(No Model.) 4 Sheets—Sheet 1.

E. C. HENN.

SCREW MAKING MACHINE.

No. 530,180. Patented Dec. 4, 1894.

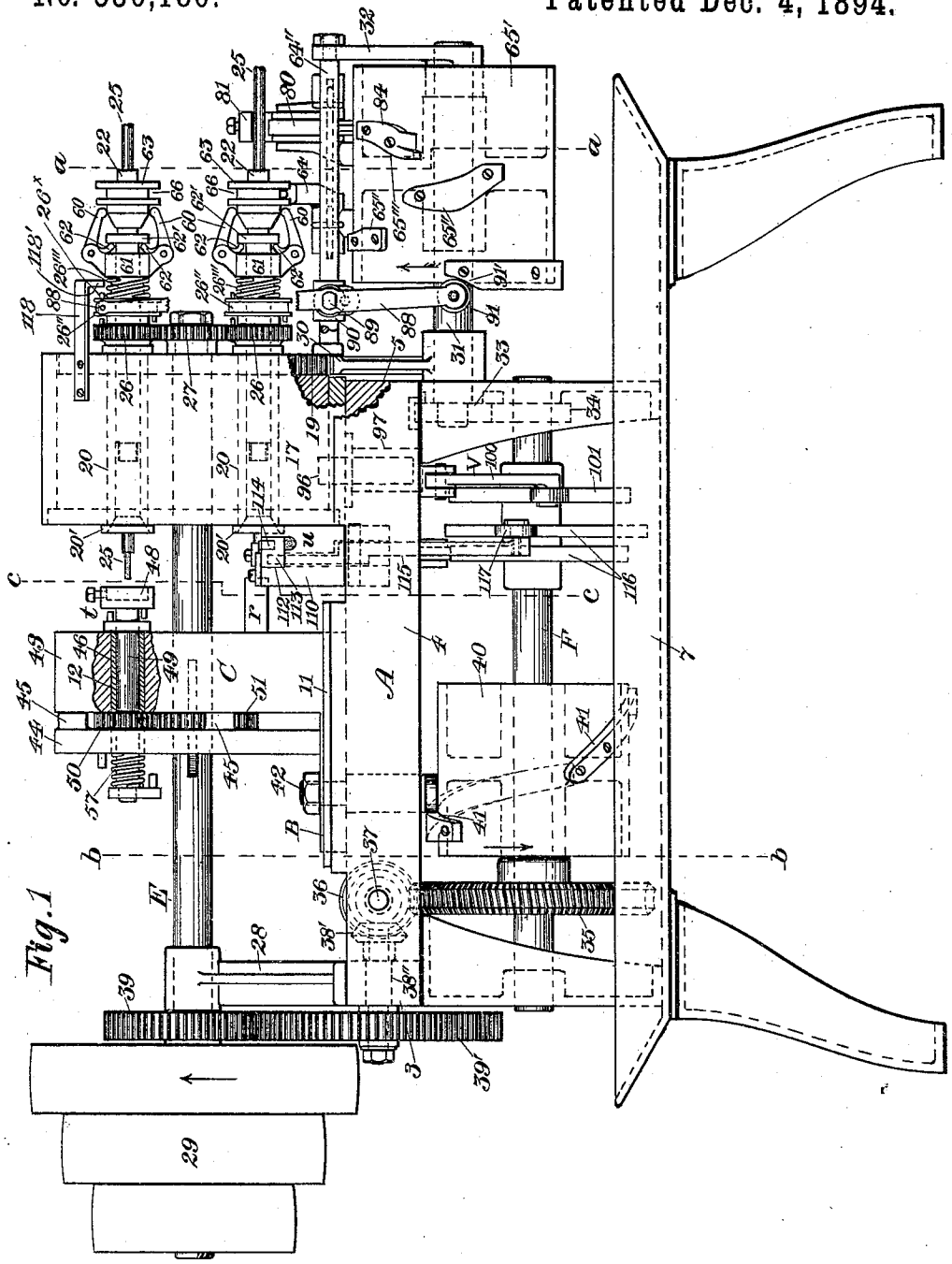

Fig. 1.

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By his Attorney.
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(No Model.) 4 Sheets—Sheet 2.

E. C. HENN.

SCREW MAKING MACHINE.

No. 530,180. Patented Dec. 4, 1894.

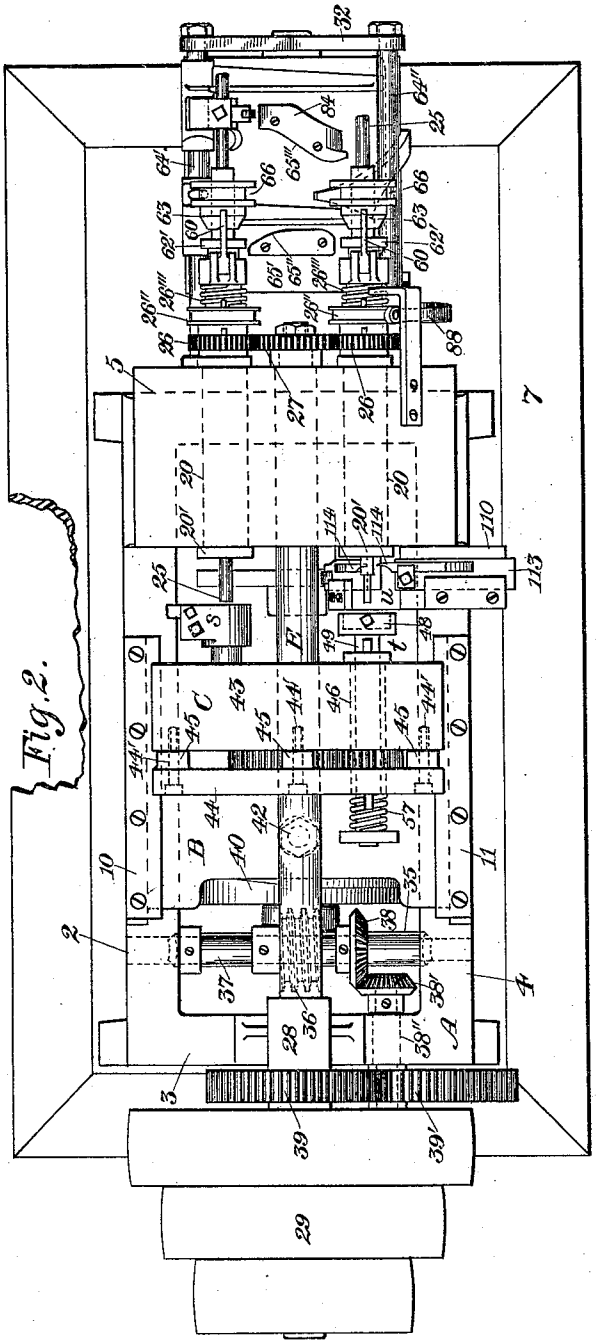

Fig. 2.

