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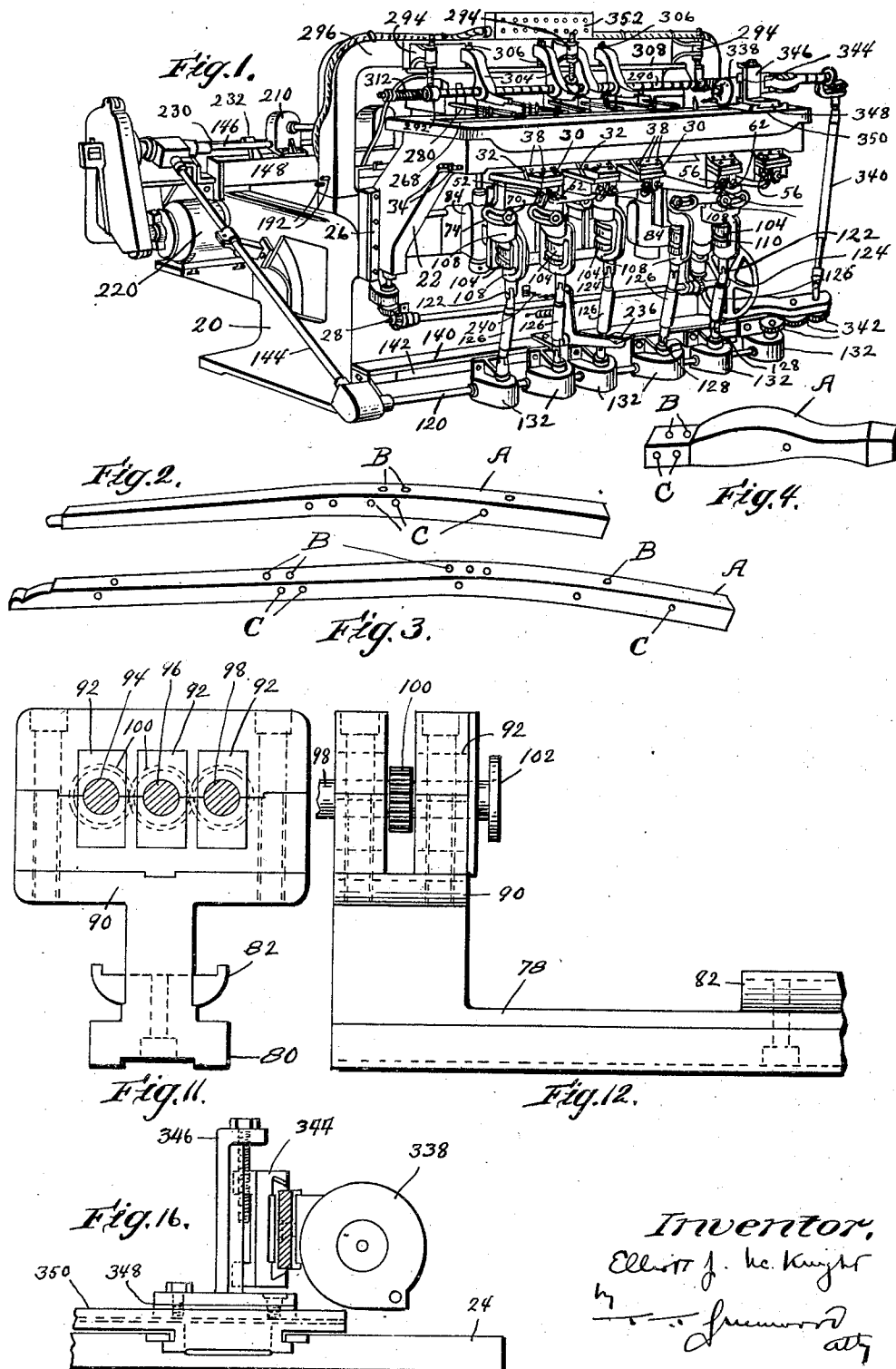
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MULTIPLE SPINDLE BORING MACHINE

Filed July 15, 1930

6 Sheets-Sheet 1



May 17, 1932.

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MULTIPLE SPINDLE BORING MACHINE

