Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 1

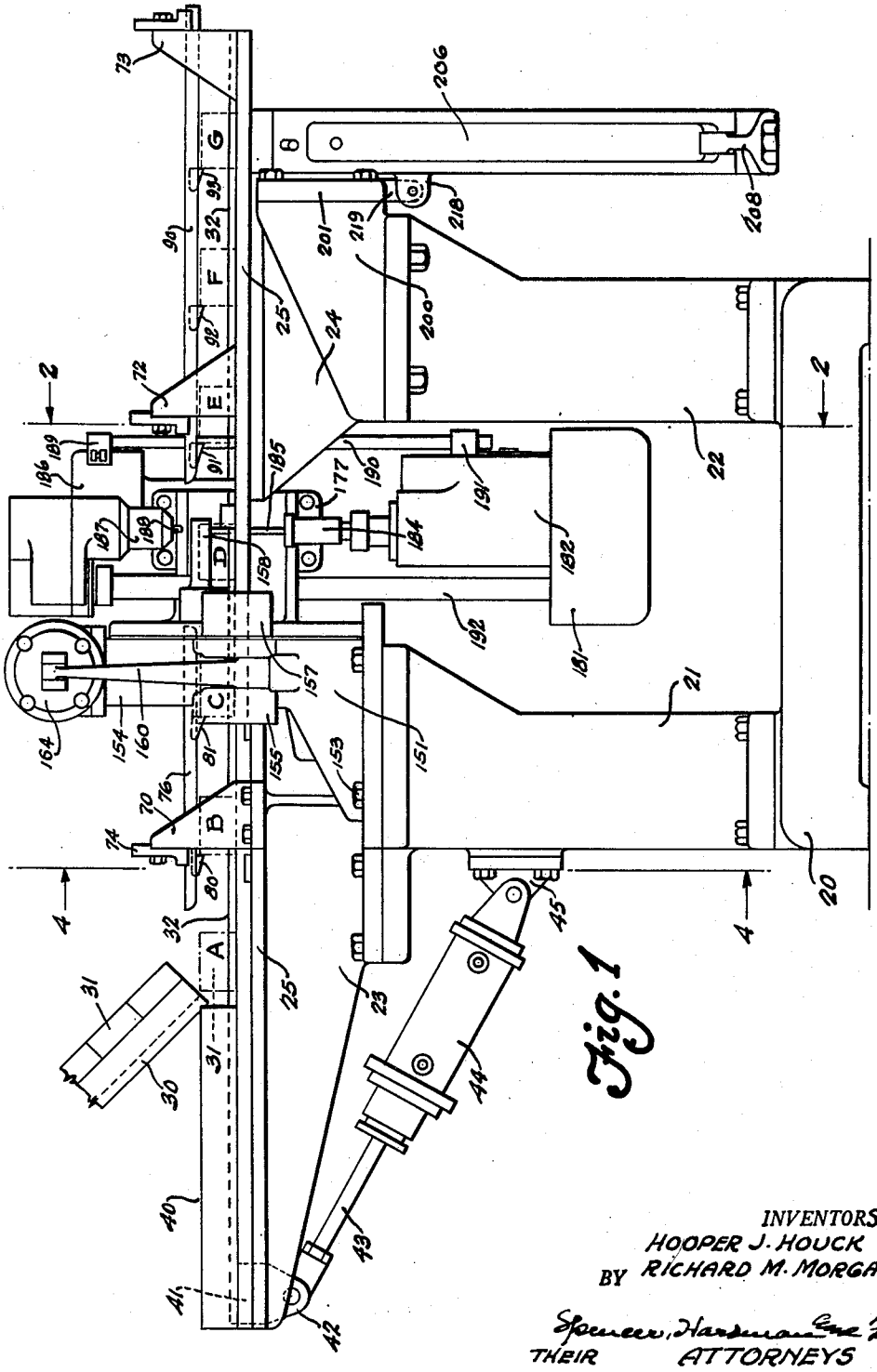


Fig. 1

INVENTORS
HOOPER J. HOUCK
BY RICHARD M. MORGAN

Spencer, Hardman & Fehr
THEIR ATTORNEYS

Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 2

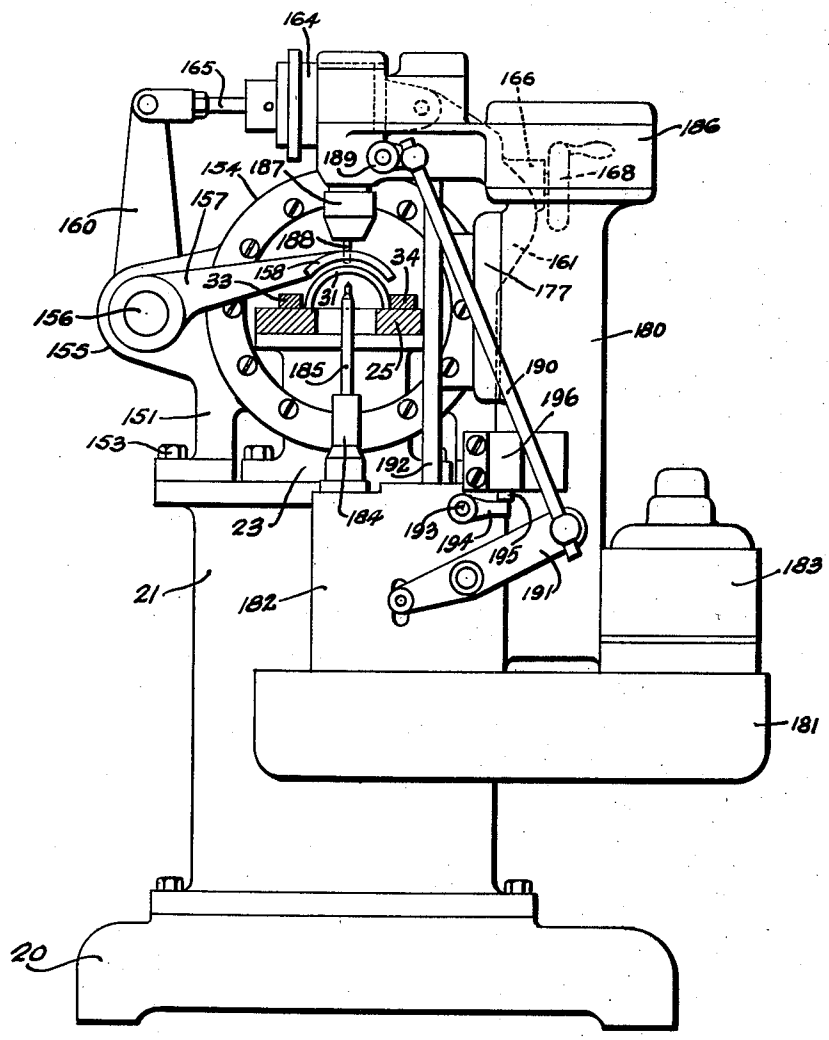


Fig. 2

INVENTORS
HOOPER J. HOUCK
BY RICHARD M. MORGAN

Spencer, Hardman & Fehr
THEIR ATTORNEYS

Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 3

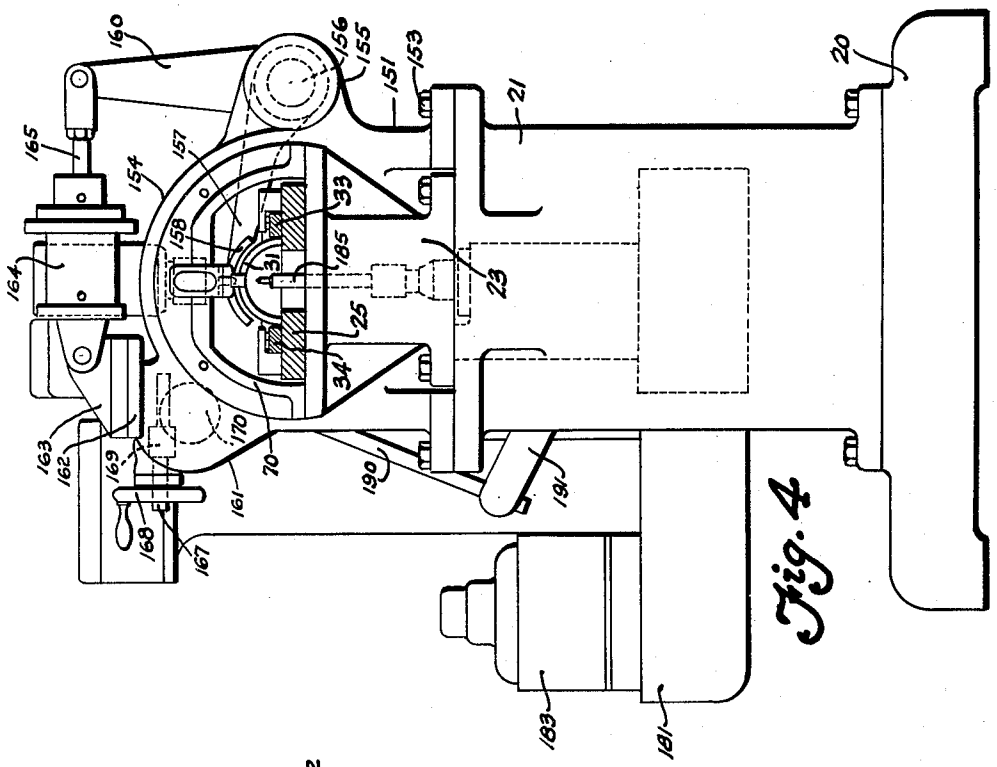


Fig. 4

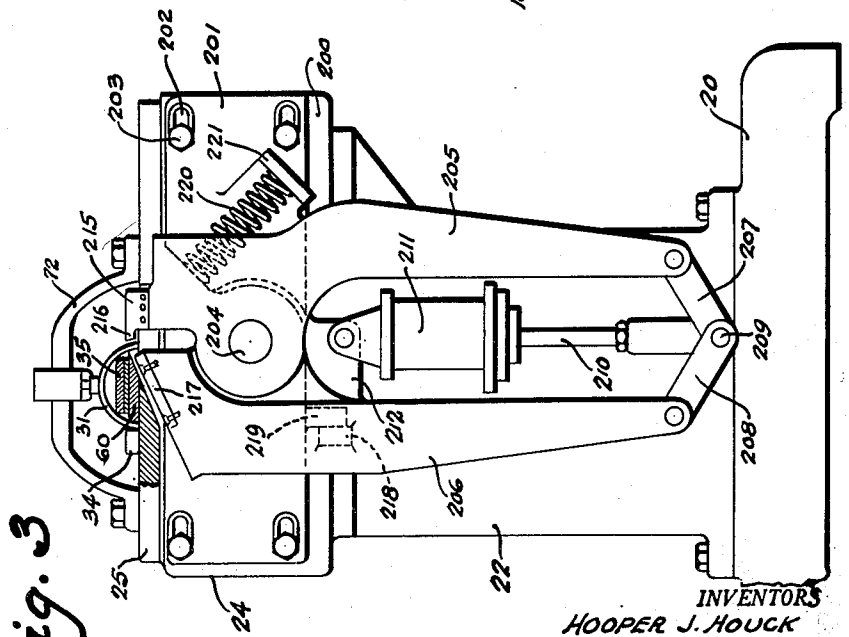


Fig. 3

INVENTORS
HOOPER J. HOUCK
BY RICHARD M. MORGAN

Spencer, Hardman & Fehr
THEIR ATTORNEYS

Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 4

