No. 873,787. PATENTED DEC. 17, 1907.

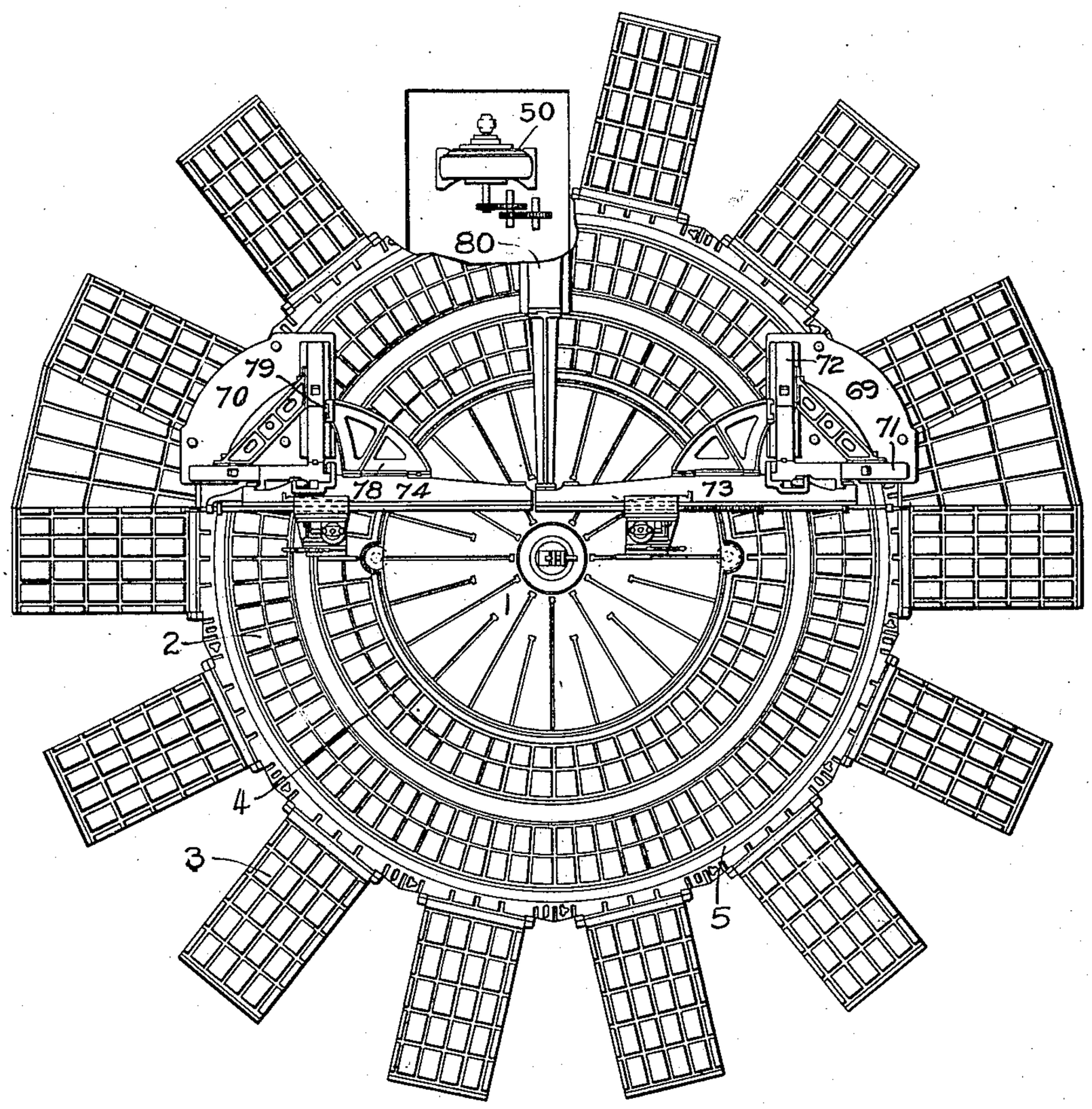
J. RIDDELL.

BORING AND TURNING MILL.

APPLICATION FILED JUNE 27, 1903.

6 SHEETS—SHEET 1.

Fig. 1.



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Helen Alford

Inventor:
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by Allen B. Davis Atty.

