

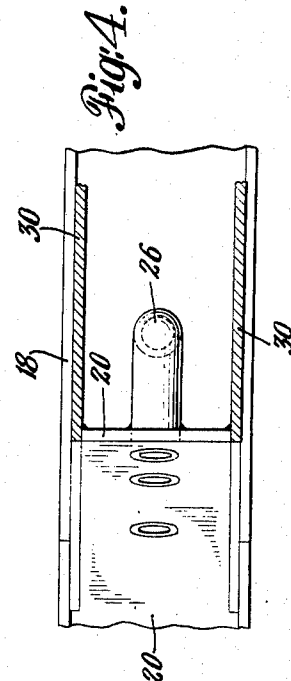
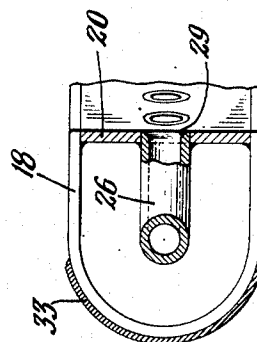
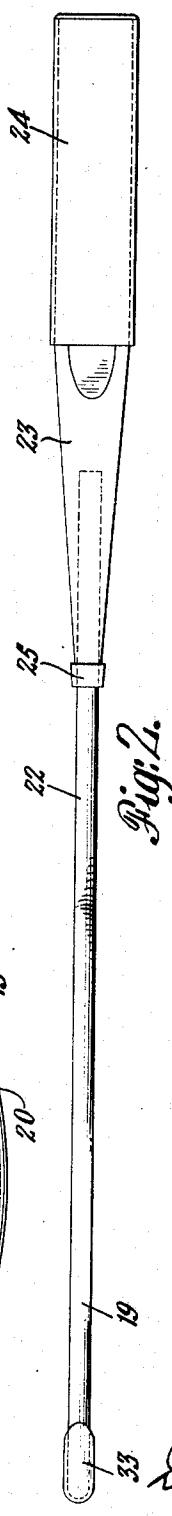
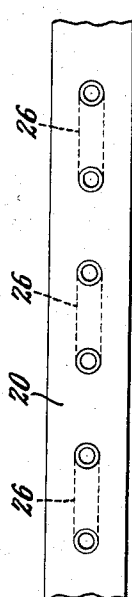
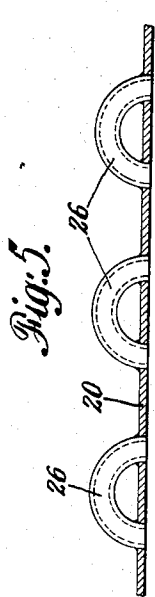
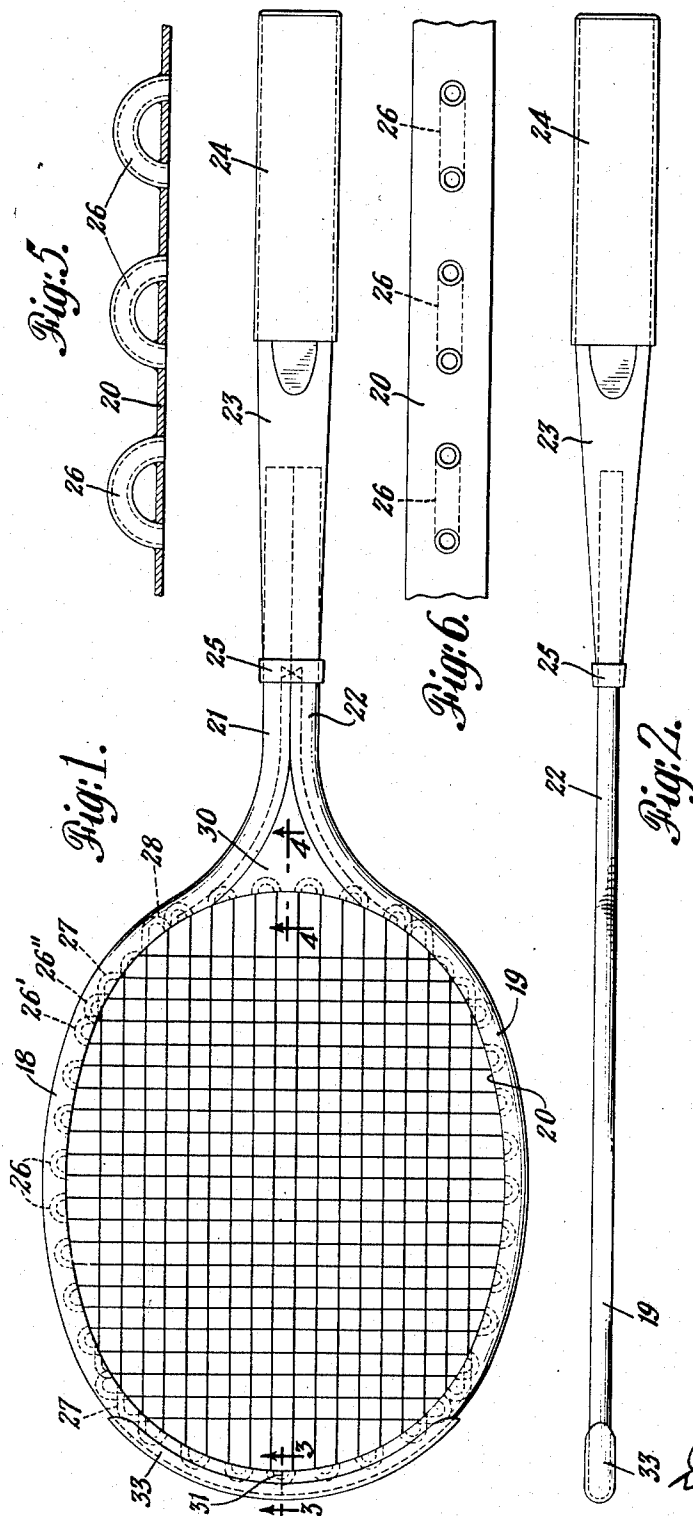
Sept. 9, 1952

