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(54) **ARTIFICIAL FEATHER FOR SHUTTLECOCK AND BADMINTON SHUTTLECOCK**

KUNSTFEDER FÜR FEDERBALL UND BADMINTON-FEDERBALL

PLUME ARTIFICIELLE POUR VOLANT, ET VOLANT DE BADMINTON

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Description

TECHNICAL FIELD

[0001] The present invention relates to an artificial feather for a shuttlecock, and a badminton shuttlecock, and more particularly to an artificial feather for a shuttlecock, and a badminton shuttlecock having excellent durability.

BACKGROUND ART

[0002] A shuttlecock employing waterfowl feathers as the feathers thereof (natural shuttlecock) and a shuttlecock employing feathers artificially manufactured using nylon resin and the like (artificial shuttlecock) are conventionally known as badminton shuttlecocks. A natural shuttlecock is more expensive than a shuttlecock employing artificial feathers since it requires time and effort to obtain natural feathers of a certain level of quality. Therefore, shuttlecocks employing artificial feathers which are inexpensive and of stable quality have been proposed (see, for example, Patent Document 1 (Japanese Patent Laying-Open No. 59-69086), Patent Document 2 (Japanese Patent Laying-Open No. 53-40335), Patent Document 3 (Japanese Utility Model Publication No. 38-1627)), and Patent Document 4 (WO 96/31260 A2).

[0003] Patent Document 1 discloses an artificial feather for a shuttlecock manufactured by overlapping thin rods made of a fiber-reinforced resin to form a feather shaft, and sandwiching and fixing a feather portion made of a thin sheet of a fiber-dispersed resin between the thin rods. Patent Document 2 discloses an artificial feather for a shuttlecock manufactured by sandwiching a feather portion at a bifurcated end portion of a shaft and bonding and fixing it. Patent Document 3 discloses a shuttlecock manufactured by sandwiching a plurality of annularly arranged feather shafts between two sheets of tubular chemical fiber fabric, from an outer peripheral side and from an inner peripheral side.

[0004] Patent document 4 discloses an artificial feather (3) for a shuttlecock, comprising a feather portion (5, 6); and a shaft (11) connected to said feather portion (5, 6), wherein said feather portion (5, 6) includes a layer (6) and a shaft fixing layer (5) bonded to said layer (6) with said shaft (11) sandwiched therebetween (see, e.g. fig. 2), and said layer (6) and said shaft fixing layer (5) have an identical planar shape (see, e.g. "The skirt is formed of an inner layer 5 and an outer layer 6 of plastics sheet material which are formed in matching part cone shapes", in lines 6-8 of page 6).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent Document 1: Japanese Patent Laying-Open No. 59-69086
Patent Document 2: Japanese Patent Laying-Open No. 53-40335
Patent Document 3: Japanese Utility Model Publication No. 38-1627
Patent Document 4: WO 96/31260 A2.

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] According to experiments conducted by the inventors, however, artificial shuttlecocks employing the artificial feathers for a shuttlecock disclosed in Patent Document 1 and Patent document 2 described above were inferior in durability to a natural shuttlecock employing waterfowl feathers, since a connection portion between the feather portion and the feather shaft became separated or broke due to stress concentration on the connection portion after actual use. Further, since feather portions corresponding to the plurality of feather shafts were formed as an all-connected, integrated member (chemical fiber fabric) in the shuttlecock disclosed in Patent Document 3, its shape and flight performance were significantly different from those of a natural shuttlecock.

[0007] In contrast, a natural shuttlecock employing waterfowl feathers is becoming increasingly expensive due to increased difficulty in obtaining the waterfowl feathers. Thus, there is a strong need for an artificial shuttlecock employing artificial feathers that has flight performance and durability equal to those of a natural shuttlecock employing waterfowl feathers.

[0008] The present invention was made to solve the above-described problems, and an object of the present invention is to provide an artificial feather for a shuttlecock, and a badminton shuttlecock having flight performance and durability equal to those of a shuttlecock employing waterfowl feathers.

MEANS FOR SOLVING THE PROBLEMS

[0009] An artificial feather for a shuttlecock according to the present invention includes an artificial shuttlecock according to appended claim 1.

[0010] With this configuration, by using the foam layer as the feather portion, an increase in the mass of the feather portion is suppressed and rigidity is improved (i.e., deformation due to hitting is suppressed), and thereby a change in the shape of the artificial feather for a shuttlecock can be suppressed. As a result, flight performance of a badminton shuttlecock employing the artificial feathers for a shuttlecock can be stably maintained, and thus an artificial feather for a shuttlecock and a shuttlecock excellent in durability can be achieved.

[0011] Further, by stacking the shaft fixing layer on the foam layer, rigidity of the feather portion can be further improved. As a result, breaking (tearing, scattering) of

the foam layer can be prevented. Furthermore, a reliable connection between the shaft and the feather portion can be established by sandwiching and fixing the shaft between the shaft fixing layer and the foam layer.

[0012] A badminton shuttlecock according to the present invention includes a hemispherical base body, and a plurality of the aforementioned artificial feathers for a shuttlecock connected to the base body. With this configuration, an inexpensive shuttlecock can be achieved using the artificial feathers. Further, the shuttlecock can have flight performance equal to that of a conventional shuttlecock employing natural feathers.

EFFECTS OF THE INVENTION

[0013] According to the present invention, since the feather portion is configured by bonding the shaft fixing layer to the foam layer with the shaft sandwiched therebetween, a badminton shuttlecock and an artificial feather constituting the shuttlecock which suppress an increase in the mass of the feather portion and improve rigidity, and consequently have excellent durability and good flight performance can be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic side view showing Embodiment 1 of a shuttlecock according to the present invention.
Fig. 2 is a schematic top view of the shuttlecock shown in Fig. 1.
Fig. 3 is a schematic plan view showing Embodiment 1 of an artificial feather for a shuttlecock according to the present invention, which constitutes a shuttlecock 1 shown in Figs. 1 and 2.
Fig. 4 is a schematic cross sectional view taken along the line IV-IV in Fig. 3.
Fig. 5 is a schematic cross sectional view taken along the line V-V in Fig. 3.
Fig. 6 is a fragmentary schematic cross sectional view showing a configuration of a portion of the shuttlecock shown in Figs. 1 and 2 where an intermediate thread is arranged.
Fig. 7 is a fragmentary schematic view for illustrating a connection portion between a base body and the artificial feather in the shuttlecock shown in Figs. 1 and 2.
Fig. 8 is a flowchart for illustrating a method of manufacturing the artificial feather shown in Figs. 3 to 5.
Fig. 9 is a flowchart for illustrating a method of manufacturing the shuttlecock shown in Figs. 1 and 2.
Fig. 10 is a schematic plan view showing a first modification of the artificial feather constituting Embodiment 1 of the shuttlecock according to the present invention.
Fig. 11 is a schematic cross sectional view taken along the line XI-XI in Fig. 10.
Fig. 12 is a schematic cross sectional view showing a second modification of the artificial feather constituting Embodiment 1 of the shuttlecock according to the present invention shown in Figs. 1 and 2.
Fig. 13 is a schematic cross sectional view showing an artificial feather constituting Embodiment 2 of the shuttlecock according to the present invention.
Fig. 14 is a schematic cross sectional view showing an artificial feather constituting Embodiment 3 of the shuttlecock according to the present invention.
Fig. 15 is a schematic plan view showing an artificial feather constituting Embodiment 4 of the shuttlecock according to the present invention.
Fig. 16 is a schematic cross sectional view taken along the line XVI-XVI in Fig. 15.
Fig. 17 is a schematic cross sectional view showing a modification of the artificial feather constituting Embodiment 4 of the shuttlecock according to the present invention shown in Figs. 15 and 16.
Fig. 18 is a schematic plan view showing another modification of the artificial feather constituting Embodiment 4 of the shuttlecock according to the present invention shown in Figs. 15 and 16.
Fig. 19 is a schematic cross sectional view taken along the line XIX-XIX in Fig. 18.
Fig. 20 is a schematic plan view showing another modification of the artificial feather constituting Embodiment 4 of the shuttlecock according to the present invention shown in Figs. 15 and 16.
Fig. 21 is a schematic plan view showing an artificial feather constituting Embodiment 5 of the shuttlecock according to the present invention.
Fig. 22 is a schematic plan view showing a modification of the artificial feather constituting Embodiment 5 of the shuttlecock according to the present invention shown in Fig. 21.
Fig. 23 is a schematic view for illustrating a configuration of an artificial feather constituting Embodiment 6 of the shuttlecock according to the present invention, and a manufacturing method thereof.

MODES FOR CARRYING OUT THE INVENTION

[0015] Hereinafter, embodiments of the present invention will be described with reference to the drawings. It is to be noted that, in the drawings below, identical or corresponding parts will be designated by the same reference numerals, and the description thereof will not be repeated.

(Embodiment 1)

[0016] Embodiment 1 of a shuttlecock according to the present invention will be described with reference to Figs. 1 and 2.

[0017] Referring to Figs. 1 and 2, a shuttlecock 1 according to the present invention includes a hemispherical base body 2, a plurality of artificial feathers 3 for the shut-

tlecock connected to a fixing surface portion of base body 2 having a convex portion described later formed thereon, a fixing cord member for fixing the plurality of artificial feathers 3 to one another, and an intermediate thread 15 for maintaining a stacked state of the plurality of artificial feathers 3. The plurality of (e.g. sixteen) artificial feathers 3 are annularly arranged at the outer periphery of the convex portion on the fixing surface portion of base body 2. Further, the plurality of artificial feathers 3 are fixed to one another by the cord member. The plurality of artificial feathers 3 are arranged such that the distance among them is increased as the distance from base body 2 increases (i.e., an inner diameter of a cylindrical body formed by the plurality of artificial feathers 3 is increased as the distance from base body 2 increases).

[0018] Intermediate thread 15 serves as a fixing member for maintaining the stacked state of the plurality of artificial feathers 3. That is, intermediate thread 15 is arranged to define the positional relation of the plurality of artificial feathers 3 as described later.

[0019] Embodiment 1 of an artificial feather for a shuttlecock according to the present invention will be described with reference to Figs. 3 to 5.

[0020] Referring to Figs. 3 to 5, artificial feather 3 constituting shuttlecock 1 shown in Figs. 1 and 2 includes a feather portion 5, and a shaft 7 connected to feather portion 5. Shaft 7 includes a feather shaft portion 8 arranged to protrude from feather portion 5, and a fixed shaft portion 10 connected to feather portion 5 at a substantially central portion of feather portion 5. Feather shaft portion 8 and fixed shaft portion 10 are arranged to extend like an identical line, and constitute one continuous shaft 7. As shown in Figs. 4 and 5, feather portion 5 includes a foam layer 92 and a shaft fixing layer 91 arranged to sandwich fixed shaft portion 10, and adhesion layers 93, 94 for fixing these foam layer 92 and shaft fixing layer 91 to each other. That is, in feather portion 5, foam layer 92 and shaft fixing layer 91 are stacked to sandwich fixed shaft portion 10. Further, in feather portion 5, adhesion layers 93, 94 are arranged to connect foam layer 92 and shaft fixing layer 91 with each other, and to connect and fix these foam layer 92 and shaft fixing layer 91 to fixed shaft portion 10. From a different viewpoint, in feather portion 5, adhesion layer 93 is stacked on foam layer 92 located on an outer peripheral side when shuttlecock 1 is configured. On adhesion layer 93, fixed shaft portion 10 is arranged to be located at a substantially central portion of adhesion layer 93 and foam layer 92. The other adhesion layer 94 is arranged to extend from above fixed shaft portion 10 to above adhesion layer 93. Shaft fixing layer 91 is arranged on adhesion layer 94.

