(No Model.)

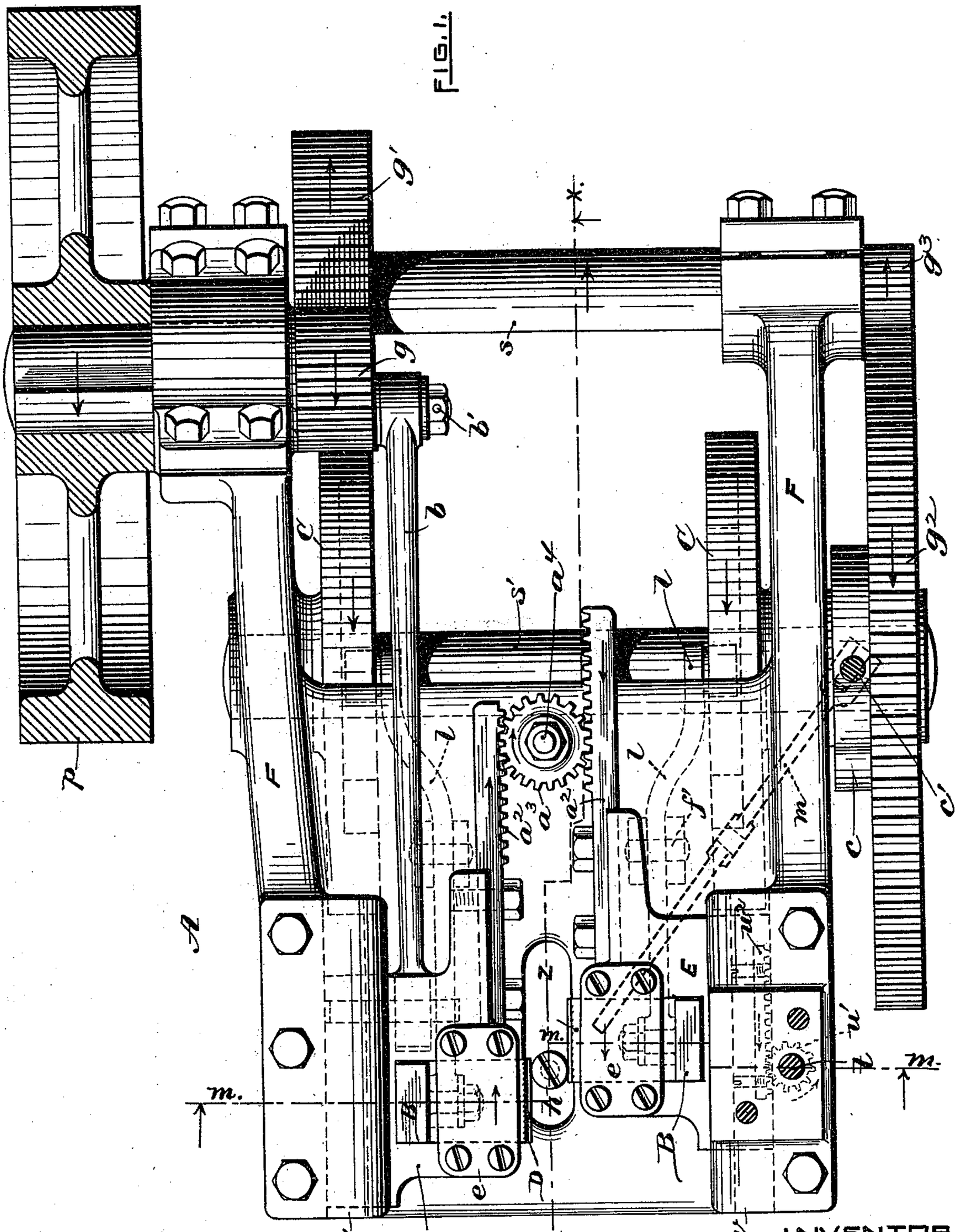
4 Sheets—Sheet 1.

# C. D. ROGERS.

## SCREW SWAGING MACHINE.

No. 408,529. Patented Aug. 6, 1889.

FIG. 1.




WITNESSES.

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Attys.

(No Model.) 4 Sheets—Sheet 2.

# C. D. ROGERS.

## SCREW SWAGING MACHINE.

No. 408,529. Patented Aug. 6, 1889.

