No. 775,613. PATENTED NOV. 22, 1904.

M. STADLER.

MACHINE FOR GROOVING WIRE MANDRELS.

APPLICATION FILED JUNE 8, 1903.

NO MODEL. 7 SHEETS—SHEET 1.

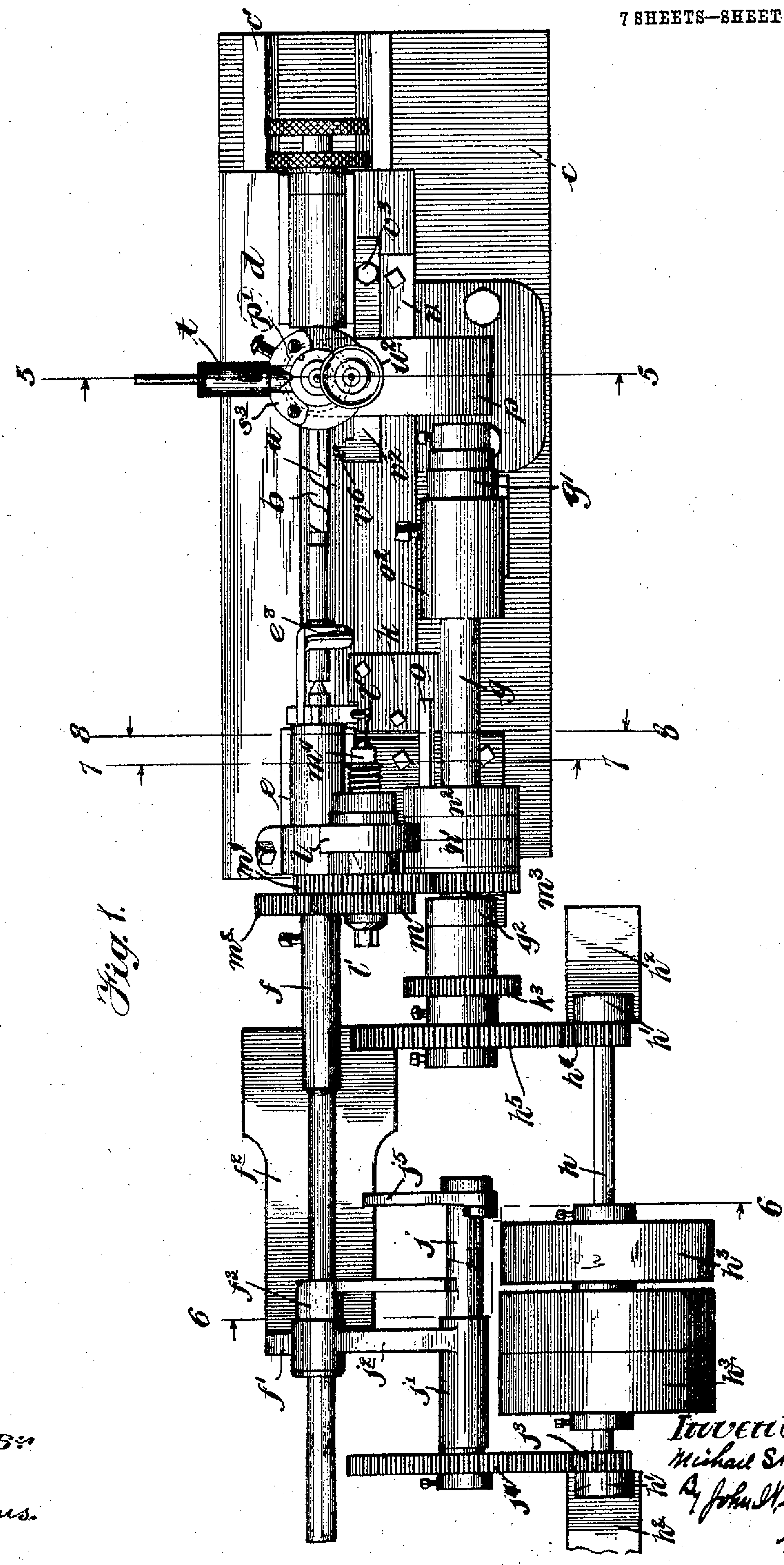

Fig. 1.

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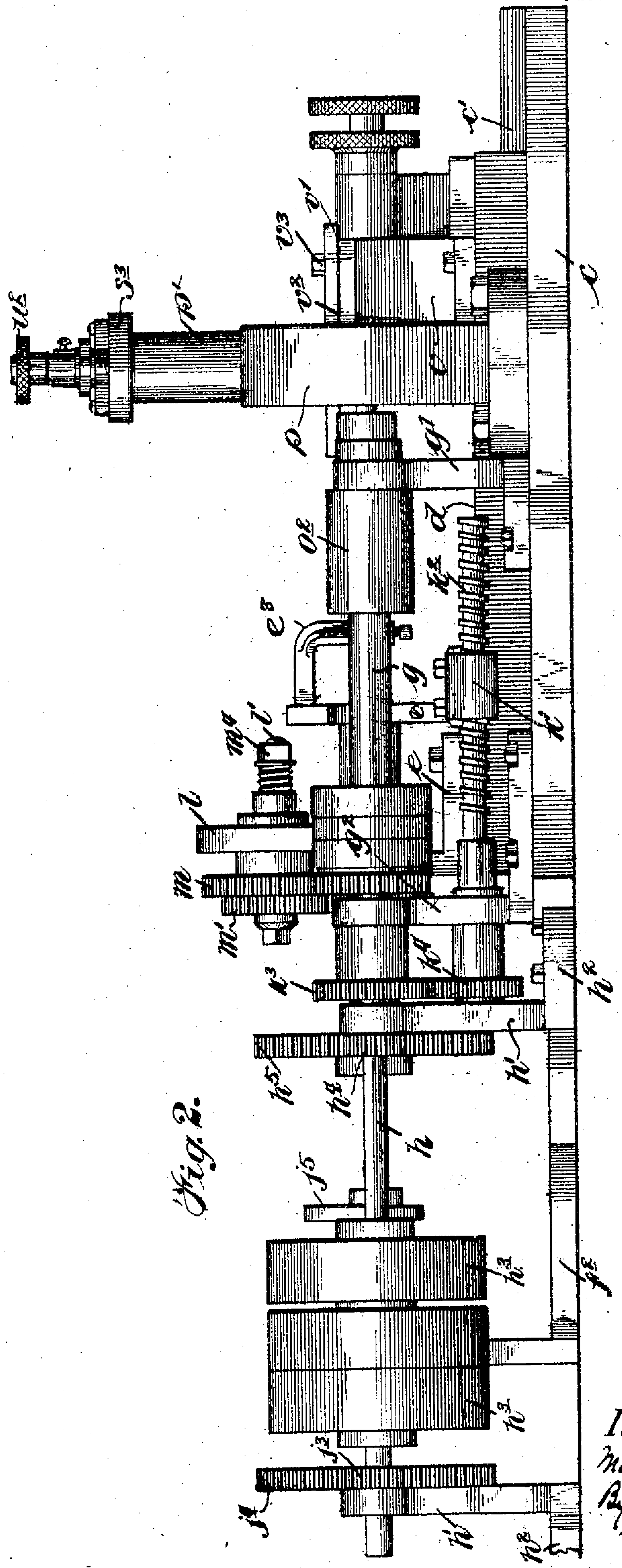

Fig. 2.

