No. 633,213. Patented Sept. 19, 1899.

J. C. PERRY.

WIRE FENCE MAKING MACHINE.

(Application filed Jan. 21, 1899.)

(No Model.) 9 Sheets—Sheet 1.

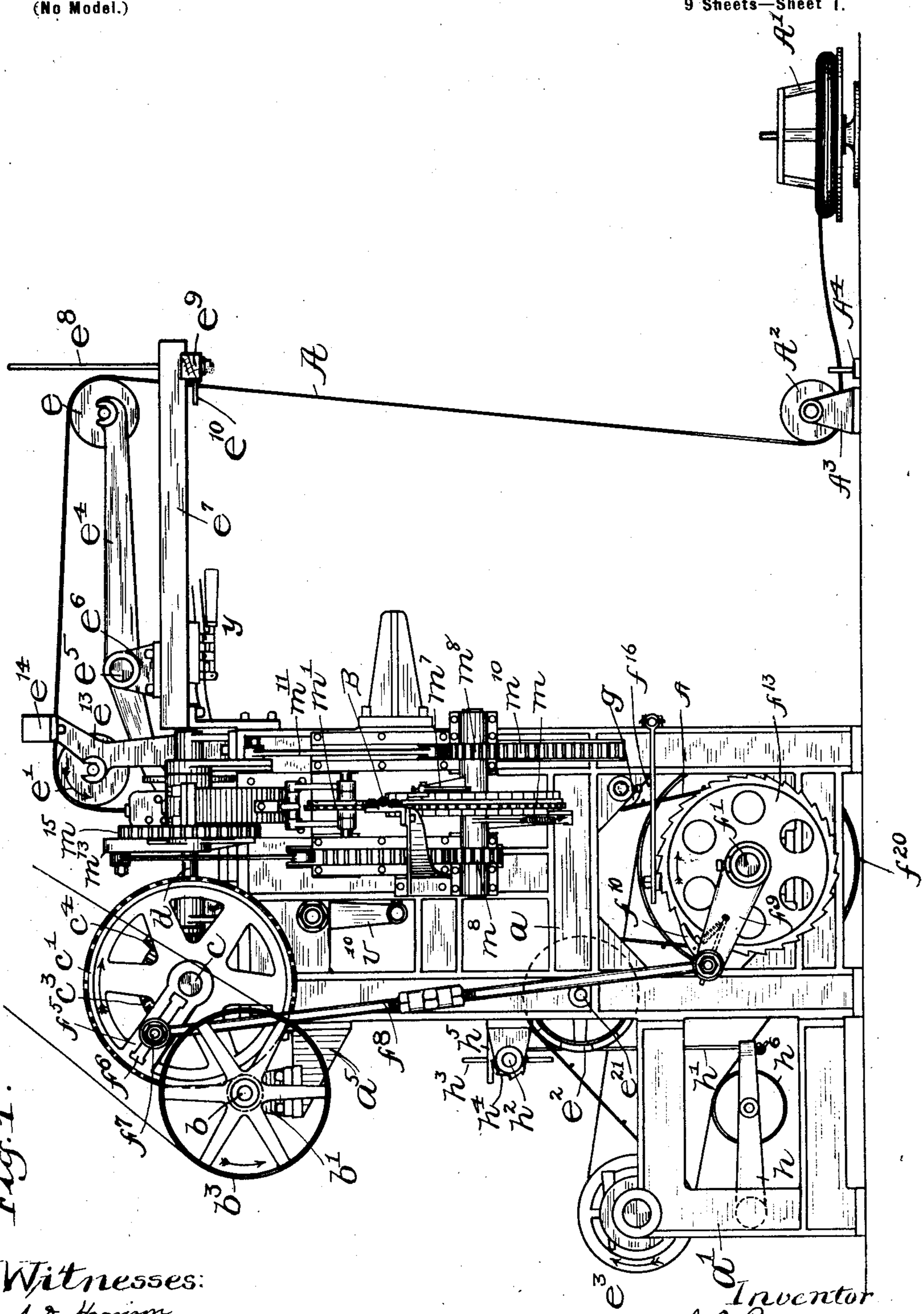

Fig. 1.

Witnesses:
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No. 633,213. Patented Sept. 19, 1899.

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(No Model.) 9 Sheets—Sheet 2.

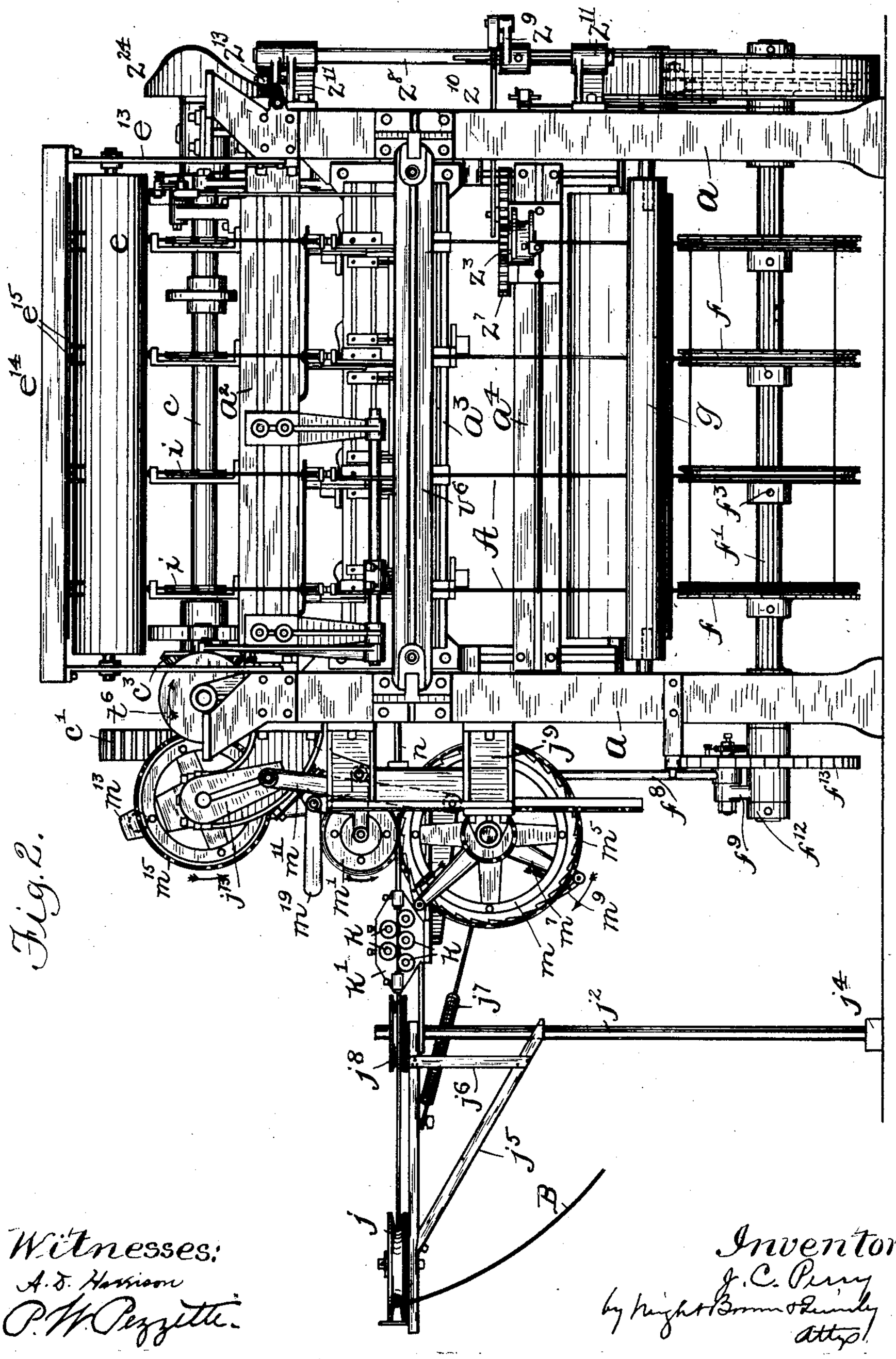

Fig. 2.

Witnesses:
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No. 633,213. Patented Sept. 19, 1899.

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(No Model.) 9 Sheets—Sheet 3.

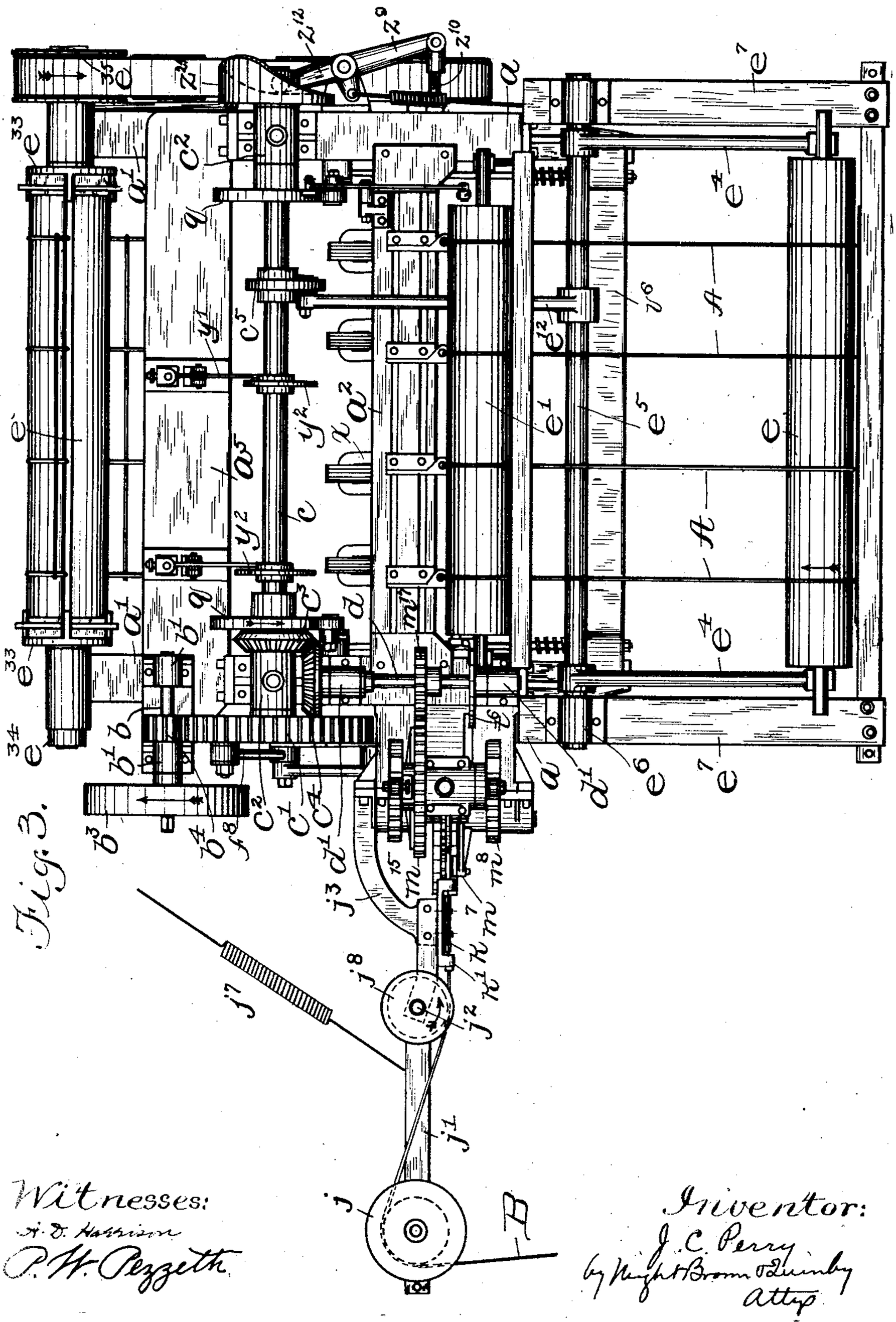

Fig. 3.

Witnesses:
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(No Model.) 9 Sheets—Sheet 4.

Fig. 4.

