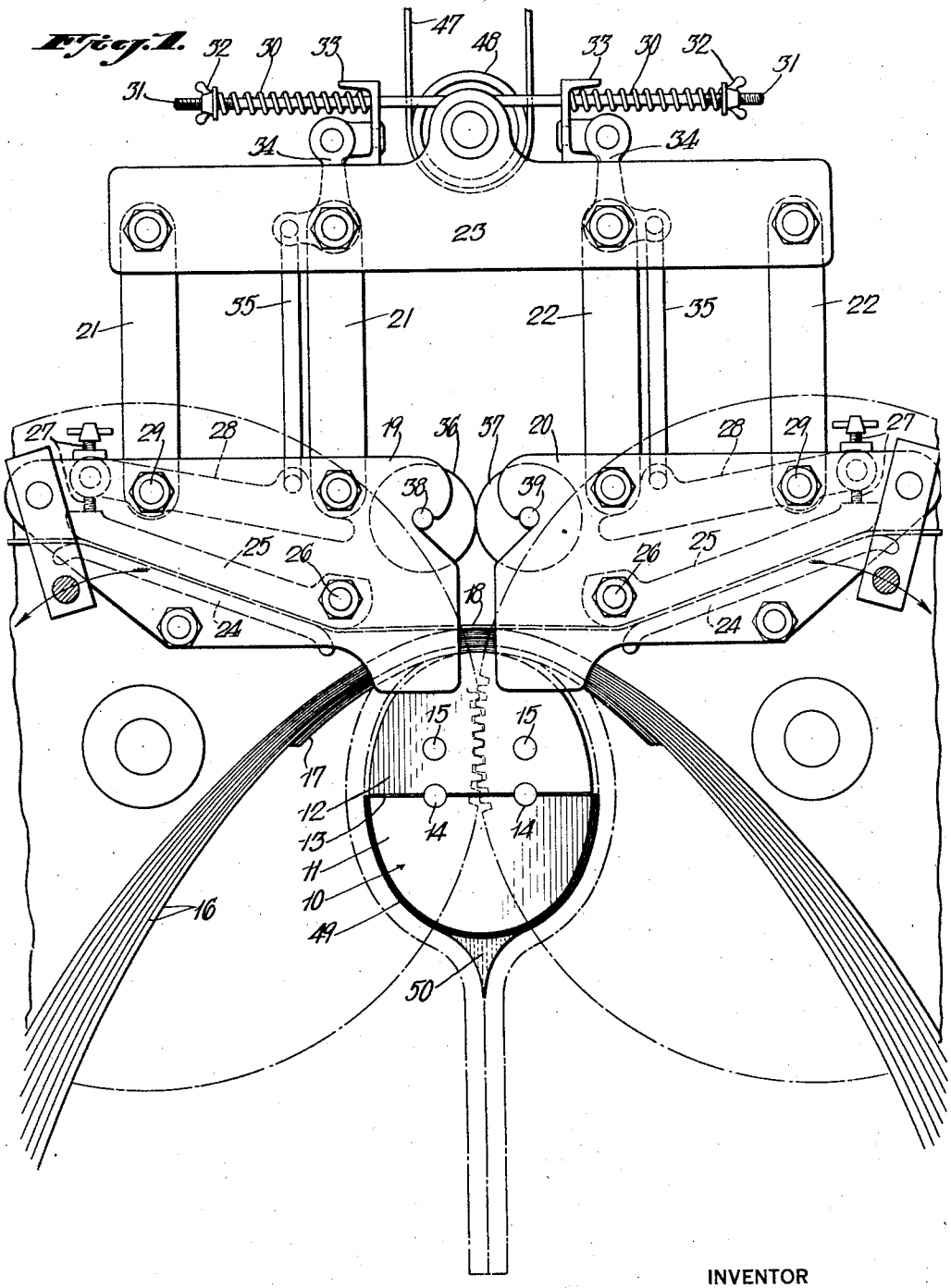
Nov. 27, 1934. R. J. NASH 1,982,447

METHOD AND APPARATUS FOR BENDING LAMINATED SHEETS

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Fig. 1.



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Fig. 2.

