W. AVERY.

MACHINE FOR AUTOMATICALLY CUTTING OR FORMING SCREW THREADS UPON SCREWS.

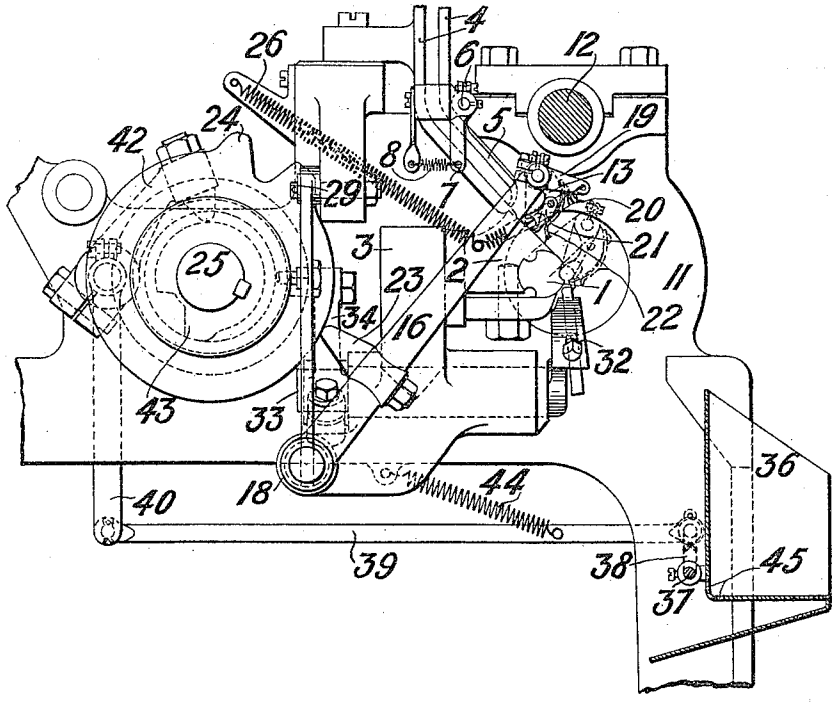
APPLICATION FILED DEC. 17, 1909.

963,976.

Patented July 12, 1910.

4 SHEETS—SHEET 1.

FIG: 1.



Witnesses

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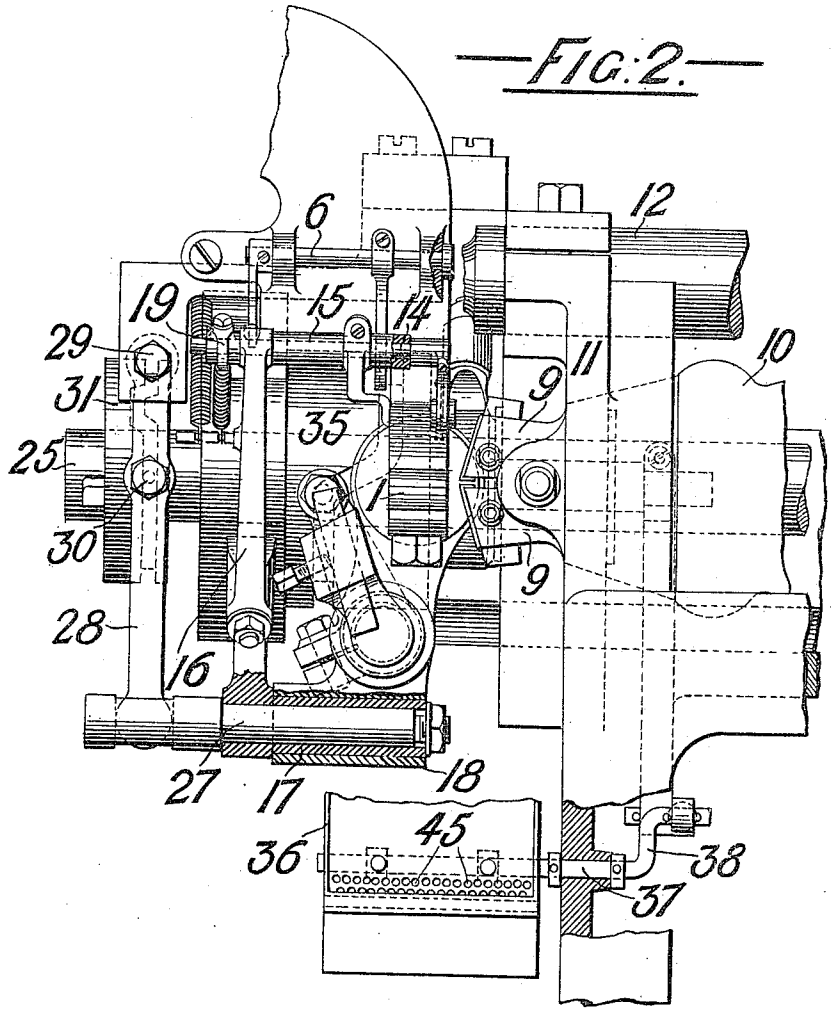
4 SHEETS—SHEET 2.

