(No Model.)

6 Sheets—Sheet 1.

W. KRUTZSCH.

MULTIPLE MILLING MACHINE.

No. 277,746. Patented May 15, 1883.

Fig. 1.

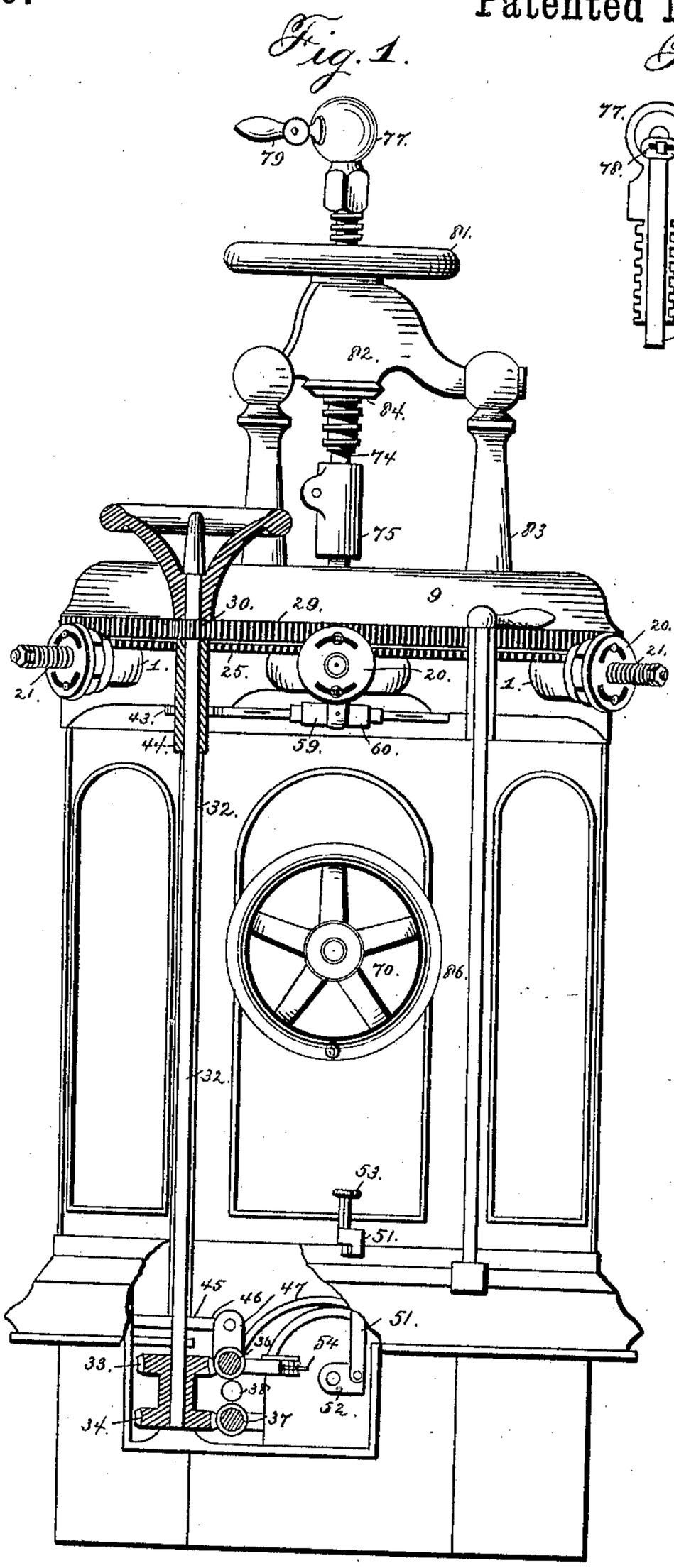
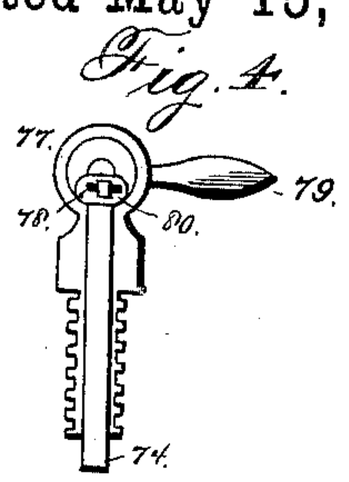


Fig. 4.



WITNESSES

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(No Model.)

6 Sheets—Sheet 2.

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Fig. 2.

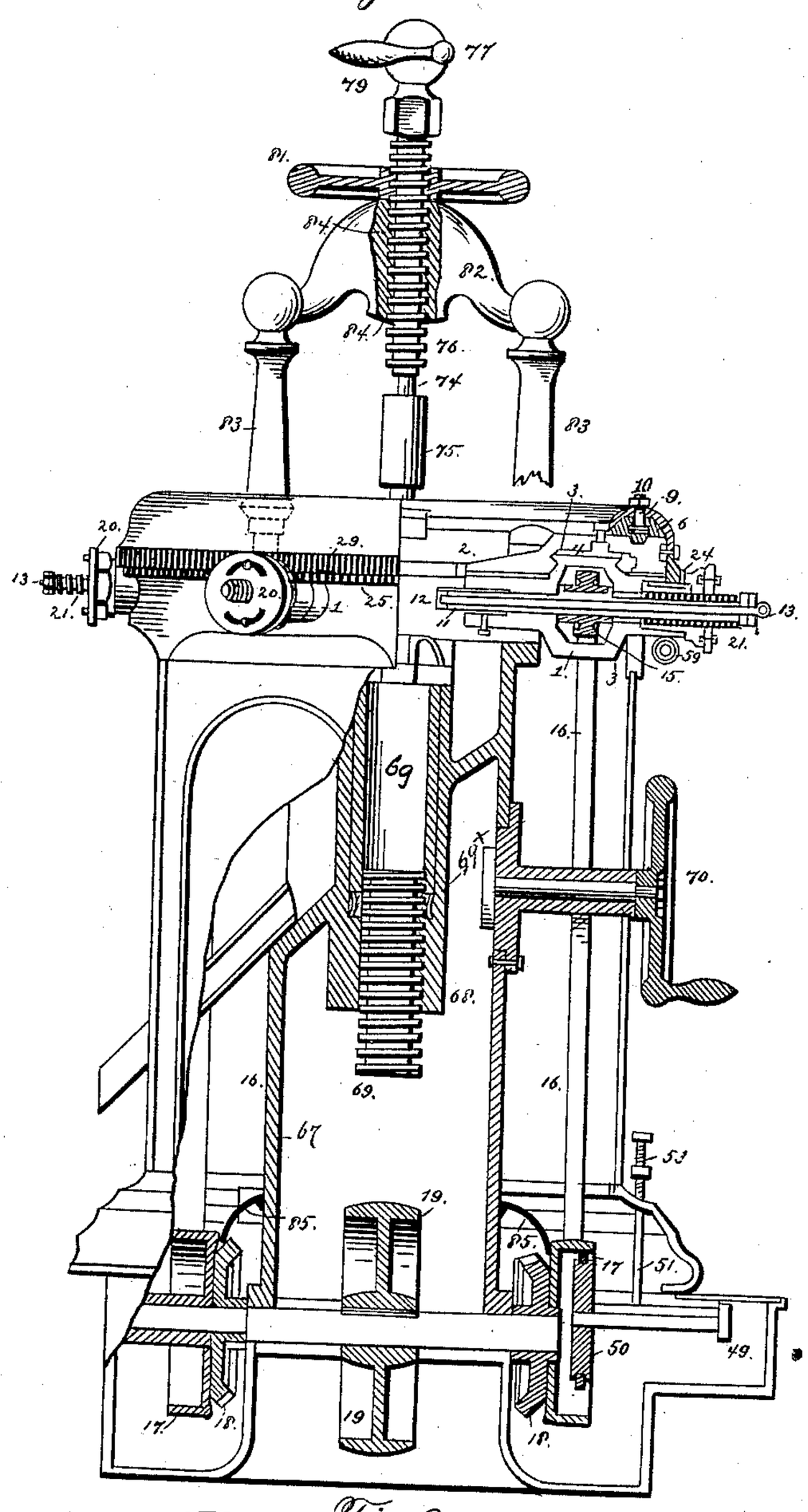
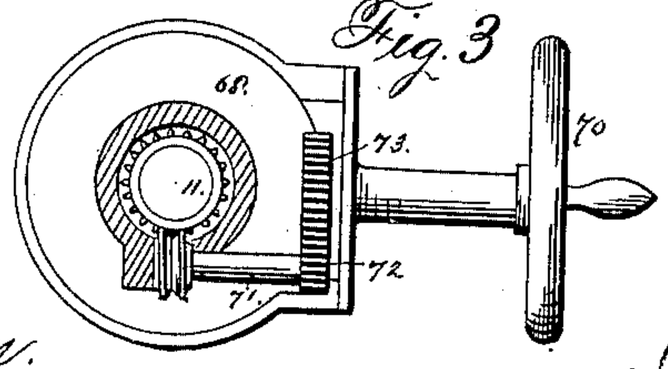