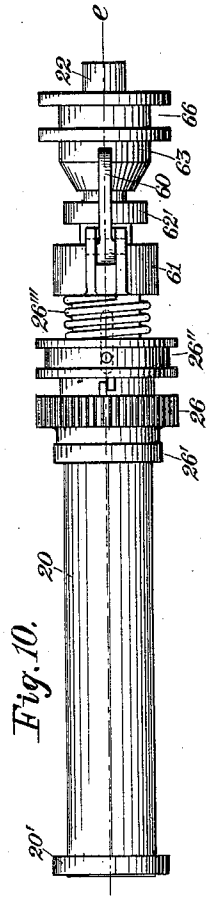

Fig. 10.

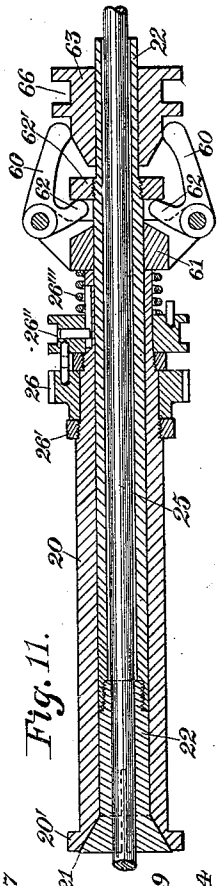

Fig. 11.

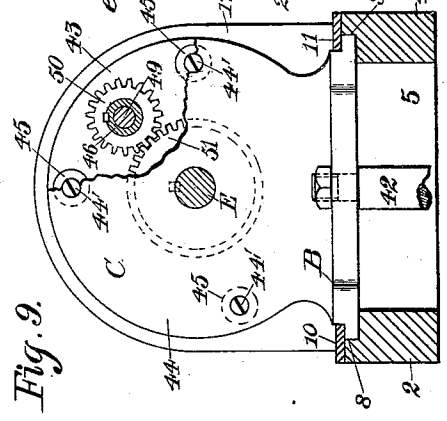

Fig. 9.

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(No Model.) 4 Sheets—Sheet 3.

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SCREW MAKING MACHINE.

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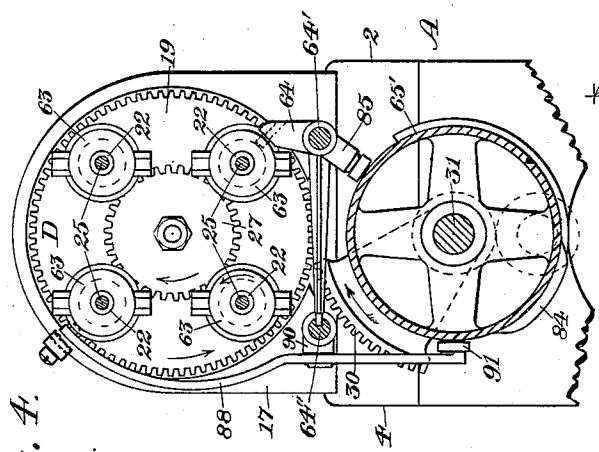

Fig. 4.

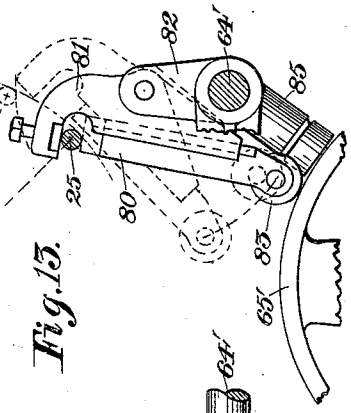

Fig. 13.

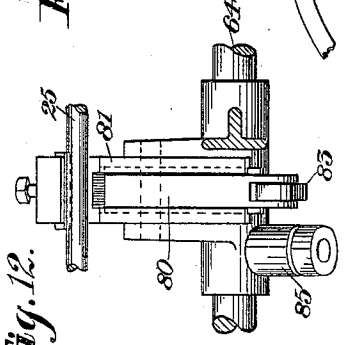

Fig. 12.

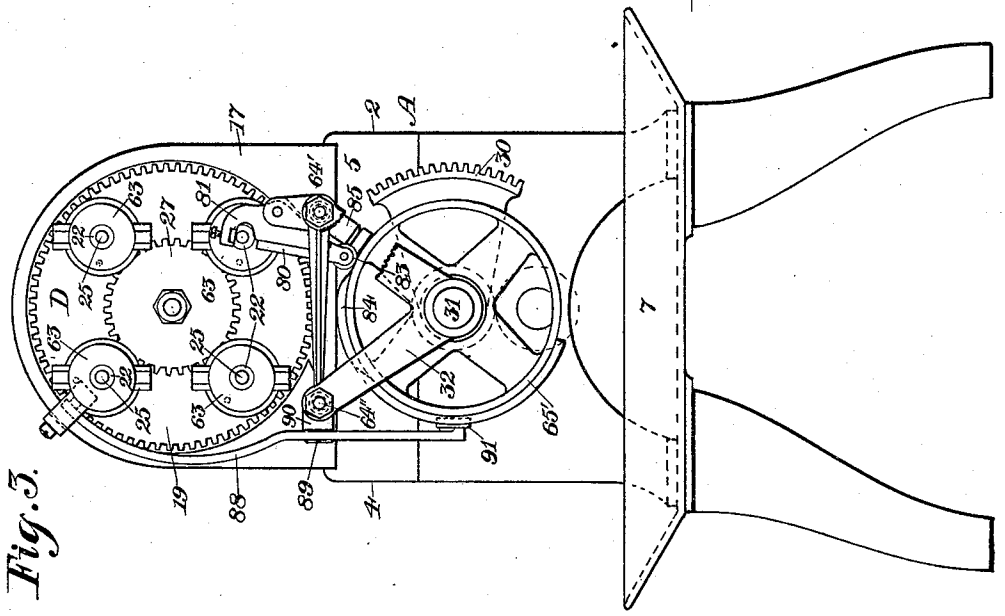

Fig. 5.

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(No Model.) 4 Sheets—Sheet 4.

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SCREW MAKING MACHINE.

No. 530,180. Patented Dec. 4, 1894.

