(Model.)

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H. REYNOLDS & J. ENGLISH.

METAL SCREW MACHINE.

No. 266,891. Patented Oct. 31, 1882.

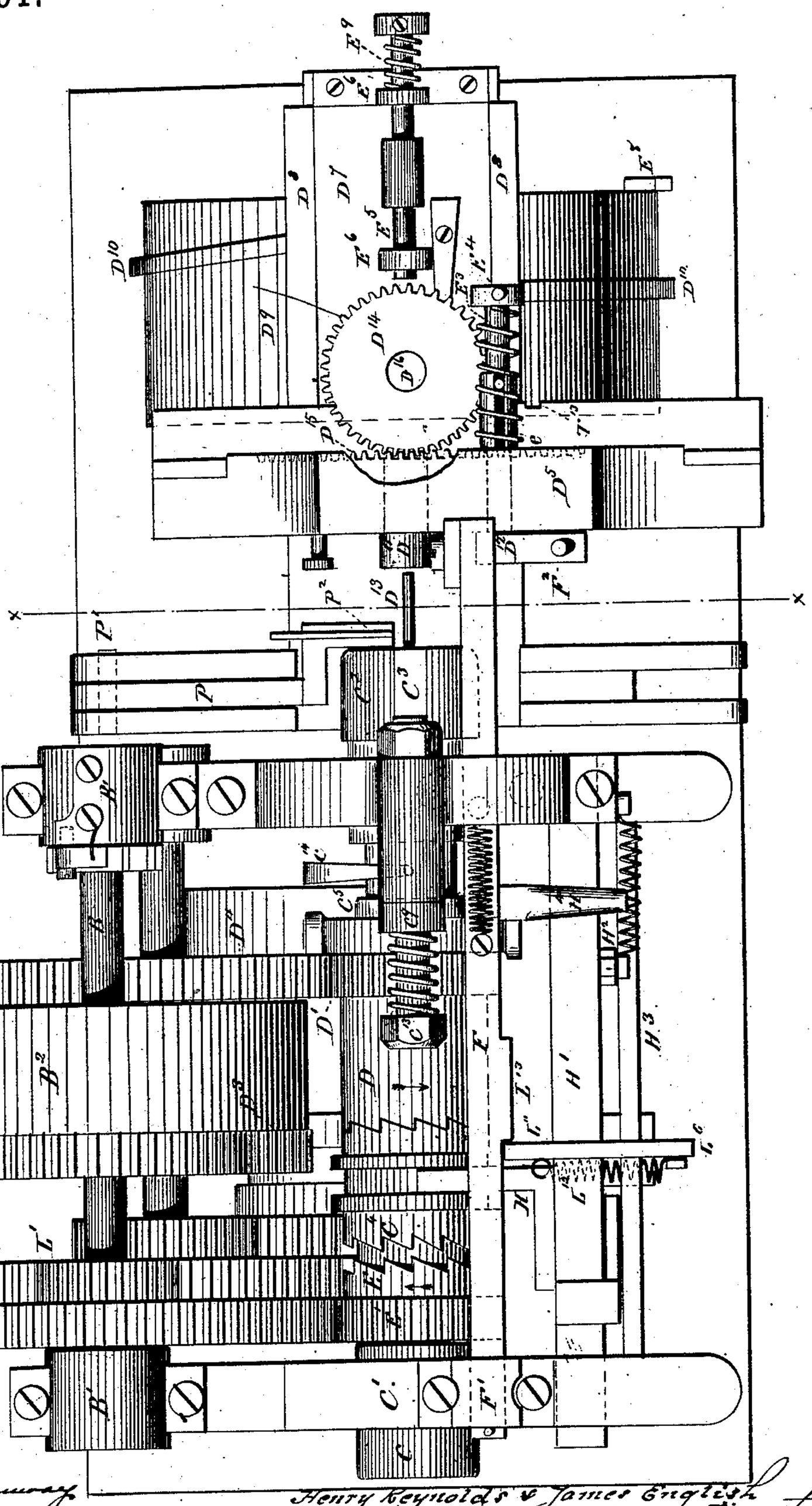

Fig. 1

Witnesses.
L. N. Shumway
L. D. Rogers

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Thos. E. Earle

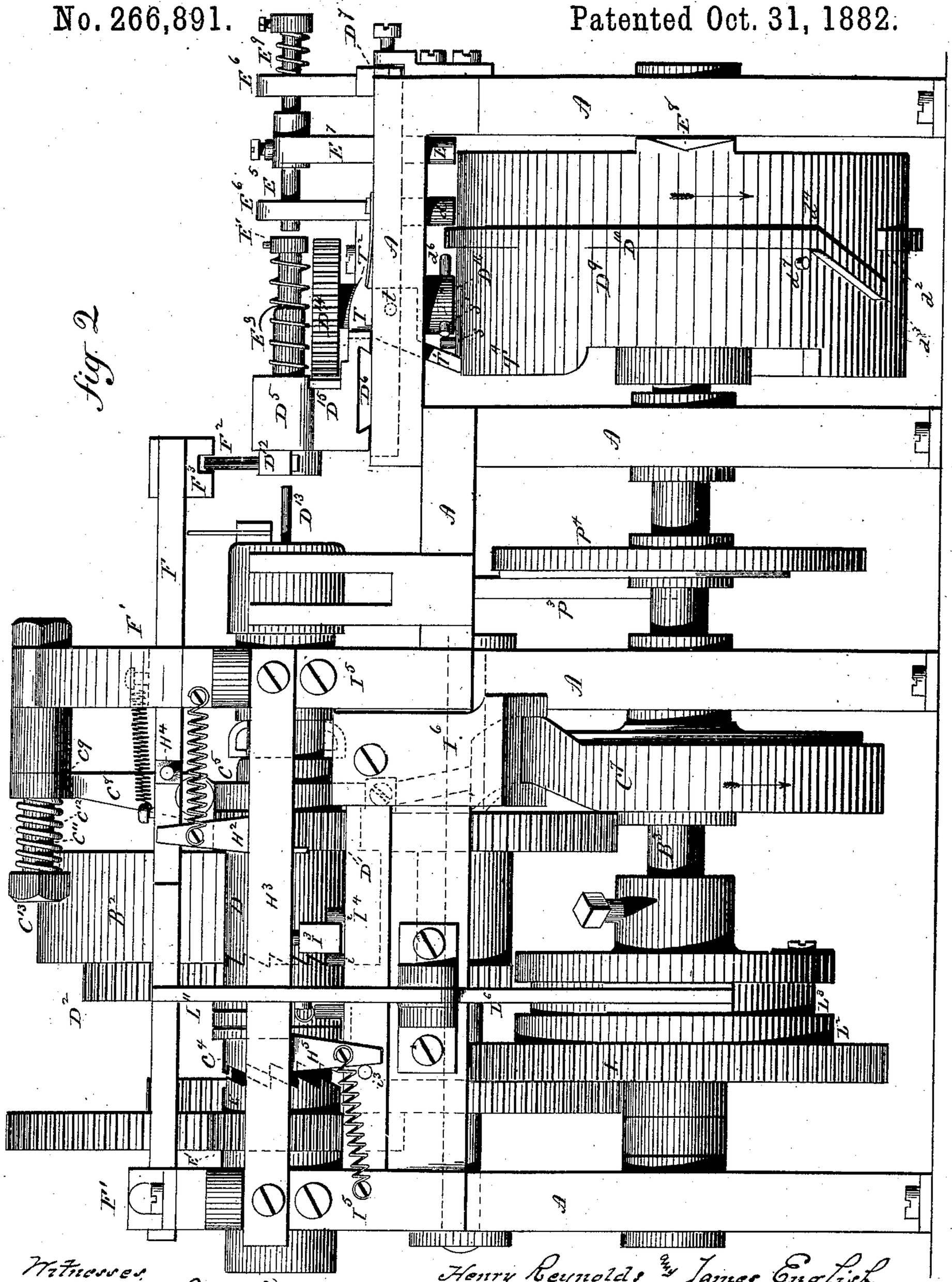
(Model.) 5 Sheets—Sheet 2.