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6 Sheets-Sheet 2

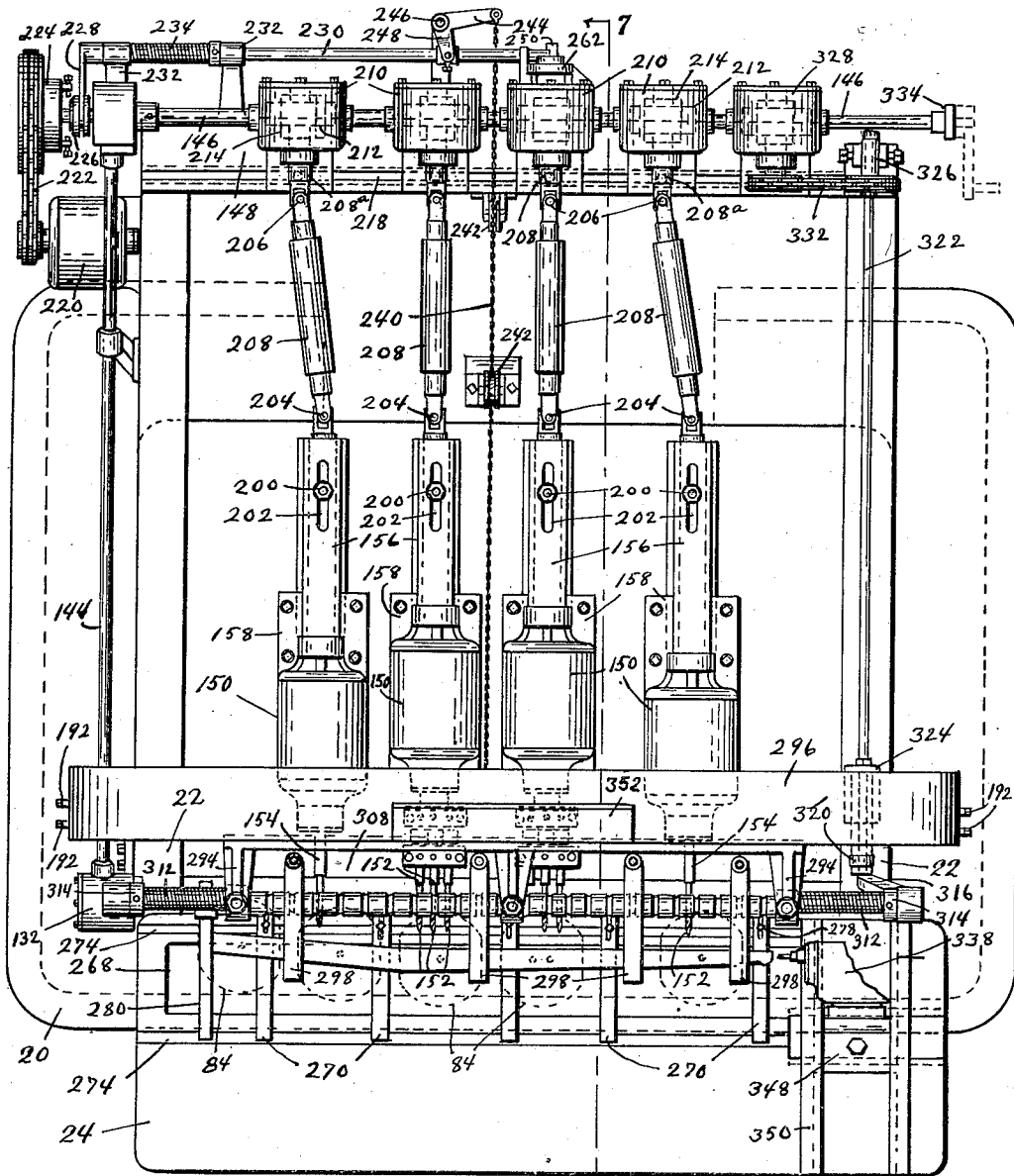


Fig. 5. ← 7

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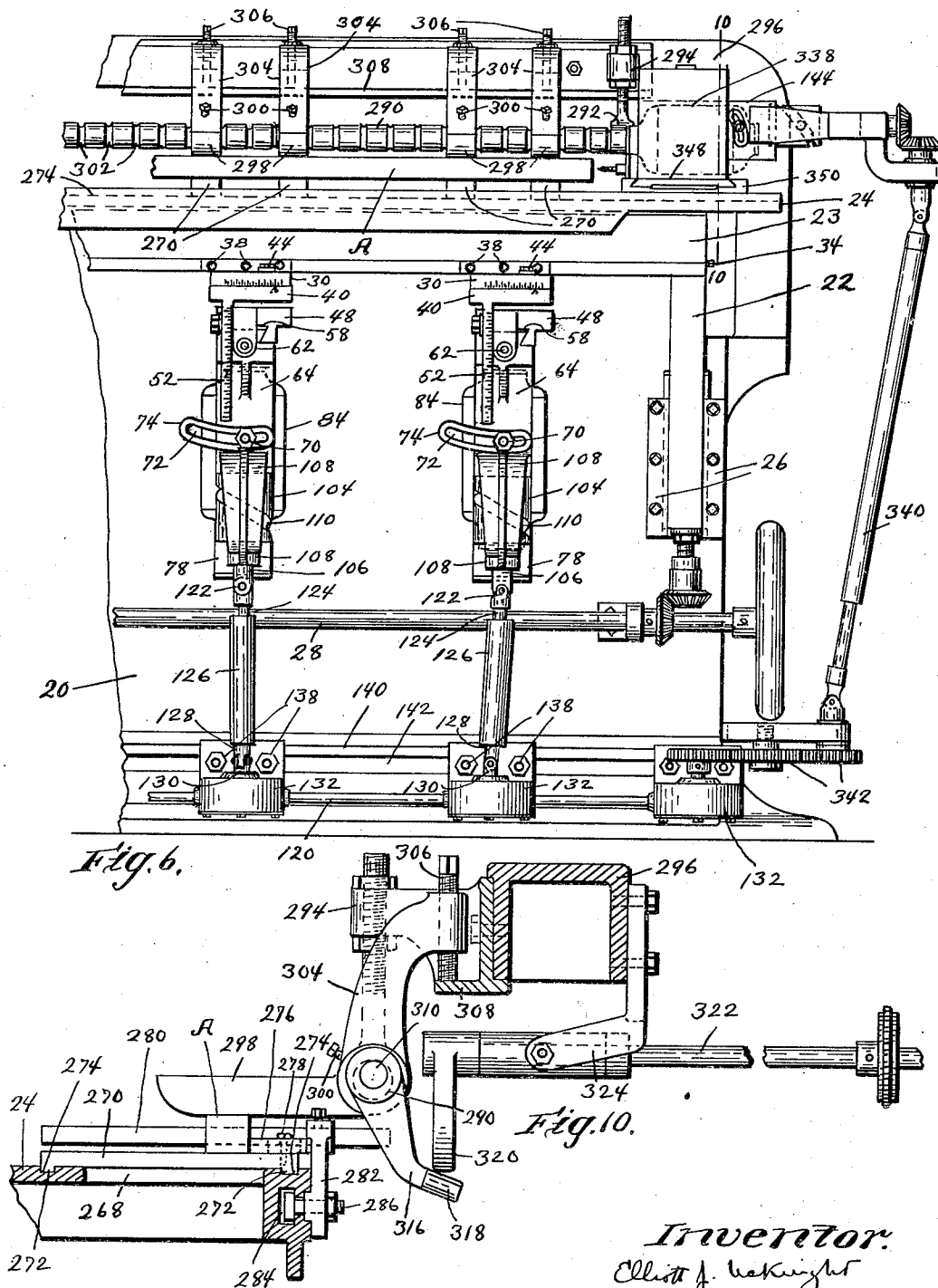
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MULTIPLE SPINDLE BORING MACHINE

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6 Sheets-Sheet 3



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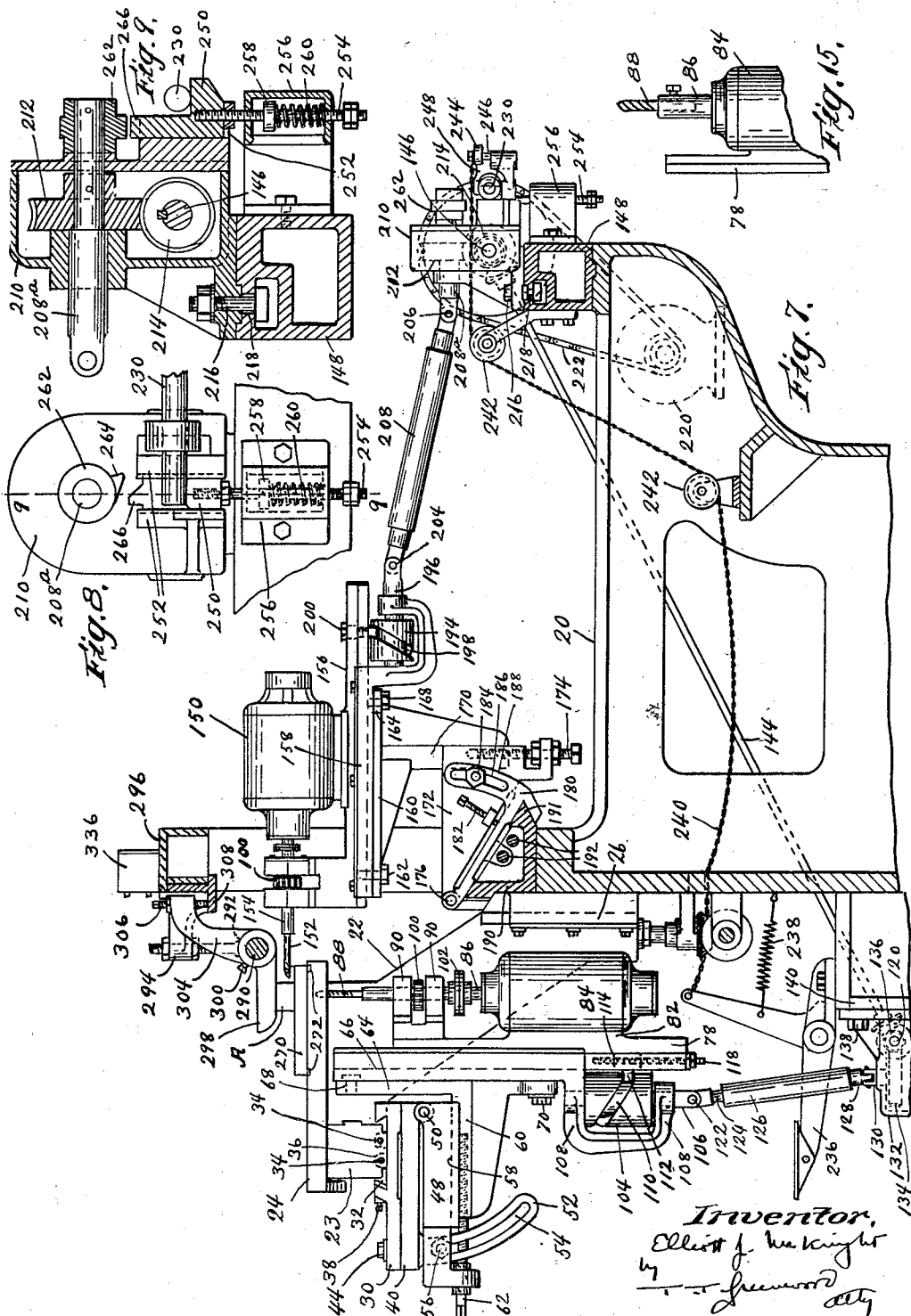
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MULTIPLE SPINDLE BORING MACHINE

