I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 1.

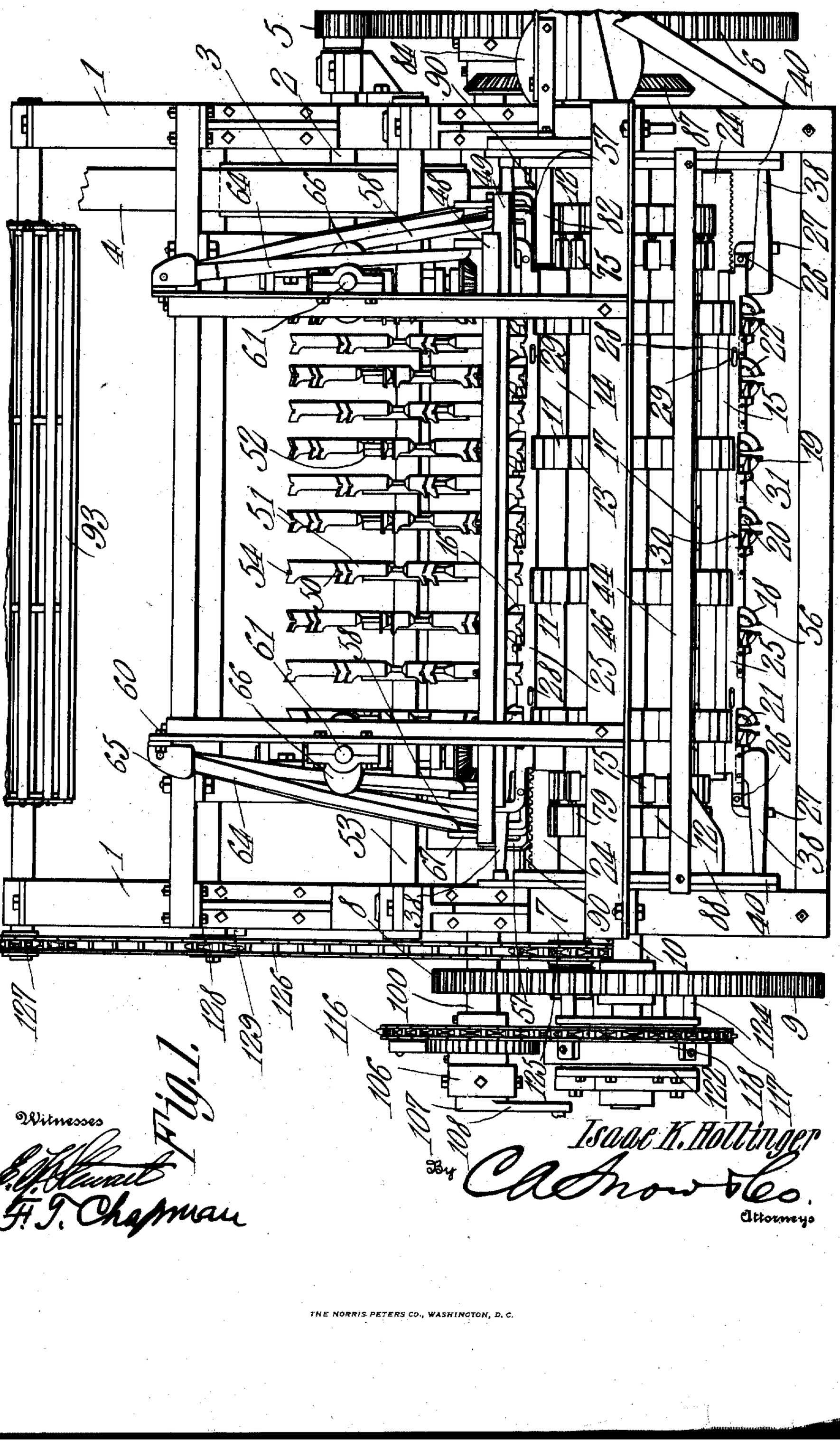


Fig. 1.

Witnesses

E. F. Edwards

F. P. Chapman

Isaac K. Hollinger

By Cushman & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

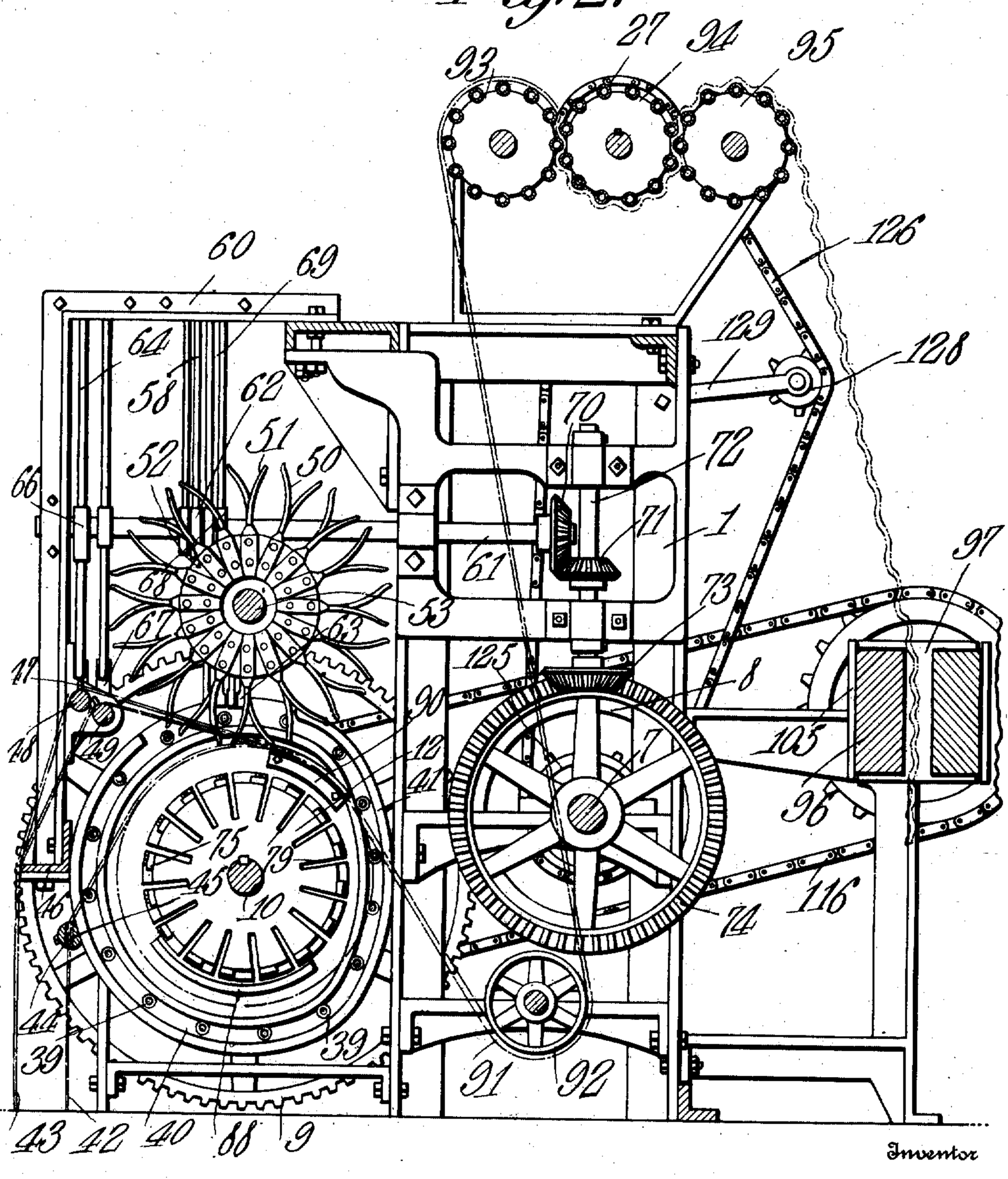
APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 2.

