(No Model.) 5 Sheets—Sheet 1.

A. JOHNSTON.

METAL SCREW MACHINE.

No. 261,816. Patented July 25, 1882.

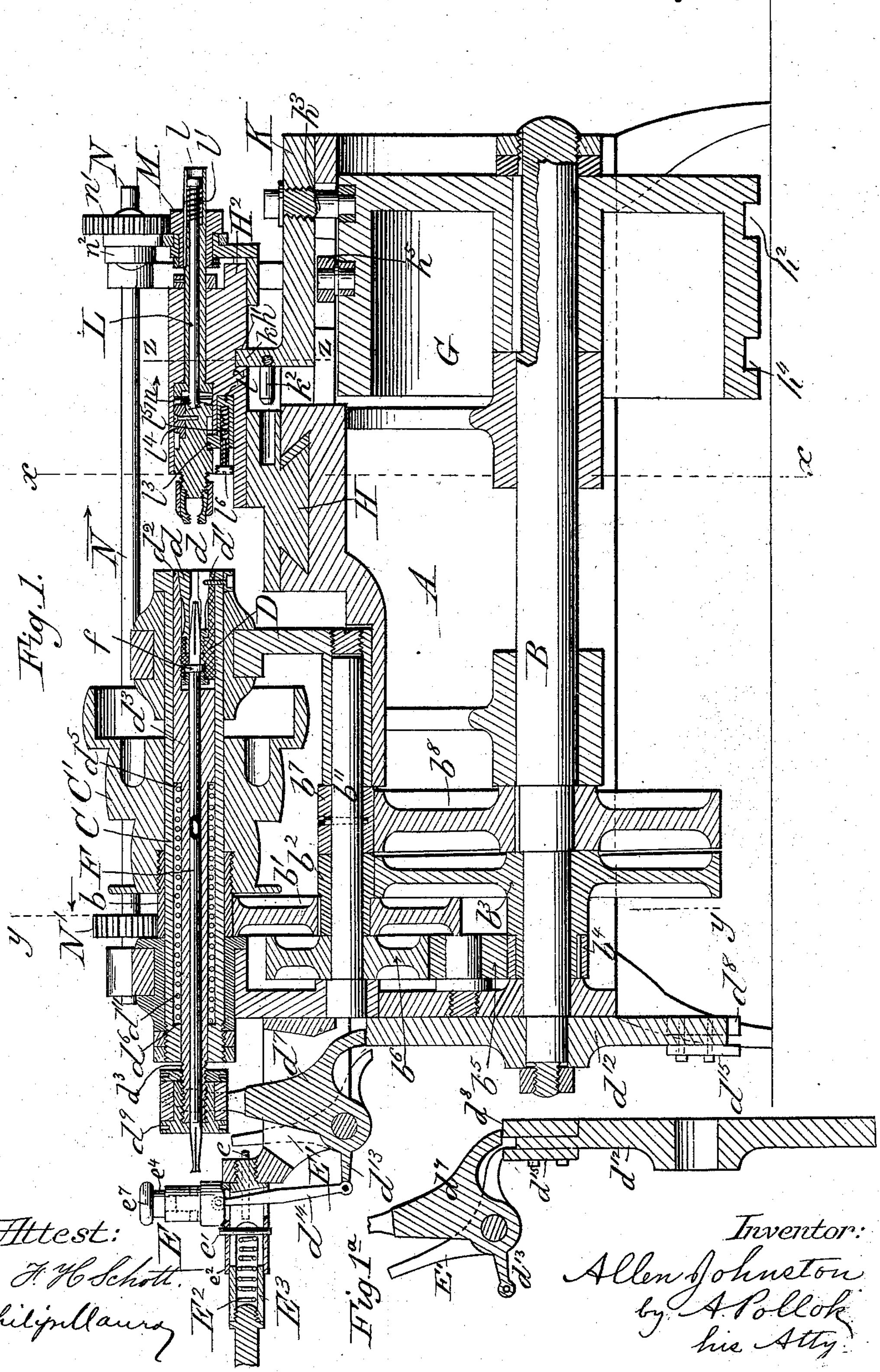

Fig. 1.

Fig. 1a

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by A. Pollok
his Atty.

