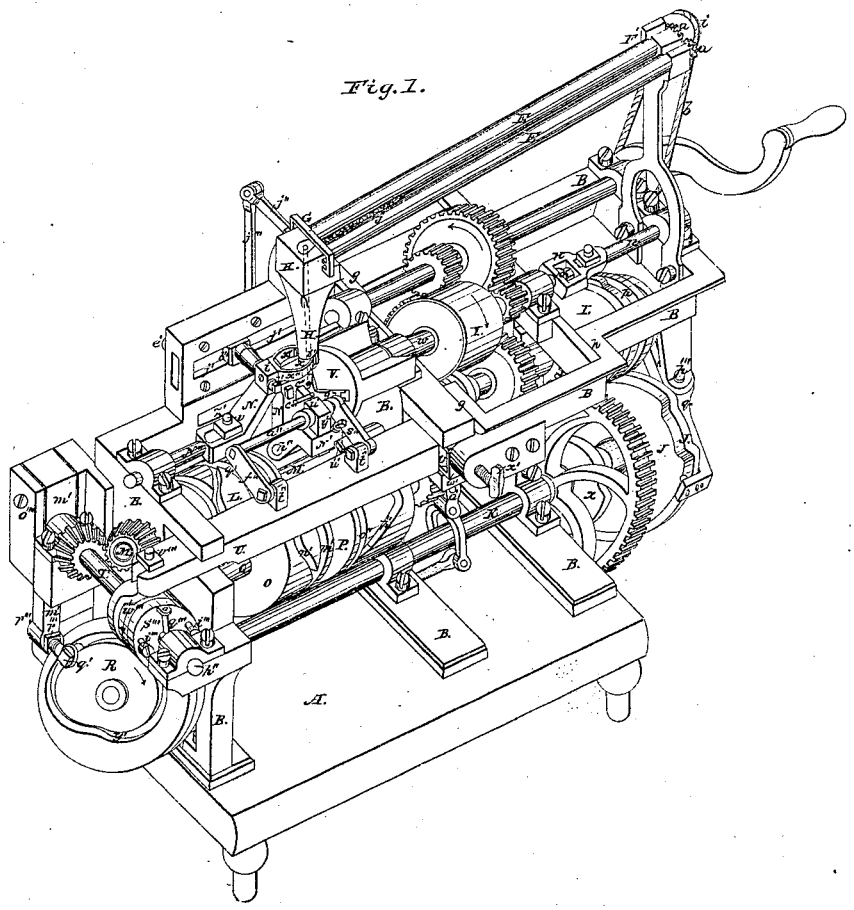
T. W. Harvey,

Making Wood Screws,

No. 4,548. Patented May 30, 1846.

Fig. 1.



I. W. Harvey,

Making Wood Screws,

No. 4,548. Patented May 30, 1846.

Fig. 3.

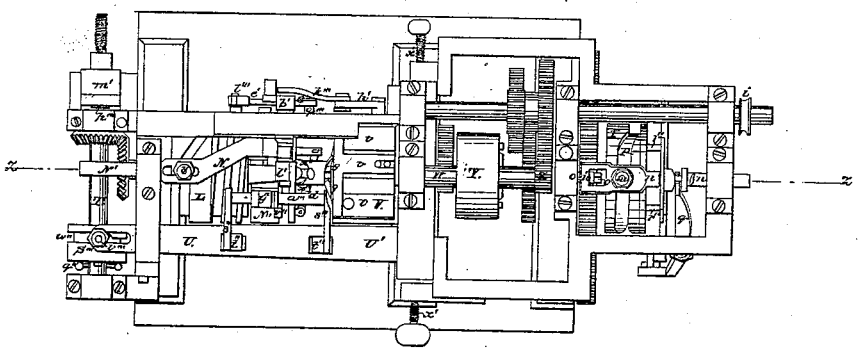


Fig. 2.

