C. C. WAIS.

METAL WORKING MACHINERY.

APPLICATION FILED FEB. 20, 1911.

1,046,691.

Patented Dec. 10, 1912.

4 SHEETS—SHEET 1.

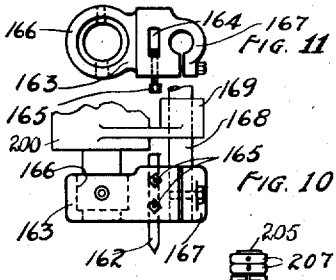

FIG. 11

FIG. 10

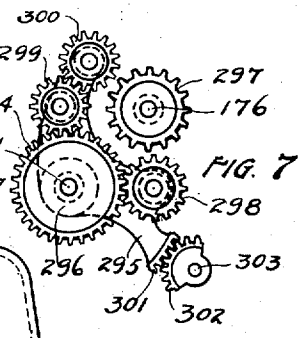

FIG. 7

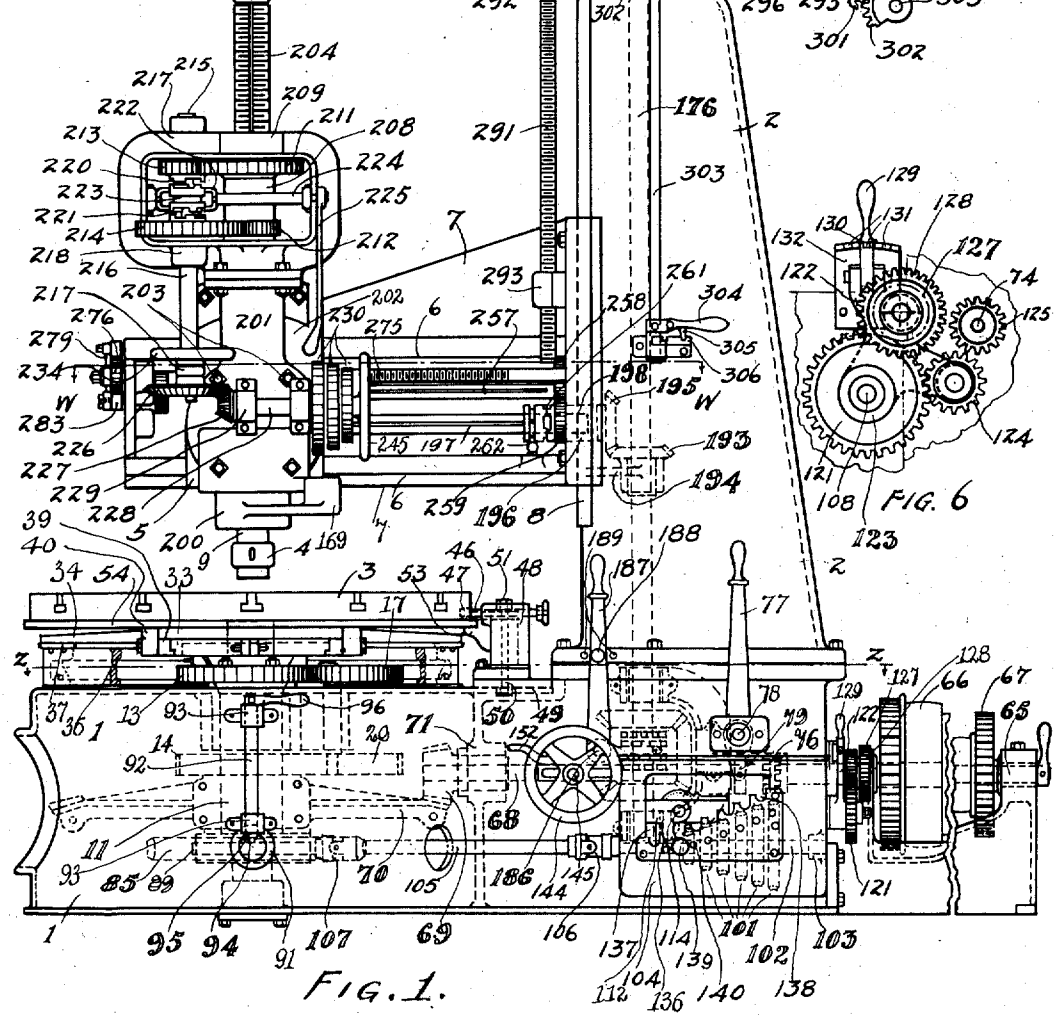

FIG. 1.

FIG. 6

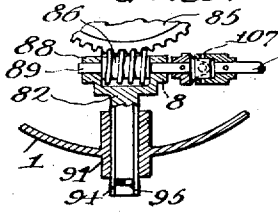

FIG. 20.

WITNESSES

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4 SHEETS—SHEET 2.

