SPECIFICATION

Badminton racket

The present invention relates to an improvement in badminton rackets.

The game of badminton generally requires a more nimble, high-speed swing to bat a shuttle-cock at short intervals in a relatively small space of court as compared with for example, the game of tennis. A badminton racket should be so constructed as to meet such nimble and high-speed swing motions. To this end, it is required that the badminton racket be light in weight and have a satisfactory resilience, a sufficient mechanical strength and a minimum air resistance. However, with the badminton racket, it is very difficult to fulfil all these requisites at the same time, since some of them are incompatible with others. For example, light weight, desirable resilience and minimum air resistance may all be provided together in the badminton racket, but all these factors result in the erosion of mechanical strength thereof. Unless a good balancing of the incompatible factors can be provided, any other improvement in the structure of the badminton racket would be meaningless.

In an attempt to provide a badminton racket which substantially fulfils all the above requisites as is possible, it has been proposed to connect an oval-shaped frame to a shaft by a T-shaped joint. Reference is now made first to a conventional badminton racket shown in Figures 1 and 2, in which:

Fig. 1*a* is a front elevation of a conventional badminton racket,

Fig. 1*b* is a sectional view taken along line A-A in Fig. 1*a*,

Fig. 1*c* is a sectional view taken along line B-B in Fig. 1*a*,

Fig. 2*a* is an enlarged front elevation of a T-shaped joint connecting a frame and a shaft of the conventional badminton racket,

Fig. 2*b* is a sectional view taken along line A-A in Fig. 2*a*, and

Fig. 2*c* is a sectional view taken along line B-B in Fig. 2*a*.

According to the conventional badminton racket shown in Fig. 1 and Fig. 2, a shaft 1 and a frame 2 are made of a light weight, rigid tubular material such as, for example, stainless steel tubing and are connected with each other by means of a tubular joint 3 as shown in Fig. 1*a*. The shaft 1 is constructed of tubing of circular cross section as shown in Fig. 1*b*, while the frame 2 is of a tubing of irregularly rounded cross section as shown in Fig. 1*c*, having a major axis thereof disposed in the swing direction which is perpendicular to the racket's face.

The tubular joint 3 is, as shown in Figs. 2*a* to 2*c*, formed substantially in a "T" shape and comprises horizontal arm portions 3*b* and 3*c* in which terminal ends 2*b* and 2*c* of the frame 2 are fixedly inserted and vertical portions 3*a* in which the upper end 1*a* of the shaft 1 is fixedly inserted.

This conventional badminton racket is thus constructed with a view to achieving a high mechanical strength to meet the requirements of a high-speed swing in addition to light-weight, a reduced air resistance and a satisfactory resilience. However, in this badminton racket, various impact loads arising from the use of a racket are structurely concentrated on the small T-shaped tubular joint 3. This means that the mechanical strength necessary for the badminton racket depends heavily upon the T-shaped tubular joint 3. It becomes necessary, therefore, to enhance the mechanical strength inherent in the structure of the T-shaped tubular joint 3 in order to obtain satisfactory mechanical strength of the racket frame as a whole as well as the other requisite elements.

Now referring to the important factor of enhancing the mechanical strength of the T-shaped tubular joint 3, the present inventor has learned that the mere pursuit of the mechanical strength of the tubular joint may create another serious problem. To enhance the mechanical strength of the tubular joint 3 may require an increase in dimensions which cause an increase in air resistance. More seriously, it has been learned that the shaft 1 and frame 2 will be subject to material fatigue most in portions 1*a*, 2*b* and 2*c* adjacent the free end portions 3*a* to 3*c* of the T-shaped tubular joint 3. That is, when the rigidity of the joint 3 is greatly increased by enhancing the mechanical strength thereof, the joint cannot be bent or twisted in harmony with the bending and twisting of the shaft 1 and frame 2. Accordingly, the bending and twisting stresses of the shaft and frame caused by high-speed swinging motion of the racket will be concentrated to the shaft and frame portions 1*a*, 2*b*, 2*c* adjacent to the free end portions 3*a*, 3*b*, 3*c* of the joint 3, respectively. This will result in breakages of the shaft and frame at these portions 1*a*, 2*b* and 2*c*.