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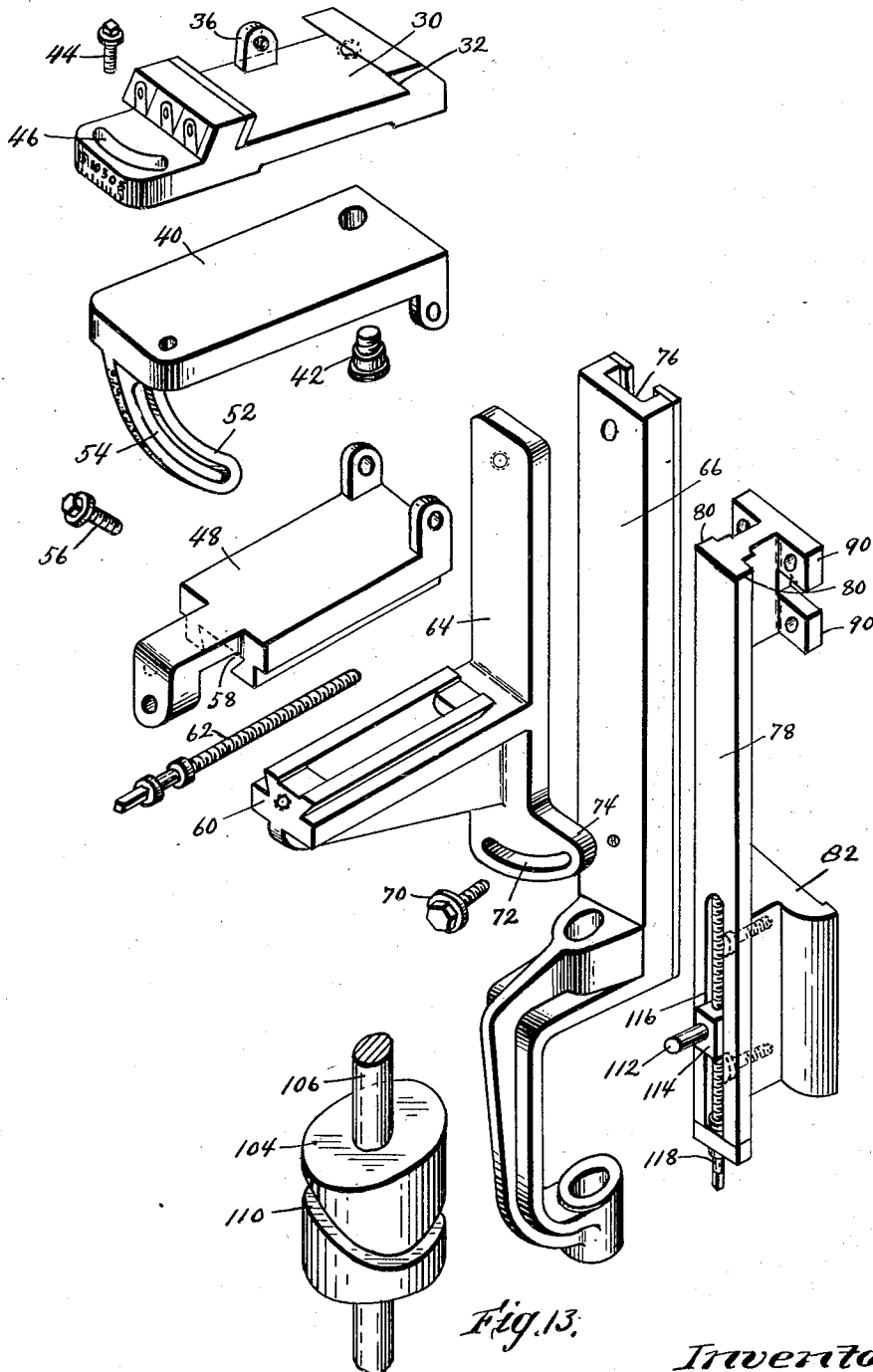
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6 Sheets-Sheet 5



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MULTIPLE SPINDLE BORING MACHINE

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6 Sheets-Sheet 6

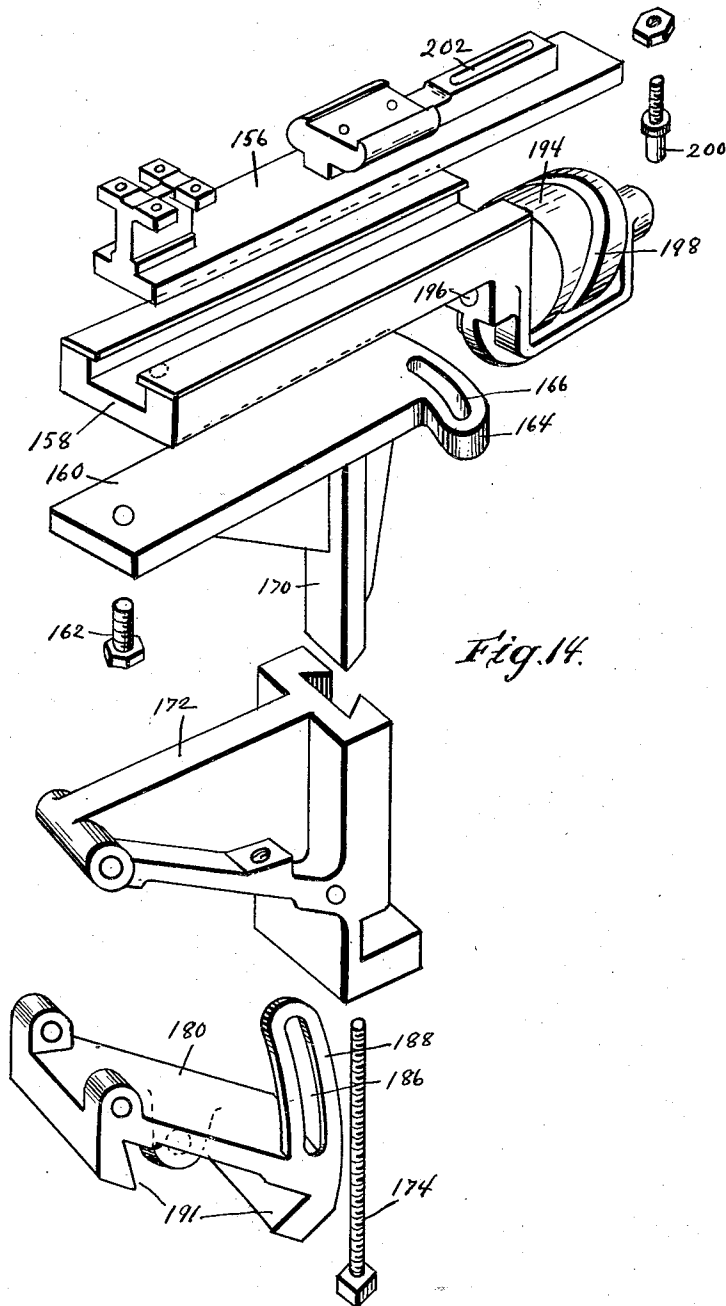


Fig. 14.

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UNITED STATES PATENT OFFICE

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MULTIPLE SPINDLE BORING MACHINE

Application filed July 15, 1930. Serial No. 468,174.

This invention relates to woodworking machines and particularly to multiple spindle boring machines.