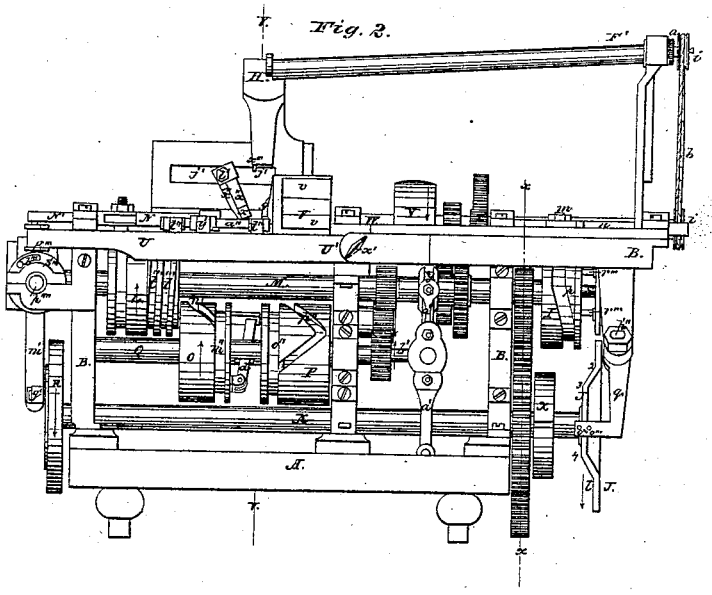


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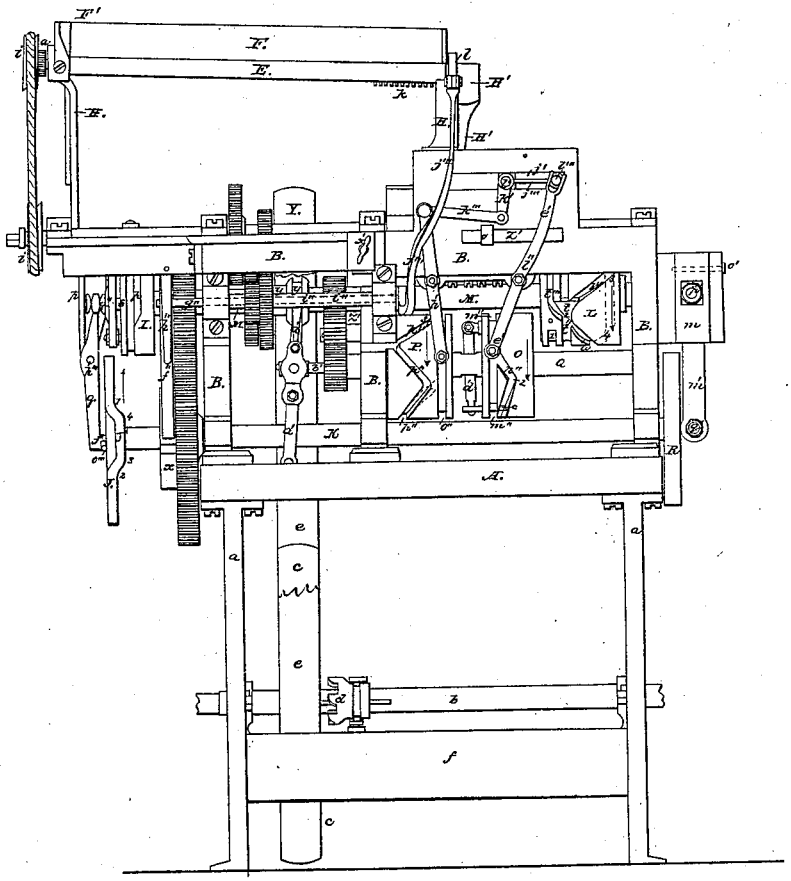
Fig. 4.



Sheet 1. - 5 Sheets.

T. W. Harvey,

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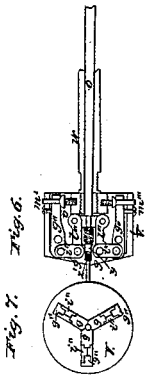

Fig. 6.

Fig. 7.

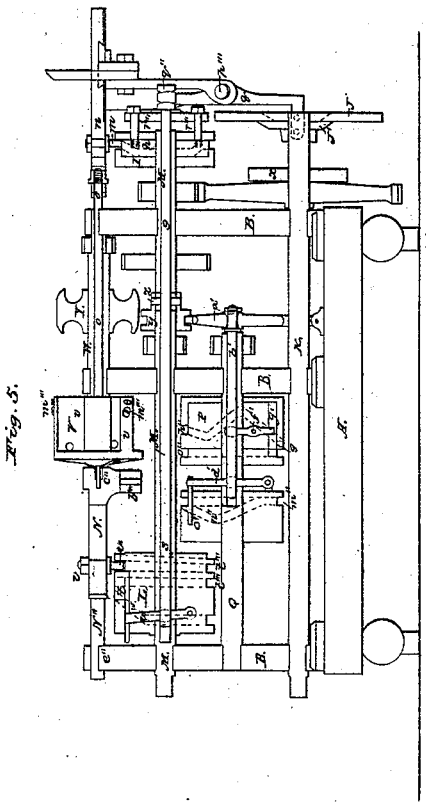

Fig. 5.

