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(54) METAL RACKET FRAMES

(57) **Abstract:**

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This invention relates to racket frames for rackets for use, for example, in badminton, tennis and squash, and to methods of manufacturing such racket frames. This application is a divisional of Serial No. 962,295 filed June 7th, 1966.

In this specification the term "frame" means the looped portion of a racket within which the stringing is carried out, as distinct from the shaft of the racket which connects the frame to the handle. Holes are provided in the frame for the strings of the racket.

It has been proposed to make rackets having steel frames and also rackets having steel shafts, but the use of steel frames has met with some difficulties, especially due to the sharp edges of the steel cutting the strings, either during the stringing or in use of the racket. In the case of tennis rackets this difficulty has been alleviated by such methods as the use of auxiliary eyelets in the holes provided in the frame for the stringing, or the use of wire wound around the frame. However, such methods add considerably to the complexity and cost of manufacture of the racket, and in the case of badminton rackets, which must be very light, such methods are not suitable due to the associated increase in weight of the frame.

It is an object of this invention to produce a metal frame for a racket which can be made light enough to be acceptable as a top class badminton racket, and also to produce, by a similar technique but in appropriately different sizes and weights, improved forms of other types of racket frames, such as tennis and squash racket frames.

According to the invention there is provided a racket frame formed from a metal tube having apertures in said tube for stringing, all or substantially all of said apertures having integral flanges projecting towards the interior of the tube, characterised in that the wall thickness of the metal tube is not more than .014 inch, and said metal tube is otherwise suitable.

By an "integral flange" is meant that metal of the tube surrounding a hole in said tube is used to form the flange, the inner edge of said surrounding metal having been turned through substantially 90° from its original position in the tube, at least in the longitudinal direction of said tube, so that said flange forms a smooth surface for the stringing.

In one embodiment of the invention the tube has recesses on its outside between integral flanged apertures.

By way of example, to make a frame for a top class badminton racket the metal tube may have a wall thickness of between .012 of an inch and .014 of an inch (.305 mm/.355 mm). The material of said tube is a steel having in its malleable state a 0.2% proof stress not exceeding 30 tons per square inch, and a maximum stress not exceeding 55 tons per square inch, but which can be hardened to a condition in which it has a 0.2% proof stress and a maximum stress of not less than 70 tons per square inch and, preferably, the maximum stress should not be less than 80 tons per square inch. Moreover, in its malleable state the steel has an elongation on 2 inches (50.8mm) of not less than 25%, while in its hardened state it has an elongation on 2 inches (50.8 mm) of not more than 15%. The forming operations which will later be described for such a material being used will be completed when the material is in its malleable state and the frame is completed by hardening the material after the forming operations. Metals having the above characteristics and otherwise suitable, e.g. they must not be too brittle, may be used.

Alternatively, the metal tube may have a wall thickness of between .012 of an inch (.305 mm) and .014 of an inch (.355 mm) and be made of a material which has a 0.2% proof stress and maximum stress of not less than 70 tons per square inch, and the maximum stress preferably being not less than 80 tons per square inch, and having an elongation on 2 inches (50.8 mm) of not more than 15% excepting locally where a local elongation of

25% may be obtained. If such a material is used the forming operations may be completed after hardening.

In one embodiment of the invention, which is especially suitable for the manufacture of badminton racket frames in which a light weight is required, the metal tube has inserted therein a strip of plastics material, such as nylon, having preformed suitably positioned and sized holes therein, prior to the flanging of the apertures in the metal frame. The holes in the plastics strip are larger than those required in the metal frame to accommodate the racket stringing, and are positioned to be concentric with said required apertures. During flanging of the apertures in the metal frame the plastics strip acts as a female die in a punching operation. The plastics strip may be removed by heating to melt the plastics material, for example, during a hardening process for the metal tube. Alternatively, the flanged apertures may be formed in the metal frame without the insertion of such a strip of plastics material.

