W. W. VOSPER.

MULTIPLE DRILLING MACHINE.

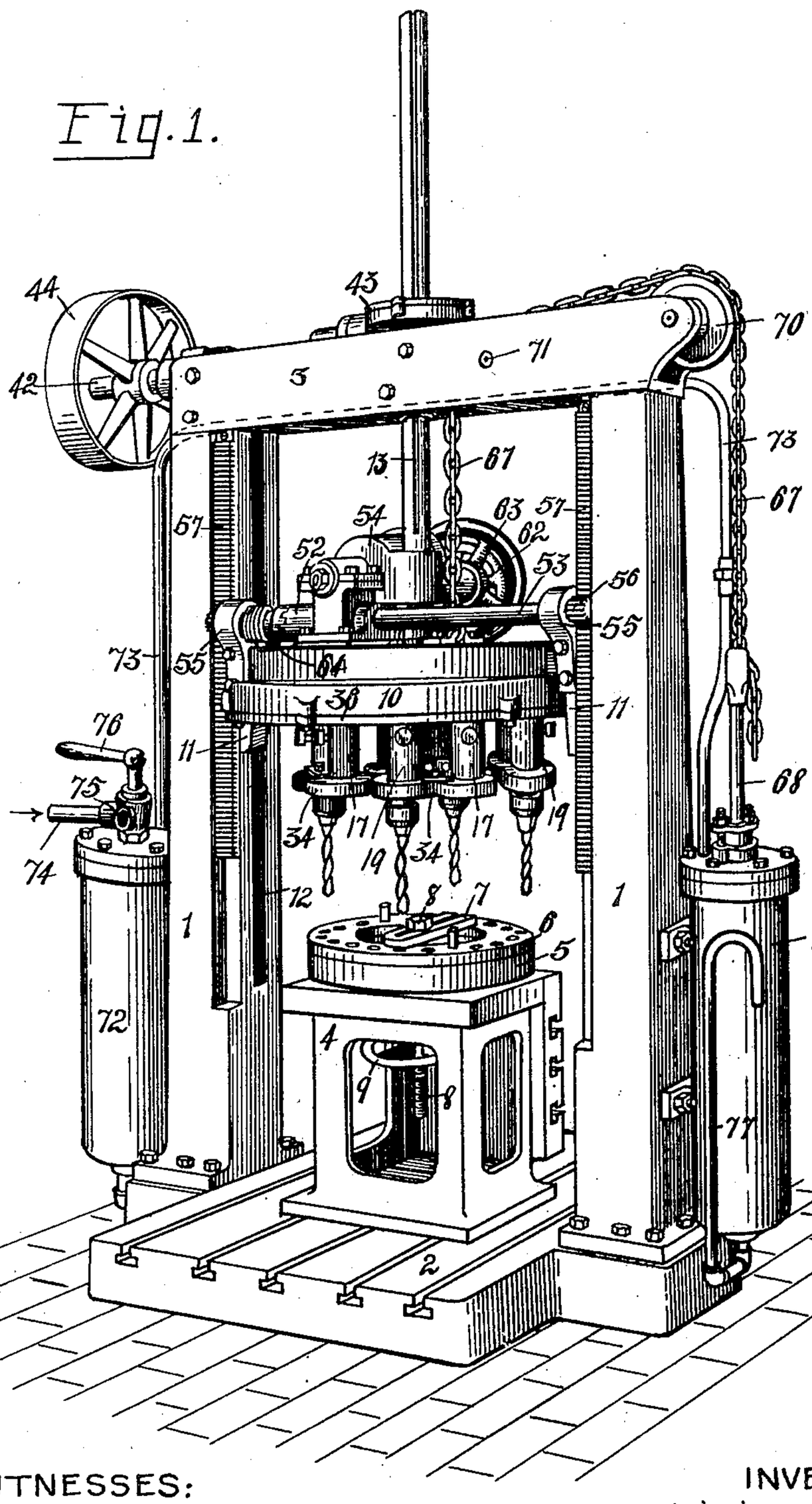
APPLICATION FILED DEC. 5, 1908.

934,776.

Patented Sept. 21, 1909.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 2.