H. REYNOLDS & J. ENGLISH.

METAL SCREW MACHINE.

No. 266,891. Patented Oct. 31, 1882.

Fig. 2



Witnesses:
L. K. Summy
L. D. Rogers.

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(Model.) 5 Sheets—Sheet 3.

H. REYNOLDS & J. ENGLISH.

METAL SCREW MACHINE.

No. 266,891. Patented Oct. 31, 1882.

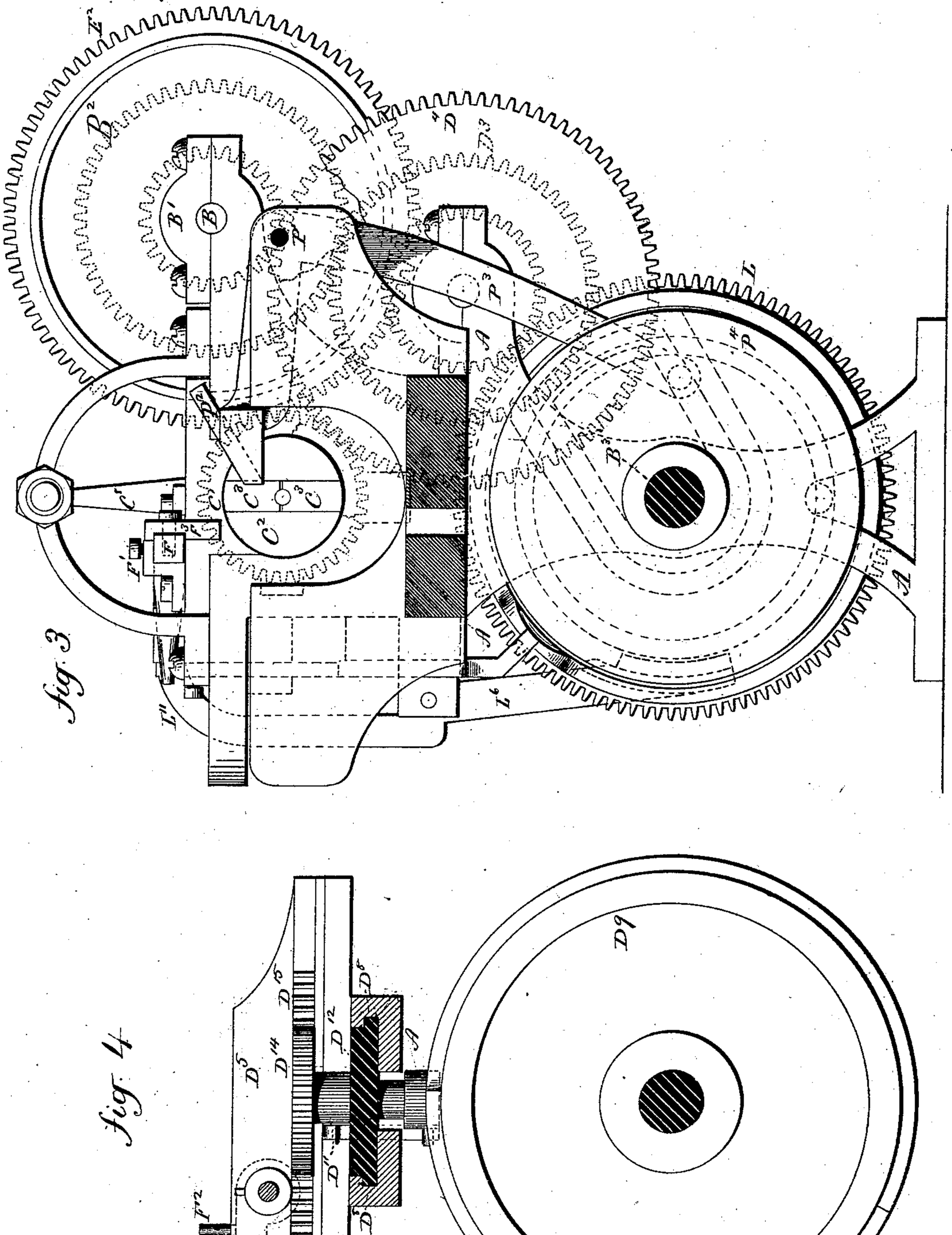

Fig. 3

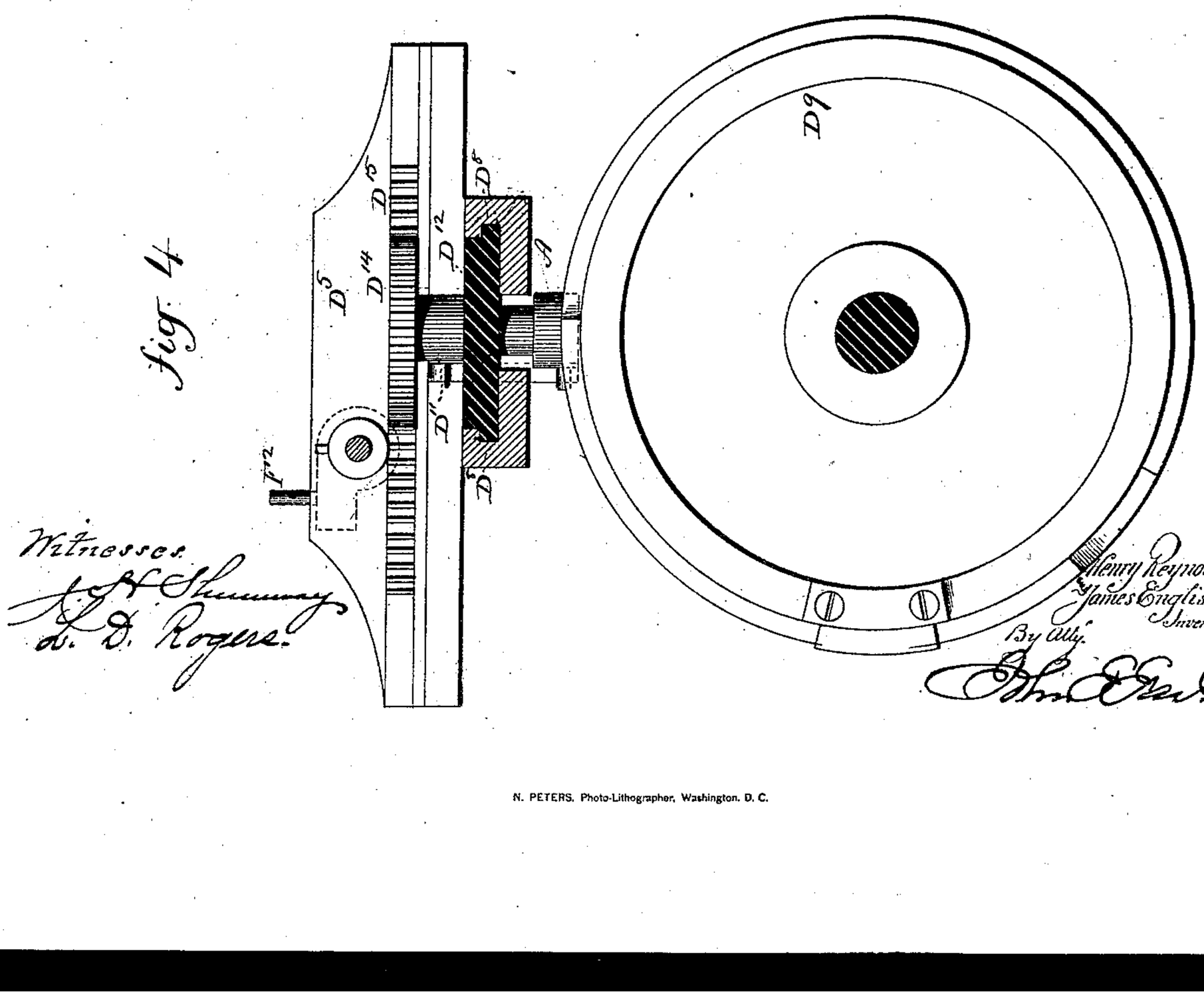

Fig. 4

Witnesses.
L. F. Shumway
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(Model.) 5 Sheets—Sheet 4.

H. REYNOLDS & J. ENGLISH.

METAL SCREW MACHINE.

No. 266,891. Patented Oct. 31, 1882.

fig 6.