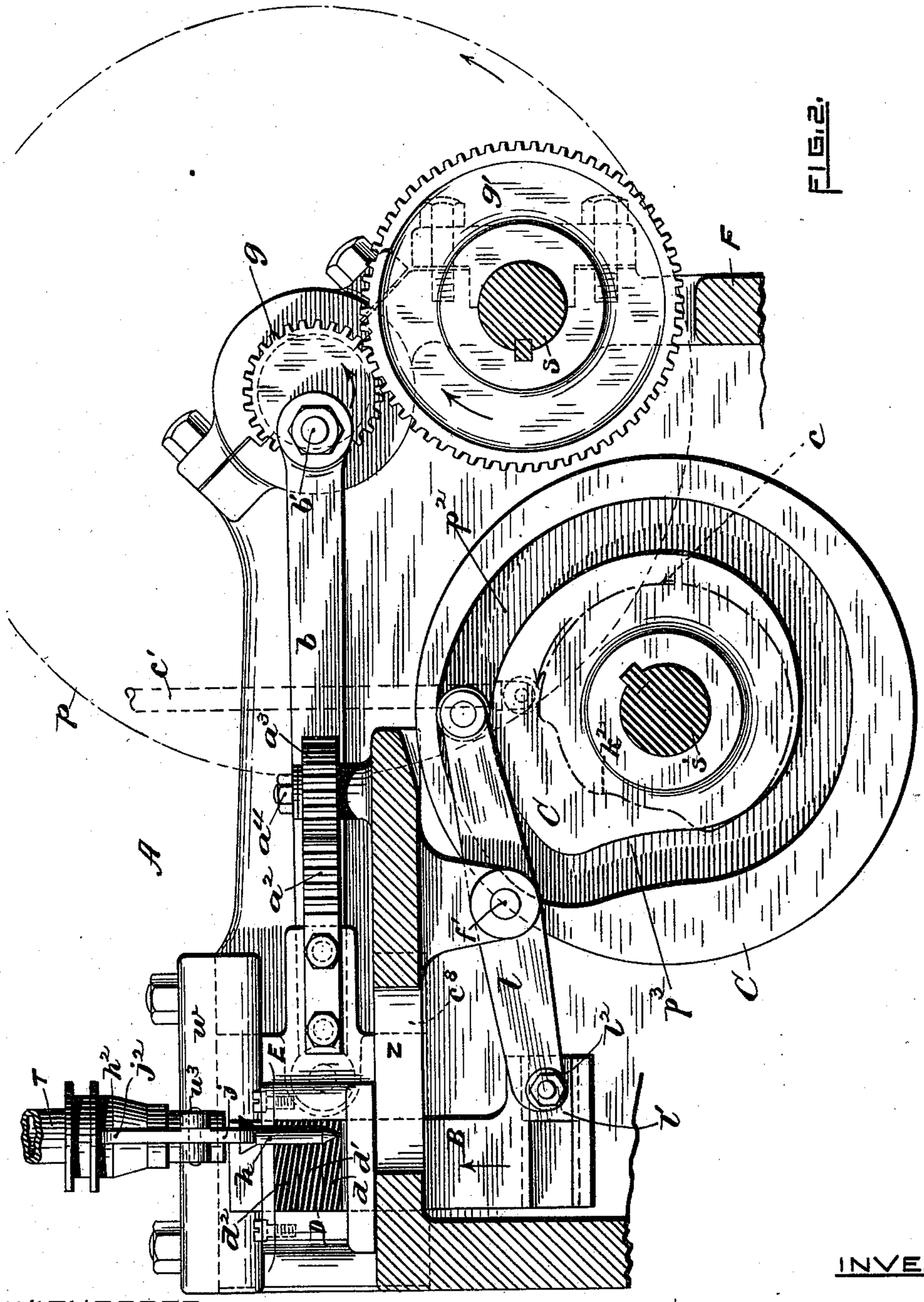

FIG. 2.

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(No Model.) 4 Sheets—Sheet 3.

# C. D. ROGERS.

## SCREW SWAGING MACHINE.

No. 408,529. Patented Aug. 6, 1889.

FIG. 10.

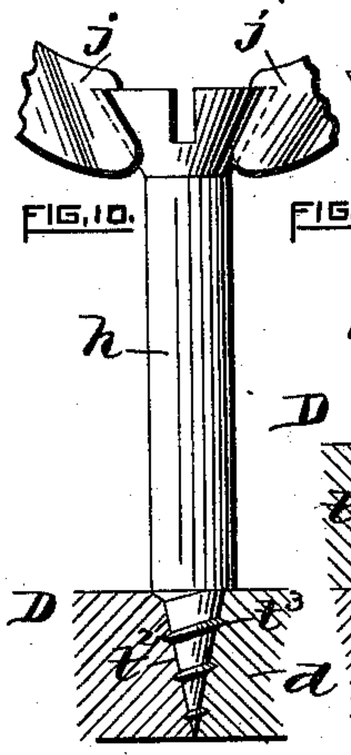



FIG. 11.

