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B. L. SMITH

3,334,579

APPARATUS FOR MANUFACTURING STRUCTURAL WOODEN DEVICES

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2 Sheets-Sheet 1

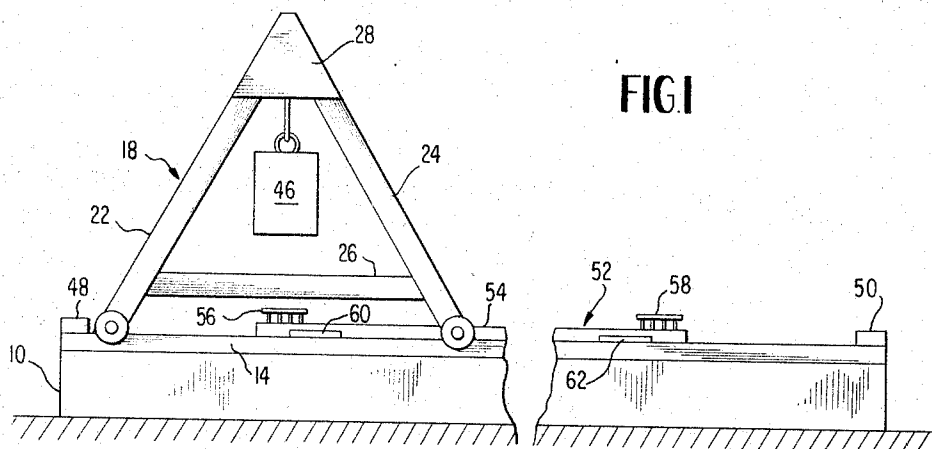
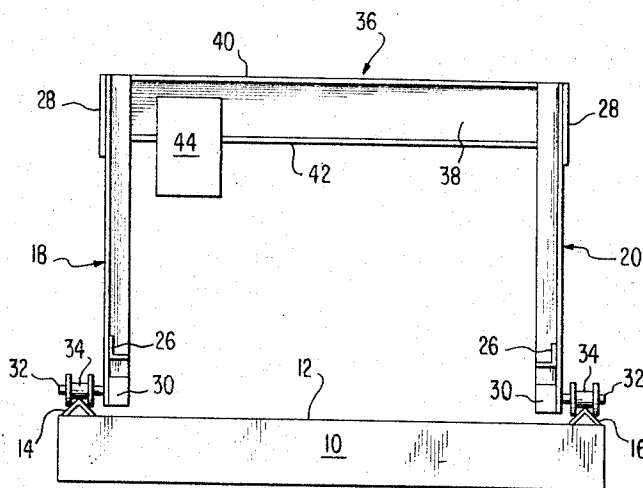


FIG 2



INVENTOR.

BERNY L. SMITH

BY

LeBlanc and Shun

ATTORNEYS

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FIG. 3

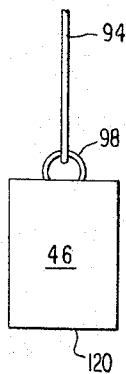
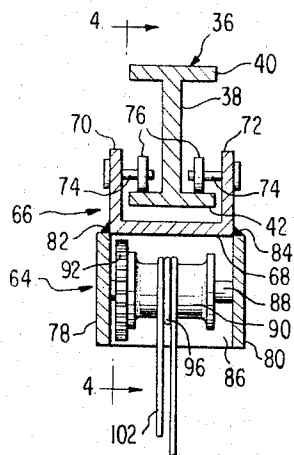


