No. 647,762. Patented Apr. 17, 1900.

A. E. ROBERTS.

FENCE MAKING MACHINE.

(Application filed Nov. 17, 1899.)

(No Model.) 7 Sheets—Sheet 1.

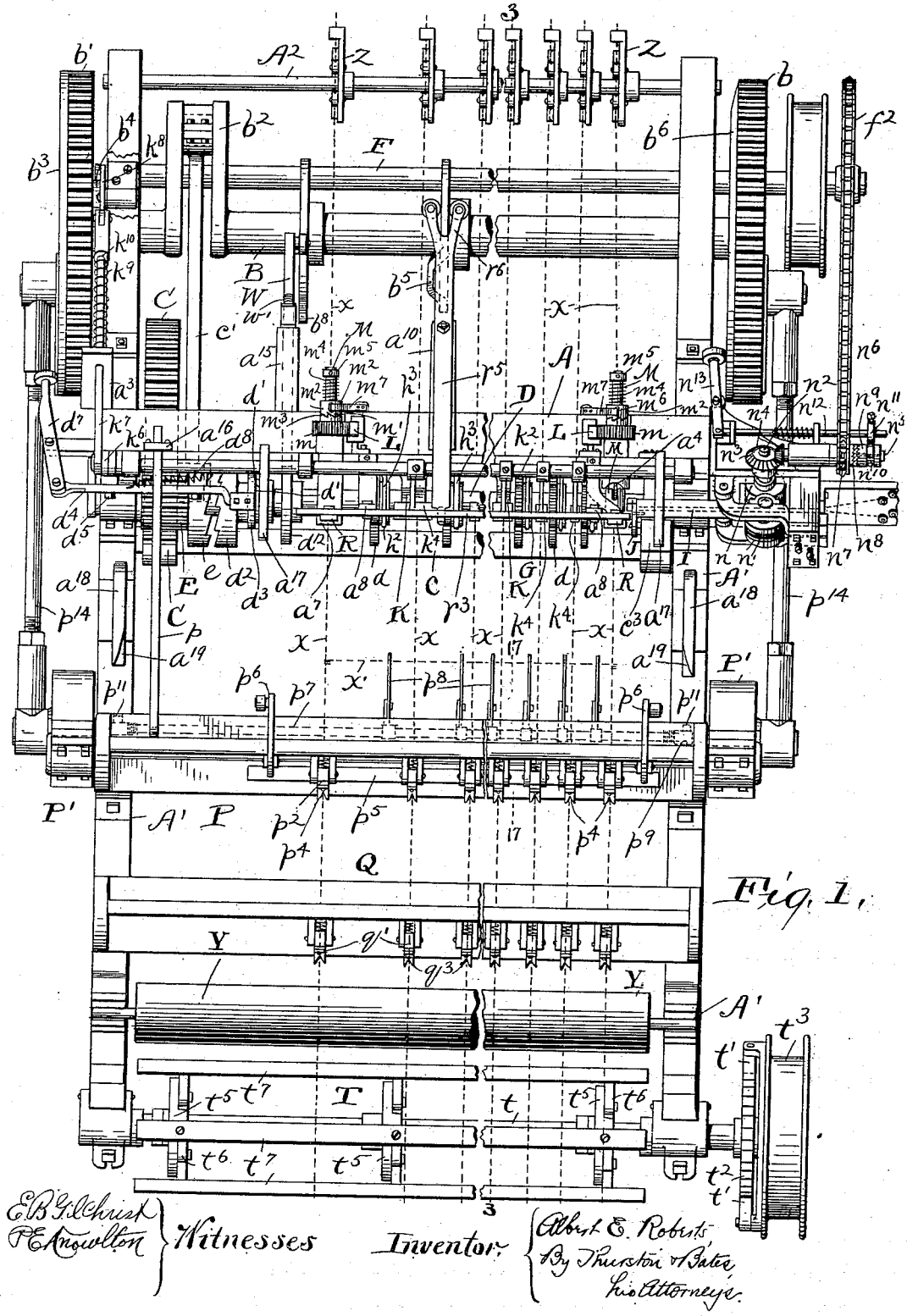

Fig. 1.

Witnesses
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P. E. Angwin

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No. 647,762. Patented Apr. 17, 1900.

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(No Model.) 7 Sheets—Sheet 2.

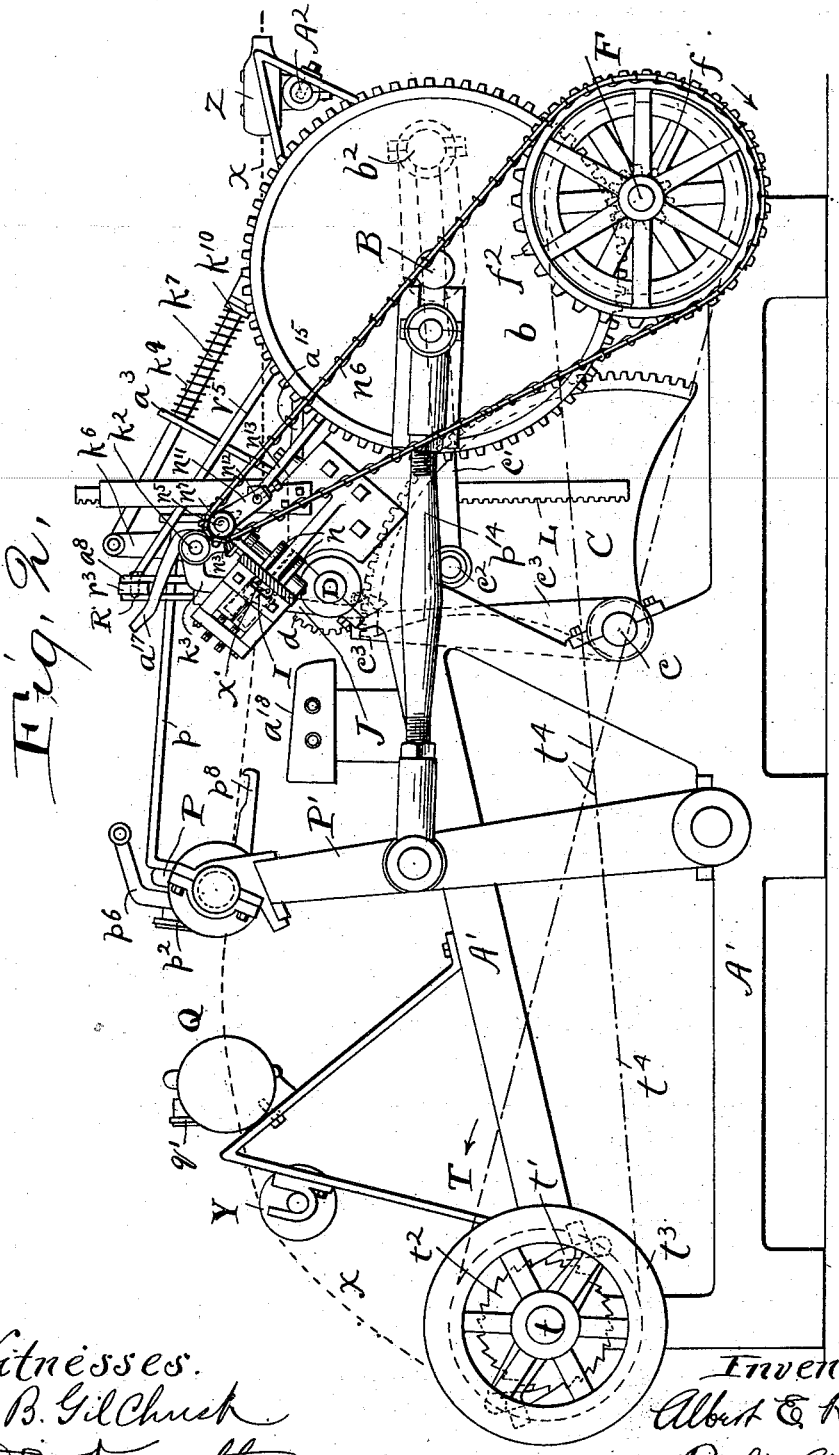

Fig. 2.