[0021] As can be seen from Fig. 5, in artificial feather 3, shaft 7 is warped toward foam layer 92 (i.e., the outer peripheral side of shuttlecock 1). From a different viewpoint, shaft 7 is warped to be convex toward shaft fixing layer 91. Further, although Fig. 5 shows a state where artificial feather 3 is warped toward foam layer 92 in a direction in which shaft 7 extends, feather portion 5 may be warped toward foam layer 92 (i.e., feather portion 5 may be warped to be convex toward shaft fixing layer 91) in a direction intersecting the direction in which shaft 7 extends (e.g., a width direction perpendicular to the direction in which shaft 7 extends and along the surface of feather portion 5). In this case, warping of artificial feather 3 in the direction in which shaft 7 extends and warping of feather portion 5 in the direction intersecting the direction in which shaft 7 extends as described above may occur simultaneously, or only one of the warpings may occur. Such warping can be implemented by a conventionally well-known method, such as subjecting constituent materials for shaft 7 and feather portion 5 to heat treatment, or originally forming constituent materials for shaft 7 and feather portion 5 in a warped state.

[0022] Here, as a material constituting foam layer 92, for example, a resin foam, and more specifically, for example, a polyethylene foam (a foam of polyethylene) can be used. For shaft fixing layer 91, a resin foam can be used as well. Further, for shaft fixing layer 91, for example, any material such as a film made of a resin or the like, or nonwoven fabric can be used, other than a polyethylene foam.

[0023] Further, for adhesion layers 93, 94, for example, a double-faced tape can be used. In artificial feather 3 shown in Figs. 3 to 5, a polyethylene foam is used as foam layer 92 and shaft fixing layer 91. Preferably, a direction in which this polyethylene foam is extruded is a direction indicated by an arrow 95 in Figs. 3 and 4. In this case, shaft 7 is connected and fixed to feather portion 5 so as to intersect the direction in which the polyethylene foam is extruded as indicated by arrow 95, thus reducing the probability of occurrence of faults such as splitting of feather portion 5 in a direction along the direction in which shaft 7 extends.

[0024] The arrangement of intermediate thread 15 will be specifically described with reference to Fig. 6.

[0025] As shown in Fig. 6, intermediate thread 1 is arranged to encircle shafts 7 of artificial feathers 3, and to pass through regions where feather portions 5 of adjacent artificial feathers 3 are opposed to each other (i.e., to pass through the spaces between stacked feather portions 5) in parts of feather portions 5 in a stacked state in adjacent artificial feathers 3. Intermediate thread 15 passes through the spaces between stacked feather portions 5 in the parts where feather portions 5 are thus stacked, whereby occurrence of such a problem that the order of stacking of feather portions 5 is changed during use of shuttlecock 1 (e.g., the order of stacking of feather portions 5 is changed by an impact of hitting with a racket) can be suppressed.

[0026] Intermediate thread 15 described above is circumferentially arranged to fix all of the plurality of annularly arranged artificial feathers 3 to one another, as shown in Figs. 1 and 2. Intermediate thread 15 can be arranged as shown in Figs. 1 and 2, for example, by being sewn by an operator using a needle or the like. With this arrangement, shuttlecock 1 exhibiting excellent durability

can be achieved by suppressing occurrence of the problem that the order of stacking of feather portions 5 is changed during use of shuttlecock 1.

[0027] It is to be noted that a sewing start end portion and a sewing finish end portion of circumferentially arranged intermediate thread 15 are connected with each other, and the remaining portions of the thread are cut in the vicinity of a knot and removed. A protective layer is preferably formed on the surface of the knot by applying an adhesive or the like. Such a protective layer is so formed that the knot can be prevented from coming loose when shuttlecock 1 is hit with a racket.

[0028] While any material such as cotton or resin can be employed for intermediate thread 15, a polyester thread is preferably employed. Further, a thread as lightweight as possible is preferably employed as intermediate thread 15 in order to minimize the influence on the center of gravity and the like of shuttlecock 1. For example, a polyester thread No. 50 may be employed as the thread. 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, it is conceivable that flight performance is hardly influenced, although the position of the center of gravity of shuttlecock 1 is slightly influenced. Further, to arrange intermediate thread 15, the distance from base body 2 can be arbitrarily set.

[0029] As shown in Fig. 7, a convex portion 61 is formed on the fixing surface portion of base body 2. Convex portion 61 has a substantially circular surface shape (i.e., a circular shape corresponding to the arrangement of insertion holes 63 into which the shafts of artificial feathers 3 are inserted). Further, a side wall 62 of convex portion 61 is inclined with respect to a surface of the outer periphery of the fixing surface portion (that is, side wall 62 is in a reverse bank state such that the width of convex portion 61 is increased as the distance from the surface of the outer periphery of the fixing surface portion increases).

[0030] As shown in Fig. 2, at the outer periphery of convex portion 61 of base body 2, insertion holes 63 for inserting shafts 7 of artificial feathers 3 are formed. Insertion hole 63 is formed to extend in a direction along a direction in which side wall 62 of convex portion 61 extends. As shown in Fig. 7, an adhesive 64 is applied with end portions of shafts 7 being inserted in insertion holes 63. As shown in Fig. 7, adhesive 64 is arranged to extend from an end portion of an upper surface of convex portion 61, via side wall 62, to the surface of the outer periphery of the fixing surface portion, and to also come into contact with shafts 7. With adhesive 64, shafts 7 of artificial feathers 3 are firmly fixed to base body 2. That is, base body 2 according to the present invention is a base body for a shuttlecock including the fixing surface portion for fixing shafts 7 of artificial feathers 3, and a plurality of insertion holes 63 for inserting and fixing shafts 7 of artificial feathers 3 as feathers for a shuttlecock, and convex portion 61 adjacent to insertion holes 63 and protruding from the surface of the fixing surface portion are formed at the fixing surface portion (an upper surface of base body 2 in Fig. 2). With this configuration, when adhesive 64 is arranged with shafts 7 being inserted in insertion holes 63, the adhesive can extend from the inside of insertion holes 63 to above convex portion 61 adjacent to insertion holes 63 (i.e., adjacent to shafts 7). Thus, a bonded surface between adhesive 64 and base body 2 can have an increased area when compared with the case where no convex portion 61 is provided, and the bonded surface has a three-dimensional shape. Therefore, bonding strength between adhesive 64 and each of base body 2 and shafts 7 of artificial feathers 3 can be improved.

[0031] Next, a method of manufacturing shuttlecock 1 and artificial feather 3 for the shuttlecock shown in Figs. 1 and 2 will be described with reference to Figs. 8 and 9.

[0032] Firstly, referring to Fig. 8, a method of manufacturing artificial feather 3 for the shuttlecock according to the present invention will be described. As shown in Fig. 8, in the method of manufacturing artificial feather 3, a constituent member preparation step (S10) is firstly performed. In this step (S 10), shaft 7, sheet-like materials constituting foam layer 92 and shaft fixing layer 91, and the double-faced tape which will be adhesion layers 93, 94 shown in Figs. 4 and 5, which constitute artificial feather 3, are prepared. The sheet-like members and the double-faced tape may have any planar shapes as long as they are larger than the size of feather portion 5 shown in Fig. 3. As the sheet-like member which will be foam layer 92, for example, a material such as a polyethylene foam (a foam of polyethylene formed in the shape of a sheet) having a thickness of 1.0 mm and a basis weight of 24 g/m^2 can be used. As the sheet-like member which will be shaft fixing layer 91, a material such as a polyethylene foam having a thickness of 0.5 mm and a basis weight of 20 g/m^2 can be used. The double-faced tape which will be adhesion layers 93, 94 can have a basis weight of 10 g/m^2.

[0033] Next, an affixation step (S20) is performed as shown in Fig. 8. In this step (S20), the double-faced tape which will be adhesion layer 93 is affixed to a main surface of the sheet-like member which will be foam layer 92. Then, fixed shaft portion 10 of shaft 7 is arranged on the double-faced tape. Further, on fixed shaft portion 10, the sheet-like member which will be shaft fixing layer 91, which has the double-faced tape which will be adhesion layer 94 affixed on a surface facing fixed shaft portion 10, is stacked and affixed. Consequently, a structure can be obtained in which fixed shaft portion 10 of shaft 7 is sandwiched and fixed between the sheet-like member which will be foam layer 92 and the sheet-like member which will be shaft fixing layer 91.

[0034] Next, a post-treatment step (S30) is performed. Specifically, an unnecessary portion of the stacked sheet-like members which will be feather portion 5 (i.e., a region other than a portion which will be feather portion 5) is cut and removed. As a result, artificial feather 3 as shown in Figs. 3 to 5 can be obtained. Then, heat treatment such as application of heat from the foam layer 92

side is performed on artificial feather 3 to constrict foam layer 92 and the like. As a result, shaft 7 and feather portion 5 can be warped as shown in Fig. 5. It is to be noted that other methods can be used to warp shaft 7 and feather portion 5 as shown in Fig. 5. For example, a method such as using shaft 7 originally having a warped shape may be employed.

[0035] Next, a method of manufacturing shuttlecock 1 shown in Figs. 1 and 2 will be described with reference to Fig. 9. As shown in Fig. 9, a preparation step (S100) is firstly performed. In this preparation step (S100), constituent members of shuttlecock 1 such as base body 2 (tip member) and artificial feather 3 described above of shuttlecock 1 are prepared.

[0036] Base body 2 can be manufactured with any conventionally known method. For example, when an artificial resin is used as a material for base body 2, a block of the material for base body 2 is firstly prepared and cut to have a rough shape. On this occasion, cutting is performed in consideration of heights of the hemispherical portion at the tip portion and of the convex portion. Then, cutting may be further performed to form an outline of convex portion 61 and insertion holes 63. Alternatively, as a material for base body 2, a natural material such as cork may be used. Further, when the artificial resin described above is used, for example, an ionomer resin foam, EVA (ethylene-vinyl acetate copolymer), polyurethane, PVC (polyvinyl chloride), polyethylene, polypropylene, or the like can be used. In addition, artificial feather 3 can be manufactured with the manufacturing method shown in Fig. 8 described above.