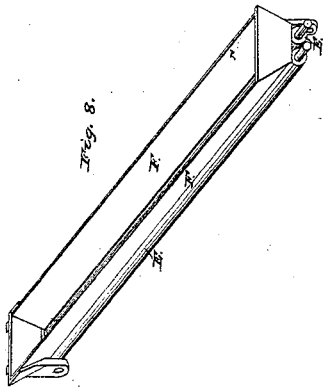

Fig. 8.

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Fig. 12.

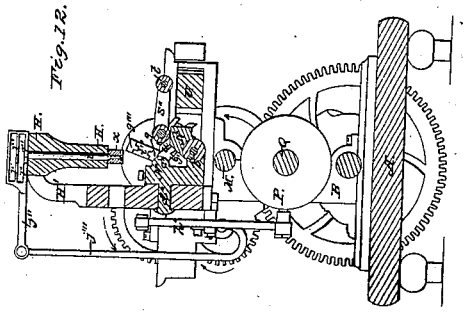


Fig. 14.

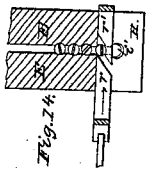


Fig. 13.

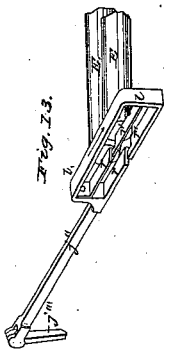


Fig. 9.

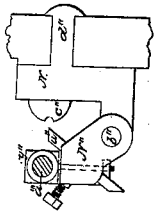


Fig. 15.

Fig. 10.

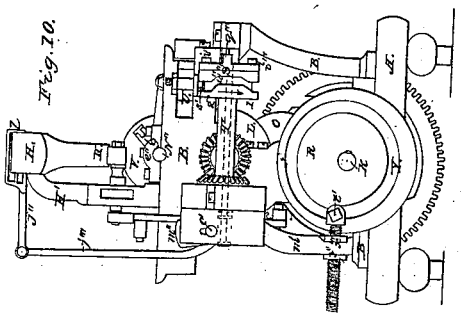
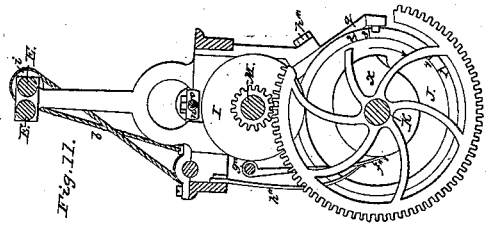


Fig. 11.



UNITED STATES PATENT OFFICE.

THOMAS W. HARVEY, OF NEW YORK, N. Y.

IMPROVEMENT IN MACHINERY FOR CUTTING SCREWS.

Specification forming part of Letters Patent No. **4,548**, dated May 10, 1846.

To all whom it may concern:

Be it known that I, THOMAS W. HARVEY, of the city, county, and State of New York, have invented new and useful Improvements in the Machine for Cutting the Threads of Wood-Screws; and I do hereby declare that the following is a full, clear, and exact description of the principle or character which distinguishes my invention from all other things before known, and of the manner of making, constructing, and using the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1, Plate 1, is a perspective view of the machine, taken in front. Fig. 2, Plate 2, is a front elevation; and Fig. 3, same plate, a plan. Fig. 4, Plate 3, is a back elevation. Fig. 5, Plate 4, is a vertical longitudinal section taken at the line Z Z of Fig. 3, and representing the shafts and spindle or mandrel in and beyond the plane of the section as cut open to exhibit sliding rods within them. Figs. 6 and 7, Plate 4, are a section and front view of the chuck and gripping-jaws, which hold and rotate the screw-blanks. Fig. 8, Plate 4, is a perspective view of the hopper; Fig. 9, Plate 5, a section in front of the chasing-tool to show clearly its connections. Fig. 10, Plate 5, is an elevation of that end of the machine which is on the left hand when looking at it from the front. Fig. 11, Plate 5, is a vertical transverse section taken at the line X X of Fig. 2, Plate 2. Fig. 12, Plate 5, is another transverse vertical section taken at the line V V of Fig. 2, Plate 2. Fig. 13, Plate 5, is a perspective view of the delivery end of the hopper-rollers and discharging-slide; Fig. 14, Plate 5, a horizontal section of the same; and Fig. 15, Plate 5, a cross-section of the conveying-fingers, as opened by a wedge-like projection on the lower end of the conveying-tube.