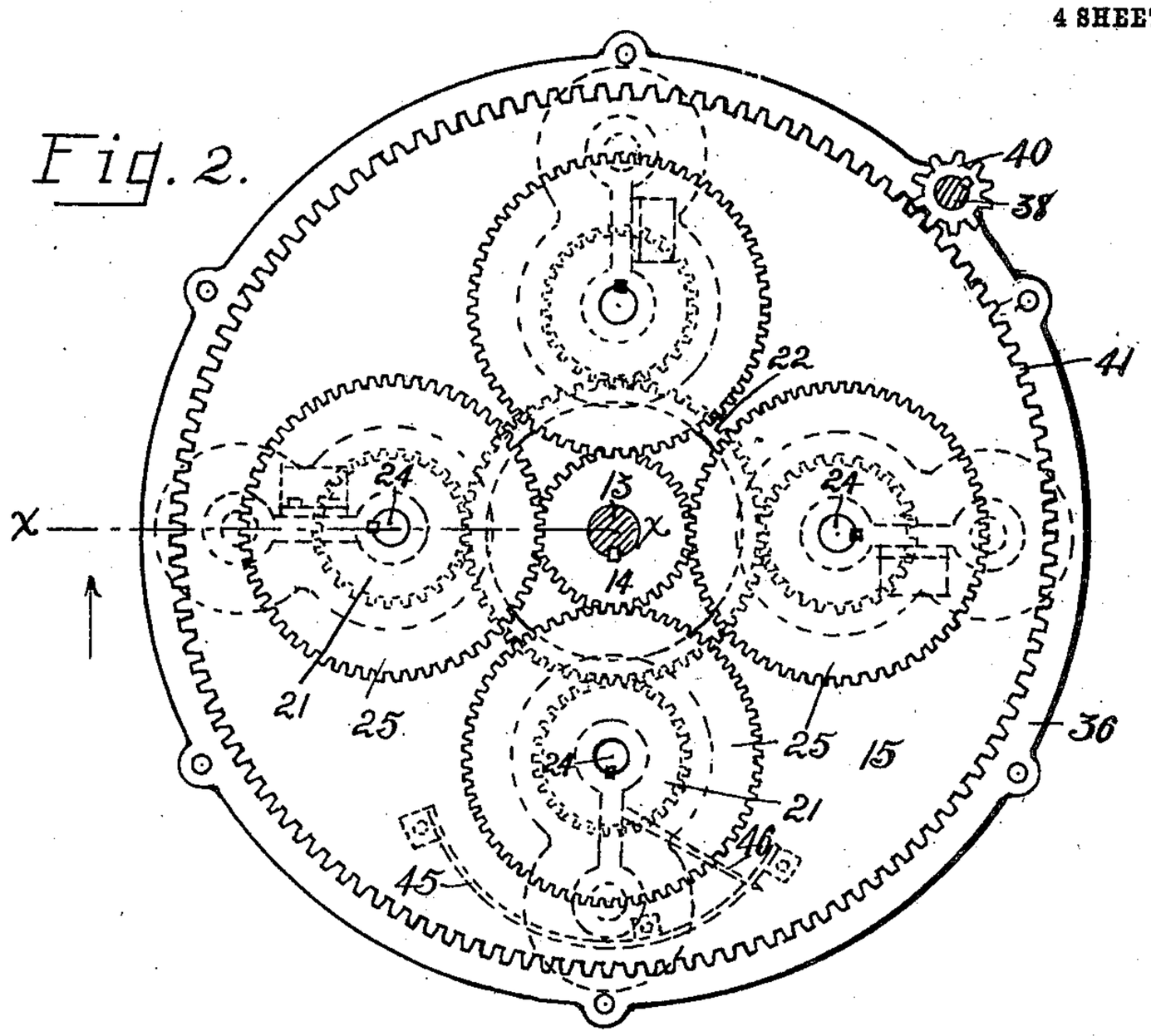
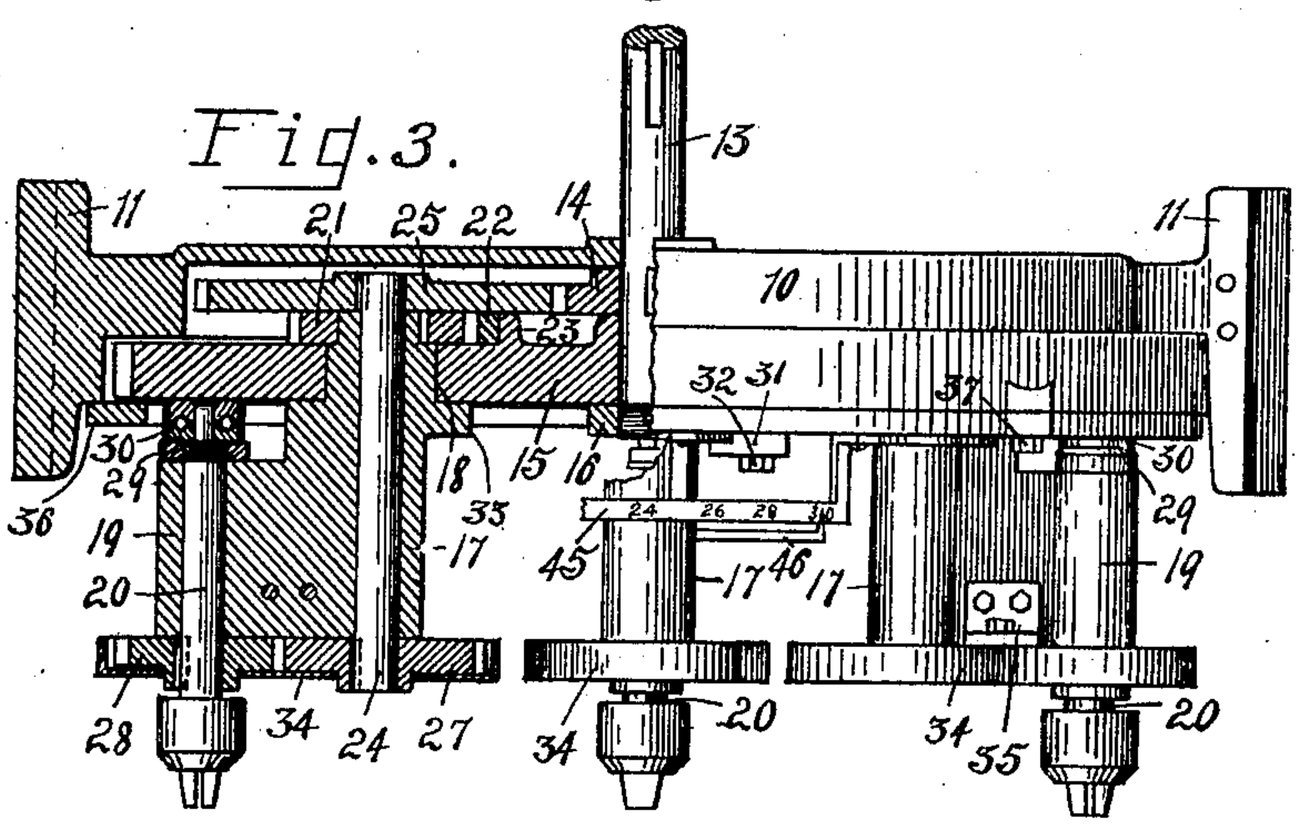


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 4.