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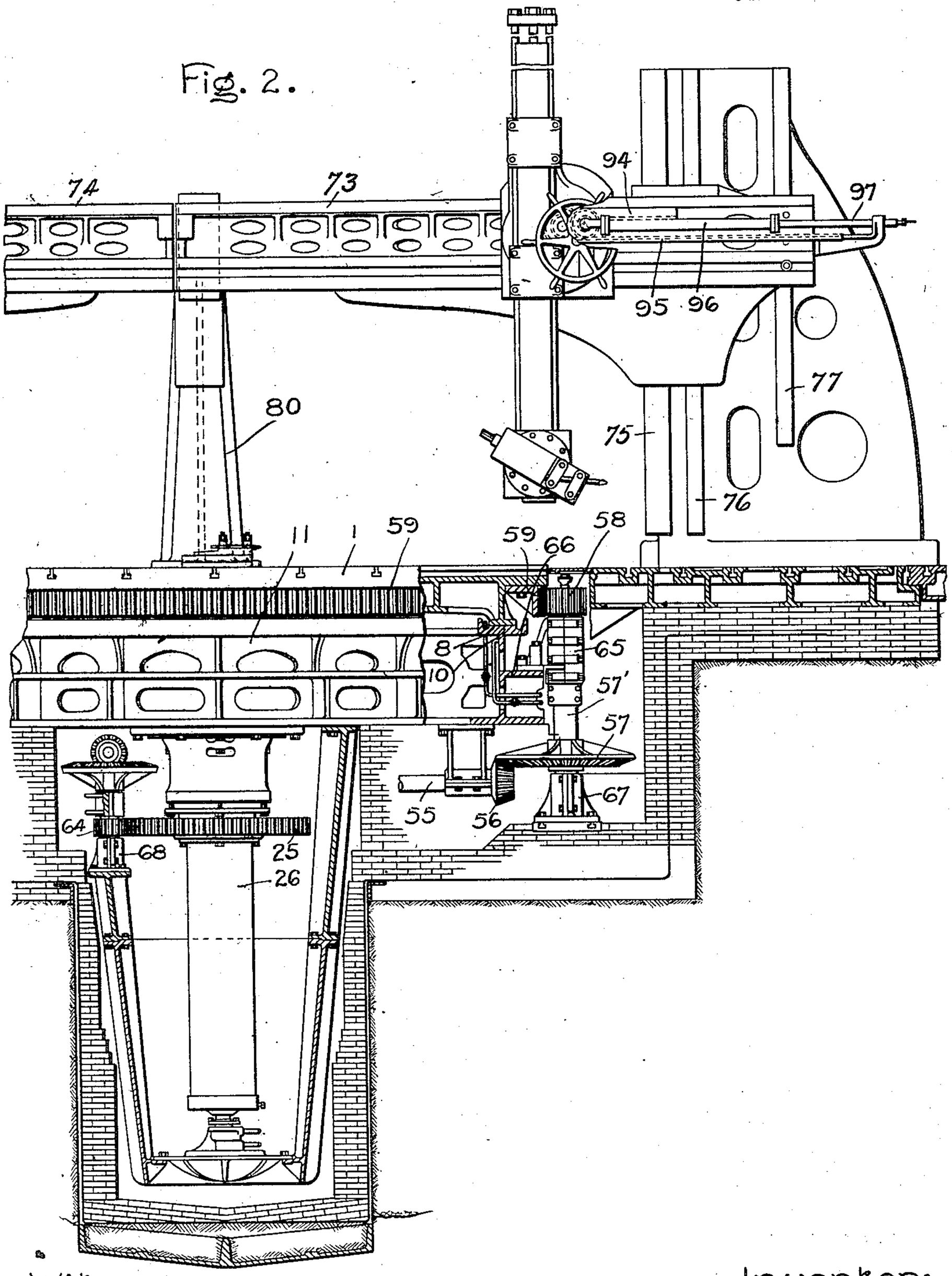
6 SHEETS—SHEET 2.

Fig. 2.



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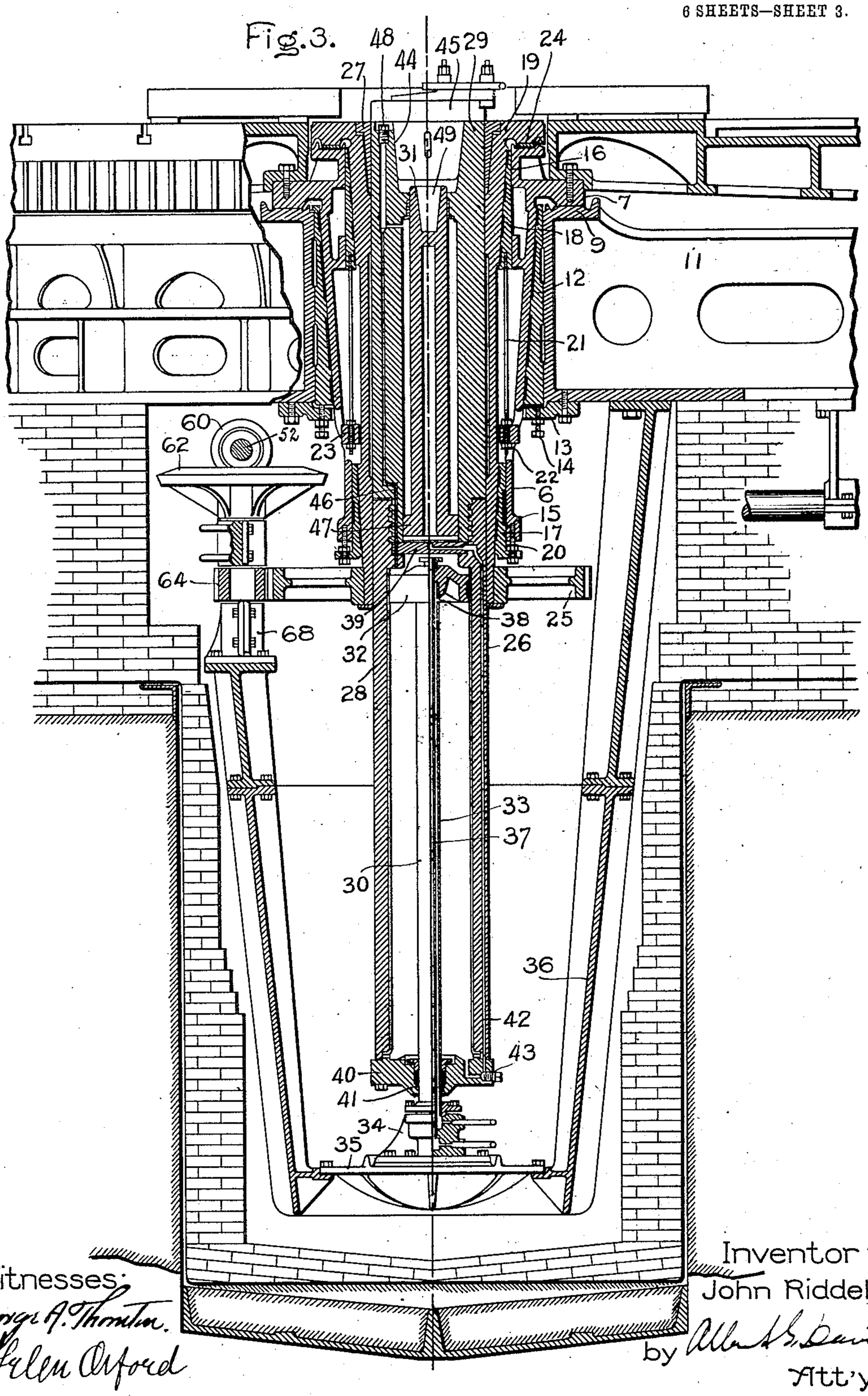
6 SHEETS—SHEET 3.

