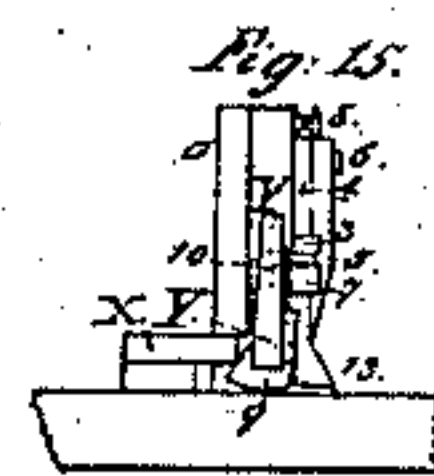
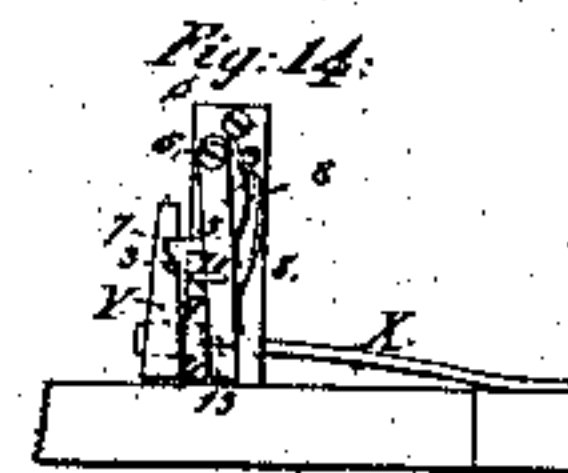
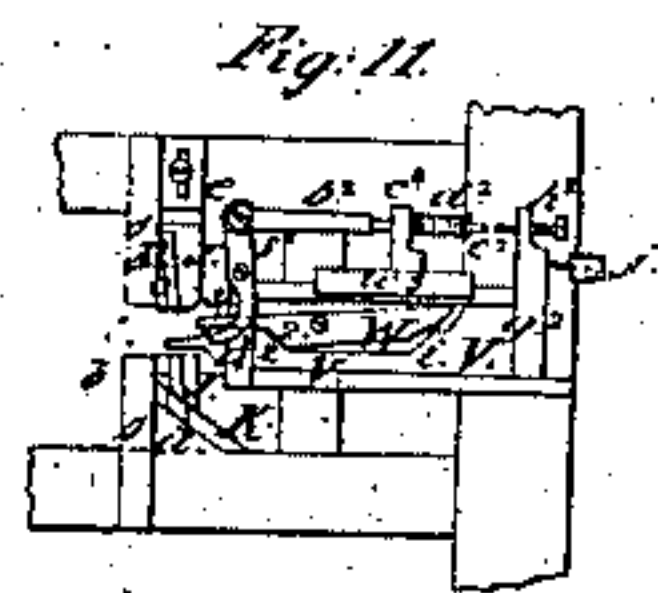
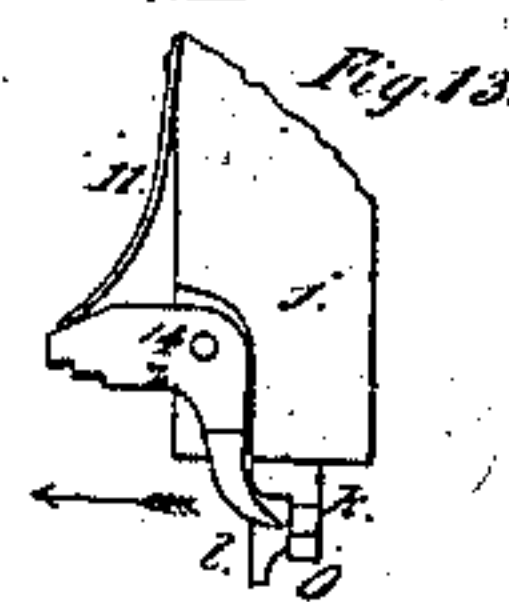