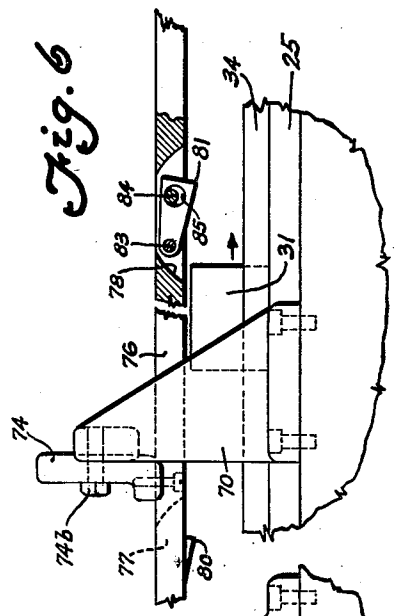


Fig. 6

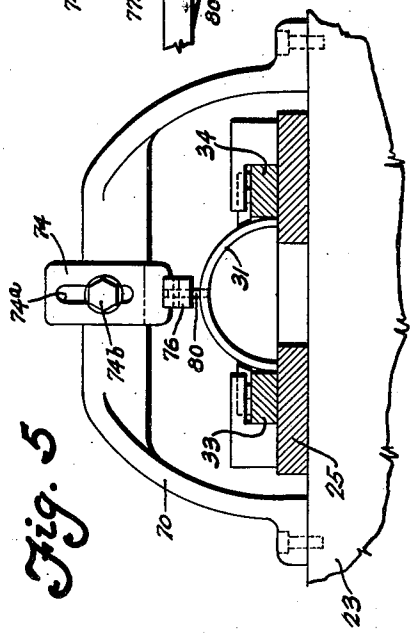


Fig. 5

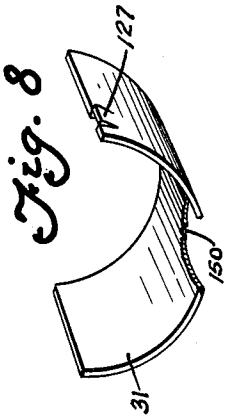


Fig. 8

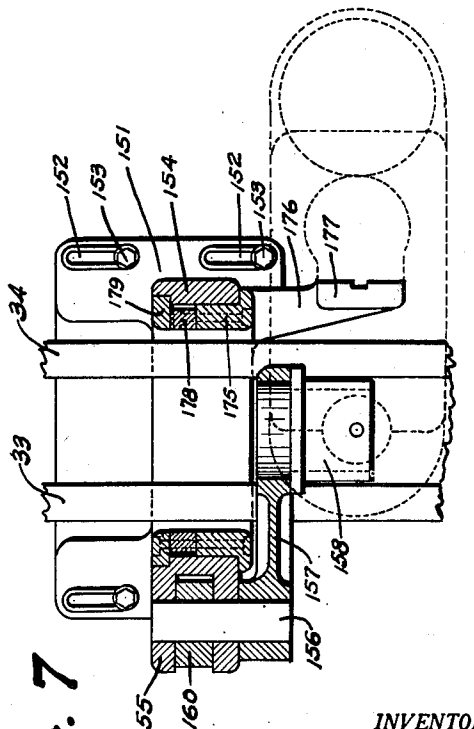


Fig. 7

INVENTORS
HOOPER J. HOUCK
BY RICHARD M. MORGAN

Spencer, Harkman and Fisher
THEIR ATTORNEYS

Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 5

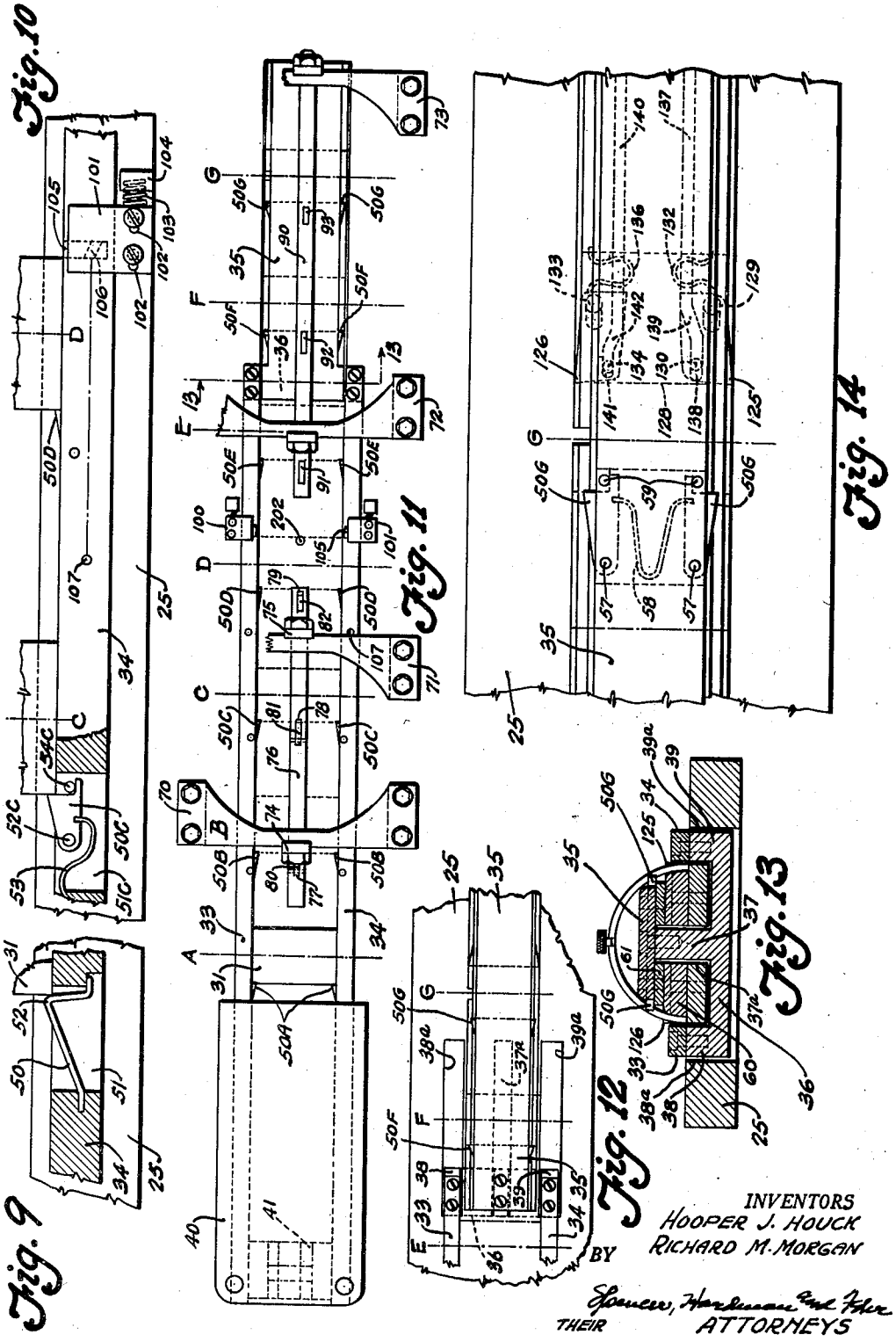


Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

INVENTORS
HOOPER J. HOUCK
RICHARD M. MORGAN
BY
Spencer, Harriman and Fyler
THEIR ATTORNEYS

Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 6

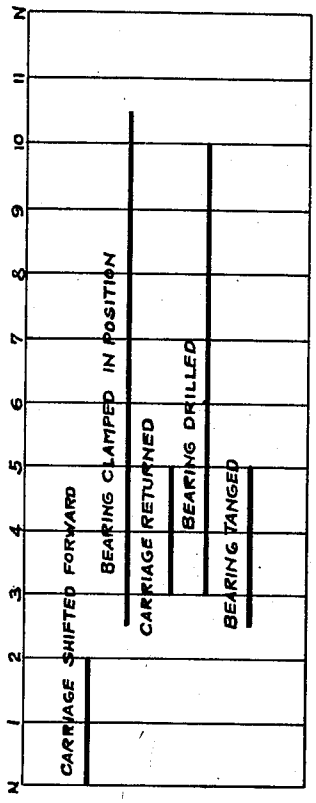


Fig. 16