Fig. 3



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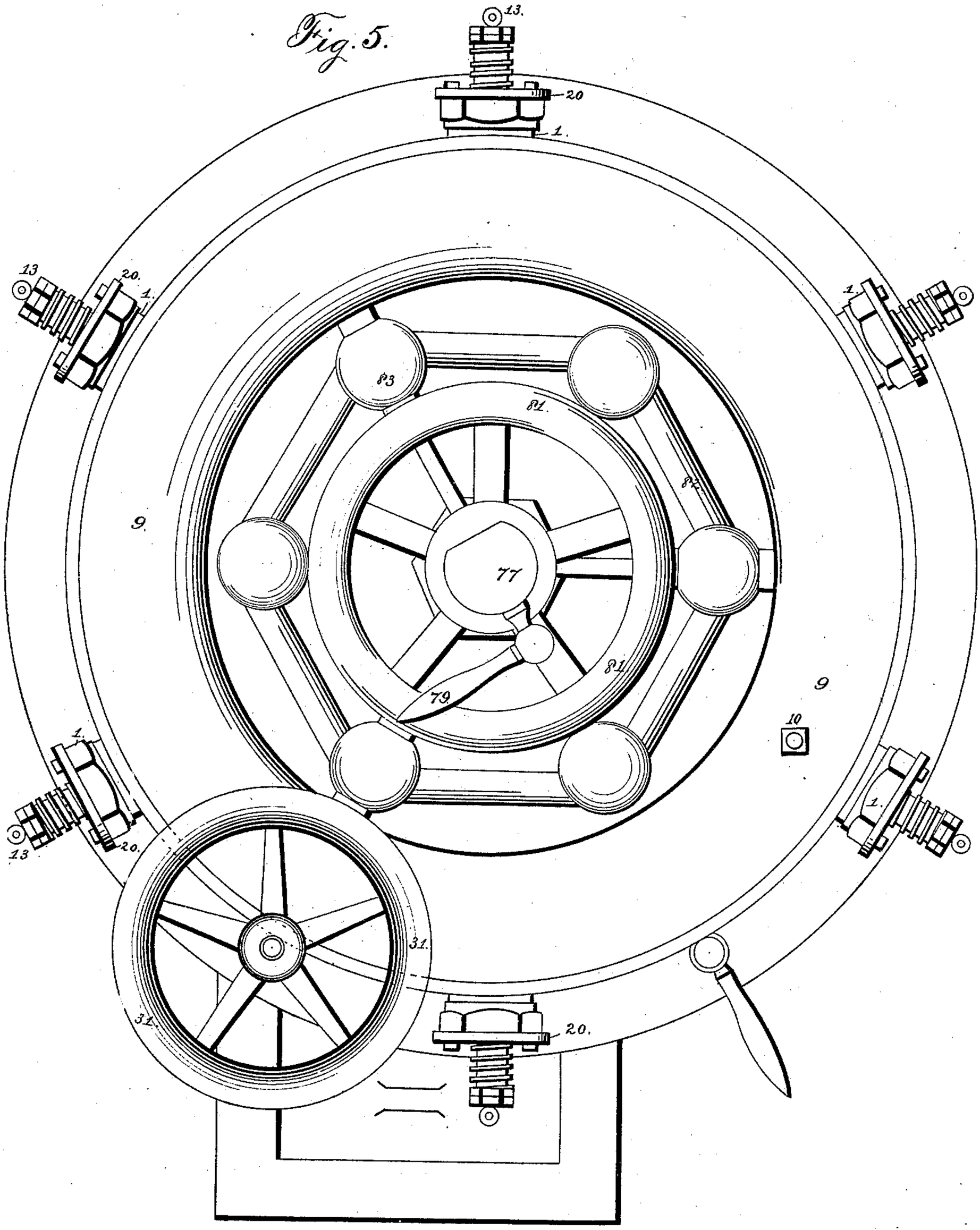
MULTIPLE MILLING MACHINE.

No. 277,746. Patented May 15, 1883.

Fig. 5.



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MULTIPLE MILLING MACHINE.

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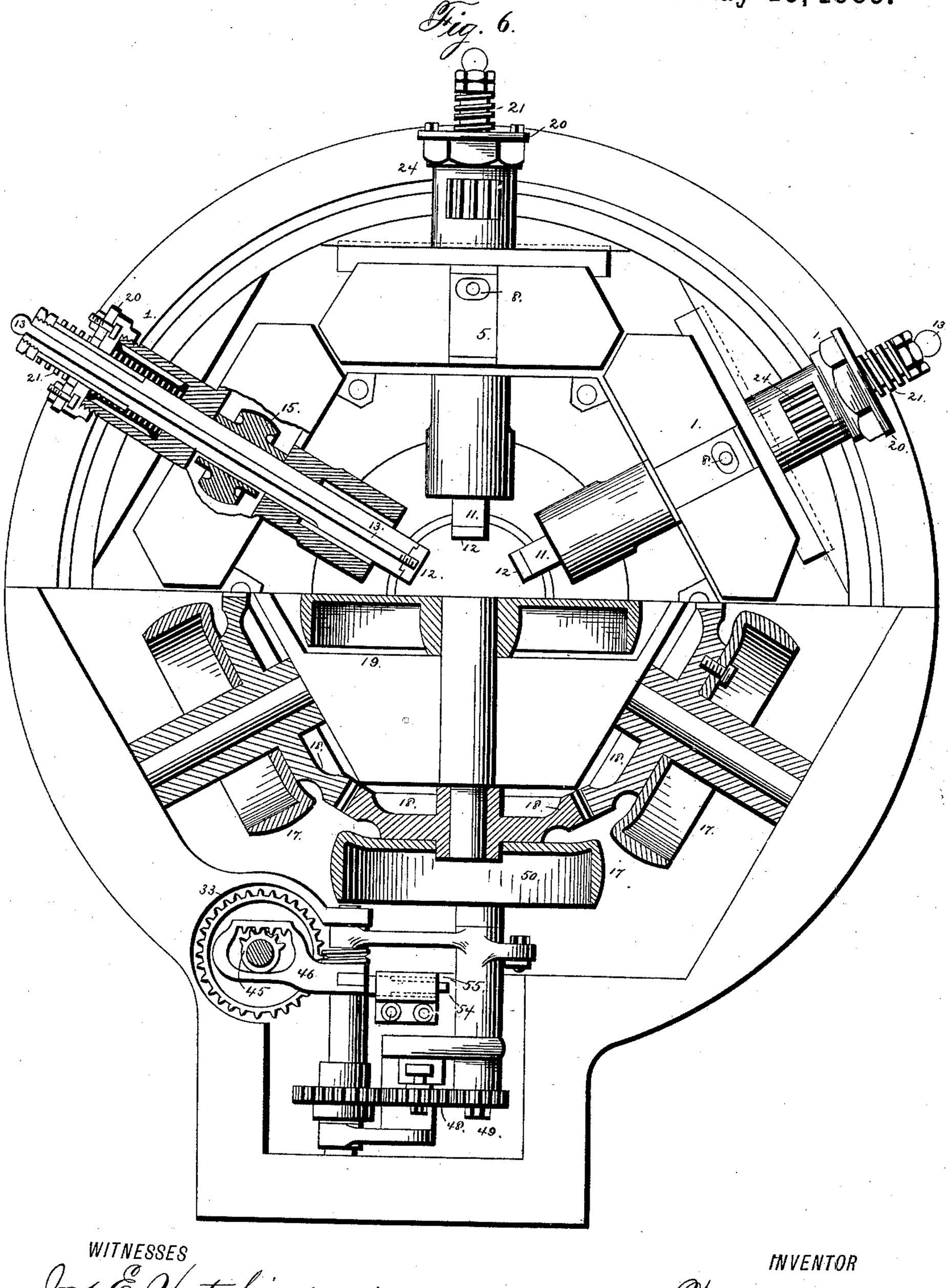
Fig. 6.