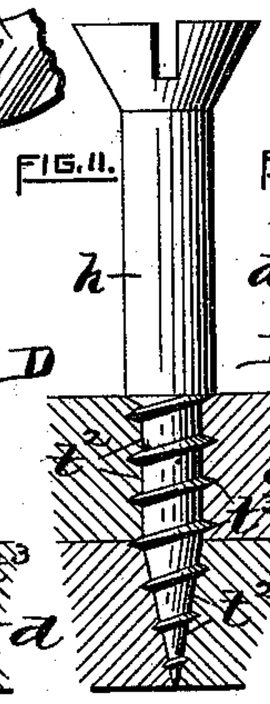



FIG. 12.

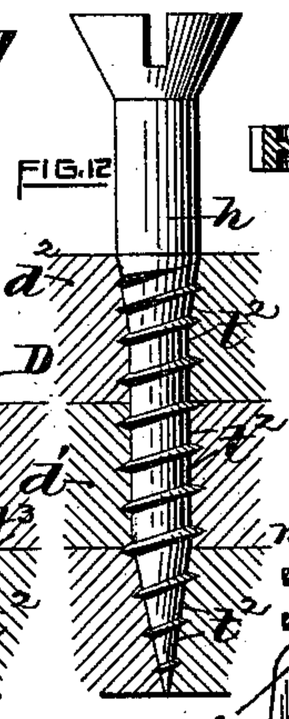
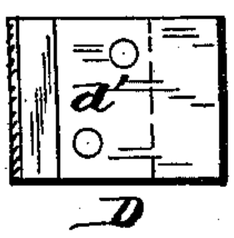






FIG. 3.

FIG. 7.



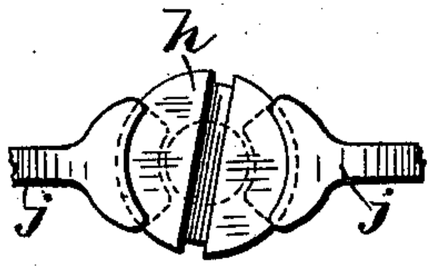




FIG. 9.

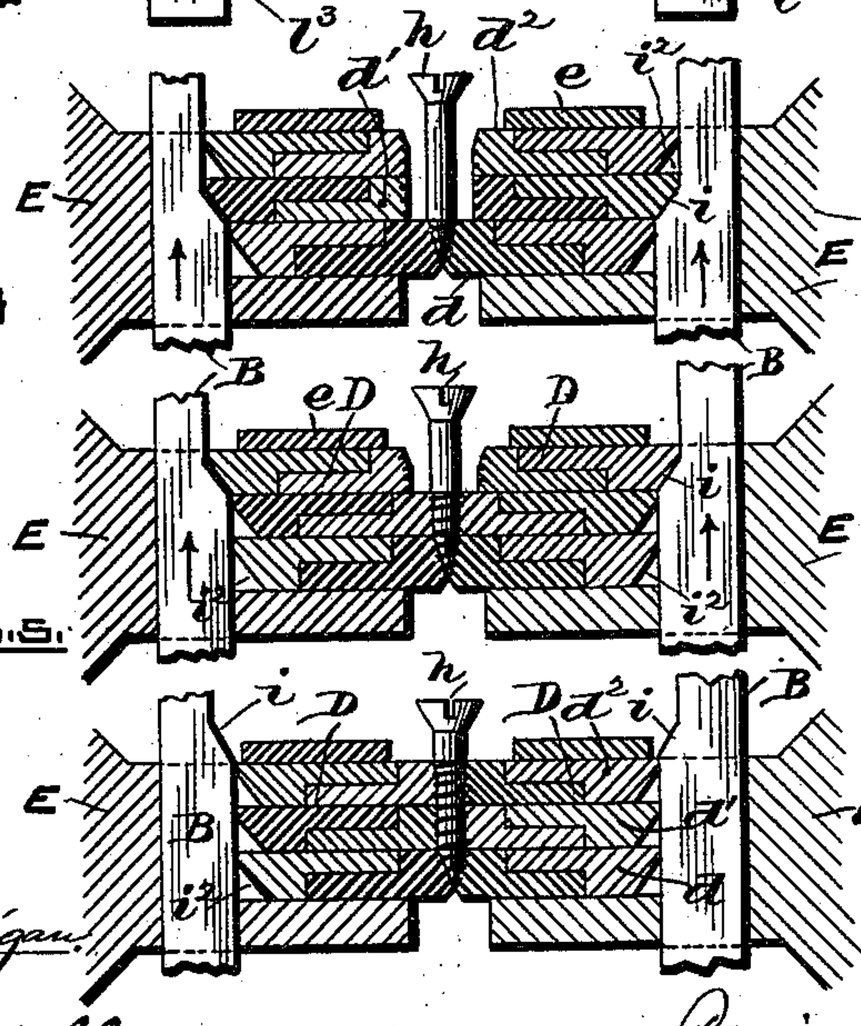



FIG. 5.

FIG. 4.

