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FIG. 3.

FIG. 4.

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This invention relates to a method of stringing lawn tennis and other rackets and apparatus for facilitating such stringing.

In ordinary hand stringing of racket frames the frame is held by being clamped by the handle only and is liable to be subjected to a variety of strains and consequent distortion during stringing. First the “mains” i.e. the longitudinal strings are strung taut but not under their final tension. Then the racket frame is strutted longitudinally by means of a screw expanding tool called a “billiard”. The mains are then successively drawn through by hand and thus stretched to the requisite tension, the billiard providing support against longitudinal shortening of the frame but not otherwise. Then the cross strings are strung under tension, thereby slightly contracting the frame laterally and expanding it longitudinally, whereupon the “billiard” drops out.

It has already been proposed to modify the ordinary hand stringing process, described above, by stretching the longitudinally-strung racket frame longitudinally or, alternatively, by compressing it laterally, prior to the insertion of the cross stringing, by means of mechanically displaced curved segments moveable in a centrally apertured frame. In connection with such apparatus it was also proposed to provide rotatable winding spindles around the frame of the apparatus, by means of which the strings could be tensioned mechanically without means of measuring or automatically regulating the tension to a predetermined amount. It has also been proposed to clamp the frame by its head and handle or alternatively by the two sides and the handle with a view to prevent distortion of the frame during stringing by means of mechanical appliances which may measure the load but do not provide automatically for a predetermined tension being applied and not exceeded.

In the above described processes the racket frame is purposely distorted during stringing or at any rate it is not positively supported against distortion in all directions, consequently the final shape of the frame and the tension of the strings depend upon the judgment and skill of the workman who effects the stringing. By such methods a good racket frame can therefore be easily wilted by a poorly skilled stringer and, even when all are strung by one and the same highly skilled stringer, the strung rackets are not all uniform.

According to the present invention, the racket frame is positively supported against distortion in all directions while the mains and the cross strings are strung to their final tension, and the strung racket frame is then released.

Further the process can be adapted to obviate the necessity for the exercise of judgment in tensioning the strings by employing a winding device for that purpose arranged so as to enable a predetermined tension to be applied and to be automatically maintained until the string is fixed.

A jig for holding the racket frame against distortion in all directions during stringing, and enabling the string frame to be released, consists, for instance, of a plurality of annular segments, presenting interrupted surfaces located to abut against the head, handle end and sides of the internal profile of the racket frame, said segments being mounted on an annular base plate, with means for displacing the said surfaces into and from firm contact with the internal profile of the racket frame.

Thus, with racket frames approximately uniform in size and shape, a racket frame can be fitted over and embrace the interrupted surfaces of the jig segments, whereupon on displacing these segments outwardly, not only is the frame securely held, but positive support is provided to resist distortion of the frame during the operation of stringing the mains and the cross-strings.

To enable the tension to which the strings are drawn to be precisely determined, a winding drum or barrel on which each string is successively wound may be yieldingly mounted but restrained by a load so as to yield, while maintaining the desired tension until the string can be fixed, when the string has been drawn to such predetermined tension.
The jig is adjustable relatively to the yielding load-restrained winding barrel, so that the several stringing holes in the racket frame can be brought into suitable operative positions relatively to the winding barrel.

A constructional embodiment of an apparatus for carrying out the invention is illustrated by way of example on the accompanying drawings, in which:

Fig. 1 is an elevation of the entire apparatus.

Fig. 2 is a perspective view of one of the interchangeable loading weights.

On a larger scale:

Fig. 3 is a plan of the jig which holds the racket frame against distortion.

Fig. 4 is a longitudinal section of the jig on the line 4—4 of Fig. 3.

Fig. 5 is a transverse section of the jig on the line 5—5 of Fig. 3.

Fig. 6 is a plan of the winder shown in relation to a portion of the jig, and

Fig. 7 is an elevation of the winder.

a. Fig. 1, is a pedestal at the head of which is a bracket arm b in which an upright spindle c is clamped by nuts c'. This spindle c provides a journal on which a jig for holding a racket frame d (shown in dot-dash lines in Figs. 3 and 4) is mounted to be rotatable by hand in a horizontal plane.

The jig, shown in detail in Figs. 3—5 comprises a cross bar e', journaled on the spindle c, on which is secured an annular frame e. At intervals around the frame e are pivoted on vertical studs f', a plurality of annular segments f, except at one end where a fixed segment g is provided on the frame e.