In the manufacture of furniture and, particularly, chairs, certain parts are required to have a relatively large number of dowel holes in different and angularly-related faces thereof. The back post of a chair, for instance, is required to have a plurality of holes in two faces thereof to receive the chair rungs and dowels for attaching the chair seat, the back and the arms. The dowel holes in each face are required to be predetermined distances apart and the location of the dowel holes in the two faces are correlated. Some of the dowel holes are adapted to be perpendicular while others may be inclined to the face of the chair post. Multiple spindle boring machines that can bore a plurality of variously-inclined holes at one operation in one face only of a piece of stock, are common in the art. A chair post, as above described, can be bored in such a machine but it necessitates running the work twice through the machine, and two complete set-ups or adjustments of the machine, since the number and arrangement of the holes in the two faces of the stock are different. Some boring machines have been provided with two spindles held in unchanging angular relation for boring holes in angularly-related faces of a special piece of work but the holes can not be simultaneously bored and usually the stock has to be shifted in position between consecutive operations. Furthermore, such a machine cannot be adjusted to operate on various classes of work, and so has but a restricted use.

It is an object of the present invention to provide an improved boring machine adapted to bore a plurality of holes simultaneously and automatically in two angularly-related faces of pieces of stock of a variety of shapes and dimensions with provision for boring each hole at any depth and angle desired so that the machine at one operation can form the complicated system of holes in the angularly related faces of such a piece of stock as a chair leg or post, thereby greatly increasing the output of a factory and reducing the unit expense.

In the usual form of multiple spindle boring machines, the work is adapted to be held by hand in boring position, or, in some instances, it is held by a manually-operated clamp, or in other instances, by a spring-supported pressure post carried by and movable with the bit spindle. An object of the present invention is the provision of a multiple spindle boring machine adapted to bore a plurality of holes in angularly related faces of the stock and having power means operated independently of movements of the bit spindles arranged automatically to clamp the stock when the machine is released for the boring operation.

In the usual multiple spindle boring machine, it is common to have the bits sunk into and withdrawn from the stock by hand. It is an object of the present invention to have clutch-controlled, power-operated means for doing this work and so arranged that the depression and subsequent release of a control lever connects a continuously-operating motor with the carriages of the bit spindles to reciprocate them into and out of the work and thereupon disengages them automatically in withdrawn position from the motor.

It has been the general practice, heretofore, to drive the bit spindles of multiple spindle boring machines by belts. Since the holes are required to be bored in different locations and at different angles, the belt drive necessitates either rapidly rotating universal joints between the bits and the driving pulleys, or a system of belting which permits the belt pulleys to be located in many angular positions, either of which requires a complicated mechanical construction. It is an object of the present invention to drive each bit spindle by a separate electric motor with the bit directly driven by the motor shaft and to support the motor for adjustment into any one of various angularly-related positions, thus greatly simplifying the mechanical construction of the machine, eliminating the necessity for rapidly-rotating universal joints in the driving shafts of the bits, and providing abundant power for each bit and eliminating the necessity for rotating more bit spindles than may be actually required.

A further object of the invention is generally to improve the construction and operation of multiple spindle boring machines.

Fig. 1 is a perspective view of the multiple spindle boring machine embodying the present invention.

Figs. 2, 3 and 4, are perspective views of various kinds of stock adapted to be operated upon by the machine of Fig. 1.

Fig. 5 is a plan view of the machine of Fig. 1.

Fig. 6 is a partial front elevation of the right hand end of the machine of Fig. 1.

Fig. 7 is a sectional elevation taken along line 7—7 of Fig. 5.

Fig. 8 is a rear view of a middle one of the horizontal line of gear boxes for reciprocating the horizontal bits and illustrating particularly the lock for the clutch of the shaft for reciprocating the horizontal motors and their bit spindles.

Fig. 9 is a section along line 9—9 of Fig. 8.

Fig. 10 is a section taken along line 10—10 of Fig. 6 and illustrating particularly the work-clamping mechanism.

Figs. 11 and 12 are end and side elevations respectively of one of the motor carriages for supporting a cluster of bit spindles.

Fig. 13 is an exploded view of the supporting mechanism for a vertical spindle-driving motor.

Fig. 14 is an exploded view of the supporting mechanism for a horizontal spindle-driving motor.

Fig. 15 is a detail view of one of the end motors showing the direct connection between the bit and the motor shaft.

Fig. 16 is a detailed end elevation of the driving and supporting mechanism for the end spindle.

The machine herein illustrated is adapted to bore holes in different pieces of stock having a large variety of shapes some of which are illustrated in Figs. 2, 3 and 4. Figs. 2 and 3 illustrate the back legs or posts of different types of chairs and Fig. 4 illustrates a front leg of a chair. The work, however, is not confined to chair stock. The stock is not necessarily straight as the back chair post A of Fig. 3 is bent so that the holes B in the top face of the stock are not in alignment. The holes C in the side face of the stock may be in alignment but, if they are of equal depth, necessitate a different setting for each bit since one part of the work would ordinarily be closer to a bit than another part of the work. The machine has provision for boring all of the holes simultaneously and for boring each hole at any desired depth, angle or position in the stock, regardless of the other holes.

The machine includes the supporting frame 20 having forwardly directed side brackets 22 which are rigidly connected by a horizontal beam 23 which supports a work-supporting

table 24 that is substantially co-extensive with the length of the machine. The table-brackets are supported for vertical adjustment in ways 26, one of which is shown in Fig. 1, so that the stock carried by the table can be positioned in proper location with respect to the horizontal line of bits. The table can be raised and lowered in any suitable manner by means including the shaft 28.

The beam 23 carries a plurality of independent vertical bit spindles which are independently driven by electric motors and are independently adjustable lengthwise of the table and in various angularly related planes and all are reciprocated vertically simultaneously.

Figs. 6, 7 and 13 illustrate most clearly the construction of the supporting mechanism for a spindle, the supporting mechanisms being identical with all of the spindles except that some driving motors may carry a single bit and other driving motors may drive a cluster of bits.

As shown in the above figures, each spindle supporting mechanism or bracket includes the horizontal plate 30 which is disposed beneath the beam 23 and is slidable lengthwise thereof, on ways 32. Each bracket is independently movable lengthwise of said beam by a screw-threaded shaft 34 which is rotatably supported in the beam 23 against axial displacement thereon and has a screw threaded connection with an ear 36 of the plate 30. Since there are four spindle supporting brackets here shown there are four screw shafts 34, each connected with a separate one of said brackets and two being extended beyond one end of the table and two being extended beyond the other end of the table, the ends of two of said shafts being illustrated in Fig. 1. By applying a suitable crank to any one of the extended ends of said shafts, they can be rotated to move the bracket connected therewith lengthwise of the table. The bracket can be locked in set position by the set screw 38.

A plate 40 is located upon the lower face of the plate 30 and is pivoted thereto at its rear end by the pivot screw 42 so that said plate 40 can be moved in a horizontal plane into any one of various angular positions with respect to the plate 30, whereby correspondingly to move the bit spindle. The plate 40 is locked in any angular setting thereof by a lock bolt 44 which is screw-threaded in the plate 40 and operates in an arcuate slot 46 in the plate 30. The front face of the plate 40 bears a witness line which registers with a series of angle indicia carried by the front face of the plate 30 whereby to indicate the angular setting of the plate 40.

