J. Cochrane.

Swaging Screws.

No. 54,687. Patented May 15, 1866.

Fig. 1.

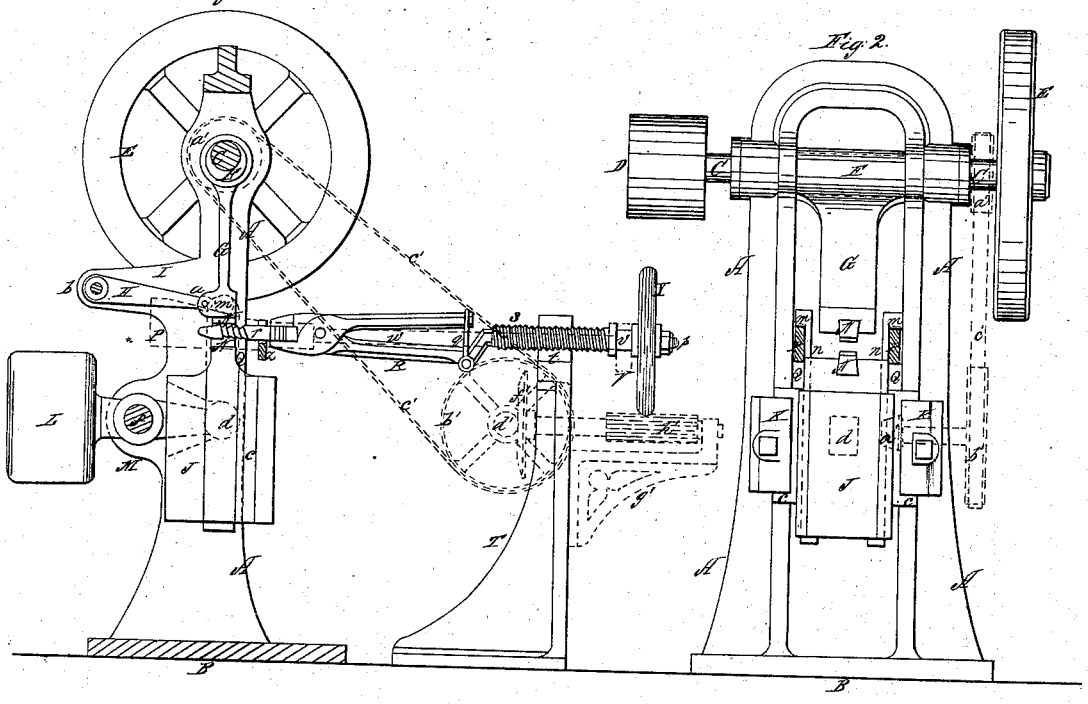


Fig. 2.

Fig. 3.

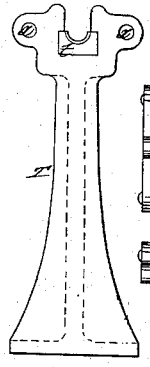


Fig. 4.

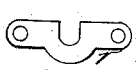


Fig. 5.

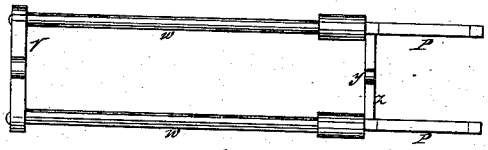


Fig. 6.

Fig. 7.

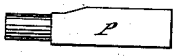


Fig. 8.

Fig. 9.

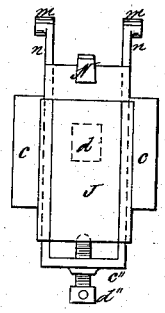


Fig. 10.

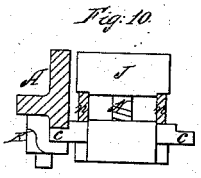


Fig. 11.

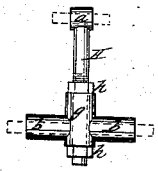
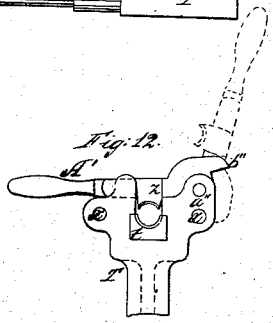


Fig. 12.



Witnesses:
A. D. Lacy
Andrew J. Fritz

Inventor:
John Cochrane

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

JOHN COCHRANE, OF WALL TOWNSHIP, MONMOUTH COUNTY, NEW JERSEY.

IMPROVEMENT IN MACHINERY FOR FORGING SCREWS.

Specification forming part of Letters Patent No. **54,687**, dated May 15, 1866.