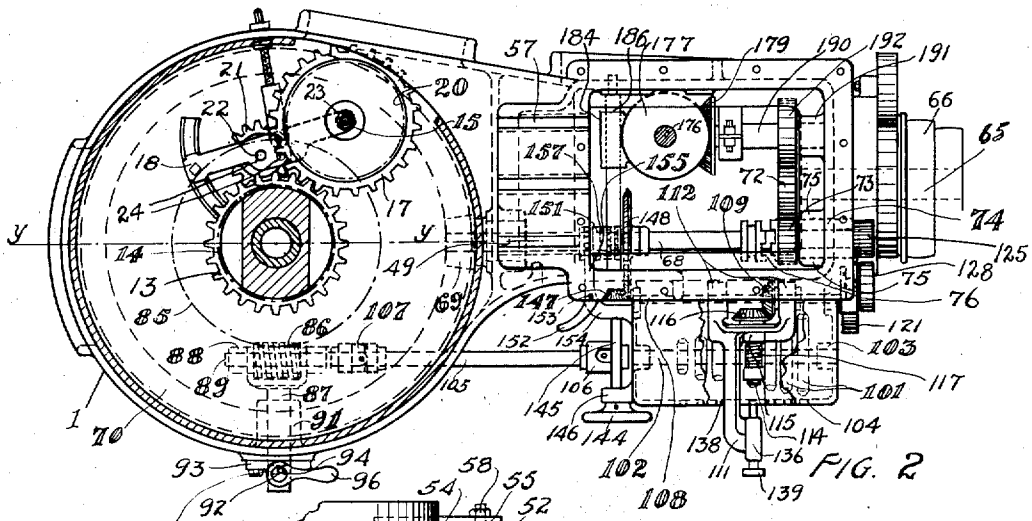

FIG. 2

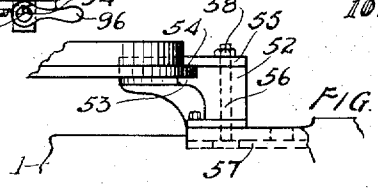

FIG. 16

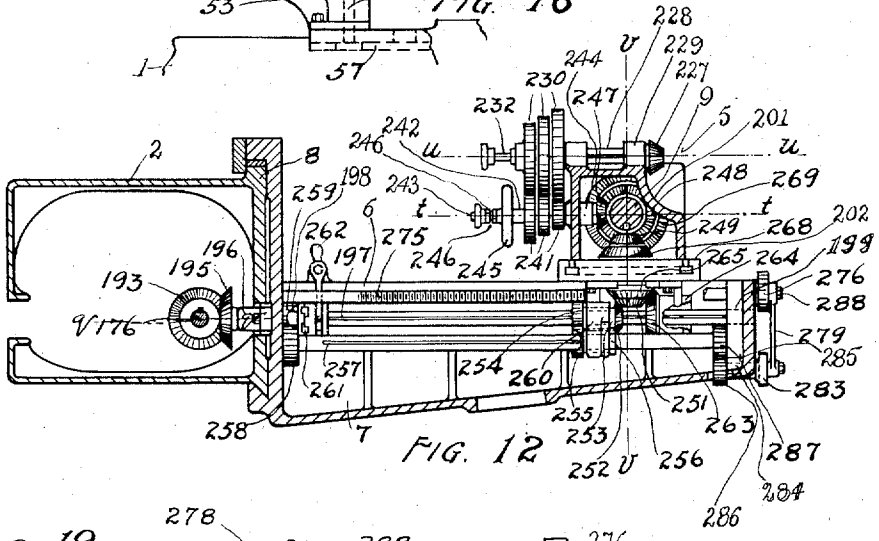

FIG. 12

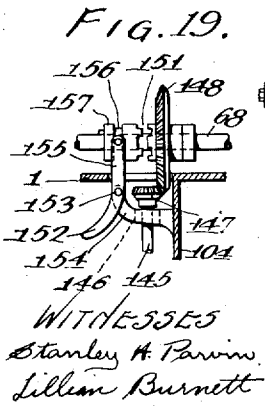

FIG. 19.

WITNESSES

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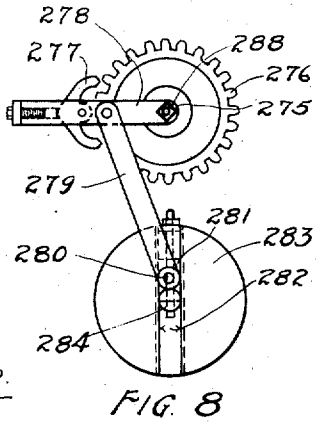

FIG. 8

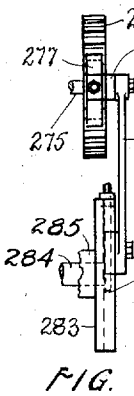

FIG. 9

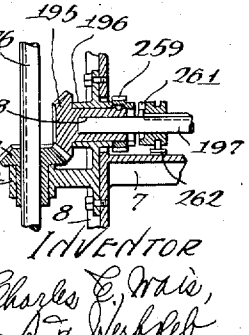

FIG. 21.

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4 SHEETS—SHEET 3.

