No. 721,605. PATENTED FEB. 24, 1903.

P. A. REID, J. KELLEY & W. V. REID.

WIRE FABRIC MAKING MACHINE.

APPLICATION FILED OCT. 15, 1901.

NO MODEL. 9 SHEETS—SHEET 1.

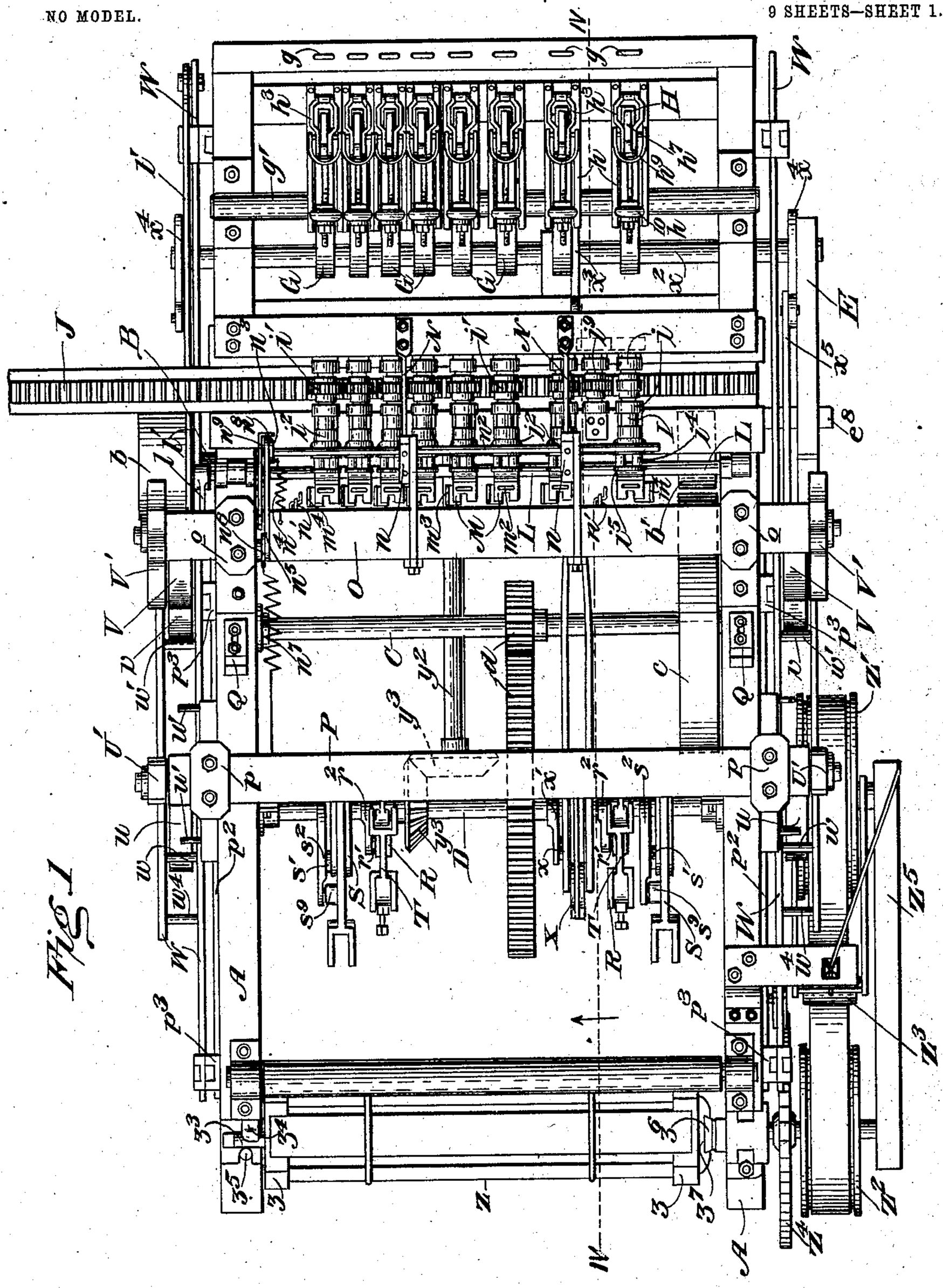

Fig. 1.

Witnesses
Norris A. Clark.
Arnold H. Dowell

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Patrick A. Reid
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NO MODEL. 9 SHEETS—SHEET 2.

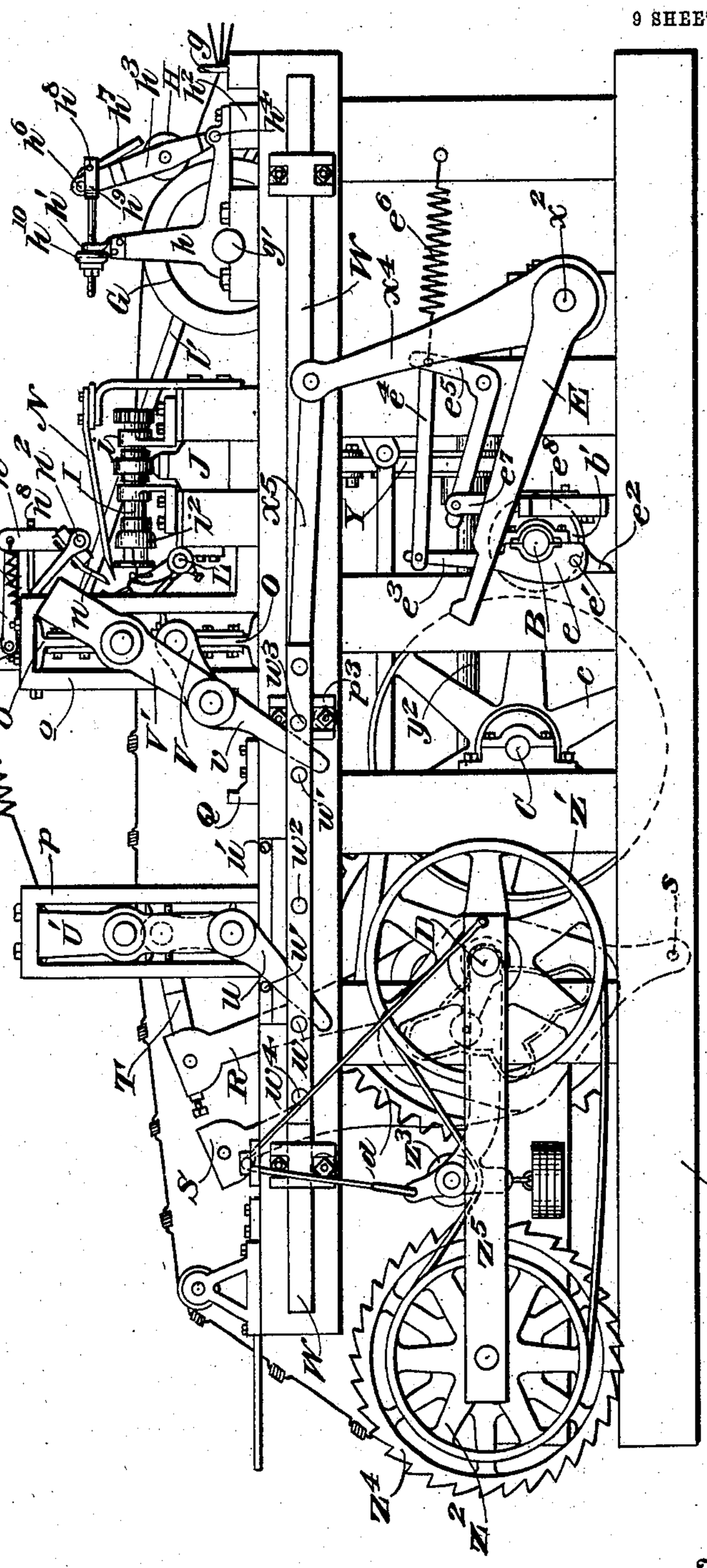

Fig. 2.

Witnesses
Fowrs & Clark.
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Pettis A. Reid
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No. 721,605. PATENTED FEB. 24, 1903.

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WIRE FABRIC MAKING MACHINE.

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NO MODEL 9 SHEETS—SHEET 3

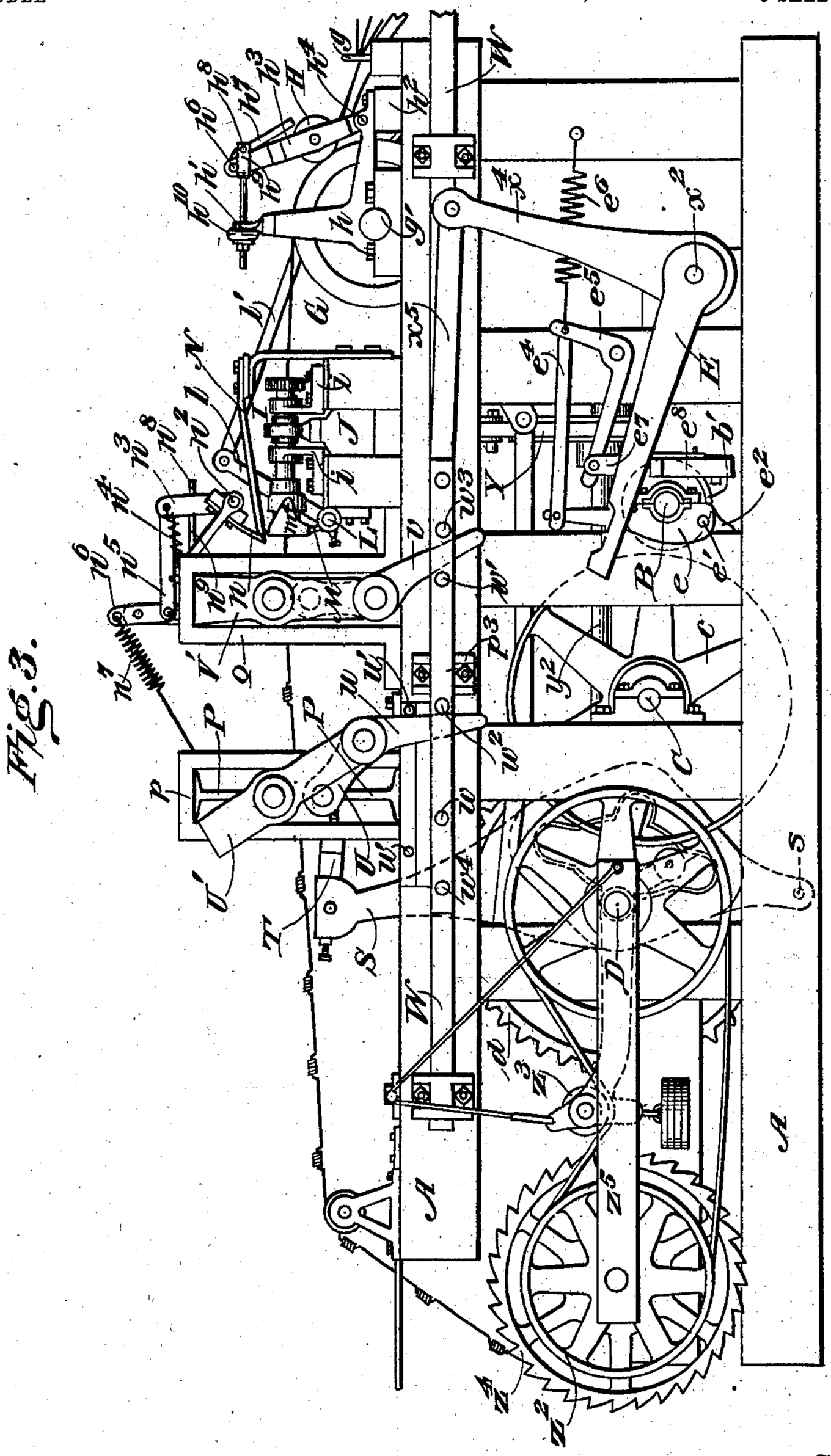

Fig. 3.

Witnesses
Norris A. Clark.
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No. 721,605. PATENTED FEB. 24, 1903.

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NO MODEL. 9 SHEETS—SHEET 4.

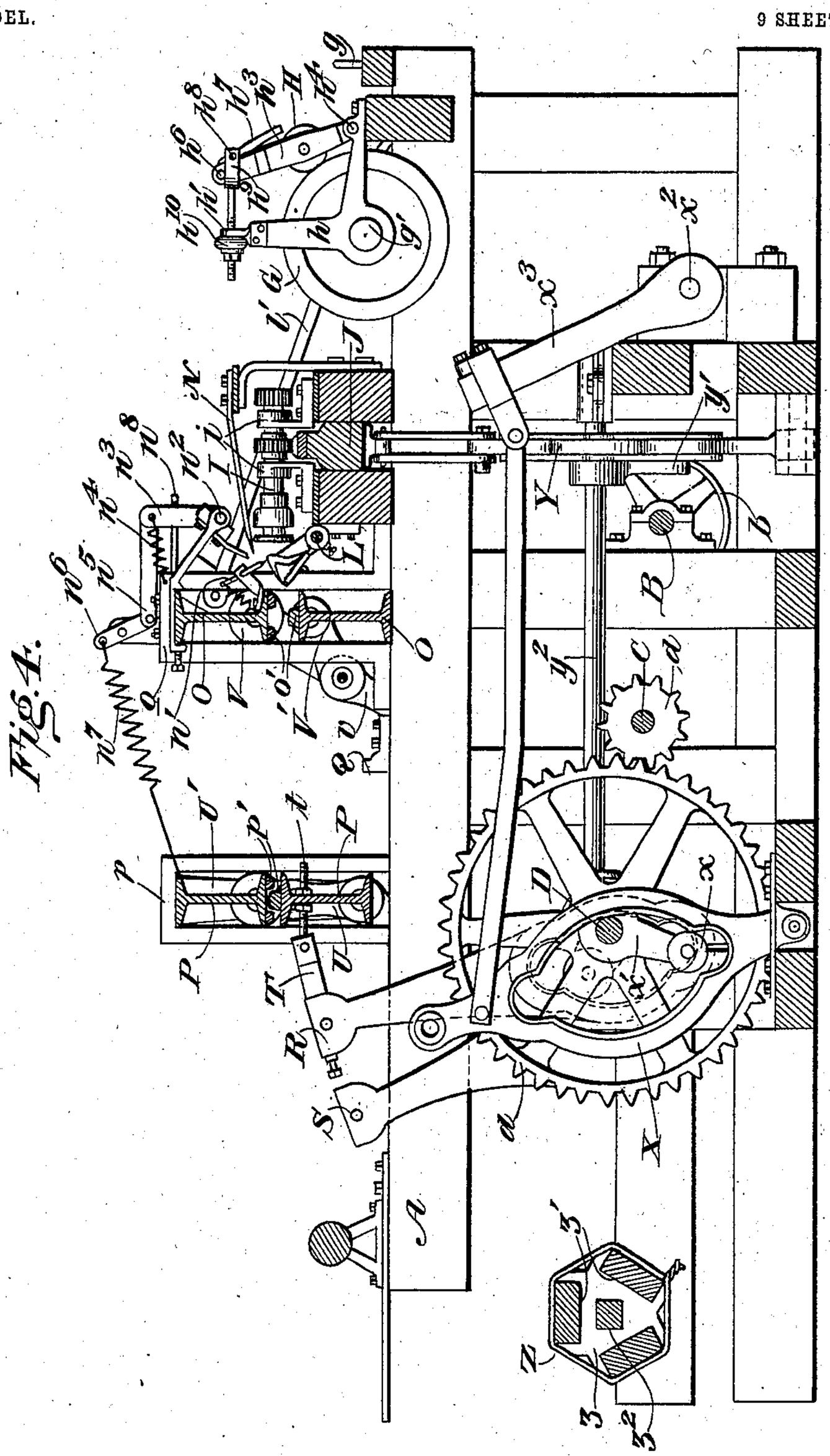

Fig. 4.

Witnesses
Morris A. Clark
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WIRE FABRIC MAKING MACHINE.