To all whom it may concern:

Be it known that I, JOHN COCHRANE, of the township of Wall, county of Monmouth, and State of New Jersey, have invented a new and useful Machine for Forging Screw-Threads upon Metal Bolts; and I do hereby declare that the following is a full and exact description thereof, reference being had to the annexed drawings, and to the figures and letters marked thereon, and in which—

Figure 1 is a side elevation of the machine; Fig. 2, a front elevation, and Figs. 3, 4, 5, &c., details thereof; and the same parts are indicated in all the figures by the same letters.

The nature of my invention consists in forming screw-threads upon metal bolts while hot by means of forging, using for that purpose swages or dies having on their faces, in reverse, a small portion of a screw of the required shape and pitch. One of said swages or dies is attached to a stamper or jumper operated by an eccentric, and the other to an anvil-block that has an automatic movement to or from the top die, as required in the process. The blank or bolt to be operated upon has a guide-screw of the required pitch attached to it or to the tongs by which it is held, which guide-screw works in a screwed bearing in the same axis with the bolt, which stationary bearing of the guide-screw is placed at a convenient distance from the forging-dies to give proper support to the bolt or tongs.

The anvil-block is made to rise and fall as required by means of sliding templets, that are shaped to suit the operation, and when in the depressed position the heated bolt or blank is passed through between the dies to the full extent to which the screw is to be formed on it. The blank-bolt and guide-screw are then gradually rotated with a direction of motion that will cause the guide-screw to draw the bolt outward through the dies, and thereby cause the forging operation to progress from the neck toward the point of the bolt, so that by the time the screw is completed it will be entirely withdrawn from the dies. In this manner screws may be produced or made of uniform pitch and of equal diameter from neck to point, or tapering or gimlet-pointed, as required, by using sliding templets of the necessary shapes for such forms.

To enable others skilled in the art to make and use my invention, I will now proceed to describe its construction and mode of operation.

I form the housing A A and bed-plate B of one casting, and secure it to a proper foundation by holding-down bolts in the usual manner. In the upper part of this housing I mount, in suitable bearings, the shaft C, having a driving-pulley, D, on one of its ends and a balance-wheel, E, on the other, and having, also, the eccentric F in its middle part, between the sides of the housing, as shown by dotted lines in Fig. 2. This shaft and eccentric should be driven with a speed of about ten hundred revolutions per minute; but a greater or lesser speed, within proper limits, may be used. The machine, however, should be run at a high speed, so as to impinge the dies with sufficient force upon the blank or bolt by a small motion of the jumper, which is desirable. The throw of the eccentric F is accordingly made about one inch, and, the vibration of the jumper being thus limited, a high speed can be adopted with safety, and thereby give greater productive capacity to the machine.

The jumper or stamper G is made with a hollow cylindrical head, which is bored out true to embrace and fit the eccentric F, and is secured in position by the radius H, which is jointed to it at the foot *a*, back of the die-bed, and also to the housing by the journals of the rocker *b*, which have bearings in the arms I, cast on either side at the back of the housing. The radius H being thus attached to the foot of the jumper or stamper G and the housing A A, the top die is retained in proper place for the work it has to peform, notwithstanding the vibration of the upper part of the jumper by the eccentric F.

Between the sides of the housing A A and beneath the jumper or stamper G, I place the cast-iron anvil-block J, and confine it to its place by the guide-plates K K, bolted to the front of the housing, and embracing between them and the housing the slides *c c*, cast upon the sides of the anvil-block J, or by any other convenient arrangement that will secure a vertical movement of the anvil in the housing. This anvil-block should be of sufficient weight to give effective resistance, by its inertia, to the force of the blows impinged upon the blank bolt or screw by the stamper G; but, for the purpose of reducing the friction upon the edges of the sliders that carry the anvil, I connect

with it, by means of a projecting head which enters the socket *d*, cast in the anvil, the counter-balance L, but of less weight than the anvil, and support it by the center pin, *f*, passing through the shank of the counter-balance, and the projections M, cast on either side of the housing at the back. This counter-balance not only relieves the sliders of a large portion of the weight they would otherwise have to sustain, but also assists the anvil, through the upward action of the head *d*, in resisting the blows impinged upon it by the top die. The counter-balance L, however, may be dispensed with, as the machine will work effectively without it, as I have experimentally ascertained. Nevertheless, it is of advantage in the working of the machine, for the reasons I have stated.