FIG. 4

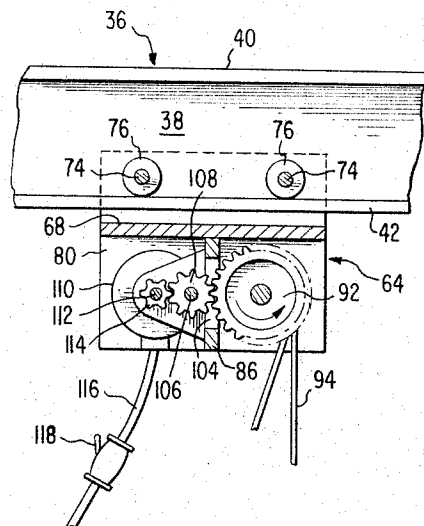
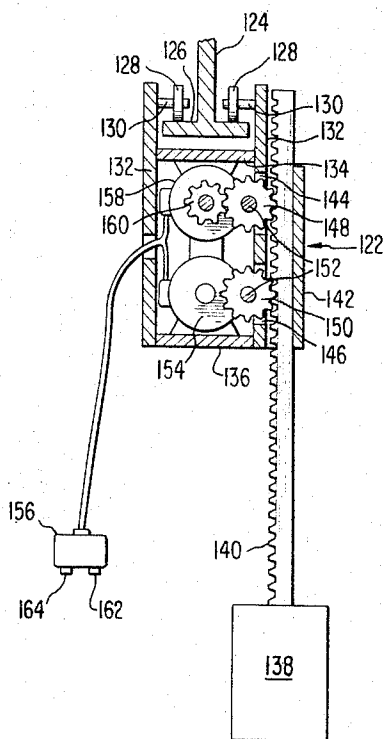


FIG. 5



INVENTOR.
BERNY L. SMITH

BY

Le Blanc and Shum
ATTORNEYS

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APPARATUS FOR MANUFACTURING STRUCTURAL WOODEN DEVICES

Berny L. Smith, Miami, Fla., assignor to Automated
Building Components, Inc., Miami, Fla., a corporation
of Florida

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14 Claims. (Cl. 100—226)

This invention relates to an apparatus for manufacturing structural wooden devices, and more particularly relates to an apparatus for forming the joints in such structural wooden devices as roof trusses and the like.

With the advent of the Jureit connector plate of Jureit U.S. Patent No. 2,877,520, it became possible to manufacture structural wooden devices such as roof trusses without the necessity of manual nailing, bolting or gluing. These connectors comprise steel plates having slender, elongated nail-like teeth struck therefrom in three or more rows so as to extend substantially perpendicular to the plate. Structural wooden butt joints may be formed with such connectors by simply sandwiching the two butted wooden members between pairs of the Jureit plates and simultaneously pressing the teeth of both plates into the lumber to form a completed joint. The operation is rapid, low in cost, and provides a built-in quality, in that there is no necessity to rely upon the proper number of nails, bolts or other fasteners being manually affixed in the formation of the joints. The adoption of such joints was widespread in the residential-housing industry and created a demand for presses capable of performing the aforementioned sandwich-pressing operation.

As a result of that demand, numerous presses of varying types were developed and found commercial usage in the roof-truss industry. Examples of such presses are found in Jureit U.S. Patents Nos. 3,079,607 and 3,195,449, Moehlenpah U.S. Patents Nos. 3,068,483 and 3,068,484, and Black U.S. Patent No. 3,100,301. Such presses make it possible to handle a high volume of roof truss work at high speed and in an economical fashion, when a relatively large number of trusses of the same type are being produced. Under such circumstances, trained crews utilizing presses such as that shown in Jureit Patent No. 3,195,449, can manufacture roof trusses at the rate of one truss per minute.

As the use of the Jureit-type connectors of Patent No. 2,877,520 became more widespread, builders and architects switched more and more to the use of roof trusses in place of conventional framing. As this shift occurred, the demand grew for the production of widely varying types of trusses which would permit architects a freedom of roof design which would allow the erection of low-cost homes with varying roof lines, so as to avoid the growth of developments wherein all houses were identical. This demand for so-called "special" trusses or "specials" led to the development of special jigs of high adjustability, such as those shown in Jureit Patents 3,241,585 and 3,238,867. These jigs permitted variation of the truss set-up in order to handle a large number of different truss designs. However, the change-over of the jig consumed time, with the result that the price of this type of truss was higher than the trusses which would be manufactured in production runs of the same type truss. The same was true to an even more exaggerated degree with those nonjig type press systems wherein a modification of the type of truss meant a moving of the presshead stands.