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MULTIPLE MILLING MACHINE.

No. 277,746. Patented May 15, 1883.

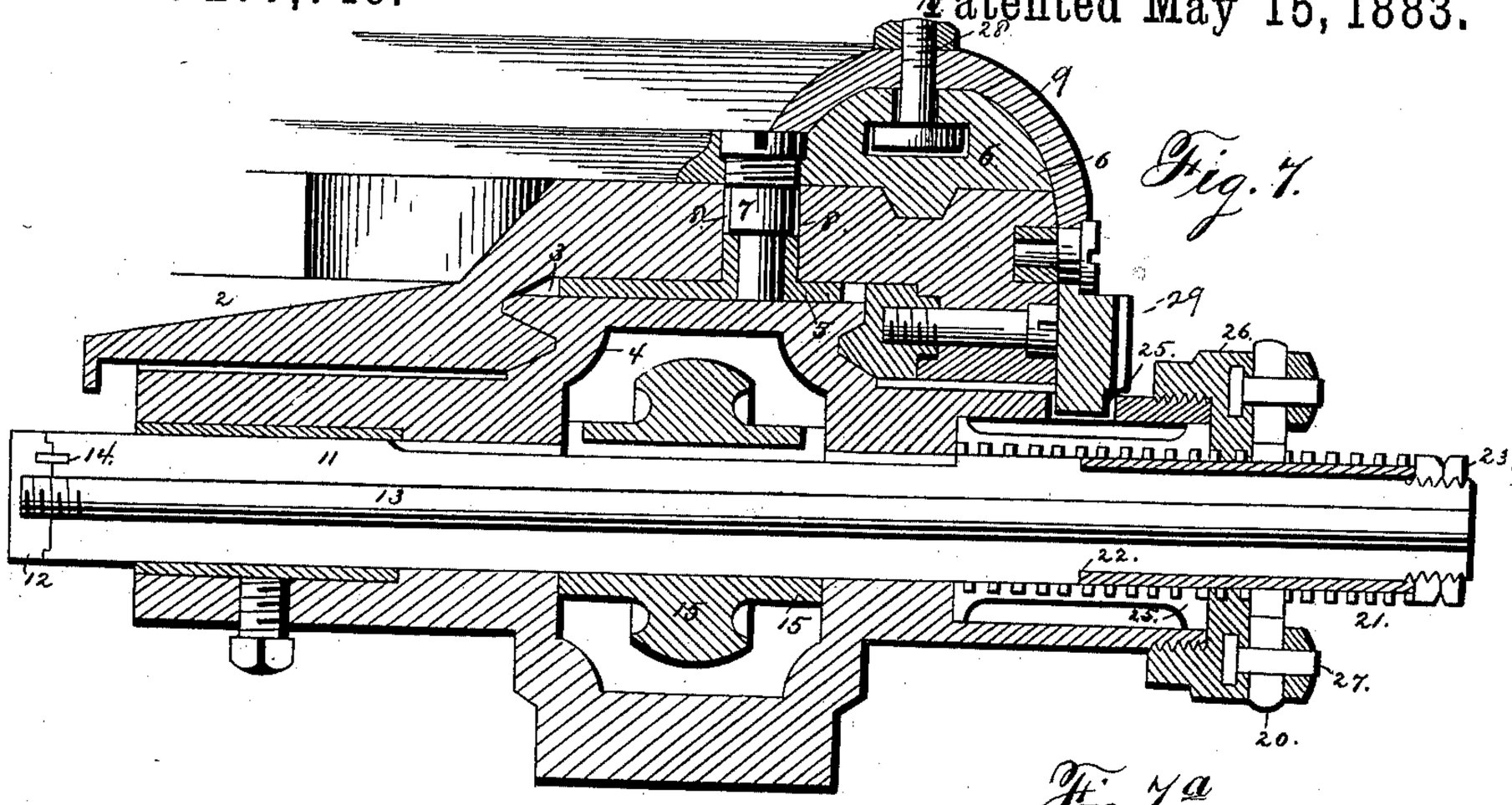


Fig. 7.

Fig. 7a.

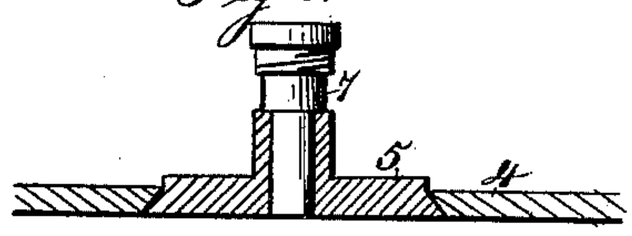


Fig. 8.

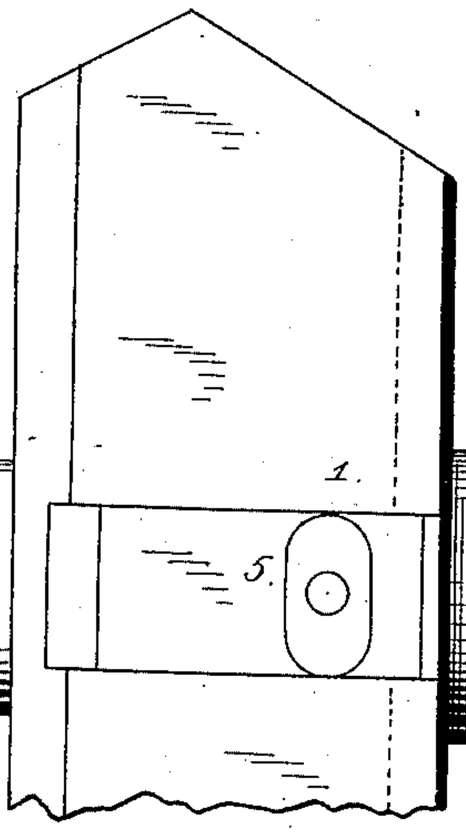
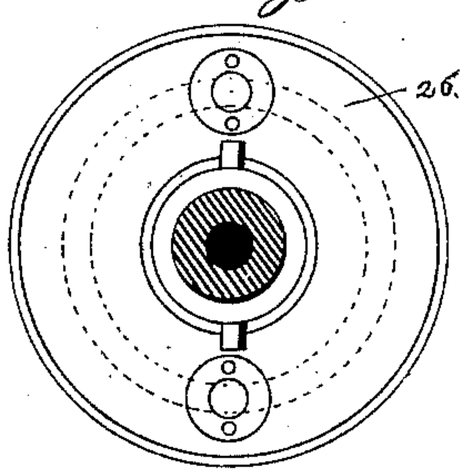
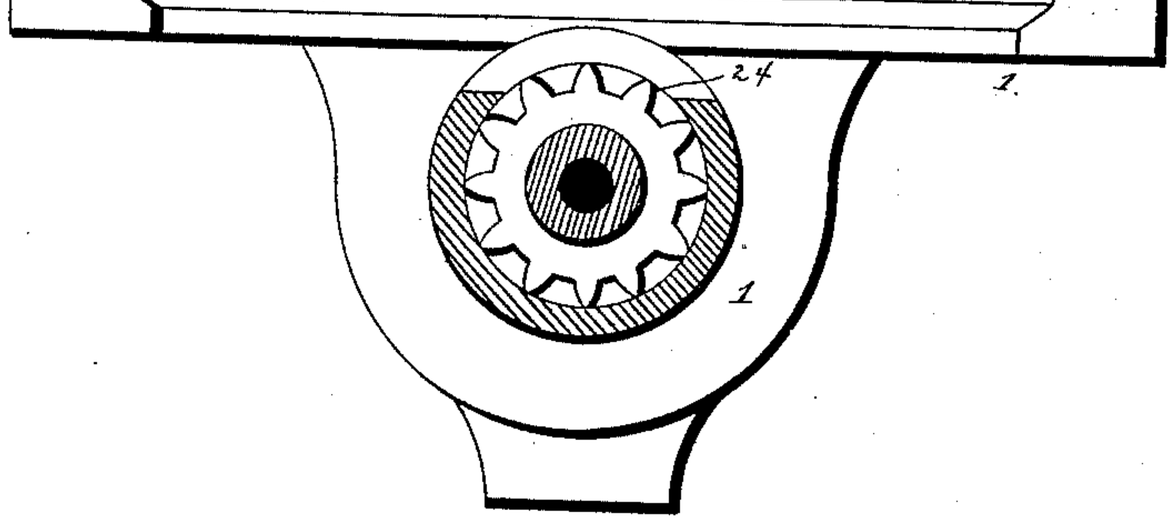