C. A. LOVELL
GAME RACKET FRAME

2,610,056

Filed Dec. 2, 1948

2 SHEETS—SHEET 1



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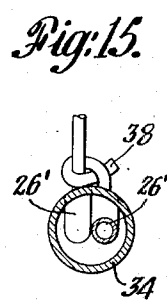
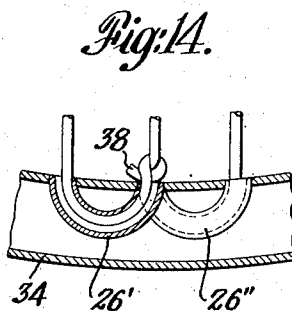
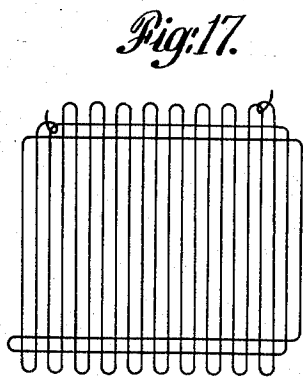
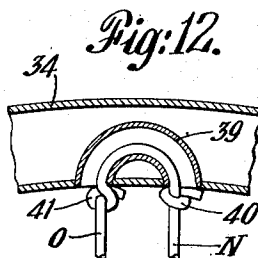
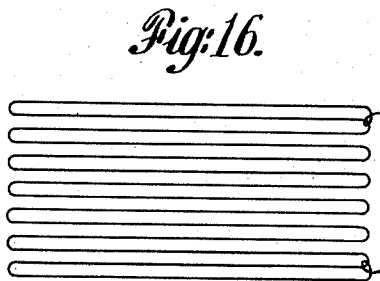
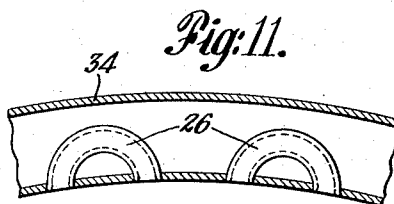
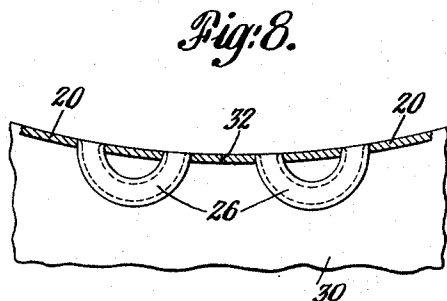
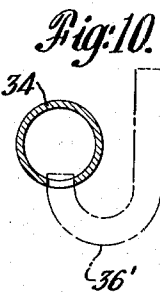
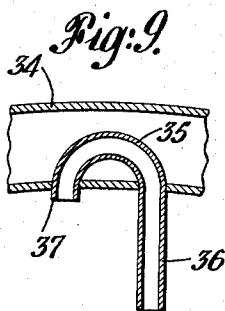
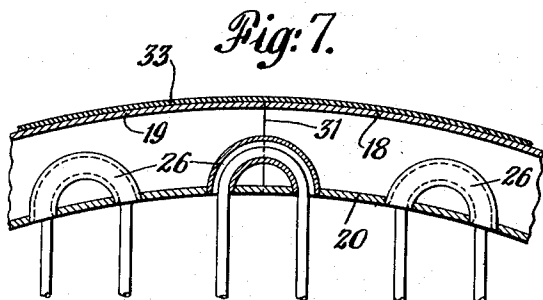
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GAME RACKET FRAME

