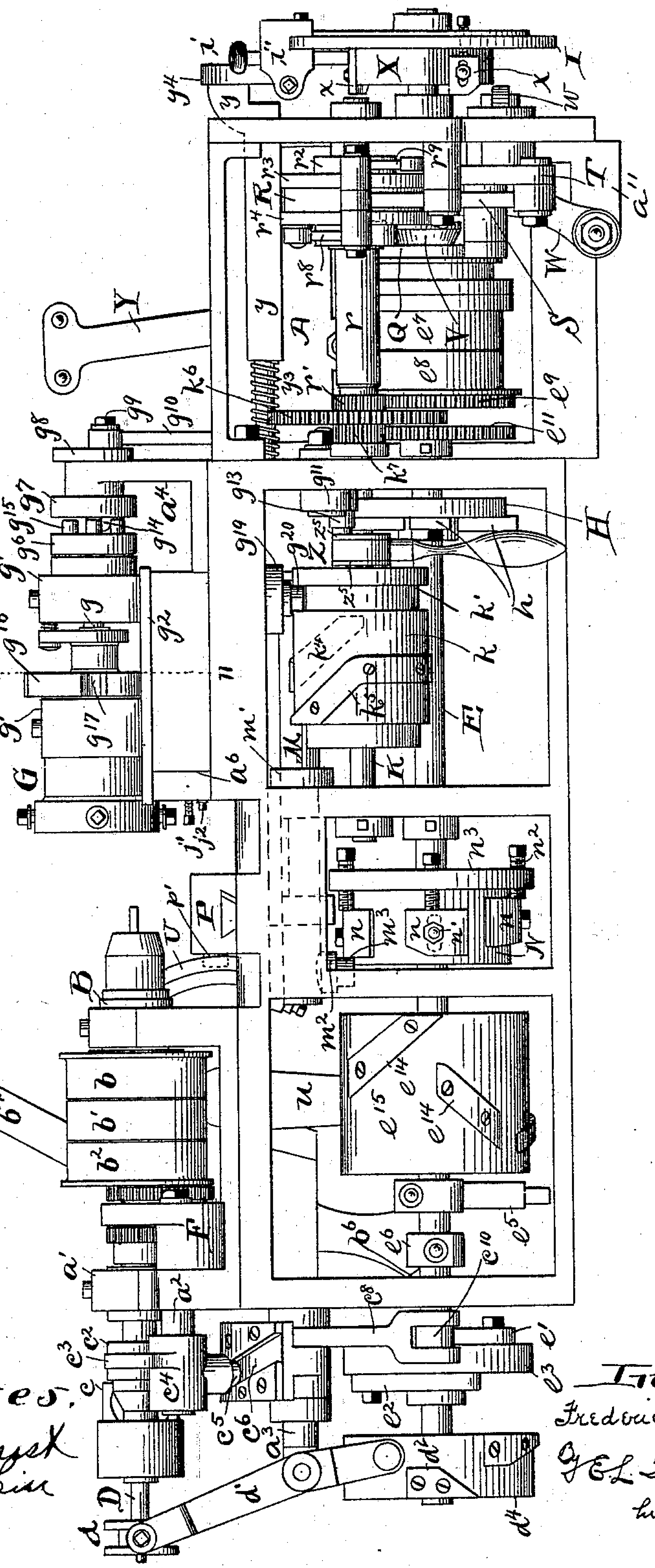
(No Model.) 7 Sheets—Sheet 1.

F. SCHULZE.

SCREW MACHINE.

No. 578,777. Patented Mar. 16, 1897.

Fig. 1.



Witnesses.
E. B. Gilchrist
A. M. Rankin

Inventor.
Frederick Schulze
by E. L. Thurston
his atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

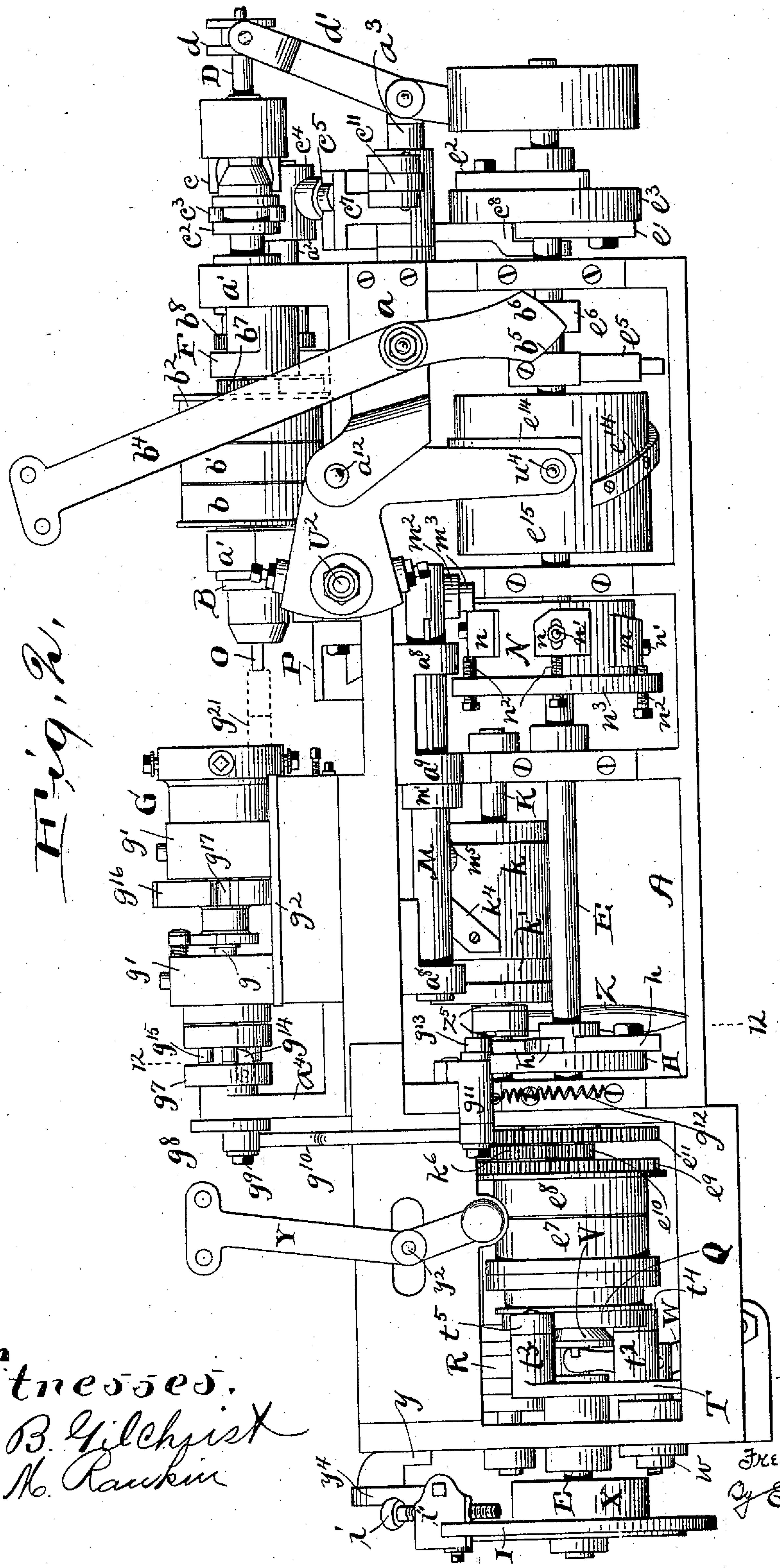
7 Sheets—Sheet 2.

F. SCHULZE.

SCREW MACHINE.

No. 578,777.

Patented Mar. 16, 1897.



Witnesses.
E. B. Gilchrist
A. M. Rankin

Inventor.
Fredrick Schulze
By E. L. Thurston
his atty.