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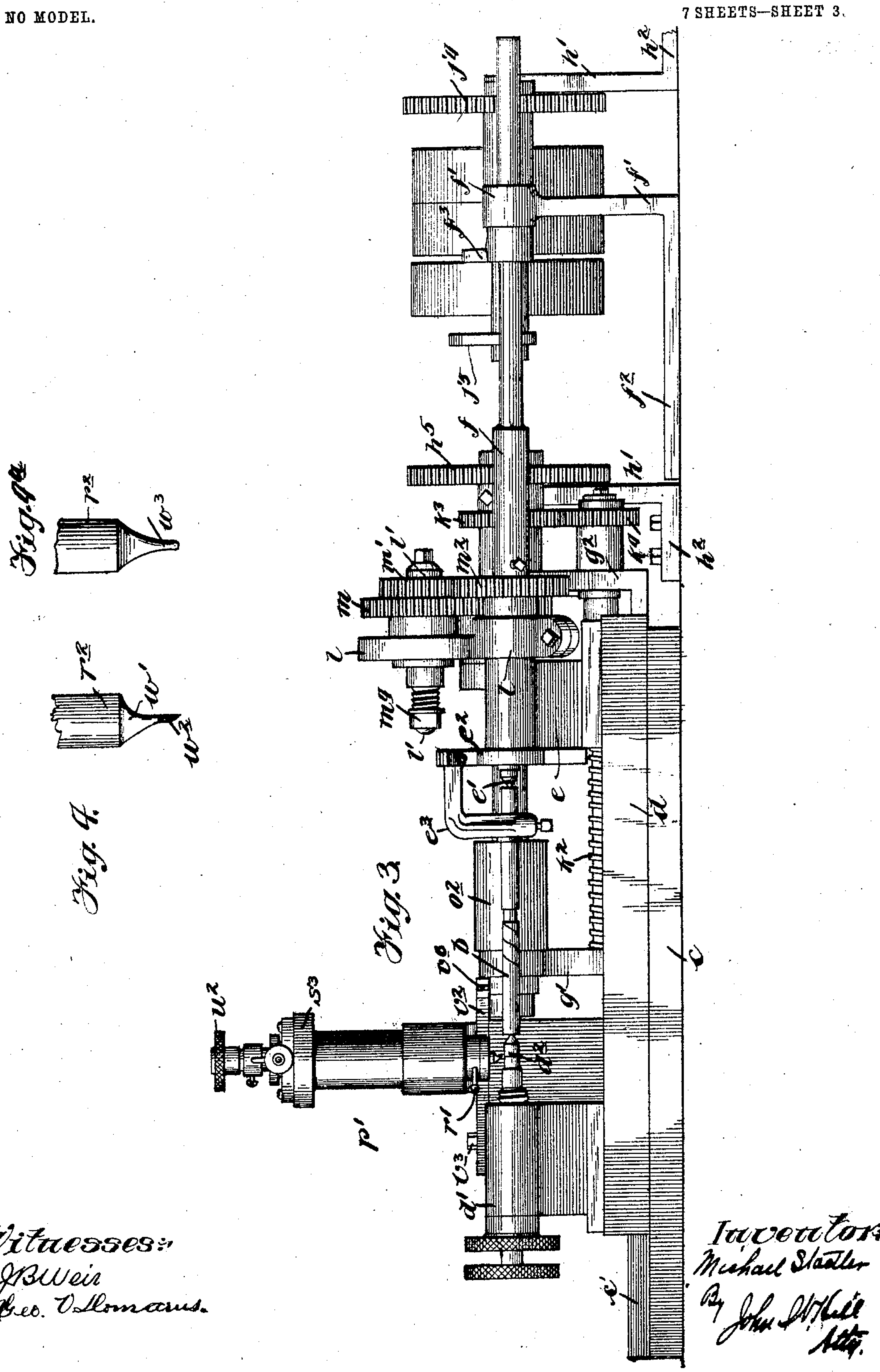

Witnesses:
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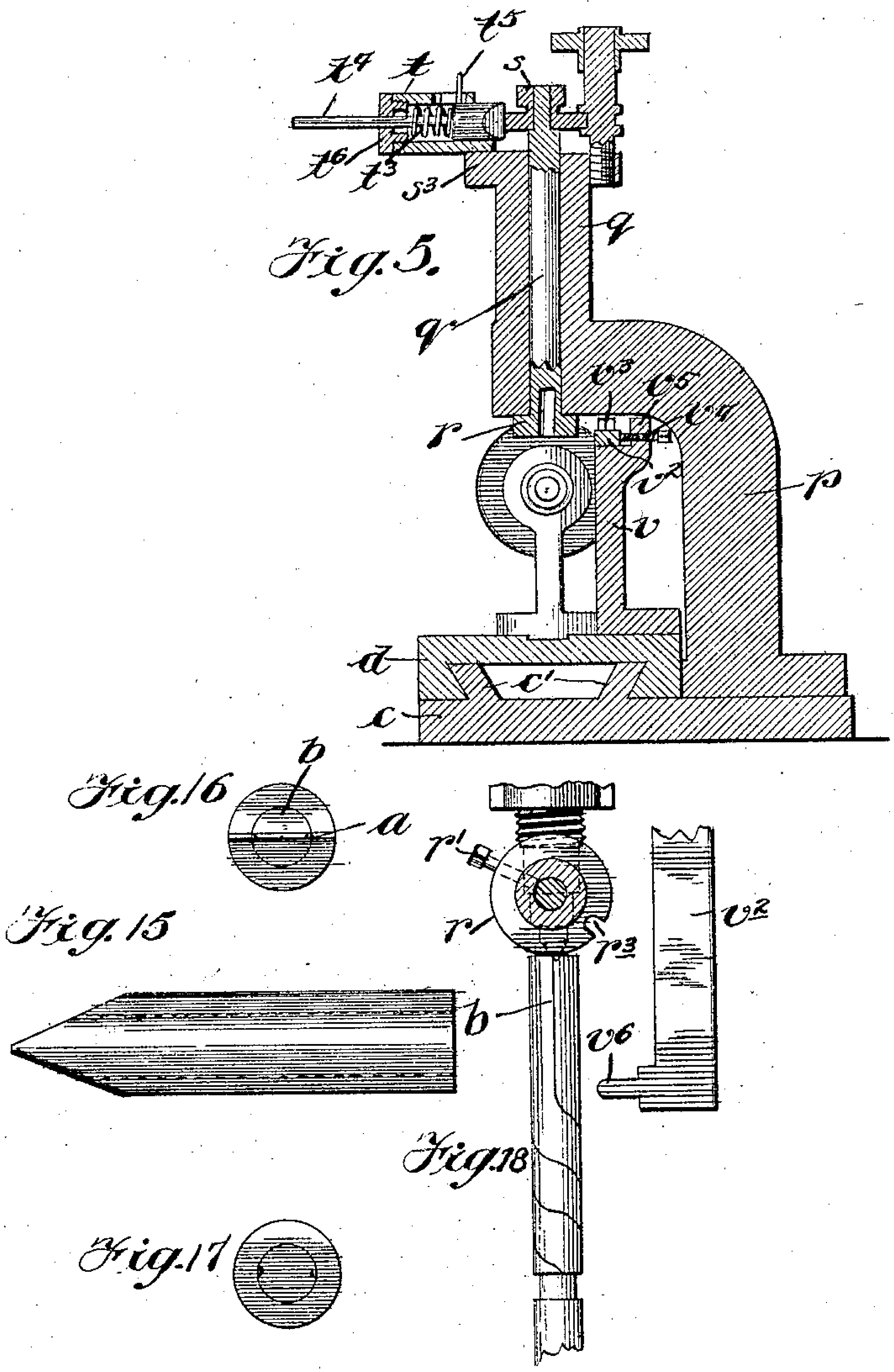

Witnesses:
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PHOTO-LITHOGRAPHED BY SACKETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

