) may be at least partially formed on regions closer to shafts 7 than intermediate points between shafts 7 and end portions of the feather portions in a width direction which is a direction perpendicular to shafts 7 of the feather portions. In this case, it follows that the portions of the feather portions outward beyond the sewn parts have a sufficient extent in artificial feathers 3, and an angle of torsion of artificial feathers 3 can be maintained.

[0119] A further shuttlecock 1 according to the present invention includes a base body 2 as a hemispherical base body, a plurality of artificial feathers 3 and a stacked state fixing portion (an intermediate thread 15, an inner thread 17, an outer thread 19, a fixing thread 21, bonding/fixing portions 31 or welding/fixing portions 41). Plurality of artificial feathers 3 include feather portions and shafts 7 connected to the feather portions. Plurality of artificial feathers 3 are fixed to base body 2, to be annularly arranged and partially stacked. The stacked state fixing portion (intermediate thread 15, inner thread 17, outer thread 19, fixing thread 21, bonding/fixing portions 31 or welding/fixing portions 41) is employed for maintaining the stacked state of artificial feathers 3.

[0120] Thus, the stacked state of artificial feathers 3 can be maintained in the initial state by forming the stacked state fixing portion also in the case of employing artificial feathers 3 whose shafts 7 are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock, whereby the flight performance of shuttlecock 1 can be inhibited from deterioration resulting from replacement of the stacked state of artificial feathers 3. Further, it follows that the stacked state fixing portion relatively fixes positions of adjacent artificial feathers 3 in order to maintain the stacked state of plurality of artificial feathers 3, whereby the same functions also as a reinforcing member. Therefore, the strength of shuttlecock 1 so improves that the durability of shuttlecock 1 can be improved as a result.

[0121] In aforementioned shuttlecock 1 for badminton, the stacked state fixing portion includes a cordlike body (an intermediate thread 15 and an inner thread 17, or an outer thread 19) regulating relative movement or deformation of

the feather portions of plurality of artificial feathers 3. In this case, the stacked state of plurality of artificial feathers 3 can be reliably maintained by regulating relative movement or deformation of artificial feathers 3 with the cordlike body (intermediate thread 15, inner thread 17, and outer thread 19). Further, an extremely thin thread (a thread of cotton or a thread of resin such as polyester, for example) or the like can be utilized as the cordlike body, whereby a cordlike body having small mass or a small occupied volume can be employed. Therefore, changes in the position of the center of gravity or balance of shuttlecock 1 resulting from arrangement of the cordlike body can be reduced to the utmost.

[0122] In aforementioned shuttlecock 1 for badminton, the cordlike body includes intermediate thread 15 as a cord member encircling respective shafts 7 (preferably fixed shaft portions 10) of plurality of artificial feathers 3 and arranged to pass through the spaces between opposed feather body portions 5 in mutually overlapping parts of the feather portions of artificial feathers 3 (parts of feather body portions 5 overlapping with adjacent other artificial feathers 3), as shown in Fig. 20. In this case, intermediate thread 15 is so arranged between the stacked parts of artificial feathers 3 that the order of stacking of artificial feathers 3 can be prevented from replacement.

[0123] In aforementioned shuttlecock 1 for badminton, the cordlike body includes inner thread 17 as another cord member encircling respective shafts 7 (preferably fixed shaft portions 10) of plurality of artificial feathers 3 and arranged on the inner peripheral sides of annularly arranged plurality of artificial feathers 3, as shown in Fig. 21. In this case, it follows that inner thread 17 is arranged along the inner peripheral sides of plurality of artificial feathers 3 (inner peripheral sides of feather body portions 5 of artificial feathers 3), whereby inner thread 17 can inhibit the feather portions (feather body portions 5) of artificial feathers 3 from bending toward the inner peripheral sides while shuttlecock 1 is used. Therefore, the flight performance of shuttlecock 1 can be prevented from changing due to bending of the feather portions. Consequently, the flight performance of shuttlecock 1 employing artificial feathers 3 can be stabilized, and the durability thereof can be improved.

[0124] In aforementioned shuttlecock 1 for badminton, the stacked state fixing portion may include sewn parts (parts fixed by fixing thread 21) formed by at least partially sewing mutually overlapping parts in feather body portions 5 of artificial feathers 3, as shown in Figs. 24 to 26. In this case, the order of stacking or the arrangement of artificial feathers 3 can be inhibited from changing by sewing artificial feathers 3 to each other (sewing the same with fixing thread 21). In other words, the stacked state of plurality of artificial feathers 3 can be reliably maintained.

[0125] In aforementioned shuttlecock 1 for badminton, the parts fixed by fixing thread 21 may be formed to extend along shafts 7 of artificial feathers 3, as shown in Fig. 25. In this case, fixing thread 21 fixing stacked artificial feathers 3 to each other is arranged to extend along shafts 7, whereby it follows that the sewn parts are formed as to wide ranges of feather body portions 5 extending along shafts 7. Therefore, the effect of inhibiting the order of stacking or the arrangement of artificial feathers 3 from changing can be more reliably attained.

[0126] In aforementioned shuttlecock 1 for badminton, the sewn parts (parts fixed by fixing thread 21) may be formed to extend in a direction intersecting with shafts 7 of artificial feathers 3, as shown in Fig. 24. The sewn parts are preferably circumferentially formed, to couple at least two of annularly arranged plurality of artificial feathers 3, preferably all artificial feathers 3. The sewn parts may be formed in a double or at least triple circumferential manner, to couple all of annularly arranged plurality of artificial feathers 3. In this case, the sewn parts coupling at least two (preferably all) artificial feathers 3 in a prescribed order of stacking can be easily formed with a sewing machine or the like.

[0127] In aforementioned shuttlecock 1 for badminton, the sewn parts may be formed on positions closer to base body 2 than central portions in the feather portions (feather body portions 5) in the extensional direction of shafts 7, as shown in Fig. 24. In this case, a possibility that the sewn parts are broken by an impact in hitting can be reduced by forming the sewn parts with fixing thread 21 not on rear end portions of feather body portions 5 (regions farther from base body 2 than the central portions in feather body portions 5 in the extensional direction of shafts 7) where the quantities of deformation relatively enlarge but on the aforementioned positions. Further, deformation of the rear end portions of feather body portions 5 in hitting can be prevented from being limited beyond necessity due to the formation of the sewn parts, whereby the flight performance of shuttlecock 1 can be rendered close to that of a natural shuttlecock.

[0128] In aforementioned shuttlecock 1 for badminton, the stacked state fixing portion may include bonding portions (bonding/fixing portions 31) connecting at least partially connecting mutually overlapping parts of feather body portions 5 of artificial feathers 3 with a bonding layer (bonding member 33), as shown in Figs. 16 and 17. Bonding/fixing portions 31 may be formed as to all of stacked parts of annularly arranged plurality of artificial feathers 3. In this case, bonding/fixing portions 31 for maintaining the stacked state of artificial feathers 3 can be easily formed by arranging bonding member 33 on a prescribed position and arranging plurality of artificial feathers 3 to partially overlap with each other. Therefore, manufacturing steps for shuttlecock 1 can be simplified.

[0129] In aforementioned shuttlecock 1 for badminton, bonding/fixing portions 31 may be formed to extend along shafts 7 of artificial feathers 3. In this case, bonding/fixing portions 31 fixing stacked artificial feathers 3 to each other are arranged to extend along shafts 7, whereby it follows that bonding/fixing portions 31 are formed as to wide ranges of feather body portions 5 extending along shafts 7. Therefore, the effect of inhibiting the order of stacking or the arrangement of artificial feathers 3 from changing can be more reliably attained.

[0130] In aforementioned shuttlecock 1 for badminton, bonding/fixing portions 31 are formed on positions closer to

base body 2 than central portions in feather body portions 5 in the extensional direction of shafts 7. In this case, a possibility that bonding/fixing portions 31 are broken by an impact in hitting can be reduced by forming bonding/fixing portions 31 not on the rear end portions of feather body portions 5 where the quantities of deformation relatively enlarge in hitting of shuttlecock 1 with a racket but on the aforementioned positions. Further, deformation of the rear end portions of feather body portions 5 in hitting can be prevented from being limited beyond necessity due to the formation of bonding/fixing portions 31, whereby the flight performance of shuttlecock 1 can be rendered close to that of a natural shuttlecock.

[0131] In aforementioned shuttlecock 1 for badminton, the stacked state fixing portions may include welding/fixing portions 41 as welding portions fixing the overlapping parts of the feather portions of artificial feathers 3 by at least partially melting and thereafter solidifying the mutually overlapping parts in the feather portions (feather body portions 5) of artificial feathers 3, as shown in Figs. 1 to 3. In this case, welding/fixing portions 41 for maintaining the stacked state of artificial feathers 3 can be formed without performing prearrangement or the like of an adhesive or the like, by at least partially melting·resolidifying the stacked parts of artificial feathers 3. Therefore, the manufacturing steps for shuttlecock 1 can be simplified.

[0132] In aforementioned shuttlecock 1 for badminton, welding/fixing portions 41 may be formed to extend along shafts 7 of artificial feathers 3, as shown in Fig. 1. In this case, welding/fixing portions 41 fixing stacked artificial feathers 3 to each other are arranged to extend along shafts 7, whereby it follows that welding/fixing portions 41 are formed as to wide ranges of feather body portions 5 extending along shafts 7. Therefore, the effect of inhibiting the order of stacking or the arrangement of artificial feathers 3 from changing can be more reliably attained.

[0133] In the aforementioned shuttlecock for badminton, welding/fixing portions 41 are formed on positions closer to base body 2 than central portions of feather body portions 5 in the extensional direction of shafts 7, as shown in Fig. 1. In this case, a possibility that welding/fixing portions 41 are broken by an impact in hitting can be reduced by forming welding/fixing portions 41 not on the rear end portions of feather body portions 5 where the quantities of deformation relatively enlarge in hitting of shuttlecock 1 with a racket but on the aforementioned positions. Further, deformation of the rear end portions of feather body portions 5 in hitting can be prevented from being limited beyond necessity due to the formation of welding/fixing portions 41, whereby the flight performance of shuttlecock 1 can be rendered close to that of a natural shuttlecock.