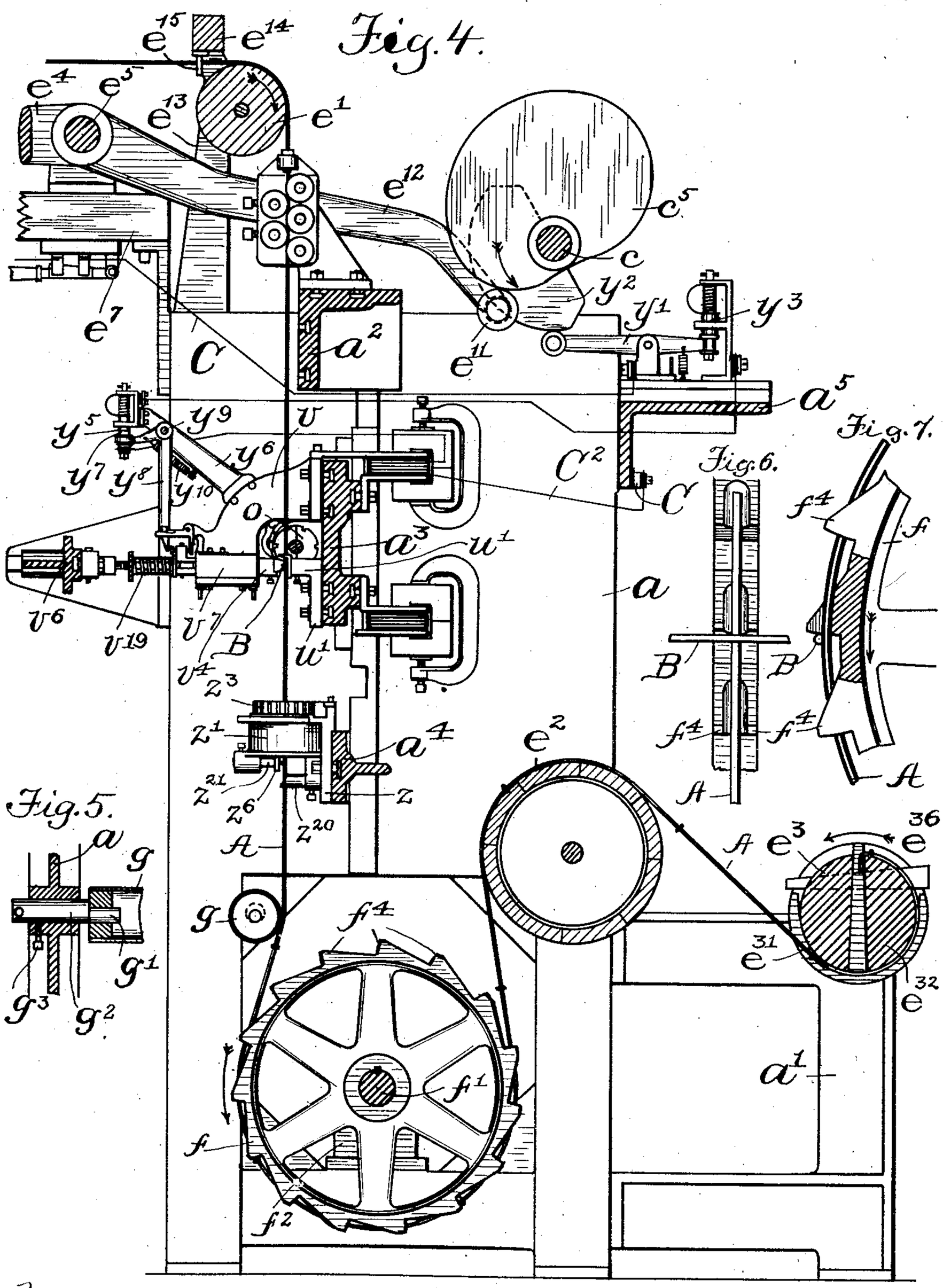

Fig. 7.

Fig. 6.

Fig. 5.

Witnesses:
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(No Model.) 9 Sheets—Sheet 5.

Fig. 8.

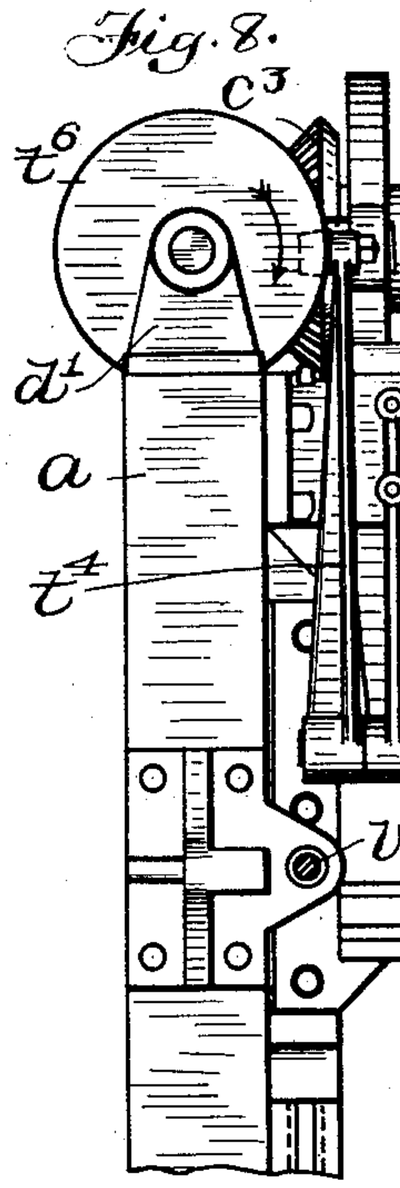


Fig. 9.

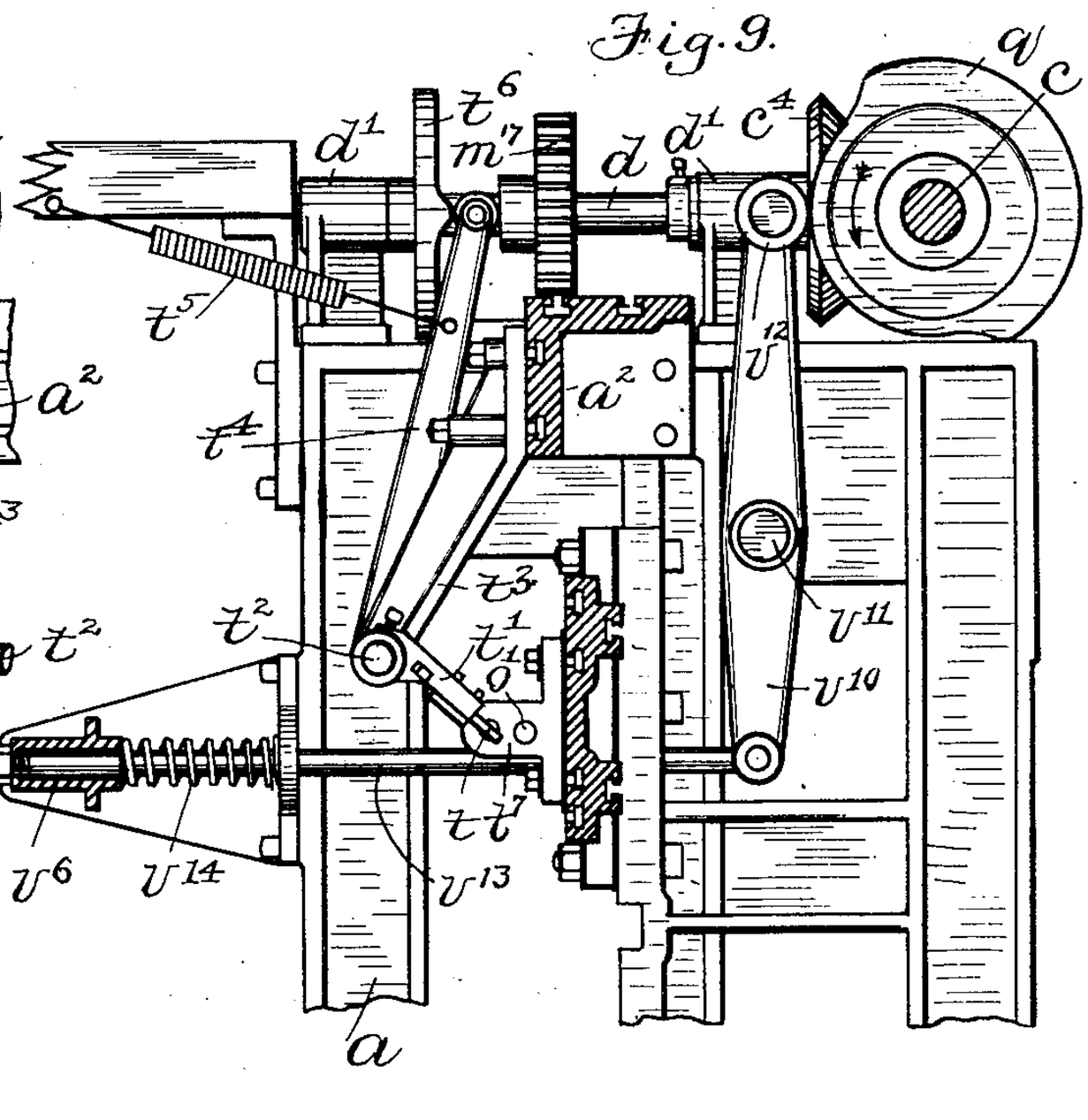


Fig. 11.

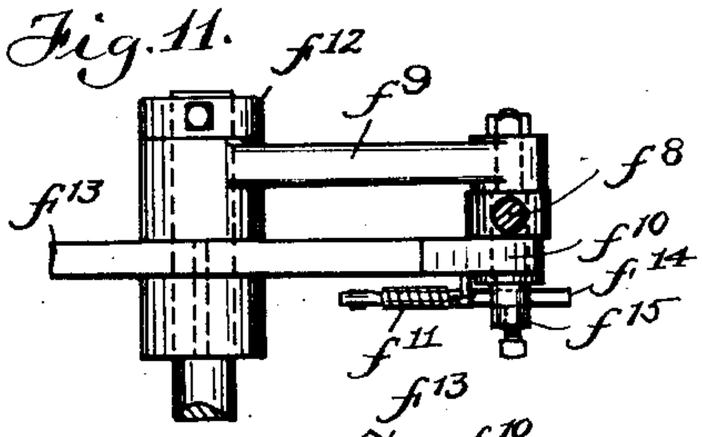


Fig. 12.

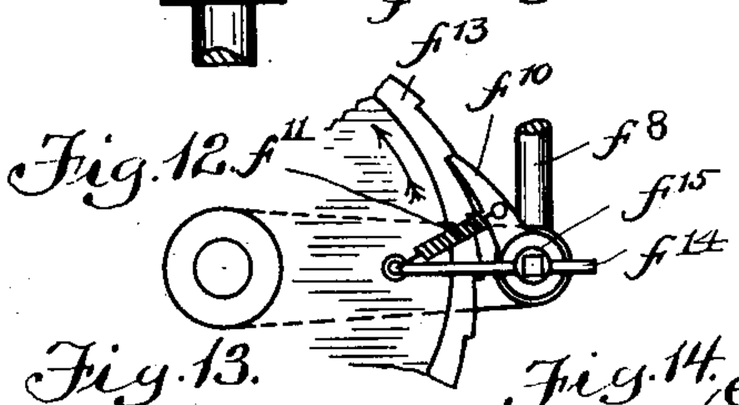


Fig. 10.