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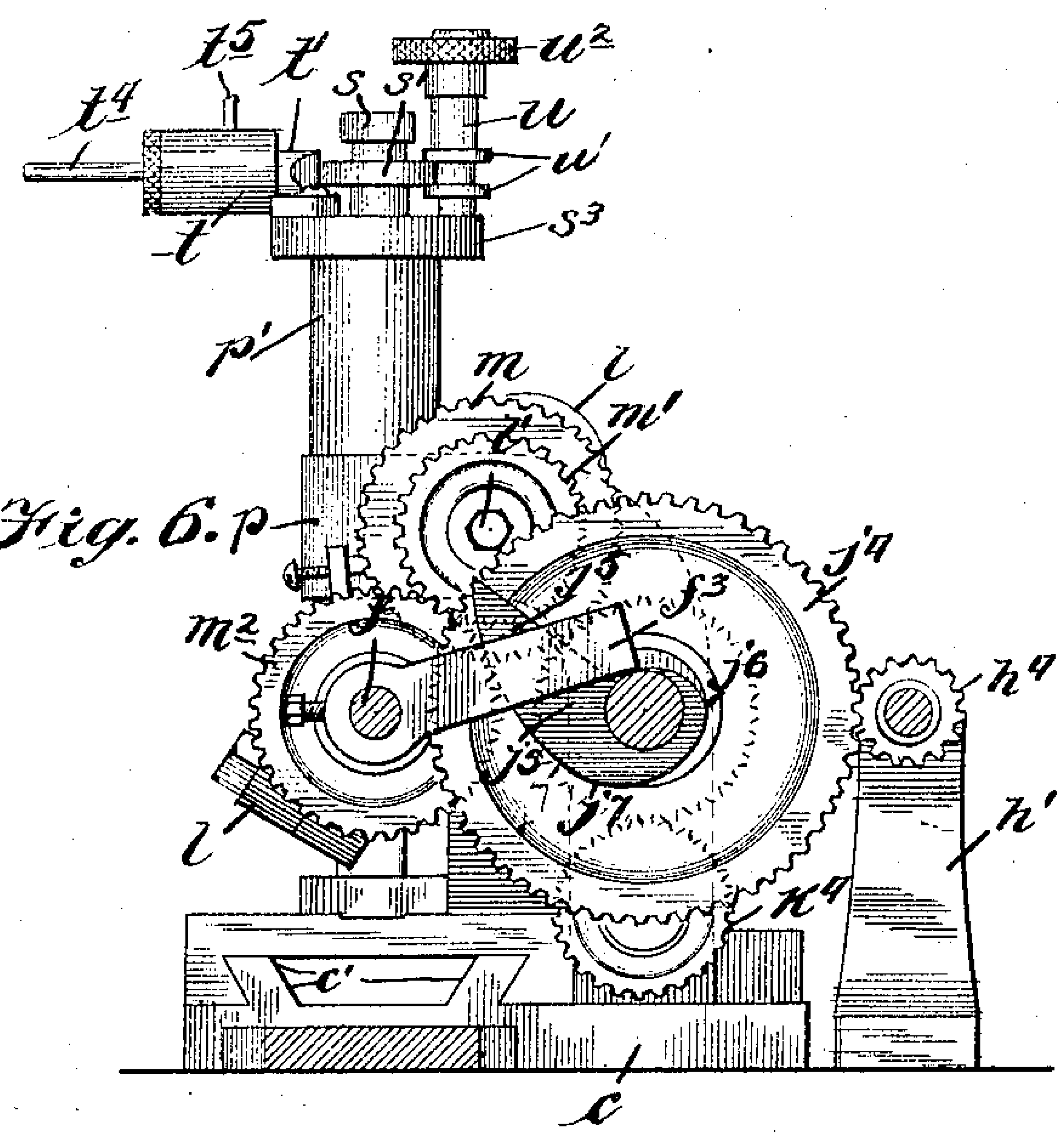

Fig. 6.

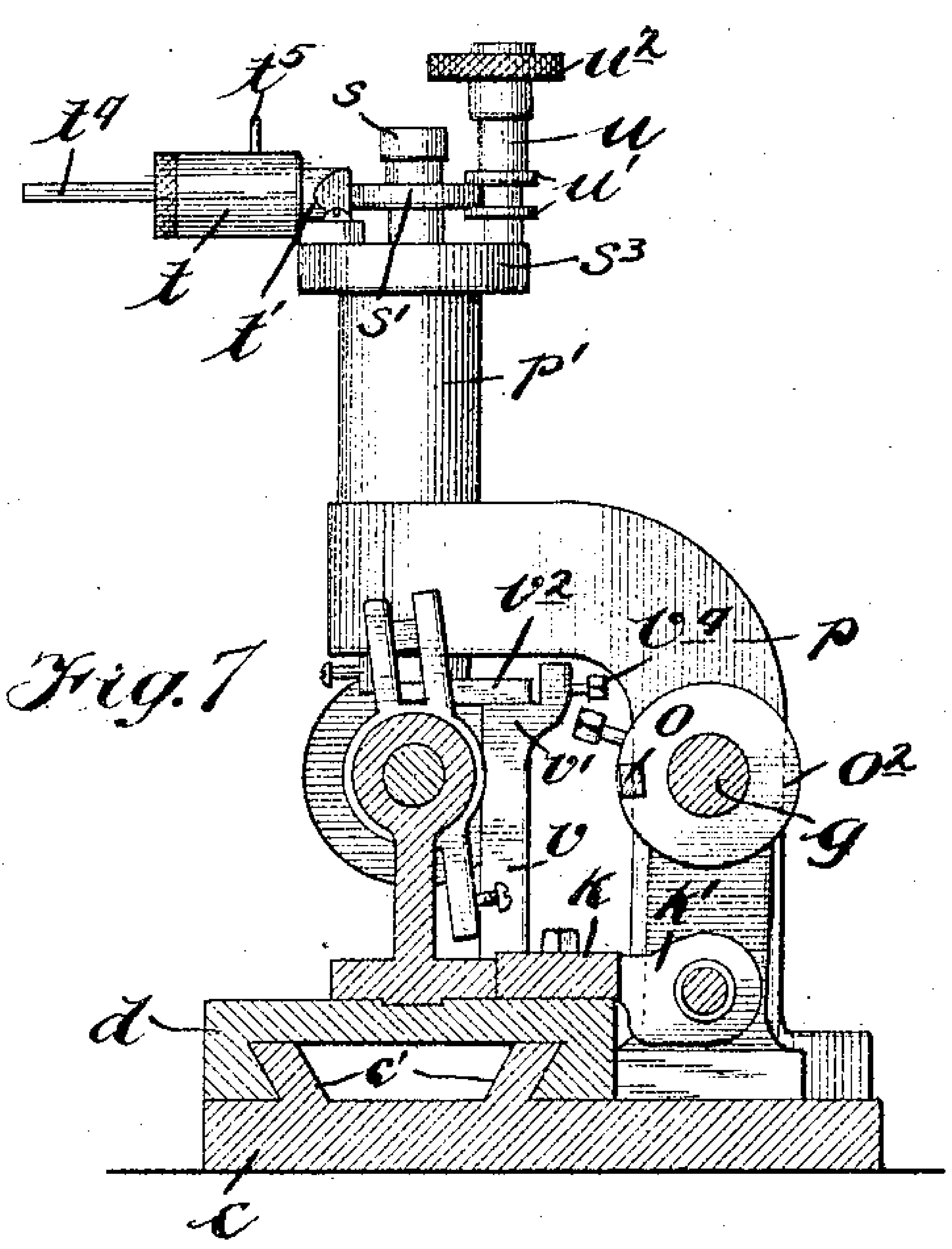

Fig. 7

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NO MODEL. 7 SHEETS—SHEET 6.

