No. 699,613. Patented May 6, 1902.

H. H. BURNS.

MACHINE FOR FINISHING METAL ARTICLES.

(Application filed June 13, 1901.)

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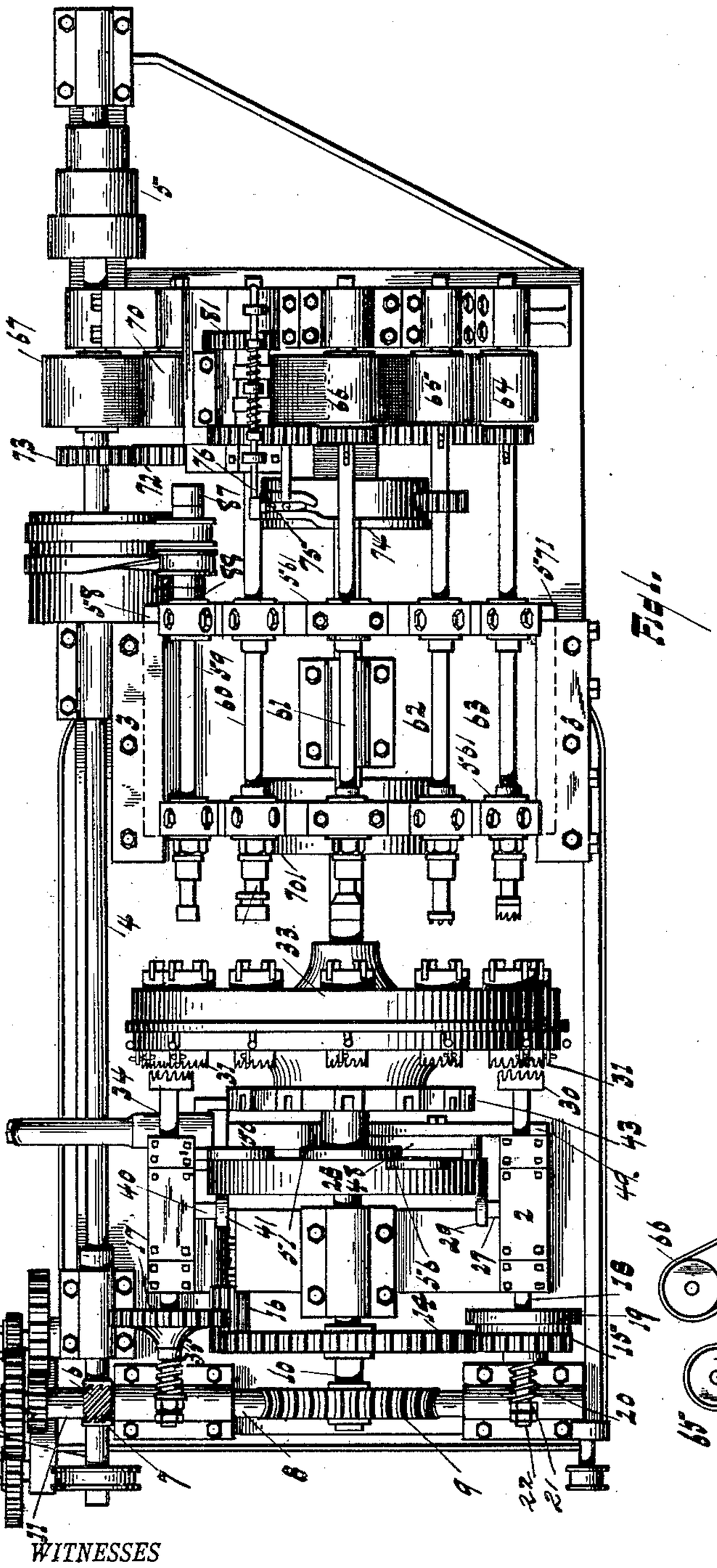

Fig. 1.

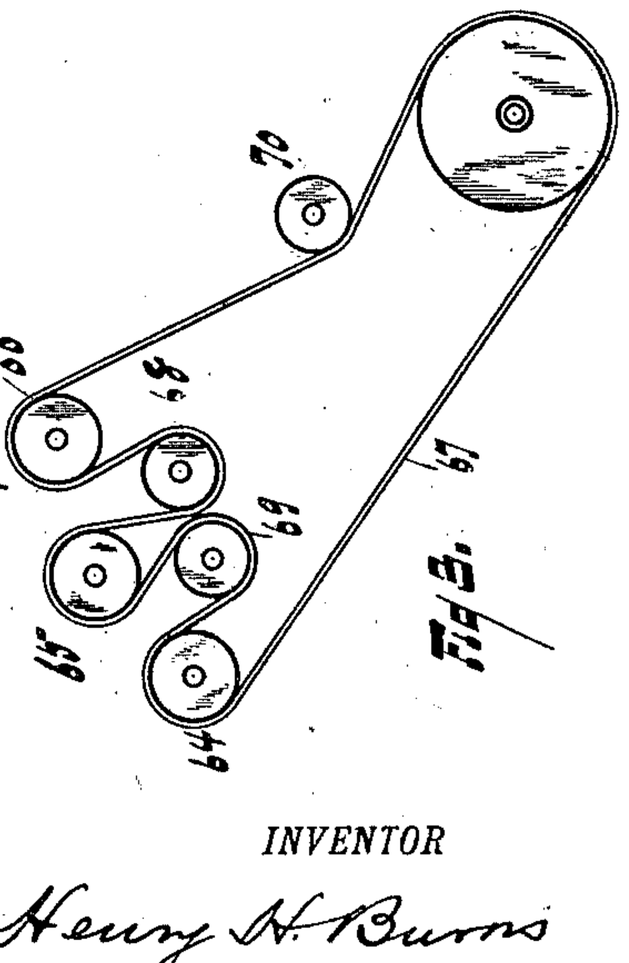

Fig. 3.