According to the present invention, it has now been found that it is possible to manufacture an almost endless variety of roof trusses and like structural devices through the use of a relatively simple apparatus which can be made available to truss fabricators, lumberyards

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and similar operators at only a fraction of the cost involved in either the purchase or lease of presses of the aforementioned types. This reduction in cost and facilitation of the manufacture of widely varying truss types is of significant value not only to present truss fabricators, who can add to their truss-producing capabilities, but also is important to the smaller operator who either cannot afford a press or whose production needs are so low that setting up such truss-production machinery is not warranted. Thus, the apparatus of the invention brings truss production within the capabilities of a large number of small operators who heretofore could not justify the use of roof trusses, despite their many constructional and economic advantages.

According to the invention, it has been found that it is possible to manufacture structural wooden butt joints and wooden devices made therewith, such as roof trusses, utilizing connector plates such as the Jureit connector plate of Jureit Patent No. 2,877,520, by doing away with the action-reaction, relatively steady application of force utilized in manufacture carried out with the previously discussed presses. As contrasted to this, the apparatus of this invention provides for a seating of the connector plates through the impulse-momentum principle without the necessity of a press. In utilizing this principle, there is provided a relatively inelastic bed or slab over which there is movably mounted a relatively heavy weight which is capable of being positioned over the connector plates to be embedded in the wooden members to be joined. The weight is suspended by means of a mechanism capable of lifting it to the desired height and then releasing the weight for a free-fall, whereby the accelerating weight, which has a flat lower surface, strikes the connector and embeds the same in the wood in a contact or collision which is preferably as close as possible to inelastic. The weight may then be lifted, moved to the next joint, released and allowed to accelerate to the point of impact, whereby the next connector is embedded.

In utilizing the apparatus, it is possible to either embed a sandwich of two connectors on opposite sides of the lumber at one time or to embed a connector into only one surface of the lumber, later "flip-flopping" the lumber to permit the embedding of connectors in the opposite surface thereof. Obviously the simultaneous sandwich procedure is more desirable, in that it permits taking full advantage of the manifold new results secured with the type of connector described in Jureit Patent No. 2,877,520. According to the invention, the bed or slab may be fitted with jig fixtures for securing the lumber in position during the embedding operation or, in the alternative, for extremely small operators, it is possible to operate without jig fixtures by preliminarily securing the lumber together, as by stapling or the use of corrugated fasteners, toenailing or the like.

It will be apparent to those skilled in the art that while the truss-manufacturing apparatus of this invention is most particularly adapted to and is most advantageous in the formation of structural joints with connector plates having slender, elongated nail-like teeth, such as, for example, those illustrated in Jureit Patent No. 2,877,520, the device also has utility in the embedment of plates utilizing triangular shear-type teeth, such as, for example, plates of the Sanford type, shown in Sanford U.S. Patent No. 2,827,676, plates of the Ronel type, shown in Lidsky U.S. Patent No. 2,974,378, and plates of still other configurations.

It is, accordingly, a primary object of the present invention to provide an improved apparatus for forming structural wooden devices utilizing connector plates having integral teeth.

It is another object of the invention to provide an improved apparatus for forming structural wooden de-

vices with connector plates without necessitating the use of presses or the action-reaction principle.

It is still another object of the invention to provide an improved apparatus for manufacturing structural wooden devices containing structural butt joints with connector plates having integral teeth extending therefrom, through use of the impulse-momentum principle.

It is a further object of the invention to provide an apparatus of the foregoing type for manufacturing structural butt joints and devices formed therewith which is highly economical in that a minimum investment is required in order to commence the manufacture of trusses.