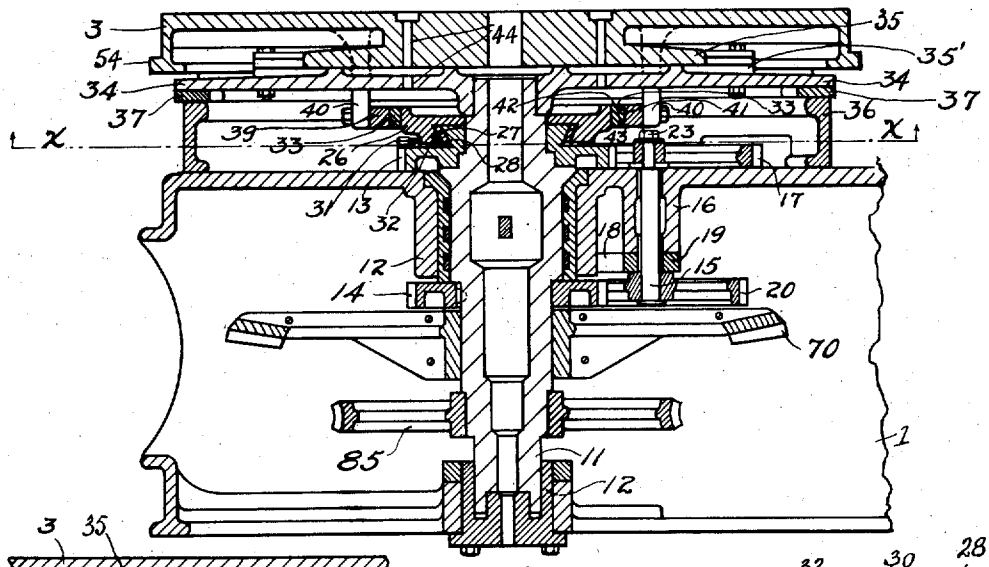

FIG. 3

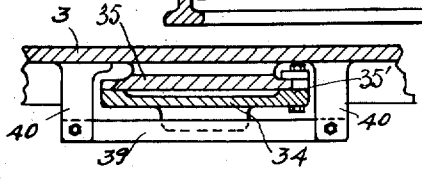

FIG. 18

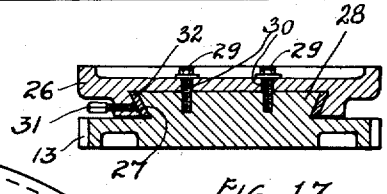

FIG. 17

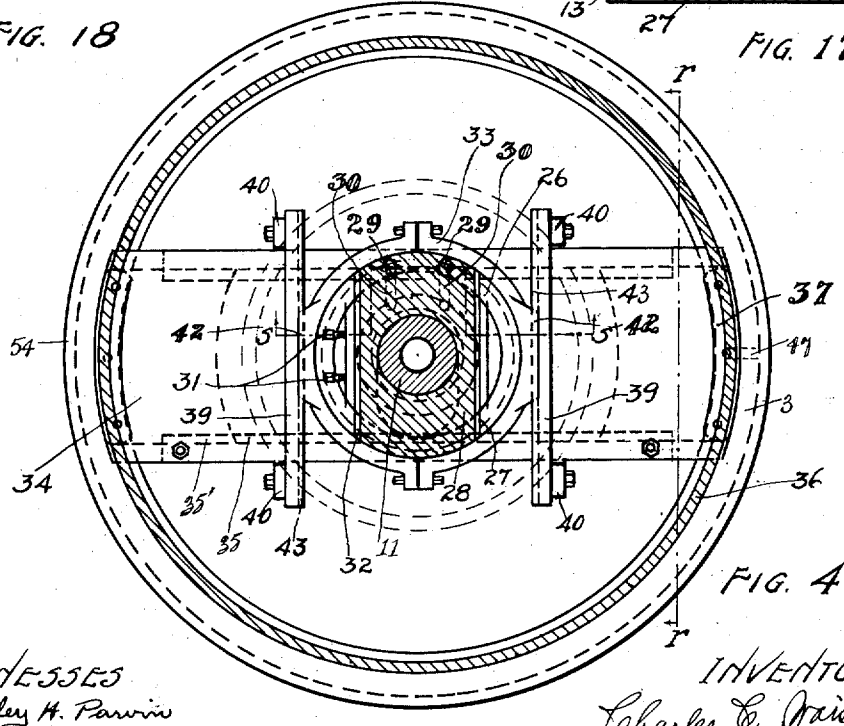

FIG. 4

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4 SHEETS—SHEET 4.

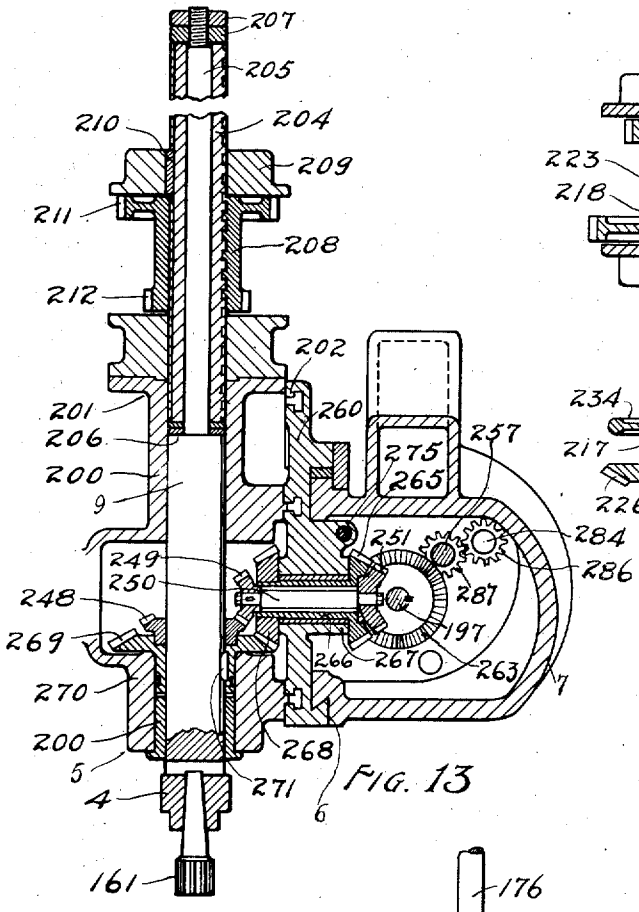

FIG. 13

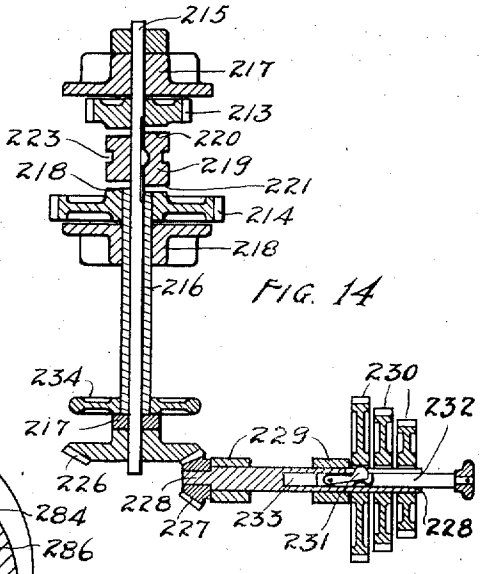

FIG. 14

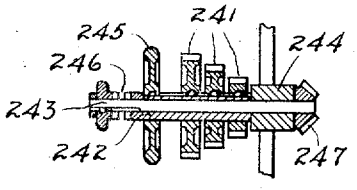

FIG. 15

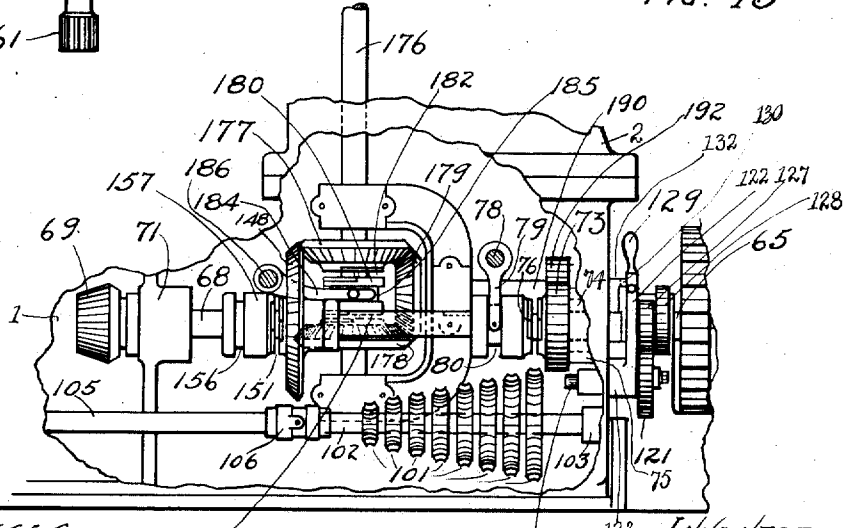

FIG. 5

WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES C. WAIS, OF OAKLEY, OHIO.

