(No Model.) 5 Sheets—Sheet 1.

J. T. WILKIN.

MACHINE FOR FORMING CYCLOIDAL SURFACES.

No. 497,998. Patented May 23, 1893.

FIG. 1.

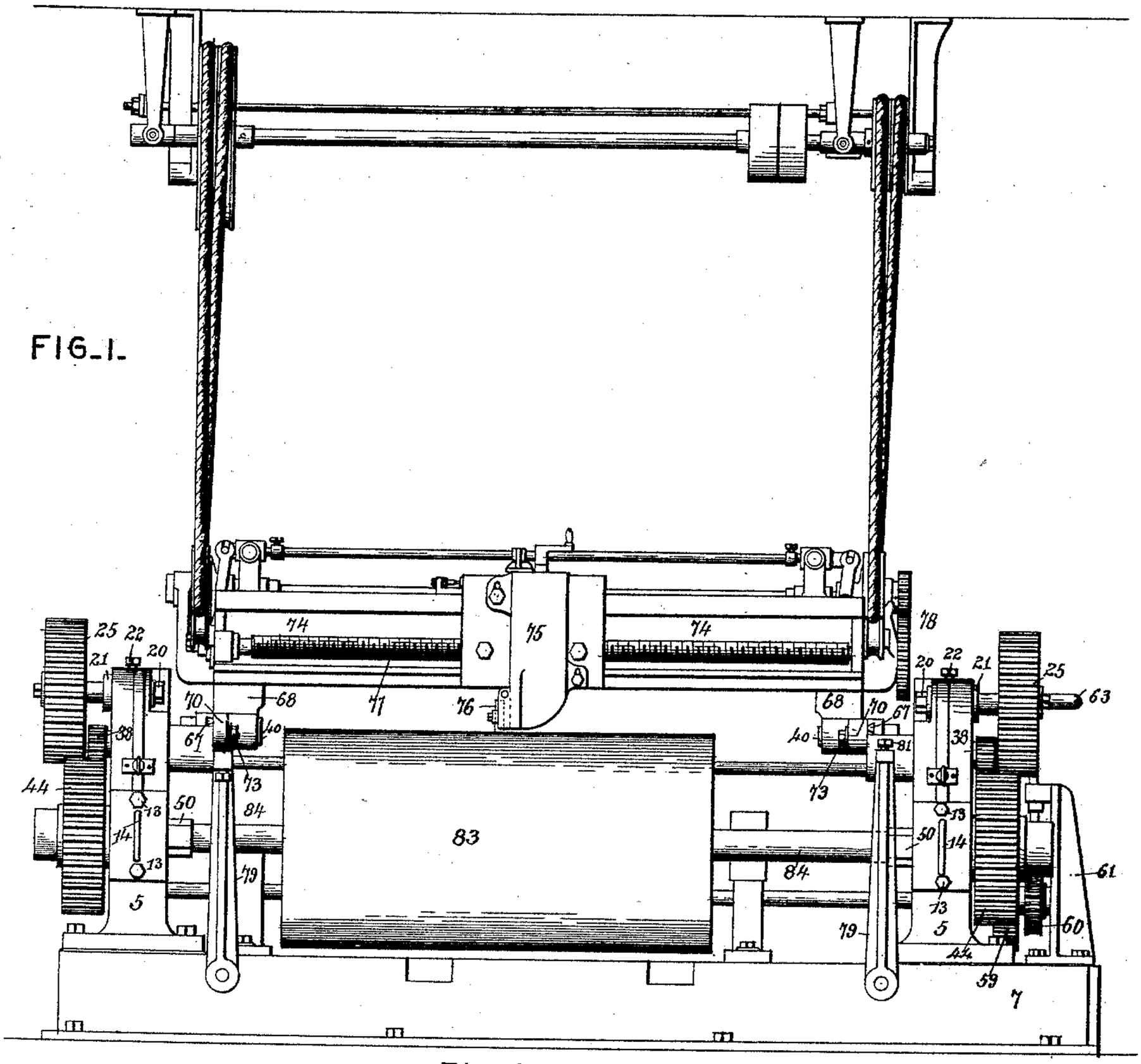
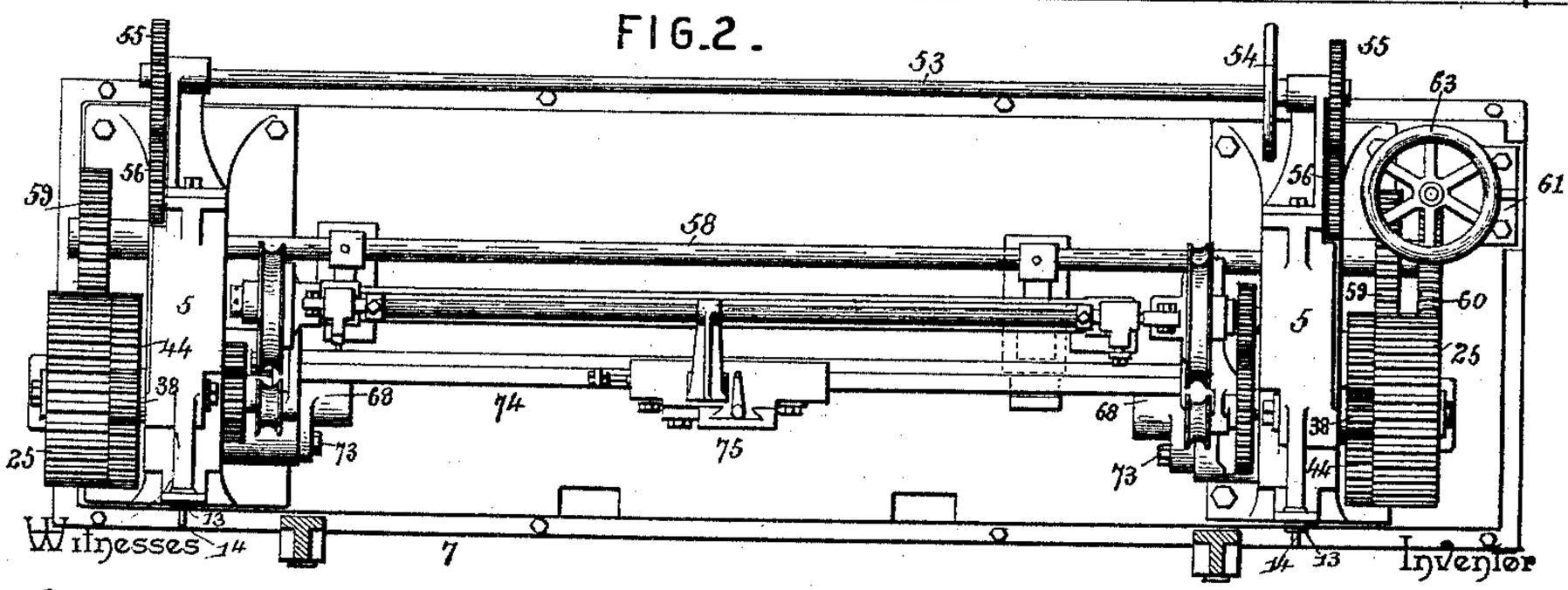


FIG. 2.