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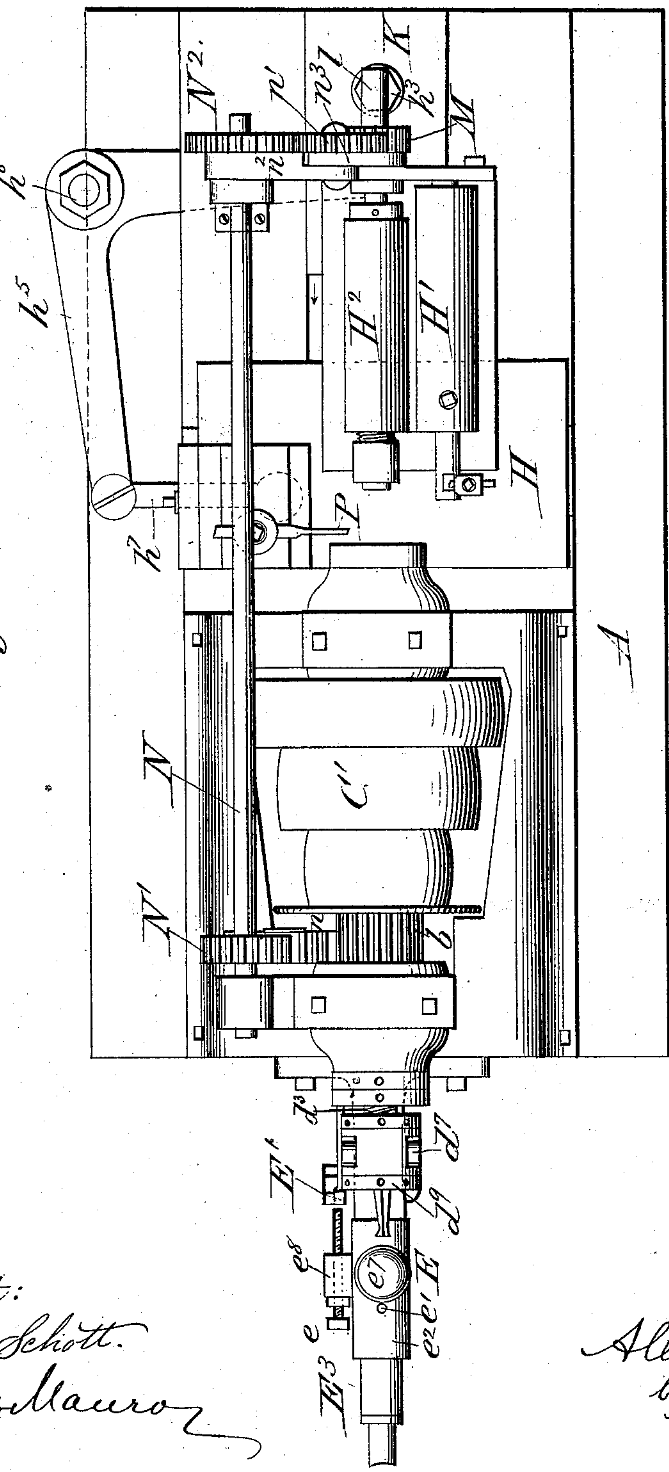

Fig. 2.

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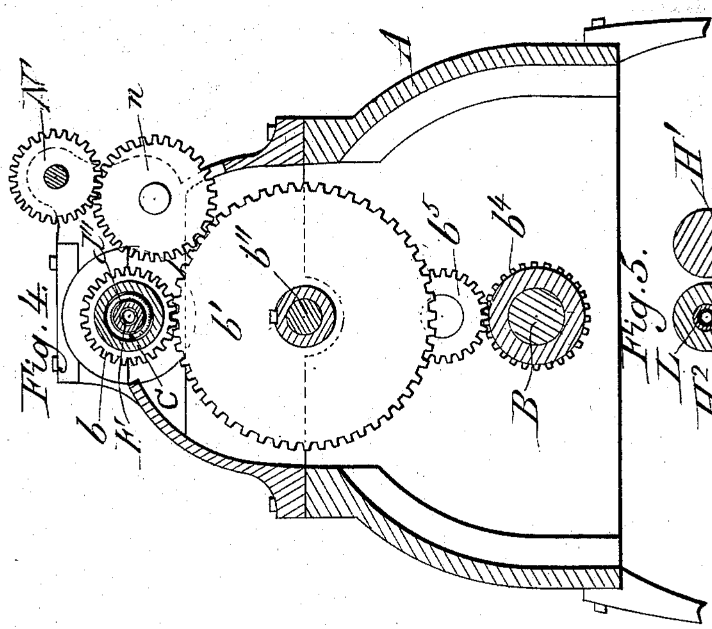

Fig. 4.

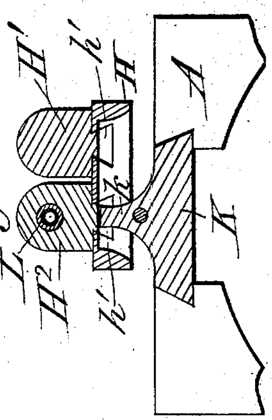

Fig. 5.

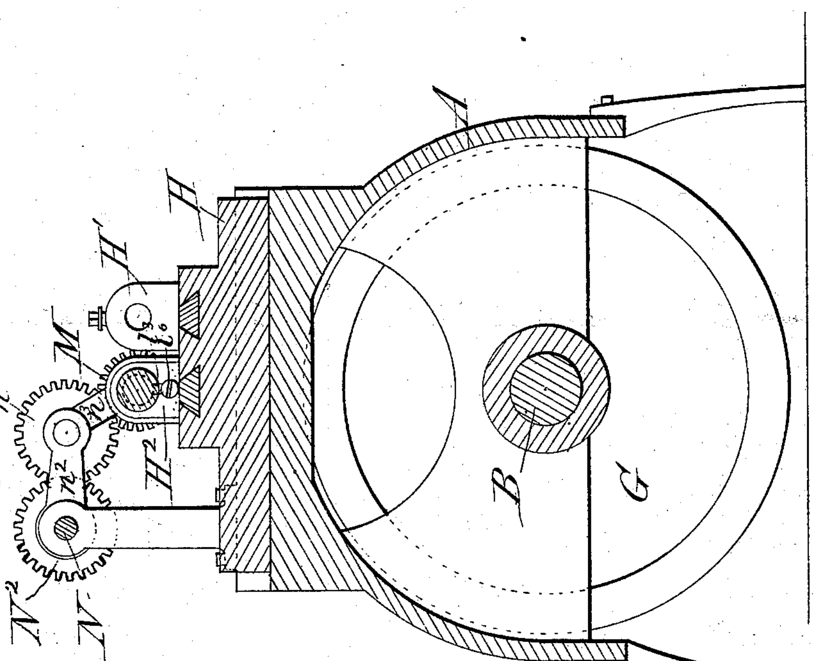

Fig. 3.