Witnesses.
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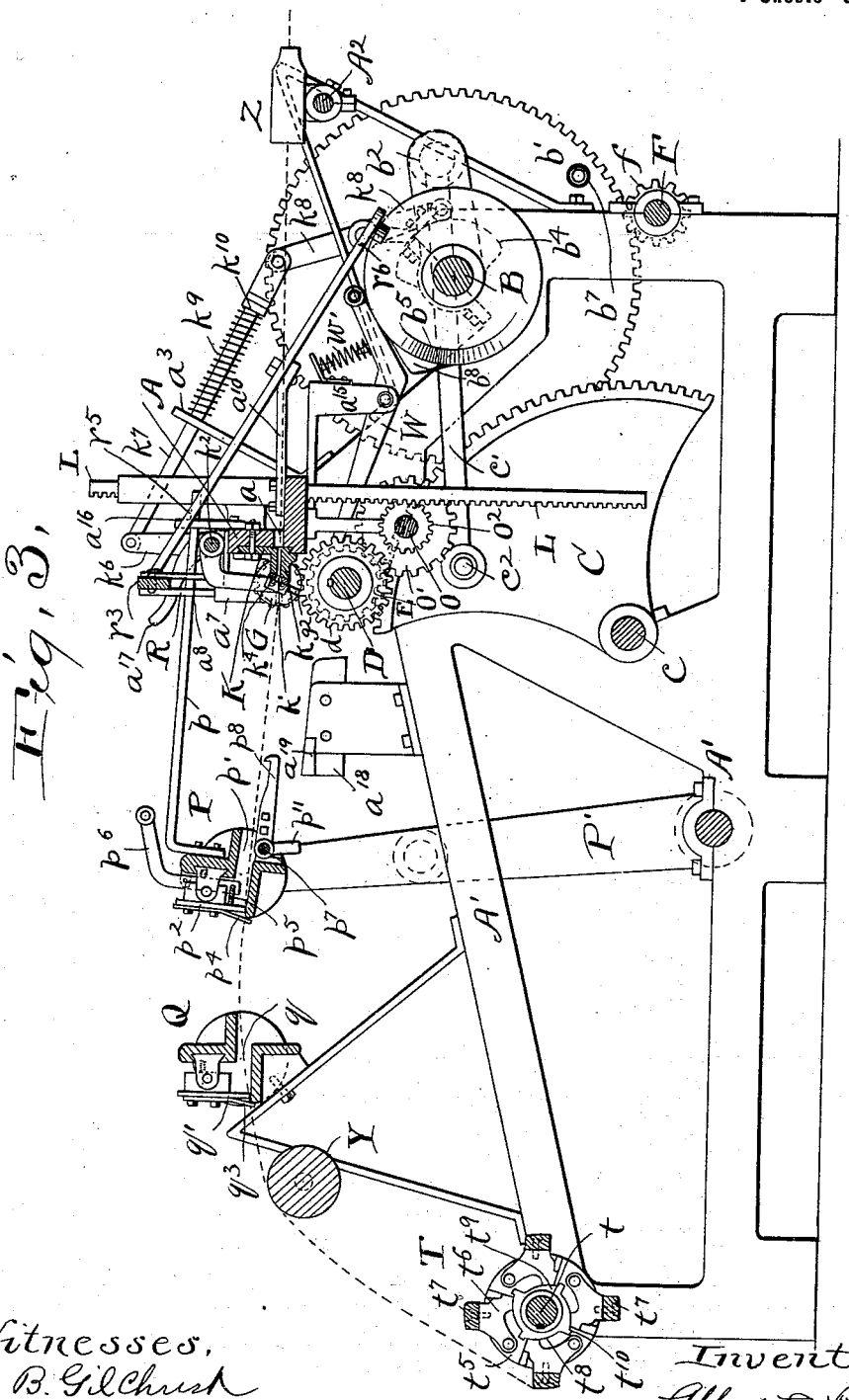
(No Model.) 7 Sheets—Sheet 3.

Fig. 3.



Witnesses,
E. B. Gilchrist
Philip E. Knowlton

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(No Model.) 7 Sheets—Sheet 4.

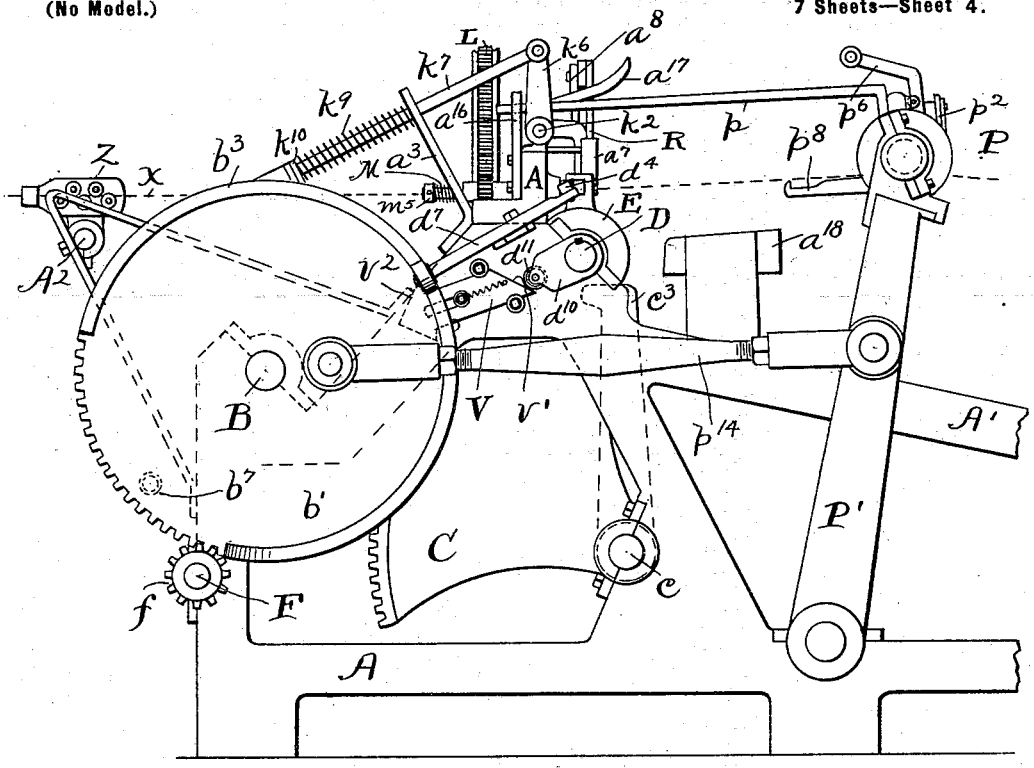

Fig. 4.

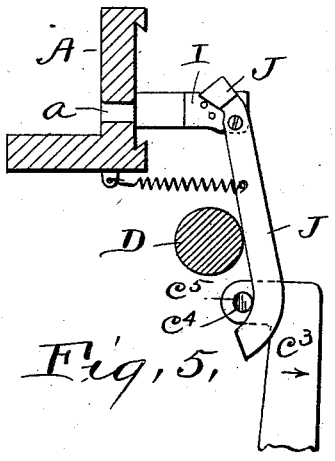

Fig. 5.

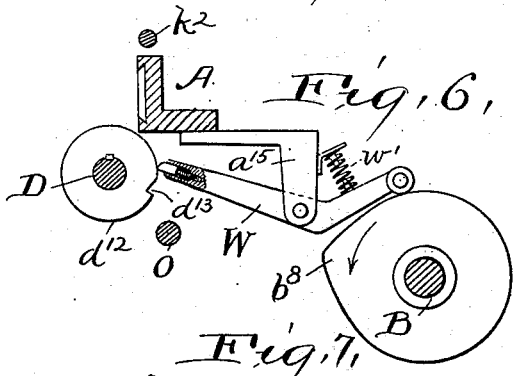

Fig. 6.

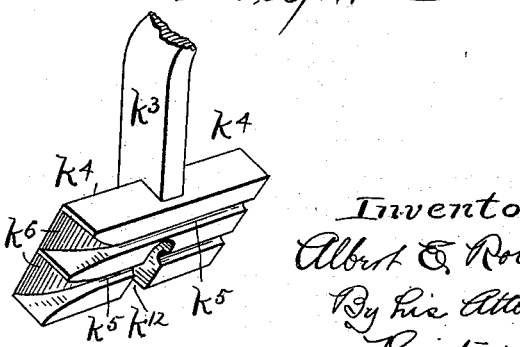

Fig. 7.

Witnesses.
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By his Attorneys,
Thurston & Bates.

No. 647,762.

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(No Model.)

(Application filed Nov. 17, 1899.)

7 Sheets—Sheet 5.

Fig. 8.

