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(54) **Badminton racket**

(57) A badminton racket comprises an oval-shaped frame and a hollow shaft joined together by a T-joint coated with adhesive. A vertical stem of the T-joint is provided with a plurality of ribs extending axially on the

external surface thereof. The ribs are formed such that, when the T-joint is inserted into an upper open end of the shaft, top edges of the ribs are brought into close contact with inner surface of the shaft.

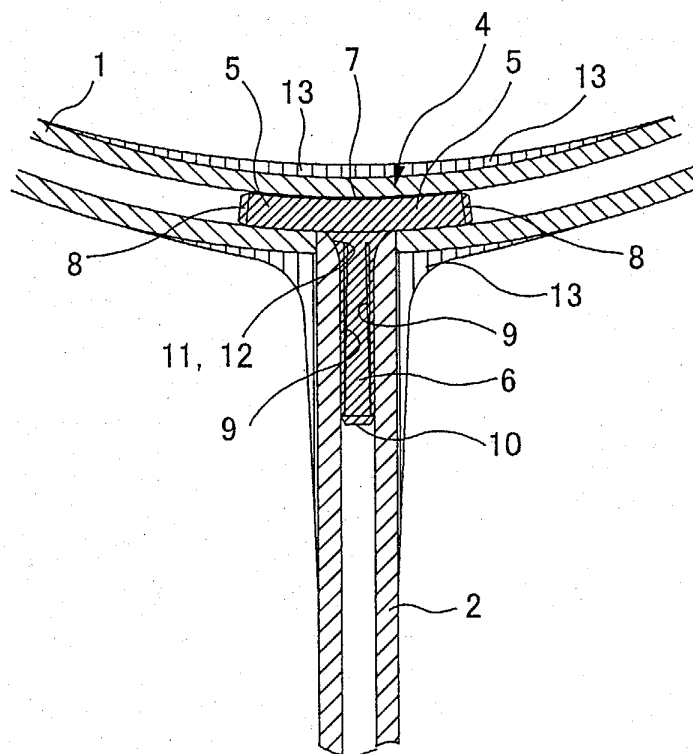


FIG. 2

Description

[0001] The present invention relates to a badminton racket comprising an oval-shaped frame and a hollow shaft joined together by a T-joint coated with adhesive. The T-joint has horizontal arms and a vertical stem extending downwardly from central portion of the horizontal arms. The horizontal arms are inserted into opposite ends of the frame, while the vertical stem is inserted into an upper open end of the hollow shaft

[0002] One prior art of this type of the badminton racket is known in Japanese Utility Model Laid-Open No. 2-19163. This prior art badminton racket is manufactured by the steps of first coating a T-joint with an adhesive such as liquid epoxy resin, inserting the vertical stem of this T-joint into an open upper end of a hollow shaft, inserting both of the horizontal arms of the T-joint into the opposite hollow ends of the oval-shaped frame, wrapping FRP tape around the joint of the shaft and the frame for reinforcement, setting the thus connected joint portion of the frame and shaft into a mold and closing the mold for a predetermined time period with predetermined temperature.

[0003] The vertical stem of the conventional T-joint is formed to have an outer diameter which is smaller by about 0.2 to 0.3 mm than the inner diameter at the upper open end of the hollow shaft in order that the T-joint can easily be inserted into the open upper end of the shaft and adhesive can be sufficiently spread between the T-joint and the shaft. Because of this, the engagement of the T-joint with the shaft is relatively loose during the assembly process. Therefore, after the vertical stem of the T-joint is inserted into the open upper end of the shaft, during the process of setting the joint portion of the frame and shaft into the mold, a slight external force applied in the pulling direction of the shaft from the T-joint will sometimes cause a slight misalignment (e.g. several millimeters) of the shaft out of the T-joint. If a badminton racket made with such a misalignment is used, a stress concentration occurs at the part of the upper end of the vertical stem of the T-joint which has slightly slipped out of the upper end of the shaft, which has occasionally resulted in breakage at this part of the T-joint.