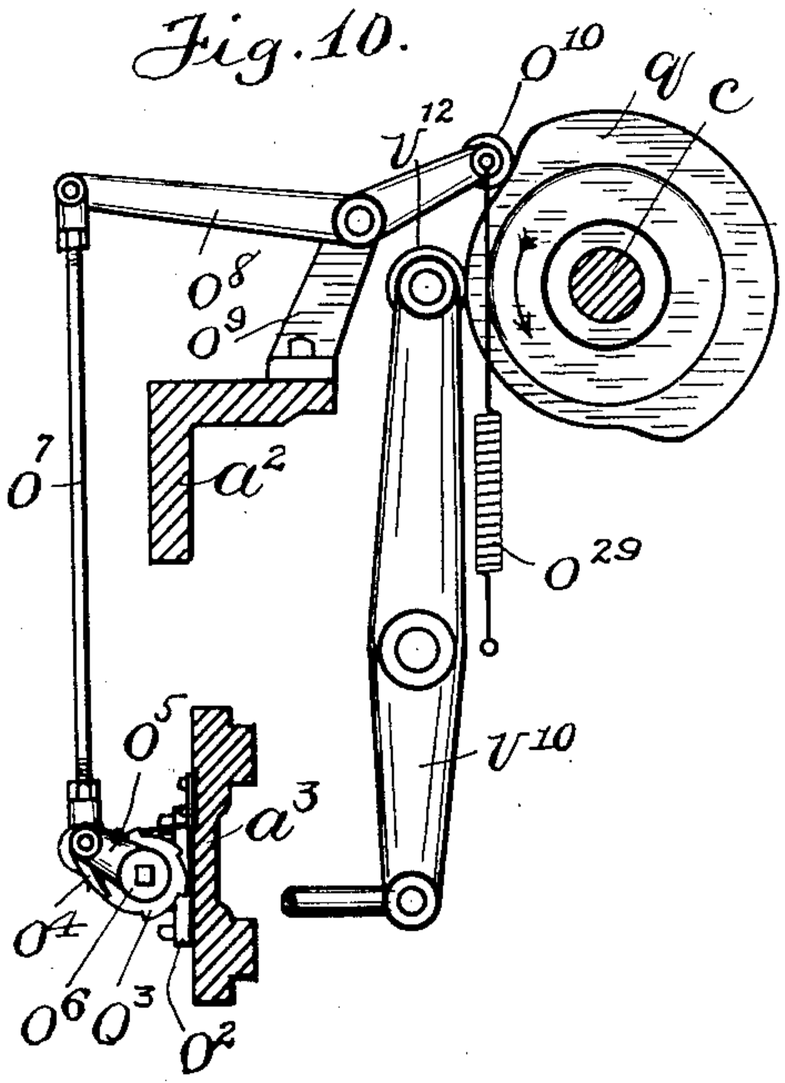


Fig. 13.

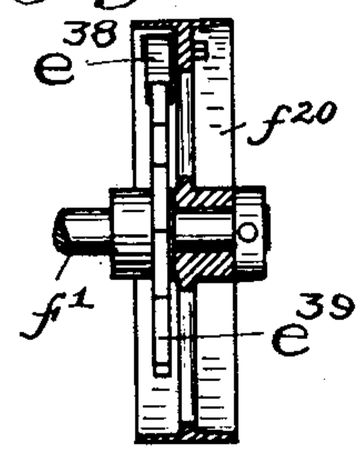
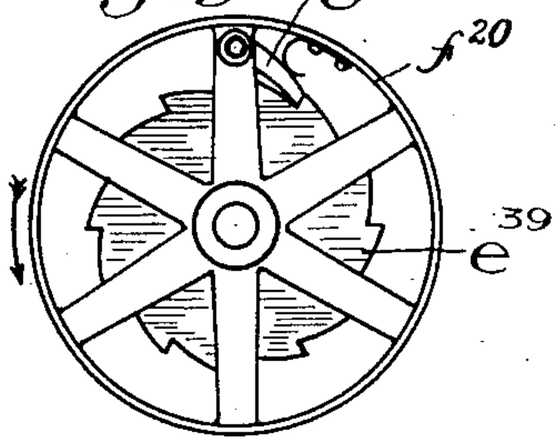


Fig. 14.



Witnesses:
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No. 633,213. Patented Sept. 19, 1899.

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WIRE FENCE MAKING MACHINE.

(Application filed Jan. 21, 1899.)

(No Model.) 9 Sheets—Sheet 6.

Fig. 17.

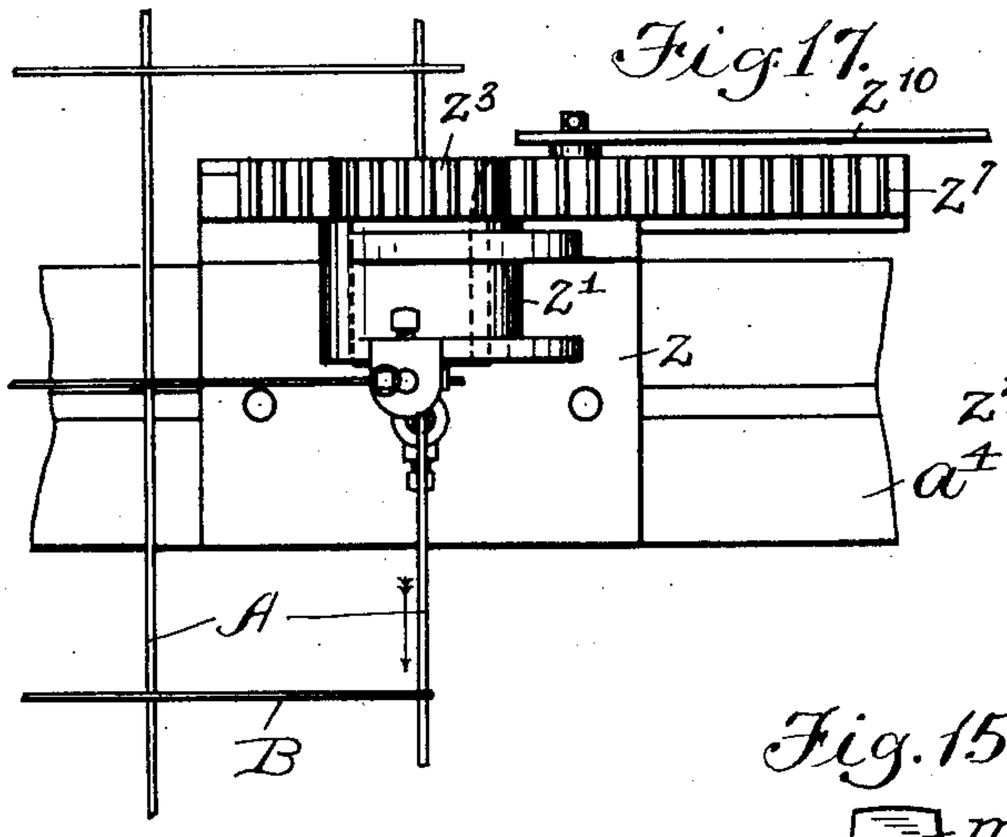


Fig. 18.

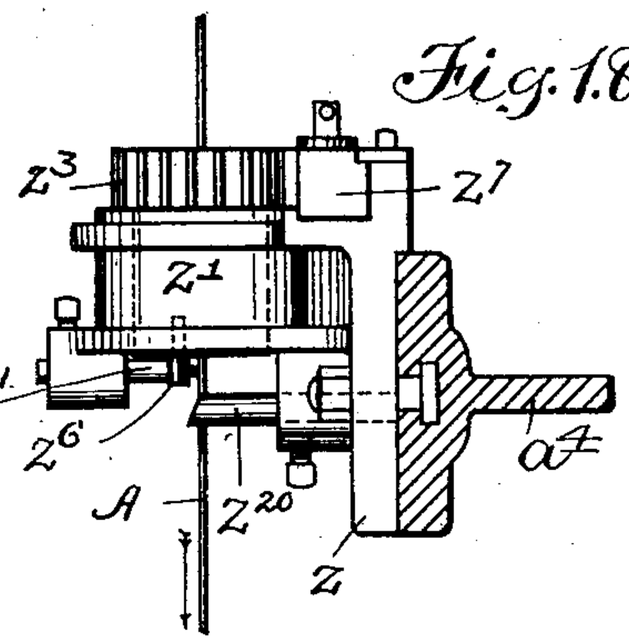


Fig. 19.

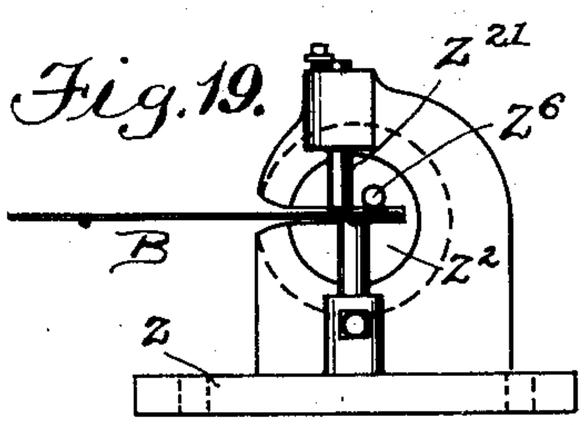


Fig. 20.

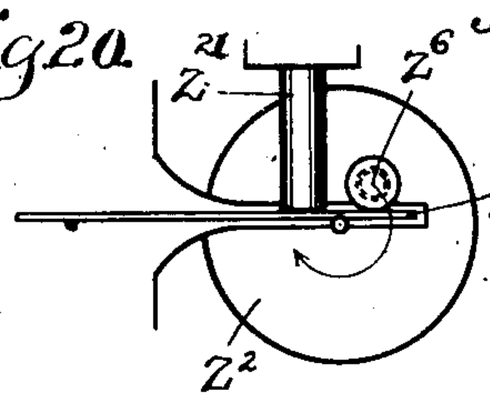


Fig. 21.

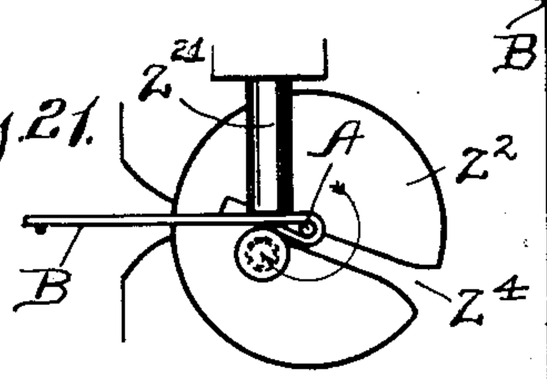


Fig. 22.

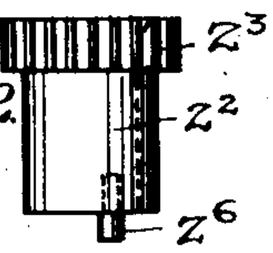


Fig. 15.

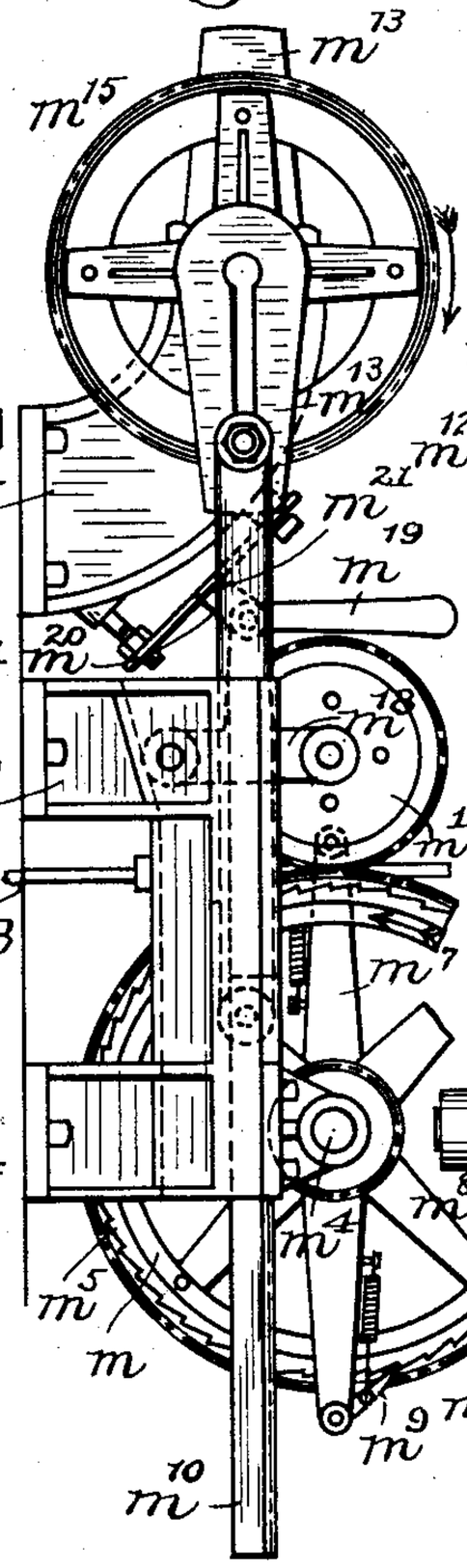
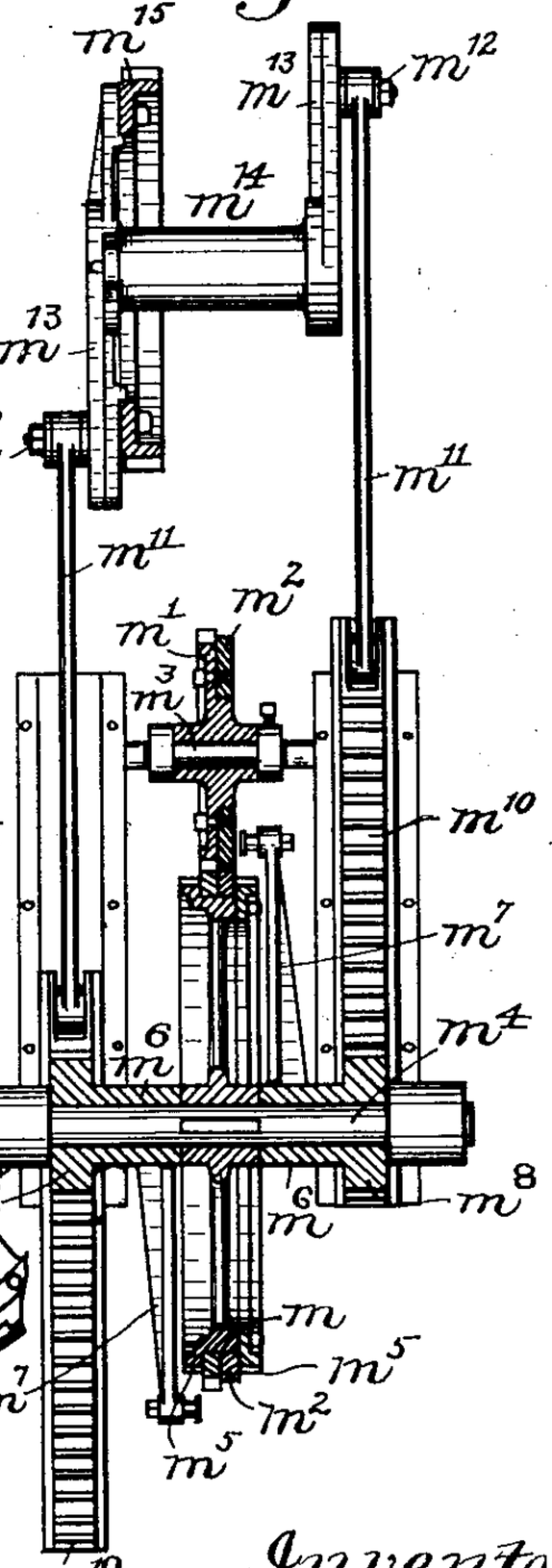