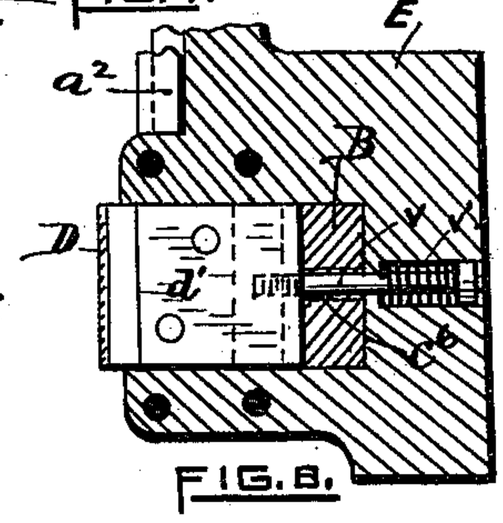



FIG. 8.

FIG. 6.

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(No Model.) 4 Sheets—Sheet 4.

# C. D. ROGERS.

## SCREW SWAGING MACHINE.

No. 408,529. Patented Aug. 6, 1889.

FIG. 14.

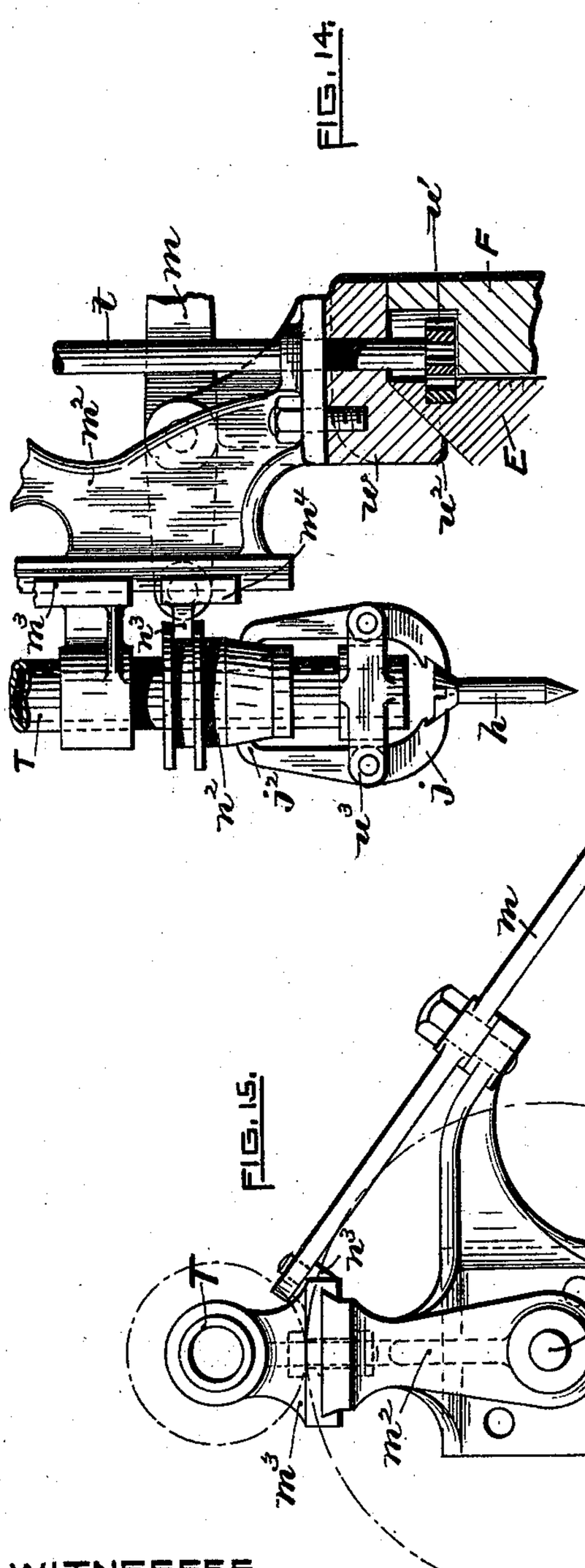


FIG. 13.