Fig. 2.



Inventor

Witnesses

E. F. Stewart

F. T. Chapman.

Isaac K. Hollinger

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

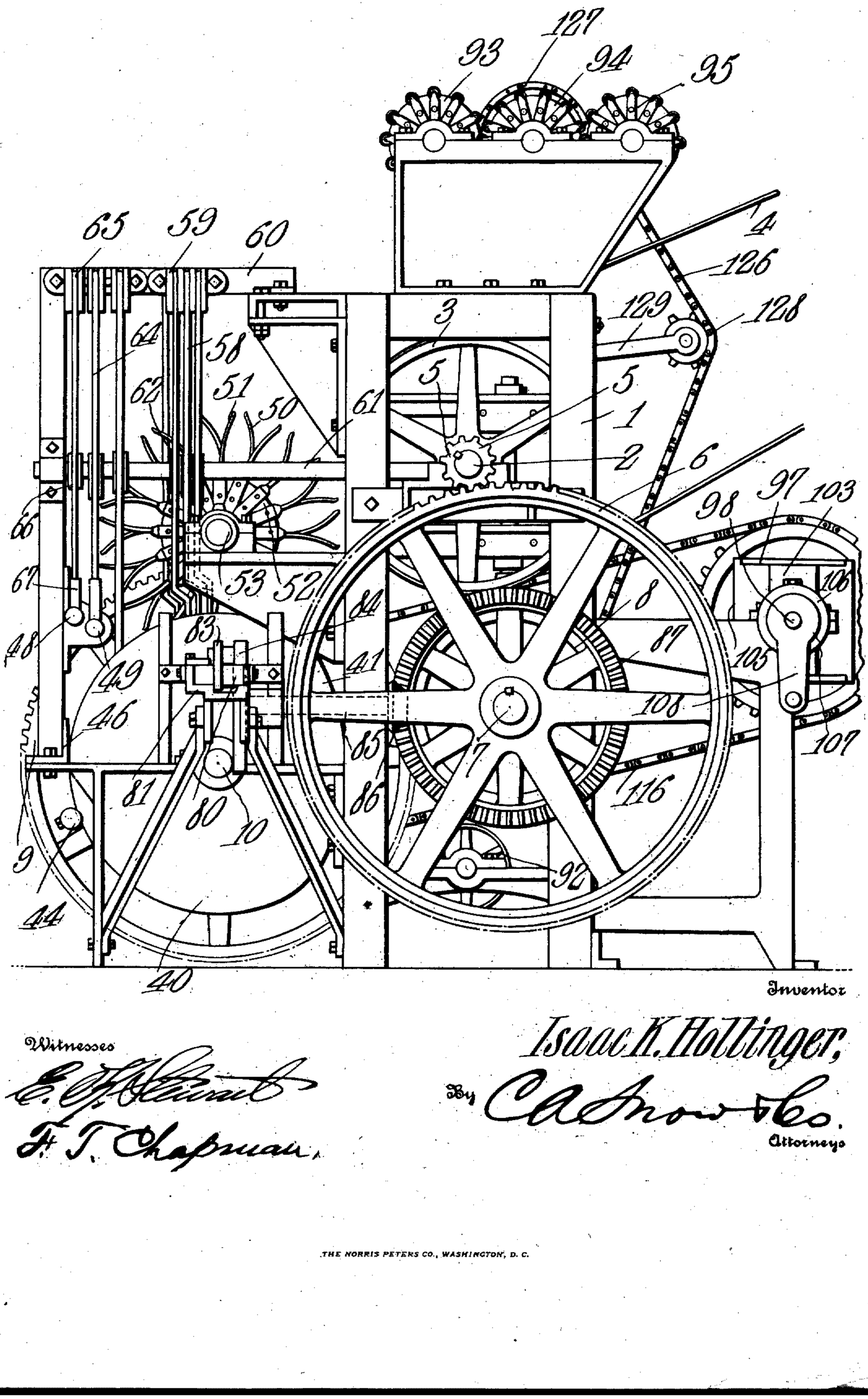
APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 3.

Fig. 3.