It is another object of the invention to provide an apparatus of the foregoing type which makes possible the economic manufacture of a wide variety of different truss types, commonly referred to as "specials."

It is still another object of the invention to provide an apparatus of the foregoing type which may be made available to the trade at a sufficiently low price to permit roof-truss manufacture by so-called "small operators" whose financing or volume of production is such that the use of the more expensive presses is not feasible.

These and further objects and advantages of the invention will become more apparent upon reference to the following specification and claims and appended drawings wherein:

FIGURE 1 is a side elevation of a structural-device-manufacturing apparatus constructed according to one embodiment of the present invention;

FIGURE 2 is an end elevation of the apparatus of FIGURE 1, showing the means for suspending the weight in block form only and omitting the weight;

FIGURE 3 is a vertical section showing one means for suspending the weight utilized in the apparatus of FIGURES 1 and 2;

FIGURE 4 is a vertical section taken along the line 4-4 of FIGURE 3; and

FIGURE 5 is a vertical section showing another embodiment of another suspension device utilized in the apparatus of the invention.

Referring now to the figures of the drawings and particularly to FIGURES 1 and 2, there is seen a bed or slab 10 which may be, by way of example, 10 feet wide and 40 feet long. Mounted near the long edges of the upper surface 12 of slab 10 are a pair of angles 14 and 16, which may be secured in any suitable manner. The angles 14 and 16 support a pair of movable A-frames, indicated generally at 18 and 20.

The A-frames are mirror images of one another, and thus the description of one frame suffices for both. The frame 18 is formed of a pair of converging angles 22 and 24 having attached to their lower portions a horizontal angle 26, secured in any suitable fashion, such as by welding or bolting. The upper ends of the angles 22 and 24 are welded or otherwise secured to a generally triangular-shaped plate 28. The bottom of each angle 22 and 24 carries an axle-support block, best seen in FIGURE 2, and this block 30 is secured to the angles in any suitable manner, such as by welding or bolting. Extending from the axle-support block 30 is an outwardly-directed axle 32 which supports a grooved wheel 34 riding on the angles 14 and 16 to provide a rolling mount for the A-frames.

Attached to the upper ends of the angles 22 and 24 of the A-frames and to the plates 28, in any suitable manner, such as by welding, is a heavy and preferably relatively-deep I-beam 36 having a web 38, upper flange 40 and lower flange 42. The depth of the web 38 and the manner of securing the I-beam to the A-frames is such that adequate transverse rigidity is provided. Alternatively, further brackets may be utilized to provide such rigidity, as will be well understood by those skilled in the art.

Movably supported from the I-beam 36 is a weight-suspension unit, indicated by the block 44 in FIGURE 2.

This weight-suspension unit is capable of moving along the I-beam transversely of the bed 10 while the A-frame unit is movable longitudinally of the bed 10, so that the weight 46 suspended from the weight-suspension unit 44 may be moved to any desired position over the bed or slab. Stops 48 and 50 may be welded or otherwise secured to the ends of the angles 14 and 16 extending along the edges of the bed or slab 10, in order to limit the movement of the A-frame unit.

Referring to FIGURE 1, a roof truss or the like is shown in position on the bed or slab, with the roof truss being indicated generally at 52. The member 54 may be the horizontal member in the truss and the connector plates 56 and 58 may be the heel joint connector plates. The lower connector plates at these positions (i.e., the connectors on the bed or slab, with their teeth uppermost) are hidden by the angle 14 in FIGURE 1. Suitable jig fixtures may be utilized to hold the assembled lumber in position, such as the members 60 and 62. Any suitable jig fixtures may be utilized; for example, those of the type shown in Jureit patent applications Serial Nos. 228,662 and 276,389, mentioned previously herein.