FIG. 2.



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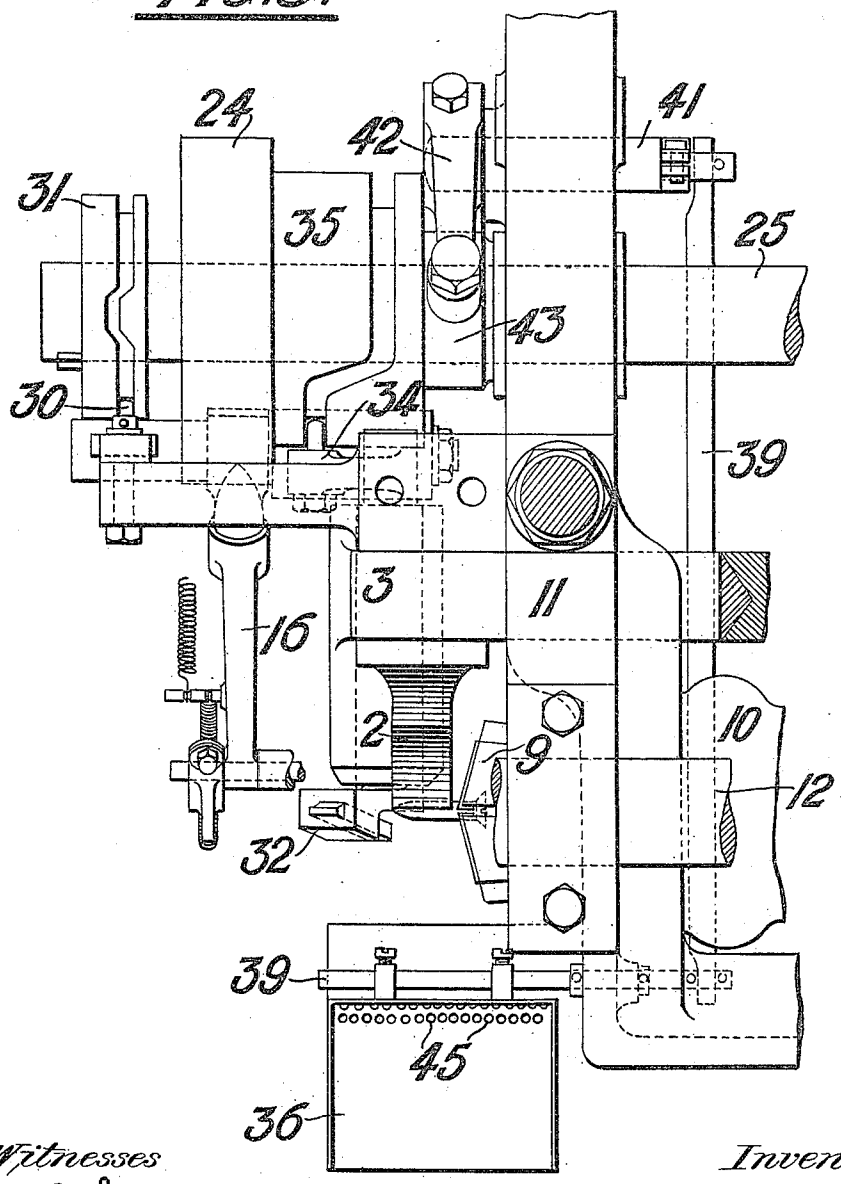
4 SHEETS—SHEET 3.

FIG. 3.