Witnesses

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FIG. 3.

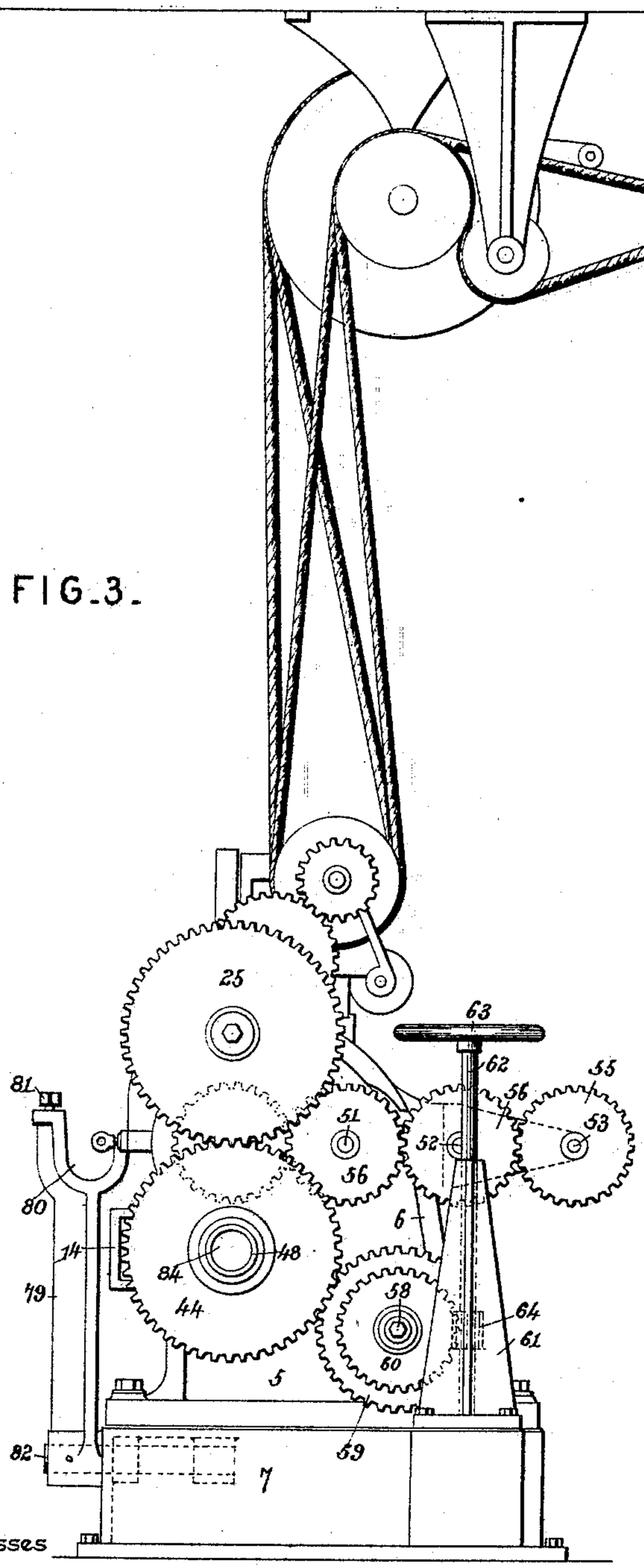

FIG. 10.

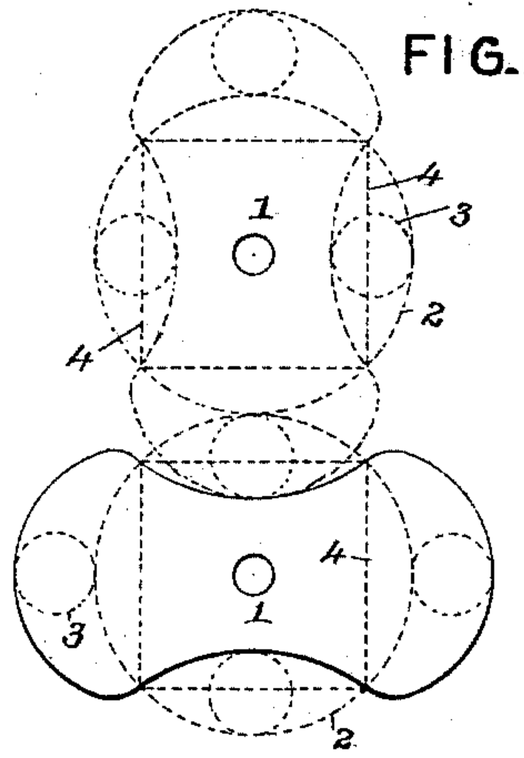

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FIG. 5.