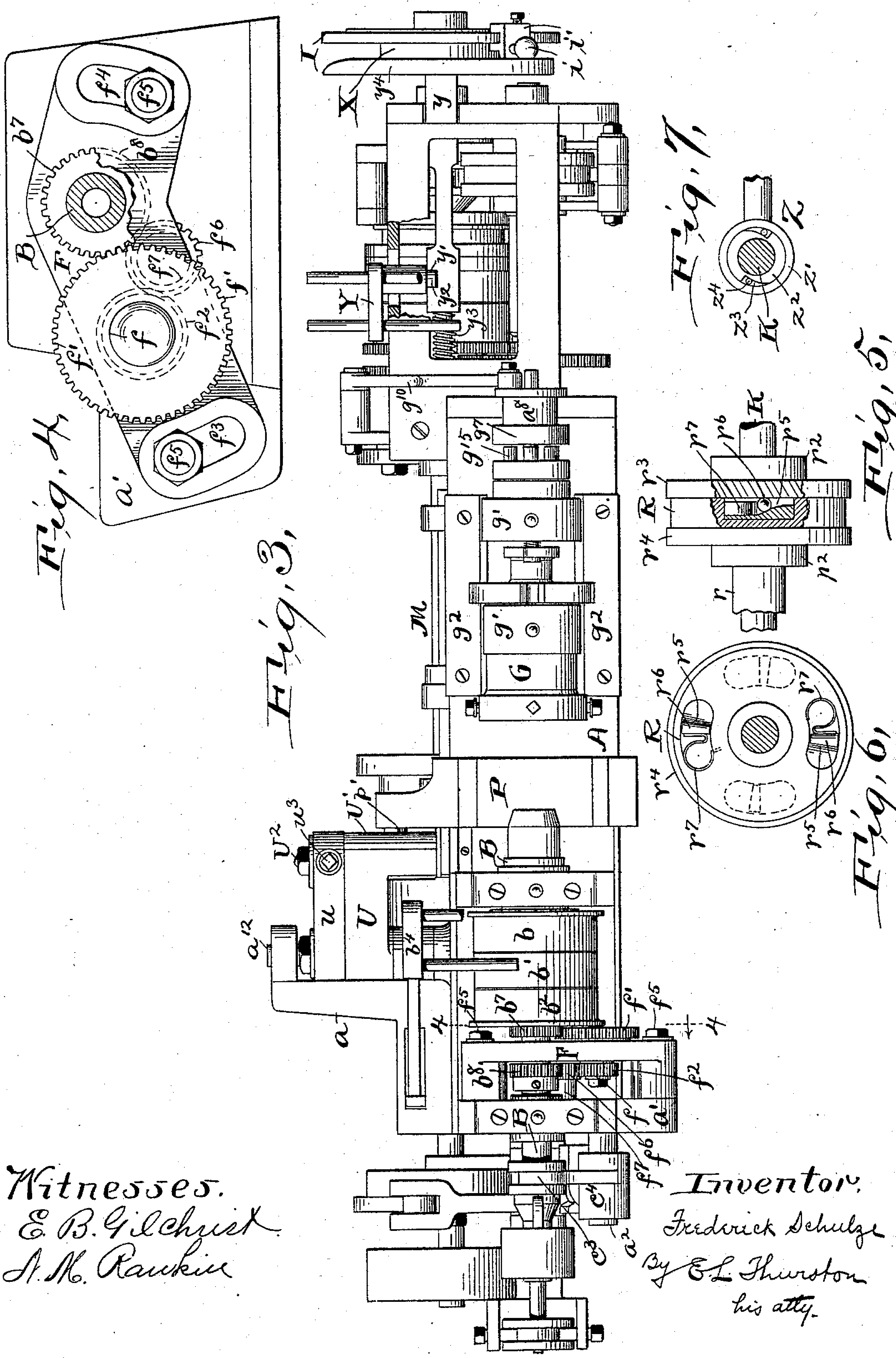
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 7 Sheets—Sheet 3.

F. SCHULZE.

SCREW MACHINE.

No. 578,777. Patented Mar. 16, 1897.



Witnesses.
E. B. Gilchrist
A. M. Rankin

Inventor.
Frederick Schulze
By E. L. Thurston
his atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 7 Sheets—Sheet 4

F. SCHULZE.
SCREW MACHINE.

No. 578,777. Patented Mar. 16, 1897.

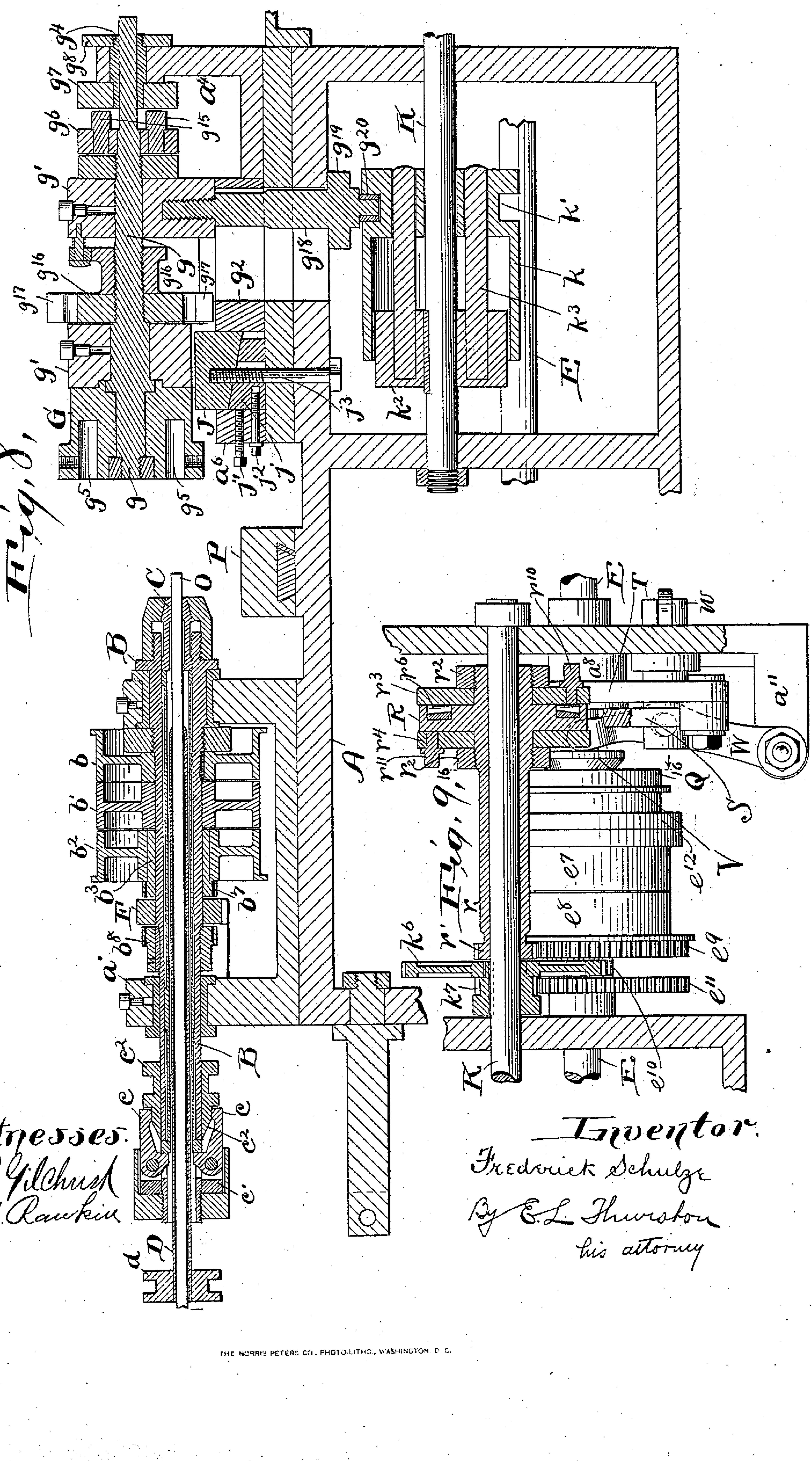


Fig. 8.

Fig. 9.