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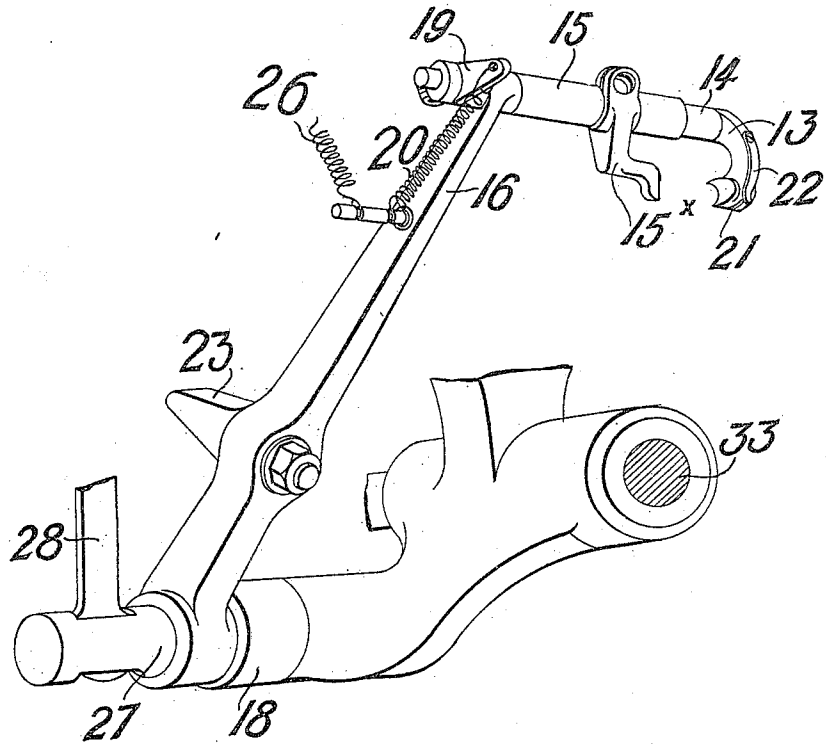
4 SHEETS—SHEET 4.

FIG: 4.



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UNITED STATES PATENT OFFICE.

WILLIAM AVERY, OF RICHMOND, ENGLAND.

MACHINE FOR AUTOMATICALLY CUTTING OR FORMING SCREW-THREADS UPON SCREWS.

963,976. Specification of Letters Patent. **Patented July 12, 1910.**

Application filed December 17, 1909. Serial No. 533,583.

To all whom it may concern:

Be it known that I, WILLIAM AVERY, a subject of the King of Great Britain, residing at Richmond, in the county of Surrey, England, have invented a certain new and useful Improved Machine for Automatically Cutting or Forming Screw-Threads Upon Screws, and of which the following is a specification.

In an improved machine for cutting screw threads upon screw blanks described in a prior specification forming part of my application for Patent, Serial No. 480,451 filed on the 27th of February 1909, (Letters Patent No. 948,200, dated the 1st of February 1910) there is a member which has certain reciprocative sliding movements parallel with the axis of the rotating gripping jaws by which the blank is gripped and turned during the screw forming operation, and this sliding member carries a grooved block which I have termed a back-die and also the said sliding member carries a rocking lever at the end of which is a pivoted finger having bifurcated ends. In one of the rest positions of the sliding member an inclined surface thereon (which carries the back-die) coincides with stationary inclined guide rails down which the blanks are fed, they being retained normally at the base of the guide rails by a spring finger; and the finger-carrying lever is so operated that the bifurcated end of the said finger is brought up over the shank of a blank in the guide rails and then by means of its carrying lever the finger is caused to traverse the blank from the spring retaining-fingers down the inclined surface until the shank of the blank has become placed in the longitudinal groove of the back-die where the finger temporarily holds it; then the slide carrying the finger and the back-die, is traversed until the head of the blank is placed in the rotating gripping jaws, upon which the finger is drawn away and the blank remains held by the jaws and supported by the back-die during the screw cutting operation. When this operation has been completed the finished screw is removed by other mechanism, quite independent of the feed mechanism and back-die here described.

Now the present invention refers to an improved and simplified feed mechanism and back-die or support.