Inventor

Witnesses

E. J. Steinmetz

F. T. Chapman.

Isaac K. Hollinger,

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

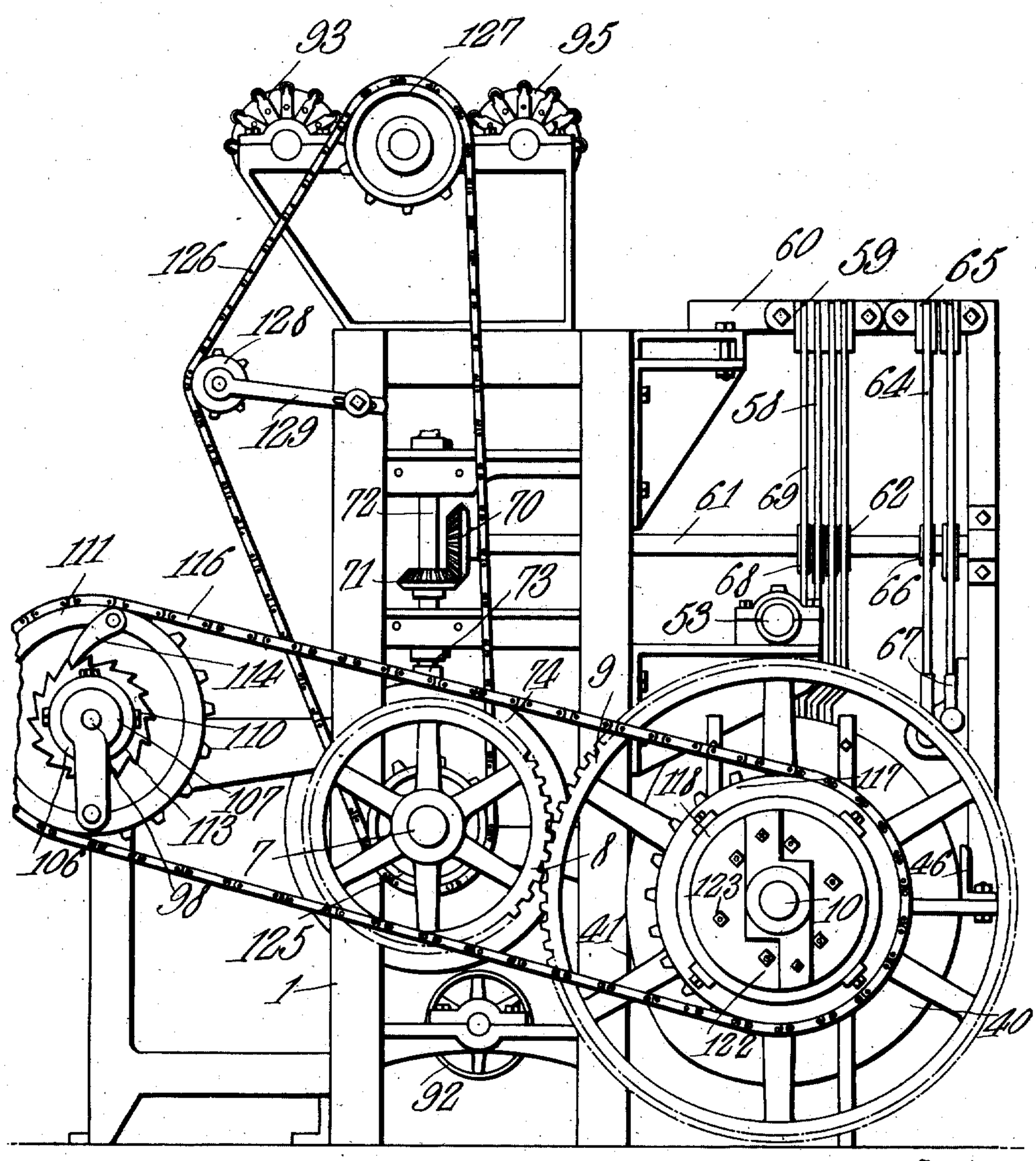
APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 4.

Fig. 4.



Witnesses

E. F. Clarke

F. T. Chapman.

Inventor

Isaac K. Hollinger,

By Cushman & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

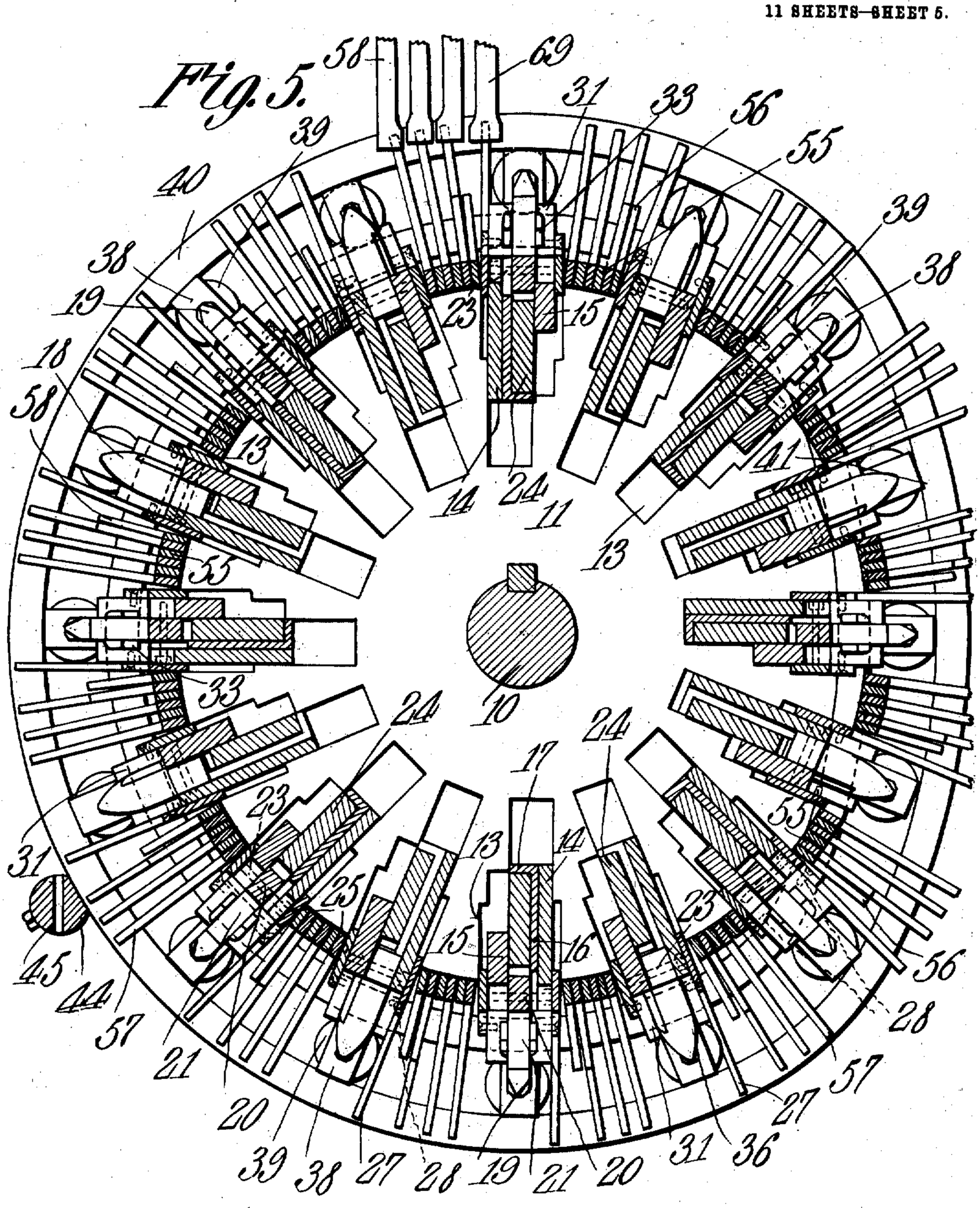
APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 5.

Fig. 5.



Witnesses

E. C. Hammett

H. T. Chapman

Inventor

Isaac K. Hollinger,

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 6.

Fig. 6.