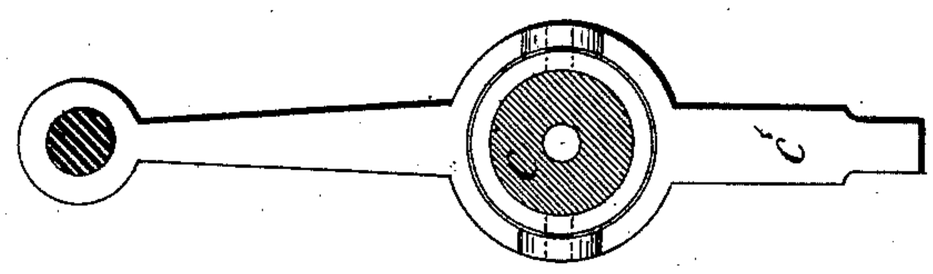


fig. 5

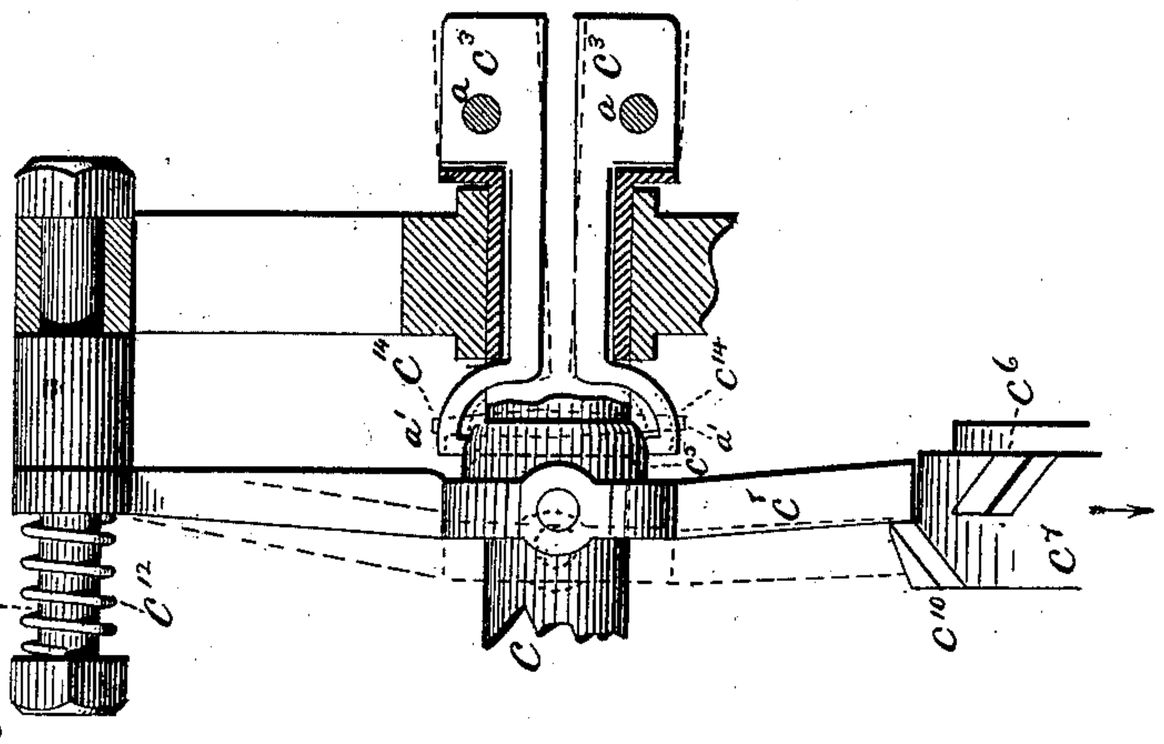


fig. 7

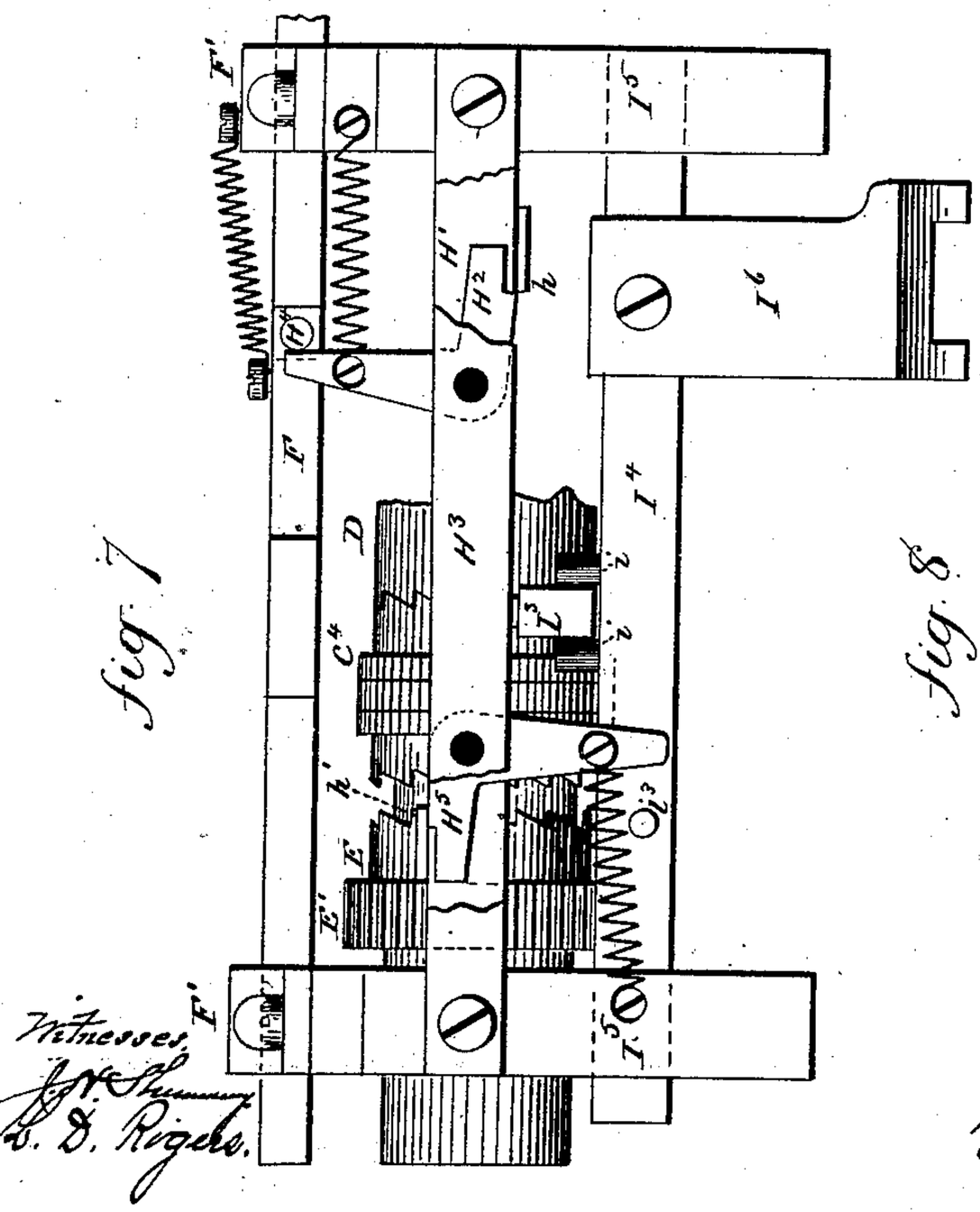


fig. 8.

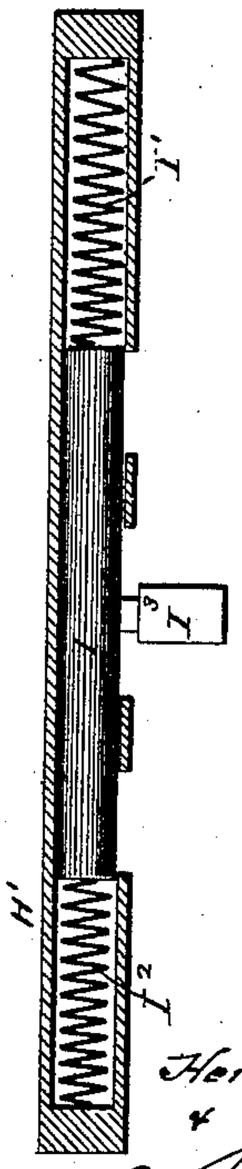
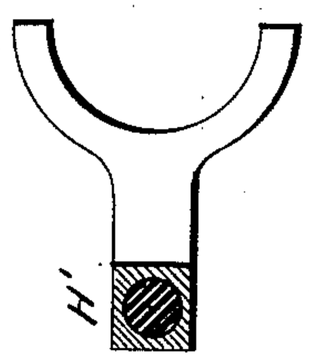


fig. 9



Witnesses.
J. R. Shumway
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(Model.)

5 Sheets—Sheet 5.

H. REYNOLDS & J. ENGLISH.

METAL SCREW MACHINE.

No. 266,891. Patented Oct. 31, 1882.