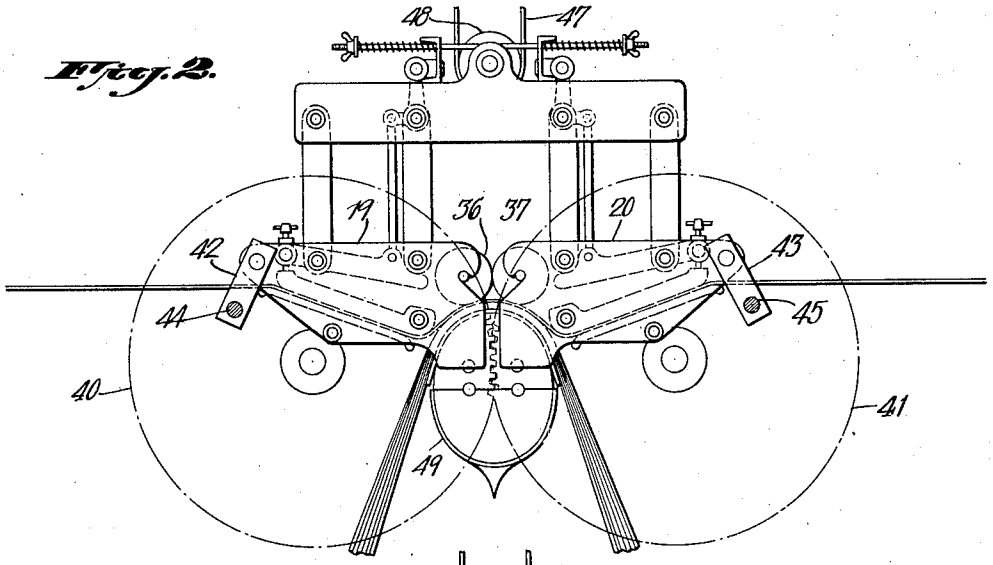


Fig. 3.

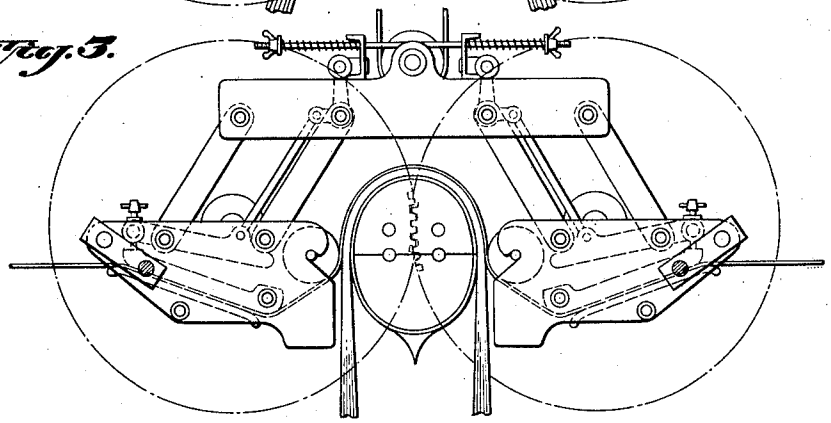
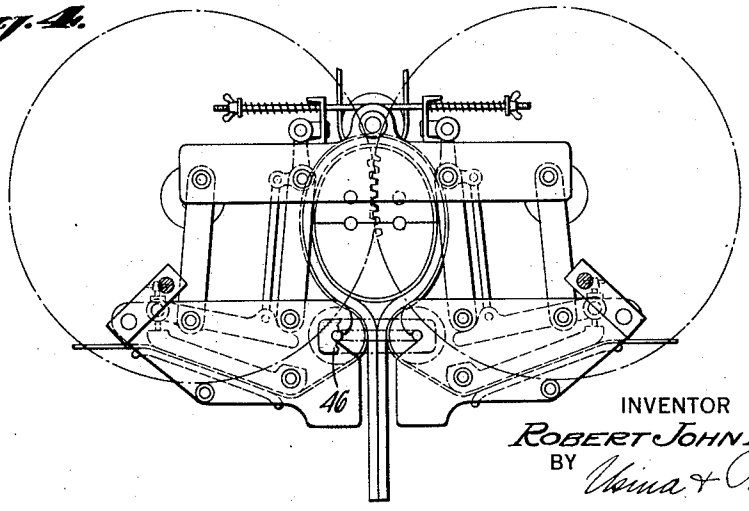


Fig. 4.