A third plate 48 is disposed beneath the plate 40 and is pivoted by a horizontal shaft 50 to the rear end of said plate so that said plate 48 can be moved vertically into various

angular positions. An arcuate ear 52 depends below the plate 40 and over a side face of the plate 48 and has an arcuate slot 54 therein in which a clamping bolt 56 is located. Said bolt is screw threaded into said plate 48 and thus can lock said plate 48 to said plate 40 in any one of a variety of angular positions whereby to hold the bit spindle in a corresponding position. As before, the side face of the plate 48 has a witness line which registers with various angle indicia carried by the front face of the ear 52 whereby to indicate the angular setting of the plate 48. Said plate 48 is provided in its under face with a horizontal guideway 58 in which a bracket 60 is horizontally slidable forwardly and rearwardly. A screw threaded shaft 62 is rotatable in said plate 48 and is fixed against axial displacement therein and has a screw threaded connection with said bracket 60 whereby the bracket 60 can be moved horizontally along said plate 48 and hold it in any set position therein. Suitable indicia not herein shown are provided on adjacent faces of the bracket 60 and the plate 48 to indicate in inches the setting of said bracket 60 away from a normal position on said plate. Thus, by moving said bracket 60 forwardly or rearwardly, the bit is moved correspondingly. The bracket 60 is provided with a vertically upstanding plate 64 against the rear face of which a vertical plate 66 is located, said plate constituting a supporting member for the carriage of a driving motor of a vertical bit spindle. Said plate 66 is pivoted to the upper end of said bracket plate 64 by a pivot screw 68 so that said plate 66 can be moved angularly in a vertical plane toward one end or the other of the work supporting table. Said plate 66 is clamped in any angular setting thereof by a bolt 70 which is screw threaded thereinto and is loosely extended through an arcuate slot 72 in an arcuate ear 74 of said bracket 60. Suitable angle-indicating indicia are provided between said ear 74 and the plate 66 to indicate the angular setting of said plate. Said plate 66 is provided with a vertical T slot 76 extending lengthwise thereof which constitutes a track in which the motor carriage 78 is reciprocable. Said carriage consists essentially of a bar having extensions 80 at the opposite sides thereof which are slidably located in said track 76. Said bar has a seat 82 on its rear face on which an electric motor 84 is secured, the motor having a vertical shaft 86 that drives a bit 88. For some purposes, the motor is adapted to drive but a single bit in which case the bit can be secured in an axial recess of the motor shaft as is the case with an end motor of Fig. 5. In Fig. 7, however, the motor drives a cluster of bits. With this construction, the motor carriage 78 is provided at its upper end with pedestals 90 having bearings 92 therein in

which three bit spindles 94, 96 and 98, respectively are rotatable, each spindle driving a bit 88. The spindles are geared together for conjoint rotation by the gears 100. The center spindle 98 is driven by the motor shaft 86 through a coupling 102. The number of bits in the cluster can be varied to suit specific requirements.

With the supporting means for the motor as above described, it is apparent that the motor and the bit driven thereby can be moved horizontally forward or rearward, or lengthwise, of the table, inclined in a vertical direction forwardly, inclined with respect to the median line of the table, and also moved about a vertical axis.

The motor is reciprocated vertically to move its bit into and out of the work carried by the table by means of a cam cylinder 104 fixed to a vertical shaft 106 and located between and journaled in forwardly extending horizontal arms 108 of the carriage-supporting plate 66. Said cam cylinder is provided with an endless cam groove 110 in its periphery in which a cam follower or pin 112 is located. Said pin is carried by the motor carriage 78 and is connected with a block 114 which is located within and is adjustable lengthwise of a vertical guide slot 116 formed in the motor carriage 78. The position of the block 114 with respect to the motor carriage is determined by an adjusting screw 118 which is rotatable in said carriage and is fixed against axial displacement therein and is screw threaded into said block. Thus, by varying the position of said block with respect to said carriage, the driving motor and the bit or bits associated therewith can be raised and lowered with respect to the work carried by the table, thereby providing for the boring of holes to different depths in the work, the stroke of the bit provided by the cam 110 being fixed. The cam is rotated by actuating mechanism which includes a horizontal drive shaft 120 located at the bottom of the machine beneath the table through an extensible and flexible driving connection. To this end, the cam shaft 106 has a pivotal connection 122 with the upper end of a shaft 124, which shaft is slidable within and has a splined driving connection with the tube 126. The bottom end of said tube has a pivotal connection 128 with a vertical shaft 130 journaled in a gear housing 132. The pivotal connections 122 and 128 are in the form of universal joints and the sliding connection between the shaft 124 and the tube 126 provides means whereby the motor-supporting parts can be moved into various angularly-adjusted positions without disconnecting said driving connection. Said shaft 130 carries, within said housing, a worm gear 134 which is in mesh with a worm 136 driven by the shaft 120 and having an axially slidable connection there-

with. Said gear housing 132 is secured by means of bolts 138 to the front face of the supporting beam 140 and is longitudinally adjustable into any one of various longitudinal positions thereon, the bolts 138 having their heads received in longitudinal T-slots 142 of said beam.

The shaft 120 has a bevel gear connection with a shaft 144 which, at its upper end, has a bevel gear connection with a shaft 146 that is extended lengthwise of the frame 20 in the rear thereof and above the rear beam 148 and serves to reciprocate the horizontal line of motors in a manner hereinafter to be described. The two shafts 146 and 120 rotate positively at the same speed.

The horizontal motors 150 are in general identical with the vertical motors 84, and either have bits 152 which are driven directly by the motor shafts 154, as is the case with the end motors, Fig. 5, or drive a cluster of bits in the manner heretofore described. The supporting mechanism or brackets for each motor and the reciprocating mechanism thereof are identical and so but one need be described.

The motor 150 is fixed to a horizontal carriage 156 which is horizontally reciprocable in ears of a horizontal carriage supporting plate 158, which plate rests upon the upper horizontal plate 160 forming part of a supporting bracket and is pivoted to the front end thereof by a pivot pin 162. Said plate is provided with a laterally horizontally extended ear 164 having an arcuate slot 166 therein through which a clamping bolt 168 is extended whereby the plate 158 can be secured in any angular setting thereof. Said bracket has a vertically depending plate or slide 170 which is vertically slidably received in ways of a hinged member 172. Said bracket can be raised and lowered vertically in said hinged member by means of an adjusting screw 174 which is rotatable in said hinged member and is fixed against axial displacement therein and is screw-threaded in said slide 170. The hinged member 172 is pivoted at its forward end on a horizontal shaft 176 which is carried by a supporting plate 180. Said member 172 can be raised and lowered vertically about its shaft 176 into any desired position with respect to said plate by means of an adjusting screw 182 which is screw threaded in said member and bears upon said plate. A clamping bolt 184 is screw-threaded in said member and is passed loosely through an arcuate slot 186 in an upwardly extended ear 188 in said plate whereby to clamp said hinged member in any angular setting thereof. Said plate 180 is carried by a horizontal beam 190 which is carried by the frame 20 and extends lengthwise of and beneath the table, and has ways 191 on which said plate is movable lengthwise whereby to move the motor carried by it into any desired

position lengthwise of the table. An operating screw 192 is screw-threaded in said plate and extends lengthwise of said beam and is rotatable therein and is fixed against axial movement. The end of said screw is terminated beyond the end of the beam so that the screw can be rotated by means of a detachable crank which is adapted to be applied to said extended end. Each motor carriage is provided with an independent screw shaft 192 so that each motor can be moved horizontally independent of all other motors. Each motor is reciprocated horizontally by means of a cam cylinder 194 which is fixed to a shaft 196 journaled in the plate 158. The cam cylinder is provided with an endless peripheral cam groove 198 in which a cam pin 200 is received. Said cam pin is connected with the motor carriage 156 but is adjustably located in a slot 202 thereof so that the motor can be moved forwardly or rearwardly by changing the position of the pin in the slot and reciprocating it in any set position, thereby to vary the depth of the hole bored by the motor. The motor is reciprocated from the shaft 146 by means including the universal joints 204 and 206 and the interposed telescoping driving connection 208 which is constructed as has been previously described in connection with the vertical motors. The shaft 208^a of the universal joint 206 is journaled in a gear housing 210 and has a worm gear 212 thereon which is in mesh with a worm 214 rotatably fixed to and slidable axially on the shaft 146. The gear housing 210 is carried by the beam 148 and can be moved into any desired position lengthwise of said beam and secured in said position by means of bolts 216, the heads of which are located in a T-slot 218 which is extended lengthwise of the beam. As thus arranged, the motors can be moved horizontally into any desired position with respect to the work table and the driving gears therefor can be moved into line therewith or, if not into line, into some suitable location with respect thereto so as to reduce the angularity of the motor reciprocating driving connections.