The pivoted segments f are symmetrically located relatively to the longitudinal axis 4—4, Fig. 3, of the annular jig frame e, and to the fixed segment g.

All the segments f and g are provided with upstanding pins h so located as approximately to fit the internal profile of the racket frame d and to come between the usual stringing holes d', Fig. 4, of the racket frame d.

The pivoted segments f are, by inwardly directed and downwardly cranked arms j at their ends remote from their pivot studs f, connected to the heads p of plunger i guided to slide radially in guides e' on the frame cross bar c' and on an arm e' thereon. The inner ends of the plungers i are located between flanges j, j of a collar j journaled on the spindle c, and are connected to these flanges j, j by pins i which extend into oblique cam slots g in the two flanges j, j. The collar j is formed with a wormwheel segment k with which gears a worm l on the end of a spindle k journaled in a bearing e' on the arm e' of the frame cross bar c'. This worm spindle k is adapted to be rotated by a tommy bar m.

Rotation of the worm spindle k in one direction angularly displaces the collar j in such direction that its cam slots g' thrust the plungers i radially outwards, which thereby thrust the segments f also outwards to bring their pins h into pressure contact with the internal profile of the racket frame d. The latter is thus held against distortion and is then strung by hand all the strings being drawn to their final tension.

After the racket frame has been strung, reverse rotation of the worm spindle k draws the pins h from pressure contact with the strung racket frame d, which can then be removed from the jig.

e' are pivoted clips for initially positioning the racket frame on the jig.

The shape of the profile of the racket frame d is determined by the profile outlined by the pins h of the jig, is the shape which the racket frame should preserve when completely strung. Consequently it is highly desirable that the individual strings be drawn to such degree of tautness that, when the strung racket frame d is removed from the jig, the tensions of the individual strings will be mutually balanced without causing any change of shape of the racket frame. This involves each string being drawn to a given tension, varying with the position of the respective string in the racket frame.

A mechanical device facilitating stretching the strings, which yields automatically while maintaining a predetermined tension as soon as the respective string has acquired that tension, is therefore provided. Such a device is illustrated on Figs. 1, 2, 6 and 7.

P is a winding drum, provided with cleats p, and mounted on a horizontal spindle in the head m' of a post m on a bracket arm m' at the head of the pedestal a. The winding drum l is fast with a wormwheel P' gearing with a hand rotated worm P. The head m' is pivoted about a horizontal pin m'b to the post m, on the side of the latter adjacent to the jig above described. The head m'b also has a lever arm m'c protruding away from the jig. This arm m'c is, by a link n connected to one end of a lever n which by its other end is pivoted to the pedestal a. A massive weight o is suspended from the lever n and by a hand rotated screw o' can be traversed along the lever n in relation to a scale marked on the lever. A small hanger p also depends from the lever n on which can be mounted additional weights, one of which o is shown in Fig. 2.

As each string r, Figs. 6 and 7, is strung through the respective holes in the racket frame d on the jig, it is wrapped around the cleats p and the winding drum l is rotated by the worm P', to stretch the string r. As soon as the tension thus imposed upon the string r is sufficient, it causes the head m' of the post m to tilt towards the racket frame d and jig, by the tension of the string r overcoming the restraining influences of the
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Thus the fact that the string $r$ has been stretched to a definite predetermined tension will be indicated.

The adjustability of the position of the weight $o$ along the lever $a$ and the ability to employ additional weights $g$, enable any desired tension of string, within working limits, to be predetermined to suit both the position of the respective string in the racket and also different classes of rackets.

On the string $r$ being stretched to the desired tension it is secured by plugging the respective string hole in the racket frame, and the string is released from the cleats of the winding drum $l$, and passed again through the racket frame to constitute the next string thereof.

During the stringing the jig is rotated about its spindle $c$ to present towards the winding drum $l$, the respective stringing hole from which the string $r$ happens to extend.

I claim:

1. In a racket stringing apparatus, means for holding a racket frame against distortion in all directions, a winding drum pivoted adjacent to and tilting towards said racket frame holding means, and loading means restraining tilting of said drum.

2. In a racket stringing apparatus, means for holding a racket frame against distortion in all directions, a winding drum, a mounting of said winding drum pivoted adjacent to and tilting towards said racket frame holding means, and loading means restraining tilting of said winding drum mounting.