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR BENDING LAMINATED SHEETS

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Application March 16, 1934, Serial No. 715,885
In Great Britain April 5, 1933

10 Claims. (Cl. 144—255)

This invention relates to a method and apparatus for bending laminæ, such as sheets and ply wood faced with adhesive or glue, about a former into predetermined shape and for pressing and holding the laminæ in the desired shape and form until they have been glued or set. The invention relates more particularly to a method and apparatus of the above character for forming frames for tennis and other rackets.

The objects of the invention are to provide a method and apparatus whereby laminæ, such as ply wood, may be wrapped tautly about a core or former under a uniform heavy pressure such as to press out all excess adhesive and bring the laminæ into the closest union and, in the accomplishment of the above object, to provide a wrapping band and mechanism whereby the band will be progressively wrapped about the laminæ so as to press them progressively from the starting line against the former; also to provide means whereby a rolling pressure may be applied from the starting point.

The various features of the invention are illustrated in the accompanying drawings, in which—

Fig. 1 is a view in elevation of apparatus embodying a preferred form of the invention, the supporting parts being omitted in order not to obscure working parts, and

Figs. 2, 3 and 4 are similar views on a smaller scale to show the position of the different working parts during the operation of the apparatus.

In my invention the laminæ or plies are bent around a former, such for example as an elliptical block in case a tennis racket is to be formed, and pressed firmly together and held against the former until such time as they are set, the result being a substantially integral structure in which all the plies or laminæ are united in the closest union.

A plurality of superposed strips or plies of wood, hereinafter known as "strip" are bent about the former by means of a constricting member maintained under tension, preferably, by being drawn through friction retaining means by the wrapping movement of the apparatus, and thereby progressively applying the constricting force from the initial point to the point at which the wrapping is completed. This constricting force may be in the form of a band of metal, or other suitable material, which is drawn through a pair of clamps as it is wrapped about the strip, pressing the latter against the forming block.

Additionally or, alternatively, pressure may be applied by means of rollers which start from the starting point and progress over the outer surface of the strip so as to press it tightly against the former, this rolling motion progressing until the strip has been completely formed and shaped. Preferably, a pair of rollers are employed which move symmetrically to a center line about opposite sides of the former, means being provided to ensure the equal progressive movement of the rollers.

Referring more particularly to the accompanying drawings, the invention is shown as applied to a former 10 of elliptical cross section and preferably formed of two symmetrical halves 11 and 12 preferably held slightly spaced as at 13 by means of pins 14. The two halves 11 and 12 may be locked together by any suitable means and supported from a support, not shown, by means of spindles 15. The laminæ of the strip 16, which are faced on their adjacent faces with a suitable glue or adhesive, are placed on the upper surface of the former 10, an insert 17 being placed between the strip and the former in case an insert is to be formed, as described in my co-pending application Serial No. 715,886 filed March 16, 1934.

A constricting and wrapping band 18 supported tautly between floating pressure links 19 and 20 is then brought downwardly into contact with the upper surfaces of the strip. Thereafter, the links 19 and 20 move downwardly still further relative to the former 10, the links swinging sidewise to encompass the former 10 and passing through the positions shown in Figs. 2, 3 and 4. During this movement, the band 18 is drawn through friction tensioning means which causes the band to wrap tightly about the laminated strip.

The pressure links are suspended by parallel links 21 and 22, respectively, from a bridge 23 that may be lowered relative to the former 10, and which permit the pressure links 19 and 20 to swing to separated position as shown in Figs. 3 and 4. The braking or tensioning means for the band 18 are the same for each of the links 19 and 20 and are indicated by corresponding reference numerals in the drawings. This braking or tensioning means comprises a lower plate 24 on which the band 18 rests and an upper pressure plate 25 pivoted at one end on the pivot 26 and pressed downwardly at the opposite end by means of a pin 27 carried on one arm of a lever 28 which is pivoted at 29 on the link. Force is applied to the lever 28 through a spring 30 mounted on a rod 31 and a retaining nut 32 to a lug 33, and thence through bell crank lever 34

and link 35 to force the free end of the lever upwardly causing the pin 27 to press downwardly on the free end of the plate 25. The extent of pressure thus exerted on the plate 25 and, accordingly, the pressure on the band 18 may be controlled or regulated by suitably adjusting the retaining nut 32 on the rod 31.