Witnesses.
E. B. Gilchrist
A. M. Rankin

Inventor.
Frederick Schulze
By E. L. Thurston
his attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 7 Sheets—Sheet 5.

F. SCHULZE.

SCREW MACHINE.

No. 578,777. Patented Mar. 16, 1897.

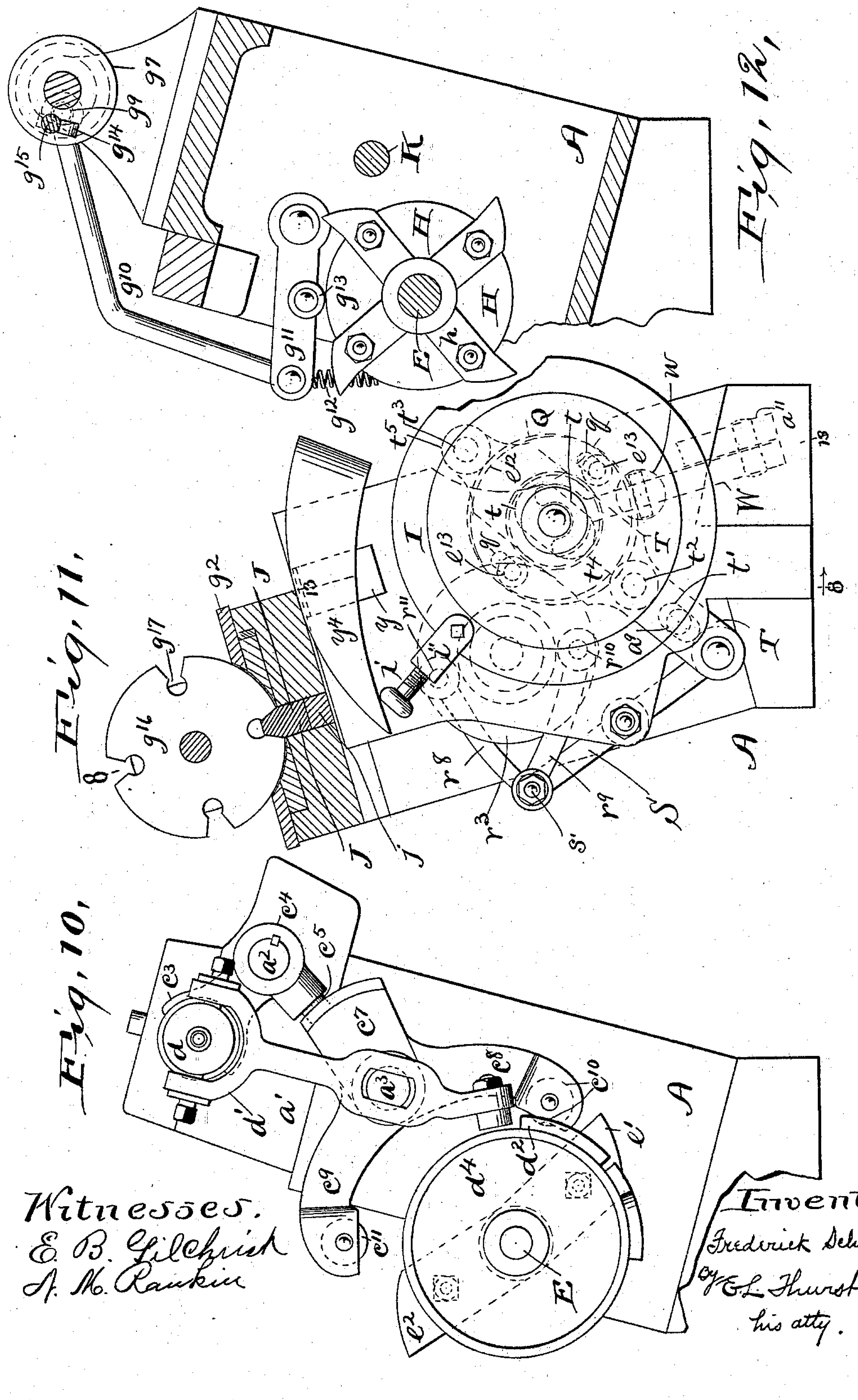


Fig. 10. Fig. 11. Fig. 12.

Witnesses.
E. B. Gilchrist
A. M. Rankin

Inventor:
Frederick Schulze
By E. L. Thurston
his atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 7 Sheets—Sheet 6.

F. SCHULZE.
SCREW MACHINE.

No. 578,777. Patented Mar. 16, 1897.

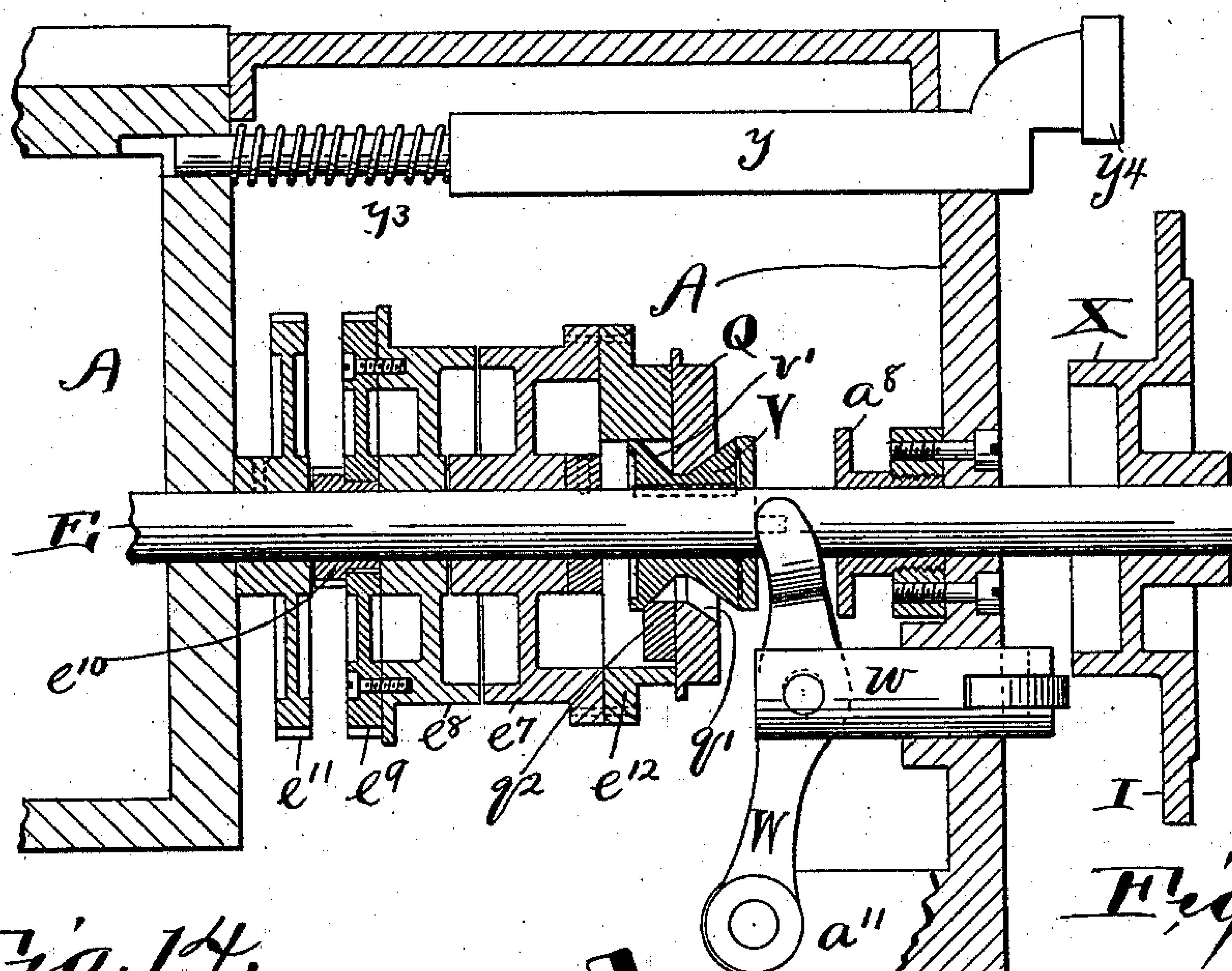


Fig. 13.