METAL-WORKING MACHINERY.

1,046,691. Specification of Letters Patent. Patented Dec. 10, 1912.

Application filed February 20, 1911. Serial No. 609,742.

To all whom it may concern:

Be it known that I, CHARLES C. WAIS, a citizen of the United States, residing at Oakley, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Metal-Working Machinery, of which the following is a specification.

It is the object of my invention to provide a metal working machine embodying means for imparting various operative movements to the work-support with relation to the tool, and provide means for controlling the tool, whereby various operative functions may be performed, instanced for instance as boring or drilling, tapping, planing or shaping, and milling movements, as well as movements for chasing or milling threads, and my invention has the further object of providing means whereby various configurations may be imparted to the paths of movement of the work-support.

The invention will be further readily understood from the following description and claims, and from the drawings, in which latter:

Figure 1 is a side elevation of my improved device partly broken away. Fig. 2 is a horizontal section on the line *z—z* of Fig. 1. Fig. 3 is a vertical section of the table mechanism on the line *y—y* of Fig. 2. Fig. 4 is a horizontal section of the same on the line *x—x* of Fig. 3. Fig. 5 is a front elevation showing the connections between the driving and feeding mechanisms and the rotary power means, and showing the front of the frame and gear-box broken away. Fig. 6 is a detail in end elevation showing the tumbler mechanism for the feeding means. Fig. 7 is a detail in plan view of the tumbler mechanism for the adjusting screw of the cross-rail. Fig. 8 is an end view of the adjusting means for the cross-slide on the cross-rail. Fig. 9 is an edge elevation of the same. Fig. 10 is a detail in side elevation showing the stationary tool-holder. Fig. 11 is a bottom view of the same. Fig. 12 is a horizontal section on the line *w—w* of Fig. 1. Fig. 13 is a vertical section of the same on the line *v—v* of Fig. 12. Fig. 14 is a vertical section of the same on the line *u—u* of Fig. 12. Fig. 15 is a detail in vertical section on the line *t—t* of Fig. 12. Fig. 16 is a detail in side elevation showing the clamping means for the table. Fig. 17 is a detail showing the adjusting means for eccentrically positioning the journal-piece with relation to the table-arbor, shown in section on the irregular line *s—s* of Fig. 4. Fig. 18 is a detail showing the sliding connection of the table with the table-guide, on the line *r—r* of Fig. 4. Fig. 19 is a plan detail of the shifting mechanism for the clutch operatively connecting the hand-wheel with the table for moving the table by hand. Fig. 20 is a plan view detail partly in section, showing the means for connecting and disconnecting the worm with the worm-wheel of the table-arbor; and, Fig. 21 is an axial section showing the driving connection between the upright shaft and the cross-shaft of the cross-rail, taken on the line *q—q* of Fig. 12.

1 represents the base and 2 the column of the machine-frame.

3 is a work-supporting table, and 4 is a tool-head shown on a cross-slide 5 having lateral adjustment on ways 6 of a cross-rail 7, adjustable up and down on the column on guides 8, a spindle 9 being in the cross-slide.

Means are provided for imparting combined rotary and reciprocating movements to the table for imparting paths of movements to the table of various configurations, whereby the work may be moved with relation to the tool along various lines, dependent upon the tool-position with relation to the axis of rotary movement of the table and the extent and speed of its reciprocating movements with relation to its speed of rotation, the reciprocating movements taking place simultaneously with the rotary movements thereof.

11 is an arbor journaled in bearings 12 of the base.

13 is a gear loose on the arbor.

14 is a gear fast on the arbor.

15 is a shaft journaled in a bearing 16 of the base. It has a gear 17 fast thereon which meshes with the gear 13.

18 is an arm which has a bearing 19 about shaft 15.

20 is a gear secured to shaft 15 and 21 is an intermediate gear shown on a stud 22 on the arm between the gear 20 and the gear 14. Various relative speeds may be imparted between the gear 14 and the gear 13 which I have shown accomplished by changing the gears 20, 21. The shaft 15 is removable, as by releasing the nut 23, whereby the gear 20 may be changed, and the gear 21 is removable by removing the stud 22 and inserting it in a given hole 24 in the arm, of which two are shown and a number may be provided, or other speed changing means employed.

26 is a turning piece, shown as a journal-piece which is adjustable with relation to the gear 13 for placing the same for instance concentric therewith or at various degrees of eccentricity thereto. It has a slideway 27 therein engaging a guide 28 on the gear and arranged to be clamped to the gear by clamp-bolts 29 passing through slots 30 in the journal-piece and into the guide, or the same may be clamped in adjusted positions by the clamp-screws 31 threaded in the journal-piece and pressing the gib 32 between the journal-piece and guide.

33 is a mating piece for the turning-piece and is shown as a bearing-piece about the journal-piece 26, which follows the movements of said journal-piece when the latter is placed eccentric to the arbor 11.

34 is a table-guide. The table has a slideway 35 thereon coacting with the slideway 35′ on the table-guide and is reciprocated thereon. The table-guide is secured to the arbor and rotates therewith. A ring 36 acts as a support for the ends of the table-guide, shoes 37 on the table-guide making contact with the ring.

39 are guide-bars, rigid with relation to the table, as by being secured to lugs 40 depending from the table, the bearing-piece 33 being provided with guide-faces 41 for the guide-bars, and the bearing-piece being preferably supported by having shoulders 42 on the guide-bars received in rabbets 43 in the bearing-piece.

As the arbor 11 turns the table-guide 34 which is rigidly secured thereto turns therewith. If the train of gearing between the gear 14 and the gear 13 is interrupted and the table is secured to the table-guide, as by pins received in holes 44, the table will rotate with the arbor. If the journal-piece is eccentrically located on the arbor and the pins removed, and relative movement is imparted between the arbor and the table, a reciprocating movement in the plane of the table will also be imparted to the table, and the path of movement of the table, and consequently the work thereon, will be the resultant of the two movements, namely rotary and reciprocating, thus imparted to the table. When this relative movement takes place and the journal-piece 26 is eccentrically placed with relation to the arbor, the table will be reciprocated lengthwise of the table-guide 34, the directions of reciprocating movement depending on the radial positions assumed by the table-guide during its rotations. The movement of the bearing-piece along the guide-bars 39 is an idle movement, and the movement of the bearing-piece in directions crosswise of the guide-bars is a movement to effect lateral reciprocations of the table. The extent of these reciprocating movements is determined by the degree of eccentricity to which the journal-piece 26 has been adjusted, and the number of lateral movements with relation to the rotation of the table is dependent on the relative speeds between the arbor and the journal-piece. In practice, in my improved construction, the distance of reciprocating travel of the table is four times the distance between the rotary axis of the arbor and the central axis of the eccentrically placed journal-piece which is parallel thereto.

