E. SAVAGE.

Threading Wood-Screws.

No. 36,196. Patented Aug. 12, 1862.

Fig. 1.

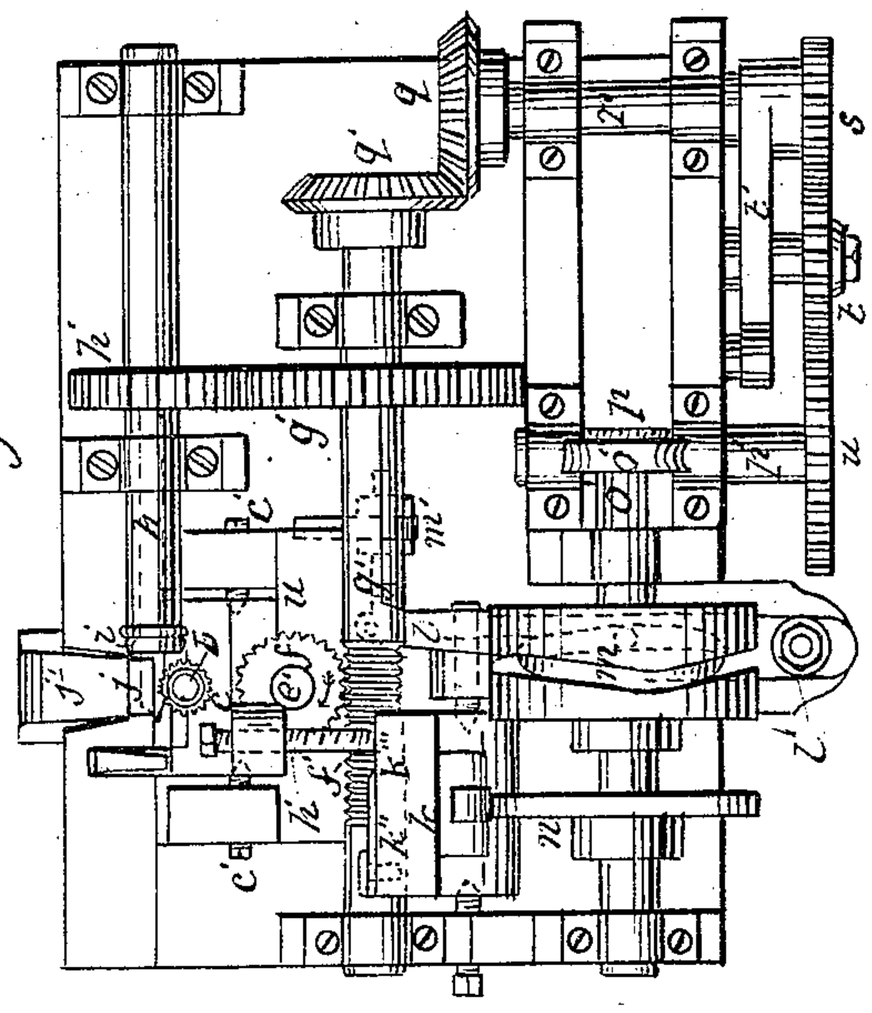


Fig. 2.

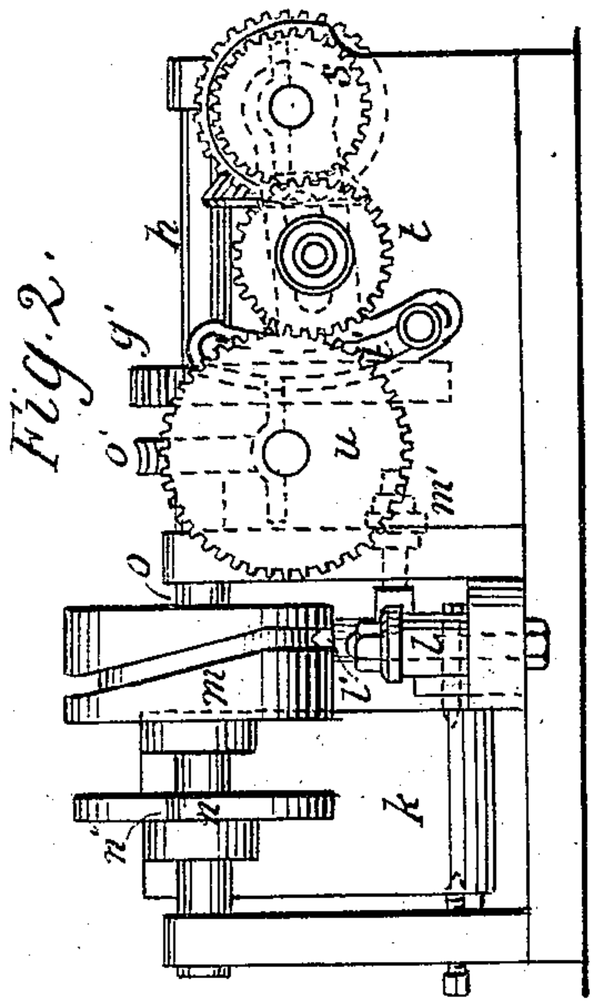


Fig. 4.