[0004] Further, when the T-joint is coated with a high viscosity adhesive such as epoxy resin for insertion into the open upper end of the shaft, it is almost impossible to insert the vertical stem of the T-joint precisely concentrically with the opening of the shaft, and the insertion is generally done eccentrically. Therefore, the adhesive coating on the external surface of the T-joint is scraped out by the end of the shaft on the eccentric side, which results in a decrease in adhesion strength and thus causes a problem of decreased torsional strength of the shaft in relation to the frame.

[0005] The present invention has been made in view of the above problems, and its object is to provide a badminton racket which permits reducing the occurrence

rate of the defective products by reducing the possibility of the misalignment occurring between the T-joint and the shaft after these have been engaged, and attains an improved adhesion strength between the T-joint and the shaft.

[0006] In order to achieve the above object, the present invention provides a badminton racket comprising an oval-shaped frame and a hollow shaft joined together by a T-joint coated with adhesive. The T-joint has horizontal arms and a vertical stem extending downwardly from central portion of the horizontal arms. The horizontal arms are inserted into opposite ends of the frame, while the vertical stem is inserted into an upper open end of the hollow shaft

[0007] The vertical stem of the T-joint is provided with a plurality of ribs extending axially on the external surface thereof. The dimensions of the above-described ribs are determined such that, when the T-joint is inserted into the upper open end of the shaft, the top edges of the ribs are brought into close contact with the inner surface of the shaft.

[0008] Therefore, a slight external force applied to the shaft in a direction to pull out the shaft from the T-joint cannot cause the misalignment of the shaft from the T-joint after the T-joint has been inserted in the opening of the shaft. Thus, the occurrence of the defective products due to the misalignment between the T-joint and the shaft can be reduced.

[0009] Further, the plurality of the ribs allows the vertical stem of the T-joint to be inserted precisely concentrically with the open upper end of the shaft, and therefore, the adhesive coating on the T-joint is not scraped out by the open upper end of the shaft, which leads to an even spread of adhesive around the external surface of the vertical stem of the T-joint, and thus no decrease in adhesion strength unlike the prior art.

[0010] Furthermore, because of the provision of the ribs, the adhesion area of the T-joint with respect to the shaft becomes greater than that of the prior art T-joint without any ribs, and therefore, their adhesion strength becomes greater than that of the prior art.

[0011] Preferably, the number of the ribs formed axially on the vertical stem is in the range of 2 to 8. Thus, the possibility of the misalignment occurring between the T-joint and the shaft can be further decreased, and the adhesion area of the vertical stem can be increased for improved adhesiveness.

[0012] Furthermore, it is preferable that the ribs are formed to gradually decrease in width and height in the downward direction for easy insertion of the vertical stem of the T-joint into the upper open end of the shaft.

[0013] Furthermore, it is preferable that a lateral rib is formed on the upper surface of the horizontal arms of the T-joint. It is further preferable that a plurality of the lateral ribs are formed. Thus, for the same reason as given above, the adhesion area between the horizontal arms of the T-joint and the hollow ends of the frame is increased for greater adhesion strength between these.

[0014] Furthermore, it is preferable that the height of the ribs is in the range of 0.1 to 1.0 mm. The height of the ribs is set to a somewhat high value in the range so that, when the T-joint is inserted into the upper end of the shaft, the ribs engage with the inner surface of the open upper end of the shaft. Consequently, because of the ribs engagement therewith in conjunction with the above-described improved adhesiveness, the connection strength between the T-joint and the shaft is increased enormously.

[0015] Furthermore, it is preferable that the boundary part of the upper end of the vertical stem and the horizontal arms of the T-joint is provided with a taper surface, and the open upper end of the hollow shaft is provided with a countersink having a substantially identical taper surface. Preferably, the taper surface of the boundary part has a radius of curvature in the range of 0.5 mm to 5.0 mm.

[0016] Hence, the strength of the T-joint itself is increased, and the open upper end of the shaft is brought into close contact with the T-joint for a much improved connection strength between them.

[0017] A preferred embodiment of the present invention will be described hereinafter with reference to the accompanying drawings.

[0018] For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a front view of a badminton racket of the present invention;

FIG. 2 is a cross-sectional view of an essential part of the badminton racket of the present invention showing the joint of a frame and a shaft;

FIG. 3 is a front view of a T-joint for the badminton racket of the present invention; and

FIG. 4 is a bottom view of the T-joint shown in FIG. 3.

