A. ELMENDORF.

METHOD OF AND APPARATUS FOR BENDING WOODEN SHEETS.

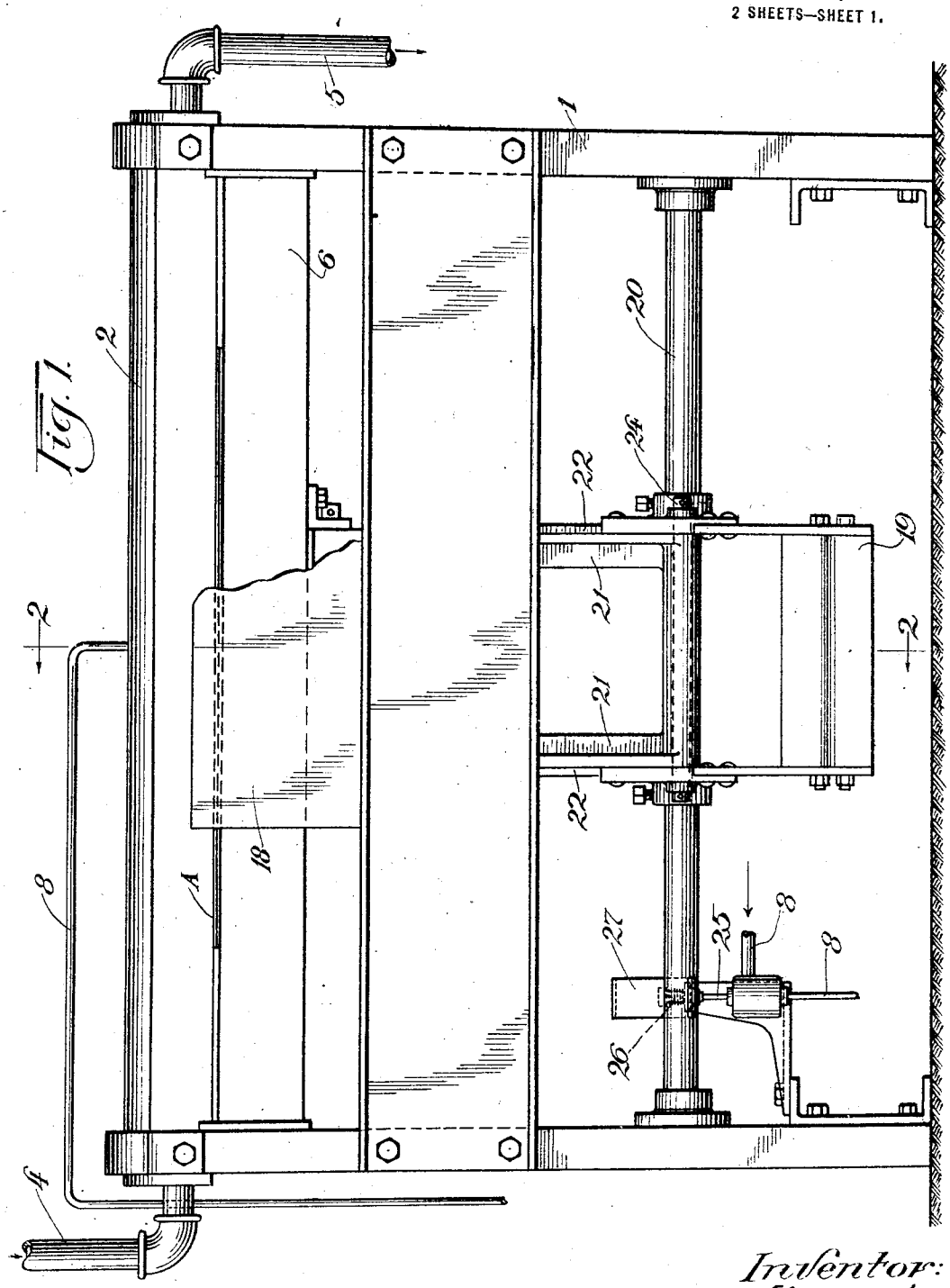
APPLICATION FILED AUG. 18, 1921.