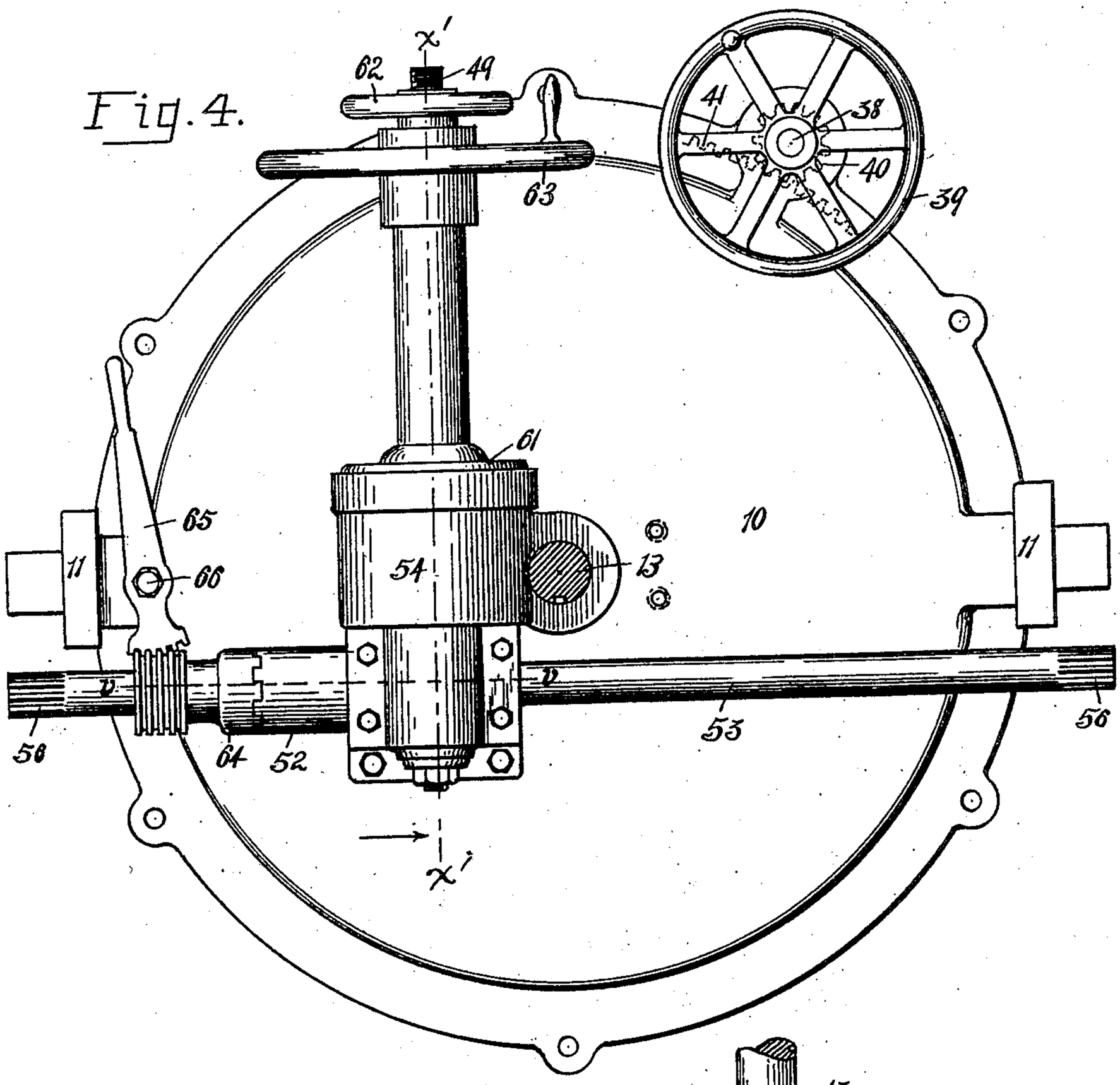
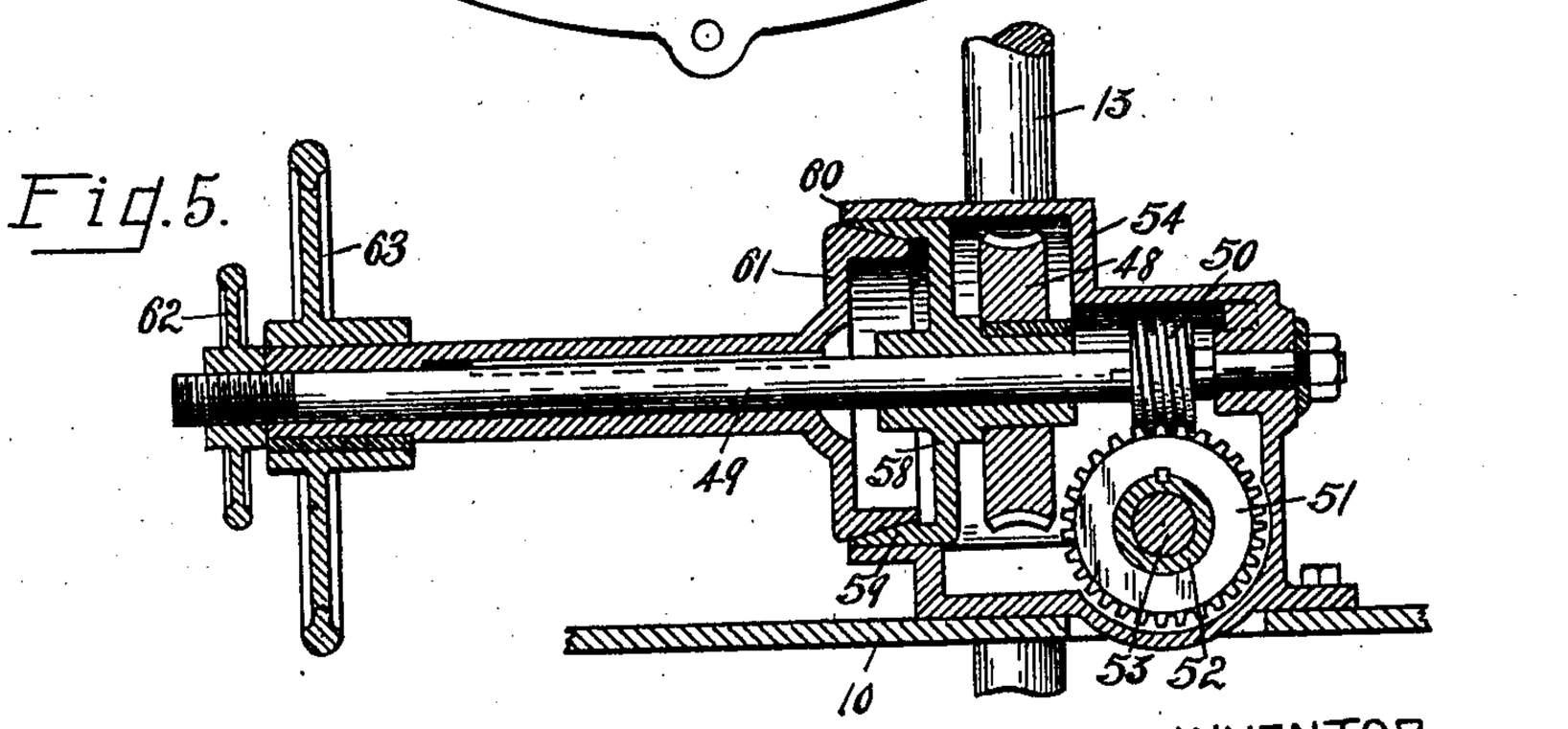