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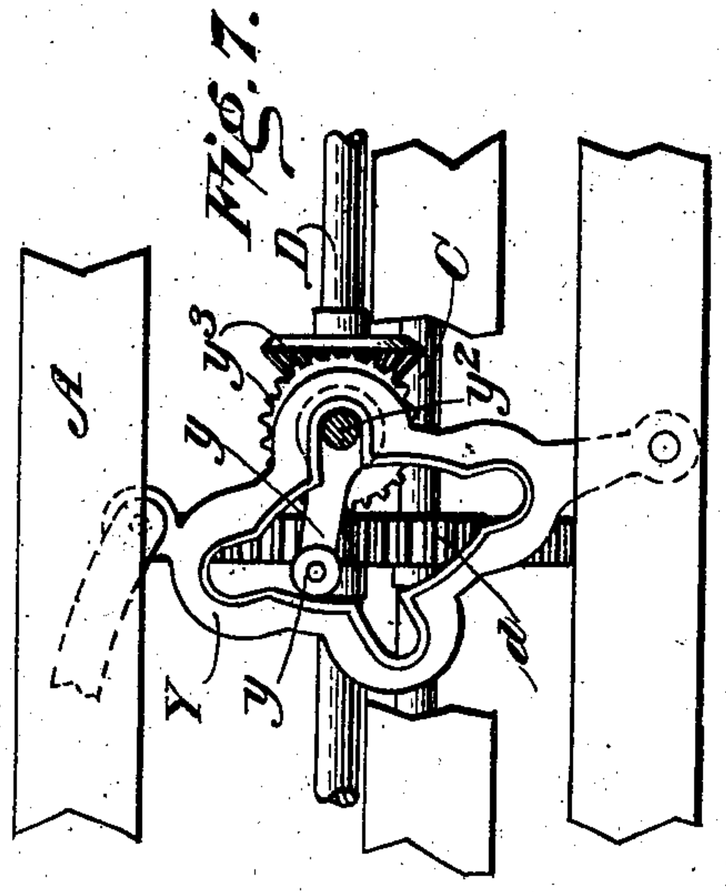
NO MODEL. 9 SHEETS—SHEET 5.

Fig. 7.



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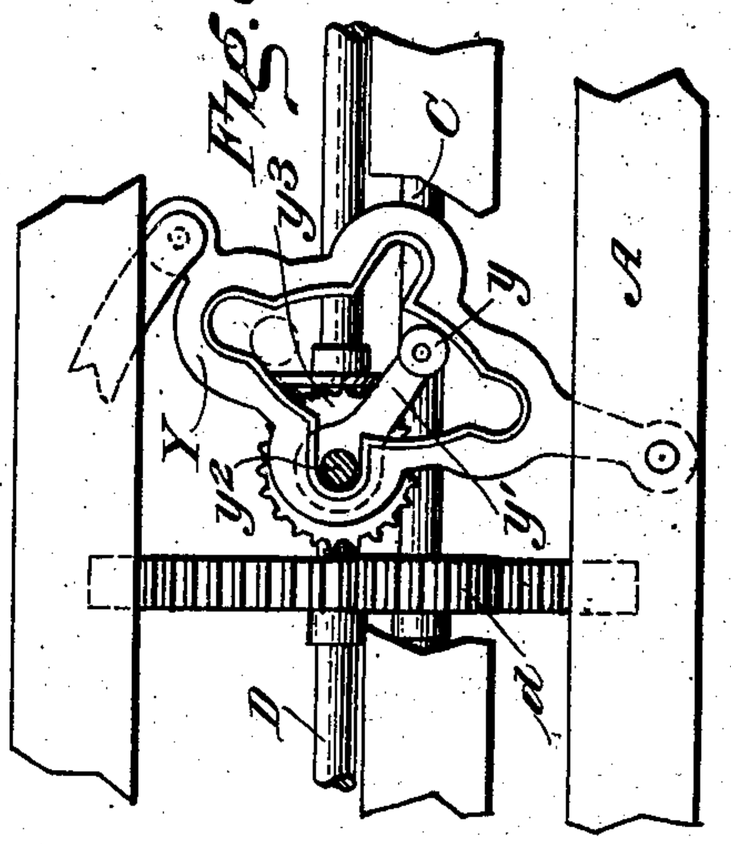
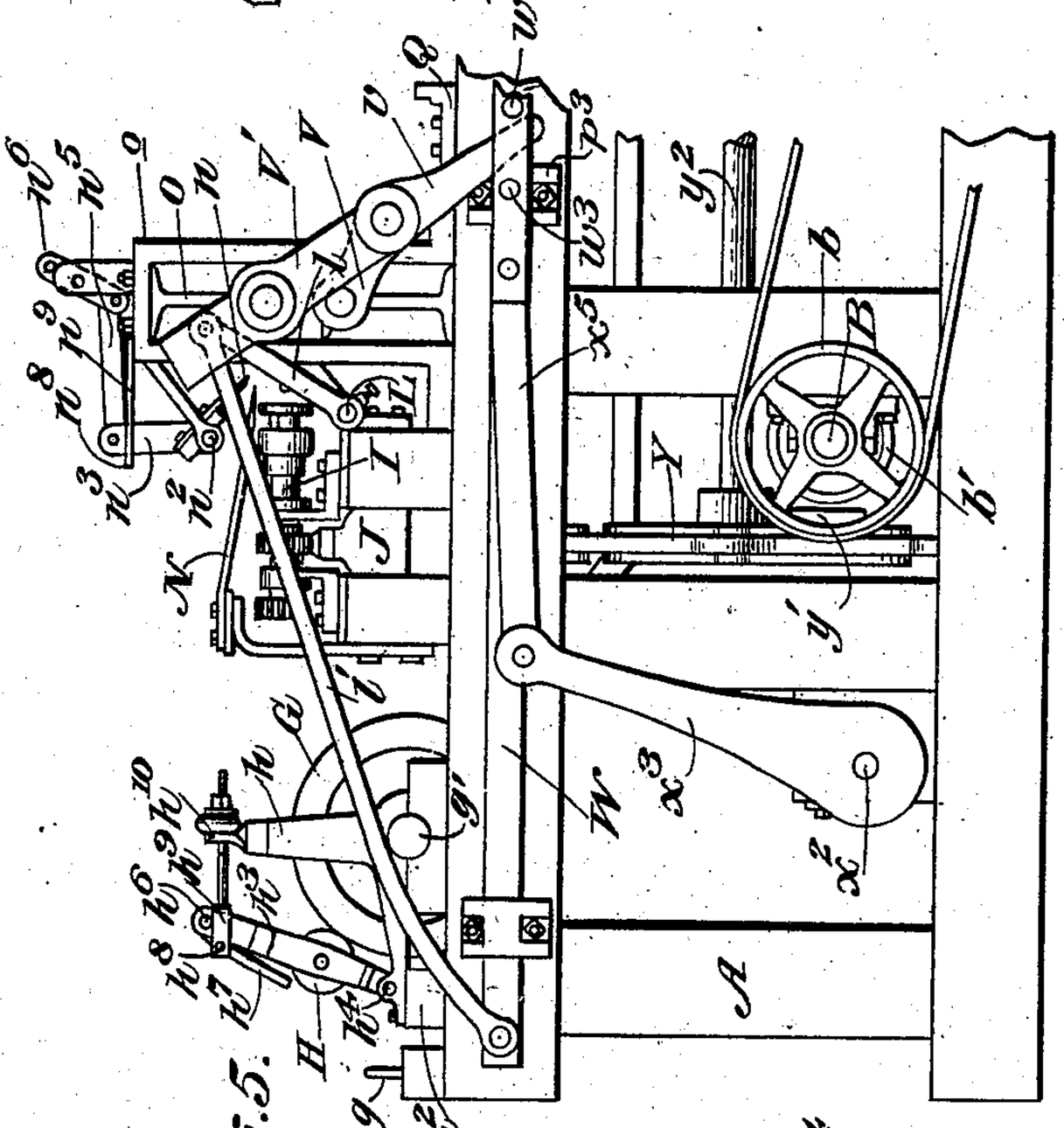


Fig. 5.



Witnesses

Loris A. Clark.

Osgood A. Gourley

Inventors.

Peter's A. Reid

James Kelley

Walter V. Reid

By Julian A. Donnell

Attorney

No. 721,605. PATENTED FEB. 24, 1903.

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WIRE FABRIC MAKING MACHINE.

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NO MODEL. 9 SHEETS—SHEET 6.

Fig. 10.

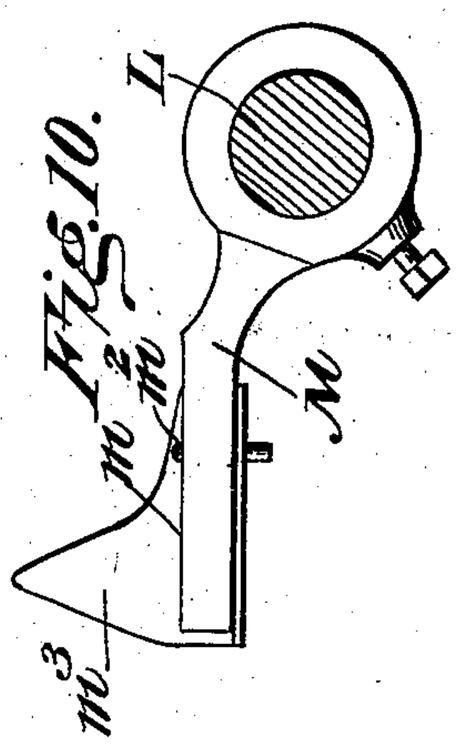


Fig. 11.

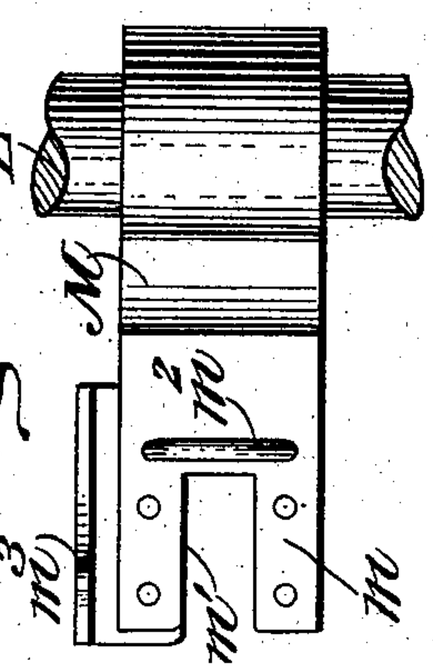


Fig. 9.

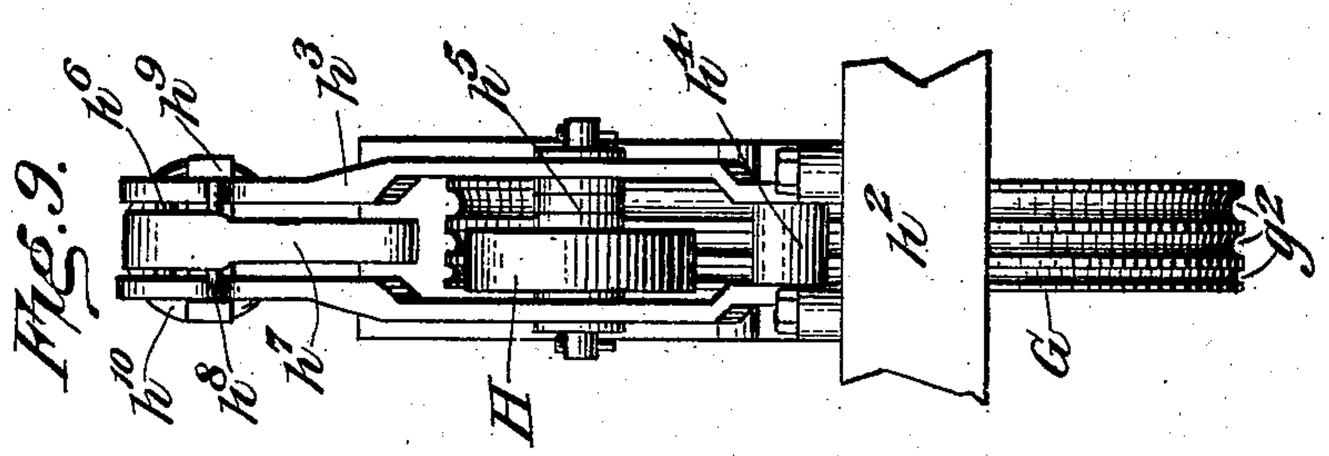
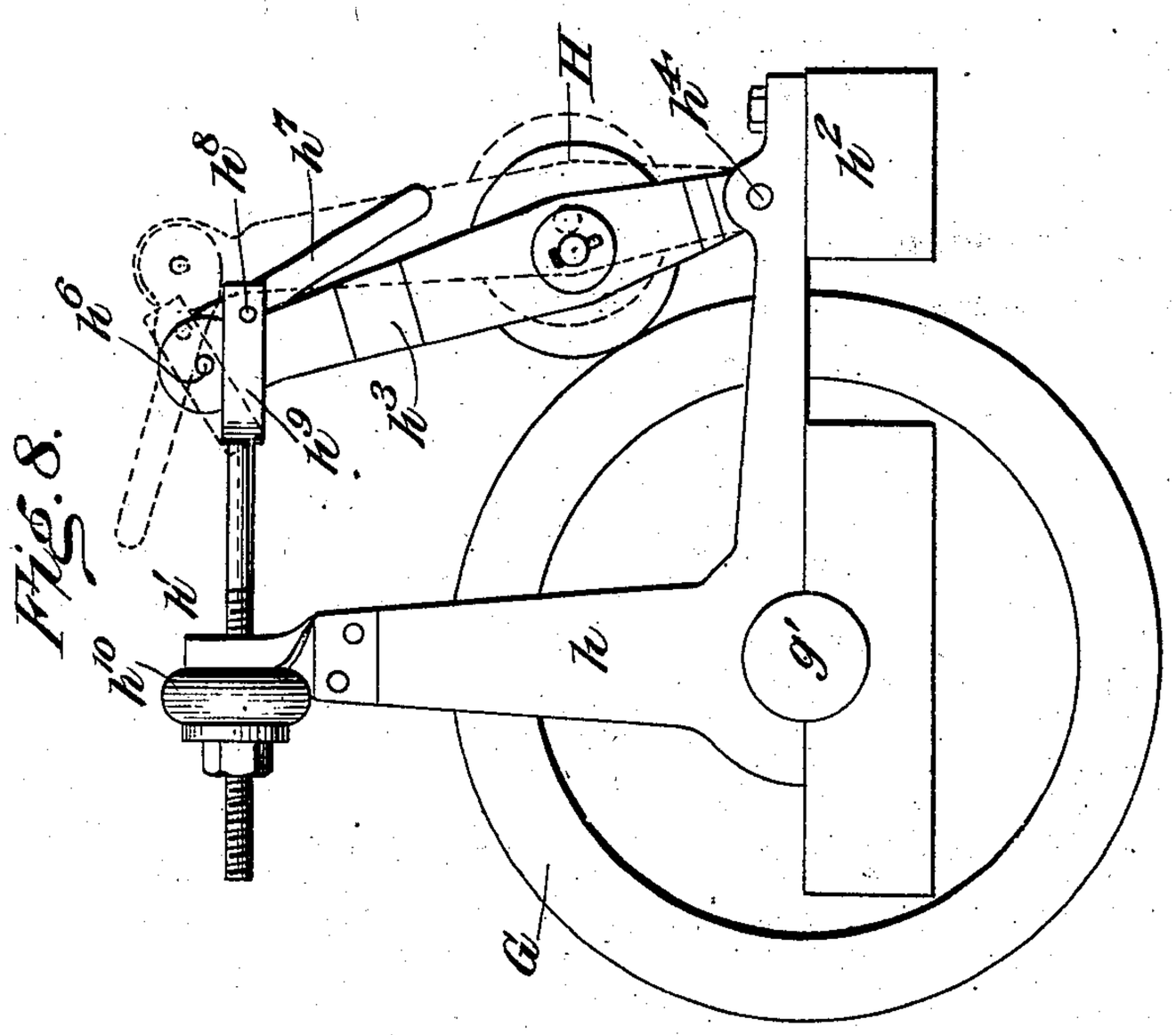


Fig. 8.



Witnesses
Norris A. Clark.
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James Kelley
Walter V. Reid
By Julian C. Dowell, Attorney

No. 721,605. PATENTED FEB. 24, 1903.

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NO MODEL. 9 SHEETS—SHEET 7.

Fig. 15.