1,409,689.

Patented Mar. 14, 1922.

2 SHEETS—SHEET 1.

Fig. 1.



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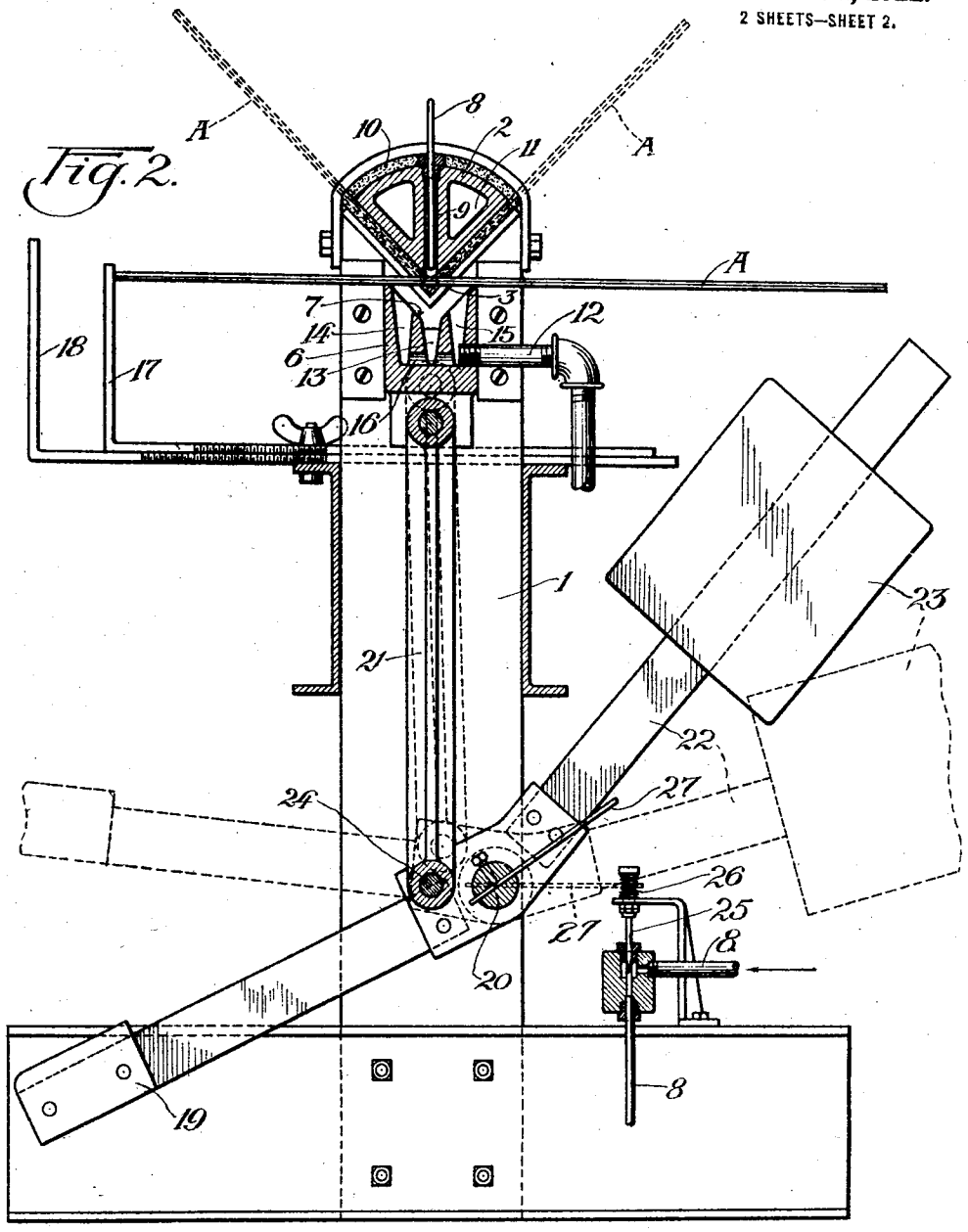
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2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR BENDING WOODEN SHEETS.