Fig. 16.



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WIRE FENCE MAKING MACHINE.

(Application filed Jan. 21, 1899.)

(No Model.) 9 Sheets—Sheet 7.

Fig. 23.

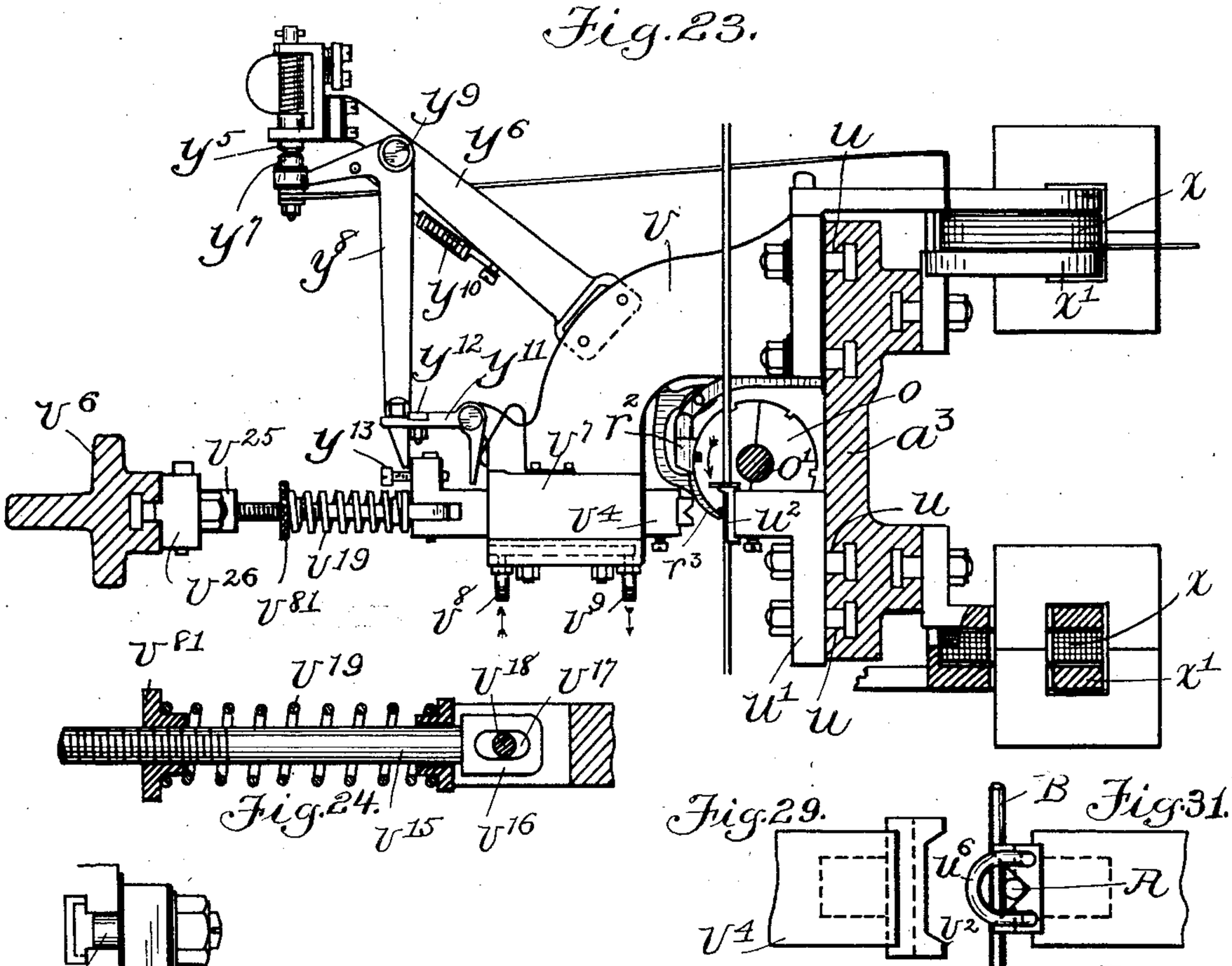

Fig. 24.

Fig. 29.

Fig. 31.

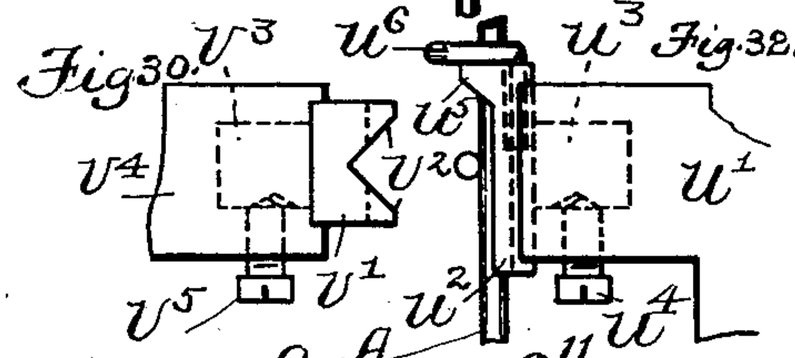

Fig. 30.

Fig. 32.

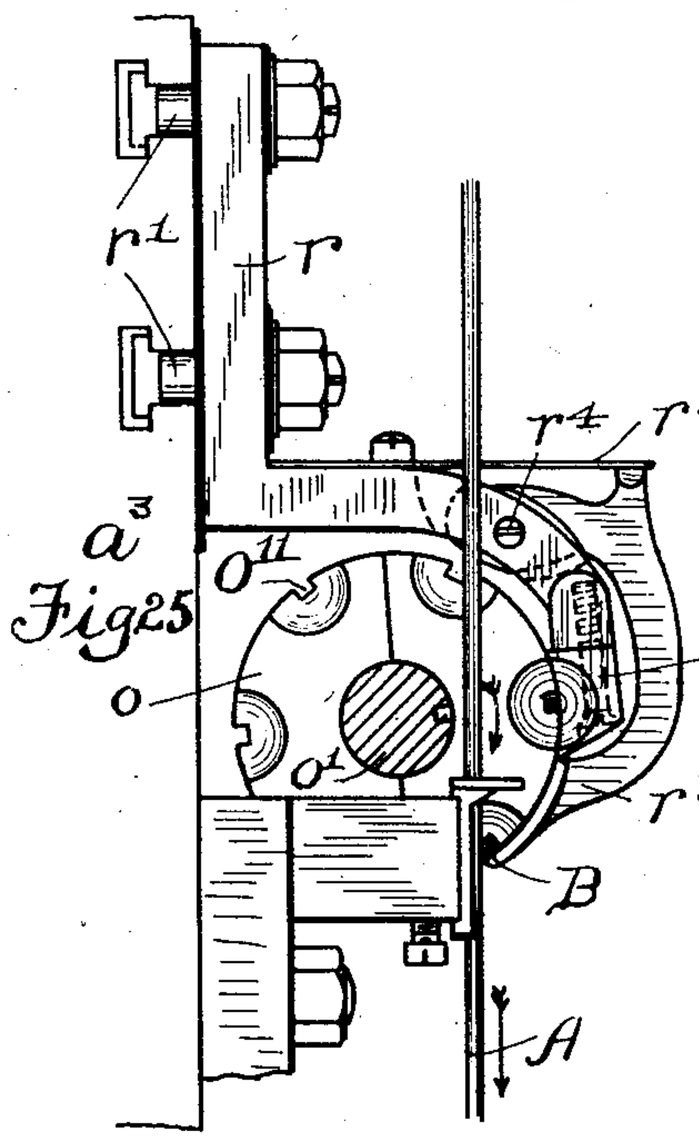

Fig. 25.

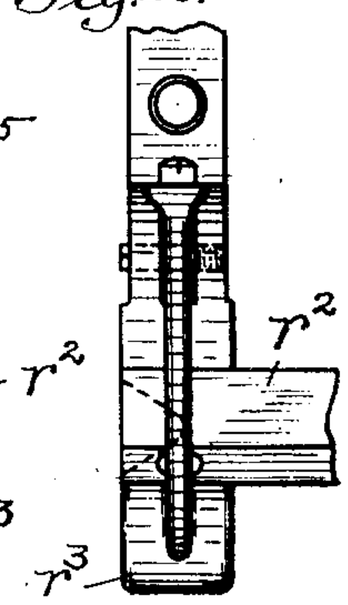

Fig. 26.

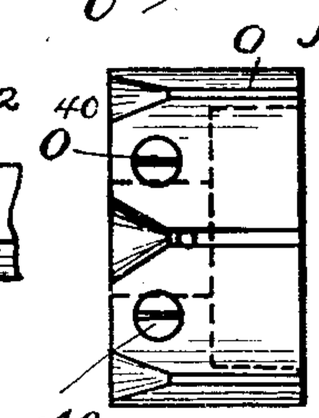

Fig. 27.

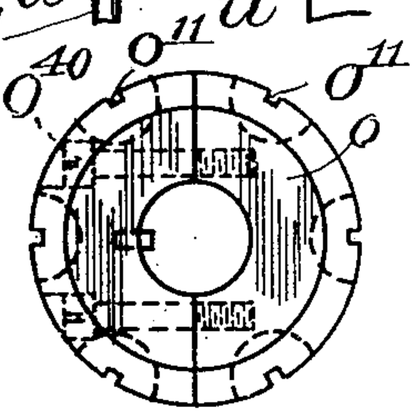

Fig. 28.

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No. 633,213. Patented Sept. 19, 1899.

J. C. PERRY.

WIRE FENCE MAKING MACHINE.

(Application filed Jan. 21, 1899.)

(No Model.) 9 Sheets—Sheet 8.

Fig. 33.