Fig. 3.



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6 SHEETS—SHEET 4.

Fig. 5.

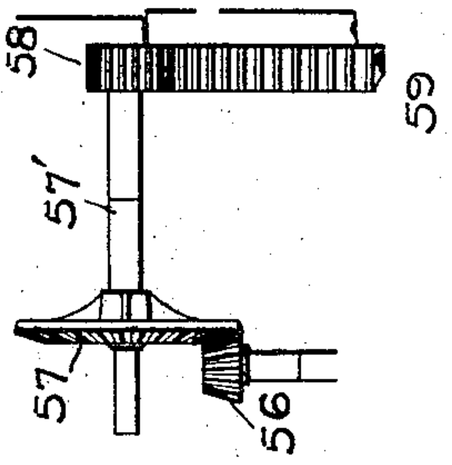


Fig. 6

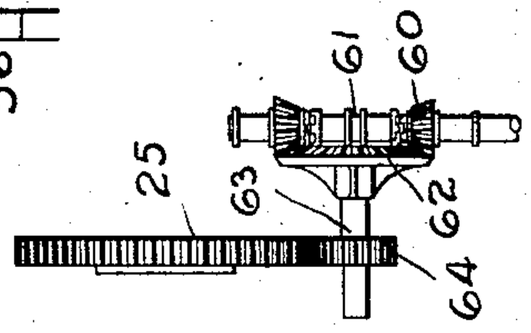
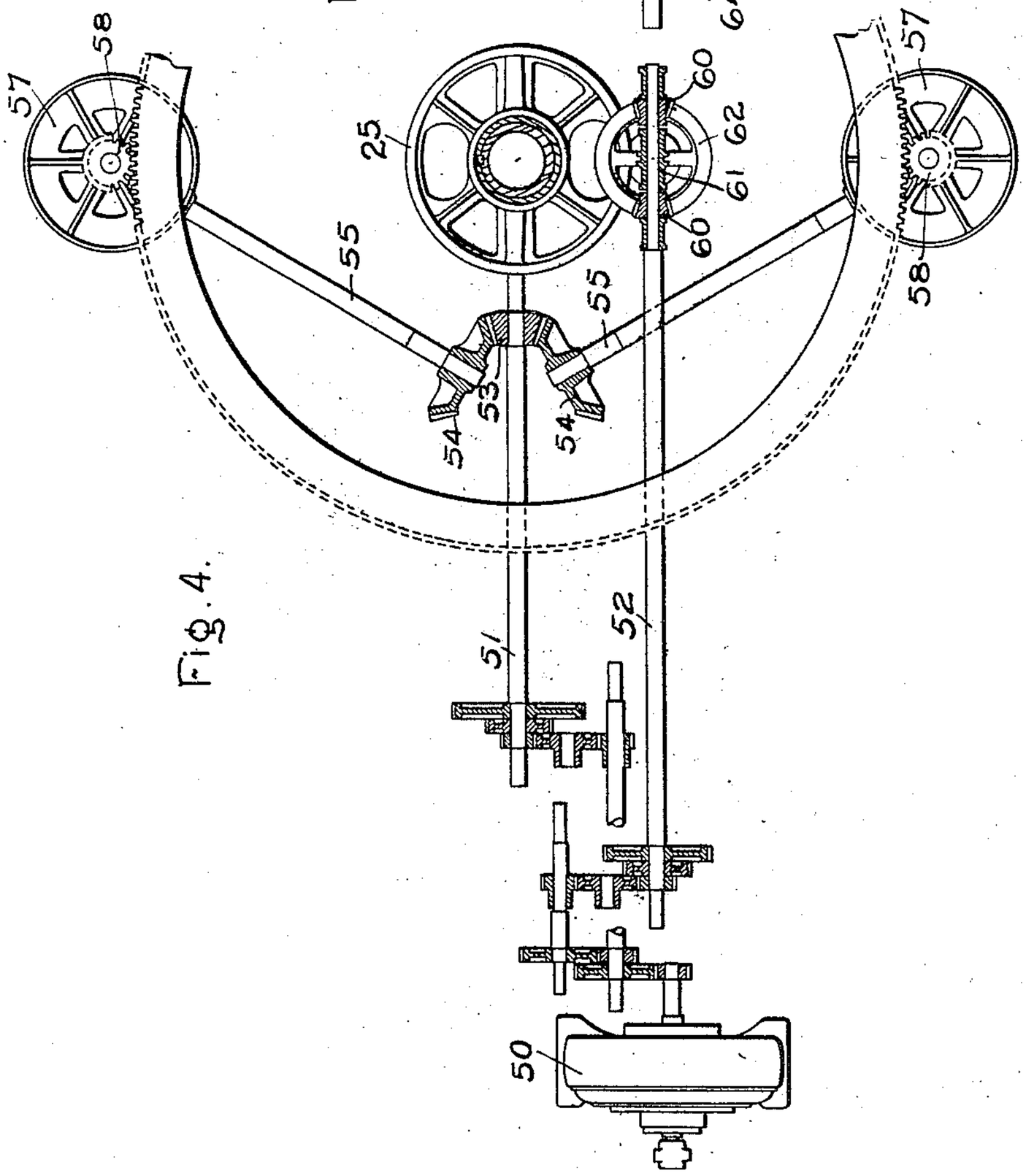


Fig. 4.