[0134] A further shuttlecock 1 according to the present invention includes a base body 2 as a hemispherical base body, a plurality of artificial feathers 3, an intermediate thread 15 as a cord member and an inner thread 17 as another cord member. Plurality of artificial feathers 3 include feather portions and shafts 7 connected to the feather portions. Plurality of artificial feathers 3 are fixed to base body 2, to be annularly arranged and to be partially stacked. Intermediate thread 15 encircles respective shafts 7 (preferably fixed shaft portions 10) of plurality of artificial feathers 3, and is arranged to pass through the spaces between opposed artificial feathers 3 in the mutually stacked parts of artificial feathers 3, as shown in Fig. 3. Inner thread 17 encircles respective shafts 7 of plurality of artificial feathers as shown in Figs. 2 and 4, and is arranged on inner peripheral sides of annularly arranged plurality of artificial feathers 3.

[0135] Thus, the stacked state and the shape of artificial feathers 3 can be maintained in the initial states by arranging intermediate thread 15 and inner thread 17 functioning as stacked state fixing portions, also in the case of employing artificial feathers 3 whose shafts 7 are lower in rigidity and strength than those of feathers (natural feathers) of a waterfowl constituting a natural shuttlecock. In other words, intermediate thread 15 is so arranged between the stacked parts of artificial feathers 3 that the order of stacking of artificial feathers 3 can be prevented from replacement. Further, it follows that inner thread 17 is arranged along the inner peripheral sides of plurality of artificial feathers 3, whereby inner thread 17 can inhibit the feather portions of artificial feathers 3 from bending toward the inner peripheral sides while shuttlecock 1 is used. Therefore, the flight performance of shuttlecock 1 can be inhibited from deterioration resulting from replacement of the stacked state of artificial feathers 3 or deformation of artificial feathers 3.

[0136] Further, intermediate thread 15 and inner thread 17, fixing shafts 7 of adjacent artificial feathers 3 to each other in order to maintain the stacked state of plurality of artificial feathers 3, function also as strength members. Therefore, the strength of shuttlecock 1 so improves that the durability of shuttlecock 1 can be improved as a result. In addition, extremely thin threads or the like can be utilized as intermediate thread 15 and inner thread 17, whereby changes in the position of the center of gravity or balance of shuttlecock 1 resulting from the arrangement of intermediate thread 15 and inner thread 17 can be reduced to the utmost.

[0137] In aforementioned shuttlecock 1 for badminton, welding/fixing portions 41 may include a reinforcing member made of a material different from that of the stacked parts of artificial feathers 3 and arranged between the stacked parts of artificial feathers 3, as shown in Fig. 3. In this case, the strength of welding/fixing portions 41 can be sufficiently increased by arranging reinforcing member 43, even if the thickness of the stacked parts of artificial feathers 3 is small.

[0138] In aforementioned shuttlecock 1 for badminton, shaft 7 may have a fixed shaft portion 10 and a stem portion 8 continuous with fixed shaft portion 10 in each artificial feather 3, as shown in Figs. 11 to 15. A sheetlike member 9 which is a member constituting each feather portion may have a feather body portion 5 in contact with fixed shaft portion 10 and larger in width than fixed shaft portion 10 and a protruding portion 12 protruding from feather body portion 5 toward stem portion 8. An end portion opposite to the side of feather body portion 5 in protruding portion 12 may be

embedded in a member constituting stem portion 8.

[0139] In this case, feather body portion 5 is in contact with and fixed to fixed shaft portion 10 and protruding portion 12 of sheetlike member 9 which is the member constituting the feather portion is embedded in the member constituting stem portion 8, whereby bonding strength between the feather portion and shaft 7 can be increased. Further, protruding portion 12 of sheetlike member 9 constituting the feather portion is in the state embedded in stem portion 8, whereby embedded protruding portion 12 functions as a reinforcing member for stem portion 8. Therefore, bonded portions of feather body portion 5 and stem portion 8 and the durability of stem portion 8 can be sufficiently increased. In addition, feather body portion 5 functions as a reinforcing member also as to fixed shaft portion 10, whereby the durability of fixed shaft portion 10 can also be increased. Therefore, artificial feathers 3 for a shuttlecock having high durability can be implemented. Consequently, strength and durability close to those of feathers for a shuttlecock employing natural feathers of a waterfowl can be implemented. Therefore, artificial shuttlecock 1 having flight performance and durability equivalent to those of a shuttlecock employing natural feathers for a shuttlecock can be implemented.

(Example 1)

[0140] In order to confirm the aforementioned effects of the present invention, the following experiment was conducted: In other words, as to a shuttlecock according to the present invention on which an intermediate thread and an inner thread such as those shown in the third embodiment are arranged, a flight track, flight stability and revolutions in flight of the shuttlecock hit with a racket were confirmed as to a state before setting these intermediate and inner threads (before setting fixing threads) and after setting the intermediate thread and the inner thread (after setting fixing threads). Further, the presence or absence of occurrence of interlacement (such a state that the order of overlapping of adjacent artificial feathers changes (is replaced) from the initial state) was confirmed as to the overlapping parts of the artificial feathers in the shuttlecock in hitting. Table 1 shows the results.

Table 1

Sample ID	Nonwoven Fabric			Before Setting Fixing Thread		After Setting Fixing Thread		Interlacement	Flight Track	Flight Stability	Revolutions in Flight
	Brand	Material	Surface Density (g/m^2)	Mass (g)	Number of Revolutions (rpm)	Mass (g)	Number of Revolutions (rpm)				
1	A	polyester	45	5.11	550	5.12	620	no	excellent	excellent	excellent
2	A	polyester	45	5.14	700	5.15	930	no	excellent	excellent	excellent
3	B	polyester	60	5.19	600	5.20	650	no	slightly excellent	slightly excellent	excellent
4	B	polyester	60	5.20	800	5.22	900	no	slightly excellent	slightly excellent	excellent
5	C	polyester	55	5.16	650	5.18	980	no	excellent	excellent	excellent
6	C	polyester	55	5.14	660	5.16	790	no	excellent	excellent	excellent
7	A	polyester	45	5.12	700	-	-	yes	instable	instable	instable
Natural Ball	-	-	-	5.12	350	-	-	no	excellent	excellent	excellent
Fixing threads (intermediate and inner threads) were set in all samples, and polyester threads No. 50 were used as the materials The intermediate and inner threads were set on positions of 45 mm and 40 mm from forward ends of stems respectively											

[0141] Samples ID Nos. 1 to 6 correspond to Example of the present invention, in which intermediate threads and inner threads as fixing threads are set. A sample ID No. 7 is comparative example, in which artificial feathers were formed by employing the same nonwoven fabric as shuttlecocks of the samples ID Nos. 1 and 2 while no intermediate and inner threads were set. For the purpose of comparison, a flight track, flight stability and revolutions in flight were similarly confirmed also as to a shuttlecock employing natural feathers.

[0142] As to the samples ID Nos. 1 and 2, the same brand (brand A) was employed as nonwoven fabric constituting artificial feathers. The material for the nonwoven fabric of the brand. A was polyester, and the surface density was 45 g/m^2. As to the samples ID Nos. 3 and 4, nonwoven fabric of a brand B was employed. The material for the nonwoven fabric of the brand B was polyester, and the surface density was 60 g/m^2. As to the samples ID Nos. 5 and 6, nonwoven fabric of a brand C was employed. The material for the nonwoven fabric of this brand was polyester, and the surface density was 60 g/m^2. As to the sample ID No. 7 as comparative example, the aforementioned brand A was employed as the nonwoven fabric constituting artificial feathers.

[0143] A hitting test was conducted as to the aforementioned samples ID Nos. 1 to 6 before setting fixing threads, and the current numbers of revolutions of the shuttlecocks were measured. As a measuring method, photographs of the shuttlecocks in flight were taken with a high-speed camera, and the numbers of revolutions were calculated from images thereof. Also as to the sample ID No. 7 and the shuttlecock (natural ball) employing the natural feathers, the numbers of revolutions in flight were similarly measured.

[0144] Another hitting test was conducted as to the aforementioned samples ID Nos. 1 to 6 after setting the fixing threads, and the numbers of revolutions were measured by the aforementioned method. Further, organoleptic evaluation in a case of making comparison with the natural ball was made as to the presence or absence of interlacement of feather portions after performing hitting 20 times as well as flight tracks in the hitting test, flight stability and the situations of revolutions of the shuttlecocks in flight. Similar measurement and evaluation were made also as to the sample ID No. 7 as comparative example and the natural ball. Polyester threads No. 50 were employed as the fixing threads. The intermediate threads were set on positions of 45 mm from forward end portions (end portions opposite to the end portions connected to base body 2 shown in Fig. 1) of the shafts of the artificial feathers. Further, the inner threads were set on positions of 40 mm from the forward end portions of the artificial feathers.

[0145] Referring to Table 1, cases were the results of evaluation are excellent, slightly excellent and defective (uneasy points) are shown with circles, triangles and crosses respectively.

[0146] As understood from Table 1, there was no interlacement of feathers in each of the samples ID Nos. 1 to 6 although the number of revolutions of the shuttlecock was slightly higher in the case of setting the intermediate thread and the inner thread (fixing threads), and evaluation substantially equivalent to that of the natural ball was obtained as to the flight track, the flight stability and the situation of revolutions in flight. As to the sample ID No. 7 of comparative example, on the other hand, interlacement of feathers took place due to the hitting test, such that the flight track, the flight stability and the revolutions in flight were remarkably different from those of the natural ball, to lead to low evaluation.