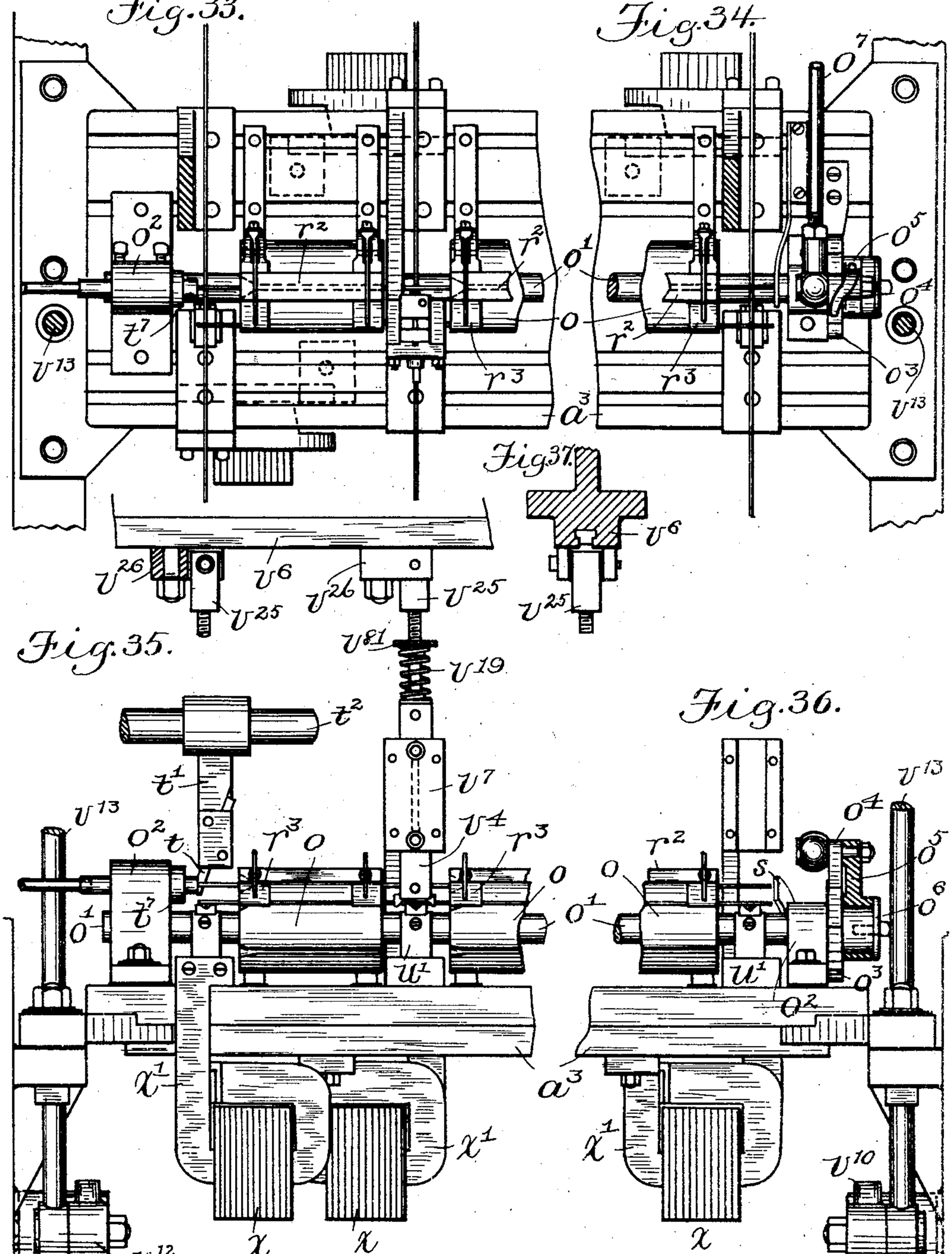

Fig. 34.

Fig. 37.

Fig. 35.

Fig. 36.

Witnesses:
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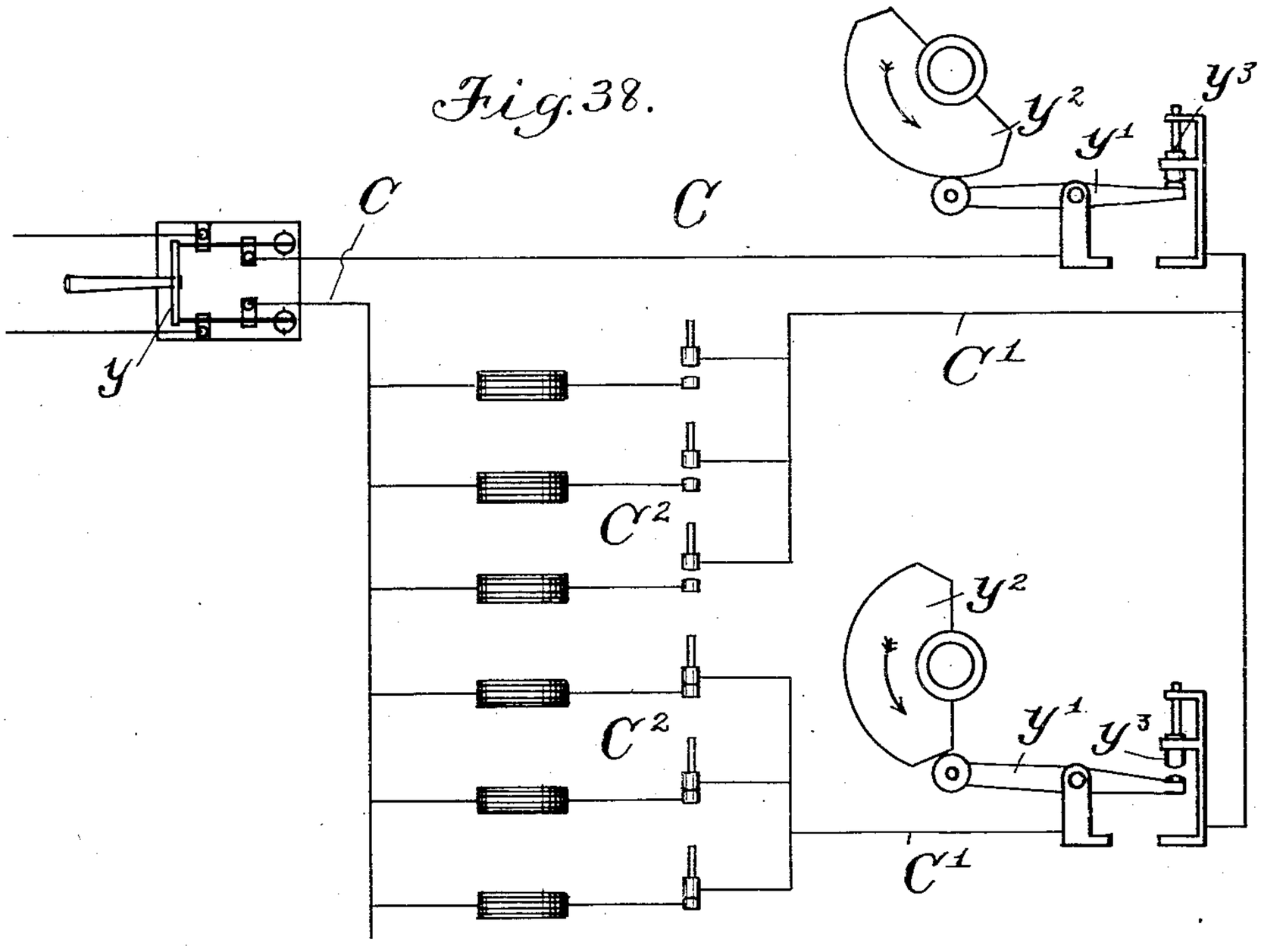
WIRE FENCE MAKING MACHINE.

(Application filed Jan. 21, 1899.)

(No Model.) 9 Sheets—Sheet 9.

Fig. 38.



Witnesses:
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UNITED STATES PATENT OFFICE.

JOHN C. PERRY, OF CLINTON, MASSACHUSETTS.

WIRE-FENCE-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 633,213, dated September 19, 1899.

Application filed January 21, 1899. Serial No. 702,901. (No model.)

To all whom it may concern:

Be it known that I, JOHN C. PERRY, of Clinton, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Machines for Making Wire Fences, of which the following is a specification.

This invention has relation to machines for making wire goods—such as fences, mats, lathing, barbed wire, &c.—and has for its object to provide a machine of the class specified having provisions for automatically welding the crossed wires at their points of intersection, and thereby obviating the necessity of coiling the wires at said points, whereby a greater quantity of finished product is turned out from a given amount of wire than heretofore.

A further object of the invention is to provide the machine with automatic mechanism by means of which its general efficiency is enhanced, its movements are rendered even and accurate, and its product is turned out neatly finished and in a high state of excellence.

To these ends the invention consists of a wire-fabric machine possessing certain characteristics or features of construction and arrangement of parts, as illustrated upon the accompanying drawings, described in the following specification, and pointed out with particularity in the appended claims.

Reference is to be had to the accompanying drawings, and to the letters and figures marked thereon, forming a part of this specification, the same letters designating the same parts or features, as the case may be, wherever they occur.

Of the drawings, Figure 1 represents in side elevation a machine embodying my invention, the equalizer for the stay-wire being omitted to prevent confusion. Fig. 2 represents a front elevation of the same, the equalizer for the strand-wires and the support for said equalizer being omitted. Fig. 3 represents a plan view of the machine. Fig. 4 represents a vertical longitudinal section through the machine. Fig. 5 represents a detail sectional view of the eccentric-stud for adjusting the guide-roll. Figs. 6 and 7 represent portions of the means for feeding the fabric, and consequently the strand-wires. Figs. 8 and 9 represent portions of the machine and illustrate the wire-cutting mechanism and the mechanism for actuating the plunger-rail. Fig. 10 represents in detail the mechanism for rotating the stay-wire holder and the lever which operates the plunger-rail. Figs. 11 and 12 represent in detail means for imparting a step-by-step movement to the fabric-feeding mechanism. Figs. 13 and 14 represent in detail means for imparting a similar movement to the take-up reel. Figs. 15 and 16 represent mechanism for feeding the stay-wire across the strand-wires. Figs. 17 to 22, inclusive, represent the coiler, or the mechanism which I employ for coiling the ends of the stay-wires around the selvage or outside strand-wire. Fig. 23 represents a partial section through the machine and illustrates the welding apparatus, including the transformers, the support therefor, the electrodes, the circuit-breaker, and the connection between the plungers and plunger-operating rail. Fig. 24 represents in sectional view the devices for operating the plungers from the plunger-rail. Figs. 25 to 28, inclusive, show in detail the holder for the stay-wires. Figs. 29 to 32, inclusive, represent the electrodes in detail. Figs. 33 to 36, inclusive, represent the welding apparatus and the parts adjacent thereto. Fig. 37 represents a sectional view of the plunger-rail and shows the method of connecting the plunger-rod therewith. Fig. 38 represents a diagram of the electric circuit from the main switch through the several automatic switches and primary coils back to the first-mentioned switch.

The machine which is represented upon the drawings and which I shall now proceed to describe is merely one embodiment of my invention and has been selected for the purpose of illustrating and disclosing the latter, so that consequently it will be understood that I am not limited to any of the details of construction thereof, and although the machine is illustrated and hereinafter described as being arranged to manufacture wire "fence," yet it can be easily adjusted to manufacture lathing, mats, barbed wire, &c., and hence whenever I use the term "wire fence" I wish to be understood as including any kind of wire fabric, as well as wire provided with points or barbs. The wires which run or extend longitudinally of the fabric I term

"strand-wires," while the cross-wires—such as the barbs on a barbed wire, the filling of a woven fabric, or the stay-wires of a fence—I term "stay-wires," so that in the description which follows no limitation is intended by the use of the said terms, especially as I may employ in lieu of wires rods or strips of metal. Again, the machine as illustrated is adapted to manufacture a fabric in which the strand and stay wires intersect each other at right angles; but it is evident that the invention comprehends mechanism for laying them obliquely to each other, as desired. With this explanation I shall now describe the said machine and its mode of operation.

The side standards (indicated at *a*) are provided with extensions *a' a'*, bolted thereto, and they are cross-connected and braced by suitable tie-rods (not shown) in addition to the angle-bar a^2, (for the wire-straighteners,) the support a^3, (for the welding mechanism,) the cross-bar a^4, (for the coiling mechanism,) and the table a^5, (for the circuit regulating or controlling mechanism.)