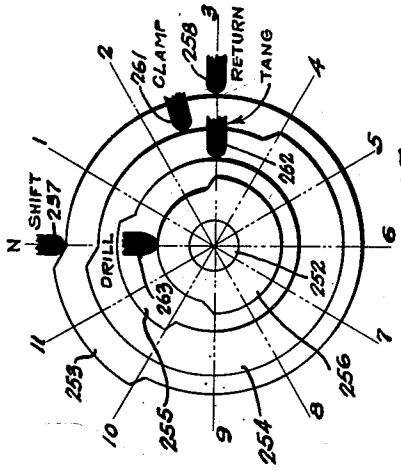


Fig. 15

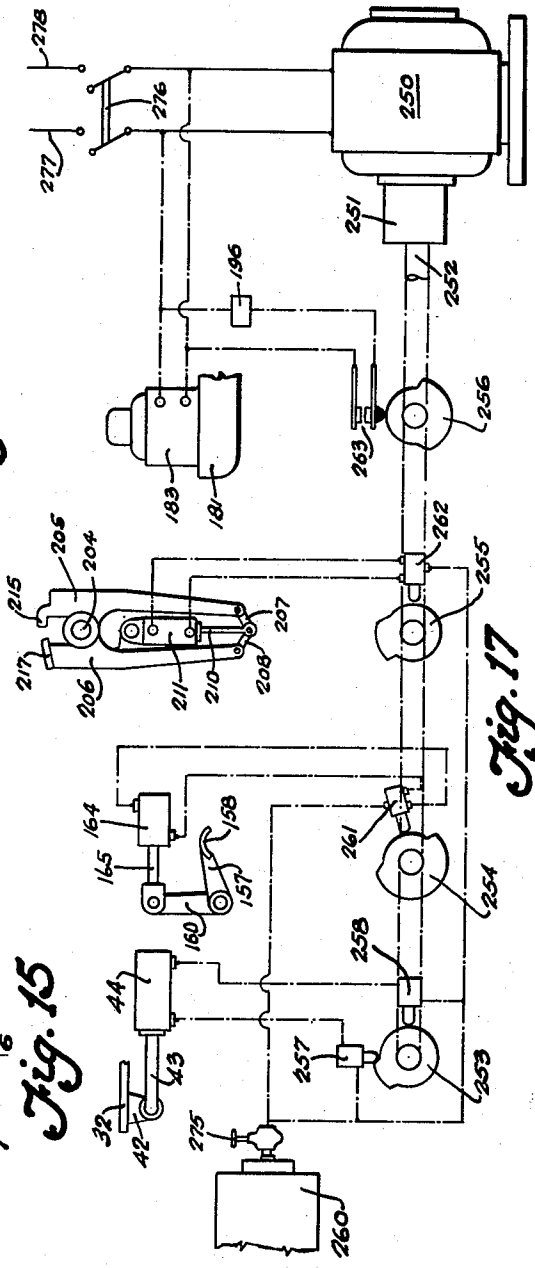


Fig. 17

INVENTORS
HOOPER J. HOUCK
BY RICHARD M. MORGAN

Spencer, Hardman & Fehr
THEIR ATTORNEYS

Dec. 8, 1953 H. J. HOUCK ET AL 2,661,523

DRILLING AND TANGING MACHINE

Filed June 11, 1948 7 Sheets-Sheet 7

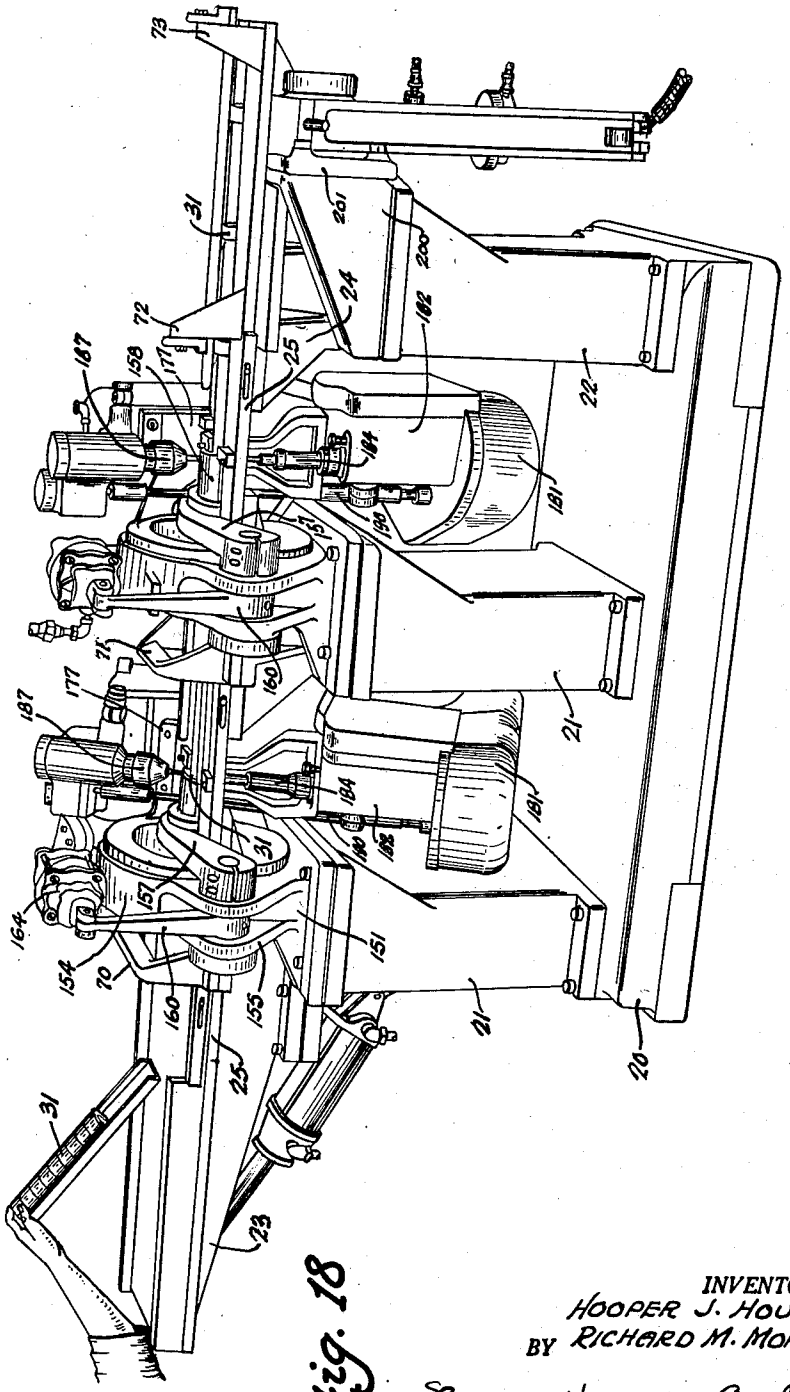


Fig. 18

INVENTORS
HOOPER J. HOUCK
BY RICHARD M. MORGAN

Spencer, Hardman and Fisher
THEIR ATTORNEYS

Patented Dec. 8, 1953

2,661,523

UNITED STATES PATENT OFFICE

2,661,523

DRILLING AND TANGING MACHINE

Hooper J. Houck and Richard M. Morgan, Dayton, Ohio, assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application June 11, 1948, Serial No. 32,290