3. In a racket stringing apparatus, means for holding a racket frame against distortion in all directions, a winding drum, a mounting of said drum pivoted adjacent to and tilting towards said racket frame holding means, an arm fast with said mounting and protruding away from said racket frame holding means, a lever pivoted beneath said arm, a link interconnecting said arm and said lever, and a weight adjustable along said lever.

4. In a racket stringing apparatus, means for holding a racket frame against distortion in all directions, a winding drum pivoted adjacent to and tilting towards said racket frame holding means, and loading means restraining tilting of said drum, said racket frame holding means and said drum being relatively angularly adjustable.

5. In a racket stringing apparatus, a rotatable annular base, relatively displaceable annular segments mounted on said annular base and presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, means for relatively displacing said segments into and from firm contact with the internal profile of a racket frame applied around said interrupted surfaces, a winding drum pivoted adjacent to and tilting towards said annular base, and loading means restraining tilting of said drum.

6. In a racket stringing apparatus, a rotatable annular base, relatively displaceable annular segments mounted on said base and presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, means for relatively displacing said segments into and from firm contact with the internal profile of a racket frame applied around said interrupted surfaces, a winding drum pivoted adjacent to and tilting towards said annular base, and loading means restraining tilting of said drum.

7. In a racket stringing apparatus, a rotatable annular base, relatively displaceable annular segments mounted on said base and presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, means for simultaneously displacing all said cam means, a winding drum pivoted adjacent to and tilting towards said annular base, and loading means restraining tilting of said drum.

8. In a racket stringing apparatus, a rotatable annular base, an annular segment fixed on said annular base, annular segments pivoted on said annular base, said fixed and pivoted segments presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, plunger pivotally connected to said pivoted segments, a rotary spindle mounted in said base, collars on said spindle formed with oblique cam slots, pins on said plungers extending through said cam slots, a worm-wheel fast with said spindle, a worm gearing with said wormwheel, a spindle of said worm mounted on said base, a winding drum pivoted adjacent to and tilting towards said annular base, and loading means restraining tilting of said drum.

9. In a racket stringing apparatus, a rotatable annular base, relatively displaceable annular segments mounted on said annular base and presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, means for relatively displacing said segments into and from firm contact with the internal profile of a racket frame applied around said interrupted surfaces, a winding drum, a mounting of said drum pivoted adjacent to and tilting towards said annular base, an arm fast with
said mounting and protruding away from said annular base, a lever pivoted beneath said arm, a link interconnecting said arm and said lever, and a weight adjustable along said lever.

10. In a racket stringing apparatus, a rotatable annular base, relatively displaceable annular segments mounted on said base and presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, cam means relatively displacing said segments into and from firm contact with the internal profile of a racket frame applied around said interrupted surfaces, a winding drum, a mounting of said drum pivoted adjacent to and tilting towards said annular base, an arm fast with said mounting and protruding away from said annular base, a lever pivoted beneath said arm, a link interconnecting said arm and said lever, and a weight adjustable along said lever.

11. In a racket stringing apparatus, a rotatable annular base, relatively displaceable annular segments mounted on said base and presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, cam means simultaneously displacing all said cam means, a winding drum, a mounting of said drum pivoted adjacent to and tilting towards said annular base, an arm fast with said mounting and protruding away from said annular base, a lever pivoted beneath said arm, a link interconnecting said arm and said lever, and a weight adjustable along said lever.

12. In a racket stringing apparatus, a rotatable annular base, an annular segment fixed on said annular base, annular segments pivoted on said annular base, said fixed and pivoted segments presenting interrupted surfaces at the internal profile of the head, handle end and sides of a racket frame applied around said interrupted surfaces, plungers pivotally connected to said pivoted segments, a rotary spindle mounted in said base, collars on said spindle formed with oblique cam slots, pins on said plungers extending through said cam slots, a wormwheel fast with said spindle, a worm gearing with said wormwheel, a spindle of said worm mounted on said base, a winding drum, a mounting of said drum pivoted adjacent to and tilting towards said annular base, an arm fast with said mounting and protruding away from said annular base, a lever pivoted beneath said arm, a link interconnecting said arm and said lever, and a weight adjustable along said lever.

13. In a racket stringing apparatus, means for holding a racket frame against distortion in all directions, means for stretching a racket string mounted adjacent to said racket frame holding means, and means automatically preventing said string stretching means stretching said string to a predetermined tension.

14. In a racket stringing apparatus, rotatable means for holding a racket frame against distortion in all directions, and string tensioning means mounted adjacent to said rotatable racket frame holding means.

In testimony whereof I have signed my name to this specification.

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