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Fig. 6.

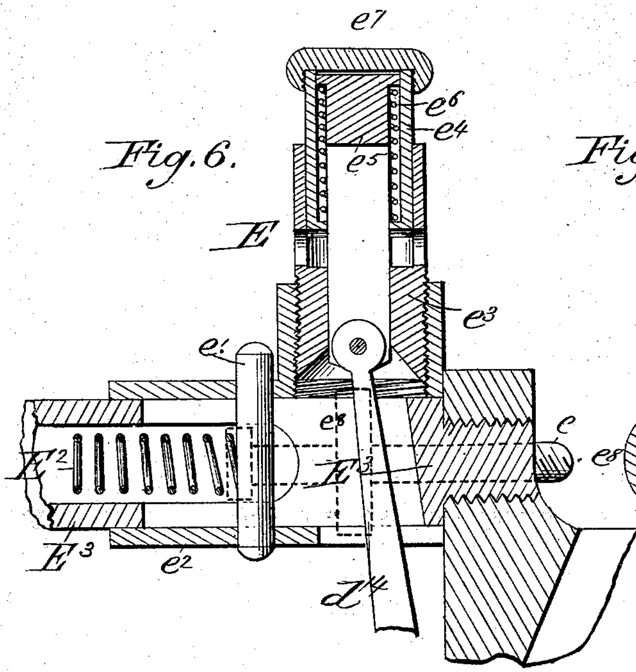


Fig. 7.

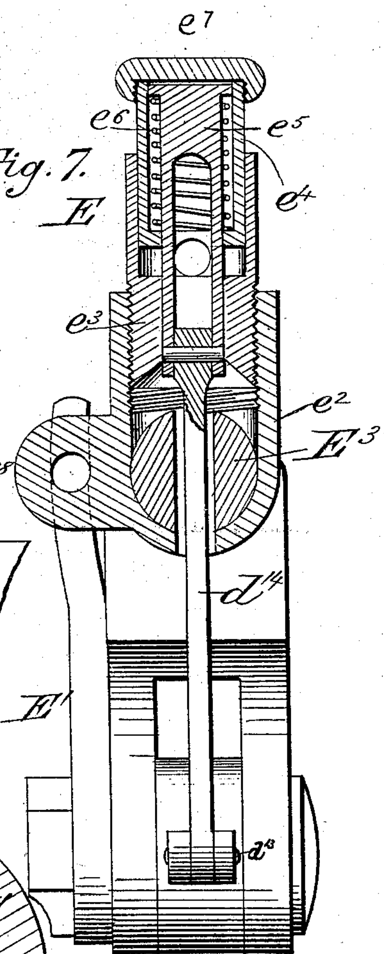
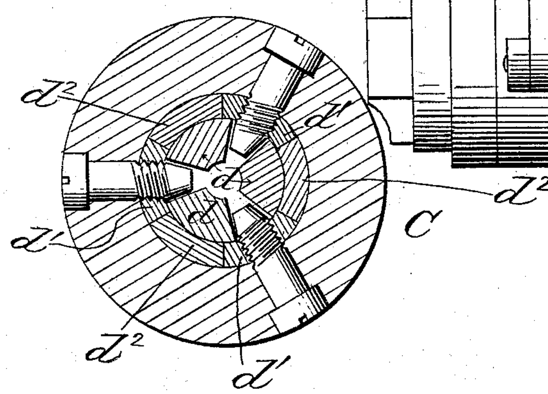


Fig. 8.



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(No Model.) 5 Sheets—Sheet 5.

