2 Sheets—Sheet 1.

W. E. WARD.

Machine for Making Bolts.

No. 38,518. Patented May 12, 1863.

Fig. 1,

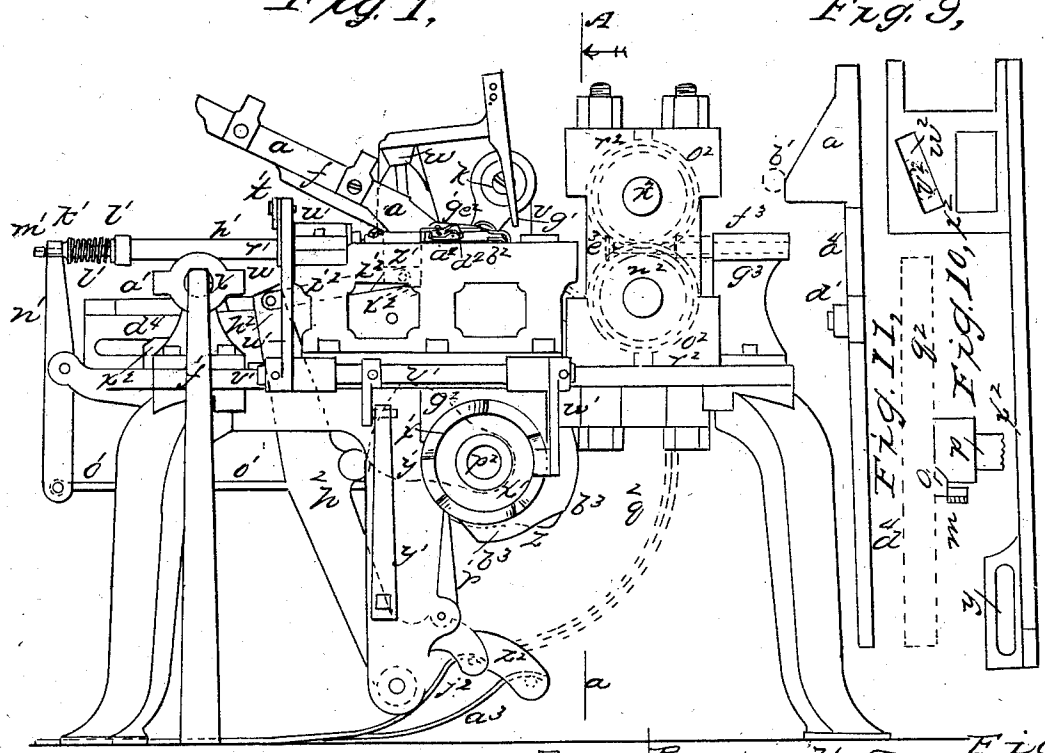


Fig. 9,

Fig. 10,

Fig. 11,

Fig. 6

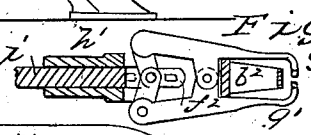


Fig. 2. A. a

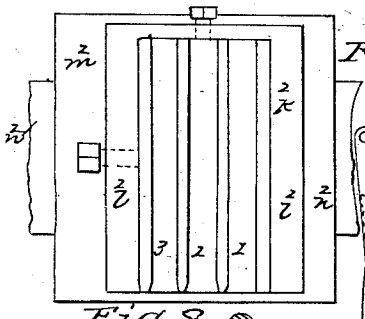
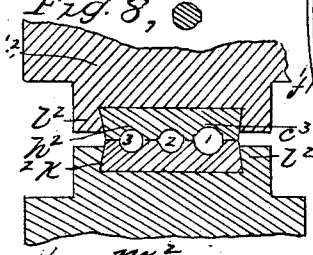


Fig. 8,



Witnesses;
Wm. H. Burbank
A. D. Jay

Inventor
W. E. Ward

2 Sheets—Sheet 2.

W. E. WARD.

Machine for Making Bolts.

No. 38,518. Patented May 12, 1863.

Fig. 3. B. b.

