

March 9, 1971

W. C. CARLTON

3,568,290

METHOD OF MAKING RACKETS HAVING METAL FRAMES

Original Filed June 13, 1966

2 Sheets-Sheet 1

FIG. 1.

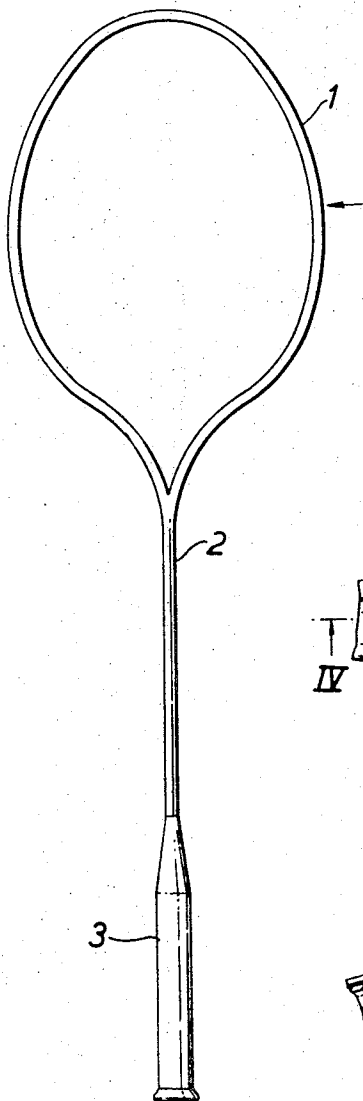


FIG. 2.

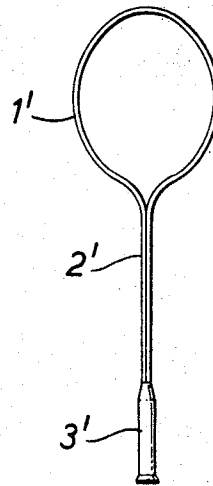


FIG. 3.

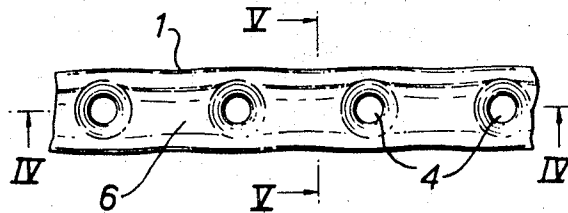


FIG. 4.

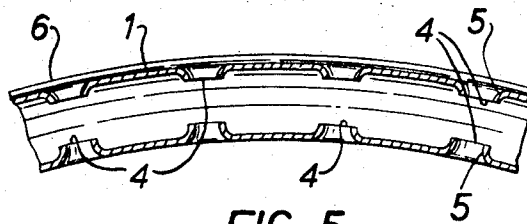
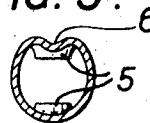


FIG. 5.