Fig. 5.



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4 SHEETS—SHEET 4.

Fig. 6.

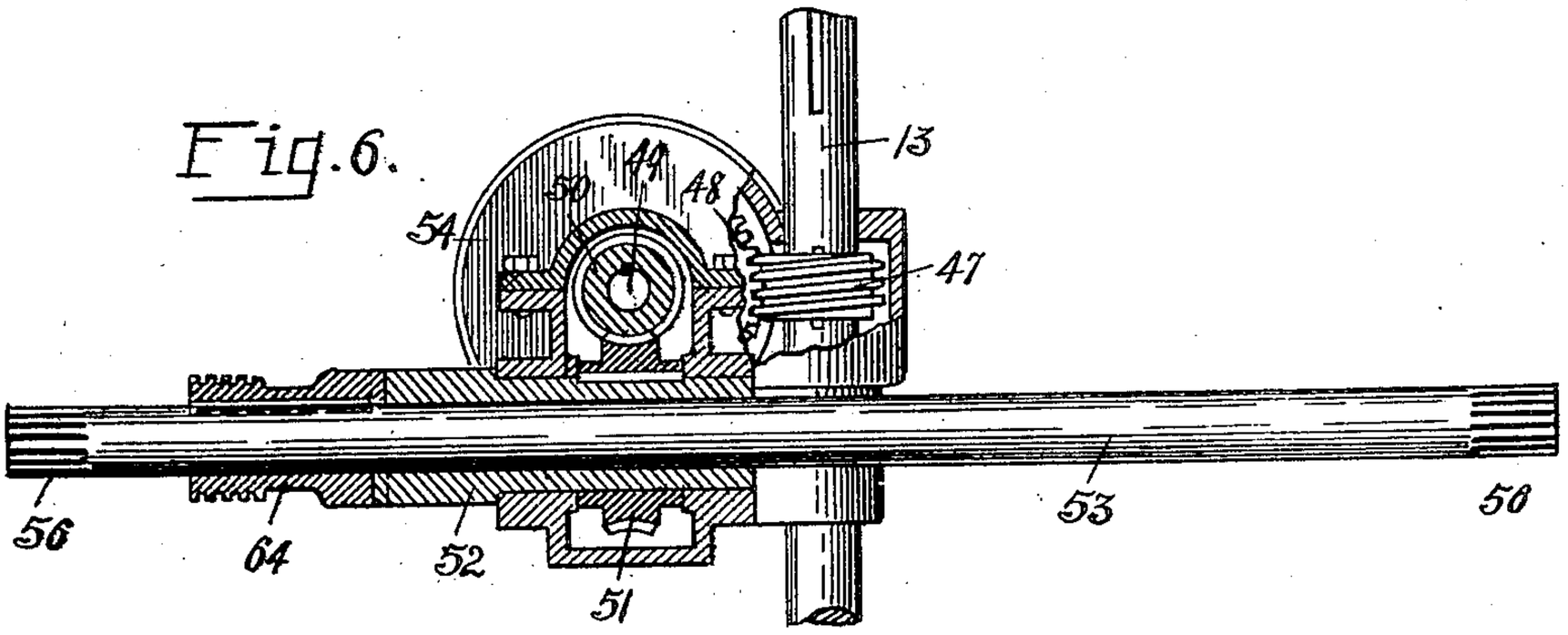


Fig. 7.

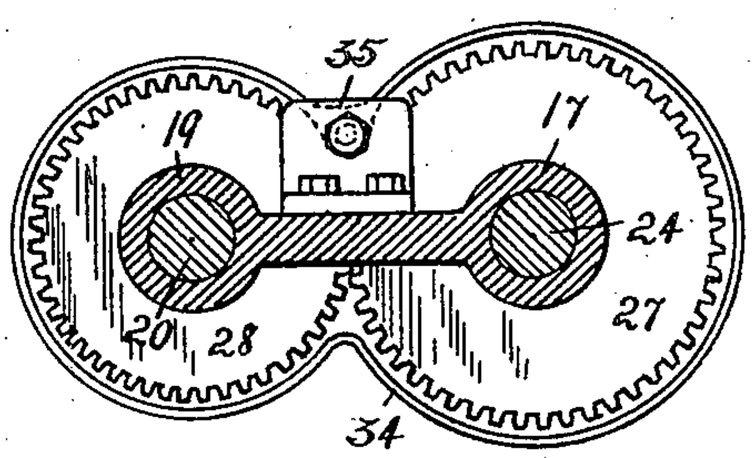