If the relative speed between the arbor and turning-piece is a one to one speed, that is, a rotation of the journal-piece to a given rotation of the arbor, an elliptical path of travel will be imparted to the table; if the relative speeds between the parts mentioned is two to one, the path of travel of the table will be of general triangular form, and other forms may be provided by variations of the relative speeds of the parts mentioned. The configuration of the cut imparted will also be dependent on the coincidence or lack of coincidence of the cutter with relation to the axis of rotation of the arbor.

It is desirable that the table be positioned for causing its table-guide to extend in a fixed direction when placing the gearing in operative relation so that its reciprocating movements may take place along predetermined paths, and for accomplishing this I provide a stop-pin 46 arranged to engage an aperture 47 in the table, the stop-pin being mounted on a stand 48 adjustably held in a slot 49 in the frame, as by means of T-bolts 50 and nuts 51, the pin or stand or both being arranged to be slid out of range of movement of the table or to be taken off the frame if desired.

In certain characters of work it is desired to clamp the table rigidly to the frame, for which purpose I provide a bracket-stand 52 having a nose 53 received under a peripheral flange 54 of the table, a clamp-block 55 being received over the flange. The parts are clamped together by T-bolts 56 received in T-slots 57 in the frame, and passing through the bracket-stand and clamp-block, and clamped in place by nuts 58. The

bracket-stand is shiftable lengthwise of the slots or may be removed from the frame if desired.

In my improved device provision is made for employing a rotary or a stationary tool, and performing the operative function under employment of the table while the latter is stationary and a rotary tool is employed, or while the table is driven by power, fed by power, or fed or positioned by hand under employment of a rotary or a stationary tool.

65 is a power-shaft to which rotation is imparted by suitable means, as through the cone-pulley 66 in connection with which the back-gearing 67 may also be employed for multiplying the speeds.

68 is a drive-shaft carrying a bevel-pinion 69 meshing with a bevel-gear 70 secured to the arbor 11, the drive-shaft being journaled in a bearing 71 in the frame.

The power-shaft has a gear 72 fast thereon which meshes with a gear 73 loose on the drive-shaft, the hub 74 of which is journaled in a bearing 75 in the frame.

76 is a clutch between the drive-shaft and the gear 73 and has spline connection with the shaft, and is arranged to be operatively engaged with the gear by an operating arm 77 which is secured to a rock-shaft 78 which has on it a fork 79 received in an annular groove 80 in the clutch. If it is desired to drive the table, the clutch 76 is moved into operative position, whereby power is transmitted from the power-shaft to the table for driving the same with a fast movement, for instance when employing a stationary cutter, as in performing planing or shaping operations. By this means a piece of work may be planed or shaped in circular, elliptical or other desired shapes under employment of a stationary tool and a rapidly moving table, and threads may also be chased while rotating the work, insuring accuracy of threads. If it is desired to move the table with a feeding movement, the feeding means for the table are brought into operative relation. This feeding movement is imparted to the table for instance when performing a milling operation, when a rotating tool, for instance a milling cutter, is attached to the tool-spindle and the table is fed for advancing the work comparatively slowly along the path of the cutting it is desired to perform, whether round, elliptical or other desired shape. The feeding movement is also employed when milling threads with a rotary cutter. For effecting these feeding movements I have provided the arbor 11 with a worm-wheel 85, with which a worm 86 is adapted to mesh, the worm being shown mounted on a slide 87 having bearings 88 for the section 89 of the worm-shaft and slidable in a bearing 91 of the base. 92 is a rock-shaft journaled in bearings 93 of the base and provided with an eccentric pin 94 operable in a cross-slot 95 of the slide, a handle 96 being on the rock-shaft. The movement of the handle causes operative or inoperative relation between the worm and worm-wheel.

101 is a nest of worm-gears of different diameters arranged side by side fast on a section 102 of the worm-shaft journaled in bearings 103 of a feed-box 104 secured to the base of the machine. The sections 89 102 of the worm-shaft are connected by the section 105 thereof, there being knuckle-joints 106, 107 between the section 105 and the sections 89, 102 respectively for permitting the lateral movement of the worm 86.

108 is a tumbler-shaft with which a bevel-gear 109 has spline-connection.

111 is a tumbler having bearings 112 about the tumbler-shaft, about which the tumbler is rockable, the tumbler carrying with it a shaft 114 journaled in bearings 115 thereon and carrying a bevel-gear 116 in mesh with the bevel-gear 109, and a worm 117 arranged to be selectively engaged with any of the nest of worm-gears 101 for imparting various speeds of feed from the tumbler-shaft 108 to the worm-gear shaft. For imparting power rotation to the worm-gear feed I provide the shaft 108 with a gear 121.

122 is a rocker-plate swinging on a bearing 123 about the tumbler-shaft. It has on it a gear 124 in mesh with the gear 121 and adapted to engage a pinion 125 on the hub 74 of gear 73.

127 128 are gears on the rocker-plate which rotate together, the gear 127 being in mesh with the gear 121 and the gear 128 being arranged to be brought into mesh with the pinion 125. Either gear 124 or 128 may be brought into mesh with the pinion 125 for imparting selective speeds to that pinion or both said gears may be brought into neutral position for interrupting the train of power feed to the shaft 108, the positions of the gears being determined by the swinging of the rocker-plate 122 by means of a handle 129 provided with a lug 130 arranged to be selectively received in notches 131 of a positioning plate 132, for maintaining the gears in adjusted positions.

The tumbler 111 is provided with a handle 136. It is received through an opening 137 in the feed-box and is arranged to rest in notches 138, the handle being provided with a pull-pin 139 selectively received in holes 140 for operatively engaging the worm 117 with any one of the nest of worm gears 101, dependent on the speed of feeding movement it is desired to impart to the table.