Fig. 9.

Fig. 9a.





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MULTIPLE MILLING MACHINE.

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Fig. 10.

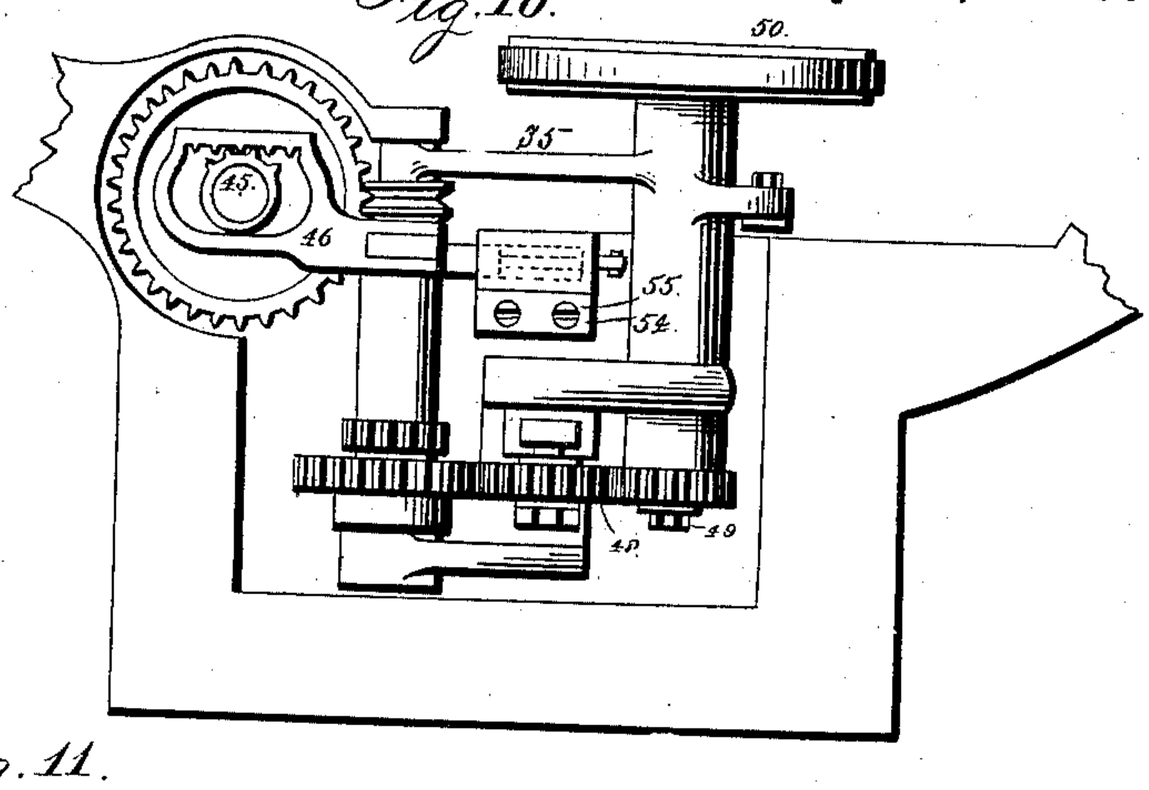


Fig. 11.

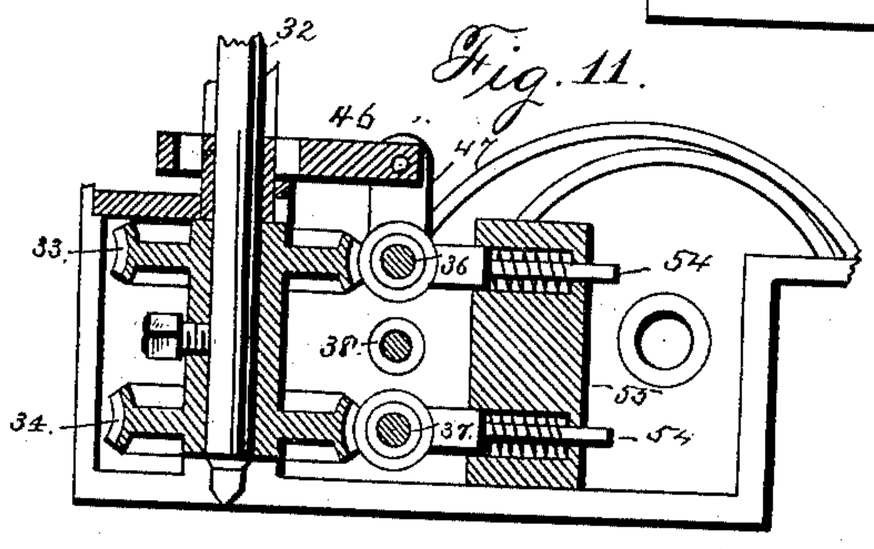


Fig. 12.

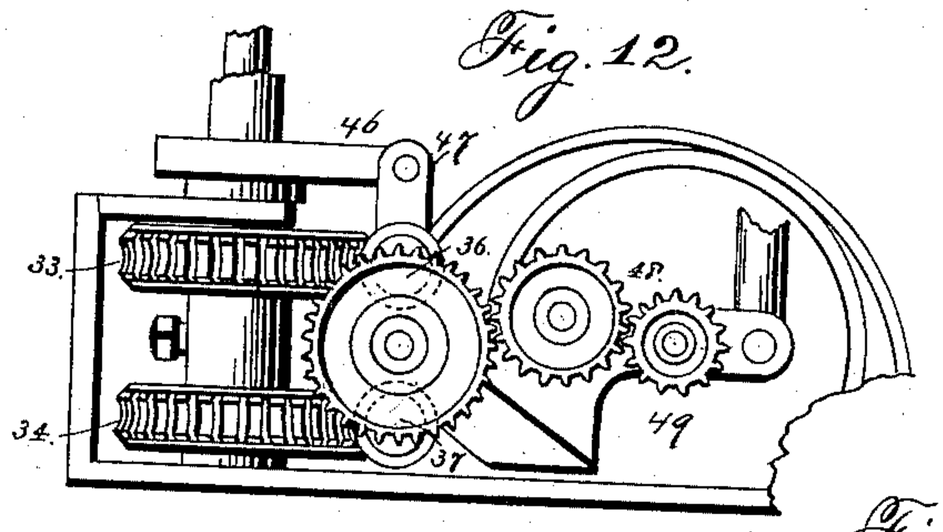


Fig. 13.