Fig. 13

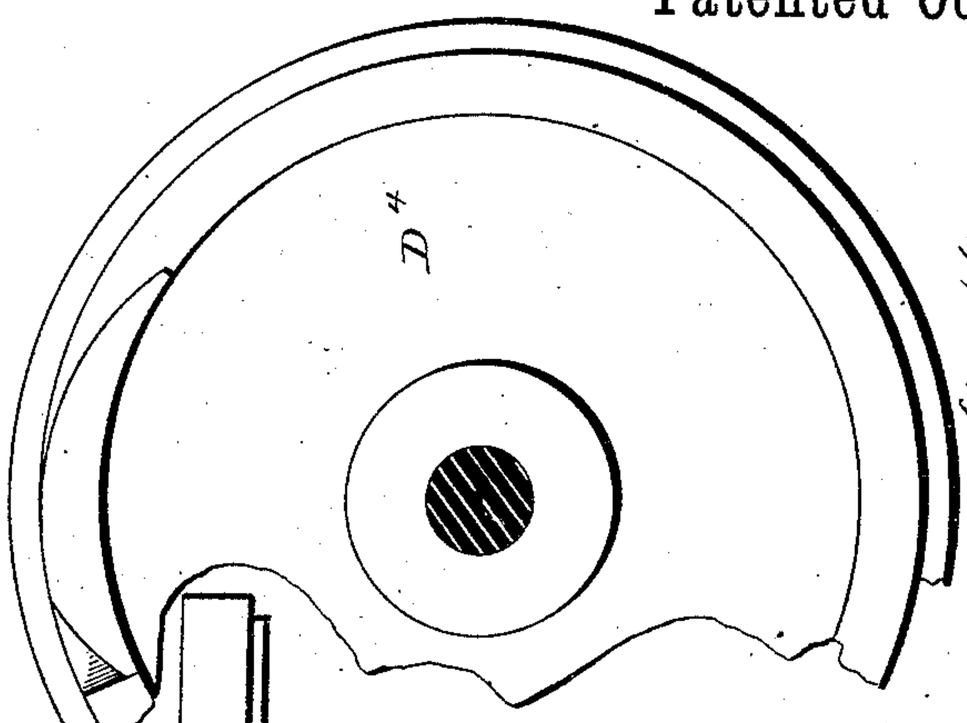


Fig. 14

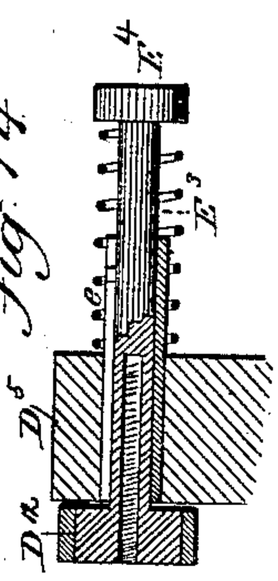


Fig. 10

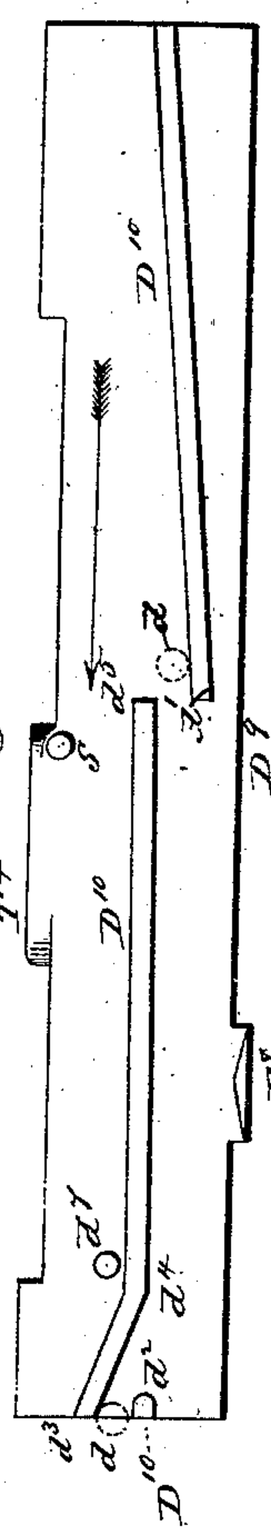


Fig. 11

Fig. 12

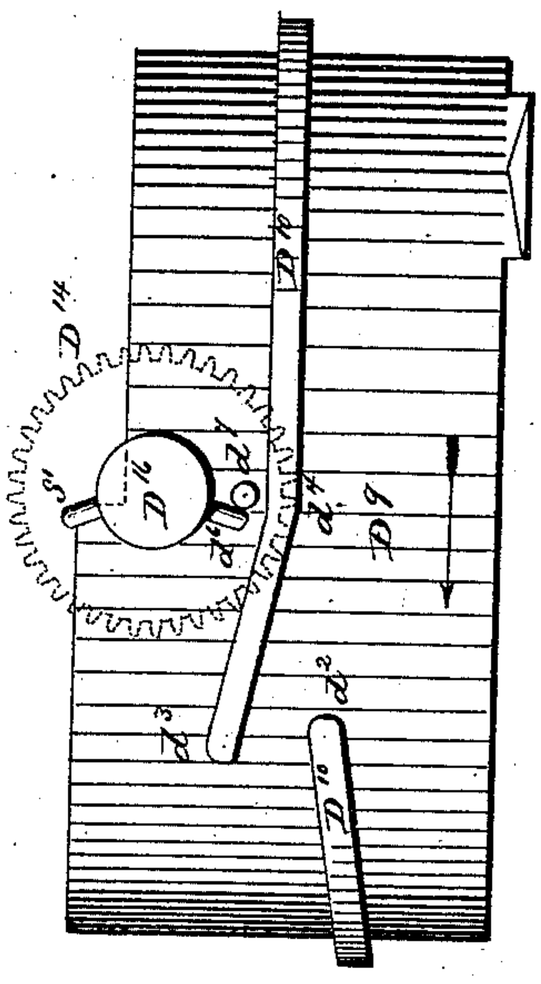


Fig. 16

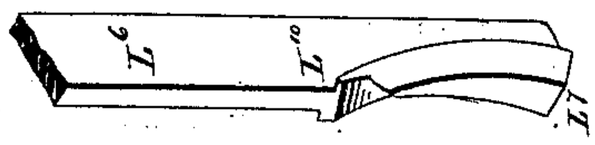


Fig. 17

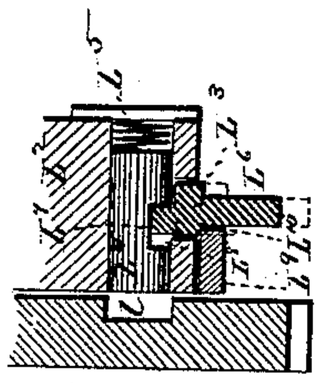
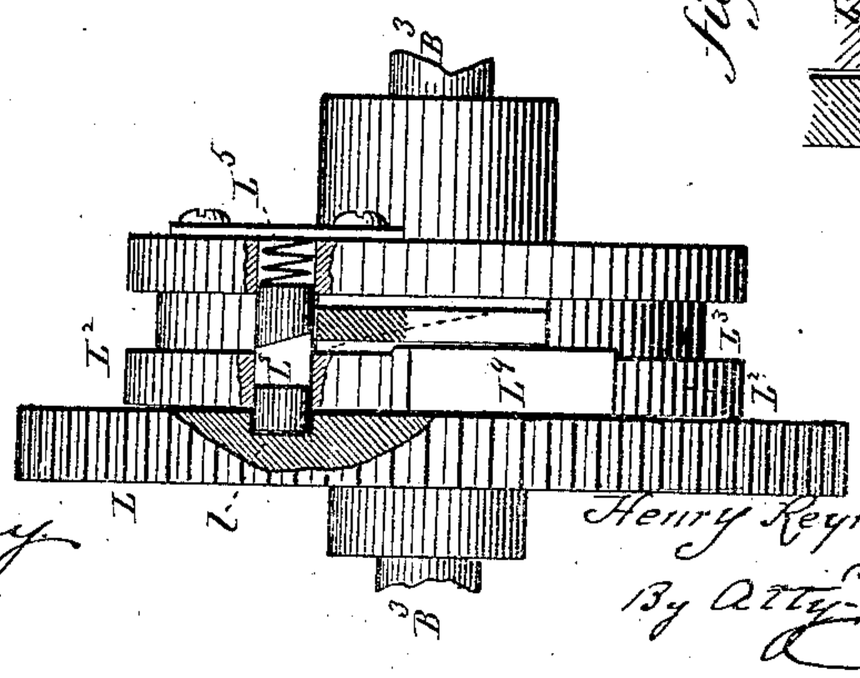


Fig. 15



Witnesses.
L. A. Shumway
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Henry Reynolds & James English
Inventors.
By Atty.

UNITED STATES PATENT OFFICE.

HENRY REYNOLDS AND JAMES ENGLISH, OF NEW HAVEN, CONNECTICUT, ASSIGNORS TO REYNOLDS & CO., OF SAME PLACE.

METAL-SCREW MACHINE.

SPECIFICATION forming part of Letters Patent No. 266,891, dated October 31, 1882.

Application filed June 23, 1881. (Model.)

To all whom it may concern:

Be it known that we, HENRY REYNOLDS and JAMES ENGLISH, of New Haven, in the county of New Haven and State of Connecticut, have invented a new Improvement in Metal-Screw Machines; and we do hereby declare the following, when taken in connection with the accompanying drawings and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1, a top or plan view; Fig. 2, front side view; Fig. 3, transverse section on line *x x*; Figs. 4 to 17, inclusive, detached views.

This invention relates to an improvement in that class of machines for making screws which are constructed to receive the rod from which the screws are to be made through a hollow mandrel. The screw-blank is formed by cutting down the rod. Then the thread is cut upon the body; and, finally, the screw is separated from the rod, the rod being then advanced for a second screw, and so on, the screws thus produced being what are commonly known as "milled" work.

The object of this invention is the construction of a machine which shall perform its work with greater facility and uniformity than has heretofore been done; and it consists in the construction, arrangement, and combination of mechanism, as hereinafter described, and particularly recited in the claims.