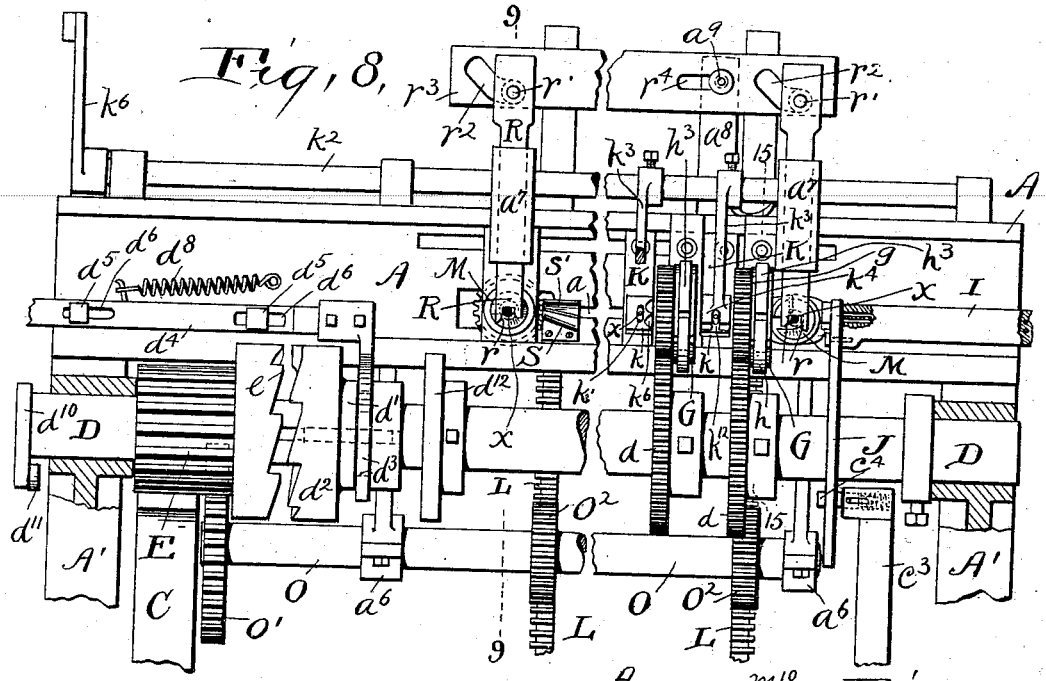


Fig. 9.

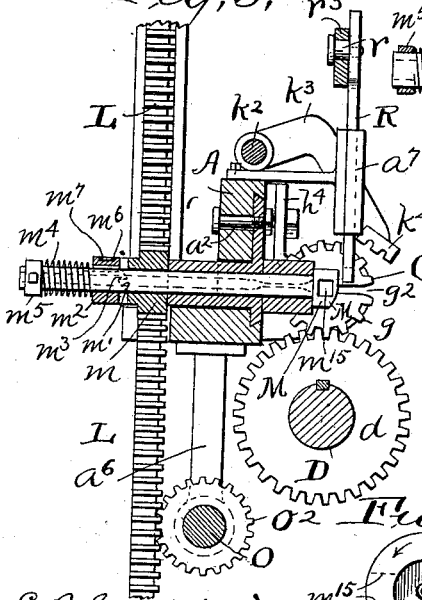


Fig. 12.

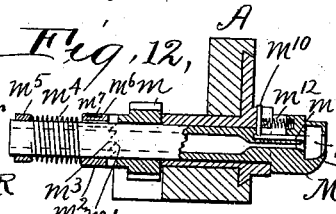


Fig. 13.

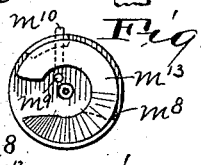


Fig. 15.

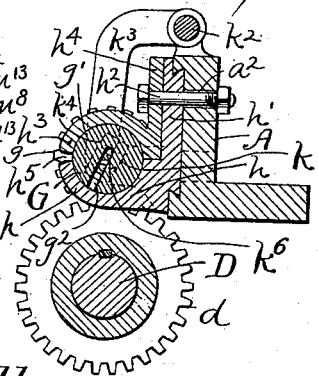


Fig. 14.

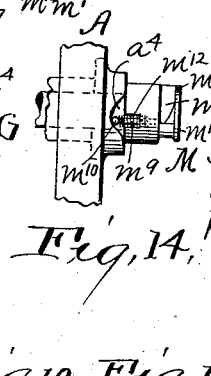


Fig. 10.

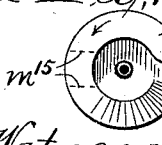
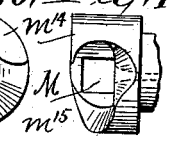


Fig. 11.



Witnesses

E. B. Gilchrist

F. E. Knowlton

Inventor:

Albert E. Roberts,

By his Attorneys,

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No. 647,762. Patented Apr. 17, 1900.

A. E. ROBERTS.

FENCE MAKING MACHINE.

(Application filed Nov. 17, 1899.)

(No Model.) 7 Sheets—Sheet 6.

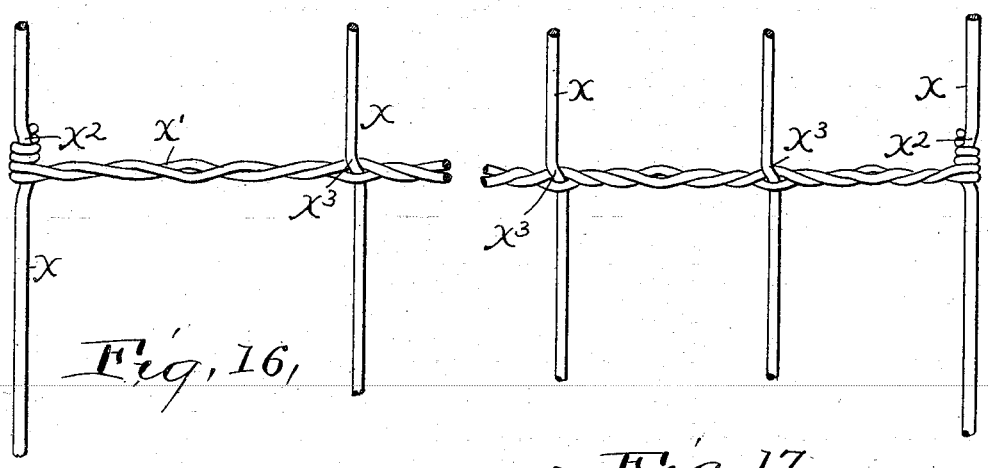


Fig. 16.

Fig. 17.

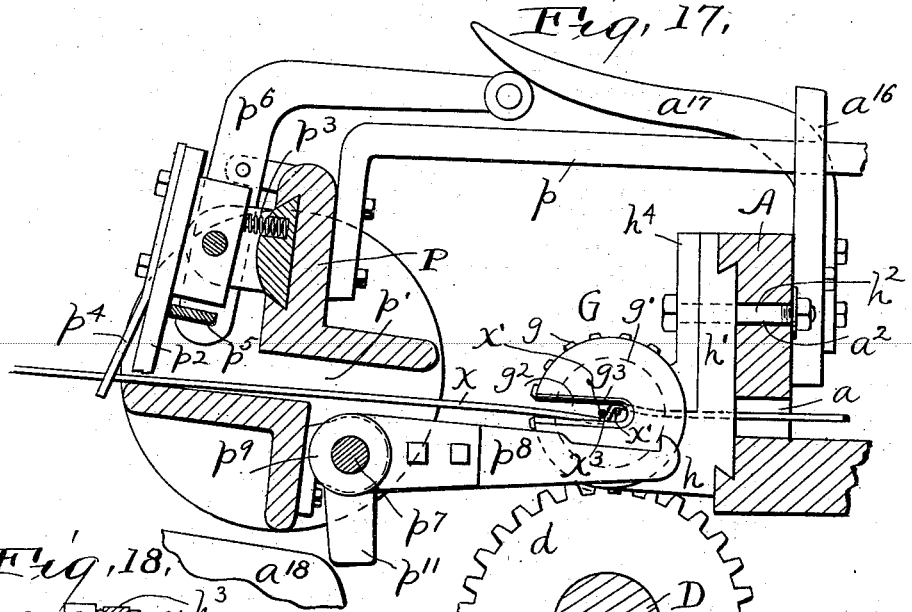


Fig. 18.

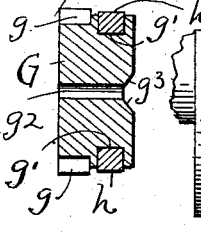


Fig. 19.

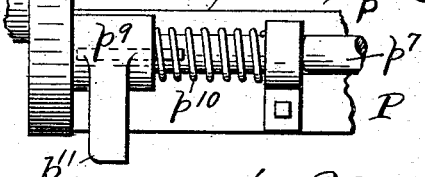
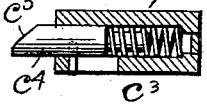


Fig. 20.