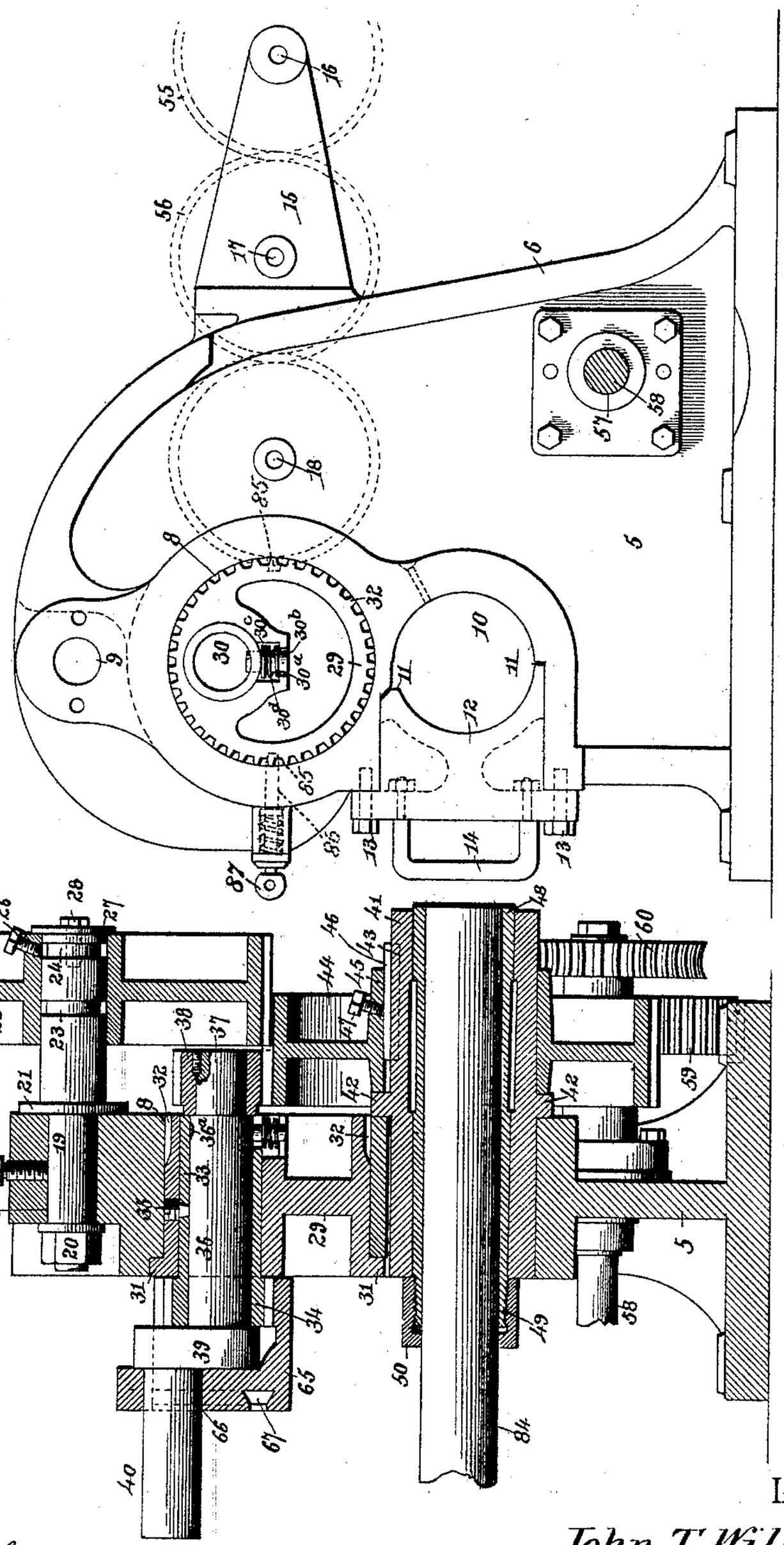

FIG. 4.

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FIG. 8.

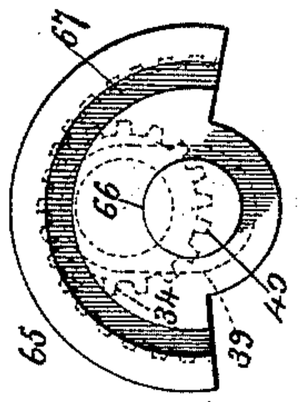

FIG. 9.

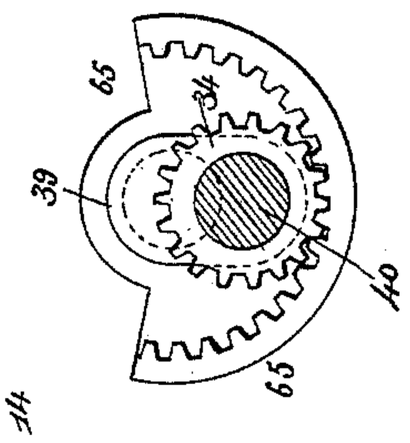

FIG. 7.