For the reasons set forth above, although it is essentially important that the joint 3 has a sufficient mechanical strength, it must not be too rigid. Hitherto, it has been difficult to provide a T-shaped tubular joint having a sufficient mechanical strength as well as such a desirable rigidity so as not to cause breakage of the joint itself and the shaft and frame portions adjacent the free ends of the joint.

The present invention has been developed in view of the above problems. Therefore, it is an object of the present invention to provide a badminton racket having an oval frame connected to a shaft by a T-shaped tubular joint, wherein the T-shaped tubular joint has a sufficient mechanical strength as well as a desirable rigidity.

Another object of the present invention is to provide a badminton racket of the type set forth above, wherein a T-shaped tubular joint can be made lighter compared with the conventional one without a decrease in the mechanical strength thereof.

A further object of the present invention is to provide a badminton racket of the type set forth above, wherein a T-shaped tubular joint can reduce air resistance applied thereto when the badminton racket is swung at high speed.

According to the present invention there is provided a badminton racket comprising a T-shaped tubular joint having fixedly inserted therein an end portion of a shaft and free end portions of an oval frame, wherein said tubular joint has a pair of ribs

disposed on and integral with opposite outer surfaces thereof, each rib having a relatively wide area at the central portion of said outer surface and extending from said central portion toward each respective free end portion of said joint in such a manner that said rib is substantially T-shaped with a thickness and width which gradually reduce toward each of the free end portions of said joint.

The present invention will be described further hereinafter with reference to the accompanying drawings which show preferred embodiment of the present invention, in which:

Fig. 3 shows a badminton racket according to a first embodiment of the present invention wherein Fig. 3*a* is a front elevation of the badminton racket, Fig. 3*b* is a sectional view taken along line A-A in Fig. 3*a* and Fig. 3*c* is a sectional view taken along line B-B in Fig. 3*a*,

Fig. 4 shows details of a T-shaped tubular joint of the badminton racket, shown in Fig. 3, wherein Fig. 4*a* is a front elevation of the badminton racket, Fig. 4*b* is a sectional view taken along line B-B in Fig. 4*a*, and Fig. 4*c* is a sectional view taken along line B-B in Fig. 4*a*, and

Fig. 5 shows a front elevational view of a badminton racket according to a second embodiment of the present invention.

Referring to the first embodiment of the present invention shown in Fig. 3 and 4, a shaft 4 and an oval frame 5 are joined together by means of a tubular joint 6 formed substantially in the shape of a "T". The material of the shaft 4 may be, for example, metal tubing of, for example, stainless steel, or a fibre reinforced pipe (FRP). The shaft 4 has a circular cross section as shown in Fig. 3*b*. The lower portion of the shaft 4 is connected to a grip portion 7. The frame 5 may be made of a metal tubing or a fibre reinforced pipe. The frame 5 is of irregularly rounded cross section as shown in Fig. 3*c*, wherein a width (*r*1) thereof in the swing direction perpendicular to the racket's face is larger than a width (*r*2) at right angles with the width (*r*1), so that the cross section of the frame 5 is substantially elliptical. The T-shaped tubular joint 6 has a vertical extension 6*a* into which an upper end portion of the shaft 4 is inserted and horizontal extensions 6*b* and 6*c* thereof into which opposite lower end portions of the frame 5. The upper end of the shaft 4 as well as the lower ends of the frame 5 terminate at the central portion inside of the tubular joint 6. The tubular joint 6 is constructed integrally by moulding aluminium or an aluminium alloy by conventional die casting.

As is shown in Fig. 4*a* to Fig. 4*c*, the tubular joint 6 has a pair of ribs 8 integrally formed or moulded on opposite outer surfaces thereof. Each rib 8 has a relatively wide area at the central part of this outer surface and extends from this central part to free ends 6*d*-6*f* of the joint along centre lines of the vertical and horizontal extensions 6*a*-6*c* in such a manner that the rib is formed substantially in the shape of a "T". The width (*w*) and depth (*d*) of the ribs 8 are gradually reduced toward the free ends of the T-shaped joint and sharpened at these free ends of the joint. Each rib 8 thus formed also fills up a space 9*a* formed between the vertical extension 6*a* and horizontal extensions 6*b* and 6*c* of the joint in such a manner that the outer surface of the rib becomes flat.