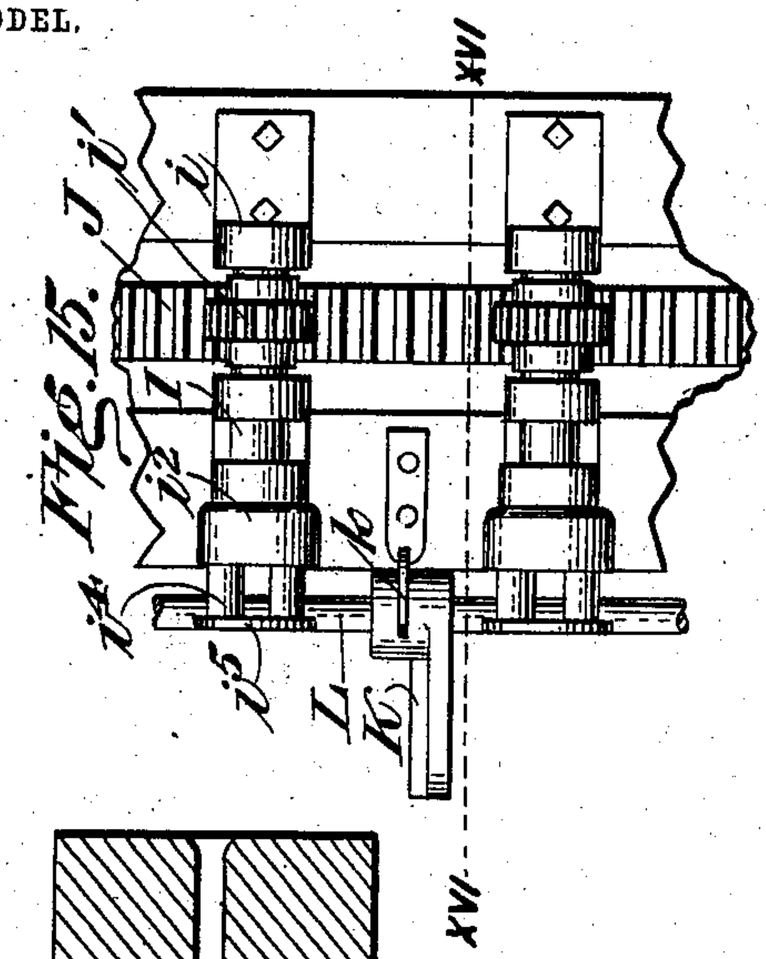


Fig. 16.

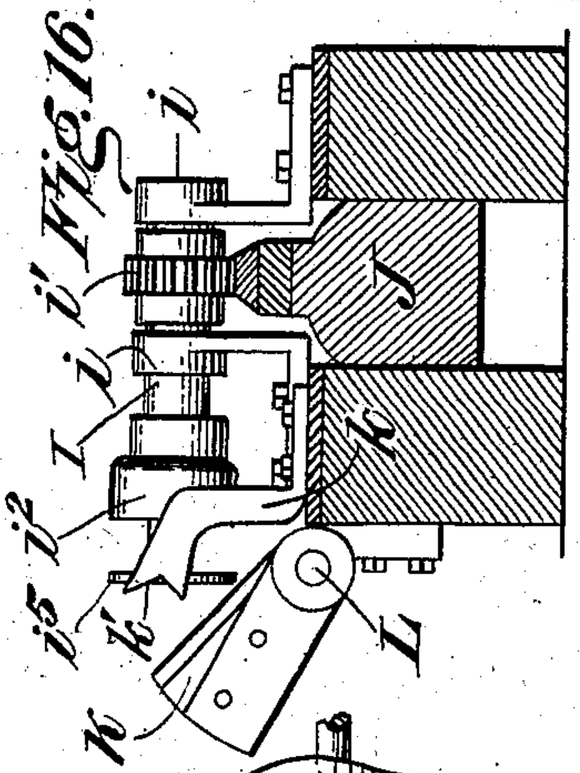


Fig. 12.

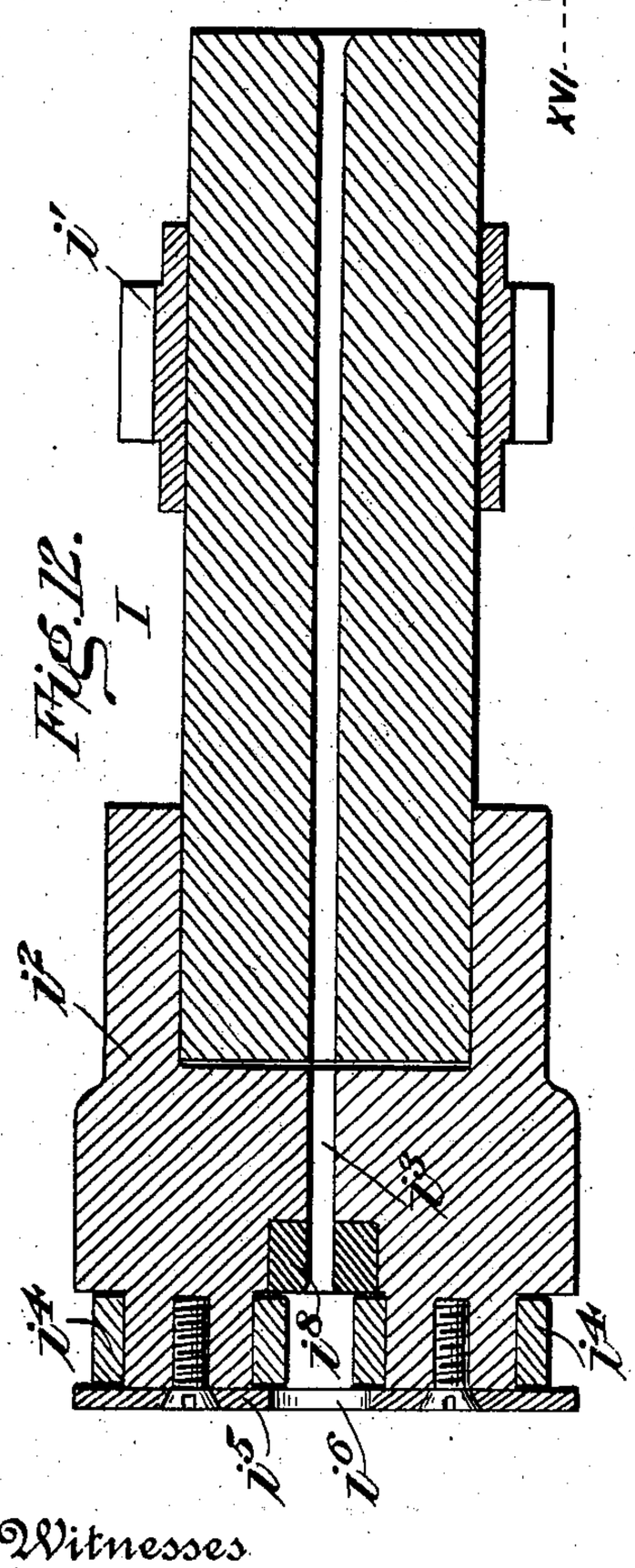


Fig. 14.

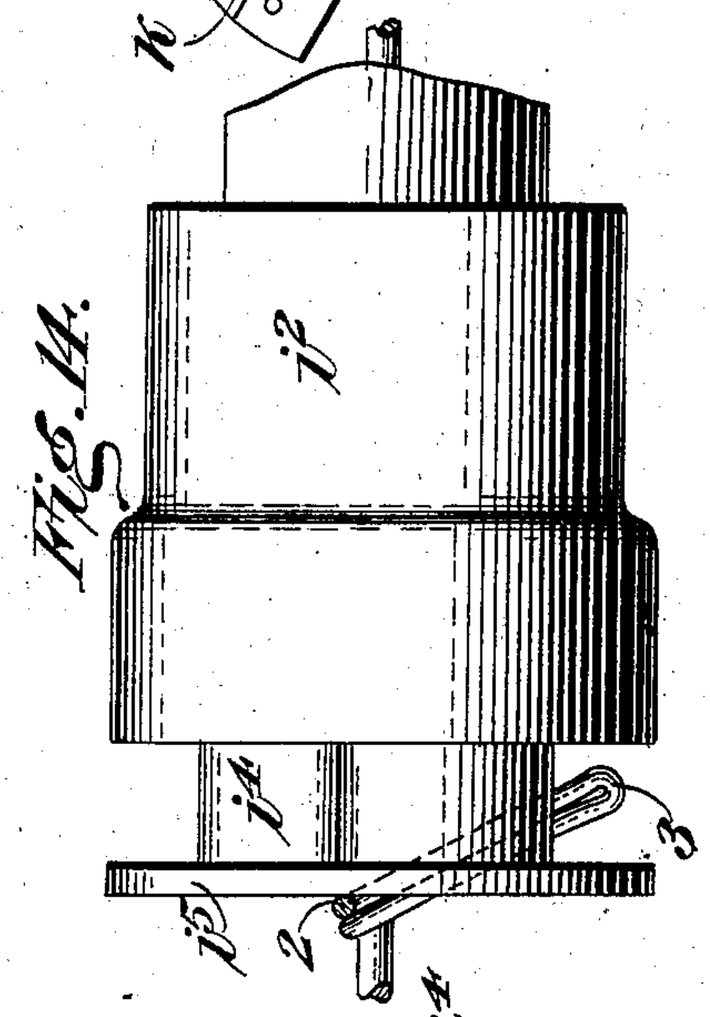
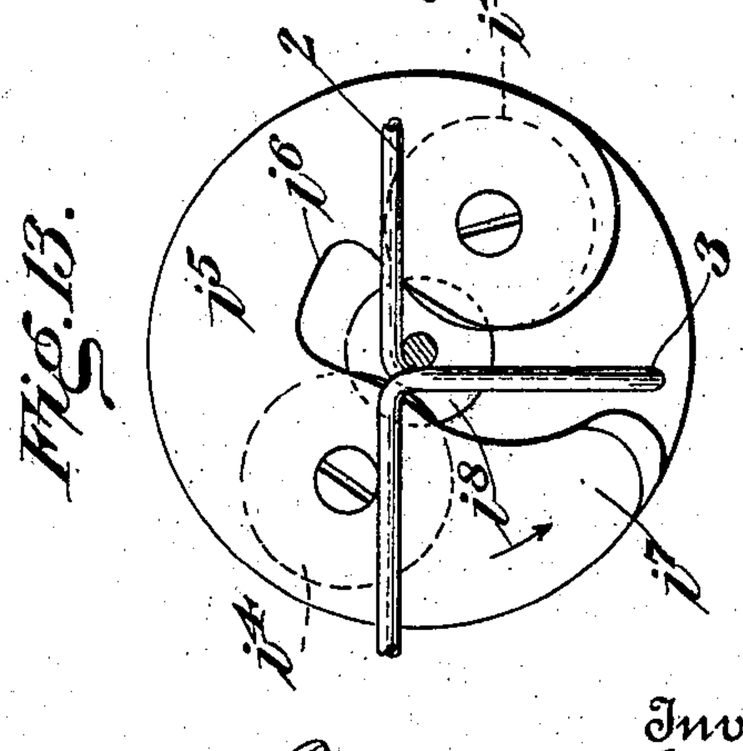


Fig. 13.



Witnesses
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No. 721,605. PATENTED FEB. 24, 1903.

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WIRE FABRIC MAKING MACHINE.

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NO MODEL. 9 SHEETS—SHEET 8.

Fig. 21.

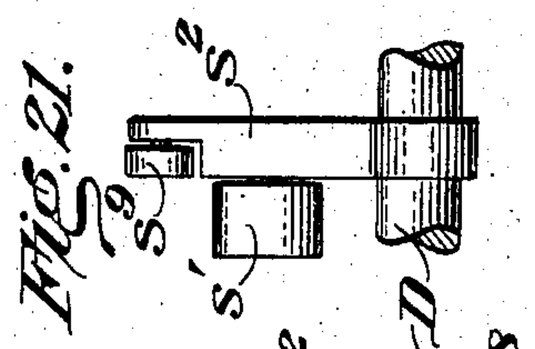


Fig. 20.

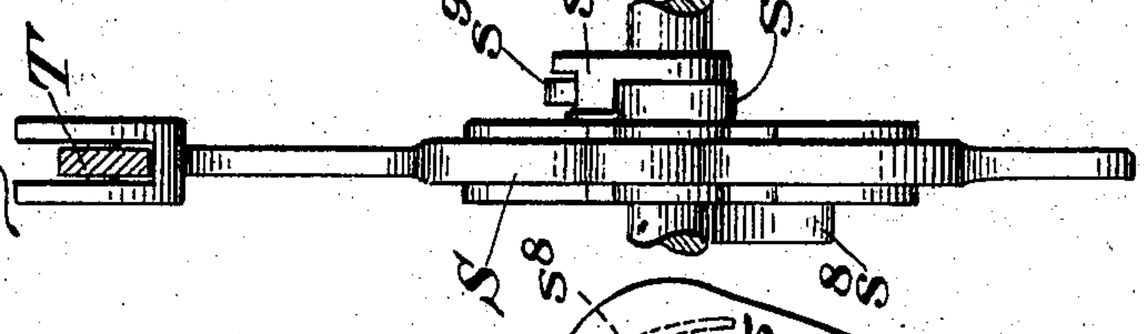
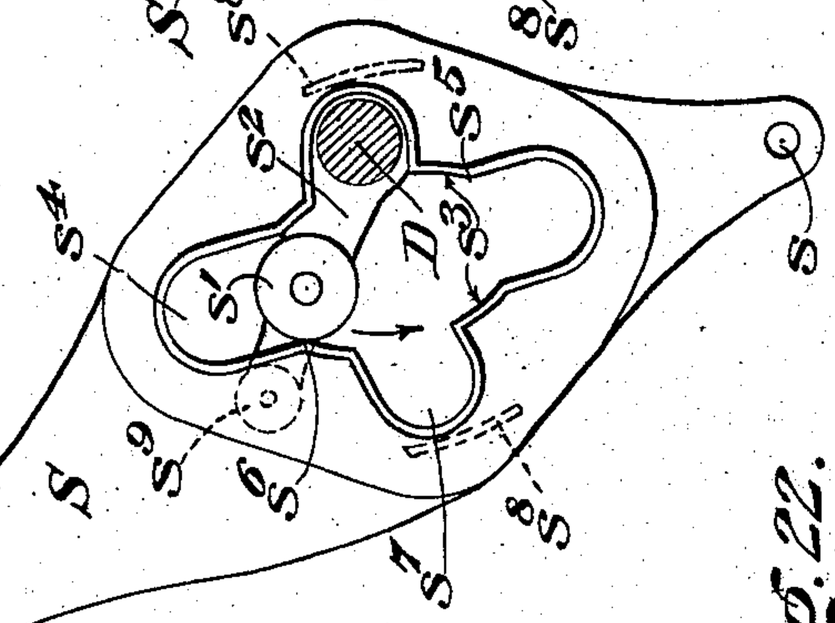


Fig. 19.