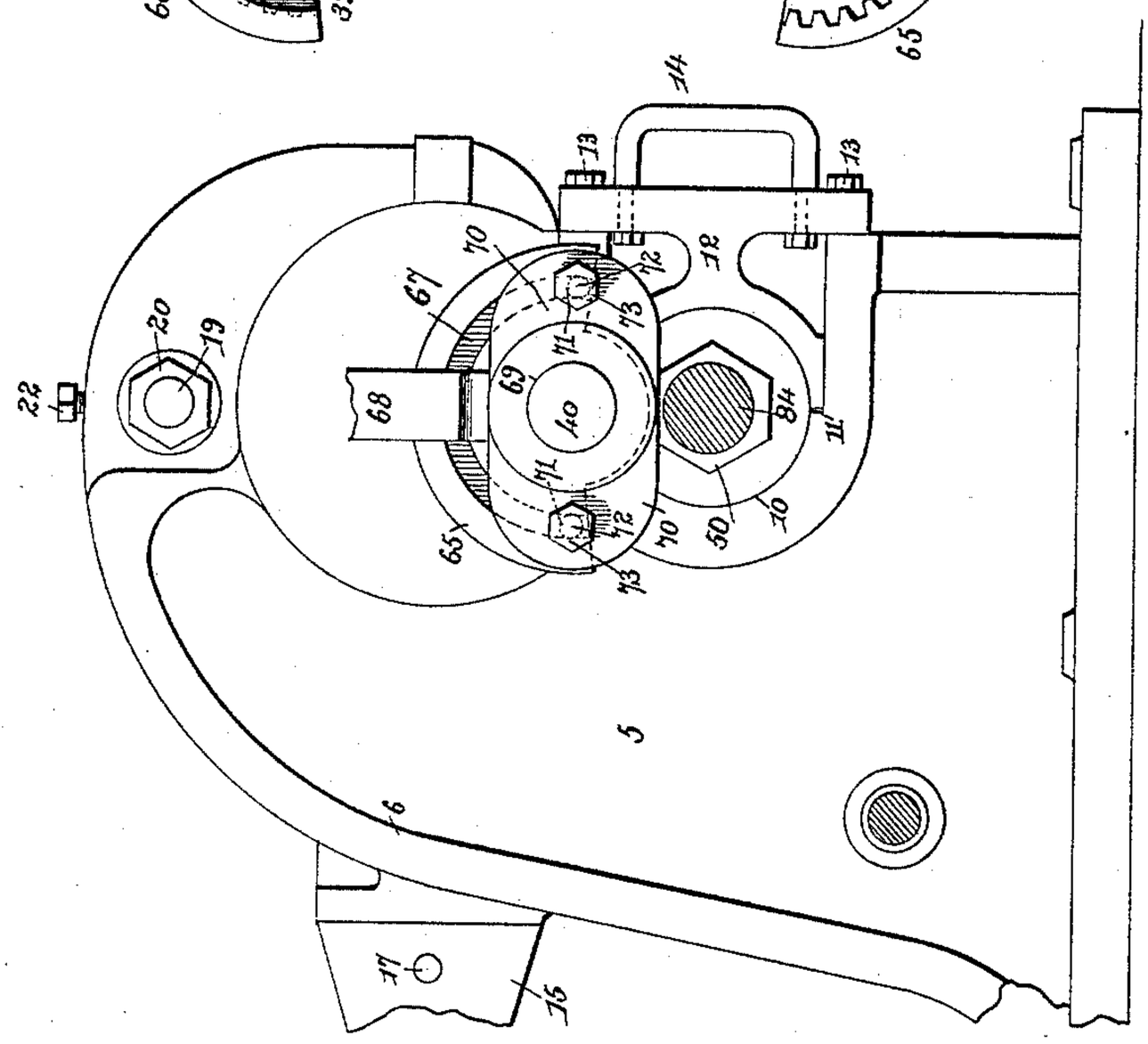

FIG. 6.

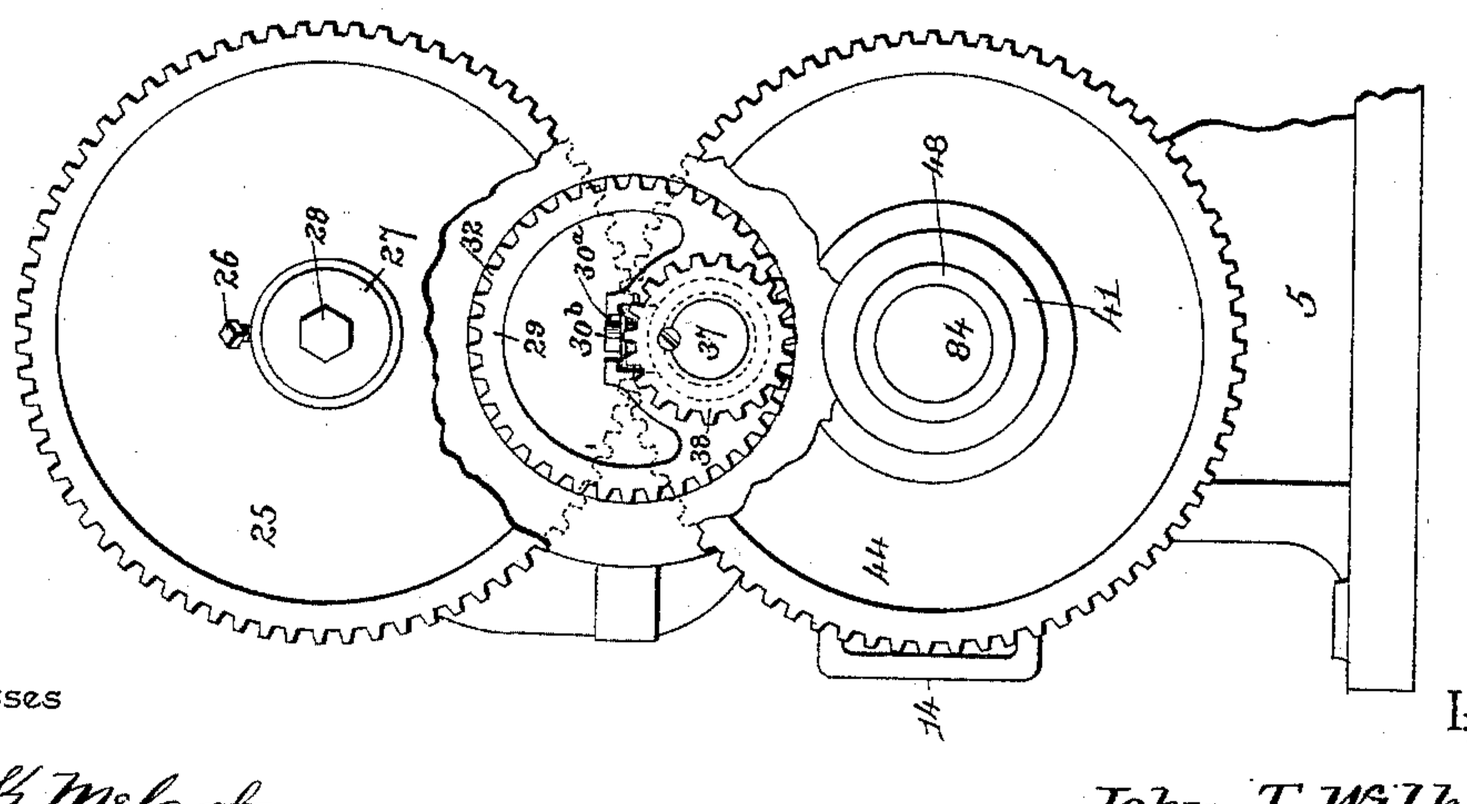

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FIG. 12.