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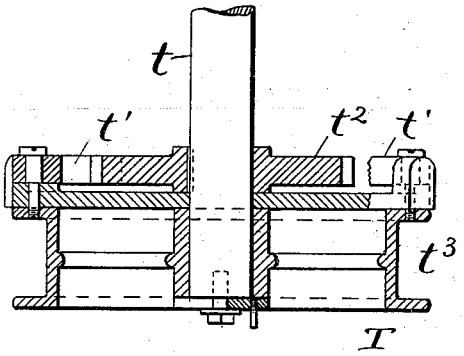
FENCE MAKING MACHINE.

(Application filed Nov. 17, 1899.)

(No Model.) 7 Sheets—Sheet 7.

Fig. 21.



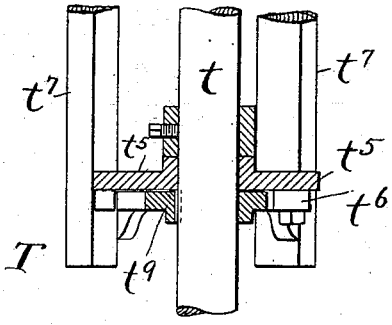


Fig. 23.

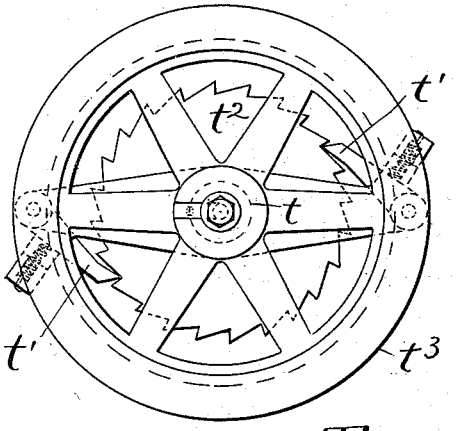


Fig. 22.

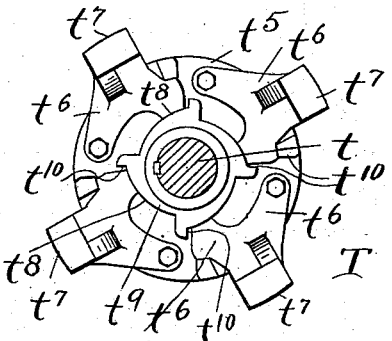


Fig. 24.

Fig. 27.

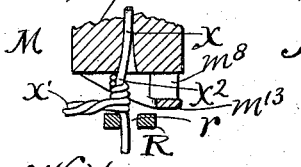
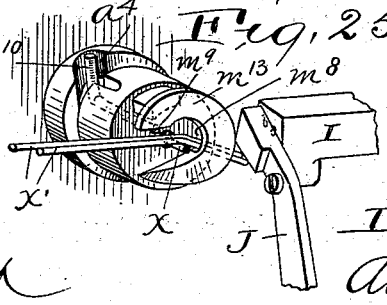


Fig. 25.



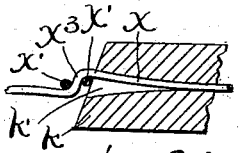


Fig. 26.

Witnesses
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R. E. Knowlton

Inventor:
Albert E. Roberts,
By his Attorneys,
Thurston & Bates

UNITED STATES PATENT OFFICE.

ALBERT E. ROBERTS, OF NORWALK, OHIO.

FENCE-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 647,762, dated April 17, 1900.

Application filed November 17, 1899. Serial No. 737,306. (No model.)

To all whom it may concern:

Be it known that I, ALBERT E. ROBERTS, a citizen of the United States, residing at Norwalk, in the county of Huron and State of Ohio, have invented a certain new and useful Improvement in Fence-Making Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of the invention is to provide an automatic machine for rapidly making indefinite lengths of wire fence substantially like that of which a section is shown in Figure 16. This fence consists of a plurality of horizontal running-wires and vertical stays secured thereto at suitable intervals, each stay consisting of two wires whose ends are wound about the top and bottom running-wires and which lie on opposite sides of the intermediate running-wires and are twisted together between the running-wires.

The invention consists in the novel combination of parts embodied in the machine as shown in the drawings and as hereinafter described, and pointed out definitely in the claims.

In the drawings, Fig. 1 is a plan view of a machine embodying my invention. Fig. 2 is a side elevation thereof. Fig. 3 is a sectional side elevation in the plane indicated by line 3 3 of Fig. 1. Fig. 4 is a side elevation of one end of the machine, this view showing the opposite side of the machine to that shown in Fig. 2. Fig. 5 is a detached view of the mechanism for cutting off the stay-wires. Fig. 6 is a detached view of the mechanism for moving the twister-shaft so that the twisters will be turned back into position to receive the stay-wires. Fig. 7 is an enlarged perspective view of one of the movable guide-plates and the arm to which it is attached. Fig. 8 is a rear view of the member A and parts supported thereon. Fig. 9 is a sectional view on the line 9 9 of Fig. 8. Fig. 10 is a rear end view of the winder shown in Fig. 9. Fig. 11 is a side elevation of the rear end thereof. Fig. 12 is a vertical sectional view of the winder on that side of the machine which is nearest the stay-wire-feeding mechanism. Fig. 13 is a rear end view of said winder. Fig. 14 is a plan view of the rear end thereof. Fig. 15 is a vertical sectional view in a plane passing through one of the twisters and its bearing. Fig. 16 is a slightly-perspective view of the fence which this machine is designed to make. Fig. 17 is a sectional side elevation of certain parts of the mechanism in the plane indicated by line 17 17 of Fig. 1. Fig. 18 is a vertical sectional view of one of the slotted twisters. Fig. 19 is a detached view of one end of the part of the mechanism for moving the hook-arms p^8. Fig. 20 is a sectional view of the spring-pin c^4 in the end of the arm c^3. Fig. 21 is a central sectional view of the mechanism at one end of the reel. Fig. 22 is an end view of the same mechanism. Fig. 23 is a sectional view of one end of the collapsible reel. Fig. 24 is an end view of one end of the collapsible reel. Fig. 25 is a perspective view of the rear end of the stay-wire winder on that side of the machine which is nearest the wire-feeding mechanism. Fig. 26 is a sectional side elevation of one of the fixed guide-plates k and of the fence-wires in the position they assume when the twisters stop their twisting movement, and Fig. 27 is a sectional plan of one of the end winders and the fence-wires when the stays have been formed and attached to the running-wires.

The various moving parts of the machine are supported on a frame, the essential parts of which are two side members A′ A′ and the transverse member A, which is secured to the tops of the side members. The running-wires X, of which there may be as many as desired, are threaded through the machine, passing through a horizontal slot a in the member A, through guide-holes k' in certain fixed plates k to be presently described, through a horizontal slot p' in the top member of the swinging frame, through fixed clamps which prevent any retrogression of the fence, over a guide-roller Y, and then to a reel T, upon which the finished fence is wound. The running-wires enter the machine through wire-straighteners Z of any suitable construction, which may be secured to a transverse bar A^2 at the front end of the machine. The stay-wires X′ X′ are automatically fed from one side of the machine across said running-wires and are cut off. Their ends are wound about the outside running-wires, and the two wires are twisted together between the running-

wires by rotating twisters G, so as to be firmly attached to the running-wires.

The driving-shaft F is mounted in the side members, and so also is the crank-shaft B, to which motion is transmitted from the driving-shaft by means of two gears $f f$, secured to the driving-shaft, and two gears b and b', secured to the ends of the crank-shaft. A gear-segment C is secured to a rock-shaft c, which is mounted in the side frame members parallel to the crank-shaft. A connecting-rod c' is employed to transmit motion from the crank b^2 of the crank-shaft to this gear-segment, the rear end of said connecting-rod being connected in the usual manner with the crank-pin c^2 on said segment. The rotation of the crank-shaft therefore causes reciprocating rocking movement of this gear-segment. The gear-segment engages with the pinion E, which is loosely mounted on a shaft D, which I call the "twister-shaft." A plurality of gears d are secured to this shaft. The function of these gears is to turn the wire-twisters G, and therefore I call these gears the "twister-gears." As the gear-segment C oscillates backward and forward it turns the pinion E first in one direction and then in the other. An automatic clutch is provided, by means of which this pinion may be connected and disconnected from the twister-shaft. One set of ratchet-teeth e, which form a part of this clutch, are on the end of the hub of this pinion E, the other set of ratchet-teeth d^2 being on the end of a sliding sleeve d', which is connected with the shaft by a tongue and groove, which permits the sleeve to slide upon the shaft, but compels both to rotate together. This sleeve has an annular groove in which the fork d^3 engages, this fork being fastened to a sliding bar d^4, which is supported on the member A by means of screw d^5, passing through slots d^6 in said bar. The outer end of this bar is connected with one end of a lever d^7, which is pivoted to the frame of the machine, and the other end of this lever engages with a cam b^3, formed on the side of the gear b'. A spring d^8 acts to move this bar in the direction which causes the disengagement of the ratchet-teeth on said sleeve and pinion, while the cam causes it to move in the opposite direction. It is evident, therefore, that during each revolution of the crank-shaft the pinion E will be for a time connected with the shaft D and for a time disconnected therefrom.