7 Claims. (Cl. 29—33)

1

This invention relates to a machine for drilling a semi-circular bearing and forming a tang in one of its straight edges.

It is among the objects of the present invention to provide a machine into which semi-circular bearings may be placed, the machine then conveying said bearing through it, during which time each bearing is properly drilled and provided with a tang projecting outwardly from one of its straight edges.

A further object of the present invention is to provide a machine capable of receiving semi-circularly shaped bearings and conveying each bearing progressively from one station into another, said machine having apparatus for drilling a hole in the bearing, said apparatus being adjustably attached to the machine so that the position of the hole may be varied both longitudinally of the bearing and circumferentially thereof if desired.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a side view of the machine, pipe connections and other incidental elements of the machine being omitted for the sake of clarity.

Fig. 2 is part end section taken along the line 2—2 of Fig. 1 and clearly illustrates the clamping and drilling mechanism.

Fig. 3 is an end view of the machine illustrating the tanging mechanism.

Fig. 4 is a view taken along the line 4—4 of Fig. 1.

Fig. 5 is a front view of one of the bridging arches, supporting the retainer mechanism of the machine.

Fig. 6 is a side view of the element shown in Fig. 5.

Fig. 7 is a fragmentary sectional view detailedly showing the ring shaped machine member in which the drill supporting bracket is rotatably supported.

Fig. 8 is a perspective view of the bearing operated upon by the machine.

Fig. 9 is a fragmentary detail section illustrating one type of pusher in the shifter bars.

Fig. 10 is a fragmentary detail section illustrating another type of pusher in the shifter bar immediately preceding the locating detent at the drilling station in the machine.

Fig. 11 is a simplified plan view of the complete shifter mechanism and its cooperating retainers.

2

Fig. 12 is a fragmentary view detailedly showing that portion of the shifter mechanism adjacent the tanging station.

Fig. 13 is a cross sectional view at enlarged scale, taken along the line 13—13 of Fig. 11.

Fig. 14 is an enlarged plan view of the pusher and locating stop at the tanging station G of Fig. 11.

Fig. 15 is a diagrammatic view of the controlling mechanism for timing of the various operations of the machine.

Fig. 16 is a timing chart.

Fig. 17 is a spread view of the timing control mechanism, each element thereof being shown connected with the machine element controlled thereby.

Fig. 18 is a perspective view of a machine built according to the present invention and including two drilling mechanisms to provide the bearing with two separate holes.

The body of the machine comprises a base 20 to which two standards 21 and 22 are attached. Standard 21 has a head bracket 23 secured thereto and a similar head bracket 24 is provided on the standard 22. Both head brackets 23 and 24 support a bed plate 25 (see Fig. 1, left end) which forms the working platform of the machine.

Station-to-station conveying mechanism

The present machine is adapted to receive bearings from any suitable introducing device 30 which places each individual bearing 31 upon the working platform so that the two flat edges of the semi-circular bearing rest upon said platform. After the bearing 31 is placed upon the bed plate 25, a reciprocating shifter 32 moves the bearing progressively into a plurality of successive stations, A to G inclusive, at one of which the bearing is drilled and at another provided with a tang.

The shifter 32, which moves back and forth upon the bed plate a predetermined distance comprises two sections, one section being two spaced parallel bars 33 and 34, the other a shiftable central core plate 35. Figs. 9 to 14 inclusive illustrate the shifter construction and its details. These two shifter sections are secured together by a bridging element 36 having three longitudinal ribs, the central one numbered 37 which, as shown in Fig. 13, extends through a longitudinal slot 37*a* in the bed plate 25 and is secured to the shiftable core portion 35, the other two ribs 38 and 39 extending along the two outer edges of the bridging element 36, each rib 38 and 39 extending through a slot 38*a* and 39*a*, respectively,

in the bed plate, parallel to the central slot therein, the rib 38 having the bar 33 attached thereto and rib 39 the bar 34. Thus this bridging element 36 secures the parallel bars and the central core sections of the shifter together so that both can be reciprocated as a unit.

A box-like structure 40 covering the shifter 32 and secured to the bed plate 25 forms a housing at the one end of the machine which secures the shifter to the machine so that it may slide on the bed plate. Within this housing 40 the two parallel shifter bars 33 and 34 are secured together by a member 41 which has spaced ears 42 depending from it, through a slot in the bed plate, and to which the end of the piston rod 43 of the hydraulic cylinder 44 is attached. The cylinder 44 is hingedly anchored to a bracket 45 secured to the standard 21. Cylinder 44 is connected to any source of fluid power and may be energized thereby to reciprocate the shifter.

The device 30 of any suitable design is adapted to introduce bearings, one by one into the machine so that the bearing is placed between the two parallel shifter bars 33 and 34 with its two straight edges resting upon the bed plate 25 on which the bearing slides as it is being moved progressively to successive stations in the machine. The Fig. 11 is a view showing the stations B to G inclusive into which the bearings are moved by the shifter 32. The station A is the initial station in which the bearing is placed by the device 30.

To move the bearings along with the shifter bars 33 and 34 as they are reciprocated through a predetermined range of to and fro movement by the rod 43 of cylinder 44, each shifter bar has a plurality of pushers 50 each secured in a recess in the bar, said recesses being equally spaced a distance substantially equal to the range of reciprocation of the shifter assembly 32. Fig. 9 illustrates one form of pusher while another form is shown in Fig. 10. In the first form, the pusher 50 is a hook-shaped element made of spring wire, one end of which is inserted in an opening in the wall of recess 51 while the other engages an offset in the opposite wall of the recess so that normally the portion 52 of said pusher extends beyond the inner surface of the shifter bar 34 and into the path of movement of the bearing 31 so that as the bar 34 moves to the right as regards Fig. 9, the bearing, engaged by the pusher 50, must necessarily move with it toward the next station. The other form of pusher comprises a dog 50C hinged in the recess 51C on pin 52C. A spring 53 is anchored at one end to bar 34, its free end engaging dog 50C normally to urge it into engagement with the stop pin 54C so that a portion of the dog extends beyond the surface of bar 34, one face of said portion being at right angles to the bar, for engaging bearing 31 to move it with the bar when it moves toward the right as regards Fig. 10, the other face of said portion sloping with regard to the bar so that the dog may move into the bar when its movement is reversed and said pusher must pass a bearing in order to get behind it.

The schematic layout in Fig. 11 shows the adjacent facing surfaces of the shifter bars 33 and 34 as having pushers extending therefrom at each station A to G inclusive, the pushers at each station being directly opposite. Pushers 50A are adapted to engage and move bearing 31 into station B when the shifter 32 is moved out of its normal position by cylinder 44. Upon the return movement of the shifter toward normal position, the pushers 50B will be moved into their respective recesses in the bars as they pass the bearing at station B, to get behind it so that when the shifter is again moved forwardly out of normal position, pushers 50B may move the bearing into station C. Pushers 50C are operative to transfer the bearing at station C into station D, pushers 50D move the bearing into station E, pushers 50E move bearing into station F, pushers 50F move bearing into station G and pushers 50G move bearing off the shifter and out of the machine.

It will be noted that pushers 50F and 50G are carried in slots provided in the core portion 35 of the shifter 32 with which the bearing moves as it passes from station E. Figs. 11 to 13 inclusive illustrate this. Fig. 14 shows the pushers 50G which are identical to the pushers 50F. Pushers 50G are dogs hinged on pins 57 in a transverse recess in the surface of the central core, shiftable plate 35 engaged by the plate 61 attached thereto. A hair-pin shaped spring 58 is interposed between the pair of pushers 50G urging them outwardly against pin stops 59 in plate 35. In this normal position the pushers 50G extend beyond the respective side edges of plate 35 into the path of movement of the bearing supported thereon so that as plate 35 is moved outwardly (to the right as regards Fig. 14) the bearing engaged by the pushers must move along with said plate.