Fig. 14.

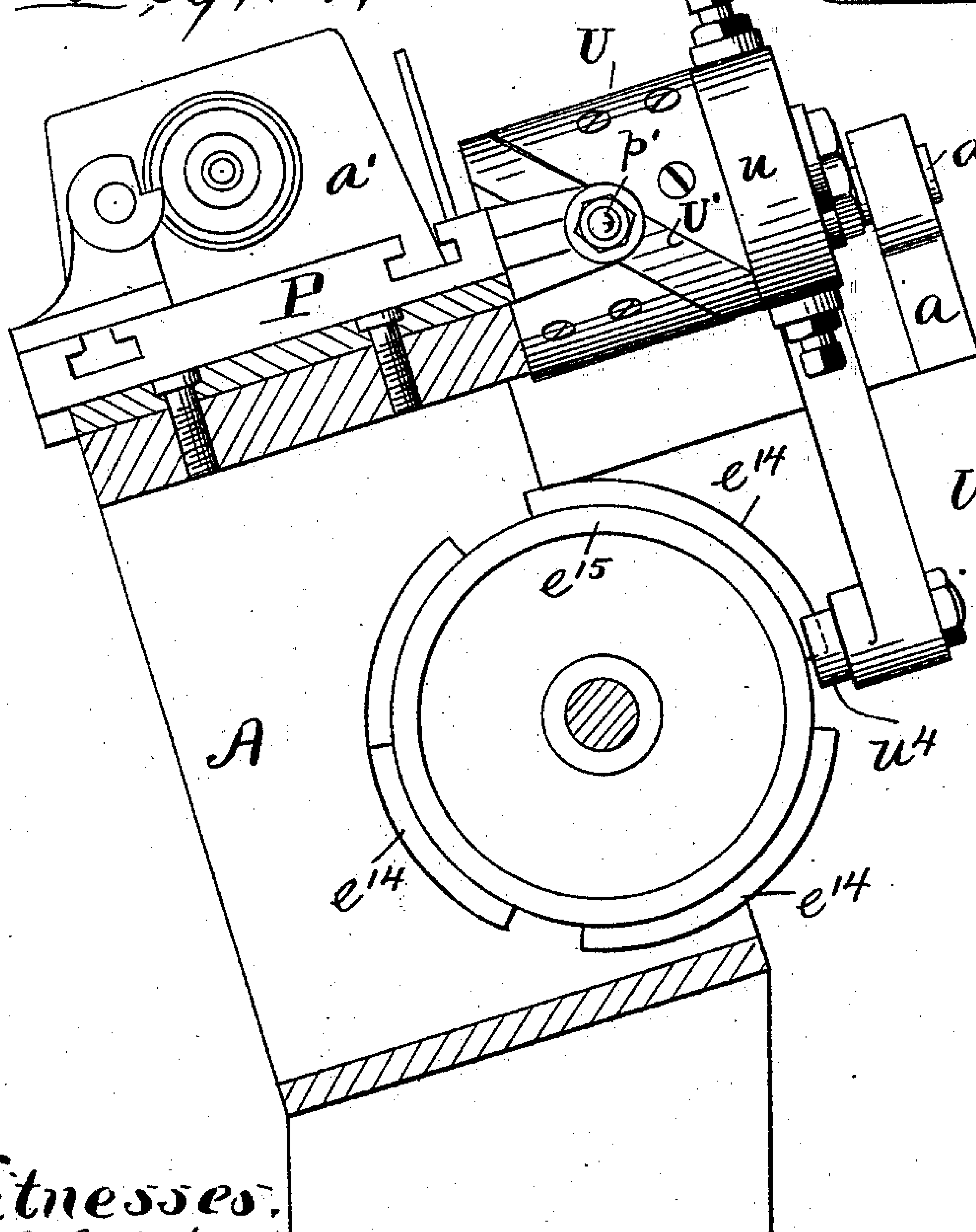
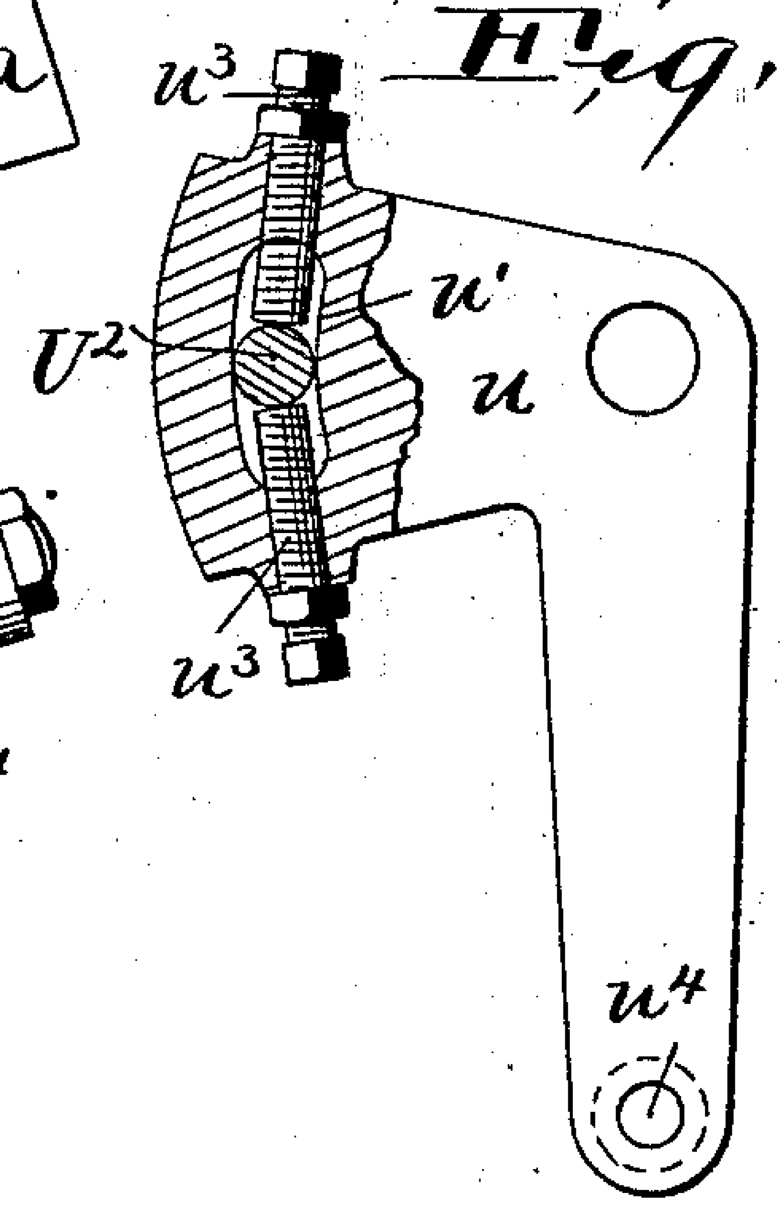


Fig. 15.