[0019] As shown in FIG. 1, a badminton racket of the present invention generally comprises a frame 1, a shaft 2, and a grip 3.

[0020] As shown in FIGS. 2 and 3, the frame 1 and the shaft 2 are joined together by a T-joint 4 which is provided inside of the frame and the shaft.

[0021] The frame 1 and the shaft 2 are of a hollow tubular configuration, which are made of an FRP which is mainly made of carbon fibers. The T-joint 4 is formed of a metal such as an aluminum alloy.

[0022] The T-joint 4 comprises generally horizontal arms 5 and a vertical stem 6 extending downward from the center of the arms. The horizontal arms 5 have an oval cross section as the frame 1, and the vertical stem has a circular cross section as the shaft 2.

[0023] One rib (small raised strip) 7 is formed along the central part of the upper surface of the horizontal arms 5 so as to extend over the entire length of the surface. Preferably, the height of the rib gradually decreases

toward both of its ends so that the arms can be easily inserted into the opposite open end of the frame, which will be described hereinafter. The ends of the arms are each formed as a tapered end 8 of small diameter for easy insertion into either of the hollow ends of the frame.

[0024] On the outer surface of the vertical stem 6 are formed four ribs (small raised strips) 9 which are equally spaced and axially extended. The lower end of the vertical stem 6 is formed as a tapered end 10 of small diameter. The rib 7 on the arms and the ribs 9 of the vertical stem 6 each have a height in the range of 0.1 to 1.0 mm. This dimension is determined in relation to the bore diameter of the shaft 2, and in any case, it is necessary that, when the vertical stem 6 of the T-joint is inserted into the shaft from the upper end thereof, the vertical stem 6 be closely fitted into the hollow shaft by the four ribs 9. Therefore, where the bore diameter of the hollow shaft is constant, as the height of the ribs is increased, the diameter of the main cylindrical portion of the vertical stem of the T-joint should be diminished. Therefore, if the height of the ribs exceeds 1.0 mm, the diameter of the main cylindrical portion of the vertical stem of the T-joint is diminished too much for a sufficient strength. Therefore, the height of the ribs is limited up to 1.0 mm. Conversely, if the height of the ribs is less than 0.1 mm, the provision of the ribs cannot produce desired effects, which will be described hereinafter.

[0025] Preferably, the width and height of the ribs 9 on the vertical stem 6 of the T-joint may gradually diminish from the upper part of the vertical stem towards its lower part. Thus, the vertical stem 6 of the T-joint can be easily inserted into the open upper end of the shaft 2.

[0026] The boundary part 11 of the vertical stem and horizontal arms of the T-joint 4 is provided with a taper surface. Concurrently, the inner surface 12 of the open upper end of the hollow shaft 2 is provided with a countersink having a taper surface which is identical to the taper surface of the boundary part 11. Thus, when the vertical stem 6 of the T-joint 4 is inserted into the open upper end of the hollow shaft 2, the taper surface of the boundary part 11 comes into close contact with the taper surface of the countersink 12 at the upper end of the hollow shaft. Further, the strength of the T-joint 4 itself is increased by the taper surface of the boundary part 11.

[0027] The radius of curvature of the taper surface at the boundary part 11 of the T-joint 4 should be in the range of 0.5 to 5.0 mm. If the radius of curvature exceeds this range, the countersink at the end of the shaft, which should be formed to correspond to the radius of curvature, will become large, which will reduce the strength of the end of the shaft too much. On the other hand, if the radius of curvature is less than 0.5 mm, a close contact between the end of the shaft and the boundary part 11 of the T-joint 4 can effect no improvement in strength.

[0028] A method for forming a badminton racket provided with the above-described T-joint will be described

below. As shown in FIG. 3, the T-joint formed of an aluminum alloy is immersed in a molten epoxy resin, which is prepared as an adhesive, so that the epoxy resin is accreted on the external surface of the T-joint. Then, the vertical stem 6 of this joint 4 is inserted through the open upper end of the hollow shaft made of FRP until the boundary part 11 of the joint comes into contact with the countersink 12 at the upper end of the shaft.