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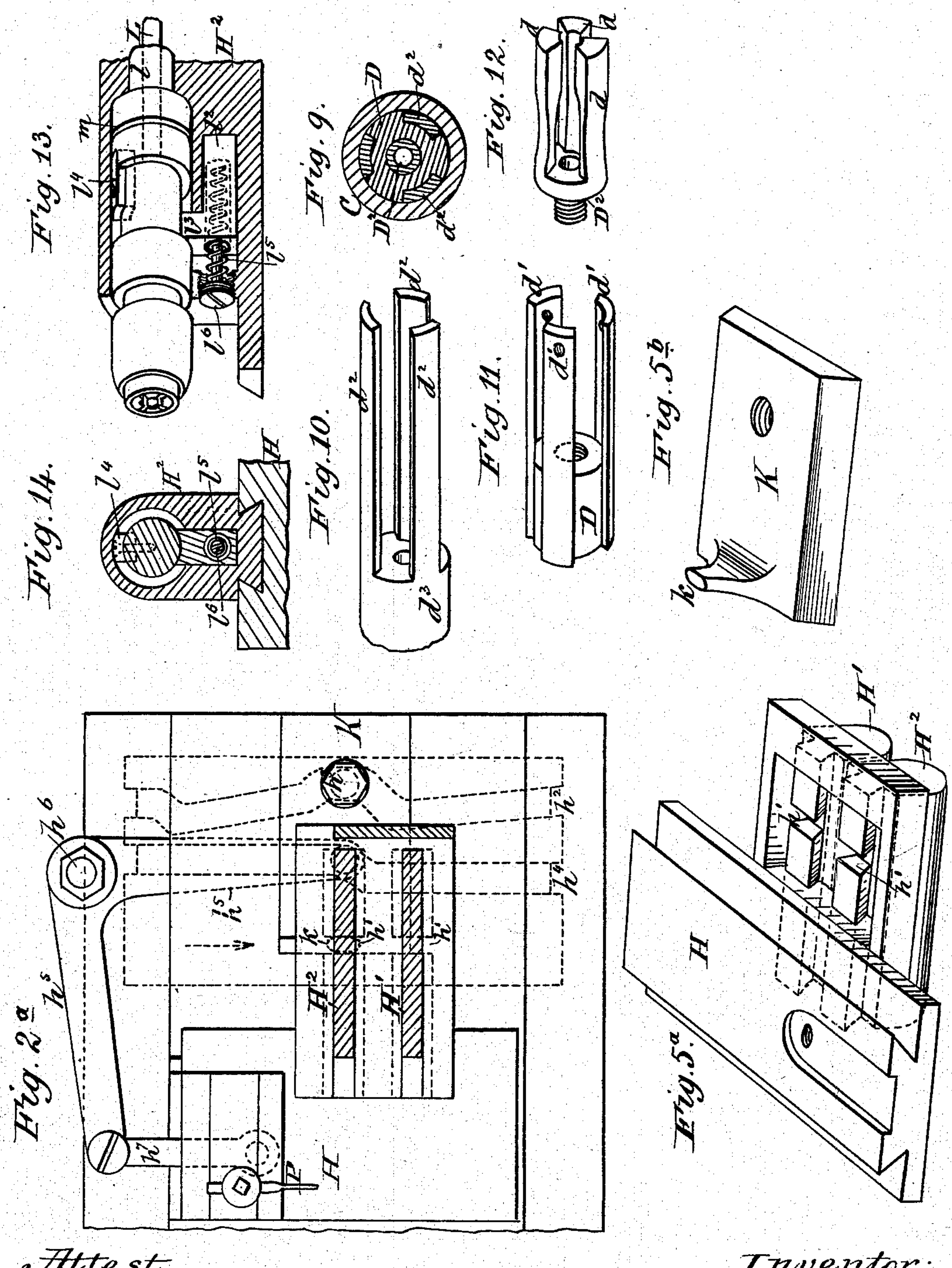

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UNITED STATES PATENT OFFICE.

ALLEN JOHNSTON, OF OTTUMWA, IOWA.

METAL-SCREW MACHINE.

SPECIFICATION forming part of Letters Patent No. 261,816, dated July 25, 1882.

Application filed July 21, 1881. (No model.)

To all whom it may concern:

Be it known that I, ALLEN JOHNSTON, of Ottumwa, Wapello county, Iowa, have invented a new and useful Improvement in Metal-Screw Machines, which improvement is fully set forth in the following specification.

This invention relates to automatic machines for making screws from the end of a rod, and has particular reference to mechanism for forming the thread upon the rod, to the feed mechanism, to the clutch, and to the general construction of the machine.

In the machine subject-matter of Letters Patent No. 241,806, granted to me May 24, 1881, a thread is formed by revolving both the chuck by which the rod is clamped and the die by which the thread is cut in the same direction, but at different speeds, instead of revolving the chuck only, as customary. As described in the patent, the motion is communicated to the die-spindle and chuck-spindles by separate belts, which, on account of slips and other causes, render it difficult to determine with precision the relative velocities of the two spindles, and consequently the rate of cutting by the die. In the present invention the difficulty is overcome by gearing the die-spindle to the chuck-spindle so as to be revolved at a definite rate of speed during the cutting operation. In the present invention also the gearing is so arranged as to allow the movements necessary to have a series of two or more tools, including the die, operate successively upon the rod. When a series of tools have been employed they have been usually held in an intermittingly-rotating turret carried by a reciprocating slide, and the gearing can be adapted to allow the die-spindle to partake of these motions; but it is preferred to use a laterally-moving tool-holder, as described in my aforesaid patent and in my application of October 22, 1880, and the gearing is shown herein embodied in a machine with such tool-holder. The same arrangement of gearing could be employed to rotate the die in unthreading; but it is preferred to hold the die stationary and rotate the chuck to release the threaded rod from the die. An improved safety-clutch, hereinafter described, is provided for the purpose.

The mechanism as herein shown for bringing the tools successively into position differs as well from that commonly employed as from that described in my aforesaid patent and application in having the tools separately movable in the tool-holder, so that the latter need have no longitudinal motion, but only the motion required to present the tools in line with the chuck. For this purpose it is preferred to have the tool-holder move laterally in ways of the frame.