The stay-twisters G have a geared portion g, whereby they are revolved by means of the twister-gears d referred to. In the hub of each twister is a circumferential groove g', in which the bearing for said twister engages. Each of these bearings is formed of two members. One member has the box part h of the bearing and an upwardly-extended bracket-arm h', which is secured to the rear face of the member A by means of a bolt h^2. The other member of the bearing has a cap part h^3 and a bracket-arm h^4, which is secured to the frame member A and to the other part of the bearing by the same bolt h^2. The rear ends of these two parts of the bearings are separated, whereby there is formed what may be termed a "slot" h^5 in the bearings, through which the twisted stays may be withdrawn. The stay-twisters G have each a radial slot g^2, extending from the periphery inward a short distance past the axis, the width of this slot being a little greater than the diameter of one of the stay-wires employed. This slot extends from one end to the other of the twister, and that end of the slot into which the stay-wires are fed is beveled outward, as at g^3, (shown in Fig. 18,) to facilitate the entrance of said wires into said twister. Secured to the rear face of the member A are other brackets K, lying between the bracket-arms which carry the twister-bearings, and on the lower ends of these brackets are the fixed guide-plates k. These guide-plates are of such width that they approximately fill the space between adjacent twisters. These fixed guide-plates have each a hole k', through which a running-wire is fed, and these holes consequently serve as guides for the running wires. The rear faces of said plates incline downward and rearward, substantially as shown in Figs. 3 and 26. A rock-shaft k^2 is mounted upon the member A, and to this rock-shaft a plurality of arms k^3 are secured. To the lower ends of these arms are secured the movable guide-plates k^4. These movable plates have in their faces, which are adapted to contact with the rear faces of the fixed plates, two horizontal transverse grooves k^5. When the movable guide-plates are in contact with the fixed guide-plates, these grooves form holes through which the stay-wires are guided as they are fed across the machine and through the twisters. It will be noticed from Fig. 3 that when the plates k^4 are in contact with the plates k these guide-grooves lie one above and one below the running-wire guide-hole k' in the fixed guide-plate, wherefore said grooves will guide one stay-wire above and one below the running-wire. The lower edges of these movable guide-plates have each a notch k^{12}, which straddles the running-wire. The rock-shaft k^2 has near one end an upwardly-extended arm k^6. To this arm a link k^7 is pivoted, the front end of the link being pivoted to one end of the lever k^8, which is itself pivoted to the frame of the machine. The lower end of this lever is engaged by a cam b^4 on the crank-shaft. This cam acting upon the lever causes, through the intermediate mechanism, the movable guide-plates k^4 to be swung down against the fixed guide-plates k. A spring k^9, which surrounds said link and thrusts against a shoulder k^{10} thereon and against a bracket a^3, through which said link passes, acts to move said rock-shaft so as to lift the movable guide-plates into the position substantially as shown in Fig. 9.

The two outside running-wires—that is to say, the wires which will be the top and bot-

tom wires of the completed fence—pass axially through tubular stay-wire winders M, which pass through and are rotatably mounted in the member A. The function of these winders is to wind the ends of the stays upon the two outside running-wires. These winders are each rotated in one direction only by means of two vertically-movable racks L and the following mechanism, namely: a pinion m, loosely mounted on the rotatable winder and having ratchet-teeth m' on its front end, a sleeve m^2, having ratchet-teeth m^3 on its rear end for engaging with the ratchet-teeth on the pinion, which sleeve has a tongue-and-groove connection with the winder, and a spring m^4, surrounding the winder, which thrusts endwise against a collar m^5, secured thereto, and against this sleeve. This sleeve m^2 has a ratchet-notch m^6 on its outer periphery, which is engaged by the pawl m^7, pivoted to the member A. When, therefore, the racks move upward, each rotates the associated pinion and it, through the ratchet-clutch referred to, rotates the tubular winder. When the rack moves down, the sliding sleeve m^2 is prevented from rotating by the pawl referred to, and as the pinion rotates in the reverse direction the sleeve yields backward and permits this operation, the winder remaining stationary. Both of these end winders are alike in the particulars described, but that one which is nearest the stay-wire-feeding mechanism has certain peculiarities in the construction of that part which engages with the ends of the stay-wires. The stay-wires pass through a transverse hole m^8 in the rear end of this winder and both of the wires pass over the running-wire which is threaded through this winder. This is because the axis of this winder is a little below the axis of the other running-wires. In the winder is a longitudinally-movable pin m^9, which when the winder is at rest lies above the hole through which the running-wire passes. This pin has an upturned arm m^{10}, upon which a spring m^{12} operates to withdraw the pin into the winder, as shown in Fig. 12. The upper end of this arm is adapted to engage with a fixed cam-surface a^4, whereby as the winder is rotated the pin is pushed out over the stay-wires which have been fed through the winder. Just before this is done, however, a shearing-knife J cuts off the stay-wires. This knife is a pivoted lever, the shearing end of which moves downward across the end of a fixed guide-block I, having two holes through which the stay-wires are fed transversely through the winder and then across the machine. When this cut-off lever is operated, it draws the cut-off ends of the stay-wires downward, substantially as shown in Fig. 25, and holds them down until the winder has begun to rotate and the pin m^9 in consequence has been pushed outward over said stay-wires. The rotation of this winder brings this pin into contact with the tops of the stay-wires, whereby the ends thereof are wound around the running-wires. The outer rear end m^{13} of this winder is of spiral formation, wherefore as the winder revolves the lower end of the spiral is carried in front of the stay-wires, and as the winder continues to revolve this spiral pushes the stay backward on the running-wire, wherefore the ends are not wound upon each other, but are wound directly upon the running-wire. The friction induced by the pressure of the pin upon the ends of the stay-wires holds the pin out in operative position until the said ends of the stay-wires have been wound upon the running-wire, whereupon, the friction being removed, the pin is moved by its spring into the winder again when the cam-surface a^4 permits it to so move. The other winder has on its operative end a cam-faced flange m^{14}, through which a transverse hole m^{15} is formed. The ends of the stay-wires just before they reach this winder as they are being fed across the machine pass into a funnel-shaped groove s' in a block S, by means of which both wires are guided above the running-wire, passing transversely through this hole m^{15} in the winder-flange. When the winder rotates, the top of this hole engages with the projecting ends of the stay-wires, whereby they are wound about the running-wire. The cam-shaped face of the flange on the end of the winder engages with the stay-wires and pushes them rearward, whereby the stay-wires are wound smoothly upon the running-wire. The racks L which operate these winders are themselves caused to move up and down through their engagement with two pinions O^2, secured to a shaft O, which is mounted in bearings on the lower ends of brackets a^6, secured to the frame member A. A pinion O, is secured to this shaft, and this pinion engages with the pinion E, which, it will be remembered, is rotated first in one direction or the other by the gear-segment C.

The shearing-knife J for cutting off the stay-wires is caused to operate by the following mechanism: An arm c^3 is secured to the rock-shaft c, to which the gear-segment C is secured. In the upper end of this arm is a transverse spring-pin c^4, having a beveled inner face c^5, and this pin is adapted to engage with the lower end of the cut-off lever when this arm is swinging backward. When the arm c^3 swings forward, however, the beveled face of the spring-pin engages with the cut-off lever, whereby the spring-pin is forced back into the arm c^3, which is thereby permitted to pass said lever without moving it.