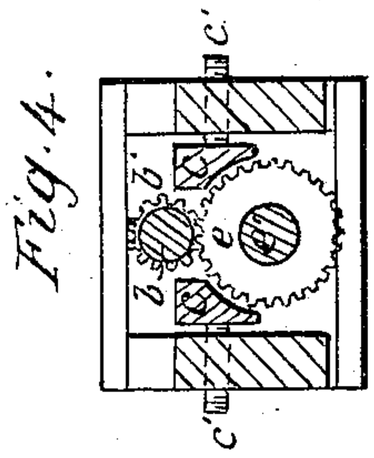
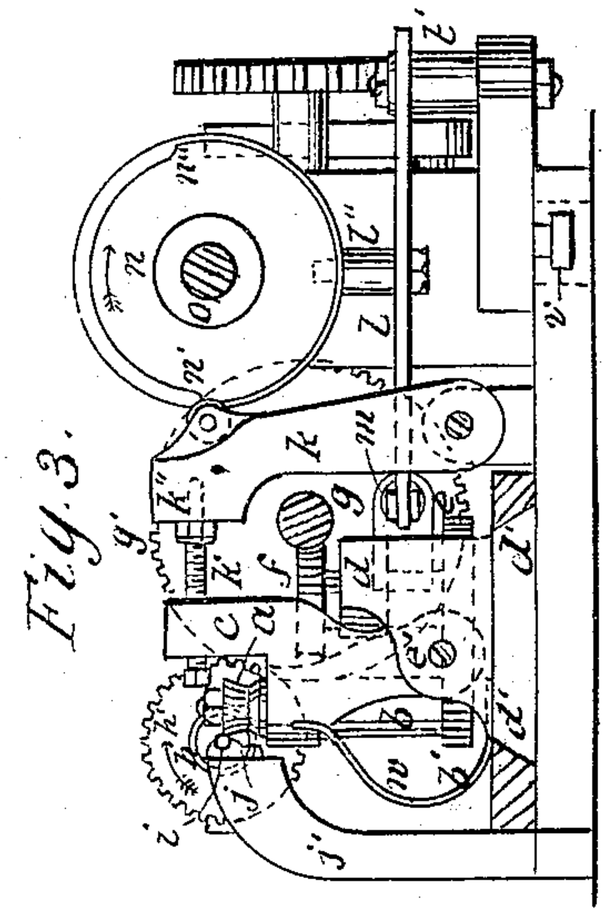


Fig. 3.



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UNITED STATES PATENT OFFICE.

ELLIOT SAVAGE, OF MERIDEN, CONNECTICUT, ASSIGNOR TO CHARLES PARKER, OF SAME PLACE.

IMPROVEMENT IN MACHINES FOR THREADING WOOD-SCREWS.

Specification forming part of Letters Patent No. **36,196**, dated August 12, 1862.

To all whom it may concern:

Be it known that I, ELLIOT SAVAGE, of Meriden, New Haven county, Connecticut, have invented certain new and useful Improvements in Screw-Cutting Machinery; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being made to the annexed drawings, making a part of this specification, which are fully described herein, and in which similar letters indicate similar parts throughout the figures.

My improvements in screw-cutting machinery relate to that part of the operation which effects the cutting or chasing of the threads upon the screw-blank.

The principal feature of this invention lies in the adaptation of mechanism to operate a single rotary cutter, to which a positive revolving motion as well as an onward feeding motion is given in order to effect the chasing of the thread upon the blank.

Rotary cutters have heretofore been used, but always in pairs or threes, and so placed that the screw-blank passed between, and they also turned freely upon an axis. Such an arrangement of freely-revolving cutters is defective in that they frequently overrun the thread and spoil it, and, besides, are not capable of forming a gimlet-pointed screw.

In cutting the threads by means of a single rotary cutter I employ, in combination, a stationary rest or support to sustain the blank on the side opposite to the cutter. Moreover, in giving a positive rotary motion to the cutter it is necessary that the speed shall coincide exactly with the speed or travel of the thread being cut upon the revolving screw-blank, and this speed of cutter must also be made to adapt itself to the different circumstances of position—*i. e.*, whether revolving and moving along the screw-blank or while at the same time chasing in a fixed position.