The improved feed mechanism comprises a clamp which has four motions imparted by suitable means. As the jaws of the chuck are released it closes upon the rod, then advances it the proper distance while the chuck-jaws are open, releases it when these close, and lastly returns for a new feed. An adjusting device is employed to regulate the amount of feed.

In connection with the feeder friction devices at opposite ends of the chuck-spindle are employed, so as to prevent, when a new rod is inserted, the remnant of the last rod from being carried by momentum too far between the chuck-jaws or the newly-inserted rod from being withdrawn when the feeding-clamp returns.

Heretofore in turret-machines a friction-feeder has been employed; but it differs from the feeder above indicated in having but two motions—backward and forward—and in exerting a constant instead of an intermittent pressure on the rod. The friction-feeder, moreover, rotates with the chuck, which the improved feed-clamp does not do.

The present invention further comprises the combination, with a rotating chuck and lateral-moving tool-holder, of a feeder for advancing the rod through the chuck.

In the machine subject-matter of my aforesaid patent and application, in which there is a lateral-moving tool-holder, a length-gage is employed. The combination of the feeder with the other parts not only effects a saving of considerable time by making the feed when the tools are withdrawn, but also enables the cams and connections for operating the length-gage to be dispensed with.

The particular construction of the chuck and special combination and arrangement of various elements in the machine, as hereinafter set forth, also form part of the invention.

In order that the invention may be fully understood, and that those skilled in the art to which it appertains may be able to make and use the same, what is deemed the best mode of carrying it into effect will now be described, in connection with the accompanying drawings, which form a part of this specification, and represent a screw-machine embodying the invention.

Figure 1 is a central vertical longitudinal section; Fig. 1^a, a partial section in the plane of Fig. 1, showing in a different position the cams for opening and closing the chuck-jaws and for operating the feeder; Fig. 2, a plan of the machine; Fig. 2^a, a plan partly in section, showing the mechanisms for operating the screw-forming tools; Fig. 3, a sectional elevation on line *x x*, Fig. 1; Fig. 4, a sectional elevation on line *y y;* Fig. 5, a sectional elevation on line *z z;* Figs. 5^a and 5^b, perspective views, respectively, of the tool-holder and of the slide for advancing the tools, the tool-holder being shown bottom upward; Figs. 6 and 7, enlarged views in longitudinal and transverse sectional elevation of the feed-clamp in planes at right angles to each other; Fig. 8, an enlarged cross-section of the chuck at the front end, (left hand, Fig. 1;) Fig. 9, a cross-section on a smaller scale near the rear end; Figs. 10, 11, and 12, perspective views of the three parts of the chuck—to wit, the wedges, stay-pieces, and chuck-jaws; and Figs. 13 and 14, views, respectively in perspective and longitudinal section and in cross-section, illustrating the construction of the threading-tool. The arrows adjoining the dotted section-lines indicate the direction in which the views are taken.

Similar letters of reference indicate like parts wherever used.

A represents the frame of the machine, and B is the main shaft, upon which the cams for bringing the tools successively into operation are mounted. The shaft B derives its motion from the chuck-spindle C through the intermediate gears, b b' b^2 b^3 b^4 b^5 b^6 b^7 b^8. The gear or idler b^5 may be mounted on a shaft adjustable in an arc-limb, so that gears of different sizes may be substituted for the gear b^4 for the purpose of changing speed. The gears b^6 and b^7 are keyed to the shaft b^{11}, and the gear b^8 to the main shaft, and the gear b to the chuck-spindle, while the gears b' and b^2 are secured together and turn loosely on the shaft b^{11}, and the gears b^3 and b^4 are similarly arranged on the main shaft.

C' is the drive-pulley for the chuck-spindle. The head of the chuck-spindle is solid, and contains the chuck-jaws and the operating-wedges. The chuck-jaws d are formed by splitting a hollow conical tube, D^2, Fig. 12, a portion of its length, into, say, three portions, and hollowing out these portions on the exterior, so as to give the necessary spring to the jaws. The wedges d^2, equal in number to the jaws, are formed by milling slots in the end of tube d^3, provided with a conical interior corresponding with the conical exterior of the chuck-jaws. The chuck-jaws are screwed into the tube D, which is bored out at the end to receive them, and is grooved and slotted, so as to leave guideways for the wedges d^2. The stay-pieces d', which remain between the guideways and alternate with the wedges, (see Fig. 8,) are fastened by screws to the head of the spindle. As shown, the ends of the screws project between the chuck-jaws. This construction makes a very simple and efficient chuck, easily made, certain in action, and not liable to wear loose or get out of order. The tube d^3 is pressed forward, so as to tighten the jaws of the chuck upon the stock by means of the spiral spring d^{11} surrounding the tube d^3, and fitting against a shoulder, d^5, on said tube, and a similar shoulder, d^6, on the interior of the spindle. The tube d^3 is retracted, so as to relieve the stock from the pressure of the chuck-jaws for feeding by means of the forked bent lever d^7, actuated by the cam d^8, bolted to wheel d^{12}, which is keyed to the main shaft. The fork of lever d^7 fits in a collar, d^9, on the end of tube d^3. When the chuck-jaws are opened the rod to be made into screws is pushed forward a definite length by the feed-clamp E. This clamp is opened and closed by an arm, d^{13}, on the lever d^7, through the intermediary of a jointed rod, d^{14}, and is moved forward and back by the action of the lever E' and spring E^2. The lever E is operated by a cam, d^{15}, bolted to the wheel d^{12}, and acts against the end of a screw, e, fastened to the clamp E. The bar E^3, which supports the feed-clamp, is fastened to an arm bolted to the frame of the machine, and is slotted for the passage of the bolt e' and jointed rod d^{14}, the slot being of sufficient length to allow of the necessary movement of these parts in feeding. It is bored out to receive the spring E^2, which bears at one end against the bolt e', fastened to the clamp E, and at the other against a rod screwed into the tube; or it may be against a portion of the tube itself.