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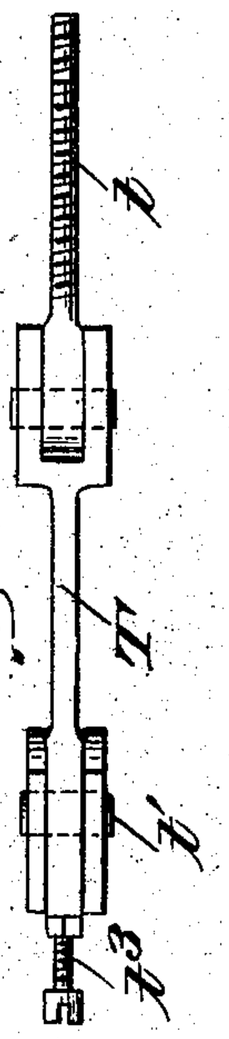


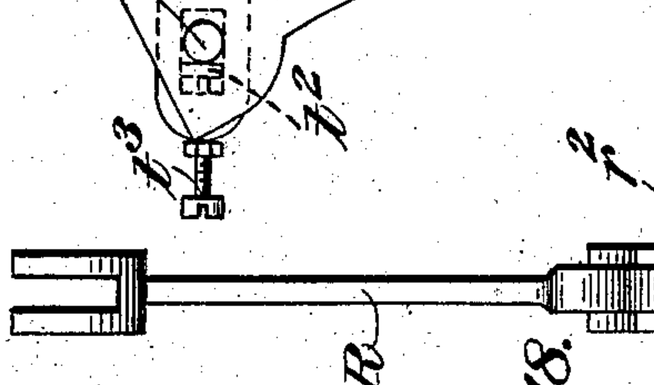
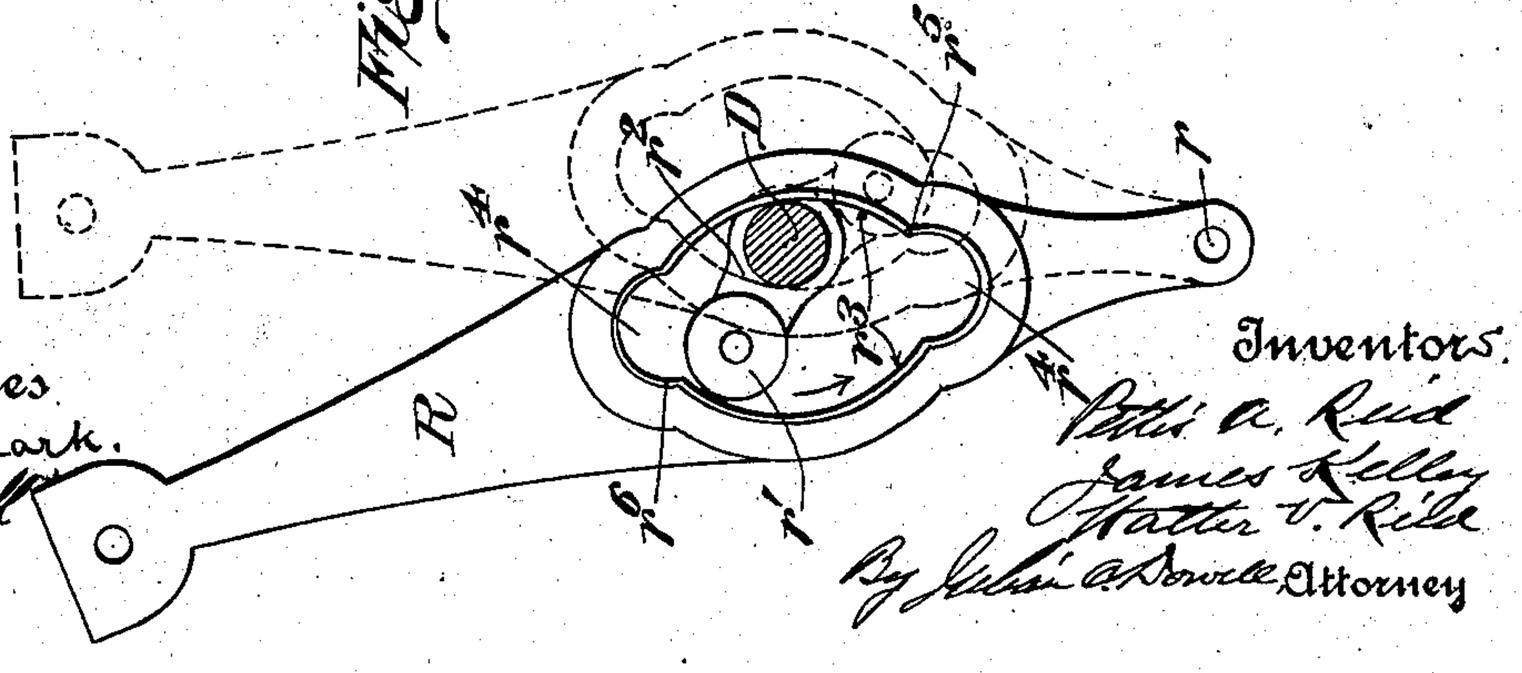


Fig. 18.

Fig. 17.



Witnesses
Norris A. Clark.
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WIRE FABRIC MAKING MACHINE.

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NO MODEL. 9 SHEETS—SHEET 9.

Fig. 25.

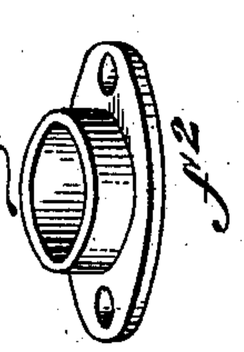
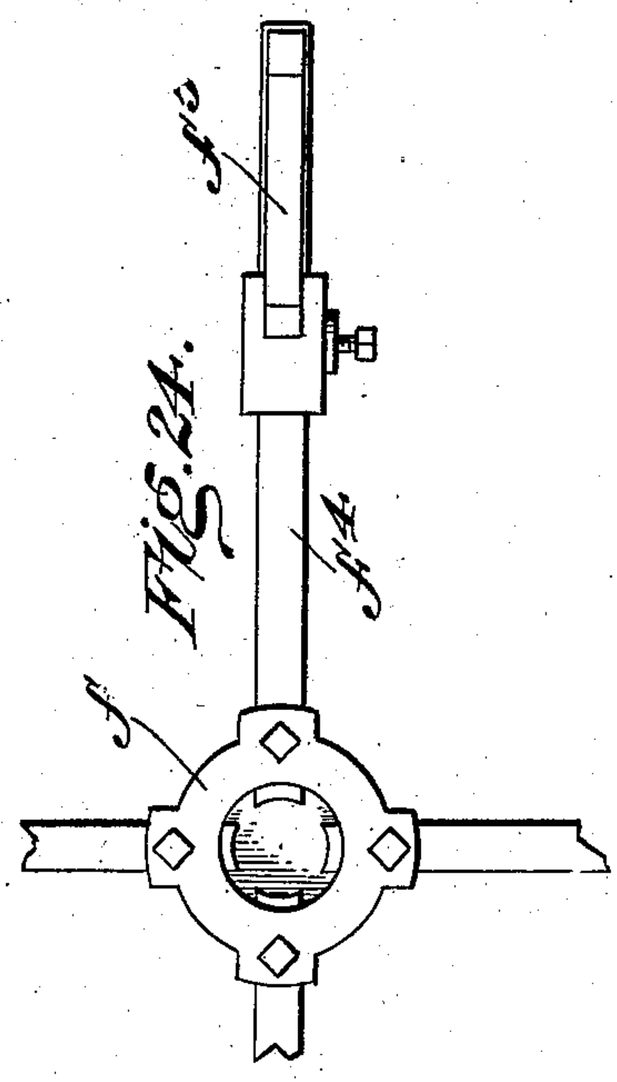


Fig. 24.



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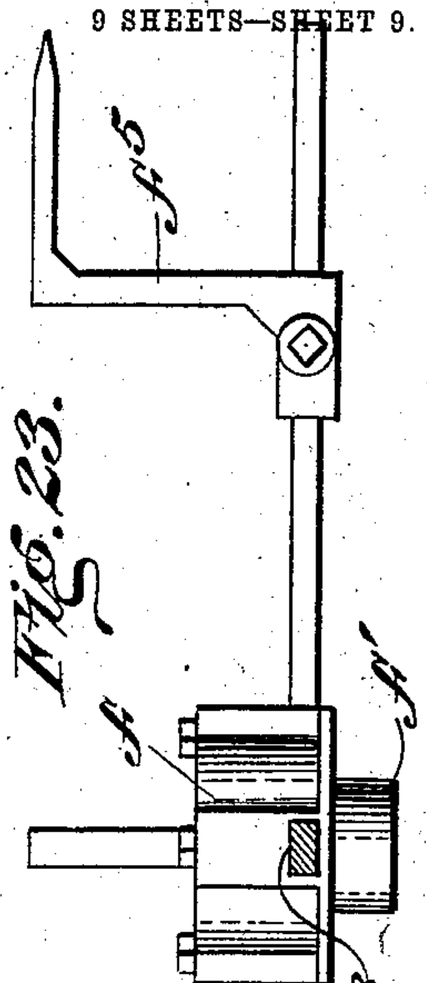

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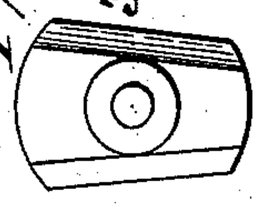


Fig. 27.

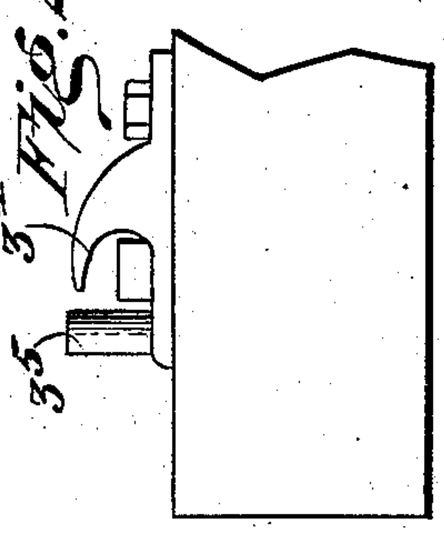


Fig. 28.

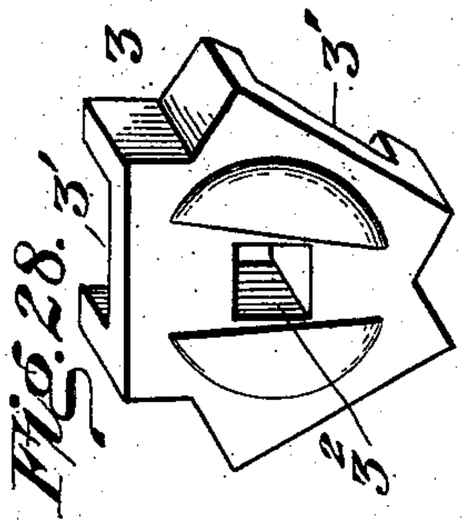
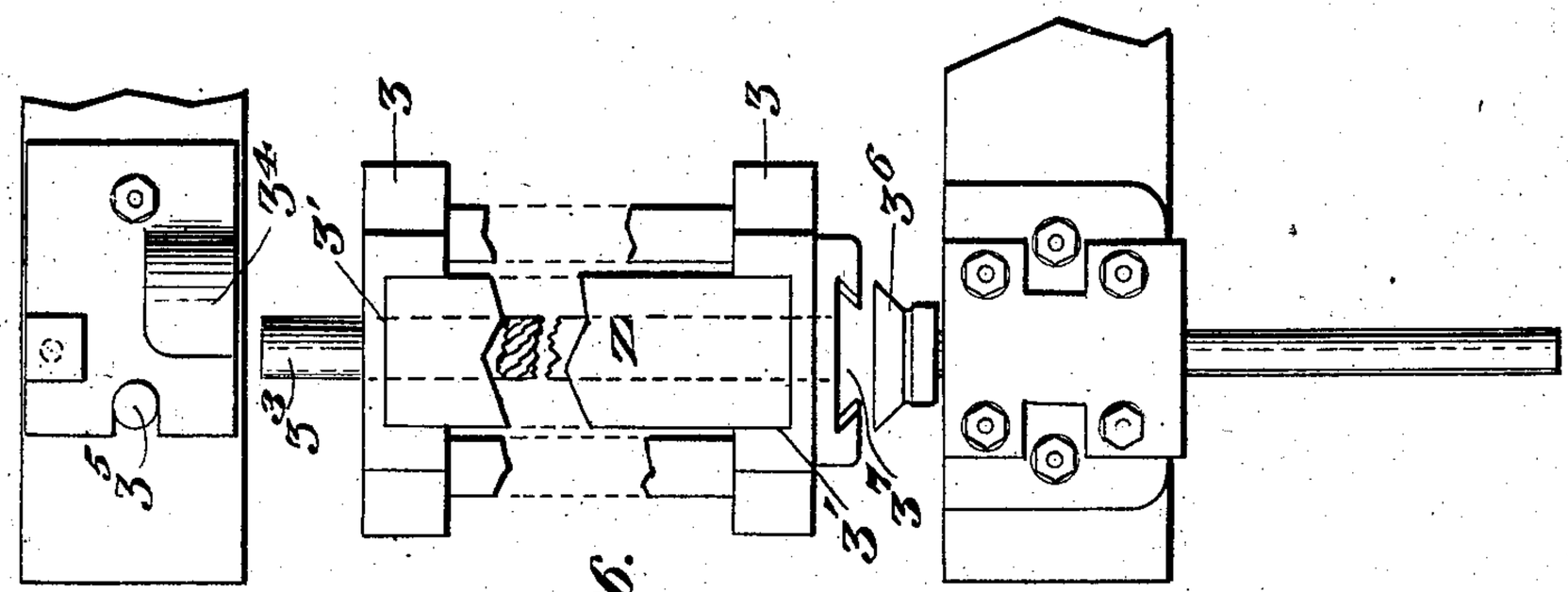


Fig. 26.



Witnesses

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UNITED STATES PATENT OFFICE.

PETTIS A. REID, JAMES KELLEY, AND WALTER V. REID, OF RICHMOND, INDIANA; SAID WALTER V. REID AND JAMES KELLEY ASSIGNORS TO SAID PETTIS A. REID.

WIRE-FABRIC-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 721,605, dated February 24, 1903.

Application filed October 15, 1901. Serial No. 78,707. (No model.)

To all whom it may concern:

Be it known that we, PETTIS A. REID, JAMES KELLEY, and WALTER V. REID, citizens of the United States, residing at Richmond, in the county of Wayne and State of Indiana, have invented certain new and useful Improvements in Wire-Fabric-Making Machines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to wire-fabric-making machinery, and more particularly to machines for the manufacture of wire fencing, consisting of a series of longitudinal strands or line-wires and cross wires or stays secured thereto at suitable intervals.

The principal object of the invention is to produce a simple, economical, and highly-efficient machine for manufacturing wire fencing of the above-noted character, which fencing shall possess maximum strength and durability, with perfect tension and equal elasticity throughout.

Further objects are to secure delivery of the strand-wires in equal lengths to the machine and the maintenance of said wires under perfect tension during the operation of attaching the stays thereto; to provide improved devices for coiling the extremities and intermediate portions of stays about the strand-wires, so as to effect rigid and permanent connections; to provide means for producing crimps or angular bends in the strand-wires at the points of connection to the stays or at other desired intervals; to automatically advance and wind the finished fabric in compact form and to provide for easily removing the same from the reel; to provide improved mechanism for operating the stay-twisting, crimp-forming, and other operative devices and for transmitting motion thereto from the main shaft of the machine; to render the machine adaptable to the production of fencing of different widths, gages, and forms and the simultaneous production of a number of lines of fencing, and to improve generally on apparatus of this same general character.

The invention will first be hereinafter more particularly described with reference to the accompanying drawings, which form a part of this specification, and then pointed out in the claims following the description.

In said drawings, in which similar parts in the several views are designated by corresponding letters of reference, Figure 1 represents a plan view of a wire-fabric-making machine embodying our invention, the parts being in the position assumed immediately after the introduction of a stay or cross wire and while the reciprocatory clutch-jaws, which engage and carry rearward the fabric after each operation of securing a stay to the strand-wires, are in their extreme rearward position. Fig. 2 is a side elevation of the same, the fabric and wires being represented in place in the machine. Fig. 3 is a similar elevation, but with the parts in the position assumed immediately prior to the operation of attaching a stay to the strand-wires, the said reciprocatory clutch-jaws being now at the limit of their forward movement. Fig. 4 is a vertical section taken on the line IV IV of Fig. 1. Fig. 5 is a partial side elevation taken at the front of the machine and from the side opposite to that represented in Figs. 2 and 3. Fig. 6 is a fragmentary detail view, in front elevation, showing mechanism for actuating the reciprocatory rack which operates the stay-twisters, the parts maintaining the same relation as in Figs. 1, 2, 4, and 5, wherein said reciprocatory rack stands at the limit of its movement preparatory to travel to effect the twisting operation. Fig. 7 is a similar view, but with the parts represented in the relation assumed immediately following the twisting operation the said reciprocatory rack being now at its opposite extreme position preparatory to movement to reverse the twisters. Fig. 8 is a detail view, in side elevation, of one of the strand-wire feeding and tensioning devices, the parts being represented in position to apply the tension and the dotted lines indicating their position when the tension is released. Fig. 9 is a front elevation of the devices illustrated in Fig. 8. Figs. 10 and 11 are enlarged detail views, in plan and side elevation, respectively, of one of the "beat-

ers" or devices for advancing and maintaining the stays in proper position for engagement by the twisters. Fig. 12 represents in detail and on an enlarged scale a longitudinal vertical section through one of the stay-twisting devices. Figs. 13 and 14 are enlarged details, in end and side elevation, respectively, of a twister-head, showing a strand-wire extending therethrough and a cross wire or stay with one of its intermediate looped portions in position to be twisted about the said strand-wires. Fig. 15 is a detail plan view of adjacent twisters of the two series of such devices and an interposed stay-cutting device of a double machine for producing simultaneously two lines of fencing. Fig. 16 is a section taken on line XVI XVI of Fig. 15. Fig. 17 is a detail view, in side elevation, of one of the reciprocatory grip and draw jaw actuating members or rocker-cams with its operating crank and roller, the full lines representing one extreme position of said member and the dotted lines indicating the opposite extreme position. Fig. 18 is an end elevation of said actuating member. Figs. 19 and 20 are corresponding views of a similar rocker-cam or actuating member with its operating crank and roller for reciprocating said jaws through a greater travel. Fig. 21 is a detail view of the crank for operating the rocker-cam represented in the last-mentioned figures. Fig. 22 is a detail plan view of one of the connecting-rods for connecting the upper arms of either of the above-mentioned rocker-cams to the said reciprocating jaws. Figs. 23 to 25, inclusive, are detail views of one of the spools for the strand-wires; and Figs. 26 to 29, inclusive, are detail views of the winding-reel.