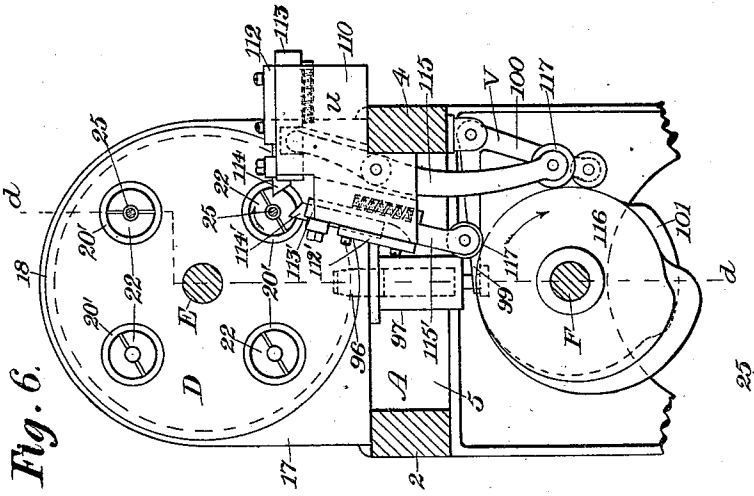

Fig. 6.

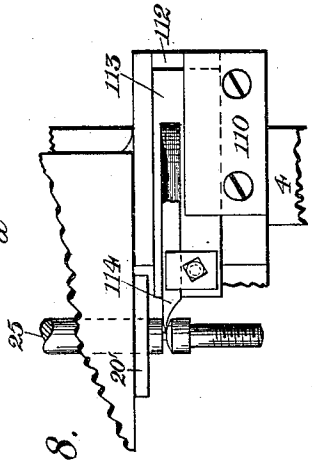

Fig. 8.

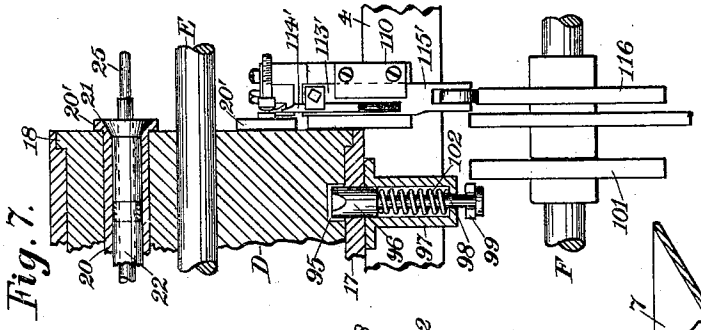

Fig. 7.

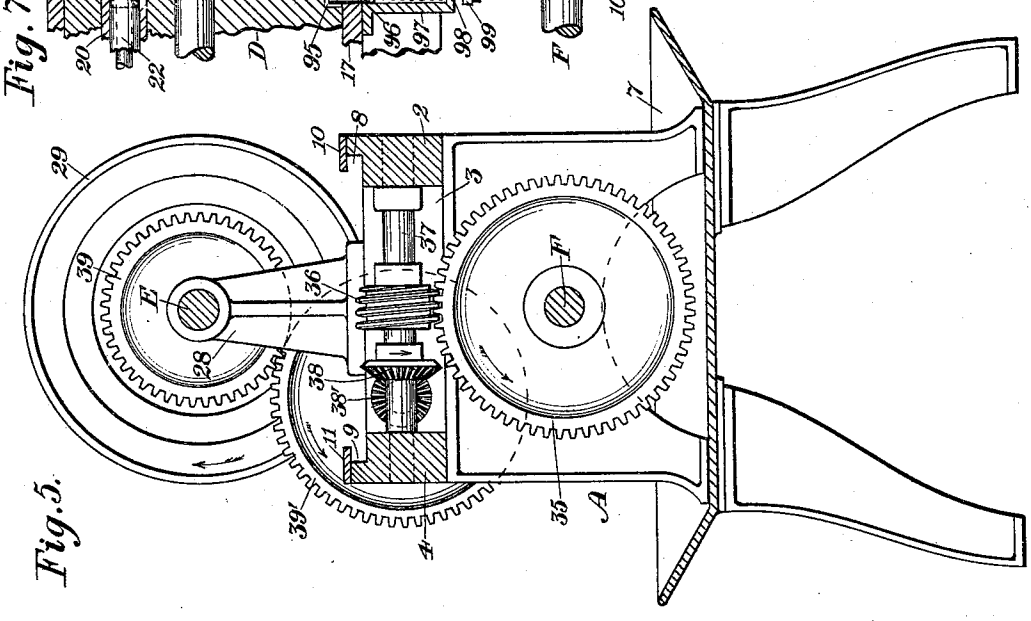

Fig. 5.

Witnesses:
Robt. Ruddell.
Fred. J. Dole.

Inventor:
Edwin C. Henn.
By his Attorney, F. A. Richards

UNITED STATES PATENT OFFICE.

EDWIN C. HENN, OF BLOOMFIELD, ASSIGNOR, BY MESNE ASSIGNMENTS, TO HIMSELF, AND HORACE S. FULLER, NATHAN F. MILLER, WILLIAM J. GABB, AND REINHOLD HAKEWESSELL, OF HARTFORD, CONNECTICUT.

SCREW-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 530,180, dated December 4, 1894.

Application filed April 19, 1894. Serial No. 508,073. (No model.)

To all whom it may concern:

Be it known that I, EDWIN C. HENN, a citizen of the United States, residing at Bloomfield, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Screw-Making Machines, of which the following is a specification.

This invention relates to improvements in screw-making machines, and is intended as an improvement upon the screw-making machine described in an application for United States Letters Patent filed by Reinhold Hakewessell November 20, 1893, Serial No. 491,317, to which I have permission to refer.

The object of my present invention is to produce a screw-making machine which will be automatic in its operation, and of such construction and organization that a multiplicity of screw-rods may be operated upon simultaneously by separate tools performing distinct functions; also to provide means for automatically bringing each screw-rod of the series (after it has been operated upon by one tool) to the next adjacent tool, and successively to the remaining tools of the series, whereby a plurality of screw-rods may be undergoing separate and distinct operations simultaneously, and by such successive operations a screw may be completed by each operation or complete movement of the machine.

Another important object of my present invention is to provide means in connection with the screw-threading die and work-carrying spindle, whereby said die and spindle will be alternately rotated; that is to say, the work-carrying spindle will be held at rest during the rotation of the threading-die, or during the operation of cutting the thread, and when the thread is completed the threading-die will be stopped in its rotation, and the work-carrying spindle will be rotated to unscrew the threading-die therefrom.