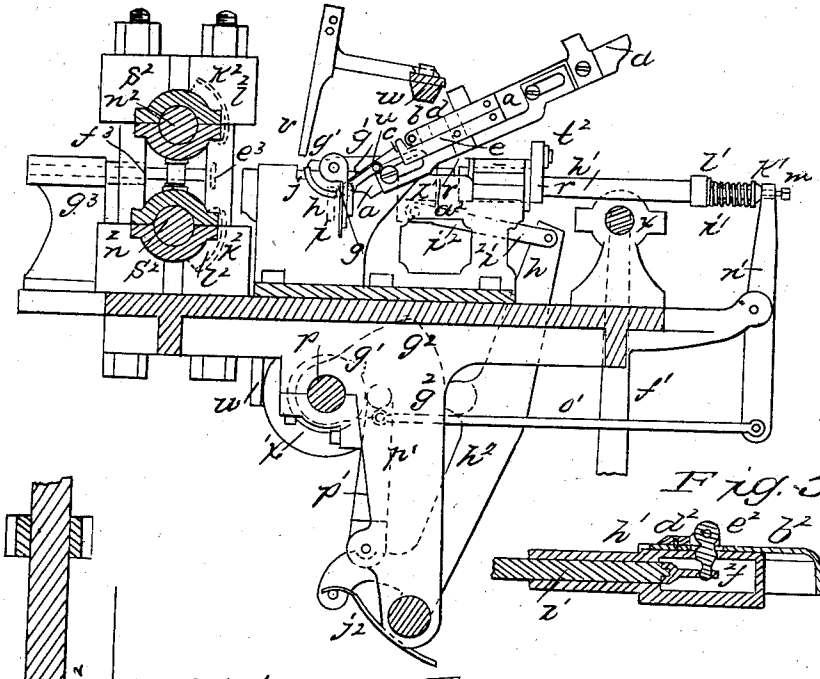


Fig. 5.

Fig. 4. B. b

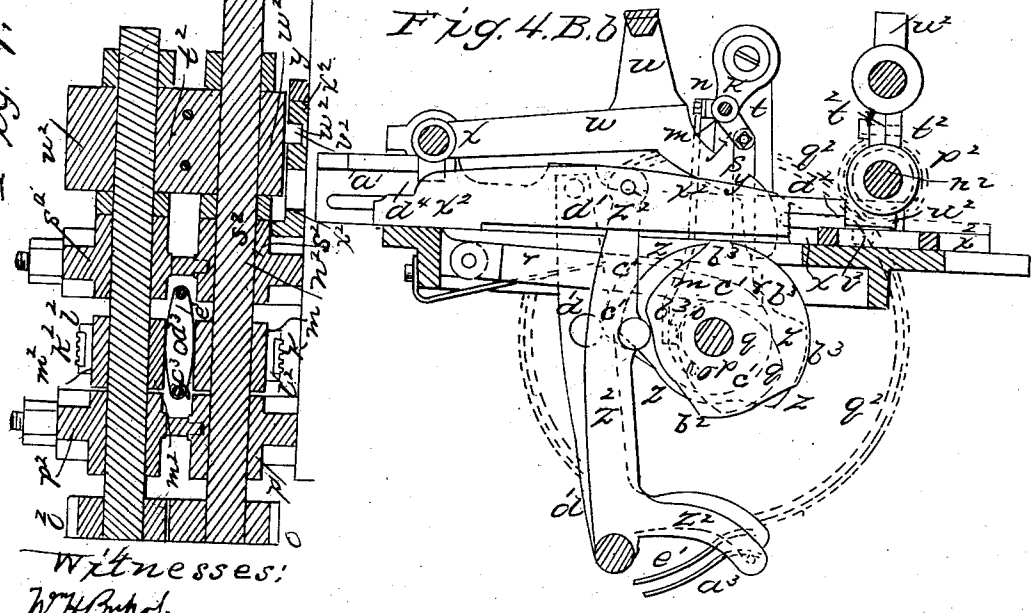


Fig. 7.

Witnesses:

Wm H Bishop

A De Lacy

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W E Ward

UNITED STATES PATENT OFFICE.

WILLIAM E. WARD, OF PORT CHESTER, NEW YORK.

IMPROVEMENT IN MACHINES FOR MAKING BOLTS.