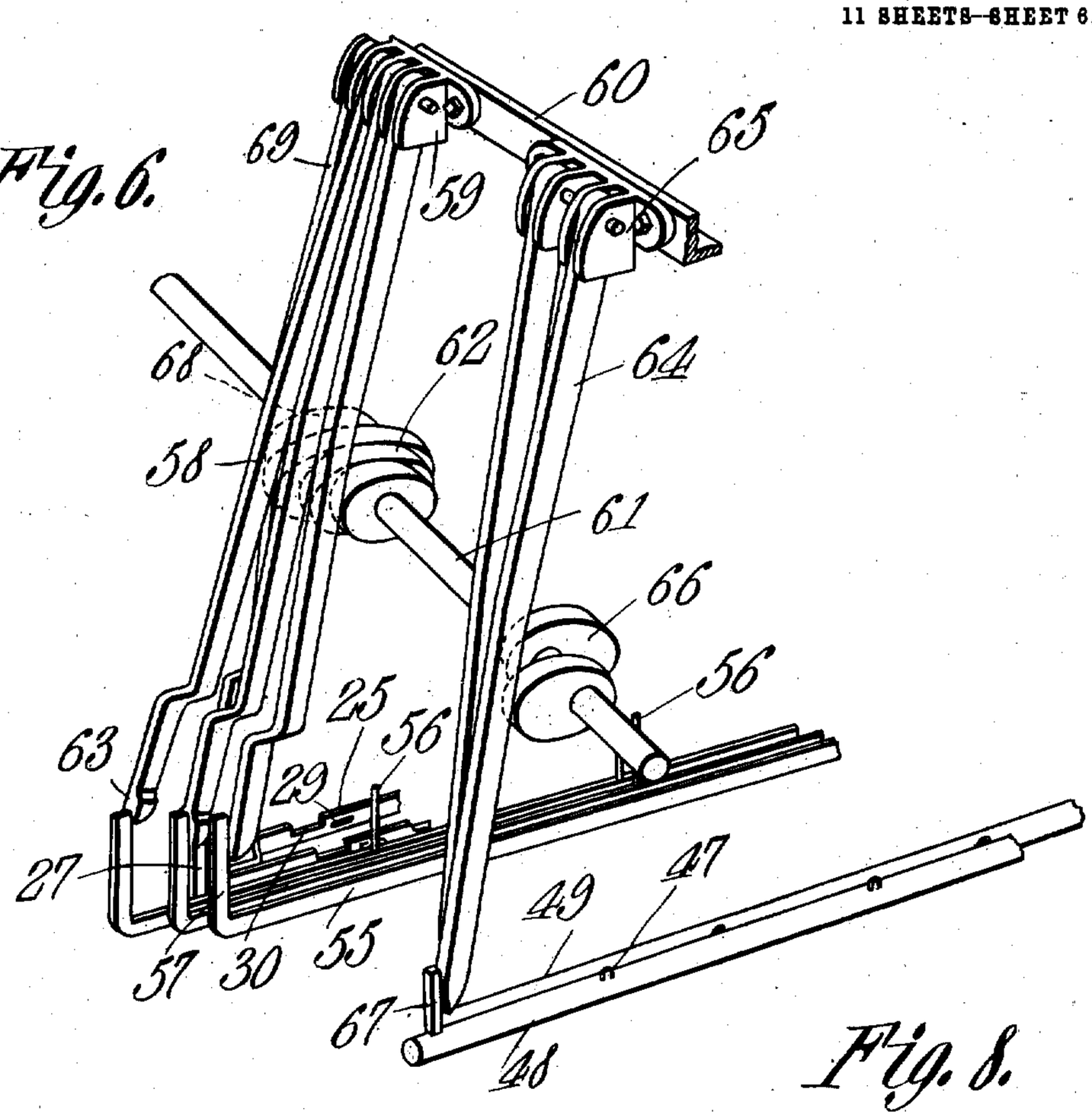


Fig. 7.

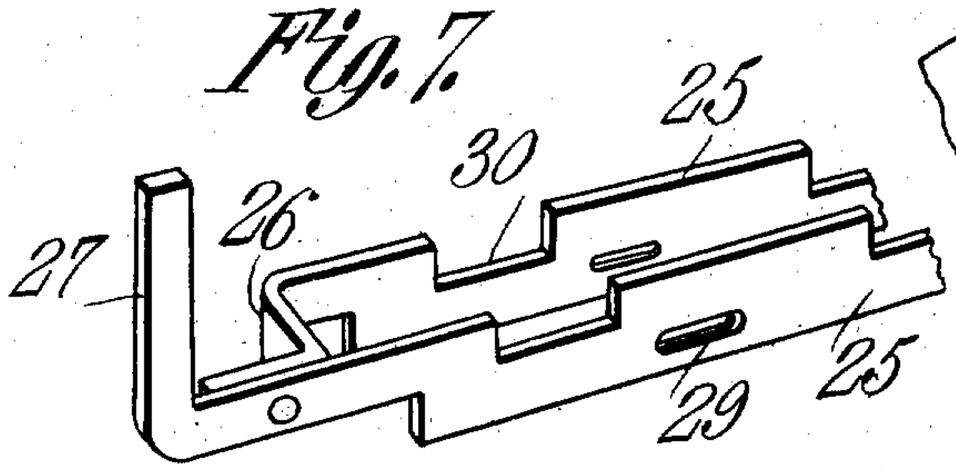


Fig. 8.

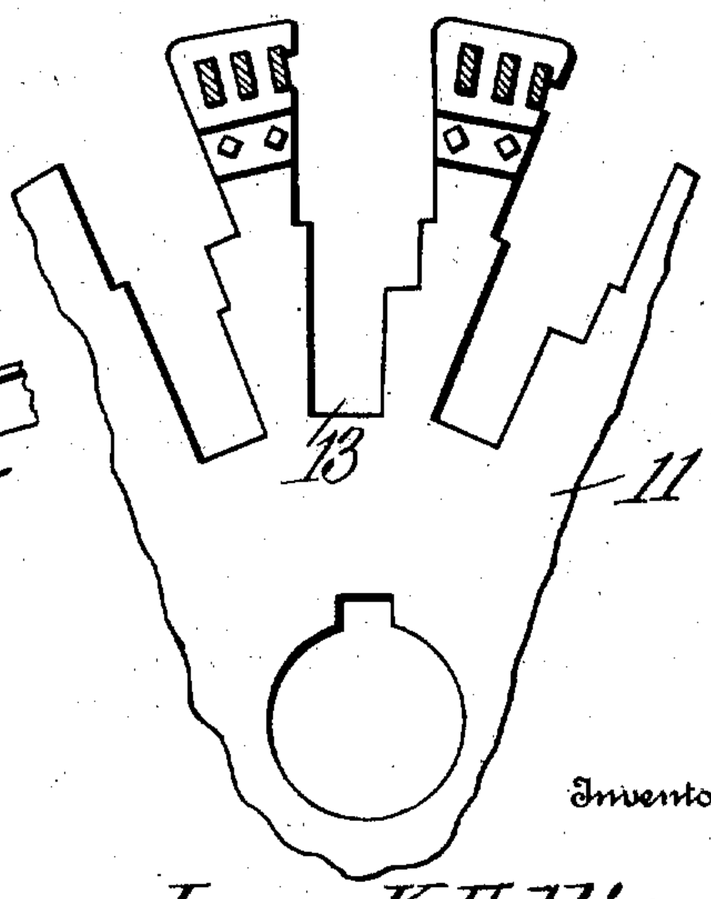
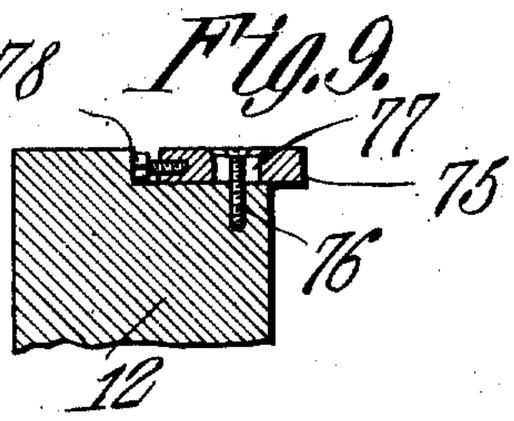