As has previously been described, plate 35 is attached to pusher bars 33 and 34 through the bridging element 36. A centrally slotted supporting plate 60 is attached to the bed plate 25 and forms a support for an intermediate plate 61 secured to and movable with plate 35.

Bearing retainers

In order to prevent the bearing 31 from moving with the shifter bars 33 and 34 as they are returned to their normal position and especially to prevent movement of the bearing as a pusher moves over the bearing to get behind it, mechanism is provided which will retain the bearing at a station after it is moved thereto. Figs. 5, 6 and 11 illustrate this mechanism which comprises arch-shaped supports 70, 71, 72 and 73. All supports being identical, only one will detailedly be described. Support 70, at station B, bridges the shifter 32 and the bearing 31 therein and is rigidly bolted to the head bracket 23. The cross bar of the support has a central, vertical slot in which a lug 74 slidably fits, this lug having an elongated slot 74*a* through which a bolt 74*b* extends threadedly to engage the cross bar. This lug 74 may be adjusted vertically relatively to the shifter extending through the support 70. Support 71, between stations C and D, has an adjustable lug 75 like lug 74. A bar 76 is suspended between supports 70 and 71, said bar being adjustably bolted to the lugs 74 and 75 of the respective supports. This bar 76 is longitudinal of and centrally located relatively to the shifter 32, the lugs 74 and 75 being so adjusted on their respective supports as to maintain the bar 76 so that it clears the bearing 31 passing beneath it longitudinally.

Bar 76 has a plurality of slots 77, 78 and 79, positioned ahead of stations B, C and D respectively. In each slot there is pivotally supported a retainer or detent 80, 81 and 82 respectively. All retainers or detents being alike only the one numbered 81, Fig. 6, will detailedly be described. The detent is hinged on a cross pin 83 in rod 76.

Another cross pin 84, transversely through slot 78, extends through a hole 85 in the detent, larger in diameter than pin 84 so that the detent can move by gravity to have its bottom corner extend into the path of the bearing moving longitudinally beneath the bar 76. Thus when pushers in the shifter move said bearing forwardly toward an advanced station, the bearing, passing beneath a detent, will push it upwardly and when the bearing is past the detent, it will drop by gravity, extend beyond the trailing edge of the bearing and so prevent its movement in the opposite direction when the shifter is moved rearwardly toward its normal position.

A detent supporting bar 90 is similarly suspended between supports 72 and 73 so as to extend longitudinally above the central core section 35 of the shifter 32. Bar 90 has a plurality of retainers or detents 91, 92 and 93, similar to detents in bar 76 and positioned respectively ahead of stations E, F and G.

Bearing locators

The bearings placed in the machine are conveyed into successive stations, at one of which the bearing is drilled and at another, a tang is formed in one of the straight edges of the bearing. The several pairs of pushers on the shifter move the bearings into said stations and the retainers or detents hold the bearings against reverse movement by the shifter as it returns to normal position. It is of the greatest importance that the bearings be precisely located at the stations D and G, for the drilling operation takes place at station D and the tanging at station G. The retainers or detents are not designed precisely to locate the bearings, therefore special locating stops are provided at the operation stations D and G. Figs. 10, 11 and 14 show these stops in detail.

A pair of oppositely disposed locating stops 100 and 101 are provided for positively locating the bearing, advancing under the influence of pushers 50D, relatively to the drilling center designated by the circle 202 in Fig. 11. Inasmuch as both stops are alike only one will be described detailedly. Figs. 5 and 10 show the stop 101 as comprising a block having an edge engaging the outer surface of shifter rod 34 and a lip portion extending over but spaced from the shifter rod. Two elongated slots 102, parallel to the path of bearing movement, are provided in the block of stop 101, said slots each receiving a bolt threaded into the bed plate 25. A spring 103 interposed between stop 101 and an abutment member 104 on the bed plate, yieldably urges stop block 101 toward the loading end of the machine (left, Fig. 10) so that the end of slots 102 move adjacent abutment member 104, normally engage the respective bolts extending therethrough.

The lip portion of the stop block extending over shifter bar 34 has a slot in the surface adjacent said bar, said slot being at right angles to the path of bearing movement. This slot provides a slideway for the stop latch 105, the outer end of which is out of the path of bearing movement when fully retracted. Stop latch 105 rests upon and is slidable transversely of the bar 34. The surface of stop latch 105 engaging the shifting bar 34 has an angular, transverse slot 106, its one open end, toward pusher 50C, being closer to the path of bearing movement than the other open end.

A pin 107 extending from the shifter bar 34 is spaced a predetermined distance from stop 101,

when the shifter 32 is in normal position. Pin 107 is so located on bar 34, that when said bar is moved outwardly from normal position or toward stop 101, it will enter slot 106 and, due to the angularity of said slot, will cam stop-latch 105 outwardly into the path of bearing movement. The pin 107 is so located relatively to pushers 50C, that said pin will actuate the latch 105 into the path of the approaching bearing, moving toward station D under the influence of pushers 50C, thereby providing a precise locating stop at this station D. If, while being moved forwardly toward station D by pushers 50C, the bearing is moved after engaging latch 105, stop block 101 will be moved on the bed plate against the effect of cushioning spring 103.

The return movement of the shifter 32, after pushers 50C have moved a bearing into station D and consequently after pin 107 has passed through slot 106 and cammed latch 105 into the path of bearing movement, will cause said pin 107 to enter slot 106 and now pin 107 will cam the latch 105 into normal position again, out of the path of bearing movement thereby permitting the bearing at station D to be moved past stop latch 105 as pushers 50D move said bearing toward station E on the next forward movement of the shifter out of normal position. Thus stop latch 105 permits a bearing to be moved forwardly from station D to station E, but is actuated to stop the bearing approaching station D on the same stroke of shifter forwardly out of normal position.

Two more, oppositely disposed locating stops 125 and 126 are provided at station G where mechanism operates on the bearing to form a tang 127 in one of its straight edges. Inasmuch as a transition in the construction of the shifter 32 takes place immediately after the station E, that is, up to and at station E, the bearings 31 are supported between spaced, parallel bars 33 and 34 whereas, after station E, they are supported by central core 35, locating stops 125 and 126 are provided in said central core. Referring particularly to Figs. 13 and 14, a transverse slot 128, indicated by dotted lines in Fig. 14, is provided in the surface of supporting plate 60 engaged by the intermediate plate 61. In this slot 128 and at one side of plate 60, a block, forming stop 125 is pivoted upon a pin 129, the hole in the stop block 125, through which pin 129 extends being elongated. Another pin 130, carried by the stop block 125 extends upwardly into an elongated slot in the surface of the intermediate plate 61 which is attached to the reciprocating outer plate 35 of the core. A hair-pin shaped spring 132 is interposed between the stop block 125 and the edge of transverse slot 128, said spring yieldably urging the block 125 toward the station G so that the pin 129 is engaged by the end of the elongated hole in said block more remote from said station.

Stop block 126 is identical to block 125. Block 126 is pivoted upon pin 133 passing through the elongated hole in said block. A pin 134 extends from block 126 into an elongated slot in the surface of plate 61. A hair-pin spring 136 urges the block 126 toward station G, limited by pin 133. Stop blocks 125 and 126 when in this normal position as shown in Fig. 14 will locate the engaging bearing at station G so that the tanging mechanism at this station will form the tang at the predetermined position in the one straight edge of the bearing.