Witnesses:
E. B. Gilchrist
A. M. Rankin

Inventor:
Frederick Schulze
By E. L. Thurston
his atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

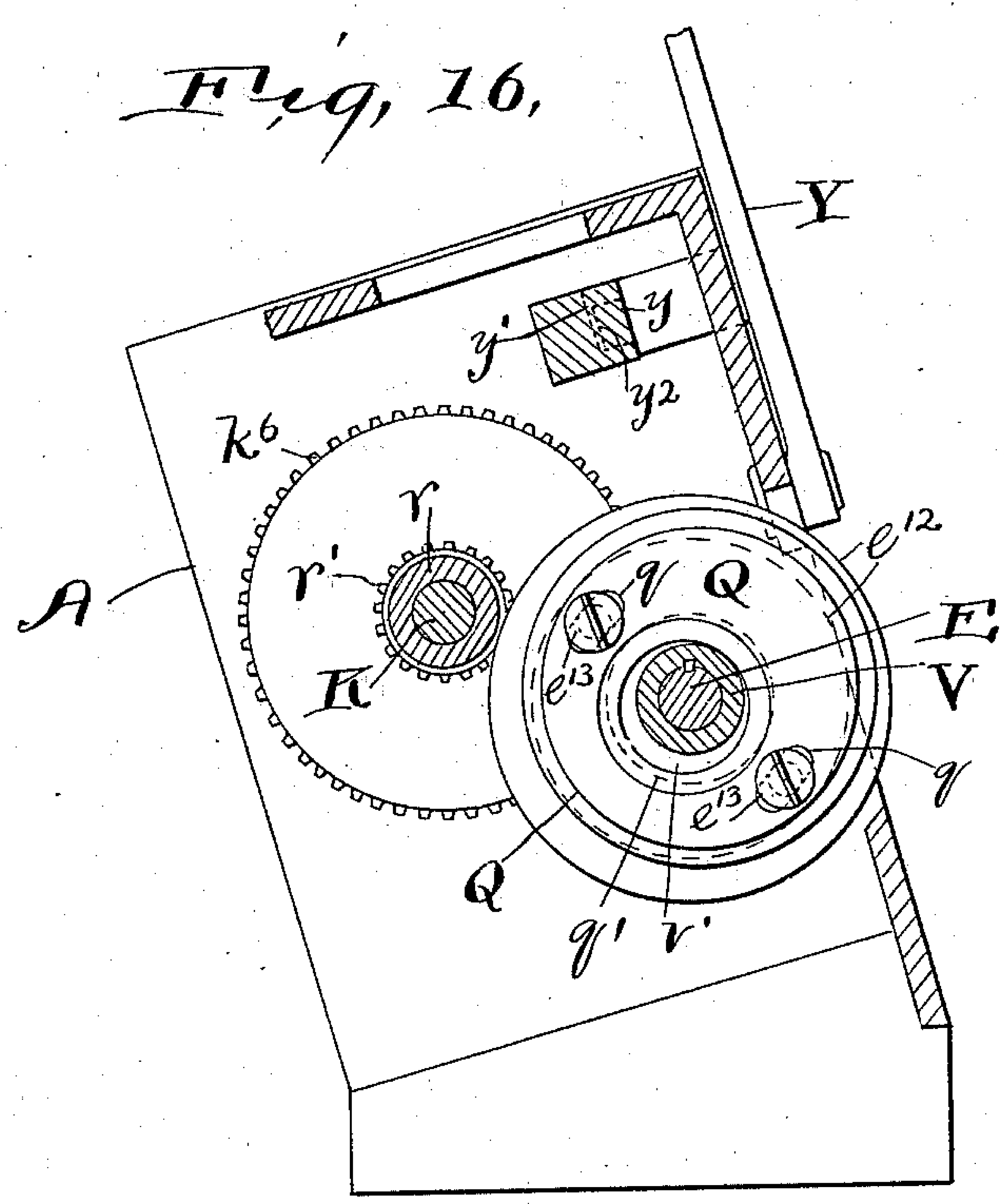
(No Model.) 7 Sheets—Sheet 7.

F. SCHULZE.

SCREW MACHINE.

No. 578,777. Patented Mar. 16, 1897.

Fig. 16.



Witnesses.
E. B. Gilchrist
A. M. Rankin

Inventor,
Frederick Schulze
By E. L. Thurston
his atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FREDERICK SCHULZE, OF CLEVELAND, OHIO.

SCREW-MACHINE.

SPECIFICATION forming part of Letters Patent No. 578,777, dated March 16, 1897.

Application filed November 16, 1896. Serial No. 612,353. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK SCHULZE, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Screw-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

It will be understood that the machine shown, although called a "screw-machine," may be used to make many other articles besides screws.

The machine is a turret-lathe containing many novel features of construction, which result in the automatic action, in proper sequence, of the turret-slide backward and forward at different rates of speed, in the several movements of the turret itself to bring the different tools carried thereby into action, in proper feed movement of the work, in the rotation of the live-spindle in both directions at the same or different rates of speed, and in the movement of the carriage carrying the cutting-off tool. The machine also contains other novel features of construction, which, together with the construction producing the results above mentioned, will be hereinafter described, and the various combinations of parts constituting the invention will be definitely pointed out in the claims.

In the drawings, Figure 1 is a front elevation of the machine. Fig. 2 is a rear elevation. Fig. 3 is a plan view. Fig. 4 is a sectional view on line 4 4 of Fig. 3. Fig. 5 is an enlarged front view, partly broken away, of the ratchet-clutch constituting part of the silent feed. Fig. 6 is a side view of the middle disk shown in Fig. 5. Fig. 7 is a transverse sectional view of the ratchet-clutch associated with the starting-handle. Fig. 8 is a sectional front elevation in the plane indicated by line 8 8 of Fig. 11. Fig. 9 is a sectional front elevation on the same plane of the right-hand end of the machine. Figs. 8 and 9 together constitute one complete sectional elevation of the machine. Fig. 10 is a left-hand elevation. Fig. 11 is a right-end elevation when wedge J is in engagement with disk, the upper part being sectioned on line 11 11 of Fig. 1. Fig. 12 is a sectional right-end elevation on line 12 12 of Fig. 2, showing the mechanism for turning the turret-spindle. Fig. 13 is a sectional front view of the right-hand end of the machine on line 13 13 of Fig. 11. Fig. 14 is a vertical transverse section showing the mechanism for moving the tool-slide. Fig. 15 is a detached rear view, partly broken away, of the bell-crank lever which forms a part of said tool-slide-operating mechanism. Fig. 16 is a sectional view on line 16 16 of Fig. 9.

Referring to the parts by letter, A represents the framework of the machine, whereon the various moving parts are supported in the manner presently to be described. B represents the tubular live-spindle. C represents the chuck-sleeve, and D represents the feeding-tube. All of these parts are of a well-known construction, and they are arranged and supported, the one within the other, in the usual manner.

E represents the main driving-shaft of the machine, which is driven by means to be presently described.

The various parts of the machine, excepting only the live-spindle, receive their motion, through suitable mechanism, from the main shaft, and this mechanism is so constructed and connected with the main driving-shaft that one revolution of said shaft causes a complete cycle of all the movements of the other parts.

Supported upon the live-spindle are three pulleys, of which the pulley b is keyed to the spindle, the pulley b' is loose upon the spindle, and the pulley b^2 is keyed to a sleeve b^3, which is loose on the spindle. A belt (which is not shown) is moved from one of these pulleys to the other by means of a belt-shipper lever b^4, which is pivoted to a fixed bracket a. The lower end of this belt-shipper lever is V-shaped, or, in other words, it has the cam-surfaces b^5 b^6 on opposite sides of its said end. Adjustably secured upon the main shaft are two arms e^5 e^6, which are adapted to engage, respectively, with the said cam-surfaces as the shaft revolves and thereby rock the lever and ship the belt from the pulley b to the pulley b^2 and back again during each complete revolution of the main shaft. When the belt is running on the pulley b^2, the spindle is revolved in the direction for cutting the stock through a train of gears, which reduces the speed of the spindle. This train of gears consists of the gear b^7, which is formed on the end of the sleeve b^3, and a gear f', which meshes with the gear b^7 and is itself fast upon a short rotatable shaft f, which shaft has also fast upon it a gear f^2. This shaft f is journaled in a rocker-arm F, which is hung loosely upon the spindle B and extends to both sides thereof. In the ends of this arm are the curved slots $f^3 f^4$, which are concentric with the spindle, and the bolts f^5 pass through these slots respectively and engage with a fixed part a' of the frame. The gear f^2 meshes with an idler-gear f^6, which is mounted on a stud f^7, which is secured to the inner face of the part a' of the frame. This idler-gear meshes with a gear b^8, which is keyed to the spindle. The motion of the pulley b^2 is transmitted through these gears b^7, f', f^2, f^6, and b^8 to the shaft, revolving it in the reverse direction to that in which it revolves when the belt is running on pulley b, and at a much lower rate of speed. When the belt is running on the pulley b, this pulley and the live-spindle are being revolved in the reverse direction at the same rate of speed as the belt is moving. The rate of revolution of the spindle when revolving in the reverse direction relative to the speed when revolving in the cutting direction may be changed by first removing the gear f^2 and substituting a larger or smaller gear therefor and by adjusting the rocker-arm F around the spindle until the said gear meshes properly with the idler-gear f^6.