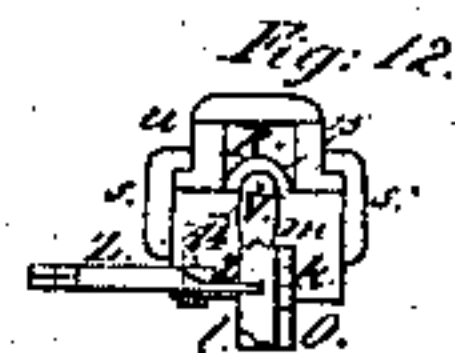
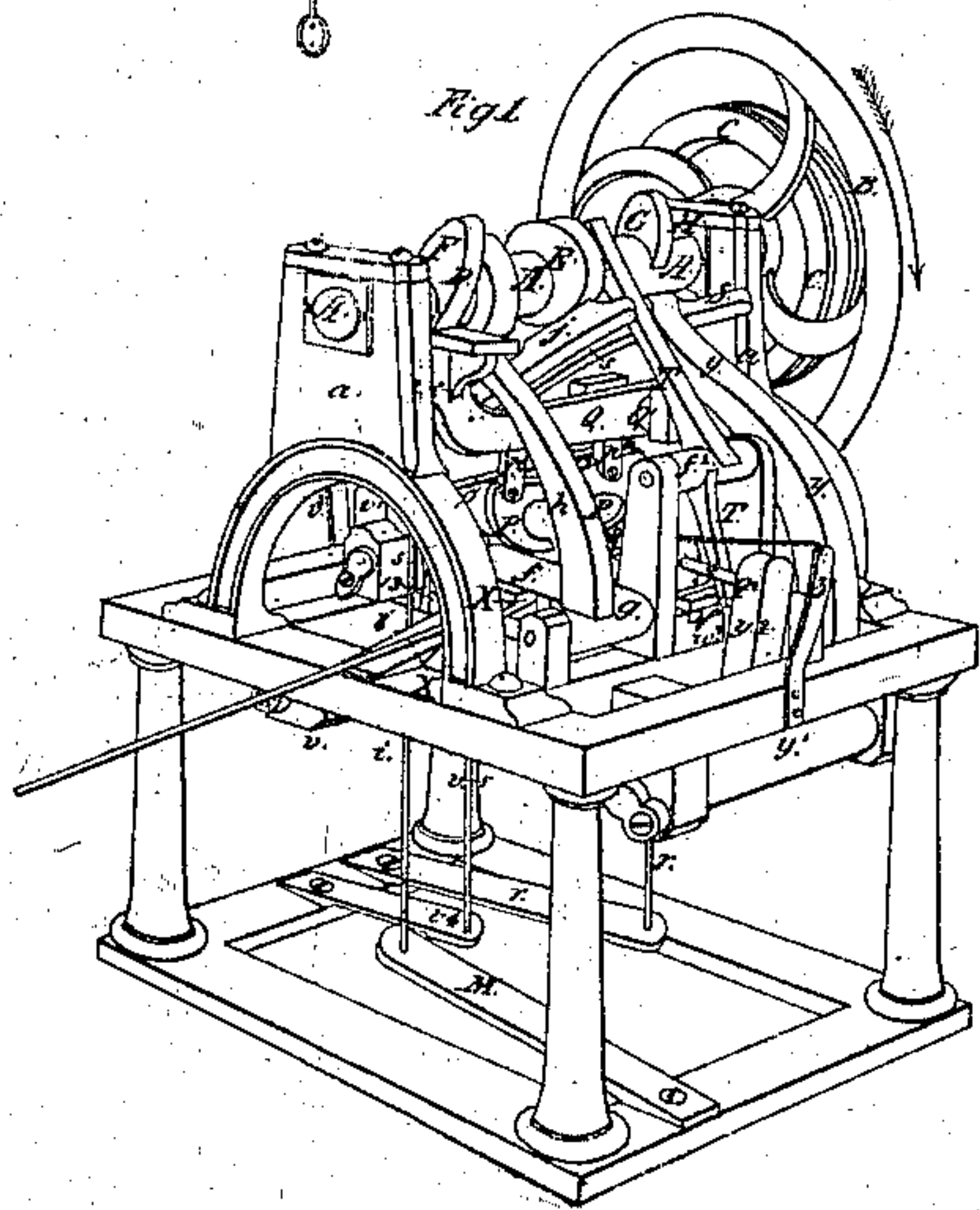
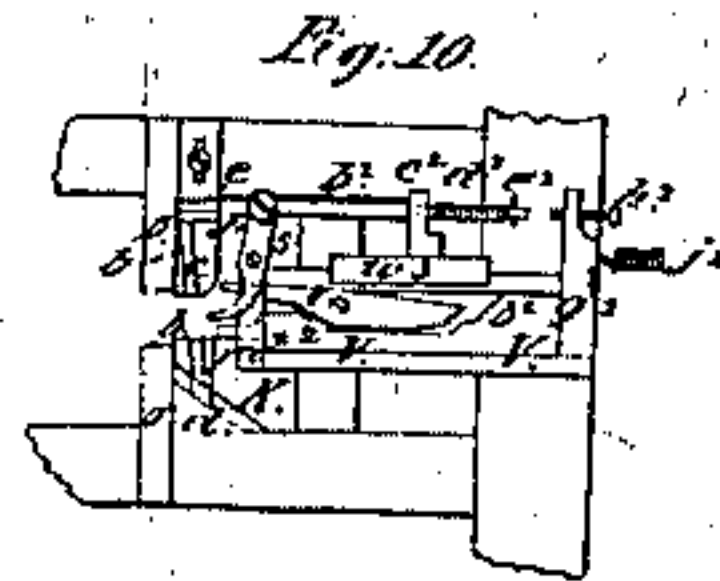
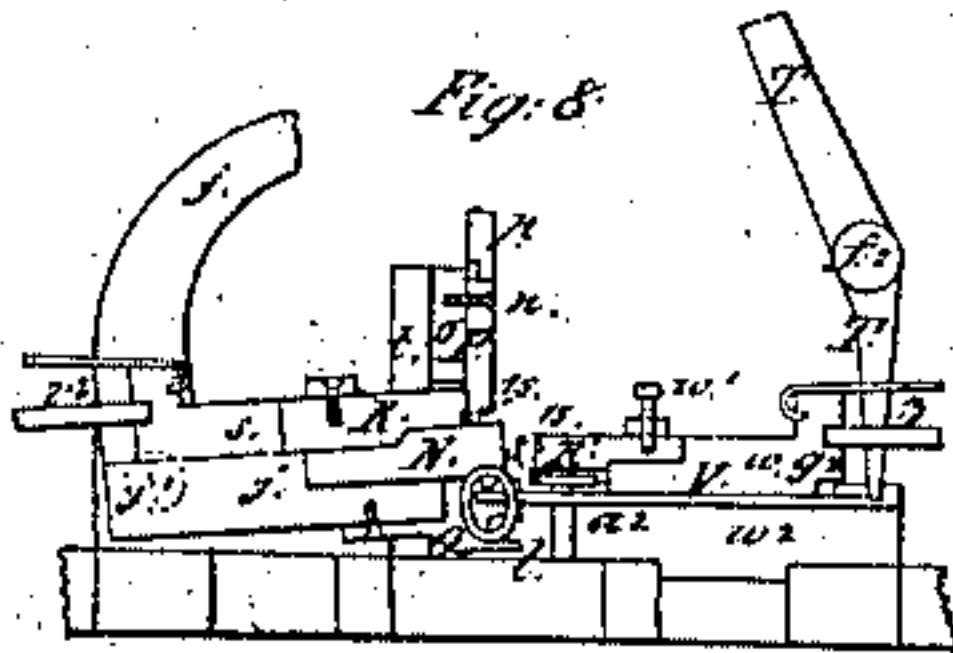