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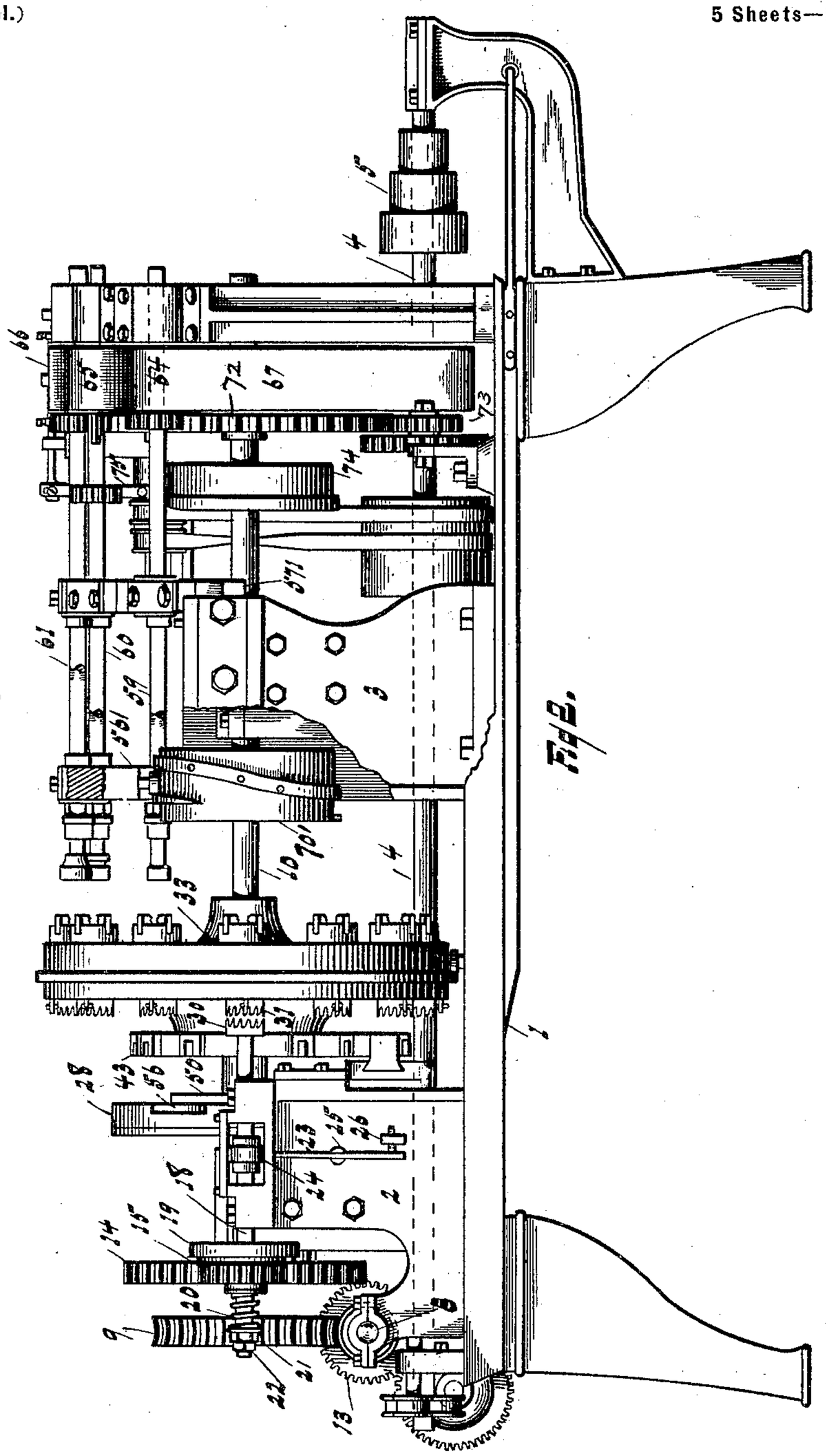

Fig 2.

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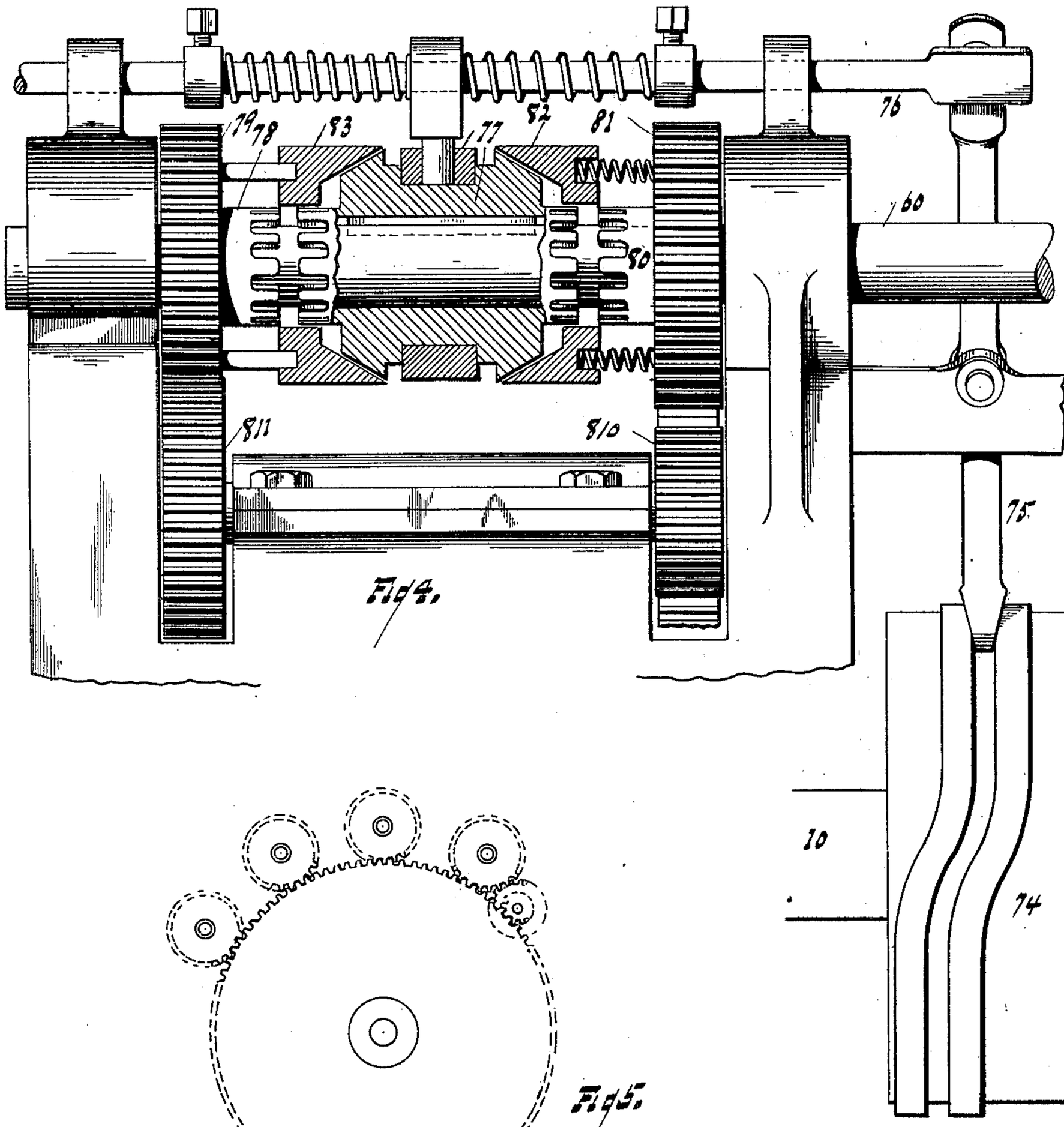