The winding of the stay-wires upon the outside running-wires exerts a force tending to draw said wires inward. To prevent them from so moving, two vertically-movable bars R are provided, which bars have forks r on their lower ends which are adapted to take over the two outside running-wires close to the winders, as shown in Fig. 8. These bars are movable vertically in suitable guides a^7, which are secured to the member A. Their

upper ends are provided with pins r', which enter inclined slots r^2 in a horizontal movable bar r^3, which bar is movably secured to two brackets a^8 by means of bolts a^9, secured to said brackets and passing through horizontal slots r^4 in the bar. This bar is moved transversely of the machine by means of a lever r^5, having its forward end projected into a hole in the bar. This lever is pivoted to a rearwardly-extended bracket a^{10}, secured to the member A, and the rear end of the lever has a fork r^6, which straddles a cam b^5 on the crank-shaft. For every revolution of the crank-shaft therefore this lever is moved back and forth once, whereby through the intermediate mechanism described these fork-bars R are moved down, so as to engage the outside running-wires, and this engagement is maintained during the winding and twisting operations and are then moved up, so as to permit the stay to be moved rearward a distance between two stays by the mechanism provided for that purpose.

The mechanism for feeding the stay-wires across the running-wires consists of two grooved rollers n n'. The roller n is fast to a shaft n^2, to which also a bevel-gear n^3 is made fast. This bevel-gear is in mesh with a bevel-gear n^4 on a shaft n^5, and this shaft is driven at the proper times by means of a sprocket-chain n^6, which engages with sprocket-wheels f^2 and n^7, secured, respectively, to the driving-shaft and to a sleeve n^8, which is rotatively mounted upon the shaft n^5. A ratchet-clutch is provided for automatically connecting and disconnecting this sleeve n^8 with the shaft n^5. One part of the ratchet-clutch is on this rotatable sleeve and the other part is on the sliding sleeve n^9, having a tongue-and-groove connection with the shaft. This sliding sleeve has an annular groove n^{10}, in which a fork n^{11} engages, this fork being made fast to a sliding bar n^{12}. The other end of this bar is pivotally connected with a lever n^{13}, which is in turn pivoted to the frame of the machine, and the other end of this lever engages with a cam b^6 on the inner face of the gear b. Thus for every revolution of the crank-shaft this ratchet-clutch will be moved to connect the wire-feeding mechanism to the driving-shaft, and this connection will then be broken when enough of the stay-wires have been fed across the machine.

The parts described operate in substantially the following sequence: After the movable guide-plates k^4 have been closed down against the fixed guide-plates the stay-wire-feeding mechanism is set into operation with the result that the stay-wires are fed across the running-wires. It will be remembered that the first winder is placed so that the running-wire which passes through it is slightly below the other running-wires, wherefore both stay-wires pass over this running-wire. The stay-wires then enter the guide-grooves between the fixed and movable guide-plates k k^4. These guide-grooves have flaring bell-shaped mouths k^6, so that the ends of the wires may readily enter them. These wires are then guided in these grooves into the twister-slots, so that one wire passes over and another wire passes under all of the running-wires until the other outside running-wire is reached. The stay-wires are then guided upward by the funnel-shaped hole s' in the block S, so that both stay-wires pass over this outside running-wire. The revolution of the stay-wire-feeding mechanism is thereupon automatically suspended. The forked bars R have in the meantime descended so as to embrace the two outside running-wires. The upward movement of the racks L then begins, with the result that the winding of the ends of the stay-wires upon the outside running-wires is begun. When these winders have revolved once, more or less, the pinion E is connected with the twister-shaft D by the operation of the ratchet-clutch referred to, and thereupon the revolution of the twisters begins. These twisters, it will be noticed, are placed substantially midway between the adjacent running-wires, and they twist together the two stay-wires. In the machine as organized these twisters are intended to make two complete revolutions, and they come to rest when the twister-shaft is disconnected from the pinion E in substantially the position shown in Fig. 15, which is the position from which they started. In this position, however, it is clear that the stays cannot be withdrawn through the slots h^5 in the twister-bearings. On the other hand, if the stay-wire twisters were to cease revolving when the slot is in a horizontal position, as shown in Fig. 9, the stays could not be easily removed, because the stays tend to untwist, and therefore they would bind in the twister-slots. In order, therefore, that the stays may be removed, these twisters are brought to rest in the position shown in Fig. 15, and are then turned backward until their slot is in line with the slot in the bearings, as shown in Fig. 17, and they are so moved by mechanism to be presently explained. This backward movement of the twisters allows the twisted stays to untwist as much as they tend to untwist. They therefore lie in the twister-slots without binding therein when said slots are in a horizontal position, and when in this position the finished fence is drawn rearward and the stays are drawn out of the embrace of the twisters. It should be here said that at this time the fork-bars R, which engage with the end wires, have been lifted. The mechanism by which these twisters are turned so as to bring the slots into horizontal position to relieve the tension upon the twisted stays is as follows: The twister-shaft is provided with a crank-arm d^{10}, having a friction-roller d^{11}. (See Fig. 4.) A sliding bar V, having an inclined rear end v', is mounted on the side of one of the frame members A', and this rear end is adapted to be moved against this

friction-roller. A friction-roller b^7 on the inner face of the gear b' is adapted to engage with the beveled front end v^2 of this sliding bar to so move it, and does engage with it immediately the clutch is moved to disconnect the gear D and twister-shaft E. The movement of this sliding bar and its engagement with the said friction-roller d^{11} causes the twister-shaft to be turned backward far enough to turn the twisters so that their slots are in horizontal position and in communication with the slots in their bearings. When they are in this position, the finished fence is drawn rearward by the swinging frame, to be described, the movable guide-plates k^4 having in the meantime been rocked upward by the instrumentalities heretofore described for that purpose. Now before the stay-wires are again fed into the machine these twisters must be returned to the position from which they have just been moved—namely, to the position where their slots are inclined and in line with the guide-grooves in the guide-plates $k\,k^4$—and this is effected by means of a lever W, which is pivoted to the bracket a^{15}, whose rear end is adapted to engage in a notch d^{13} in a disk d^{12}, attached to the twister-shaft. The front end of this lever is engaged by a cam b^8 on the crank-shaft, which by its engagement rocks the lever, and the lever by engaging in this notch turns the twister-shaft forward sufficiently to cause the twisters to resume the desired position—namely, that in which their slot is inclined—as shown in Fig. 15. A spring w' acts upon this lever to move it in opposition to the cam.

Attention is here called to two peculiarities in the finished fence made in the machine, reference being first made to the form of the two outside running-wires. As the stay-wires are twisted together the stays are more or less shortened. This twisting does not begin, however, until the wires are wrapped at least once around the end wires. Therefore this twisting of the stay-wires tends to draw the outside running-wires inward. This tendency is resisted by the fork-bars R and by the winders through which the wires are threaded, and the result is that these two outside wires are bent inward just a little, as shown in Figs. 16 and 27, this bend being between the winder and the forked bar R in that part of the running-wire upon which the stay-wires are twisted. This bend or kink x^2 in these two outside wires tends to prevent the stays from being moved along the same and also permits the contraction and expansion of these running-wires without injury to the fence. The intermediate running-wires are also kinked or bent. The bend, however, is in what will be when the fence is erected a horizontal plane, and this kink is due to the stress of the two stay-wires—that is to say, the stay-wire which is on top of the running-wire bends the running-wire downward, and the stay-wire which is on the bottom of the running-wire bends it upward, the rear end of the longitudinal hole k in the guide-plate K being enlarged above the wire to permit such bending, the result being the slight kink shown at x^3 in Figs. 16 and 26. These bent parts of the intermediate running-wires are embraced by the stays, which are thereby prevented from moving along said wires, and they also permit the expansion and contraction of said running-wires.

I will now describe the manner in which the fence is moved through the machine periodically a distance equal to the desired distance between the stays.