The same letters and numerals indicate like parts in all the figures.

The nature of my invention consists, first, in arranging the screw-blanks in a continuous row when thrown promiscuously into a hopper, and delivering them one by one without the necessity of an attendant, which is effected by means of two inclined rollers placed far enough apart to permit the shanks of the screws to hang vertically between them, so that by their rotation and inclination they cause the blanks to arrange themselves side by side with the heads resting on and the shanks hanging between them, and thus gradually to force them toward the delivery end.

My second improvement consists in taking the blanks from the ends of the rollers and delivering them into a vertical conveying-tube by means of a slide, which has an aperture in it that admits the blank, and by its motion and the oblique side of the aperture forces it horizontally and in a vertical position to the aperture of the delivery-tube, down which it descends, at the same time checking the farther descent of the blank between the rollers until its return, the aperture being so formed as to permit the descent of the blanks into it from the rollers before the repetition of the delivery operation.

My third improvement consists of a pair of spring conveying-fingers, which are presented to the lower end of the vertical tube, down which the blanks descend and slightly opened, by coming in contact with a projection from the lower end thereof to receive the end of the blank as it descends, and which is gripped by the fingers as they are moved away, the conveying-fingers projecting from a shaft so operated by a slide and a series of cams and levers that it rotates through a part of a circle to bring the blank in a horizontal position and then horizontally to present the head of the blank to the grippers preparatory to cutting the threads.

My fourth improvement relates to the employment of grippers jointed to a chuck or head on the end of a hollow mandrel and connected to one end of a sliding rod within the mandrel, the other end being connected with a slide governed by a cam, the sliding of which causes the grippers to take hold of the blank just within the head to rotate it while under the operation of the chasing-tool, when this is used in combination with a turn-screw that slides within or on the sliding rod and forced toward the head of the screws by a spring, so that if the blank should turn in the grippers in consequence of the bite of the chasing or threading tool the turn-screw will be forced into the nick in the head and there hold it.

My fifth improvement relates to the arrange-

ment of the thread cutter or chaser and the sliding rest, the latter of which is secured to a sliding chasing frame or carriage for the purpose of preventing the shank of the screw from yielding while under the action of the chaser, which latter is also properly secured in an adjustable tool holder or head jointed by its lower end to the chasing sliding frame, the upper end sliding on a rod secured to a sway-bar, one end of which is jointed to an adjusting-slide and the other governed by a cam which gives the requisite taper and point to the screw. The chasing-frame is governed in its motion by a chasing-cam groove on a cylinder, the groove being so formed as to move the chasing-slide to carry the cutter gradually from the commencement of the thread toward the point with a motion so regulated relatively to the rotation of the mandrel as to give the pitch of the thread, and then moved back again for another cut, one part of the groove crossing the other for this purpose, and that part of the groove which moves the chasing-slide for chasing the thread is in the form of a helix, and at the end thereof it crosses the helix with a sudden curve to run back the chaser, and at the end of the helix the groove runs into another groove, the junction of these two being provided with a sliding switch connected with a sliding rod within the chasing-cam shaft and governed by another cam called the "index-cam," that when the thread is chased the switch is shifted, which opens this latter groove to draw the chasing-frame and chaser far enough out of the way to admit of the operation of the conveying-fingers to supply a new blank.

My sixth improvement relates to the method of adjusting the motions of the chaser to the varying lengths of blanks and to the different form of points, so as to insure the formation of good points on the screws by making the cam which governs the motions of the sway-bar adjustable on its shaft.

My last improvement relates to the mode of changing the cams that operate the conveying-fingers, the gripping-cam, and the chasing-cam by means of an index-cam which operates sliding switches through the intervention of sliding rods within the hollow mandrel and the cam-shafts.

By means of these improvements I constitute an automatic machine which performs all the operations of arranging the blanks in regular order, supplying them one by one, conveying them to the grippers, chasing the thread with any desired taper and point, and discharging the chased screw with no other human labor than is necessary to keep the mechanism in order and to throw a large quantity of blanks into the hopper at given intervals.

In the accompanying drawings, A A represent a bench or platform, which may be extended to any desired length, dependent on the number of individual machines which are to be placed in a line. In Fig. 4 this platform is represented as raised upon the vertical standards *a a*, through which passes a line-shaft *b*, on which there is a loose pulley *c c*, there being a sliding clutch at *d* to engage with said pulley. Around this pulley passes a belt *e e*, that embraces the pulley Y on the spindle W, that carries the screw-holder or chuck V, said screw-holder containing the gripping-jaws that hold the blanks while being cut On the shaft W is a pinion Z, which gives motion to the gearing-wheels on the respective spindles.