Fig 4.

Fig 5.

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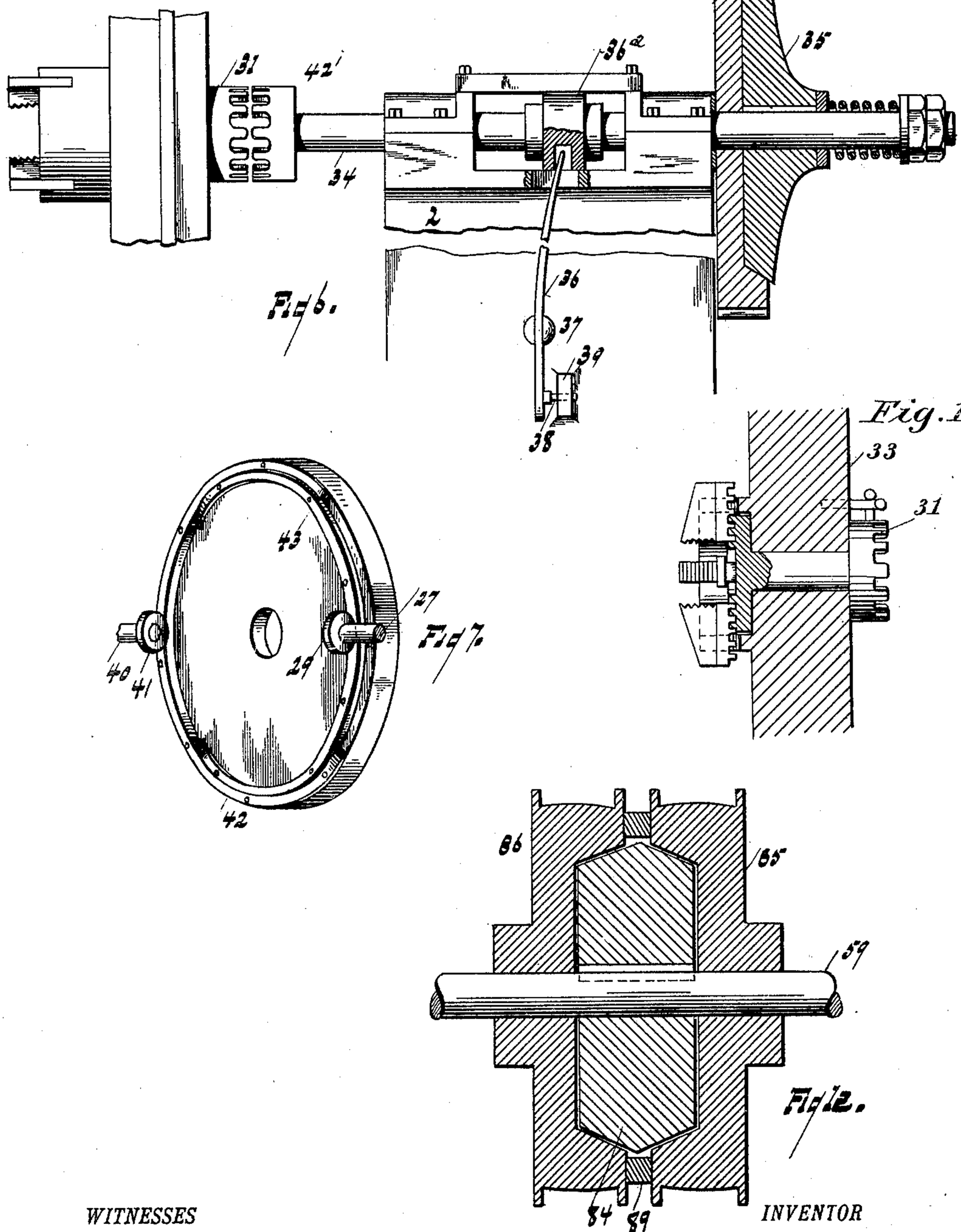

Fig 6.

Fig 7.

Fig. 13.

Fig 12.