Specification forming part of Letters Patent No. **38,518**, dated May 12, 1863.

To all whom it may concern:

Be it known that I, WILLIAM E. WARD, of Port Chester, Westchester county, and State of New York, have invented certain new and useful Improvements in Machinery for Making Iron Bolts; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a side view; Fig. 2, a vertical cross-section taken at the line A *a* of Fig. 1; Fig. 3, a longitudinal vertical section taken at the line B *b* of Fig. 2, and looking in the direction of the red arrow; Fig. 4, another longitudinal vertical section taken at the same line, B *b*, of Fig. 2, and looking in the direction of the black arrow. Figs. 5 and 6 are enlarged longitudinal sections taken at right angles to each other and in the plane of the axis of the mandrel which presents the blank to the rolling-dies. Fig. 7 is a vertical section, taken in the plane of the axis of the shafts of the rolling-dies. Fig. 8 is an enlarged face view of the rolling-dies and a cross-section thereof, with the form of the blank after the first rolling; Fig. 9, a separate plan view of the sliding wedge a'; Fig. 10, a separate plan view of the sliding bar x^2; Fig. 11, a separate plan view of the cam *o*.

The same letters indicate like parts in all the figures.

My said invention relates to machinery for making what are known under the denomination of "carriage-bolts"—that kind of bolts having that portion of the shank which is next to the head square and the rest round. Such bolts have heretofore been made by machinery, and on the 10th day of July, 1855, Letters Patent of the United States were granted to me for improvements in machinery by which such bolts have been made successfully, but from iron rods in the heated state. It has long been desired to make such bolts from iron in the cold state, and many attempts have been made to produce machinery by which such a result could be accomplished, but, so far as I have been informed, without success. To make such bolts by machinery, it is necessary to form them from rods of square iron of the size of that part of the shank next to the head. To form the cylindrical part of the shank the rod of iron must be reduced from the square to the cylindrical form, and to accomplish this in the cold state has presented the most serious difficulty. It has long been known that if iron is drawn in the cold state by passing it between rollers which alternately squeeze it at right angles, as by turning it a quarter of a circle after each rolling, the strength of the metal will not only be very much reduced, but will be split, unless the iron is of a remarkably good quality. Nasmyth long since demonstrated this tendency of iron to disintegrate under the operation of the hammer on a flat anvil, and that this tendency could be avoided by making the anvil or the face of the hammer of a V shape, so that the compressing-surfaces shall form a triangle, so that the compressing forces shall converge to the center. In view of this the square rod in the cold state cannot be drawn to a cylindrical form by first drawing down two opposite angles, and then turning the rod a quarter of a circle to draw down the other two angles, for that would have a tendency to disintegrate or split the iron. I am enabled, however, by my invention to accomplish the desired result. By the first rolling I draw it down near the edges, and then by turning it at right angles during the second rolling the compressing forces all tend toward the axis of the rod, as by Nasmyth's method of hammering. By my said invention the bolts are made from square rods of iron of the size of the square part of the shank. These rods are cut into pieces of the required length, and the head swaged onto one end of each piece by machinery well known and not necessary to be described, as it makes no part of my invention.

Referring to the accompanying drawings, the headed blanks are supplied to inclined ways *a a*, between which they hang by their heads, and along which they slide by gravity until the lowest one of the series comes in contact with a stop, *b*, (see Figs. 2 and 3,) by which the descent is arrested. They are delivered one at a time by this stop *b*, which acts as a separator, and by another stop, *c*, below it. The stops *b* and *c* project from the side of springs *d* and *e*, attached to the ways, so that the tension of these springs will tend to keep them across the space between the ways. At the required time the stop *b* is drawn out, which permits the whole series of blanks to