1,409,689. Specification of Letters Patent. Patented Mar. 14, 1922.

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To all whom it may concern:

Be it known that I, ARMIN ELMENDORF, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented a certain new and useful improvement in Methods of and Apparatus for Bending Wooden Sheets, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

In order to bend wood sharply as, for example, to produce a comparatively sharp right angle corner, it is necessary that the wood be first softened. This applies both to sheets made of a single layer and to plywood sheets or panels. The softening can be produced by moisture or by a combination of moisture and heat, both moisture and a comparatively high degree of heat being necessary to make the process rapid enough for commercial purposes. So far as I am aware, the practice heretofore has been to steam or otherwise moisten and heat an entire sheet in order to permit a sharp bend to be made therein. Afterwards the entire sheet must again be dried. This wetting of the entire sheet simply for the purpose of making a sharp bend along a line extending across the same therefore necessitates a prolonged drying operation which not only wastes time but is otherwise costly. A far greater objection, however, results in many instances from the wetting of an entire sheet, namely the warping effect on the wood which causes the wood to become distorted.

One of the objects of the present invention is to produce a simple and novel method of making a sharp bend in a sheet or panel made of one or more layers, whereby the moisture is applied only along a narrow strip traversed by the line along which the bend is to be made, so that the main body of the sheet will not be in any way affected.

A further object of the present invention is to produce a simple and novel method of moistening and heating a comparatively narrow strip extending across a sheet, so as to soften such strip without affecting the remainder of the sheet.

A further object of the present invention is to produce a simple and novel method of forming a sharp bend in a wooden sheet in such a manner that the bend may be formed and the work as a whole be left in a dry state by a single comparatively rapid manipulation or operation.

A further object of my invention is to produce a simple, novel and efficient machine for rapidly forming bends in wooden sheets and delivering the product in a dry state.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a front elevation of a simple machine by means of which my invention may be carried out; and

Figure 2 is a section taken approximately on line 2—2 of Fig. 1, the water-controlling valve being also shown in section.

My invention is capable of wide application. One of the important uses to which it may be put is the manufacture of shells or containers of polygonal cross section formed by bending a sheet of two-ply wood into the proper shape and then fastening the meeting edges together in any suitable way; and, for the sake of brevity, I shall confine the detailed description to this particular use.

Referring to the drawing, 1 represents a suitable frame which supports a horizontal bar 2 having a downwardly-facing corner 3. The bar is shown as being approximately triangular in cross section and it is made hollow so as to provide for the admission of steam into the interior thereof; a suitable steam delivery pipe 4 and a discharge pipe 5 being connected to the respective ends of the bar for this purpose. Underneath the member 2, and parallel therewith,

is a vertically-movable bar or pressure device 6 having a trough-shaped upper side 7 adapted to fit around the downwardly-projecting corner of the member 2 when the member 6 is raised.