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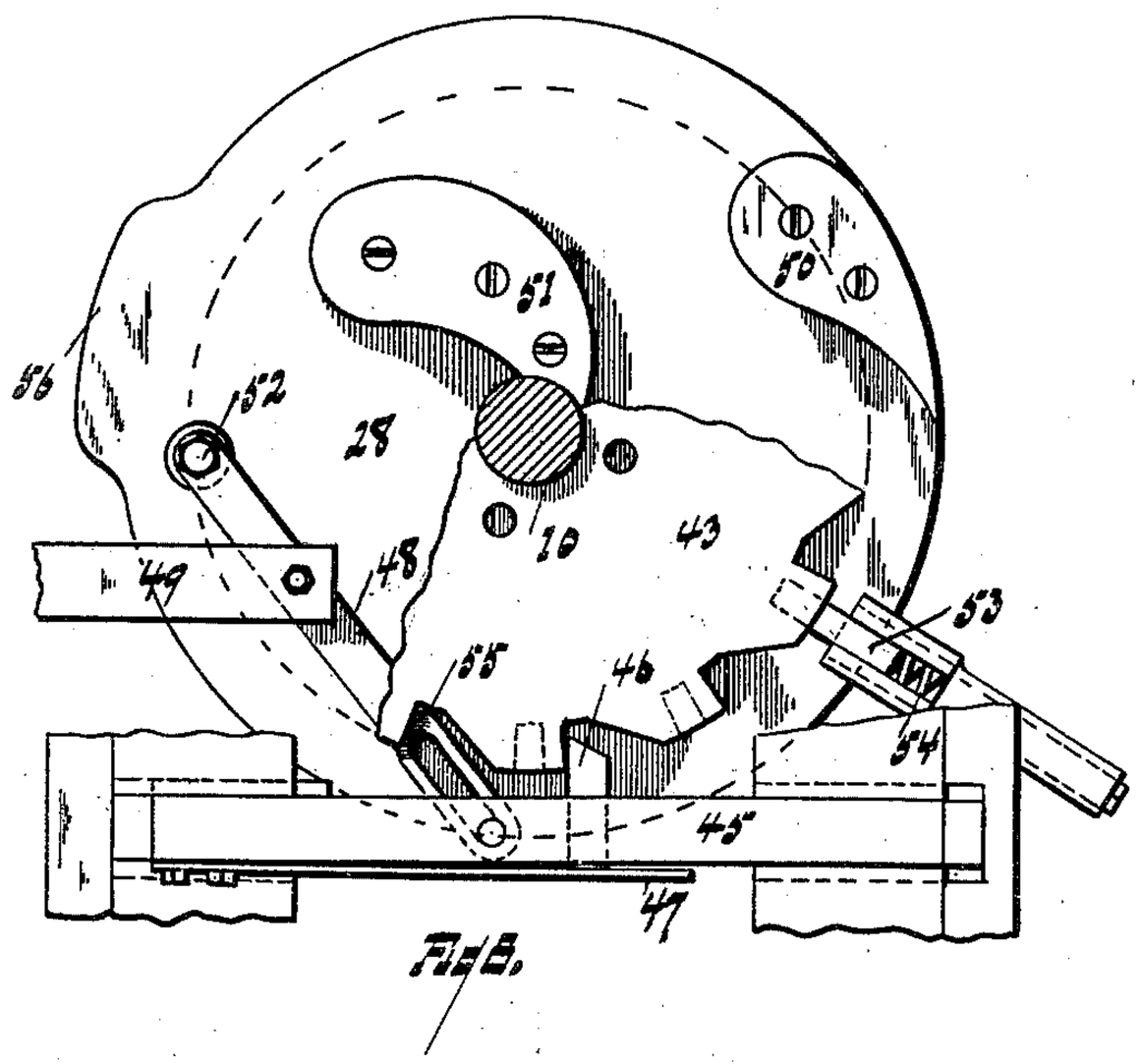

Fig 8.

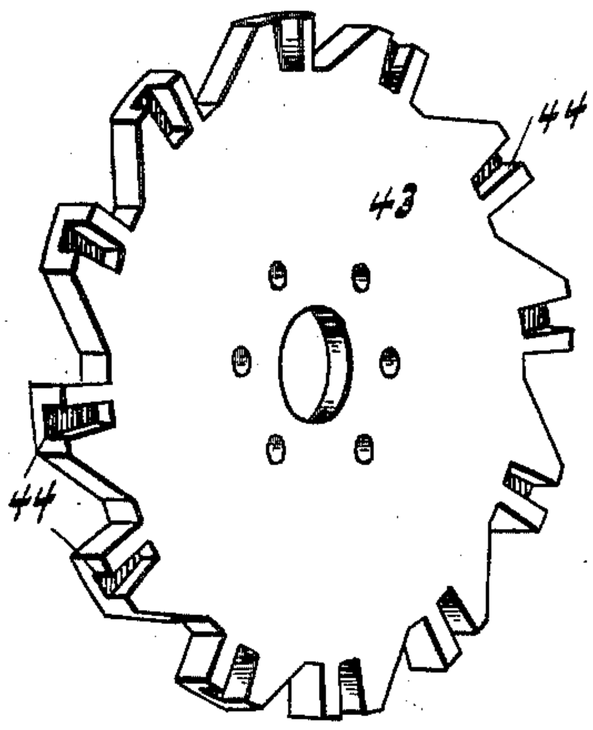

Fig 9.