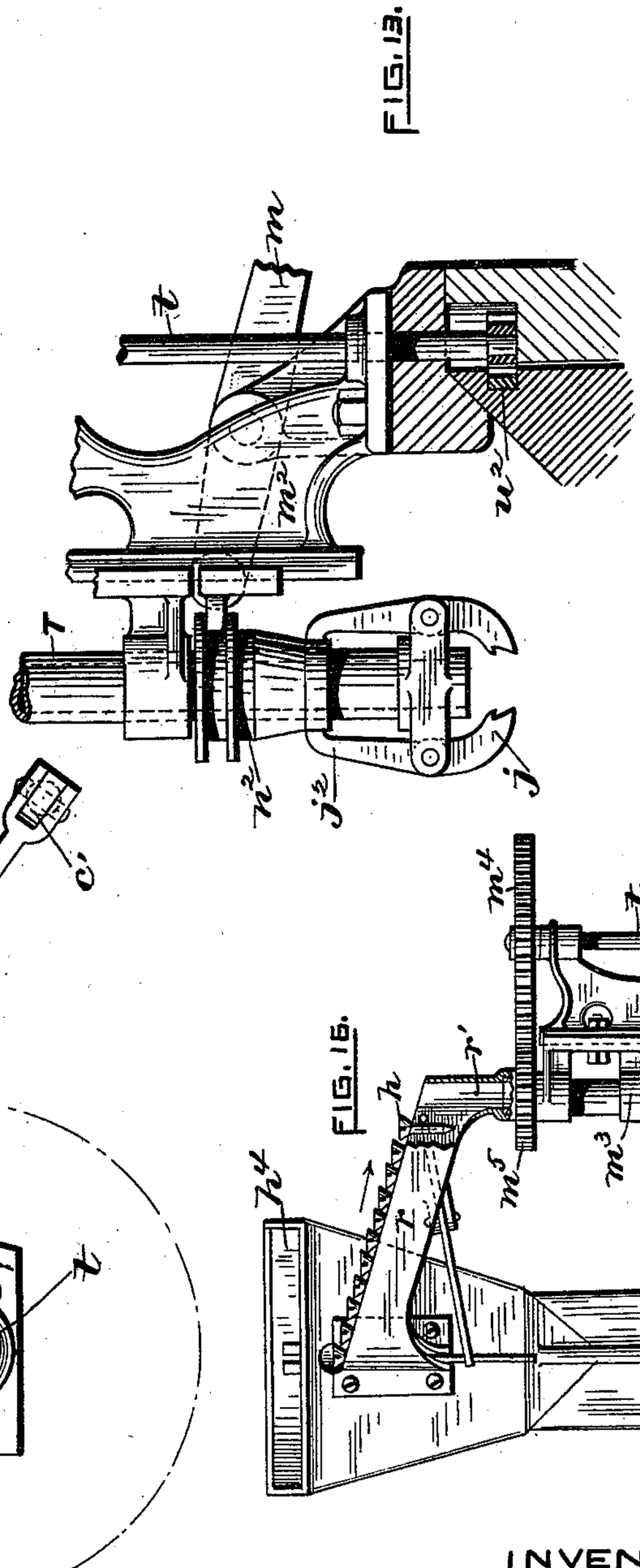


FIG. 15.




FIG. 16.




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Charles Hannigan.

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# UNITED STATES PATENT OFFICE.

CHARLES D. ROGERS, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO THE AMERICAN SCREW COMPANY, OF SAME PLACE.

## SCREW-SWAGING MACHINE.

SPECIFICATION forming part of Letters Patent No. 408,529, dated August 6, 1889.

Application filed February 21, 1889. Serial No. 300,708. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES D. ROGERS, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Screw-Threading Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

In the rolling of threads upon screw-blanks to form wood-screws by means of the dies described in a patent granted to me September 20, 1887, and numbered 370,354, the metal is expanded radially to form the threads, with the result that the diameter of the screw across the threads is greater than the diameter of the blank or unthreaded portion of the screw. In this respect the form of the screw differs from that of the common wood-screw heretofore made by cutting away the metal to form the groove. The dies described in the patent above referred to engage with the metal along the whole length of the threaded portion of the screw, and by reason of this engagement the displaced metal must expand radially and the length of the blank is not increased. If it is desirable to produce the thread by rolling and without the radial expansion of the metal, so as to produce a screw of the common form by rolling, the displacement of the metal must be provided for by the elongation of the blank, so that the finished screw shall be longer than the blank from which it is formed. This involves the condition that the part of the die which at any instant is being forced into the metal shall be engaged with the metal but a short distance longitudinally, so that the metal may flow under the die in the direction of the axis of the blank. The object of my present invention is to provide a die which shall meet this condition and to provide means for operating it. The dies consist of two or more parallel sections, combined with oppositely-mounted wedge-blocks adapted to be actuated simultaneously in a vertical direction, and to force the sections in succession into engagement with the blanks. By means of this arrangement of the dies, &c., the blank is acted upon first by the lower section of the two dies, which in traveling back and forth impress or roll a screw-thread upon the point portion of the blank and simultaneously elongate the blank, followed by the action of the next section of the dies, which continues the formation of the thread upon the blank, the last section of the dies (in case three be used) continuing and completing the threading operation, the several die-sections meanwhile, as before stated, being subjected to a reciprocal movement. Upon thus completing the thread of the screw the two wedge-blocks are quickly forced rearwardly or downwardly to the normal position, the gripping-jaws open and the finished screw drops from them past the dies and is caught in a suitable receiver beneath.