descend until the lowest one of the series is arrested by the stop *c*. The stop *b* is then permitted to be forced in by the tension of its spring, and thereby to pass between the lowest of the series of blanks and the one next above it, and then the stop *c* is drawn out to deliver the blank which it was holding back. The in-and-out movement of the two stops is effected by a slide, *f*, provided with two cam-like projections, one of which operates the stop *b*, and the other the stop *c*, the two cam-like projections being so arranged relatively to like projections on the springs of the stops that, as the slide reciprocates, at the end of its downward motion it will draw out the stop *b*, and on its starting to return will liberate it at the end of such return motion, and will draw out the other stop, *c*. The ways *a a* extend some distance below the said stops, and their lower ends are curved upward in the form of a segment of a circle, so as to prevent a blank, when liberated by the stops, from falling out. As soon as a blank descends to the lowest part of the ways, it is prevented from swinging back by a notch, *g*, (see Fig. 3,) in each of the ways which form shoulders, against which the head of the blank rests, hanging by the head with the shank in a vertical position, as shown by red lines at *h*. From this last position the shank of the blank is to be shifted into a horizontal position, which is effected by a vibrating wing, *i*, on a rock-shaft, *j*, which slides and turns in a stock, *k*, making part of the frame. Starting from the vertical position represented in the drawings, the wing is to be pushed toward the ways to get behind the shank of the blank *h*. This is effected by a spring, *l*, (see Fig. 2,) which acts on the lower arm of a lever, *m*, the upper arm of which is connected by a joint-link, *n*, with the rock-shaft of the wing, the face of a cam, *o*, on the main cam-shaft *p* being of such form as to permit this lever to be so operated by the spring after a blank has been liberated by the lower stop, *c*. So soon as the wing *i* gets behind the shank of the blank, the rock-shaft is rotated a quarter of a revolution by a cam, *q*, on the main cam-shaft, which operates a lever, *r*, connected by a joint-link, *s*, with an arm, *t*, of the rock-shaft *j*. (See Figs. 2 and 4.) The cam *q* is so formed as to hold the wing in a horizontal position with the blank on it until the blank is taken by a pair of transferring-fingers, and then the rock-shaft is rotated in the opposite direction to bring back the wing to its original vertical position, and as it is being so rocked back it is drawn from the ways, that the next blank may pass by it, the face-cam *o* being so formed as to operate at the appropriate time on the lever *m* to slide the rock-shaft *j* in the reverse direction of that first described. The slide *f*, for operating the stops *b* and *c*, is connected by a joint-link, *u*, (see Figs. 2 and 3,) with the wing *i*, so as to receive its motions from the rocking motion of the wing. A pair of spring-tongs, *v*, consisting of two opposite springs, are attached to and project down from an arm, *w*, of a rock-shaft, *x*. The lower jaws of these tongs are kept apart to a distance nearly equal to the thickness of the rod to be gripped, and their lower ends are slightly beveled, that they may be forced open by the bolt-blank when presented. When a blank is to be presented, the tongs stand in a vertical position and in the plane of the space between the ways *a a* and a little beyond their turned-up ends, so that when the vibrating wing *i* changes the blank *h* from a vertical to a horizontal position it shall force it into the grip of the tongs, which then transfers it to a pair of gripping-jaws, to be presently described. To impart the required motions to the tongs, the rock-shaft *x* not only turns, but slides in its boxes, and the arm *w*, to which the tongs are attached, has a branch arm, *y*, which extends down to and rests on the periphery of a cam, *z*, (see Figs. 2 and 4,) on the main cam-shaft *p*. So soon as the blank is inserted in the tongs, the cam *z* lifts the tongs slightly, so as to lift the blank out from between the extreme and turned-up ends of the ways, for it is important that the blank should be between the ways at the time of its presentation to the tongs, as it is important to the success of the operation that the square faces of the blank be held in their proper relations to the ways. The rock-shaft *x* is then made to slide endwise to transfer the blank to and over the gripping-jaws, which endwise motion is given to the rock-shaft by a sliding wedge, *a'*, the inclined face of which acts on a roller, *b'*, turning on a pin projecting from an adjustable collar on the rock-shaft *x*. The sliding motion of the wedge *a'* is given by a cam, *c'*, on the cam-shaft, which acts against one arm of a rocking lever, *d'*, the upper end of which is suitably connected with the stock d^4 of the sliding wedge, the said rocking lever being operated in the opposite direction to withdraw the wedge by the tension of a spring, *e'*, on a counter-weight. So soon as the tongs have brought the blank in the vertical plane of the axis of the jaws, to be hereinafter described, they are depressed by the form of the cam *z* until the axis of the blank is brought in line with the axis of the mandrel which carries the gripping jaws, and the tongs are there held stationary until the blank is gripped by the jaws, and then the tongs are carried back to their original position by reversed movements of the parts described, a spring, *f'*, acting by its tension against the end of the sliding rock-shaft *x* to force it back as the wedge *a'* is drawn back. The gripping-jaws *g' g'* are hinged to the forward end of a hollow rotating and sliding mandrel, *h'*, in which there is a rod, *i'*, the forward end of which is connected by toggle-levers *j' j'* with the rear arms of the jaws, so that by sliding the rod *i'* within the mandrel the jaws can be made to liberate or grip a blank. The rear end of this rod *i'* extends out beyond the rear end of the mandrel, and is there provided with a nut, *k'*, to confine a