Referring to the drawings by specific letters of reference, A designates the supporting-frame of the machine, consisting of suitable side members and intermediate standards, beams, and braces.

The letter B denotes a power-shaft, to which power may be applied through a friction-pulley b, and C denotes an idle shaft, driven through the medium of friction gears or drums b' and c by the power-shaft and driving in turn through gearing d the main shaft D, from which latter motion is transmitted to the various operative parts of the machine. The friction gear or drum b' is preferably normally maintained out of contact with the drum c', that end of the shaft B to which said drum b' is keyed or secured being mounted in a movable journal-box e, pivoted, as at e', to a member of the supporting-frame and adapted to be rocked to bring said friction-gears into contact to apply the power. The journal-box e (see Figs. 2 and 3) may be provided with a depending lug e^2, abutting a member of the machine-frame and serving to properly limit movement of the power-shaft away from the idle shaft when the power is released and also provided with an upstanding arm or projection e^3, connected by a link e^4 to preferably the shorter member of a bell-crank lever e^5, which is normally held in position to maintain the drum b' out of contact with the drum c by a retractile spring e^6 or other suitable means. The longer member of said bell-crank lever may be connected by a link e^7 to a lever e^8, fulcrumed to the framework of the machine and having its free end under control of the operator by a treadle or foot-lever E, which may be fulcrumed to any suitable support, being herein represented as loosely mounted on the end of a rock-shaft extending transversely through the lower front portion of the machine and connected to the wire-clutch and crimp-forming mechanism. On depressing the treadle E the power-shaft is moved, through the medium of levers and links e^3 to e^8, inclusive, to throw the drum b' into frictional engagement with the drum c, the combined leverage of the treadle E and the levers e^8, e^5, and e^3 serving to transmit a powerful pressure between the two friction-gears, while on releasing the treadle the levers are instantly retracted to release the said drum b' from such contact. Power may thus be applied and retracted at will, and the machine may be instantly started or brought to a full stop at any stage of its operation for adjustment, withdrawal of an imperfect or an improperly-delivered stay, or for other purposes. It will be understood that while the interposed idle shaft C and gearing d are preferably employed for the purposes of properly reducing the speed of the main shaft and taking the initial strain when power is applied the main shaft might, if desired, be driven directly from the power-shaft.

The longitudinal or strand wires, which may be of any desired number and gage or spacing, are threaded through the machine and may be delivered thereto from a series of horizontally-disposed spools, mounted for economy of space in a vertical stand or rack F at the front end of the machine, (see Figs. 5 and 23 to 25, inclusive,) and said spools, one of which is provided for each wire, preferably consist each of a hub or central portion f, having a depending spindle f', rotatable in a suitable bearing therefor, as f^2, and having a number of radial sockets f^3, in which are fitted and secured the inner ends of radial arms f^4, provided with upstanding brackets or angle-irons f^5, adjustably or slidably mounted on said arms and secured in place by set-screws or other suitable means, the upper outwardly-projecting members of said brackets and the said radial arms thus constituting extensible forks or bifurcations to receive and hold the coil or bundle of wire, which can be conveniently applied to the spool by loosening and moving inwardly the said brackets to clear the coil. The said radial arms are preferably of square or polygonal cross-section to prevent turning within their sockets or turning of the brackets f^5 thereon.

On leaving the spools the wires may pass

over a guide-roller or a series of guide-rollers G, which constitute members of the tensioning devices, and under tension-rollers H, which latter bear them down against said guide-rollers, the wires first entering the machine through eyes or guides g, which serve to direct them and also to prevent upward pressure of said wires against the tension-rollers. The guide-rollers G, one of which is provided for each wire, are keyed or otherwise secured to a central shaft g', journaled in suitable bearings at the sides of the machine, being thus all rotatable in unison, and to assure uniform advance of every wire, which has heretofore been attended with difficulty in cases where wires of different sizes—such as the top, bottom, and intermediate wires of a fence—are employed in the same fabric, said guide-rollers may each be provided with a number of circumferential grooves g^2, Fig. 9, of preferably substantially semicircular cross-section and of several sizes conforming to the diameters of different-sized wires. The several strand-wires being fitted in the proper grooves of their respective guide-rollers, so as to make the distances from the center of the shaft g' to the middle of each wire substantially equal, and said wires being closely confined in said grooves and against the guide-rollers by the tension, it follows that every wire will be advanced a uniform distance during any degree of rotation of the guide-rollers, thus rendering all the wires equally taut in the finished fabric. In place of the several guide-rollers a single roller or drum having suitable grooves at proper intervals to receive the different wires might be employed, though the construction shown is preferred, since it permits utilization of the portions of the shaft g' intermediate the said wheels as bearings for the angle-like frames or braces h, which receive the strain from manipulative levers for throwing down the tension-rollers against the guide-rollers, said frames h each comprising, preferably, a pair of angle-shaped irons or brackets, enlarged and bored at their vertices and loosely mounted on the shaft g' at the opposite sides of a guide-wheel and having their upright members suitably joined, as by an interposed connecting-iron h', and their other members extending forwardly and bolted or otherwise secured to a beam or support, as h^2, extending transversely across the machine. The tension-rollers H may be mounted in rocking frames or supports h^3, fulcrumed in front of the guide-rollers and preferably between the forwardly-extending members of the angle-shaped frames or braces h, as shown at h^4, said frames h^3 being preferably of such formation as to permit adjustment therein of the tension-wheels to cover any one of the grooves in the corresponding guide-rollers, which adjustment may be easily effected by means of washers h^5. The free ends of the frames h^3, which for the purpose of leverage are preferably removed a considerable distance from the pivots or axes of the tension-wheels, are pivotally connected, as at h^6, to manipulative levers h^7, which levers are also eccentrically pivotally connected, as at h^8, to yokes or pull-pieces h^9, having connection slightly yieldable under tensile strain with the upright members of the angle-shaped frames or braces h, in the construction shown the said yokes h^9 being loosely connected or swiveled to bolts passing through and secured behind the connecting-irons h' at the tops of said braces and stout hard-rubber buffers or compression-springs h^{10} being interposed between said irons and the fastening-nuts. When a tension-roller is raised from contact with the corresponding guide-roller, the several parts assume the relative positions indicated by dotted lines in Fig. 8, the manipulative lever h^7 being raised and thrown rearward, with the pivot h^8 standing behind the pivot h^6. To apply the tension, the manipulative lever is carried forwardly, moving the frame h^3 to bring the tension-roller against the guide-roller or the wire thereon, and after such contact by applying sufficient pressure to the lever to compress the spring or buffer h^{10}, (which is designed to be compressible only under great force,) so as to permit the pivot h^8 to pass a point forward the pivot h^6, said lever is forced down to the position shown in full lines, the pressure against the guide-rollers being considerably increased by the leverage acquired through the frame h^3. In such position the lever is obviously self-locking, so that constant high pressure is maintained against the wire, preventing all slipping, and the tension devices are furthermore self-bracing, the frames h and h^3 being connected at the extremities of each of them and upward pressure against the shaft g' being substantially counterbalanced by the pressure of the tension-roller against the guide-roller. It will be observed also that the tension-roller bears against the guide-roller at a point somewhat removed from the upper surface of the latter, so that the wire may be confined in its appropriate groove a considerable distance, thus insuring its proper advance.

The stays or cross-wires, which are formed by means independent of the machine embodying the present invention, consist of wires 2, having loops or looped portions 3 formed therein at intervals corresponding in number and spacing to the strand-wires, the said loops being preferably formed in alinement and at right angles to the body of the wire, with the two members of each lying in substantially the same plane and the intermediate portions of the wire extending or deflecting from and to corresponding members of adjacent loops—that is, from right to left, or vice versa—throughout for the purpose of securing general straightness of the stay, uniform action of the twisters, and uniformity and tightness of the knots or connections of the fabric.

The letter I indicates the rotatable twisters or coilers for wrapping the extremities

and intermediate loops of the stays about the strand-wires, a series of which twisters corresponding in number and spacing to the strand-wires are arranged transversely the machine behind the guide-wheels, preferably in substantial alinement with the upper surfaces thereof, the same being rotatably mounted in bearings or journals i and provided with gear teeth or pinions i', adapted to be engaged by a transversely-reciprocatory rack J. Said twisters may consist of spindles journaled in the bearings i, longitudinally bored to receive the strand-wires and having twister-heads i^2 fitting over and rigidly secured to preferably the rear ends thereof, Figs. 12, 13, and 14, said twister-heads being similarly bored concentrically with the spindles, as at i^3, and each head being provided at its face end with a twisting-roller or device, preferably a pair of such rollers, as i^4, which may be journaled at opposite sides of the central bore i^3 on spindles secured between the twister-head and a rear face-plate i^5, the said spindles or roller-axes being at such distances from the center of the twister as to leave only about the space of the thickness of a stay-wire between the central bore thereof and the periphery of each roller. Each face-plate i^5, which is of course rotatable with its twister-head, is preferably cut away or slotted from the periphery to the center and also a considerable amount about the center, as shown at i^6, to permit the loop or extremity, as the case may be, of the stay, which in operation is held against the face-plates, to be pushed forward through the slot between the plate and the twister-head for proper engagement by the twisting-rollers and to permit withdrawal therefrom of the knot or connection after its formation, one horn of the face-plate being also preferably extended or inturned at the mouth of said cut-away portion, as at i^7, to engage and confine the loops or extremities between the rollers in operation, said horn or prong being also suitably beveled or reduced at the extremity to prevent engagement or catching thereof in the body of the stay as the twister rotates. In operation, the strand-wires being threaded through the twisters, which prior to rotation maintain substantially the position shown in Figs. 13 and 14, the stay is laid upon the strand-wires flush against the twister faces or face-plates, the loops thereof preferably depending beside the respective strand-wires at the same sides thereof as the horns or prongs i^7, and by means hereinafter explained said loops are moved forward through the cut-away portions i^6, as illustrated in said Figs. 13 and 14, while the extremities of the stay, which project a suitable distance beyond the two outermost strand-wires of the fabric, are simultaneously bent down and snapped into the slots i^6 of the faces of the corresponding outermost twisters. On rotation of the twisters the horns or extensions i^7 of the face-plates immediately move past said loops and the extremities of the stay, confining them between the face-plates and the twister-heads, and the adjacent approaching twister-rollers engage said loops or extremities immediately behind the strand-wires or at the body of the stay and wrap them closely about the strand-wires, the other rollers following and securing or pressing the coils against said wires and also opposing the strain of the first-mentioned set of rollers, while after completion of the knots or connections the rollers of both sets continue to revolve, compressing the coils and overcoming all tendency thereof to unwind or relax. By reason of the slight amount of space left between the strand-wires and the peripheries of the revolving rollers the portions of the stays which are being wrapped are held tightly against the strand-wires, the coils prevented from overlapping and rolled compactly, thus insuring rigid and durable connections, and, furthermore, the said revolving rollers, being disposed at opposite sides of the strand-wires, prevent undue strain upon or stretching of the latter and consequent wear of the central bores of the twisters. To further insure against wear by the strand-wires during the above-described operation, the twister-heads are preferably recessed at the rear ends of the bores i^3 and provided with apertured plugs or rings i^8, of hard metal or other suitable material, which take the wear and which may be renewed and replaced when necessary. When the twisting operation is completed, the entire fabric or fencing is drawn rearwardly or toward the reel, the knots or connections passing out through the slots i^6 of the twister face-plates, and the twisters are then reversed by the rack, coming again to their initial position preparatory to attaching the succeeding stay. The two extremities of the stay are preferably twisted in opposite directions, being of course oppositely bent down over the two outermost strand-wires, (thus also tensioning the stay,) and for this purpose the proper one of the said outermost twisters (see Fig. 1) is made rotatable in an opposite direction to the remainder of the series, as by independently gearing the same with the adjacent twister or, if wanting proper proximity thereto, with an interposed idler i^9.

It will be understood that the twisters and the corresponding guide-wheels and tension devices may be of any desired number and arrangement, according to the size and style or the fencing or fabric. For the purpose of clearness and simplicity there is represented in Fig. 1 a machine designed for the production of a single line of fencing and having therefor a single series of twisters arranged at intervals corresponding to the varying distances between the strand-wires of the fence; but in practice the machines are preferably constructed for the production simultaneously of two or more lines of fencing, being therefore accordingly provided with two or more series of twisters and corresponding

guide-wheels and tension devices. The cross-wires for the several series are preferably formed integrally and are introduced in the usual manner to the twisters, a suitable cutting device being provided between the adjacent twisters of each series to sever the cross-wire prior to the twisting operation, so as to permit the severed ends to be secured to the outer wires of the two fabrics to be formed in the usual manner. Such a construction is illustrated in enlarged detail in Figs. 15 and 16, wherein are represented adjacent twisters of two series and an interposed cutting device, the latter consisting of a blade or shearing-knife K, secured to a rock-shaft L, the movements of which rock-shaft are automatically controlled by mechanism hereinafter described, and a standard or holder k, having a mouth or notched portion, as k', against which the stay is lodged when forced against the twister-faces and past which the knife moves when the shaft is rocked, thus severing the cross-wire into stays for the two series. The rock-shaft L carries also a series of "beaters" M or devices for properly advancing and forcing the stays against the twister-faces, said devices (shown in detail in Figs. 10 and 11) being arranged preferably one behind each twister and consisting of arms or members rigidly secured to the rock-shaft, which in rocking alternately elevates and lowers the beaters to throw the flat faces m thereof against and away from the rear face-plates i^5 of the twisters, the face ends of the beaters being slotted or bifurcated, as at m', to clear the strand-wires. The beaters are provided with transverse projections m^2, which when the faces m confront the face-plate i^5 stand preferably immediately beneath the strand-wires, and are further provided with forwardly-curved fingers or projections m^3, upstanding at the sides, so as to clear said face-plates i^5. Preliminarily to each twisting operation, the stay being delivered in proper position upon the strand-wires, the rock-shaft is rocked to raise or advance the beaters, which strike and push the stay against the face-plates i^5 of the twisters, the curved fingers m^3 moving over and holding the stay firmly down on the strand-wires, and the projections m^2 engaging and forcing the loops of the stay well through the slots i^6 in said face-plates for engagement by the twisting-rollers. On completion of the twisting operation the rock-shaft is oppositely rocked to depress or withdraw the beaters, thus permitting the connections of the fabric to be withdrawn from the twisters. The two outermost beaters are provided with fingers m^4, Fig. 3, upstanding at the outer sides of each and similar to the fingers m^3 of the intermediate beaters, but considerably larger, being adapted on rocking of the shaft L to bend down the extremities of the stay which project beyond the two outer strand-wires and snap the same into the slots i^6 of the face-plates of the two outermost twisters.

The stays may be delivered to the strand-wires from inclined guides or pointing-fingers N, upon which they are laid one at a time during each successive operation of the machine, and the time of delivery may be controlled by fingers n, held normally closed against the delivery ends of the guide-fingers N and intermittently opened to drop the stay just prior to the twisting operation, the proper delivery of the stays immediately behind the twisters being insured by spring-pressed pins n', Fig. 4, or other suitable devices. The said fingers n may be secured to a rock-shaft n^2, here shown supported in bearings secured to the upper member of a set of stationary wire-gripping jaws O, the rock-shaft being provided with an arm n^3, held to maintain the fingers closed by a retractile spring n^4. To intermittently open the fingers, the arm n^3 may be connected by a link n^5 to one end of a lever n^6, the other end of said lever being yieldably connected, as by a retractile spring n^7, to the upper member of a similar set of longitudinally-reciprocatory traveling wire gripping and drawing jaws P, so that the rock-shaft is turned to open the fingers when the jaws travel rearward, Figs. 2 and 4, and oppositely rocked to close the fingers when the jaws travel forward, Fig. 3. Movement of the rock-shaft under rearward pull of the jaws P may be limited by a stop n^8, projecting in the way of the arm n^3 from a suitable arm or support, as n^9, which may be secured to the said upper member of the stationary jaws.