For moving the table by hand, I provide a hand-wheel 144 on a cross-shaft 145 jour-

naled in bearings 146 and having thereon a bevel-pinion 147 in mesh with a bevel-gear 148 loose on the drive-shaft 68.

151 is a clutch between the bevel-gear 148 and the drive-shaft operated by a lever 152 pivoted on a pin 153 in a bracket 154 secured to the feed-box and having thereon a fork 155 received in an annular groove 156 in a sleeve 157 on which part of the clutch-faces are located, the sleeve having spline-connection with the drive-shaft.

In my improved device the power-drive, the power-feed, or the manual movement may be imparted to the table.

A rotary tool 161 may be secured to the spindle. This rotary tool may be in the form of a drill, a milling cutter, or other suitable tool. A stationary tool may also be employed and secured to the spindle. I have shown the same however at 162 secured in an auxiliary holder 163, forming a tool-head, the auxiliary holder having a tool-opening 164 in which the tool is secured by set-screws 165, the holder having a bearing 166 received about the spindle and a bearing 167 received about a rod 168 slidable in a bearing 169 on the cross-slide. Rotary and axial movements may also be imparted to the spindle, and the cross-slide be moved upon the cross-rail. For accomplishing these movements 176 is an upright shaft arranged to be rotated in reverse directions by means of bevel-gears 177 178 with which a bevel-gear 179 meshes.

180 is a clutch-sleeve having spline-connection with the upright shaft, between which and the bevel-gears 177 178 there are clutches 182 183, either of which may be rendered operative for driving either bevel-gear 177 178 or both rendered inoperative for causing the upright shaft to remain at rest. The clutch-sleeve is shifted by a fork 184 received in an annular groove 185 in the sleeve and mounted on a rock-shaft 186, on which an operating arm 187 is secured, positioned by a pull-pin 188 received in selective apertures 189 on the frame. The bevel-gear 179 is secured to a shaft 190 journaled in bearings 191 in the base, and having a gear 192 thereon which meshes with the gear 72.

193 is a bevel-gear journaled in a bearing 194 on the cross-rail and having spline-connection with the upright shaft and meshing with a bevel-gear 195 whose hub is journaled in a bearing 196 on the cross-rail.

197 is a cross-shaft which is journaled in a recess 198 in the end of the hub of bevel-gear 195 and in a bearing 199 on the cross-rail.

The spindle is journaled in bearings 200 of a housing 201 of the cross-slide, the housing being adjustable on the saddle 202 of the cross-slide about the axis of the transmitting gears hereinafter mentioned for positioning the longitudinal axis of the spindle in upright position or at an angle thereto, the same being clamped in adjusted positions by clamp-bolts 203.

204 is a screw having a bore through which the reduced shank 205 of the spindle extends, being held longitudinally with relation thereto by a shoulder 206 and the positioning nuts 207.

208 is a nut received about the spindle screw 204 for moving the same longitudinally, the spindle-screw passing through a bearing 209 on the housing, with which it has spline-connection 210 for preventing turning of the screw. The spindle-nut has gears 211 212 fast thereon with which gears 213 214 mesh. The gear 213 is loose on a shaft 215 and the gear 214 is fast on a sleeve 216 received about said shaft. The shaft is journaled in bearings 217, and the sleeve in a bearing 218. A clutch-sleeve 219 has spline-connection with the shaft. Clutches 220 221 are between the clutch-collar and the respective gears 213, 214, a fork 222 being received in an annular groove 223 of the collar and mounted on a rock-shaft 224 journaled in the housing and operated by an arm 225 for moving the collar into neutral position or for engagement of either of the clutches, the arm being suitably positioned.

A bevel-gear 226 is secured to the shaft 215 and is meshed by a bevel-pinion 227 on a shaft 228 journaled in bearings 229 on the housing and having thereon a nest of gears 230 of various diameters, any one of which is arranged to be made fast to the shaft by a locking shoe 231 on a pull-pin 232 in a bore 233 in the shaft 228, the locking shoe being arranged also to be placed in neutral position, as by being shoved to the end of the bore, for permitting the gear 214 to be turned by a hand-wheel 234 on the sleeve 216, for imparting a quick longitudinal movement to the spindle.

The nest of gears 230 is in mesh with a nest of gears 241 on a sleeve 242 received about a shaft 243 journaled in a bearing 244 of the housing, the sleeve having thereon a hand-wheel 245, the sleeve and shaft being arranged to be secured together by a clutch 246.

If it is desired to feed the spindle by hand, the clutch 246 is released, permitting the hand-wheel and nests of gears to be turned for transmitting movement through a selective one of the nest of gears 230 to the upright shaft for feeding the spindle longitudinally by hand. When gear 213 is clutched to the shaft 215, the nut is arranged for imparting comparatively rapid longitudinally by hand. When gear 213 stance for boring. When the clutch is engaged with the gear 214, the nut is arranged for imparting a slower longitudinal feed to the spindle, for chasing or cutting threads

of a pitch determined by which of the nest of gears is clutched to its shaft, and which may be instanced as quarter inch threads, eighth inch threads, or pipe threads which are eleven and one half to the inch. Under this arrangement the holes can be bored and the threads chased with a stationary tool or milled with a rotary tool under employment of a rotary movement of the table, and without resetting of the piece of work, and accuracy and alinement of the threaded holes assured, as firm relation of the moving parts can be obtained, which is often missing when tapping threads, and holes of large diameters may be threaded economically, as the provision of large diameter taps, which are expensive, is avoided.

The shaft 243 has a bevel-pinion 247 fast thereon which is meshed by a transmitting bevel-gear 248 journaled loosely about the spindle and meshed by a bevel-pinion 249 on a shaft 250 which has a bevel-pinion 251 thereon meshed by a bevel-gear 252 on a sleeve 253 rotating loosely about the cross-shaft 197 and having a gear 254 thereon meshed by a gear 255 on a sleeve 256 having spline-connection with a cross-shaft 257 parallel with the cross-shaft 197 and having a gear 258 fast thereon which is meshed by a gear 259 fast with relation to the bevel-gear 195, whereby feeding motion is imparted to the spindle. The sleeves 253 256 are journaled in bearings of a connecting piece 260 on the saddle and slidable longitudinally of the cross-shaft.