helical spring, l', between it and the end of the mandrel, the tension of which spring tends constantly to close the jaws, so that the grip of the jaws will depend upon the force of this spring and the leverage of the toggle-levers. By means of the nut k' the tension of the spring can be regulated at pleasure. When the mandrel is drawn back to the required position to discharge a finished blank and to receive another, the rear end of the rod i' is brought in contact with an adjusting-screw, m', on one end of a lever, n'. The other end of this lever is linked by a rod, o', with a rock-lever, p', which is acted upon by a cam, q', on the cam-shaft, and this forces the adjusting-screw m' against the rear end of the rod i', contracts the spring l', which opens the gripping-jaws to liberate a finished blank, and holds them open while the tongs insert a fresh blank, and then, the active part of the cam having passed, the rock-lever p' is liberated and the tension of the spring l' is permitted to close the jaws to grip the blank. The only object in having a screw, m', on the lever n', to act on the rod i', is for the purpose of adjustment. The shank of the blank, when held by the tongs, has two of its faces horizontal, and the jaws are then in a horizontal plane, and as it is desirable to grip the shank of the blank by two of its opposite angles, the better to insure its not turning in the jaws during the operation of rolling, to be presently described, it is necessary for this purpose to turn the mandrel and jaws one-eighth of a revolution as the jaws are closing, that the angles of the shank of the blank may be received in triangular notches made for that purpose in the faces of the jaws. This turning of the mandrel is effected by a rocking sleeve, r', in which the mandrel slides, and to which it is feathered so as to turn therewith. This rocking sleeve is journaled in a suitable box, as represented at s', Fig. 3. The arm of this rocking sleeve is connected by a joint-link, t', with an arm, u', of a rock-shaft, v', provided with another arm, w', which carries a roller that is acted upon by a face-cam, x', on the end of the cam-shaft, a spring, y', being employed to give the counter-motions depending on the form of the cam. The forward end of the mandrel is journaled in another sleeve, z', fitted to slide in longitudinal ways a^2 a^2, (see Fig. 2,) to give the required steadiness to the mandrel and jaws as they slide back and forth. When the blank is gripped by the jaws, it is important to force and keep the under face of the head against the inner face of the jaws, so that in the after-rolling operation the rounded part of the shank in all the bolts shall be at the same distance from the head. To obtain this result there is combined with the jaws and mandrel an instrument termed the "sliding stop" b^2, which performs the double function of forcing the head of the blank against the jaws, and there holding it to prevent it from being forced back during the rolling operation. This stop is a plate of iron fitted to slide longitudinally between dovetail ways on one side of the head of the mandrel to which the jaws are hinged, and its forward end is bent so as to extend between the jaws to act against the outer face of the head of the blank. To the outer face of this stop is secured a piece, d^2, provided with ears, to which is hinged one end of a short lever, e^2, (see Fig. 5,) that passes through a hole in the stop-slide, and also through a hole in the head of the mandrel to the inside thereof, the inner end of the said lever being inserted in a hole in the forward end of a central piece, f^2, to which the toggle-levers of the jaws are hinged, the rear end of this said piece, f^2, being secured to the forward end of the central rod, i'. The hole in the stop-slide, through which the lever e^2 passes, is sufficiently large to allow the lever to vibrate without touching, and the hole through the head of the mandrel, through which it also passes, must be of such a size and form that the lever will act therein as it it were there hung on a fulcrum pin. The hole in the end of the piece f^2 to receive the inner end of the lever e^2 should be such as to form a connection equivalent to a joint-pin. The connection of these parts may be made by joint-pins, if desired. By reason of the foregoing connection, when the central rod i' is pushed forward in the mandrel to open the jaws, the sliding stop b^2 is drawn back out of the way, to permit a fresh blank to be inserted, and as the rod is drawn back by the tension of its spring to make the jaws grip the shank of the blank, the sliding stop is moved forward by the vibration of the lever e^2 to act against the head of the blank to force its inner face against the inner face of the jaws and hold it there firmly. When a finished blank is to be discharged, the mandrel is to be drawn back and then pushed forward, after a fresh blank is inserted, to present it to the rolling action. This back and forward motion is governed by a cam, g^2, on the main cam-shaft, which cam acts on a rocking lever, h^2, connected by joint-links i^2 with the sliding sleeve z', before described, in which the mandrel is journaled, so that by sliding this sleeve in its ways a^2 a^2, the required back and forward motion is given. The rocking lever h^2 is moved toward the cam by the tension of a spring, j^2, and the cam is of such form that after the rolling operation it forces the mandrel back, holds it back until a fresh blank is inserted, and then permits the spring to force it forward, and during the rolling operation it is out of the way, that the mandrel may be free to move back by the action of the rolling-dies on the blank, and forward by the tension of the spring. The rolling operation is performed by a pair of segmental rolling-dies, k^2 k^2, fitted and secured in recesses in bosses l^2 l^2 on the rollers m^2 m^2, so that they can be taken out and replaced or others substituted. The shafts n^2 n^2 of these rollers have their journals of such length that they can not only rotate, but slide therein endwise. The two shafts n^2 n^2 are