[0037] Next, an assembly step (S200) is performed. During the assembly step (S200), the bottoms of shafts 7 of the plurality of artificial feathers 3 described above are inserted and fixed in insertion holes 63 in the fixing surface portion of the base body. Further, the plurality of artificial feathers 3 are fixed to one another by the cord member. In addition, sewing is performed such that intermediate thread 15 for maintaining the stacked state of the feather portions is arranged as shown in Fig. 6. Thus, shuttlecock 1 shown in Figs. 1 and 2 can be manufactured. It is to be noted that the fixing member for fixing the plurality of artificial feathers 3 to one another is not limited to the cord member as described above, and any member such as a ring-shaped member may be used.

[0038] Further, as a material for the fixing member described above, for example, any material such as resin and fiber can be used. For example, a fixing member made of FRP (Fiber-Reinforced Plastic) prepared by impregnating aramid fiber or glass fiber with a resin (e.g., a thermosetting resin) and curing the resin may be used as the cord member. Such a fixing member made of FRP can have improved strength and rigidity. As the thermosetting resin, for example, epoxy resin or phenolic resin can be used. By using the thermosetting resin for FRP in this manner, the fixing member can be readily made of FRP using the thermosetting resin simultaneously during a heating step and the like in a process for fixing the fixing member to shaft 7.

[0039] An artificial feather constituting a first modification of Embodiment 1 of the shuttlecock according to the present invention will be described with reference to Figs. 10 and 11.

[0040] Artificial feather 3 shown in Figs. 10 and 11 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 3 to 5, but is different in the shape of adhesion layer 93. Specifically, in artificial feather 3 shown in Figs. 10 and 11, adhesion layer 93 arranged between foam layer 92 and fixed shaft portion 10 includes a central portion covering a surface of fixed shaft portion 10 located on the foam layer 92 side, and an extending portion continuing to the central portion and extending from a side end portion of fixed shaft portion 10 to side end portions of foam layer 92 and shaft fixing layer 91. Although the extending portion extends to between the side end portion of fixed shaft portion 10 and the side end portion of foam layer 92, it does not reach the side end portion of foam layer 92. In this case, in the vicinity of the side end portions of foam layer 92 and shaft fixing layer 91, adhesion layer 94 is brought into direct contact with foam layer 92 and fixed thereto. Thus, even in the case where a configuration in which adhesion layer 93 is partially arranged is employed, an effect similar to that of artificial feather 3 shown in Figs. 3 to 5 can be achieved as long as foam layer 92, shaft fixing layer 91, and fixed shaft portion 10 can be firmly connected to one another.

[0041] An artificial feather constituting a second modification of Embodiment 1 of the shuttlecock according to the present invention will be described with reference to Fig.12. It is to be noted that Fig. 12 corresponds to Fig. 11.

[0042] Artificial feather 3 shown in Fig. 12 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 10 and 11, but is configured such that not only adhesion layer 93 but also adhesion layer 94 are arranged only in the vicinity of fixed shaft portion 10. In this case, in the vicinity of outer peripheral end portions of foam layer 92 and shaft fixing layer 91 (i.e., portions where adhesion layers 93, 94 are not arranged), foam layer 92 and shaft fixing layer 91 are brought into direct contact with each other, and the contact portion is fusion-welded to connect and fix foam layer 92 and shaft fixing layer 91. By employing such a configuration, foam layer 92, shaft fixing layer 91, and fixed shaft portion 10 can also be firmly connected and fixed to one another using adhesion layers 93, 94. Further, decreased areas of adhesion layers 93, 94 can result in a reduction in the mass of artificial feather 3.

(Embodiment 2)

[0043] An artificial feather constituting Embodiment 2 of the shuttlecock according to the present invention will be described with reference to Fig. 13. It is to be noted that Fig. 13 corresponds to Fig. 4.

[0044] A shuttlecock including artificial feathers 3 shown in Fig. 13 has a structure which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 3 to 5. However, artificial feather 3 shown in Fig. 13 is different from artificial feather 3 for the shuttlecock in Embodiment 1 described above in that a resin film 81 is used as the shaft fixing layer constituting feather portion 5. Further, since film 81 1 relatively thinner than the resin foam used for shaft fixing layer 91 shown in Figs. 3 to 5 is used as the shaft fixing layer, it is preferable to increase the thickness of foam layer 92 to be thicker than foam layer 92 of artificial feather 3 in Embodiment 1 described above.

[0045] By configuring shuttlecock 1 as shown in Figs. 1 and 2 using artificial feathers 3 with such a configuration, an effect similar to that by shuttlecock 1 shown in Figs. 1 and 2 can also be achieved. Further, since the thickness of foam layer 92 of artificial feather 3 shown in Fig. 13 is increased to be relatively thicker than foam layer 92 of artificial feather 3 in Embodiment 1 described above, strength of feather portion 5 is fully ensured by foam layer 92. This can prevent occurrence of such a problem that film 81 is broken and pieces of film 81 are scattered due to hitting with a racket, as with artificial feather 3 shown in Figs. 3 to 5.

[0046] For film 81, any material can be used. For example, a material such as a polyethylene (PE) film having a thickness of 10 μm and a basis weight of 10 g/m^2, a material such as a polypropylene (PP) film having a thickness of 20 μm and a basis weight of 18 g/m^2, a material such as a polyethylene terephthalate (PET) film having a thickness of 12 μm and a basis weight of 17 g/m^2, or a material such as a polyamide (PA) film having a thickness of 15 μm and a basis weight of 18 g/m^2 can be used.

(Embodiment 3)

[0047] Embodiment 3 of the shuttlecock according to the present invention will be described with reference to Fig. 14. It is to be noted that Fig. 14 corresponds to Fig. 4.

[0048] A shuttlecock including artificial feathers 3 shown in Fig. 14 has a structure which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 3 to 5. However, artificial feather 3 shown in Fig. 14 is different from artificial feather 3 shown in Figs. 3 to 5 in that nonwoven fabric 71 is used as the shaft fixing layer. When nonwoven fabric 71 is thus used as the shaft fixing layer, the thickness of foam layer 92 is fully increased to ensure strength of feather portion 5. This can suppress occurrence of such a problem that feather portion 5 is deformed due to hitting with a racket. For example, for nonwoven fabric 71, a material such as polyester nonwoven fabric having a basis weight of 15 g/m^2 can be used. Further, in this case, for foam layer 92, a material such as a polyethylene foam having a thickness of 1.5 mm and a basis weight of 30 g/m^2 can be used.

(Embodiment 4)

[0049] An artificial feather constituting Embodiment 4 of the shuttlecock according to the present invention will be described with reference to Figs. 15 and 16.

[0050] A shuttlecock including artificial feathers 3 shown in Figs. 15 and 16 has a structure which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 3 to 5. However, artificial feather 3 shown in 15 and 16 is different in that a reinforcing member 21 is arranged on a tip side of feather portion 5 (i.e., on an end portion side of fixed shaft portion 10 located opposite to an end portion thereof which continues to feather shaft portion 8). As shown in Fig. 16, reinforcing member 21 is sandwiched and fixed between adhesion layer 93 and foam layer 92.

[0051] Reinforcing member 21 may be connected to foam layer 92 for example by thermal fusion welding, or another adhesion layer (e.g., a double-faced tape or a layer of an adhesive) may be arranged between reinforcing member 21 and foam layer 92 to connect and fix reinforcing member 21 to foam layer 92. As a material for reinforcing member 21, any resin film can be used. For example, a polyethylene film having a thickness of 10 μm may be used as reinforcing member 21. Reinforcing member 21 can have a thickness of, for example, not less than 1 μm and not more than 20 μm, more preferably not less than 5 μm and not more than 15 μm. For reinforcing member 21, any material other than the polyethylene film described above may be used.

[0052] Arranging such reinforcing member 21 at a tip portion of artificial feather 3 can suppress occurrence of such a problem that, when shuttlecock 1 is hit with a racket, foam layer 92 on the tip portion side of artificial feather 3 (i.e., the side on which reinforcing member 21 is arranged) is broken due to the impact of the hitting, causing exposure of fixed shaft portion 10 or separation of fixed shaft portion 10 from foam layer 92.

[0053] A modification of the artificial feather shown in Figs. 15 and 16 will be described with reference to Fig. 17. It is to be noted that Fig. 17 corresponds to Fig. 16.

[0054] A shuttlecock including artificial feathers 3 shown in Fig. 17 has a structure which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 15 and 16. However, artificial feather 3 shown in Fig. 17 is different from artificial feather 3 shown in Figs. 15 and 16 in that another reinforcing member 31 is arranged on the tip portion side of artificial feather 3, on the outer peripheral side of foam layer 92. Preferably, reinforcing member 31 has a planar shape basically identical to that of reinforcing member 21. It is to be noted that a configuration in which reinforcing member 31 has a planar shape smaller than that of reinforcing member 21, or a planar shape larger

than that of reinforcing member 21 may be employed. In this case, the tip portion of artificial feather 3 can be protected more reliably.

[0055] Reinforcing member 31 may be bonded to an outer peripheral surface of foam layer 92 with an adhesion layer such as a double-faced tape or an adhesive interposed therebetween, or reinforcing member 31 may be fusion-welded to foam layer 92. Further, a material for reinforcing member 31 and a thickness thereof may be identical to the material for reinforcing member 21 and the thickness thereof, or may be different from the material for reinforcing member 21 or the thickness thereof.

[0056] Another modification of the artificial feather shown in Figs. 15 and 16 will be described with reference to Figs. 18 and 19.

[0057] A shuttlecock including artificial feathers 3 shown in Figs. 18 and 19 has a configuration which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 15 and 16. However, artificial feather 3 shown in Figs. 18 and 19 is different from artificial feather 3 shown in Figs. 15 and 16 in the manner of the reinforcing member arranged on the tip portion side of artificial feather 3. Specifically, in artificial feather 3 shown in Figs. 18 and 19, a cord body like a thread is arranged as a reinforcing member 41 on the tip side of feather portion 5 to extend in the direction intersecting the direction in which shaft 7 extends (e.g., the direction perpendicular to the direction in which shaft 7 extends and along the surface of feather portion 5). As reinforcing member 41, for example, a thread made of a resin such as a polyester thread, or a thread made of another material such as natural fiber can be used. The size (thickness) and the like of the cord body can be arbitrarily selected, and for example a polyester thread No. 60 can be used as the polyester thread described above. As shown in Fig. 19, reinforcing member 41 made of such a cord body is sandwiched and fixed between adhesion layer 93 and foam layer 92.

[0058] Reinforcing member 41 can be arranged at any position other than between adhesion layer 93 and foam layer 92 described above in the thickness direction of feather portion 5. For example, reinforcing member 41 may be bonded to the surface of foam layer 92 on the outer peripheral side (i.e., the surface of foam layer 92 opposite to the surface thereof bonded to adhesion layer 93) using an adhesive or the like. Alternatively, reinforcing member 41 may be arranged between adhesion layer 93 and adhesion layer 94. Alternatively, reinforcing member 41 may be arranged between adhesion layer 94 and shaft fixing layer 91. Further, reinforcing member 41 may be bonded to the surface of shaft fixing layer 91 on the outer peripheral side (i.e., the surface of shaft fixing layer 91 opposite to the surface thereof bonded to adhesion layer 94) using an adhesive or the like. By using reinforcing member 41 made of such a cord body, an effect similar to that in the case of using artificial feather 3 shown in Figs. 15 and 16 can also be achieved. In addition, since reinforcing member 41 in artificial feather 3 shown in Figs. 18 and 19 is a cord body, reinforcing member 41 is lighter than sheet-like reinforcing member 31 in artificial feather 3 shown in Figs. 15 and 16, and deforms flexibly. Therefore, a shuttlecock manufactured using artificial feathers 3 shown in Figs. 18 and 19 has an improved hit feeling.