The chuck-sleeve C is moved back and forth in the spindle to grasp and release the work by means of the levers c, which are pivoted to a collar c', fast on the spindle; and these levers are operated by a cone c^2, which is movable longitudinally on the spindle, these parts being substantially the same as the mechanism heretofore in common use for the purpose of operating similar chucks. This cone is moved back and forth by means of fork-arms c^3, secured upon a sleeve c^4, which is longitudinally movable upon a stud a^2, secured to the framework a'. A pin c^5, which is secured to this sleeve, enters a cam-groove c^6 in the segment-shaped face of the work-arm c^7 of a three-armed lever, which is loosely pivoted on a stud a^3. The two power-arms c^8 c^9 of this lever lie on opposite sides of the main shaft E at points where the friction-rollers c^{10} c^{11}, mounted in the ends of the lever-arms c^8 c^9, will be struck, respectively, by the cam-plates e' e^2, which are adjustably secured to opposite faces of the disk e^3, which is secured to said main shaft.

The feed-tube D is moved forward for the purpose of feeding the stock, and backward to its original place in readiness for another feed movement, by means of a grooved collar d, secured to the end of the feed-tube, a fork-lever d', pivoted to the end of the stud a^3, and the cam-plates d^2, which are secured to the face of the drum d^4, which is in turn secured to the main shaft E.

G represents the turret which is secured to the end of the spindle g. This spindle is mounted in the turret-slide g', which slide is mounted in guides in a cradle g^2, which is secured upon the bed-plate of the machine in the usual manner. The tail end of the turret-spindle is slidable through the sleeve g^4, which is mounted in a fixed standard a^4. In the face of the turret there may be as many sockets g^5 for holding tools as desired, and the machine will be organized so that the complete revolution of the turret will be effected by as many independent movements as there are sockets. In the present case four of these sockets are formed in the turret. When the turret-slide is drawn back, the turret is turned to bring the tools carried in these sockets into position to act upon the stock by the following mechanism: Secured to the turret-spindle is a ratchet-wheel g^6, which may have any suitable construction. Adjacent to it is a disk g^7, which is fast on a sleeve g^4. On the extreme end of this sleeve is a disk g^8, having a crank-pin g^9, upon which is pivoted the upper end of a bent connecting-rod g^{10}, the lower end of which is pivoted to a lever g^{11}. This lever is pivoted to a fixed part of the framework, and it is normally drawn down by the spring g^{12} into contact with the face of the disk H, which is secured to the main shaft E. Adjustable cam-blocks h, corresponding in number to the number of sockets in the turret, (in the present case four,) are secured to this disk, and they are adapted to severally engage with a friction-roller g^{13} on the lever, thereby rocking the lever upward upon its pivot, with the result of rotating the sleeve g^4 one-quarter of a revolution. This movement is transmitted to the ratchet-wheel g^6 by means of a pawl g^{14}, which is carried by the disk g^7. In the particular construction of these parts shown the pawl g^{14} is pivoted in a socket in disk g^7. The pawl may swing entirely into this socket or it may project at right angles therefrom, as shown in the drawings. The teeth of the ratchet-wheel g^6 are four pins g^{15}, which project horizontally toward the disk g^7 and into position to be engaged by said pawl g^{14}. When the disk g^7 is being revolved in one direction, the pawl engaging with one of said pins is forced back into the socket in disk g^7. When it has passed said pin, it falls out behind said pins g^{15}, and when the disk g^7 moves in the reverse direction the pawl engages with said pin and moves the ratchet g^6 with it.

The turret-slide is moved toward and from the work by mechanism to be presently explained. Novel means are provided, however, for locking the turret in its different working positions. The turret is locked by means of a disk g^{16}, having in its edge as many radial tapered slots g^{17} as there are tool-sockets in the turret. A fixed but adjustable wedge-block J is adapted to enter one of these slots when the turret is moved forward, that is, toward the work. This wedge-block is tapered so as to fit the tapered slots. Its lower surface is inclined and rests upon the oppositely-inclined top of a block j. A bolt j^3, which passes through the bed-plate of the machine and through a slot in this block j, screws into the wedge-block J and holds these parts down upon each other and upon the bed-plate. The position of the block j is adjusted by means of two screw-bolts, one of which (indicated by j') screws through a fixed bracket a^6 against the end of the block j, while the other j^2 passes loosely through said bracket and screws into said block j. By the movement of this block j the position of the wedge-block J may be accurately adjusted, so that it will tightly fit the slots in the disk g^{16}, and thereby hold the turret absolutely immovable as to motion upon its axis. When the turret-slide has been moved back far enough, the said disk g^{16} is disconnected from the wedge-block J, and the turret may be turned; but soon after the turret-slide begins its forward movement the described engagement of the wedge-block in said slots in said disk takes place. It is believed that this is a far more effective mechanism for holding the turret firmly in position while the cutting is going on than any of the mechanisms heretofore employed for this purpose.

The forward and backward movements of the turret-slide are accomplished by the following mechanism: A stud g^{18}, which screws into the turret-slide, passes through slots in the cradle and the bed-plate, and it is provided with a collar g^{19}, which bears against the under side of the bed-plate. A roller g^{20} on the lower end of this stud enters a circumferential groove k' in a drum k, which is loosely mounted on the supplemental shaft K, which is parallel with the main driving-shaft E. This drum is caused to revolve with the shaft, but is permitted to move longitudinally thereon by means of a disk k^2, which is keyed to the shaft, and the pins k^3, which are driven into this disk and pass loosely through holes in the hub of the drum k. This drum is moved longitudinally upon the shaft K, thereby effecting the forward and backward movements of the turret-slide by the following mechanism: The sliding rod M is mounted in fixed brackets a^8 a^9, and it is parallel with the main driving-shaft. Projecting laterally from it is a pin m^5, which pin is adapted to be engaged by two cam-plates k^4 k^5, which are secured upon the face of the drum k. These cam-plates have their spiral edges, which engage with a roller m^5 on this pin, laid in opposite directions, wherefore it is clear that if the rod is prevented from moving longitudinally the engagement of these spiral cams with said roller will cause the drum to slide longitudinally upon the shaft K. The longitudinal movement of this rod M is limited, first, by the engagement of a fixed collar m' with the fixed bracket a^9, in which the rod slides. Its movement in the other direction is limited by the engagement of a friction-roller m^3, mounted upon a pin m^2, which projects laterally from the rod, with the dogs n, which are adjustably secured upon the face of the drum N, which is secured to the main driving-shaft E. By means of these adjustable dogs n the length of the movement of the turret-slide may be varied for every tool in the turret. For example, to shorten the length of any movement of the turret-slide one of these dogs n may be moved on the face of the drum N toward the turret end of the machine. This permits the rod to slide in its bearings a short distance in either direction, but only until either the collar m' engages the fixed bearing a^9 or the roller m^3 engages the face of the said dog n. These dogs n are each slotted and are secured upon the face of the drum by screws n'. Their position is adjusted by means of the screws n^2, which screw through the flange n^3 on drum N. During this longitudinal movement of the rod the turret-slide remains stationary. It is only when the movement of this rod M in one direction or the other is checked that the turret-slide is caused to move. In the rotation of the drum one of the cams k^4 or k^5, as the case may be, strikes the roller m^5 and first moves the rod until the collar m' strikes the framework of the machine, or until the roller m^3 strikes one of the dogs n. In the subsequent rotation of the drum it is drawn longitudinally on the shaft, with the result of moving the turret toward or from the work, as the case may be.