2,610,056

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2 SHEETS—SHEET 2



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2,610,056

GAME RACKET FRAME

Clarence A. Lovell, Summit, N. J.

Application December 2, 1948, Serial No. 63,089

1 Claim. (Cl. 273-73)

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The invention relates to the construction of rackets for playing games such as tennis, squash, squash racquets, badminton, etc. More particularly, it relates to the manufacture of metal racket frames which can be strung with gut, nylon, silk, or any other suitable fibrous material, as well as with metal strings.

The disadvantages of the ordinary racket frame made of wood have long been recognized. For one thing, it is affected by moisture and will warp. The racket usually must be kept in a waterproof case and be put into a clamp or frame when not in use to help preserve its shape, but notwithstanding such precautions warping may, and frequently does, occur, making the racket of little further use. Another disadvantage of the wood racket frame is that because of the rather low crushing strength of wood, the strings of the racket, being under considerable tension, will cut into the wood at the corners of the string openings at the points where the string turns at right angles along the outer surface of the frame. This may in time contribute to a lessening of the tension on the strings, necessitating more frequent re-stringing or decreasing the driving power or harming other playing characteristics of the racket.

These, and perhaps other, drawbacks of the ordinary wood racket frame, have led to various attempts to substitute metal for wood in making the frame. These attempts have been reasonably successful wherever steel strings have been used in place of gut or nylon. However, steel strings do not seem to have as desirable playing qualities as do gut and other fibrous string materials. On the other hand, the metal rackets heretofore offered have not been well suited to gut stringing. Perhaps one reason for this is that in the case of tubular metal frames difficulty is encountered in avoiding abrasion and cutting of the strings at their points of contact with the edges of the thin metal walls of the frame even though embossed holes are used to minimize these effects. Whatever the reasons, it is a fact that wood rackets, with all their conceded disadvantages, are still in general favor with tennis players and other users of rackets.

It is a leading object of my invention to provide a racket frame construction which is especially adapted to be made of metal, and which also can be strung with gut, nylon, silk, or other material (as well as with metal strings, if desired) yet which permits the stringing of gut and the like to be drawn up to high tension without danger of abrasion or cutting of the strings, so as to make a thoroughly practicable racket having a metal frame with gut or other fibrous stringing, and having playing qualities similar to those of the most acceptable rackets now in use.

Another object is to provide a racket frame which facilitates the stringing operation.

A still further object is to provide a racket

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frame which has a smooth outer edge devoid of string openings, and a method of constructing such a racket.

Other objects and advantages will appear as the description proceeds.