In another embodiment of the invention, which is more suitable for the manufacture of rackets which are required to be of a certain weight, and not as light as possible, for example, tennis and squash rackets, an inner metal member is provided within the metal tube of the racket frame. The inner metal member may be tubular or solid, or part tubular and part solid, and it may extend throughout substantially the whole of the metal tube or only a part of it. The inner metal member is provided with holes therein which are larger than those required in the outer metal tube and are positioned to be concentric with said required apertures. During a forming operation in which the flanged apertures in the outer metal tube are formed, the inner metal member serves as a female die, the arrangement being such that the flanges of the apertures in the outer metal tube extend within the larger holes in the inner metal member. The inner metal member is not subsequently removed but forms a part of the

finished racket and can be arranged to impart a desired weight and weight distribution to the racket. The inner metal member is made of a material which is malleable to enable it to be formed into the shape of the relevant part of the frame of the racket, and preferably the material of said inner metal member is hardenable coincidentally with the material of themetal tube, after the frame and the flanged apertures have been formed. Alternatively, the material of the inner metal member may be such that substantially no hardening or deterioration occurs during the hardening of the metal tube, or both tubes may be made of a material which requires no hardening subsequent to the forming operations.

In order that the invention may be clearly understood and readily carried into effect it will now be more fully described with reference to the accompanying drawings in which: -

Figure 1 shows a racket in accordance with one embodiment of the invention, the stringing having been omitted,

Figure 2 shows on a reduced scale a racket according to another embodiment of the invention, the stringing again having been omitted,

Figure 3 shows, on an enlarged scale, a side elevation of a portion of the frame of the racket of Figure 1 or 2,

Figure 4 shows, on the same ~~enlarges~~ enlarged scale, a longitudinal section through a part of the tube from which the frame is made, on the line IV-IV of Figure 3, but before the tube is formed into a frame, and

Figure 5 shows, on the same enlarged scale, a cross section through the frame of the racket of Figure 1 or 2, on the line V-V of Figure 3,

Figure 6 shows a racket in accordance with yet another embodiment of the invention,

Figure 7 and 8 are cross sections through the frame of the racket of Figure 6 on the lines VII-VII and VIII-VIII respectively, and on an enlarged scale,

Figure 9 shows a racket in accordance with a still further embodiment of the invention, and

Figures 10 and 11 are cross sections through the frame of the racket of Figure 9 on the lines X-X and XI-XI respectively.

Referring initially to Figures 1 to 5 of the drawings, the invention will be described, by way of example, as applied to embodiments of a badminton racket. The badminton racket shown in Figure 1 comprises a frame 1 formed from a metal tube in a manner which will be described in greater detail hereinafter in connection with Figures 3 to 5. The racket of Figure 1 also comprises a metal shaft 2 which connects the frame 1 to a handle 3, which may be made from moulded plastics material or may be of any other suitable form. Alternatively, as shown in Figure 1, the shaft 2 may be constituted by an extension of one end of said tube forming the frame 1, the other end of said tube being welded to said one end. The stringing for the racket is not shown.

In an alternative construction, illustrated in Figure 2, in which references 1', 2' and 3' are used for the frame, shaft and handle of the racket, both ends of a metal tube forming the frame 1' are extended to form the shaft 2' so that the shaft 2' is a doubled tubed shaft. The two tubes of the shaft 2' may be secured together along their lengths, such as by welding and the handle 3' may be moulded or otherwise formed over the ends of the two tubes.

The construction of the frames of the rackets in Figures 1 and 2 is the same and this will now be described in greater detail with reference to Figures 3, 4 and 5. The metal tube of which the frame 1 (or 1') is made is provided with a plurality of holes 4 therethrough positioned to accommodate the required strings of the racket. These holes, and their surrounding metal, are referred to as apertures. The holes 4 are bounded by flanges 5 which can be seen most clearly in Figures 4 and 5 and which project towards the interior of the tube and are integral with the tube. The flanges project towards the interior of the tube and provide a smooth surface for the strings both on the inside and outside of the racket frame.