(Example 2)

[0147] Then, the following experiment was conducted, in order to compare a case of forming welding/fixing portions 41 such as those shown in Fig. 1 and a case of setting an intermediate thread 15 and an inner thread 17 such as those shown in Figs. 18 and 19:

> First, two types of samples (samples ID Nos. 8 and 9) as Example of the present invention and a sample (sample ID No. 10) as comparative example were formed by employing the same base bodies and artificial feathers. The sample ID No. 8 was brought into the structure arranging intermediate thread 15 and inner thread 17 as shown in Figs. 18 and 9. In the sample ID No. 9, artificial feathers 3 were fixed to each other by forming welding/fixing portions 41 as shown in Fig. 1. On the other hand, the sample ID No. 10 as comparative example was brought into such a state that artificial feathers were independent of each other, without forming the aforementioned welding/fixing portions or the like. Two pieces were prepared for each sample.

[0148] As to each of the aforementioned samples ID Nos. 8 to 10, an actual hitting test of performing a high clear and a smash was conducted. The clear denotes a general flight of largely hitting the shuttlecock toward a rear portion of the court of the opponent from the center to a rear portion of the badminton court. The high clear denotes that of moving the opponent to the rear portion of the court by highly hitting the shuttlecock in the aforementioned clear. The clear includes that referred to as a driven clear, which denotes an aggressive clear intending to send the shuttlecock flying over the opponent's head by relatively lowly hitting the shuttlecock. The aforementioned smash denotes a flight hitting the shuttlecock from an overhead stroke at an acute angle with respect to the opponent's court, and is the most aggressive flight.

[0149] The results of the aforementioned actual hitting test were as follows: First, as to the experiment of performing

the high clear as to each sample, no interlacement took place in feather body portions of artificial feathers in the samples ID Nos. 8 and 9 according to the present invention, also after performing 150 high clears. Further, revolutions of the shuttlecocks in flight of the shuttlecocks were also substantially equivalent to those of a natural shuttlecock, and did not remarkably change during the test. While flight states were stabler than that of the sample ID No. 10 according to comparative example described later in both of the aforementioned two samples, particularly the sample ID No. 9 was stabler in flight state than the sample ID No. 8.

[0150] As to the sample ID No. 10 according to comparative example, interlacement took place in feather body portions of artificial feathers at the time of performing two high clears. After the interlacement of the feather body portions took place, revolutions of the shuttlecock were extremely reduced, and the flight state also got instable.

[0151] As to the experiment of performing the smash as to each sample, no interlacement took place in the feather body portions of the artificial feathers in the samples ID Nos. 8 and 9 according to the present invention, also after performing 10 smashes. As a result of taking photographs of states immediately after hitting with the high-speed camera and observing the same, the artificial feathers were in a state slightly opening than the state before the hitting, after the shuttlecock was brought into a crushed state by the hitting in the sample ID No. 8. In the sample ID No. 9, the artificial feathers opened only to an extent substantially identical to the state before the hitting, after the shuttlecock was brought into a crushed state by the hitting. In other words, the opening of the artificial feathers immediately after the hitting was smaller in the sample ID No. 9.

[0152] As to the sample ID No. 10 according to comparative example, on the other hand, interlacement took place in feather body portions of artificial feathers at the time of performing one smash. As a result of taking a photograph of a state immediately after the hitting with the high-speed camera and observing the same as described above, the artificial feathers were in a state remarkably (more remarkably than the sample ID No. 8) opening than the state before the hitting, after the shuttlecock was brought into a crushed state by the hitting.

[0153] From the aforementioned results, it is understood that the samples ID Nos. 8 and 9 are superior in durability to the sample ID No. 10 according to comparative example. In view of flight characteristics, it is understood that both of the samples ID Nos. 8 and 9 according to the present invention are superior to the sample ID No. 10 according to comparative example, while the sample ID No. 9 particularly exhibits excellent flight characteristics.

[0154] The embodiments and Examples disclosed this time must be considered as illustrative in all points and not restrictive. The range of the present invention is shown not by the above description but by the scope of claims for patent, and it is intended that all modifications within the scope of claims for patent are included.

INDUSTRIAL APPLICABILITY

[0155] The present invention is advantageously applied to a shuttlecock for badminton, profitably an artificial shuttlecock whose flight performance must be maintained in the initial state over a long period of time.

Claims

1. A shuttlecock (1) for badminton comprising:

a hemispherical base body (2);
a plurality of artificial feathers (3), including feather portions (5) and shafts (7) connected to said feather portions (5), fixed to said base body (2) so that the same are annularly arranged and adjacent said feather portions (5) partially overlap with each other;
a stacked state fixing portion (15, 17, 19, 21, 31, 41) for maintaining a stacked state of said artificial feathers (3), said stacked state fixing portion (15, 17, 19, 21, 31, 41) including a cordlike body (15, 17, 19, 21) regulating relative movement or deformation of said feather portions (5) of plurality of said artificial feathers (3), said cordlike body (15, 17, 19, 21) including a cord member (15) encircling said shafts (7) of the respective ones of plurality of said artificial feathers (3) **characterised in that** said cord member (15) is arranged to pass through the spaces between said feather portions (5) opposed to each other on mutually overlapping parts of said feather portions (5).

2. The shuttlecock (1) for badminton according to claim 1, wherein
said cordlike body (15, 17, 19, 21) includes another cord member (17) encircling said shafts (7) of the respective ones of plurality of said artificial feathers (3) and arranged on inner peripheral sides of the feather portions (5) of annularly arranged plurality of said artificial feathers (3).

3. The shuttlecock (1) for badminton according to claim 1, wherein

said cordlike body (21) constitutes sewn parts by at least partially sewing mutually overlapping parts in said feather portions (5) of said artificial feathers (3).

4. The shuttlecock (1) for badminton according to claim 3, wherein said sewn parts are at least partially formed on regions closer to said shafts (7) than intermediate points between said shafts (7) and end portions of said feather portions (5) in a width direction of said feather portions (5) which is a direction perpendicular to said shafts (7).

5. The shuttlecock (1) for badminton according to claim 3, wherein said sewn parts are formed to extend along said shafts (7) of said artificial feathers (3).

6. The shuttlecock (1) for badminton according to claim 3, wherein said sewn parts are formed to extend in a direction intersecting with said shafts (7) of said artificial feathers (3).

7. The shuttlecock (1) for badminton according to claim 3, wherein said sewn parts are formed on positions of said feather portions (5) closer to said base body (2) than central portions in the extensional direction of said shafts (7).

8. The shuttlecock (1) for badminton according to claim 1, wherein said stacked state fixing portion (15, 17, 19, 21, 31, 41) includes bonding portions (31) at least partially connecting mutually overlapping parts in said feather portions (5) of said artificial feathers (3) with a bonding layer (33).

9. The shuttlecock (1) for badminton according to claim 1, wherein said stacked state fixing portion (15, 17, 19, 21, 31, 41) includes welding portions (41) fixing overlapping said parts of said feather portions (5) by at least partially melting and thereafter solidifying mutually overlapping parts in said feather portions (5) of said artificial feathers (3).

Patentansprüche

1. Federball (1) für Badminton, mit:

einem halbkugelförmigen Basiskörper (2);
vielen Kunstfedern (3), die Federabschnitte (5) und mit den Federabschnitten (5) verbundene Schäfte (7) aufweisen und an dem Basiskörper (2) so befestigt sind, dass selbige ringartig angeordnet und sich angrenzend an den Federabschnitten (5) teilweise miteinander überlappen;
einem Stapelzustandsfixierabschnitt (15, 17, 19, 21, 31, 41), um einen gestapelten Zustand der Kunstfedern (3) aufrechtzuerhalten, wobei der Stapelzustandsfixierabschnitt (15, 17, 19, 21, 31, 41) einen seilartigen Körper (15, 17, 19, 21) aufweist, der eine relative Bewegung oder Verformung der Federabschnitte (5) von vielen der Kunstfedern (3) reguliert,
wobei der seilartige Körper (15, 17, 19, 21) ein Seilelement (15) aufweist, das die Schäfte (7) der jeweiligen Kunstfeder (3) von den vielen Kunstfedern (3) umschlingt,
dadurch gekennzeichnet, dass
das Seilelement (15) so angeordnet ist, dass es durch die Räume zwischen den Federabschnitten (5) hindurch tritt, die sich an sich gegenseitig überlappenden Teilen der Federabschnitte (5) einander gegenüberliegen.

2. Federball (1) für Badminton gemäß Anspruch 1, wobei der seilartige Körper (15, 17, 19, 21) ein anderes Seilelement (17) aufweist, das die Schäfte (7) der jeweiligen Kunstfedern (3) der vielen Kunstfedern (3) umschlingt und an einer Innenumfangsseite der Federabschnitte (5) von ringartig angeordneten, vielen der Kunstfedern (3) angeordnet ist.

3. Federball (1) für Badminton gemäß Anspruch 1, wobei der seilartige Körper (21) Nahtteile bildet, in dem sich einander überlappende Teile in den Federabschnitten (5) der Kunstfedern (3) zumindest teilweise vernäht sind.

4. Federball (1) für Badminton gemäß Anspruch 3, wobei die Nahtteile zumindest teilweise an Bereichen ausgebildet sind, die näher an den Schäften (7) als Zwischenpunkte zwischen den Schäften (7) und Endabschnitten der Federabschnitte (5) in einer Breitenrichtung der Federabschnitte

(5) sind, die eine senkrechte Richtung zu den Schäften (7) ist.

5. Federball (1) für Badminton gemäß Anspruch 3, wobei
die Nahtteile so ausgebildet sind, dass sie sich entlang den Schäften (7) der Kunstfedern (3) erstrecken.

6. Federball (1) für Badminton gemäß Anspruch 3, wobei
die Nahtteile so ausgebildet sind, dass sie sich in einer Richtung erstrecken, die die Schäfte (7) der Kunstfedern (3) schneidet.