It is required with a T-shaped tubular joint of this type that the highest mechanical strength is provided at the central part of the joint inside which the upper end of the shaft and the lower free ends of the frame terminate and that the rigidity of the T-shaped joint is not enhanced too much at the free end portions 6*a*-6*c* thereof so that it is able to absorb bending stress applied thereto by the bending of the shaft and the frame. According to the present invention, the ribs 8 integrally formed on the outer surfaces of the T-shaped tubular joint 6 has a relatively wide area at the central part of this outer surface of the joint so that the central part of the joints is sufficiently reinforced. The width and depth of the ribs are gradually reduced toward the free ends 6*d*-6*f* of the T-shaped joint, so that the rigidity of the joint is reduced toward the free ends thereof. Thus, the stresses applied to the shaft 4 and frame 5 at the portions 4*a*, 5*b* and 5*c* adjacent the free ends 6*d*, 6*e* and 6*f* of the joint can be reduced, respectively, compared with the conventional T-shaped joint having a uniform wall thickness which is higher than that of the present joint at the free end portions thereof. Further, it becomes possible by forming the ribs on the T-shaped joint to make the wall thickness of the joint thinner than that of the conventional joint, except for the ribbed portion, and to make the weight of the present joint itself lighter than that of the conventional one. Accordingly, it becomes possible in the present invention to provide a lighter joint with sufficient mechanical strength, which does not cause excessive stress concentration on the shaft and frame adjacent the free ends of the joint. In addition, since the mechanical strength of the present joint is increased due to the ribs integrally formed on the joint, the external dimensions of the present joint can be reduced compared with the conventional joint. Also, the rib on the T-shaped joint has a T-shape but of a smaller "T", so that the air resistance to be developed on the joint when the present badminton racket is swung at a high speed can be reduced.

Tests carried out using the present ribbed joint have proved that the strength of the joint in the swing direction of the frame could be enhanced by about 60% with a marginal overall increase in the volume of the joint of 5.9%.

Another preferred embodiment of the present invention is shown in Fig. 5. In this second embodiment, the end extensions 6*a*-6*c* of each rib 8 are not sharpened and do not reach the free ends of the T-shaped joint, so that the rib 8 is formed in the shape of a "T" analogous to that of the outer surface of the joint, as shown in Fig. 5. As may be understood from the description set forth in connection with the first embodiment, the T-shaped tubular joint of this second embodiment can provide the same advantages as those of the first embodiment.

Thus, the badminton racket made by using the T-shaped joint according to the present invention can have characteristics such as sufficiently high mechanical strength, satisfactory light weight and

minimum air resistance simultaneously.

CLAIMS

1. A badminton racket comprising a T-shaped tubular joint having fixedly inserted therein an end portion of a shaft and free end portions of an oval frame, wherein said tubular joint has a pair of ribs disposed on and integral with opposite outer surfaces thereof, each rib having a relatively wide area at the central portion of said outer surface and extending from said central portion toward each respective free end portion of said joint in such a manner that said rib is substantially T-shaped with a thickness and width which gradually reduce towards each of the free end portions of said joint.

2. A badminton racket as claimed in claim 1, wherein said rib is sharp toward the respective ends which extend from the central portion, the sharp ends of said rib reaching the corresponding free ends of said T-shaped joint.

3. A badminton racket as claimed in claim 1, wherein the T-shape of each of the ribs is of substantially the same form as that of the outer surface of said T-shaped joint, the ends of said rib which extend from the central portion being blunt.

4. A badminton racket substantially as herein described with reference to any of Figures 3 and 4 or 5 of the accompanying drawings.

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2. A badminton racket as claimed in claim 1, wherein said rib is sharp toward the respective ends which extend from the central portion, the sharp ends of said rib reaching the corresponding free ends of said T-shaped joint.

3. A badminton racket as claimed in claim 1, wherein the T-shape of each of the ribs is of substantially the same form as that of the outer surface of said T-shaped joint, the ends of said rib which extend from the central portion being blunt.

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