In an application for Letters Patent filed by me in the United States Patent Office December 11, 1888, Serial No. 293,269, I have shown, described, and claimed mechanism for positively retaining and revolving a blank while being acted upon by the reciprocating threading-dies, the rate of travel of the surface of the blank and of the dies being substantially the same.

In the appended four sheets of drawings, Figure 1, Sheet 1, represents a plan view of a machine, in partial section, embodying the improvements forming the subject of my present invention. Fig. 2, Sheet 2, is a vertical sectional view taken on line *x x* of Fig. 1. Fig. 3, Sheet 3, is a partial transverse sectional view taken on the irregular line *m m* of Fig. 1, and also showing a device for gripping and revolving the blanks, a blank being in position to be acted upon by the sectional threading-dies. Fig. 4 is a sectional view of the dies, the lower section thereof having been advanced to produce the thread upon the point portion of the blank. Fig. 5 is a similar view, the middle section of the dies having completed their work. Fig. 6 represents the same, wherein the dies as a whole have completed the screw-threading operation, it

being understood that the several sections of the dies meanwhile are reciprocated back and forth and that the blank is revolving. Fig. 7 is a plan view of one of the die-sections. Fig. 8 is a horizontal sectional view taken through the dies, &c., on line $x$ $x$ of Fig. 3. Fig. 9 is a plan view, enlarged, showing the head of a blank embraced by the gripping-jaws. Fig. 10 is a side elevation, enlarged, showing the dies in the act of screw-threading the point of a blank. Fig. 11 is a similar view showing the lower and intermediate sections of the dies acting upon the blank. Fig. 12 shows the blank completely screw-threaded by the several die-sections, the screw being elongated somewhat during the operation. Fig. 13, Sheet 4, is a partial side view of the gripping device, the jaws being opened to receive a blank. Fig. 14 is a similar view, a blank having been dropped through the hollow spindle and arrested by the gripping-jaws, the latter also being in the act of closing upon the head of the blank to hold it in position and revolve it while being subjected to the action of the threading-dies. Fig. 15 is a plan view of the same; and Fig. 16 is a reduced elevation of the hollow spindle, &c., combined with a feeding apparatus, from which the blanks are passed along a runway or track to the spindle.

A more detailed description of my improved screw-threading machine is as follows. I will first, however, describe the manner in which the various driving shafts and wheels are geared together and operate.

$p$, referring to the drawings, indicates the driving-pulley secured to a short shaft and adapted to be driven by a belt leading from a suitably-mounted pulley, as common. To the opposite end of the pulley-shaft is secured a small gear $g$, which meshes into a gear $g'$, secured to the shaft $s$, mounted in the forward end of the main frame or bed F. A crank-pin $b'$ is secured to the gear $g$, which, in connection with the link $b$, jointed to the pin and corresponding cross-head E, imparts to the latter a reciprocating movement. By means of a rack $a^2$, secured to the forward end of the cross-head, and an intergearing stud-gear $a^3$, the latter imparts a simultaneous reverse movement to a similar rack-carrying cross-head mounted at the opposite side of the machine, as clearly shown by Fig. 1. The said shaft $s$ has secured thereto at its outer end a small gear $g^3$, which engages a larger gear $g^2$, secured to the main shaft $s'$. To this shaft are fixed the main cams C, which, by means of the pivoted levers $l$, Figs. 1 and 2, serve to vertically reciprocate the backing-plates B, as is more fully hereinafter described.

The following briefly describes a device for seizing and revolving the screw-blanks.

T indicates a vertically-mounted hollow spindle, having its upper end communicating with the lower portion $r'$ of a runway $r$, along which the headed blanks $h$ pass from a hopper $h^4$, and are checked singly into the spindle, as common. The spindle is revolved by means of gears $m^4$ $m^5$, which receive motion from some reciprocating part of the machine, as a cross-head E, through the medium of a gear-rack $u^2$, a small gear $u'$ meshing into the rack, and a vertical shaft $t$, to which said gears $u'$ and $m^4$ are secured, the proportion or ratio of the gears to each other being such that the surface of the blank travels at substantially the same rate or velocity of the cross-head. The spindle T is mounted to revolve in bearings forming part of a bracket $m^3$, adjustably secured to the face of a frame $m^2$, which in turn is secured to the top of the main frame or bed F of the machine. The lower portion of the spindle is splined and fitted with a flanged or grooved cone-shaped sliding clutch or sleeve $n^2$. The spindle is further provided at its lower end with a head $w^3$, in which two gripping-jaws $j$ are pivoted. These jaws at the bottom are adapted to receive the head of a blank and hold it firmly in position, the top portion $j^2$ being arranged to bear against the sleeve $n^2$. A gibbed plate $m^4$ is fitted to slide up and down the face of the frame $m^2$, said plate having an extension or arm $n^3$, which engages with the grooved portion of the sleeve. This arm $n^3$ is pivoted to a lever $m$, having its fulcrum in the frame $m^2$. The other or free end of the lever is jointed to a guided rod $c'$, which in turn engages and is actuated by a cam $c$, secured to the revolving main shafts $s'$. It will be seen now that the sleeve is made to reciprocate upon the revolving hollow spindle T, in conformity with the shape of the said cam $c$, and at the same time producing a vibratory movement of the jaws, as opening and closing.