All of the horizontal and vertical line of motors are reciprocated simultaneously by means including the electric motor 220 which is supported on a bracket of the frame 20. Said motor is maintained continuously in operation and drives through a chain 222 one element of a clutch mechanism 224 which is rotatable on the shaft 146. Said element is clutched to the shaft 146 by operating mechanism which includes the cone 226 which, when moved to the left, Fig. 5, sets the clutch and connects the motor to the shaft 146 and when moved in the opposite direction frees the motor from the shaft. The cone 226 is moved axially of the shaft by means of a bifurcated arm 228 that is fixed to an axially movable shaft 230 which is slidable in bear-

ing brackets 232 carried by the beam 148. A coil compression spring 234 encircles said shaft and bears thereagainst and also against one of the brackets to urge said shaft and cone constantly in a clutch-free position. The shaft is moved axially toward the left into a clutch-setting position by means of a pedal 236 which is pivotally supported at the front of the machine beneath the table and is held yieldingly in elevated or unoperated position by the spring 238. A flexible cable 240 extends from said pedal over guide sheaves 242 to one arm 244 of a bell crank lever which is pivoted on a vertical pin 246 carried by the beam 148. The other arm 248 of said lever has an operative connection with the shaft 230 so that when said pedal is depressed, said shaft is moved to the left to set the clutch and effect the reciprocatory movement of all of the motors simultaneously. When the pedal is released, the spring 234 automatically moves the shaft in the opposite direction and disconnects the driving and driven members of the clutch. Means are provided to hold the shaft 130 in clutch-set position for one complete cycle of reciprocatory movement of the spindle-motors and then to disengage the clutch whereby to stop the reciprocatory movement with the motors in withdrawn position. To this end, a locking pin 250, see especially Figs. 8 and 9, is vertically slidably received in ways 252 of one of the middle gear housings 210. A rod 254 is connected with and extends downwardly from said key and is slidable through a bracket 256 carried by the beam 148. A collar 258 is fixed to said rod and a compression spring 260 encircles said rod and bears against the collar and against said bracket whereby to urge said key upwardly. When said shaft 230 is in clutch-disengaged position, it is located above said key and thereby holds it in depressed position. When said shaft is moved into a clutch-setting position, however, it moves horizontally away from said key, thereby permitting the key to move upwardly under influence of said spring 260 into the path of movement of the shaft, thereby holding the clutch set. The key is depressed automatically at the end of each complete reciprocatory movement of the spindle-motors by a cam 262 which is fixed to the end of the middle gear shaft 208^a and has a cam projection 264 which is rotatable into and out of engagement with a cam projection 266 carried by said key. Thus, when said cam projection 264 engages and depresses the key, it permits the clutch to become disengaged and thereby stops the reciprocatory movement of the motors with the motors in extreme withdrawn position. Since the cam is in engagement with the key for but a short portion of a complete revolution, the depression and immediate release of the treadle 236 is sufficient to effect one complete reciproca-

tory movement of the motors to move the bits driven by them into and out of the work carried by the work table 24.

The work table has a longitudinally-extended opening 268 which is of substantial width so that the bits can reciprocate there-through in any of the various adjustments thereof into and out of engagement with the work. The work is supported upon a plurality of work supports 270 which consist of bars that transversely overlie the opening 268 and have depending projections 272 which are slidably received in grooves 274 that are extended lengthwise of the table on opposite sides of the opening therein so that the bars can be moved into any desired position lengthwise of the table and are held against transverse movement under urge of the stock that is acted upon by the horizontal line of bits. Plates 276 are received on the upper faces of said work supports at the rear ends thereof and constitute back-stop members against which the work A is placed to define the operative position thereof with respect to the bits. Said plates have longitudinal slots therein in which bolts 278, screw-threaded in said bars 270, are received, whereby to secure the stop-members in any adjusted position lengthwise of the bars. An end-stop member comprising a bar 280 overlies the work table and is adapted to be engaged by one end of the work so that the holes in duplicate pieces of work will all be bored in the same position from this end of the work. Said bar 280 is longitudinally adjustable in a bracket 282 which is slidable in a longitudinal T-shaped groove 284 in the rear edge of the table and is clamped in any adjusted position thereon by the bolt 286, the head of which is located in said groove.

Means are provided to clamp the work upon the work supporting bars 270 at a plurality of changeable locations along the length of the work. Said means includes an eccentric clamping shaft 290 which is located horizontally above the work-supporting table and is journaled in bearings 292 which are vertically adjustable in brackets 294 fixed to the front face of a horizontal top beam 296 carried by the frame of the machine above and behind the table. A plurality of horizontal clamping feet 298 are received loosely on said shaft and overlie the table. Said clamping feet are adjustable lengthwise of the shaft and are secured loosely thereto against unintentional axial displacement by means of screws 300, the ends of which can be located in any one of a plurality of peripheral grooves 302 in said shaft. Said feet have vertical arms 304 that are provided with vertically adjustable fulcrum screws 306 the lower ends of which bear upon a forwardly extended flange 308 of said beam 296. The opposite ends 310 of said shaft and those portions thereof that are rotatably supported by

bearings 292 are eccentric with respect to the feet-supporting portion of the shaft so that when the shaft is rotated about a greater turn, the feet are caused to be moved downwardly with considerable pressure into firm engagement with the work, the feet pivoting upon the fulcrum screws 306. The shaft is rotated in a work clamping direction by means of helical springs 312 which encircle the ends of the shaft and have their outer ends connected with collars 314 fixed to the shaft and their inner ends connected with the shaft end-bearings 292.

The operation of the springs on the shaft is controlled by the motor reciprocating mechanism. To this end, an arm 316 is fixed to one end of the shaft and has a cam roller 318 thereon which is adapted to be engaged and released by a rotatable cam lobe 320. Said lobe is fixed to a shaft 322 which is journaled at its forward end in a bracket 324 fixed to the top beam 296 and at its rear end in a bracket 326 carried by and upstanding above the rear beam 148. Said shaft is driven from the shaft 146 by worm gears identical with those which reciprocate the horizontal line of motors and enclosed in a gear housing 328 which is carried by the beam 148. The driving shaft 330 of said housing has a driving connection with the shaft 322 by means of a driving chain 332 which rotates said shaft at the speed of the shaft 330. The arrangement of the cam lobe 320 and the arm 316 is such that when the mechanism is stationary in the withdrawn position of the motors, the cam lobe engages the arm 316 and depresses it and thus holds the shaft from rotation under urge of its springs. When the treadle is depressed, and the motors begin to move toward the work, the cam lobe 320 moves away from holding relation with the arm 316 and thus permits the springs 312 to rotate the shaft and thereby to move the work clamping feet 298 into holding engagement with the work, this clamping operation being effected before the bits engage the work. The cam is arranged to engage and depress the lever 316 and thus remove the clamping pressure on the work just prior to the movement of the motors into their final withdrawn positions. The pressure feet can be adjusted to engage stock of various thicknesses by a proper setting of the fulcrum screws 306 so that some feet can engage thick portions of the stock and other feet thin portions of the stock when said stock is of a non-symmetrical shape as, for instance, like that illustrated in Fig. 4.

One end of the shaft 146 is extended beyond the frame of the machine and is provided with a coupling member 334 that is adapted to be engaged by a detachable crank so that the motor reciprocating mechanism can be actuated by hand for adjusting the ma-

chine to operate on some selected shape of stock.

