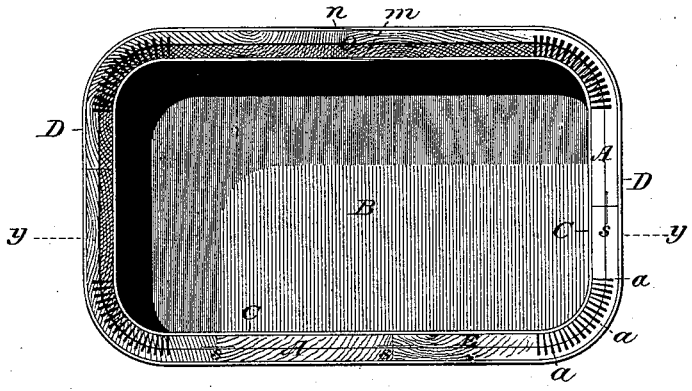
2 Sheets—Sheet 1.

H. C. WHITE.
Bending Wood.

No. 207,635. **Patented Sept. 3, 1878.**

FIG. 1.



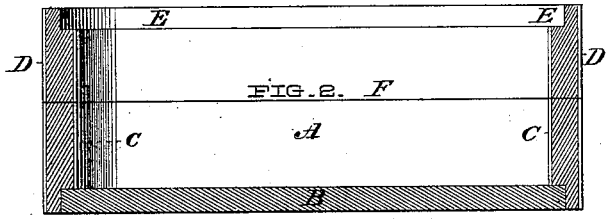


FIG. 3.

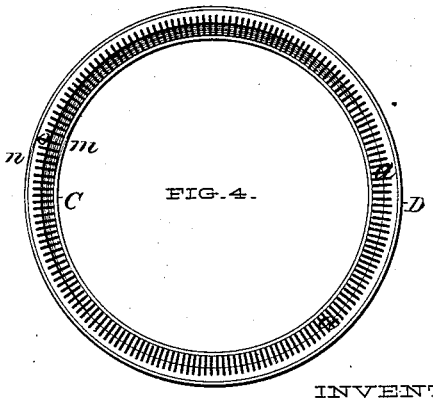


FIG. 4.

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2 Sheets—Sheet 2.

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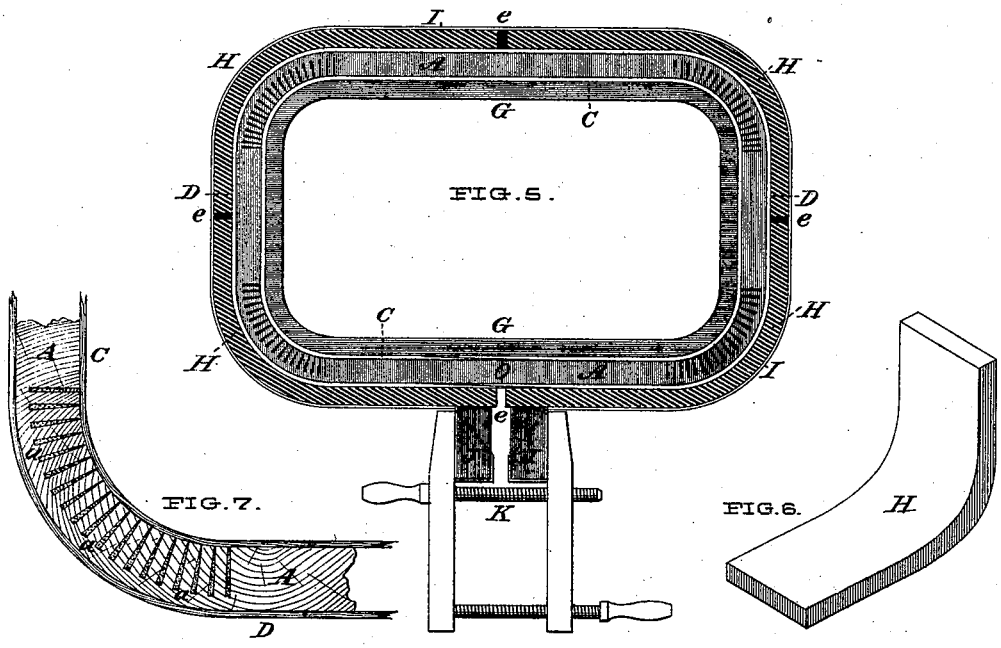

FIG. 5.