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6 SHEETS—SHEET 5.

Fig. 7.

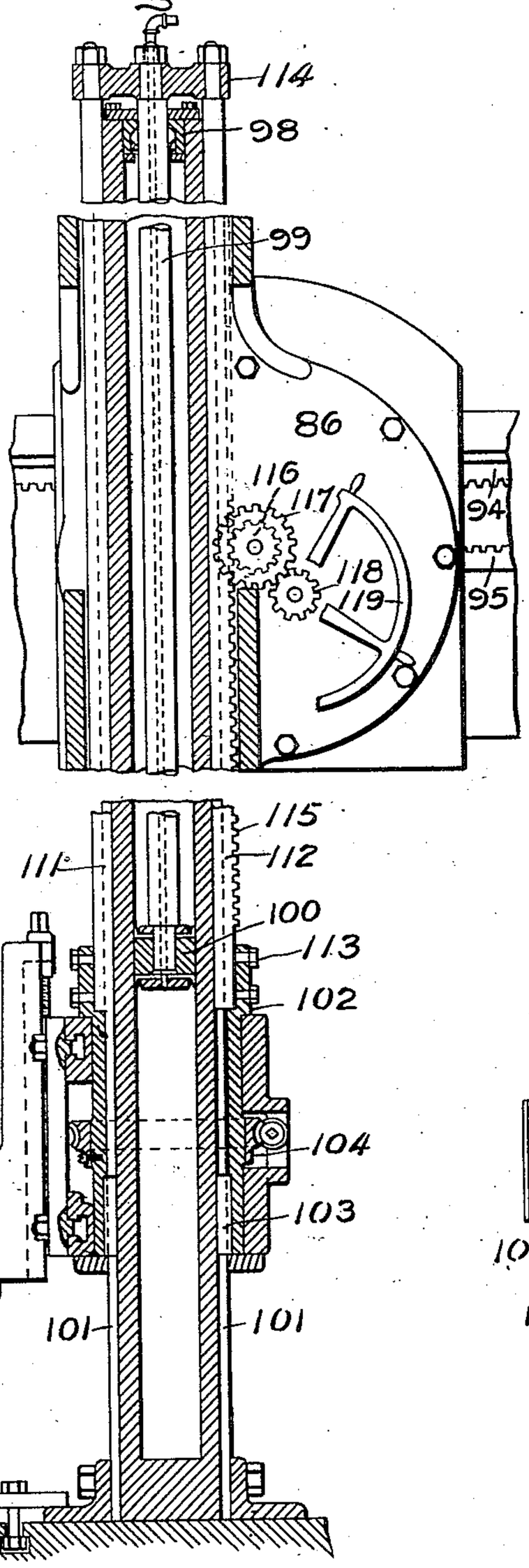


Fig. 8.

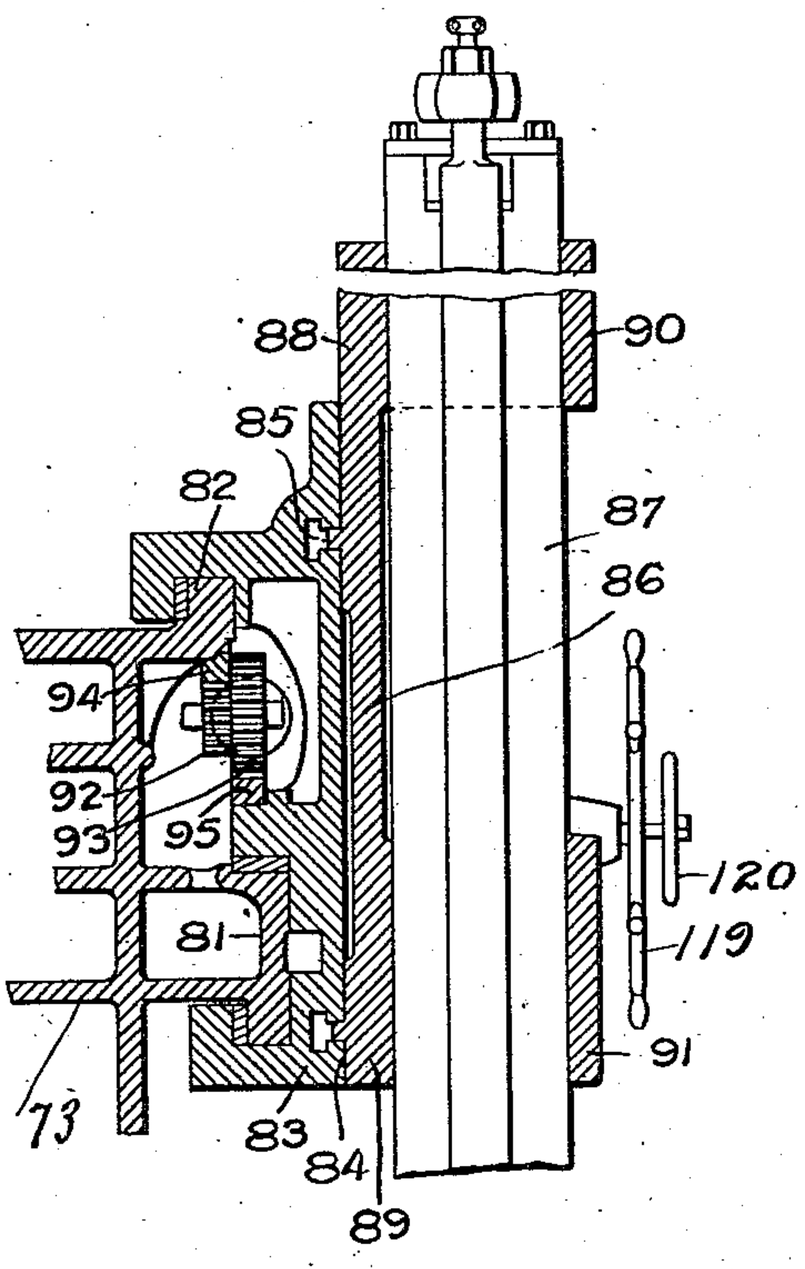
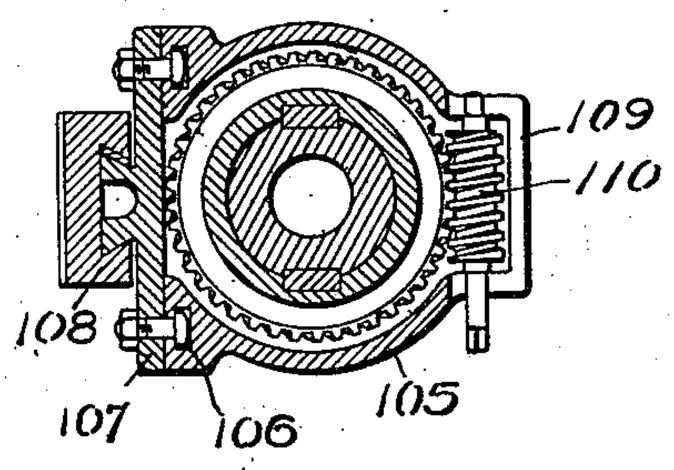