This greatly increases the life of the strings. In the particular embodiments illustrated, the outer periphery of the frame 1, as indicated by the arrow in Figure 1, is provided with a recess or groove 6, visible in Figures 3, 4 and 5, to accommodate the strings between the apertures 4.

Although in the particular embodiments described the tube forming the frame 1 or 1' is shown to be predominantly of circular bore (apart from the groove 6) as an alternative the bore may be eliptical, or otherwise suitably shaped.

In manufacturing the frame of the racket described with reference to Figure 1 or 2 together with Figures 3 to 5 a metal tube, for example, of a steel having the characteristics hereinbefore stated as suitable for working in a malleable state has whilst in its malleable state the flanged apertures 4 and the grooves 6 formed in it by making small holes and then forming the metal tube to enlarge the holes and form the inwardly projecting flanges 5 and grooves 6. Whilst still in its malleable state the tube is formed into a loop. It is preferable, but not essential, that the forming should be done in the above order. The frame 1 or 1' with the flanged apertures 4 formed therein is subsequently hardened by a suitable hardening process, for example, by heat treatment. Alternatively, the material selected may have an elongation after hardening adequate to permit the necessary forming operations and subsequent hardening then becomes unnecessary.

In a modified method of manufacturing the racket, a strip of plastics material, such as nylon, is inserted into the metal tube, said plastics strip being of such a thickness as to be a close sliding fit with respect to the wall portions of the metal tube which are to be apertured. The plastics strip has therein holes positioned to be concentric with the required apertures in the metal tube, but larger than said required apertures. The plastics strip acts as a female die during a punching operation for forming the flanged apertures 4 in the metal tube, the flanges 5 projecting within the

apertures in the plastics strip. The plastics strip may subsequently be removed by heating to melt the plastics strip. By way of example, said plastics strip may be removed during a hardening process for the metal tube.

Although the embodiments of Figures 1 to 5 have been particularly described with respect to the manufacture of badminton rackets, a similar method and construction may be employed for other rackets such as tennis and squash rackets with a suitable adaptation of size and weight of the racket frame.

The invention will now be described with reference to the embodiments of Figures 6 to 11 as applied to a squash racket frame.

In the embodiment of Figures 6 to 8 a squash racket comprises a frame 7, a shaft 8 and a handle 9. The handle 9 may be a moulded plastics one or may be of other suitable form. The shaft 8 may be in the form of a metal tube which may be separate from the frame of the racket but secured thereto or may be an extension of a metal tube forming a part of the frame 7 of the racket. The frame 7 comprises a metal tube 10 formed with apertures 11 having inwardly projecting flanges 12 as previously described with reference to the embodiments of Figures 1 to 5. Moreover, the outer periphery of the metal tube 10 is provided with a recess or groove 13 similar to the groove 6 of the previously described embodiments. In this particular embodiment of the invention in addition to the metal tube 10, the frame comprises an inner metal member 14 disposed within the metal tube 10 and having holes therein concentric with the apertures in the metal tube 10 but larger than the last mentioned apertures so that the flanges 12 project within the holes in the inner metal member 14. In the embodiment of Figures 6 to 8 the inner metal member 14 comprises a tubular member with a solid insert 14a in a portion of its length. This portion of the length of the inner metal member is arranged to be at the remote end of the frame 7 from the shaft 8, and thus imparts additional weight, if required, to said remote end. The particular length and density of the solid insert 14a may be chosen in accordance with the desired weight of the racket.

In manufacturing the racket of Figures 6 to 8, the inner metal member 14, formed with holes therethrough as described, is inserted in the metal tube 10, in which it is preferably arranged to be a sliding fit. Preferably both the metal tube 10 and the inner metal member 14, which includes the solid insert 14a, are made of a steel having the characteristics defined hereinbefore, although other metals with suitable properties may be employed. The metal tube 10 containing the inner metal member 14 correctly positioned therein is then formed into a loop to form the frame of the racket, the inner metal member 14 taking up the same configuration in the part of the frame in which it is situated. Small holes are then made in the metal tube 10 in appropriate positions for the racket strings, and apertures having flanges 15 are then formed employing a punching operation during which the inner metal member 14, where this is provided, acts as a female die. Alternatively, the loop may be formed after the punching operation to form the flanged apertures. Subsequently, the metal tube 10 of the frame is hardened by any suitable process, for example, by heat treatment. Depending upon the material of the inner metal member 14 this may be hardened coincidentally, or may remain in its malleable state.