FIG. 7.

FIG. 6.

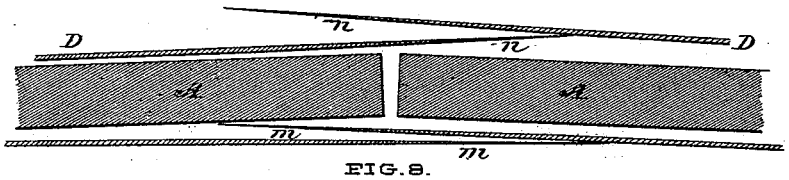

FIG. 8.

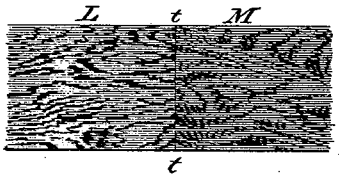

FIG. 9.

FIG. 10.

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UNITED STATES PATENT OFFICE.

HAWLEY C. WHITE, OF NORTH BENNINGTON, VERMONT.

IMPROVEMENT IN BENDING WOOD.

Specification forming part of Letters Patent No. **207,635**, dated September 3, 1878; application filed November 28, 1877.

To all whom it may concern:

Be it known that I, HAWLEY C. WHITE, of the village of North Bennington, in the county of Bennington and State of Vermont, have invented a new and improved process for making novel bent, corrugated, cylindrical, and other analogous structures of wood and like substances, and have devised novel tools, mechanism, and apparatus especially adapted to the use, working, and operation of said process and to the construction of such wooden structures, fabrics, or manufactures, of which the following is a specification:

This invention has for its object, among other things, primarily, the manufacture of the walls, ribs, or sides (as distinguished from tops and bottoms) of rectangular or polygonal boxes having rounded or bent corners, circular and oval boxes, bent corners of furniture, musical instruments, carriage bodies and seats, the construction of patterns for foundry use where thin but light and rigid curved forms are desired, and a variety of other similar articles.

My apparatus is not adapted to be used in any other processes, nor in the manufacture of any other articles, nor in any other constructions than those which form the subject-matter of these Letters Patent.

For a clearer understanding of this specification, reference is hereby made to the accompanying drawings, which constitute a part thereof, wherein Figure 1 represents a top or plan view, with the top removed, of a rectangular wooden box constructed after and embodying such principles of my invention as are embraced in the product. Fig. 2 exhibits a vertical longitudinal section of said box, taken on the plane *y y* of Fig. 1. Fig. 3 shows, in cross-section, the several layers or laminæ of material in position preparatory to being brought together and wrought into the rim of a box similar to Fig. 1. Fig. 4 exhibits a plan view of the top of a circular-box rim, and shows a rabbet at its upper edge for the reception of the top piece or cover. Fig. 5 illustrates the application and mode of use of my specially-constructed appliances and apparatus in the construction or manufacture of rims and round or bent corners similar to those found in Figs. 1 and 4. Fig. 6 is a perspective view of one of the sectional female metallic cauls, of which four are seen in Fig. 5. Fig. 7 shows a bent corner of a box or other structure having the scoring or saw kerfs, which are made to facilitate the process of bending, filled with adhesive indurating material, so as to constitute a solid corner. Fig. 8 shows the relative position of the several parts of wood which are to constitute the walls or rim of the structure, and the mode of bringing together and uniting the several extremities, so as to break joints and leave a smooth exterior surface. Fig. 9 shows the external appearance of the lap of the outside or inside veneer before the same has been leveled or worked down, the end of the overlapping piece being seen at *t t*. Fig. 10 exhibits the external appearance of the lapped joint of the veneer after the same has been scraped and leveled down.