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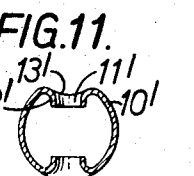
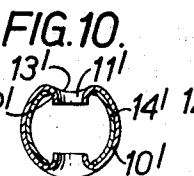
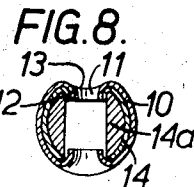
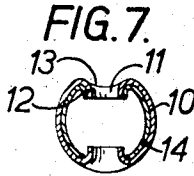
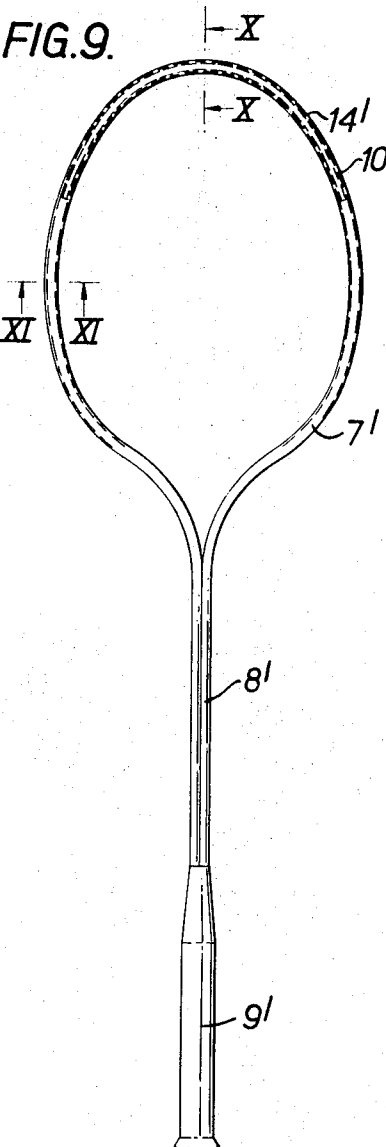
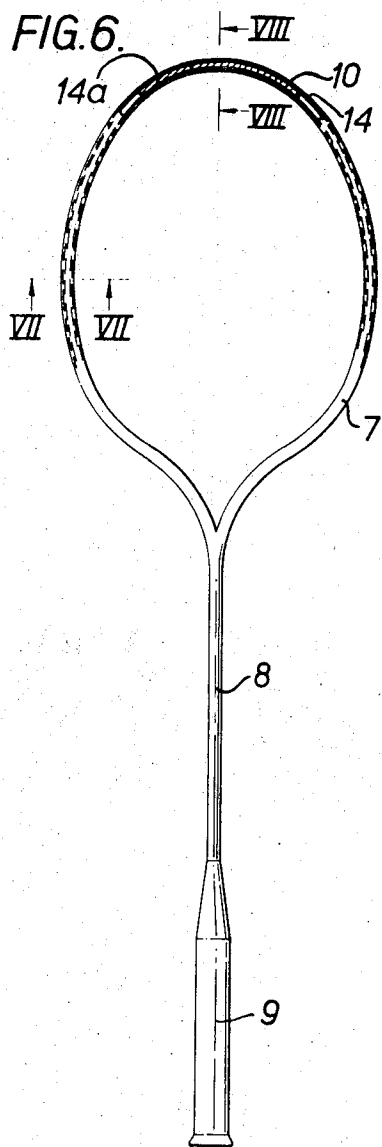
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**METHOD OF MAKING RACKETS
HAVING METAL FRAMES**

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Original application June 13, 1966, Ser. No. 557,159, now Patent No. 3,431,626, dated Mar. 11, 1969. Divided and this application Jan. 21, 1969, Ser. No. 792,293
Int. Cl. B23p 15/16, 17/00
U.S. Cl. 29—163.5

4 Claims

ABSTRACT OF THE DISCLOSURE

An improved method for the manufacture of metal frames for badminton, tennis and other games rackets having flanged apertures for the strings thereof, starting from a metal tube having an 0.2 proof stress not exceeding 30 tons/square inch, maximum stress not exceeding 55 tons/square inch and an elongation on 2 inches of not less than 25%. After the flanged apertures have been formed in the tube and the latter bent into the shape of the racket frame, the frame is subjected to a hardening process to give the metal a 0.2% proof stress and a maximum stress each not less than 70 tons/square inch and an elongation on 2 inches of not more than 15%.

This application is a divisional application of pending application Ser. No. 557,159 filed on June, 13, 1966, now Pat. No. 3,431,626, granted March 11, 1969.

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. 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.

It has previously been proposed to make rackets having steel frames but the use of steel frames has met with considerable difficulties, especially with regard 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.