In the mechanism forming the subject matter of the present invention the back-die is stationary being fixed to a part of the framework of the machine, and an inclined surface extends from the stationary guide rails down which the blanks are fed to the groove of the said back-die, the blanks being retained in the said guide rails by a hinged and spring-held finger; the groove of the back-die being coaxial with the gripping jaws into which the head of the blank is to be delivered, and during the screw cutting operation the back-die serves to support as before the shank of the blank against the thrust of the screw cutting tool. In conjunction with this mechanism the invention provides a crescent-ended feed finger fixed on one end of a shaft and fixed upon the same shaft at a short distance therefrom there is also a stop arm, and the feed finger shaft is freely carried at the end of a feed arm and is capable of rocking motion therein against the action of a spring. The feed arm is also capable of receiving rocking motions in a plane transverse to the axis of the jaw-carrying spindle and of traverse motions parallel with the axis of the same.

This present invention is specially characterized by the fact that the crescent ended feed finger partly embraces the shank of a blank held by an ordinary spring arm in a guide chute, draws the shank away from the said spring arm and slides it down an incline, the shank being held between the end of the feed finger and the stationary surface and so traverses it until the shank is placed into the groove of the back-die, wherein the feed finger still holds the shank; and then the feed finger moves in the direction of the axis of the blank carrying the blank with it, because the stop arm carried on the same member as the feed finger, stands against the end of the shank. Thus the shank of the blank is slid in the direction of its axis by the feed finger and stop arm upon the stationary surface of the back-die until its head has entered the gripping jaws; and having so done, the feed finger recedes during the operation of screw-cutting and then returns, and moves the finished screw in the direction of its axis, the latter being held

between the feed finger and the stationary back-die, so bringing it away from the gripping jaws, and then allowing it to become released and so drop into a suitable receptacle.

In another prior specification forming part of my application for Patent Serial No. 480,450 filed on the 27th of February, 1909, (Letters Patent No. 948,492, dated the 8th of February, 1910), I have described a machine for nicking and turning the heads of screw blanks prior to their introduction to the machine above described for forming the screw thread thereon. The feed mechanism in this head nicking machine consisted of a pair of feed fingers, which grasped between them the shank of a headed blank which the said fingers seized from guide rails, and the fingers were moved until the axis of the blank was coaxial with the gripping jaws; and then the fingers were traversed to carry the shank of the blank into the jaws, and to assist this action a sliding sleeve on a spindle carrying said fingers was traversed relatively to the latter, and said sleeve had a projecting arm which contacted with the head of the blank and caused the blank to slide through the feed fingers to the proper distance within the gripping jaws. In this feed device therefore, neither the feed fingers nor the projecting push arm are rocked about the axis of the parts by which they are directly carried, while they have traversing motions relatively to each other, and moreover this feed mechanism wholly and alone actually carries the blank from the guide rails to the gripping jaws; the nicked blank in this case ejected by certain spring devices not connected with the feed mechanism.

The requirements of the present invention are different, because in the latter the feed mechanism is called upon to act in conjunction with a stationary back-die, and moreover has to operate not only to feed the blank but also to extract and deliver the finished screw, and to these ends the stop arm which is somewhat analogous to the projecting push arm of the nicking machine before mentioned, does not have any traverse motion relatively to the feed finger, and the latter consists not of duplex gripping fingers, but of a single arm co-acting with a stationary member, *i. e.* the back-die.

In already known machines such as a machine for turning pins or studs, it has been proposed to provide a spring finger capable of being traversed backward and forward above a stationary inclined surface, the finger retaining and preventing the stud which is located on the inclined surface beneath it from sliding down by gravity; and then the stud has been released by the spring finger being slid down over the end of the inclined surface and the stud permitted to fall therefrom, and then the finger has been receded, and the stud which has fallen down has been received upon some other member and rigidly clamped between that member and the stationary head of the inclined surface. But in such a feed mechanism, the stud has not been slid in the direction of its axis by the feed mechanism while in contact with the head of the said inclined surface, neither has the stud been held in the groove of the head by the feed mechanism.

The present invention will now be described with reference to the accompanying drawings.

Figure 1 of the accompanying drawings is a sectional left-hand end elevation of the machine, and Fig. 2 is a front sectional elevation. Fig. 3 is a plan view of some of those parts of the machine illustrated at Figs. 1 and 2, sufficient of such plan view being shown as will serve for the purposes of this description; and Fig. 4 is a perspective view showing the feed finger, the member by which it is carried, and also the stop arm.

The grooved back-die 1—which is of a like construction to a similar member described in my prior specification forming part of said application Serial No. 480,451 (Letters Patent No. 948,200)—is carried by a clamping head 2 mounted upon a stationary part 3 of the framework of the machine, and has an inclined upper forward face forming an incline in continuation of the guide rails 4 shown at Fig. 1, which guide rails have been removed in the plan view Fig. 3.