7. Federball (1) für Badminton gemäß Anspruch 3, wobei
die Nahtteile an Positionen der Federabschnitte (5) ausgebildet sind, die näher an dem Basiskörper (2) als mittlere Abschnitte in einer Erstreckungsrichtung der Schäfte (7) sind.

8. Federball (1) für Badminton gemäß Anspruch 1, wobei
der Stapelzustandsfixierabschnitt (15, 17, 19, 21, 31, 41) Fügeabschnitte (31) aufweist, die zumindest teilweise einander überlappende Teile in den Federabschnitten (5) der Kunstfedern (3) mit einer Fügelage (33) zumindest teilweise verbindet.

9. Federball (1) für Badminton gemäß Anspruch 1, wobei
der Stapelzustandsfixierabschnitt (15, 17, 19, 21, 31, 41) Schweißabschnitte (41) aufweist, die die Teile der Federabschnitte (5) durch zumindest teilweises Schweißen überlappend fixieren und danach einander überlappende Teile in den Federabschnitten (5) der Kunstfedern (3) verfestigen.

Revendications

1. Volant (1) de badminton comprenant :

un corps de base hémisphérique (2) ;
une pluralité de plumes artificielles (3), comprenant des parties de plume (5) et des tiges (7) reliées auxdites parties de plume (5), fixées audit corps de base (2) de sorte que celles-ci soient disposées de manière annulaire et lesdites parties de plume (5) adjacentes se chevauchent partiellement ;
une partie de fixation de l'état empilé (15, 17, 19, 21, 31, 41) destinée à maintenir un état empilé desdites plumes artificielles (3), ladite partie de fixation de l'état empilé (15, 17, 21, 31, 41) comprenant un corps de type corde (15, 17, 19, 21) régulant le mouvement relatif ou la déformation desdites parties de plume (5) de la pluralité desdites plumes artificielles (3), ledit corps de type corde (15, 17, 19, 21) comprenant un élément de corde (15) encerclant lesdites tiges (7) des plumes respectives de la pluralité desdites plumes artificielles (3), **caractérisé en ce que** ledit élément de corde (15) est disposé pour passer dans les espaces entre lesdites parties de plume (5) opposées les unes aux autres sur des parties se chevauchant mutuellement desdites parties de plume (5).

2. Volant (1) de badminton selon la revendication 1, dans lequel
ledit corps de type corde (15, 17, 19, 21) comprend un autre élément de corde (17) encerclant lesdites tiges (7) des plumes respectives de la pluralité desdites plumes artificielles (3) et disposé sur des côtés périphériques intérieurs des parties de plume (5) de la pluralité disposée de manière annulaire desdites plumes artificielles (3).

3. Volant (1) de badminton selon la revendication 1, dans lequel
ledit corps de type corde (21) forme des parties cousues en cousant au moins en partie des parties se chevauchant mutuellement dans lesdites parties de plume (5) desdites plumes artificielles (3).

4. Volant (1) de badminton selon la revendication 3, dans lequel
lesdites parties cousues sont au moins partiellement formées sur des régions plus près desdites tiges (7) que des points intermédiaires entre lesdites tiges (7) et des parties d'extrémité desdites parties de plume (5) dans une direction de largeur desdites parties de plume (5) qui est une direction perpendiculaire auxdites tiges (7).

5. Volant (1) de badminton selon la revendication 3, dans lequel
lesdites parties cousues sont formées pour s'étendre le long desdites tiges (7) desdites plumes artificielles (3).

6. Volant (1) de badminton selon la revendication 3, dans lequel

lesdites parties cousues sont formées pour s'étendre dans une direction croisant lesdites tiges (7) desdites plumes artificielles (3).

7. Volant (1) de badminton selon la revendication 3, dans lequel
lesdites parties cousues sont formées sur des positions desdites parties de plume (5) plus près dudit corps de base (2) que les parties centrales dans la direction d'extension desdites tiges (7).

8. Volant (1) de badminton selon la revendication 1, dans lequel
ladite partie de fixation de l'état empilé (15, 17, 19, 21, 31, 41) comprend des parties de liaison (31) reliant au moins partiellement des parties se chevauchant mutuellement dans lesdites parties de plume (5) desdites plumes artificielles (3) à l'aide d'une couche de liaison (33).

9. Volant (1) de badminton selon la revendication 1, dans lequel
ladite partie de fixation de l'état empilé (15, 17, 19, 21, 31, 41) comprend des parties de soudage (41) fixant le chevauchement desdites parties desdites parties de plume (5) par fusion au moins partielle puis solidification des parties se chevauchant mutuellement dans lesdites parties de plume (5) desdites plumes artificielles (3).