The clamp (see Figs. 6 and 7) consists of a slide, e^2, a lower jaw, e^3, an upper jaw, e^4, a follower, e^5, a spring, e^6, and a cap-piece, e^7. The slide e^2 encircles the bar E^3, and is provided on the side with a lug e^8 in a threaded hole in which the screw e engages. To it the bolt e' is fastened, and by it the other parts of the clamp are carried. The lower jaw, e^3, is pierced with a hole for the passage of the rod from which the screws are to be made, and is bored out to receive the upper jaw, e^4. It is connected with the slide e^2 by a screw-joint, so that it can be adjusted for clamping rods of different sizes. The spring e^6 is held between an external shoulder on the follower e^5 and an internal shoulder on the upper jaw, e^4, so that the pressure of the follower is conveyed through the spring. The cap e^7 screws over the top of the upper jaw and excludes the dust from the interior. It may also, by contact with the upper end of the follower, be made to lift the upper jaw positively.

In the interior of the chuck-spindle is a tube, F, (see Fig. 1,) which is held from endwise movement by a collar, f, and has its ends split to form springs or friction devices, which maintain a slight pressure on the rod at both ends of the spindle. These springs or friction devices co-operate with the feed-clamp in the following way: When a rod becomes so short that it is no longer held in the clamp a new rod is inserted, so that its front end acts against the rear end of the short rod, but in so acting the latter is no longer held by the clamp, and the momentum acquired is liable to carry it too far in the chuck, while the new rod, not being held by the chuck, is liable to be drawn back by the clamp. The springs or friction devices overcome the difficulty, being made of sufficient strength to prevent the momentum of the short rod from carrying it forward, or the friction between the clamp and long or new rod from carrying the latter back.

The tool-holder H is supported in guides or ways in the machine-frame, and is moved laterally back and forth by means of a cam, h^4, bell-crank lever h^5, and connecting-rod h^7. The cam h^4 is formed on the periphery of a drum, G, which is keyed to the main shaft B so as to revolve with it. The bell-crank lever h^5 is pivoted at h^6 to the machine-frame, and the rod h^7 is jointed at one end to the bell-crank lever and at the other to the tool-holder H. Upon the tool-holder are carried a series of tool-slides, H′ H². Two are shown, one for the milling or turning-down tool and the other for the die or threading-tool; but a larger number can be used, if necessary, for particular purposes, or where deemed desirable. The tool-slides are longitudinally movable at right angles to the movement of the tool-holder and parallel or in line with the axis of the chuck-spindle. The rear end of the tool-holder (right-hand end in Figs. 1 and 2) overhangs the longitudinal slide K and a portion of the machine-frame, and is cut away underneath (see Fig. 5) to allow the necessary freedom of motion to a projection, k, which operates the tool-slides. The latter have each an opening or groove, h', to receive the projection k. The slide K moves back and forth in ways in the machine-frame, and is operated by the cam h^2 on the drum G and the pin h^3, secured to said slide. A pin or stud, k^2, attached to slide K, extends into a hole in the tool-holder and serves to insure the exact centering of the tool in line with the axis of the chuck.

The milling-tool is held in a socket in its slide H′ by a set-nut, or is secured in the slide in any suitable way. The die or threading-tool is carried by a spindle, L, which fits loosely within a sleeve, l, but is normally engaged by a clutch, m, so as to turn with the sleeve. A spring, l', bearing at one end against the spindle L and at the other against the sleeve l, tends to hold the two plates of the clutch m in engagement with each other. A gear, M, supported in bearings on the tool-holder, is connected with the sleeve l by spline and groove, or key working in an elongated keyway, so as to revolve said sleeve and at the same time allow it to have an independent endwise movement. In cutting the thread the die-spindle is turned with the sleeve l in the same direction as the chuck-spindle, but at a different speed, and preferably the die-spindle has the higher speed, and both are turned in a direction opposite to the ordinary motion of the chuck-spindle, so that when the die-spindle is stopped the continued rotation of the chuck-spindle turns out the threaded rod, or, as it is termed, "unthreads the die."