[0059] Another modification of the artificial feather shown in Figs. 15 and 16 will be described with reference to Fig. 20.

[0060] A shuttlecock including artificial feathers 3 shown in Fig. 20 has a configuration which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 18 and 19. However, artificial feather 3 shown in Fig. 20 is different from artificial feather 3 shown in Figs. 18 and 19 in that a plurality of reinforcing members made of cord bodies are arranged on the tip side of feather portion 5. Specifically, in artificial feather 3 shown in Fig. 20, cord bodies are arranged as a plurality of reinforcing members 41 to 43 on the tip side of feather portion 5 to extend in the direction intersecting the direction in which shaft 7 extends (i.e., the direction perpendicular to the direction in which shaft 7 extends and along the surface of feather portion 5). Although the plurality of reinforcing members 41 to 43 are arranged to extend parallel to one another, at least a portion of the plurality of reinforcing members 41 to 43 may be arranged in a direction intersecting one another. With this arrangement, an effect similar to that of artificial feather 3 shown in Figs. 18 and 19 can also be achieved, and the tip portion of feather portion 5 can be reinforced more reliably.

[0061] It is to be noted that sheet-like reinforcing member 31 shown in Figs. 15 and 16 and at least any of reinforcing members 41 to 43 made of cord bodies described above may be combined and arranged. Further, a member shaped like an elongated sheet cut in the form of a strip may be used as reinforcing members 41 to 43. In addition, for example, one or more openings may be formed in reinforcing member 31 to reduce the mass of reinforcing member 31.

(Embodiment 5)

[0062] An artificial feather constituting Embodiment 5 of the shuttlecock according to the present invention will be described with reference to Fig. 21.

[0063] A shuttlecock including artificial feathers 3 shown in Fig. 21 has a structure which is basically similar to that of shuttlecock 1 shown in Figs, 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 3 to 5. However, artificial feather 3 shown in Fig. 21 is different in that feather portion 5 is provided with a shaft direction reinforcing member 44 arranged to extend along the direction in which shaft 7 extends (specifically, to extend parallel to shaft 7 in Fig. 21). As shaft direction reinforcing member 44, for example, a thread as a cord body can be used.

As the thread, a thread made of any material can be used, and for example a resin thread may be used. As a resin constituting the thread, for example, polyester may be used. More specifically, for example, a polyester thread No. 60 may be used as shaft direction reinforcing member 44. Reinforcing member 44 is sandwiched and fixed between adhesion layer 93 and foam layer 92, for example as with reinforcing member 21 shown in Fig. 16.

[0064] Shaft direction reinforcing member 44 may be connected to foam layer 92 for example by thermal fusion welding, or another adhesion layer (e.g., a double-faced tape or a layer of an adhesive) may be arranged between shaft direction reinforcing member 44 and foam layer 92 to connect and fix shaft direction reinforcing member 44 to foam layer 92. As a material for shaft direction reinforcing member 44, any resin film may be used instead of a thread as described above. For example, a polyethylene film in the form of a strip (or in the form of a line) may be used as shaft direction reinforcing member 44. As a material for shaft direction reinforcing member 44, any material other than the polyethylene film described above may be used.

[0065] Arranging such shaft direction reinforcing member 44 at feather portion 5 of artificial feather 3 can suppress occurrence of such a problem that, when shuttlecock 1 is hit with a racket, feather portion 5 of artificial feather 3 is split in the direction intersecting the direction in which shaft 7 extends, due to the impact of the hitting.

[0066] Shaft direction reinforcing member 44 can be arranged at any position other than between adhesion layer 93 and foam layer 92 described above in the thickness direction of feather portion 5. For example, shaft direction reinforcing member 44 may be bonded to the surface of foam layer 92 on the outer peripheral side (i.e., the surface of foam layer 92 opposite to the surface thereof bonded to adhesion layer 93) using an adhesive or the like. Alternatively, shaft direction reinforcing member 44 may be arranged between adhesion layer 93 and adhesion layer 94. Alternatively, shaft direction reinforcing member 44 may be arranged between adhesion layer 94 and shaft fixing layer 91. Further, shaft direction reinforcing member 44 may be bonded to the surface of shaft fixing layer 91 on the outer peripheral side (i.e., the surface of shaft fixing layer 91 opposite to the surface thereof bonded to adhesion layer 94) using an adhesive or the like.

[0067] A modification of the artificial feather shown in Fig. 21 will be described with reference to Fig. 22.

[0068] A shuttlecock including artificial feathers 3 shown in Fig. 22 has a configuration which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Fig. 21. However, artificial feather 3 shown in Fig. 22 further includes reinforcing member 41 on the tip portion side thereof as with artificial feather 3 shown in Fig. 18, in addition to shaft direction reinforcing member 44. Reinforcing member 41 is a cord body, and arranged to extend in the direction intersecting shaft 7 (specifically, the direction perpendicular to shaft 7). With this arrangement, an effect obtained by artificial feather 3 shown in Fig. 18 can also be achieved in addition to an effect obtained by artificial feather 3 shown in Fig. 21. It is to be noted that a reinforcing member in another form indicated in Embodiment 4 of the present invention may be used instead of reinforcing member 41.

[0069] Reinforcing member 41 and shaft direction reinforcing member 44 shown in Fig. 22 may be arranged in an identical layer or in different layers in the thickness direction of feather portion 5. Further, reinforcing member 41 and shaft direction reinforcing member 44 may be formed of a single member or separate members.

(Embodiment 6)

[0070] An artificial feather constituting Embodiment 6 of the shuttlecock according to the present invention, and a manufacturing method thereof will be described with reference to Fig. 23. It is to be noted that Fig. 23 shows a cross section in a direction along the shaft of artificial feather 3, and corresponds to Fig. 5.

[0071] A shuttlecock including artificial feathers 3 shown in Fig. 23 has a structure which is basically similar to that of shuttlecock 1 shown in Figs. 1 and 2, and artificial feather 3 has a structure which is basically similar to that of artificial feather 3 shown in Figs. 3 to 5. However, artificial feather 3 shown in Fig. 23 is different from artificial feather 3 shown in Figs. 3 to 5 in that shaft fixing layer 91 is directly connected to shaft 7. With such a configuration, an effect similar to that of artificial feather 3 shown in Figs. 3 to 5 can also be achieved.

[0072] Next, a method of manufacturing artificial feather 3 shown in Fig. 23 will be described. Although the method of manufacturing artificial feather 3 shown in Fig. 23 is basically similar to the method of manufacturing an artificial feather shown in Fig. 8, it is different in the content of the affixation step (S20). Specifically, in the method of manufacturing artificial feather 3 shown in Fig. 23, a support 51 and a pressing plate 52 as manufacturing jigs as shown in Fig. 23 are used. An upper surface of support 51 and a lower surface of pressing plate 52 face each other. The upper surface and the lower surface described above are provided with concave portions such that, when pressing plate 52 overlies support 51, a gap in the shape of feather portion 5 and shaft 7 of artificial feather 3 is formed at a contact portion between support 51 and pressing plate 52. As can been seen from Fig. 23, the upper surface and the lower surface are curved to correspond to the shape of artificial feather 3 to be formed.

[0073] In the method of manufacturing artificial feather 3 shown in Fig. 23, after the constituent member preparation step (S10) shown in Fig. 8 is performed, the step described below is performed as the affixation step (S20). Specifically, firstly, a sheet-like member which will be shaft fixing layer 91 is placed on the upper surface of

support 51. Then, shaft 7 is arranged on the sheet-like member. Further, a double-faced tape which will be adhesion layer 93 is affixed to one surface of another sheet-like member which will be foam layer 92, and then the other sheet-like member is placed on shaft 7. On this occasion, the other sheet-like member is arranged such that the surface of the other sheet-like member to which the double-faced tape is affixed faces shaft 7. Subsequently, pressing plate 52 is pressed from above the other sheet-like member toward support 51. Thus, the sheet-like member which will be shaft fixing layer 91, shaft 7, and the other sheet-like member which will be foam layer 92 are bonded. Thereafter, the post-treatment step (S30) is performed as in Embodiment 1.

[0074] Specifically, an unnecessary portion of the sheet-like member and the other sheet-like member is removed, and the shape is trimmed, and thus artificial feather 3 as shown in Fig. 23 can be obtained.

[0075] Characteristic features of the invention of the present application will be listed below, although the description thereof partially overlaps the description of the embodiments described above.

[0076] Artificial feather 3 for a shuttlecock according to the present invention includes feather portion 5 and shaft 7 connected to feather portion 5. Feather portion 5 includes foam layer 92, and a shaft fixing layer (shaft fixing layer 91, film 81, nonwoven fabric 71) bonded to foam layer 92 with shaft 7 sandwiched therebetween. Foam layer 92 and the shaft fixing layer have an identical planar shape.

[0077] With this configuration, by using foam layer 92 as feather portion 5, an increase in the mass of feather portion 5 is suppressed and rigidity is improved (i.e., deformation due to hitting is suppressed), and thereby a change in the shape of artificial feather 3 for the shuttlecock can be suppressed. As a result, flight performance of badminton shuttlecock 1 employing artificial feathers 3 for the shuttlecock can be stably maintained, and thus artificial feather 3 for the shuttlecock and shuttlecock 1 excellent in durability can be achieved.

[0078] Further, by stacking the shaft fixing layer (shaft fixing layer 91, film 81, nonwoven fabric 71) on foam layer 92, rigidity of feather portion 5 can be further improved. As a result, breaking (tearing, scattering) of foam layer 92 can be prevented. Furthermore, a reliable connection between shaft 7 and feather portion 5 can be established by sandwiching and fixing shaft 7 between the shaft fixing layer and foam layer 92.

[0079] Artificial feather 3 of the invention further include adhesion layers 93, 94 located between foam layer 92 and the shaft fixing layer. In this case, adhesion layers 93, 94 can strengthen connection between foam layer 92 and the shaft fixing layer, and connection between foam layer 92 and each of the shaft fixing layer and shaft 7. As a result, durability of artificial feather 3 for the shuttlecock can be improved.

[0080] Further, even if shaft 7 and feather portion 5 are made of materials that cannot be directly connected (e.g., by thermal fusion bonding), adhesion layers 93, 94 can bond feather portion 5 to shaft 7. Therefore, the degree of freedom in selecting materials for shaft 7 and feather portion 5 can be increased.