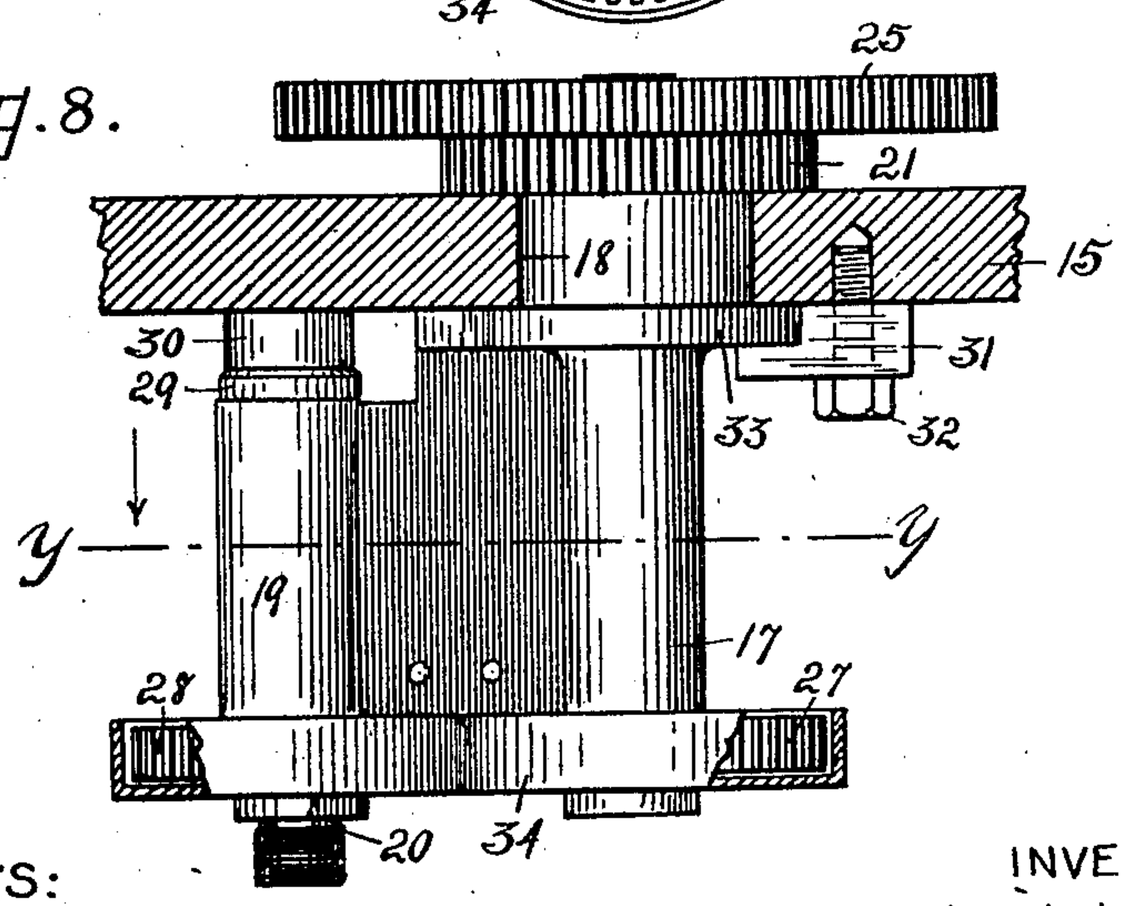


Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM W. VOSPER, OF TOLEDO, OHIO, ASSIGNOR TO THE SHAW-KENDALL ENGINEERING COMPANY, OF TOLEDO, OHIO, A CORPORATION OF OHIO.