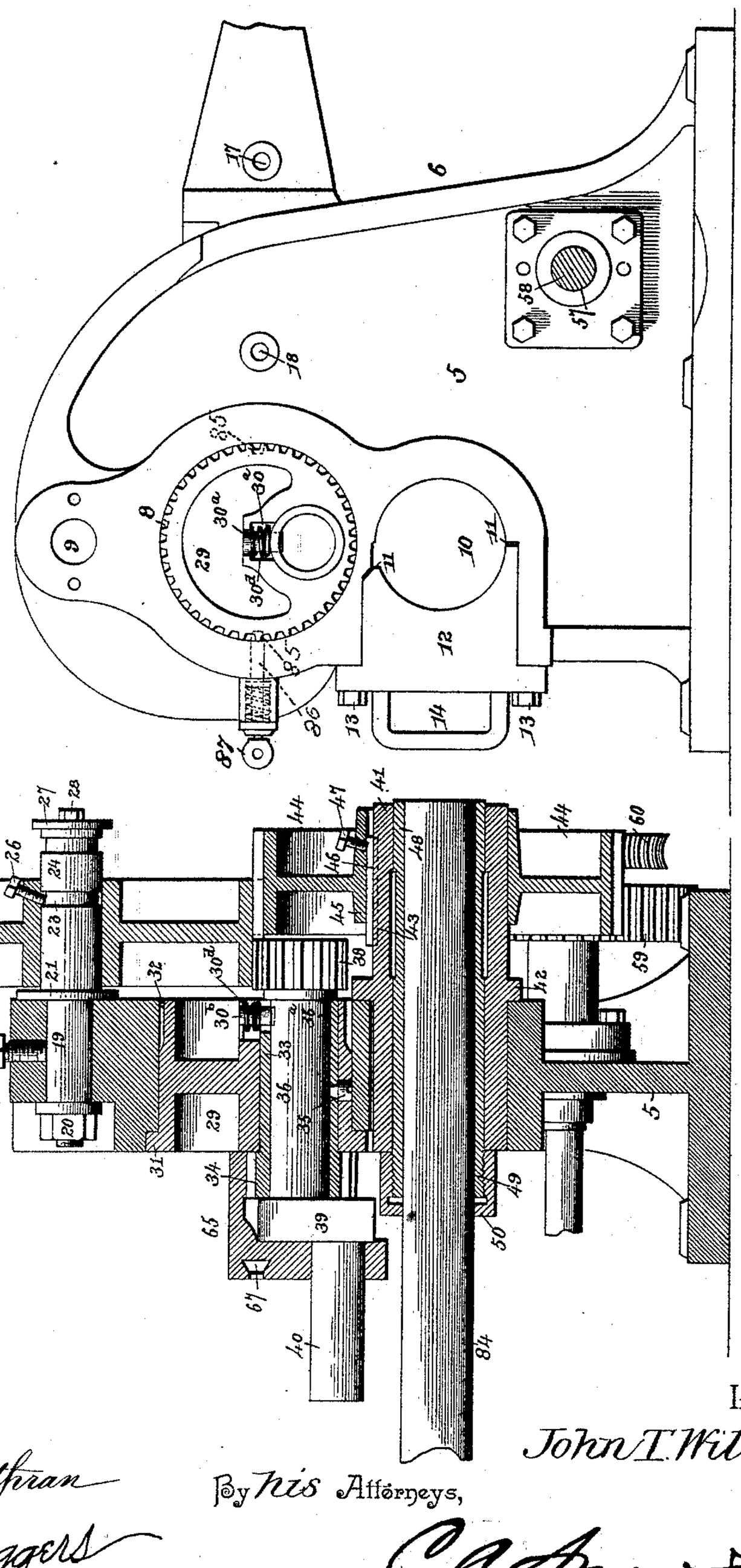

FIG. 11.

Witnesses

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UNITED STATES PATENT OFFICE.

JOHN T. WILKIN, OF CONNERSVILLE, INDIANA.

MACHINE FOR FORMING CYCLOIDAL SURFACES.

SPECIFICATION forming part of Letters Patent No. 497,998, dated May 23, 1893.

Application filed February 2, 1893. Serial No. 460,723. (No model.)

To all whom it may concern:

Be it known that I, JOHN T. WILKIN, a citizen of the United States, residing at Connersville, in the county of Fayette and State of Indiana, have invented a new and useful Machine for Forming Cycloidal Surfaces, of which the following is a specification.

My invention relates to improvements in forming cycloidal surfaces, as for instance in cutting revolvers for rotary-blowers, pumps, &c., gear-teeth and the like, or in fact any form of gear or blower employing two or more lobes formed on cycloidal lines.

My invention is designed particularly as an improvement upon the construction of machine illustrated in a companion application filed by me May 19, 1892, bearing Serial No. 433,609, and in which I illustrate a construction of machine adapted to practice my invention. In the aforesaid construction the hypocycloidal line was generated by means or through the instrumentality of a small pinion upon a crank-shaft for supporting the tool, revolving and engaging with the teeth of an internal or ring-gear located upon the blank-carrying shaft; whereas by my present invention a transmitting gear is added to the train of gearing formerly employed for the purpose of transmitting motion from the spur-gear on the blank-carrying shaft to the small pinion of the crank-shaft which carries the tool. Furthermore, in the former construction of machine shown for practicing my invention in forming the epicycloidal curve the pinion of the crank-shaft revolved on the spur-gear of the blank-carrying shaft, thus necessitating a removal of the internal gear and a substitution for the same of the spur-gear; whereas, in the present instance, motion is imparted directly from the spur gear of the blank-carrying shaft to the pinion of the crank-shaft, the added spur-gear remaining idle. Heretofore it will be seen that the construction of the machine required a change of gears at the end of the epicycloidal and beginning of the hypocycloidal, or vice versa, and this change caused loss of time and considerable trouble. By the present invention the machine is adapted to cut or pass from one curve to the other without the removal of any gears or the addition of any such gears.

Referring to the drawings:—Figure 1 is a side elevation of a machine constructed in accordance with my improvements and adapted to practice my invention. Fig. 2 is a plan view of the machine. Fig. 3 is an end elevation. Fig. 4 is a vertical transverse section of one of the end-standards of the machine, the parts being in the position they occupy when the machine is adapted for cutting epicycloidal curves. Fig. 5 is an outer side elevation of one of the standards the gears and shafts being removed. Fig. 6 is a similar view, the gears being in position and the outer gears broken away to expose the inner gears of the series. Fig. 7 is an inner side elevation of the standard shown in Fig. 5. Fig. 8 is an external view in elevation of the segmental gear. Fig. 9 is an opposite elevation of the same and the pinion for operating the same. Fig. 10 is a diagram intended to illustrate the cycloidal curves cut by my machine. Fig. 11 is a section similar to Fig. 4 with the exception that the gears are arranged in the position they occupy when the machine is cutting hypocycloidal curves. Fig. 12 is a view similar to Fig. 5, the gears and shafts being removed, but the parts being otherwise in the positions they occupy, as illustrated in Fig. 11.