Another feature of my invention is to provide improved means for "chucking" and holding the screw-rod, and for gripping said screw-rod at predetermined intervals and feeding the same forward, as will be hereinafter more fully described; also, to provide improved means for automatically shaping the head of, and cutting off, the finished screw.

In the drawings accompanying and forming a part of this specification, Figure 1, Sheet 1, is a side elevation of a screw-making machine embodying my improvements, said figure showing the parts of the machine in the position they occupy during operation just preparatory to screw-threading the turned or reduced end of the screw-rod. Fig. 2, Sheet 2, is a plan view of the same. Fig. 3, Sheet 3, is an end elevation of the screw-making machine, as seen from the right-hand in Fig. 1. Fig. 4, Sheet 3, is a vertical cross-section of a portion of the screw-making machine, taken in dotted line *a*—*a*, Fig. 1. Fig. 5, Sheet 4, is a vertical cross-section of the screw-machine, taken in dotted line *b*—*b*, Fig. 1, showing the parts at the left-hand of said line. Fig. 6, Sheet 4, is a vertical cross-section of a portion of the screw-making machine, taken in dotted line *c*—*c*, Fig. 1, showing the parts at the right-hand of said line. Fig. 7, Sheet 4, is a vertical longitudinal section of a portion of the screw-making machine, taken in dotted line *d*—*d*, Fig. 6, it showing the parts at the right-hand of said line. Fig. 8, Sheet 4, is a plan view, on an enlarged scale, of a portion of the screw-making machine, as seen from the upper side in Fig. 6, said figure showing the cutting-off mechanism in its operative position with relation to the screw-rod. Fig. 9, Sheet 2, is a rear elevation of the tool-carriage, showing a portion of the framework and the driving-shaft in cross-section, a portion of the back-plate of said carriage being broken away to show the parts more clearly. Fig. 10, Sheet 2, is a plan view, on an enlarged scale, of the work-holding spindle and clutch-mechanism in connection therewith. Fig. 11, Sheet 2, is a longitudinal section of the same, taken in dotted line *e*—*e*, Fig. 10. Fig. 12, Sheet 3, is a side elevation, on an enlarged scale, of the wire or rod-gripping mechanism, as seen from the left-hand in Fig. 3, a portion thereof being broken away. Fig. 13, Sheet 3, is a front elevation of said gripping-mechanism, as seen from the right-hand in Fig. 12, said figure illustrating, in dotted lines,

the position of said gripping-mechanism during the disengagement of the rod or wire therefrom.

Similar characters designate like parts in all the figures.

Briefly stated, my improved screw-making machine embodies the following material elements, which are constructed and organized for co-operation to produce a screw, namely: a non-rotating reciprocatory tool-carrier adapted for carrying a plurality of screw-forming tools; mechanism for automatically moving said tool-carrier toward and from, and for limiting the movement thereof with relation to, the work; mechanism for independently rotating one or more of said tools intermittently; an intermittently revoluble work-spindle-carrying head, or turret, having a series of remotely-disposed spindle-holding sockets formed therein; a series of work-holding spindles, or chucks, revolubly supported in said turret; mechanism for imparting an intermittent rotary movement to said turret, and for locking the same at given points in the revolution thereof; means for rotating the work-holding spindles and the screw-rods held therein; means for automatically alternately rotating the screw-threading die and the work-carrying spindle which is in alignment therewith; means for automatically cuting off the screw-threaded rod, and means for automatically feeding the rod forward.

The framework of the machine, which is designated in a general way by A, may be of any form and construction suitable for carrying the several details of the mechanism. In the form thereof herein shown, it consists of a bed, comprising the two side-rails, 2 and 4, and end-rails, 3 and 5, supported upon suitable legs; the usual oil-pan, 7, being herein shown as located underneath the working parts of the machine and as forming the base portion of said machine.

Formed in the side-rails, 2 and 4, of the machine, are the usual longitudinal slide-ways, 8 and 9, fitted to which, and held in place by the usual straps, 10 and 11, is a longitudinally-sliding tool-carriage, B, having the tool-carrying head, C, at or near the forward end thereof, as shown in Fig. 1, Sheet 1, of the drawings. In the form thereof herein shown, this head C has a series of tool-carrying sockets, 12, (herein shown as four in number,) arranged equi-distantly about a common center, and in which are supported a series of screw-forming tools, one of which, *i. e.*, the screw-threading tool, designated by *t*, is revolubly supported in its respective socket, as will be hereinafter more particularly described.

The work-spindle-carrying head, or "turret," D, which will in some instances be herein referred to as the "spindle-carrier" and "work-carrier," is revolubly supported in a horizontal bearing in an upright, 17, formed preferably integral with the bed or frame of the machine near the forward end thereof. This spindle-carrying head will preferably have a peripheral flange at its rear end, as shown at 18, to fit an annular groove at the rear end of the bearing 17 to prevent longitudinal displacement thereof, and has secured to, or formed upon, its forward end, concentric to the axis thereof, a spur, or driving-wheel, 19. Formed longitudinally through said turret D, is a series of sockets, or bearings, in each of which sockets is journaled a tubular shaft, or sleeve, 20, which, in practice, will be flanged at its inner end as shown at 20′, Fig. 7, and bear against the face of the turret D, to prevent longitudinal movement thereof.

By the terms "inner ends" and "outer ends," as applied to certain of the parts of the tool-carrier and of the spindle-carrier, are meant those ends adjacent to the space between the tool-carrier and spindle-carrier, and those ends most remote therefrom, respectively.

The tubular shaft, or sleeve, 20, is conically bored at its inner end, as shown at 21, and has a split chuck-sleeve, or work-carrying spindle, 22, fitted for sliding movement therein, which spindle has its inner end flared or conically flanged peripherally to coincide with the conical bore 21 of the tubular shaft 20. Through this spindle 22 is extended the screw-rod, 25, to be operated upon.

Loosely mounted upon the outer end of the tubular shaft 20, between collars, 26′, as most clearly shown in Figs. 10 and 11, is a pinion, 26, which pinion is constructed to form a clutch-member adapted for engagement with another clutch-member, 26″, which, in the form thereof herein shown, consists of a peripherally-grooved pulley, or wheel, splined to the outer end of the shaft 20. These clutch-members are each provided with inwardly-projecting clutch-pins, which are normally held in engagement one with the other by means of a spiral spring, 26‴, bearing against the outer face of the clutch-member 26″.