When the stock has been fed forward by the mechanism heretofore described, the end of said stock O strikes a stop g^{21}, which may be carried in one of the tool-sockets in the turret; or, rather, to be more exact in the manner of stating this operation, the stock is fed forward, and then, before the chuck is closed, the turret is fed toward the stock, the end of the stop in the turret striking the end of the stock, and, if necessary, pushing said stock backward and holding it against further outward movement until the chuck is closed.

To save as much time as possible, all the motions not used for cutting are performed considerably faster than those that are used for cutting. This alternate slow and fast motion is attained by the use of a train of gears and a "silent feed" so called. Mounted loosely upon the main driving-shaft, side by side, are two pulleys e^7 e^8. The pulley e^8 has rigidly connected with it a gear e^9 and a pinion e^{10}. Adjacent to these gears is a gear e^{11}, which is keyed or otherwise rigidly secured to the main driving-shaft E. Keyed to the shaft K are the two gears k^6 k^7, which mesh, respectively, with the gears e^{10} e^{11}. For the fast motion of the driving-shaft and the various parts which are driven thereby the power is transmitted from the pulley e^8, through the gears e^{10} e^{11} k^6 k^7, to the driving-shaft E. For the slow motion the belt is shipped to the pulley e^7.

The slow movement is secured through what is known as the "silent feed," which, in the novel form shown, is constructed, connected, and operated as follows:

R represents a disk formed upon or secured to a sleeve r, which is loosely mounted on the shaft K. A pinion r', rigid with said sleeve, meshes with the gear e^9. Loosely mounted on the sleeve r, on opposite sides of the disk R, against which they are held by nuts r^2, are the two disks r^3 r^4. In each face of the disk R are two cam-shaped recesses r^5, in which are placed the rollers r^6. Said rollers are held in by the two disks r^3 r^4. When either disk r^3 r^4 is moved in one direction upon its axis, the rollers r^6, which are under the influence of spring r^7, wedge themselves between said disk and the faces of the cam-shaped recesses r^5, thereby causing disk R to move with it. When either disk r^3 r^4 is rocked in the opposite direction, it moves alone, the rollers dropping back into the cam-recesses. These disks r^3 r^4 act alternately in the manner described, the result being a slow, but practically continuous, movement of the disk R in one direction. The cam-shaped recesses and rollers constitute one form of a ratchet-clutch, and any other form of ratchet-clutch might be substituted. These two disks r^3 r^4 are rocked back and forth upon sleeve r by means of two links r^8 r^9, which are pivoted on the same pin s' to a lever S, said lever being pivoted to the frame of the machine. These two links are respectively connected at their other ends with crank-pins r^{10} r^{11} on the disks r^3 r^4. This lever S is operated by a ram-bar T, having a longitudinal slot t, which embraces a fixed sleeve a^8, which embraces the shaft E. A fixed pin a^9 passes through a parallel slot t', and consequently the ram-bar is compelled to follow a path transverse to the axis of the shaft E, being guided therein by the said slots t t' and the sleeve a^8 and the pin a^9. Projecting laterally from this ram-bar are two pins t^2 and t^3, bearing, respectively, the friction-rollers t^4 t^5, which rollers bear against the opposite edges of an eccentric disk Q, which is carried by the pulley e^7. This disk causes the ram-bar to be moved longitudinally backward and forward, the length of this movement being proportionate to the eccentricity of the said disk Q. This movement of the ram-bar operates the lever S, with the result of oscillating the disks r^3 r^4, and this movement of these disks produces, as before described, the slow, but practically continuous, movement of the disk R in one direction. This movement of said disk is transmitted to the main driving-shaft through sleeve r, pinion r', gear e^9, and the train of gears e^{10} e^{11} k^6 k^7 before described.

The eccentric disk Q is connected with the pulley e^7, and its eccentricity is varied by the following construction and combination of parts: This pulley e^7 has rigidly secured to or formed upon its outer side a disk e^{12}, to the side of which the eccentric disk Q is connected by means of the screws e^{13}, which project from disk e^{12} into two slots q in the eccentric disk on opposite sides of its center. This eccentric disk Q is held in the desired position relative to the shaft and is moved to change its eccentricity by means of the following mechanism: A conical wedge V is slidable upon the shaft E within a tapered eccentric opening q' in disk Q, the inner edges of this disk engaging with said wedge, as shown in Fig. 13. As shown in this figure, the disk is in its least eccentric position. The movement of said wedge V toward the pulley e^7 moves the cam-disk to increase its eccentricity, while the subsequent reverse movement of said double wedge permits the opposite movement of said eccentric disk. This latter movement is effected positively by a reverse-cone v', integral with the cone V, which reverse-cone engages with a block q^2, secured to the inner side of the eccentric disk Q.

In machines of this character the speed of the mechanism should vary as the work being done is heavy or light. The speed of the silent feed is, as before explained, proportionate to the eccentricity of the disk Q. The cone V is moved automatically at the proper times to change the eccentricity of this disk by means of a lever W, which is pivoted to a fixed bracket a^{11} and bears against the end of the cone V, a rod w, which is pivotally connected with said lever W and is longitudinally movable in the frame, and the adjustable dog x, which is secured to a drum X on shaft E. This dog may be positioned so as to cause any desired movement of the lever W and at any desired time, and it may be shaped to hold said lever in the position to which it is thereby moved for any period. There may be as many of these dogs as are necessary to effect the desired number of changes in speed.

The belt (not shown) for driving the pulleys e^7 e^8 is automatically shipped from one pulley to the other by means of a belt-shipper lever Y. This belt-shipper lever is moved by a longitudinally-movable bar y, having a slot y', which receives a pin y^2 on said lever. This bar is moved in one direction by a spring y^3, and it is moved in the opposite direction by dogs i, which are secured to a disk I on the main shaft E. These dogs engage with a laterally-projecting arm y^4, which is secured to or formed integral with the bar y. The end of this arm with which the dogs first engage is beveled, as shown in Figs. 3 and 11, whereby the engagement between the said dogs and face of this arm is effected. The inner edge of this arm, as shown in Fig. 11, is eccentric to the path of the dog, being nearest at the end thereof with which the dog first contacts, and when the dogs leave contact with this bar they slide off of such inner edge. The dogs themselves are the round heads of radially-adjustable screws which screw into the clamps i', which are fastened to the disk I. The farther the head of this screw is from the axis of the shaft the longer will the contact between it and the arm y^4 be maintained.

The cut-off slide P is mounted on the bedplate of the machine. A pin p' projects from one side of this slide and enters a cam-groove U′ in the segment-shaped end of a rocker U, which is pivoted on the fixed stud a^{12}.

u represents a bell-crank lever pivoted on the same stud. In its approximately horizontal arm is a concentrically-curved slot u', into which projects a pin U^2, which is rigid with the rocker U. Two adjustment-screws u^3 screw into this horizontal arm of the bell-crank lever, entering the ends of said curved slot on opposite sides of said pin U^2. By the manipulation of these screws the position of this pin within the slot may be adjusted. The approximately vertical arm of this bell-crank lever has a laterally-projecting pin u^4, which is adapted to be engaged by oppositely-inclined spiral cam-strips e^{14}, which are secured upon the face of a drum e^{15}, which is secured to the main driving-shaft E. These cam-strips, while spiral in form at one end, whereby the tool-slide may be moved, are straight at and near the other end, whereby the tool-slide will be held for the proper length of time in the position to which it has been moved. The distance which the tool-slide shall travel may be shortened and otherwise changed by loosening one or the other of the adjustment-screws u^3, so that the bell-crank lever may have a greater or less movement before the ends of said screws engage with the pin and cause the segment-bar to move.

Z represents a handle which may be used for slowly moving the machine, and it is principally useful in setting the machine for a new job. This handle has a ring z', which embraces a disk z^2, which is secured to the shaft K. In the face of this disk two cam-shaped notches z^3 are cut, and in these notches lie the rollers z^4. Collars z^5, secured to this shaft, hold the ring in the described position and prevent the escape of the rollers. In the movement of the handle in one direction these rollers wedge themselves between the cam-faces on the disk z^2 and the ring z', whereby the shaft is caused to turn. The handle is moved in the other direction without causing any motion of said shaft.