B B is the cast-iron frame-work which supports the principal operating parts of the machine.

F is an inclined hopper into which the blanks are thrown promiscuously at the upper end. It is sustained above the machine on standards H H. Its sides are inclined, and its bottom consists of two parallel inclined rollers E E, placed at such distance apart as to permit the shanks *k* of the blanks to hang freely between them while the heads rest on them. These two rollers are geared together by two cog-wheels *a* and receive a rotary motion by a belt *b* from one of the intermediate shafts and passing around pulleys *i i*, so that by their inclination and rotation they cause the blanks to arrange themselves in regular order, with the shanks *k* hanging between them and the heads resting on the peripheries of the rollers, and gradually to descend toward their lower end, where in succession they are received in apertures made in the two bars *r r* of a delivery and check slide *l*, which is then moved in the direction of the arrow, and by the inclination of the bars *r r* at the aperture forces the blank in a vertical position to the hole in the vertical tube *i'*, made in a projection of one of the standards H. As the slide *l* discharges a blank, its inner face prevents the further delivery of the blanks from the rollers until its return to receive another. The form of these apertures is represented in plan at Fig. 14, where it will be seen that the diagonal aperture in the arms *r r* is enlarged in the parts *r' r'* of the arms to receive a blank so soon as the slide runs back from one discharge, where it is held by a lip until the slide is again moved forward for the delivery. The arms of the slide work in recesses in the upper part of the delivery-tube *i'*, and between it and the end of the rollers and its periodical movements, which must correspond with the operations of the other parts of the machine, and are given by an arm *j'''*, jointed to it by a link *j''* and attached to one end of a rock-shaft *g''*, which passes through and has its bearing in the hollow shaft *i''* of one of the intermediate cog-wheels. The other end of this rock-shaft has another arm *f'''*, operated by a cam X on the shaft of the index-cam J, which makes but one revolution to each complete operation of the machine, and therefore the position of this cam is such relatively to the index-cam as to deliver one

blank for each operation. The arm f'' is borne up to the face of its cam by a spring h''. (See Fig. 4.)

The delivery and check slide l is made with two sets of bars r r' to leave room between them for the journals of the two hopper-rollers, as the check-face of the slide should be nearly in contact with their ends. One of these bars may be dispensed with; but the two are important to keep the blank in a vertical position as it is moved out, which is effectually attained by the two bars, one above and the other below the journals of the rollers.

Before the blank is discharged by the deliver-slide the conveying-fingers x are presented to the lower end of the delivery-tube i', which is provided with a wedge-pin x''', that forces open the fingers to receive the point of the blank, which is prevented from descending too far by a flange or any other device within the fingers. These conveying-fingers are made of two springs x'' x'', projecting from an arbor l', that rocks in a slide l'', that slides in a slot j' of the frame. After the blank has been received by the fingers they (the fingers) are rotated to bring the blank to a horizontal position by a lever h', which turns on a stud-pin, its upper end being connected by a link k''' with an arm k' of the rocking arbor l', and its lower end is provided with a cam-pin that runs in a cam-groove o'', cut in the surface of a cylinder P on the shaft Q, by which the required movements are given. The conveying-fingers are then pushed forward to introduce the head of the blank within the grippers by means of a lever e' e', that turns on a stud-pin l'', its upper end being forked to embrace a pin l''', connected with the slide l'' (in which turns the arbor l') by a rod j'''', and its lower end is provided with a cam-pin that runs in a cam-groove m'', (cut in the surface of a cylinder O on shaft Q,) which gives the requisite motion to the lever. After the head of the blank has been gripped by the grippers the coveying-fingers retrograde by the same movements in an inverse order to receive another blank.