261 is a clutch between the cross-shaft 197 and the bevel gear 195 for causing the cross-shaft 197 to rotate, thereby transmitting driving movement to the spindle. The clutch 261 is operated by a handle 262.

263 is a bevel-gear which has spline-connection with the cross-shaft 197, the hub whereof is journaled in a bearing 264 on the saddle. The bevel-gear 263 meshes with a bevel-gear 265 on a sleeve 266 journaled in a bearing 267 in the saddle and also having fast thereon the bevel-gear 268. The shaft 250 is journaled in the sleeve 266. The bevel-gear 268 meshes with a bevel-gear 269 whose hub is journaled in a bearing 270 of the housing and which has spline-connection 271 with the spindle for rotatively driving the same.

For feeding the cross-slide lengthwise of the cross-rail I provide a cross-feed screw 275 having threaded engagement with the saddle and a ratchet-wheel 276 thereon.

277 is a double-tooth pawl, either of the teeth of which is arranged to be placed in operative engagement with the ratchet-wheel, or the pawl may be placed in neutral position with relation thereto. The pawl is mounted on a rocker-arm 278 which swings about the cross-feed screw. A link 279 connects the rocker-arm with a crank-pin 280 on a crank-block 281 adjustable in a slot 282 of a crank-plate 283 secured to a shaft 284 journaled in a bearing 285 and having a gear 286 thereon which meshes with a gear 287 on the cross-shaft 257. By these means the screw may be turned in either direction or remain idle as desired. It has a square end 288 for the reception of a hand-crank.

For raising or lowering the cross-rail on the column, a screw-rod 291 is journaled in a bearing 292 on the column and has threaded engagement in a nut 293 on the cross-rail. It has a gear 294 secured thereto.

295 is a rocker-plate having a bearing 296 about the screw-rod 291, the upright shaft 176 having a gear 297 thereon. On the plate there is a gear 298 and a pair of gears 299 300. Either gear 298 or 300 is adapted to make engagement with the gear 297 for rotating the screw-rod in either direction for raising or lowering the cross-rail, or the gears are placed in neutral positions, when the cross-rail remains at rest. The plate may be provided with a segment-gear 301 with which a segment-gear 302 meshes, the latter being on a rock-shaft 303 operated by a handle 304, having a positioning-lug 305 thereon arranged to be received in suitable slots in a positioning-plate 306.

Describing the operation of my invention as applied to one of the uses to which it may be put, and instancing that use as the machining of a locomotive dome, it may be stated that a locomotive dome has an elliptically formed man-hole which it is necessary to finish for the reception of the man-hole cover, and the man-hole cover must be finished to fit the man-hole in the dome, the man-hole cover being provided with a laterally extending flange received against the inner face of the wall of the man-hole, the cover closing the hole from the inside of the dome.

The man-hole in practice must be cut out of the solid steel shell of the dome. In practice this has heretofore been accomplished by drilling a series or gang of holes in an elliptical line surrounding the part of the dome which it has been desired to remove, then forcing out the part to be removed, and then chipping off the ridges left between the drill holes. The operation has been tedious and an accurate fit with the cover cannot be obtained thereby. With my improved device I place the dome-head on the table, set the table for an elliptical closed path of travel, insert an ordinary square-nose tool in the tool-head, and then connect up the power driving mechanism for rotating and reciprocating the table during rotation, for imparting an elliptical path of movement to the table, corresponding with the elliptical form for the man-hole it is desired to cut, the tool in the meantime being fed by the

feeding action of the spindle. When this operation has been completed, a facing tool, which projects under the wall of the elliptical hole just cut, is placed in the tool-head, the table driven as before, and the inner face of the wall of the man-hole finished for the reception of the man-hole cover. When this operation has been performed, a milling cutter may be inserted in the spindle, rotation imparted to it, the table-drive thrown into inoperative relation and the table-feed operatively connected with the table, for feeding the table in its predetermined path of movement slowly for operating in conjunction with the rapidly rotating milling cutter, the spindle drive also having meanwhile been thrown into operative relation, and in this manner the vertical wall of the man-hole may be finished. All these operations take place without resetting the parts determining the path of movement of the table, insuring accuracy of movement and coincidence of movement when performing the various cutting operations. These domeheads also are provided with threaded openings, one for the pop-valve, one for the safety-valve, one for the air-brake pipe, and for other purposes. These holes may be formed in manner similar to the formation of the elliptical man-hole, by shifting the position of the dome upon the table so as to bring the center of the hole above the axis of rotation of the table-arbor, or the same may be formed by clamping the table in stationary position and supporting the same upon the nose-block, having positioned the cross-slide and the table selectively to bring the spindle into correct position for boring these holes, and after boring the same, applying a tapping attachment to the spindle for tapping the threads. The man-hole cover may be finished in similar manner to a true fit with the man-hole wall, without intermediate resetting of the parts determining table movement, insuring true matching in form between the engaging faces of the man-hole and its cover. The man-hole or the cover may be first finished.

With my improved device various forms of openings and covers therefor, or mating faces of various configurations on different parts may be accurately formed to fit each other, as readily as round openings and covers or parts received thereby have heretofore been formed on an ordinary boring mill. Other operations than those instanced may be performed by employment of my invention.

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

1. In a metal working machine of the character described, the combination of a tool-head, a table, a table-guide having guiding connection with said table, means for rotating said table-guide, and means for imparting linear movements to said table along said table-guide comprising a rotatable element, said last-named rotatable element and said means for rotating said table-guide being connected for relatively timed movements.

2. In a metal working machine of the character described, the combination of a tool-head, a table, a table-guide having guiding connection with said table, means for rotating said table-guide, means for imparting linear movements to said table along said table-guide comprising a rotatable element, said last-named rotatable element and said means for rotating said table-guide being connected for relatively timed movements, and means for changing the relative speeds of rotation between said rotatable element and said means for rotating said table-guide.

3. In a metal working machine of the character described, the combination of a tool-head, a table, a table-guide having linear guiding connection with said table, a rotating part for rotating said table-guide, means for reciprocating said table simultaneously with the rotary movements of the said table-guide, said last-named means comprising a rotating element, and means for relatively adjusting the speeds of rotation between said rotating element and said rotating part, and thereby controlling the paths of movement of said table with relation to said tool-head, substantially for the purpose described.