As previously stated, pin 130 on the stop block

125 extends into a longitudinal slot in the adjacent surface of plate 61, said slot being longitudinal of said plate and having two disaligned portions 137 and 138 connected by an angular portion 139. Similarly, pin 134 of stop block extends into a longitudinal slot in plate 61, this slot also having two disaligned portions 140 and 141 connected by a slanting portion 142. Portions 137 and 140 of said slots are parallel with the path of bearing movement by the shifter portion 35 and are spaced a greater distance from the respective sides or edges of plate 61 than are the portions 138 and 141 of said slots. Thus as long as pins 130 and 134 of the respective stop blocks 125 and 126 travel through the slot portions 137—140, said blocks will be held in their fully retracted positions in the transverse slot 128 in plate 61 thus being completely out of the path of travel of the bearing. However, when pins 130 and 134 traverse the slanting portions 139 and 142 respectively and enter slot portions 138 and 141 then the stop blocks are moved outwardly, as shown in Fig. 14, into the path of bearing movement, being operative to stop said bearing movement to locate the bearing in the proper position at station G. The slots 137—138—139 and 140—141—142 are so located in plate 61 that while the shifter 32 and its plates 35 and 61 are moving forwardly from their normal position, pins 130 and 134 of the stop blocks 125—126 respectively will travel through the slot portions 137—140 and maintain said stop blocks retracted a sufficient length of time to permit pushers 50G to move the bearing already operated upon at station G past the locating stop toward the unloading end of the machine. After said finished bearing has passed the retracted locating stop blocks and before the bearing, moving forwardly out of station F under the influence of pushers 50F, reaches station G, pins 130 and 134 will pass from slot portions 137—140 through the slanted portions 139—142 into the portions 138—141 respectively, at which time the stop blocks 125 and 126 are extended so as to lie in the path of movement of the bearing approaching from station F. If pushers 50F move the bearing forwardly a slight distance after it has engaged the stop blocks 125—126, said blocks will move with said bearing and compress springs 132—136. However, when the shifter and pushers 50F start on their return to normal movement, springs 132—136 will move the stop blocks 125—126 back to normal position, thus properly locating the bearing relatively to the tanging mechanism at station G.

Clamping mechanism at drilling station D

After the pushers 50C have moved a bearing 31 against the locating stops 105 at station D, the mechanism for rigidly clamping the bearing upon the machine for the purpose of drilling a hole 150 in the bearing becomes effective. The clamping mechanism is pivotally supported in a housing 151 which has a base provided with elongated holes 152 through which bolts 153 extend to secure the housing to the standard 21. The elongated holes 152 permit the housing to be adjusted on the standard 21 longitudinally of the path of movement of the bearing in the machine. Housing 151 comprises a ring-shaped portion 154 through which the shifter mechanism 32 extends so that the bearings 31, moved by the shifter, are concentric with the ring-shaped portion 154 as they pass therethrough.

Housing 151 has two spaced, parallel ears 155 extending from its outside, said ears having openings for supporting the stub shaft 156, the axis of which is parallel with the center line of bearing travel and also substantially in the horizontal plane passing through the center of the semi-circular bearing at station D in the machine. One end of shaft 156 extends outside one of the ears 155 and has the clamping lever 157 attached thereto, said lever extending inwardly so that its free end is directly over the line of travel of the bearings as they are moved through the machine. At its free end, lever 157 has a curved lip 158 extending at right angles from said lever, the curvature of said lip coinciding with the contour of the semi-circular bearings so that lever 157 may be actuated to move its lip 158 to rest upon the bearing located at station D by the stops 100 and 101 and clamp said bearing immovably upon the bed plate of the machine.

Between the parallel ears 155 of housing 154, shaft 156 has one end of lever 160 attached thereto. Housing 154 has a hollow bulge 161 extending from it which provides a platform plate 162 upon which a bracket 163 is secured. One end of a hydraulic cylinder 164 is hingedly attached to bracket 163, a piston rod 165 extending from the other end of said cylinder and being adjustably attached to the free end of lever 160. When piston rod 165 is in fully extended position as shown in Figs. 2 and 4, levers 160 and 157 are held to maintain the curved clamping lip 158 of lever 157 lifted so that the bearing 31, being moved from station C to station D by shifter pushers 50C, may pass beneath said clamping lip 158. However, when said bearing is properly located at station D, the actuator 164, a hydraulic cylinder, is rendered active to retract the piston rod 165 whereby levers 160 and 157 are actuated to move the clamping lip 158 into nesting engagement with the bearing beneath it and thus rigidly clamp said bearing to the machine. Inasmuch as the bearing rests upon the stationary bed plate of the machine and is confined between the parallel bars 33 and 34 of the shifter, clamping of the bearing to the machine will not preclude the return movement of said shifter bars while the bearing is so clamped.

The hollow bulge 161 on housing 154 has a lug 166 on its outer surface, said lug having a hole in which the shaft 167 of adjusting wheel 168 is rotatably supported. The shaft 167 extending into the hollow bulge has a worm gear 169 thereon which cooperates with other gearing 170 within the bulge and the housing to effect certain adjustments when wheel 168 is rotated. This will be described detailedly hereinafter.

Drilling mechanism

It has been stated that housing 151 comprises a ring-shaped portion 154 through which the bearings 31 are moved so that both housing portion 154 and the semi-circular bearings are concentric. The inner, annular surface of the ring-shaped housing portion 154 is machined to provide a bearing in which the ring-shaped portion 175 of bracket 176 rotatably fits. (See Fig. 7.) Bracket 176 has a platform plate 177 adapted to have the drilling apparatus attached thereto. A ring gear 178, having teeth in its outer peripheral surface, is attached to the inner end of the ring-shaped portion 175. A ring-shaped retainer 179 is secured to the ring gear 178. This retainer seats in an annular recess in the housing ring 154, of greater diameter than the inside diameter of said ring 154 in which portion 175 is rotatably supported. Thus portion 175 is rotatably locked

in housing portion 154. The ring gear 170 is operatively connected to the gearing 170, so that operation of the wheel 166 acts through gears 169, 170 and 178 to rotate the bracket portion 175 relatively to the stationary housing portion 154. This results in a movement of drill carrying plate 177 in a circular path concentric to the center of the semi-circular bearing clamped at station D.

The perspective view of the bearing 31 in Fig. 8 shows hole 150 therein to be midway between its curved edges and countersunk at each end to insure removal of any burrs on either surface of the bearing. Burring both ends of hole 150 requires two oppositely acting boring tools, the one operative to drill the hole and countersink its one end, the other, operative to countersink the opposite end of the hole.

The drilling and countersinking apparatus used in the present machine and shown in the accompanying drawings is of standard design, available in the open market and therefore no detail illustrative thereof is included in the drawings nor will more than a general description thereof be given. The apparatus comprises a standard 180, bolted to the plate 177 and having a housing 181 attached to its lower end. A housing 182 is carried by housing 181 as is also a main driving motor 183. An extension on housing 182 carries the chuck 184 in which the combination drill and countersink 185 is secured. As shown in Fig. 2, drill 185 is beneath the bearing 31 at station D and is normally spaced therefrom so as to permit the bearing to pass over it.

Another housing 186 is attached to the top of standard 180. This housing 186 rotatably supports the chuck 187 so that its contained countersink bit 188 is coaxially aligned with the drill 185. Bit 188 is normally maintained above the bearing 31 at station D to permit said bearing to pass beneath it. Lever 189 is operative to move the chuck 187 and its contained countersink bit 188 toward the bearing. This lever 189 has a rod 190 swivelly secured thereto, said rod being attached also to one end of lever 191 pivoted to the housing 182. Electric motor 183 operates continuously while the machine is being operated. Through suitable connections in housings 181, 182 and 186 and hollow tube 192, it rotates the chucks 184 and 187. Motor 183 also rotates a cam through a slip clutch mechanism in housing 182. The cam has a lug engageable by a dog on a lever secured to stub shaft 193 inside housing 182. Shaft 193 has a lever 194 secured to it outside the housing, which is engageable to be actuated by the armature 195 of the electromagnet 196 so as to move the dog from the path of the cam lug and permit the cam to be rotated by the slip clutch driven by motor 183. The driving connections between the electric motor 183 and the cam are such that said cam makes one complete revolution for each cycle of drilling operation. The cam in turn is arranged to actuate the drill 185 toward the bearing clamped at station D and complete the drilling and countersinking operation of drill 185 during one portion of the turn while during another portion thereof, the countersinking tool 188 is moved toward said bearing for countersinking the other end of the drilled hole. When the cam has actuated both bits 185 and 188 to move toward the bearing successively to do their task and then has returned them to normal position, the dog associated with shaft 193 stops cam rotation which will not again be repeated until the electromagnet 191 has been energized to actuate lever 194, shaft 193 and the dog attached thereto to release said cam.

The oppositely disposed, axially aligned drilling and countersinking apparatus is shown in Fig. 2 to be directly vertical of the machine bed 25 thus the hole 150 in the bearing will be substantially midway between its two straight edges engaging said machine bed. If it is necessary to drill the hole closer to one of said straight edges than the other, the wheel 166 is operated to rotate the drill apparatus supporting bracket 176 within the housing portion 154 in a clockwise or counterclockwise direction respectively. If said hole 150 is to be closer to one curved edge of the bearing than the other, then the bolts 153 are released and the entire housing 151 is moved in one direction or the other on the machine. At any adjusted position, bits 185 and 188 are diametrical relatively to the bearing 31 at station D for the pivotal point of rotation adjustment of the drilling unit is the center of the semi-circular bearing.