The form of the cam-grooves o'' and m'' on cylinders O and P is fully represented in Figs. 2 and 4, where it will be seen that these grooves run entirely around the cylinders in the direction of their periphery, and that there is a lateral groove p'' n'' in each, which runs therefrom diagonally and into it again, and where they run out there is a sliding switch c' in cylinder O, and a corresponding one g' in the other to keep the cam-pins in the grooves o'' m'' to permit the cylinders to rotate without moving the levers during the operation of chasing the thread on the screw; but where a new blank is to be supplied these switches are shifted to close the direct grooves and open the lateral ones to give the required movements to the levers h' and e'. This shifting of the switches is effected in the following manner: The cam-cylinders O and P are made partly hollow to receive the sliding switches, which are connected by means of cross-levers d' and f' with a sliding rod b' within the hollow cam-shaft Q, which is slotted for the passage and play of the cross-levers, and this sliding rod is connected by means of a swivel-collar with a lever a', the lower end of which turns on a joint-pin and the other end embraced by a sliding collar y on the shaft M, connected by a pin z with a sliding rod e within the shaft, which is slotted for the play of the pin z, the end of the sliding rod being connected by a collar q'' with one end of a lever q, that turns on a fulcrum-pin p''', its lower end being made to embrace the fillet of the index-cam J on the shaft K, by which the switches are shifted. This cam makes but one revolution to each complete operation of the machine, and the cam-fillet from 1 to 2 in the direction of the arrow runs at right angles to the axis for the purpose of keeping the diagonal grooves p'' n'' closed. At 2 it takes a diagonal direction to 3 to open these diagonal grooves, that they may operate the levers, and during this operation the index-cam fillet runs in the direction of the periphery from 3 to 4, and then it takes a diagonal direction back to 1 for the purpose of shifting the switches back again to close the grooves p'' n''.

The form of the lateral grooves p'' and n'' is as follows: The groove p'' in cylinder P is the one which operates lever h' and conveying-fingers to move the blanks from a vertical to a horizontal position. When the switch g' is shifted to close the direct groove o'', it runs from the direct groove to 1 in an oblique direction, as represented by dotted lines in Figs. 4 and 5, to change the blank from the vertical to a horizontal position. At this time the lever e' e' begins to push the blank horizontally to introduce it in the gripping-jaws, which motion is effected by the lateral cam-groove n'' of the cylinder O, that runs diagonally from the switch c' to the point 2. During this motion, however, it will be obvious from the connection of the conveying-fingers by means of the arm k' with the lever h' (by which they are vibrated) that the horizontal movement would cause them to vibrate back again in part, and to prevent this the groove on cylinder P runs from 1 to 3 in the reverse direction to retain the fingers in a vertical position, and then the grooves p'' and n'' run into the direct grooves by similar angles reversed.

The grippers g, that grip the blanks when presented to them by the conveying-fingers, are three in number, and are connected to a chuck V on the end of a hollow mandrel W. The chuck is hollow and has three parallel bars g, (dividing the circle into three equal parts,) to which the grippers are connected in the following manner: To the bars g are connected by a joint-pin the levers g'', the back ends of which are provided with two adjusting-screws m'''—one for each—and their for-

ward ends are jointed by links i'' to the grippers g, which are made with jaws adapted to the shank and head of the blanks and running back some distance to form a connection by joint-pins with arms on the end of a rod o, that passes through and slides within the mandrel W to form a connection by means of a collar with a slide n, that has a cam-pin m, operated by a grooved cam I on the shaft M, so that by the sliding of this rod o the grippers operate in the manner of a toggle-joint to grip or liberate the screw. When the grippers are closed, the cam-pin of the slide (during the operation of chasing) runs in that part of cam-groove I which runs entirely round in the direction of the periphery of its cylinder; but when the grippers are to be opened for the purpose of discharging a cut screw and to receive a new blank a sliding piece p is moved in the position represented in Fig. 3, which changes the direction of the groove and makes it diagonal for a short distance to open the grippers to discharge the finished screw, then parallel to hold them open while another blank is introduced, and then in a diagonal direction back again to grip the blank. The shifting of the pin p to make this change is effected by the index-cam J in the same manner as the shifting of the switches in the cam-grooved cylinders O P, by connecting the shifting-piece p with the rod s, that slides in the shaft M of the cam, the sliding rod being connected by a bar r''' r''' with the lever q, operated by the index-cam J, as before described. On that end of the sliding rod s which is connected with the grippers there is a tubular cylindrical projection y', in which slides a turn-screw z', with projections at the back end that pass through elongated holes in the tube, and acted upon by a helical spring on the cylindrical projection, by which the turn-screw is forced up against the head of the blank, so that when the blank is introduced by the conveying-fingers the turn-screw is forced back, and if the nick be not properly presented for the reception of the turn-screw the moment the bite of the chaser on the shank turns the blank the turn-screw is forced into the nick by the tension of the spring, and then the blank is prevented from turning by the turn-screw in the nick, and the grippers only hold it in a true central position, which avoids the necessity of mutilating the shank and head by a grip such as is necessary when held by the grippers only.