In the drawings, the spindle-carrier is shown as having four spindle-carrying sockets formed therein, which sockets are equi-distantly disposed around a common center, and each socket has a spindle revolubly supported therein. These spindles, clutches and driving-wheels therefor, are substantially duplicates of one another, and are simultaneously driven by a gear-wheel, 27, secured to the forward end of the main driving-shaft, E, of the machine, which shaft is journaled at its forward end in the work-carrying head, or turret, D, and at its rear end in a bearing, 28, secured to or formed a part of the bed of the machine. This shaft E extends through the tool-carrying head, as shown in the drawings, and is provided at its rear end with the usual driving-pulley, 29.

In the construction of the spindle-carrier D, the same may be adapted for carrying an indefinite number of work-spindles, and the tool-carrier may be likewise constructed to

carry a number of tools coinciding with the number of work-carrying spindles. The number of work-carrying spindles and screw-forming tools provided will, of course, depend upon the form of screw it is desired to make. In the present instance, as shown in the drawings, the spindle-carrier is provided with four screw-rod-holding spindles, which are adapted for independent rotation through the medium of the gearing shown, which consists of the gear-wheel 26, one for each spindle, and a center wheel, 27, upon the main shaft, E, of the machine, and in mesh with the wheels 26.

Through mechanism, as hereinafter described, the work-carrying spindles not only have an intermittent rotary movement about a common axis, but will also be constructed and provided with mechanism whereby each spindle will have a rotary movement about its individual axis which will be interrupted at predetermined points in its orbital movement, or in its travel about the common axis E. This intermittent orbital movement is imparted to the series of work-carrying spindles for the purpose of bringing the screw-rods carried by said spindles successively into axial alignment with, and in position for being successively operated upon by, the successive tools of the tool-carrying head C. As a means for securing this intermittent orbital movement to the work-carrying spindles about a common axis, a segmental gear-wheel, 30, is provided, which, as shown in the drawings, is carried upon a counter-shaft, 31, journaled at one end in a bracket, or hanger, 32, which may be secured to the framework in any suitable manner, and is supported at its opposite end in a bearing formed in the end-wall of the frame-work, as will be clearly understood by reference to Figs. 1, 2 and 3 of the drawings. This segmental gear-wheel is constructed, and is in position, to mesh with the spur-wheel 19 upon, and intermittently to rotate, the work-carrying head D a distance equal to the distance between the work-carrying spindles at each complete revolution of the counter-shaft 31. In other words, the toothed segment (whose teeth coincide with the teeth of the spur-wheel 19) is of sufficient length to rotate the spur-wheel 19 and the connected carrier D a predetermined distance at each complete revolution of the shaft 31, which is herein shown as one-fourth of a revolution, and to allow said head to remain stationary the proper length of time for the tools to complete their operation upon the ends of the various screw-rods.

An ordinary locking-device will be provided, as hereinafter described, for engaging and locking the turret, or spindle-carrier, in its successive operative positions.

The extent of rotation of the turret at each revolution of the shaft 31, and the length of time intervening between movements thereof, will depend, as hereinbefore stated, upon the number of work-carrying spindles and screw-forming tools employed.

Secured to the shaft 31, upon which the segmental gear-wheel 30 is mounted, is a pinion, 33, which meshes with a like pinion, 34, upon the forward end of the cam-shaft F. This cam-shaft is journaled in bearings at its either end in the framework, as shown in the drawings, and has near the rear end thereof a worm-wheel, 35, which meshes with, and is driven by, a worm, 36, upon a transverse worm-shaft, 37, journaled in bearings formed in the side-rails of the frame of the machine. The worm-shaft is provided with a bevel-gear, 38, which meshes with, and is driven by, a similar bevel-gear, 38′, secured to a shaft, 38″, journaled in bearings formed in the rear wall of the framework. This shaft 38″ is driven by means of a spur-wheel, 39, secured to the main shaft E and meshing with a similar gear, 39′, upon said shaft 38″, the shaft E being driven, as before stated, by the driving-pulley 29 at the rear end thereof.

As a means for actuating and governing the sliding tool-carriage B, a cam-wheel, 40, is provided, which is secured to the cam-shaft F, and has cam faces, 41. A stud, 42, secured at its upper end in the tool-carriage B, is provided to secure an operative connection between said cam and tool-carriage, said stud being preferably provided with a friction-roller at its lower end which bears against the cam-faces of the cam-wheel 40. This cam-wheel may be of any construction adapted for imparting the required forward and return movements to the tool-carriage.

In the form herein shown, the tool-carrier head is constructed in two pieces; *i. e.*, the forward or main portion 43 secured to or formed a part of the tool-carriage, and the back-plate 44 secured to the tool-carrier head by means of suitable screws; a series of blocks, 45, being interposed between said plate and tool-head to provide sufficient space between said head and plate for the interposition of tool-driving mechanism. These separating blocks 45 are herein shown as three in number, they being herein held in place by means of the screws 44′, as shown.

In the drawings, the tool-carrier head C is shown as provided with four equi-distantly disposed tool-receiving sockets, 12, as before stated, and in three of these sockets are secured tools, designated by *r*, *s* and *t*, respectively, the one *r* being simply a gage against which the screw-rod abuts when it is fed forward, and which acts to determine the length of the finished screw. The next successive tool, *s*, is a cutting-tool for reducing the diameter of the end of the rod; and the next successive tool, *t*, of the series is the screw-threading die for cutting the thread and for finishing the screw. The tools *r* and *s* will usually, in practice, be non-rotative, but the screw-threading die *t* will be supported for rotary movement in the tool-carrier head.

The mechanism for moving the tool-carriage toward and from the work-carrier, and the mechanism for intermittently rotating

the work-carrier, will be so timed in their movements with relation to each other that immediately after the completion of a partial rotation of the work-carrier to bring the spindles thereof to an operative position in alignment with the tools, the tool-carriage will be moved toward the work-carrier with its tools in engagement with the several screw-rods carried by said carrier, each tool performing its own function; and immediately after the tools have completed their operation, the tool-carriage will at once be retracted, and, after the tools have passed the end of the screw-rods on the retractive movement of said carriage, the work-carrier will be again rotated as in the first instance.

One of the chief objects of my present invention is to provide improved means for facilitating the cutting of the thread upon the screw-rod. To accomplish this end, I have provided automatic controlling-means whereby the screw-rod is held stationary during the rotation of the threading-die when cutting the thread, and whereby, when the threading-die has completed its operation of cutting the thread, said threading-die is held against rotation, and the work is immediately rotated in a direction coinciding with the direction of rotation of the threading-die, to unscrew the die from the screw-rod. This enables the screw-rod to be quickly screw-threaded aud withdrawn from the threading-die.