The following description relates more especially to the construction of the dies, the manner of operating them, and the action of the machine as a whole.

F indicates the main frame or bed provided with suitable bearings for the several shafts, and also having oppositely-located ways formed at the back end of the frame, in which the die-holders or cross-heads E reciprocate, the latter being actuated by a connecting-rod $b$, jointed to a crank-pin $b'$, secured to a small gear $g$, which in revolving imparts a short-stroke movement to the cross-head. The other cross-head, which is reversely arranged, is driven at exactly the same rate of speed as the first named by means of the toothed racks $a^2$, secured thereto, and the interposed gear $a^3$, loosely mounted on a stud $a^4$, as clearly shown in Fig. 1. The cross-heads are planed out to receive each a threading-die D and the cam-shaped backing-plate B. (See Fig. 8, &c.) A cap $e$, firmly bolted to the cross-head, prevents the die from moving upwardly in the recess.

The die D as drawn is divided horizontally into three parallel sections $d$ $d'$ $d^2$. The first to act, being the lower section $d$, is constructed to form the screw-thread upon the point portion of the blank, the next section $d'$ then

acting to form a continuation of the thread upon the plain portion of the shank, when, finally, the top section $d^2$ completes the thread. The rear side of each section is beveled, as at $i^2$, to engage the beveled or cam-shaped surface $i$ of the backing-plate B. The dies are made of steel, the same being suitably hardened and tempered. The length of the die corresponds to some twice the circumference of the blank $h$, the actual travel or stroke being somewhat less or equal to about one and one-half revolution of the blank. By reason of this arrangement the dies in traveling do not pass beyond the blanks, as would be the case in the event of the blank being completely screw-threaded during one reciprocation of longer dies, (or as clearly shown in United States Patent No. 389,168, granted to me September 4, 1888.)

In Figs. 1 and 2 the relative position of the blank and die at an extreme of the travel is clearly shown. The inclined thread-forming ribs $t^2$ are parallel to each other, each rib being substantially uniform in cross-section throughout the length of the die, the grooves $t^3$, lying between the ribs, and which are the counterpart of the threads to be produced, also being uniform in cross-section, as represented in Figs. 10, 11, and 12. A rectangular opening is formed vertically through each cross-head at the rear of the dies, through which the said plate B is fitted to travel. The upper portion of the plate is slotted transversely, thereby forming an opening $c^6$, Fig. 3. The cross-head is drilled and counterbored from the outside in line with each of the several die-sections to receive headed bolts $v$, which pass through the said opening $c^6$ and are screwed into the dies. The spring $v'$ surrounding each bolt serves to maintain the dies in contact with the acting face of the backing-plate. The width of the latter corresponds to the length of the dies and is provided at its lower end with an extension, which is planed out to receive a gibbed block $l^3$, having a pin $l'$, fitting an end of the cam-actuated lever $l$, as clearly shown in Fig. 2.

From the foregoing it is evident that the action of the connecting-rod $b$ causes the cross-heads, and with them the dies D and backing-plates B, to travel back and forth in the ways formed in the bed F, the plates moving in elongated openings $c^8$, formed in the lower portion of the bed. Such movement of the cross-heads, however, does not in itself form the screw-threads upon the blanks. This latter is effected by the joint action of the vertically-traveling plates B, whose cam-shaped portion $i$ successively engages the several cam-sections and forces them outwardly into contact with the blank's surface. The lever $l$, before referred to, is pivoted at $f'$ to the under side of the bed, an end of the lever being constructed to engage the cam-path $P^2$ of a cam C. These cams as drawn (one being mounted at each side of the machine on the shaft $s'$) are constructed so as (during their revolution) to gradually force the plates B in an upward direction, thereby causing the cam or inclined surfaces $i$ thereof to simultaneously engage the dies D, the continued movement causing the several die-sections to successively engage the blank's surface. Immediately after the plates B have reached the limit of upward movement the "quick" portion $P^3$ of the cams acts to rapidly return them to the normal position, or as shown in Fig. 3. During the revolution of the cam-shaft $s'$ another cam $c$, secured thereto, in conjunction with the vertically-guided rod $c'$, in contact with said cam, and the lever $m$, acting upon the revolving clutch-sleeve $n^2$ and the gripping-jaws, serves to rigidly hold the blank and prevent it from slipping.