It will be seen that when a piece of plywood, such as indicated at A, is slipped between the two bars and the lower bar is raised, the work will be engaged on the under side by the two side edges of the trough and on the upper side by the downwardly-facing corner of the member 2 along a line lying midway between and parallel with the lines of contact between the sheet and the lower bar. Therefore a comparatively small upward pressure on the lower bar will bend the two parts of the sheet lying on opposite sides of the line of contact between it and the member 2 upwardly to a sufficient extent to produce a slight valley effect in the top of the sheet. When the sheet has assumed the shape in which it contains a slight valley, a small amount of water may be placed in the valley and will remain in the bottom of the valley so that the wetting of the sheet will be confined to the comparatively narrow strip in contact with the corner of the member 2 while all the rest of the sheet will remain dry. The water may be introduced into the valley of the sheet in any convenient way. In the arrangement shown, I have provided a single water pipe 8 the delivery end of which extends down through a vertical passage 9 at about the middle of the bar 2, said passage opening out through the corner 3 of the bar. By permitting a regulated amount of water to be discharged by the water delivery pipe after the work has been gripped between the two bars of the machine, the water will flow in opposite directions from the delivery point along the valley in the work, coming in contact with the heated surfaces of the bar 2 and having its temperature raised to about the boiling point, at which temperature it acts quickly to penetrate the wood and effect the softening thereof. If the upward pressure on the lower bar is continued, the gradual softening of the wood as the heated water penetrates the same will reduce its capacity to resist the bending stresses and it will be gradually bent from the condition illustrated in full lines in Fig. 2 to that shown in dotted lines. When it reaches the condition shown in dotted lines it will have been bent to the shape of the lower side of the bar 2 and will lie in contact with the lower converging faces 10 and 11 of the bar. Assuming that the flow of water has been stopped when a sufficient amount has been delivered to produce the desired degree of softness in the work, it will be seen that the damp corner in the work will be dried through contact with the hot bar and, if the moisture has spread somewhat away from the corner, the comparatively wide areas of contact between the work and the hot bar will insure dryness at all points, if the work is left in the machine long enough. Because of the small amount of water used, the evaporation of the same takes place very quickly.

The machine illustrated is designed to receive work at various lengths and therefore it may sometimes happen that some of the water will run out of the ends of the valleys in the work and down into the trough of the lower bar. I have therefore provided the trough in the lower bar with a discharge pipe 12 through which any wasted water may escape. Warm air may be introduced through this pipe to accelerate the drying.

I prefer to arrange a series of wells in the top of the lower bar, there being, in the arrangement shown, a central well 13 opening down from the bottom of the trough and two other wells 14 and 15 opening down from the sides or slopes of the trough; all three wells being connected together at the bottom by a transverse passage 16. By this arrangement there is very little metal at any time in engagement with the under surface of the work.

The machine may be provided with adjustable gauge bars of which two, indicated at 17 and 18, are illustrated. If a sheet is to be bent into the form of a box or shell rectangular in section, the gauge 17 will be set so the distance between the same and the corner 3 is equal to the width of the short side of the shell or box and the gauge 18 is set so that the distance between the same and the corner 3 is equal to the width of the wider side of the shell or box. The gauge 17 is not quite as high as the gauge 18 so that when a flat sheet is placed in the machine it will strike the gauge 17, but, if the free or advance end is lifted slightly it may pass over the gauge 17 and travel over to the other gauge.

The pressure bar 6 may be operated in any suitable way. The machine which I have illustrated is one adapted to be operated manually and I have therefore provided a treadle 19 fixed to a horizontal shaft 20 lying below and parallel with the bar 6; the bar 6 being connected to the treadle by means of a connecting rod 21 whose lower end is arranged close to the treadle shaft. Projecting in the opposite direction from the treadle shaft to that in which the treadle extends are a pair of arms 22 provided with a heavy counterweight or counterweights 23 which may be adjusted lengthwise of the arms. The parts are so proportioned that the counterweights force the movable pressure bar upwardly with considerable pressure to effect the bending operation; these counterweights constituting a simple means for exerting a continuous yielding upward pressure on the work.

When the operator places a piece of work

in the machine or desires to move it or remove it, he places his foot on the pedal and draws down the lower bar, leaving the work free. When the work is in position to be acted on by the machine, the operator removes his foot from the treadle allowing the counterweight to raise the lower bar.

It will be seen that the greatest resistance of the sheet to bending is exerted at the start, the resistance decreasing as the softening of the wood progresses. The result is that the pressure on the work becomes progressively greater in proportion to the resistance offered by the work, so that when the bending movement has been completed, the pressure is great enough to insure that those portions of the sheet adjacent to the corner 3 will be pressed firmly against the converging sides of the upper bar and insure a sharply defined corner. The ratio between the pressure and the resistance may be made still greater as the pressure bar rises by so positioning the center of gravity of the counterweights and the pivotal connection 24 between the connecting rod and the treadle, that the counterweights act through a gradually increasing leverage as the pressure bar rises. This is conveniently accomplished, as shown, by causing the horizontal distance between the axis of the shaft 20 and the pivotal axis 24 to decrease as the pressure bar rises while the horizontal distance between the axis of the shaft 20 and the center of gravity of the counterweight increases as the counterweight descends.