The initial power-shaft *b* is journaled in bearings *b' b'*, resting upon the table a^5, and it is driven by a belt-wheel b^8 in the usual way. The shaft extends but part way across the machine and is provided with a pinion b^4, intermeshing with and driving a gear-wheel *c'* on a main shaft *c*, journaled in bearings c^2 c^2 on the side standards *a a*. Bevel-gears c^3 c^4 transmit power from said shaft *c* to a shaft *d*, arranged longitudinally of the machine and journaled in bearings *d' d'*. By these two shafts are driven the operative parts of the machine, including the welding apparatus, the wire-feeding mechanism, and the stay-wire-coiling apparatus, as I shall subsequently make clear.

The strand-wires A are fed from reels A', placed in front of the machine, and pass under a guide-roll A^2, journaled in bearings A^3, being guided thereto by a comb A^4, between the teeth of which they pass. From the guide-roll A^2 the wires pass upward and over an equalizing-roll *e*, then horizontally over a roll *e'*, and then downward between the electrodes to the feeding-wheels *f*, after which they are passed over a roll e^2 and are wound upon a take-up reel e^3. The roll *e* is trunnioned in sockets in the ends of arms e^4, which are secured upon a shaft e^5, journaled in bearings e^6, supported by forwardly-extending brackets e^7, bolted to the standards and hung at their outer end from suspenders e^8, let down from the ceiling, the outer ends of said brackets supporting a comb e^9, having teeth e^{10} for guiding the strand-wires. The shaft e^5 is provided with an inwardly-projecting arm e^{12}, which, as shown in Fig. 4, is provided with a roll e^{11}, bearing against a cam c^5 on the main shaft *c*, so that as the shaft *c* rotates the shaft e^5 is rocked and the roll *e* is raised and lowered. As will be subsequently explained, the strand-wires are fed intermittingly, and were the equalizing mechanism not employed they would receive jerks at intervals, which would tend to snarl them, whereas by timing the equalizing mechanism properly the roll is raised while the wire in the machine is clamped between the electrodes and is lowered while the feeding-wheels are being advanced, and consequently the wires are drawn from the reels evenly and without danger of kinking or snarling. The roll *e'* has trunnions on its ends which are journaled in bearings in brackets e^{13}, and the strand-wires are guided thereto by a comb e^{14}, having teeth or pins e^{15}, as best shown in the figure last referred to.

Between the feed-wheels *f* and the electrodes is the guiding-roll *g*, which is adjustable so as to relieve the the fixed electrode from the excessive pressure of the fence and consequent wear. The roll is journaled on the eccentric-pins *g'*, which extend from the inner ends of studs g^2, which are rotarily adjustable in the standards *a* and are held after adjustment by the set-screw g^3, as best shown in Fig. 5.

The mechanism for feeding the strand-wires through the machine and pulling the completed fence from the electrodes after the welding operation comprises the wheels *f f*, hereinbefore referred to, together with means for imparting an intermittent rotary movement to them. The said wheels *f f* are equal in number to the strands of the fence, and they are splined upon a shaft *f'*, journaled in bearings f^2, supported by the side standards. They are held upon the shaft *f* by any suitable means, as by set-screws f^3, (see Fig. 2,) and they are adjustable thereon to vary the distance between the strand-wires, their number being increased or diminished in accordance with the number of strands in the fence. Each wheel is provided with a plurality of grooved teeth f^4, (see Figs. 6 and 7,) in which the strand-wires rest. The distance between the stay-wires in the fence is determined by the movement of the feeding-wheels, and the teeth of the said wheels are spaced so as to engage the said wires and prevent slipping, said stay-wires operating as sprockets on the strand-wires. Where it is desired to vary the distance between the stay-wires, the feed-wheels may be replaced by others having teeth properly spaced to engage them, unless the spaces between the stay-wires are equal to or are multiples of the spaces between the teeth.

The shaft *f'* and the feed-wheels are intermittently rotated by the following devices: The gear *c'* on the shaft *c* is provided with a rib f^5, having a radial groove or slot f^6, in which is adjustably secured a crank-pin f^7. Said crank-pin is connected by an adjustable coupling-rod f^8 with an arm f^9, loosely mounted on the shaft *f'* and held against axial movement by a collar f^{12} and a ratchet-wheel f^{13}, both rigidly mounted upon said shaft, so that as the gear-wheel *c'* is rotated an oscillating motion is imparted to the arm, as will be

readily understood. A pawl f^{10} (see Figs. 1, 11, and 12) is mounted on said arm and is arranged to engage the ratchet-wheel f^{13} when the arm is oscillated, said pawl being drawn toward said ratchet-wheel by a spring f^{11}, connected thereto and to the end of a pin f^{14}, passed through the stud or pivot f^{15}, which connects the pawl, the arm f^{9}, and the coupling-rod f^{8} together. The teeth of the ratchet-wheel are equal in number to the teeth on the feed-wheels, and they are engaged by a retaining-pawl f^{16}, as shown best in Fig. 1. The movement of the feed-wheels and the feed of the strand-wires may be varied by adjusting the crank-pin f^{7} in the radial slot f^{6}, so that the spaces between the stay-wires may be varied at will.

After the strand-wires leave the feed-wheels they pass over the guide-roll e^{2}, as I have previously stated, and by examining Fig. 4 it will be seen that the latter is in a plane above the feed-wheels, so as to lengthen the line of contact of the strand-wires therewith. The said roll e^{2} is provided with trunnions e^{21}, journaled in bearings in the side standards a.

The reel e^{3} for the completed fence consists of two semicylindrical timbers e^{31} e^{32}, mounted in sockets e^{33} e^{33}, formed on the ends of stud-shafts e^{34} e^{35}, journaled in bearings in the rear extension a' of the side standards. Said timbers are held in the sockets by wedges a^{36}, and when the roll of fence is completed the wedges are withdrawn and the reel is then collapsible, whereby the timbers may be drawn separately from the roll of fence. On the shaft e^{35} is a belt-wheel e^{37}, around which a belt is passed from a belt-wheel f^{20}, on the shaft f', said belt being tightened by an ordinary tightener, such as that shown in Fig. 1. The wheel f^{20} is connected to the shaft f' by a pawl e^{38} and ratchet e^{39}, so that the roll is capable of an independent forward rotation to take up slack in the strand-wires. The belt is adapted to slip, so that the reel is driven frictionally at a proper rate of speed. The tightener consists of a pivoted arm h, connected by a cord or wire h' with a shaft h^{2}, adapted to be rotated by a handle h^{3} and to be held against reverse movement by a ratchet h^{4} and pawl h^{5}. On the arm h' is journaled a loose belt-wheel h^{6}, in engagement with the belt. By rotating the shaft h^{2} the belt-wheel may be drawn tightly against the belt to increase its frictional engagement with the belt-wheels e^{37} and f^{20}. As the strand-wires leave the roll e' to reach the electrodes, they pass between a plurality of staightener-rolls i i, journaled on a bracket i'. There are a plurality of these brackets, which are mounted upon the angle-bar a^{2}, said bar being provided on its upper face with T-shaped grooves to receive the heads of the securing-bolts, as shown in Fig. 4, whereby said brackets are adjustable transversely on the machine, so as to accommodate themselves to the strand-wires

Having thus explained the means for feeding the strand-wires, I shall now proceed to describe the mechanism for feeding the stay-wires transversely thereof and the mechanism for holding them during the process of welding.

The wire B from which the stay-wires are cut is drawn from a reel similar to that shown in Fig. 1 and passes around a grooved guide-wheel j, mounted upon the end of an equalizing-arm j', fulcrumed by an upright j^{2} to a bracket j^{3}, extending out from the machine, as shown in plan in Fig. 2. The upright j^{2} forms a standard to support the bracket j^{3} and the arm j', and its lower end is stepped in a block j^{4}, the outer end of the arm j' being supported by braces j^{5} j^{6}, as shown in Fig. 2, which bear against the said standard j^{2}. The thrust of the wire as it is drawn from the reel is taken by a spring j^{7}, which is secured at one end to the arm j' and at its other end to a suitable support. (Not shown). The wire b is fed into the machine intermittently, and consequently the equalizing-arm j' and spring j^{7} are employed to draw the wire from the reel evenly to prevent it from being snarled. When the wire is being fed into the machine, the strain upon it swings the arm j' forward and the latter assumes its normal position when the feeding movement stops, so that its effect is to draw the wire from the reel slowly and without jerking it. From the wheel j the wire b passes in front of a grooved wheel j^{8}, journaled on the stud or standard j^{2}, and from thence it passes between the plurality of straightening-rolls k k, journaled on a plate k, supported by the bracket j^{3}. The bracket j^{3} is itself bolted to a bracket j^{9}, which extends out from one of the standards a and which supports the devices for feeding the stay-wire. The feeding-wheels are best shown in Figs. 15 and 16, and they are indicated by m and m', respectively. They are provided with intermeshing gear-teeth, whereby their peripheries travel at the same rate of speed, and they are also equipped with wire-gripping rings m^{2} m^{2}, between which the wire passes. The wheel m' is journaled on a stud-shaft m^{3}, secured in a movable-bearing pivoted to and extending out from the bracket j^{9}, while the wheel m' is keyed to a shaft m^{4}, journaled in bearings on the same bracket. On either side of the gear-teeth and the ring m' the wheel m is formed with ratchet-teeth m^{5}, and loosely mounted on the shaft m^{4} are sleeves m^{6} m^{6}, which are formed with arms m^{7} m^{7} and pinions m^{8} m^{8}. Each arm m^{7} carries a pawl m^{9}, as shown in Fig. 15, adapted to engage the teeth m^{5}, and when the arms are oscillated in opposite directions they impart an intermittent motion to said feeding-wheels. Intermeshing with the pinions m^{8} are racks m^{10}, sliding in guides afforded by the bracket j^{9}, and said racks are connected by rods m^{11} with crank-pins m^{12}, adjustably mounted in radial slots in crank-arms m^{13} on a shaft m^{14}, journaled in the bearings in the

bracket j^{11}. A gear-wheel m^{15} is secured to the shaft m^{14}, as shown in Fig. 16, and intermeshes with and is driven by a pinion m^{17} on the shaft d, hereinbefore referred to and shown in Fig. 3. As the shaft m^{14} is rotated the racks m^{10} are reciprocated vertically in opposite directions to cause the pawls carried by the crank-arms m^7 to intermittingly engage the ratchet-teeth of the wheel m and rotate the same, the degree of movement of the said wheel m being varied at will by adjusting the crank-pins m^{12} in the slots in the crank-arms m^{13}. As the racks m^{10} reach the extremes of their movements they pause momentarily while the crank-pins m^{12} pass the dead-centers, and during the period in which the stay-wire is quiescent it is cut, and the holder therefor, which I shall subsequently describe, is rotated to bring the severed wire into position to be welded to the strand-wires. The shaft m^3 for the wheel m' is journaled in arms m^{18}, fulcrumed on the bracket j^9, as shown in dotted lines in Fig. 15, said arm being provided with a lateral extension, to which is pivoted a handle m^{19}, having a cam m^{20} bearing against a spring m^{21}, connected to the bracket j^{11}. By throwing the handle downward the cam m^{20} is engaged with the spring m^{21}, and the wheel m' is forced tightly into engagement with the wheel m; but by raising the lever or handle m^{19} the tension upon the wheel m' is relieved, and the wheels $m\,m'$ cease to grip the stay-wire between them. By adjusting the crank-pins before referred to the feed-wheels may be rotated alternately at unequal distances, so as to feed long and short stay-wires alternately in case it be desired to construct a fence with them. The stay-wire passes from the feed-wheels through a tubular guide n (see Fig. 2) into the holder shown in Figs. 23 to 28, inclusive. Said holder consists of a plurality of rolls o o, splined upon a shaft o', journaled in bearings o^2 o^2, mounted upon the support a^3 for the electrodes, (being electrically insulated from said support.) Said shaft o' is provided with a ratchet-wheel o^3, (see Figs. 35 and 36,) with which engages a pawl o^4, mounted on an arm o^5, loosely mounted on the hub of said wheel and held against axial movement by a washer-disk o^6, secured to the end of the shaft. The arm o^5 is connected by a rod o^7 with a centrally-fulcrumed lever o^8, (from which it is electrically insulated,) supported by a bracket o^9, (see Fig. 10,) mounted upon the angle-bar a^2. The rear end of the lever o^8 has a roll o^{10}, caused by a spring o^{29} to bear against a cam q, rigidly secured to the shaft c, (see Figs. 3 and 10,) so that as the cam rotates the arm or lever o^8 is reciprocated, and the shaft o' is intermittently rotated. Each roll o consists of two semicylindrical portions rigidly connected by screws o^{40}, so that they can be removed from the shaft without trouble, said rolls being splined upon the shaft so as to be axially adjustable thereon. Each roll is provided in its periphery with a plurality of grooves o^{11} for the stay-wires, said grooves having flaring mouths or entrances o^{12}, as clearly shown in Figs. 25 and 27.