[0081] In artificial feather 3 for the shuttlecock described above, adhesion layers 93, 94 are arranged at a position overlapping at least shaft 7 (specifically, fixed shaft portion 10). That is, adhesion layers 93, 94 fix foam layer 92 and the shaft fixing layer to shaft 7. In this case, adhesion layers 93, 94 can establish a reliable connection between shaft 7 and feather portion 5. As a result, durability of artificial feather 3 for the shuttlecock can be reliably improved.

[0082] In artificial feather 3 of the invention, adhesion layers 93, 94 are arranged in an entire region between foam layer 92 and the shaft fixing layer, as shown in Figs. 4, 13, 14, 16, 17, and the like. In this case, adhesion layers 93, 94 can improve durability of entire feather portion 5.

[0083] In artificial feather 3 for the shuttlecock described above, feather portion 5 may be warped toward foam layer 92 in at least one of the direction in which shaft 7 extends and the direction intersecting the direction in which shaft 7 extends, as shown in Fig. 5. In this case, artificial feather 3 for the shuttlecock can have a shape close to that of a waterfowl feather (natural feather). Thus, when shuttlecock 1 is manufactured using artificial feathers 3 for the shuttlecock, shuttlecock 1 can have a shape close to that of a shuttlecock employing natural feathers. Further, it is also possible to adjust flight performance of shuttlecock 1 manufactured using artificial feathers 3 for the shuttlecock by changing the degree of the warping. As a result, artificial shuttlecock 1 manufactured using artificial feathers 3 for the shuttlecock can have flight performance close to that of a conventional shuttlecock employing natural feathers.

[0084] In artificial feather 3 for the shuttlecock described above, foam layer 92 may be thicker than the shaft fixing layer (shaft fixing layer 91, film 81, nonwoven fabric 71). In this case, by increasing the thickness of feather portion 5 on the foam layer 92 side having a relatively small apparent density, the thickness of feather portion 5 required as a total can be ensured, and an increase in the weight of feather portion 5 can be avoided.

[0085] In artificial feather 3 for the shuttlecock described above, shaft 7 may include a bottom portion to be connected to base body 2 of shuttlecock 1, and a tip portion located opposite to the bottom portion and sandwiched between foam layer 92 and the shaft fixing layer. Artificial feather 3 for the shuttlecock described above may further include reinforcing members 21, 31 arranged to overlap the tip portion of shaft 7, as shown in Figs. 15 to 17. In this case, by arranging reinforcing members 21, 31 at the tip portion of shaft 7 which is most likely to be broken when shuttlecock 1 is hit, the possibility that the tip portion is broken due to the hitting can be reduced.

[0086] In artificial feather 3 for the shuttlecock described above, reinforcing members 21, 31 are arranged

on a side of shaft 7 close to foam layer 92 in the thickness direction of feather portion 5. In this case, when artificial feathers 3 are provided to base body 2 such that the foam layer 92 side faces outward in shuttlecock 1, reinforcing members 21, 31 can effectively protect the tip portion of shaft 7 from external impact by employing a configuration as described above.

[0087] In artificial feather 3 for the shuttlecock described above, at least one of foam layer 92 and the shaft fixing layer may be formed using an extrusion method, and the direction in which shaft 7 extends may intersect a direction in which foam layer 92 or the shaft fixing layer is extruded by the extrusion method. Here, foam layer 92 or the shaft fixing layer formed by the extrusion method is likely to split in the extrusion direction described above. Therefore, if shaft 7 is fixed as described above, shaft 7 serves as a reinforcing member for foam layer 92 or the shaft fixing layer. As a result, durability of feather portion 5 can be improved.

[0088] Preferably, in artificial feather 3 for the shuttlecock described above, foam layer 92 is made of foamed polyethylene, and has a basis weight amount of not less than 10 g/m^2 and not more than 30 g/m^2 and a thickness of not less than 0.5 mm and not more than 2 mm. Further, preferably, shaft fixing layer 91 is made of foamed polyethylene, and has a basis weight amount of not less than 10 g/m^2 and not more than 30 *g/m^2* and a thickness of not less than 0.3 mm and not more than 1 mm. In this case, the position of the center of gravity and the total mass close to those of a natural feather can be achieved in artificial feather 3 for the shuttlecock. Further, badminton shuttlecock 1 manufactured using artificial feathers 3 for the shuttlecock can have a good flight performance equal to that of a natural shuttlecock.

[0089] Preferably, artificial feather 3 for the shuttlecock described above includes shaft direction reinforcing member 44 arranged in feather portion 5 to extend along the direction in which shaft 7 extends. In this case, splitting of feather portion 5 in the direction intersecting the direction in which shaft 7 extends can be suppressed.

[0090] Badminton shuttlecock 1 according to the present invention includes hemispherical base body 2, and a plurality of artificial feathers 3 for the shuttlecock described above connected to base body 2. With this configuration, an inexpensive shuttlecock 1 can be achieved using artificial feathers 3. Further, shuttlecock 1 can have flight performance equal to that of a conventional shuttlecock employing natural feathers.

[0091] In badminton shuttlecock 1 described above, artificial feathers 3 for the shuttlecock may be fixed to base body 2 such that they are annularly arranged in base body 2 and adjacent feather portions 5 partially overlap. Badminton shuttlecock 1 described above may further include intermediate thread 15 as a cord body limiting relative movement or deformation of feather portions 5 in the plurality of artificial feather 3 for the shuttlecock. In this case, a change in the order of stacking of feather portions 5 can be reliably prevented.

[0092] It should be understood that the embodiments disclosed herein are illustrative and non-restrictive in every respect. The scope of the present invention is defined by the scope of the claims, rather than the description above, and is intended to include any modifications within the scope of the claims.

DESCRIPTION OF THE REFERENCE SIGNS

[0093]

1: shuttlecock, 2: base body, 3: artificial feather, 5: feather portion, 7: shaft, 8: feather shaft portion, 10: fixed shaft portion, 15: intermediate thread, 21, 31, 41 to 43: reinforcing member, 44: shaft direction reinforcing member, 51: support, 52: pressing plate, 61: convex portion, 62: side wall, 63: insertion hole, 64; adhesive, 71: nonwoven fabric, 81: film, 91: shaft fixing layer, 92: foam layer, 93, 94: adhesion layer, 95: arrow.

Claims

1. An artificial feather (3) for a shuttlecock, comprising:

a feather portion (5); and
a shaft (7) connected to said feather portion (5),
wherein said feather portion (5) includes a foam layer (92), and a shaft fixing layer (71, 81, 91) bonded to said foam layer (92) with said shaft (7) sandwiched therebetween, and
said foam layer (92) and said shaft fixing layer (71, 81, 91) have an identical planar shape,

further comprising an adhesion layer (93, 94) located between said foam layer (92) and said shaft fixing layer (71, 81, 91),
wherein said adhesion layer (93, 94) is arranged in an entire region between said foam layer (92) and said shaft fixing layer (71, 81, 91),
the shaft (7) being fixable to a base body of the shuttlecock (1).

2. The artificial feather (3) for a shuttlecock according to claim 1, wherein
said adhesion layer (93, 94) is arranged at a position overlapping said shaft (7), and
said adhesion layer (93, 94) fixes said foam layer (92) and said shaft fixing layer (71, 81, 91) to said shaft (7).

3. The artificial feather (3) for a shuttlecock according to claim 1, wherein said feather portion (5) is warped toward said foam layer in at least one of a direction in which said shaft (7) extends and a direction intersecting the direction in which said shaft (7) extends.

4. The artificial feather (3) for a shuttlecock according to claim 3, wherein said foam layer (92) is thicker than said shaft fixing layer (71, 81, 91).

5. The artificial feather (3) for a shuttlecock according to claim 1, wherein
said shaft (7) includes a bottom portion to be connected to a base body (2) of a shuttlecock (1), and a tip portion located opposite to said bottom portion and sandwiched between said foam layer (92) and said shaft fixing layer (71, 81, 91), and
the artificial feather further comprises a reinforcing member (21, 31, 41 to 43) arranged to overlap said tip portion of said shaft (7).

6. The artificial feather (3) for a shuttlecock according to claim 1, wherein
at least one of said foam layer (92) and said shaft fixing layer (71, 81, 91) is formed using an extrusion method, and
a direction in which said shaft (7) extends intersects a direction in which said foam layer (92) or said shaft fixing layer (71, 81, 91) is extruded by said extrusion method.

7. The artificial feather (3) for a shuttlecock according to claim 1, comprising a shaft direction reinforcing member (44) arranged in said feather portion (5) to extend along a direction in which said shaft (7) extends.

8. A badminton shuttlecock (1), comprising:

a hemispherical base body (2); and
a plurality of the artificial feathers (3) for a shuttlecock according to claim 1 connected to said base body (2).

Patentansprüche

1. Kunstfeder (3) für einen Federball, aufweisend:

einen Federabschnitt (5); und
einen Schaft (7), welcher mit dem Federabschnitt (5) verbunden ist, wobei der Federabschnitt (5) eine Schaumschicht (92), und eine mit der Schaumschicht (92) verbundene Schaftfixierungsschicht (71, 81, 91), mit dem Schaft (7) dazwischen eingelegt, aufweist, und
die Schaumschicht (92) und die Schaftfixierungsschicht (71, 81, 91) eine identische ebene Gestalt aufweisen,
des Weiteren aufweisend eine Klebeschicht (93, 94), welche zwischen der Schaumschicht (92) und der Schaftfixierungsschicht (71, 81, 91) angeordnet ist,
wobei die Klebeschicht (93, 94) in einem vollständigen Gebiet zwischen der Schaumschicht (92) und der Schaftfixierungsschicht (71, 81, 91) angeordnet ist,
wobei der Schaft (7) an einem Basiskörper des Federballs (1) fixierbar ist.

2. Kunstfeder (3) für einen Federball gemäß Anspruch 1, wobei
die Klebeschicht (93, 94) an einer den Schaft (7) überlappenden Position angeordnet ist, und
die Klebeschicht (93, 94) die Schaumschicht (92) und die Schaftfixierungsschicht (71, 81, 91) an dem Schaft (7) fixiert.

3. Kunstfeder (3) für einen Federball gemäß Anspruch 1, wobei
der Federabschnitt (5) in wenigstens eine der Richtungen zur Schaumschicht gebogen ist, in welche sich der Schaft (7) erstreckt und/oder in eine Richtung, welche die Richtung, in die sich der Schaft (7) erstreckt, kreuzt.

4. Kunstfeder (3) für einen Federball gemäß Anspruch 3, wobei die Schaumschicht (92) dicker als die Schaftfixierungsschicht (71, 81, 91) ist.

5. Kunstfeder (3) für einen Federball gemäß Anspruch 1, wobei
der Schaft (7) einen unteren Abschnitt, um mit einem Basiskörper (2) des Federballs (1) verbunden zu sein, und einen Spitzenabschnitt, welcher gegenüber des unteren Abschnitts angeordnet und zwischen die Schaumschicht (92) und die Schaftfixierungsschicht (71, 81, 91) eingelegt ist, aufweist und wobei die Kunstfeder des Weiteren ein Verstärkungselement (21, 31, 41 bis 43) aufweist, welches zum Überlappen des Spitzenabschnitts des Schafts (7) angeordnet ist.