In accordance with my invention, a racket frame of hollow tubular construction having a series of string openings around its inner perimeter, is provided with string guides connecting the string opening in pairs. In my preferred construction the string guides take the form of curved tubular elements connecting adjacent pairs of string openings, and these curved tubular elements have two principal functions: (1) they constitute guides for stringing the racket and (2) they serve as bearings against which the string is tensioned. In addition, these curved tubular elements strengthen the tubular frame itself. There is thus provided a racket frame construction having a series of curved passages, each extending from one point on the inner perimeter of the frame to another point on the inner perimeter of the frame whereby a string inserted at one point will be guided for emergence at another point. This construction makes it possible to have the outer perimeter of the frame devoid of string openings, for inasmuch as the curved guide elements are located entirely within the tubular frame of the racket, a smooth surface is preserved along the outside edge of the frame. This not only creates an improved appearance, but has the advantage of protecting the strings from the damage which might otherwise result from contact with court surfaces, such as that due to abrasion and moisture, as could occur with ordinary rackets in which the strings extend to the outside of the frame.

One of the principal problems in manufacturing a tubular racket frame which has curved tubular string bearings within it, is to simplify the manufacturing steps sufficiently to enable it to be fabricated at a low enough cost to make the racket commercially practicable. In making a tennis racket frame having the conventional number of interlaced strings across its face, 42 string bearings must be provided. In accordance with my invention all of these string bearings are completely hidden within the frame, and the problem from an assembly standpoint entails the construction and anchoring of these 42 string bearings on sub-assemblies. Accordingly my invention in its overall aspect deals not only with the provision of an improved racket frame construction but also with a novel fabricating method. These and other features of my invention will now be described with reference to the particular preferred embodiments shown in the accompanying drawings in which:

Fig. 1 is a face view of a racket having a frame constructed in accordance with the principles of the invention in what I now consider to be its preferred form.

Fig. 2 is a side view of the same racket.

Figs. 3 and 4 are detail cross-sectional views taken as indicated at 3—3 and 4—4 in Fig. 1 but to an enlarged scale.

Figs. 5 and 6 are enlarged detail views of a portion of the frame sub-assembly, illustrating the manner in which the curved tubular guiding elements or string bearings are affixed to a strip which later will be bent into a closed loop and secured to the edges of the remaining frame members to form the inner perimeter of the frame. Fig. 6 is a bottom plan view of this sub-assembly, and Fig. 5 is a central vertical longitudinal cross-sectional view of the assembly shown in Fig. 6 with the curved string bearings shown in side elevation.

Figs. 7 and 8 are further detail cross-sectional views of portions of the racket of Fig. 1. These are central cross-sectional views taken parallel to the face of the racket, Fig. 7 illustrating a section at the end of the frame (extreme left-hand end of Fig. 1), and Fig. 8 illustrating a section at the throat.

Figs. 9, 10 and 11 are detail views illustrating a modified frame construction and an alternative method of assembling the curved string bearing elements. Fig. 9 is a central cross-sectional view through a portion of the tubular frame in the plane of the face of the racket showing one of the string bearing elements in place and ready to be secured. Fig. 10 is a cross-section taken at right angles to Fig. 9, showing an intermediate position of the string bearing element during its insertion into the tubular frame. Fig. 11 is a view similar to Fig. 9, but showing two of the string bearings secured in place in the completed racket frame.

Figs. 12 and 13 are detail cross-sectional views illustrating one method of anchoring the strings when a length of new string is put in to repair a racket without entirely re-stringing it.

Figs. 14 and 15 are detail cross-sectional views showing my presently preferred method of anchoring the strings when the racket is initially strung or completely re-strung.

Figs. 16 and 17 are diagrams illustrating the string arrangement employed in the racket of Fig. 1, Fig. 16 showing what we may refer to as the longitudinal stringing, and Fig. 17 the transverse stringing.