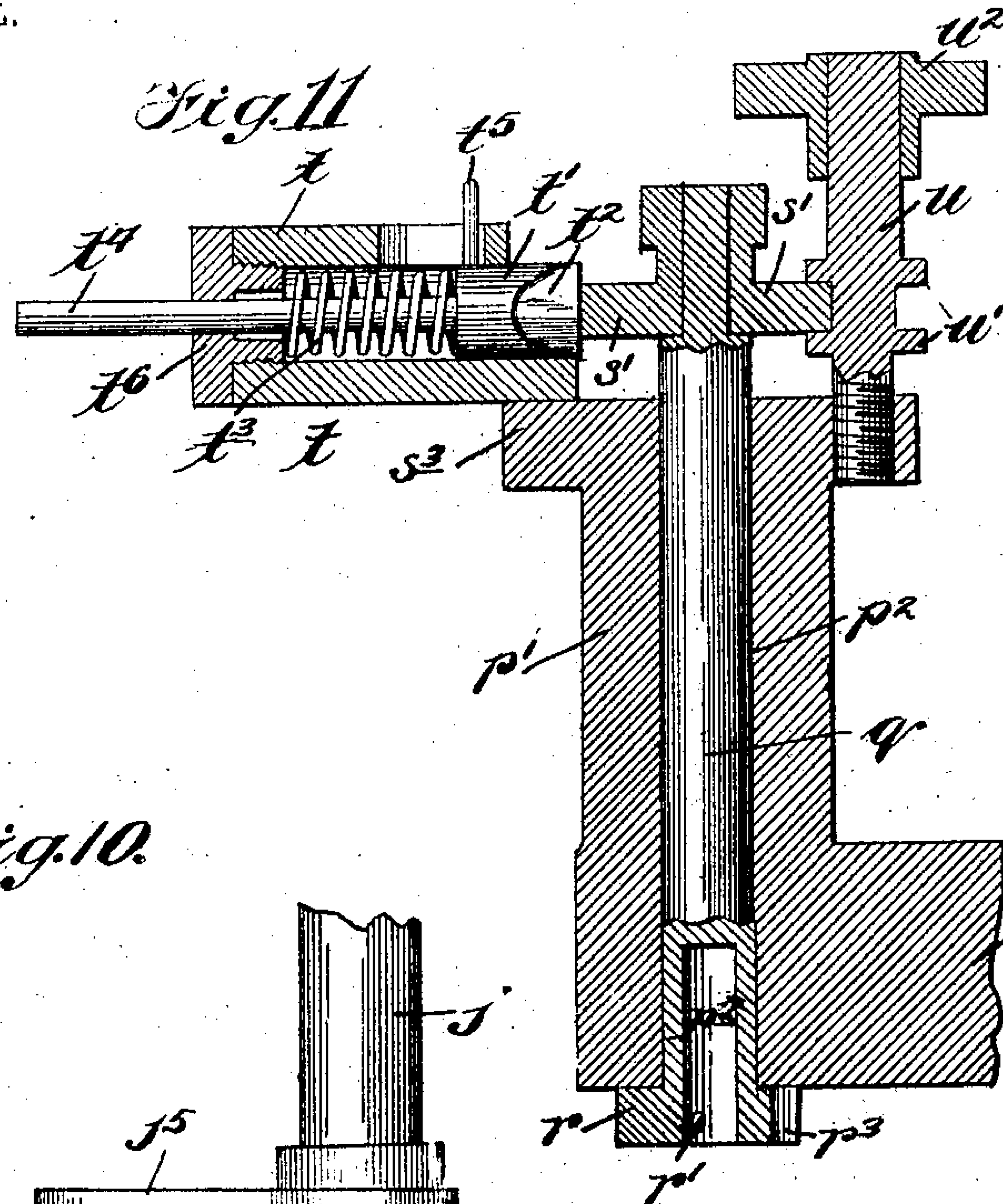

Fig. 11

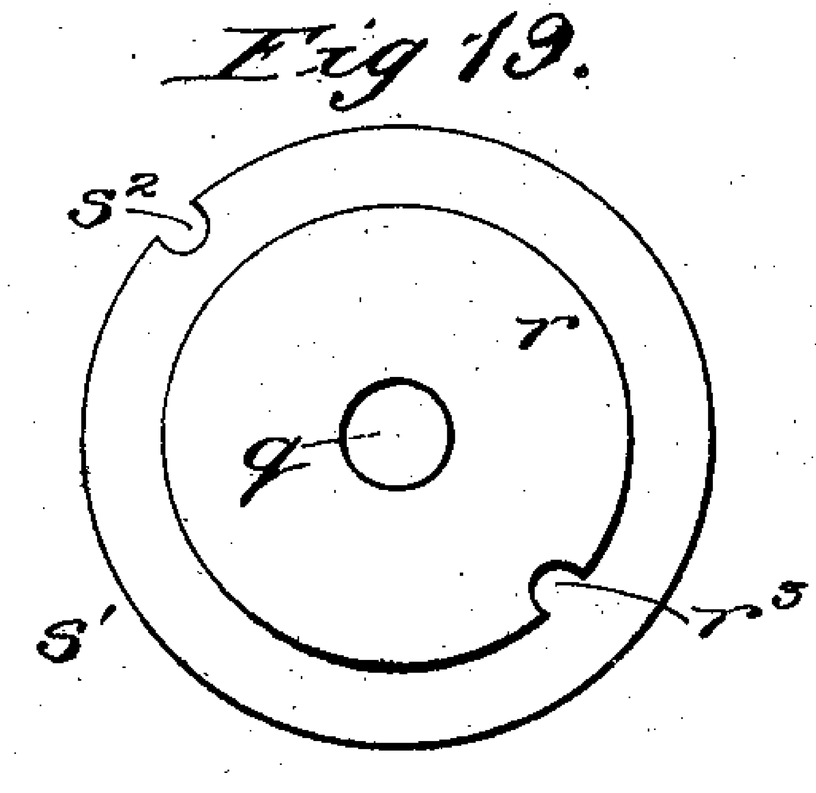

Fig. 19.

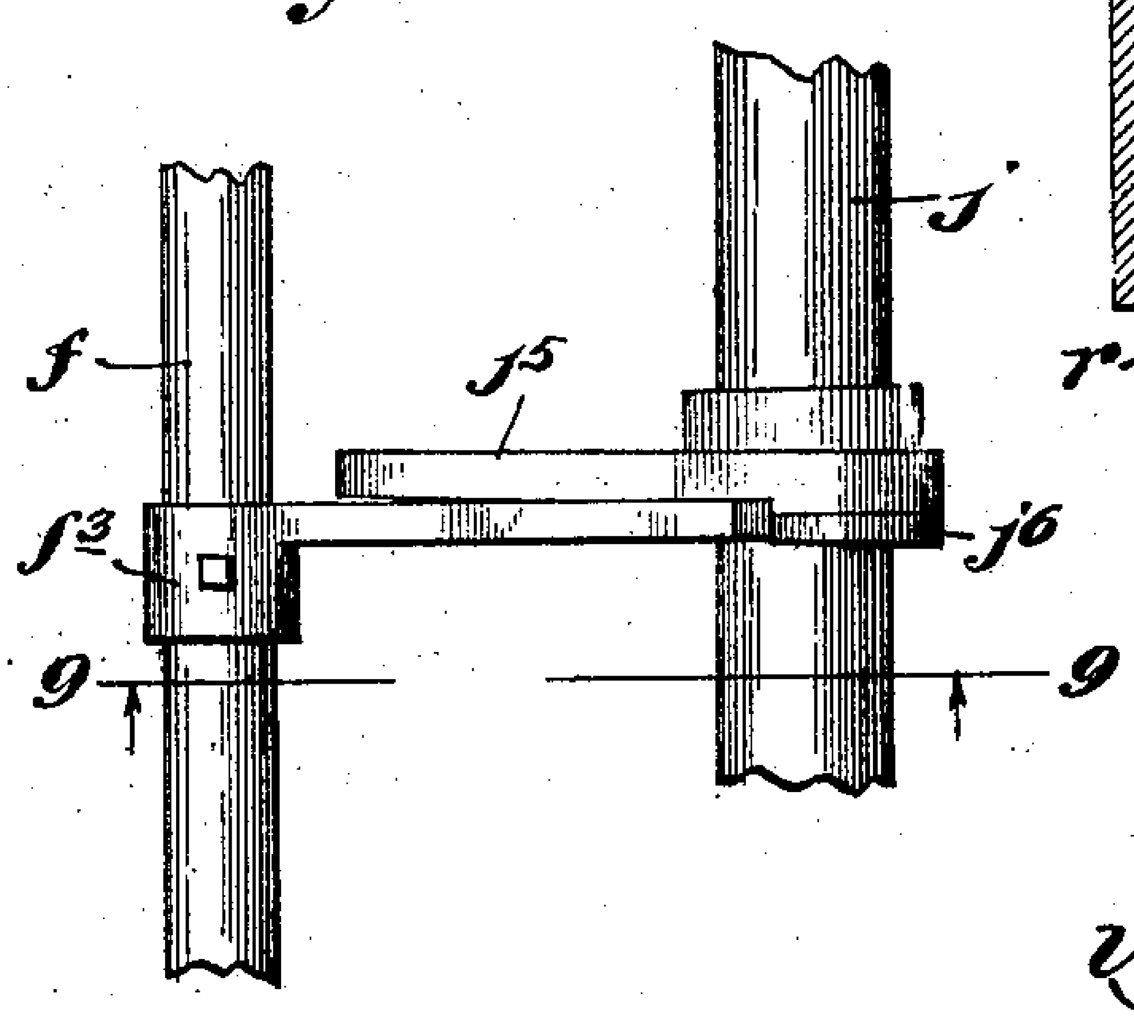

Fig. 10.