In the construction of articles from wood for the manufacture of which this apparatus and process is adapted male and female metallic cauls are employed, which are used hot. The box-rims or other articles made are preferably composed of three constituent parts, to wit, an inside and outside veneer of any suitable or ornamental wood, and an intervening body of wood too thick to be bent to the desired form without being scored at the bending-point in a direction parallel to the axis of curvature, the grain of the inner and outer pieces or veneers at the points of curvature being arranged longitudinally parallel with each other and with the circumference of the rim, while the grain of the intermediate or foundation piece is arranged transversely to that of the veneers and parallel with the axis of the curves or bends. This combination of parts is of a width, when designed for boxes, to make the rims of both body and cover or lid. After the bending and completion of the rim by trimming and rabbeting its top and bottom edges, as seen in Fig. 2, and the insertion of the top and bottom, the said box is sawed in two, as on the line F, Fig. 2, thus constituting a body and cover.

I am aware that thin veneers, scale-boards, or laminæ of wood glued or cemented together, and having the grain of the several layers arranged transversely with reference to each other, have been employed for various purposes. The scoring of the material on the in-

side of the proposed curve to facilitate bending, and the application of a veneer to the curved surface so formed, is a well-known operation.

I am also aware that bent or curved structures of wood, consisting of layers of wood laid up in glue, with the grain crossed to prevent splitting, and having the thicker pieces scored or kerfed to facilitate bending, have been formed by pressure between heated male and female cauls.

The novelty of this invention rests on other grounds.

In the construction of box-rims, cylinders, corners, &c., by this process, I first prepare two veneers, one for the exterior of the proposed structure and another for the interior. In the case of cylindrical or prismatic structures these are cut of a length to extend entirely around the proposed article and make a long lap, as seen in longitudinal section in enlarged detail in Fig. 8. Each end of such veneer is beveled or scarfed down where the union is to take place, so that when they are brought together there shall be but little surplus thickness, if any, and the surface shall be continuous and smooth.

The body-piece A of the rim for large structures is made by gluing together by their edges a sufficient number of pieces to equal the circumference of the rim. These glued joints may be more effectually secured by the use of dowels or splines, as seen at *s s s*, Fig. 1.

For spherical or polygonal structures, with rounded corners, this body-piece A is cut to precisely the length which will extend around the rim and have the ends thereof meet and form a joint, as at O, Fig. 1. Those parts of the foundation or body piece A which are to be bent or curved are scored, as seen at *a a a*, Fig. 3.

The straight portion of the walls or rim between the bent corners may have the foundation or thick portion thereof constructed with its grain arranged either parallel with the grain of the veneers or at right angles therewith, as may be found desirable. In some instances the latter disposition of the grain of the material might be most advantageous.

In those cases where it is desirable to have an absolutely rigid corner or curve I prepare an adhesive indurating cement or filling from glue and sawdust or other suitable material, with which I fill the grooves or scoring *a a a* preparatory to the bending of the parts. In cases where, by reason of the veneers being cross-grained, or on account of any natural peculiarity the same will not bend well without breaking across the grain or splitting, I sponge or steam such parts as may require it to facilitate the bending process.

In the working of this invention I employ a solid male and sectional female metallic cauls, which are applied in the process of bending simultaneously both to the interior and the exterior of the article being formed. Preparatory to use these cauls are heated to a proper temperature, (which is variable for different woods and kinds of glue,) for the purpose of keeping the glue or cement in a sufficiently fluid condition to allow the bending and clamping to be properly accomplished.

As applied to a rectangular box having round corners, I have shown (Fig. 5) the male caul G and four sectional female or outside cauls, H H H H, one for each corner, having interposed between them the body-piece A, inner veneer, C, and outer veneer, D, the union of the extremities of the respective parts being shown at O.