The strand-wires are passed between the transverse stationary jaws or grippers O, thence between the reciprocatory traveling wire gripping and drawing jaws P, and finally over a suitable guide-roller to the reel z, which automatically winds the finished fabric. The stationary jaws may consist of transverse beams or members mounted one above the other in fixed frames o at the sides of the machine, one member, preferably the upper one, being rigidly secured to said frames with its lower side in substantial alinement with the twisters and the other member being arranged to reciprocate vertically therein to intermittently grip and release the strand-wires, and preferably the adjacent or gripping sides or flanges of said jaws are provided with interengaging longitudinal strips or projections o', as shown in cross-section in Fig. 4, which clutch the wires more securely and produce short offsets or angular crimps therein in an obvious manner. The crimps or offsets thus produced render the fabric elastic, and, as shown in Figs. 2 and 3, they provide snug seats for the coils of the stays, preventing lateral displacement of the latter along the strand-wires. The traveling grip and drag jaws may be similarly constructed and arranged and similarly provided with crimp-forming devices, as at p', said members being, however, mounted in longitudinally-reciprocatory carriage-frames p, which for the purpose of stability are preferably mounted on

slides or bars p^2, (seen more clearly in Fig. 1,) slidable in bearings, as p^3, at the sides of the machine, preferably on rollers within said bearings. The said traveling jaws are arranged to reciprocate intermittently to grip the fabric when at the limit of their forward movement and on backward motion to draw the fabric rearwardly, the stationary jaws remaining separated during such backward travel. When at the limit of their backward movement, the traveling jaws release and simultaneously or an instant previously the stationary jaws grip the wires, which are thus held perfectly taut between said stationary jaws and the tension devices. During advance of the traveling grip and draw jaws while the stationary jaws remain closed to hold the strand-wires taut the twisters are operated to secure the stay to said wires, and at completion of this operation the traveling jaws again grip the wires, and the stationary jaws instantly release, whereupon the fabric is carried rearwardly by said traveling jaws, withdrawing the knots or connections thereof from the twisters.

It will be observed that the strand-wires are always gripped and held taut either by the stationary or traveling jaws, one set of said jaws always clutching substantially simultaneously or an instant before the other releases, so as to stretch the fence or fabric at all times independently of the action of the reel, and thereby to stretch every strand of the series with equal tension.

The longitudinal travel of the jaws P, which determines the intervals between the stays, may be made variable and is preferably fixed so as to bring at each rearward reciprocation of said jaws a previously-attached stay either directly between the stationary jaws or to an equal distance from before to beyond the same, so that said stationary jaws crimp the strand-wires accordingly, either at the stay or midway adjacent stays, while the reciprocatory jaws are arranged to always clutch and crimp said strand-wires at the stays, the forward travel thereof always terminating at the same point or limit, which may be fixed by stops Q, standing in the path of the carriages p and preferably adjustable, as by slot-and-bolt fastenings or other suitable means. Thus in both cases crimps are produced directly at the knots or connections of the fabric, thereby preventing longitudinal movement or slipping of the stay on the strand-wires, though in the latter instance the stays are arranged at greater intervals and at alternate crimps. During the clutch by either of the jaws O or P the stay is of course projected by the tongue member of the crimping devices o' or p' between the groove members, thus preventing mutilation of the coils. In the present construction means are provided for regulating the length of travel of the jaws P to equal either the distance from the twisting devices to midway the jaws O or twice such distance, as desired, so that in the first case said reciprocatory jaws on each rearward movement draw back the fabric till the stay just previously attached to the strand-wires is brought between the stationary jaws which on closing thus crimp at the connections, the crimps formed by the preceding operation being of course drawn the same distance rearward, where on a return or later movement of the reciprocatory jaws they are again clutched by the latter to draw back the fabric, while in the second case the fabric is drawn back twice as far, carrying the said stay from the twisters to an equal distance beyond or behind the stationary jaws, which latter on closing thus crimp midway the stay and the twisters, the crimps at the connections being produced by the reciprocatory jaws on a later movement. If desired, the length of travel of the reciprocatory jaws might be made a different multiple than one or two of the distance specified and provision made for crimping the wire at other points, so as to produce other fabrics of varying design.

In their longitudinal reciprocatory travel the grip and draw jaws P are actuated from the main shaft B through the medium of preferably a pair of rocking actuating members or rocker-cams, as R R or S S, pivotally mounted in the machine-frame, as at r or s, and of internal character or formation, being operated by inner traveling contact-rollers r' and s', carried by cranks r^2 and s^2 on the main shaft. As herein shown, the jaws are connected by rods T to the swinging arms or ends of the rocker-cams R, which are designed to reciprocate said jaws through their lesser travel. The connection may, however, be changed when desired to the rocker-cams S, which are designed to double the travel of the jaws, said rocker-cams having twice the throw of the first-mentioned rocker-cams. Each rocker-cam R (shown in detail in Figs. 17 and 18) is constructed with confronting arc-shaped surfaces r^3, each of which is in turn traversed by the roller r' to maintain the rocker-cam stationary at one or the other of its opposite extreme inclined positions, (being accordingly drawn with the radius of the circle described by the outer periphery of said roller and oppositely positioned to lie, respectively, in the path thereof during said respective opposite stationary positions,) and said confronting surfaces terminate at both ends in recesses or cut-away portions r^4, into the approaching one of which the roller passes as it leaves each arc-shaped surface r^3, striking and bearing against the opposing wall r^5 or r^6 of the recess, and thereby throwing the rocker-cam from one extreme position to the other and at completion of the throw traversing the opposite arc-shaped surface r^3, and thereby holding the rocker-cam stationary in its later extreme position. In either extreme position the rocker-cam may be supported against action of the roller by the main shaft, which passes therethrough,

though it is obvious that in some constructions said shaft might terminate at the side of the rocker-cam, which would then be otherwise supported, as by providing a slot for the roller conformable to its travel. In Fig. 17 the rocker-cam is represented in the extreme position assumed to hold the traveling jaws R stationary at the limit of their rearward movement, the roller traveling, in the direction of the arrow, one of the arc-shaped surfaces r^3, and thereby retaining the rocker-cam stationary in such position, and during this time said traveling jaws are operated by means hereinafter described to release the wires and the stationary jaws O to grip the same. On leaving said surface the roller strikes and bears against the contact-surface r^5 of the lower recess r^4, thus throwing the rocker-cam to its opposite extreme position, (indicated by dotted lines,) and thereby moving the now open jaws P forwardly, and said roller then passes up the opposite arc-shaped surface, maintaining the jaws in their foremost position, during which time said jaws are operated to grip the strand-wires and the stationary jaws are simultaneously operated to release the same. When the roller strikes the contact-surface r^6 of the upper recess, the rocker-cam is again thrown rearward, drawing rearwardly the now closed jaws P with the wires tightly gripped between the same. It will be observed that by reason of contact of the roller at the surfaces r^5 and r^6, which are respectively nearer and more remote from the fulcrum r, the jaws P are moved more swiftly in their forward or reverse direction and with greater power in their rearward direction when drawing the wires through the machine, which is obviously very advantageous. Each of the rocker-cams S (shown in detail in Figs. 19 and 20) is similarly constructed, having confronting arc-shaped surfaces s^3, similarly terminating in recesses or cut-away portions s^4, engaged by the roller at the respective contact-surfaces s^5 and s^6 to throw the member; but for the purpose of securing a greater throw without unnecessarily lengthening the roller-crank the said confronting surfaces are arranged in closer proximity, and to prevent interference by the shaft B said surfaces are intermediately intercepted by internal cutaway portions of the member or arc-shaped slots s^7, described from the fulcrum s, and which move over and inclose the shaft as the rocker-cam reciprocates. To prevent improper rocking movement of the member as the roller passes either of the slots s^7, said rocker-cam may be provided on the crank side thereof with curved projections or ledges s^8, preferably described concentrically with the surfaces s^3, which ledges are traversed by an auxiliary roller s^9, carried by an extension of the crank-arm. (Shown more clearly in Fig. 21.) The traveling jaws P are preferably arranged to move forwardly to the stops Q in both their lesser and greater reciprocations, the difference in travel being therefore gained only in a rearward direction, which is effected by properly rearwardly inclining the upper swinging arms or ends of the rocker-cams S of greater throw. The connecting-rods T (shown in detail in Fig. 22) are preferably adjustably or extensibly connected to the jaws P, as by means of fastening screw-bolts t, (see Fig. 4,) and also preferably secured to the arms or swinging ends of the rocker-cams R or S, as the case may be, by pin-and-slot connections or in such other suitable manner as to permit play, so as to prevent jamming when the carriages p abut the stops Q. In the present construction the ends of the connecting-rods are slotted and slidably secured, as by bolts t', between the upper bifurcated ends of the rocker-cams, the extent of play being regulated by means of slides t^2, located in the slots behind the bolts and swiveled to screws t^3, entered through the connecting-rods and secured at any adjustment by fastening-nuts or other suitable means.

The traveling grip and draw jaws P are operated to grip and release the wires, preferably through the medium of cranks U and links U', connected as shown, the cranks, which are pivotally secured to the lower or vertically-movable jaw, being pivotally supported by the links, which are pivotally secured to or suspended from the upper or fixed jaws in such manner that when the links stand vertical the cranks hold the jaws closed, movement thereof to separate the jaws being permitted only when the links are thrown to an inclined position. The stationary jaws O are similarly operated by cranks V and links V', similarly arranged. Both the cranks U and V are preferably provided with lever arms or extensions, as u and v, respectively, which depend between intermittently longitudinally reciprocatory frames or slides W, slidable in suitable bearings at the sides of the machine and having transverse pins or other devices, preferably rollers, as w w^2 and w' w^3, respectively adapted to engage at proper periods the said lever arms or extensions u and v to operate the cranks to open and close the jaws, the arrangement being such that when the stationary jaws O are operated to close the traveling jaws P are operated to release, and vice versa. Thus in Figs. 2 and 4 the traveling jaws are shown at the limit of their rearward movement and closed, the stationary jaws being separated. On forward movement of the slides or frames W, which is the first motion occurring from such position, the rollers w engage the lever-arms u, thereby swinging the cranks U and links U' to positively separate the jaws, (though in the present arrangement the lower jaw falls by gravity the instant the pivotal connections of the cranks and links move from vertically beneath the pivots of said crank and said lower jaw,) and simultaneously, or an instant previously, the rollers w', by engagement against the lever-arms v, swing the cranks V and links V' into

such position as to positively close the stationary jaws O. The traveling jaws are now moved by the cams R or the cams S, whichever one they may be connected to at the time, to their extreme forward position, as shown in Fig. 3, said jaws remaining separated during such forward travel and the links and cranks maintaining the same relation, and when at rest in such position the frames W move rearwardly, the rollers w^2 by contact against the lever-arms u closing the jaws P, and the rollers w^3 by contact against the lever-arms v closing the jaws O, whereupon the jaws P move rearwardly, drawing out the fabric. On account of the difference in travel of the jaws P when actuated by the cams R and the cams S, other rollers w^4 are provided behind the rollers w for contact with the lever-arms u in place of said first-mentioned rollers when the jaws are actuated from the cams of greater throw, the said rollers w being at such times removed. The lever-arms u may also be properly limited in their movements by pins or stops, as u', projecting from the sides of the carriage p, or by other suitable means.

The slides or frames W, or one thereof, may also actuate the beater rock-shaft L, before mentioned, said rock-shaft, as shown in Fig. 5, having an arm l connected, as by means of the rod l', to one of the said slides, and it will be seen that the shaft L is rocked to elevate and depress the beaters during forward and rearward movements, respectively, of the slides.

The sliding frames W are actuated to reciprocate intermittently by a rocker-cam X, (shown more clearly in Fig. 4,) of construction similar to the cams R and S, already described, and operated by a roller x, carried by a crank x' on the main shaft, said crank being set at such position relative to the cranks r^2 and s^2 as to throw the rocker-cam X to either direction immediately after full throw of the rocker-cams R and S, so that the frames or members W are reciprocated to operate the stationary and traveling jaws the instant the latter come to rest in either their foremost or rearmost position.

In the arrangement herein represented the rocker-cam X transmits its motion to the sliding frames W through the medium of a rock-shaft x^2, having a rocker-arm x^3 connected to the rocker-cam, and rocker-arms x^4, Figs. 2 and 3, connected to said frames, as by the rods x^5.

The twister-operating rack J is also actuated by a rocker-cam Y, of similar construction to those before described, the same being operated by a roller y, carried by a crank y' on a counter-shaft y^2, driven by the main shaft through the medium of bevel-gearing y^3, the arrangement being such that the roller throws the rocker-cam in a direction (or toward the position shown in Fig. 7) to move the rack to operatively rotate the twisters while the stationary jaws O are gripping the wires and the traveling jaws P are traveling forwardly and in a direction (or toward the position shown in Fig. 6) to reverse the rack while the fabric is being drawn rearwardly by said traveling jaws, the roller traversing in turn the opposite arc-shaped surfaces of the rocker-cam to maintain the same stationary in its successive extreme positions during the intervals when the traveling jaws P stand at their respective foremost or rearmost positions pending release or gripping of the jaws.

The reel Z is driven to automatically wind the fabric as the same is intermittently drawn out by the traveling jaws P, preferably by means of a slack belt passing around friction-pulleys Z' and Z^2, keyed or otherwise secured, respectively, to the main shaft and the reel-shaft, suitable tension being imparted to the belt by a weighted roller Z^3 or other means, so that when the reel, having taken up the slack of the fabric, is thereby held against further winding rotation the belt slips on the momentarily-idle reel-pulley Z^2, unwinding of the reel being at all times prevented by means of a pawl-engaged ratchet-wheel Z^4. Thus the fabric is tightly wound as rapidly as it is drawn out by the traveling jaws without employment of expensive mechanism for automatically timing the reel to compensate for the varying increase in size of the roll being wound thereon.

To facilitate removal of the roll or bale from the reel, which is generally attended with difficulty by reason of the tension with which the fabric is wound thereon, the reel (shown in detail in Figs. 26 to 29, inclusive) is preferably of collapsible construction, and may consist of a number of annularly-arranged bars removably supported endwise between heads or frames z, having radially-disposed sockets, as z', to receive the ends of said bars, which latter may be secured in place therein by temporary wings or binding-wires, as shown in Figs. 1 and 4, the said heads being preferably detachably though rigidly secured at opposite ends of a central shaft, here shown of polygonal confiuration to fit correspondingly-shaped sockets, as z^2, in the heads. One end of the said shaft, formed into a rounded spindle, as z^3, which projects through one of the heads and when the reel is in place, is removably journaled to the machine-frame, preferably on a flat bearing having an overhanging projection, as z^4, under which the spindle may be properly retained by a removable pin z^5. The opposite head is detachably secured to the same shaft which carries the ratchet Z^4 and reel-pulley Z^2, as by means of an integral wedge-block z^6 on said shaft fitting a correspondingly-shaped slot z^7 in the outer face of the head and secured therein by a set-screw or otherwise. Undue cross strain upon this short shaft under pull of the reel-driving belt may be obviated by bracing with a strut or beam Z^5, loosely mounted upon the outer ends of said shaft and the main shaft. The reel may obviously be detached from the

machine and the heads separated from their connecting-shaft, whereupon the bars will collapse to permit withdrawal of the coil of wire.