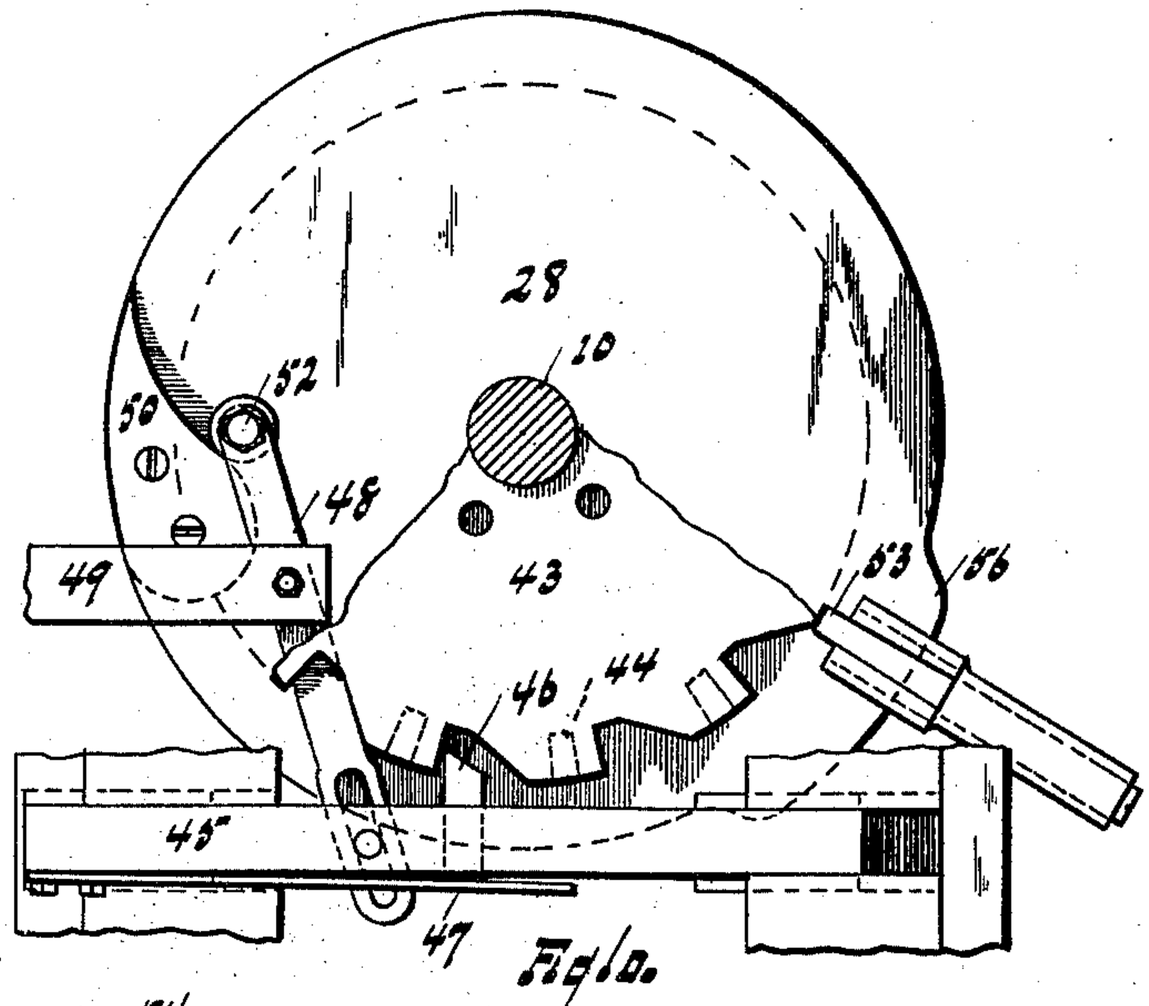

Fig 10.

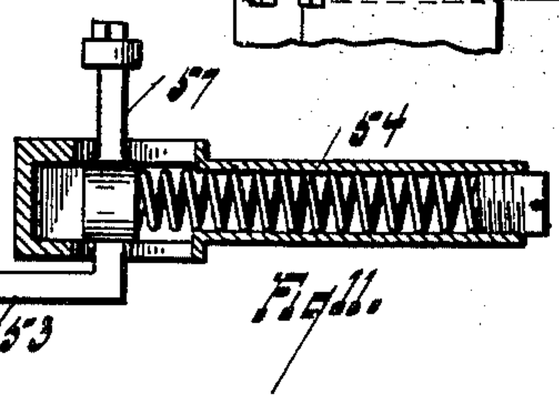

Fig 11.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR FINISHING METAL ARTICLES.

SPECIFICATION forming part of Letters Patent No. 699,613, dated May 6, 1902.

Application filed June 13, 1901. Serial No. 64,469. (No model.)

To all whom it may concern:

Be it known that I, HENRY H. BURNS, a citizen of the United States, residing at Hastings, county of Barry, State of Michigan, have invented a certain new and useful Improvement in Machines for Finishing Metal Articles; and I 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 pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to machines for finishing metal articles, and comprises a machine for turning, milling, boring, drilling, tapping, threading, and similar operations.

The purpose of the invention is to produce a machine in which there are a number of work-holding chucks or collets arranged to bring the work to be treated successively into place to be operated upon by the tools, and there are also involved in the construction of the machine a number of tools which act simultaneously on different articles, but in such a way that each article is treated by the number of tools required to complete the article.

The machine is nearly automatic, requiring only in some cases that an attendant place the work or article in the jaws of the chuck. The chuck itself is closed on the article by the machine, and after traveling in its path and being treated by each of the tools the jaws of the chuck are opened and the article expelled or dropped therefrom and the chuck arrives at the place where the attendant or an automatic attachment places an article within the jaws for treatment. The number of the chucks is indefinite and the number of tools is indefinite. In the machines which have so far been constructed embodying the idea I have used twelve chucks and four to six tools; but either number may be increased or diminished at will in the original construction of the machine.

In the drawings, Figure 1 is a plan view. Fig. 2 is a side elevation. Fig. 3 is a diagram of belting used to drive the tools. Fig. 4 is a detail, on a large scale, of a reversing mechanism used with one of the tools—as, for example, with a tap. Fig. 5 is a diagram of gear transmission with which the machine is equipped in order that either belt or gear transmission may be used. Fig. 6 shows the details of the mechanism by which the chuck is actuated. Fig. 7 is a perspective of the cam-wheel. Fig. 8 is an elevation showing the cam which opens and closes the chucks. Fig. 9 is the locking-disk connected with the cam of Fig. 8 and shown in that figure as being partly broken away. Fig. 10 shows the cam-wheel of Fig. 8 in another position. Fig. 11 is a plan of the locking-bolt used with the locking-disk of Fig. 9. Fig. 12 is a belt-reverse for one of the tools. Fig. 13 is a detail sectional view of one of the chucks.

In Fig. 2 a part of the frame is broken away to bring into view the cam-wheel underneath it.