In the lower part of the stamper G, and in the corresponding upper part of the anvil J, I insert, by means of dovetails or in any other suitable manner, the steel swaging-dies N N, having upon each, in reverse, a few threads of the required form and pitch of screw. In practice I have found that two threads in each of the dies are sufficient to produce a well-formed screw. These threads I make straight at both edge and bottom, as upon a flat surface, so that they may approach closely toward each other when required, which is essential to the formation of gimlet-pointed screws as well as in the making of screws that have a varying diameter; and they should be properly tempered, and so adjusted in relation to each other that they shall operate correctly together in forging a continuous screw-thread around and upon the blanks or bolts submitted to their action. This adjustment can be made by setting the dies back or forward, as required, till their exact coaptation is obtained, when they may be secured in that position by tightening a key or wedge at the side of the die, as practiced in analogous cases. But as this mode of adjustment is somewhat tedious, I have devised a mechanism for the purpose, which is shown in Fig. 11.

The rocker *b b*, which is attached to and supported by the arms I, cast on the back of the housing A A, as shown in Fig. 1, as before described, has in its middle part and at right angles with it, a socket, *g*, through which is passed the rear end of the radius H, upon which portion of the radius a screw is formed and fitted with two nuts, *h h*, one at either end of the socket *g*.

The head *a* of the radius being jointed to the foot of the jumper G, that carries the top die, as before described, any degree of adjustment, either rearward or forward, can be given to the top die by means of the nuts *h h*, to suit the position of the bottom die.

The anvil-block J is elevated and depressed within the housing, so as to increase or diminish the distance between the top and bottom dies, as required, by means of the sliding templets or sliders P P. (Shown in red lines in Fig. 1 and in vertical cross-section in Fig. 2.) The lower edges of these sliders are made straight and rest upon the bearers Q Q, cast on or attached to the inner side of the housing A A, as shown in Fig. 2, and their upper edges take under and support the trunnion-like projections *m m* of the anvil-hangers *n n*. These anvil-hangers should be of wrought-iron, and have the bearing-surface of the parts *m m* faced with steel, and should be securely attached to the anvil, so as to sustain its weight and the force of the blows impinged upon it in the screw-forging process.

The upper edges of the sliders P P should be case-hardened or chilled if of cast-iron, or faced with steel if made of wrought-iron, and should be of such form or shape as will cause the anvil to fall sufficiently to permit the passage of the blank bolt between the dies while the machine is in motion without being struck by them; but their shape must also be such that upon the sliders being drawn outward a little distance they will elevate the anvil, and with it the blank bolt till the dies both above and below strike into it sufficiently to form the screw.

The shape of the bearing-edges of the sliding templets or sliders is important, and is thus determined: The breadth of the slider near the front end, immediately below the bearing of the anvil-hanger, should be such that the die of the anvil shall be sufficiently low to allow the shank of the blank or bolt to repose on it clear of the action of the top die while in motion. It should then slope upward and rearward from that point till the threads of the dies shall strike into the blank to their full depth; then continue parallel from that point to the back end, as shown in Fig. 7, if the screw is to be of the same size from neck to point. If, however, the screw is to have a gimlet-point, then the back end of the slider must also be inclined upward and rearward, as shown in Fig. 8, so as to bring the dies gradually together till they almost touch each other at the point of the bolt; but if the screw is to be of tapering form from the shank to the point, the slider must be made of tapering form also, as shown in Fig. 6; and, in like manner, if swelled or concave taper-screws are to be forged, the inclined bearing-edges of the sliders must be rounded or hollowed to suit such forms of screw.

If screws of uniform diameter only are required the anvil may be elevated or depressed in such case by means of a revolving or partially-revolving cam of proper shape, instead of by the sliding templets above described, which cam may be operated by a hand-lever or a treadle, or by any convenient mode, so as to drop the anvil at the right moment for the admission of the blank bolt to the machine, and to elevate it and retain it in such position as will cause the dies to strike into and forge the screw upon the bolt.

For the purpose of properly holding the blank bolt in the machine and while passing through between the dies, I use the tongs or holder R, Fig. 1, upon one leg of which, it being extended

outward as a central shank, I place the guide-screw S, by passing the shank of the tongs or holder through it, and secure it thereto by the nut *p* on the outer end of the shank, the other leg of the tongs being secured to the shank-leg by the link or binder *q* on compressing them toward each other, as practiced by blacksmiths, so as to hold the blank bolt *r* tightly between the jaws.

The guide-screw S works in a half-nut or screwed bearing, *t*, in the stationary pedestal T, Figs 1 and 3, which should be so placed relatively with the forging-dies N N that there will be sufficient length of guide-screw between the tongs and the screwed bearing in the pedestal to complete the required length of screw upon the bolt.