4. In a metal working machine of the character described, the combination of a tool-head, a table, a rotatable table-guide, means for rotating said table-guide, rotating eccentric means operated by the latter for reciprocating said table on said table-guide during rotations of the latter, means for adjusting the relative speeds of rotations between said last-named means and said rotatable table-guide, and means for locking said table and table-guide together, substantially for the purpose described.

5. In a metal working machine of the character described, the combination of a tool-head, a table, an arbor, a table-guide rotated thereby and provided with a guideway for linear movements of said table extending at substantially right angles to said arbor, a gear loose about said arbor, an eccentric thereon, the said eccentric having slide connection with said table and thereby reciprocating said table lengthwise of said guideway during rotations of said table-guide, and causing travel of said table with relation to said tool-head, substantially for the purpose described.

6. In a metal working machine, the combination of a tool-head, a table opposed thereto, an arbor, a table-guide rotated thereby

and provided with a guideway for linear movements of said table extending at substantially right angles to said arbor, a gear loose about said arbor, a turning piece adjustable thereon with relation to its axis of rotation, a gear on said arbor, transmitting gearing between said gears, and a mating piece for said turning piece having slide-connection with said table for reciprocating said table lengthwise of said guideway, substantially for the purpose described.

7. In a metal working machine, the combination of a tool-head, a table opposed thereto, an arbor, a table-guide secured to said arbor and provided with a guideway for linear movements of said table extending at substantially right angles to said arbor, a thrust-ring for support of said table-guide, a gear loose about said arbor, a turning piece adjustable on said gear with relation to its axis of rotation, a mating-piece therefor having idle slide-connection with said table in one direction and moving said table lengthwise of said guideway at substantial right angles to said last-named direction, and speed-change means between said arbor and gear for changing the speed of rotation of said turning-piece with relation to the speed of rotation of said table-guide, substantially for the purpose described.

8. In a metal working machine, the combination of a tool-head, a table opposed thereto, an arbor, a table-guide secured to said arbor and provided with a guideway for linear movements of said table extending at substantially right angles to said arbor, a thrust-ring for support of said table-guide, a gear loose about said arbor, a turning piece adjustable on said gear with relation to its axis of rotation, a mating-piece therefor having idle slide-connection with said table in one direction and moving said table lengthwise of said guideway at substantial right angles to said last-named direction, and speed-change means between said arbor and gear for changing the speed of rotation of said turning-piece with relation to the speed of rotation of said table-guide, and means for locking said table and table-guide together, substantially for the purpose described.

9. In a metal working machine, the combination of a table, a table-guide with which said table has linear guiding connection, means for rotatively driving said table-guide, means for rotatively feeding said table-guide, rotating power means, means for reciprocating said table lengthwise of said table-guide, and means for selectively operatively connecting said first-named means or said second-named means with said rotating power means, substantially for the purpose described.

10. In a metal working machine, the combination of a table, a table-guide with which said table has linear guiding connection, means for rotatively driving said table-guide, means for rotatively feeding said table-guide, means for manually turning said table-guide, means for reciprocating said table lengthwise of said table-guide, and means for selectively operatively connecting any of said first three named means with said table, substantially for the purpose described.

11. In a metal working machine of the character described, the combination of a tool-head comprising means for reception of a rotary tool and a stationary tool, and means for rotating said rotary tool, a table thereunder, a rotatable table-guide, an arbor for the the latter, means between said table and arbor for reciprocating said table lengthwise of said table-guide during rotation of the latter, rotating power means, and feeding means for said table comprising power means for rotatively driving said table-guide at comparatively high speed, means for feeding said table at comparatively slow speed, and means for selectively engaging said driving means or said feeding means with said rotating power means, substantially as described.

12. In a machine of the character described, the combination of a table, an arbor, a table-guide for said arbor provided with a guideway extending at substantial right angles to said arbor, a gear loose about said arbor, an eccentric therefor for reciprocating said table lengthwise of said table-guide, gearing between said first-named gear and said arbor, and a positioning stop for locating correct operative angular position of said table-guide with relation to said gearing, substantially for the purpose described.

13. In a metal working machine of the character described, the combination of a table, an arbor, a table-guide rotated by said arbor and provided with a guideway extending at substantial right angles to said arbor, a gear loose about said arbor, an eccentric turning-piece adjustable thereon, a mating-piece for said turning-piece having slide connection with said table for reciprocating said table lengthwise of said guideway, a gear secured to said arbor, speed-change gearing between said gears, and a positioning stop locating said table-guide in angular relation to said train of speed-change gearing, substantially for the purpose described.

14. In a metal working machine of the character described, the combination of a frame, a cross-rail thereon, a cross-slide adjustable on said cross-rail, a tool-head therefor, a table thereunder, an arbor under said table, a table-guide for said arbor provided with a guideway extending at substantial right angles to said arbor, a gear loose about

said arbor, a turning-piece adjustable thereon with relation to its axis of rotation, a gear on said arbor, transmitting gearing between said gears, a mating-piece for said turning-piece having slide-connection with said table for reciprocating said table lengthwise of said guideway during rotation of said table-guide, said turning-piece adjustable to a position concentric with said arbor, a peripheral support for said table, and a clamp for said table coacting with said support, substantially as described.

In testimony whereof, I have signed my name hereto in the presence of two subscribing witnesses.

CHARLES C. WAIS.

Witnesses:
EDWARD SOUTHWORTH,
LILLIAN BURNETT.

Corrections in Letters Patent No. 1,046,691.

It is hereby certified that in Letters Patent No. 1,046,691, granted December 10, 1912, upon the application of Charles C. Wais, of Oakley, Ohio, for an improvement in "Metal-Working Machinery," errors appear in the printed specification requiring correction as follows: Page 7, line 82, strike out the article "the," second occurrence; same page, lines 85–87, after the word "means" strike out the comma and the words "and feeding means for said table comprising power means;" and that the said Letters Patent should be read with these corrections therein, that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of January, A. D., 1913.

[SEAL.]

C. C. BILLINGS,
Acting Commissioner of Patents.

said arbor, a turning-piece adjustable thereon with relation to its axis of rotation, a gear on said arbor, transmitting gearing between said gears, a mating-piece for said turning-piece having slide-connection with said table for reciprocating said table lengthwise of said guideway during rotation of said table-guide, said turning-piece adjustable to a position concentric with said arbor, a peripheral support for said table, and a clamp for said table coacting with said support, substantially as described.

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