geared by pinions o^2 o^2, so as to turn in opposite directions with equal velocity, and the shaft of the lower roller, which is the driving-shaft, carries a pinion, p^2, which engages a cog-wheel, q^2, on the cam-shaft, before described, so that the motions given by the several cams, before described, shall be appropriate to the series of rolling motions. There are three parallel grooves (numbered 1, 2, and 3) in the faces of each of the rolling-dies. (See Fig. 8.) For the first rolling operation on each blank, grooves No. 1 must be in line with the axis of the mandrel, and when this is performed the shafts of the rollers must be moved endwise to bring grooves No. 2 in line with the axis of the mandrel, and after the second rolling they must be again shifted to bring grooves No. 3 in line. Each blank receives one rolling from grooves No. 1, one rolling from grooves No. 2, and two rollings from grooves No. 3, and then the rollers are shifted back to their original position, to repeat the operations on a fresh blank. The journals of the rollers are mounted in three sets of boxes, r^2 r^2 and s^2 s^2 being stationary, and t^2 t^2 in a movable frame, u^2, provided at the lower end with a spur, v^2, fitted to an oblique mortise, w^2, in a bar, x^2, (see also Fig. 10,) adapted to slide in ways y^2, (see Figs. 7 and 10,) so that when the bar slides back and forth it shall by its oblique mortise move the boxes t^2 t^2, and with them the rollers; and this bar x^2 is connected with and receives motion from a rocking lever, z^2, which is operated in one direction by a spring, a^3, or counter-weight, and in the opposite direction by a cam, b^3, on the cam-shaft. This cam has three divisions, the first to operate the sliding bar x^2 after the first rolling with grooves No. 1 to shift the rollers to bring grooves No. 2 in line; the second, after the second rolling, to bring grooves No. 3 in line; the third, after the two rollings with grooves No. 3, to shift the rollers back to their original position; but the third division is subdivided, there being a portion of this division concentric to suspend the sliding motion while the rolling-dies are passing each other, as it was deemed advisable to make the return endwise motion of the rollers gradual and extending through two revolutions, and to continue this endwise motion as the dies pass each other would give too much strain to the parts, the friction due to the grip of the dies being necessarily great.

One of the important features of my said invention relates, as before stated, to the first rolling operation. The shank of the blank is to be reduced along part of its length from a square to a cylindrical form by a series of rollings in the cold state.