The several positions of the chaser during the operation of threading a blank are these: When a blank is fed into the holding stock or spindle, the chaser is at first to stand out of the way. It is then made to approach the blank as high up on the shank as the thread is to start at, cutting the thread at that place to its full depth before beginning to move down. Then it commences its motion toward the point. It will now be seen that a different speed must be given to the cutter, because its motion along the screw-blank must be compounded with the travel of the thread, as otherwise the cutter would immediately overrun and destroy the threads as fast as they were chased. Finally, when arrived near the point the chaser is made to advance toward the axis of the blank in order to turn off and thread the gimlet-point.

At *a*, Figs. 1 and 3, is shown the rotary cutter in that position when just brought up against a blank. It is firmly bolted down on the head of a driving-shaft, *b*, which stands in a vertical position, having at bottom a pinion, *b'*, as shown. As the chaser must approach and recede from the blank during the operation of its being received and discharged, the shaft *b* is supported in a swinging frame, *c*, which is pivoted by means of two pointed screws, *c'*, to the side blocks in the carriage *d*, these points *c'* being placed with respect to the gears *b'* so that the cutter can vibrate without affecting the meshing of the gear-wheels, as shown in Fig. 3. Upon the carriage *d* is also placed the wheel for driving the pinion *b'*, as shown at *e*, Figs. 3 and 4, which wheel is double the size of *b'*. The carriage *d* has a beveled base piece or slide made to fit into parallel bevel-guides *d'*, secured to the bed of the machine. These guides lie parallel also with the screw-blank. Thus the carriage conveys the chaser in the proper direction along the front of the blank. On the head of the shaft *e'*, to which the driving-wheel *e* is attached, there is a worm-wheel, *f*, gearing into an endless screw, *f'*, cut upon the body of the shaft *g*, as shown in Fig. 1. The pitch of the thread *f'* is twice the pitch of the screws to be cut upon the machine, the reason for which will be explained hereinafter.

At *h* is the shaft which holds and revolves the screw-blank while being threaded, having a pinion, *h'*, upon the same gearing into a wheel, *g'*, upon shaft *g*, the pinion being one-half of the size of the wheel, as shown. The relation of these several parts will now be made apparent. The cutter-points in *a* must always be revolved with exactly the same speed as the travel of the threads, otherwise

it would cut those off as fast as formed. It is evident, therefore, that the gripper-shaft must be in such combination with the shaft that rotates the cutter that a revolving motion cannot be imparted to one without communicating it to the other. Now, as the cutter not only rotates, but has also a translatory movement from one place to another, gear-wheels would not operate, because any such movement of the axis of the cutter would disconnect the wheels.

The arrangement of mechanism which I have invented consists, then, of a screw-shaft lying parallel with the gripper-shaft, and also parallel with the line of travel of the cutter-shaft, the said screw-shaft being geared with the gripper-shaft by toothed wheels, and with the cutter-shaft by the endless screw working in a worm-wheel upon the latter. Thus the cutter-wheel is driven by the shaft *g* through the train of wheels *f e b*, and by reason of the pinion *b* being half the size of *e* and *f* the cutter will make two revolutions to one of *f* and *e*, while the same proportionate speeds are maintained between the shafts *h* and *g*. In order, therefore, to keep the relations of the speeds to one another, it will be necessary that the endless screw *f'* have twice the pitch of the screw which is being threaded.

At *i*, Figs. 1 and 3, is shown the blank in position as held by the spindle *h*. One-half of its shank lies in the concave in the stationary rest *j*, which latter is a piece of metal affixed to a post, *j'*, which holds it firmly in position. This rest stands immediately opposite the cutter, as seen in Figs. 1 and 3, thus preventing the screw-blank from being deflected by the pressure of the cutter. The cutter has two motions given to it in a direction toward the axis of the blank—the first after a blank has been put into the stock or shaft *h*, ready to receive its action, and the second when the gimlet-point is to be formed. Immediately behind *c* is a vibrating standard, K, made to communicate with *c* by means of a screw-regulating stud, K', having its nut in *c* and its point bearing against K. At the place where this point bears a plate or strip of metal is fixed to receive its pressure, which plate is of differing thickness on its face, K''', Fig. 1, showing the thin and K'' the thick parts. When a movement of K first takes place toward the screw-blank, it is when the screw-stud K' is resting against the thin part of the strip at K''', as in Fig. 1, and as the chaser moves along the shank of the screw-blank *i* toward its point K' rides up the bevel or slant onto the thick part K'', and thus advances the cutter still farther upon the screw-blank. The angle or shape of the slant forms a pattern from which the point of *i* is shaped. The carriage *d* is caused to move back and forth in the guides *d'* by means of a lever operated by a cam. This lever is at *l*, having its fulcrum at *l'*. The cam is at *m*.