The flow of water may be controlled in any suitable way. In the arrangement shown, I have made the control automatic. To this end I have placed in the pipe 8 a valve device containing a needle valve 25 which may be adjusted so as to produce any desired flow of water when the valve is open. A spring 26 tends constantly to hold the valve open. Fixed to the treadle shaft 20 is a radial arm 27 in position to engage with the upper end of the needle valve and force it down into a closed position whenever the treadle is up or, in other words, whenever the pressure bar has been moved to its upper limit. Consequently, when the operator places his foot on the treadle to open up the machine, he opens the needle valve and water immediately begins to flow upon the work when the latter is placed in the machine. The water continues to flow, in gradually reduced amounts, if desired, until the machine has completed the bending operation; whereupon the arm 27 forces the needle valve into its closing position and shuts off the supply of water.

It will thus be seen that all that the operator has to do is to put his foot on the treadle, place the work properly in the machine, and then remove his foot, the machine then performing its work automatically. The time required for drying the work is sufficient to enable the operator to place a piece of work into or shift the work in another machine, so that no time need be lost in waiting for the work in a machine to dry.

While I have explained my invention by means of a simple and novel machine in which the invention may successfully be carried out, I do not desire to be limited to the specific machine illustrated, because my invention may be carried out by hand manipulations and by other forms of machines. Furthermore, while reference is herein made to sharp bends and sharp corners I do not mean by those terms bends or corners in which two surfaces meet in a single line, but rather bends or corners which bring two surfaces which lay in the same plane into two planes at an angle to each other.

I claim:

1. The method of bending a sheet of wood which consists in applying pressure to the sheet held horizontally to form a bend sufficient to produce a slight valley, supplying water to the valley, and continuing the pressure and at the same time applying heat to the water until the bend has been completed.

2. The method of bending a sheet of wood which consists in applying pressure to the sheet held horizontally to form a bend sufficient to produce a slight valley, supplying water to the valley, continuing the pressure and at the same time applying heat to the water until the bend has been completed, shutting off the water, and continuing the application of heat until the moistened portion of the wood has been dried.

3. The method of bending a sheet of wood which consists in applying pressure to the sheet while held horizontally so as to bend it sufficiently to form a slight valley, introducing a small amount of water into the valley, and heating the water and continuing the pressure to complete the bending operation as the wood forming the bottom of the valley softens.

4. The method of bending a sheet of wood which consists in applying pressure to the sheet while held horizontally so as to bend it sufficiently to form a slight valley, introducing a small amount of water into the valley, heating the water and continuing the pressure to complete the bending operation as the wood forming the bottom of the valley softens, and thereafter continuing the application of heat and pressure until the water has evaporated and the dampened portion of the wood has become dry.

5. The steps in the method of bending a sheet of wood which consists in flexing or bending the sheet sufficiently to form a slight horizontal valley, placing water in the bottom of the valley, and heating the water.

6. The method of bending a sheet of wood which consists in pressing it against a heat-

ed sharp corner in such a manner as to tend to bend it around said corner and form a valley, delivering a small amount of water into said valley, and continuing the bending pressure as the heat and moisture soften the sheet until the bending has been completed.

7. The method of bending a sheet of wood which consists in placing it against a sharp heated corner, applying pressure on the opposite face of the sheet and on opposite sides of the corner in a direction to bend the sheet over the corner and form a valley, delivering a small quantity of water into said valley, and continuing the pressure on the sheet as the latter is softened by the heat and moisture until the bending is completed.

In testimony whereof, I sign this specification.

ARMIN ELMENDORF.