6. Kunstfeder (3) für einen Federball gemäß Anspruch 1, wobei
wenigstens eine der Schaumschicht (92) oder Schaftfixierungsschicht (71, 81, 91) durch die Verwendung eines Extrusionsverfahrens geformt ist, und
wobei eine Richtung, in die sich der Schaft (7) erstreckt, eine Richtung kreuzt, in welche die Schaumschicht (92) oder die Schaftfixierungsschicht (71, 81, 91) durch die Extrusionsmethode extrudiert ist.

7. Kunstfeder (3) für einen Federball gemäß Anspruch 1, aufweisend
ein Schaftrichtungs-Verstärkungselement (44), welches im Federabschnitt (5) angeordnet ist, um sich entlang einer Richtung zu erstrecken, in welche sich der Schaft (7) erstreckt.

8. Ein Badminton-Federball (1), aufweisend:

einen halbkugelförmigen Basiskörper (2); und eine Vielzahl von Kunstfedern (3) für einen Federball gemäß Anspruch 1, welche mit dem Basiskörper (2) verbunden sind.

Revendications

1. Plume artificielle (3) pour un volant, comprenant :

une partie de plume (5) ; et
une tige (7) raccordée à ladite partie de plume (5),
dans laquelle ladite partie de plume (5) comprend une couche de mousse (92) et une couche de fixation de tige (71, 81, 91) collée à ladite couche de mousse (92), avec ladite tige (7) prise en sandwich entre elles, et
ladite couche de mousse (92) et ladite couche de fixation de tige (71, 81, 91) ont une forme plane identique, comprenant en outre une couche d'adhésion (93, 94) positionnée entre ladite couche de mousse (92) et ladite couche de fixation de tige (71, 81, 91),
dans laquelle ladite couche d'adhésion (93, 94) est agencée dans une région entière entre ladite couche de mousse (92) et ladite couche de fixation de tige (71, 81, 91),
la tige (7) étant susceptible d'être fixée à un corps de base du volant (1).

2. Plume artificielle (3) pour un volant selon la revendication 1, dans laquelle :

ladite couche d'adhésion (93, 94) est agencée dans une position recouvrant ladite tige (7), et
ladite couche d'adhésion (93, 94) fixe ladite couche de mousse (92) et ladite couche de fixation de tige (71, 81, 91) sur ladite tige (7).

3. Plume artificielle (3) pour un volant selon la revendication 1, dans laquelle ladite partie de plume (5) est voilée vers ladite couche de mousse dans au moins l'une parmi une direction dans laquelle ladite tige (7) s'étend et une direction coupant la direction dans laquelle ladite tige (7) s'étend.

4. Plume artificielle (3) pour un volant selon la revendication 3, dans laquelle ladite couche de mousse (92) est plus épaisse que ladite couche de fixation de tige (71, 81, 91).

5. Plume artificielle (3) pour un volant selon la revendication 1, dans laquelle :

ladite tige (7) comprend une partie inférieure à raccorder à un corps de base (2) d'un volant (1), et une partie de pointe positionnée à l'opposé de ladite partie inférieure et prise en sandwich entre ladite couche de mousse (92) et ladite couche de fixation de tige (71, 81, 91), et
la plume artificielle comprend en outre un élément de renforcement (21, 31, 41 à 43) agencé pour recouvrir ladite partie de pointe de ladite tige (7).

6. Plume artificielle (3) pour un volant selon la revendication 1, dans laquelle :

au moins l'une parmi ladite couche de mousse (92) et ladite couche de fixation de tige (71, 81, 91) est formée à l'aide d'un procédé d'extrusion, et
une direction dans laquelle ladite tige (7) s'étend, coupe une direction dans laquelle ladite couche de mousse (92) ou ladite couche de fixation de tige (71, 81, 91) est extrudée par ledit procédé d'extrusion.

7. Plume artificielle (3) pour un volant selon la revendication 1, comprenant un élément de renforcement (44) dans la direction de la tige agencé dans ladite partie de plume (5) pour s'étendre le long d'une direction dans laquelle ladite tige (7) s'étend.

8. Volant de badminton (1), comprenant :

un corps de base hémisphérique (2) ; et
une pluralité de plumes artificielles (3) pour un volant selon la revendication 1, raccordées audit corps de base (2).