After the blank has been gripped and the conveying-fingers have been moved out of the way the chasing operation commences, and it is important during this operation to support the shank of the blank by a rest opposite to the chaser, and therefore and for this purpose they are both connected with and carried by the sliding carriage N. The carriage N is connected with the back of the frame by means of a bolt d'', that passes through and slides in a slot z'' in the frame and to the end by a cylindrical rod N″, projecting from it, that slides in an appropriate box at the end of the frame. The rest c'' is secured in a proper manner in a socket in the back of the carriage to admit of adjustment, and the chaser v'', which is opposite to it, is secured in like manner to an adjustable head N′, jointed to the lower part of the carriage at b'', and so situated relatively to the point of the chaser that a circle struck from the center of this joint will intersect the axis of the blank and the joint of the chaser when properly adjusted. The adjustable head is provided with a swivel-box y'', that slides on a rod a''', connected by means of two links s'' s'' at t'' t'' with a sway-bar U U′, by which the chaser is moved toward and from the blank during the operation of chasing the screw, and the carriage receives its motions for chasing and running back the chaser and rest by means of a cam-groove t''', cut in the surface of the cylinder L on the shaft M, that carries the cam, before described, for opening and closing the grippers, and this groove receives a cam-pin attached to the carriage. This groove, from the point 1 to 2 in the direction reverse of the arrow, is in the form of a regular helix, and from 2 it runs back in a regular curve to 1, so that during the rotation of the shaft as the cam-groove passes the cam-pin on the carriage from 1 to 2 the chaser is regularly drawn from that part of the thread nearest the head to the point to chase the thread, that motion of the chaser relatively to the number of revolutions of the mandrel determining the pitch of the thread. At the end of each cut the chaser is run back by the passage of the cam-groove from 2 back to 1. When the thread is completed, the carriage, with its chaser, must be moved out of the way until the completed screw is discharged and another blank supplied, which is effected by the lateral cam-groove w, that runs out diagonally from the groove t''' at 2, and at 3 it takes a direction at right angles to the shaft and continues so, holding the carriage back until it reaches the point 4, (see dotted lines, Fig. 4,) where it runs diagonally back again into groove t''' preparatory to another operation. The cam-pin on the carriage is made to follow either of these grooves by means of a sliding switch t, connected with the sliding rod s in the cam-shaft M by a lever u and operated by the index-cam J, as in manner fully pointed out in the description of the mode of gripping the blanks.

During the operation of chasing the thread, which is done by several successive cuts, the chaser must be drawn back clear of the thread before the carriage can be carried back to commence the next cut. For this purpose it is that the chaser-head is connected with the sway-bar U U′, as stated above, and for the further purpose of determining the taper of the screw to be cut. One end of this sway-bar is jointed to a block U″, (see Fig. 1,) that slides in the frame governed by two set-

screws x' x' on opposite sides of the frame, by which the point of the chaser can be adjusted horizontally with accuracy during the operation of the machine, and the other end of this sway-bar is provided with a cam-pin v''', that is operated by a cam-groove w'' on a transverse shaft T, driven by bevel cog-wheels on it and the cam-shaft M, the wheels being of the same diameter to insure the turning of the two by equal motions. The form of this cam-groove, which is cut in the surface of a short cylinder, is from the point 1 to 2 (in the direction of the arrow) in the form of a regular helix, to move the point of the chaser toward the axis of the blank to give a regular taper to the screw, if it be desired to make the screw tapering; but if the screw is to be made cylindrical or without taper, then this part of the groove must run at right angles to the shaft. As the chaser approaches the end of the screw, the groove runs out of the line of the helix with a sudden curve to form what is called the "gimlet-point" to the screw, the form of this part of the cam being governed by the form of the intended point of the screw. From this the groove takes a reversed diagonal direction to draw the chaser far enough back to clear the threads when the carriage is run back, the groove running at right angles to the shaft during this motion of the carriage, and finally it takes the reversed diagonal direction, running into the helical part of the groove to recommence the cut; but as the thread is chased by several successive cuts it is necessary that the chaser should at each successive cut be carried the thickness of one shaving nearer to the axis of the screw. For this purpose the cam slides on its shaft, (which is hollow,) and is attached to a sliding rod p'''' within the shaft by means of a feather rod or bayonet q''', that passes at right angles through a slot in the shaft. The outer end of this rod is connected by a collar with a lever m', that turns on a joint-pin at o''', and its lower end is provided with a cam-pin q', attached to it by adjusting-nuts r''', which run in a cam-groove Y', cut in the face of a wheel R on the shaft K of the index-cam J. The position of this cam is on the shaft relatively to the index-cam, and its form is such (as represented in the drawings) that at the commencement of the operation of chasing a screw the cam-pin is nearest the center of the cam-wheel, and its diameter increases irregularly so as to move the chaser toward the axis of the screw less for each successive cut to give a good finish to the thread, the last operation being rather to clean the thread than to cut, and then the cam runs by a more sudden curve back to the place of beginning, and for the purpose of adjusting the cam-groove w'' to the length of thread to be cut its cylinder is made adjustable on its shaft by connecting it with the feather rod or bayonet of the sliding rod p'''' by the intervention of a circular plate s''', to which it is attached by screws i''', that pass through slots in the plate in manner well known to mechanicians.