In the embodiment of Figures 9 to 11 like reference numerals, but with the appendix ', are employed to indicate parts corresponding to those in the embodiment of Figures 6 to 8. The embodiment of Figures 9 to 11 differs from that of Figures 6 to 8 in the length and form of the inner metal member 14. More precisely the inner metal member 14' is a tubular member without a solid insert, and is of shorter length than the inner metal member 14. This can be seen in Figure 9 in which the outline of the inner metal member 14' is shown dotted. The frame of the racket shown in Figure 9 can be manufactured in a manner similar to that already described with reference to the frame of the racket in Figure 6.

The shaft 8' of the racket of Figure 9 is a double tubular one as shown, formed by a continuation of the ends of the metal tube 10'. The handle 9' is formed over the ends of said continuation, and may be a moulded plastics one or of other suitable form.

Although the invention has been described with reference to particular embodiments thereof, these may be modified in various ways without departing from the scope of the claims. By way of example, the embodiments of Figures 6 and 9 may be varied by varying the lengths of the inner metal members 14, 14'. Moreover, the inner metal member in either of these embodiments may be replaced by a solid member, or the solid insert in the embodiment of Figure 6 may be provided throughout the whole of the extent of the inner metal member, or any other suitable part thereof.

SUPPLEMENTARY DISCLOSURE

The previous disclosure describes various forms of frame, and handle. In particular there is described a badminton racket in which the frame is of metal tubing attached to shaft of moulded plastics material or other suitable material. There is also described a badminton racket in which frame and shaft are made from a single length of metal tubing formed so that both ends of the tube are brought together and extend parallel to each other to form the shaft.

Figure 12 illustrates a further form of racket.

In the embodiment illustrated in Figure 12, the frame $1^2$ is made from one length of tube and the shaft $2^2$ is made from a separate length of metal tube. The ends of the tube forming the frame $1^2$ are butted together and one end of the shaft $2^2$ is secured, as by brazing or welding, to the ends of the tube forming the frame.

Apart from the alternative form of the frame and shaft, the racket is as described previously, both as regards forming the apertures for the stringing and the provision of inserts. The construction illustrated in Figure 12 is also suitable for other rackets such as tennis and squash rackets.



A

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A racket-frame for a badminton racket, the frame comprising a metal tube having a wall thickness of not more than 0.014 inch and having apertures for stringing, at least substantially all of said apertures having integral flanges, which project inwardly towards the interior of the tube, said flanges formed by turning the metal surrounding the edges of a series of small holes in the tube through substantially 90° from its original position in the tube, at least in the longitudinal direction of the tube, said flanges providing a smooth bed for the strings of the racket.

2. A racket-frame according to claim 1, in which the metal tube has a wall thickness of 0.012-0.014 inch.

3. A racket-frame according to claim 1 or 2, in which the metal of the tube is one which has an elongation on 2 inches of not more than 15%, except locally where it may be up to 25%.

4. A method of making a racket-frame for a badminton racket comprising (a) forming in a length of metal tube having a wall thickness not greater than 0.014 inch and an elongation on 2 inches of not less than 25% a series of small holes whose positions correspond to the positions of the intended stringing apertures; (b) turning the metal surrounding the edges of said holes through substantially 90° from its original position in the tube, at least in the longitudinal direction of the tube, to provide flanged stringing apertures whose flanges provide a smooth bed for the strings of the racket; (c) bending the tube into the shape of a racket-frame; and (d) hardening the tube to a state in which it has an elongation on 2 inches of not more than 15%.

5. A method according to claim 4, in which step (c) is carried out before step (b).



C

FIG. 1.