Tanging mechanism at station G

As shown in Fig. 8, the bearing 31 has a tang 127 extending outwardly from the one straight edge thereof. The mechanism for forming the tang is supported by the bracket 200 adjustably secured to the standard 22. Figs. 1 and 3 illustrate this mechanism as comprising a plate 201 having elongated slots 202 through which bolts 203 extend to screw into bracket 200, thereby providing adjustment of plate 201 on bracket 200 transversely of the machine which adjustment is at right angles relative to the adjustability of bracket 200 on the standard 22.

Plate 201 has a stub shaft 204 upon which the two levers 205 and 206 of the scissors-like tanging mechanism are pivotally supported. The longer, depending portions of levers 205 and 206 are tied together by the toggle links 207 and 208. The hinged joint 209 of links 207 and 208 has the piston rod 210 attached thereto, the cylinder 211, containing the piston to which rod 210 is attached, being hingedly secured to an extension 212 on lever 206.

The shorter end of lever 205 has an anvil 215 secured thereto, said anvil having a portion 216 operative, when the lever 205 is actuated out of normal position by cylinder 211, to engage the bearing 31 adjacent its one straight edge and clamp it tightly upon the stationary plate 60 which, as has been described, is secured to the bed plate 25. The shorter end of lever 206 has a shearing and bending plate 217 secured thereto which, when lever 206 is moved out of normal position, is moved to engage the bearing now clamped upon the plate 60 by anvil 215. The end of the plate 217 engaging the bearing is so shaped that the two sides of the plate will shear the bearing while the portion between said sides will bend the sheared bearing portion outwardly into a shallow recess in the face of the anvil 215 to form tang 127.

Lever 206 has a stop lug 218 which normally engages a projection 219 on plate 201. A substantially heavy coil spring 220 has its one end engaging a flat surface provided on the shorter end of lever 205, the other end of the spring resting upon the abutment shelf 221 on plate 201. This spring 220 exerts a constant force to rotate the two levers 205 and 206, tied together by the toggle links 207 and 208, in a counterclockwise direction (Fig. 3), this rotation, however, being prevented due to the engagement of lug 218, on lever 206,

with the projection 219 on plate 201. Thus normally, the anvil 215 and plate 217 on levers 205 and 206 respectively, are held spaced from the bearing 31, even though spring 220 is constantly exerting a force to move the anvil 215 against the bearing. However, when the cylinder 211 is energized to retract the piston rod 210, the toggle links 207 and 208 will be moved toward alignment, causing the lower ends of levers 205 and 206 to be moved apart. Lever 205 will move before lever 206 due to the influence of spring 220 upon lever 205 in the same direction. Lever 206 will remain stationary, against stop 219, until lever 205 has moved sufficiently to cause the anvil portion 216 to engage the bearing 31 and press it upon the plate 60 after which continued movement of the toggle links by the piston rod 210 will move lever 206 clockwise about pivot shaft 204 causing the shear plate 217 to engage the bearing and form the tang therein. Fig. 3 shows the stationary bed plate 25 and the plate 60 attached thereto undercut to provide a passageway for the tanging plate 217 on lever 206.

Timing of the machine

Fig. 16, the timing chart, shows one complete cycle of the machine as comprising twelve intervals. During intervals 1 and 2, the carriage or shifter is moved from normal to full outward position during which time bearings in or on the shifter are each moved from one station, forward to the succeeding station. Beginning at the 2.5 and continuing through to the 10.5 interval the bearing is clamped at station D. During the intervals 4 and 5, the carriage or shifter is returned to normal position. While clamped at station D and during the intervals 4 to 10 inclusive, the clamped bearing is drilled and countersunk. During the last half of interval 3 and through intervals 4 and 5, the tang is formed in the bearing.

The schematic Fig. 17 shows a motor 250 having suitable gear reduction mechanism 251 to drive shaft 252 at a predetermined reduced speed. This motor and shaft are attached to the machine in any suitable location. Shaft 252 has a plurality of actuating cams 253, 254 and 255 and 256 mounted thereon so as to rotate therewith. Cam 253 actuates the two hydraulic valves 257 and 258 which control fluid pressure flow from the source of supply 260 to the two ends of cylinder 44 for actuating the piston and rod 43 to move the shifter forward out of normal position and then rearward into normal position respectively. Control valve 261 normally directs fluid flow from the source 260 to the end of cylinder 164 so that the clamp lever 157 is maintained in normal bearing disengaging position as shown in Fig. 2. However, cam 254 is operative to actuate valve 261 to direct fluid to the opposite end of cylinder 164 at which time it will actuate the clamp lever 157 to engage and clamp the bearing to the machine. Valve 262, when not actuated by cam 255, directs fluid pressure from the source of supply into the upper end of cylinder 211 so that its piston rod 210 actuates the toggle links 207 and 208 to hold levers 205 and 206 free of the bearing in the shifter. However, as soon as the cam 255 engages and actuates valve 262, it will connect the lower end of cylinder 211 with the pressure supply causing the piston rod 210 to actuate toggle links 207—208 to move levers 205 and 206 so that their respective anvil and tanging plate, clamp and tang the bearing respectively. The fourth cam 256 on shaft 252 is operative to close switch 263 for energizing the electromagnet 196 to release the drilling and countersinking apparatus and permit it to complete its cycle of operation.

The Fig. 15 is a schematic view showing all cams 253, 254, 255 and 256 and their associated control devices in their relative angular positions.

Résumé in terms of machine operation

To operate the aforedescribed machine, the attendant opens the main valve 275 at the source of fluid pressure supply 260 permitting the fluid, under pressure, to be directed into the various connections with the hydraulic control devices. At the same time master switch 276 is closed connecting motors 193 and 250 as well as the electromagnet 196 with the electric power lines 277—278. This renders motors 193 and 250 operative. Operation of motor 250 rotates the shaft 252 and its cams 253, 254, 255 and 256. They in turn render their respective control devices 257—258, 261, 262 and 263 operative to control their respective machine actuators, cylinders 44, 164 and 211 and the electromagnet 196 active at properly timed intervals.

With the machine in operation, bearings 31, in the hopper feed 30, are directed to fall into position at station A. The bearing is positioned between the two parallel bars 33 and 34 of shifter 32 with the two straight edges of the bearing resting upon the bed plate 25, each parallel to a shifter bar and in close proximity thereto. When cam 253 actuates valve 257 to direct fluid pressure from the source 260 to cylinder 44, piston rod 43 is actuated to move the shifter 32 forward from its normal position. As the shifter 32 moves forwardly, the pushers 50A will move the bearing from station A into station B. The bearing moves beneath retainer 80 by raising it, however, when the shifter has moved forwardly its full range of travel, the bearing will have been moved past the retainer 80 sufficiently to permit it to drop, by gravity, so as to retain the bearing at station B. Now cam 253 will engage and actuate valve 258 which causes the cylinder to be activated to return the shifter into normal loading position. On the next forward stroke of the shifter, pushers 50B, back of the bearing at this station, will move said bearing past retainer 81 into station C. Concurrently a new bearing at the loading station is moved into station B. Following the progress of the bearing now at station C, pushers 50C will move said bearing past retainer 82 and into engagement with the locating stops 190 and 191 at station D. After the bearing has engaged the locators at station D, the cam 254 operates the control device 261 to effect energization of actuator 164 to move the lever 157 and its clamping portion 158 into engagement with said bearing to clamp it rigidly upon the bed plate 25 of the machine. While the bearing is so clamped, the shifter 32 is returned to its normal, loading position. Also, while the bearing is clamped by lever 157, cam 256 actuates the control device 263 to effect energization of the electromagnet 196 which renders the drilling mechanism effective to drill and countersink the clamped bearing at station D, the drill 185 first performing its drilling and countersinking operation.

As a result of the next three successive forward movements of the shifter 32, this bearing, drilled at station D, will be advanced successively into stations E, F and G by pushers 50D, 50E and 50F respectively. At station G the bearing is pre-

cisely located by the locating stops 125 and 126. Shortly after the shifter 32 has moved bearing 31 into station G and before said shifter starts to return to its normal position, cam 255 operates the control device 262 to render the cylinder 211 effective to cause the piston rod 210 to actuate the levers 205 and 206 first to clamp the bearing upon the stationary plate 60 of the machine then to form the tang 127 on the bearing. This operation is completed and the bearing released before the shifter is again moved forwardly out of its normal position. When said shifter does move forward again, pushers 50G will move the finished bearing along the machine toward the unloading end thereof.

It will be understood that during its operation the machine will have a bearing at each of its stations A to G inclusive, all being progressively advanced with each forward stroke of the shifter 32.