The pin 27 is threaded into the end of the lever 28 so that the adjustment of the position of the plate 25 may also be obtained by an adjustment of the position of the pin 27. The surfaces of the plates 24 and 25 may be provided with a suitable friction surface to render effective the resistance of the band 18 to passage therebetween. It will, therefore, be apparent that as the links 19 and 20 are forced downwardly, the band 18 is drawn from between the plates 24 and 25 against the braking effect of the above mechanism and this braking effect serves to press the band 18 tightly onto the laminated strip and progressively squeeze the latter from the top of the former to the bottom thereof. A rolling pressure may be also applied to the laminated strip by means of a pair of rollers 36 and 37 which are removably carried in bearing recesses 38 and 39 respectively, in the links 19 and 20. After the initial downward movement of the pressure links 19 and 20, the rollers 36 and 37 press tightly onto the band 18, as shown in Fig. 2. As the bridge 23 and the links 19 and 20 continue to move downwardly, the rollers roll about the periphery of the former, passing symmetrically of the center line thereof and finally reaching the lower end of the former, whereupon the laminated strips are completely wrapped about the former and the motion of the rollers is terminated.

During this movement of the rollers they are caused to press tightly onto the outer surface of the laminated strip and they are also moved simultaneously and symmetrically. To accomplish this simultaneous movement and to provide suitable pressure against the former, the links 19 and 20 are moved by means of intermeshing gears 40 and 41 rotatably mounted at equal spaced distances from opposite sides of the former 10. Motion is imparted from the gears 40, 41 to the pressure links 19 and 20 by means of connecting links 42 and 43 connected at one end, respectively, to the links 19 and 20 and, at the opposite ends, to pins 44 and 45 mounted on the gears 40 and 41. When the rollers 36 and 37 first contact with the laminated strip in the position shown in Fig. 2, the downward pressure of the movement of the rollers 36 and 37 which movement reacts against the force required to draw the band 18 through the friction or tensioning plates 24 and 25, serves to press the strip tightly onto the upper face of the former. When, however, the links 19 and 20 have moved downwardly so that the rollers 36 and 37 press against the side faces of the former, the length of the links 42 and 43 and their position relative to the pressure links 19 and 20 and to the pins 44 and 45 are such that they create a pressure component against the side faces of the former as well as a relatively smaller force causing the downward movement of the links.

This pressure results from the fact that the friction on the constricting band 18 resists the downward movement of the links 19 and 20 and sufficient force is required to overcome it. This force is applied to the links 19 and 20 through the connecting links 42 and 43 and, when the links 42 and 43 are in the position shown in Fig. 3, this force may be resolved into a horizontal pressing force and a downwardly acting moving force the magnitudes of which depend upon the inclination of the links 42 and 43. As shown in Fig. 3, the horizontal pressing force is somewhat greater than the downward result.

As the rollers move to the position shown in Fig. 4, the connecting links 42 and 43 are inclined inwardly and upwardly so that there is now created a horizontal pressing force, and an upper pressing force which tends to hold the rollers tightly together and tightly toward the lower surface of the former 10. The rollers may then be secured by a chain or loop 46 (Fig. 4) which may be tightened, and the former together with the laminated strip and the rollers may be removed as a unit to a drying room.

Through the above arrangement, therefore, the pressure links 19 and 20 are so moved by the links 42 and 43 that the latter always press the rollers tightly against and normal to the surface of the former throughout the movement of the rollers.

When the rollers have been secured in position by the chain 46, the plates 25 may be released to release the band 18, the pressure links 19 and 20 may be swung apart and the bridge 23 lifted by means of a cable 47 and pulley 48 from which the bridge is suspended. A new band and new rollers may then be placed in position and the apparatus is again ready for a second forming.