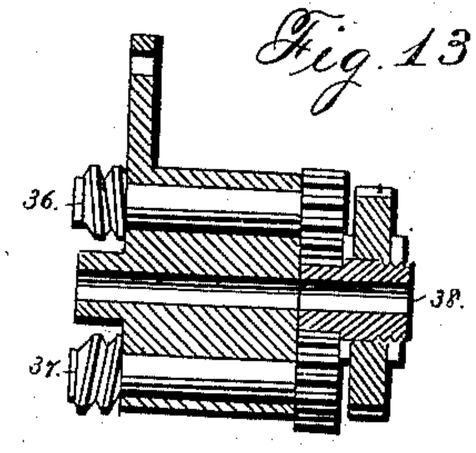


Fig. 14.

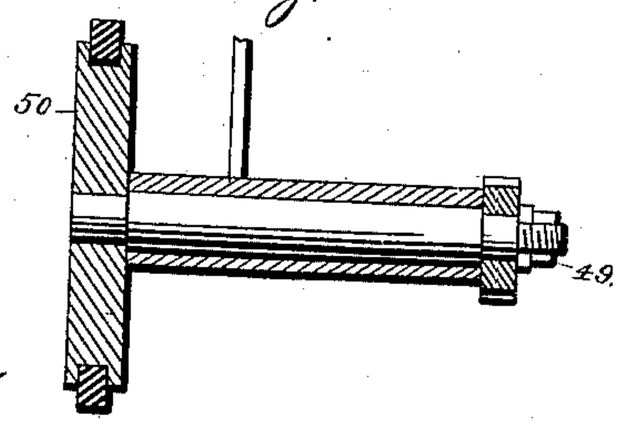


Fig. 15.

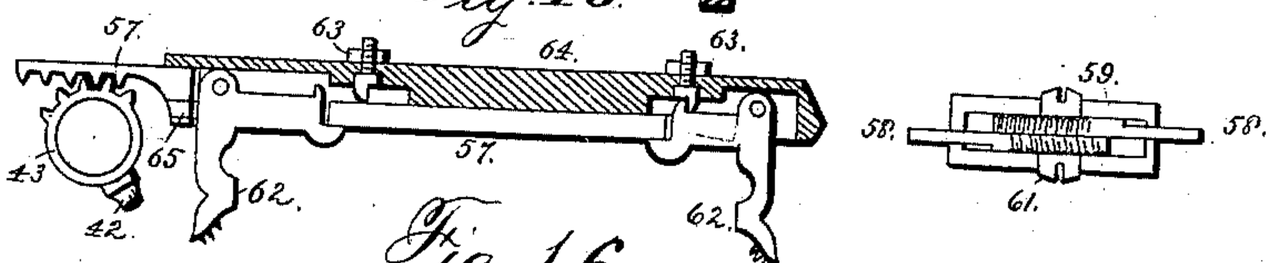
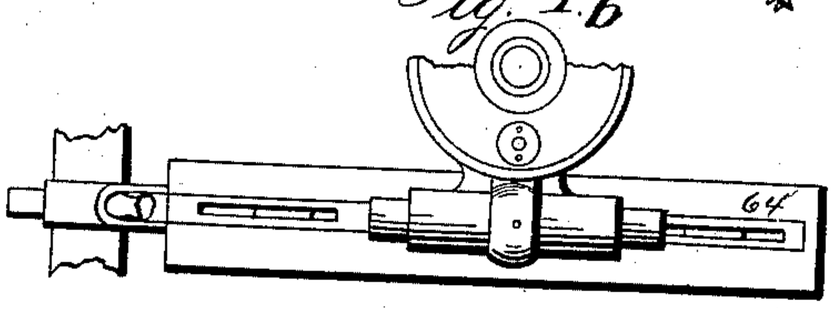


Fig. 16.



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UNITED STATES PATENT OFFICE.

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MULTIPLE MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 277,746, dated May 15, 1883.

Application filed September 19, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM KRUTZSCH, a citizen of the United States, residing at Dayton, Montgomery county, Ohio, have invented new and useful Improvements in Multiple Milling-Machines, of which the following is a specification.

My invention relates to a machine for milling polygonal or multiple-sided objects of different shapes, sizes, and configurations; and the novelty consists in the combination and arrangement of parts, as will be more fully hereinafter set forth, and specifically pointed out in the several clauses of claims.

Among others, the essential objects of the invention may be briefly stated to be as follows: first, to provide a machine having a series of carriages containing a series of revolving cutter-spindles, said carriages being adapted to have a reciprocating and lateral movement in corresponding ways or guides, each movement of each carriage being sufficient to allow its respective cutter to effectively mill that side of the work which is presented to the carriage; second, to provide means for adjusting the spindles either simultaneously or independently of each other, as may be desired; third, to provide means for causing certain rotary feed devices to effect straight lateral movement of the carriage; fourth, to provide means for automatically stopping the feed, and for reversing the same, so as to cause the carriage to be moved back and forth; fifth, to furnish improved means for holding work of various sizes and shapes. These objects are accomplished by the mechanism, the arrangement, construction, and combinations of mechanical features, as illustrated in the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is a side elevation of my improved milling-machine, with the feed-motion and reverse-gears in section. Fig. 2 is a front elevation, partly in section, to illustrate the carriage and slides, adjusting-screw for various lengths of work, driving-pulley, and gears. Fig. 3 is a top plan view of a portion of the machine, showing the devices for raising and lowering the work to be milled and presenting it at the proper height for the cutters. Fig. 4 is a detail view, showing a portion of the mechanism for raising and lowering the clamping device which holds the work to be milled. Fig. 5 is a top plan view of the machine. Fig. 6 is a horizontal section taken on different planes to show the cutting devices. Fig. 7 shows a longitudinal section through one of the carriages, and also illustrates means for propelling the carriage and operating and adjusting the cutter-spindle. Fig. 7ª is a cross-section of a detail. Fig. 8 represents one of the carriages. Fig. 9 shows principally a transverse section taken through one of the carriages, and Fig. 9× a detail. Fig. 10 is a detached top plan view of the feed-gears and friction-pulley actuating the feed. Fig. 11 is a detail section of the alternate worm-gear, and Fig. 12 a side elevation of the same. Figs. 13 and 14 are details. Fig. 15 is a detail view, partly in section, of devices for stopping the feed mechanism and causing a reverse motion of the same; and Fig. 16 is a detached view of an attachment to one of the carriages.

Referring to the drawings, in which similar figures of reference indicate like parts in all the figures, 1 indicates the carriage for the cutter-spindles. As the machine illustrated in this application is designed to mill a hexagonal article, six of these carriages are shown; but it will be understood that, as the machine is designed to mill all kinds of multiple-sized objects or articles, the number of carriages may be varied according to the number of sides to be milled. These carriages are radially arranged in a circle, and supported by a horizontal plate, 2, which constitutes a portion of the frame of the machine, and is provided with a series of grooved ways or guides, 3, in which the flanges or dovetails 4 of the carriages are received, so as to reciprocate or slide therein. These ways or guides 3 are tangential to a circle described about the center where the article to be milled is held, said guides 3 being arranged relatively to each other at angles which depend upon the number of carriages and ways employed. To admit of the straight lateral movement on the part of the carriages, each carriage has a slid-

ing connection with a slide-plate, 5, which connects with an annular plate, 6, by means of a screw, 7, passing through a slot, 8, in the fixed plate 2. By this construction, as the carriage is moved laterally in the straight guide 3 by means of the slide, the said slide 5, while moving in the same direction as the carriage, will also have a longitudinal movement at right angles to the line of travel of the carriage 1, (see Fig. 7ª,) and hence as the plate 6 is turned the cutter 12 will be caused to pass along the sides of the articles or objects upon which they are designed to operate, and thereby mill the said sides by one simultaneous movement on the part of all the carriages. The plate 6, (see Fig. 7,) which is adapted to turn upon the fixed plate 2, is connected with an annular grooved plate, 9, by means of one or more bolts, 10, which are so arranged that the plates 6 and 9 can be disconnected when desired, in order that the plate or shelf 9 can be revolved independently of plate 6, the object of which will be hereinafter explained.