At *l''* is a pin projecting from the lever *l* into the groove of the cam, the vibrating end of *l* being attached to the carriage *d* by a screw-link, *m'*, by which link the exact position of the carriage can be regulated for the place to start the cutter from. Upon the same shaft there is a second cam, *n*, which operates to produce the vibratory motion of the cutter to and from the screw-blank. It is a circle the circumference of which is partly cut down, thus leaving two projections, *n'* and *n''*. These act against the post *k*, as shown in Figs. 1 and 3, and through it upon the cutter, as already described. The cam-shaft *o* is made to revolve by means of a worm-wheel, *o'*, which is driven by an endless screw, *p*, upon the shaft *p'*, as in Fig. 1. The cam-shaft is put in motion by a train of gear-wheels connected with the shaft *g*.

At *q* and *q'* are a pair of bevel-gears connecting the shafts *g* and *r* at a right angle to each other, and from *r* a train of three wheels, *s t u*, couples the shafts *r* and *p'* together. Thus rotary motion imparted to either of the shafts will communicate motion to all the others.

It is sometimes necessary to vary the speed with which the carriage *d* is made to move when cutting different kinds of screws without varying the speed at which the cutter and screw-blank revolve. This is accomplished by changing either one of the wheels *s t u*. In case a larger one than that shown at *n* is to be put on to slow down the motion of the cam-shaft *o*, the wheels *t* and *s* would not be able to gear with it in the positions shown in the drawings. I place *t*, therefore, upon the arm of a quadrant, *t'*, the center of motion of which is upon the axis of the wheel *s*, so that moving the arm of the quadrant, while it changes the distance between *t* and *u*, does not affect that between *t* and *s*; or, if either of the other wheels is found to be more easily changed the set may be brought into gear by shifting the axis-pin of *t* along a slot in the arm of the quadrant, as shown in dotted lines in Fig. 2.

In order to cut threads upon screws of different lengths, the travel of the carriage *d* along the slide must be more or less, according to such length. The distance between the fulcrum *l'* of the lever *l* and the pin *l''*, which engages in the cam *m*, must be capable of being varied. There is a slot in *l* at its fulcrum end, through which the fulcrum-pin *l'* passes. On this latter is a pinch-nut, to screw down upon the lever and keep it in place. The fulcrum-pin is also fixed to the bed-plate of the machine so that it can also slide along. By loosing therefore the nut *v*, and that on *l'*, the fulcrum may be moved along the slot in *l* toward *l''*, and thus the length of travel of the carriage *d* is increased. From this arises the principal reason for the arrangement of gears for altering the relative speeds of the cam *n* and the rotary cutter *a*, because the movement of the latter along the blank must not be any faster than will allow time to cut away the metal to the full depth of the thread without risk, for there is a limit to the speed which

may be employed in chasing said thread. Thus whenever the distance between the fulcrum and power of the lever *l* is shortened the speed of the cam *m* must also be reduced proportionably.

The operation is as follows: The feeding of the blanks to the gripper in the end of the shaft *h* in regular order is performed automatically by other mechanism, not necessary to describe. At the moment of feeding a blank the rest *j* is drawn out of the way. The cutter *a* has also retreated, by reason of the bearing-point of *k* pressing upon the recessed portion of the cam-wheel *n*. While this portion is passing by—*i. e.*, from *n''* to *n'*—the cutter *a* is being carried toward that part of the screw-blank where the chasing of the thread is to commence. Arrived at that point the shape of the curve of the cam *m* is such that the carriage *d* is allowed to remain stationary until the cutter has been advanced toward the blank *i* and fully commenced the chasing of the thread by cutting at first to the full depth of the same.