On the outer end of the guide-screw S a bearing or journal, *v*, is formed, having a collar on each side of it. Into this bearing or journal is fitted the yoke V, Figs. 4 and 5, and shown in cross-section by red lines in Fig. 1. To this yoke is attached the sliding rods *w w*, connecting with the sliding templets P P, as shown in Figs. 5 and 6 and by red lines in Fig. 1. These sliding rods pass through holes or steady-bearings *x x*, in the upper part of the pedestal T, as shown in Fig. 3. By this arrangement of the parts the sliding templets P P are combined with the guide-screw S, and are drawn outward by its outward movement, and with the same degree of motion, thus causing the sliding templets and the bolt upon which the screw is being forged to move outward together as the operation progresses. On completing the screw the sliding templets are run back so as to drop the anvil for the reception of another blank bolt. This I accomplish by pushing home the yoke V by hand, which mode of returning the sliding templets I find answers the purpose efficiently.

To the guide-screw S is attached the smooth-rimmed wheel Y, for the purpose of rotating it and the tongs and bolt by hand; but, if preferred, this may be done automatically by substituting a cog-wheel for the smooth hand-wheel, and causing a long pinion, receiving motion from the eccentric-shaft, to work into it, so as to keep in gear during the whole traverse of the screw, which will carry the wheel from the inner to the outer end of such pinion.

A simple mechanism for such automatic movement is shown in Figs. 1 and 2 by blue lines.

Upon the eccentric-shaft C is a small pulley, *a'*, operating by means of the belt *c'*, a larger pulley, *b'*, supported by the pedestal T. Upon the spindle of the pulley *b'* is a small bevel-pinion, *d'*, gearing into the bevel-wheel *f'*, at the inside of the pedestal T, its spindle passing through the pedestal, where it has a bearing to the outer bearing on the bracket *g*, and carrying the long pinion *h'*, before referred to as gearing into the large wheel Y of the guide-screw S. This train of gearing should be so proportioned as to give a circumferential motion to the bolt of about one-sixteenth of an inch, more or less, for each blow impinged upon it by the forging-dies.

When long bolts are to be screwed by this machine the tongs may be dispensed with, and the guide-screw and its rotating wheel be placed upon the bolt itself and secured thereto so as to carry it properly, when the operation will be the same as already described.

For the purpose of securing a central position of the bolt or blank in the forging-dies I attach the cross-bar Z to the sliders P P, having a bearing or clevis, *y*, in it for the reception of the shank or neck of the bolt. This bearing or clevis *y* accordingly travels with the bolt, giving it lateral support between the dies from the moment it enters the machine till it comes out finished.

The tongs R, with its guide-screw S and rotating wheel Y, are detachable from the machine as one piece, so as to receive or disengage the bolts while out of the machine. I accordingly construct its bearings so as to permit its free introduction to or removal from the machine without interrupting its speed. The bearing or clevis *y*, the screw-bearing *t*, and the bearing in the yoke V are therefore made open at top, so that the tongs, with a blank or bolt and the guide-screw and wheel, can be placed in or taken from the machine while it is running at full speed. The weight of this detachable part or apparatus is sufficient, if properly proportioned, to keep it to its bearings, especially if operated by hand, which causes a downward pressure upon the guide-screw; but when operated automatically the wheel Y should be of extra weight, so as to keep it in gear with the long pinion; or a top nut or bearing, *z*, as shown in Fig. 12, may be used to press upon the guide-screw by means of the hand-lever A', which is jointed to the pedestal T at *a''*, and can be raised up and set back out of the way when required, as shown by the drawings of this part in blue lines. At the back end of this lever there is a projection, *b''*, to act as a stop, by which the lever is held up and in a convenient position for the hand of the operator.

A bolt or blank, being duly heated, is grasped by the tongs R and firmly secured therein by the link or binder *q*. It is then placed in the machine by passing it through the neck-bearing or clevis *y*, into the space between the forging-dies N N, the guide-screw S dropping into the screwed bearing *t* in the pedestal T, and the journal of the guide-screw S into the bearing made for its reception in the yoke V of the sliding rods *w w*, the jumper or stamper G being in the meantime at full speed. The wheel Y of the guide-screw is then rotated with a direction of motion that will cause the screw to move outward to the front, and thereby rotate and bring the bolt outward with it while passing through and receiving the action of the forging-dies, and from which it emerges a completely-formed screw.