Like numerals of reference indicate like parts in all the figures of the drawings.

In order that I may fully explain the formation of the surface or curve to be produced by my invention, I make the following statement, calling attention to Fig. 10 of the drawings wherein I have shown two cycloidal revolvers as a matter of illustration in operative contact: In this figure, 1 designates the center of motion, and 2 is the pitch-circle. Equal chords 4—4 are drawn within the pitch circle forming an exact square. This having been done it is simply necessary to revolve a circle 3, which is one-fourth the diameter of the pitch-circle, over the pitch-line of the pitch-circle between the opposite angles formed by the chords beginning and ending exactly at said angles, and the lines scribed by the scribing-point of the circle 3 which will be in its circumference, will form the opposite epicycloidal lobes. Now by arranging the same size circle inside the pitch-circle and revolving from angle to angle of the opposite chords, as before described, the line scribed by the scribing-point of the circle 3 will consti-

tute the hypocycloidal curve. In the same manner and upon the same principle revolvers having a greater number of lobes may be formed, for instance a three-lobed revolver would be formed by first scribing the pitch-circle, next forming a hexagon by means of six chords drawn upon the circle, and scribing lines between the angles of the chords by means of the circle one-sixth the diameter of the pitch-circle and alternately at opposite sides of said circle, all as will be obvious.

Having described the principle upon which the cycloidal lines are formed, I will now proceed to describe my improved machine.

The general framework of the machine comprises a pair of opposite sides or standards 5, preferably cast and surrounded by a heavy flange 6, the whole being bolted securely to a base or sill 7. As each of these standards or sides is a counterpart of the other, a description of one will be sufficient for both, and I will therefore confine myself in my description to a single standard. The standard is provided at a point slightly above its transverse center with a circular opening 8, and above the same with a bearing 9, while vertically below said opening 8 a larger bearing 10 is formed. These bearings 8, 9, and 10 are in direct vertical alignment, and are surrounded by a thick flange, as shown. The bearing 10 is merely a half-bearing and is provided at opposite sides with shoulders 11, against which abut the ends of a companion bearing-block 12 that is removably slid into the open side of the bearing 10 and is held in place by means of a pair of bolts or screws 13, which pass through the projecting ends or flanges of the bearing-block and into the edges of the standard 5. The block is further provided with a handle 14, by which when the screws are removed, said block may be withdrawn from its position. Transversely opposite the opening 8 in the standard the flange surrounding the edge of the same is removed partially and from the edge there projects rearwardly an arm 15 integrally formed with the standard and provided at its outer extremity with a bearing opening 16, and near the standard with a second bearing-opening 17, the same being in horizontal alignment with the opening 8 in the standard. The standard is further provided with a bearing opening 18, the same being in alignment with the three openings 16, 17 and 8.

In the bearing opening 9 there is located a short shaft 19, the same having its inner end threaded and provided with a nut 20, while beyond the standard the shaft is provided with a collar or boss 21, whereby it may be clamped snugly in position. It is further held in position by means of a binding-bolt 22 passed down through a threaded perforation formed in the upper end of the standard and at its lower end bearing upon the shaft.

Beyond the collar 21 the shaft is slightly greater in diameter, in this instance, than that portion within the standard, and it is provided between its collar and outer end with an inner and an outer annular groove designated as 23 and 24, respectively. Upon this shaft is mounted for rotation a spur-gear 25, and through the hub of the same a bolt or screw 26 is passed, the same being designed to engage at its lower end with one or the other of the grooves 23 or 24.

A retaining-plate or cap 27 is located at the outer end of the shaft 19 and the same is held in place by a screw 28 passing through the cap and into the end of the shaft. It will be seen that by loosening the screw 26 the spur-gear may be moved in or out upon the shaft and locked for revolution at such point by engagement of the screw with the grooves 23 or 24, as the case may be.

Mounted for rotation in the large opening 8 is a ring 29, and the same is provided with an eccentrically located bearing opening 30. The ring is provided at one side of its bearing opening with a recess 30^a in which is mounted a bolt 30^b provided with a flange 30^c near its lower end, between which and the outer contracted mouth of the recess 30^a there is coiled upon said bolt a spring 30^d, the tendency of which is to force the bolt into the opening 30. The inner edge of the ring is preferably provided with a surrounding annular flange 31, while its outer edge within the standard is provided with a series of teeth 32, which register or are in line with the recessed flange surrounding the standard and the opening 8. Located in the aforesaid eccentric opening 30 is a sleeve 33, whose inner end extends beyond the inner face of the standard and is there enlarged and provided with teeth forming an integral pinion 34. The sleeve and ring are provided with registering openings or perforations between their opposite ends, that of the ring being threaded while that of the sleeve is plain, and in the threaded perforation of the sleeve there is inserted a screw 35 whose lower end is plain and tapered and takes into the perforation of the sleeve 33; whereby the sleeve and ring are locked against any independent movement and must move together.

Mounted for rotation in the sleeve 33 is a shaft 36, whose outer end beyond the standard and sleeve is slightly reduced as at 37 and receives a pinion 38, the diameter of which is the same as that of the pinion 34, which as will be seen, is located also upon the shaft 36, but at the opposite side of the standard. The inner end of the shaft 36 is provided with a crank-arm 39, and at its free end carries a crank-pin 40, the length of the arm being the same as the radius of the pinions 34 and 38. The shaft 36, in line with the longer end of the crank-arm 39, is provided with a cavity 36^a. It will be seen that the diameter of the wheel 25 is of no importance, that is, compared with the diameter of the pinions 38 and 34, but it is necessary that the lower teeth of the pinion 38 and the lower teeth of the gear 25 should be in horizontal alignment when the

ring 29 is so arranged as to bring its bearing opening 30 in its uppermost position, as shown in Figs. 4 and 5 of the drawings.

Mounted for rotation in the bearing-opening 10 of the standard is a sleeve 41 the same having its outer end projecting some distance beyond the outer face of the standard, and is provided adjacent to the standard with an external boss 42. Beyond the boss the sleeve is provided with a key-seat 43 and mounted upon and for rotation with the sleeve is a spur-gear 44 also provided with a key-seat 45 which registers with that of the sleeve. A spline 46 is located in the seats of the sleeve and the gear so as to lock the two together, and a binding-screw 47 passes through a perforation in the hub of the gear and bears upon the spline. The sleeve 41 is slightly reduced or tapered internally toward its inner end.