Although Fig. 1 illustrates the machine in its simplest form, that is, having one drilling station to provide a single hole in the bearing, plural drilling apparatus may be provided to drill more holes in the bearing if necessary, this change requiring a longer base 20, a longer bed plate 25, extending shifter rods 33 and 34 and the required controls and actuators. The perspective view, Fig. 18, shows a machine with two drilling mechanisms angularly arranged.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a machine for drilling and shearing a semi-circular bearing, the combination with a reciprocative shifter comprising two spaced, parallel bars slidable on a stationary part of the machine and adapted to have the bearing placed therebetween so that its edges seat upon the machine, said shifter having provisions for progressively moving the bearing from one station to another as the shifter is moved out of normal position; means on the machine for engaging the bearing at each station and preventing movement thereof as the shifter is returning to its normal position; a circularly shaped clamp movable into engagement with the bearing at one predetermined station for pressing the bearing rigidly upon the machine; a ring shaped stationary part of the machine adjacent said predetermined station and concentric with the semi-circular bearing; a bracket having a circular portion pivotally supported in the ring shaped stationary part of the machine so as to be circumferentially adjustable relatively thereto: drilling apparatus attached to said bracket, said apparatus having its drill centrally aligned with the clamped bearing so as to be diametrical relatively thereto; a pincer mechanism consisting of two pivoted levers one operative to clamp the work piece to the machine at another predetermined station, the other to shear said clamped work piece; means for actuating the shifter; means for actuating the clamp to engage the bearing after the shifter has moved it to said one predetermined station and before said shifter starts to return to its normal position; means for rendering the drilling apparatus active to drill the bearing while it is clamped upon the machine, and means for actuating the pincer mechanism, all of the four last mentioned actuating means each being under the control of an individual control device engageable with and operated in timed intervals, one relatively to the other, by an individual cam, all of said cams being mounted upon and driven by a common, power actuated shaft.

2. In a machine for drilling and shearing a semi-circular bearing, the combination with a reciprocative shifter comprising two spaced, parallel bars slidable on a stationary part of the machine and adapted to have the bearing placed therebetween so that its edges seat upon the machine, said shifter having provisions for progressively moving the bearing from one station to another as the shifter is moved out of normal position; means on the machine for engaging the bearing at each station and preventing movement thereof as the shifter is returning to its normal position; a lever arm pivoted on the machine and having a circularly shaped end movable into engagement with the bearing when it is at one predetermined station for rigidly clamping said bearing upon the machine; a stationary housing adjustably secured to the machine adjacent said one predetermined station, said housing having a circular opening surrounding the shifter and a portion pivotally supporting the lever arm, said circular opening being concentric with the bearing clamped upon the machine; a bracket provided with a ring-shaped flange, rotatably carried in the circular opening of said housing and surrounding the shifter; means supported by the housing and engaging the ring-shaped flange of the bracket, said means being operative rotatably to adjust said bracket relatively to the housing; drilling apparatus secured to the bracket, said apparatus having coaxial, oppositely disposed drills, one on each side of the bearing and diametrical relatively thereto, said drilling apparatus being operative to apply first one drill then another to said bearing; a pincer consisting of two, coaxially pivoted levers, one for engaging and clamping the work piece, the other for shearing a portion of the clamped workpiece; separate means for actuating the shifter, the lever arm the drilling apparatus and the pincer in predetermined timed relation, certain of said means being connectible to one power source and the other means to another power source by a separate control device respectively; and a power driven shaft having a plurality of cams thereon, each cam engaging and operating one of said control devices.

3. In a machine of the character described, the combination with a reciprocative shifter comprising two spaced, parallel bars slidable on the machine and adapted to have a work piece placed therebetween for purposes of moving said work piece progressively from one station to another until it reaches stations at which it is to be operated upon; a plurality of oppositely disposed spring-loaded pushers, equally, longitudinally spaced, extending from the facing sides of the shifter bars, each pair of oppositely disposed pushers being operative, when the shifter is moved out of normal position, to engage and move the work piece to the next advanced station; bridging members on the machine, extending over the shifter; a bar supported between said bridging members and extending centrally, longitudinally over the shifter; a plurality of hinged retainers depending from said bar, each retainer being operative to engage and hold a bearing when the shifter moves it to an advanced station, thereby preventing movement of the bearing as the shifter returns to normal position; a locating stop on the machine adjacent a predetermined station; a pin on the shifter; a cam on said lo-

cating stop, engageable by said pin to move the stop in the path of a bearing approaching said predetermined station during the final range of movement of the shifter out of normal position, said pin engaging the cam to move it out of the path of the bearing as the shifter is returned to normal position, whereby the bearing occupying the said predetermined station is movable past the stop during the initial range of movement of the shifter out of normal position; means operative to engage and clamp the bearing upon the machine after said bearing engages the stop; means operative to drill said bearing while clamped upon the machine; a locating stop at a second predetermined station; a pincer at said second station, said pincer having two levers, one for clamping the work piece, the other for shearing said clamped workpiece; and means for actuating the shifter, the clamp, the drill and the pincer, all at predetermined times, one relatively to the other and in recurrent sequence, said means consisting of an individual hydraulic motor for each, the shifter, the clamp and the pincer and an electric motor for the drill, each motor being provided with an individual control device each of which is periodically actuated, to render its respective motor operative, by a cam, all cams being driven by a common shaft powered by an electric motor.

4. In a machine for drilling and forming a tang on one straight edge of a circular bearing, the combination of, a reciprocative shifter comprising two spaced parallel bars slidable on a stationary part of the machine and forming guide rails between which the straight edges of a semi-circular bearing are placed for guiding movement of the bearing longitudinally between the guide rails, said shifter having a plurality of pushers engageable with the rear edges of bearing elements placed between the guide rails for moving the bearing elements from one station to another in the machine as the shifter is moved in a forward bearing advancing direction, detent means on the machine for engaging the bearings at each station to prevent return movement thereof as the shifter moves in a retraction movement to its normal position, locating stop means on a stationary part of the machine adjacent a work station for engagement by a bearing element to position the same in a work station, camming means between the locating stop and the shifter operable by the shifter to move the locating stop into the path of a bearing element approaching a work station and during the final portion of the forward movement of the shifter, said shifter moving the locating stop out of the path of the bearing as the shifter returns to its normal position, whereby the bearing occupying the work station position is movable past the locating stop during the initial portion of the forward movement of the shifter, drilling means on the machine at one of the work stations having a locating stop, means operative to engage and clamp a bearing upon the machine in the drilling station after the bearing engages the stop at the station, a pincer at a second work station having a locating stop for positioning of a bearing relative to the pincers, said spincers having two levers one of which clamps the work-piece on the machine and the other of which shears and forms a tang in an edge of the bearing, and means for actuating the shifter, the clamp, the drill, and the pincer at pre-determined intervals one relative to the other in recurrent sequences, said means consisting of individual motor means for the shifter, the clamp, the pincers and the drill, each of said motor means being provided with an individual control device to render the said motor means operative, all control devices being operative by individual cams driven concurrently by a common shaft powered by an electric motor.

5. A machine in accordance with claim 4 in which one portion of the shifter guides forward movement of bearing elements through the machine by engagement with the lower edges of the bearing elements and a second portion of the shifter guides movement of the bearing elements through the machine by engagement with the internal periphery of the bearing elements.

6. A machine in accordance with claim 4 wherein one portion of the shifter comprises spaced parallel guide rails for engaging the stationary edges of a semi-circular bearing for longitudinal guiding movement thereof and a second portion of the shifter comprises a core plate positioned internally of the bearing for supporting the same and guiding the bearing longitudinally relative to the spaced parallel guide rails, and further wherein the pushers in that portion of the shifter consisting of the parallel guide rails are placed within the guide rails and the pushers within that portion of the shifter comprising the core plate are placed in the core plate.

7. In a machine in accordance with claim 1 wherein the bracket supporting the drilling apparatus is movably supported upon the machine for adjusting the position of the drilling apparatus relative to the ends of the bearing in the drilling station.

HOOPER J. HOUCK.
RICHARD M. MORGAN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,757,415	Conway	May 6, 1930
1,812,350	Lingwood	June 30, 1931
1,846,645	Lach	Feb. 23, 1932
1,986,699	Winterkamp	Jan. 1, 1935
2,049,400	Strawn et al.	July 28, 1936
2,227,145	Lex et al.	Dec. 31, 1940
2,238,921	Waldsmith	Apr. 22, 1941
2,249,230	Schafer	July 15, 1941
2,302,878	Muhl et al.	Nov. 24, 1942
2,371,906	Millholland	Mar. 20, 1945
2,392,169	Mansfield	Jan. 1, 1946
2,462,327	Mills	Feb. 22, 1949
2,475,091	Hackman	July 5, 1949