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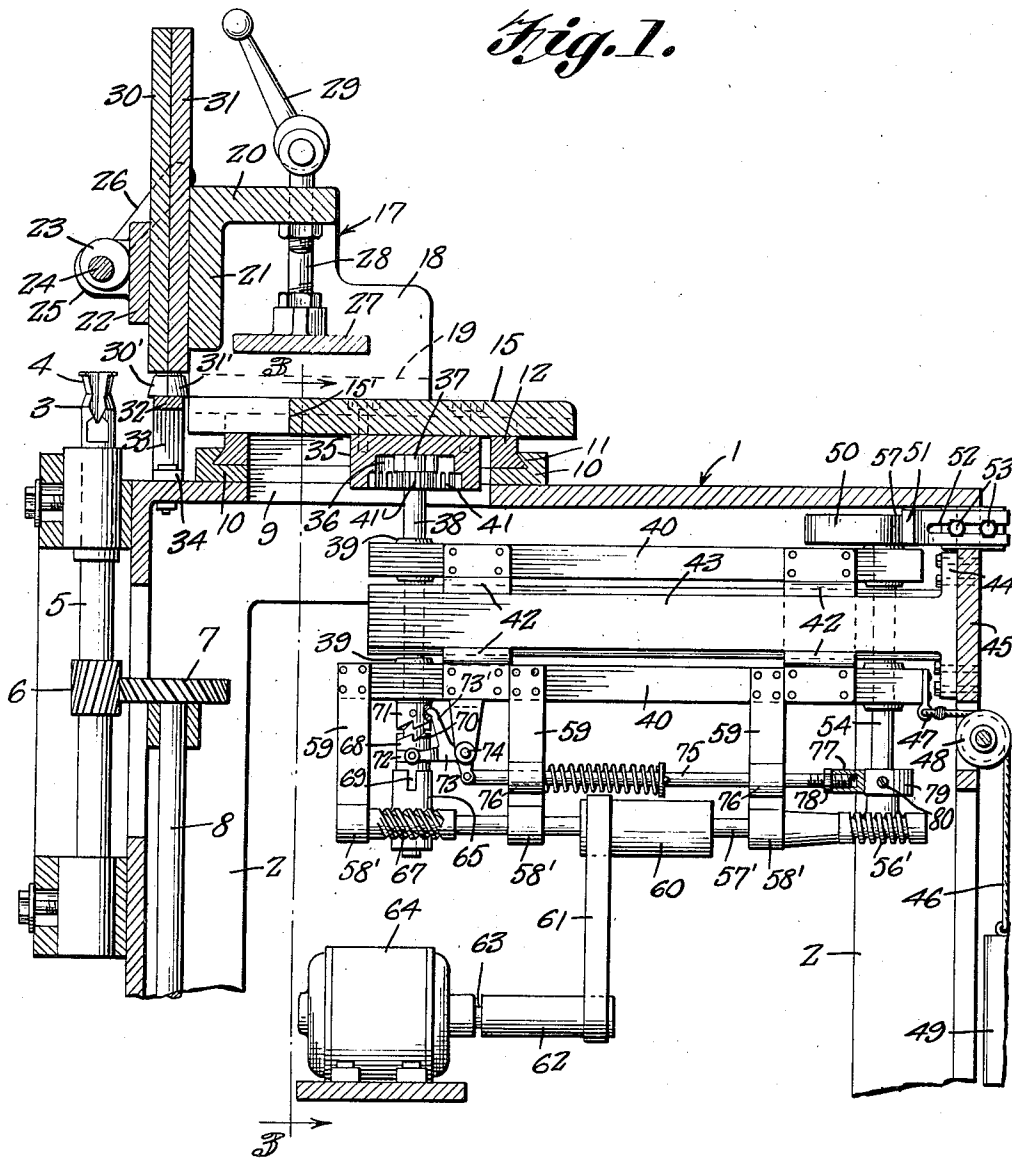
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2,225,263