As a means for rotating the threading-die, and for stopping the same after it has cut the screw-thread, I have provided a tubular shaft, 46, which is supported in a socket in the tool-carrying head, and extends through both parts, 43 and 44, thereof. This shaft is provided at the inner end thereof with one member of a pull-off, or pin-clutch device, adapted for engaging a like clutch-member upon the die-head 48, which die-head is secured to a die-spindle, 49, revolubly supported in said sleeve or shaft 46.

Secured to the spindle-driving shaft 46 between the front and back plates 43 and 44 of the tool-carrying head, is a pinion, 50, which meshes with and is driven from a gear-wheel, 51, splined to the main shaft E of the machine, as most clearly shown in Figs. 1, 2 and 9. Said splined connection between the gear-wheel 51 and shaft E permits said gear-wheel to be revolved with the shaft and also permits movement longitudinally of said shaft during the reciprocations of the tool-carriage B. The die-spindle 49 extends beyond the outer end of the spindle-shaft 46, and is provided at this end with a clutch-member adapted for engagement with a clutch-member secured to the back-plate 44 of the tool-carrying head.

As a means for retaining the two clutch-members at the inner ends of the die-spindle and shaft therefor normally in engagement, a spring, 57, is interposed between the back-plate 44 and clutch-member at the opposite outer end of the die-spindle, this arrangement normally retaining the die-spindle in operative engagement with its driving-shaft.

By reference to the drawings, it will be seen that the die-spindle, through the medium of the clutch at the inner end thereof, is continuously driven by the shaft 46 when the die is not operating to cut the thread upon the screw-rod, and also that the two clutches, one at either end of said die-spindle, are adapted for alternate operation; that is to say, when the two clutch-members at the inner end of the die-spindle are in engagement, the two clutch-members at the opposite end thereof are disengaged, and vice versa. In cutting the thread upon the screw-rod, the work-carrying spindle, when opposite the threading-die, will be held against rotation by mechanism hereinafter described, after which the revolving threading-die is moved forward with the carriage into engagement with the inner end of the rod and carried forward until the thread is completed, or approximately so, when the movement of the tool-carriage is reversed, which throws the two clutch-members contiguous to the threading-die out of engagement, and brings the two clutch-members at the opposite end of the die-spindle into engagement, which immediately stops the rotation of the die. At this time the screw-rod-carrying spindle is started to rotate in a direction coinciding with the former rotation of the screw-threading die, which screws the threading-die off from the threaded rod, and, when the screw-threading die has passed off the end of the rod, the spring 57 immediately throws the two clutch-members at the inner end of the die-spindle into engagement, and the die then continues its rotation, all of said operations being performed automatically. After the threading-die has passed off the screw-rod, the spindle-carrying head is then unlocked and partially rotated to present the screw-threaded rod to the shaping and cutting-off mechanism, designated in a general way by *u*, the construction and operation of which mechanism will be hereinafter described.

In the drawings, I have illustrated one form of clutch mechanism for opening and closing the work-holding or "chucking" spindles to release and grasp the screw-rods, and also means for automatically grasping and feeding the screw-rods into proper position to be operated upon by the screw-forming tools. In the form thereof herein shown, this mechanism consists of a set of elbow-levers, 60, pivoted upon a collar, 61, fitted for sliding movement upon the outer end of the work-carrying spindle 22, and bearing at its inner face against the outer end of the tubular shaft or sleeve 20 journaled in the turret D. These levers have two inwardly-extending arms, 62, so disposed with relation to the levers 60 as to be thrown outward as said levers are pressed inward. These arms 62 bear at their inner ends against the inner face of a flange, 62′, fixed to the outer end of the chuck, or work-

carrying spindle, 22, and are adapted (as the levers 60 are thrown outward) to move the spindle outward, bringing the inclined or conical face at the inner end thereof against the conical inner end of the tubular shaft which compresses the spindle and grasps the screw-rod therein, as will be fully understood by reference to Figs. 10 and 11 of the drawings.

As a means for spreading the levers 60 of the chuck-actuating mechanism so as to grasp and release the rod, a conical hub, 63, is loosely journaled upon the outer end of the work-carrying spindle 22 slightly in advance of said levers, which hub is moved endwise upon said spindle at predetermined intervals for releasing and re-engaging the spindle from and with the screw-rod.

As a means for operating the chuck-mechanism, the hub 63 thereof has an annular groove, 66, formed in its periphery to receive the end of a shipper-lever, 64, shiftably supported, as shown at 64′, Fig. 4, upon a rod secured to the frame of the machine at one side thereof. This shipper-lever is located in position for engagement with the hub 63 of the chucking-device when the work-carrying spindle thereof comes in alignment with the gage or stop *r* supported in the tool-carrying head C. This shipper-lever is actuated to throw the hub 63 into and out from engagement with the levers 60 of the chucking-device by a cam-face, or cam, 65′, secured to the end of the counter-shaft 31, which cam 65′ is also provided with cam-faces, 65″, adapted for operating the rod-gripping device, as will be hereinafter more fully described.

The rod-gripping mechanism, in the form thereof herein shown, consists of two members, 80 and 81, having rod-gripping jaws at one end thereof, which members are made longitudinally shiftable with relation to each other to open and close said jaws. These members are pivotally connected at one side to a bracket, or carrier, 82, shiftably supported upon the rod 64′, and are adapted to swing into and out of the plane of movement of the screw-rods, as will be understood by reference to Fig. 13 of the drawings.

As a means for operating the gripping-device to engage the jaws thereof with the screw-rod after the same has been released from its chucking-spindle, and for moving said gripping device longitudinally of the machine to feed the rod forward the requisite distance, and for releasing said gripping-jaws after the rod is positioned, the member 80 is provided at its lower end with a friction-roller, 83, adapted to override the laterally-deflected cam-face, 84, upon the cam-wheel 65′, and the bracket 82 is provided with a depending arm, 85, located in position for engagement with the cam-face 65‴ of said cam 65′. In operation, when the screw-rod is in position for engagement by the two members 80 and 81 of the gripping-device, the cam-face 84 of the cam 65′ first throws the jaws of the two members into impinging-engagement with the rod, after which the cam-face 65‴ of said cam shifts the gripping-device longitudinally of the machine, feeding the screw-rod forward until its inner end abuts against the inner end of the stop or gage *r*, after which the movements of the parts just described are automatically reversed by said cam-faces, which releases the rod and brings the gripping-device back to its normal position ready for engagement with the next succeeding rod. After the gripping-device is released from the screw-rod, the rotation of the work-carrier will carry the screw-rod from the position shown in full lines in Fig. 13, in the arc designated by the dotted line 87, which tilts the two members of the gripping-device to the position shown by dotted lines in said figure, thus allowing the rod to pass out from between the jaws thereof, after which said members will return by gravitation to their normal operative position.