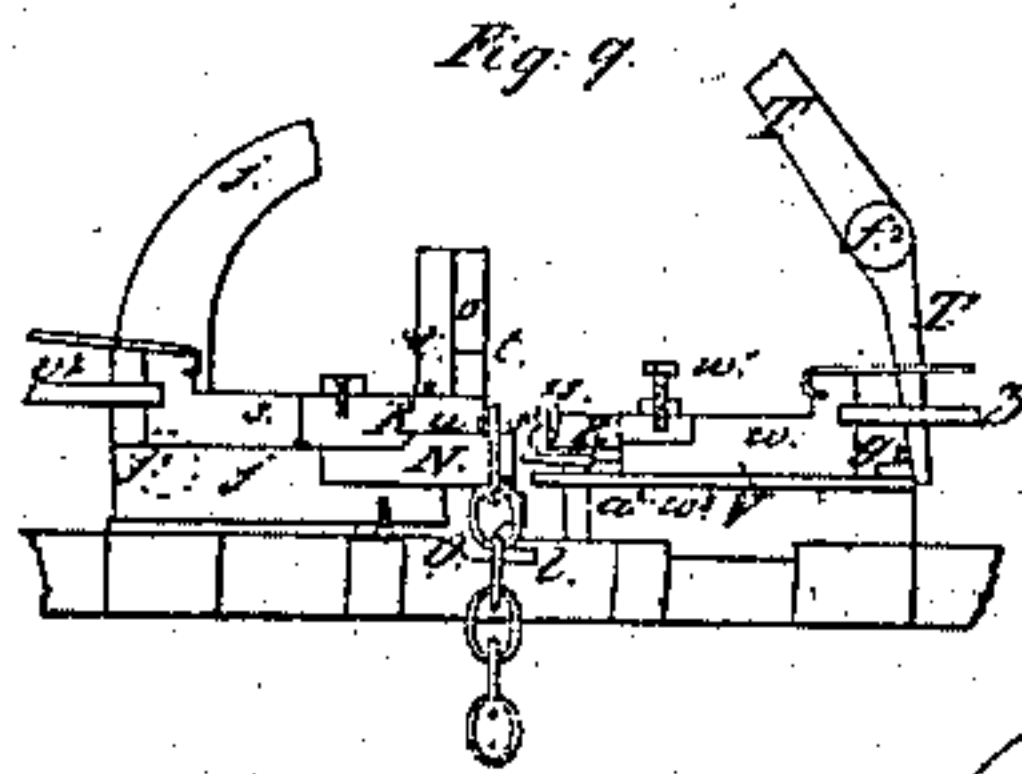
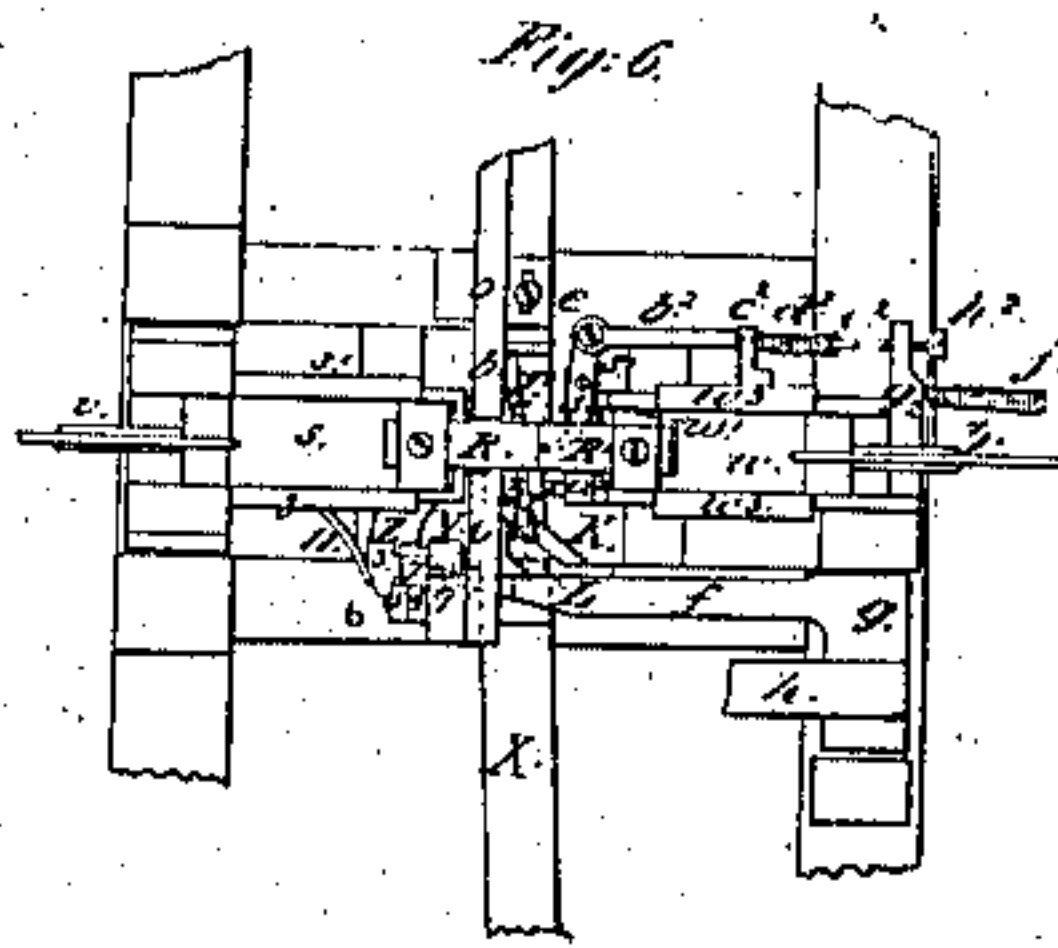
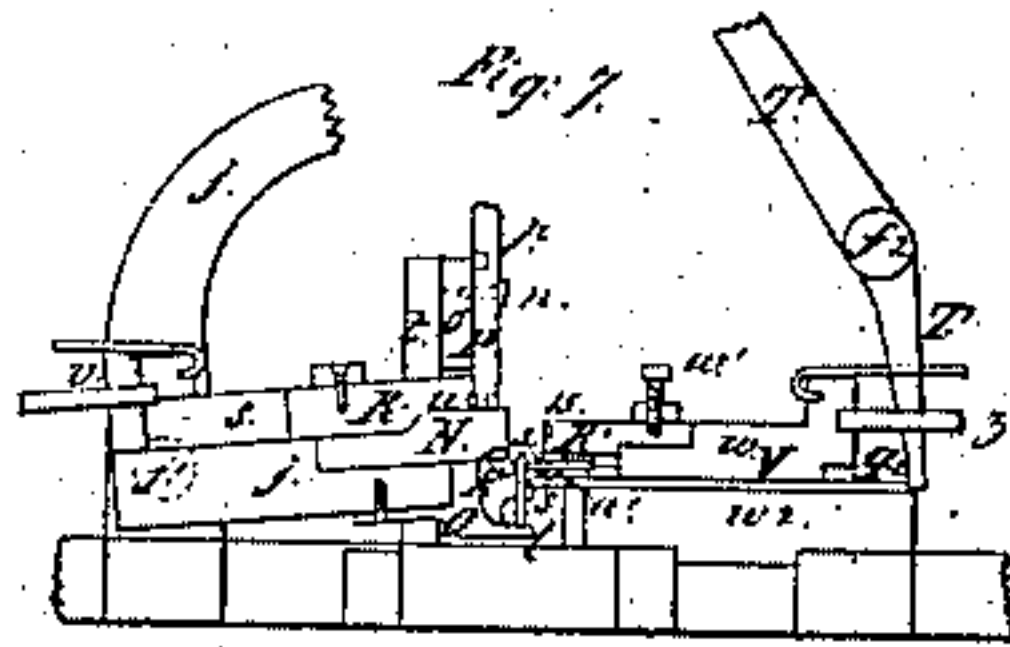