TENONING MACHINE

Filed Jan. 30, 1939

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

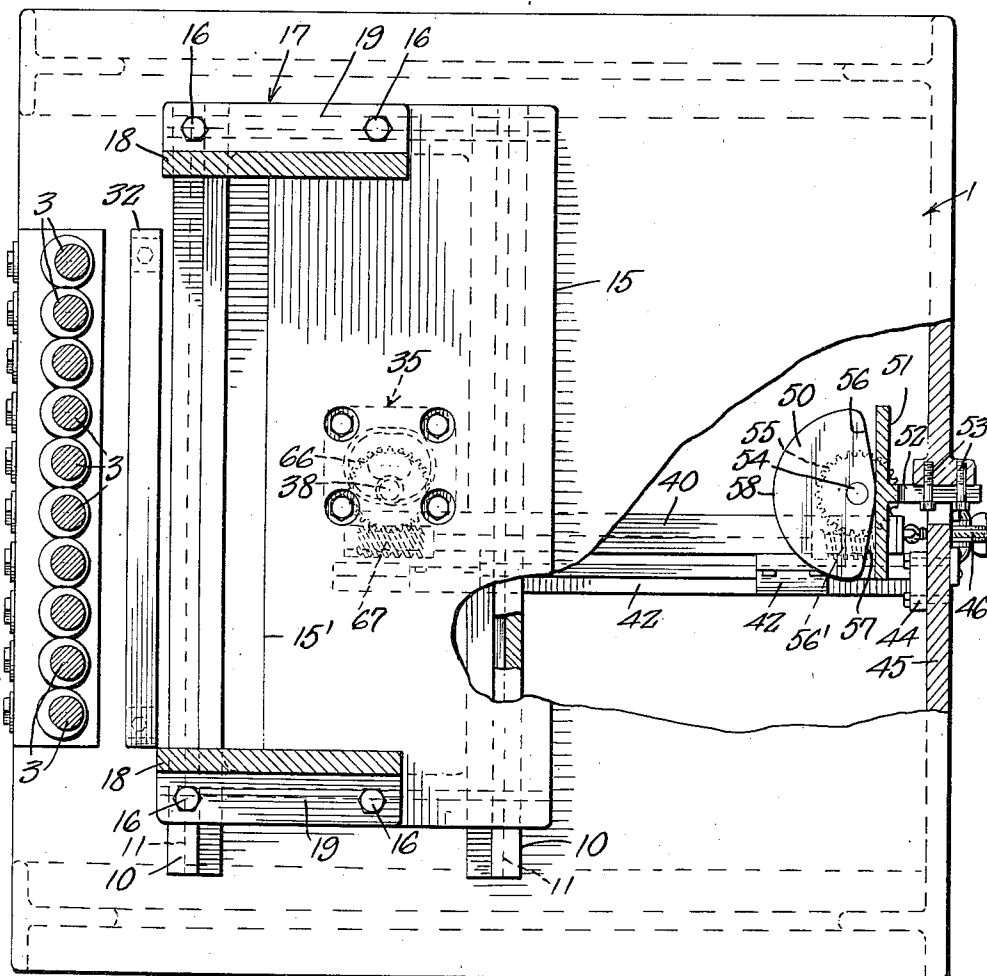
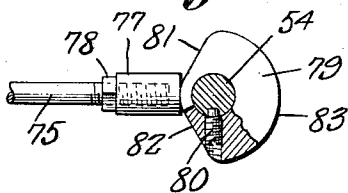


Fig. 2.

Fig. 6.