In forming a tennis racket, an insert 49 may be placed about the lower half 11, this insert to form a part of the tennis racket, and a wedge 50 may be mounted on the lower side of the insert 49 when the latter is used or, directly on the former 10 so that the laminated strip will be wrapped tightly against this wedge. The surfaces of this wedge are preferably of cylindrical curvature formed as described in my co-pending application Serial No. 715,887 filed March 16, 1934, so that the rollers 36 and 37 fit the curvature of the wedges or of the laminated strip formed against these wedges.

The rollers 19 and 20 may be surfaced by a resilient material, such as rubber. After the shaped strip has been set and dried sufficiently, the pins 14 may be removed from the former halves 11 and 12 so that the latter may be collapsed and removed from the shaped frame.

It will be understood that while the above is the preferred form of the invention, it may be modified in features of embodiment as, for example, the rollers may be mounted on separate links from those supporting the wrapped band and the pressure may be applied to the rollers by other means than that illustrated.

It will also be understood that other types of braking means for the constricting band may be employed.

The frame has been shown merely in profile. It will be understood that the ply wood may be of sufficient width to form a frame several times the width of a tennis frame which, after setting and drying may be cut lengthwise into rackets of the desired thickness. The invention may, however, be applied to the forming of frames of the thickness of an individual tennis racket.

What I claim is:—

1. Apparatus for bending laminæ about a former which comprises a pair of meshed gears, a pair of pressure links, one for each gear, a pair of rollers, one on each pressure link and mounted symmetrically to the center line of the former,

and connecting links, one between each gear and its respective pressure link, in position to move said link longitudinally of the center line of the former, and to cause a pressure component on said link against said former.

2. Apparatus for bending laminæ about a former which comprises a pair of pressure links, means to grip a wrapping band to said links by a friction means to permit said band to slip under tension, and means to move said links symmetrically of the center line of said former from one side of said former to the opposite side, whereby said band is drawn tightly about said former against said friction means.

3. Apparatus for bending laminæ about a former which comprises a pair of meshed gears, a pair of pressure links, one for each gear, a pair of rollers, one on each pressure link and mounted symmetrically of the center line of the former, a pressure band extending between said links and between said rollers and said former to be wrapped about said former as said links move about said former, and connecting links between said gears and their respective links to move said links longitudinally of the center line of the former and to cause a pressure component of said links against said former.

4. Apparatus for bending laminæ about a former which comprises a pair of meshed gears, a pair of pressure links, one for each gear, a pair of rollers, one on each pressure link and mounted symmetrically of the center line of the former, a pressure band extending between said links and between said rollers and said former to be wrapped about said former as said links move about said former, connecting links between said gears and their respective links to move said links longitudinally of the center line of the former and to cause a pressure component of said links against said former, and means on said pressure links to support said pressure band frictionally and tautly between said pressure links.

5. The apparatus of claim 1 having means to secure said rollers at the end of their movement.

6. The apparatus of claim 2 in which said friction means comprises a movable plate, a pressure mechanism, and a linkage between said plate and said pressure mechanism.

7. Apparatus for bending laminated strip to the form of a racket frame which comprises a two-part former block of elliptical shape, a pair of pressure links, means to move said pressure links from one end of said block about the elliptically curved surface thereof symmetrically with respect to the center line of said block, rollers, one for each link to be pressed against the elliptic surface of said former as said links move from one end to the other thereof, and means for applying pressure on said rollers with a component normal to the surface contacted by said rollers.

8. Apparatus for bending laminated strip to the shape of a racket frame which comprises a former having a surface of elliptical curvature, a pair of pressure links, means for frictionally holding a band of material tautly between said links, and means for moving said pressure links from one end of said former about the elliptically curved surface thereof symmetrically to a center line so as to wrap said band tautly about said block from the starting point to the opposite side thereof.

9. A method of bending wood into racket shapes which comprises wrapping a layer of wood and a wrapping strip about a forming surface while maintaining said strip under tension, and applying a rolling pressure on the outer surface of said strip as it passes from one side of said forming surface to the diametrically opposite side.

10. Apparatus for bending wood into racket shapes which comprises a former, a wrapping strip, means for wrapping a layer of wood and said wrapping strip about the surface of said former, means for maintaining said strip under tension and means for applying a rolling pressure on the outer surface of said strip as it passes from one side of said former to the diametrically opposite side.

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