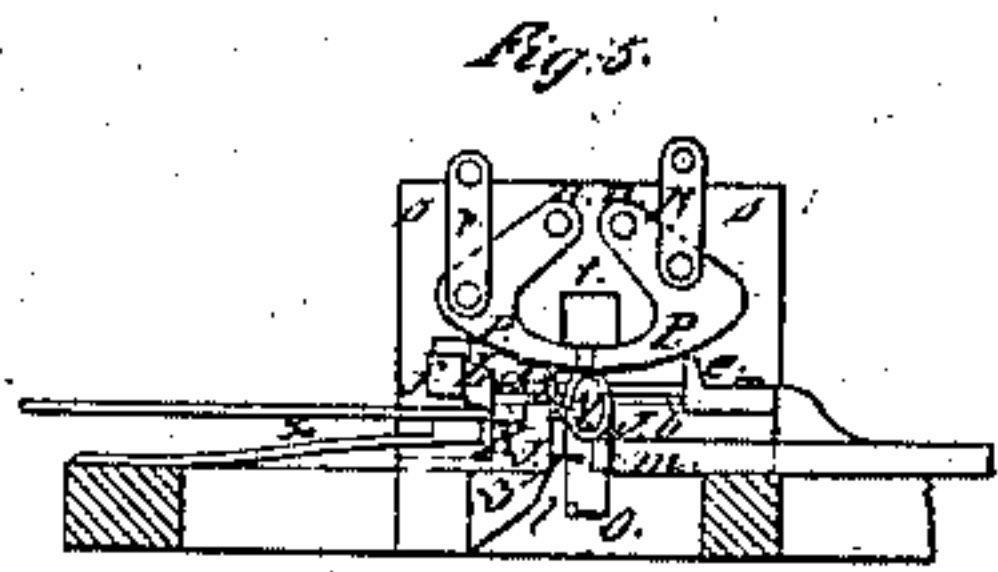
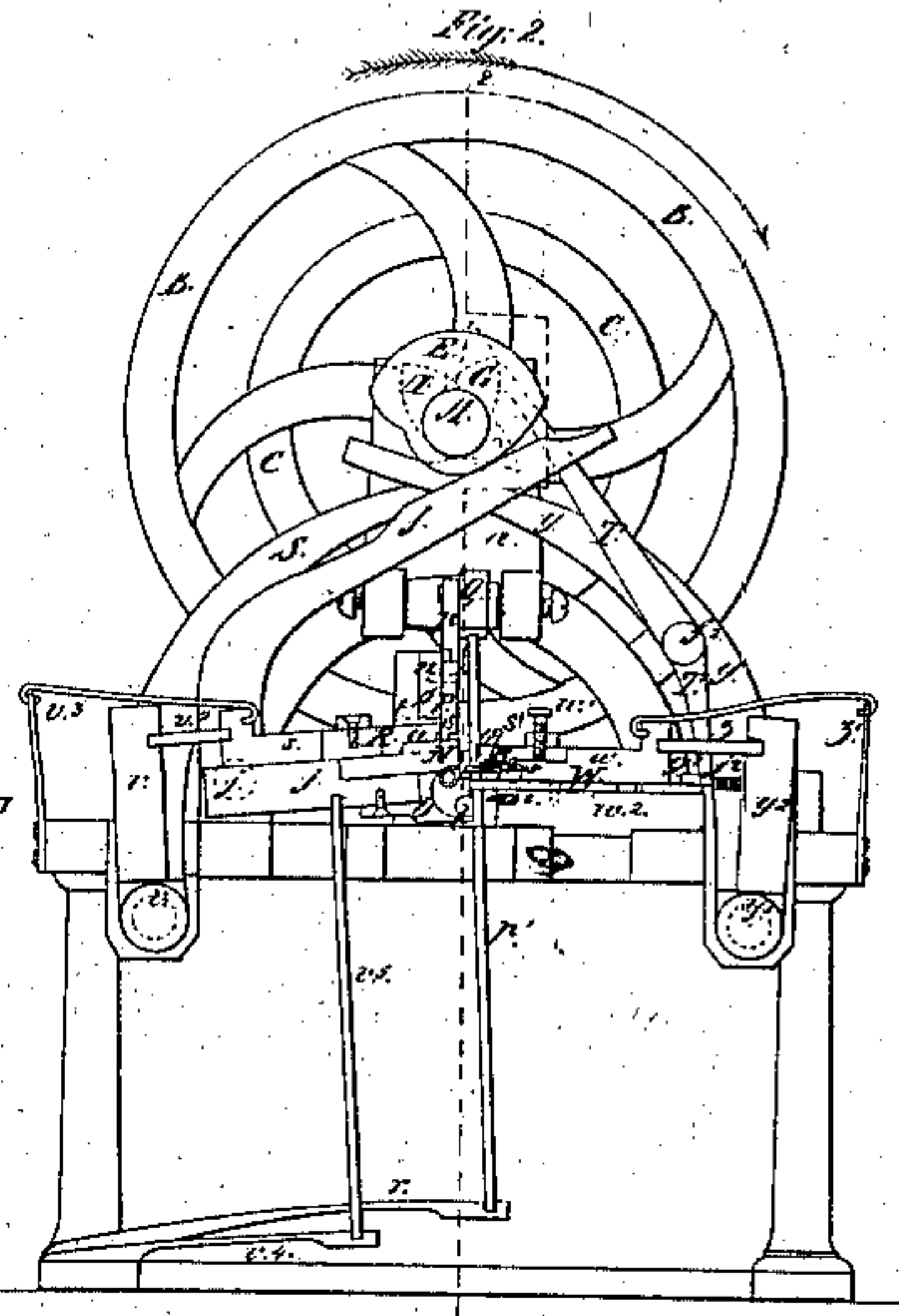
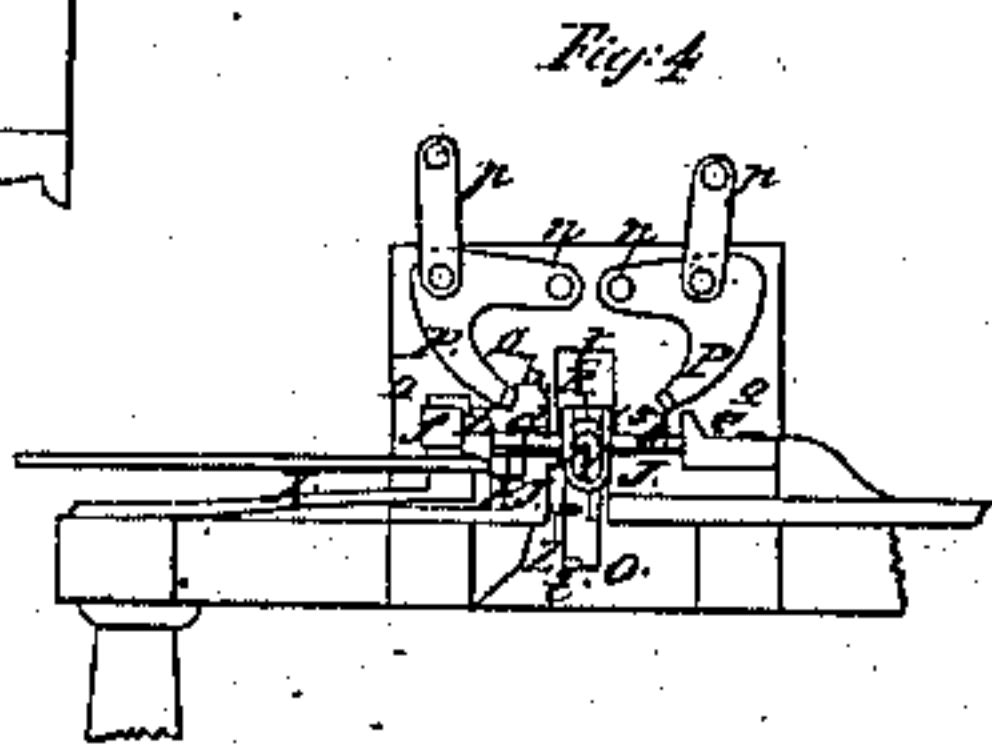
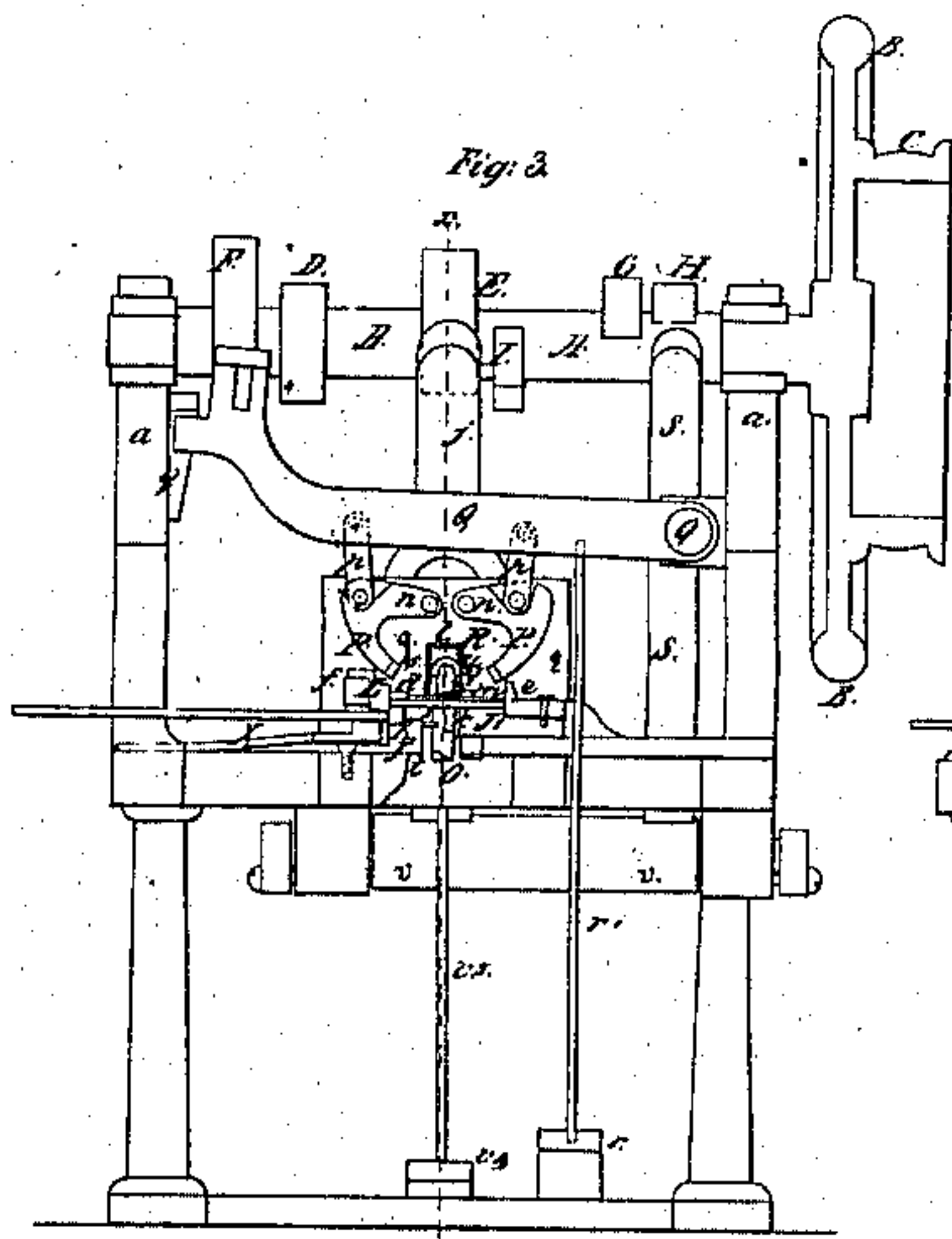