FIG.1

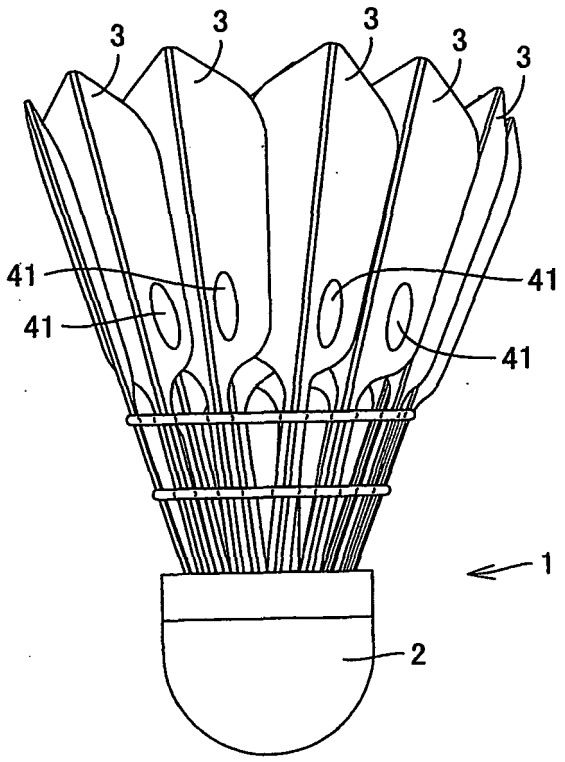

FIG.2

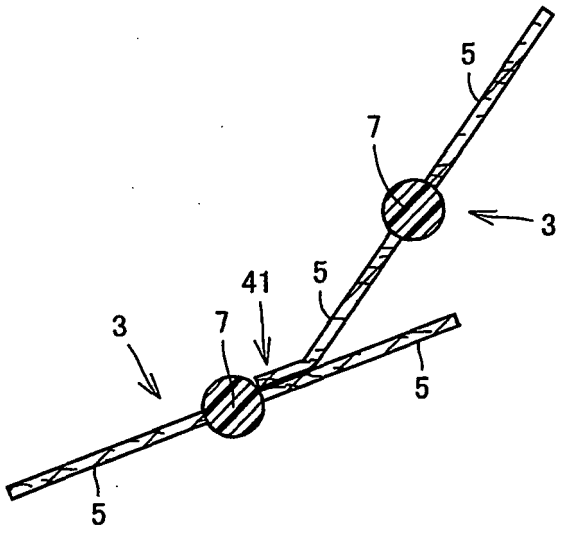

FIG.3

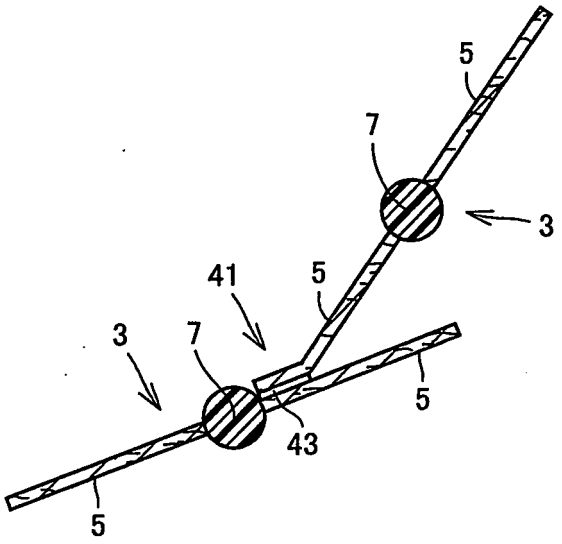

FIG.4

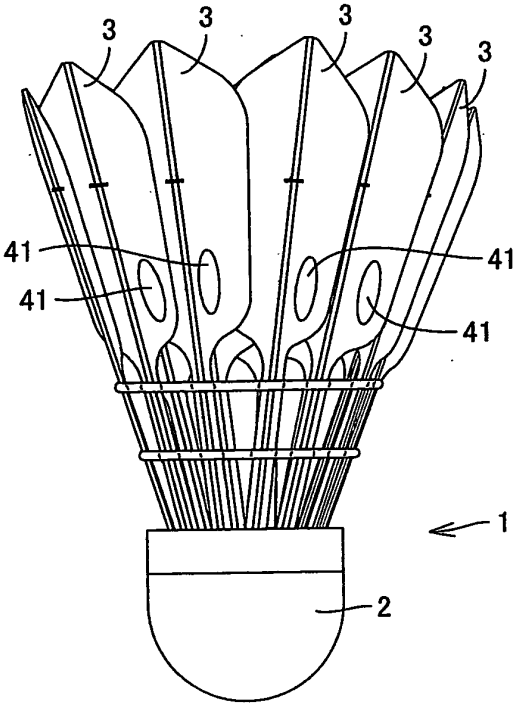

FIG.5

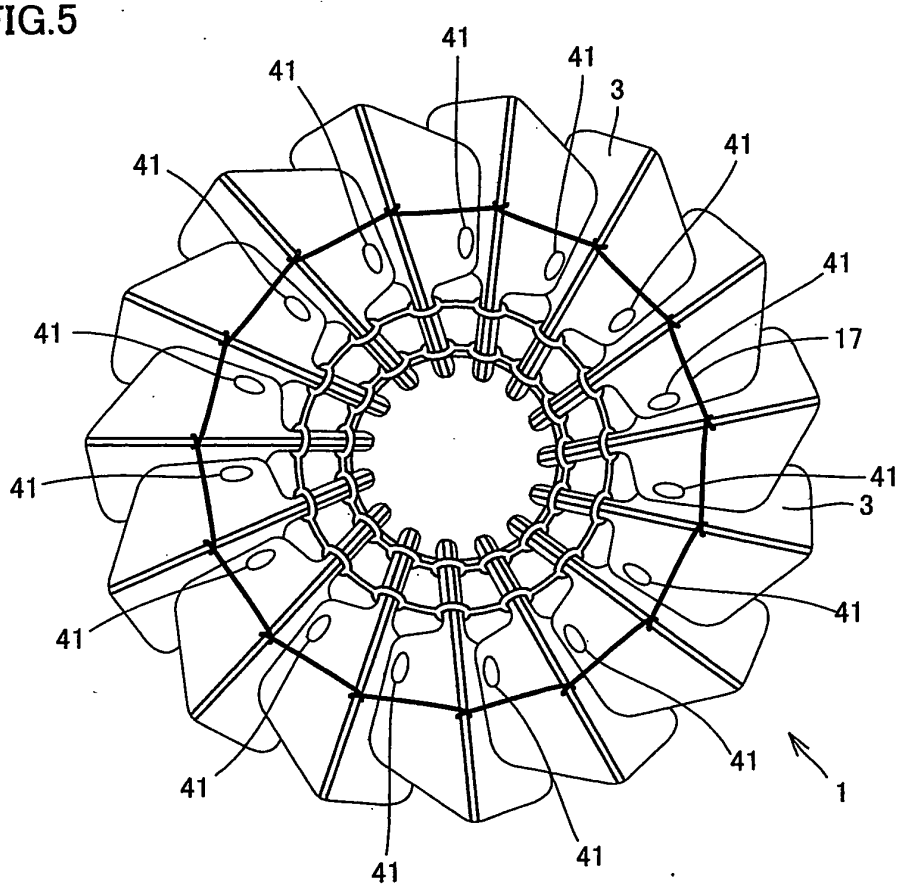

FIG.6

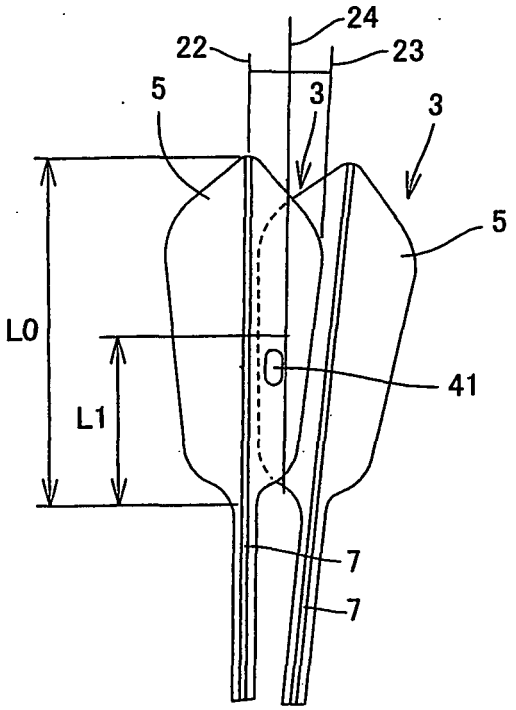

FIG.7

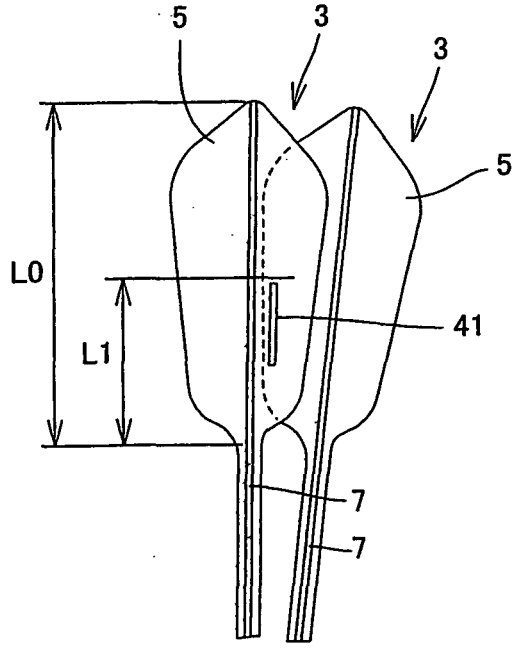

FIG.8

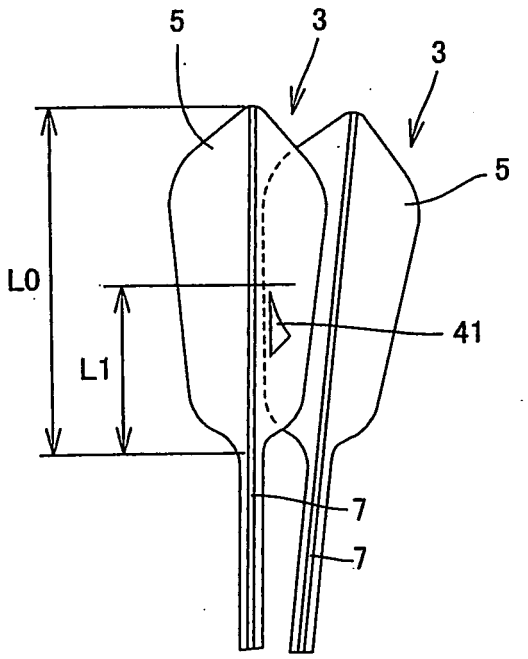

FIG.9

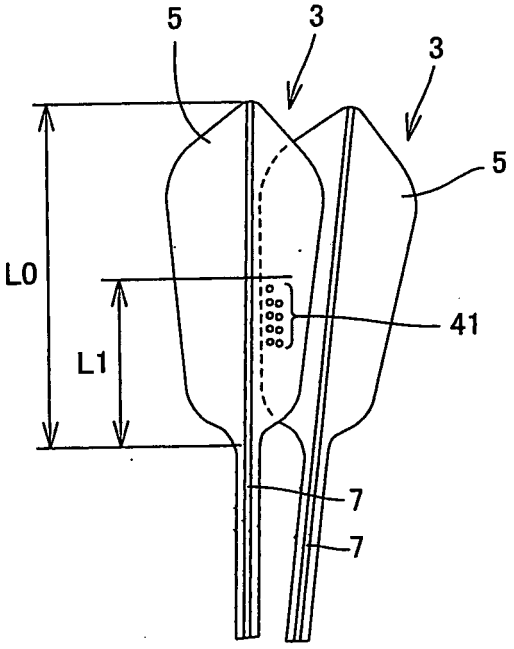

FIG.10

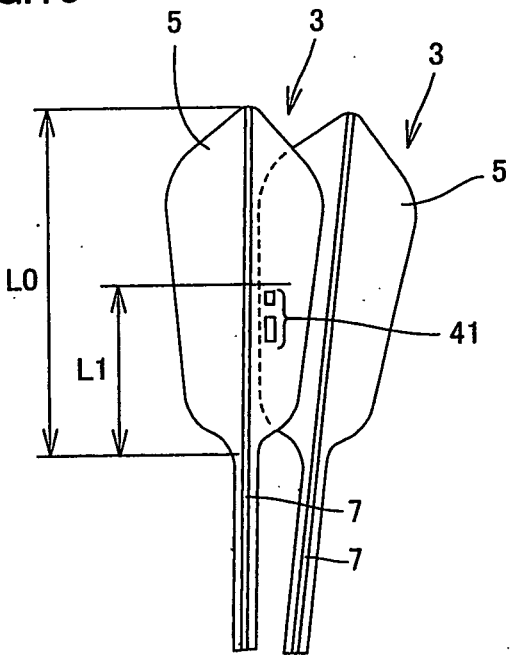