As each stay-wire is fed by the feeding-wheels through the tubular guide it enters the grooves in the rolls which constitute the holder, and when a predetermined length of the stay-wire has been fed it is cut off by means which I shall now describe, and the holder is rotated one step to bring another line of the grooves into alinement with the feeding guide or nozzle n.

In order to hold the stay-wire in the grooves in the holder, I provide the device shown in Figs. 25 and 26. r is a bracket adjustably secured to and insulated from the electrode-support a^3 over each of the rolls, being connected to said support by bolts r', having their heads sliding in grooves in the front face thereof. The bracket is bent forwardly and downwardly, and to its lower end is secured a stationary guide-bar r^2, having a concave face to fit the periphery of the roll. The guide-bars or retainers are stationary, and hence to hold the wires in the grooves o^{11} when the holder is advanced one step I employ the auxiliary guides or retainers r^3, which are pivoted at r^4 in the brackets r' and are pressed against the holder by springs r^5. When each stay-wire reaches its welding position, upon the rotation of the holder one step, it is held by the retaining-finger r^3 until the weld is completed, after which the strand-wires are fed along, carrying the stay-wire with them, and at this time the retaining-fingers yield to permit the stay-wire to pass out of the grooves o^{11} in the holder. The guides r^2 operate to retain the stay-wires in the holder when they are first fed in, the supplemental retaining-fingers holding said stay-wires when the holder is rotated.

In order to limit the inward movement of the stay-wires, I may employ the stop s, (shown in Figs. 34 and 26,) secured to the support a^3 and projecting into the path of the stay-wire, as best shown in Fig. 34.

The cutting of the stay-wire automatically after a length thereof has been fed into the hole is accomplished by the mechanism shown in detail in Figs. 8 and 9. The cutter-blade t is mounted in an arm t', rigidly secured to a shaft t^2, mounted in brackets t^3, extending downwardly from the angle-bar a^2, which is grooved on its front face to receive the bolts which fasten the brackets t^3 thereto. The said brackets are adjustable, so that they may be placed at any point to escape the strand-wires, and the arm t' is adjustable on the shaft t^2, so as to cut the wire at any predetermined point. On the end of the shaft t^2 is an arm t^4, which is held by a spring t^5 against a cam t^6 on the shaft d. Said cam has an operating rise which engages a roll at the end of the arm t^4 and quickly operates the knife t. There is a guide t^7 for the wire in close proximity to the knife t, which operates to hold the wire against the stress of the knife

when the latter is operated and furnish, as it were, a stationary blade. The parts are so timed that the knife is operated when the feeding-wheels m m' for the stay-wire have stopped momentarily, as previously described.

From the mechanism which I have now described it will be seen that the strand-wires and stay-wires are automatically fed into the machine and arranged at an angle to each other, whereby they may be welded at their intersection, and hence to accomplish the welding I employ the devices which I shall proceed to describe.

The support a^3 is a plate which extends across the machine and is arranged vertically, as shown in Figs. 4, 23, 33, 34, and 35, being suitably insulated from the side standards a a. The said plate is grooved on its front face, as at u u, to receive the brackets u' and v for the electrodes with which they are in circuit. The brackets u' support the stationary electrodes, (shown in Figs. 31 and 32,) which consist of grooved plates u^2, having shanks u^3 to fit in the brackets u', each shank being engaged by a set-screw u^4. The brackets are grooved to receive the electrodes, whereby the latter are always maintained in alinement and are easily returned to normal position after being removed. Each electrode u^2 is provided with teeth or guiding-lugs u^5 and also with a curved yoke or guide u^6, whose ends are set in sockets in the electrodes, said yokes u^6 preventing the strand-wires from being drawn away from the stationary electrodes during the feeding. The movable electrodes v' are grooved plates arranged at right angles to the electrodes u^2 and have guiding or positioning lugs or teeth v^2 for the stay-wires, being also provided with shanks v^3, extending into the ends of plungers v^4 and held therein by set-screws v^5. Said plungers v^4 are grooved to receive said electrodes and hold them in proper relation to the stationary electrodes. The plungers v^4 move in guides in the brackets r and are connected to a plunger-rail v^6 by resilient connections, as I shall subsequently explain. The guides v^7 in the ends of the brackets v for the plungers are each provided with an annular chamber into which a cooling medium, such as water, is introduced through nozzles v^8, the same being drawn therefrom through nozzles v^9.

On the rear of the plate or support a^3 are adjustably supported the primary and secondary coils of the transformers. The primary coils are indicated at x, and the secondary coils at x', said secondary coils being relatively large in cross-section and having two turns. One pole of each secondary coil is electrically connected to the support a^3, while the other is connected to either the bracket u' or the bracket v. In order to space the coils properly, they are arranged in two rows, as shown in Fig. 23, one above the other, and consequently the brackets v are alternately insulated from the support a^3, the intermediate brackets being electrically connected thereto. Each alternate bracket u' is also electrically connected to the support a^3, the remaining brackets being insulated therefrom, and the brackets u' and v are so arranged that in each pair only one bracket is electrically connected to the support, while the other is insulated therefrom, and hence one pole of each secondary coil is connected to the support, while the other is connected to the bracket v or u', which is insulated from the said support. There are as many pairs of electrodes as there are joints to be welded in the fence—that is, as many joints as are formed by each stay-wire—and the brackets and the transformer-coils are all so mounted upon the support a^3 that they can be adjusted transversely thereof to enable the manufacture of a fence having any suitable number of strands, the parts being all separable and being easily attached to or disconnected from the machine. The electrodes are so formed that they grasp the wires at their points of intersection and position them automatically. The movable electrodes are thrust against the stay-wires to bind them firmly against the strand-wires, after which the current is passed through the primary coils to generate a welding-current in the secondary coils.

The plunger-rail v^6, before referred to, is reciprocated by two levers v^{10}, (see Figs. 9 and 10,) fulcrumed at v^{11} on each of the side frames of the machine and having their upper ends provided with rollers v^{12}, which bear against the cams q on the shaft c. The lower end of the lever v^{10} is connected by a rod v^{13} with the plunger-rail v^6, there being a spring v^{14}, which normally holds the rail at the outward extreme of its movement. The plunger-rail is connected to each plunger v^4 by means of a bolt v^{15}, having its end screwed in a head v^{25}, pivoted in a block v^{20}, (see Figs. 35 and 37,) adjustably connected to the said rail by bolts having their heads sliding in a groove in said rail, and each bolt v^{15} has its head v^{16} provided with an elongated slot v^{17}, through which the pin v^{18} passes. Each head v^{25} is insulated from its block v^{26}. The head v^{16} extends between ears on the rear end of the plunger, so that when the plunger-rail is moved there is a certain amount of lost motion, due to the pin-and-slot connection with the plunger. A nut v^{81} is screwed on the bolt v^{15}, and between it and the rear end of the plunger is arranged a spiral spring v^{19}, so that when the plunger-rail is moved rearward the movable electrode yieldingly engages the stay-wire to position it and thrust it into contact with the strand-wire. By providing the yielding connection between the plunger-rail and the plunger I compensate for any inequalities in the wires and insure a perfect electrical contact between the electrodes and the wires.

In order to insure that the welding-current shall be of the proper duration, so as to pre-

vent the burning of the wires, I employ two sets of circuit-controllers, one adapted to be actuated by the plungers and the other to be actuated by the movable part of the machine. The primary circuit is indicated at C and is divided into two or more branches C′ C′, one group of the primary coils being in one branch and the other group being in the other branch and said branches being arranged in multiple arc in the main circuit. As there are four pairs of electrodes, there are two primary coils in each branch circuit, as indicated in Fig. 38. In the main circuit there is the ordinary hand-switch y, (see Fig. 4,) and in each branch there is an automatic circuit breaker or controller y' y', consisting of a lever fulcrumed on a table or support a^5 in the rear of the machine and suitably insulated therefrom. There are two cams y^2 on the shaft c, which engage rolls upon (and insulated from) the ends of the said levers and throw their outer ends into contact with the stationary contacts y^3 to close the circuit through the said branches, and I have so arranged the cams y^2 that the circuit is closed first through one branch and then through the other, with slight intervals of rest, so as not to throw a heavy load on the dynamo at any one time. The parts are suitably insulated so that the branch circuits are not closed until the cams y^2 move the switches y' into contact with the contacts y^3. Arranged in each branch circuit are other switches to break each of the branch circuits C^2 C^2 into which the circuits C′ C′ are divided.

The supplemental or auxiliary controllers each comprise a stationary spring-tensioned contact y^5, of which there are as many as there are pairs of electrodes, these stationary contacts being supported upon and insulated from an arm y^6, secured to each bracket v. The movable contacts y^7 are mounted on and insulated from a bell-crank y^8, fulcrumed at y^9 on the arms or brackets y^6. Springs y^{10} draw the lower ends of the levers y^8 against the bell-crank y^{11}, fulcrumed on the brackets v, the lower end of the said bell-cranks y^8 extending down far enough for this purpose and resting against lugs on the plungers b^4. As said plungers move inward the lower end of the bell-cranks v^8 follow them until they engage knife-edges y^{12} on the said bell-cranks y^{11}, the several contacts y^5 being spring-tensioned to permit this. When the movable electrodes are moved a predetermined distance, set-screws y^{13} on the plungers engage the bell-cranks y^{11} and disengage them from the bell-cranks or switch-levers y^8 to break the circuit. The circuit is not closed through each pair of electrodes until after the plunger has just about completed its movement, so that the strand and stay wires are first positively engaged with each other and forced together before the current is passed through them. The electrodes operate as dies for firmly clamping the wires to hold them in close contact before the circuit is closed through them. This is an important point in the operation of the machine, for if the electrodes are in circuit before they clamp the wires an arc is apt to form just as they contact with the wires and a proper weld is prevented. The duration of the welding-circuit is practically very short, for it is closed by one controller and opened by the other. The closing of the two branch circuits C′ C′ is effected by the switch-lever y', which is operated by the cam y^2. The circuit is closed after the electrodes have clamped the wires and just before the plungers have reached the extremes of their movements. Almost instantly after the circuits have been closed they are broken by the auxiliary controllers, each branch circuit C^2 being broken by the plunger which is in that circuit. By this arrangement it is practically impossible for the machine to stop with the circuit closed so as to burn the wires, as it might were the cams alone depended upon to operate the switch-levers.

After the stay-wires have been welded to the strand-wires and the feed-wheels have turned the strand-wires forward to permit of the placing of another stay-wire in position to be welded the projecting end of the stay-wire which extends beyond the selvage or the outer strand-wire is coiled about said strand-wire by the mechanism shown in detail in Figs. 17 to 22, inclusive. The coiling apparatus consists of a bracket z, adjustably secured to the front face of the cross-bar a^4. Said bracket is formed with a tubular bearing z' to receive a cylindrical coiler z^2, having formed on its upper edge a pinion z^3. Said coiler is slotted, as at z^4, to permit the passage of the selvage or outer strand-wire and the stay-wires, the guide z' being formed with a slot z^5 to register therewith. On the under side of the coiler z^2 is a pin z^6, which is adapted to engage the end b' of the stay-wire and coil it about the strand-wire A, as shown in Fig. 21, there being an abutment or anvil z^{20} to resist the thrust thereof. The coiler is operated by a rack z^7, engaging the pinion z^3, and reciprocated by a rock-shaft z^8, having an arm z^9, connected to said rack by a rod z^{10}. The rock-shaft z^8 is arranged vertically in suitable bearings z^{11} z^{11}, attached to the frame of the machine, and on its upper end is an arm z^{12} with a roller z^{13}, bearing against a cam z^{14} on the end of the shaft C. The cross-bar a^4 is vertically adjustable in the machine, so as to adjust the coiler vertically whenever desired, while the bracket z' for said coiler is adjustable longitudinally of said bar a^4, and the connecting-rod z^{10} is adjustably connected to the rack, whereby the coiling mechanism may be shifted transversely of the machine. The arm z^9 is likewise adjustable on the rock-shaft z^8, being splined thereto for this purpose.