*J. M. Crawford,*

*Making Chains,*

*N<sup>o</sup> 8,437.*

*Patented Feb. 17, 1852.*





# UNITED STATES PATENT OFFICE.

JNO. M. CRAWFORD, OF NEW CASTLE, PENNSYLVANIA.

## MACHINERY FOR MAKING CHAINS.

Specification of Letters Patent No. 8,737, dated February 17, 1852.

*To all whom it may concern:*

Be it known that I, JOHN M. CRAWFORD, of New Castle, in the county of Mercer and State of Pennsylvania, have invented certain new and useful Improvements in Machines for Making Chains; and I do hereby declare the following to be a full, clear, and exact description of the construction and operation thereof, reference being had to the annexed drawings, forming part of this specification, in which—

Figure 1 is a perspective view of the machine, looking toward the front, and right end thereof, and showing the wire or rod under operation. Fig. 2 is a vertical longitudinal section taken through the machine, as denoted by the dotted line *x x* of Fig. 3, the wire or rod to form the link having been cut to the required length, and situated to be bent, by the swage, to a semi-oval or U shape. Fig. 3 is a vertical transverse section, taken as indicated by the dotted line 2, 2, of Fig. 2, the parts maintaining the position seen in Fig. 2. Fig. 4 is a transverse sectional view taken as indicated by the line 2, 2 of Fig. 2, and showing the wire or rod bent to the semi-oval or U shape. Fig. 5 is a similar section to Fig. 4, showing the lapping levers closed and the form of the link completed. Fig. 6 is a horizontal sectional view showing the sliding dies R, R', closed to weld or unite the ends, and thus finish the formation of the link. Fig. 7 is a vertical sectional view taken on the line *x x* of Fig. 3, showing the welding dies open and the swage or former, with the link seat, raised, and the link mounted upon a suspending arm, to be pushed into its seat. Fig. 8 is a similar view to Fig. 7, the link being seated and held by the arm Z and the wire or rod, for the succeeding link, fed into the finished link. Fig. 9 is a similar view to Fig. 8, the wire or rod, to form the succeeding link, having been cut, and bent to the semi-oval or U shape, several links of the chain being also shown. Fig. 10 is a sectional plan view showing the pushing bar V, turning lever W, vibrating suspending arm S', stationary bed dies, &c., the several parts being shown in the position when the link is suspended to the arm S'. Fig. 11 is a similar view to Fig. 10, the several parts being shown in the position when the link is turned and seated. Fig. 12 is an end view of the swage, N, link seat O, and holding arm Z. Fig. 13 is a horizontal section