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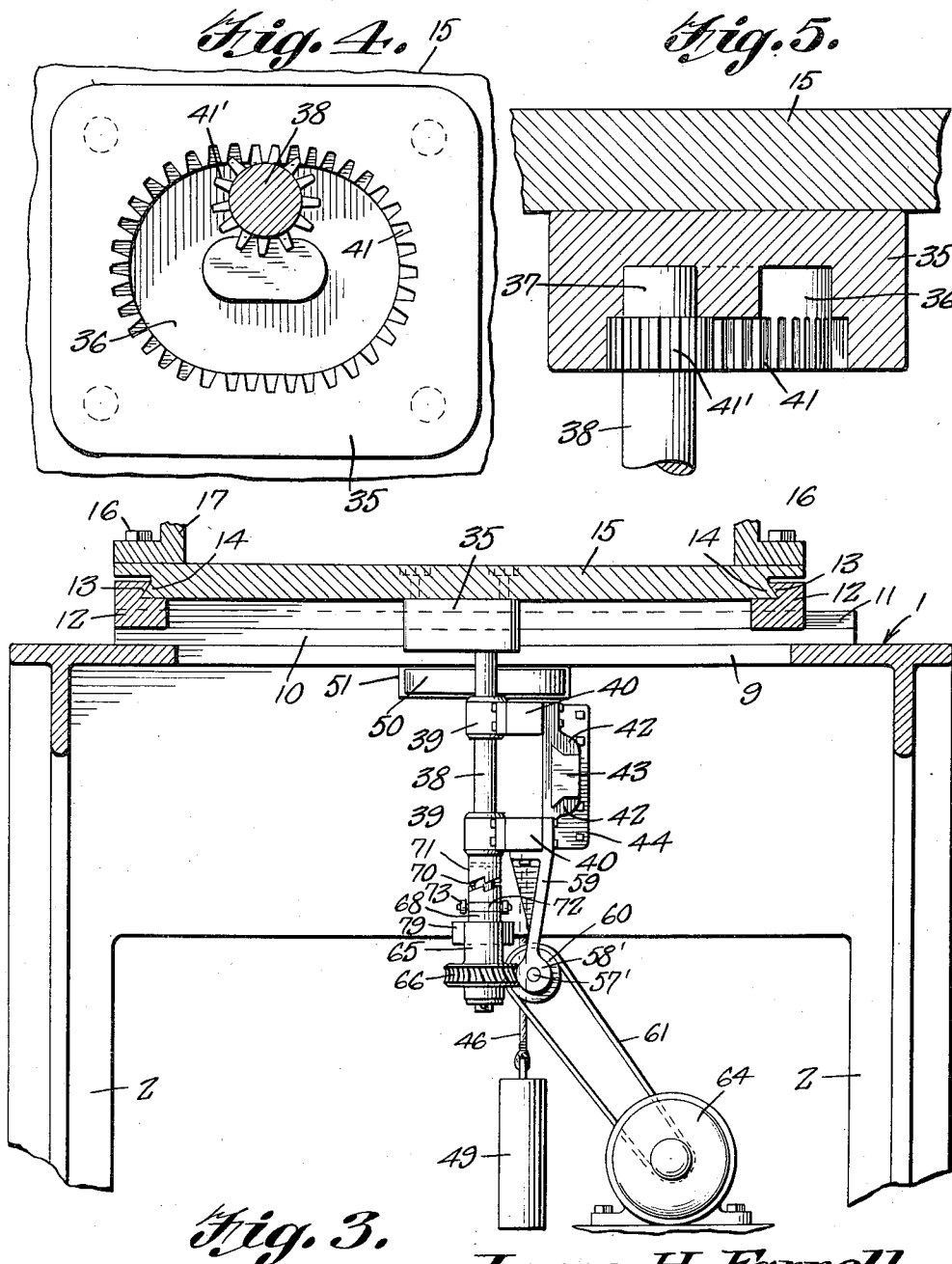


Fig. 3.

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TENONING MACHINE

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Application January 30, 1939, Serial No. 253,688

3 Claims. (Cl. 144—87)

This invention relates to woodworking machinery and more particularly to a machine having provision for forming dovetail tenons.

In present day mortising and tenoning the tenons formed at the edge of the board are usually sharp-edged at one side of the board and the opposite sides of the tenons are rounded, the mortises being correspondingly recessed to receive the tenons. It has been found in the formation of the tenons on the edge portion of a single board that, while the rounded portion of the tenons are satisfactorily formed without appreciably tearing the wood, the cutting cones or knives do tear and appreciably mutilate the sharp corner portions of the tenons when the cones or knives leave the material. To overcome this disadvantage machines or attachments have been produced and so constructed that it is possible to place two boards back to back in the machine and causing the carrier of the boards to travel forwardly and backwardly in spaced parallel planes, with rounded loop movement at the end of each lineal stroke. In other words, the two boards so placed back to back travel entirely around the respective cutting cones or knives so as to effect the formation of the tenons smoothly throughout.

While the formation of the tenons upon an assembled pair of boards as above described makes for a better finished dovetailed joint there are certain disadvantages in the mechanical arrangement and operation of the machines on which the tenon forming operations are performed. It is, therefore, the principal object of the present invention to improve generally upon the dovetailing machines or attachments.