The joint operation of the several devices embodied in my machine is substantially as follows: The blank is first fed from a hopper or reservoir $h^4$ down the inclined runway $r$, and dropped into the upper end of the suitably-mounted revolving hollow spindle T, and thence out at the bottom end of the spindle, where it is caught and arrested by the gripping-jaws, which are partially separated for the purpose at the instant. The cam $c$ then acts to quickly close the jaws upon the head of the blank, the cross-heads E, with their dies and attachments, meanwhile traveling back and forth in opposite directions, through the medium of the quick-running connecting-rod $b$. It is assumed that the proper relation or adjustment has already been made, so that the point of the blank will be exactly in line with the lower edge of the dies. Now, when the jaws have been fully closed, the rod $c'$ will be found to bear against the concentric surface of the cam $c$, the cams C and their connections $l$ then being in the position shown in Figs. 2 and 3. By turning the cam-shaft in the arrow direction the backing-plates B are slowly forced upward by the spiral-shaped portion of the cam-path $p^2$, the cross-heads, dies, and plates being continually reciprocated, (at the same time the blank is revolved in opposite directions in unison with the cross-head's movement,) the plates first acting to force the two lower die-sections $d$ (against the tension of the springs $v'$) into engagement with the point portion of the blank and produce the thread thereon, (see Figs. 4 and 10,) the blank elongating slightly during the operation. At about the instant of the complete embedding of the ribs $t^2$ into the blank the plates B will have reached the next die-sections $d'$, which in turn are gradually forced partially from the rectangular recess formed in the cross-heads and into contact with the shank or plain portion of the blank, thereby forming the thread, which is a continuation of that begun at the point, (see Figs. 5 and 11,) the blank still elongating slightly, from the fact that the diameter of the threads is substantially the same as the diameter of the plain shank. The plates, in continuing their upward movement, finally engage the top die-

sections $d^2$, which in like manner are forced outwardly to complete the thread upon the blank. (See Figs. 6 and 12.) Now, after a few more reciprocations of the cross-heads the portion $P^3$ of the cams C will cause the plates B to quickly drop to the normal position shown in Fig. 3, the springs $r'$ at the same time acting to withdraw the several die-sections from the screw and back into the recess of the holders, the lateral space between the dies being sufficient to permit the head of the screw to pass freely. At about the same instant, or just prior to the completion of the downward movement of the plates B, the cam $c$ causes the clutch $n^2$ to be lifted, thereby opening the gripping-jaws and releasing the threaded blank or screw, which instantly drops from them past the dies and through an opening $z$, formed in the bed, to any suitable receptacle beneath. As soon as the screw is thus released the inclined surface $k^2$ of the cam $c$ acts to partially close the jaws, when now the blank-feeding device again comes into play and deposits another blank into the gripping-jaws, the several subsequent operations, all being automatic, close the jaws firmly upon the blank and gradually develop the thread upon the then revolving blank from the point up by the joint action of the plates B and the sectional dies mounted in the short-stroke reciprocating cross-head, as just described. It will be seen, referring to Figs. 10, 11, and 12, that the blank is elongated somewhat during the threading operation, the direction of such elongation being from the point up, rather than from the head down. By this arrangement the points of the blanks are uniformly presented to the corresponding section of the dies, thereby producing a much greater proportion of perfect or salable screws than would be the case otherwise.

In another application for United States Letters Patent, filed by me February 21, 1889, Serial No. 300,709, I have described and claimed the method of rolling screw-threads upon wood-screws as embodied in my present improved screw-threading machine.

I claim as my invention—

1. A swaging-die for forming threads upon screw-blanks, made up of parallel sections which are successively brought into action to compress the metal to form the thread and elongate the blank.

2. The combination, substantially as hereinbefore described, of oppositely-reciprocating cross-heads, sectional screw-threading dies, and simultaneously-moving backing-plates for forcing successively the several sections of the dies into engagement with the screw-blank while the thread is being formed.

3. The combination of revolving gripping-jaws which receive the blank from a feeding mechanism, and hold it while thus revolving in the proper position to be acted upon by the dies, reciprocating sectional threading-dies arranged to simultaneously engage opposite sides of the blank and alternately revolve it repeatedly in forming the thread, and mechanism for forcing the traveling dies into engagement with the revolving blank, and for withdrawing them therefrom after they have completed their work, substantially as hereinbefore described.

4. The combination of revolving gripping-jaws arranged to receive, retain, and release the blank, two oppositely-arranged reciprocating cross-heads, each having mounted therein a thread-forming die divided horizontally into two or more parallel sections, and a cam bar or plate mounted at the back of each die and reciprocating in unison therewith, and means for vertically actuating said cam-plate to successively operate the die-sections, substantially as hereinbefore set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

CHARLES D. ROGERS.

Witnesses:

CHARLES HANNIGAN,

GEO. H. REMINGTON.