The machine is also provided with a bit driven through reduction gearing by a motor 338 for boring holes in one end of the work. The motor is reciprocable horizontally over the table in the manner previously described by means including an operating shaft 340 which is connected through extension-gearing 342 with the end gear box 132 for operation by the shaft 120, thus being operated simultaneously with the vertical line of motors. The motor is reciprocable by the usual cam mechanism in a plate 344, see especially Fig. 16, which is angularly adjustably carried in a bracket 346 that is pivoted for horizontal swinging movement on a plate 348 slidable forwardly and rearwardly in a plate 350 that is movable in ways lengthwise of the table, thus providing the necessary angular and linear adjustments. The machine can be provided with a similar motor and supporting and operating mechanism at the other end of the table, if desired, in an obvious manner not necessary to illustrate and, in such case, the end stop 280 will be so adjusted that it can be engaged by the stock in a location which out of the line of the bit.

Each motor is independently started and stopped by control push buttons contained in a casing 352 carried by the top beam 296, see Fig. 1, and located in position convenient to access by an operative. Flexible electric cables, not shown, serve to connect the movable electric motors through protective switches with a power circuit.

I claim:

1. A multiple spindle boring machine having a stationary work supporting table, a plurality of bit spindle carriages reciprocable toward and away from said table, a separate tilting support for each spindle carriage, individual means associated with each bit spindle carriage and carried by the tilting support therefor arranged to reciprocate the carriage, and common actuating means for all of said reciprocating means separate from said tilting supports and operating continually in the same direction.

2. A multiple spindle boring machine having a stationary work supporting table, a plurality of bit spindle carriages reciprocable toward and away from said table, a separate tilting support for each spindle carriage, individual means associated with each bit spindle carriage and carried by the tilting support therefor to reciprocate the carriage, and common actuating means for all of said reciprocating means separate from said tilting supports and operating continually in the same direction including universal and extensible driving connections individually connecting each reciprocating means with said common actuating means whereby to op-

erate said reciprocating means in any adjusted positions of said tilting supports.

3. A multiple spindle boring machine having a stationary work supporting table, a plurality of bit spindle carriages which are reciprocable toward and away from the work on said table, a separate tilting support for each carriage, individual cam means carried by the respective supports for reciprocating said carriages, and common actuating means for all of said cam means operating continually in the same direction.

4. A multiple spindle boring machine having a stationary work supporting table, a plurality of bit spindle carriages which are reciprocable toward and away from the work on said table, a separate tilting support for each carriage, individual cam means carried by the respective supports for reciprocating said carriages, common actuating means for all of said cam means, operating continually in the same direction, and universal driving connections separately connecting said cam means with said common actuating means.

5. A multiple spindle boring machine having a work supporting table, a set of vertically reciprocable bit spindles having individual electric driving motors therefor, a set of horizontally reciprocable bit spindles having individual electric driving motors therefor, means to reciprocate each bit spindle and its driving motor separately toward and away from the work on said table, power-actuated driving mechanism common to all of said reciprocating means for actuating them simultaneously in the same sense, manually-controlled means for initiating the action of said power-actuating mechanism, and means operated in timed relation with the reciprocatory movement of a selected one of said bit spindles for discontinuing the operation of said power actuated mechanism.

6. A multiple spindle boring machine having a work supporting table, a plurality of bit spindles reciprocable toward and away from the work on said table, actuating mechanism for reciprocating said spindles simultaneously in the same direction, means to clamp the work on said table including an eccentric shaft, a plurality of clamping levers loosely mounted on said shaft and having fulcrum supports therefor, spring means constantly urging said shaft for rotation in a direction to urge said clamping members against the work on said table, and means operated in timed relation to the reciprocatory movements of said bit spindles for controlling the operation of said spring means.

7. A multiple spindle boring machine having a work supporting table, a plurality of bit spindles reciprocable toward and away from the work on said table, actuating mechanism for reciprocating said spindles simultaneously in the same direction, means to clamp the work on said table including an ec-

centric shaft, a plurality of clamping levers loosely mounted on said shaft and having fulcrum supports therefor, spring means constantly urging said shaft for rotation in a direction to urge said clamping members against the work on said table, and means operated in timed relation to the reciprocatory movements of said bit spindles for holding said shaft against rotation and also for releasing said shaft for rotation and additionally for rotating said shaft against said spring means to effect the release of said clamping members.

8. A multiple spindle boring machine having a work supporting table, a plurality of bit spindles reciprocable toward and away from the work on said table, actuating mechanism for reciprocating said spindles simultaneously in the same direction, means to clamp the work on said table including an eccentric shaft, a plurality of clamping levers loosely mounted on said shaft and having fulcrum supports therefor, spring means constantly urging said shaft for rotation in a direction to urge said clamping members against the work on said table, and means operated in timed relation to the reciprocatory movements of said bit spindles for holding said shaft against rotation and also for releasing said shaft for rotation and additionally for rotating said shaft against said spring means to effect the release of said clamping members, said last-named means including an arm fixed to said shaft and a cam engageable with said arm having rotating means therefor actuated by said actuating mechanism.

9. A multiple spindle boring machine having a vertically-adjustable work supporting table, a bit spindle supporting beam fixed to and located beneath and extended lengthwise of and movable with said table, a bracket carried by and movable lengthwise of said beam, and having means for holding it in any one of a plurality of angularly related positions with respect to said beam, an electric driving motor having a bit spindle vertically reciprocable on said bracket, and means to reciprocate said motor and spindle toward and away from the work on said table in any setting of said bracket and also of said table.

10. In a multiple spindle boring machine, the combination of a stationary work supporting table, a spindle supporting beam extended lengthwise of said table, a supporting plate carried by and slidable lengthwise of said beam, a tiltable supporting member having a pivotal connection with said plate, a bracket carried by and having a sliding connection with said supporting member and having an extension that is extended transversely of said beam, a carriage supporting member carried by said extension of said bracket and having a pivotal connection therewith at right angles to the pivotal connection of said plate, a carriage carried by

and reciprocable on said carriage supporting member toward and away from the work on said table, an electric driving motor and bit spindle carried by and movable with said carriage, means carried by said carriage supporting member for reciprocating said carriage, stationarily-supported means operating continually in the same direction for actuating said reciprocating means, and a flexible and extensible driving connection connecting said reciprocating means and said actuating means in any angular position of said carriage supporting member.

11. In a multiple spindle boring machine, a stationary work supporting table, an electric driving motor having a bit spindle, a carriage supporting said motor and spindle, a carriage supporting plate on which said carriage is reciprocable toward and away from said stationary table, a supporting beam extended lengthwise of said table, means connecting said carriage supporting plate with said beam having mechanism providing for the angular movement of said carriage supporting plate in two angularly-related planes and also for the movement of said plate lengthwise and also transversely of said beam, and means for reciprocating said carriage in any adjusted position of said carriage supporting plate.

12. In a multiple spindle boring machine, a work supporting table, an electric driving motor having a bit spindle, a carriage supporting said motor and spindle, a carriage supporting plate on which said carriage is reciprocable toward and away from said table, a supporting beam extended lengthwise of said table, means connecting said carriage supporting plate with said beam having mechanism providing for the angular movement of said carriage supporting plate in two angularly-related planes and also for the movement of said plate lengthwise and also transversely of said beam, means carried by said carriage supporting plate for reciprocating said carriage, stationarily-supported actuating mechanism for said reciprocating means, and a flexible and extensible driving mechanism connecting said reciprocating means and said actuating means.

13. In a multiple spindle boring machine, a stationary work supporting table, a beam extended lengthwise of said table, a supporting plate carried by and slidable lengthwise of said beam, a bracket having means connecting it for pivotal movement with said plate and also for movement transversely of said beam, a carriage supporting plate having a pivotal connection with said bracket at right angles to the pivotal connection between said bracket and supporting plate, a carriage slidable in said carriage supporting plate, a motor and bit spindle carried by said carriage and movable therewith, and means

to reciprocate said carriage toward and away from said work supporting table.