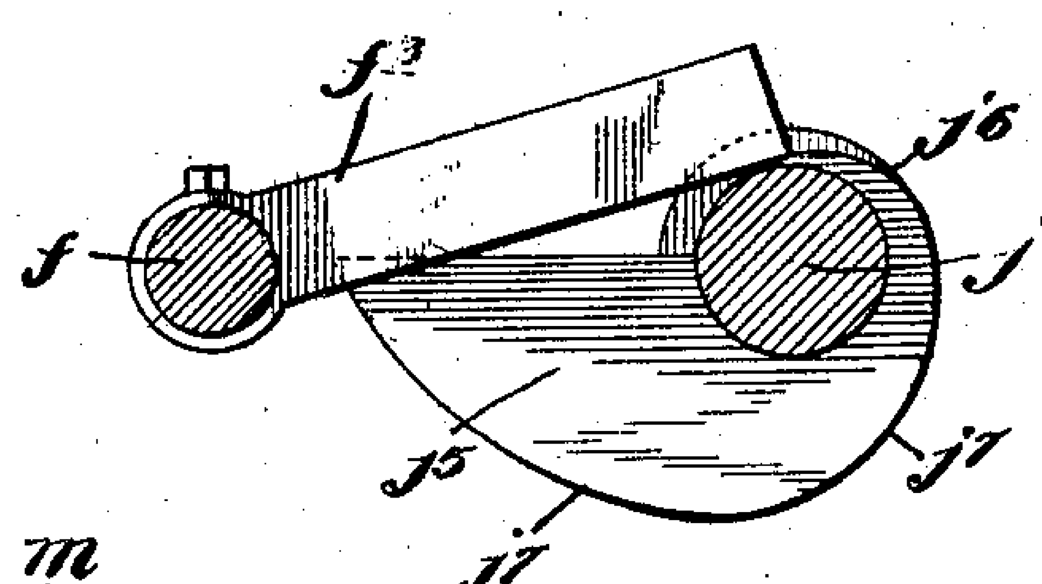

Fig. 9.

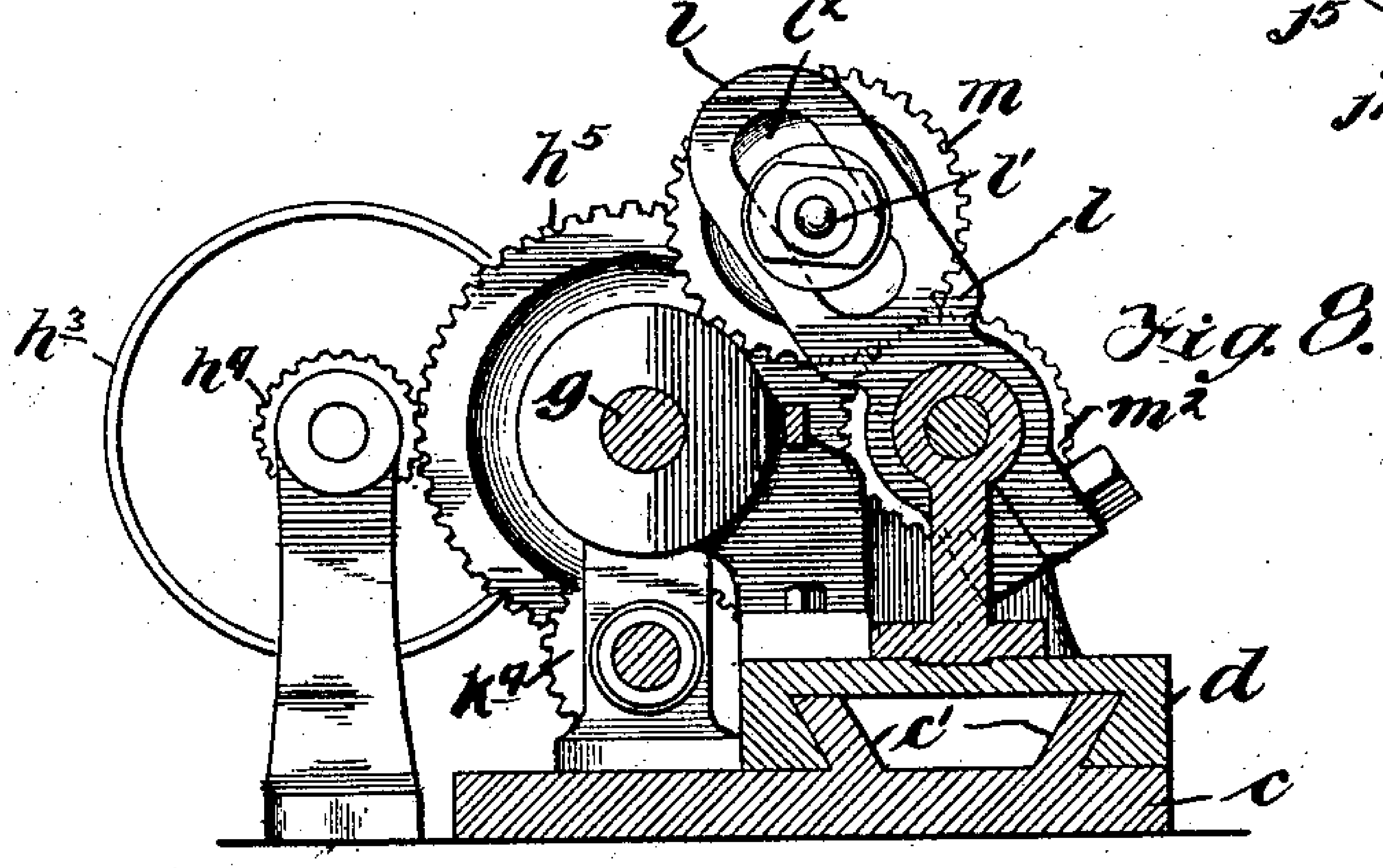

Fig. 8.

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No. 775,613. PATENTED NOV. 22, 1904.

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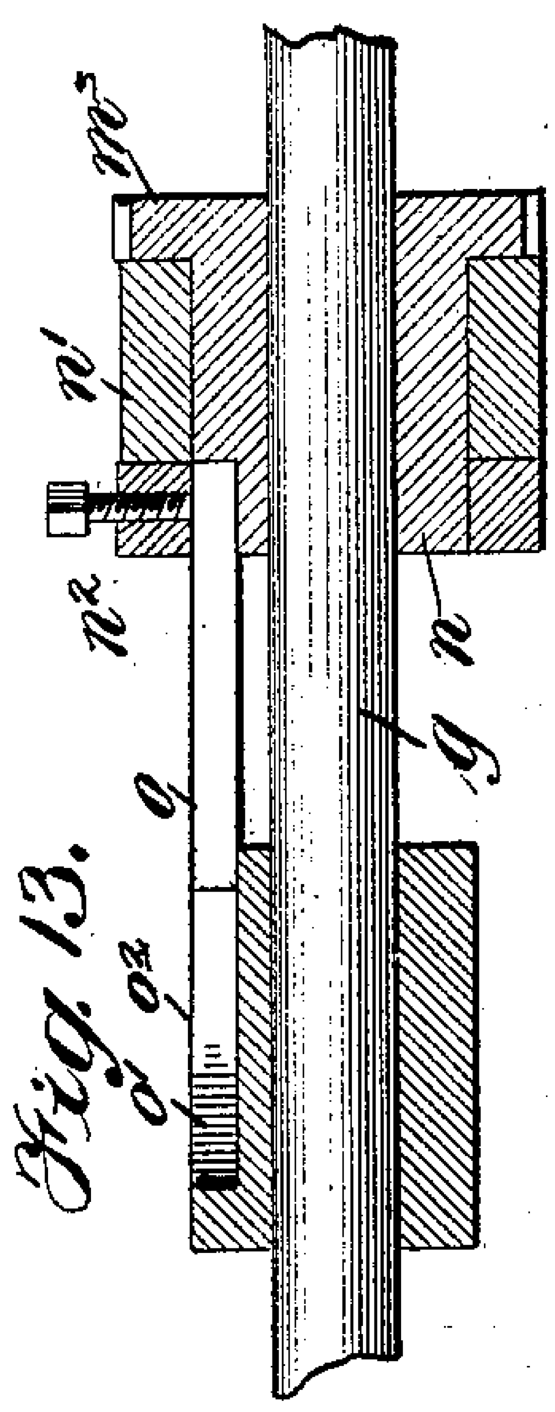
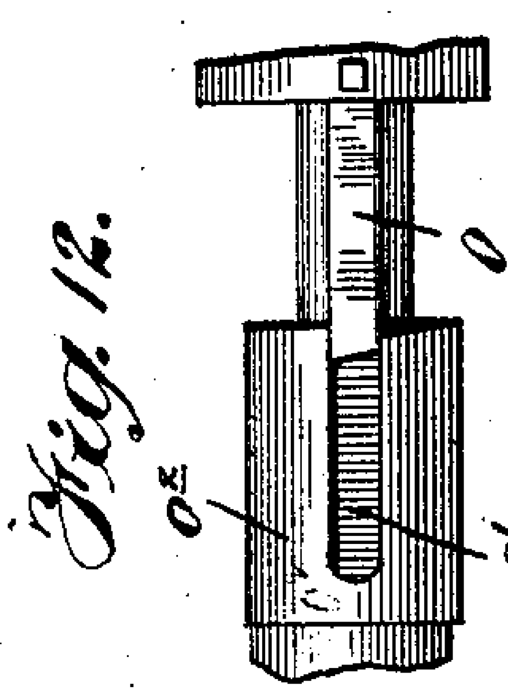
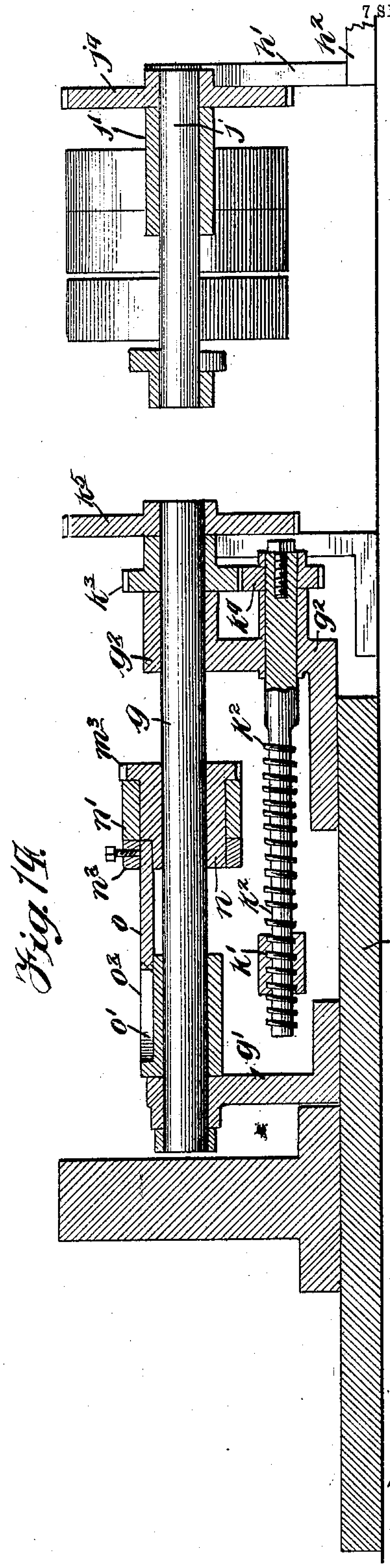
MACHINE FOR GROOVING WIRE MANDRELS.