The lowermost blank is retained in position between the guide rails 4 by means of a hooked finger 5 (Fig. 1) pivoted on a rock-shaft 6 (Fig. 2), and normally retained with its hooked end in contact with the surface of the lower guide rail (see Fig. 1) by means of an arm 7 fixed on the shaft 6 and retained by a spring 8 (Fig. 1).

When the shank of a screw blank is located in the exposed groove of the back-die 1 (Fig. 1) the axis of the said blank is coaxial with the axis of the gripping jaws 9 (Fig. 2), which gripping jaws are carried by a revolving head 10 which is revolved in bearings carried in the framework 11 of the machine (Fig. 2) and the cutter-carrying shaft 12 (Fig. 1) is located above the said gripping jaws as has previously been described in said prior specification forming part of my application for Patent Serial No. 480,451 (Letters Patent No. 948,200).

The feed finger 13 (see particularly Fig. 4) is fixed at one end of a shaft 14, which is capable of turning about its axis in the free end of the feed finger arm 16, and a sleeve 15 is fixed upon the shaft 14. The feed finger arm 16 at its lower end has a sleeve extension 17 (Fig. 2) capable of rocking and

sliding motions in a bearing 18 forming part of the framework 3 of the machine.

The feed finger 13 is retained with its free end in contact with the surface over which it moves and with the shank of the blank when it engages the same, by means of a lever arm 19 (Fig. 4) fixed on the shaft 14 and influenced by the tension of a spring 20.

The free end of the finger 13 is formed of a shape to partially embrace the shank of a screw blank, and this embracing end of the finger 13 may be serrated so as to grip the blank or the finished screw with more certainty, but I preferably, as indicated in Figs. 1 and 4, bifurcate the end of the finger 13, and between the two fork members thus formed I insert a pivoted blade 21 normally retained by a spring 22 in a position relative to the forked end of the finger 13 as indicated at Fig. 1, that is so that the gripping end of the blade 21 is resiliently held out of line with the gripping end of the finger, whereby when the gripping end of the finger is brought over a finished screw, the said blade 21 will pass between two adjacent threads and insure the screw being carried along endwise when the finger 13 is traversed in such direction as hereafter described.

Upon the sleeve 15 which is fixed on the shaft 14, a stop arm $15^{\times}$ (Fig. 4) is clamped so as to be adjustable longitudinally upon the said sleeve, and this stop arm $15^{\times}$ is set upon the sleeve 15 in a position to accord with the length of the blanks being operated upon, and so that its foot comes into contact with the end of the blank opposite to the head, for the purpose of causing the said blank to accompany the traverse of the feed finger 13 when the blank is to be moved in the direction of its axis to place the head of the said blank into the gripping jaws 9.

The feed finger arm 16 carries a rubbing piece 23 (Fig. 4) which bears against the periphery of a cam 24 (Fig. 1) mounted on the main cam shaft 25, the rubbing piece 23 being held thereto by a spring 26, the office of the cam 24 being to rock the feed finger arm about the axis of the sleeve extension 17.

A shaft 27 passes into the sleeve extension 17 and is fixed thereto, and the projecting end of this shaft 27 is slotted to receive the lower end of a lever 28, fulcrumed at 29 to a part of the stationary framework and carrying a pin or bowl 30 which enters the groove of a cam 31 on the main cam shaft 25, the cam 31 being designed to rock the lever 28 in both directions and communicate the necessary longitudinal sliding motions of translation to the feed finger arm 16 and the parts carried thereby.

The arm 32 (Fig. 1) carrying the cutter for effecting the pointing of the screw blank is fixed on a short horizontal shaft 33, Fig. 1, capable of rocking in a bearing formed by an extension of the framework 3, and at the opposite end said shaft is fitted with an arm 34 (Fig. 3) carrying a pin which engages the groove of a cam 35 mounted on the main cam shaft 25.

A tilting trough 36 (Fig. 1) to receive the finished screw is clamed upon a rock-shaft 37 carried in bearings in the framework of the machine, and fitted at its end with a crank 38, which, by a connecting rod 39, is connected to the free end of an arm 40, the upper end of which is fixed upon a shaft 41 (Fig. 3) also carried in bearings in the framework of the machine toward the rear of same. The shaft 41 has at its opposite end an arm 42 (Figs. 1 and 3) carrying at its free end a rubbing piece which bears upon the periphery of a cam 43 mounted on the main cam shaft 25, and the rubbing piece of the arm 42 is held in contact with the surface of the said cam 43 by means of a spring 44 (Fig. 1). The trough 36 is formed with draining holes 45.