A represents the frame of the machine, which supports the operative mechanism; B, the driving-shaft, supported in bearings B′, and to which power is applied through a fixed pulley, B^2, thereon, or otherwise.

C is the mandrel, supported in bearings C′, and fitted at its inner end with a chuck, consisting of head C^2, in which gripping-jaws C^3 are hung to grasp the blank-rod in the usual manner for this class of machines. On the mandrel C is a movable clutch, C^4, splined to the mandrel, so as to revolve with it and yet be free for longitudinal movement. On the same mandrel is a loose collar, D, forward of the clutch, which is attached to or made a part of a pinion, D′. In rear of the clutch C^4 is a second loose collar, E, which is attached to or made a part of a pinion, E′. The faces of the two collars D E are constructed to engage with the adjacent faces of the clutch C^4 when that clutch is moved so as to bring those faces into contact—that is to say, if moved forward it engages the collar D, and if moved to the rear it engages the collar E. At a position intermediate between the two collars no engagement will be made with either. A constant revolution is imparted to the collar D from a gear, D^2, on the driving-shaft, in connection with the pinion D′, by intermediate gears, D^3 and D^4, the revolution of the collar D being in the forward direction—that is to say, in the direction for work upon the rod or blank. The other collar, E, is caused to revolve in the opposite direction by a gear, E^2, on the driving-shaft, working into the pinion E′ on the collar E, so that when engaged with the collar D the driving-shaft imparts a constant forward or working revolution to the said collar D, and when engaged with the collar E it imparts a constant reverse revolution to the collar E. Hence a corresponding revolution is imparted to the hollow mandrel C and to the rod held therein.