FIG.11

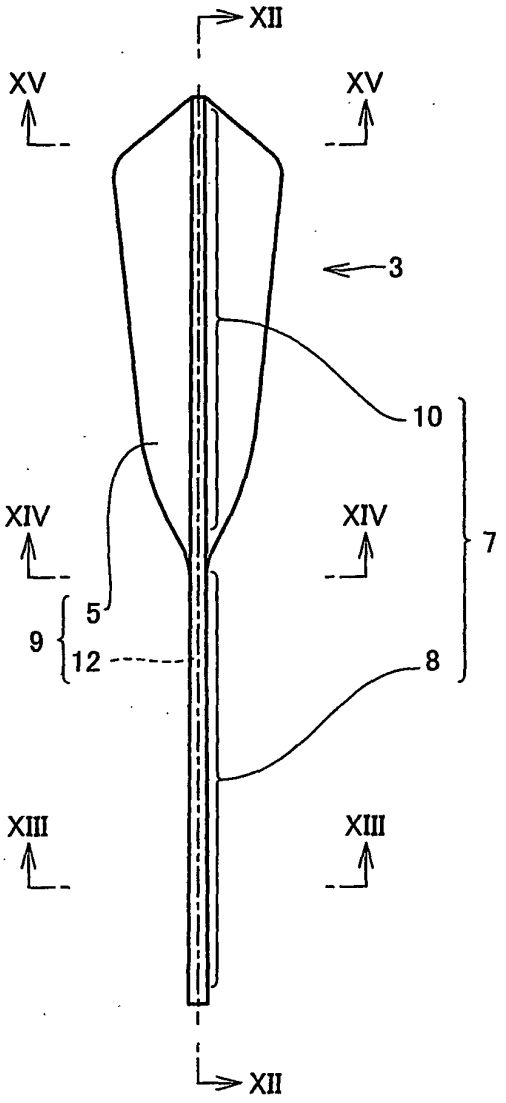

FIG.12

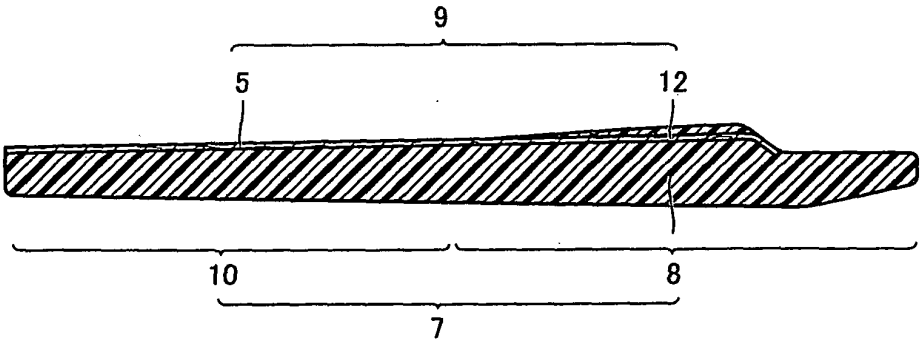

FIG.13

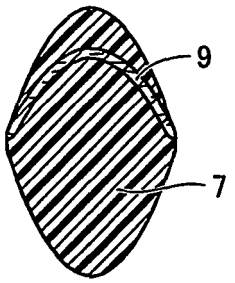

FIG.14

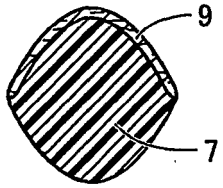

FIG.15

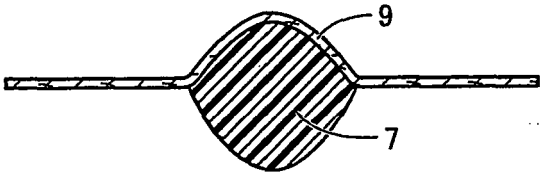

FIG.16

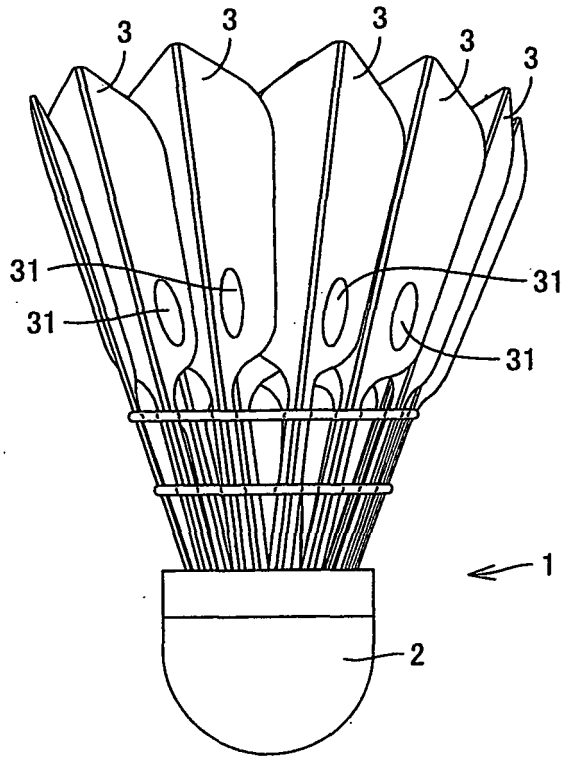

FIG.17

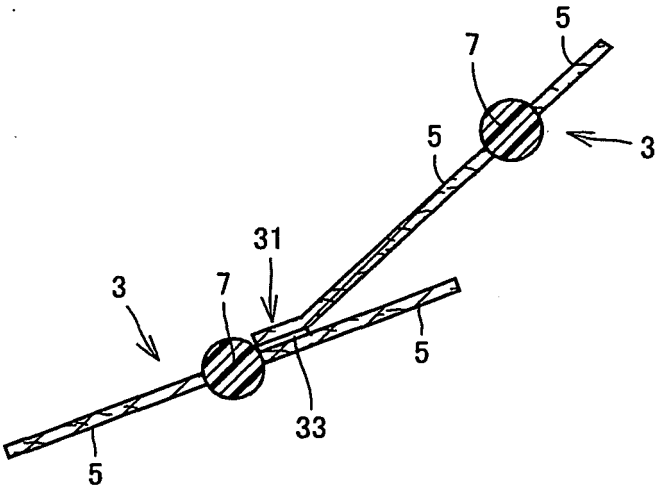

FIG.18

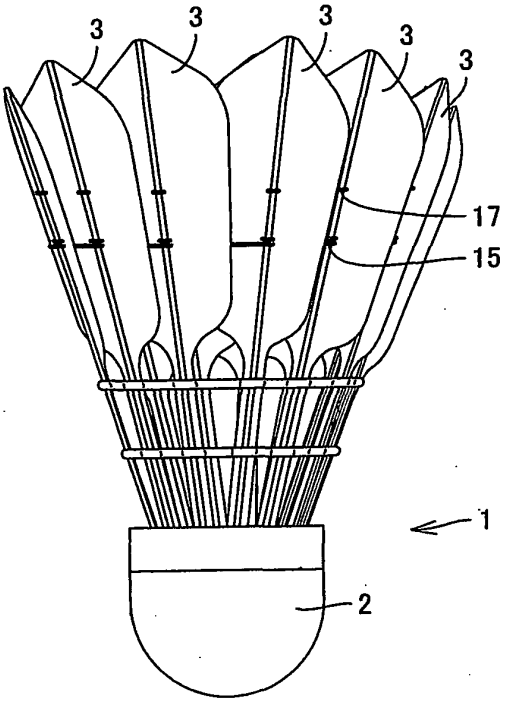

FIG.19

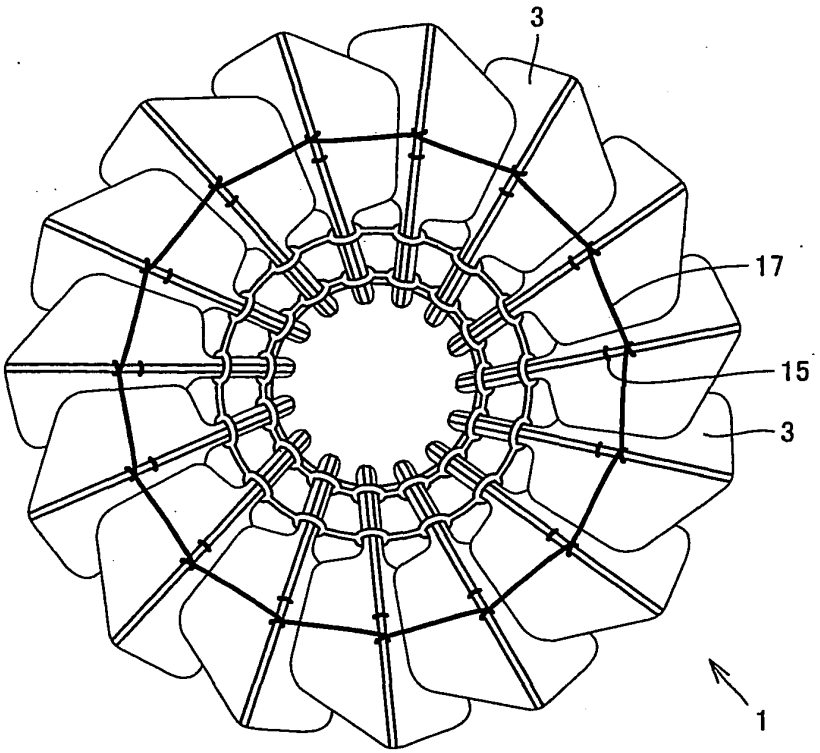

FIG.20