MULTIPLE DRILLING-MACHINE.

934,776. Specification of Letters Patent. **Patented Sept. 21, 1909.**

Application filed December 5, 1908. Serial No. 466,103.

To all whom it may concern:

Be it known that I, WILLIAM W. VOSPER, a citizen of the United States, and a resident of Toledo, in the county of Lucas and State of Ohio, have invented a certain new and useful Multiple Drilling-Machine; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to drilling machines, and particularly to those of the multiple drill type, and has for one of its objects the provision in a machine of this character of simple and efficient means for easily and quickly adjusting the drill-spindles in unison in the arcs of a common circle to change the positions thereof relative to the work as it may be desired to successively act thereon, thus obviating the slow and unsatisfactory practice of adjusting the work relative to the drills to enable the drills to successively operate thereon.

A further and very important object of my invention is the provision of means for effecting an easy, accurate and rapid adjustment of the spindles in unison in the arcs of different circles to permit of a wide range of adjustment of the spindles relative to a common axis, thus adapting the machine to be adjusted to operate on various sizes of work.

The invention is fully described in the following specification, and while in its broad aspect it may be embodied in numerous forms of machines, a preferred form thereof is shown in the accompanying drawings, in which,—

Figure 1 is a perspective view of a machine embodying my invention. Fig. 2 is a plan view of the spindle-carrying head with the top casing removed. Fig. 3 is a side elevation of the spindle-carrying-head with a part in section, as on a line *x x* in Fig. 2, and the power transmission on the top thereof removed. Fig. 4 is a plan view of such head with the power-transmission parts thereon. Fig. 5 is a vertical section of a part of the power-transmission mechanism taken on the line *x' x'* in Fig. 4. Fig. 6 is a vertical section of a portion of such mechanism taken on the line *v v* in Fig. 4, with a portion of the worm and worm-wheel housing removed. Fig. 7 is a horizontal section on the line *y y* in Fig. 8, and Fig. 8 is an enlarged elevation of one of the sets of spindle-operating mechanisms.

Referring to the drawings, 1, 1 designate the two columns or uprights of a machine, which rise from the base-plate 2 and are connected at their upper ends by a head-beam or cross-piece 3; 4 the work-supporting table, which rests on the base-plate; 5 the work, and 6 the templet, which is shown as being clamped to the work by the coöperating action of the cross-bar 7, bolt 8, and hand-wheel 9, which latter is threaded to the bolt beneath the table top.

Having reference now to the spindle-carrying head which forms the essential feature of my invention, 10 designates a cross-head, which is of circular form and undercored, as best shown in Fig. 3, to form a housing over the spindle operating and adjusting gearing, and has its opposite sides formed with guide-bosses 11, 11 provided with ribs working in grooved-ways 12 in the inner sides of the columns 1 for guiding the vertical movements of the head. Journaled in the center of the cross-head or housing member 10 is a vertical shaft 13, which has its upper end projected through the head-beam 3 and its lower end projected below the cross-head and carrying a fixed spur-gear 14 and a subjacent loose master-wheel 15, which latter rests on a collar 16, (Fig. 2) that is fixed to the shaft. A plurality of castings or spindle-carrying members 17, in the present instance four in number, are disposed beneath the master-wheel 15 and have their upper ends journaled in equidistantly spaced openings 18 provided concentrically in the master-wheel, as shown in Figs. 3 and 8. The members 17 are each provided with axially offset portions 19 in the outer ends of which are journaled the vertical drill-carrying-spindles 20, and have the upper ends of their journals projected above the master-wheel to enable pinion-gears 21 to be keyed thereto, as shown in Figs. 3 and 8. These pinions mesh with a common ring-gear 22, which is mounted to turn on a bearing-rib or shoulder 23 formed concentrically on the upper surface of the master-wheel 15, see Fig. 3, thus adapting

the members 17 for rotary adjustment in unison when any one of them is turned on its axis.

Projecting axially through each member 17 is a vertical shaft 24, which has a spur-gear 25 keyed to its upper end immediately above the associated pinion 21 for meshing with the gear 14 carried by the shaft 13, see Figs. 2, 3 and 8, and has a spur-gear 27 keyed to its lower end for meshing with a gear 28 on the lower portion of the associated spindle 20, see Figs. 3 and 8, thus causing rotation to be communicated to the several spindles from the shaft 13. The spindles 20 are supported in their respective carrying parts 19 by collars 29, which are hreaded to their upper ends and rest on the upper ends of the parts 19, and have their upper end thrusts against the under side of the master-wheel 15 through the medium of the ball-bearing thrust members 30, see Figs. 3 and 8, thus providing a firm thrust wall for the spindles in whatever position of adjustment they may be placed. The members 17 are locked in adjusted position relative to the master-wheel 15 by blocks 31 (Fig. 8), which are carried at the under side of the master-wheel by screws 32 and have lips for coacting with annular flanges 33 at the upper ends of the members 17 to prevent a turning thereof when said screws are tightened. While all of the members 17 may be locked in this manner, it is apparent that a locking of only one would be sufficient, as the several members are restricted to move in unison by the interconnecting gearing.