APPLICATION FILED JUNE 8, 1903.

NO MODEL. 7 SHEETS—SHEET 7.







Witnesses:
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No. 775,613. Patented November 22, 1904.

UNITED STATES PATENT OFFICE.

MICHAEL STADLER, OF CHICAGO, ILLINOIS.

MACHINE FOR GROOVING WIRE MANDRELS.

SPECIFICATION forming part of Letters Patent No. 775,613, dated November 22, 1904.

Application filed June 8, 1903. Serial No. 160,546. (No model.)

To all whom it may concern:

Be it known that I, MICHAEL STADLER, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Grooving Wire Mandrels, of which the following is a description.

In the manufacture on a large scale of the long steel-wire springs for mattresses and the like the two wires forming the spring are twisted by means of a die consisting of a mandrel on the surface of which is cut a spiral consisting of not less than one complete turn running out at the entrance into a straight furrow parallel to the axis and acting as guide for the incoming wire and of a shell closely fitting the mandrel and confining the wire to the groove above mentioned. The groove is made of such depth and cross-section as to rather tightly fit the wire, which, emerging from the rear end of the die as a spring spiral, at once engages and curls up with the other wire, forming a double-wire spring which may be made of any length required.

In the following specification where the word "spiral" or "helical" is used in relation to the last "reach" of the groove in the mandrel described I wish it to be understood as a helix comprising not less than one complete turn.

In cutting the groove on the mandrel much difficulty has been encountered owing to the peculiarity of shape and the necessity of forming an easy smooth flowing curve of transition from the entering straight groove to the spiral. Originally this groove was cut by hand; but as the mathematical accuracy of the spiral is a prime requisite to proper functioning this method was abandoned, and the work was and is now done in three successive machine operations, which are well known in the art. This method is wasteful of time, requires great accuracy in setting the tool in the second and third steps, and has the more serious defect of producing a break of continuity of the curve at the point a^3, where the straight part passes over into the spiral. This causes a stress and excessive wear on the tightly-stretched thin wires, which should be gradually guided or led into their helical path instead of being snubbed around what is tantamount to a corner. In consequence the mandrels thus formed tear the wire or injure it until in the course of using them the jag has been worn smooth, and by that time the rest of the groove has worn so much that its limit of usefulness is soon reached, and it ceases to properly curl the wire. Furthermore, in turning the helix on the lathe the tool must stand at a constant definite angle to the axis, being the angle of pitch corresponding to that helix; otherwise the furrow is not mathematically accurate, sectionally considered, the point of greatest depression varying in location with reference to the sides of the furrow. Even if in turning these mandrels on a lathe this fact is considered and the tool so set, which rarely is the case, as it is usually left square to work, it will be impossible to preserve this identical section of the cut in the two other portions of the groove, so that two additional rough places occur—one at the junction of the straight with the transition reach, the second at the junction of the transition with the spiral reach. This again produces stress and wear on the wire. The ideal groove would be one formed by the impression of the wire itself, if spirally wound about a plastic mandrel, and this can never be obtained by machine-turning unless the tool is presented at the proper angle at each stage of the cut.

The present invention consists in a machine which will cut the entire groove in one operation divided into suitable steps automatically interconnected and will produce a smooth transition from the straight to the spiral part and will cut a helical furrow of accurate and uniform cross-section at all parts of the axial length according to the ideal groove above defined. These objects are accomplished by causing the mandrel to be slotted out for the straight part by its being carried forward against a fixed cutting-tool and then turning the work gradually, as shown, as the end of the straight cut is reached, at the same time causing it to move forward, thus producing the curve of transition and then providing means for regularly rotating the still-advancing mandrel, thus producing in the third stage of the operation the helical groove, also by causing the tool to suitably vary its position in azimuth, so as to present its cutting edges at the proper angle to the axis at each point of the operation, being held with its cutting-face at right angles to the tangent of the curve at each point of its progress along the spiral cuts. The mechanism by which these coördinated movements are accomplished is described in the following specification and illustrated in the drawings, in which—

Figure 1 is a plan view of a machine embodying my invention in its preferred form. Fig. 2 is a rear elevation thereof. Fig. 3, a front elevation of said machine; Fig. 4, an enlarged detail of the cutting-tool; Fig. 4^a, a like detail of said tool, showing the cutting-face; Fig. 5, a transverse section on line 5 5 of Fig. 1, as indicated by arrows; Fig. 6, an end elevation, partly in section, on line 6 6 of said Fig. 1 seen in the direction of the arrows; Fig. 7, a transverse section on line 7 7 of Fig. 1, also seen in the direction indicated by the arrows; Fig. 8, a transverse section on line 8 8 of Fig. 1 as indicated; Fig. 9, a sectional detail showing the turning-arm in engagement with the cam; Fig. 10, a top plan view of the parts indicated in Fig. 9; Fig. 11, a vertical section, on an enlarged scale, through the tool-holder in the upper part of Figs. 5 and 7; Fig. 12, a detail showing turning-finger just engaged in turning-block; Fig. 13, a sectional view of carrier-block, finger, and turning-block; Fig. 14, a vertical longitudinal section showing elements of Figs. 12 and 13, also the feed-screw and its gearing. Fig. 15 is a longitudinal view of the complete die; Figs. 16 and 17, end views of the die of Fig. 15, showing the nose and the holes of entrance and exit of wires; Fig. 18, a detail showing tool-trigger and tool-trigger plate; Fig. 19, an enlarged top plan outline showing the relative positions of the notches in the latch-plate and the tool-trigger plate.