The outside or sectional cauls are so constructed that when drawn or forced home to their work their ends shall not touch or interfere with each other. When so applied, the cauls, with the included material, are secured by passing around them a flexible metallic strap, I I, of proper width to effectually clamp and bind the whole, and provided at its ends with clamping-pieces J J for attaching any griping device, as a hand-clamp or a screw, by means of which the same may be tightly drawn up and all parts of the adjacent surfaces of the body-piece and veneer be brought into close contact and union.

Articles with curved or bent corners or forms are made, by use of this process and apparatus, substantially as follows: The cauls being properly heated, the said scorings *a a a* of foundation-piece A are, if desired, filled with the adhesive filling prepared for that purpose. The body-piece A and veneers C and D, all properly warmed, are then coated with hot glue or its equivalent, and said parts are then laid up substantially in the order and in the relative positions shown in Fig. 3. The male caul G is then laid onto the pile of material so laid up, care being taken that the curved parts of the caul are arranged in juxtaposition with the scored parts *a a* of body-piece A. The several pieces A C D are then bodily wrapped or bent up around and over caul G, the extremities of said parts being brought into the several positions indicated in Fig. 8. At this juncture the heated sectional cauls H H H H are applied in proper position in relation to the bent curves, and the flexible metallic strap I is wrapped around the whole. The clamping-projections J J are brought around into position over the union O, and the hand-clamp K or any other adequate device is applied to draw up and tighten the strap I until a perfect union of all the adjacent surfaces of the parts A, C, and D is effected.

During the process of tightening up the cauls blows are or may be freely applied to the exterior of the strap and outside cauls to drive the work home and settle the whole firmly together. When thus properly tightened up and secured the cauls with the inclosed structure are allowed to stand until the glue has firmly set or is dry. When removed from the cauls the lap of the veneers appears as shown at Fig. 9—that is, the overlapping end presents or shows a square abutment or joint, as at *t t*.

In process of finishing the whole exterior of the veneered rim is either brought to a uniform surface on a sand-wheel or otherwise leveled, which sandpapering, scraping, or leveling process destroys or cuts away the abrupt end of the veneer and leaves the joint, where any is traceable at all, (which seldom happens,) with an irregular or zigzag contour, as at *t t*, Fig. 10, and with many kinds of wood having variegated grain or texture, like rosewood, French walnut, &c., leaves the grain of the adjacent parts apparently so interjected as to obscure and conceal the joint.

I have found, in practice, that it is not desirable, in scarfing the ends of the veneers, to have it done perfectly even and true—that is, to have the face of the scarf true and level. On the contrary, any undulating irregularities which may happen to remain contribute in the subsequent process of finishing to produce the uneven zigzag contour of union which is to be desired. I regard this feature as novel and useful, and a resultant from the working of my process, although not an essential element therein.

In the construction of rims for boxes, or of other curved forms where a very strong bent corner or curve is not needed, I dispense with the filling of the scoring with adhesive material, as for any light work it is not required.

Boxes constructed by this process possess many advantages over those made in the ordinary way. The grain of the several pieces of wood of which the rim or sides is composed, being crossed, liability to warp, split, or check is averted.

When the box is constructed in the way described and has the scoring in the corners filled with any suitable composition, the corner, by reason of its partial cylindrical form, becomes the strongest part of the structure instead of the weakest, as it is in many ways of square construction, or when the round corner is formed of pieces worked out to the desired curve and then fastened to the contiguous sides. There are no ends of the grain of the wood to protrude and show where the adjacent wood has, in course of time, shrunken away, as often occurs with dovetails. They can be made and finished much cheaper than in other and more common ways. Round corners of many articles of furniture, pianos, &c., can be constructed in this way, and thus dispense with the use of auxiliary supporting-pieces and stiffening-irons.

After the box-rim, (shown in Figs. 1 and 2,) has been formed in the manner described, any slight departure from its true form after it leaves the cauls is corrected by the mode of insertion of the top and bottom. For this purpose the inner edges or corners of the top and bottom of said rim are rabbeted away, as seen at E, Fig. 2. This rabbet forms a seat for the reception of the top or bottom, as the case may be, which is inserted, as shown at B, Fig. 2. When so inserted and fastened, all parts of the sides and ends are firmly supported, and the box so built is of true and regular form.