Fig. 11 indicates the hollow revolving cutter-spindle, which is mounted on the carriage 1. The cutter 12 is arranged at the inner end of the spindle 11 upon the screw-threaded end of a rod, 13, which passes through the axial bore of the spindle, and the said cutter 12 is connected with the inner end of the spindle 11 by means of a pin, 14, fitted eccentrically into the spindle 11 and the cutter 12. This mode of connecting the cutters 12 with their respective spindles 11 admits of the ready disconnection of the cutters when desired, it being only necessary to grasp the rod 13 at the outer end and turn it until the inner end is unscrewed from the cutter.

In order to cause a simultaneous rotation of the cutter-spindles 11, each spindle has keyed thereon a pulley, 15, arranged within a recess formed in the carriage 1. These pulleys are driven by vertical belts 16, passing around belt-pulleys 17, arranged at the base of the machine. Each of the lower pulleys, 17, connects with one of a circular set of intermeshing gears, 18, one of the said gears being fixed upon the shaft of the main driving-pulley 19, which is driven by suitable belting.

As the sizes of the articles to be milled may vary, it is necessary to provide for a simultaneous longitudinal or axial adjustment of the cutter-spindles 11, so as to adjust the cutters to a common center or outwardly from the same, according to the size of the article to be milled. Moreover, as the cutters become unequally worn, or if they are of unequal sizes, an independent adjustment thereof becomes necessary. The independent adjustment of a cutter is effected by means of a band-plate, 20, fitted upon and feathered to a longitudinal grooved screw-threaded sleeve, 21, which is arranged to turn upon the outer end of the cutter-spindle. This screw-threaded sleeve fits upon the cutter-spindle between an annular shoulder, 22, and a nut, 23, on the latter, and has its inner end fitted to work in the nut 24, which is screw-threaded both internally and externally, and is arranged within a recess in the carriage. A portion of the nut 24 is exposed through an opening in the carriage, as illustrated in Fig. 8, and is engaged by an annular line of rack-teeth, 25, (see Fig. 7,) with which the annular plate or shell 9 is provided at its lower outer edge. The shell or plate 9, which thus engages the nut 24 will, when not rotated, hold the latter stationary, and hence by turning the hand-plate 20, which, it will be remembered, is feathered upon the screw-threaded collar 21, the said collar will be rotated and caused to slide through the hand-plate 20 by reason of its engagement with the nut 24, now held stationary. The collar 21, in its longitudinal movement, will be forced against the shoulder or the nut upon the cutter-spindle, according to the direction in which the hand-plate 20 is turned, and hence the spindle can be moved in or out in a line coincident with the axis. After the spindle 11 has been thus adjusted it can be secured against further longitudinal adjustment by rigidly securing the hand-plate 20 to a cap, 26, fitted upon the outer end of the carriage. The hand-plates can be thus connected with the said caps by means of bolts 27, countersunk in the cap 26 and passing through slots in the hand-plate 20, so as to receive on their outer ends nuts, which, when tightened up, hold the hand-plates in rigid connection with the caps at the outer ends of the carriage. (See Fig. 7.)

In order to effect a simultaneous adjustment of the cutter-spindles, the annular shell or plate 9 must first be unlocked from its rigid connection with plate 6 by loosening the nut upon the bolt 10, which will have its head countersunk in said plate 6, and its upper screw-threaded end extended up through an opening in the annular shell 9. This shell 9 is then caused to turn by means which will be presently described, and while thus moving independently of the plate 6 the shell 9 will rotate the gear-nuts 24, with which its line of teeth engages, and the said rotating nuts, by reason of their engagement with the screw-threaded collars 21, held against rotation by the hand-plates 20, will cause the said collars to move longitudinally, and thus effect a simultaneous longitudinal movement on the part of all the spindles 11. During such operation the feathers of the hand-plate 20, received in longitudinal grooves in the screw-threaded collar, while preventing the same from rotating, will allow them to slide longitudinally. After the spindles have been thus adjusted the annular shell 9 and plate 6 are again locked together by tightening up the nuts on bolt 10. These plates 9 and 6 being locked together, a rotary movement on the part of the shell 9 will cause the lateral travel of the carriages, so as to carry the cutters across the face of the work. The shell 9 is provided with a ring-gear, 29, which meshes with a pinion,

30, upon the shaft of a hand-wheel, 31. When it is desired to turn the shell 9, so as to cause the simultaneous adjustment of the spindles by the means already described, the said hand-wheel 31 can be turned so as to effect the required partial revolution of the shell in either direction. The lateral movement of the carriages can also be effected by turning the said hand-wheel 31, if such result be desired. The vertical shaft 32 of this hand-wheel extends down to the base of the machine, at which point it is properly stepped, as shown.

In order to produce the required reverse feed-motions, the shaft 32 has keyed upon its lower portion the right and left hand worm-wheels 33 and 34. A rocking frame, 35, carrying a pair of rotary worm-shafts, 36 and 37, is supported on a rock-shaft, 38, arranged between the rotary shafts, and journaled in the casing of the machine or in other suitable bearings. These rotary worm-shafts 36 37 are respectively provided with right and left hand worms 33 34, so that the direction in which the shaft 32 is rotated will depend upon which one of the worm-wheels is engaged by its appropriate worm-shaft. The rocking frame 35 is actuated so as to bring either one of its worm-shafts into such engagement by means of an upper gear-segment, 43, which is provided with a handle, 42, and fixed upon a sleeve, 44, through which the shaft 32 passes.

This sleeve is provided at its lower end with a gear-segment, 45, arranged to engage and operate a sliding rack-bar, 46, which is pivotally connected with an arm, 47, of the rocking frame 35, that carries the worm-shafts. By operating the handle 42 the vertical sleeve can be turned in either direction, and hence the rocking frame vibrates through the medium of the lower gear-segment, 45, and sliding rack-bar 46.

Motion is transmitted to the worm-shafts 36 and 37 through the medium of a suitably-arranged train of gears, 48, one of which is mounted upon a shaft, 49, of a friction-pulley, 50, arranged to bear against the inner face of one of the driving-pulleys 17. In this way the worm-shafts are driven by the said driving-pulley 17, and hence as a worm-shaft is brought into engagement with its appropriate worm-wheel the shaft 32 will be rotated and the annular shell 9 revolved until the carriages have been moved laterally to the required extent, and the feed stopped by operating the gear-segment 43, so as to tilt back the rocking frame and throw the shaft out of engagement with the worm-wheel. In case of accident or necessity both of the worm-shafts can be thrown out of connection with the worm-wheels, and the frame 35 maintained in a vertical position by dropping the bar 51, which connects with the pivoted bearing 52 for the axle of friction-wheel 50. The bar 51 extends up through the casing at the base of the machine, and can be raised or allowed to drop so as to bring the wheel 50 into frictional contact with the driving-pulley 17, or freed therefrom by means of a set-screw, 53, passing through an arm on the upper end of the bar 51 and bearing upon the casing.

In order to avoid all shock in reversing the feed, to give an equable pressure of the worm-shafts against their respective wheels, and to effect an instantaneous disengagement of said worm-shafts from the worm-wheels, I provide two spindles, 54, which pass through a support, 55, having recesses in which coiled springs are located and connected with the spindle 54, so as to throw the same forward, and thereby cause them to act on the rocking frame 35. These springs are important elements in attaining these results. When the worm-shafts are both disengaged from the worm-wheels 33 and 34 the feed will be stopped; and when one of the worm-wheels is next engaged by its respective worm-shaft the feed will recommence, the direction of its motion depending on which worm-wheel is engaged. The feed is automatically stopped, and at the appropriate time is reversed by means of devices best illustrated in Figs. 16 and 17, in which 57 indicates a sliding rack-bar engaged by the gear-segment 43.