In this machine the motions of both the anvil and stamper are positive or of certain and

definite extent. The stamper being operated by an eccentric and the anvil by the action of the sliding templets or cam, it follows that the distance between the dies is also positive and definite, as controlled by the sliding templets, and that to reduce this distance so as to compensate for wear or for other purposes, it will be necessary to set the dies out to the required extent by liners, as usually practiced by machinists in adjusting the height of dies in the die-beds; but to accomplish this object with greater facility I have devised the mechanism shown in Fig. 9, and in which the hangers *nn* are extended down below the bottom of the anvil in grooves made in it for that purpose, as shown in Fig. 10, where they are connected by the cross-piece *c''*, through which is tapped the screw *d''*, bearing upward against the anvil, and upon which it rests. By elevating or depressing the anvil in the hangers by means of this screw any degree of adjustment can be given to the space between the dies without disturbing their position in the die-beds.

The bolts upon which screws are to be formed by this process being heated, as in the ordinary operations of forging, they will impart an injurious heat to the dies if it is not counteracted. It will therefore be necessary to cool the dies from time to time during the operation, or immediately upon the withdrawal of the bolt from the dies, which may be accomplished by directing small jets of water against them at such intervals, either by hand or by an attachment to the machine itself, so that on the finished bolt being withdrawn jets of water shall be directed against the dies, which may be done by connecting, for example, one of the sliding templets or rods with the faucet of the water-pipe, or it may be done by the attendant stepping on a treadle connecting with such faucet or by any other suitable arrangement or means.

In forming the threads of screws upon bolts by forging, as herein described, the material from between the threads is worked into the bolt, thus economizing that portion of the material which is unavoidably wasted when the thread is produced in the usual manner by chasing or cutting dies. Forged screws are also much stronger than chased screws of equal size, because the interior iron of the bolt, which in round-rolled iron, is of inferior strength, is consolidated by the process, while an unbroken relation is preserved between the thread and the body of the screw, the fiber of the iron being continued through all the undulations of the screwed surface.

This forging-machine is principally intended to manufacture screws for entering and holding in timber and requiring a coarse pitch with a deep thread, usually of serrated form, such as the screws for attaching the armor-plates of war-vessels to the timber and the screw-spikes for fastening railroad-rails to the cross-ties, in either of which cases the forged screws would be of about double the strength of chased screws made from the same description of iron. Its application, however, is not limited to such kind of screws, as it will manufacture screws of common form, to be used with metallic nuts, with sufficient accuracy for some purposes; but such forged screws can be passed with rapidity, when cold, through finishing-dies, it being only necessary to take off a very small cut to give them a fine bearing-surface, and thereby produce a screw in which the best finish and the greatest strength would be combined.

In this specification I have described the construction and operation of a practical machine which I have built and used; nevertheless I do not confine or limit myself to the exact details and arrangements herein shown, but claim the right, under this patent, to vary the same as convenience or the purpose to which it may be applied will require, while the principle of my invention, as herein described, remains unchanged.

Having thus described the nature, construction, and mode of operating my improved screw-forging machine, what I claim therein as my own invention, and desire to secure by Letters Patent, is—

1. The method of forming screw-threads upon metal bolts by means of forging-dies of proper shape, in combination with a guide-screw and rotating wheel, all constructed and arranged substantially as described.

2. The combination of the tongs and guide-screw with the forging-dies and templets, constructed and operating substantially as described.

3. The combination of the clevis with the sliding rods or templets, so as to sustain and move with the bolt or blank while it is under the action of the screw-forging dies, constructed and operating substantially as described.

4. Controlling the space between the dies, operating as described, as the operation progresses, by means of sliding templets or their equivalent, so as to forge screws of uniform diameter or taper, or gimlet-pointed, substantially as described.

5. The combination of the sliding templets with the guide-screw by means of the slide-rods and yoke, so as to be operated by it with an equal and simultaneous retractive movement, constructed and arranged substantially as described.

6. The combination, with screw-forging machinery, of the open bearing or clevis in front of the dies and the open screwed-bearing in the pedestal for the guide-screw, so that a blank or bolt and the detachable apparatus by which it is held and rotated can be safely and expeditiously placed in or removed from the machine while in motion and without interruption to the speed, substantially as described.

7. The straight-threaded forging-dies, in combination with the jumper *c* and anvil-block J, constructed and operating in the manner and for the purpose substantially as described.

8. The combination, in a screw-forging ma-

chine, of a screw-forging die that has a positive and definite reciprocating movement, and a screw-forging die that has a positive movement to or from the other, as required in the production of screws of varying diameter, when such movement of the latter die is caused and controlled by means of sliding templets or their equivalent, substantially as described.

9. The method of forming or making screws upon metal bolts by operating upon and completing them from the neck or shank toward the point by the means and in the manner substantially as described.

JOHN COCHRANE.

Witnesses:
A. DE LACY,
ANDREW I. TODD.