It is desirable and necessary to have the body-piece A of much greater thickness than either its inner or outer covering or veneer, for several reasons—as, for instance, in the construction of boxes, cases, desks, &c., a considerable thickness of stuff is needed for the attachment of hinges, locks, &c. Moreover, I have found from experience that a thick body-piece is much more cheaply, conveniently, and successfully manipulated than the same thickness secured by using a multitude of thin pieces or veneers glued up.

By the employment of material prepared as aforesaid and the use of the herein-described apparatus, the rims which constitute the sides or ends, or both, of boxes may be formed in a very few seconds, and when so made are rigid and unyielding, and are, in fact, as solid as though they were wrought from a single piece of homogeneous material.

I am aware that it has been attempted to lay veneers on convex cylindrical surfaces or round corners in connection with plane or flat surfaces, of which one is the prolongation of the other, by means of a flexible strap or wrapper, independent of a rigid intervening caul. Such process of construction with veneers is defective, in this, that it often happens that the strap or flexible wrapper is not rigid enough to press down and hold the veneer to its bed so but that in process of drying it will rise from the surface in corrugations or blisters, and this very serious difficulty is most frequently encountered where such veneer and flexible caul bridge a flat or approximately flat part of the structure. Hence I regard the intervening sectional female cauls as inseparable from the confining or binding strap, and vice versa, and they are both so considered in this specification.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The hereinbefore-described process for manufacturing the rims of boxes and analogous structures, consisting in the employment for the body or foundation piece of a thick layer of wood having its grain disposed parallel with the axis of the proposed curvature at such points of curvature, and scored at the points where such proposed curvature is to occur, in connection with a thin inside and outside layer or veneer having the grain of each at the points of curvature disposed transversely with the grain of the foundation-piece, the said veneers being each cut to such a length as will extend or reach around the proposed circumference of said rim and form a lapped joint, and having the overlapping ends of such veneers scarfed and arranged as described, all laid up in glue or other adhesive material, as described, the whole being then bent and molded into the desired curved form by being pressed and confined by means of a strap and clamps or other suitable mechanism

between male and female cauls heated to that degree of temperature best suited to the working of the glue and the bending of the material, in the manner substantially as described and set forth.

2. The hereinbefore-described process of forming round or curved corners or angles of wooden structures by the use of a single thick and two thin layers of wood, the intermediate and thicker one of which is scored opposite to and parallel with its axis of curvature, and has its grain disposed with reference to the grain of the inner and outer layers and the axis of curvature transversely, as described, the whole arranged and laid up with glue or other adhesive material, as described, and bending or molding the same into the desired form by pressing and confining the same between heated male and female cauls until the adhesive material has set or dried, substantially as described and set forth.

3. As a new article of manufacture, a box made from wood, having its sides and corners or walls constructed of a thick central or body piece, scored at the corners, said walls being covered internally and externally with a thin veneer, having the grain of such veneers disposed transversely with that of the body-piece at the curved or bent portions or corners, and having the joint where the ends of the veneers meet finished by scarfing, lapping, gluing, and leveling, substantially as described and set forth.

4. Curved formations in structures or fabrics made from wood or other similar flexible material, the component parts of which formation consist of a thick central foundation-piece, scored to adapt it to be bent, and an inside and outside veneer of thin material, the grain of which is disposed transversely with that of said foundation-piece, the whole being laid up in glue or other adhesive material, as described, and molded into form by bending between rigid male and female cauls compressed by a tightening-strap, substantially as described and set forth.

5. The apparatus described and shown for shaping or molding curved formations in the described compound structures of wood, consisting of the male caul G, sectional female cauls H H H H, and clamping-strap I I, provided with any suitable tightening device, all arranged, combined, and operated substantially as described and set forth.

In testimony whereof I have hereunto subscribed my name, at the village of North Bennington, Vermont, this 26th day of November, 1877.

HAWLEY C. WHITE.

In presence of—
FRANKLIN SCOTT,
M. B. SCOTT.