Fig. 9.



Witnesses

E. F. Clement

H. T. Chapman

Inventor

Isaac K. Hollinger

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 7.

Fig. 10.

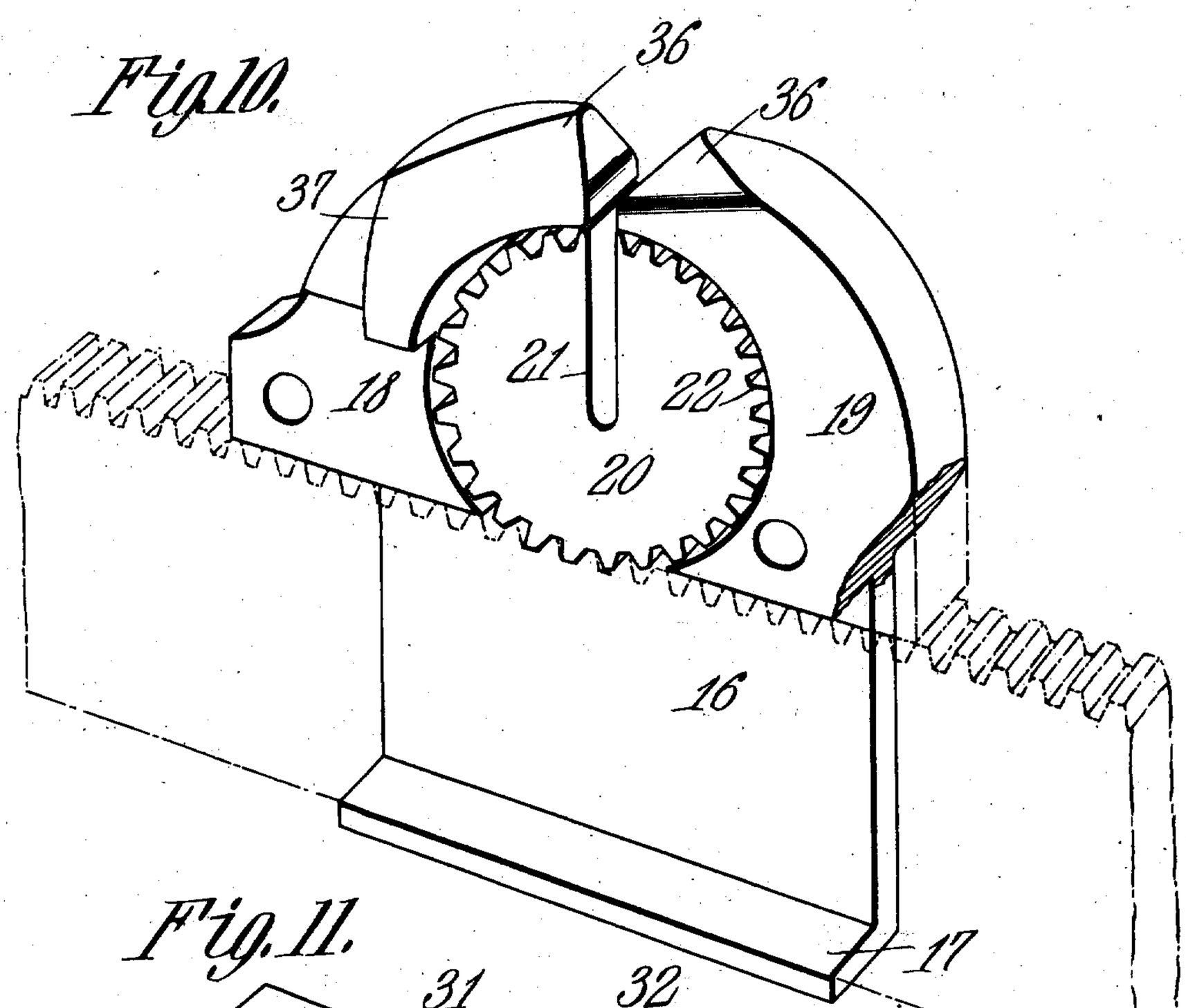


Fig. 11.