A further object is to provide a simplified structural arrangement in a dovetailing machine with provision for adjustment and automatic operation thereof in the formation of tenons on boards of different thicknesses. A still further object is to make provision for rendering selected portions of the mechanism inactive, at will.

With the foregoing and other objects and advantages to be attained, the invention consists in the novel general structure and in the particular parts and combinations and arrangements of the parts as hereinafter described and set forth in the appended claims, reference being had to the accompanying drawings forming a part of the specification, and in which:

Figure 1 is a vertical sectional view of a machine equipped in accordance with the present invention;

Figure 2 is a view partly in top plan and partly in horizontal section of that portion of the machine illustrated in Fig. 1;

Figure 3 is a vertical section taken on or about the line 3—3 of Figure 1;

Figure 4 is a fragmentary inverted plan view of the unitary element for controlling the combined lineal and rotary reciprocatory movement of the work holding carriage;

Figure 5 is a cross section through the unitary element shown in Figure 4; and

Figure 6 is a fragmentary detail view showing the cam spindle in cross section and the cam of the clutching and declutching mechanism thereon in partial top plan and section and with other parts directly associated therewith in top plan.

Referring now to the drawings, the numeral 1 designates generally the top plate or table portion of the machine which is mounted on the usual frame standards 2. At the front of the machine is a multiple set of rotary cutters 3 of any conventional type having the usual tapered undercut or inverted conical cutting portion 4 at their upper ends. As these cutters per se form no part of the present invention other than in the relation hereinafter described and claimed, suffice it to state that they are mounted on the usual vertical spindles 5 which are provided with spiral gears 6, the gears of groups of said spindles meshing with each other so that the spindles are accordingly rotated one by the other, and certain of said spiral gears 6 being engaged by a driving gear or gears 7 accordingly provided on the vertical driving shaft or shafts 8. In this connection, it is noted that the driving shaft or shafts 8 are driven and controlled separately from the work carrying means to be now described. The adjustment, operation and control of the cutter elements being that of the usual or ordinary character, further description thereof is deemed unnecessary herein.

Mounted on the top plate or table portion 1 of the machine frame, at opposite sides of a rectangular opening 9 therein, is a pair of parallel transverse supporting and guiding rails 10. These rails 10 are provided with undercut slideways 11 in their inner sides, a movable carriage frame 12 being mounted on said supporting and guiding rails 10 to reciprocate transversely of the machine by means of a slidable interfitting engagement with the undercut slideways.

The carriage frame 12 is provided with longitudinal slideways 13 in its opposite end members to receive correspondingly formed marginal

portions 14 of a carriage body plate 15. Mounted fixedly on the carriage plate 15, either by integral formation therewith or made separately and bolted thereto, as at 16, is a work-supporting frame 17 comprising the vertical end members 18 which are flanged at their lower ends, as at 19, and apertured to receive the securing bolts 16. Rigidly connecting said end members 18 is an elongated member of rightangular cross-section providing a horizontal top shelf-like portion 20 and a vertical abutment 21.

Movably mounted in spaced relation to the outer face of the abutment member 21 is an elongated work-clamping plate 22, cooperating with the opposite end portions of which are cam eccentrics 23 which are mounted on an operating rod 24 journaled at its opposite ends in bracket extensions 25 of the carriage frame 17 and provided with a manipulating handle or handles 26 (see Figure 1). This work-clamping provision, just described, is for holding the boards to be mortised and tenoned vertically in the machine, particularly for the operations hereinafter described in accordance with the present invention. For holding the work horizontally on the carriage body plate 15, for certain other cutting operations, also to be later described, a vertically adjustable work-clamping element 27 of a conventional type is provided as indicated in Figure 1. As this second mentioned clamping element 27, of itself, forms no part of the present invention other than in its general relation to the carriage body plate 15, further detailed description thereof is deemed unnecessary except to state generally that it is carried by vertical reciprocatory bars or rods 28 which are pressed downwardly by cam and lever means 29 when in use.