My preferred racket construction illustrated in Figs. 1 to 8 inclusive comprises in its general arrangement a pair of complementary curved members generally U-shaped in cross-section and a mating inner loop section 20 secured to the edges of the U-shaped members 18, 19. These three members, together with the associated string guides and gusset plates, form the head of the racket frame. The complementary curved members 18, 19 are reversely curved adjacent the throat of the racket and terminate in straight parallel adjacent sections 21, 22 forming a part of the handle of the racket and secured in a socket of the handle section 23 having a suitable hand grip 24. In the construction shown, members 18, 19 and 20 are made of metal and the handle 23 of wood covered with the usual leather wrapping to form the grip 24. The wood is machined to fit closely over the metal sections 21 and 22 and may be bonded thereto with a heat curing cement. While this construction has proved to be satisfactory, alternative methods for applying the grips may be employed if desired, such as casting plastic material around the ends of the metal sections, or the metal sections may be extended and flared to form the

grip. An encircling strengthening band 25 also may be employed where the ends of the wood part of the handle terminate at the metal sections 21 and 22 of the frame. It will be appreciated that details of this nature are also subject to variation, and as such details do not relate directly to the invention, it will be unnecessary to elaborate on them further.

The inner loop section 20 is provided with a series of string openings, and adjacent pairs of these openings are connected by a series of curved tubular elements 26, 27, 28. These curved tubular elements constitute guides for stringing the racket and bearings against which the string is tensioned. They are of several different forms as will readily be seen from Fig. 1. Most of them have 180° bends, as, for example, elements 26 and 28, while others such as elements 27, have 90° bends. The form of these bearing elements also is adjusted to fit the final curvature of the inner perimeter of the frame. Where more than one bearing element terminates at the same string opening, that is, opposite the end of the same string, they are slightly offset from one another, as clearly indicated in Figs. 14 and 15. This construction is employed for example in the case of bearings 26', 26'' in Fig. 1. A similar offset arrangement is employed in the case of the bearings 26'', 27 of Fig. 1, except that in this instance the overlapping ends of the bearings lead respectively to a transverse string and a longitudinal string which intersect the frame in closely adjacent relationship.

The string openings, that is the openings in the inner loop section 20 which are to receive the ends of the string bearing elements, may be formed in any suitable manner, as for example by drilling or punching the strip, preferably while the latter is flat, as shown in Fig. 5. The bearing elements are welded or brazed, or otherwise secured, to the strip, for example by copper welding, and the projecting parts cleaned off by a milling operation. Then the ends of the tubular bearing elements are flared by drilling, spinning, peening or upsetting the metal so as to form smooth rounded entering portions, as shown at 29 in Fig. 3. This will avoid cutting or abrading of the strings while the racket is in use.

The sub-assembly of Figs. 5 and 6 as so formed is then accurately positioned in a bending jig and brought into the form of a hoop which defines the inner perimeter of the racket frame head. This hoop is assembled with the curved frame members 18, 19 previously described, to which it is butt-welded or otherwise joined to form the tubular section illustrated in Fig. 3. The bearing elements 26, 27, 28, etc. may change their shape slightly in the bending of strip 20 into its final form, and if desired this may be compensated for by initially forming the bearing elements to allow for the slight change in their shape. It will be observed that strip 20 is made from stock of uniform width. Also, the curved members 18 and 19 may be formed from flat stock of uniform width. Therefore there is little or no waste of the metal from which the frame is formed, and it is possible to employ more expensive materials than would be the case if there were considerable waste in the form of scrap. I recommend the use of a high strength steel alloy clad with a layer of non-tarnishing material such as copper or nickel, to protect the frame from corrosion and give it an attractive appearance.

My preferred throat construction is shown in Figs. 1 and 4. Gusset plates 30 formed to fit the

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curvature of the inner edge of the throat portions of frame members 18, 19 and the adjacent portion of the frame member 20 are welded to these members. As shown, these plates extend flush with member 20 and slightly overlap the flanges of members 18, 19. Members 18, 19 may be butt-welded at 31 (Fig. 7) and the ends of member 20 may be butt-welded at 32 (Fig. 8).

A protective shoe 33 of rubber, plastic or other relatively soft and pliant material may be fastened to the nose of the racket, extending, say, three inches on each side of the longitudinal center line and covering approximately half of the tubular frame section. I have found that such shoes can be secured successfully by heat curing cements. For uses where injury to players may be sustained by accidental striking with the racket frame, as, for example, in the game of "squash racquets," the protective shoe is extended to cover the entire perimeter of the racket head or any portion thereof which it is deemed necessary or desirable to cover in such a manner in order to make the racket acceptable for use in enclosed courts.