The work-carrying spindles are all continuously rotated until they come into alignment with the threading-die, the clutch-members 26 and 26″, (one of which is splined to the tubular shaft 20, and the other of which is in the nature of a pinion in constant mesh with the spur-wheel 27 and is loose upon said shaft,) being normally held in engagement, as hereinbefore stated, by the spiral springs 26‴. When the successive work-carrying spindles have arrived in alignment with the threading-die, the clutch-members in connection with that particular spindle are automatically thrown out of engagement by means of a shipper-lever, 88, which at this particular time engages the member 26″. This shipper-lever is pivotally supported at 89, upon a bracket, 90, secured to a rod, 64″, secured to the frame of the machine, the lower end of said shipper-lever being provided with a roller, 91, adapted to be engaged and operated by the cam-face 91′ upon the cam 65′, said cam-face being so constructed, and located upon the cam 65′, as to throw the two clutch-members of the spindle whose rod is being screw-threaded, out of engagement, to thereby stop the rotation of the rod carried by said spindle, while the same is being screw-threaded, and to hold the said rod in such condition till the thread has been completed, after which the shipper-lever is retracted, which throws the two clutch-members again into engagement, thus allowing the rod to rotate to screw-off the threading-die.

The means for holding the work-carrying spindles against rotation while the rod is being threaded is shown herein as a clutch-device, one member $26^{\times}$ of which is shown as a pin extending laterally from the face of the grooved collar 26″, while the other member is shown as a pin, 118′, disposed transversely to the pin $26^{\times}$ and formed as the short arm of an L-shaped projection 118 extending laterally from the upright 17 of the machine.

It will be evident that, when the shipper-lever 88 disengages the two clutch-members 26 and 26″, the pin $26^{\times}$ will be shifted laterally into the path of the pin 118′, and will be engaged thereagainst when the spindle and rod are brought into position for threading said rod; also that when the shipper-lever is retracted, and the two clutch-members again become engaged, the path of movement of said pin $26^{\times}$ will be shifted out of the way of the pin 118′, and will not be engaged thereby until a complete rotation of the turret is effected.

The turret, or work-carrying head, D, has formed in its periphery a series of lock-notches, 95, adapted to be engaged by a lock-bolt, 96, to lock said head in its successive positions with its screw-rods in position to be operated upon by the several tools of the tool-carrying head C. This locking-mechanism, in the form thereof herein shown, consists of the bolt 96 carried in a sleeve, or barrel, 97, secured to the under side of the bearing 17, as shown most clearly in Fig. 7. This sliding bolt has a reduced extension or shank, 98, which extends through the sleeve 97, and has a flange at its lower end adapted to be engaged by the arm 99 of a bell-crank lever, V, pivoted to the framework of the machine. The opposite arm, 100, of said lever will preferably be provided with a friction-roller at its extreme end which engages the cam-face of a lock-bolt-engaging cam, 101, secured to the cam-shaft F. A spring, 102, is interposed between the head of the bolt 96 and bottom-wall of the sleeve 97, and acts to retain the friction-roller of the bell-crank in engagement with the cam 91.

In the drawings I have shown one form of shaping and cutting-off mechanism adapted for automatically shaping the head of, and for cutting off, the threaded screw-rod. In the form thereof herein shown, the combined head-shaping and cutting-off mechanism comprises a head, 110, supported by the framework of the machine and having horizontal and, approximately, vertical slide-ways, 112 and 112′, respectively; two independent cutter-carriers, 113 and 113′, adjustably carried in said slide-ways 112 and 112′ respectively; two independent cutters, 114 and 114′, carried by the carriers 113 and 113′, respectively; an actuating-lever, 115, fulcrumed in the head and connected with the carrier 113; an actuating-arm, 115′, connected with the carrier 113′, and a cam, 116, for actuating said levers to bring the two cutters alternately to the work at different angles, as will be readily understood by reference to Figs. 6, 7 and 8 of the drawings. At the lower ends of the carrier-actuators are friction-rollers, 117, which bear upon the cam-faces of the cam 116, as shown in said figures, the cam being so constructed and the actuators being so arranged as to first elevate the shaping-cutter 114′ to shape the head and subsequently carry the cutter 114 forward to cut off the screw; springs being preferably employed for retracting the cutters.

Having thus described my invention, I claim—

1. In a screw-making machine, the combination with a work-spindle carrier and a tool-carrier and mechanism for moving one of them toward the other, of a work-carrying spindle revolubly carried in said spindle-carrier, a threading-die having a spindle revolubly carried in the tool-carrier, and automatic controlling-means organized and adapted for reciprocally and alternately rotating and stopping the work-carrying spindle and the threading-die respectively without altering the direction of rotation thereof, whereby after the cutting of the thread the work is released from the die without affecting the direction of movement of said rotatable parts, substantially as described.

2. In a screw-making machine, the combination with an intermittently-revoluble work-spindle carrier and with a non-revoluble sliding tool-carrier, of a work-carrying spindle revolubly carried in said spindle-carrier, a threading-die having a spindle revolubly carried in the tool-carrier, and automatic controlling-means organized and adapted for reciprocally and alternately rotating and stopping the work-carrying spindle and the threading-die respectively without altering the direction of rotation thereof, whereby after the cutting of the thread the work is released from the die without affecting the direction of movement of said rotatable parts, substantially as described.

3. In a screw-making machine, the combination with a work-spindle carrier and a tool-carrier and mechanism for moving one of them toward the other, of a work-carrying spindle revolubly carried in said spindle-carrier, a threading-die having a spindle revolubly carried in the tool-carrier, and automatic controlling-means organized and adapted for stopping the rotation of the work-carrying spindle and simultaneously rotating the threading-die to cut the thread upon the screw-rod and for reciprocally rotating the work-carrying spindle and simultaneously stopping the rotation of the screw-threading die to release said die from the work and all without altering the direction of rotation of said rotatable parts, substantially as described.

4. In a screw-making machine, the combination with an intermittently-revoluble work-spindle carrier and with a non-revoluble sliding tool-carrier, of a work-carrying spindle revolubly carried in said spindle-carrier, a threading-die having a spindle revolubly carried in the tool-carrier, and automatic controlling-means organized and adapted for stopping the rotation of the work-carrying spindle and simultaneously rotating the threading-die to cut the thread upon the screw-rod and for reciprocally rotating the work-carrying spindle and simultaneously stopping the rotation of

the screw-threading die to release said die from the work and all without altering the direction of rotation of said rotatable parts, substantially as described.