The jaws C^3 are hung in the mandrel upon pivots *a*, as seen in Fig. 5, their tail ends turning outward from the mandrel, the one in one direction and the other in the opposite direction, as seen at *a′ a′*.

On the mandrel, near the tails of the jaws, is a sleeve, C^5, arranged to be moved longitudinally out from or in between the tails of the jaws. The forward end of this sleeve is inclined or made cam shape, so that as it is moved forward between the tails of the jaws it forces them apart and closes the jaws upon the rod; but when moved in the opposite direction, as indicated in broken lines, Fig. 5, it releases the tails of the jaws and loosens their grasp upon the rod. The movement to open the jaws is produced by an inclined rib, C^6, (see Fig. 11,) on the surface of the cam C^7 on the cam-shaft B^3. This rib strikes the lower end of a lever, C^8, which is hung to a fulcrum, C^9, above, (see Fig. 5,) and is attached to the sleeve C^5, so that as the cam-rib C^6 strikes upon the front side of the lower end of the lever C^8 it will force it rearward, as indicated in broken

lines, Fig. 5, and draw the sleeve C^5 out from between the tails of the jaws, so as to cause the jaws to release their grip upon the rod. Instantly upon the release of the grip of the jaws upon the rod it (the rod) is moved forward by any suitable force applied at the rear—such as a spring, a weight, or it may be by hand—until the required length to make a screw projects from between the jaws. Then a reverse rib, C^{10}, on the same cam, C^7, strikes the lower end of the lever C^8 upon the opposite side, forcing it forward, and with it the sleeve C^5, between the tails of the jaws to force them apart and press the ends of the jaws upon the rod, so as to grip and hold the rod and cause it to turn with the revolving mandrel.

To make a self-adjusting pressure upon the jaws, so that they may be adapted to grasp rods of slightly-varying size, or to operate varying diameters of the same rod, the fulcrum C^9 at the upper end of the rod C^8 is made upon a spindle, C^{11}, with a spring, C^{12}, arranged to bear against the fulcrum end of the lever, and so that while the operation of the cam-ribs at the lower end is positive the upper end will give way under a too great force, so that as soon as the jaws have firmly grasped the rod the spring C^{12} will yield for the completion of the movement of the lever. Hence the grasp of the jaws upon the rib is limited or regulated by the force or power of the spring C^{12}, and this power may be adjusted by means of a nut, C^{13}, on the spindle C^{11}. The tails of the jaws are forced together by a U-shaped spring, C^{14}, its two ends being connected respectively to the two tails a' a' of the jaws, so as to force them together when the cam is withdrawn.

D^5 is the tool carrier or slide, which is arranged to move transversely across the machine upon a transverse guide, D^6. This transverse guide D^6 is arranged upon or made a part of a longitudinally-sliding carriage, D^7, the said carriage being arranged to be moved longitudinally between guides D^8. The longitudinal movement of the carriage D^7 is imparted by a cam, D^9, shown detached in Fig. 12, top view, and in Fig. 13, a partial end view, Fig. 10 being a diagram showing the entire surface of the cam on a reduced scale. On this cam D^9 is a rib, D^{10}, which works against a stud, d, extending down from the carriage D^7, as seen in Fig. 2. The advance movement of the slide begins with the end d' of the rib D^{10}. Broken lines indicate the stud d. (See Fig. 10.) The rib from that point running spirally over the surface of the cam advances the carriage D^7 toward the head of the mandrel, and with it carries the transverse slide D^5 to the extent of the inclination of the rib from the point d' to the other end, d^2, of that portion of the rib. At this point, as indicated in broken lines, Fig. 10, the next section of the rib at d^3 strikes the stud d upon the opposite side. The inclination of the rib from the point d^3 to the point d^4 is short and quick and opposite to that part of the rib from d' to d^2, so as to give a very quick return of the carriage D^7, carrying the transverse slide D^5. This brings the slide back to its point of starting, and from that point, d^4, to the end d^5 of the rib the slide remains stationary, as hereinafter described. The transverse slide D^5 carries the several tools necessary for doing the work upon the rod to produce the screw, (here represented as a milling-tool, D^{11}, and the screw-cutting die D^{12}.)

In Fig. 1 the slide D^5 is represented as in the position for presenting the milling-tool D^{11}. The rod having been advanced so as to leave the requisite length, D^{13}, projecting through the mandrel, as before described, the slide D^5 gradually advances by the action of the cam D^9, which forces the milling-tool D^{11} onto the end of the rod, reducing it to the size required for the body of the screw. This work accomplished, the slide quickly returns, as before described, and then it is necessary to give a transverse movement to the slide D^5 in order to present the screw-cutting die D^{12}. This transverse movement is imparted to the slide by means of a pinion, D^{14}, arranged in the carriage D^7 to work in a rack, D^{15}, on the transverse slide D^5. The shaft D^{16} of the pinion D^{14} extends down through the carriage to the cam D^9, and is there provided with a radially-projecting arm, d^6. On the cam D^9 is a radially-projecting stud, d^7, which, so soon as the slide has been returned, comes in contact with the arm d^6 of the shaft, (see Fig. 12,) and, as the cam revolves, turns the shaft D^{16} until the stud d^7 can pass the arm d^6, which imparts to the pinion D^{14} the requisite rotation to give to the slide D^5 the required transverse movement to present the next tool or screw-cutting die D^{12}. While the screw-cutting die is operating the straight part of the rib D^{10} is passing the stud d on the longitudinal slide, and hence imparts no longitudinal movement to the slide to advance the screw-cutting die.

It is difficult, not to say impossible, to construct and arrange a cam which shall give the required lead to screw-cutting dies, so as to follow the thread required to be cut. To provide a leading-screw to carry the screw-cutting die through its cutting operation necessitates a complication of mechanism, which it is desirable to avoid in machines of this class. To this end we have arranged a mechanism which will advance the screw-cutting die until it fully engages the blank, and the power which advanced it is then removed, and the die is left to work its way onto the body of the screw simply by the draft of the thread which is being cut.

The screw-cutting die D^{12} is arranged on the end of a hollow spindle, E^3, which extends through the transverse slide or tool-holder D^5, as seen in section, Fig. 14. The spindle is prevented from rotation by means of a spline or stud working in a longitudinal groove, e, in the spindle-bearing, leaving it free for longitudinal movement. On the rear end of the spindle E^3 is a head, E^4, and between which