34 designates guards, one of which is secured to the lower portion of each of the members 17 by brackets 35, see Figs. 3 and 7, and encircle the gears 27 and 28. A guard-ring 36 is secured by screws 37 to the bottom edge of the housing or cross-head 10 and projects inwardly therefrom under the edge of the master-wheel 14, see Figs. 1, 2 and 3.

Journaled in one side of the cross-head 10 in a suitable bearing provided therefor is a vertical shaft 38, see Figs. 2 and 4, which carries a hand-wheel 39 at its upper end and a pinion 40 at its lower end, which pinion meshes with peripheral teeth 41 on the master-wheel 15, thus causing a turning of said hand-wheel to communicate rotation to the master-wheel 15 and effect a circular adjustment of the spindles 20 in the arcs of a common circle as it may be desired to shift their positions to enable them to successively act on the work.

The shaft 13 has rotation imparted thereto from a counter-shaft 42 (Fig. 1) through a set of bevel-gears (not shown) which are mounted in a housing 43 carried by the cross-beam 3 of the frame, and through one of which gears the shaft 13 is feathered to adapt it to have vertical reciprocatory movements relative thereto. 44 designates a belt-pulley which is carried at the outer end of the shaft 42.

To facilitate a quick and accurate finding of any desired range of what may be termed "radial adjustment" of the spindles 20 when their carrying members 17 are relatively rotated, I suspend a curved dial-bar 45 from the bottom of the master-wheel 15 in front of one of the members 17 and attach an index-finger 46 to such member, the outer end of which finger is intended to move longitudinally of the dial-bar and register with the graduations thereon when the member is turned, said bar being curved to conform to the arc of movement of the index-finger end, as indicated in Figs. 2 and 3.

In order to effect a slow downward feed of the spindle-carrying head during the drilling operation, the shaft 13 carries a worm 47, see Fig. 6, in mesh with a worm-wheel 48 carried by a counter-shaft 49, which shaft in turn carries a worm 50 in mesh with a worm-wheel 51, which is keyed to a sleeve 52 mounted loosely on the rack-shaft 53, see Figs. 4, 5 and 6. The shaft 49 has its inner end suitably journaled in the housing 54 which is mounted on the cross-head 10 and inclosing the transmission gears, while the shaft 53, in addition to journaling in said housing, has its end portions journaled in bearing-blocks 55, (Fig. 1), which are secured to the sides of the guide-bosses 11. The ends of the shaft 53 project beyond the bearing-blocks 55 and are peripherally toothed, as at 56, to form pinions for meshing with vertical rack-bars 57, 57 secured to the columns 1, 1, see Fig. 1. As it is sometimes desired to lower the spindle-carrying head by hand, the worm-wheel 48 instead of being secured directly to the shaft 49 is keyed to the extended portion of a friction clutch member 58, which is loosely carried by the shaft 49 and has its periphery formed with the outwardly projecting flange 59, which is shown as having a bearing in the open end 60 of the housing 54, thus assisting in supporting the shaft 49. A companion clutch member 61 is feathered to the shaft 49 without the member 58 and when forced into engagement with the inner face of the flange 59 coöperates with the member 58 to impart rotation to said shaft from the worm-wheel 48. The clutch member 61 has its hub extended to near the outer end of the shaft 49 and is engaged at such end by the hub of a hand-wheel 62, which is threaded to the shaft end and adapted to be moved to force the clutch member 61 into engagement with its companion or to permit a release thereof. A hand-wheel 63 is keyed to the outer end of the hub of the clutch member 61 to facilitate a turning of such member and the shaft 49 by hand.

A clutch-sleeve 64 is feathered to the rack-

bar 53, and is intended to coöperate with the contiguous end of the sleeve 52, when moved into clutch engagement therewith, to impart rotation to said shaft from the worm-wheel 51, see Figs. 4 and 6. The clutch-sleeve 64 has its movements controlled by a lever 65, which is fulcrumed to the cross-head top, as at 66, Fig. 4, and has its inner end formed with teeth which mesh with annular ribs on the sleeve 64, as shown.

For the purpose of effecting a rapid raising or lowering of the spindle-carrying head independent of the mechanism above described, I connect the top of the cross-head 10 by a chain, or other suitable draft means, 67 to the upper end of a piston-rod 68 which projects through the top of a vertical cylinder 69 at one side of the frame and carries a piston (not shown) at its inner end which works in said cylinder. The draft-means 10 works over a sheave 70 at one end of the cross-beam 3 of the frame and another sheave (not shown) which is carried by a shaft 71 near the center of the cross-beam. On the opposite side of the frame to the cylinder 69 or in any other suitable position is located another cylinder 72, which is preferably filled or partially filled with oil or other suitable operating liquid and communicates at its lower end with the upper end of the cylinder 69 through a pipe 73. Air or other suitable fluid under pressure is admitted to the top of the cylinder 72 through a pipe 74 and is exhausted therefrom through an opening 75 into which an exhaust-pipe may be threaded. The inlet and outlet ports for the air are controlled by a suitable valve of which 76 is the handle.