A further object of the invention is a method by which metal racket frames having flanged stringing apertures can be made while avoiding the splitting of the metal frames which has hitherto precluded the putting into practice of various prior proposals for frames having flanged stringing apertures. Accordingly, the present invention provides a method for the manufacture of a frame for a badminton, tennis, squash or other games racket from a metal tube, comprising selecting a tube having an 0.2% proof stress not exceeding 30 tons/square inch, a maximum stress not exceeding 55 tons/square inch and an elongation on 2 inches of not less than 25%, and then:

(a) Forming a series of holes along said tube corresponding in position to the positions of the described stringing apertures;

(b) deforming the metal at the edges of said holes so that it is turned inwardly towards the interior of the tube to form flanged stringing apertures which provide a smooth bed for racket strings;

(c) Bending the tube into a loop corresponding to the shape of the described racket frame;

(d) Completing the racket frame by joining the ends of the loop to form the frame; and

(e) Subjecting the racket frame to a hardening process to give the metal of the frame a 0.2% proof stress and a maximum stress each not less than 70 tons/square inch (preferably not less than 80 tons/square inch) and an elongation on 2 inches of not more than 15%; the afore-said "tons" being long tons of 2240 lbs.

The flanged stringing apertures are preferably obtained by first forming, for instance by drilling, a series of holes along the tube corresponding in position to the positions of the desired stringing apertures, and then forming the flanges by use of a punch to turn the metal at the edges of said holes. The amount by which said metal is turned is preferably a right-angle, at least in the direction of the length of the tube. The flanged apertures are preferably, though not necessarily, formed before the tube is bent into a loop corresponding to the shape of the desired racket frame.

When the metal of the tube used in the method of the invention is a steel a suitable material is that sold by Firth-Vickers Limited of England as FV 520(S).

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:

FIG. 1 is an elevation of a badminton racket made in accordance with the invention, the stringing being omitted.

FIG. 2 is an elevation on a reduced scale of a slightly different form of badminton racket, the stringing being omitted.

FIG. 3 is a fragmentary side elevation of the racket frame of either FIG. 1 or FIG. 2.

FIG. 4 is a longitudinal section, on line IV—IV of FIG. 3, through a part of the tube from which the racket frame is made.

FIG. 5 is a cross section on line V—V of FIG. 3, on the same scale as FIG. 3.

FIG. 6 is an elevation of a second racket made in accordance with the invention omitting the stringing and having the structure of a racket of my application Ser. No. 557,159, now Patent No. 3,431,626, granted Mar. 11, 1969.

FIGS. 7 and 8 are enlarged cross sections on the lines VII—VII and VIII—VIII respectively of the racket of FIG. 6.

FIG. 9 is an elevation of a further racket made in accordance with the invention, omitting the stringing, and having the structure of a racket of my application Ser. No. 557,159.

FIGS. 10 and 11 are enlarged cross sections on the lines X—X and XI—XI respectively of the racket of FIG. 9.

Referring initially to FIGS. 1 to 5 of the drawings, the racket comprises a frame 1 formed from a metal tube in a manner which will be described in greater detail hereinafter in connection with FIGS. 3 to 5. For a first class badminton racket using steel tube for the frame, the wall thickness of the tube is preferably not more than 0.014 inch, a suitable thickness being in the range 0.012–0.014 inch. The racket of FIG. 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. The shaft 3, in this embodiment, is

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a single tubular shaft which may be separately formed from the frame 1 and secured, such as by welding, to the two ends of the tube forming said frame 1. Alternatively, 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 FIG. 2, in which references 1', 2', and 3' are used for the frame, shaft and handle respectively 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 tube 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 racket in FIGS. 1 and 2 is the same and this will now be described in greater detail with reference to FIGS. 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 apertures 4 are bounded by flanges 5 which can be seen most clearly in FIGS. 4 and 5 and which project towards the interior of the tube and are integral with the tube. Because all the flanges project towards the interior of the tube smooth surfaces are provided 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, indicated by the arrow in FIG. 1, is provided with a recess or groove 6, visible in FIGS. 3, 4 and 5, to accommodate the strings stretched 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 elliptical, or otherwise suitably shaped.