Located in the bore of the sleeve is a tubular, externally-tapered bushing 48, the same being slightly longer than the sleeve and having its inner end projecting beyond the same and externally threaded as indicated at 49. The inner end of the bushing is encompassed by a binding-cap or nut 50, said cap having an opening coinciding with that of the bushing. Stub-shafts 51 and 52 are located in and extend from the openings 17 and 18 heretofore described as being formed in the arm 15 and the standard, each of said shafts being stationary. The shaft 53, located in the outer bearings 16 of the two arms 15, extends entirely across the framework thus connecting the two standards 5. The shaft 53 is provided with a hand-wheel 54 by which it may be revolved. The extremities of the shaft 53 beyond the arms 15 carry spur-gears 55 that revolve with the shaft and these spur-gears engage with gears 56 which are mounted respectively upon the shafts 51 and 52, the inner spur-gear of the series engaging with the teeth 32 of the rotatable shifting ring 29.

Each of the standards 5 near its lower end and near one edge is provided with a bearing opening 57, and in the same is journaled a shaft 58, the same like the shaft 53 serving to connect the two standards and projecting beyond the outer sides thereof. Upon this shaft is mounted beyond the standards at one side an inner spur-gear 59 and an outer worm-gear 60, while at the opposite end but the single spur-gear 59 is located. The inner spur-gear 59 engages with the lower spur-gear 44 at that side of the machine, and serves to transmit motion through the same to the gear 25 and to the pinion 38 when the latter is elevated or in its uppermost position (as shown in Fig. 4) wherein the machine is designed to cut the epicycloidal curve. But on the other hand, when the gear 38 is in its lowermost position for cutting the hypocycloidal curve, the motion is then imparted to the pinion 38 through the spur-gear 25. Raising from the sill and bolted thereto just beyond the worm-gear 60 is a vertical bearing standard 61, and in the same is journaled a vertical shaft 62 provided at its upper end with a hand-wheel 63 and near its lower end with a worm-screw 64, which engages with the aforesaid worm-gear 60.

65 designates a segmental, internally-toothed gear, the same being substantially L-shaped in cross-section, and having its vertical wall provided with an opening 66. Two of these gears are provided, one for each of the crank-pins 40. The toothed-portions of these gears engage with the pinions 34, and being twice the pitch diameter of the stationary pinion 34 when the crank-arm 39 revolves the said segmental gear changes contact continually, the point of contact between the gear 34 and the segmental gear 65 being always in direct longitudinal alignment with that of the crank-arm 39. The outer face of the vertical wall of the segmental gear is provided with a circular dovetail groove 67.

Upon each of the crank-pins 40 is mounted a standard 68, the same having an opening 69 at its lower end for the aforesaid crank-pin. At diametrically-opposite sides of the arm and the opening 69 the arm is reduced to form lugs 70, and these lugs are provided with perforations 71 through which are passed bolts or pins 72 whose inner ends or heads take into the circular dovetail groove 67, and whose outer ends beyond said lugs are provided with nuts 73, whereby said bolts or pins may be tightened within the grooves and thus the standards securely locked at opposite sides of the crank-pins to the segmental gears. The standards support at their upper ends an ordinary carriage-way or frame 74 on which is mounted for movement a carriage 75, the same being designed to carry a tool 76. The carriage is fed by the usual threaded feed-rod 77, which receives motion through a train of gearing 78, by means of which the tool is reciprocated back and forth upon the way.

Above the machine is located an ordinary tension mechanism for driving the tool-carriage, and so constructed as to permit of a swinging of the same.

At one side of the base of the machine there is located a pair of vertical standards 79, the same being provided at their upper ends with yokes or recesses 80. These standards are provided at their ends with adjustable rest-screws 81, which support the tool-carrying mechanism when the end of its swing or travel is reached and the machine is to be adjusted for the cutting of an opposite or contrary cycloid. The standards 79 it will be observed, are pivoted at their lower ends at 82 to the base or sill, so that they may be swung down flush with or below the plane of the sill to permit of the introduction of the work or blank to the machine.

83 designates a blank upon which the machine is in the act of operating, as shown in Fig. 1, and it will be observed that the same has an axial-shaft 84, the diameter of which is the same as the bore of the tapered bush-

ing 48 and the opening in the binding V nut or cap 50.

To introduce the work, as before intimated, the standards 79 are swung to a horizontal position and the bearing-blocks 12 withdrawn from the standards, for which purpose the screws 13 are partially removed. After the blocks 12 have been removed, the sleeves together with their bushings, and the spur-gears 44 are removed from the openings 10 and the inner ends of the bushings slipped over the ends of the shaft 84, after which the parts are replaced, the blocks placed in position, the screws 13 tightened and the caps or nuts 50 run down upon the bushings drawing the same inwardly and setting or clamping the shaft. The work having been placed in position in the machine the standards 68 are swung upon the crank-pins 40 until the tool-carriage and its support rest upon the screw-rests 81. The tool is now started and a gradual feeding of the work and also of the tool is accomplished by a gradual rotation of the hand-wheel 63 the motion being conveyed in a manner heretofore described and as will be obvious. Assuming the crank-shaft to be in an elevated position as shown in Fig. 4, it will be seen that the movement of the tool, when the same has reached the end of its feed, that is where the crank has traveled from the rest-standards to the opposite side of the machine, will be arrested by reason of the spring-bolt 30^b engaging with the cavity 36^a in the crank-shaft 36, and this arrest of movement will be at the completion of the curve.

Having formed the epicycloidal surface upon the work the following shifting of the parts takes place: The set-screws 47 are loosened and the spur-gears 44 slid outward upon the sleeves 41 until their inner faces are slightly beyond the outer faces of the pinions 38 when the hand-wheel 54 is revolved and through the medium of the gears 55 and 56 motion is imparted to the ring 29, and the same is revolved until its bearing-opening 30 is diametrically opposite the position it previously occupied, or in other words, is vertically below the center of the ring. That brings the upper side of the pinions 38 in the same plane as the upper side of the spur-gears 44. The set-screws 26 are now loosened or withdrawn from the annular groove 24 of the shaft 19, and the spur-gears 25 slid inward upon the shafts 19 and the set-screws run down into the grooves 23 of the shafts 19. Thus it will be seen that the two gears 25 engage with the gears 44 and the pinions 38 and the same result is obtained as if internal gears were substituted for the spur-gears 44 as in the construction of machine described in the pending application.