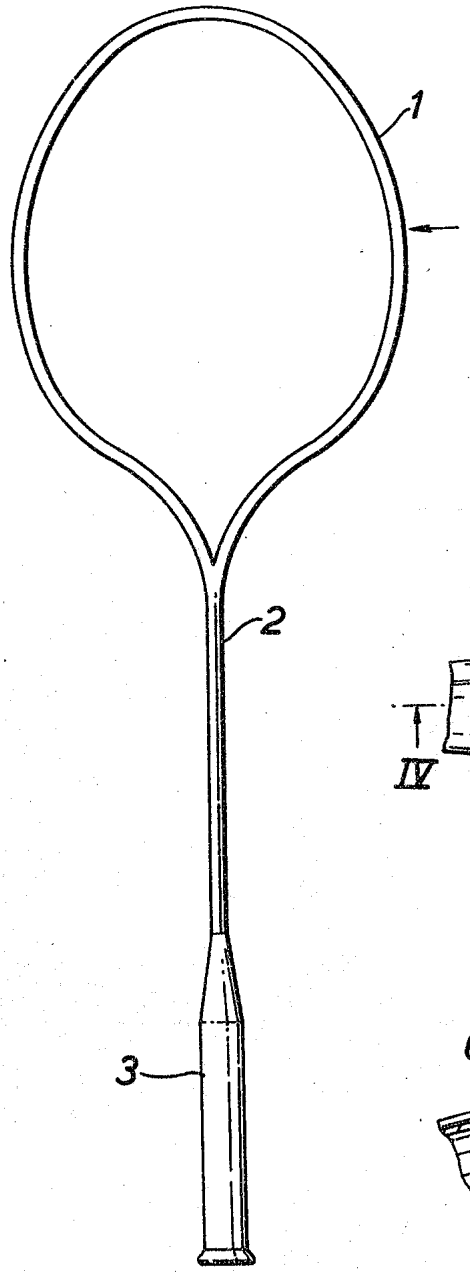


FIG. 2.

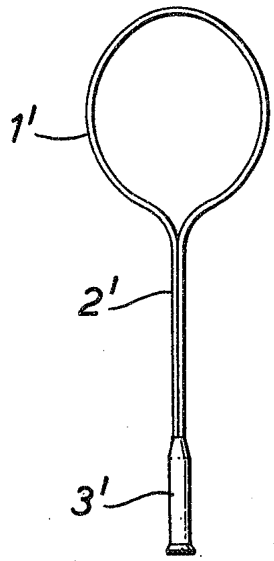


FIG. 3.

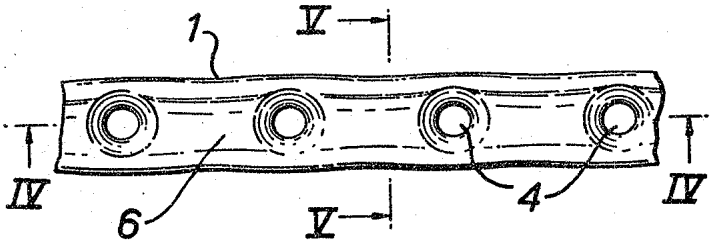


FIG. 4.

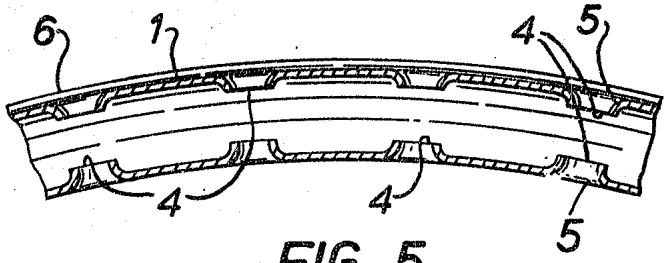


FIG. 5.

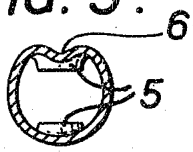


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FIG.6.