Fig. 9.



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BORING AND TURNING MILL.

APPLICATION FILED JUNE 27, 1903.

6 SHEETS—SHEET 6.

Fig. 10.

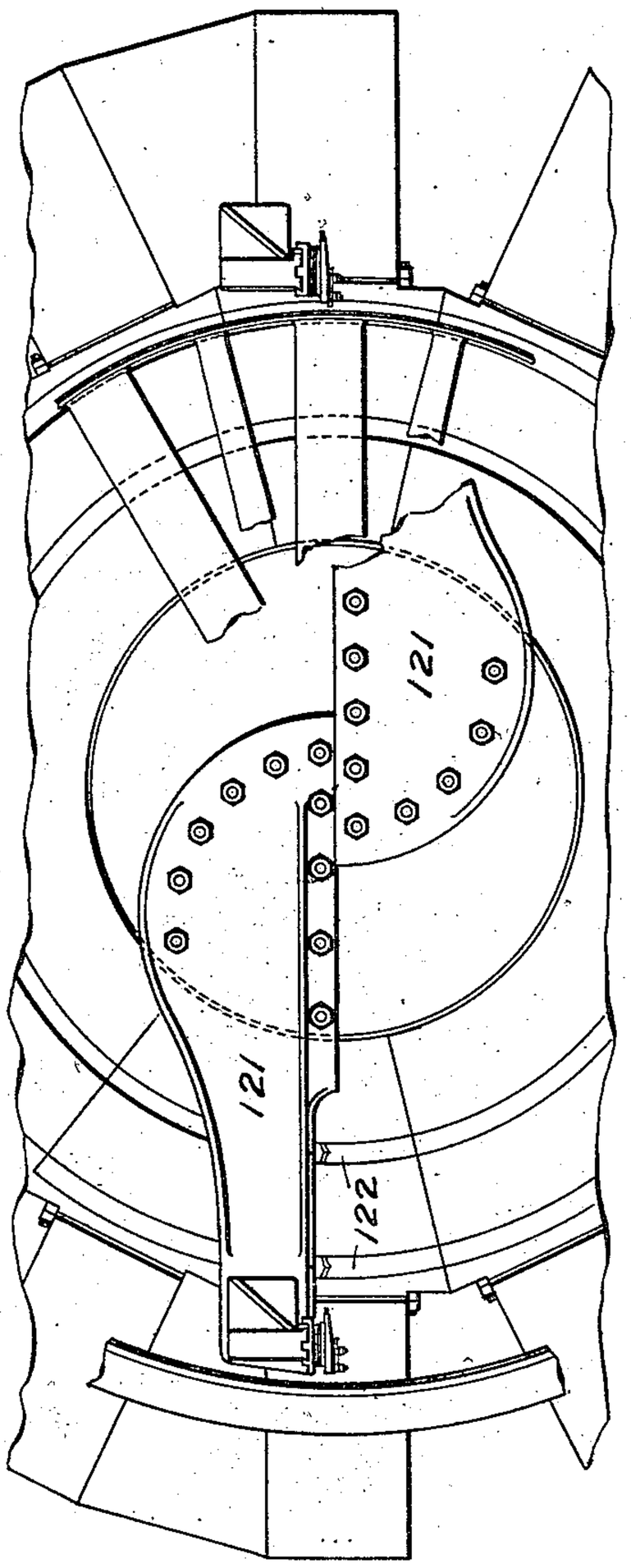
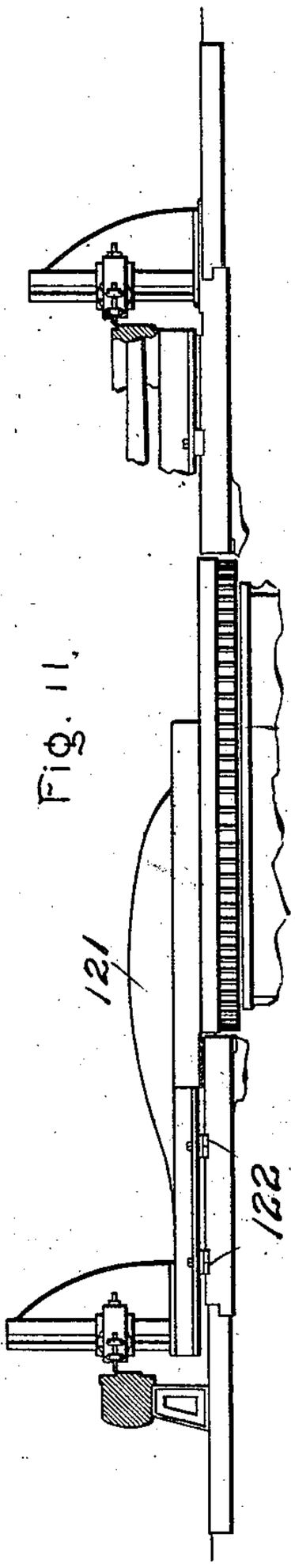