Referring to Figs. 1, 2, and 3 of the drawings, the bed-plate c carries integral with it the dovetail guide c', extending along its entire length at its front part. On either side of the guide the bed is planed off, forming, with the guide, a true slide for the carriage d, which is movably mounted thereon. Mounted on this carriage at one end is the tail-stock d', carrying the adjustable center d^2, which supports one end of the work, as in an ordinary lathe. The head-stock e, provided with center e' and driver-clamp e^2, driving the dog e^3, which supports the other end of the work, is mounted at the opposite end of the carriage. These parts are identical in construction and function to those of a lathe. The head-stock carries the live spindle f, provided with gearing, as will be described, and the live spindle is journaled at its outer end on the standard f', mounted on and integral with the bed-stand f^2, the bearing being such that the spindle is free to slide longitudinally adjacent to the standard f' and the arm f^3, below described. The main shaft g, mounted parallel to and in rear of the slide d, is journaled in the standards g' g^2, bolted to the bed-plate. The power-shaft h, journaled on the standards h', rising from the bed-stands h^2, carries the belt-pulleys h^3, having a driving and reversing and an idle pulley, as is customary in such arrangements and to which the power is applied by belt from any suitable motor. It also has a pinion h^4 on one end, meshing with and driving a gear h^5 on the main shaft.

A cam-shaft j, parallel to and between the power-shaft and the live spindle, is journaled in a long sleeve j', integral with the bracket-arm j^2, projecting from the standard f'. This cam-shaft is driven by the power-shaft through the gears j^3 j^4 of the same size as the above-mentioned gears h^4 h^5, which drive the main shaft. The spiral cam j^5, of which the part j^8 is the hub, rigidly mounted on the other end of the cam-shaft, is given the peculiar shape shown in Fig. 9 to enable it in coöperation with the turning-arm f^3, rigidly mounted on the live-spindle extension and projecting over part of said cam, to produce the motion to be described farther on. The contour of the cam-curve may be determined by calculation or by trial and error. Longitudinally considered the cam has a small whirl j^6 leading up to and merging into the larger whirl j^7 adjacent to it. The bracket-plate k, bolted to and extending rearward from the carriage, is developed at its rear end into screw-threaded sleeve k', engaging the feed-screw k^2, driven by the main shaft through spur-wheels k^3 k^4, thus effecting the longitudinal movement of the carriage.

The slotted arm l is clamped to the head-stock e, being adjacent to the head-stock. This arm carries the stub-axle l', adjustably clamped in the slot l^2 by the nuts at the end thereof. This arm is slotted to provide for changing the gear so as to vary the pitch of the helical groove. The two intermediate gears m m' on the stub-axle l', meshing, respectively, with a gear-wheel m^2, keyed to the live spindle, and the wheel m^3, driven by the main shaft, transmit the power to the live spindle, permitting, as above said, of changing the relation of speed between the main shaft and the live spindle. In Fig. 3 of the drawings the nut m^4 at the end of the stub-shaft has been run out preparatory to changing the wheels.

The spur-wheel m^3 is both rotatable and longitudinally slidable on the main shaft, accompanying the carriage in its motion and accompanied by the gearing-train, with which it engages, the latter being mounted in bearings from the head-stock e. The hub of this wheel has a long sleeve, Fig. 14, carrying a collar n', by which it is connected to said bracket e intermediate between the gear m^3 and a ring

n^2. This ring with the aid of a set-screw secures to the hub of gear m^3 a projecting finger o, hereinafter termed the "turning-finger," of the proper dimensions and situated at the proper radial distance from the main shaft g to enable it to engage in a slot o', cut in the cylindrical surface of the turning-block o^2, which is keyed to and turns with the main shaft. Clearly, then, when the finger o enters the slot the motion of the main shaft will be transmitted through the finger, the spur-wheel m^3, and the intermediate gears m', m, and m^2 to the live spindle, and from this time on as long as the finger remains in the turning-block slot the machine will act precisely like an ordinary screw-cutting lathe. The end of the finger and the leading edge of the slot are slightly cut away at the same angle to facilitate and insure engagement and later on disengagement upon reversal of the motion.

The curved standard p, bolted to the bed-plate c, near the tail-stock, carries the tool-post p', the axis of which is directly over the line connecting the live and dead centers. This tool-post is provided with an axial cylindrical bore p^2, into which the shank of tool-holder q is snugly yet slidingly fitted. The holder is a cylindrical piece having at its lower end a flange r, carrying the set-screw r', which keeps in place the tool r^2 by pressing on its shank. A notch r^3 is cut in the flange r, adapted to engage the nose of the tool-trigger, to be described, the flange r constituting a tool-trigger plate. The lower end of the tool-holder has an axial hole sufficiently deep to carry the shank of the tool.

At its upper end a long step is cut in the tool-holder, to which is secured the shoulder-piece s, Fig. 11, carrying at its lower end the flange s', forming a latch-plate, and provided with a notch s^2, Fig. 19. The top of the tool-post has a flange s^3, to which is secured the latch-housing t, forming a guide for the latch-piston t', which terminates in a nose t^2, adapted to engage the notch in the latch-plate s'. The latch-piston is held out by the spring t^3, coiled about the latch-stem t^4, and the latch may be sprung back at will by the pin t^5 projecting through a slot cut in the latch-housing. The screwed head t^6 of the latch-housing serves as a guide for the stem and to vary the compression of the spring if need be. The nose is rounded and the sides of the notch in the latch-plate are eased off to facilitate the engagement and disengagement of the latch.

Diametrically opposite the latch-housing a screwed hole is provided in the flange s^3, which carries the screwed lower end of the screw u. The rim of the latch-plate rests between the shoulders u' of the screw, so that by turning the milled head u^2 the tool-holder may be raised and lowered.

A bracket v, Figs. 1, 5, and 7, bolted to the carriage at its tail-stock end, has a step v' at its upper end on, which lies the trigger-arm v^2, secured at one end by a set-screw v^3, so as to permit of its free end being adjusted forward by the set-screw v^4, passing through the flange of the shoulder v^5. This trigger-arm has a lateral projection at its free end pointing forward and terminating in a tooth v^6, having a rounded tip and adapted to engage with the notch r^3 of the flange r. The trigger is mounted at the proper height to enable it to engage the notch when the carriage has sufficiently advanced to bring the tooth opposite to the notch. The set-screw is adjusted sufficiently well to insure this engagement. This adjustment need never be changed except when it is desired to change the arc of rotation of the grooving-tool.

The tool r^2 (shown in Fig. 4 at right angles to the cutting-face and in Fig. 4^a with the cutting-face to the front) has a very short point quickly tapering down from the stout shank to give it strength, diminish tool-chattering, and because the tool makes but a shallow cut. As smoothness of all parts of the cut is the prime requisite, this special form has been designed, and a great preponderance of metal has been left behind the point or on its following side, as shown at w, the leading side w' being curved back to throw the point under the axis of the shank and then dropped down straight to permit of sharpening. The oblique line w^2 is to give the tool its clearance and permit of readily restoring the semicircular edge of the cutting-point w^3, Fig. 4^a, which makes the bottom cut and which conforms to the size of the wire to be used.