Previous to the partial rotation of the eccentric ring 29 the nuts 73 of the bolts 72 are loosened. It will be seen that when at the end of its movement the crank-pin will be at its lowest position, and after the nuts 73 have been loosened on the bolts 72 and the eccentric ring 29 swung or partially rotated so that its bearing-opening is in the lower position, the said bolts will have changed position upon the segmental-gear, whose position is now reversed to that shown in Fig. 4.

In Fig. 8 I have illustrated the position of the segmental-gear when the crank-pin is lowered; and in Fig. 9 I have illustrated the same when the crank-pin is elevated. Having retightened the bolts and the parts having been placed in the positions described, the machine is now ready to cut the hypocycloidal surface, the operation being the same as that before described, and the crank-shaft revolving once in cutting the curve, when the machine is ready for repeating the operation. The eccentric-ring 29 is provided in its periphery at opposite sides of its center with cavities 85, and at one side of the opening 8 in the standard a radial bore 86 is provided. In this bore a spring-pressed pin 87 is located, the inner end of the pin extending into the opening and being designed to engage with either one of the cavities 85. By such means it will be seen that in revolving the ring to change the location of the shaft 36 and its gear or pinion, the ring will be stopped or its motion arrested at the proper point, or directly as the said shaft reaches a point vertically below its former position.

From the foregoing description in connection with the accompanying drawings it will be seen that I have greatly improved and simplified the construction and operation of the machine illustrated and described in my previous application, and that I have avoided the necessity during the operation of the machine of the removal of any gears and the substitution of others for those removed, and accomplish the same result by a simple and convenient mechanism readily operated by hand.

Although I have herein shown and described in minute details the various elements composing my improved machine I would herein state that I do not limit my invention to the employment of such, as these may be readily varied as experience and practice suggest within the scope and knowledge of the skilled mechanic without departing from the spirit and principle of my invention.

Having described my invention, what I claim is—

1. In a machine of the class described, the combination with a framework having openings, rings mounted in the openings and provided with eccentric bearings, crank-shafts journaled in the bearings, pinions mounted upon the shafts at the opposite sides of the frame, segmental gears carried by the cranks of the shafts and engaging the inner pinions, and a tool-carrying frame secured to the segmental gears, of a support for the work, shafts located at one side of the crank-shafts, gears mounted adjustably on the shafts and adapted to engage the outer pinions, means for driving the gears, shafts at the opposite sides of

the crank-shafts, gears mounted on the same and engaging the other gears, and means for adjusting the gears thus engaging, and for rotating the rings, substantially as specified.

2. In a machine of the class described, the combination with opposite frames having circular openings, rings mounted in the openings and having eccentric bearings, crank-shafts mounted in the bearings, tight pinions carried upon the outer ends of the crank-shafts, stationary pinions encircling the inner portions of the crank-shafts, segmental gears internally toothed and mounted upon the crank-pins and having their teeth engaging the inner pinions, standards loosely mounted on the crank-pins, circular grooves formed in the outer faces of the segmental-gears, bolts passed through the standards into the grooves, nuts mounted on the bolts and a tool-supporting frame carried by the standards, of upper and lower bearings formed in the frames, shafts located in the upper bearings, spur-gears mounted adjustably on said shafts, shafts located in the lower bearings, spur-gears adjustably mounted on said shafts and adapted to engage the teeth of the upper spur-gears and of the outer pinions when the latter are in their elevated positions, and means for rotating said lower gears, substantially as specified.

3. In a machine of the class described, the combination with opposite frames having circular openings, rings mounted in the openings and having eccentric bearings, crank-shafts mounted in the bearings, pinions fixed on the outer ends of the crank-shafts, fixed pinions encircling but independent of the inner portions of the crank-shafts, segmental gears internally toothed and mounted upon the crank-pins and engaging the inner gears, means for temporarily arresting the motion of the crank-shaft at each rotation thereof, shafts located diametrically opposite the crank-shafts and extending beyond the outer ends thereof, gears adjustably mounted upon said shafts and intermeshing with each other and adapted to intermesh with the pinions upon the outer ends of the crank-shafts, and means for rotating said gears, substantially as specified.

4. In a machine of the class described, the combination with the opposite frames having circular openings, rings mounted for rotation in the openings and provided with eccentric bearing recesses formed at one side of the bearings, pins mounted in the recesses and provided near their inner ends with shoulders, coiled springs mounted upon the pins and interposed between the shoulders and the outer ends of the recesses, crank-shafts journaled in the bearings, pinions mounted fixedly on the outer ends of the crank-shafts, fixed pinions extending from the inner sides of the frame and loosely encircling the crank-shafts, segmental-gears loosely mounted on the crank-pins and internally toothed to engage the said fixed pinions, a tool-carrying frame supported by the segmental gears, and cavities formed in the crank-shafts in line with the pins, of shafts located at diametrically opposite sides of the crank-shafts, adjustable gears mounted thereon and engaging each other and adapted for engagement with the outer pinions of the crank-shafts in accordance with the positions of the same, and means for rotating the gears, substantially as specified.

5. In a machine of the class described, the combination with a framework having opposite openings, movable bearings mounted in the openings, crank-shafts mounted in the bearings and adapted to revolve, pins located upon said shafts at the inner and outer sides of the bearings, segmental L-shaped gears mounted on the inner or cranked ends of the shafts, and a tool-carrying frame secured to and supported by the segmental gears, of a support for the work, shafts located at one side of each of the crank-shafts, gears mounted thereon and adapted to be shifted into and out of mesh with the outer pinions of the crank-shafts when the latter are lowered to their lowest positions and in a horizontal plane with said pinions when said crank-shafts are elevated to their highest positions, gears located at those sides of the outer pinions of the crank-shafts at which the first-mentioned gears are located, means for shifting and driving said gears and for communicating motion from them to the work-support, substantially as specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JOHN T. WILKIN.

Witnesses:
WM. N. YOUNG,
WM. E. OCHILTREE.