FIG.1

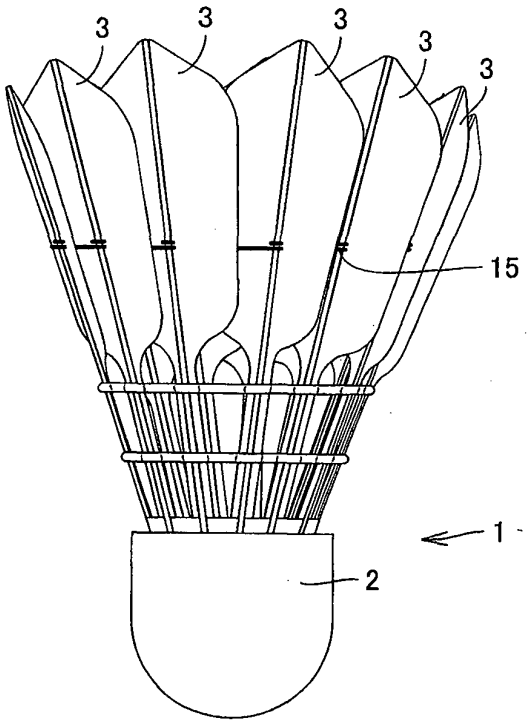


FIG.2

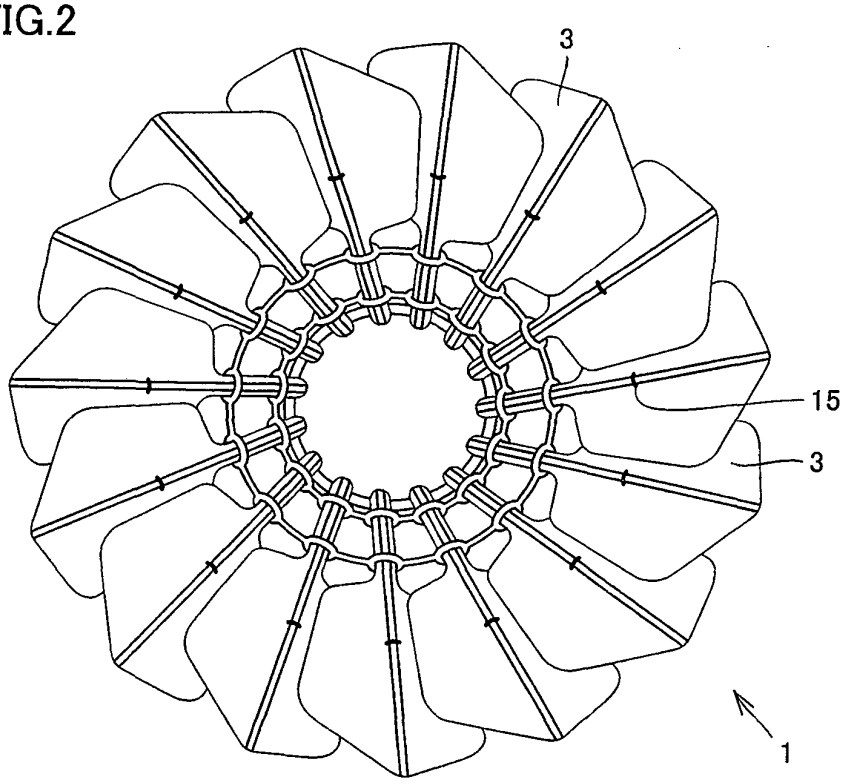


FIG.3

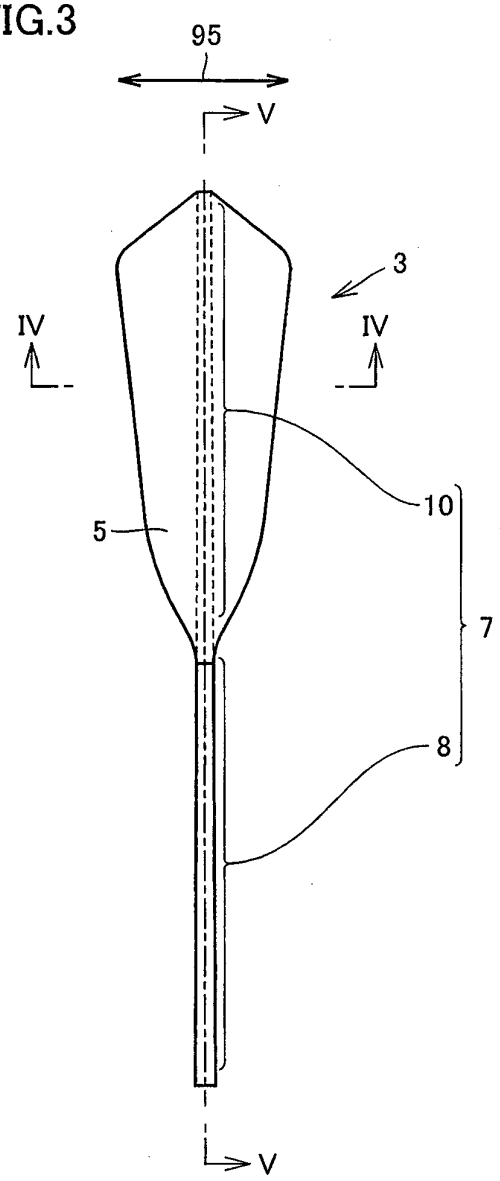


FIG.4

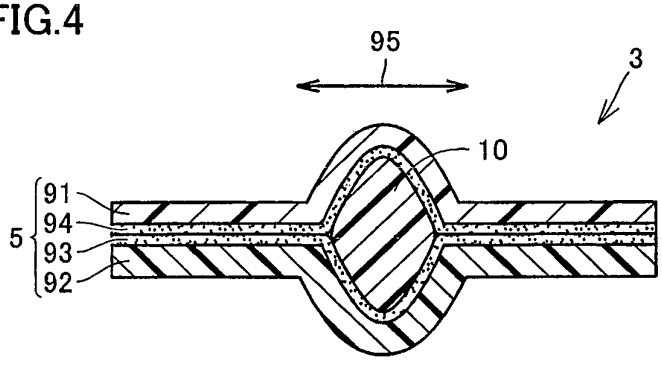


FIG.5

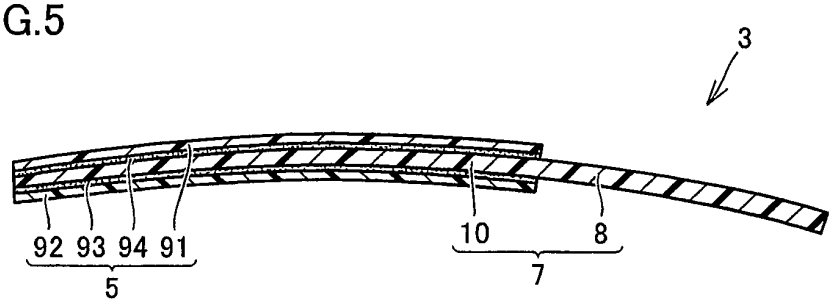

3
92 93 94 91
5
10
8
7

FIG.6

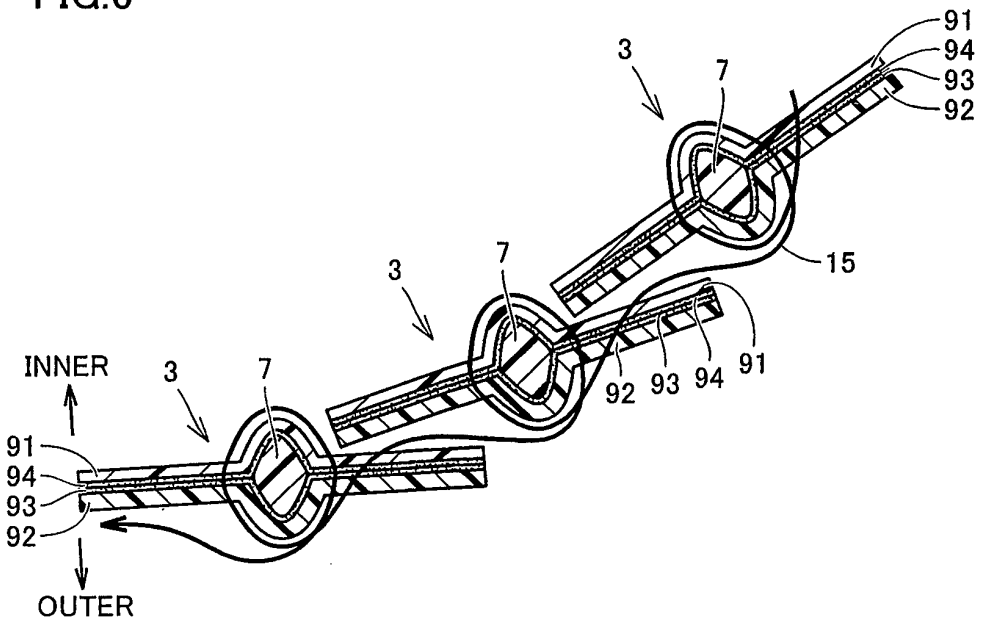

91
94
93
92
3
7
15
3
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INNER
3
7
91
94
93
92
92 93 94 91
OUTER