The machine is mounted on a frame 1, at one end of which there are secured the bearings 2 or that part of the machine which may be compared to the head-stock of a lathe, and to the frame is also bolted a bearing 3, which may be compared to the tail-stock of a lathe, differing, however, from the ordinary tail-stock of a lathe in that it is bolted to the main bed-plate and is not generally movable thereon. Provisions may be made for adjustment of the tail-stock, so as to be moved to and from the head-stock. It is not shown in the present application as adjustable in this way. The main frame also carries bracket supports or bearings for a main driving-shaft 4, that receives motion through a cone-pulley 5 from any convenient source of power.

Pulleys or gear-wheels mounted on the driving-shaft 4 are used to transfer power from this shaft to the tools that are located in the tail-stock or to the chuck-actuating mechanism that is located in the head-stock. On the head-stock end of the main driving-shaft 4, near the extremity of the shaft, is a helical gear 6, that meshes with a second helical gear 7, sleeved on a cross-shaft 8, and on the cross-shaft 8, at the middle line of the frame 1, is a worm that meshes with a worm-wheel 9 on the central shaft 10 of the machine. The central shaft 10 runs centrally through the chuck-disk, hereinafter mentioned, through the head-stock bearings, through the tail-stock bearing, and it carries the gears by which the

chucks are actuated and the cams by which the tool-carriage in the tail-stock is reciprocated and one of the cams by which one of the tools is reversed in its movement.

The tools themselves are actuated directly from the main shaft 4, and the machine is arranged to employ either belt actuation or gear actuation, being fitted up with both appliances. In order that the speed may be changed, so that the tools may work rapidly with respect to the movement of that part of the machinery which is included in the head-stock or, if desired, may work slowly with respect to it, there is a speed-changing mechanism interposed between the main shaft 4 and the cross-shaft 8, which is similar to the ordinary speed-changing mechanism of any screw-cutting lathe, except that the gear 6 on the main shaft 4 meshes with a gear 7 on a sleeve 11, that surrounds the cross-shaft, instead of with a gear that is secured to the cross-shaft, and a spur-gear 12 on the sleeve constitutes the first gear of the chain of gears, the last of which is the spur-gear 13 on the cross-shaft. This class of gearing for changing the speed by changing gears is common and well known and need not be described more particularly. The central shaft 10 has secured to it a spur-gear 14, which meshes with a pinion 15 at the front of the machine and which drives, by means of an interposed idler 16, a pinion 17 at the rear of the machine. The pinion 15 is a part of the chuck-closing mechanism, and the pinion 17 is a part of the chuck-opening mechanism. The pinion 15 is mounted loosely on a counter-shaft 18, which is mounted in bearings in the head-stock frame 2. On the shaft 18, in close frictional contact with the pinion 15, is secured a disk 19. The pinion 15 is held to the disk by the tension of a spring 20, interposed between the pinion and a collar at the end of the counter-shaft 18. The tension of the spring is adjustable and can be regulated at will by changing the position of the holding-nut and set-nut 21 and 22. Ordinarily the counter-shaft 18 revolves in unison with the central shaft 10, but if a strong resistance to such revolution is caused in any way the counter-shaft 18 can be held while the pinion 15 revolves on it without turning it. This is a safety feature, the utility of which will appear hereinafter.

The counter-shaft 18 is normally pressed toward the tail end of the machine by a spring 23, that engages a collar 24 and is held in a fulcrum-bearing 25, that projects from the side of the head-stock frame 2. Below the fulcrum-bearing 25 the end of the spring 23 bears against an adjusting-pin 26, that is inserted through a lug projecting from the side of the head-stock frame 2. The tension of the spring 23 is adjusted by the pin in the lug 26. From the collar 24 projects a finger 27, which bears against a cam 28. The end of the finger is provided with a friction-wheel 29. The cam 28 is mounted on the central shaft 10, and its construction will be understood by referring to Fig. 7. It is a circular plate and is provided with cam-races on both its faces, and on the face which lies toward the head end of the machine it is provided with two concentric races, on one of which runs the roller of the finger 27, now being described, and on the other of which runs the roller of a similar finger 40, that is a part of the chuck-opening mechanism. The race with which the roller of finger 27 engages extends around the disk and projects out or is raised from the general plane of the disk 28, and during the period of the revolution of the disk when the roller 29 is engaged with this projecting part of the race the counter-shaft 18 is pushed toward the head of the machine so far that the clutch 30 is entirely disengaged from the clutch-head 31 on the chuck. During that period of the revolution when the roller 29 is in engagement with the surface of the disk the shaft 18 is pushed by the spring 23 toward the tail of the machine, and the two clutch-sections are brought into engagement and the chuck is revolved with the shaft 18. The chuck is held in a plate which is fixed to the central shaft 10. The chuck-jaws are actuated by the stem, which projects through the plate to the rear and terminates with a crown-wheel-shaped clutch arranged to engage with the similarly-shaped clutch 30 on the end of the shaft 18. Each one of the several chucks is provided with a similarly-shaped projecting clutch-head, and each clutch-head is provided with a finger which engages against a stop, allowing the clutch part of the chuck to make only a single revolution. This maintains the adjustment of the chuck, inasmuch as when the chuck-jaws come into close engagement with the work or when the finger engages against the stop the shaft 18 stops revolving; but it is under a strong frictional tension tending to produce revolution of it and holding it constantly with a firm grip on the work.

At the opposite side of the machine there is a counter-shaft 34, corresponding in its general characteristics to the counter-shaft 18, arranged to be actuated by a pinion 17, that is itself actuated by the main gear 14 through an intermediate idler 16. The pinion 17 is loose on the shaft 34, but is in close frictional engagement with a disk 35, that is secured to the shaft 34. The shaft 34 is mounted in bearings in the head-stock 2. It is provided with a collar 36^a, from which projects a finger 40, terminated by a friction-wheel 41, and the friction-wheel 41 bears against the race 42 on the disk 28. The race 42 is similar to the race 43 in that it projects for a part of the distance from the face of the disk 28, and for a part of the distance the friction-wheel 41 runs on the face of the disk. The shaft 34 is pressed toward the end of the machine by a spring 36, that is held in a fulcrum-bearing 37, and its tension is regulated by a set-screw 38, that is run into a threaded

lug 39. The details of this construction are shown on a large scale in Fig. 6, and this figure illustrates the principle employed with both shafts 18 and 34. At the end of the shaft 34 is a crown-clutch head 42′, that is capable of engagement with the clutch-section 31 of each chuck. To the counter-shaft 34 is given a direction of motion proper to actuate the chuck to open its jaws. The engagement between the clutch-section 30 and the clutch-section 31 is brought about by the action of the spring 23, and in order that this engagement may be produced with precision the disk 19 is given a step-by-step movement from the continuous rotation of the center shaft 10, and the mechanism by which the step-by-step movement is produced is detailed in Figs. 8, 9, 10, and 11.