In the use of the machine in accordance with the principal object of the present invention, the work comprising two boards 30 and 31, respectively, is secured on the carriage as shown in Figure 1, that is to say, the boards are placed back to back and clamped in true alinement with each other, in a vertical position, between the abutment member 21 and the clamping member 22. As shown in Figure 1, the tenons are indicated at 30' and 31', respectively, the tenons having been formed by moving the carriage lineally forward, thence transversely with arcuate or other rounding movement, and then backwardly in a lineal direction, thence again rounding in the opposite lateral direction and again lineally forward to the original starting point, or, in other words, the orbit of carriage travel during the tenon forming operation is substantially elliptical except that the middle portions of the two opposite sides of the adjoined tenons 30' and 31', so formed, are flattened. In this connection, it is here noted that a gauge element 32 is provided on the top plate or table portion 1 of the machine transversely thereof between the outer one of the carriage supporting rails 10 and the row of cutter elements 3 (see Figure 1), said gauge element 32, as shown, comprising an elongated flat bar having down turned rightangular end portions 33 provided at their ends with inturned ears 34 which are bolted to the top plate or table portion 1. Obviously, the gauge element 32 may be made with any suitable provision for vertical adjustment or interchangeable elements 32 of different heights may be provided for the purpose, that of properly positioning the lower ends of the two boards 30 and 31 in working alinement with relation to the cutter elements 3. These particular gauge provisions being obvious, a de-

tailed illustration or description thereof is not here necessary.

Mounted on the under side of the carriage body plate 15 is a rectangular block 35, said block being provided with a substantially elliptical groove 36 constituting an endless trackway for the upper end portion 37 of a vertical spindle 38 which is journaled in bearing brackets 39 provided therefor on the side of a reciprocatory carriage 40 near one end thereof. The block 35 is counter-recessed about the track groove 36 and formed with a series of teeth 41 providing, in effect, an elliptical internal gear which is engaged by a pinion 41' fixed on the spindle 38 adjacent the end portion 37 thereof which rides in the track groove 36. By this provision, together with an automatic clutching and declutching driving mechanism, to be later described, the hereinbefore described travel of the work-holding carriage in an elliptical orbit, is effected.

As shown in Figures 1 and 2, the reciprocatory carriage 40 on which the spindle 38 is mounted is slidably mounted with dovetailed guide fittings, as at 42, on an elongated horizontal guiding and supporting arm 43 of a bracket 44 which is bolted or otherwise rigidly secured to the back end wall portion 45 of the machine body frame, said guiding and supporting arm 43 extending parallel with the longitudinal axis of the block 35 whose longitudinal axis also extends parallel with the longitudinal axis of reciprocation of the work-carrier 15.

The reciprocatory carriage 40 is yieldably held in and automatically returned to a normally retracted position by a cable or other suitable flexible element 46 attached at one end to the carriage 40, as at 47, thence passed over a supporting pulley or idler 48 and provided at its free end with a weight 49. The carriage 40 is moved from its normally retracted position on the supporting arm 43 by a rotating cam 50 which works against an adjustable abutment 51 mounted on the end wall 45 of the machine frame. As shown, the abutment 52 comprises a transverse plate portion and is formed in substantially T-shape with its stem portion slotted longitudinally, as at 52, for the reception of securing bolts 53 by which the adjustment of the abutment towards and from the adjacent wall portion 45 of the machine frame is accomplished. The cam element 50 is fixed on the upper end portion of a vertical driving spindle 54, and, as shown, it is provided with abrupt quick-acting camming faces 56 and 57 whereby the reciprocatory movement of the carriage 40 as effected and controlled thereby is rapid in movement. However, there is a concentric peripheral portion 58 on the cam 50 which is of considerable length between the camming faces 56 and 57, by the provision of which the carriage 40 remains stationary for a considerable period of time after it is moved from its normally retracted position. During this period of rest of the carriage 40 the work carrier 15 is actuated by means of the peculiar gear connection between the block 35 secured on the under side of the work carrier 15 and the correlated tracking provision in the block for the end portion 37 of the spindle 38 which effects the movement of the carrier in the hereinbefore described elliptical orbit for the formation of the tenons 30' and 31' on the respective boards 30 and 31.

The actuation of the cam spindle 54 is effected by means of a worm drive including the suitable gear 55 fixed on the lower end of the spindle 54 in mesh with the drive screw portion 56' provided

therefor on the end of the horizontal countershaft 57' journaled in bearings 58' provided at the lower ends of depending supporting brackets 59 on the lower longitudinal member of the carriage 40.