58 indicates two slide-bars, made semicircular in cross-section, and arranged with their flat sides together. These bars are respectively provided at their inner ends with right and left hand screw-threads, and are arranged to operate through a right and left threaded sleeve or nut, 59, which is supported from one of the carriages by means of a collar, 60, passing around said nut, and provided with a pin entering a peripheral groove, 61, in the latter. By turning the sleeve or nut 59 the bars 58 will be simultaneously extended from or retracted within the nut, so as to increase or decrease the distance between their outer striking ends.

The rack-bar 57 carries a pair of pivoted triggers, 62, which, when brought into contact with the catches 63 on guide-bar 64, are thrown into engagement with the same by means of springs 65, located in recesses in the rack-bar and adapted to bear against the triggers. As the nut or sleeve 64 moves with the carriage, one of its striking-rods 58 will impinge against one of the triggers at a moment predetermined by the extent to which the rods have been extended from the nut. This action on the part of the rod 58 will release the trigger 62 from its catch 63, and hence release and allow the rack to slide, thereby permitting the gear-segment 43 to turn, which said segment will be automatically actuated by one of the springs 54, which, having been contracted, will now be allowed to expand, and thus bring the rocking frame 35 to a vertical position, and thereby move the lower rack-bar, 46, which, through the lower segment, 45, causes a partial rotation of the sleeve 44, upon which the upper gear-segment, 43, is secured. As the rocking frame 35 is

thus operated its worm-shaft (previously engaged with one of the worm-wheels) will be disengaged therefrom, and hence the feed will be automatically checked and all the carriages simultaneously stopped. It will be seen that the distances traversed by the carriages can be thus regulated by projecting the rods 58 to a greater or less extent from the sleeve or nut 59.

In order to start the carriages on their return movement, it will only be necessary to properly move the handle 42 of the upper gear-segment, whereby the rack 57 will be caused to slide back, during which movement one of the triggers—as, for example, that shown at the right hand in Fig. 16—will engage with its appropriate catch. The sleeve 44, during this movement of the handle 42 and gear-segment 43, is necessarily rotated, so that the gear-segment at its lower end, 45, will move the lower rack-bar, 46, and consequently vibrate the rocker-frame 35, so as to cause one of the springs 54 to be compressed and the next one of its worm-shafts to engage its appropriate worm-wheel on shaft 32. The feed will then be started, and when the travel of the carriages is completed the trigger thus engaged will be struck by one of the bars 58 and released, thus allowing the rack-bar 57 to slide and permit the gear-segment 43 on the sleeve 44 to be turned, so as to stop the feed, as before.

The means for adjusting the clamps or centers which hold the object to be milled so as to adapt them to articles of various sizes are as follows:

69 indicates a vertical screw, arranged to move longitudinally within a suitable fixed sleeve, 68, secured by braces to the inner walls of a vertical hollow standard, 67. This screw, which extends upward without threads and has the upper end adapted to support the article to be milled, is raised or lowered by means of a worm, 70, upon the worm-shaft 71, having at one end a pinion, 72, engaged by a gear, 73, upon the shaft of a hand-wheel, 70. This screw 69 is operated by a nut, $69^{\times}$, which has an internal thread to engage the threads of the screw-rod 69, and an external quick screw to engage the worm on the shaft 71. A feather on the screw 69 and a slot in the sleeve 68 prevent the screw from turning, and the nut is held against vertical movement by any proper means. The upper head, 75, for holding down the work, is secured upon the lower end of a vertical rod, 74, which passes up through a hollow screw, 76, and has at its upper end, which extends into a hollow head, 77, of said screw, an oblong eye or slot, 78, as shown in Fig. 4. A handle, 79, pivoted to the hollow head of said screw, is provided with a pin, 80, eccentrically connected to its pivot, and received into the slot at the upper end of rod 74. The hollow screw 76 works through an internally-screw-threaded sleeve, 84, which is provided with a hand-wheel, 81, and arranged to turn in a frame, 82, supported before the machine by standards 83. After the handle 79 has been turned so as to depress rod 74 and bring the pin 80 on the dead-center, the hand-wheel 81 can be turned so as to rotate its sleeve 84, whereby the screw and rod will be lowered, and hence the head 75 brought down and clamped upon the work.

85 indicates an annular curved plate or flange for protecting the train of beveled gears at the base of the machine, and 86 indicates a rod which will be provided at its lower end with mechanism suitable for shifting the main driving-belt from pulley 19 to a loose pulley, which can be mounted on the same shaft as in ordinary belt-shifting devices.

Modifications in details of construction may be made without departing from the principle or sacrificing the advantages of my invention, the essential features of which have been described, and are fully illustrated in the drawings.

I am aware that a machine for dressing and pointing bolts and nuts has heretofore been provided with a series of radial spindles adjustable toward and from a central point, and having the cutting-tools on their inner adjacent ends, and such, therefore, I do not broadly claim.

Having thus described my invention, what I claim is—

1. In a machine for milling multiple-sided objects, the combination, with an annular series of laterally-movable carriages, of rotary and longitudinally-movable cutter-spindles mounted in said carriages, and mechanism, substantially as described, for effecting an independent longitudinal adjustment of the cutter-spindles, as and for the purpose specified.

2. In a machine for milling multiple-sided objects, the combination of a horizontal plate provided with ways set at suitable angles to each other, carriages adapted to slide simultaneously in said ways, rotary cutter-spindles supported in said carriages, and each provided with a proper cutter readily removable and interchangeable at will, and mechanism, substantially as described, for adjusting and operating the carriages and cutter-spindles, whereby all sides of the object may be cut or milled at a single operation, substantially as set forth.

3. In a machine for milling multiple-sided objects, the combination of the annular series of laterally-moving carriages with the rotary and longitudinally-movable cutter-spindles mounted in said carriages, and with mechanism, substantially as described, for effecting a simultaneous longitudinal adjustment of all of the cutter-spindles, for the purposes set forth.

4. In a multiple-sided milling-machine, the combination, with a series of cutter-spindles mounted in carriages adapted to slide in suitable ways, said carriages being provided with suitable gear-nuts, of a plate provided with a rack, a vertical shaft having a gear arranged to engage therewith, and a friction-pulley,

worm-gears, and intermediate mechanism, substantially as described, whereby the necessary feed is imparted to the carriages, as and for the purposes specified.

5. In a milling-machine, substantially as described, the combination of an annular series of laterally-movable carriages with a fixed supporting-plate provided with a series of straight ways or guides for the said sliding carriages, each one of said carriages being provided with a rotary cutter-spindle and connected with a revolvable plate by means of a slide adapted to partake of the revolving movement of the plate, so as to thereby cause the lateral movement of the carriage, and being further adapted to slide in a line coincident with the axis of the cutter-spindle, whereby as the said plate is revolved the carriage will be allowed to move freely in its straight way, substantially as described.

6. In a multiple-sided milling-machine, the combination of the fixed plate 2, having suitable guideways, 3, the carriages 1, having slides 5, the shell-plate 9, having rack 10, and the operating mechanism, substantially as described.

7. The combination, in a milling-machine, of a set of laterally-movable carriages carrying rotary cutter-spindles with a horizontal fixed plate having a series of straight ways for the said carriages, a rotary plate connected with a revolvable shell and with the carriages by means of a slide and set-screws 7, passing through slots in the said fixed plate, substantially as described.

8. The combination, in a milling-machine, of a series of carriages, each carrying a rotary cutter-spindle, with a hand-plate feathered upon an externally-screw-threaded sleeve loosely arranged upon the cutter-spindle, a screw-threaded nut fitted upon and meshing with the said screw-threaded sleeve, means for holding the nut stationary when the sleeve is rotated by turning the hand-plate, and devices for securing the hand-plate to the carriage after it has been turned and the spindle adjusted, whereby the spindles of each carriage can be adjusted independently of the others, substantially as described.

9. The combination, in a milling-machine, of a series of carriages, each carrying a rotary cutter-spindle, with screw-threaded sleeves loosely fitted upon the cutter-spindles, means, substantially as described, for securing the sleeves against rotation, the externally and internally screw-threaded nuts fitted upon the said sleeves, and the revolvable shell provided with a line of gear-teeth engaging the screw-threaded nuts, whereby by a revolving movement on the part of the said plate a simultaneous longitudinal adjustment on the part of the cutter-spindles can be effected, substantially as described.