The construction described is generally a ratchet-clutch which connects the handle and the shaft. The specific form of this ratchet-clutch shown is not new, but it is believed that the combination, with one of the shafts of a screw-machine, of an oscillating handle and a ratchet-clutch for connecting said shaft and handle is new.

Having described my invention, I claim—

1. In a screw-machine, in combination, the live-spindle, a pulley tight thereon, a pulley loose thereon, a gear tight to said loose pulley, a gear tight to the spindle, a rocker pivoted concentrically with said spindle, means for fixing its position, connected gears mounted on said rocker, and an idler-gear whereby motion is transmitted from one gear on the spindle to the other, and a belt-shipper, substantially as and for the purpose specified.

2. In a screw-machine, in combination, the live-spindle, a pulley loose thereon, a gear tight to said pulley, a gear tight to the spindle, a rocker hung upon said spindle, and means for securing it in fixed position, a shaft mounted thereon, two gears tight to said shaft, and an idler-gear, substantially as and for the purpose specified.

3. In a screw-machine, in combination, the live-spindle, a tight pulley thereon, a loose pulley thereon, means for transmitting motion from the loose pulley to the spindle, a belt-shipper lever having on one arm two cam-surfaces, the driving-shaft, and two arms adjustably secured thereto for engagement with the said cam-surfaces, substantially as and for the purpose specified.

4. In a screw-machine, the described means for operating the cone which actuates the chuck, consisting of the following parts in combination, the fork-lever movable longitudinally with respect to the live-spindle, an operating-pin secured thereto, a three-arm lever having on the segment-shaped end of the work-arm spiral cams for engagement with said operating-pin, a rotating disk, and adjustable cams secured thereto, which engage with and alternately operate the two work-arms of said lever, substantially as and for the purpose specified.

5. In a screw-machine, in combination, the tubular live-spindle, tubular chuck, levers for operating the chuck, a cone for actuating said levers, a sliding sleeve having a fork for moving said cone and an operating-pin, a pivoted lever having two power-arms and a segment-shaped work-arm, cams upon the end of this work-arm for engagement with said operating-pin, and cams for engaging said power-arms alternately, substantially as and for the purpose specified.

6. In a screw-machine, the means substantially as described for moving the tool-slide, consisting of a segment-shaped rocker pivoted to a fixed stud, cams on its surface, a pin projecting from the tool-slide into engagement with said cams, an operating-lever pivoted on the same stud, rotating cams for engaging with one arm of said lever, and means for adjustably connecting said segment-shaped arm and the operating-lever, substantially as and for the purpose specified.

7. In a screw-machine, the means substantially as described for moving the tool-slide, consisting of a rocker having a segment-shaped end, cams thereon engaging a pin on the tool-slide, a bell-crank operating-lever having in one arm a curved slot, adjustment-screws which enter the ends of this slot, a pin on the rocker which enters this slot between said screws, and rotating cams engaging with the other arm of the bell-crank lever, substantially as and for the purpose specified.

8. In a screw-machine, in combination, the turret-slide, a stud secured thereto, the main shaft, a secondary shaft, a suitable connecting mechanism, a drum longitudinally mov-

able upon said secondary shaft having cams on its surface, said drum also having a circumferential groove in which said stud engages, a longitudinal sliding bar having a projection which engages with said surface cams, and having also a stop-collar and a second projection, a drum secured to the main shaft, adjustable dogs thereon adapted to engage with the last-named projection on said bar, substantially as and for the purpose specified.

9. In a screw-machine, in combination, the turret-slide, the main shaft, a secondary shaft driven therefrom, a disk secured to said secondary shaft, a drum loosely mounted on said shaft, pins parallel with the shaft secured to said disk passing loosely through holes in the hub of said drum, cams secured to the face of said drum, a sliding rod having a projection adapted to engage with said cams, a stop-collar on said rod, a second projection on said rod, a drum secured to the main shaft, adjustable dogs secured to the surface of said drum, and a stud secured to the turret-slide entering a circumferential groove in the drum first named, substantially as and for the purpose specified.

10. In a screw-machine, in combination, the main shaft, two pulleys loosely mounted thereon, a secondary shaft, gears transmitting motion from one of said pulleys through the secondary shaft to the main shaft, a silent feed mounted on the secondary shaft, mechanism intermediate of the other loose pulley and said silent feed, gears transmitting motion from said silent feed to the first-named loose pulley, substantially as and for the purpose specified.

11. In a screw-machine, in combination, the main shaft, two pulleys loosely mounted thereon, two gears fast to one of the said loose pulleys, a gear fast upon the main shaft, two gears fast on the secondary shaft in mesh, as described, whereby motion is transmitted from said loose pulley to the main shaft, a sleeve loose upon the secondary shaft, a gear fast thereto in mesh with one of the gears secured to said loose pulley, a silent feed on said sleeve, and mechanism intermediate of the other loose pulley and silent feed, substantially as and for the purpose specified.

12. In a screw-machine, in combination, the main shaft, a pulley loosely mounted thereon, an eccentric disk rotating with said pulley, a ram-bar operated by said eccentric disk, a lever operated by said ram-bar, a secondary shaft, a silent feed mounted thereon, mechanism intermediate of said lever and silent feed whereby the latter is operated, and a train of gears transmitting motion from said silent feed to the main shaft, substantially as and for the purpose specified.

13. In a screw-machine, in combination, the main shaft, a pulley loosely mounted thereon, an eccentric disk rotating with said pulley, means for varying the eccentricity of said disk, a ram-bar engaging said disk, a lever operated by said ram-bar, a silent feed operated by said lever, and a train of gears transmitting motion from said silent feed to the main shaft, substantially as and for the purpose specified.

14. In a screw-machine, in combination, the main shaft, a pulley loosely mounted thereon, a transversely-movable eccentric disk connected with said pulley and having an eccentric hole, a cone longitudinally movable upon the main shaft within the disk and in engagement therewith, mechanism operated by said eccentric disk whereby the main shaft is rotated, a lever for moving said cone, and adjustable cams for operating said lever, substantially as and for the purpose specified.

15. In a screw-machine, in combination, the main shaft, a pulley loosely mounted thereon, an eccentric disk rotating with the pulley, a ram-bar operated by said disk, a lever operated by said ram-bar, a sleeve mounted on the secondary shaft, a disk rotating with said sleeve, mechanism for transmitting motion from the sleeve to the main shaft, two oscillating disks mounted axially with respect to said sleeve, clutching devices for alternately connecting said two disks with the disk which is fast to said sleeve, and two links respectively connecting these two disks with said lever, substantially as and for the purpose specified.

16. In a screw-machine, in combination, the main shaft, two pulleys loosely mounted thereon, mechanisms for transmitting motion at different speeds from said pulleys respectively to the shaft, a belt-shipper lever, a longitudinally-movable bar for operating said lever, a spring for moving said bar in one direction, a rotating disk, dogs adjustably secured thereon, and a plate having a beveled end secured to said bar, substantially as and for the purpose specified.

17. In a screw-machine, in combination, a belt-shipper lever, a longitudinally-movable bar, a spring, an eccentrically-curved plate on the end of said bar, a rotating disk, radially-adjustable dogs secured thereto for engagement with said plate, substantially as and for the purpose specified.

18. In a screw-machine, in combination, the turret-slide, the turret-spindle mounted therein, and a ratchet secured to said turret-spindle with an oscillating sleeve mounted in the fixed support concentric with said turret-spindle, a pawl carried thereby, a connecting-rod pivoted on a crank-pin secured to said sleeve, a pivoted lever to which the other end of said connecting-rod is pivoted, a rotating disk, and cams secured thereto for operating said lever, substantially as and for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

FREDERICK SCHULZE.

Witnesses:
E. L. THURSTON,
LEON F. SCHULZE.