Motion is communicated to the mandrel W, and from this to the other shafts, by a succession of cog-wheels and pinions, as fully represented in the drawings, the direction of the rotation of each being indicated by arrows. It is only necessary in this connection to state that the relative revolutions of the mandrel and chasing-cam will depend on the diameter, length, and pitch of the thread to be cut, the relative revolutions of the mandrel and chasing-cam and pitch of the chasing-cam, together with the diameter and length of the screw, determining the pitch of the thread, and the relative revolutions of the chasing-cam and index cam determining the number of cuts to be given for the complete chasing of the screw, it being observed that the index-cam must make but one revolution to each complete operation.

It will be obvious that the various parts of this machine are susceptible of slight modifications without changing the principles of my improvements—as, for instance, the conveying-fingers can be operated to change the blank from a vertical to a horizontal position (to present it to the grippers) by a different arrangement of levers and cams, and instead of operating them by means of cams having sliding switches to admit of several revolutions of the cams to each complete operaton of the machine. The same end may be attained by common cams making but one revolution; but this would be less perfect, as the cams would have to be made of very great diameter, or the motions would be too sudden and imperfect.

It will be obvious, also, that some of my improvements may be employed without others, but to less advantage than when all are combined together—as, for instance, the hopper-rollers and discharging-slide may be omitted and the blanks supplied to conveying-fingers by hand—and the advantage arising from changing the blanks from a vertical to a horizontal position retained, for this device presents a decided advantage for hand or other mode of feeding over all other modes of presenting the blank to the rotating grippers with which I am acquainted, and so with other operations too numerous and not necessary to mention.

What I claim as my invention in the above-named machine, and desire to secure by Letters Patent, is—

1. The method of arranging screw-blanks and all other similar articles and regularly delivering them by means of two inclined rollers, substantially as described, whereby the rollers by their inclination and rotation cause the screw-blanks thrown into the hopper promiscuously at the upper end to arrange themselves with the shanks hanging in the space between the rollers and the heads resting on their peripheries, and thus gradually to

descend toward the delivery end, and this whether both or only one of the rollers be made to rotate, or whether the rollers constitute the bottom only or the entire hopper.

2. The delivery-slide, in combination with the tube or any analogous device into which the blank or other similar article is discharged, substantially as described, whereby the blanks received from a hopper or other feeder are delivered in a vertical position into a conveyer, and the further delivery from the hopper is checked until a repetition of the operation is required, as described.

3. So operating the fingers as to receive the blanks, &c., in a vertical and change them to a horizontal position, and move them forward to introduce them into the grippers, substantially as herein described.

4. The grippers, in combination with the sliding spring turn-screw, substantially as herein described, by means of which combination the blank is prevented from turning by the turn-screw in the nick, the grippers simply holding it steady and in a central position without defacing the head and shank, and by which also the turn-screw is made to enter the nick irrespective of its direction when the blank is introduced, as described.

5. Governing the motions of the chaser toward and from the axis of the blank by combining the chaser-head with a carriage and sway-bar moved by a cam, substantially as described.

6. Connecting one end of the sway-bar with an adjusting-slide when this is combined with the chaser or chaser-head, as described, whereby the amount of taper to be given to the screw can be regulated at pleasure.

7. Changing the directions of the various cam-grooves by means of sliding switches operated by sliding rods within the hollow camshafts and shifted by an index-cam, by which the various changes of the motions of the machine are effected, substantially as described.

8. Making the cam which operates the sway-bar adjustable on its shaft, substantially as described, for the purpose of adjusting the motions of the chaser to the length of the blank to insure the proper formation of the point of the screw, as described.

THOS. W. HARVEY.

Witnesses:
CHS. M. KELLER,
J. J. GREENOUGH.