14. In a multiple spindle boring machine, a work supporting table, a beam extended lengthwise of said table, a supporting plate carried by and slidable lengthwise of said beam, an intermediate plate carried by said supporting plate and having a vertical pivotal connection therewith, a bottom plate having a horizontal pivotal connection with said intermediate plate, a bracket carried by said bottom plate and having a horizontally sliding engagement therewith, a carriage supporting member carried by said bracket and having a horizontal pivotal connection therewith which is at right angles with the aforesaid pivotal connections, a carriage carried by and reciprocable on said carriage supporting member, an electric motor and bit spindle carried by and reciprocable with said carriage, and means to reciprocate said carriage toward and away from said table in any setting of the aforesaid parts.

15. In a multiple spindle boring machine, a work supporting table, a beam extended lengthwise of said table, a supporting plate carried by and slidable lengthwise of said beam, an intermediate plate carried by said supporting plate and having a vertical pivotal connection therewith, a bottom plate having a horizontal pivotal connection with said intermediate plate, a bracket carried by said bottom plate and having a horizontally sliding engagement therewith, a carriage supporting member carried by said bracket and having a horizontal pivotal connection therewith which is at right angles with the aforesaid pivotal connections, a carriage carried by and reciprocable on said carriage supporting member, an electric driving motor and bit spindle carried by and reciprocable with said carriage, a rotatable cam member carried by said carriage supporting member having means connecting it with said carriage for reciprocating the latter, stationarily-supported driving means for rotating said cam member, and a flexible and extensible driving connection which connects said cam member and said stationarily-supported driving means.

16. In a multiple spindle boring machine, the combination of a work supporting table, an angularly-adjustable carriage supporting member, means supporting said carriage supporting member fixedly in any one of various angular positions, a carriage reciprocable on said carriage supporting member toward and away from said table, a bit spindle rotatably supported by said carriage, and means carried by and movable with said carriage supporting member for reciprocating said carriage and said bit spindle toward and away from the work on said table in any angular setting of said carriage supporting member, and means supported independently of said

carriage supporting member and operating continually in the same direction for operating said carriage reciprocating means.

17. In a multiple spindle boring machine, the combination of a work supporting table, an angularly-adjustable carriage supporting member, means supporting said carriage fixedly in any one of various angular positions, a carriage reciprocable on said carriage supporting member toward and away from said table, a bit spindle rotatably supported by said carriage, means carried by said carriage supporting member for reciprocating said carriage and said bit spindle toward and away from the work on said table in any angular setting of said carriage supporting member including a cam member having a rotatable support on said carriage supporting member, a cam follower carried by said carriage and operated by said cam member, stationarily-supported driving means for said cam member, and an extensible and flexible driving connection which constantly connects said cam member and said driving means.

18. In a multiple spindle boring machine, the combination of a work supporting table, a carriage supporting member, means supporting said carriage supporting member in any one of several angularly-related positions lengthwise of said table, a carriage reciprocable on said carriage supporting member toward and away from said table, a bit spindle having a rotatable support on said carriage, means carried by said carriage supporting member for reciprocating said carriage, stationarily-supported driving means for said reciprocating means which is movable into any one of a number of positions longitudinally of said table, and a flexible and extensible driving connection which connects said reciprocating means and said driving means.

19. In a multiple spindle boring machine, the combination of a work supporting table, a carriage supporting member having means fixedly supporting it in any one of a plurality of angularly-related positions, a carriage reciprocable on said carriage supporting member toward and away from said table, a bit spindle having a rotating support on said carriage, and means for reciprocating said carriage including a cam member having a rotatable support on said carriage supporting member, a cam follower having means connecting it fixedly in any one of a plurality of positions disposed lengthwise of said carriage, and stationarily-supported means for rotating said cam member.

20. In a multiple spindle boring machine, the combination of a work supporting table, a spindle supporting beam extended lengthwise of said table, a carriage supporting member having means connecting it with said beam for movement longitudinally thereof and also for supporting it in any one of vari-

ous angularly-related positions, a carriage reciprocable on said carriage supporting member toward and away from said table, a bit spindle having a rotatable support on said carriage, cam means carried by said carriage supporting member for reciprocating said carriage, and means to rotate said cam means including a stationarily-supported driving shaft extended lengthwise of said table, meshing driving and driven gears rotated by said driving shaft and movable lengthwise thereof while maintaining their operative connection therewith, and a flexible and extensible driving connection which connects said cam means and said driven gear.

21. In a multiple spindle boring machine, the combination of a work supporting table, a carriage having means supporting it for reciprocating movement toward and away from said table, a bit spindle having a rotatable support on said carriage, means for reciprocating said carriage including a driving shaft, the angular position of which corresponds to the reciprocated position of said carriage, an actuating shaft having a driving connection with said driving shaft, continuously operating driving means having a clutching connection with said actuating shaft, manually operated means to set the clutch for reciprocating said carriage, and means controlled by said driving shaft to effect the release of said clutch at a predetermined position of said carriage.

22. In a multiple spindle boring machine, the combination of a work supporting table, a carriage reciprocable toward and away from said table, a bit spindle having a rotatable support on said carriage, reciprocating mechanism for said carriage including a drive shaft the angular position of which corresponds to the position of said carriage, an actuating shaft having a constant driving connection with said drive shaft, continuously operated power mechanism having means including a clutch for connecting said mechanism and actuating shaft, an operating member including a shaft slidable in one direction to set the clutch, and slidable in the opposite direction to release the clutch, manually controlled means to move said sliding shaft in a clutch setting position, a latch member engageable with said shaft in the clutch setting position thereof to hold it in such position, spring means to move said sliding shaft in a clutch release direction, and a cam member driven by said drive shaft for moving said latch out of engagement with said sliding shaft and effecting the release of said clutch in a predetermined position of said carriage.

23. In a multiple spindle boring machine, the combination of a stationary table having an opening extended longitudinally thereof, a plurality of bit spindles vertically reciprocable beneath said table under said opening,

a plurality of bit spindles horizontally reciprocable over said table, and a plurality of work supporting bars extended transversely over said opening and having a sliding connection with said table lengthwise thereof and transversely of the reciprocating paths of said horizontal spindles, and clamping members adjustable for position lengthwise of said table and located above said bars for holding down said bars and the work thereon against the action of said vertically reciprocable spindles.

24. In a multiple spindle boring machine, the combination of a work supporting table having an opening extended longitudinally thereof, parallel grooves extended lengthwise of said table on opposite sides of said opening, a plurality of work supporting bars extended transversely across said opening having depending projections which are slidably received in said grooves whereby to guide said bars for sliding movement lengthwise of said table, work clamping members located above said bars, a plurality of vertically reciprocable bit spindles located beneath said table, and said opening, and a plurality of horizontally reciprocable spindles located above said table and said work supporting bars.

25. A boring machine having a stationary work-supporting table, a bit spindle reciprocable toward and away from said table, a tilting support for said spindle, means carried by and movable with said tilting support for reciprocating said spindle, and stationarily-supported actuating means independent of said tilting support and operating continually in the same direction for operating said reciprocating means.

26. A spindle boring machine having a work-supporting table that is adjustable into any one of several vertical positions, work-clamping means located above said table and supported independently thereof for clamping the work thereon, a bit spindle located vertically beneath and movable therewith, a vertically-reciprocable support for said spindle carried by and movable with said table, and means for reciprocating said support including a drive shaft supported independently of said table, and a support-reciprocating shaft extended between said drive shaft and support and having an operative connection therewith in any position of said table.

In testimony whereof, I have signed my name to this specification.

ELLIOTT J. McKNIGHT.