The gripping jaws 9 and the revolving head 10 may be actuated, controlled and driven substantially as described in said prior specification forming part of my application for Patent Serial No. 480,451 (Letters Patent No. 948,200), and therefore such mechanism does not require further illustration or description, and likewise the cutter-carrying shaft may be similarly controlled and operated as described in the same prior specification.

The operation of the machine is as follows:—The blanks pass down between the guide rails 4 lying upon one another with their axes horizontal, and the lowermost blank lies up against and is retained, by the hooked end of the finger 5. The cam 24 then permits the free end of the feed finger arm 16 to be drawn upward by the spring 26, and the rear edge of the feed finger 13 contacts with the lower end of the uppermost guide rail 4, and is permitted to slightly rock the shaft 14 by which it is carried against the action of the spring 20 (Fig. 4); the gripping end of the finger 13 is thereby slightly lifted above the shank of the lowermost blank. Then as the free end of the feed finger arm 16 begins to descend through the action of the cam 24, the jaws of the finger 13 pass on to the shank of the lowermost blank gripping the same, and carrying that blank downward along the slope of the lowermost guide rail, and causing the hooked finger 5 to lift against the action of the spring 8 which normally retains it in place. The lowermost blank is thus taken away from the control of the finger 5. The feed finger 13, by the continued motion of the feed finger arm 16, traverses the blank down the slope of the clamping head 2 and conducts the blank into the groove of the back-die 1, this position of the finger being

shown by dotted lines in Fig. 1. The foot of the stop arm 15^x is, as aforesaid, so located that it stands against the end of the blank. At this time, that is when the blank is held by the feed finger 13 in the dotted position shown in Fig. 1, *i. e.* in the groove of the back-die, the cam 31 acts upon the lever 28 and slides the sleeve extension 17 (Fig. 2) in the bearing 18 and thus carries the blank in an endwise direction so that its head enters the revolving gripping jaws 9, which are immediately—by mechanism such as described in my aforesaid prior specification forming part of my application Serial No. 480,451 (Letters Patent No. 948,200)—closed and caused to firmly grip said blank. The feed finger arm 16 is then again brought into position as shown in Fig. 2 and pauses during the operation of pointing the blank and cutting the screw-thread thereon. The pointing operation is effected by the cam 35 rocking the arm 34 and thereby bringing the arm 32 carrying the pointing cutter up to the revolving screw blank. Then the screw-cutting operation is effected as described for example in my prior specification forming part of said application Serial No. 480,451 (Letters Patent No. 948,200). Upon the completion of the screw-cutting operation, the free end of the feed finger arm 16 again descends and the gripping end of the finger 13 passes over the shank of the screw, the resilient blade 21 entering between two adjacent threads, and then the jaws 9 having opened, the cam 31 slides the sleeve 17 and the feed finger arm 16 endwise away from the said jaws 9, and thereby takes the head of the finished screw out of the said jaws. The feed finger arm 16 is then rocked in an upward direction and the finger 13 releases the finished screw from the groove of the back-die 1, that screw falls into the trough 36, the feed finger 13 takes another blank, and the motions are repeated. The finished screw which has been so released from the back-die falls into the trough 36 which has been rocked into a rearwardly inclined position to receive the said screw, and then the cam 43 rocks the trough into the position shown in Fig. 1 and pauses to allow time for the attendant to inspect the finished screw, after which the trough is rocked farther forward so that the screw falls out into some convenient receptacle, and then the trough returns to its original substantially vertical position to act as a baffle or splash-board while the next screw blank is being cut, and so on.