In view of the purpose to be accomplished, instead of making grooves No. 1 semi-cylindrical—that is, presenting a circle in the cross-section when the two dies are in contact—I make them of the form represented in that part of Fig. 8 which presents an enlarged longitudinal section of the rollers and dies in the plane of the axis of the two rollers, and therefore a cross-section of the grooves. The sides of the grooves No. 1 for nearly half the depth are at right angles to the axis of the rollers and as far apart as the size of the square rod to be drawn, leaving angular shoulders on each side and the rest in the segment of a circle. The mode I adopt is to form the grooves so that each shall present a semicircle in the cross-section, and I then cut down a rabbet each side, extending down nearly half the depth, as represented at c^3 c^3, Fig. 8. The grooves Nos. 2 and 3 are of a form presenting in their cross-section each a circle, except at their junction, where they are slightly flared off, as represented, No. 2 being a little larger than the intended diameter of the cylindrical part of the shank of the blank, and No. 3 of the diameter to which the iron is to be reduced. The three sets of grooves should be beveled at the front edge.

Preparatory to the rolling operation, as before stated, the mandrel carries forward the blank to the required position, the rolling being from the head toward the point; and as the blank is thus advanced it must enter a a hole, d^3, (see Fig. 7,) in a shield-plate, e^3, situated between the gripping-jaws and the rolling-dies. This plate is provided with two parallel rods, f^3 f^3, fitted to slide freely in a guide, g^3. The object of this shield is twofold: First, to prevent the blank from being carried between the rolling-dies, if by accident it should not be held properly in line by the gripping jaws, for in such an event the end of the blank, instead of entering the hole d^3, will strike against the face of the shield, and will remain there until put straight; and, secondly, to shield the gripping jaws and prevent them from being struck by the forward edge of the rolling dies as they approach and grip the blank. By the interposition of this shield the jaws are perfectly protected, the edges of the dies striking the shield instead.

It is necessary in presenting the blank to the action of the first rolling to have two of the faces horizontal and the other two vertical, that it may be properly taken by the grooves No. 1 of the rolling-dies. This first rolling will reduce that part of the shank which is to be made cyliudrical to the form represented in the enlarged cross-section, Fig. 8. As the rollers are being shifted to present grooves No. 2, the mandrel is turned a quarter-revolution to present the blank for the second rolling at right angles to the position it occupied during the first rolling. After the second rolling it is to be turned back, that it may be subjected to the third rolling in the position it occupied during the first rolling, and then it is again turned, that during the fourth rolling it may occupy the same position as during the second rolling. These various turnings are effected by the face-cam x', as before described, in connection with the gripping operation, except that the projections on the face of the cam vary in size. The one for turning the man-

drel at the time of gripping the blank, and to present the jaws to the tongs to receive a fresh blank, only turns the mandrel one eighth of a revolution, while the others turn it a quarter-revolution.

Having thus described the mode of operation of my said invention and the manner of constructing and using it, I wish it to be distinctly understood that I do not limit my claim of invention to the specific mode of construction, as this may be greatly varied without departing from the mode of operation which I have invented.

What I claim as my invention, and desire to secure by Letters Patent, in machinery for forming carriage and other like bolts from square rods of iron, is—

1. Forming the first set of grooves of the rolling-dies for a portion of their depth with the sides square—that is, at right angles with the axis of the rollers, or nearly so—and having a mode of operation such as herein described, in combination with other grooves of a semicircular or other equivalent form for the after rollings, substantially as described.

2. The rolling-dies, with two or more sets of grooves, substantially as described, in combination with a sliding and rotating mandrel with jaws, substantially as described, the two or more sets of grooves in the rolling-dies acting in succession on each blank, the mandrel being turned for each successive rolling, as described.

3. In combination with the gripping-jaws on the mandrel, the sliding stop, operated substantially as herein described, for forcing and holding the inner face of the head of the blank against the inner face of the gripping-jaws, as described, and for the purpose specified.

4. The sliding shield-plate, substantially as described, in combination with the rolling-dies and the jaws on the mandrel, substantially as and for the purpose specified.

W. E. WARD.

Witnesses:
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