Fig. 8 is an elevation of that face of the disk 28 which is turned toward the tail of the machine. On this face of the disk are secured several irregular pieces which act as wipe-cams to actuate other parts of the machine. On the shaft 10, between the disk 28 and the disk 33, is a ratchet-wheel 43. This ratchet-wheel is bolted to the hub of the disk 33 and is provided with ratchet-teeth equal in number to the chucks carried by the disk 33, and into the body of each tooth is cut a notch 44, that extends into the wheel from its periphery toward the center but does not extend from face to face through it, giving to the wheel, when seen as in Fig. 9, the appearance of a gear-wheel in which half the notches are cut through from surface to surface and half the notches are walled in on one side and the full notches and walled-in notches alternate. Lying under the ratchet-wheel across the machine is a sliding bar 45, from the upper side of which projects a tooth 46. The bar and the tooth form an actuating-pawl for the ratchet-wheel. The tooth 46 rests on a spring 47, which yields to allow the tooth 46 to clear the tooth of the ratchet-wheel when the slide 45 makes a back stroke, and the tooth of the ratchet-wheel is scarfed off to cause the tooth 46 to clear it in the way specified. The wall which closes one side of the notch 44 prevents the pawl 46 from engaging in the notch 44, and it can only engage in those notches which extend clear through from face to face of the ratchet-wheel. The slide 45 is actuated by a lever 48, hung on an arm 49 upon the frame and the free end of which engages with the cam-race on the face of the disk 28. There are two wiping-cams 50 and 51, one of which engages the wrist-pin 52 on the end of the lever 48 and compels its movement for the back stroke of the slide 45 and the other of which engages with the wrist-pin 52 at another part of the revolution of the disk 28 and compels the draw stroke which starts the disk 33 gradually and stops it gradually. A holding-pawl 53 projects from the frame and is held by the tension of a concealed spring 54 against the ratchet-wheel 43. The end of this pawl 53 is arranged to engage in the notch 44. It can engage in the notches 55, but when in the notches 55 it will not hold the ratchet-wheel against further rotation. The notch 44 being a radial notch and the pawl 53 having a radial movement with respect to the disk 43, the engagement between these two parts holds the disk firmly, and in order that it may be very accurate the notch 44 narrows from its mouth toward the bottom, and the pawl 53 is slightly tapered to produce that accuracy of location which is necessary for a perfect centering of the chucks with respect to the tools that are to work in conjunction with them. The continuous rotation of the disk 28 finally brings a projection 56 on the disk into engagement with an extending part 57 of the pawl 53, and the pawl is pushed out of engagement with the notch 44 just at the time that the wiper-cam 50 engages the wrist-pin 52 of the lever 48, actuates the slide 45 and the pawl 46, and gives to the ratchet-wheel a step movement forward. This is at a time when the clutch-sections of shafts 18 and 34 are disengaged from the clutch-section of the chucks, and immediately following the stopping of the ratchet-wheel the pawl 53 returns to notch 44, holding the disk firmly, and the clutches again engage after a sufficient time has passed for the operator to place the work in the chuck or the automatic attachment to perform the placing of the work, and the chucks are actuated, the one of them to close its jaws on a new piece of work and the other to disengage its jaws from the finished work. During the time of stoppage the tools in the tail-stock have advanced, each has performed its office on the work in the chuck in front of it, and the tools have then receded to allow the chuck mechanism to take another step forward.

The tools, of which the number may be indefinite, are mounted in a frame which has a reciprocating movement, which can be adjusted for any length of stroke. This frame 561 extends as an arch from slide 571 to slide 58, and the slide 571 engages in a race at the top of the tail-stock 3 and at the front of the machine. The slide 58 engages in a race at the top of the tail-stop 3 and at the rear of the machine. The frame is arched so that the tool-shafts 59, 60, 61, 62, and 63 are in the periphery of a circle concentric with the central shaft 10, and they are spaced so that each registers with one of the chucks carried by the disk 33. At the tail end of the machine is a fixed frame in which there are a number of sleeves, and through each sleeve engages the shaft of one of the tools. The sleeves are provided with pulley-surfaces on which engage the belting by which the tools are driven. The comparative location of the sleeves may be understood from Fig. 3, where the pulley-sleeve of tool-shaft 63 is seen at 64 and the pulley-sleeve of the tool-shaft 62 is seen at 65 and the pulley-sleeve of tool-shaft 61 is seen at 66. The tool-shaft 60 and the tool-shaft 59 are both arranged to have

their motion reversed, and the tool-shaft 59 is provided with a direct and cross belt, which will be referred to later. The tool-shaft 60 is provided with a shifting clutch mechanism, which will also be referred to later.

Each of the tool-shafts is splined to the sleeve and is thus capable of longitudinal movement through the sleeve, although it is compelled to rotate with it. The belting 67 is carried around idlers 68 and 69, and a single belt actuates all of those tool-shafts which have continuous motion in one direction. A tightener 70 is provided.

The reciprocating motion of the frame which carries the tools is produced by a worm-cam 701, that is mounted on the central shaft 10 and in the race of which engages a wrist-pin that projects from the frame 561. If it be desired to use the slow or more absolute movement of gearing, provision is made that that may be done, and to this end there is mounted on the central shaft 10 a loose wheel 72. This is driven from a gear 73 on the main driving-shaft 4, and it engages with spur-wheels that are on the tool-shafts and which are loose on the tool-shafts when the machine is driven by belting, but which are bolted to the pulley-sleeves and brought into mesh with the central driving-wheel when it is desired to use them and the belt is thrown off for that purpose. One or more spindles may be run by belt and the remaining number of spindles run by gear at the same time. The chain of gearing employed at this time is indicated in Fig. 5.