[0029] The dimensions are determined such that this joint is force-fitted into the hollow shaft 2 with the four ribs 9 on the external surface of the vertical stem 6 being in close contact or engaged with the inner surface of the hollow shaft 2. Thus, a slight external force cannot misalign the joint 4 in relation to the shaft 2.

[0030] Next, both of the horizontal arms 5 of the T-joint 4 are inserted into the opposite open ends of the hollow oval-shaped frame 1, which is formed from an FRP composed of carbon fibers. At this point, the rib 7 formed along the central part of the upper surface of the arms is brought into close contact with the inner surfaces of the open ends of the frame, and therefore the joint 4 can be securely engaged with the frame, and uneven spreading of adhesive can be prevented, which ensures the desired strength in adhesion. Then, an FRP prepreg in a tape form is wound around the joint of the frame 1 and the shaft 2 which abuts the external surface of the T-joint, and while maintaining this state, the T-joint portion is placed inside a mold, followed by the closing of the mold and the molding operation under high temperature for curing the epoxy resin.

[0031] As shown in FIG. 2, in the badminton racket manufactured in the above-described manner, the frame 1 and the shaft are securely connected through the T-joint 4, and their joint is covered with the FRP layer 13.

[0032] The present invention is not limited to the above-described embodiment, and the number of the ribs 9 formed on the vertical stem can be anything that is plural, and preferably the number is 8 or less. Further, the number for the rib 7 on the horizontal arms is not limited to one, and more than one of the rib may be provided.

[0033] Although the preferred embodiment of the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the inventions as defined by the appended claims.

Claims

1. A badminton racket comprising an oval-shaped frame and a hollow shaft joined together by a T-joint coated with adhesive;
said T-joint having horizontal arms and a vertical stem extending downwardly from central portion of said horizontal arms;

said horizontal arms being inserted into opposite ends of said frame, said vertical stem being inserted into an upper open end of said hollow shaft;

wherein said vertical stem is provided with a plurality of ribs extending axially on the external surface thereof, said ribs being formed such that, when said T-joint is inserted into said upper open end of said shaft, top edges of said ribs are brought into close contact with inner surface of said shaft.

2. A badminton racket as claimed in claim 1, wherein the number of said ribs formed to extend axially on said vertical stem is in the range of 2 to 8.
3. A badminton racket as claimed in claim 1 or 2, wherein the width and height of each of said ribs decrease gradually from up to down.
4. A badminton racket as claimed in any preceding claim, wherein a lateral rib is formed on the upper surface of said horizontal arms of said T-joint.
5. A badminton racket as claimed in claim 4, wherein more than one of said lateral ribs are formed.
6. A badminton racket as claimed in any preceding claim, wherein the heights of said ribs on said vertical stem are in the range of 0.1 mm to 1.0 mm.
7. A badminton racket as claimed in any preceding claim, wherein the boundary part of the upper end of said vertical stem and said horizontal arms of said T-joint is provided with a taper surface, and an opening at the upper end of said hollow shaft is provided with a countersink having a substantially identical taper surface.
8. A badminton racket as claimed in claim 7, wherein said taper surface of said boundary part has a radius of curvature in the range of 0.5 mm to 5.0 mm.