The drawings show the position of the parts when about to commence cutting a thread. The cutter has been forced upon the blank by the cam *n* pressing upon *k* by the projection *n'*, Fig. 3. The shaft *h* being in rapid revolution in the direction indicated by the arrow on *h'*, Fig. 3, and all the parts being also in motion corresponding to the positions of their gear-wheels, cams, &c., the cutter *a* is made to turn with a speed which accords exactly with the travel of the spiral or pitch of screw it is chasing in the blank. As soon as the thread has been cut to the proper depth, the cutter is ready to be advanced along the blank to continue said thread down to the point. The curved portion of the cam *m* now arrives at the driving-pin *l''* of the lever *l*, and causes the carriage *d* to move toward the point of the blank. It will now be obvious that if the speed of the cutter while its axis is stationary is the same as the travel of the thread on the screw the circumstances will be altered the moment the cutter commences to move along the blank, provided it continues to revolve with the same speed it had while not so moving, for, as the direction in which the cutter turns or revolves is toward the point of the blank, as shown by the arrow in Fig. 1 on *a*, this travel of the cutter, combined with its revolving motion, will alter the pitch of the screw. To prevent this alteration of pitch, the rotary speed of the cutter must be retarded in exact proportion to the speed with which it is moved along the screw-blank. This, it will be seen, is accomplished by the direction in which the endless screw *f'* acts upon the worm-wheel *f*. Suppose the whole of the machine to be stationary and the carriage *d* uncoupled from the cam *m*. Then *d* might be moved along its slide *d'*, and the screw *f'* would act as a stationary rack, turning *f*, and the thread on the screw would act in like manner upon the chaser, so that the two would rotate with the same relative speed. These relative motions may not therefore be changed, whether the carriage be in motion or stationary. When the carriage D, then, is moving in the same direction as the travel of the screw *f'*, the speed of *f* will be greater or less, according to the relative velocities of the two, for if *d* were moved along as fast as the thread *f'* moved, then *f* would remain stationary. Accordingly, the slowing down or increase of motion in the cam *m* cannot effect any derangement of the motion of the cutter as regards the alteration in the pitch of the screw. The incline *m'* having pressed K forward, the cutter chases a portion of the thread on the blank *i*. It is then ready to be advanced along said blank in the direction of its point. The cam-groove *m* now causes the lever *l* to move, and this advances the carriage *d*. The end of the screw K' presses against the gage-plate on K, which is straight for a certain distance, as shown at K''', Fig. 1, carrying the cutter along therefore in a line parallel with the axis of the screw-blank. As it nears the point of the latter—which is to be finished with a taper to make the true gimlet-point—the screw-stud K' at the proper time rides up an incline on the gage-plate shown in Fig. 1, between K'' and K''', thus forcing C forward and the cutter with it, which accordingly finishes the screw with the proper taper to its point. By this time *n''* will have arrived at the place of *n'*, Fig. 3. The friction-roller on K descends to the recessed portion of *n*, thus causing the withdrawal of the cutter out of the way of the finished screw. A spring at W, pressing against C, keeps the screw K' all the time bearing against K upon the gage-plate. The grippers now let go of the screw, and a blank is fed in in the usual manner. Meantime the carriage *d* has returned the cutter to the place of beginning, and the operation, as already described, is repeated.

The wheel *e* has been described as twice the size of the pinion *b*, and the worm-wheel *f* twice the size of the cutter *a*, as is also the case with the gears *g'* and *h'*. It is not requisite, however, that these proportions should invariably be preserved, for the worm-wheel *f* might be made exactly of the same size as the cutter-wheel, in which case all the other gear-wheels above named must be made of equal size, and the endless screw *f'* of the same pitch as that which is to be chased upon the blank. The same principle will apply to other sized gear-wheels and pitch of screw *f'*, provided they are of like proportions throughout.

To change the pitch of the thread to be chased on the blank, the cutter is either enlarged or diminished in diameter, preserving the same number of teeth that there are on the wheel *f*. This plan, however, is not a necessity, for the different pitches for different sized screws may be produced by cutters of the same diameter, but differing in the number of their teeth, although in such case the

wheel f and the pinion b' must also be changed so that the number of their teeth shall also be made to agree with those of the cutters.

I claim—

1. So mounting the rotating cutter in its relation to the screw-blank that the said cutter may have a positive rotary motion given to it, the speed of which shall be so varied automatically that, whether cutting in a fixed spot or moving along the blank, the velocity of rotation of said cutter shall be such as to cause its cutting-edges always to correspond with the spiral threads as they are being formed upon the blank, irrespective of the speed with which said cutter is moved bodily along toward the point of the blank, substantially in the manner set forth.

2. The construction and arrangement of mechanism, as hereinbefore described, for imparting rotary motion to the cutter.

3. Connecting the cam m with the driving-shaft g by an arrangement of mechanism capable of being so adjusted as to produce a change in the speed of the cam and in the extent of travel of the carriage without changing the speed of the shafts g or h, substantially as set forth.

In witness whereof I have hereunto set my hand.

ELLIOT SAVAGE.

Witnesses:
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