The machine operates as follows, it being understood that movements of the carriage ahead means toward the left of Figs. 1 and 2: The blank being turned up to the proper diameter and centered, the carriage is brought back to its extreme travel for the beginning of the cut. This is the position shown in Fig. 3. The arm f^3 is at the end of its travel farthest away from the cam, and the finger o is at its greatest distance from the turning-block o^2. The tool-holder is turned to bring the tool-face at right angles to the axis of the mandrel. The notch r^3 of flange r is in the position shown in Fig. 18, and the latch is not engaging the latch-plate notch, which is in the position shown in Fig. 19. The machine being started acts just like a slotting-machine of slow movement. As soon as the advance edge of the mandrel comes up to the tool the longitudinal furrow a begins to be cut. The depth is regulated by the adjusting-screw of the tool-holder. The straight cut continues until the advance movement of the carriage has brought the turning-arm to bear on the first whirl of the cam. This cam in rotating turns the arm and thence the spindle and mandrel to the front, causing the cut on the advancing mandrel to deviate toward the rear. This rotation of the mandrel, and the consequent deviation of the slot, is very slight at first, but rapidly increases as the parts of the cam having a greater distance from the center come to bear on the arm. It is clear that the curve of transition of the groove from the straight to the spiral can be modified by altering the curve of the cam. During the advance of the carriage the carrier-block has advanced along the main shaft so that the turning-finger is now on the point of engaging the slot in the turning-block. The length of the part is so proportioned that the engagement will take place when the cam is about to release the arm, the transition curve or junction-piece having been completed. Immediately after engagement of the turning-finger the mandrel is turned while still advancing and the tool cuts a helix the pitch of which depends on the ratio between the speed of the advance and the speed of the turning, just as in all screw-cutting lathes. As the finger engages the turning-block the turning-arm clears the cam and passes on by it. When the desired length of spiral is reached, the machine is stopped, the tool is lifted clear, the movement reversed, and the carriage run to its first position. The work is now set to have a precisely similar groove cut on its opposite side, the straight part being one hundred and eighty degrees from the straight part just made. The work is run through, and the grooves of the mandrel are completed. In the example shown the end of the cut is determined by cutting a short length of the stock. This is done so that at the end of the groove the cutting-tool will work itself clear, pushing the metal into the blank space, thus avoiding the bur, which would be caused by cutting on the full-bored cylinder and then cutting off with a parting-tool. During these operations the mechanism controlling the tool-holder has been employed in regulating the position of the cutting-face to suit the different angles of the groove. During the straight run the face was set square to the axis, and as there was no tendency to twist it no appliance was used to keep the tool-holder in position. By the time the straight part was finished the trigger-arm had presented the tooth v^6 abreast of the notch r^3, and as the mandrel began to turn to make the curve of transition the flange r had become engaged and the tool-face began to be turned toward the rear. This turning movement increased as the groove approached the spiral part, as the notch r^3 was by this time pointing almost straight to the rear and the trigger-arm was pulling the plate around at almost a directly-applied pull. As soon as the notch had been pulled around past the line at right angles to the mandrel-axis the still-advancing trigger-arm began to disengage therefrom. At the moment of disengagement the curve of transition was completed and the spindle had commenced to cause the regular spiral to be cut. From this point on the angle of the curve to the mandrel-axis would remain the same, so that there was no need of further turning the tool, but there was need of keeping it from turning. Therefore the notch s^2 in the latch-plates is so located with reference to the notch r^3, circumferentially considered, that at the moment of disengagement of the trigger-arm nose the notch s^2 comes under the latch-nose. The latch springs in and locks the tool-holder during the remainder of the cut. Upon reversing the motion of the carriage the trigger-arm nose would reëngage, the latch would become disengaged, the parts would automatically be returned to their original position. were this desired, or, as was assumed in the analysis of the spindle movements, the tool may be lifted clear and the tool-holder twisted into position by hand by first throwing back the latch. With light wire the operation of grooving can be performed in one cut; but as many cuts can be taken as may be desired.

It will be clear from the above that the phases of the operation are primarily conditioned by the distance of the turning-arm from the cam, which determines the length of the straight run, and by the distance the turning-finger o must travel along the main shaft before engaging the turning-block, as the latter determines the commencement of the spiral cut. Hence by securing the turning-arm adjustably to the live spindle, as by means of a set-screw, and by altering the length of the finger o, the machine may be adjusted for various kinds of work. The location of the notches in the two plates, while of great importance, is secondary to the above-mentioned elements, as after the phases of mandrel motion are determined the notches may be located to suit these phases, and these positions may be altered at will by mounting the shoulder-piece s on the tool-holder in such a manner that it may be twisted and again secured, as the relative positions of the notches must depend on the length of the transition curve. Finally, an alteration in length of the trigger-arm, such as by bolting on one of different size, would secure proper adjustment for a variation in length of the straight cut.

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

1. The combination, in a lathe of the nature set forth, of a cutting-tool, means for feeding the mandrel forward without revolution while the tool cuts the straight reach, means for rotating the mandrel gradually while the tool cuts the transition reach, means for rotating said mandrel at a regular speed while the tool

cuts the helix, and means for holding the face of the cutting-tool square to the trend of the groove during said transition reach, substantially as described.

2. The combination, in a lathe of the nature set forth, of a cutting-tool, means for feeding the mandrel forward without revolution while the tool cuts the straight reach, means for rotating the mandrel gradually while the tool cuts the transition reach, means for rotating said mandrel at a regular speed while the tool cuts the helix, means for holding the face of the cutting-tool square to the trend of the groove during such transition reach, and means for locking it in position while it cuts the helical reach, substantially as described.

3. The combination, in a lathe of the nature described, of a traveling carriage carrying the head and tail stock, mechanism for feeding it, an initially-undriven spindle mounted in the head-stock and extending therebeyond parallel with a driven cam-shaft in fixed bearings, a snail-cam on the cam-shaft, a turning-arm on the live spindle brought into engagement with the lesser whirl of said cam at the termination of a certain period of advancing movement of the carriage to turn the spindle with a gradually-increasing speed, and a cutter arranged to cut a groove in the work, whereby a straight groove is first cut longitudinally of the mandrel and then as the turning-arm engages the cam, gradually-increasing curved groove merging into a helix is cut as a direct continuation of the straight groove, substantially as described.

4. The combination, in a lathe of the nature described, of a traveling carriage carrying the head and tail stocks, mechanism for feeding it, an initially-undriven live spindle mounted in the head-stock, a cutter which cuts a straight groove in the work during the initial forward non-rotative movement of the live spindle with the carriage, means for imparting a gradually-increasing rotative movement to the spindle at the termination of the straight reach to cause the tool to cut a transition reach, a continuously-driven shaft and clutching mechanism between the live spindle and said driven shaft arranged to be automatically clutched when the transition reach is finished whereby the work is rotated continuously and the cutting-tool continues the transition groove into a regular helix, substantially as described.

5. The combination, in a lathe of the nature described, of a traveling carriage carrying the head and tail stock, mechanism for feeding it, an initially-undriven live spindle mounted in the head-stock and extending therebeyond parallel with a driven cam-shaft in fixed bearings, a snail-cam on the cam-shaft, a turning-arm on the live spindle brought into engagement with the lesser whirl of the cam at the termination of a certain period of advancing movement of the carriage, to turn the spindle with a gradually-increasing speed, a cutter arranged to cut a groove in the work, and clutching mechanism brought into action at the moment the turning-arm rides off the cam, and connecting the live spindle with a constantly-driven shaft, whereby the cutting-tool is caused to cut a continuous groove having an initial straight reach, a spiral transition reach and a helical reach into which the latter merges, substantially as described.

6. In a machine for cutting in mandrel grooves having a straight reach, a transition reach, and a helical reach, a fixed standard which supports a partly-rotatable tool-holder, a grooving-tool held by the latter, a carriage having a head-stock and a tail-stock mounted thereon, means for feeding the carriage to produce longitudinal movement of the work, and a tool-turning device connected to the carriage for momentarily engaging the tool-holder and turning it for changing the angle of the tool, substantially as and for the purpose described.

7. In a machine of the kind described, a fixed standard which supports a partly-rotatable tool-holder, a grooving-tool held by the latter a carriage having a head-stock and a tail-stock mounted thereon, means for feeding the carriage to produce longitudinal movement of the work, and a tool-turning device connected to the carriage for momentarily engaging the tool-holder and turning it and means for arresting the movement of the tool-holder at the moment said tool-turning device is disengaged from the tool-holder, substantially as, and for the purpose described.

8. In a machine of the kind described, a fixed standard; a partly-rotatable tool-holder stem supported thereby, one end of said stem forming a tool-holder; the latter being provided with a flange having a recess r^3 therein; a latch-plate fixed upon the tool-holder stem, a tooth which is adapted to engage said recess in the tool-holder flange, means for actuating said tooth, and a latch which engages said latch-plate and arrests the movement thereof at the moment said tooth passes out of engagement with said recess; substantially as described.

9. The combination, in a lathe of the nature described, of a traveling carriage, head and tail stocks, a tool-holder and cutting-tool carried thereby, and initially non-rotating live spindle mounted in the head-stock, means for gradually turning it at the conclusion of the non-rotating period with an increasing speed, a power-shaft mounted in fixed bearings on the bed-plate of the machine, a loose gear on the main shaft sliding thereon with the motion of the carriage, an elongated driving-finger projecting from the hub of said gear, a gear-

train leading from said gear to the live spindle, and a turning-block keyed to the main shaft and having a longitudinal groove for receiving the driving-finger, so located that said finger is caused to enter concurrently with the termination of said non-rotating period, substantially as described.

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

MICHAEL STADLER.

Witnesses:
JOHN W. HILL,
CHARLES I. COBB.