The manner of stringing the racket is indicated in the diagrams, Figs. 16 and 17. However this is simply one of the more conventional string arrangements and is subject to variation in accordance with any of the several systems employed by those versed in the art of racket stringing.

In the modification illustrated in Figs. 9, 10 and 11, the frame is made of a seamless tube 34 provided with string openings around its inner perimeter as before. In this modification the sub-assembly described with reference to Figs. 5 and 6 is not employed. Instead the individual string bearing elements are inserted from outside the seamless tube. I have found that this can be accomplished by using bearing elements of the form shown at 35 in Fig. 9, having an elongated handle portion 36 by which it can be manipulated to bring it into its proper position within the tubular frame section. The element 35 is grasped by the handle portion 36 and threaded through one of the string openings by first placing it approximately in the position shown by the dot-dash lines 36', Fig. 10. As the leading end of the bearing element is slid through the opening in the frame, the element is twisted around, being manipulated so as to bring it into the final position shown in Fig. 9. Then the short projecting end 37 is slightly peened over or staked sufficiently to hold it in place, while the element 35 is welded or brazed to the frame after which both portions 36 and 37 are trimmed off flush with the inner racket surface. The entering portions of the curved passageway formed by the tubular bearing element 35 may be rounded off by counter-boring, milling, grinding, or upsetting the metal to form a flared entering portion similar to that depicted at 29 in Fig. 3.

There are several ways in which the ends of the strings may be anchored. Figs. 14 and 15 show my presently preferred method. The end 38 of the string is brought out close to another string already in place and in a direction parallel to the string. This end is knotted around the string as shown and pulled tight, forming a half hitch. The tension on the string pulls the end tightly against the frame, forming a secure anchorage. The adjacent bearings 26', 26'' here illustrated may be offset with their centers less than a diameter apart, in which case the walls of the bearings will be cut away slightly to permit this close arrangement and bring the strings

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nearer together. That is, the strings will be nearer together than twice the wall thickness of the tubular bearing elements 26', 26''.

While the special string bearings which I have described do much to eliminate string breakage, there will always be cases in which breakage will occur as for example where there is a weakness or defect in the string material or where the racket is misused, or due to other causes. In order to facilitate the repairing of broken strings, I prefer to use at selected points around the frame bearings 39 (Figs. 12 and 13) made of tubing large enough to allow two of the strings to pass through. The majority of breaks involve strings which pass through an area near the center of the racket. Consequently bearings 39 should be located somewhere near the mid-points of the sides and ends of the head of the racket and spaced so that repairs can be made by replacing only a small number of strings. The end of the old string O is looped around the new string N as at 40, and the new is looped around the old as at 41. These ends are secured in the same manner as the string ends shown in Figs. 14 and 15.

It will be appreciated that the features illustrated in Figs. 12 to 15 inclusive are applicable both to the seamless frame 34 therein shown and to the built-up form shown in Figs. 1 to 4 inclusive. In practicing my invention, I have constructed racket frames of conventional weights and balances which duplicate the playing qualities of rackets constructed by conventional methods from the finest ash wood and plastics laminations. My racket frames have margins in strength of materials sufficient that they should have long life under severe conditions of string tension and under the stress of normal play which produce high percentages of structural failures in frames of the best wooden construction now available.

The terms and expressions which I have employed are used in a descriptive and not a limiting sense, and I have no intention of excluding such equivalents of the invention described, or of portions thereof, as fall within the purview of the claim.

I claim:

A racket frame of hollow tubular construction, the inner surface of the frame being constructed of a substantially flat strip having a series of string openings therein, string guides connecting adjacent pairs of said string openings, the outer part of the frame being constructed of members substantially U-shaped in cross-section, and the flat strip with its string guides being bent to form a closed loop and secured to the edges of the U-shaped members with said string guides disposed within the tubular frame thus formed.

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