of the end of the bent lever *j*, and showing the holding arm Z, more clearly in connection with the link seat. Fig. 14 is a vertical sectional elevation showing the pendant cam bars 4 and 5, spring bar X, &c., looking toward the left side of the same. Fig. 15 is a similar view to Fig. 14 looking toward the inside.

The same letters of reference denote the same parts on the several figures.

The arrows Figs. 1 and 2 show the direction of the turning of the cam shaft.

The nature of my invention consists, in a certain new and useful combination and arrangement of mechanical devices, which operate successively upon the wire or rod (previously heated to a welding heat) cutting a piece therefrom of the proper length to form the link, bending the same to a semi-oval or U shape, lapping the ends, and welding them together, and thus form the link, and deliver it upon a vibrating suspending arm, on which it is turned, and carried to a seat, from which (seat) it is displaced by the formation of the succeeding link, there being required during the operation of the machine, but one attendant to feed the wire or rod in the machine.

The frame for supporting and containing the several parts of the machine is of a rectangular or other form and of suitable dimensions.

A is the propelling cam shaft, mounted in bearings in pillars *a, a*, and on one end of which is a balance or fly wheel B, and a pulley C, to receive the band from the propelling power. On the shaft A, there is a cam D, for depressing the shear cutter L, to cut a piece of the required length to form the link, from the wire or rod. On the shaft A, there is a cam E, for depressing the swage or former N, to bend the wire or rod to the semi-oval or U shape. On the shaft A, there is a cam F, for actuating the lapping levers P, P. On the shaft A, are cams G, H, for advancing the dies R, R' to weld or unite the ends to finish the link.

I, is a cam on the shaft A, for actuating the finishing arm or bar V, turning lever W, and vibrating suspending arm S' to turn the link, and push it into its seat.

J J' are two fixed dies, supported by central beams of the frame, between the ends of which the wire or rod is bent to the semi-oval or U shape. On the upper surfaces of the dies J J' there is formed slightly oblique



grooves  $b$   $b'$ , Figs. 6 and 10, into which the wire or rod enters, the groove  $b'$ , of the die  $J'$ , having a rib  $c$  on the right side thereof, for the purpose of canting that portion of the wire or rod, resting therein, leftward, while it is being bent to the semi-oval or U shape, which allows the ends to pass or lap each other, when closed by the lapping levers  $P$ ,  $P$ , the space between the ends of the dies being sufficient to allow the link to be bent and turned to be seated.

$K$ , is an oblique steel cutter, fixed on the bed of the front die  $J$ , having a cavity  $d$  therein corresponding with the grooves in the dies  $J$   $J'$  through which the wire or rod is fed. The rod or wire is gaged to the proper length by an adjustable stop  $e$  on the die  $J'$ .

To the inner end of a lever  $f$  whose fulcrum is at  $g$ , Fig. 1, and having a branch  $h$  extending upward and leftward to receive the action of the cam  $D$ , is attached a shear cutter  $L$ , extending outward, and rearward from the lever  $f$  at an angle corresponding with the stationary cutter  $K$ , so that on the descent of the cutter  $L$ , the piece to form the link will be separated from the rod. The branch  $h$  of the lever  $f$  is kept in contact with the cam  $D$ , by means of a spring  $M$ , attached to the frame, and united to the branch  $h$  by a vertical rod  $i$ , said spring  $M$ , elevating the cutter  $L$ , to the feed of the rod, when the lever is relieved from the cam  $D$ .

$N$ , is the swage or former, made of cast steel, of the form and size of the links to be formed, secured permanently to the lower inner end of a bent lever  $j$  and projecting therefrom a sufficient distance to allow the formation of the links thereon, the fulcrum of the lever being at  $j'$  and its curved end extending upward and frontward to receive the action of the cam  $E$ .

$O$ , is an arm, fixed to and projecting from the inner end of the lever  $j$  directly beneath the swage or former,  $N$ , and is furnished on one side thereof, with a recess into which the finished link is pushed, as seen in Figs. 8, 12 and 13, the top of said arm  $O$ , being provided with a cavity  $k$  to guide the wire or rod, when inserting it into the grooves of the dies  $J$   $J'$ , and also serves to prevent the displacement of the wire or rod while being bent by the swage. The lower end of this arm  $O$ , is formed into a curved jog or projection  $l$ , see Figs. 12 and 13, and forms the bottom of the seat of the link, upon which rests the lower portion of the link, when finished, and suspended upon the curved end of the vibrating arm  $S'$ , whereby the lower portion of the link is sustained or steadied while being turned by the arm or bar  $V$ , and pushed into its seat, as will be hereafter described. When the finished link is seated, the lower portion thereof fits upon

the projecting jog  $l$  and the upper portion fits into a semi-circular cavity  $m$  in the underside of the swage, as seen in Fig. 8.

$P$ ,  $P$ , are the lapping levers, the fulcrum  $n$   $n$  thereof being in an upright plate  $o$  of the frame, and the ends whereof curving downward, and toward each other, on either side of the swage  $N$ , and uniting by connecting arms  $p$   $p$  to a transverse lever  $Q$ , having its fulcrum at  $Q'$ , and elevated (to open the lapping levers  $P$ ,  $P$ , when relieved from the cam  $F$ ) by a spring  $r$  and vertical rod  $r'$  attached to the end of said lever  $Q$ , the end of the latter moving between cleats  $q$ , Fig. 3, on the inside of the pillar  $a$ . The object of these levers  $P$ ,  $P$ , is to bend, and lap, the ends of the wire or rod over, and upon the swage  $N$ , to be united or welded by the dies  $J$   $J'$ . The ends of the levers  $P$ ,  $P$ , are notched so as to form a ship lap when closed, and are also grooved on their undersides to hold the ends of the wire or rod while lapping them as seen in Fig. 5.