As shown, the countershaft is provided with an elongated cylindrical pulley 60 which is belted, as at 61, to a correspondingly elongated pulley 62 provided on the driving shaft 63 of an electrical or other motor 64. By this provision of elongated cylindrical pulleys 60 and 62 the belted connection 61 between the pulleys is maintained constantly during the time the reciprocatory carriage 49 is either in its normally retracted or extended position as well as during the time of travel to and from the said positions.

In the operation of the machine, the cam element 50 working against the abutment 51 effects a positive and definite movement of the reciprocatory carriage 40 from its normally retracted position, it being understood that the abutment 51 is adjusted on the supporting wall portion 45 of the machine frame so that the outer board 30 as clamped on the abutment member 21 of the upper frame portion of the carrier body 15 is brought contiguous to the cutter elements 3, at the moment of which the spindle 38 carrying the gear 41' which is in engagement with the internal gear 41 is automatically connected to the countershaft 57' whereby the work carrier 15 is actuated in the elliptical orbit as hereinbefore described. The spindle 38 is connected to and disconnected from the countershaft 57' by the provision of a sleeve element 65 which is mounted loosely in any conventional manner on the lower end portion of the spindle 38 so that the sleeve and spindle are rotatable independently of each other but are held against relative endwise movement, said sleeve having a gear 66 thereon, similar to the gear 55 on the cam spindle 54, in mesh with the worm screw 67 fixed on the countershaft 57', by which provision the sleeve 65 rotates constantly with said shaft 57'. Sleeved also loosely on the spindle 38 is a clutch collar 68 having a spline extension 69 at its lower end engaged in a corresponding open-ended slot provided therefor in the adjacent end portion of the sleeve member 65, whereby the clutch collar 68 is interlocked with the sleeve element 65 so as to rotate therewith but is permitted endwise movement relative to the sleeve member 65 and also the spindle 38. Clutch collar 68 is provided at its upper end with a series of ratchet teeth 70 to engage the corresponding teeth provided on the adjacent lower end portion of a thrust collar 71 pinned or otherwise fixedly secured to said spindle 38.

For the actuation of the clutch collar 68 it is provided with an annular circumferential groove for the reception of an ordinary shipper ring 72 to which one arm of a bellcrank element 73 is cooperatively attached, said bellcrank member being pivotally mounted as at 74 on a supporting bracket depending from the under side of the reciprocatory carriage 40. The opposite arm of the bellcrank element is pivotally attached to a tappet rod 75 which is slidably mounted in suitable guide portions 76 provided therefor on two of the bracket members 59 which support the countershaft 57', said tappet rod extending substantially parallel with said countershaft and being provided on its end remote from the connected bellcrank element with a cam abutment member 77 which is axially bored and screw-threaded to fit adjustably on the correspondingly threaded end portion of the rod, said cam abutment member

being locked in its longitudinal position on said tappet rod 75 by a jam nut 78.

The cam abutment 77 on said tappet rod 75 is yieldably held constantly in engagement with a cam element 79, which latter is securely fastened to the cam spindle 54 by a set-screw 80, whereby said cam element 79 normally rotates with the spindle 54 in the operation of the machine as hereinbefore described for the formation of the tenons 30' and 31' on the vertically positioned boards 30 and 31. However, when the machine is to be used in other ways and not requiring the operation of the spindle 38, said set-screw 80 is turned and moved outwardly so as to disengage its inner end portion from the cam spindle 54 whereupon said spindle is free to rotate only the cam 50 and accordingly reciprocate the carriage 40 to effect a corresponding longitudinal reciprocation of the work carrier 15 without any transverse movement thereof.

The cam element 79, like the cam element 50, is provided with rather abrupt and quick-acting camming faces 81 and 82 and a concentric peripheral face 83 to hold the spindle 38 clutched to the countershaft 57' throughout a period of time sufficient for the accomplishment of the hereinbefore described tenon-forming movement of the work-carrier in the elliptical orbit. In this connection, it is here pointed out that the cam element 79 is positioned on the spindle 54 in timed relation to the cam 50 which drives and controls the reciprocatory carriage 40, the relative proportion of the concentric peripheral portion 83 of said cam 50 being such that the cam element 79 is actuated to move the tappet rod 75 and effect the engagement of the clutch collar 68 with the thrust collar 71 fixed on the spindle 38 after the reciprocatory carriage has reached the end of its movement from the normally retracted position and the actuations of the work-carrier 15 are effected by the operation of the spindle 38, which operative connection with the block 35 is completed during the rest period of said reciprocatory carriage 40.