Referring now to FIGURES 3 and 4, there is seen one embodiment of a weight-suspension unit, indicated generally at 64. According to this embodiment of the invention, a U-shaped plate 66 is suspended from the lower flange 42 of the I-beam 36. This plate has a web 68 with upwardly-directed flanges 70 and 72 at opposite sides thereof. Mounted to the flanges 70 and 72 are four stud axles 74 which support rollers 76 which roll along the upper edges of the lower flange 42 on the I-beam 36.

Depending from the lower edges of the flanges 70 and 72 of the U-shaped plate 66 are a pair of substantially parallel plates 78 and 80, which may be secured by welds 82 and 84. Extending transversely between the plates 78 and 80 is a transverse plate 86, which may be welded to the plates 78 and 80 and to the underside of the web member 68 of the U-shaped plate 66.

Referring to FIGURE 3, a relatively heavy shaft 88 extends between the plates 78 and 80 and carries rotatably thereon a drum 90 having a gear 92 affixed to one end thereof for rotation therewith. A rope 94, which may be wire, manila or otherwise, is wound around the drum at 96 and has one end attached at 98 to a weight 46. The other end 102 of the rope 94 may be grasped by an operator, as presently to be explained.

Referring now to FIGURE 4, the transverse plate 86 is slotted at 104 to permit the gear 92 to extend into such slot. The plates 78 and 80 support a shaft 106 on which is mounted a gear 108 which extends through the slot 104 and engages with the gear 92. A motor 110 is mounted on the transverse plate 86 and has a shaft 112 carrying a gear 114 engaging the gear 108. The motor is provided with a power cord 116 and control switch 118.

It will be appreciated that the weight-suspension unit 64 is movable along the I-beam 36 by virtue of the rolling engagement of the rollers 76. When the control switch 118 is turned on, the motor 110 drives the drum 90 in the counterclockwise direction indicated in FIGURE 4 through the reduction gearing provided by gears 114, 108 and 92. Obviously, other equivalent reduction gearing may be utilized. As the drum rotates, the rope 96 wound therearound will slip unless the operator applies some force to the end 92 in the ordinary manner of the operation of a windlass. If the operator applies weight or force to the rope end 102, the drum 90 will lift the weight 46. The weight may be caused to fall by the operator releasing the end 102 of the rope, either with or without a deenergization of the motor 110. The weight 46 then falls freely.

As set out hereinbefore, it is desirable that the impact between the weight 46 and the connectors, and ultimately with the bed or slab, be as inelastic as possible, in that this has been found the most satisfactory method of properly embedding the teeth of the connectors. To this

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end, it is desirable that the bed or slab itself be relatively inelastic in nature, while at the same time offering firm support for the truss during the manufacturing operation. According to one embodiment of the invention, the bed or slab 10 is formed of concrete approximately 18 inches high, 10 feet wide and 40 feet long. The jig fixtures, such as fixtures 60 and 62 in FIGURE 1, are affixed directly to the concrete. The weight 46 may be an iron casting from 250 to 500 pounds, having a flat bottom or surface 120 which may be 10 inches by 15 inches, by way of example. Alternatively, the bottom of the weight may carry a plate having an area greater in cross section than that of the weight. In a specific example, with a weight of 275 pounds and a lower face of 10 inches by 15 inches, and with the weight undergoing a free-fall of 2-3 feet, it has been found that it is possible to completely embed a 14-gauge "Gang-Nail" connector of 3 x 7 inches dimension in one impact.

The method of operation is as follows:

Assuming a bed or slab 10 with jig fixtures, the lower connector plates are placed in position beneath the positions of the intended butt joints, with their teeth uppermost. The cut lumber for the roof truss is then laid over the plates and clamped into position by the jig fixtures, such as, for instance, jig fixtures of the type shown in Jureit patent applications Serial Nos. 228,662 or 276,389, mentioned hereinbefore. The upper plates or connectors 56-58 are then placed in position. The A-frame unit and suspension unit are then moved to suspend the weight 46 over the first sandwich or joint. The weight is raised to the desired height by the workmen hauling in on the rope end 102. The weight 46 is then allowed to fall by releasing the rope end 102, whereupon the weight accelerates, impacts with the upper connector plate, and in one impulse-momentum transfer operation completes the joint. The weight may then be raised and moved in a similar manner to the next joint to be formed.