$R$   $R'$  are two horizontal sliding welding dies. The die  $R$ , is mounted upon a slide  $s$  on the horizontal end of the lever  $j$ , and made to move back and forth between side plates  $s'$   $s'$ , the latter being grooved to receive tongues on the slide  $s$ . This die  $R$  is situated directly over the swage  $N$ , and has a cavity  $u$  on its underside of the exact counterpart of the upper part of the swage  $N$ , into which the latter fits, whereby the die  $R$ , is allowed to slide over the swage to move the link to the end of the swage, where the dies meet, and weld the ends of the link. The swage  $N$ , and die  $R$ , project through an opening  $t$ , in the plate  $o$  wherein they rise and fall with the end of the lever  $j$ . The advance movement of the die  $R$ , is effected by means of a curved lever  $S$ , having its fulcrum at  $v$  and extending upward and rightward to receive the action of the cam  $H$ . This lever  $S$ , has an upright branch or arm  $v'$  which connects with the slide  $s$  of the die  $R$ , by a rod  $v^2$ , Fig. 2, and thus the descent of the lever  $S$ , by the cam  $H$ , advances the die  $R$ . The die  $R$ , is made to recede simultaneously with the upward motion of the swage or former by a spring  $v^3$  attached to the frame, and slide  $s$ . The upward motion of the die  $R$ , swage  $N$ , and arm or seat  $O$  (after the link has been finished, and the lever  $j$  relieved from the cam  $E$ ) is effected by a spring  $v^4$  and rod  $v^5$ , see Fig. 2. The die  $R'$  is mounted on a slide  $w$  and held by a set screw  $w'$ , the slide  $w$  being mounted upon and moving over a bed  $w^2$  furnished with side plates  $w^3$  grooved to receive tongues on the slide  $w$ . The ends of these dies  $R$   $R'$ , are furnished with semi-circular cavities  $15$   $15$  into which the upper part of the link fits when the dies are brought together to weld or unite the ends of the link. The advance movement



of the die R moves the link flush with the face of the swage or former, where the welding takes place, by the advance of the die R' and the link dropped upon the end of the suspending arms S', as will be more fully hereafter described. The advance and receding movement of the die R' is effected by means of a curved lever y, having its fulcrum at y', and extending upward and leftward to receive the action of the cam G. This lever has a branch y<sup>2</sup> projecting vertically from the fulcrum y' and connects with the slide w by a rod z, whereby the descent of the lever y advances the die R', and the latter is made to recede by a spring z' attached to the slide w and frame.

S' is the vibrating hook shaped arm upon which the finished link is suspended, attached by a bolt to a bar a<sup>2</sup> on the bed w directly beneath the end of the die R', the inner or curved end of the arm S' extending opposite the center of the swage, in a position to receive the finished link when dropped from the dies R R'. The outer end of the arm S' is attached to a rod b<sup>2</sup> extending horizontally through an opening in a jog c<sup>2</sup> of the plate w<sup>3</sup>, said rod b<sup>2</sup> having a spring d<sup>2</sup> coiled around its outer end, and bearing against the jog c<sup>2</sup> and a pin e<sup>2</sup> whereby the tendency of the rod b<sup>2</sup> is to move outward (which motion of the rod is governed by a shoulder thereon acting against the jog c<sup>2</sup> as shown in Figs. 10 and 11) for retaining the curved end of the arm S' in a position to receive the finished link. The arm S' is vibrated to withdraw its curved end from the swage to relieve it of the link and allow it to be pushed into the seat of the arm O, by means of a lever T, whose fulcrum is at f<sup>2</sup> having a branch extending upward and leftward to receive the action of the cam I, and a branch extending downward against a horizontal cross bar g<sup>2</sup> of the pushing slide bar v, there being a set screw h<sup>2</sup> in the end of the cross bar g<sup>2</sup> for striking the end of the rod b<sup>2</sup>, to force it inward when the cam I, moves the upper branch of the lever T, outward, and thus vibrates the arm S' to deliver the link.

V, is the pushing slide bar, placed upon the bed w, beneath the die R', and extending the length of the same, its outer end being attached to the cross bar g<sup>2</sup> and its inner end made pointed and so situated in relation to the swage N, that on its advance (which must be simultaneous with the withdrawal of the curved end of the arm S') it will strike the front side of the link while suspended upon the end of the arm S' and push it leftward, and at the same moment the pushing bar V, will actuate a turning lever W, the end whereof catches against the opposite side of the link and turns it rightward and frontward, during which the lower portion of the link is sustained and held

(while being turned) by the projecting jog l of the arm O, and delivered into its seat. The turning lever W, is about two thirds the length of the pushing slide bar V, and has its fulcrum near the center thereof. Its outer end is notched and inclined to receive the action of an inclined shoulder i<sup>2</sup> on the slide bar V, the inclination of the end of the lever W, and shoulder i<sup>2</sup> being such as to impart to the turning lever W, the peculiar motion required to turn the link, while the slide bar V, pushes it into its seat, there being also corresponding inclined shoulders 2 2, Figs. 10 and 11, on the adjacent sides of and near the inner ends of the lever W, and bar V, for the purpose of moving the inner end of the turning lever rearward, as seen in Fig. 10, by the receding movement of the slide bar V, when the lever T, is relieved from the cam I.

Directly in front of the shear cutter L, there is attached to the frame a spring bar X, Figs. 3 and 4, 6 and 14, the inner end whereof, is situated so as to be depressed by the descent of the shear cutter L, and has attached to its end an arm Y, projecting upward, near the end whereof is a pin 3, Figs. 14 and 15.

To the left side of the plate o are attached a pair of pendant cam bars 4 and 5 which turn upon a fulcrum pin 6 at the upper end thereof. From one of these bars 4 projects a cam 7 in a position to receive the upward action of the pin 3 of the arm Y, when the shear cutter L, rises, and with it the end of the spring bar X, and arm Y, the pendant bar 4 being formed into a cam 13 at its lower end, as seen in Fig. 15, and the arm 5 being a little shorter than the arm 4 and tapered to a point, for the purpose of passing alternately behind the outer or notched end of the curved holding arm Z, Fig. 13, to keep it open, to allow the link to be removed from its seat (when the die R, advances to move the succeeding link from the swage to be welded) and to be in readiness to hold the next link, pushed into the seat.

8, 8, are springs for the purpose of forcing the ends of the cam bars 4 and 5 behind the outer or notched end of the holding arm Z.

9 is a short pendant arm pivoted by a pin 10, Fig. 15, and so situated, that on the depression of the end of the spring bar X, the end of the short pendant bar 9 will be forced leftward, and with it the outer or notched end of the holding arm Z, and permit the ends of the pendant cam bars 4 and 5 to pass behind, or in the notches of said arm Z, and thus turn the latter, which moves its curved end from the link seat or arm O, in the direction of the arrow, Fig. 13.