In order to assure a positive driving connection between the reciprocatory carriage 40 and the work-carrier 15 during both the forward stroke and the return stroke of said carriage 40, releasable locking means is provided for holding the spindle 38 against rotation during such reciprocatory movement of said carriage 40, said locking means being conventionally shown in Figure 1 of the drawings as comprising a hooked arm 73' formed as a part of the bellcrank whose arm 73 actuates the clutch collar 68, said hooked arm 73' engaging in a peripheral notch provided therefor in the fixed thrust collar 71 on said spindle 38 when the clutch collar is disengaged from said fixed thrust collar 71. Obviously, with the spindle 38 thus held against rotation and the gear 41' engaged with the toothed portion 41 of the block 35 on the work-carrier 15, the work-carrier is moved positively with the reciprocatory carriage 40 and in the same longitudinal direction therewith and without any transverse movement until the cam-actuated bellcrank is operated to engage the clutch collar 68 with said fixed thrust collar 71, at which time the hooked arm 73' of the bellcrank is swung out of engagement with the peripheral notch in said thrust collar 71, it being understood that the clutching and declutching of the spindle 38 occurs, as hereinbefore described, during the rest period of the reciprocatory carriage 40.

In the operation of the machine, in the pre-

ferred setup and adjustment of the respective actuating and controlling parts, the initial forward longitudinal movement of the work-carrier 15 brings the two boards 30 and 31 into a position where the plane of their meeting faces coincides with the plane of the axes of the row of cutter elements 3, at which time the reciprocating carriage and the then connected work-carrier come to rest, and immediately thereafter the cam element 79 effects the engagement of the clutch collar 68 with the fixed thrust collar 71, whereupon the spindle 38 is positively driven by the countershaft 57' as hereinbefore described. Up to this time, a kerf has been cut straightway through the outermost board 30 and partially into the companion board 31, and as soon as the spindle 38 starts rotating in its neutral position at one side of the elliptical trackway 36 and midway between the rounded ends of said trackway, movement of the block 35 in an elliptical orbit is thereby caused due to the engagement of the gear 41' with the elliptical series of teeth 41, the block being positively guided in its elliptical movement by the fitting of the end portion 37 of the spindle without play in the coinciding elliptical trackway 36. This travel of the block and, of course, the work-carrier 15 therewith, continues until one lap is completed, or, in other words, until the spindle 38 has returned to its neutral position with relation to the block 35, and immediately therewith said spindle 38 becomes automatically declutched with relation to the countershaft 57' and again locked against rotation by the engagement of the hooked arm 73' of the bellcrank in the peripheral notch of said thrust collar 71. After this declutching and locking of the spindle 38 is accomplished the cam 50 immediately or shortly thereafter has reached a position in its rotation whereby the carriage 40 is returned to its normally retracted position under the influence of the weighted cable or flexible element 46 which is attached to the end of the carriage and passes over the idler pulley 48.

By the use of the machine of the present invention, as hereinbefore described, tenons are accurately and symmetrically formed on a pair of boards at the same time, and without any tearing effect which ordinarily occurs at the sharpened corners of the tenons in the ordinary process of forming the tenons on single boards. Furthermore, the tenoning mechanism of the present invention may be disconnected or rendered inactive, at will, and the machine used in the ordinary way of forming mortises to receive the tenons and also for forming plain straight-across dovetailed tenons and mortises, either the straight box dovetailed or the undercut type as desired.

It is, of course, understood that the elliptical trackway 36 in the block 35 on the work-carrier 15 is proportioned as to both width and length depending upon the size of the tenon and in accordance with the thickness of the respective pairs of boards to be tenoned, and, in this connection, it is further noted that the block 35 is made detachable and interchangeable, in different sizes and the cams 50 and 79 must, of course, be made in interchangeable sizes and accordingly adjusted for the proper operation in the tenon forming process.