and the back of the slide D^5 is a spiral or other suitable spring, the tendency of which is to hold the screw-cutting die against the face of the tool-holder D^5; but said spring yields so as to permit the die to be moved forward from the face of the said tool-holder. The screw-cutting die has now been presented into line with the blank by the transverse movement of the tool-holder, as before described, and at the same time into line with a spindle, E^5, which is arranged in bearings E^6 on the carriage D^7 free for longitudinal movement. From the spindle E^5 an arm, E^7, extends down through the slide into the path of an inclined rib, E^8, on the cam D^9, which, as the cam revolves, strikes in rear or outside of the arm E^7 and forces it forward, carrying with it the spindle E^5 against the end of the spindle E^3, which imparts to the spindle E^3 a corresponding longitudinal movement, carrying the screw-cutting die onto the revolving blank, causing the die to cut the thread a short distance on the blank, sufficient to make a firm engagement therewith. So soon as the die has thus engaged the revolving blank the rib E^8, which advances the die, passes away from the arm E^7, relieving that arm from the forward pressure, and then a spring, E^9, or other suitable mechanism withdraws or returns the spindle E^5, leaving the screw-cutting die free from pressure or other movement than that which it acquires by the thread which it is cutting upon the blank. As the screw-cutting die is brought into its position in line with the blank to be threaded it is also brought into connection with a bar, F, arranged in guides F′, so as to be free for longitudinal movement and parallel with the mandrel. This engagement is made by a stud, F^2, on the die, passing into a fork, F^3, on the bar F, (see Fig. 2,) and so that after such engagement the bar will be moved longitudinally with the die. The object of moving the bar is to shift the clutch C^4 for reversing the revolution of the mandrel to unscrew the threaded blank from the die, it being understood that while the work is being performed upon the blank the clutch is engaged with the collar D on the mandrel, as seen in Fig. 7, and is there held by the clutch-arm H, attached to a clutch-bar, H′, arranged in suitable bearings for longitudinal movement only. A spring-pressure is applied to operate upon the clutch-bar H′ to throw it in either direction, so that the clutch may engage with either of the collars D or E, as the case may be. The clutch is held in engagement with the collar D by means of a bell-crank lever-latch, H^2, hung upon a stationary bar, H^3, in front of the clutch-bar H′, as seen in Fig. 7, the shoulder of the latch engaging with a projection or shoulder, *h*, on the clutch-bar. As the cutting of the thread is being completed the bar F, moved by the advancing die, brings the arm H^4, projecting from the said bar F, against the other arm of the latch H^2, which raises the latch from its engagement with the shoulder *h*, and permits the spring, applied as hereinafter described, to force the clutch-bar H′ backward, and so as to carry with it the clutch C^4 from its engagement with the collar D into engagement with the reverse collar E, thus reversing the direction of revolution of the blank, and causing the die to withdraw therefrom. When the clutch-bar has been thrown, as described, to engage the clutch with the sleeve E it is caught by a bell-crank lever-latch, H^5, which engages a shoulder, *h*′, on the clutch-bar. The latch H^5 is hung upon the same bar, H^3, as the first latch. The spring which forces the clutch-bar H′ is applied first to throw the clutch in one direction and then at the proper time in the opposite direction. The construction whereby the spring is so applied is shown in Fig. 8. The bar H′ is made tubular, closed at both ends, and centrally within the bar is a follower, I, arranged to be moved longitudinally therein. A spring, I′, is arranged between the closed end of the bar and that end of the follower, and at the opposite end is a similar spring, I^2, the one substantially counterbalancing the other. From the follower I a stud, I^3, extends downward, and stands in a notch or between studs *i i* on the sliding bar I^4, (see Fig. 7,) the bar I^4 being arranged for longitudinal movement in bearings I^5. To the bar I^4 a longitudinal or back-and-forth movement is imparted by means of the cam C^7 on the cam-shaft, which works in a notch in the end of an arm, I^6, extending down from the bar I^4. (See Fig. 2.) The cam C^7 is shaped, as seen in Fig. 11, between the points *i*′ *i*² to move the bar I^4 in both directions within a short space. The position seen in Fig. 2 is that in which the cam C^7 has reached the position which carries the bar I^4 to its most forward position and just after the clutch has been thrown into connection with the sleeve D. As the cam C^7 continues its movement it will force the bar I^4 to the rear, as seen in Fig. 7, correspondingly moving the follower I in the clutch-bar H, and compress the spring I^2, as seen in Fig. 8, preparatory for the movement of the clutch-bar, which is to change the clutch from its engagement with the sleeve D to the sleeve E, as before described. The clutch-bar is held by the latch H^2 while this compression takes place, as seen in Fig. 7.

As soon as the latch H^2 is disengaged, as before described, the spring I^2 is free to react, and forces the clutch-bar rearward and the clutch C^4 from its engagement with the collar D into engagement with the collar E, and the shoulder *h*′ on the clutch-bar into engagement with the latch H^5 to hold it in that position and until the next action of the cam C^7 moves the bar I^4 forward, when a stud, i^3, on the bar I^4 will strike the lower arm of the latch H^5 and trip it, so as to permit the clutch to be returned into connection with the sleeve D, the forward movement of the bar I^4 having compressed the spring I′ in the clutch-bar before the tripping takes place, so that the said spring I′ is in condition to force this movement of the clutch-

bar and clutch. The latches are each provided with a spring to force them into engagement with their respective shoulders. So soon as the screw-cutting die has made suitable engagement with the screw, as before described, the cam-shaft B^3 is disconnected from the driving-shaft, so that while the threading is being performed the cam-shaft remains stationary. The mechanism for making the disconnection is illustrated in Figs. 15, 16, and 17.

On the cam shaft B^3 is a gear-wheel, L, loose on the shaft, and which engages with the pinion L′ on the driving-shaft B by a train of gearing, as seen in Fig. 3, so that the wheel L has a constant revolution speeded by the intermediate gearing, so as to give the proper relative rotation to the shaft B^3. Fast upon the shaft B^3, and running close to the wheel L, is a disk, L^2, in which is an annular groove, L^3. In the disk L^2 is a bolt, L^4, arranged in the disk parallel with its axis, (see Figs. 15 and 17,) and provided with a spring, L^5, the tendency of which is to force the bolt toward the wheel L. In the side of the wheel L, and next the disk L^2, is a recess, *l*, the same radial distance from the center of the shaft as the bolt, so that when the bolt and the recess *l* coincide, as in Fig. 15, the bolt may spring into the recess *l* and engage the wheel L with the disk and its cam-shaft B^3, so that the cam-shaft B^3 will revolve in its regular relation to the driving-shaft so long as the bolt is in such engagement with the wheel L. At the time when the threading-die has fully commenced its work the bolt L^4 is withdrawn from the wheel. This withdrawal is produced by means of a lever, L^6, the lower end of this lever being constructed, as seen in Figs. 16 and 17, with a cam-piece, L^7, to stand in the groove L^3 in the disk. The bolt lies partly in the groove L^3 of the disk, and in it is a notch, L^8, which, as the disk revolves, engages upon the inclined surface of the cam-piece L^7, and, the revolution of the disk continuing, that cam-piece causes the bolt L^4 to move away from its engagement with the wheel L, as seen in Fig. 17. So soon as the withdrawal of the bolt L^4 is completed the disk L^2, with the cam-shaft B^3, stops, the wheel L moving the notch *l* away from the bolt. As re-engagement of the wheel L cannot be made so long as the bolt is thus held by the lever L^6, the said lever is held out of active position, as indicated in broken lines, Fig. 17, until about the time the disconnection is required, and is then brought into play by means of a cap, L^9, on the disk, which partially overlaps the groove L^3, as seen in Figs. 15 and 17. On the side of the lever is a shoulder, L^{10}, with which the cap L^9 engages as the disk revolves. This engagement occurs just before the disconnection is required, and the engagement draws the lower end of the lever toward the disk and the cam-piece L^7 into the groove in the path of the notch in the bolt to operate, as before described.