The holding arm Z, is confined by a pivot bolt 14 to the inner end of the horizontal portion of the bent lever j and is curved as shown in Fig. 13. Its curved end extends



to the link seat in such a manner as to be forced against the left side of the link when at rest, in the seat, by means of a spring 11 made to bear against its outer end, in which end are two notches to receive the ends of the pendant cam bars aforesaid.

In order to explain more clearly the arrangement of the parts, to operate the holding arm Z, I will here give their operation.

10 Simultaneously with the descent of the shear cutter L, to cut from the wire or rod a piece of the proper length to form the link the end of the spring bar X is depressed a distance equal to the thickness of the wire or rod (the latter remaining between the 15 shear cutter L, and end of the spring bar X) and with it the projecting arm Y, which relieves the pin 3 of said arm of the cam 7, and at the same time forces the short pendant arm 9 outward, and with it the outer end of the holding arm Z. The lower end of the pendant cam bar 4 will then be made to pass into the notch of the holding arm Z, and the latter, with the swage N, and sliding 20 die R, will at this moment commence descending and bend the piece of iron to a semi oval or U shape, its ends bent and lapped (by the lapping levers P P) and welded by the dies R R'. The latter then 25 recedes, and the swage is raised, and with the arm Z, the notched end whereof rises over the tapered end of the pendant cam bar 5, and the link moved from its seat and the succeeding pushed into its place. At 30 this moment the shear cutter L rises, and with it the end of the spring bar X, and its projecting arm Y, strikes the cam 7 on the pendant cam bar 4 and forces the latter frontward from the holding arm, and thus 40 unlocks said arm and allows its curved end to be forced inward by the spring 11 against the link and hold it in its seat until the completion of the succeeding.

45 The size of the swage or former, dies, &c., will be governed according to the size of the links to form the chains.

When it is desired to adapt the machine for making chain cables, with bars across the links, the swage or former is recessed 50 horizontally across its face to receive the bar, so that when the piece of iron to form the link is bent over the swage the ends of the cross bar (being concave) will fit the sides of the link, and thus they are united or 55 welded together.

Operation: The machine being put in motion by any adequate power, the wire or rod from which the links are to be formed, being heated to a red heat, is fed into the machine 60 in a slightly oblique direction through the cavity *d* in the fixed cutter K, and into the grooves *b b'* of the dies J J', through the cavity *k* of the arm or link seat O, and is gaged by the stop *e*. The shear cutter then 65 descends and cuts from the wire or rod a

piece, which is then bent to the semi-oval or U shape by the descent of the swage N, between the ends of the dies J J', the ends of the rod being slightly canted by the oblique position of the grooves *b b'* and shoulder *c* while being bent. Immediately after the descent of the swage the bending and lapping levers P, P, are made to approach each other and bend and lap the ends of the rod or wire over and upon the swage, during 70 which the grooves in the ends of the levers P, P, serve to hold the ends of the wire, and prevent them striking when passing to form the lap. After the link is formed the levers P, P, recede (the shear cutter L, and swage 75 remaining down) and the horizontal welding dies R R' made to advance and meet flush with the face of the swage N. The die R, in its advance pushes the link to the end of the swage, where its ends are forced 80 into the grooves 15 15 in the ends of the dies and welded. The dies then recede, and the finished link is dropped upon the curved end of the vibrating arm S', and simultaneously therewith the swage N, arm or link 85 seat O, are made to rise, and the slide bar V, moves forward and pushes the link, and the movement of said bar actuates the lever W, to turn the link. At this moment the suspending arm S' will be vibrated and its 90 curved end withdrawn from the swage and the link delivered into the seat of the arm O, and the shear cutter L allowed to rise. This completes the operation of making the link and seating the same, after which it is held 95 by the holding arm Z, as before described, until the succeeding link is formed and brought forward by the die R, to the end of the swage, and with it the finished link, from the seat, to be dropped when the link under 100 operation shall have been finished and dropped upon the suspending arm S' to be seated. The feeding of the rod or wire through the finished link takes place immediately after the shear cutter L, rises and 105 the finished link is seated. The shear cutter then descends and depresses the spring bar X, and vibrates or opens the holding arm Z, to allow the seated link to be removed for the succeeding link. The shear cutter then 110 rises and actuates the holding arm as before described. The operation of the several parts of the machine in this manner is continuous, the finished links dropping from the link seat as fast as succeeding links are 115 formed. 120

Having thus described the construction and operation of my machine for making chain, I wish it to be understood that I do not claim to be the original inventor of "the 125 combination of the parts, movements, and operations, in one machine, which are required to make jack chains, by one process, from straight wire, after it is cut off in suitable lengths to the finished chain." Nor do 130



I claim "the stud pin, with a recess in it, as a mandrel, around which the bow of a link is bent, while the bow of another link is held in the recess, thereby forming a continuous chain." Nor do I claim "a partly revolving mandrel with a stud pin, and nipper, and other appendages, for bending the last bow of each link, as combined, used, and constituting part of a machine" already patented. But

What I do claim as new and of my own invention, and desire to secure by Letters Patent, is—

1. The combination of the welding dies R R' with the swage N, for welding or uniting the lapped ends of the link, and dropping the latter upon the suspending arm S' the advance of the die R, moving the link to the face of the swage, where the operation of welding is performed.

2. Attaching the vibrating arm S' to the bed w<sup>2</sup> of the die R' and operating the same in such manner as to receive the finished link, and suspend the same in a position to be seated.

3. The combination of the slide bar V, turning lever W, and cross bar g<sup>2</sup> constructed and arranged as described and represented, the said bar V, and lever W, operating to turn, and push the finished link into its seat.

4. The link seat O, attached to the lever j beneath the swage N, for receiving the finished link, from the suspending arm S', and holding the same, until the wire or rod, for the succeeding link is fed into the finished link, cut off, bent, and ready to be welded.

5. The employment of the curved holding lever Z, attached to the lever j, in combination with the pendant cam bars 4 and 5, short pendant arm 9, arm Y, pin 3 and spring bar X, constructed, arranged, and operating as described, whereby the finished link is held in its seat and liberated therefrom, simultaneously with the advance of the die R, to finish the succeeding link.

6. The combination of the spring bar X, with the shear cutter L, whereby the pendant cam bars 4, and 5, are actuated through the pin 3 and springs 8, 8, to hold or relieve the arm Z, from the seated link, as described, and shown in the drawings.

7. Finally I claim making the grooves b b' in the bed dies J J' slightly oblique to their faces for the purpose of canting the ends of the rod or wire, so as to allow them to lap when bent by the levers P P as described.

In testimony whereof I have hereunto signed my name before two subscribing witnesses.

JOHN M. CRAWFORD.

Witnesses:

ROBT. GANE,  
EDMUND S. GARDE.