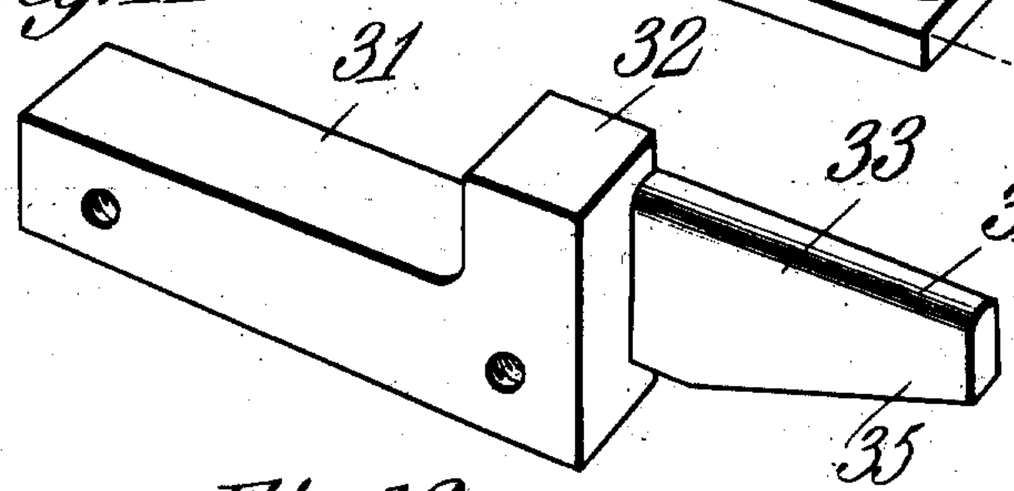
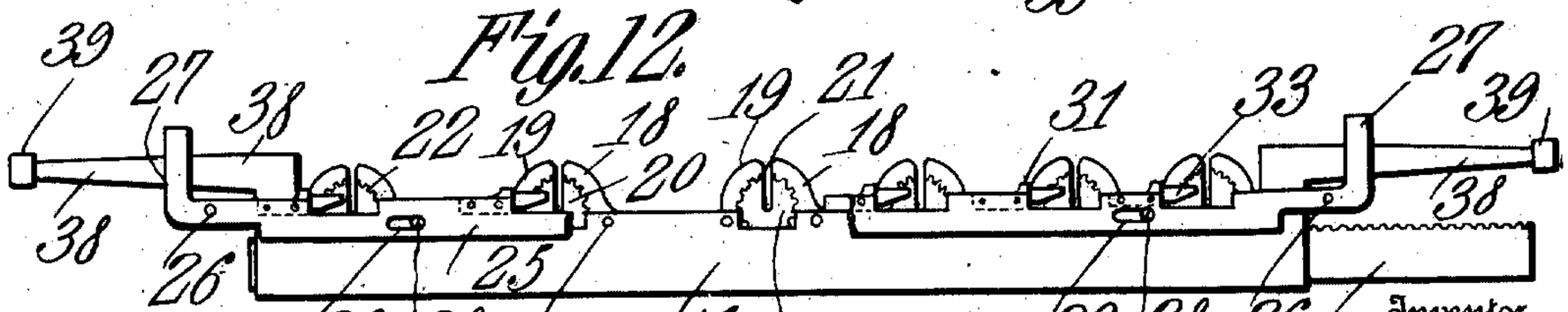


Fig. 12.



Inventor

Witnesses

E. J. Clinton

H. T. Chapman

Isaac K. Hollinger,

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 8.

Fig. 13.

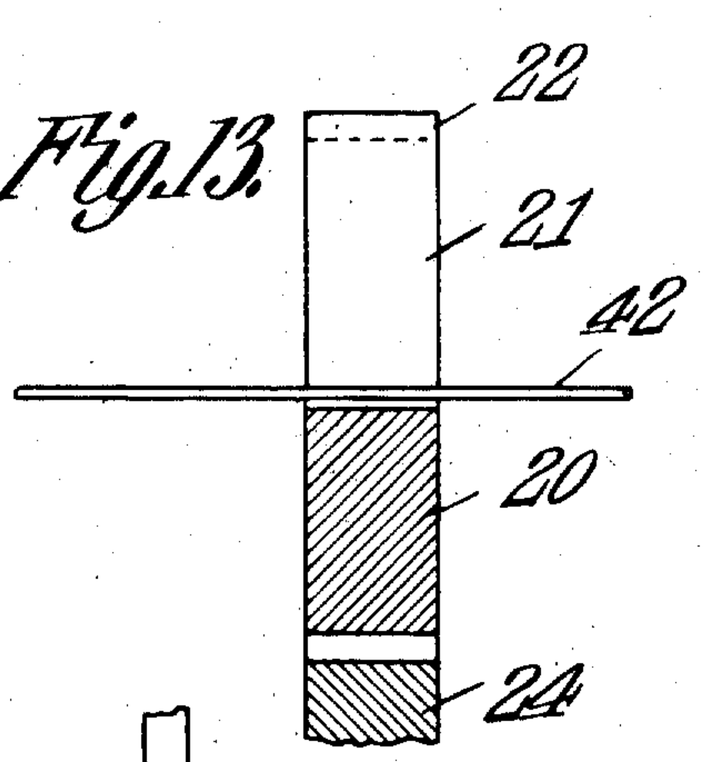


Fig. 14.

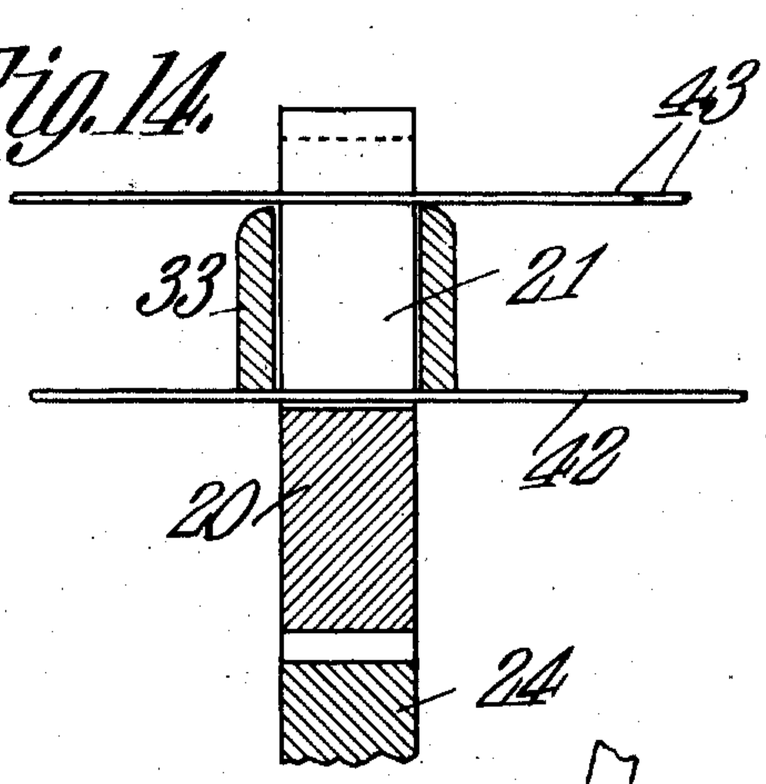


Fig. 15.

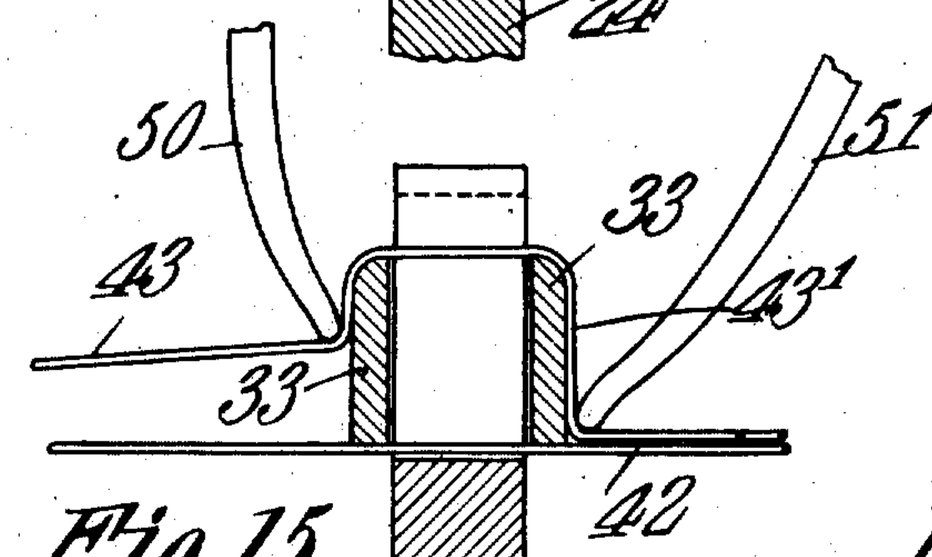


Fig. 16.