10. The combination, in a milling-machine, of the laterally-movable carriages, carrying the rotary and longitudinally adjustable cutter-spindles, with the slides having a sliding connection with the carriages, the screws connecting said slides with a revolvable plate, the screw-threaded sleeves loosely arranged upon the cutter-spindles, the hand-plates feathered upon the sleeves and detachably connected with the carriages, the screw-threaded nuts fitted upon the screw-threaded sleeve, and the annular rotary shell 9, provided with gear-teeth engaging said nut and detachably connected with the plate 6, whereby either the independent or simultaneous longitudinal adjustment of the spindle can be effected at will, substantially as described.

11. In a multiple-sided milling-machine, the combination, with a hollow spindle and a cutter carried thereby, of eccentric pins connecting the parts, and a screw-bolt passing through the hollow spindle and engaged with the cutter, whereby it may be disengaged from the outside of the machine, substantially as described.

12. The combination, in a milling-machine, of the annular series of laterally-movable carriages 1, each carrying a rotary cutter-spindle, with the pulleys feathered upon the cutter-spindles, the lower driving-pulley, 19, connected with the spindle-pulleys by endless belts, and the circular train of bevel-gears in rigid connection with the lower belt-pulleys, substantially as described.

13. In a milling-machine, the combination, with the hollow cutter-spindle supported in a carriage, of the rod passing through the bore of the spindle and screwed at one end into the cutter, and a pin fitted eccentrically into the cutter and the spindle, whereby by unscrewing the rod from the cutter the said cutter can be removed at will, substantially as described.

14. The combination, in a milling-machine, with the series of laterally-movable carriages, each provided with a rotary and longitudinally-adjustable spindle, of the rotary shell and means, substantially as described, for effecting the movement of the carriage, and the hand-wheel having upon the vertical shaft a pinion engaging a ring-gear upon the rotary shell, whereby, when desired, said parts may be actuated by hand, substantially as described.

15. The combination, in a milling-machine, of a series of laterally-movable carriages carrying the cutter-spindles with the feed mechanism, consisting of a right and left hand worm-wheel, both mounted upon a shaft, from which, through the medium of connections, substantially as described, the said carriages are caused to move in their ways, and a rocking frame carrying a right and left hand rotation worm-shaft, said worm-shafts being adapted to be brought into alternate engagement with the said worm-wheels or both thrown out of connection from the same, whereby the feed can be stopped or reversed, as and for the purpose specified.

16. In a multiple-sided milling-machine, the combination, with the spindle-supporting car-

riages 1 and the plate 9, having rack 29, of the feed-shaft 32, segmental gear 43, rack 57, sleeve 44, rack 46, worm-wheels 33 and 34, and rocker-frame 35, having worm-gears 40 41, substantially as described.

17. In a milling-machine, the combination, with a series of carriages provided with revolving cutter-spindles, of means, substantially as described, for holding the work in a fixed position, and mechanism, substantially as described, for causing the cutters to traverse its faces, thereby removing the surplus metal and polishing all of its sides or faces at one operation, substantially as described.

18. In a milling-machine, the combination, with a hollow spindle provided with a cutter, of a screw-bolt arranged to be operated from the outside of the machine and screwed into or unscrewed out of connection with said cutter, whereby the latter is held against an eccentric pin or key, substantially as described.

19. In a milling-machine, the combination, with the series of carriages carrying the cutter-spindles, of the rotary shaft carrying the right and left hand worm-wheels, the rocking frame carrying the right and left hand rotating worm-shafts, a sliding rack-bar connecting with the rocking frame and engaged by a gear upon sleeve 44, and means, substantially as described, for turning the said sleeve so as to rotate the rocker-frame, as and for the purpose specified.

20. The combination, in a milling-machine, of the sliding carriages carrying the cutter-spindles, of the rotary shell 9, with connections, substantially as described, for operating the carriages, means, substantially as described, for revolving the shell, and devices, substantially as set forth, for automatically stopping the feed after the carriages have traveled the required distance, substantially as set forth, for the purposes specified.

21. The combination, in a milling-machine, of the laterally-movable carriages carrying cutter-spindles, a rotary shell, 9, for effecting the movement of the carriages through connections, substantially as described, means for revolving the said shell, devices for automatically stopping the feed, and means, substantially as set forth, for effecting the reversal of the feed-motion and a reverse rotation of said shell 9, so as to cause the carriages to make the return movement, as and for the purpose specified.

22. The combination, in a milling-machine, of the carriages and rotary cutter-spindles with the rotary shaft provided with right and left hand worm-wheels 33 and 34, connections between said rotary shaft and the sliding carriages, the rocker-frame 35, provided with right and left hand worm-shafts, and springs adapted to maintain the rocking frame in such position that its worm-shafts shall both be disengaged from the worm-wheels, substantially as described.

23. The combination, in a milling-machine, of the sliding carriages carrying the rotary cutter-spindles with the rotary shaft 32, provided with right and left hand worm-wheels 33 34, connections between said rotary shaft 32 and the sliding carriages, the rocking frame 35, carrying the right and left hand worm-shafts, the springs connected with the spindles, and means, substantially as described, for actuating the rocker-frame, as and for the purpose specified.

24. In a milling-machine, the combination, with a series of carriages provided with rotary cutter-spindles, of means, substantially as described, for effecting a simultaneous longitudinal adjustment of all the spindles to correspond with varying sizes of work, said adjusting devices consisting, essentially, in a hand-plate rendered stationary and feathered to a screw-sleeve, on which operates a gear-nut attached to said carriage, said gear being actuated by a common rack, substantially as specified.

25. The combination, in a milling-machine provided with sliding carriages carrying rotary longitudinally-adjustable cutter-spindles, of the right and left hand worm-wheels 33 and 34 with the rocking frame 35, carrying right and left hand worm-shafts, the rotary sleeve 44, provided with a lower gear which engages a sliding rack-bar connected with the rocker-shaft, and the upper gear-segment, 43, fixed upon said sleeve and provided with a suitable handle, substantially as described.

26. In a milling-machine, the combination, with a feed mechanism for the carriages carrying the cutter-spindles, of devices, substantially as described, for causing the automatic stoppage of the feed, the same consisting in a sliding rack-bar, 57, provided with pivoted triggers 62, and the striking-rods 58, supported from one of the carriages, and adapted to alternately strike the triggers when the carriage has traveled the required distance, and thus release the triggers from their catches, substantially as described.

27. The combination, in a milling-machine, of the nut 59, having a right and left handed thread, with the right and left screw-threaded bars 58, the carriage from which the nut is supported, the sliding rack-bar 57, and the trigger 62, substantially as described.

28. The combination, in a milling-machine, of the laterally-movable carriages carrying the rotary cutter-spindles, with the right and left hand worm-wheels upon a rotary spindle or shaft, 32, connections between said shaft and the sliding carriages, the right and left worm-shafts adapted to be brought into alternate engagement with the worm-wheels 33 and 34, a spring or springs, 37, for facilitating the disengagement of the worm-shafts from the worm-wheels, the sleeve 11, with means, substantially as described, for connecting it with the rocking frame carrying the worm-shafts, the gear-segment 43, rack-bar 57, engaged by said gear

and carrying the triggers 62, and the striking-rods 58, supported from one of the carriages, substantially as described.

29. The combination, in a milling-machine, of the feed mechanism for the sliding carriage carrying the rotary cutter-spindles, substantially as described, with the friction-wheel 50, for actuating the feed mechanism, substantially as set forth.

30. In a milling-machine, the means for holding down the work, consisting of a vertical rod, 74, passing through a hollow screw, the handle 79, provided with an eccentric pin entering a slot in the head of said nut, and the hand-wheel fixed upon a rotary sleeve, which is fitted upon the screw and adapted to turn on a frame located above the machine, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

W. KRUTZSCH.

Witnesses:
JAMES L. NORRIS,
JAMES A. RUTHERFORD.