In manufacturing the frame of the racket described with reference to FIGS. 1 to 5 a metal tube, for example, of a steel having an 0.2% proof stress not exceeding 30 tons/square inch, a maximum stress not exceeding 55 tons/square inch and an elongation on 2 inches of not less than 25% has the apertures 4 and the grooves 6 formed in it by making small holes and then forming 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 described 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, to give the metal of the frame a 0.2% proof stress and a maximum stress each not less than 70 tons/square inch and an elongation on 2 inches of not more than 15%.

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 the punching operation 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. FIGS. 4 and 5 show the metal tube after the plastics strip has been removed by heat as aforesaid.

Although the embodiments of FIGS. 1 to 5 have been particularly described with respect to the manufacture

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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 FIGS. 6 to 11 as applied to a squash racket frame.

In the embodiments of FIGS. 6 to 8 the squash racket comprises a frame 7, a shaft 8 and a handle 9. The handle 9 may be of a moulded plastics material 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 FIGS. 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 FIGS. 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 FIGS. 6 to 8, the inner metal member 14, formed with holes therethrough as described, is inserted in the metal tube 10, in which it preferably has a sliding fit. The metal tube 10 and preferably also the inner metal member 14, which includes the solid insert 14a, are made of a steel having an 0.2% proof stress not exceeding 30 tons/square inch, a maximum stress not exceeding 55 tons/square inch and an elongation on 2 inches of not less than 25%. The metal tube 10 containing the inner metal member 14 correctly positioned therein is then formed into a loop to provide 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 12 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 made after the apertures are flanged. Subsequently, the metal tube 10 of the frame is hardened by any suitable process, for example, by heat treatment, to give the metal of the frame a 0.2% proof stress and a maximum stress each not less than 70 tons/square inch and an elongation on 2 inches of not more than 15%. 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 FIGS. 9 to 11 like reference numerals, but primed, are employed to indicate parts corresponding to those in the embodiment of FIGS. 6 to 8. The embodiment of FIGS. 9 to 11 differs from that of FIGS. 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 members 14. This can be seen in FIG. 9 in which the outline of the inner metal member 14' is shown dotted. The frame of the racket shown in FIG. 9 can be manufactured in a manner similar to that already described with reference to the frame of the racket in FIG. 6.

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The shaft 8' of the racket of FIG. 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 continuations, 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 invention. By way of example, the embodiments of FIGS. 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 FIG. 6 may be provided throughout the whole of the extent of the inner metal member, or any other suitable part thereof.

Having now described my invention—what I claim is:

1. A method for the manufacture of a frame for a badminton, tennis, squash or other games racket from a metal tube, comprising selecting a tube having an 0.2% proof stress not exceeding 30 tons/square inch, a maximum stress not exceeding 55 tons/square inch and an elongation on 2 inches of not less than 25%, and then:

- (a) forming a series of holes along said tube corresponding in position to the positions of the desired stringing apertures;
- (b) deforming the metal at the edges of said holes so that it is turned inwardly towards the interior of the tube to form flanged stringing apertures which provide a smooth bed for racket strings;
- (c) bending the tube into a loop corresponding to the shape of the desired racket frame;

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(d) completing the racket frame by joining the ends of the loop to form the frame; and

(e) subjecting the racket frame to a hardening process to give the metal of the frame a 0.2% proof stress and a maximum stress each not less than 70 tons/square inch and an elongation on 2 inches of not more than 15%; the aforesaid "tons" being long tons of 2240 lbs.

2. A method according to claim 1, in which the metal at the edges of each of said holes is turned inwardly towards the interior of the tube through substantially a right-angle, at least in the direction of the length of the tube.

3. A method according to claim 1, in which the maximum stress of the metal after said hardening is not less than 80 tons/square inch.

4. A method according to claim 1, in which the frame is a frame for a badminton racket and the thickness of the wall of the tube is in the range of 0.012–0.014 inch.

References Cited

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THOMAS H. EAGER, Primary Examiner

U.S. Cl. X.R.

29—423; 273—73