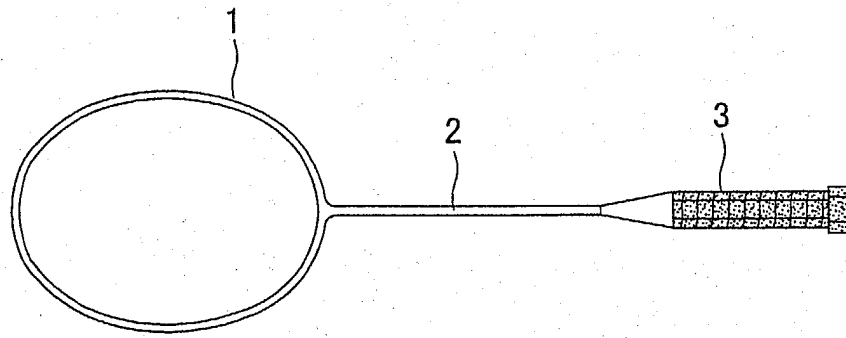


FIG. 1

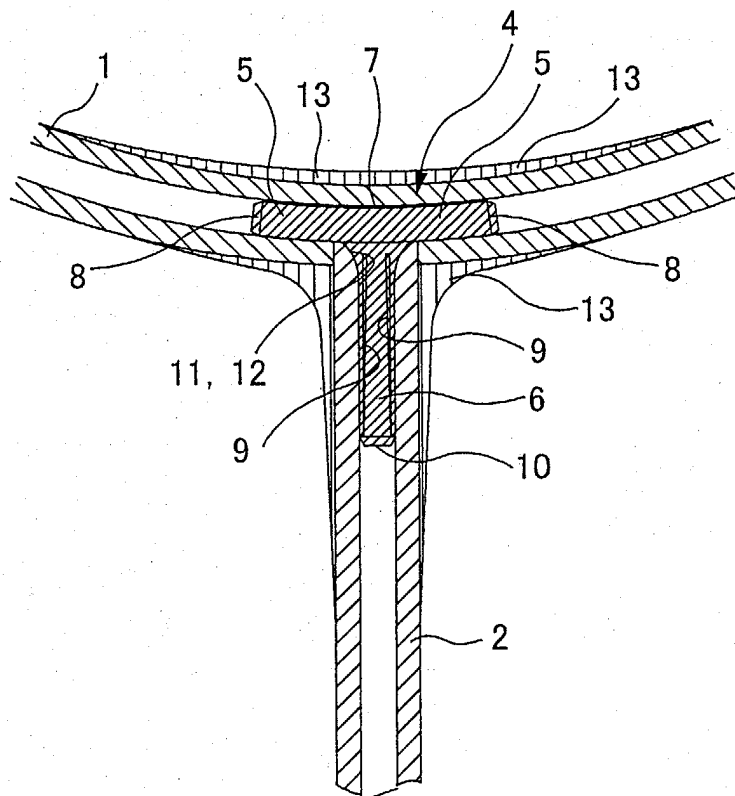


FIG. 2

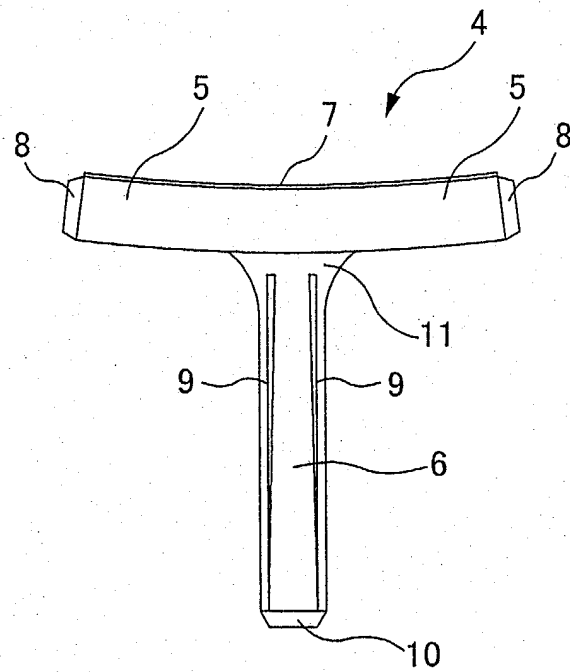


FIG. 3

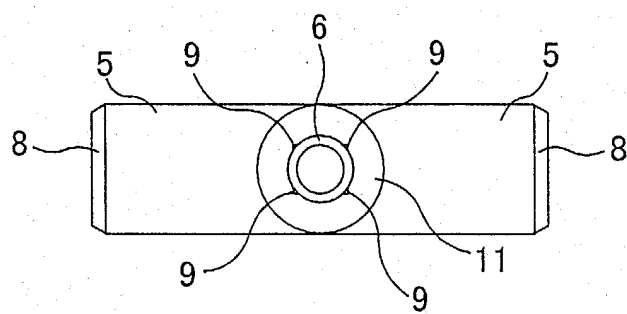


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 4340

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Place of search		Date of completion of the search	Examiner
MUNICH		8 October 2003	Jekabsons, A
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