The operation of the machine will be readily understood from the foregoing description, taken in connection with the accompanying drawings. To introduce the strand-wires, the machine may be brought to the position shown in Figs. 1, 2, and 4, it being remembered that the machine may be instantly started or brought to a full stop at any stage of its movement by manipulation of the treadle or foot lever E to throw the friction-gear b' into or out of engagement with friction-gear c. The tension-rollers H being now raised, the strand-wires are passed over the guide-rollers G in their respective appropriate feed-grooves, are threaded through the twisters I, and inserted between the open stationary gripping-jaws O. The machine may now be further operated to move the reciprocatory grip and draw or traveling jaws P to their forward open position, Fig. 3, where the wires are inserted between them. The tension-rollers being now forced down upon the wires on the guide-rollers, the movement is continued, whereupon said jaws P close and grip the wires and travel rearward, drawing them perfectly taut, and as the traveling jaws release the stationary jaws close and grip the wires and hold them perfectly taut during the succeeding forward travel of said traveling jaws. The operation of securing the stays to the strand-wires may be begun as soon as the strand-wires have once been clutched and carried rearward under tension by the traveling jaws P, a stay being placed upon the delivery or guide fingers N during each successive action of the machine. As the jaws P approach the limit of their rearward movement the rock-shaft n^2 is rocked by reason of pull on the spring connection n^7 to open the fingers n, thus dropping the stay upon the strand-wires behind the twisters, said stay being preferably held at one end by the operator, who stands at the side of the machine to control the treadle E and who maintains the stay with its intermediate loops bearing against the proper sides of the respective strand-wires. The jaws P, having now reached the limit of their rearward travel, (during which rearward travel the twister-operating rack J has been moved by its actuating rocker-cam Y to the position shown in Fig. 6, while the rocker-cam X, which actuates the reciprocatory slides or frames W, has been maintained by its operative roller stationary in its rearwardly-inclined position, as shown in Fig. 4,) the roller x now throws the rocker-cam X to its opposite position, thus moving forwardly the slides or frames W, and thereby causing the stationary jaws O to grip the wires and the traveling jaws P to release, while at the same time the rock-shaft L is rocked to advance the beaters M, which in the manner hereinbefore described force and hold the stay against the twister face-plates i^5, with the extremities and intermediate loops thereof extending through the slots i^6 of said face-plates for proper engagement by the twisting-rollers. During the last-mentioned movement the twister-rack-actuating rocker-cam Y remains stationary in its extreme position, (shown in Fig. 6,) its operating-roller y passing up one of its confronting arc-shaped surfaces to the point indicated by dotted lines ready to throw said rocker-cam to move the rack in a direction to effect the twist, and the rocker-cams R or S, as the case may be, likewise remain stationary, their operating-rollers similarly traveling to positions ready to throw said members in a direction to move the jaws P forwardly. The strand-wires being now held taut between the tension devices and the stationary jaws O, as by vises, the rocker-cam Y is thrown by its operating-roller to the position represented in Fig. 7, thus moving the rack J to operatively rotate the twisters, and during the twisting operation, hereinbefore fully described, the traveling grip and draw jaws P are returned by their actuating rocker-cams R or S, as the case may be, to their foremost position, ready to again grip and carry rearwardly the fabric. On completion of the twist, said traveling jaws being now at the limit of forward travel, the slides W instantly move rearwardly by rearward throw of the rocker-cam X, thus lowering or withdrawing the beaters, causing the reciprocatory jaws P to close and grip the wires and releasing the stationary jaws P, the rocker-cams R and S and also the rocker-cam Y being meanwhile maintained stationary. The jaws P then travel rearwardly again, drawing out the fabric under tension, during which travel the rocker-cam Y is thrown by its operating-roller toward the position shown in Fig. 6, returning the rack, which completes the cycle of operations, the succeeding stay being now dropped into place by opening of the fingers n as the jaws P approach again the limit of their rearward movement. As before stated, when the traveling jaws P are connected to the rocker-cams R the fabric is at each reciprocation of said jaws drawn rearward a distance equal to the distance from the twisters to the crimping devices of the stationary jaws O, which on closing thus crimp the strand-wires directly at the knots or connections of the previously-attached stay, the traveling jaws also gripping the wires at the same points on a later movement, while when said jaws P are connected to the rocker-cams S of greater throw the fabric is drawn rearwardly double such distance, the wires being thus crimped at the connections of the stay by the jaws P and gripped and crimped by the jaws O at points midway such connections. When sufficient length of the fabric has been produced, the rearmost extremities of the strand-wires may be secured in any suitable

manner to the reel, which will then automatically wind the fabric into rolls or bales, as previously explained.

It will be understood that the invention is susceptible of various modifications in details of construction and arrangement of parts without departing from the scope thereof.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a wire-fabric-making machine, the combination with means for intermittently feeding a series of strand-wires, of mechanism for wrapping about said strand-wires, during their intermittent periods of rest, the extremities and intermediate loops formed in stays or cross-wires laid upon said strand-wires; substantially as described.

2. In a wire-fabric-making machine, the combination with means for intermittently feeding a series of strand-wires, of mechanism for simultaneously wrapping about said strand-wires, during their intermittent periods of rest, the extremities and intermediate loops formed in stays or cross-wires laid upon said strand-wires; substantially as described.

3. In a wire-fabric-making machine, the combination with means for feeding a series of strand-wires, of mechanism for wrapping about said wires portions of stays laid thereupon, and means for producing short crimps or bends in the strand-wires at intervals coincident with the connections of the stays to prevent movement of the latter along the strands; substantially as described.

4. In a wire-fabric-making machine, the combination with means for feeding a series of strand-wires, of mechanism for wrapping about said wires the extremities and intermediate loops of stays laid thereupon, and means for producing short crimps or bends in the strand-wires at intervals coincident with the connections of the stays to prevent movement of the latter along the strands; substantially as described.

5. In a wire-fabric-making machine, the combination, with means for feeding a series of strand-wires, of mechanism for securing stays or cross-wires at intervals thereto, and means for producing short angular bends or offsets in the strand-wires at the connections of the stays to prevent lateral movement of the latter along the strands; substantially as described.

6. In a wire-fabric-making machine, the combination, with means for feeding a series of strand-wires, of mechanism for securing stays at intervals thereto, and means for forming short angular crimps or bends in the strand-wires at the connections of the stays, and similar crimps at intermediate points; substantially as described.

7. In a wire-fabric-making machine, the combination, with means for feeding a series of strand-wires, of mechanism for securing stays at intervals thereto, and means for varying the distance between the points of attachment of adjacent stays; substantially as described.

8. In a wire-fabric-making machine, the combination with means for intermittently feeding a series of strand-wires, of mechanism for attaching stays at regular intervals thereto, and means for changing the feed independently of the remaining operative mechanism, whereby said stays may be attached at different intervals; substantially as described.

9. In a wire-fabric-making machine, the combination, with means for feeding a series of strand-wires, of mechanism for producing short crimps or bends at intervals therein, means for attaching stays to the strand-wires at intervals, and interchangeable feed-operating devices whereby the stays may be attached so as to leave crimps between adjacent stays; substantially as described.

10. In a wire-fabric-making machine, the combination, with means for feeding a series of strand-wires, of mechanism for producing short crimps or bends at intervals therein, means for attaching stays to said strand-wires at intervals, and interchangeable feed-operating devices whereby the stays may be secured to the crimps of each series or of alternate series, as desired; substantially as described.

11. In a wire-fabric-making machine, the combination, with means for intermittently feeding a series of strand-wires, of mechanism for producing at intervals therein short angular crimps offset from intermediate straight portions, substantially as and for the purposes described.

12. In a wire-fabric-making machine, the combination, with means for intermittently feeding a series of strand-wires, of mechanism for producing at intervals therein short angular crimps offset from intermediate straight portions, and means for attaching stays in the seats formed between the ends of said crimps, substantially as described.

13. In a wire-fabric-making machine, the combination, with means for intermittently feeding or drawing the strand-wires under tension, of devices for independently maintaining said wires taut during the intermediate intervals between the periods of feeding, and mechanism for attaching stays to said taut strand-wires during said intermediate intervals; substantially as described.

14. In a wire-fabric-making machine, the combination, with means for intermittently feeding or drawing the strand-wires under tension, of means for independently holding said wires taut during the intermittent non-feeding periods, means for simultaneously producing crimps or bends in said strand-wires, and mechanism for attaching stays to said wires while at rest; substantially as described.

15. In a wire-fabric-making machine, the combination, with means for alining and tensioning the strand-wires, of traveling devices

arranged to intermittently grip and draw said strand-wires a distance against the tension, and intermediately-disposed devices arranged to grip and hold said wires taut when released by the traveling devices and during return movement of the latter; substantially as described.

16. In a wire-fabric-making machine, the combination, with the wire-tensioning devices, of the reciprocatory jaws arranged to intermittently grip and draw the wires a distance out from the tensioning devices, and the stationary jaws arranged to grip and hold taut said wires when released by the reciprocatory jaws; substantially as described.

17. In a wire-fabric-making machine, the combination, of the intermittently-reciprocatory grip and draw devices, and the stationary wire gripping and holding devices, with means whereby said stationary devices are operated to respectively grip and release the wires substantially simultaneously with release and gripping thereof by the reciprocatory devices; substantially as described.

18. In a wire-fabric-making machine, a series of stay-twisters, an intermittently-reciprocatory carriage having clutch devices arranged to draw back the strand-wires on backward travel of the carriage, stationary clutch devices arranged to hold said wires taut during forward travel of said carriage, means whereby said stationary devices are operated to clutch the wires and the traveling devices to release them when the carriage stands at the limit of its forward travel and vice versa when at the limit of its backward travel, and means for operating the twisters while the carriage moves forward; substantially as described.

19. In a wire-fabric-making machine, a series of stay-twisters, an intermittently-reciprocatory carriage having clutch devices arranged to draw back the strand-wires on backward travel of the carriage, stationary clutch devices arranged to hold said wires taut during forward travel of said carriage, means whereby said stationary and traveling clutch devices are respectively operated to grip and release the wires and vice versa when the carriage stands respectively at the limits of its forward and backward travels, means for forcing the stays into engagement by the twisters when said stationary clutch devices grip the strand-wires, and means for operating the twisters while the carriage moves forward; substantially as described.

20. In a wire-fabric-making machine, a series of stay-twisters, an intermittently-reciprocatory carriage having clutch devices arranged to draw back the strand-wires on backward travel of the carriage, stationary clutch devices arranged to hold said wires taut during forward travel of said carriage, means whereby said stationary and traveling clutch devices are respectively operated to grip and release the wires and vice versa when the carriage stands respectively at the limits of its forward and backward travels, a series of beaters arranged to respectively advance the stay to the twisters and to withdraw therefrom simultaneously with the operations of said stationary devices to clutch or release, and means for operating the twisters while the carriage moves forward; substantially as described.

21. In a wire-fabric-making machine, a series of stay-twisters, a rock-shaft carrying a series of beaters, reciprocatory gripping-jaws arranged to intermittently draw the strand-wires through the machine on travel in one direction, stationary gripping-jaws arranged to hold said wires taut during the return travel, and a reciprocatory actuator arranged to simultaneously operate said jaws to grip or release and the rock-shaft to advance or withdraw the beaters from the twisters, substantially as described.

22. In a wire-fabric-making machine, a series of stay-twisters, means for intermittently drawing or feeding the strand-wires through the machine, and for simultaneously delivering stays thereupon, means for clutching and holding taut said strand-wires immediately after each intermittent feed thereof and for simultaneously advancing the stay to the twisters, and means for operating the twisters prior to the succeeding feed; substantially as described.

23. In a wire-fabric-making machine, a series of twisters for securing stays to the strand-wires, means for intermittently feeding the strand-wires, and a crimping device positioned to successively crimp said strand-wires after each intermittent feed at the connections of previously-attached stays; substantially as described.

24. In a wire-fabric-making machine, a series of devices for securing stays to the strand-wires and reciprocatory grip and crimp forming jaws arranged to intermittently draw the strand-wires through the machine, said jaws being arranged to grip the wires at the connections of previously-attached stays; substantially as described.

25. In a wire-fabric-making machine, a series of stay-twisters, reciprocatory grip and crimping jaws arranged to draw the strand-wires therefrom a distance after each twisting operation, said jaws being arranged to grip and thus crimp said wires at the connections of stays previously attached, and intermediate stationary grip and crimping jaws arranged to grip and crimp said strand-wires between said connections; substantially as described.

26. In a wire-fabric-making machine, a series of twisting devices, means for periodically operating the same to secure stays to strand-wires, crimping-jaws arranged to grip and hold the strand-wires stationary during the twisting operation, reciprocatory traveling jaws arranged to intermittently grip and draw said strand-wires through the machine, and means for varying the travel of said re-

ciprocatory jaws so that said strand-wires may be drawn at each reciprocation into position to be crimped by the stationary jaws either at the connections of the stays or at intermediate points, as desired; substantially as described.

27. In a wire-fabric-making machine, the combination with a series of stay-securing devices, of a rotary member over which the strand-wires advance thereto under tension, said member having a corresponding series of circumferential grooves or channels which receive and aline said strand-wires; substantially as described.

28. In a wire-fabric-making machine, means for feeding a series of strand-wires through the machine, and means for advancing the several wires in equal lengths, thereby insuring uniformity of feed; substantially as described.

29. In a wire-fabric-making machine, a rotary member over which the strand-wires advance having a series of circumferential grooves which receive said wires and bring their longitudinal axes or centers substantially equidistant from the axial center of said rotary member, and means for maintaining the wires in said grooves while being drawn over said rotary member; substantially as described.

30. In a wire-fabric-making machine, a rotary member over which the strand-wires advance having a series of circumferential grooves or channels which receive said wires and bring their centers substantially equidistant from the axial center of the member, means for pressing said wires against the member to prevent slipping, and means for simultaneously drawing all of said wires through the machine against such pressure; substantially as described.

31. In a wire-fabric-making machine, the combination with a series of stay-twisting devices, of a rotary member over which the strand-wires advance thereto, said member having several corresponding series of circumferential grooves of varying sizes, and means for retaining the wires in said grooves; substantially as described.

32. In a wire-fabric-making machine, a series of uniformly-rotative guide-rollers over which the strand-wires pass, said guide-rollers having circumferential grooves in which the strand-wires lie with their longitudinal centers substantially equidistant from the axial center of the rollers, a series of tension-rollers pressing said wires against the guide-rollers, and means for simultaneously drawing all of said wires through the machine; substantially as described.

33. In a wire-fabric-making machine, the combination with means for feeding strand-wires, of a series of uniformly-rotative guide-rollers, each provided with a number of circumferential grooves of different sizes, substantially as and for the purposes described.

34. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller having a peripheral groove for the wire, a tension-roller adapted to bear against the wire in said groove, and means for applying and maintaining substantially non-yieldable pressure upon said tension-roller, substantially as described.

35. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller, a tension-roller, means for sustaining said tension-roller out of contact with said guide-roller and means for moving the tension-roller into contact with and maintaining a practically non-yielding pressure upon the wires passing over said guide-roller; substantially as described.

36. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller, a tension-roller mounted in a movable support, and a manipulative lever connected to said support, combined with a coacting pressure device arranged to force said tension-roller to bear the wire against the guide-roller; substantially as described.

37. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller, a coöperating tension-roller mounted in a movable support and a manipulative lever connected thereto arranged to force the tension-roller under pressure against the guide-roller, the parts being self-locking in position to apply the pressure; substantially as described.

38. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a coöperating tension-roller, a movable support for the latter, a manipulative lever pivotally connected thereto and having an eccentric fulcrum; the arrangement being such that when said fulcrum stands at one side of the pivot, the frame is held in position to sustain the tension-roller out of contact with the guide-roller, and when at the opposite side said frame is held to maintain the tension-roller under pressure against the guide-roller; substantially as described.

39. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller, and a coöperating pressure-applying device adapted to bear the wire against the same, a movable support for the latter, a member pivotally connected to said support and having an eccentric fulcrum, and means whereby when the pressure device bears against the guide-roller the said fulcrum may be carried by force past a dead-center, thereby exerting pressure against said guide-roller; substantially as described.

40. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a tension-roller mounted in a movable support, a manipulative lever pivoted to said support and having an eccentric shiftable fulcrum, and means whereby when the rollers contact said fulcrum may be shifted past a dead-center by application of force to the lever to bear the tension-roller forcibly

against the guide-roller; substantially as described.

41. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a coöperating tension-roller mounted in a movable support, a manipulative lever pivoted to said support and having an eccentric shiftable fulcrum, the parts being slightly yieldable under strain, whereby when the rollers are brought together said fulcrum may be shifted against resistance past a dead-center by movement of the lever to apply pressure against the guide-roller; substantially as described.

42. In a wire-fabric-making machine, strand-wire-tensioning means comprising a guide-roller, and a coöperating pressure-applying device adapted to bear the wire thereagainst, a movable support for the latter, a manipulative lever pivoted thereto and having an eccentric shiftable fulcrum, and a brace having connection yieldable under strain with said fulcrum, the arrangement being such that when the pressure device is against the roller the lever may be moved to apply pressure by force to shift its fulcrum past a dead-center, overcoming the yieldable resistance of the brace; substantially as described.

43. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a coöperating tension-roller, a movable support for the latter, a manipulative lever having a pivotal connection thereto and having an eccentric shiftable fulcrum and a brace having connection yieldable under strain with said eccentric fulcrum; the arrangement being such that on movement of the lever to bring the tension-wheel into contact the fulcrum is shifted to position to resist the brace, whereupon the lever may be further moved to apply pressure against the guide-roller by application of sufficient force to shift said fulcrum past a dead-center, overcoming resistance of the brace; substantially as described.

44. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a coöperating tension-roller, a movable support for the latter, a manipulative lever having a pivotal connection thereto and having an eccentric shiftable fulcrum, and a brace having connection yieldable under strain with said fulcrum, the arrangement being such that when the lever is moved to throw the tension-roller against the guide-roller the fulcrum is brought toward a dead-center to resist the brace, whereby said lever may be further moved to shift the fulcrum past the dead-center by force to overcome resistance of said brace, the parts being thereby self-locking in position to apply pressure against the guide-roller; substantially as described.

45. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a coöperating tension-roller, a movable support for the latter, a manipulative lever pivoted thereto, a pull-piece to which said lever is eccentrically fulcrumed, a brace and an interposed spring secured to said pull-piece to resist strain, whereby said lever may be moved and maintained in position to apply pressure against the guide-roller by force to shift its fulcrum from behind to and past a dead-center in front of the said pivot; substantially as described.

46. In a wire-fabric-making machine, a strand-wire-tensioning device comprising a guide-roller and a coöperating tension-roller, a movable support for the latter, a manipulative lever pivoted thereto and having an eccentric shiftable fulcrum, a brace, a pull-piece secured to said shiftable fulcrum and secured behind the brace and an interposed compressible device; the arrangement being such that when the tension-roller stands in contact with the guide-roller the lever may be further moved to shift its fulcrum past a point in front of the pivot by application of force to compress the said compressible device, thereby exerting pressure against the guide-roller; substantially as described.

47. In a wire-fabric-making machine, a strand-wire-tensioning device, comprising a guide-roller and a coöperating tension-roller, a swinging frame or support for the latter having an extended free arm, a manipulative lever pivoted to said arm and having an eccentric fulcrum, and a brace having connection yieldable under strain with said eccentric fulcrum; the arrangement being such that on movement of the lever to throw the tension-roller into contact with the guide-roller the fulcrum thereof is shifted to position to draw against the brace, whereby said lever may be further moved by application of force to cause the brace to yield, and thereby applying increased pressure against the guide-roller; substantially as described.

48. In a wire-fabric-making machine, self-contained wire-tensioning means comprising a rotary member, a brace mounted on the shaft thereof, a pressure-applying device adapted to bear the wire against said rotary member, a movable support for said pressure device, and means connecting said brace and support whereby they may be drawn together; substantially as described.

49. In a wire-fabric-making machine, self-contained wire-tensioning means comprising a roller, a brace mounted on the shaft thereof, a pressure device adapted to bear the wire against the roller, a swinging support therefor fulcrumed to said brace, and means connecting the swinging portion of said support with the brace whereby the same may be drawn together against resistance by the contacting pressure device and roller; substantially as described.

50. In a wire-fabric-making machine, a self-contained wire-tensioning device comprising a roller, a brace consisting of angle-shaped members mounted at the sides of said roller

on the shaft thereof, a pressure device adapted to bear the wire against the roller, a rockable support therefor fulcrumed between arms of said angle-shaped members, and means connecting the swinging portion of said support to the other arms of said members whereby said support may be drawn toward the brace against resistance by the contacting roller and pressure device, substantially as described.

51. In a wire-fabric-making machine, means for tensioning the strand-wires comprising a roller, and a series of pressure devices arranged to bear the several wires thereagainst, movable supports for said pressure devices, and manipulative levers whereby said supports may be moved to cause said pressure devices to bear against the roller, said levers being self-locking in position to maintain the pressure; substantially as described.

52. In a wire-fabric-making machine, means for tensioning the strand-wires consisting of a guide-roller having a series of grooves, a series of tension-rollers arranged to confine the wires in said grooves, movable supports for said pressure-rollers and manipulative levers and coacting resisting pressure devices whereby said supports may be moved to apply pressure against the guide-roller, said levers being self-locking in position to maintain the pressure; substantially as described.

53. In a wire-fabric-making machine, means for tensioning the strand-wires consisting of a roller, a series of coöperating pressure devices, movable supports therefor, braces loosely mounted on the roller-shaft, and connections between said supports and braces whereby they may be drawn together against resistance by the contacting pressure devices and roller; substantially as described.

54. In a wire-fabric-making machine, means for tensioning the strand-wires consisting of a shaft, a series of rollers mounted thereon, a series of braces comprising angle-shaped members loosely mounted on said shaft at the sides of said rollers, a series of pressure devices, and supports therefor fulcrumed between arms of said angle-shaped members, and connections between the other arms of said members and the swinging portions of said supports whereby the latter may be drawn toward the braces against resistance by the contacting pressure devices and rollers; substantially as described.

55. In a wire-fabric-making machine, a series of rotary twisters through which the strand-wires are threaded, means for intermittently feeding said strand-wires, and means for rotating said twisters during intermittent periods of rest to wrap about said wires simultaneously the extremities and intermediate loops of stays laid thereupon; substantially as described.

56. In a wire-fabric-making machine, a series of rotary twisters through which the strand-wires are threaded, means for intermittently feeding the strand-wires and delivering a stay, means for advancing the stay to the twister, and forcing the extremities and intermediate loops thereof into engagement by said twisters, and means for rotating the latter to wrap said extremities and loops about the strand-wires; substantially as described.

57. In a wire-fabric-making machine, a series of twisters and a series of beaters, means for intermittently feeding the strand-wires and simultaneously placing a stay thereupon, and means for advancing the beaters to force the stay into engagement by the twisters and operating said twisters and withdrawing the beaters between the periods of feed; substantially as described.

58. In a wire-fabric-making machine, a series of rotary twisters through which the strand-wires are threaded, means for intermittently feeding the strand-wires and simultaneously delivering a stay, and means for advancing the stay to the twisters and operating the latter to secure the same to the strand-wires between the periods of feed; substantially as described.

59. In a wire-fabric-making machine, the combination with means for holding a strand-wire, of a wrapping device comprising a rotary head carrying a roller arranged to revolve closely about said strand-wire and adapted to engage and wrap about the same a portion of a stay placed against said strand-wire; substantially as described.

60. In a wire-fabric-making machine, the combination with means for supporting a strand-wire, of a roller adapted to revolve about the same and to engage and wrap thereabout a portion of a stay placed against said strand-wire; substantially as described.

61. In a wire-fabric-making machine, the combination with means for supporting a strand-wire, of a pair of revolving rollers disposed at opposite sides of said wire and adapted to wrap and press about the same a portion of a stay placed against said strand-wire; substantially as described.

62. In a wire-fabric-making machine, a twister comprising a rotating member having a bore to receive a strand-wire and provided with a wrapping-roller adapted to revolve closely about said wire and engage and wrap about the same a portion of a stay placed against said wire; substantially as described.

63. In a wire-fabric-making machine, a twister comprising a rotary member or spindle longitudinally bored to receive a strand-wire and having oppositely-disposed wrapping-rollers arranged with their peripheries about the distance of the thickness of a stay from said bore; substantially as described.

64. In a wire-fabric-making machine, a rotary twister through which a strand-wire is passed, comprising a head, an end face-plate and an interposed twisting device, said face-plate being cut away to permit a portion of a stay placed against said plate to be pushed therethrough for engagement by said twisting device and withdrawal of the knot or con-

nection after its formation; substantially as described.

65. In a wire-fabric-making machine, a stay-twister comprising a rotary member bored to receive a strand-wire, revolving twisting-rollers arranged at opposite sides of said bore, and an end face-plate secured to the axles of said rollers, and slotted from the periphery to and around the bore or passage of the strand-wire; substantially as described.

66. In a wire-fabric-making machine, a stay-twister comprising a rotary member bored to receive a strand-wire, an end face-plate slotted to permit a bent portion of a stay lodged against the plate to be projected therethrough, and an interposed twisting device adapted to wrap said bent portion about the strand-wire, said face-plate having a horn or inward turn at the outer end of its slot which on rotation of the twister engages said bent portion of the stay; substantially as described.

67. In a wire-fabric-making machine, a rotary twister having a slotted face-plate and a bore for a strand-wire, and a beater arranged to force a stay placed upon the wire against said face-plate, and having a projection adapted to force a bent portion of said stay through the slot thereof for engagement by the twister; substantially as described.

68. In a wire-fabric-making machine of the character described, a series of stay-twisters through which the strand-wires are threaded, and a series of beaters arranged to force a stay placed upon said wires against the faces of and into position for engagement by said twisters; substantially as described.

69. In a wire-fabric-making machine, a series of stay-twisters through which the strand-wires are threaded, and a series of beaters adapted to force a stay placed upon said wires into position for engagement by said twisters, said beaters having fingers adapted to overlie and hold down the stay upon the strand-wires during the operation of attaching said stay thereto; substantially as described.

70. In a wire-fabric-making machine, a series of stay-twisters through which the strand-wires are threaded, said twisters having slotted end faces, means for forcing a stay placed upon the strand-wires against said faces, means for bending down the extremities of said stay over the two outermost strand-wires, and means for projecting said bent extremities and intermediate loops of the stay through the face-plates of the respective twisters, for engagement by the twisting devices; substantially as described.

71. In a wire-fabric-making machine, a series of twisters through which the strand-wires are threaded, said twisters having slotted end faces, a rock-shaft carrying a series of beaters having faces adapted on rocking of the shaft to confront said twister-faces and force a stay placed upon the wires against the same, said beaters being provided with projections adapted to force bent portions of said stay through the slotted twister-faces for engagement by the twisting devices, and being also provided with fingers adapted to overlie and hold said stay down upon the strand-wires, and means for rocking said shaft to advance or withdraw the beaters; substantially as described.

72. In a wire-fence-making machine, means for feeding a number of strand-wires, means for delivering looped cross-wires upon said strand-wires, means for severing said cross-wires into several stays, and means for wrapping the extremities and intermediate looped portions of said stays about their respective strand-wires, thus producing simultaneously a number of lines of fencing; substantially as described.

73. In a wire-fence-making machine for producing simultaneously a number of lines of fencing, corresponding series of stay-twisters through which strand-wires are threaded, and interposed cutting devices between adjacent twisters of the different series for severing into a corresponding number of stays a cross-wire laid upon said strand-wires; substantially as described.

74. In a wire-fence-making machine for producing simultaneously a number of lines of fencing, corresponding series of stay-twisters through which the strand-wires are threaded, and a rock-shaft having corresponding series of beaters adapted to force a cross-wire into engagement by the twisters, said rock-shaft carrying a cutter between adjacent twisters of different series adapted to sever the cross-wire into a corresponding number of stays on turning of said shaft to advance the beaters; substantially as described.

75. In a machine of the character described, a pair of wire-gripping jaws, guiding-frames in which said jaws are held to close and separate, cranks pivoted to one jaw, links pivoted to said cranks and to the other jaw, the arrangement being such that when the cranks and links are brought into alinement the jaws are maintained closed and when thrown out of alinement are separated, and means for operating said cranks to cause the jaws to alternately grip and release the wires; substantially as described.

76. In a machine of the character described, the reciprocatory jaws adapted to grip and draw the strand-wires through the machine, cranks and suitable connections whereby said jaws may be brought together or separated, and means for operating said cranks to cause the jaws to grip the wires when at the limit of travel in one direction and to release the wires when at the limit of travel in the opposite direction; substantially as described.

77. In a machine of the character described, the reciprocatory jaws adapted to grip and draw the strand-wires through the machine,

cranks and suitable connections whereby said jaws may be brought together or separated, and coöperating intermittently-reciprocatory members having devices adapted to engage and operate said cranks to cause the jaws to grip the wires when at the limit of their forward travel and to release said wires when at the limit of their rearward travel; sustantially as described.

78. In a machine of the character described, the reciprocatory jaws adapted to intermittently grip and draw the strand-wires through the machine, and the stationary jaws arranged to grip said wires when released by the traveling jaws, cranks and suitable connections whereby said jaws may be closed or separated, and intermittently-reciprocatory members having devices adapted to engage said cranks to cause the stationary jaws to grip and the traveling jaws to release the wires and vice versa when the traveling jaws stand respectively at the limits of their rearward and forward travels; substantially as described.

79. In a machine of the character described, the stationary jaws, guiding-frames therefor, links pivoted to one of said jaws, cranks pivoted to said links and to the other jaw and having arms or extensions whereby they may be operated to close or separate the jaws, the similarly-equipped reciprocatory jaws, and reciprocatory members adapted to engage said crank-arms to cause the stationary jaws to grip and the traveling jaws to release the wires when the traveling jaws reach the limit of rearward travel, and to cause the traveling jaws to grip and the stationary jaws to release when said traveling jaws reach the limit of their forward travel; substantially as described.

80. In a machine of the character described, the combination, with the driving-shaft, of an intermittently-reciprocatory member, an intermediate power-transmitting rocker-cam or actuating member, and an operating-roller therefor carried by a crank on the driving-shaft, said rocker-cam having confronting arc surfaces traversed by the roller to maintain the member stationary at its opposite extreme positions, and recesses at the terminals of said surfaces which receive the roller as the rocker-cam is thrown thereby from one position to the other; substantially as described.

81. In a machine of the character described, the combination, with the driving-shaft, of an intermittently-reciprocatory member, an intermediate rocker-cam or actuating member, and a crank on the shaft having an operating-roller traveling in engagement with said rocker-cam and an extension provided with an auxiliary roller; said rocker-cam having internal confronting arc-shaped surfaces traversed by the operating-roller to maintain the member stationary, recesses at the terminals of said surfaces to receive said roller as it throws the rocker-cam from one position to the other, intermediate recesses which pass over and inclose the driving-shaft when the rocker-cam is at one or the other of its opposite positions, and external ledges traversed by the auxiliary roller as the main roller passes across said intermediate recesses; substantially as described.

82. In a wire-fabric-making machine, means for automatically winding the finished fabric comprising a reel, a driving-shaft, pulleys on the reel-shaft and driving-shaft and a slack belt passing around said pulleys and adapted to rotate the reel to wind the fabric as it is drawn out by the machine and to slip on the reel-pulley when the taut fabric holds the reel against further rotation; substantially as described.

83. In a wire-fabric-making machine, a collapsible reel comprising heads or end frames having axial polygonal openings and confronting radial sockets, a polygonal shaft removably fitted in said openings and having a spindle protruding through one of said heads and removably journaled in the machine-frame, the opposite head being detachably secured to the shaft of the driving-pulley, and transverse bars supported and temporarily secured in the radial sockets of said heads; substantially as described.

84. In a wire-fabric-making machine, the combination with a series of strand-wire-tensioning devices, of means for intermittently drawing said wires through the machine against the tension, interposed means for holding said wires taut during the periods of rest, and a series of twisters between said holding means and the tension devices adapted to attach stays to said taut wires during said periods of rest; substantially as described.

85. In a wire-fabric-making machine, the combination with means for intermittently feeding or drawing a series of strand-wires under tension, of devices for maintaining said wires taut during the periods of rest, and mechanism for wrapping about said taut wires the intermediate loops and extremities of stays or cross-wires placed thereupon; substantially as described.

86. In a wire-fabric-making machine, the combination, with means for feeding a series of strand-wires intermittently, of means for placing against said strand-wires looped stays or cross-wires, and mechanism for wrapping said loops about said strand-wires during their periods of rest; substantially as described.

87. In a wire-fabric-making machine, the combination with means for intermittently feeding a series of strand-wires, of mechanism for wrapping about said strand-wires while at rest the loops of stays held against the same, and means for crimping said strand-wires at the connections of the stays after attachment of the latter to prevent said stays from slipping on the strands; substantially as described.

88. In a wire-fabric-making machine, the

combination with means for tensioning a series of strand-wires, of reciprocatory jaws adapted to grip and draw said wires a distance against the tension on each rearward travel, stationary jaws adapted to grip and hold the wires taut when released by the reciprocatory jaws, and a series of twisters adapted to attach stays to the strand-wires during their intervals of rest, one set of said jaws being positioned to clutch and crimp the strand-wires at the connections of previously-attached stays; substantially as described.

89. In a wire-fabric-making machine, a wire-holding spool consisting of a central hub portion having a short depending vertical spindle, a socket-bearing in which said spindle is removably journaled, radial polygonal sockets in said hub portion, radial arms having their ends removably received in said sockets, and upstanding brackets having sleeves or sockets adjustably fitted on said arms, said brackets having outwardly-extending members between which and the arms the coil of wire is placed; substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

PETTIS A. REID.
JAMES KELLEY.
WALTER V. REID.

Witnesses:
JOHN E. MOFFITT,
FORREST B. AULT.