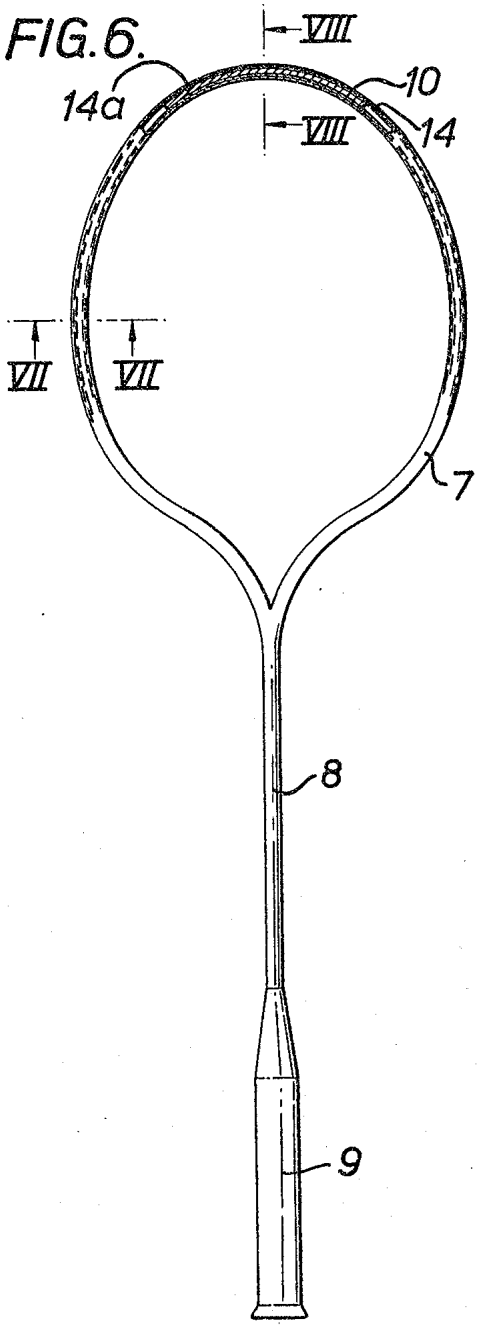


FIG.9.

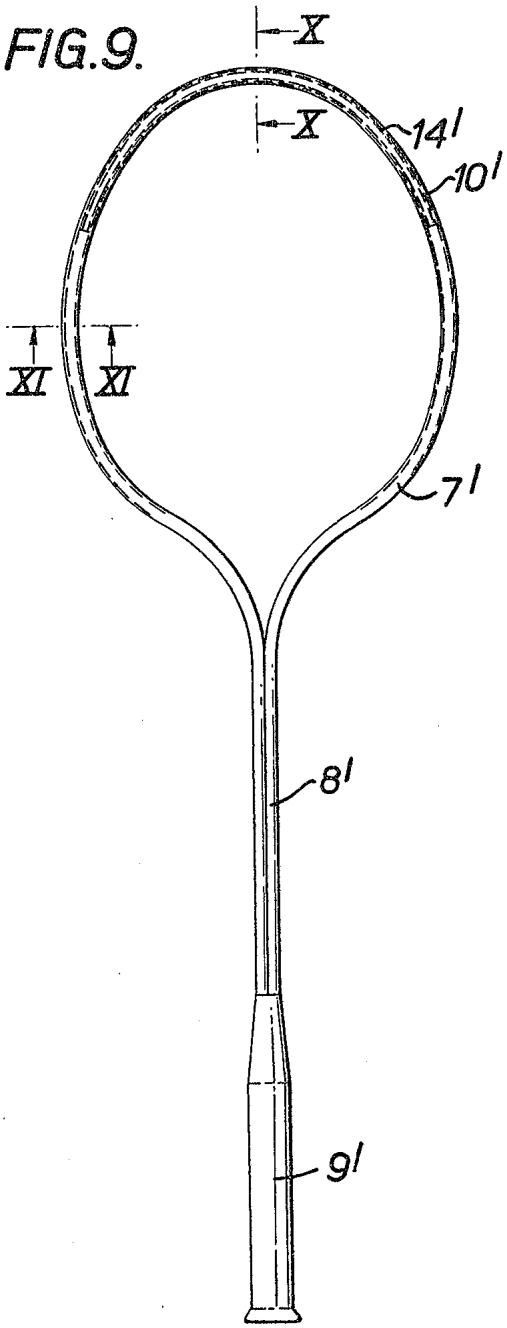


FIG.7.