Fig. 11.



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by Allen Hyde Davis
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UNITED STATES PATENT OFFICE.

JOHN RIDDELL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

BORING AND TURNING MILL.

No. 873,787. Specification of Letters Patent. Patented Dec. 17, 1907.

Application filed June 27, 1903. Serial No. 163,319.

To all whom it may concern:

Be it known that I, JOHN RIDDELL, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Boring and Turning Mills, of which the following is a specification.

The present invention relates to power-driven machine tools, and more particularly to that class of machine tools known as boring and turning mills.

The object of my invention is to provide a machine of this class which shall be adapted to receive and operate upon much larger pieces of metal than the machines heretofore in use, and which will not require a greater expenditure of effort on the part of the operator to manipulate.

A further object of my invention is to provide a boring mill on which a greater number and variety of operations may be performed either separately or simultaneously, so that the number of changes of the part operated upon from one kind of machine to another is greatly reduced, and in a large number of cases the entire work may be performed without removal therefrom.

The device comprises a table having a revoluble peripherally-driven center section, and a stationary outer section upon which stand massive upright housings that are designed to be moved radially thereover to provide clearance between them, according to the diameter of the part operated upon, and these housings are each provided with an inwardly-projecting cross-arm, upon which tool-supporting and feeding means are carried, and the inner end of which is rigidly held by an inwardly-projecting bracket secured to the stationary part of the table. The central spindle of the table is provided with an independently-actuated tool bar which is adapted to be rotated to bore out and face off the central part of the piece operated upon, such as the hub of a fly-wheel, and also adapted to be reciprocated vertically to cut key-slots and the like. The device also comprises numerous structural details whereby the tendency of the parts to vibrate is overcome, and the adjustment of the various tool-holding means to different positions is accomplished by power means.

The invention will be readily understood upon reference to the following description and the accompanying drawings forming a part of this specification, in which

Figure 1 is a top plan of a boring and turning mill, with a part of the table shown broken away, embodying one form of my invention; Fig. 2 is a front elevation of the right-hand housing and parts carried thereby, and a part elevation and part section of the table and bed plate; Fig. 3 is a vertical section of the table-spindle and central tool-supporting bar; Fig. 4 is a plan of the driving motor and power connections with the table and boring-bar sleeve; Figs. 5 and 6 are elevations of the table and sleeve-actuating gears; Fig. 7 is a vertical section of a boring-bar carried by a tool-head; Fig. 8 is a cross-section of a cross-arm, the saddle and swivel-plate; Fig. 9 is a horizontal section of the tool-post and swivel-connection; Figs. 10 and 11 are a part plan and a part elevation of the mill, showing the method by which the part operated upon, or long overhanging tool supports, may be rotated and partially supported by the stationary part of the table.

The table of the boring and turning mill shown in the drawings consists of a central revoluble section 1, an intermediate stationary continuous section 2, and an outer stationary non-continuous section 3. The outer section 3 consists of polygonal plates radially arranged, and connected at intervals to the outer periphery of the intermediate continuous section 2. The intermediate section 2 is provided in its upper surface with two concentric guide-channels 4 and 5 for a purpose to be described later, and both of the stationary sections 2 and 3 are directly supported on masonry or other suitable foundations. The central revoluble section 1 is provided on its lower side with a tapered central spindle 6 by which it is held in fixed central position, and inner and outer bearing surfaces or ways 7 and 8 which rest upon corresponding flanged ways 9 and 10 in the upper surface of a bed-plate 11, and by which the entire weight of the revoluble section and parts carried thereby is supported.

The bed-plate 11 is directly supported upon masonry work, and is provided with a large central bore for the reception of adjustable wedge-shaped bearing-blocks 12 for the tapered spindle 6, and an inwardly-projecting ring 13 through which extend adjustable set-screws 14.

The central spindle 6 is made hollow and

provided with cylindrical bearing surfaces 15 and 16 near its respective ends for the reception of sets of adjustable wedge-shaped bearing-blocks 17 and 18 for a rotary sleeve 19. The blocks 17 are actuated by adjustable set-screws 20 secured to the lower end of the cylinder 6, and blocks 18 are actuated by long rods 21 connected therewith and provided at their lower ends with nuts 22 arranged on opposite sides of stationary parts 23 of the spindle 6.