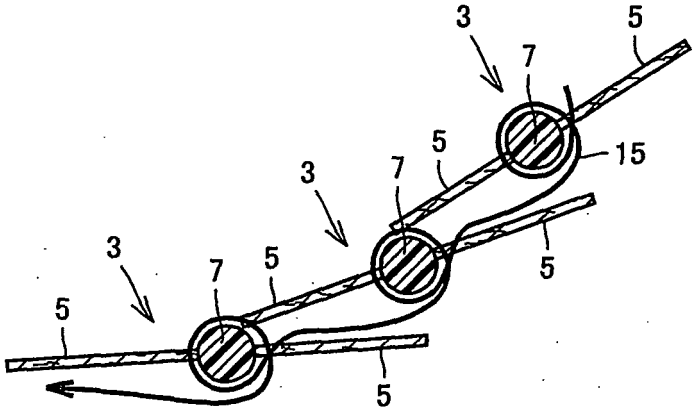

FIG.21

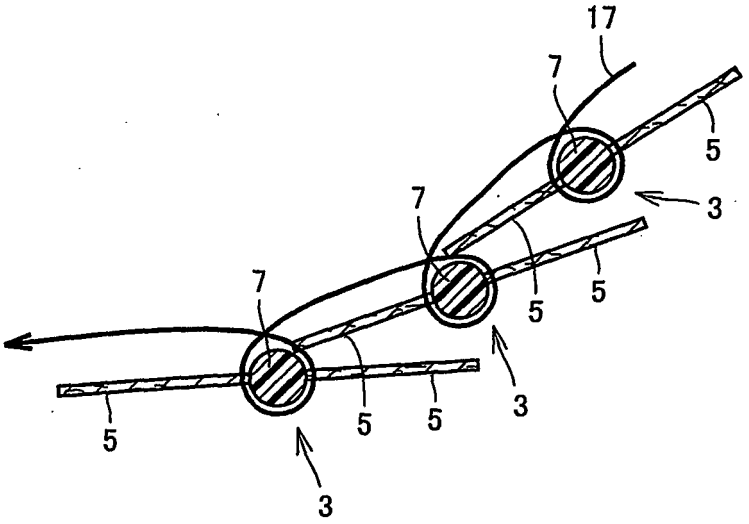

FIG.22

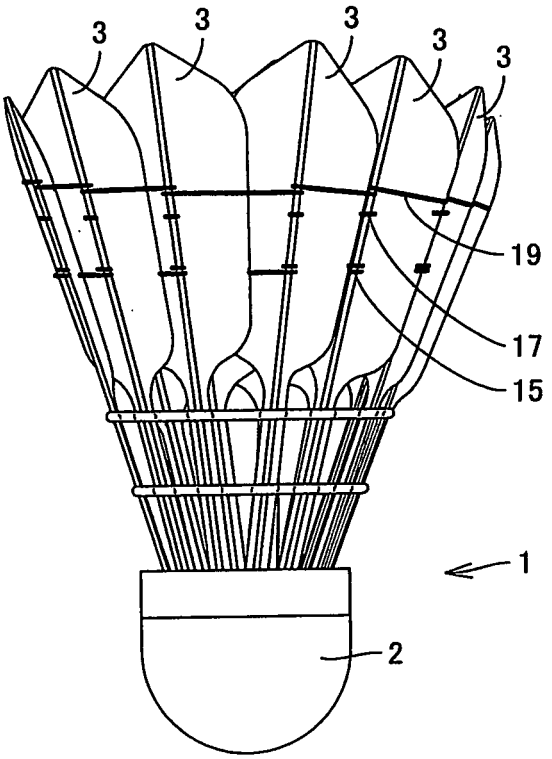

FIG.23

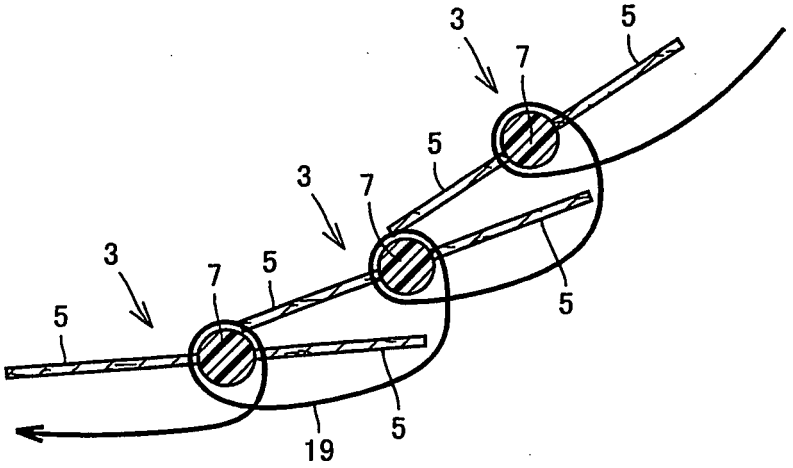

FIG.24

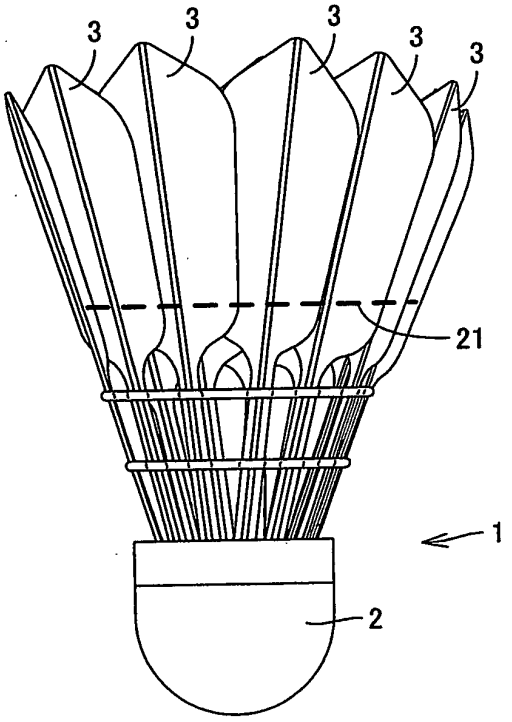

FIG.25

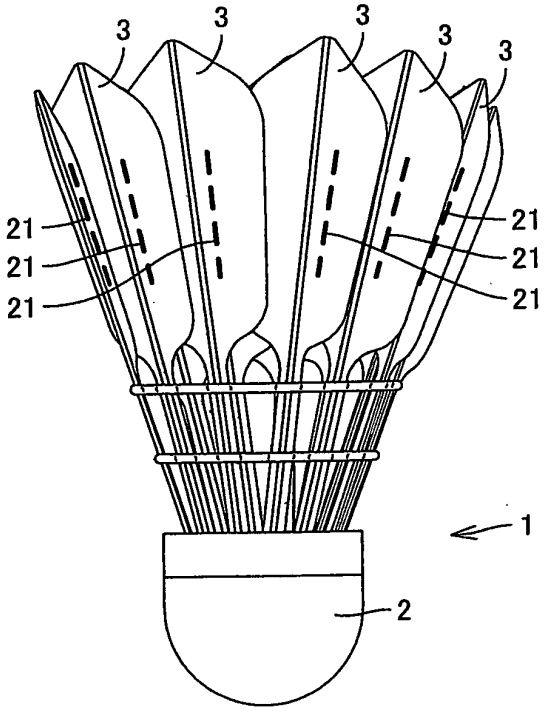

FIG.26

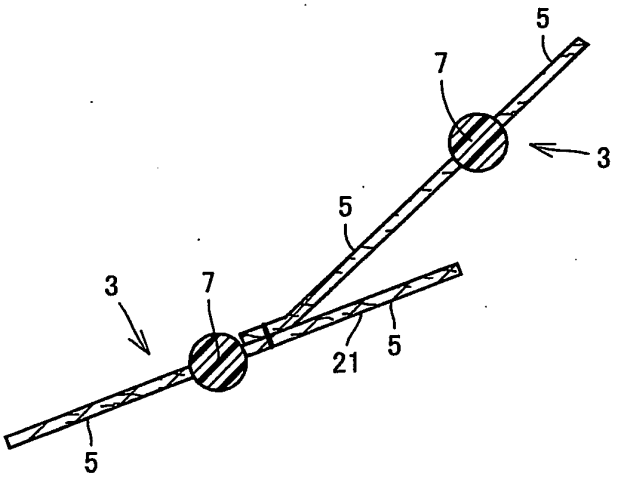
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FIG.27

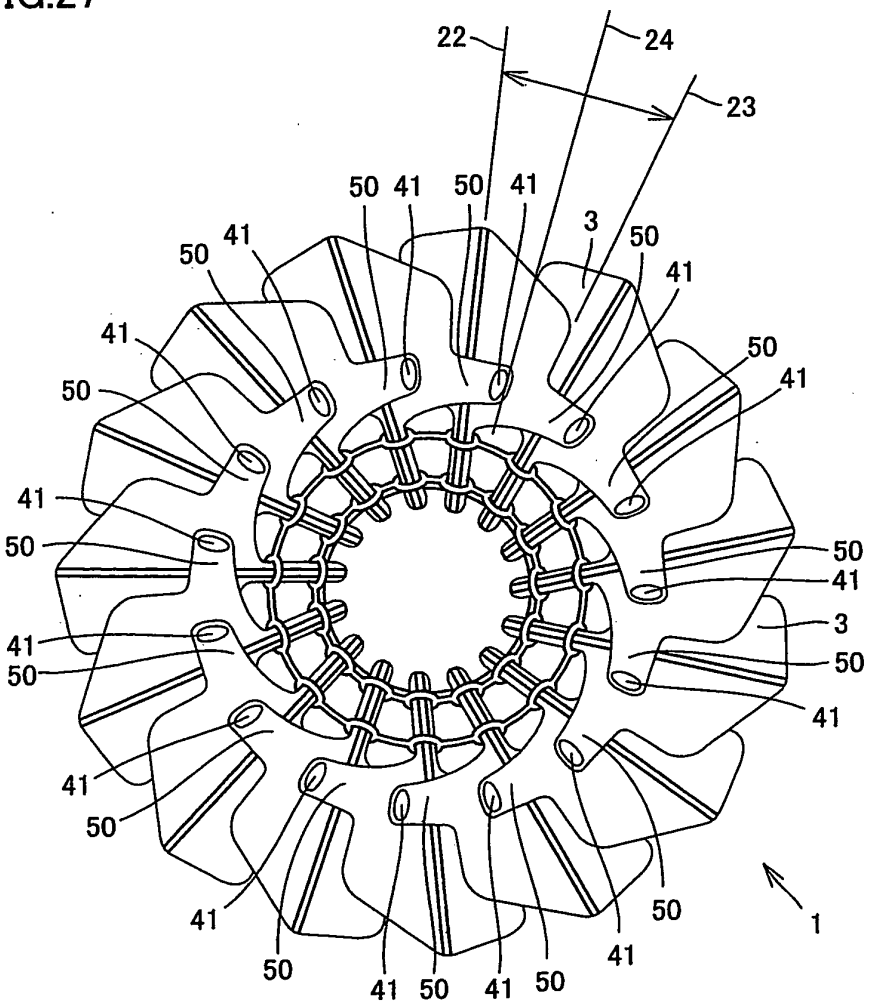
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FIG.28