What I claim as my invention and desire to secure by patent is:—

1. In a machine for cutting screw threads upon screw blanks, the combination with means including rotary gripping jaws for holding and rotating each blank during the screw-cutting operation, of a stationary back die fixed on the frame work of the machine and having a groove coaxial with said gripping jaws, feed rails down which the blanks are fed, a spring-held finger to retain the lowermost of said blanks in position on said feed rails, an incline extending from said feed rails to said back die, a feed-finger arm, bearings in the frame work adapted to carry said arm and to permit the latter to have traverse motions in the direction of the axis of the gripping jaws and rocking motions in a plane at right angles thereto, mechanism for rocking and traversing said arm, a shaft carried at the free end of said arm and extending in a direction parallel with the axis of said gripping jaws, a lever arm on said shaft, a spring acting on said lever arm to maintain said shaft resiliently in one axial position, a feed finger fixed on said shaft and having an embracing end adapted to extend over and grip the shank of a blank in said guide rails to draw said blank away from said retaining finger and to carry said blank down said incline into the groove of said back die when said feed arm is rocked forwardly, a stop arm fixed on said shaft and adapted to engage the end of said blank and to carry said blank in the direction of its axis between said gripping jaws to the requisite distance when said feed finger arm is traversed in such direction while said blank is held by said feed finger in the groove of said back die, substantially as set forth.

2. In a machine for cutting screw threads upon screw blanks, the combination with means including rotary gripping jaws for holding and rotating each blank during the screw-cutting operation, of a stationary back die fixed on the frame work of the machine and having a groove coaxial with said gripping jaws, feed rails down which the blanks are fed, a spring-held finger to retain the lowermost blank in position on said feed rails, an incline extending from said feed rails to said back die, a feed-finger arm, bearings in the framework adapted to carry said arm and to permit the latter to have traverse motions in the direction of the axis of the gripping jaws and rocking motions in a plane at right angles thereto, mechanism for rocking and traversing said arm, a shaft carried at the free end of said arm and extending in a direction parallel to the axis of said gripping jaws, a lever arm on said shaft, a spring acting on said lever arm to maintain said shaft resiliently in one axial position, and a feed finger fixed on said shaft and having an embracing end adapted to extend over and grip the shank of a blank in said guide rails to draw said blank away from said retaining finger and to carry said blank down said incline into the groove of said back die when said feed arm is rocked forwardly, substantially as set forth.

3. In a machine for cutting screw threads upon screw blanks, the combination with means including rotary gripping jaws for holding and rotating each blank during the screw-cutting operation, of a stationary back die fixed on the frame work of the machine, and having a groove coaxial with said gripping jaws, feed rails down which the blanks are fed, a spring-held finger to retain the lowermost of said blanks in position on said feed rails, an incline extending from said feed rails to said back die, a feed-finger arm, bearings in the frame work adapted to carry said arm and to permit the latter to have traverse motions in the direction of the axis of the gripping jaws and rocking motions in a plane at right angles thereto, a cam shaft, a rotary cam on said shaft adapted to rock said arm forward toward the back die to feed the screw blank thereto, a spring acting on said arm to draw said arm back as permitted by said cam during the screw-cutting operation, said cam being constructed to again advance said arm and again permit its backward movement on the finish of the screw-cutting operation for the extraction of the finished screw, a grooved cam on said cam shaft, a lever pivoted at one end to the frame work and operated by said grooved cam to transmit traverse motions in the direction of the axis of the gripping jaws to said feed-finger arm, a shaft carried at the free end of said arm and extending in a direction parallel to the axis of said gripping jaws, a lever arm on said shaft, a spring acting on said lever arm to maintain said shaft resiliently in one axial position, a feed finger fixed on said shaft and having an embracing end adapted to grip the shank of a blank or of a finished screw, and a stop arm fixed on said shaft and adapted to engage the end of the shank of the blank and to carry said blank in the direction of its axis in the operation of inserting the blank between the gripping jaws preliminary to the screw-cutting operation, substantially as set forth.

4. In a machine for cutting screw threads upon screw blanks, the combination with rotary gripping jaws and a back die having a groove coaxial with said gripping jaws adapted to receive and guide the screw blank during its introduction into the gripping jaws, to support said blank during the screw-cutting operation and to serve as a guide during the removal of the finished screw from said jaws, of a feed-finger carrying shaft, means for carrying and communicating the requisite motions thereto, a feed finger fixed on said shaft having an embracing end adapted to fit over the shank of a blank or of a finished screw and having a slot therein, a blade pivoted within said slot, and a spring attached to said feed finger and adapted to act upon said blade to normally hold it resiliently out of line with the gripping end of said finger to cause said blade to pass in between the formed screw threads of a finished screw preliminary to the endwise extraction of the latter from said gripping jaws, substantially as set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

WILLIAM AVERY.

Witnesses:
ALFRED P. DEARLE,
WILLIAM A. MARSHALL.