For the purpose of automatically stopping the spindle when the thread is completed an improved stop-clutch is employed, of which this is the construction: A clutch-bar, l^2, provided with a projection, l^3, is fitted in a groove in the tool-slide. The head of the spindle L is provided with a projection, l^4. So long as the clutch m engages the projection l^4 rotates out of contact with the projection l^3 on the clutch-bar l^2; but so soon as the tool-slide begins to retreat after the thread has been cut the spindle L is drawn forward, the clutch m is released, and the projections l^3 l^4 engage, preventing further revolution of the die-spindle, but at the same time allowing a limited longitudinal motion to the die-spindle. It may sometimes happen that the edges of the two projections will so engage that the die-spindle cannot move forward without advancing the clutch-bar. If the latter is held rigidly, it is obvious that, the die-spindle being drawn back at the speed of the slides H² and K, there would be danger of stripping the thread. To avoid this difficulty the clutch-bar is held in its place by a spring, l^5, which bears at one end against the clutch-bar and at the other against the head of a pin, l^6. The head of this pin is threaded and engages with a threaded opening in the tool-slide. Whenever the projections l^3 l^4 improperly engage the clutch-bar is drawn forward slightly, and the projection l^4 slips past, the clutch-bar is immediately forced back, and the projection l^4, at its next revolution, comes squarely against the projection l^3 on the clutch-bar.

Motion is communicated from the chuck-spindle to the gear M through the shaft N and a set of gears at each end. The shaft N turns in bearings attached to the machine-frame. The gear N′ (see Fig. 4) meshes with an idler, n, and this with the gear b', which, as already explained, meshes with the gear b, fast on the chuck-spindle. The idler n turns on a stud attached to the machine-frame. The gear n^2 (see Figs. 2 and 3) meshes with an idler, n', and this with the gear M. The idler n' is supported on a pin that passes through and connects the ends of two links, $n^2 n^3$. The link n^2, at its inner end, fits loosely around the shaft N. The head of link n^3 similarly embraces the bearing of the tool-holder, wherein the gear M is mounted. This arrangement of linked gears communicates rotary motion to the gear

M and sleeve l, while allowing said parts to move laterally with the tool-slide H^2 and tool-holder H.

The cutting-off tool is shown at P, Fig. 2, being adjustably connected with the tool-holder H.

In forming a screw the following operations take place: The rod is fed forward a distance equal to the length of the screw. It is turned down to the required diameter by the milling-tool. It is threaded by the die or threading-tool and severed from the rod by the cut-off tool. During all these operations the chuck-jaws d and chuck-spindle C, the sleeve l, surrounding the die-spindle, and the cam-drum G are revolved continuously, and during all, except that of feeding, the rod to be made into screws is also revolved. In feeding, the clamp E being open, the lever E′ is operated by the cam d^{15}, and, acting against the screw e, pushes back the clamp E a distance equal to the length of the screw. This distance is regulated by turning the screw e in the lug e^3, so that it will be struck sooner or later by the lever E′. While the clamp is held back by the cam d^{15} the wedges d^2 are withdrawn, thus releasing the pressure of the chuck-jaws on the rod, and the jaws of clamp E are closed by the action of the cam d^8 on the lever d^7. The cam d^8 holds lever d^7 in position until the lever E′ is released by cam d^{15} and the feed-clamp has been advanced by the spring E^2, when it also releases the lever d^7. The feed-clamp is thus released, the chuck-jaws are immediately closed by the action of spring d^{11}, and the rod rotates with the chuck. In the meantime the tool-holder H has been moved by the cam h^4, so that the milling-tool is in line with the axis of the chuck. The slide K is now advanced by the cam h^2, carrying with it the slide H′ of the milling-tool, and is then returned. The cam h^4 moves the tool-holder H laterally and brings the die or threading-tool in line with the axis of the chuck. By this lateral movement the projection k on slide K is made to engage with the groove in the bottom of tool-slide H^2. The cam h^2 again advances and returns the slide K, which, at this reciprocation, carries with it the slide H^2 of the threading-tool. During the advance of this tool the die-spindle is revolved, being engaged by the sleeve l through the chuck m. The return movement of the tool-slide, which is at first quick or sharp, causes the die-spindle L to be drawn forward in the sleeve l, disengages the clutch m, and effects the engagement of the projection l^4 with the projection l^3 on the clutch-bar l^2. The die or threading-tool being held from turning by the projection on the clutch-bar, the continued revolution of the rod unthreads it. Another lateral movement of the tool-holder H brings the cutting-tool into action and severs the screw just made. The tool-holder is now moved by the cam h^4 to bring the milling-tool again in line, and during this operation a new feed of the rod takes place.

Various modifications may be made in the details of construction of the improved screw-machines without departing from the spirit of the invention, and portions of the invention may be used without the others. For example, in place of linked gears for conveying the motion from the chuck-spindle to the die-spindle, an arrangement of bevel-gears could be employed.

A friction or two-motion feed-clamp of ordinary or suitable construction could be employed instead of the improved four-motion feeder described; or a length-gage could be used. It may be placed on the tool-holder with or without being carried by a tool-slide; or it may be located in other suitable position. So, also, the cutting-off tool could be placed in a slide to be advanced by the slide K. The tools could be carried by a common slide instead of each by its own slide. Equivalent mechanism could be used instead of cams, such as a system of partial gearing which gives quick motions followed by periods of rest.

In another application filed of even date herewith an arrangement is shown whereby lateral movements are imparted to the chuck instead of to the tools. The independent tool-slides could be used with such a chuck, and the same arrangement of toothed gearing as hereinbefore explained could be used to convey the motion from the chuck-spindle to the die-spindle.