The means for reversing the tool-shaft 60 is shown in Fig. 4. On the central shaft 10 is mounted a cam-wheel 74, and into the race of this wheel projects the end of a lever 75, the swinging end of which is connected by a sliding link 76 with a double-ended clutch or friction cone 77, which is provided with a feather engaging a slot in the shaft 60. The connection between the link 76 and the clutch 77 is such that the clutch may revolve freely in the coupling by which it is united to the lever. At one end the clutch 77 engages with a counterpart 78, that projects from the shaft of a gear-wheel 79, keyed to a sleeve upon the tool-shaft 60. At the opposite end the clutch-section engages with a clutch-section 80 on a gear-wheel 81, that meshes through the gear-wheel and intermediate idlers 810 811 with the gear 79 on the tool-shaft. The engagement and the disengagement of the clutch-sections 77, with the clutch-sections 78, or 80, is accomplished while the clutch-sections 78, or 80, is in motion and to bring the clutch-sections 77 to a corresponding motion, or to nearly corresponding motion before the clutch engagement actually takes place. I cone both ends of the clutch-sections 77, and on each of the shafts I mount hollow cones. The hollow cone 82 is held by springs from the pinion 81, and the hollow cone 83 is held by similar springs from the pinion 79. The cone 83 is connected and turns with the pinion 79, and the cone 82 is connected and turns with the pinion 81. These connections may be made in any well-known means, though in the drawings I have indicated pins which form a connection between the cone 83 and pinion 79. When the clutch-cone 77 is pushed in either direction by the lever 75 and link 76, it engages with that one of the hollow cones which is in front of it and begins to rotate under the frictional pressure exerted between the cone 77 and the hollow cone. As the sliding movement of the clutch or cone 77 continues the hollow cone yields in front of it, still causing it to rotate, however, and by the time the engagement between the toothed parts of the clutch-sections takes place the two are rotating in unison.

A somewhat similar appliance is used in the belt-reversing mechanism shown on tool-shaft 59, and the reversing part of which is shown in large detail in Fig. 12. Here there is splined to the shaft 59 the friction-clutch disk 84. At each side of this is a loose pulley-wheel with friction-clutch surface to fit disk 84, around one of which, 85, is the straight belt and around the other of which, 86, is the cross-belt. The shaft is held in bearings 87 and 88, that are fixed to the carriage, and between the bearings the two pulleys 85 and 86 are mounted, having a very slight movement; but they are spaced the one from the other by an elastic washer 89. The tool-shaft 59 can be pressed with force against either pulley 85 or pulley 86. If it be pressed against the pulley 85, the rotation of the pulley 85 will be communicated to it, and the shaft will have one direction of rotation. If it be pressed or pulled against the pulley 86, the rotation of the pulley 86 will be communicated to it, and it will have the opposite direction of rotation. The pressure exerted in either case is produced by the inner action of the tool and the work. The tool being of a screw-cutting character will press the clutch 84 against the pulley 85 when the tool is going forward and will pull it in the opposite direction when the tool is backing out, and in this way the necessary rotation is given to the tool and to the tool-shaft.

What I claim is—

1. The combination of a chuck-carrier, a chuck provided with a jaw-actuator, a clutch arranged to engage therewith, a positively-driven clutch-actuator, and friction-gearing between the clutch and its driver, substantially as described.

2. The combination of a chuck-carriage, a plurality of chucks, jaw-actuators on the chucks, a clutch adapted to engage the jaw-actuators, and close the jaws, friction-gearing adapted to allow the clutch to stop while its driving means is in action, and means for regulating the tension of the friction-gearing, substantially as described.

3. The combination of a chuck-carriage,

driving mechanism therefor, a stop mechanism acting alternately with the driving mechanism, non-rotatable chucks or collets on said carriage, actuators adapted to operate the jaws of said collets, and a clutch arranged to engage said actuators to operate the jaws of the chuck during the period of rest of said carriage.

4. The combination of a chuck-carriage, non-rotatable chucks or collets therein, means for operating the jaws of said chucks, a driving mechanism for said carriage arranged to act intermittently, a stop mechanism acting alternately with the driving mechanism, a gang of rotatable tool-spindles mounted in a reciprocating carriage and so arranged that the tools therein shall operate upon the work in said chucks, at one end of the reciprocation of the reciprocating carriage, and means for reciprocating the tool-carriage.

5. The combination of a chuck-carriage arranged to rotate, chucks provided with jaw-actuators adapted to operate by rotating, mounted in the chuck-carriage, a rotating shaft mounted in a stationary bearing, and means for engaging and disengaging said shaft with said jaw-actuators.

6. The combination of a chuck-carriage arranged to rotate, chucks provided with jaw-actuators adapted to operate by rotating, mounted in the chuck-carriage, two rotating shafts mounted in stationary bearings and rotating in opposite directions and means for engaging and disengaging said shafts alternately with said jaw-actuators.

7. A means for actuating the jaws of a chuck, comprising a spindle, a clutch-head secured to said spindle, a disk secured to said spindle, a driving-wheel journaled on the spindle, and adapted to have frictional engagement with the disks, a spring arranged to produce longitudinal movement of the spindle in its bearings, a cam-driver arranged to produce longitudinal movement of the spindle in its bearings against the tension of said spring, substantially as described.

8. A means for actuating the jaws of a chuck, comprising a spindle, a clutch-head secured to said spindle, a disk secured to said spindle, a driving-wheel journaled on the spindle, and adapted to have frictional engagement with the disks, a spring arranged to produce longitudinal movement of the spindle in its bearings, a cam-driver arranged to produce longitudinal movement of the spindle in its bearings against the tension of said spring, a spring arranged to hold said disk and wheel in frictional contact, and means adjusting the tension of said spring, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

HENRY H. BURNS.

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