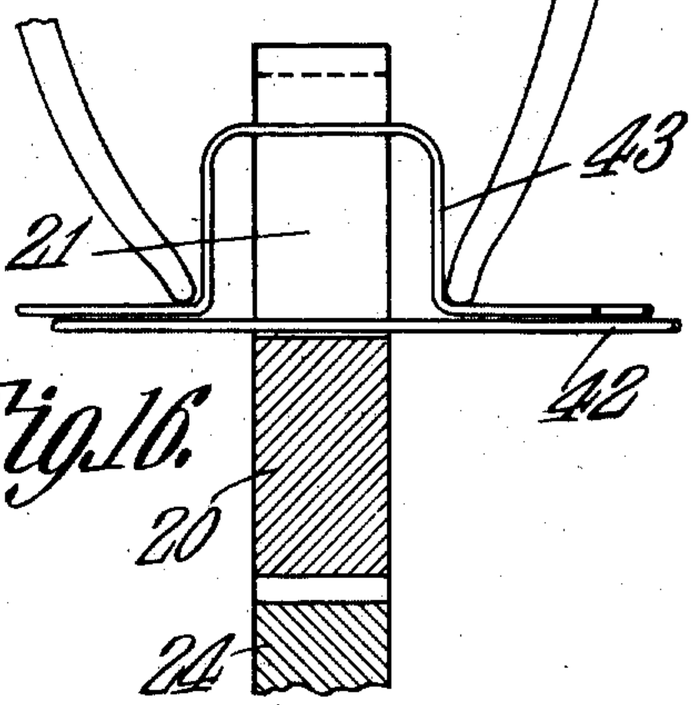


Fig. 17.

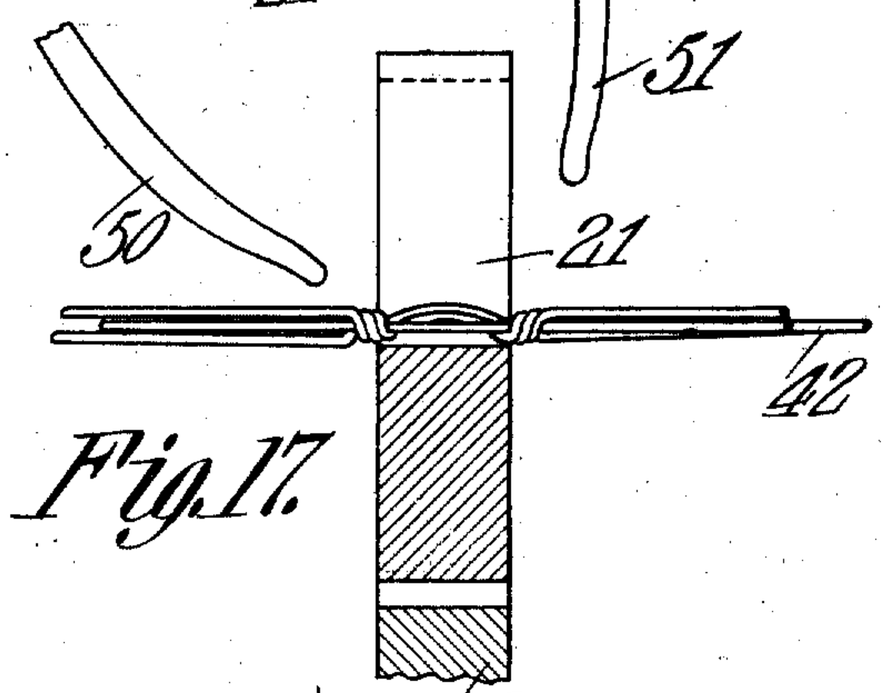
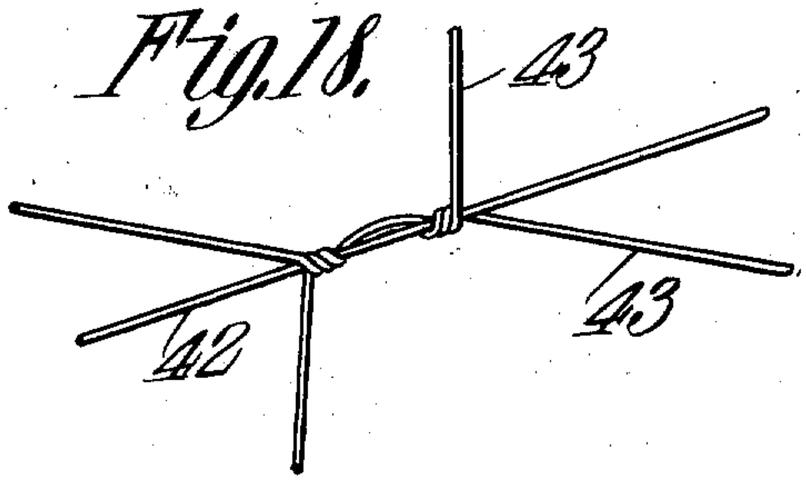


Fig. 18.



Witnesses

E. J. Stewart

H. T. Chapman

Inventor

Isaac K. Hollinger,

By Cachow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 9.

Fig. 19.