The term "die-spindle" is employed herein as a convenient term for the spindle of the threading-tool, which, it is obvious, may be a tap for cutting internal threads as well as a die for cutting external threads. In such a case the milling-tool would be a drill to bore out the hole to be threaded instead of a turning-down tool.

The term "lateral movement" or "lateral movement back and forth" is used herein in contradistinction to the intermittent rotary movement of the ordinary turret employed in screw-machines, and is not limited to a rectilinear movement in guides, which is the preferred movement, and which is therefore provided for in the machine shown, but includes a vibratory or to-and-fro movement in short arcs of a circle.

Parts of the invention are applicable as well to hand machines in which the tools are shifted by the hand of the operator as to automatic machines which require only a general superintendence.

Having now fully described my said invention and the manner of carrying the same into effect, I would observe, in conclusion, that no claim is made herein to the mechanism for bringing the tools successively into action upon the rod or screw-stock, said mechanism being reserved for separate divisional application; but

I do claim all the other new improvements herein described, to wit:

1. The chuck-spindle and the die-spindle, in

combination with the system of gearing comprising the shaft parallel with the axes of said spindles, toothed gears between the said shaft and the chuck-spindle at one end of said shaft, and toothed gears and links between the said shaft and the die-spindle at the opposite end, said gears and links being constructed, substantially as described, to allow one of said spindles to have a lateral movement with respect to the other, as set forth.

2. The combination, with the revolving chuck, the die-spindle, movable lengthwise in its bearings, the revolving shaft or sleeve, the clutch for revolving said spindle with said shaft or sleeve when engaged, the longitudinal slide, and the cam and connections for advancing said slide to bring the threading-tool into action upon the stock held in said chuck, and for effecting or controlling the return of the same, of the stop-clutch comprising a projection on the spindle, and a non-rotating projection extending inside the circular path of the end of the former projection, and arranged to engage it when the spindle is drawn forward in its bearings, one of said projections having a long contact-surface, so as to permit a longitudinal movement to the spindle without disengaging the projections, substantially as described.

3. The safety stop-clutch described, comprising, in combination with the spindle, the clutch device carried by and revolving with the same, and the non-rotating clutch device for engaging the clutch device on the spindle when the latter is drawn forward in its bearings, the spring connected with one of said devices, and arranged to yield and allow said device to be moved longitudinally when the two devices do not fairly engage, substantially as described.

4. The combination, with the chuck adapted to receive and grasp a rod or long screw-stock, the series of cutting-tools—such as turning, milling, or threading tools—laterally and longitudinally movable supports or slides, and the feed-clamp or device for taking hold of the rod or screw-stock, of the automatic mechanism for reciprocating the laterally and longitudinally movable supports or slides to bring the aforesaid cutting-tools into action on the aforesaid rod or screw-stock, the automatic mechanism for relieving and restoring the pressure of the chuck-jaws, and the automatic mechanism for advancing said clamp a determined distance when the pressure of the chuck-jaws is relieved, so as to advance the rod step by step, substantially as described.

5. The combination, with a hollow revolving spindle and a chuck carried thereby, of a feed-clamp, mechanism for closing, advancing, opening, and returning said clamp, and friction devices carried by a tube held in place in aforesaid spindle by means of a collar, so that said friction devices are free to revolve with the rod or screw-stock when the latter is grasped by the chuck-jaws or to remain stationary when it is grasped by the feed-clamp, substantially as described.

6. In a chuck, the combination, with the wedges formed by the ends of a slotted tube, of the stay-pieces, also formed by the ends of a slotted tube, and arranged alternately with the wedges, substantially as described.

7. The combination, with a tube having its ends slotted to form stay-pieces, of chuck-jaws secured to said tube, and wedges held in position between the stay-pieces, substantially as described.

8. The combination of a solid head, stay-pieces fastened thereto, chuck-jaws, and wedges longitudinally movable between the stay-pieces, the solid head, and the chuck-jaws, substantially as described.

9. A four motion feed-clamp comprising, in combination, a slide, a lower jaw, an upper jaw, a follower, and a spiral spring interposed between the follower and the upper jaw, substantially as described.

10. The combination, with the chuck, the longitudinal slide, the threading-tool, comprising a die-spindle, a clutch for engaging the said spindle during the threading operation, and the second clutch for engaging the spindle during the unthreading operation, and mechanism for reciprocating said slide to bring the threading-tool into and out of action, of the spring tending to draw the die-spindle backward or away from the chuck, so as to engage the first-named clutch, but adapted to yield and allow the spindle to be drawn forward when required, substantially as described.

11. The improved automatic screw-machine, comprising, in combination, the hollow rotary spindle, the chuck, mechanism for opening and closing said chuck, the feed-clamp, mechanism for operating said feed-clamp, the laterally-moving tool-holder, the series of tool-slides thereon, the cams and connections or equivalent mechanism for moving said tool-holder and tool-slides back and forth in lines at right angles to each other, gears for communicating motion from the chuck-spindle to the said cams, the die-spindle with sleeve and clutches supported on one of said tool-slides, toothed gears for conveying motion from the chuck-spindle to the die-spindle, and the cutting-off tool, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ALLEN JOHNSTON.

Witnesses:
PHILIP MAURO,
C. J. HEDRICK.