While jig fixtures have been discussed, it is also feasible to operate without the same where some other means is provided for initially and preliminarily fastening the butted wooden members together. Thus, according to another embodiment of the invention, it is possible to simply paint the truss configuration or configurations on the surface of the bed or slab, to lay the cut truss members in position as indicated by the painted truss, and then preliminarily secure these wooden members together, as by stapling, fastening with corrugated fasteners, or toenailing. The upper plates are then placed in position, the weight moved to an overlying position, and the joint formed.

It will be appreciated that while A-frames have been illustrated, other traveling frames may be utilized. Further, it is also feasible to suspend the weight-suspension unit from an overhead frame, although the slab-supported unit which is illustrated is more economical.

It will be further appreciated that the power drive for lifting and releasing the weight and its control need not be necessarily completely suspended from the I-beam. That is to say, a portion of the power drive may be carried by one of the A-frames, with suitable connection to that portion of the unit movably suspended from the I-beam.

Referring now to FIGURE 5, there is seen another embodiment of a weight-suspension unit, which is indicated generally at 122. In this embodiment of the invention, the I-beam having web 124 and lower flange 126 supports four rollers 128. The rollers 128 are mounted on stud axes 130 secured to generally parallel and vertical plates 132. A transverse horizontal plate 134 extends between the plates 132 and is secured thereto in any suitable manner, such as by welding. A second horizontal transverse plate 136 is secured across the lower ends of the plates 132.

In this embodiment of the invention, a weight 138 has extending from its upper surface an elongated rack 140 which is received in a U-shaped guide 142 welded or

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otherwise secured to the rightmost plate 132 in FIGURE 5. This same plate 132 has slots 144 and 146 therein which receive a pair of pinion gears 148 and 150 which engage the rack 140. The gears 148 and 150 are mounted on shafts 152 suitably mounted in outer plates (not shown) extending across the ends of the plates 132.

Mounted on the lower transverse plate 136 is a motor 154, which may be energized by a suitable control unit 156. The motor 154 drives an electric clutched reduction gear 158 wherein the clutch is controlled by the control unit 156. The output of the reduction gear is connected by means of a gear 160 to the gear 148 which drives the rack 140. According to this embodiment of the invention, the motor is energized, as by the control button 162, with the clutch in an engaged position, to raise the weight 138 through the clutch and reduction gear 158, gears 160 and 148. The clutch may then be denegitized by the button 164, whereupon the weight 138 executes a free fall to form the joint. The mode of operation with this embodiment of the invention is similar to that described hereinabove in connection with the embodiment of FIGURES 1-4.

It will be apparent to those skilled in the art that other weight-suspension units may also be utilized in order to obtain the advantages of this invention. For instance, it is feasible to use a weight lifted by a strap of metal pinched between rollers, one of which is fixed and one of which is movable in order to permit release to allow the weight to drop. Another method of providing the weight suspension is the so-called "walking beam" type mechanism. Still other arrangements may be used, so long as they provide for a lifting of the weight and release for acceleration and impact.

It will be apparent from the foregoing that there has been provided by this invention an apparatus for manufacturing an almost endless variety of roof trusses and like structural devices, which apparatus is relatively simple and thereby can be made available to truss fabricators, lumberyards and similar operators at only a fraction of the cost involved in the purchase or lease of presses of the type previously utilized to perform this function.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. An apparatus for manufacturing structural devices comprising wooden members having butt joints formed between the wooden members by toothed connector plates, comprising a slab for receiving said wooden members in assembled butted relation, a weight having a substantially flat lower surface, means for suspending said weight over said slab, said last-named means including means to provide for translational movement of said weight over said slab to permit positioning of the weight over the connector plates used in forming the joints, and means for lifting and releasing said weight, to permit it to fall and thereby embed the teeth of a connector plate in said wooden members.