77 designates a vent pipe which leads from the lower end of the cylinder 69. To effect an elevation of the spindle-carrying head, fluid under pressure is admitted to the top of the cylinder 72 above the oil or other liquid therein by a turning of the handle 76 in the proper direction for such purpose, thus forcing the oil or other liquid in said cylinder through the pipe 73 and into the top of the cylinder 69 above the piston therein. As the liquid enters the cylinder 69 the piston and its rod 68 are forced down, thus moving the chain 67 to raise the spindle-carrying head. To lower such head the valve-handle 76 is turned to close the inlet port and open the exhaust port 75 from the cylinder 72, thus permitting a rapid exhaust of the actuating fluid from such cylinder and a return of the oil or other liquid thereto as the piston raises under the weight of the spindle-carrying head.

The operation of my invention is as follows:—The work 5 and templet 6 having been placed on the table 4, the operator moves the valve-handle 76 to open the exhaust port 75, thus permitting the spindle-carrying head to run down to place the drill points in contiguous relation to the templet to enable it to be adjusted to position a set of holes therein in register with such drill points before clamping the templet and work to the table by a tightening of the bolt 8 on the clamp-bar 7. This having been done, the operator moves the controller-lever 65 to throw the clutch-sleeve 64 on the rack-shaft 53 into engagement with the loose sleeve 52 carrying the worm-wheel, thus causing rotation to be communicated to the rack-shaft 53 from the driven shaft 13 through the medium of the worm and worm-wheel 47 and 48, friction-clutch members 58 and 61, which are in engagement, shaft 49, and worm and worm-wheel 50 and 51, whereby to effect a properly timed slow lowering movement of the drills through the work due to the pinioned ends of the shaft 53 working in the rack-bars 57, 57 carried by the columns 1, 1. The drill spindles are driven from the shaft 13 through the intermediate set of gears 14 and 25, shafts 24, and second set of gears 27 and 28. The drilling of the holes being completed the lever 65 is thrown to release the engagement of the clutch-sleeves 52 and 64 after which the air-valve handle 76 on the cylinder 72 is moved to admit fluid-pressure to the top of the cylinder 72, thus forcing the oil or other liquid in said cylinder to the other cylinder 69 on top of the piston therein and effecting a rapid ascent of the spindle-carrying head. The drills are now shifted in unison in the arcs of a common circle to place them in position to again act on the work by merely turning the hand-wheel 39 carried by the shaft 38 to effect a turning of the master-wheel 15 and relatively fixed drill-carrying spindles 20 the desired distance. To adjust the spindles for operating on different sizes of work or for drilling two or more sets of concentrically arranged holes in the same piece of work it is only necessary to loosen the blocks 31, which coact with the flanges 33 of the spindle-carrying members to lock them against movement relative to the master-wheel 15, and then to take hold of the outer or spindle-carrying end of one of the members 17 and swing it to the desired position of adjustment relative to the axis of the wheel 15. As one member 17 is swung about its axis the other spindle-carrying members will be caused to swing the same distance in unison therewith, due to the ring-gear 22 meshing with the gear 21 on the journal end of each member. The operator by watching the movement of the index-finger 46 along the face of the dial-bar 45 can tell when the desired position of adjustment is reached. The members 17 being adjusted, they are again locked to the master-wheel by a tightening of the blocks 31 thereon. It is apparent with this manner of adjusting the spindles that a very

wide range of adjustment thereof may be had, as such adjustment is only limited by the size of the circle which can be described by a spindle relative to the master-wheel, and this of course depends upon the length of throw of the members 17.

I desire to be understood that my invention is not limited to any specific form, arrangement or size of parts except in so far as such limitations are specified in the claims.

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

1. In a machine of the class described, the combination of a shaft mounted for rotary and longitudinal reciprocatory movements, a master-wheel loosely carried by said shaft, a part rotatably carried by said master-wheel, a spindle carried by said part for adjustment therewith around the axis of said part gearing for communicating rotation to the spindle from the shaft.

2. In a machine of the class described, the combination of a shaft mounted, for rotary and longitudinal reciprocatory movements, a master-wheel loosely carried by said shaft, a plurality of members pivotally carried by said wheel, a spindle carried by each of said members for adjustment therewith around the axis of such member, means for communicating rotation from the shaft to the spindles, and means for causing a like adjustment to be communicated to all of said members when any one is turned relative to the master-wheel.

3. In a machine of the class described, the combination of a shaft mounted for rotary and longitudinal movements, a master-wheel carried thereby for relative rotary adjustment, a plurality of parts carried by said wheel for rotary movements relative thereto, and having their axes parallel to said shaft, a spindle carried by each member at one side of its axis, means communicating rotation to the spindles from the shaft, a gear keyed to each of said parts, and a gear meshing with said gears for communicating like rotation from one to the others.

4. In a machine of the class described, the combination of a frame, a cross-head movable in said frame and forming a housing, a main shaft journaled in said cross-head, a master-wheel loosely carried by the shaft and having a plurality of openings therethrough, spindle-carrying parts journaled in said openings, a shaft axially journaled in each part, a spindle carried by each part at one side of its axis, means for communicating motion to the spindles from the main shaft through said other shafts, and means for causing said parts to rotate in unison through partial circles relative to said wheel.

5. In a spindle-carrying head, the combination of a base part, a member rotatably carried by said part, a spindle carried at the free end of said member and having its inner end thrust against said base part, and means for driving the spindle.

6. In a machine of the class described, the combination of a head, a plurality of members rotatably carried by said head, a spindle carried at the free end of each member, antifriction thrust means disposed between the inner end of each spindle and the head in contact with each whereby the spindle thrust is on such head, and means for driving the spindles.

In testimony whereof I have hereunto signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM W. VOSPER.

Witnesses:

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Hazel B. Hiett.