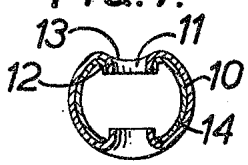


FIG.8.

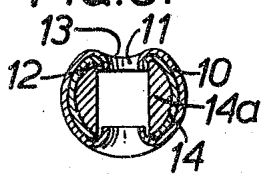


FIG.10.

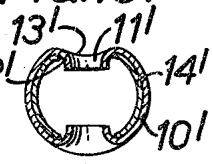


FIG.11.

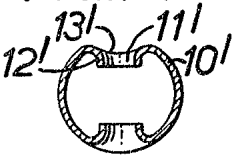


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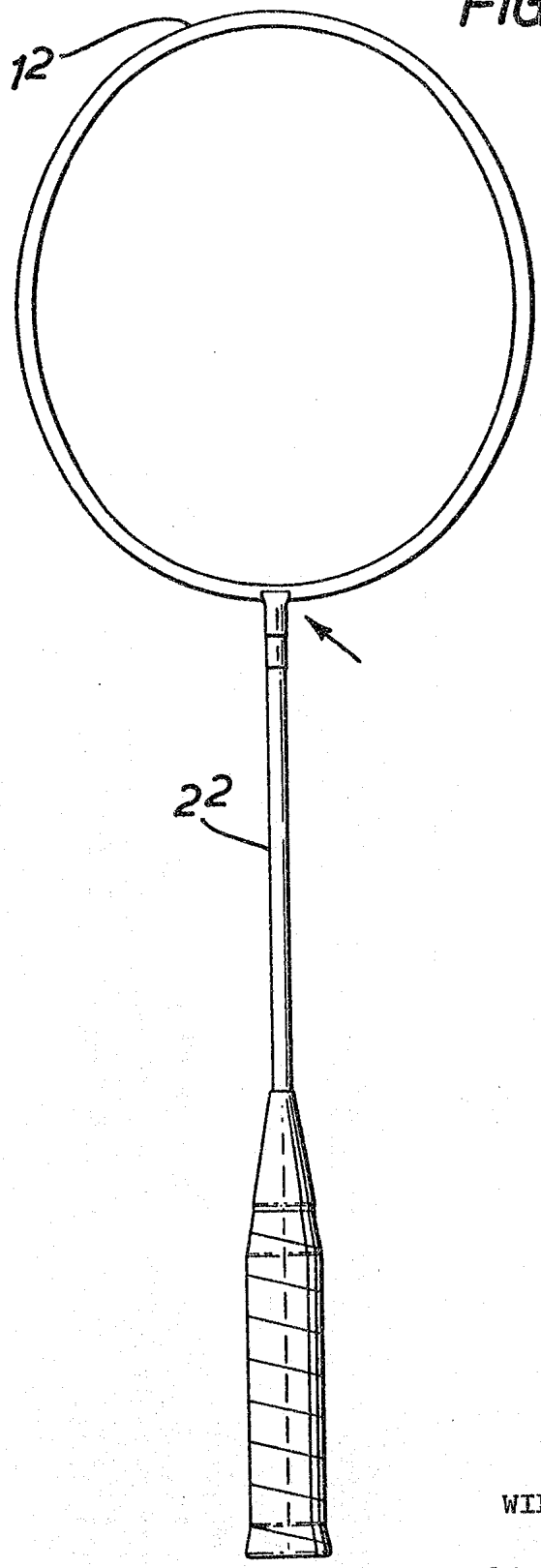
FIG. 12.

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