The operation of the machine is as follows:

Assuming that the strand-wires have been fed from the reels through the various guides past the electrodes and finally secured upon the take-up roll and that the stay-wire has been fed from its reel into position ready for feeding, power is applied to the belt-wheel b^3 and the main circuit C is closed by means of the hand-switch y. The stay-wire is fed by its feeding-wheels into the rotatory holder, the strand-wires being also fed forward one step at this time. When the stay-wire pauses momentarily in its feeding movement, the cutter is actuated to cut off a length therefrom, and immediately thereafter the holder is rotated one step to bring the severed length of stay-wire against the strand-wires. The movement of the holder brings another line of grooves into alinement with the stay-wire guide, so that the stay-wire can be again fed slowly into the holder while the next succeeding operations are taking place. Immediately after the stay-wire is placed against the strand-wires the plunger-rail v^6 is moved toward the support a^3 by the cams q and the levers v^{10}. The plungers force the movable electrodes against the crossed wires and bind them firmly together and firmly against the stationary electrodes, the pressure, however, being yielding. Then the branch circuits C' C' are each closed in succession by the cams y^2 and the circuit-closers y', and the current flowing through the primary coils of the transformers causes the formation of a welding-current through the secondary coils, whereby the wires are welded together. The springs between the plunger-rail and the plungers force the plungers forward as the wires soften, the movement of the plungers being sufficient to operate the circuit-breakers y^8 and break the circuit in each one of the branch circuits C^2, into which the main branch circuits C' are divided. The plunger-rail is then returned to its normal position, and as the plungers move back the switch-levers y^8 are forced back, bringing the contact-points y^7 into contact with the stationary contact y^5. At this time the cams y^2 are rotated sufficiently to permit the switch-levers y' to be drawn away from the contacts y^3, so as to break the main branch circuits C' at those points. As the plungers return to their normal positions the feeding-wheels f for the strand-wires are advanced to feed the strand-wires forward and the cycle of operations is completed.

The coiling apparatus is actuated while the strands are quiescent, being operated, as described, by a rack reciprocated by power-transmitting devices from the shaft c.

During the intermittent feeding of both the strand and the stay wires the equalizing devices operate automatically to maintain a steady pull upon the wires in the reels.

It will be observed from the foregoing description that the machine is adapted for many and varied uses. It is so constructed that the parts are all capable of adjustment with relation to each other, many of them being removable or interchangeable, whereby I am enabled to manufacture upon the same machine wire fabric of a great many kinds. The distance between the strand-wires may be varied, while the number of strand-wires may be increased or decreased for the formation of a fence or fabric having any desired number of strands.

By employing the movable holder for the stay-wire I am enabled to provide for the slow in-feeding of said stay-wire, and thereby prevent the jerking of the latter during the feeding operation. The feeding of the stay-wire is practically continuous, it ceasing only momentarily while the wire is being cut and the holder is being rotated to present a stay-wire to the electrodes for the welding operation.

While the strength of the current and the amount of mechanical pressure exerted by the movable electrode may be varied, yet for the best results and to make welds quickly I find it preferable to have the movable electrode yieldingly exert upon the parts to be welded at their point of contact a mechanical pressure of such an intensity that the electrode will move forward instantly upon the softening of the metal to complete the weld—that is, this mechanical pressure is nearly equal to the crushing strength of the material. If a mechanical pressure of much less intensity were used, the movable electrode would not give its final movement quick enough nor until the metal had been softened more than would be necessary for the purposes of the weld. The current should be of relatively large volume to localize its heating action—that is, to soften the parts to be welded at their point of contact before the heating action has time to extend to more remote portions of said parts adjacent to the point of contact and which it is not necessary to soften for the purposes of the weld. The machine therefore simultaneously exerts upon the parts to be welded at their point of contact a heavy yielding mechanical pressure and a heavy current, producing a rapid heating action, the movable electrode by which the mechanical pressure is applied to the parts to be welded operating to automatically cut off the current as the electrode gives its final forward movement upon the softening of the metal.

Having thus explained the nature of the invention and described a way of constructing and using the same, though without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. A machine of the character specified comprising means for holding the strand and the stay wires, and means for electrically welding said wires at their point of contact consisting of electrodes, an automatic circuit-closer, and an independent automatic circuit-breaker.

2. A machine of the character specified

comprising means for holding the strand and the stay wires, and means for electrically welding said wires at their point of contact, consisting of electrodes of which one is movable, and a device controlled by said movable electrode for closing and opening the current through the electrodes.

3. A machine of the character specified comprising means for holding the strand and the stay wires, and means for electrically welding said wires at their point of contact, consisting of electrodes of which one is movable and an electrical circuit having two switches in series, means for automatically operating said switches in succession to close the circuit, and a device controlled by the movable electrode for automatically moving the first-closed switch to break the circuit at the completion of the weld.

4. A machine of the character specified comprising a plurality of welding devices, each consisting of two electrodes of which one is movable, an automatically-movable plunger-rail, and operative connections between the movable electrodes and the plunger-rail.

5. A machine of the character specified comprising a plurality of welding devices, each consisting of two electrodes of which one is movable, an automatically-movable plunger-rail, and operative yielding connections between the movable electrodes and the plunger-rail, whereby the electrodes can accommodate themselves to the wires.

6. A machine of the character specified comprising a plurality of welding devices, adjustable mechanism for feeding wires to said welding devices, and a support on which said welding devices are mounted adjustably with relation to each other.

7. A machine of the character specified comprising a plurality of electrical welding devices, each including electrodes and a transformer, a main circuit in which said welding devices are arranged in multiple arc, and a circuit-controller for each welding device.

8. A machine of the character specified comprising a plurality of electrical welding devices divided into groups, a main electrical circuit having a branch for each group, and circuit-controller for each branch circuit.

9. A machine of the character specified comprising a plurality of automatic electrical welding devices divided into groups, a main electrical circuit having a branch for each group, a circuit-controller for each branch circuit, and an auxiliary circuit-controller for each welding device.

10. A machine of the character specified comprising a plurality of electrical welding devices divided into groups, a main electrical circuit having a branch for each group, a circuit-controller for each branch circuit, and means for automatically operating said controllers in succession.

11. A machine of the character specified comprising welding-electrodes of which one is movable toward and from the other, and a guide on the stationary electrode for one of the wires.

12. In a machine of the character specified electrical welding means, including electrodes, and a closed guide for the strand-wire on one of the electrodes.

13. A machine of the character specified comprising means for electrically welding the strand and the stay wires together, and a holder for the stay-wire, said holder consisting of a shaft and a plurality of rolls on said shaft, each roll being formed in separable sections adjustably secured to said shaft.

14. A machine of the character specified comprising means for electrically welding a strand and a stay wire, an automatic cutter for severing the stay-wire, and means for securing said cutter at any adjustment to vary the length of the stay-wire.

15. A machine of the character specified comprising means for electrically welding the strand and the stay wires, means for feeding the stay-wire from a suitable source of supply, and means for equalizing the stress of the feeding means on the wire.

16. A machine of the character specified comprising means for electrically welding the strand and the stay wires, means for feeding the stay-wire from a suitable source of supply, and a yielding equalizing-roll for the stay-wire.

17. A machine of the character specified comprising means for electrically welding the strand and the stay wires, a feeding-wheel for said stay-wire, a pawl and ratchet for rotating said wheel, an arm carrying said pawl, and a rack and pinion for oscillating said arm.

18. A machine of the character specified comprising means for electrically welding the strand and the stay wires, a feeding-wheel for said stay-wire, double cranks and operative connections between said cranks and said wheel.

19. A machine of the character specified comprising means for electrically welding the strand and the stay wires, a pair of automatically-driven pawls, and a feeding-wheel for said stay-wire actuated by said pawls alternately.

20. A machine of the character specified comprising means for electrically welding the strand and the stay wires, feed-wheels for said stay-wire, and a spring-pressed handle for holding said wheels in frictional engagement with the stay-wire.

21. A machine of the character specified comprising means for electrically welding the strand and the stay wires at their points of intersection, means for intermittingly feeding the strand-wire, and means for equalizing the stress upon the strand-wire, whereby said wire is drawn evenly from its reel.

22. A machine of the character specified

comprising means for electrically welding the strand and the stay wires at their points of intersection, means for intermittingly feeding the strand-wire, and devices between the feeding means and the supply-reel for intermittingly unwinding the wire from its reel.

23. A machine of the character specified comprising means for electrically welding the strand and the stay wires at their points of intersection, means for intermittingly feeding the strand-wire, and devices between the feeding means and the supply-reel for intermittingly unwinding the wire from its reel, when the feeding means are quiescent, whereby the wire is drawn evenly from its reel.

24. A machine of the character specified comprising means for welding the strand and the stay wires at their points of intersection, and one or more circumferentially-grooved toothed wheels for feeding said strand wire or wires the teeth of said wheels being arranged to engage the stay-wires while the strand-wires lie in the grooves.

25. A machine of the character specified comprising means for welding the strand and the stay wires at their points of intersection, and a feeding-wheel for the strand-wire, said wheel being constructed and arranged to engage the stay-wire which is welded on the strand-wire.

26. A machine of the character specified, comprising electrodes for welding the strand and the stay wires at their points of intersection, and means for guiding the strand-wires between said electrodes, said means comprising two or more rolls for said strand-wires, one roll being adjustable transversely of its axis and of the line of feed of said strand-wire.

27. In a machine of the character specified, means for feeding the strand-wires, means for electrically welding stay-wires to said strand-wires, and mechanism for coiling the projecting ends of the stay-wires around the outer or selvage strand-wire.

28. In a machine of the character specified, means for feeding the strand-wires, means for electrically welding stay-wires to said strand-wires, mechanism for coiling the projecting ends of the stay-wires around the outer or selvage strand-wire, and an adjustable support for said coiling mechanism.

29. A machine of the character specified comprising holders for the strand and the stay wires, and means for electrically welding said wires at their points of contact, said welding means consisting of supports having slots or recesses in their ends, and dies or electrodes fitting in the recesses in the said supports.

30. A machine of the character specified comprising means for electrically welding the strand and the stay wires together, said means including a stationary electrode, a movable electrode, and a rail for operating said movable electrode, and means for regulating the electrical current, including a switch operated by the movement of said rail.

31. A machine of the character specified comprising means for electrically welding the strand and the stay wires together, said means including a stationary electrode, a movable electrode and means for operating the last-mentioned electrode, and current-controlling means including a switch, and mechanical connections between the switch and the electrode-operating means, whereby the circuit is broken when the movable electrode is moved in one direction, and is closed when it is moved in the opposite direction.

32. A machine of the character specified, comprising a plurality of electrical welding devices, each including electrodes and a transformer, a main electrical circuit having a branch leading to each of said welding devices, a circuit-closer for each branch circuit and means for automatically operating said closers in succession.

33. In a machine of the character specified, means for applying pressure to the parts to be welded comprising a positively-actuated member, an electrode yieldingly connected to said member, means for applying a current of electricity to said parts comprising a circuit-closer, means for operating the same to close the circuit at the time of the weld, an independent circuit-breaker arranged to be operated by the final forward movement of the electrode, whereby the parts to be welded are softened at their point of contact and the electrode automatically forced forward to complete the weld and operate the circuit-breaker to break the circuit.

34. In a machine of the character specified, means for applying pressure to the parts to be welded at their point of contact, comprising a positively-actuated member, an electrode yieldingly connected to said member, means for applying a current of electricity to said parts at their point of contact, comprising a circuit-closer, means for operating the same to close the circuit at the time of the weld, an independent circuit-breaker arranged to be operated to break the circuit by the final forward movement of the electrode, whereby when the parts are not in a position for welding, the electrode is given its full movement by said member, and the circuit is opened by the circuit-breaker before it is closed by the circuit-closer.

35. In a machine of the character specified, means for simultaneously applying to the parts to be welded at their point of contact a yielding mechanical pressure nearly equal to the crushing strength of the material, and a current of electricity of relatively large volume, said means including a yieldingly-mounted electrode and a circuit-breaker arranged to be operated thereby.

36. In a machine of the character specified, means for simultaneously applying to the parts to be welded at their point of contact,

a yielding mechanical pressure nearly equal to the crushing strength of the material, and a current of electricity of relatively large volume, said first-mentioned means being arranged to automatically further force said parts together when the material softens and automatically break the circuit.

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

JOHN C. PERRY.

Witnesses:
MARCUS B. MAY,
A. D. HARRISON.