The rotary sleeve 19 is outwardly flanged at its upper end and provided with a bearing surface 24 which engages a corresponding surface at the upper end of the spindle 6, and is extended at its lower end below the end of the spindle 6 and provided with a spur-gear 25 whereby it is adapted to be actuated in either direction independent of the motion of the revoluble section of the table.

In the bore of the sleeve 19 is feathered a reciprocating tool-supporting bar 26, and at the upper end of the bore a beveled packing ring 27 is provided. The tool-supporting bar 26 is designed for use in boring out and facing off central parts such as the hubs of fly-wheels and for cutting key-slots therein, and consists of two hydraulic cylinders 28 and 29 connected by screw-threads. The lower cylinder incloses a stationary piston 30 and the upper cylinder a telescoping auxiliary tool-supporting bar 31 which is adapted for use in boring out holes of less diameter than the bar 26, and also constituting an extension of the bar 26 whereby holes of greater length than the travel of the bar 26 may be made.

The stationary piston 30 comprises a piston-head 32 and a hollow rod 33 supported in a block 34 connected by pipes to any suitable pressure device and secured to a head-plate 35 of a supporting-shell 36 bolted to the under side of the bed-plate 11. Extending concentrically through the piston-head 32 and rod 33 is a tube 37 which extends into block 34 and constitutes a conductor of the pressure-fluid to the top side of the piston-head 32, while the space between the tube 37 and the hollow rod 33 constitutes a conductor of the pressure-fluid to the under side of the head 32, the rod 33 being provided with a port 38 near the head for the passage of fluid into the cylinder 28.

The lower hydraulic cylinder 28 is closed at its upper end by a disk 39, and at its lower end by a cylinder head 40 provided with a stuffing-box 41 for the piston-rod 33. A passage-way 42 for conducting the pressure fluid from the lower cylinder into the upper beneath the auxiliary bar 31 leads from the upper surface of the head 40, up lengthwise of the cylinder and through the disk 39, and at some point in the passage a plug-valve 43 is provided which is kept closed when the auxiliary bar 31 is not in use.

The upper hydraulic cylinder 29 is provided at its upper end with a frusto-conical socket 44 in which a tool-holder 45 may be keyed, and at the lower end of the socket 44 a packed aperture is provided for the passage of the auxiliary bar 31. A passage-way 46 for conducting the pressure-fluid from the space above the upper end of the stationary piston 30 to the upper side of the auxiliary piston 47 leads through the disk 39 and up lengthwise of the cylinder 29, and is provided with a plug-valve 48 which also remains closed when the auxiliary bar 31 is not in use.

The auxiliary bar 31 is provided at its upper end with a socket 49 for the reception of a tool-holder and normally rests at its lower end upon the disk 39 with its upper end standing in the plane of the bottom of the socket 44 in the tool-supporting bar 26. This arrangement of the central tool-supporting bar provides a readily-controlled means for feeding it while it is being driven by the gear 25, or for reciprocating it up and down without turning when cutting a keyway.

The means for driving the rotary table 1 and the central tool-supporting bar 26 consists of a motor 50 located in a pit below the level of the table and connected through suitable reducing-gearing to two shafts 51 and 52. Shaft 51 is provided with a bevel-gear 53 which meshes with two larger bevel-gears 54 on the ends of diagonal shafts 55 which carry at their other ends small miter-gears 56 meshing with large gears 57 on short vertical shafts 57′ located at diametrically opposite points with respect to the rotary table 1, and carrying at their upper ends pinions 58 which mesh with a gear-ring 59 secured to the rotary table 1 near its periphery. The other shaft 52 is provided with two loose bevel-gears 60 and a feathered clutch-sleeve 61 adapted to connect either gear 60 to the shaft, and these gears mesh with a larger bevel-gear 62 carried by a short vertical shaft 63 having a pinion 64 at its lower end which engages the large gear 25 on the central tool supporting-bar sleeve 19. The bearings 65 for the vertical shafts 57′ are rigidly secured to an outer ledge 66 of the bed-plate 11, and step-bearings 67 for the lower ends of the shafts are secured to the masonry foundations. The bearings 68 for the vertical shaft 63 are secured to the supporting-shell 36 of the central boring-bar.

The portable housings 69 and 70 each comprise an upright bracket 71 standing in the line of the divided cross-rail and a second upright bracket 72 standing at right angles thereto, and braced and tied therewith. The cross-rail or arms 73 and 74 are secured to the housings for vertical adjustment on suitable guide-ways 75, 76 and 77, and each arm is provided with a diagonal brace 78 at

its back, which extends to and engages a way 79 on its respective housing. The extreme inner end of the cross-arm 73, as shown in Figs. 1 and 2, is stayed by a bracket 80 which extends over the revoluble table 1 and bears at its inner end against the back side of the cross-arm. The cross-arms 73 and 74, as indicated in Fig. 8, each has a relatively narrow guide-way 81 at its lower side and a bearing surface 82 at its upper edge, whereby a double bearing is provided for the saddle 83, and by means of which the latter is held from oscillating. The saddles 83 are each provided with a vertical bearing-surface 84 in which is cut a circular bolt-groove 85 for the reception of a swiveled tool-head 86 for a boring-bar 87. The tool-heads 86 are each provided with two bearings 88 and 89 having cover-plates 90 and 91 adapted to clamp the boring-bar and hold it in adjusted position.

The means for moving each of the saddles 83 upon its respective cross-arm comprises two gears 92 and 93, the smaller of which engages a rack 94 secured to the cross-arm and the larger of which engages a rack 95 carried by the saddle; and these gears 92 and 93 are carried at the inner end of a hydraulic cylinder 96 having a stationary horizontal piston 97 connected to suitable fluid-pressure means.