The upper end, L^{11}, of the lever L^6 turns inward toward the sliding bar F, and rests against it when the lower end is free or out of the groove in the disk, being held there by a spring, L^{12}. On the sliding bar F, immediately forward of the end L^{11} of the lever L^6, is a projection, L^{13}. The lower end of the lever is drawn in, as before described, just as the screw-cutting die commences its work. Then the projection L^{13}, moving with the bar F, passes behind the end L^{11} of the lever, and prevents the return of the lever when freed from the cap L^9, so that the cam-piece L^7 is still held in the groove L^3 of the disk. So soon as the lever is thus held the cap L^9 is carried beyond the shoulder L^{10}, so as to leave that end of the lever free, so far as the cap L^9 is concerned. The lever will be thus held, locking the bolt in its withdrawn condition until the screw-cutting dies have retreated and returned the bar F, so that the end L^{11} of the lever can escape from the projection L^{13}, as seen in Fig. 1. Then the upper end, L^{11}, springs back against the bar F, withdrawing the cam-piece L^7 from the groove, as seen in broken lines, Fig. 17, and leaving the bolt free to re-engage the wheel L whenever the corresponding recess, *l*, in the wheel comes into line therewith, which is immediately after the screw-cutting dies have been withdrawn, or near that point. The screw is not completely formed on the end of the rod, and the final operation of cutting off is to be performed.

P is a cutter-lever, hung upon a fulcrum, P′, in rear of the axial line of the machine. (See Figs. 1, 2, 3.) One arm of this lever extends forward toward the center, and is there provided with a cutter, P^2. The other arm, P^3, extends down and engages with a groove in a side cam, P^4, on the cam-shaft B^3, the groove being seen in broken lines, Fig. 3. This cam forces the arm P^3 of the lever outward, and brings the cutter downward and inward onto the rod back of the head of the screw, and so as to cut the completed screw from the rod.

In some cases a second cutter-lever is employed, hung upon the opposite side of the mandrel, for the purpose of facilitating the cutting-off operation; but one only is shown in the drawings. This cutter or cutters may also shape the upper surface of the head. The screw cut off falls from the machine, the jaws are then opened, and the rod advanced for the second screw, as before described. After the final operation of the screw-cutting die the transverse slide D^5 requires to be returned to its first position, and this is accomplished by a radially-projecting stud, S, on the cam D^9 striking an arm, S′, on the shaft of the wheel D^{14}, nearly opposite the arm d^7, so as to reverse the direction of the movement of the wheel D^{14} and return the slide.

To prevent accidental movement of the tool-holder after it has been once set, or to insure its stopping at exactly the right position, a latch, T, is hung on the carriage D^8 upon a pivot, *t*, with a tail-piece, T′, extending therefrom down through the carriage toward the

cam D^9, and forward of the pivot of the latch, and so that by raising the tail-piece T′ the end of the latch is thrown backward, or when free the spring T^2 will throw the ends of the latch forward:

The tool-holder D^5 is constructed with notches T^3 on its rear edge, each in such positions relatively to the respective tools that the end of the latch T will enter the notch which is presented before it when the tool is in its proper relative position to the rod, and secure the tool-holder in that position until the latch is removed. To withdraw the latch at the proper time, an incline, T^4, on the cam D^9, arranged at the point where the removal of the latch is required, raises the tail of the latch and turns the latch from its engagement with the tool-holder, but will escape therefrom in time for the latch to engage the tool-holder at the next position.

The distance to which the screw-cutting die will advance depends upon the position of the arm H^4 on the bar F. If it be nearer the arm of the latch H^2, the latch will be tripped sooner; hence a shorter screw. If farther off, it will be tripped later; hence a longer screw. For the purpose of adapting the machine to varying lengths of screw the said arm H^4 should be made adjustable on the bar F.

In case more tools are required to perform the work on the screw—as, for instance, more than one mill to cut the body of the screw or shape the head, or both—the number of arms on the lower end of the shaft of the gear D^{14} may be increased, and corresponding studs arranged on the cam D^9. In that case the cam D^9 will be provided with additional ribs, which will give the forward-and-back movement to the tool-holder. For this purpose the ribs on the cam may be made adjustable or interchangeable, and the gears changed to give the necessary rotation to the cam-shaft.

We claim—

1. The combination of a chuck or holder for the blank to be operated upon, with a tool-holder arranged on a carriage and in guides on said carriage at right angles to the axis of the chuck, said carriage arranged on guides parallel to the axis of said chuck, and means, substantially such as described, to impart longitudinal movement to said carriage on its guides and transverse movement to said tool-holder on its guides, substantially as described.

2. In a screw-making machine substantially such as described, the combination of a longitudinally-sliding carriage, with a tool-holder carrying the several tools and arranged upon said carriage on transverse guides, and mechanism, substantially such as described, to impart to said carriage its longitudinal or forward-and-back movement, and to the said tool-holder a transverse movement to present the several tools for work upon the rod and return the said sliding carriage after the tools have performed their respective operation, and a locking device, substantially such as described, to engage said tool-holder as each tool is presented for work upon the rod, substantially as described.

3. In a screw-cutting machine substantially such as described, the combination of the hollow mandrel C, carrying the jaws C^3, the tails of the jaws extending outside the mandrel, with the inclined sleeve C^5, movable longitudinally on the mandrel between the tails of the jaws, and a lever hung to said sleeve, a cam operating upon one arm of the said lever to move said sleeve forward and back to close and open said jaws, and a fulcrum upon which the other arm of the lever is hung, with a spring on said fulcrum, against which the said arm of the lever bears, so as to permit the lever to yield so soon as the power of said spring is overcome, substantially as described.

4. In a screw-making machine substantially such as described, a longitudinally-sliding carriage, a tool-holder movable transversely upon said carriage to present the respective tools for operation upon the blank, a gear-wheel hung in said carriage, working in a rack on said tool-holder, and a cam to impart a back-and-forth longitudinal movement to said carriage, and also, at the proper time, to impart rotation to the said gear-wheel and corresponding transverse movement to the tool-holder, substantially as described.

5. In a screw-making machine substantially such as described, the combination of the longitudinally-movable screw-cutting die, the bar F, movable longitudinally with said die, the clutch-bar H′, arranged to slide parallel with said bar F, the clutch-arm H, extending from said clutch-bar into engagement with the clutch C^4, and latch-levers, substantially as described.

6. The combination of the longitudinally-movable screw-cutting die with the bar F, lever L^6, projection L^{13} on said bar, the disk L^2, fixed to the cam-shaft, the gear L, loose on said shaft and engaged with the driving-shaft, inclined rib L^7 on the lower end of the lever, bolt L^4 in the disk, and cap L^9 on the disk, operating to draw the rib L^7 into the path of the notch in the bolt, substantially as described.

7. The combination of the longitudinally-movable screw-cutting die, the bar F, movable longitudinally with said die, the clutch-bar H′, provided with an arm extending therefrom to the clutch on the mandrel, a follower within said clutch-bar, provided with a spring at each end, a cam to impart to said follower a longitudinal movement to compress the spring first at one end and then at the other, a latch to engage the said clutch-bar at its extreme movement, an arm on said bar F to trip the latch which engages the clutch with the mandrel to impart a forward rotation, and mechanism, substantially such as described, to engage the mandrel for reverse rotation, substantially as described.

8. In a machine for automatically making screws from the rod, the combination of the hollow mandrel carrying a chuck to grasp the

rod as the rod is presented thereto through the said hollow mandrel, a longitudinal carriage, a tool-holder arranged in transverse guides thereon, and carrying a series of tools which are successively presented in axial line with the mandrel for operation upon the projecting end of the rod, and a lever hung upon a pivot to swing in a plane at right angles to the axis of the mandrel, one arm of said lever engaged with a cam on the cam-shaft to impart a swinging movement to said lever in said plane, the other arm extending forward and carrying the cutter rigidly attached thereto, and which, by the vibratory movement of the lever is forced inward to cut the screw formed on the end of the rod by said tool, substantially as described.

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Witnesses:
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