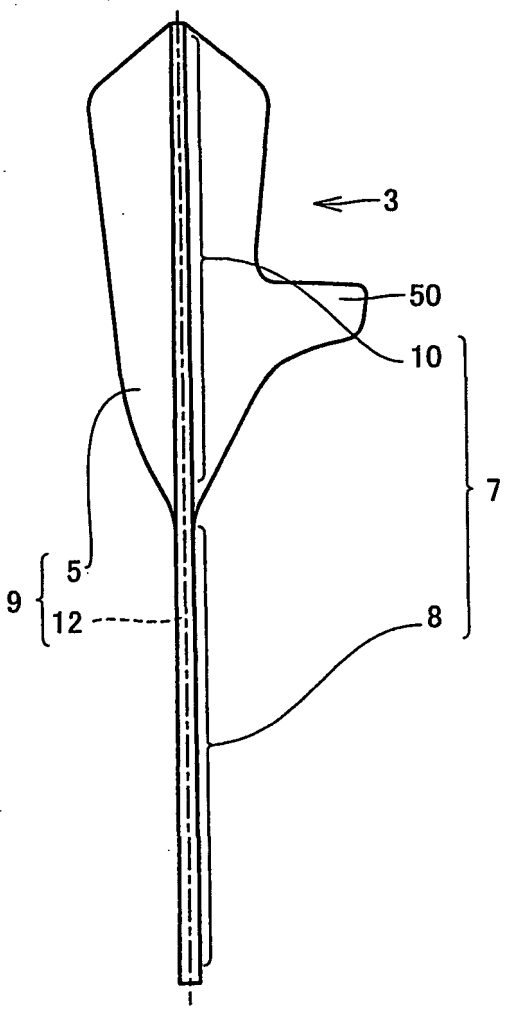

FIG.29

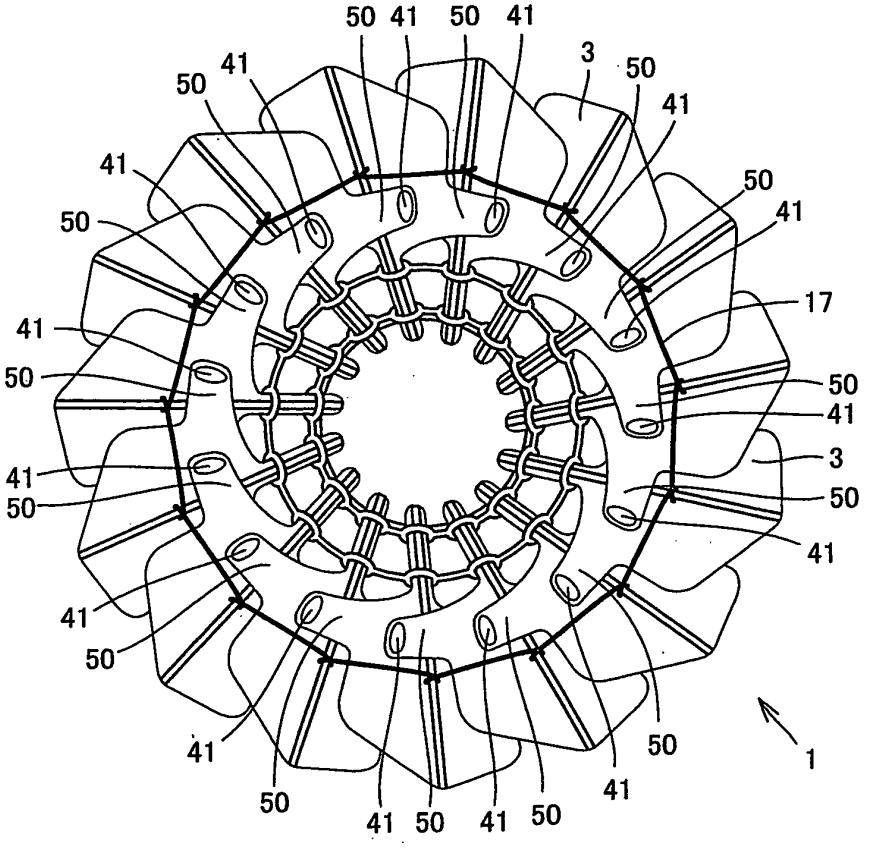

FIG.30

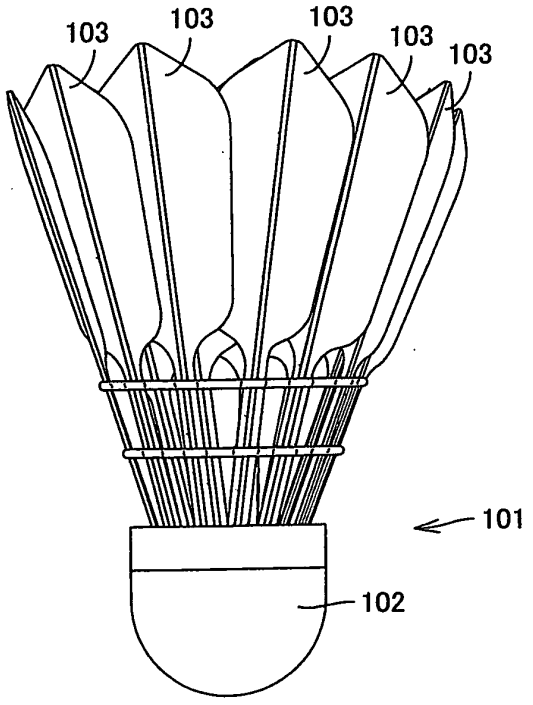

FIG.31

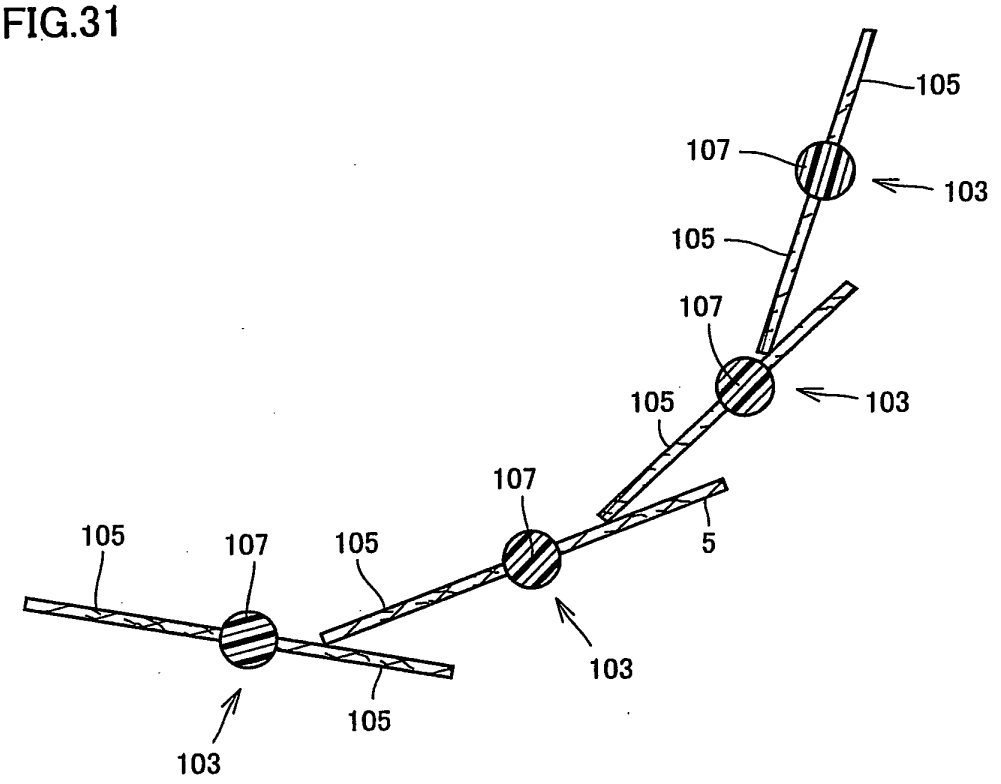
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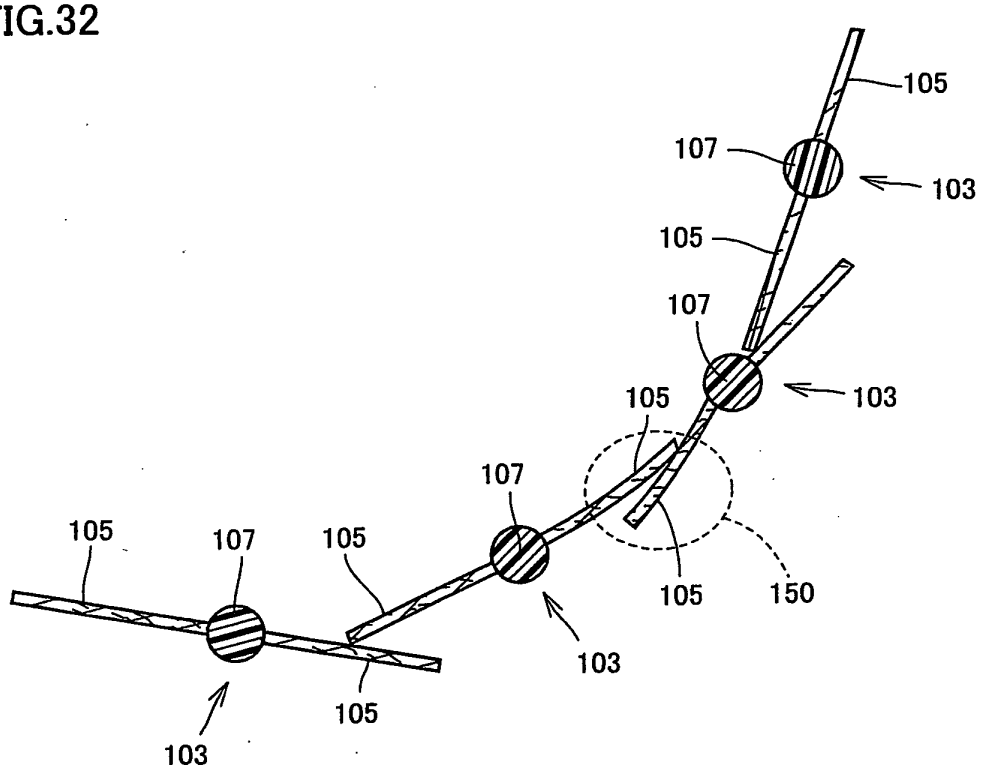
FIG.32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