It is further pointed out that, to provide for ample maximum movement of the work carrier 15, both longitudinally and transversely, as well as circularly, the plate portion of the work carrier is cut away, as at 15', throughout the entire width

thereof between the vertical end members 18 of the work-supporting frame 17 and for a considerable distance inwardly from the forward end of the body plate portion, so that the work carrier 15 is movable about the gauge element 32 with ample clearance therebetween.

While the machine as illustrated in the drawings and herein described embodies a practical adaptation of the invention, it is understood that considerable modification may be made therein without departing from the spirit and scope of the invention as defined in the appended claims. The invention, therefore, is not limited to the specific construction and arrangements shown in the accompanying drawings.

What is claimed is:

1. In a woodworking machine of the character described, a body frame having a stationarily mounted rotary cutter element thereon and a work carrier slidably mounted on the frame for both longitudinal and transverse movement, clamping means on said carrier for holding a pair of boards back to back and vertically thereon with the aligned lower edge portions of the boards in a plane to be operated upon by the cutter element, a longitudinally reciprocable driving carriage slidably mounted on the body frame with provision for yieldably holding it in normally retracted position and for returning it to such position, a power-driven cam element on said driving carriage in working relation to an adjustable abutment for moving the carriage from its normal position and holding the carriage so moved during a definite period of rest, a guide element on said work carrier having an endless track groove therein with a surrounding counter-recessed portion provided with an endless series of rack teeth, a spindle journaled on said driving carriage and provided with a toothed gear meshing with the toothed rack portion of said guide element on the work carrier with the adjacent end portion of the spindle projected into the track groove of said guide element, means for releasably locking said spindle against rotation during the reciprocating movements of said driving carriage, and cam-actuated means operating in timed relation to the cam element which controls the actuation of said driving carriage whereby to release said spindle from its interlocked relation and operably connecting it to a driving medium on said driving carriage during the rest period of the carriage, whereby to rotate said spindle and through its connection with said guide element impart a revoluble movement to said work carrier so as to carry the boards supported thereon in an orbit about the cutter element to form duplicate tenons on the portions of the boards thus carried in engagement with the cutter element.

2. In a wood working machine of the character described and including a body frame having a stationarily mounted rotary cutter element and a correlated work carrier mounted on the body frame for longitudinal, transverse and revoluble movement in a definite plane with relation to the cutter element, said work carrier having provision for supporting a pair of boards back to back thereon with their lower edge portions aligned in the working plane of said cutter element, a prime mover including a longitudinally reciprocable carriage having provision for yieldably holding it in a normally retracted position and returning it to such position, a power-driven cam spindle on said carriage having a cam element working against an adjustable abutment

for moving the carriage a predetermined distance from normal position and formed with a proportioned concentric surface for a rest period, endless looped guide means on said work carrier, 5 geared driving means on said prime mover in working engagement with said guide means for imparting a revoluble movement to said work carrier during the rest period of said prime mover, and means for automatically rendering said 10 geared driving means inactive as to such revoluble movement of the work carrier during the reciprocation of said prime mover but effecting a connection with said prime mover whereby the work carrier reciprocates therewith.

15 3. In a wood working machine of the character described and including a body frame having a conventional rotary cutter element and a correlated work carrier mounted thereon for longitudinal, transverse and revoluble movement in a 20 definite plane with relation to the cutter element, a prime mover including a longitudinally reciprocable horizontal carriage having provision for yieldably holding it in a normally retracted position and returning it to such position, power 25 means for moving the carriage from normal posi-

tion and holding it during a definite period of rest in extended position, an operable connection between said carriage and said work carrier whereby the latter is moved lineally with the carriage in its reciprocation, said connection including a guide element on the underside of said work carrier and provided with an endless trackway, a vertical spindle mounted on said carriage and having a geared engagement with said guide element and interfitted to the trackway thereof, 10 whereby, upon rotation of said spindle, orbital travel is imparted to the work carrier, said spindle being normally locked against rotation, a common drive shaft on said carriage for actuating the moving means of the carriage and 15 having a normally declutched driving arrangement with said spindle, and means for automatically clutching said driving shaft and spindle during the period of rest of the carriage in extended position whereby the orbital travel of the 20 work carrier is effected, and then declutching the shaft and spindle prior to the termination of such period of rest.

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