5. In a screw-making machine, the combination with a work-spindle carrier and a tool-carrier and mechanism for moving one of them toward the other, of a work-carrying spindle revolubly carried in said spindle-carrier, a threading-die having a spindle supported for longitudinal and revoluble movement in the tool-carrier, driving-mechanism for rotating said threading-die, clutch-members in position and adapted for operatively connecting the threading-die spindle with the driving-mechanism, means for stopping the rotation of the threading-die when the clutch-mechanism is disengaged, driving-mechanism for the work-carrying spindle, a clutch connecting said work-spindle and its driving-mechanism, and means organized and adapted for automatically and alternately operating the work-spindle clutch and the die-spindle clutch, whereby the rotatable spindles may be reciprocally actuated and stopped and without affecting the direction of movement thereof, substantially as described.

6. In a screw-making machine, the combination with a revoluble work-spindle carrier, of means for imparting an intermittent rotary movement to said carrier, a non-revoluble sliding tool-carrier, means for moving said tool-carrier toward and from the work-spindle carrier, a threading-die spindle supported for longitudinal and rotary movements in and with a tubular shaft carried in the tool-carrier, means for rotating said shaft, a clutch in connection with said shaft and threading-die spindle, a work-carrying spindle revolubly carried by a tubular shaft carried by the spindle-carrier, means for rotating said spindle-shaft, a clutch connecting said work-spindle and shaft, and means for automatically, intermittently and reciprocally operating the clutch of the work-spindle and the clutch of the threading-die spindle to reciprocally stop and rotate said spindles alternately, as and for the purpose set forth.

7. In a screw-making machine, the combination with a revoluble work-carrying head, of a plurality of work-carrying spindles revolubly supported on said head, means for imparting an intermittent rotatory movement to said head, means for locking said head in its successive positions, automatic controlling-means for rotating said spindles and for intermittently stopping the rotation thereof at given points in their travel about a common axis, a sliding tool-head carrying a revoluble threading-die, and automatic controlling-means for rotating said die and for intermittently stopping the rotation thereof reciprocally with the rotation and intermittent stopping of said work-carrying spindles and without affecting the direction of movement of said spindles and die, substantially as described and for the purpose set forth.

8. In a screw-making machine, the combination with a revoluble work-carrying head and with means for intermittently rotating said head and for locking the same in its successive positions, of a chuck-spindle conically flanged peripherally at one end thereof and fitted for longitudinal movement in a tubular shaft conically tapered internally at one end to engage the conical flange of the spindle, driving mechanism in connection with said shaft, mechanism for moving the spindle longitudinally of the shaft to engage or release the screw-rod, a clutch in connection with the shaft and adapted for engaging the driving-mechanism to cause the spindle to rotate, and means for automatically shifting the clutch at equal intervals to intermittently stop the rotation of the spindle during the period of threading of the screw-rod, substantially as described.

9. In a screw-making machine, the combination with an intermittently-revoluble work-spindle carrier, of a non-revoluble sliding tool-carrier, means for intermittently rotating the spindle-carrier, means for locking said spindle-carrier in its successive positions, a plurality of work-carrying spindles revolubly carried by said spindle-carrier, means for rotating said spindles about their independent axes and means for stopping the rotation of each successive spindle at each revolution of the carrier, a threading-die revolubly carried by the tool-carrier, means for rotating said die, and means for stopping the rotation of said die intermittently at predetermined periods, the beginning of rotation and stopping of the die being substantially coincident, respectively, with the stopping and beginning of rotation of the successive adjacent work-carrying spindles, substantially as described.

10. In a screw-making machine, the combination with an intermittently-revoluble work-spindle carrier and with means for intermittently rotating said carrier and for locking the same in its successive positions, of a plurality of chucks or spindles supported for longitudinal movement in tubular shafts journaled in sockets formed in the carrier, a gear-wheel loosely mounted upon each shaft and meshing with a driving-wheel carried upon the main shaft of the machine, a clutch connected with each shaft and adapted for automatically connecting said shaft with and disconnecting it from its gear-wheel at determined intervals, mechanism connected with each chuck and adapted for opening and closing said chucks, a lever in position and adapted for operating the chuck mechanism, and means for operating said lever to successively engage and actuate the successive chucks, substantially as described.

11. In a screw-making machine, the combination with an intermittently-revoluble work-spindle carrier, a plurality of work-spindles revolubly carried in said carrier and adapted for carrying screw-rods, and with mechanism for intermittently rotating said carrier and

for rotating the spindles, of screw-rod gripping-and-feeding mechanism located in position and adapted for engaging the screw-rods successively at a given point in their travel around a common center, and comprising two gripping-members movably connected together and pivotally connected with the frame of the machine, and a cam for actuating said members to grip the rod and to move said members laterally to feed said rod, substantially as described.

12. In a screw-making machine, the combination with the intermittently-revoluble work-spindle carrier and with a plurality of work-spindles revolubly carried in said carrier, each of which spindles carries a screw-rod, of a swinging grip-device having shiftable gripping-jaws located in the plane of travel of the screw-rods about a common axis, and means for shifting said jaws to grip the screw-rod, moving said rod longitudinally, releasing said jaws, and shifting them laterally, substantially as described and for the purpose set forth.

13. In a screw-making machine, the combination with an intermittently-revoluble work-spindle carrier carrying a plurality of work-spindles each of which carries a screw-rod, and with means for intermittently rotating said carrier and locking the same in its successive positions; of shaping and cutting-off mechanism connected to the frame of the machine contiguous to the work-spindle carrier and comprising a head having two sets of slide-ways, two independent cutter-carriers shiftably supported in said slide-ways and carrying cutters, and means substantially as described for independently shifting the two cutters alternately toward and from a common center, whereby the shaping and cutting-off actions are effected practically simultaneously while the screw-rod is maintained in a fixed position, as set forth.

14. In a screw-making machine, the combination with the intermittently-revoluble work-spindle carrier carrying a plurality of work-spindles each of which carries a screw-rod, and with means for intermittently rotating said carrier and locking the same in its successive positions, of shaping and cutting-off mechanism comprising a head secured to the framework and having two differently-disposed slide-ways, two independent cutter-carriers mounted for movement in said slide-ways, cutters carried thereby, levers connected with said cutters and adapted for independently moving the cutters alternately toward and from a common center, retracting-springs for said cutters, and a cam having cam-faces adapted to engage and operate the cutter actuating levers, substantially as described and for the purpose set forth.

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