FIG.7

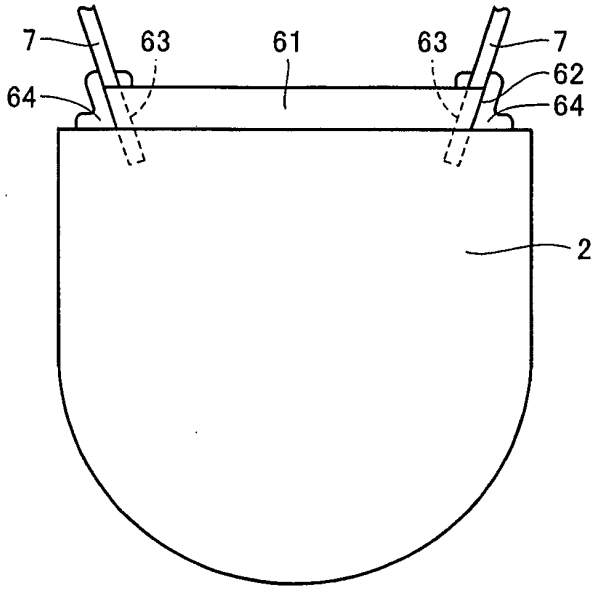


FIG.8

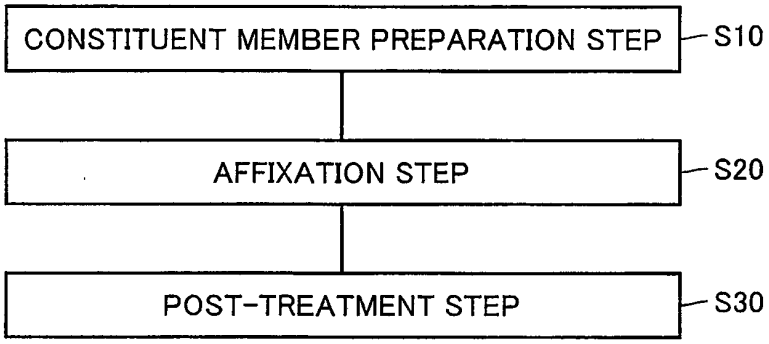


FIG.9

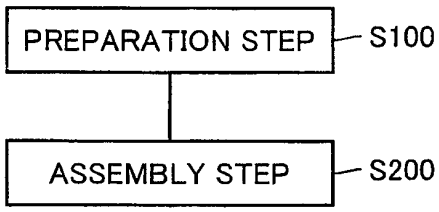


FIG.10

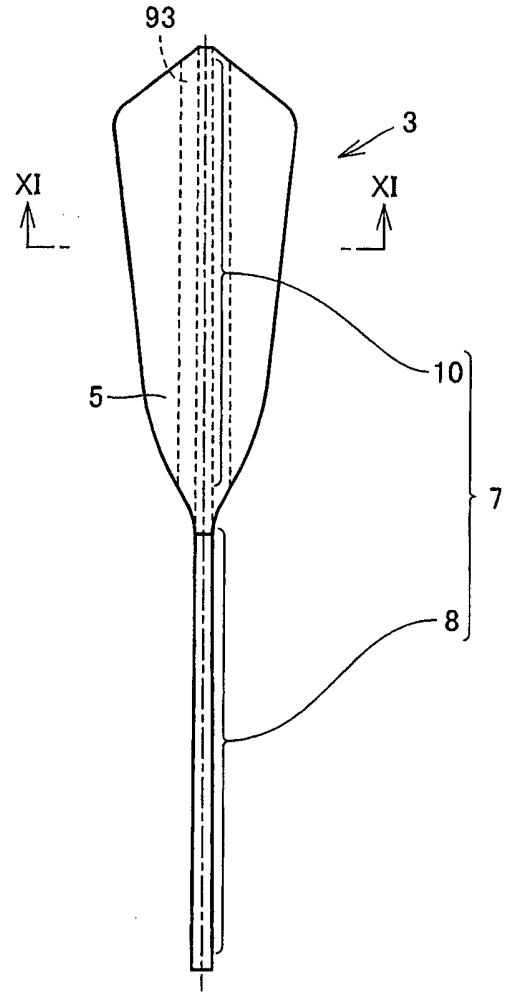


FIG.11

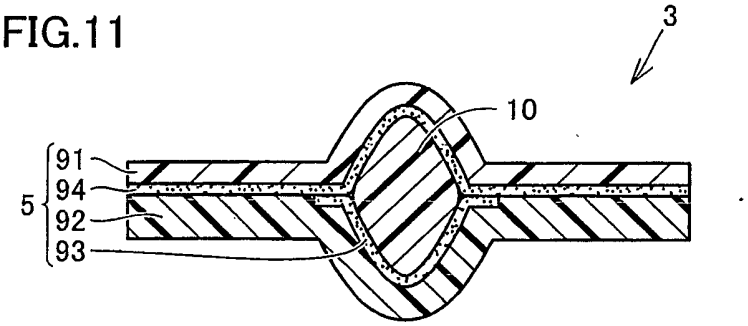


FIG.12

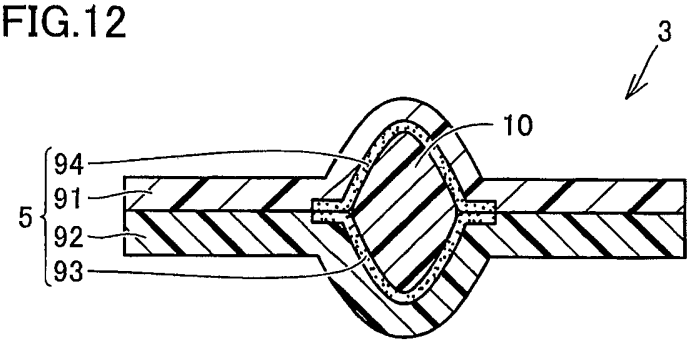


FIG.13

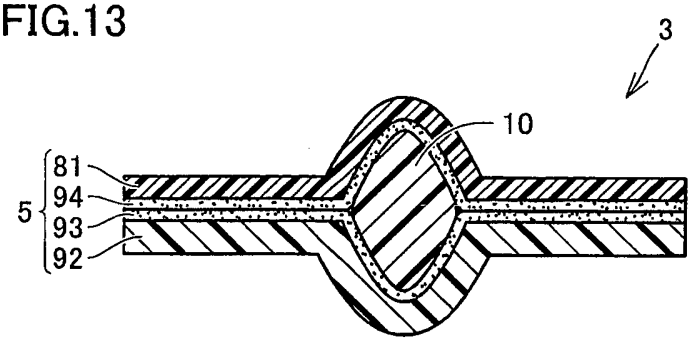


FIG.14

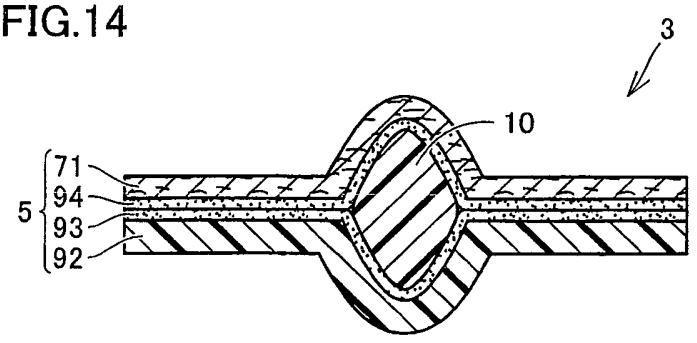


FIG.15

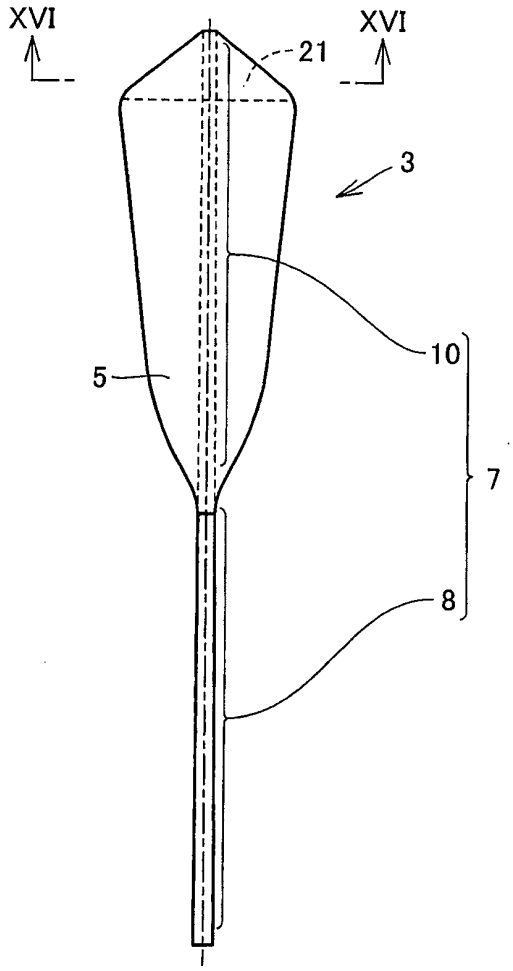


FIG.16

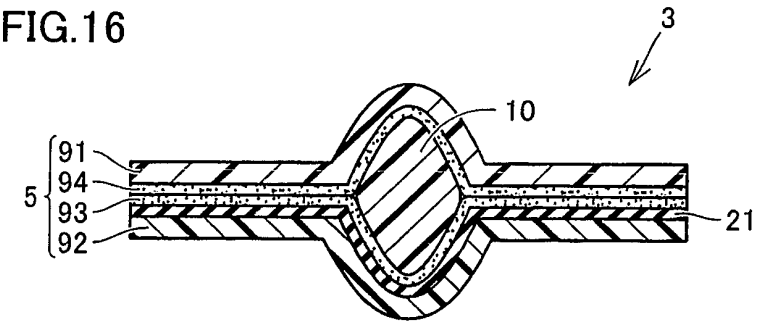


FIG.17

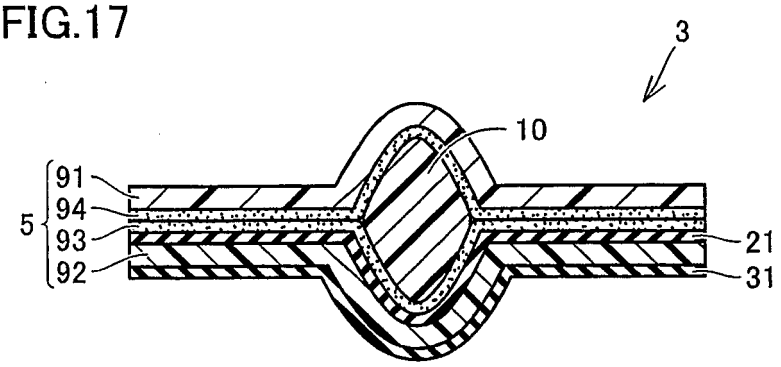


FIG.18

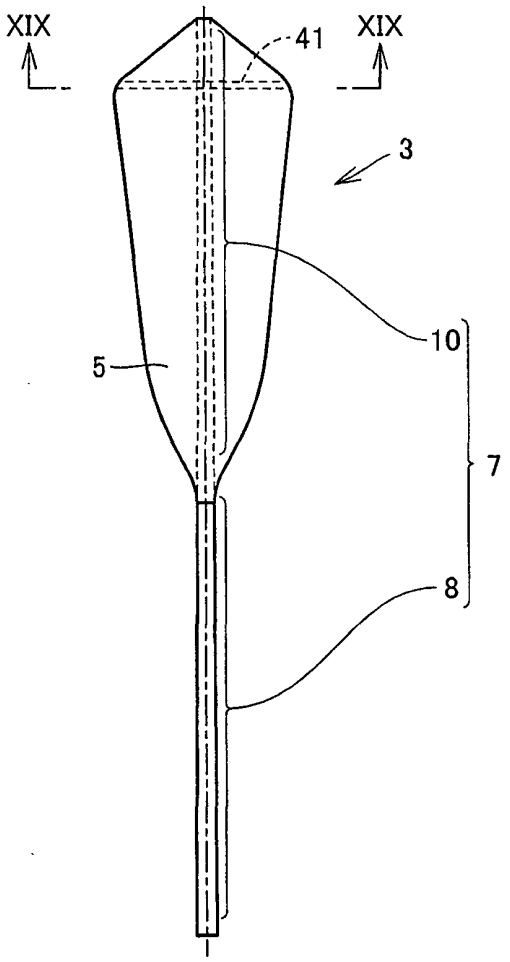


FIG.19

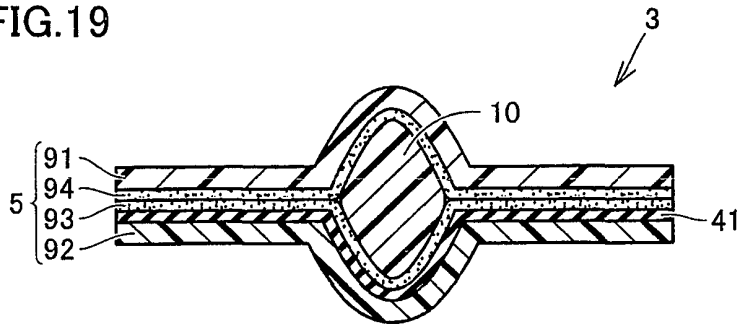


FIG.20

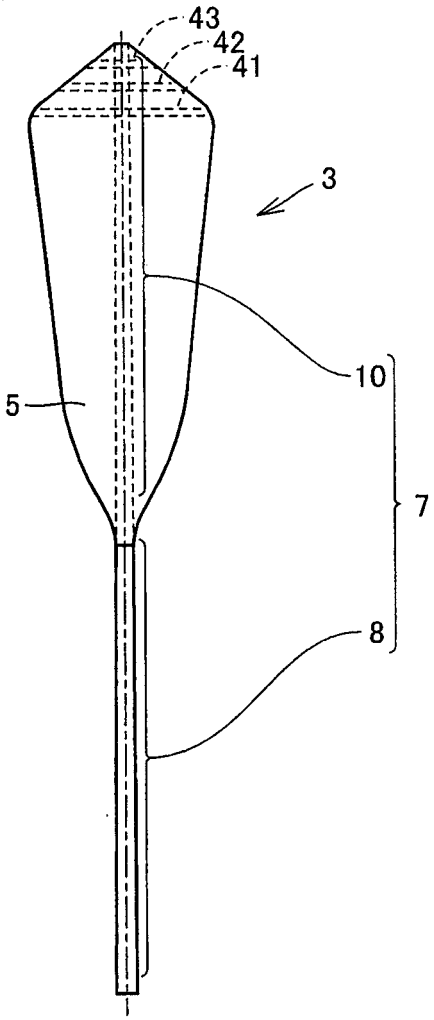


FIG.21

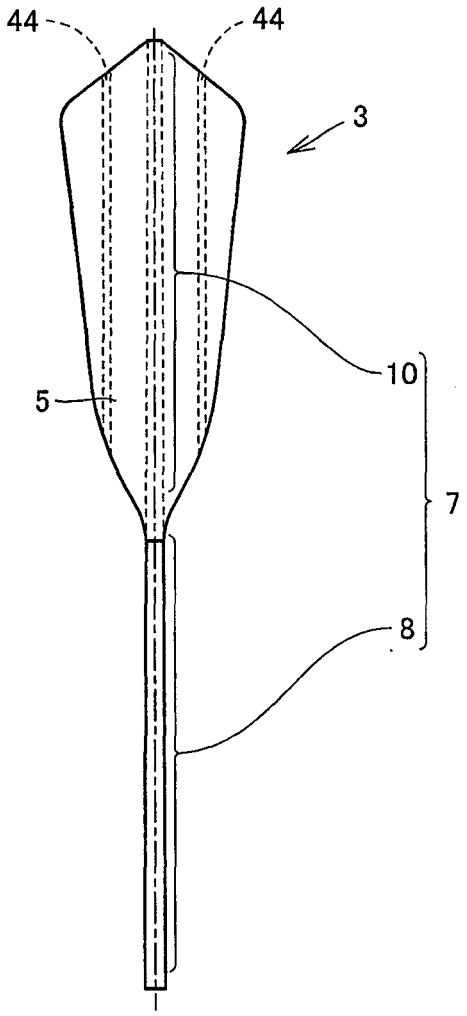


FIG.22

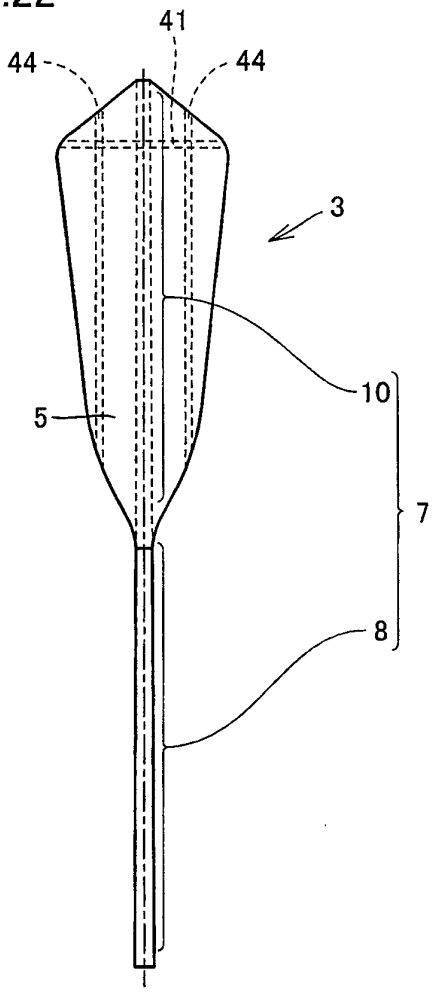
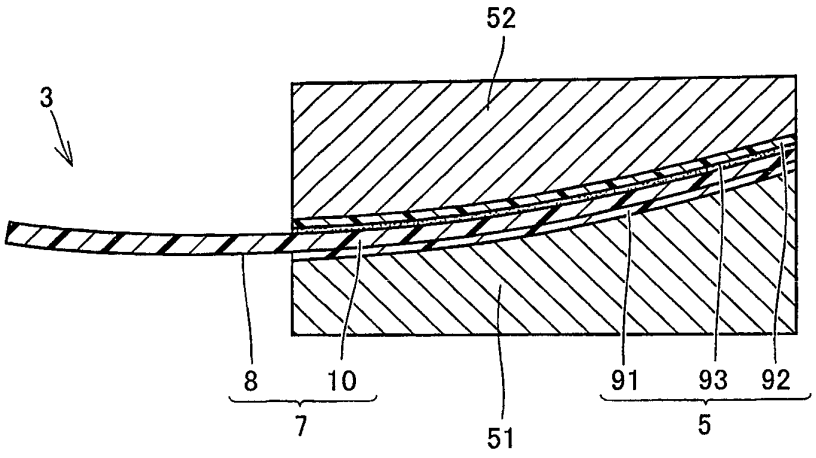


FIG.23



REFERENCES CITED IN THE DESCRIPTION

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- JP 53040335 A **[0002] [0005]**
- JP 381627 A **[0002] [0005]**
- WO 9631260 A2 **[0002] [0005]**