The boring-bars 87 each consists of a large hydraulic cylinder closed at its lower end and provided with a stuffing-box 98 at its upper end for the passage of a hollow piston-rod 99, similar to rod 33 of the central boring-bar, and adapted to conduct pressure-fluid therethrough to opposite sides of its head 100. The bars 87 are each provided on opposite sides with slots 101, and surrounded by a sleeve 102 which is held from turning thereon by feathers 103 engaging the slots. Each sleeve 102 has fixed thereon a worm-wheel 104, and journaled thereon an adjustable shell 105 provided with a plane side having a circular bolt-groove 106 for a swivel-plate 107, which carries a tool-slide 108, and opposite the plane side it is provided with an extension 109 in which is journaled a worm 110 which engages the worm-wheel 104, and by means of which the shell 105 and the tool-holder mounted thereon may be swiveled about the axis of the boring-bar and held in adjusted position. The sleeve 102 extends somewhat above the shell 105 and is provided with slots at diametrically opposite sides for the reception of the lower ends of vertical rods 111 and 112 of rectangular section, and loosely fitting the slots 101. The rods 111 and 112 are detachably secured at their lower ends to the sleeve 102 by set-screws 113, and at their upper ends to a cross-piece 114 to which the piston-rod 99 is also secured. One of these rods, 112, is provided with rack-teeth 115 which engage a pinion 116 mounted on the tool-head 86 and connected by reducing-gears 117 and 118 to a hand-wheel 119 provided with a clutch-wheel 120. The hand wheel 119 is provided as an auxiliary means for use in setting up and adjusting the tool to the work, the tool being fed and raised and lowered to position through the hydraulic means above described.

When the tool is employed in turning up the outer periphery of a part, the boring-bar 87 may be lowered to rest at its lower end upon the stationary table and bolted thereto, as shown in Fig. 7, to prevent vibration. The raising and lowering of the boring-bar is accomplished by first raising or lowering the piston 99 and parts carried thereby, securing it in adjusted position through the clutch mechanism of the hand-wheel 119, releasing the cover-plates 90 and 91, and forcing the bar 87 up or down by regulating the flow of the pressure-fluid.

When work of extra large diameter is to be operated upon, as indicated in Figs. 10 and 11, the part of the work, or the tool-supporting arms 121, as the case may be, which overhangs the stationary table is supported therefrom and held from vibrating by shoes 122 bolted to the under side thereof and resting upon the guide channels 4 and 5 formed in the stationary table concentric with its axis.

The arrangement of the electric connections for the motor, the piping for conveying the pressure-fluid to the various hydraulic actuated parts and the oil-conductors for lubricating the various bearings have not been shown or described herein, for the reason that they may be of any approved construction, and in no way constitute a part of my invention.

It is apparent that the form, construction and arrangement of parts of the device herein described may be changed and modified in many respects, without departing from my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is—

1. A boring and turning mill provided with a cross-rail having a rack secured thereto, a saddle carried by said rail and provided with a rack, gears of different sizes rigidly connected together and respectively engaging said racks, and means to move said gears lengthwise of said rail.

2. A boring and turning mill provided with a cross-rail having a rack secured thereto, a saddle carried by said rail and provided with a rack, gears of different sizes rigidly connected together and respectively engaging said racks, and hydraulic means for moving said gears lengthwise of said rail.

3. In a boring and turning mill, the combination of a bed plate, a revoluble table mounted thereon, a tool-supporting bar car-

ried by said bed plate and journaled in said table, and means for rotating said bar independently of said table.

4. In a boring and turning mill, the combination of a bed plate, a revoluble table mounted thereon, a tool-supporting bar mounted upon said bed plate concentric with said table, and means for independently rotating and reciprocating said bar.

5. In a boring and turning mill, the combination of a revoluble table, a tool-supporting bar located concentrically therewith and normally below the surface thereof, and means for independently rotating and reciprocating said bar.

6. In a boring and turning mill, the combination of a revoluble table, a telescopic tool-supporting bar supported concentrically therein, and means for independently rotating and reciprocating said bar.

7. In a boring and turning mill, the combination of a revoluble table, an independently revoluble sleeve journaled therein, a tool-supporting bar feathered in said sleeve, and means for reciprocating said bar.

8. In a boring and turning mill, the combination of a revoluble table provided with a central bearing surface, a revoluble sleeve supported upon said bearing surface, a tool-supporting bar located within said sleeve and feathered thereto, means for rotating said sleeve, and means for reciprocating said bar.

9. In a boring and turning mill, the combination of a tool-supporting bar comprising two hydraulic cylinders, an auxiliary tool-supporting bar located in the upper cylinder, a stationary piston located in the lower cylinder, and means for conducting fluid under pressure to one or both of said cylinders.

10. In a boring and turning mill, the combination of a centrally-journaled table provided with peripheral gear-teeth, a plurality of drive-gears located on opposite sides of the table axis and meshing with said teeth, and means for rotating said gears simultaneously.

11. In a boring and turning mill, the combination of a bed plate provided with a central vertical bearing, a concentric horizontal bearing-way adjacent said bearing and a second concentric horizontal bearing-way remote from said vertical bearing, and a revoluble table having a central journal and horizontal bearing surfaces corresponding to said bearing-ways.

12. In a boring and turning mill, the combination of a central revoluble table and a stationary table surrounding said revoluble table and provided with guide-ways concentric with the axis of said revoluble table, for supporting parts carried by the revoluble table and projecting beyond the periphery thereof.

In witness whereof, I have hereunto set my hand this 26th day of June, 1903.

JOHN RIDDELL.

Witnesses:
EDWARD WILLIAMS, Jr.,
BENJAMIN B. HULL.