2. An apparatus for manufacturing structural devices as set out in claim 1 wherein said means for suspending said weight over said slab comprises a frame means movable along the long direction of the slab and including means supported by said frame means for movement substantially perpendicular to the long direction of the slab, said last-named means supporting the weight.

3. An apparatus for manufacturing structural devices as set out in claim 1 wherein said slab has mounted on its

upper surface fixtures for clamping said wooden members in position against movement in a generally horizontal direction but permitting limited movement in a vertical direction.

4. An apparatus for manufacturing structural devices as set out in claim 1 wherein said means for lifting and releasing said weight includes a rotary drive source driving a rotary member, and a substantially vertical support member extending between said weight and into engagement with said rotary member.

5. An apparatus for manufacturing structural devices as set out in claim 1 wherein said slab is formed of a material of relatively low elasticity.

6. An apparatus for manufacturing structural devices as set out in claim 5 wherein said slab is formed of concrete.

7. An apparatus for manufacturing structural devices as set out in claim 3 wherein said means for lifting and releasing said weight includes a rotary drive source driving a rotary member, and a substantially vertical support member extending between said weight and into engagement with said rotary member.

8. An apparatus for manufacturing structural devices as set out in claim 7 wherein said slab is formed of concrete.

9. An apparatus for manufacturing structural devices as set out in claim 8 wherein said frame means is supported on tracks extending along said slab and comprises one frame assemblage on each side of said slab, and a beam connecting said frame assemblage and extending across said slab and supporting said means supported by said frame means for movement substantially perpendicular to the long direction of the slab.

10. An apparatus for manufacturing structural devices comprising wooden members having butt joints formed between the wooden members by toothed connector plates, comprising a bed defining a surface for receiving wooden members and connector plates for the fabrication of structural devices; said bed being formed of a substantially non-yielding and non-resilient material providing a hard surface; a weight having a surface for engaging said connector plates; means for suspending said weight over said bed, said last named means including means providing for translational movement of said weight over said bed to permit positioning of the weight over the several connector plates used in forming the joints of the structural device; and said suspending means including means for lifting and releasing said weight to permit it to fall and thereby embed the teeth of said connector plates in said wooden members.

11. An apparatus for manufacturing structural devices as set out in claim 10 including means on said bed surface for locating said wooden members in predetermined assembled relation.

12. An apparatus for manufacturing structural devices as set out in claim 10 wherein said bed defines an elongated surface; wherein said means for suspending said weight over said bed comprises a frame means movable along the long direction of the bed and including means supported by said frame means for movement substantially perpendicular along the direction of said bed, said last named means supporting the weight.

13. An apparatus for manufacturing structural devices as set out in claim 10 wherein said bed defines an elongated surface; parallel track means secured to said bed adjacent the long sides thereof; wherein said means for suspending said weight over said bed comprises a gantry-type frame including upright frame members provided with grooved wheels for supporting said frame members on said track means and transverse rail means extending between said upright frame members; and carriage means mounted for translational movement along said rail means, said carriage means supporting the weight.

14. An apparatus for manufacturing structural devices as set out in claim 10 wherein said bed defines an elongated surface; parallel track means secured to said bed adjacent the long sides thereof; wherein said means for suspending said weight over said bed comprises a gantry-type frame including upright frame members provided with grooved wheels for supporting said frame members on said track means and transverse rail means extending between said upright frame members; and carriage means mounted for translational movement along said rail means, said carriage means supporting said weight, said carriage means including a rotary drive member for lifting said weight relative to said carriage; and a rotary drive source for driving said rotary drive member; said rotary drive member comprising a drum and a flexible tension member attached at one end to said drum and at the other end to said weight.

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BILLY J. WILHITE, *Primary Examiner.*