A swinging frame having two side arms P' P' and a transverse top member P is pivoted to the side members A' A' by pivots, which pass through the lower ends of said side arms P'. This top member is pivoted on a horizontal pivot to the side arms; but it has only a limited movement because of an arm p, which is bolted thereto and passes loosely through a hole in an upwardly-extended bracket a^{16}, secured to the transverse member A. This top member of the swinging frame has a transverse slot p' through it, through which all of the running-wires pass and through which the stay-wires may also pass after they have been secured to the running-wire. A plurality of clamps p^2 are pivoted on horizontal pivots to the top member of this swinging frame above the slot p' therein and are so placed that the lower ends of these clamps may engage with the running-wires. These clamps are of such length that they will bite upon the running-wires and hold them down firmly against the part of the top member below the slot therein. Springs p^3 are provided for inducing this clamping action, and forked arms p^4 are also secured to the clamps for embracing the running-wires to hold them in proper relation to the clamps. A bar p^5 lies just in front of all of these clamps, and this bar is secured at its ends to two bell-crank levers p^6, which are pivoted to the top member. The upper arms of these bell-crank levers are adapted to engage with the curved arms a^{17}, secured to the member A, when this swinging frame is moved forward, the result being that these bell-crank levers are rocked upon their pivots and the bar p^5, engaging with all of the clamps, swings them up out of engagement with the running-wires. These clamps are held up out of engagement with the running-wires until the swinging frame has moved rearward a short distance. A transverse rock-shaft p^7 is also pivoted to the top member of this swinging frame, and to it are secured a plurality of forwardly-extending arms p^8, having hooks on their forward ends. Normally these arms fall by gravity to a position where they may pass under the stays, and they do pass under them when the swinging frame is moving forward. On this rock-shaft at each end, a sliding sleeve p^9 is mounted, which is connected therewith with a tongue and groove, and a spring p^{10} is provided for moving this sleeve as far as it can be moved in

one direction. An inclined plate a^{18} is secured to each of the side frame members A, and this plate has an inner beveled face a^{19}. This plate is placed in such position that when the swinging frame moves forward an arm p^{11}, which is fast to said sleeve p^9, engages with this beveled face a^{19} and is moved inward against its spring without producing any effect upon the position of the rock-shaft. When the frame has completed its forward movement, this arm has moved past this plate a^{18}. Then the spring moves the sleeve outward. When, therefore, the swinging frame begins its rearward movement, this arm p^{11} engages this plate, the result being that the rock-shaft is rocked slightly, but enough to swing the hooks up behind the twisted stays. When this swinging frame moves rearward, therefore, two instrumentalities act together to draw the fence with it—namely, the hook-arms p^8, which engage with the stays, and the clamps, which engage with the running-wires and clamp them down upon the top member of the swinging frame. The finished fence is therefore drawn rearward the desired distance between two stays. This frame is caused to rock backward and forward by means of connecting-rods p^{14}, which connect the side arms P′ with crank-pins which project outward from the gears b and b'. The finished fence passes through a slot q in a fixed transverse bar Q. A plurality of clamp-fingers q' are pivoted to this bar above the slot q in position to engage with the running-wires and to clamp them onto the part of the bar below the slot. These clamps are moved in the clamping direction by springs. Fork-arms q^3 are fastened to the clamps and straddle the running-wires. These clamps and associated parts are like those carried by the swinging frame, and they operate automatically to prevent any retrogression of the fence, but permit it to be moved toward the delivery end of the machine. The finished fence after passing through these clamps passes over a guide-roller Y and thence to a collapsible reel, upon which it is wound. The reel T is on a transverse shaft t, which is removably mounted in bearings at the delivery end of the machine. The pulley t^3 is loosely mounted on this shaft, and it carries two spring-pawls t', which engage with a rachet t^2, secured to the shaft. This ratchet-and-pawl connection between the reel-shaft and pulley makes it possible to turn the fence-making mechanism backward without turning the reel-shaft backward. A belt t^4 passes around the pulley t^3 and around a pulley on the driving-shaft. Through this pulley and the other mechanism described the reel-shaft is turned, so as to wind up as much of the fence as is drawn along by the swinging frame D. At other times the belt slips on this pulley, and applied thereto is such force tending to turn it that the fence is held taut and prevented from being drawn backward by any of the mechanisms which operate to make the fence.

The reel, as shown, is a collapsible reel. It consists of three disks t^5, loosely mounted on the shaft t, each of which has a plurality of bell-crank levers t^6 pivoted to it, and the bars t^7, which are parallel to the shaft and are secured to the outer arms of these levers. The inner arm of these levers engages with cam-surfaces t^8 on a disk t^9, which is keyed to the shaft. When the shaft is turned in the direction to wind up the reel, the cam-surfaces referred to push the levers out, and thereby expand the reel until shoulders t^{10} at the ends of the cam-surfaces engage with the levers, whereby the reel is caused to revolve with the shaft; but when the shaft is turned relatively backward these levers move inward and draw the bars inward, thereby contracting the reel, whereby the bale of fence may be removed from it.

Having described my invention, I claim—

1. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, intermediate slotted bearings, rotatable slotted twisters mounted therein, mechanism for simultaneously rotating all of said twisters, and mechanism for feeding two stay-wires into the slots in the twisters, one wire above and one below the intermediate running-wires, substantially as specified.

2. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, intermediate slotted bearings, rotatable slotted twisters mounted therein, mechanism for simultaneously rotating all of said twisters, and mechanism for feeding two stay-wires across the machine and into the slots in the twisters, one wire above and one below the intermediate running-wires, mechanism for cutting off the stay-wires, substantially as specified.

3. In a fence-making machine through which a plurality of running-wires may be threaded, rotary twisters and their slotted bearings located between the running-wires, and winders rotatable about the two outside running-wires, combined with mechanism for feeding two stay-wires into said twisters on opposite sides of the intermediate running-wires, and into the embrace of said winders, and mechanism for rotating said twisters and winders, substantially as specified.

4. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, intermediate slotted bearings, rotatable slotted twisters mounted therein, mechanism for simultaneously rotating all of said twisters, and mechanism for feeding two stay-wires across the machine and into the slots in the twisters, one wire above and one below the intermediate running-wires, and mechanism for cutting off the stay-wires, and mechanism for winding the ends of the stays upon the two outside running-wires, substantially as specified.

5. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, intermediate slotted bearings,

slotted twisters mounted in said bearings, mechanism for feeding two stay-wires transversely of the machine, guides which guide said stay-wires into the slots in the twisters and onto the same side of each of the two outside running-wires, and onto opposite sides of the intermediate running-wires, wire-cut-off mechanism for cutting off the stay-wires, and winders for winding the ends of the stay-wires about the outside running-wires, substantially as specified.

6. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, a plurality of intermediate rotatable slotted twisters, slotted bearings for said twisters, fixed and movable guide-plates between said twisters having in their engaging faces transverse grooves for the stay-wires, one above and one below the running-wire, with mechanism for feeding the stay-wires across said running-wires and through said guide-grooves and twisters, and means for winding the ends of the stay-wires around the outside running-wires, substantially as specified.

7. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, a plurality of intermediate rotatable slotted twisters, slotted bearings for said twisters, fixed and movable guide-plates between said twisters having in their engaging faces transverse grooves for the stay-wires; one above and one below the running-wire guides, with mechanism for feeding the wire across said running-wires and through said guide-grooves and twisters, guides which guide both stay-wires to the same side of each of the outside running-wires, and means for winding the ends of the stay-wires around the outside running-wires, substantially as specified.

8. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, a plurality of intermediate rotatable slotted twisters, slotted bearings for said twisters, fixed and movable guide-plates between said twisters having in their engaging faces transverse grooves for the stay-wires, one above and one below the running-wire guides, with mechanism for feeding the wires across said running-wires and through said guide-grooves and twisters, means for periodically connecting and disconnecting said stay-wire-feeding mechanism with the operating power, substantially as specified.

9. In a fence-making machine, the combination of a plurality of longitudinal running-wire guides, a plurality of intermediate rotatable slotted twisters, slotted bearings for said twisters, fixed and movable guide-plates between said twisters having in their engaging faces transverse grooves for the stay-wires, one above and one below the running-wire guides, with mechanism for feeding the wire across said running-wires and through said guide-grooves and twisters, with longitudinal tubular stay-wire winders, guides to guide both stay-wires into the embrace of said winders and onto the same side of each of said outside running-wires, and means for periodically rotating said winders whereby to wind the ends of the stay-wires about the running-wires, substantially as specified.

10. In a fence-making machine, the combination of a plurality of slotted bearings, slotted stay-wire twisters mounted therein, longitudinal guides for running-wires between said twisters, mechanism for periodically rotating said twisters, and bringing them to rest with their slots out of line with the slots in the bearings, mechanism for turning said twisters backward to bring said slots into line and to relieve the tension on the twisted stay-wires whereby said twisted stay-wires may be removed, substantially as specified.

11. In a fence-making machine, the combination of a plurality of slotted bearings, slotted stay-wire twisters mounted therein, longitudinal guides for running-wires between said twisters, mechanism for periodically rotating said twisters and bringing them to rest with their slots out of line with the slots in the bearings, mechanism for turning said twisters backward to bring said slots into line and to relieve the tension on the twisted stay-wires whereby said twisted stay-wires may be removed, and mechanism for turning said twisters forward to carry their slots out of line with the slots in their bearings, substantially as specified.

12. In a fence-making machine, the combination of a plurality of slotted stay-wire twisters each having a geared part and a cylindrical part, slotted bearings in which the cylindrical parts are mounted, a rotatable shaft, gears secured thereto meshing with the geared part of the twisters, and an automatic clutch for periodically connecting and disconnecting said shaft with a rotating part of the machine, substantially as specified.

13. In a fence-making machine, the combination of a plurality of slotted stay-wire twisters each having a geared part and a cylindrical part, slotted bearings in which the cylindrical parts are mounted, a rotatable shaft, gears secured thereto meshing with the geared part of the twisters, and an automatic clutch for periodically connecting and disconnecting said shaft with a rotating part of the machine, mechanism which operates after the shaft is disconnected for turning said shaft a short distance backward after the stays have been twisted whereby the slots in the twisters are brought into line with the slots in the bearings, substantially as specified.

14. In a fence-making machine, the combination of a plurality of slotted stay-wire twisters each having a geared part and a cylindrical part, slotted bearings in which the cylindrical parts are mounted, a rotatable shaft, gears secured thereto meshing with the geared part of the twisters, and an automatic clutch for periodically connecting and dis-

connecting said shaft with a rotating part of the machine, means for turning said shaft a short distance backward after the stays have been twisted whereby the slots in the twisters are brought into line with the slots in the bearings, and mechanism for again turning said shaft forward a short distance before said clutch operates to connect the shaft with said rotating part of the machine, and fixed and movable guide-plates intermediate of said twisters, having transverse grooves in their proximate faces adapted to guide the stay-wires into the slots in the twisters when said slots are in the position into which they will be moved by the forward movement of said shaft, substantially as specified.

15. In a fence-making machine, the combination of guides for running-wires, stay-wire guides having grooves respectively above and below the running-wire guides, stay-wire-feeding mechanism, and means for moving said stay-wire guides out of and into operative position, with stay-wire-twisting mechanism located between said running-wire guides, substantially as specified.

16. In a fence-making machine, the combination of the running-wire guides, intermediate slotted stay-wire twisters, slotted bearings therefor, and fixed stay-wire guide-plates intermediate of said twisters, with the rock-shaft, stay-wire guide-plates connected with said rock-shaft, which guide-plates have in the face which contacts with the fixed plates, two horizontal guide-grooves located respectively above and below the running-wire guides, mechanism for operating said rock-shaft, and stay-wire-feeding mechanism, substantially as specified.

17. In a fence-making machine, the combination of two tubular stay-wire winders through which the outside running-wires are threaded, a plurality of intermediate fixed guide-plates having longitudinal holes through which the intermediate running-wires are threaded, movable plates adapted to move into and out of contact with said fixed plates and having in their engaging faces horizontal transverse grooves which when the fixed and movable parts are in contact are located one above and one below the holes in the fixed plates through which the running-wires are threaded, slotted stay-wire twisters intermediate of said parts of guide-plates, slotted bearings in which they are mounted, mechanism for periodically feeding two stay-wires across the running-wires in said guide-grooves and through the slotted twisters, a device for cutting off the stay-wires, two movable forked bars adapted to be moved into engagement with the two outside running-wires, mechanism for rotating the stay-wire winders, and mechanism which does not begin to operate until after said winders have begun their rotation for simultaneously rotating all of the stay-wire twisters, and mechanism for periodically moving the movable guide-plates toward and from the fixed guide-plates, substantially as specified.

18. In a fence-making machine, the combination of slotted stay-wire twisters, each having a geared part and a part in which a cylindrical annular groove is formed, with slotted bearings which embrace the grooved cylindrical part of the twisters, substantially as specified.

19. In a fence-making machine, the combination of slotted stay-wire twisters having each a geared part and a cylindrical part, with bearings in which said cylindrical parts are mounted, each bearing consisting of two parts, viz., one having a box part and a bracket-arm whereby it can be connected with a suitable support and the other having the cap part of the bearing and a bracket-arm adapted to be connected to the bracket-arm of the other part, the outer edges of the box and cap parts of the bearing being separate so as to form a slot in said bearing, substantially as specified.

20. In a fence-making machine, the combination of a rotatable tubular stay-wire winder having a transverse hole through which the stay-wires pass and having a cam-shaped end, and means for rotating said winder, substantially as specified.

21. In a fence-making machine, the combination of a rotatable tubular stay-wire winder having a transverse hole in one end, a rotatable gear mounted upon said tubular winder, a sliding sleeve upon said winder, and connected thereto by a tongue and groove, said gear and sleeve having interlocking ratchet-teeth, a reciprocating rack-bar engaging with said gear, and a pawl for engaging with a ratchet-tooth on the periphery of said sleeve, and a spring for moving said sleeve toward said gear, substantially as specified.

22. In a fence-making machine, the combination of a rotatable tubular stay-winder through which a running-wire may pass, having a transverse hole through which the stay-wires may pass, a gear loosely mounted on said winder, a movable rack-bar for turning said gear, and an automatic clutch for connecting said winder and gear, substantially as specified.

23. In a fence-making machine, having guides for the running-wires, and means for connecting stay-wires thereto, with a reciprocating swinging frame, and a plurality of automatic clamps carried by said frame and adapted to engage with the running-wires to draw them simultaneously through the machine, substantially as specified.

24. In a fence-making machine adapted to wind the ends of two stay-wires upon the two outside running-wires and of twisting the two stay-wires together, between the running-wires, mechanism for bending inward those parts of the two outside running-wires, upon which the stay-wires are wound, combined with mechanism for bending the parts of the

intermediate running-wires with which the stay-wires engage, substantially as specified.

25. In a fence-making machine, the combination of mechanism for winding the ends of two stay-wires upon the outside running-wires, and means engaging with said outside running-wires on opposite sides of said stay-wires, and mechanism for twisting together two stay-wires which lie on opposite sides of the intermediate running-wires, whereby the parts of the outside running-wires with which the stay-wires engage are bent inward, and the parts of the intermediate running-wires with which the stay-wires engage are bent vertically out of line, substantially as specified.

26. In a fence-making machine, the combination of two rotary winders which embrace the two outside running-wires, and are adapted to wind the ends of stay-wires thereon, two fork-bars for engaging with said running-wires close to said winders, guides for the intermediate running-wires, and twisters for twisting together between the running-wires, two stay-wires which lie on opposite sides of the intermediate running-wires, whereby the twisting of said stays bends the two outside wires inward and bends the intermediate running-wires out of the plane of said wires, substantially as specified.

27. In a fence-making machine, the combination of guides for running-wires, intermediate twisters, slotted brackets in which said twisters are mounted, mechanism for operating the twisters, with a series of hooks movable forward and backward and adapted to engage with the twisted stays and draw them out of the twisters and toward the delivery end of the machine, substantially as specified.

28. In a fence-making machine, the combination of guides for running-wires, intermediate slotted twisters, slotted brackets in which said twisters are mounted, mechanism for feeding two stay-wires respectively over and under said running-wires, mechanism for operating the twisters, with a swinging frame, hooks carried thereby, and adapted to engage with the twisted stay-wires, and mechanism for operating said swinging frame, substantially as specified.

29. In a fence-making machine, the combination of a swinging frame consisting of two pivoted reciprocating side members and top member pivotally connected therewith, and means for limiting the movement of said member upon its pivot, with a series of hook-arms, a rock-shaft mounted on the frame, a series of hooks which are secured to said rock-shaft, and means for periodically operating said rock-shaft, substantially as specified.

30. In a fence-making machine, a reciprocating frame, a plurality of pivoted automatic clamps carried thereby for engagement with the running-wires, a bar which engages with all of said clamps, pivoted arms to which said bar is secured, and a cam which engages with one of said arms, whereby all of said clamps are lifted off the running-wires, substantially as specified.

31. In a fence-making machine, the combination of a rotatable tubular stay-wire winder through which a running-wire is adapted to extend longitudinally, said winder having in one end a transverse hole for the passage of the stay-wires, a longitudinally-movable pin in said winder, and means for moving it out over the ends of the stay-wires, substantially as specified.

32. In a fence-making machine, the combination of a rotatable tubular stay-wire winder through which a running-wire is adapted to extend longitudinally, said winder having in one end a transverse hole for the passage of the stay-wires, a longitudinally-movable pin in said winder, having an upturned arm, a fixed cam-surface for engaging with said arm whereby it is moved outward over the ends of the stay-wires, and a spring for moving it in the opposite direction, substantially as specified.

33. In a fence-making machine, a stay-wire twister having a cylindrical part whereby it may be revolved, a geared part by which it may be revolved, and a radial slot which extends from the periphery inward past the center and from one end to the other of said twister, said slot having at one end of the twister outwardly-beveled edges, substantially as specified.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

ALBERT E. ROBERTS.

Witnesses:
E. L. THURSTON,
PHILIP E. KNOWLTON.