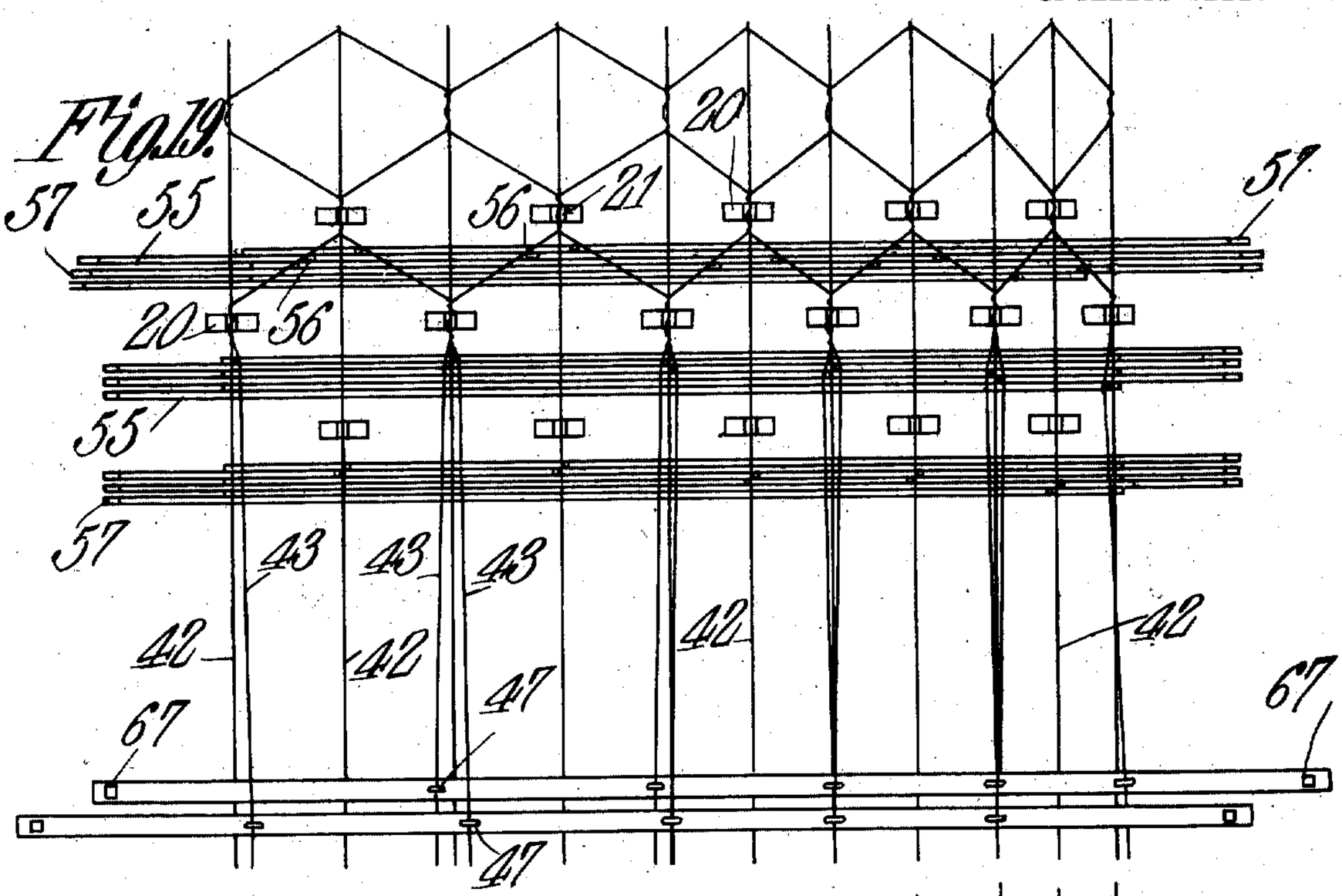
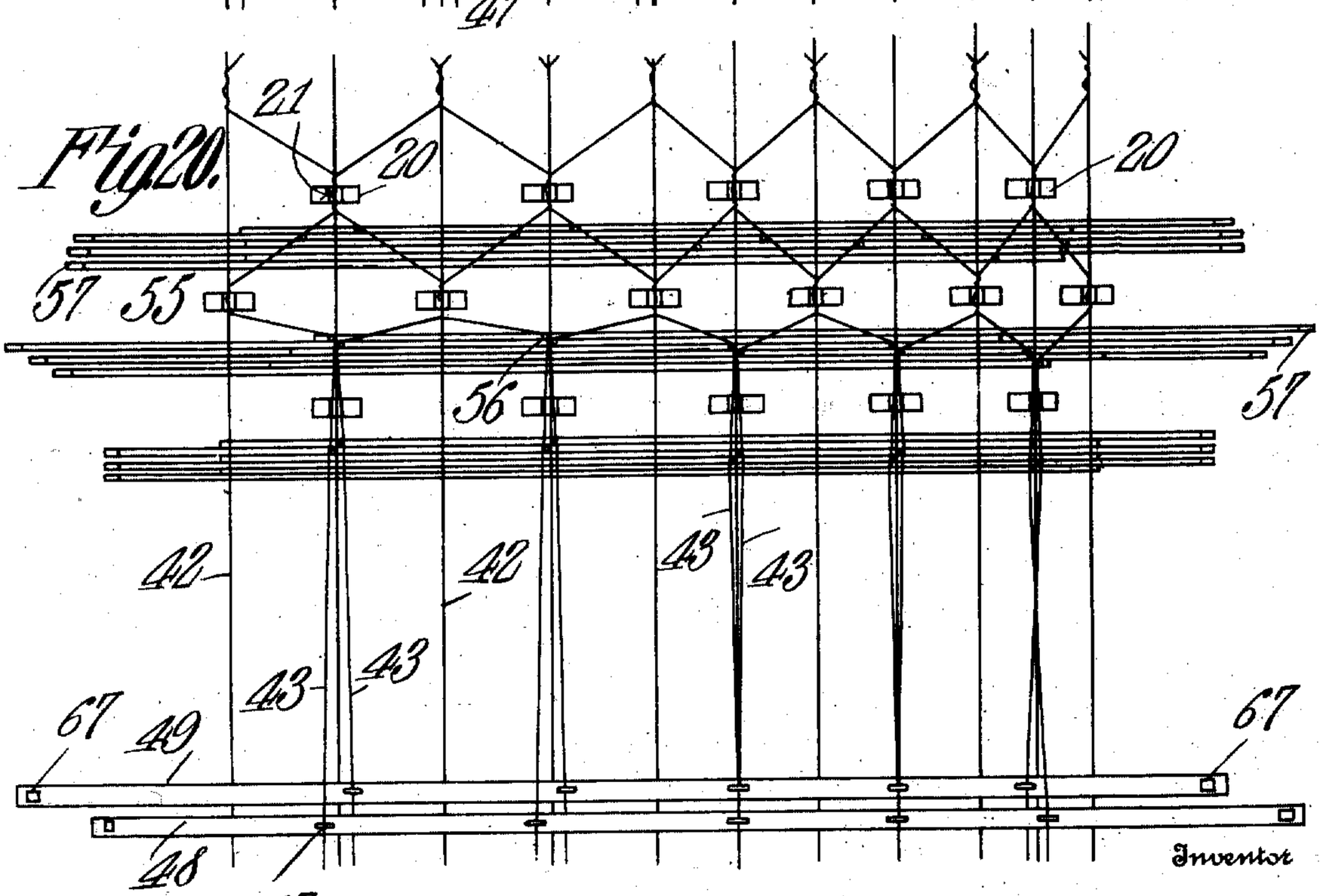


Fig. 20.



Witnesses

E. J. Stewart

H. T. Chapman,

Inventor

Isaac K. Hollinger

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 10.

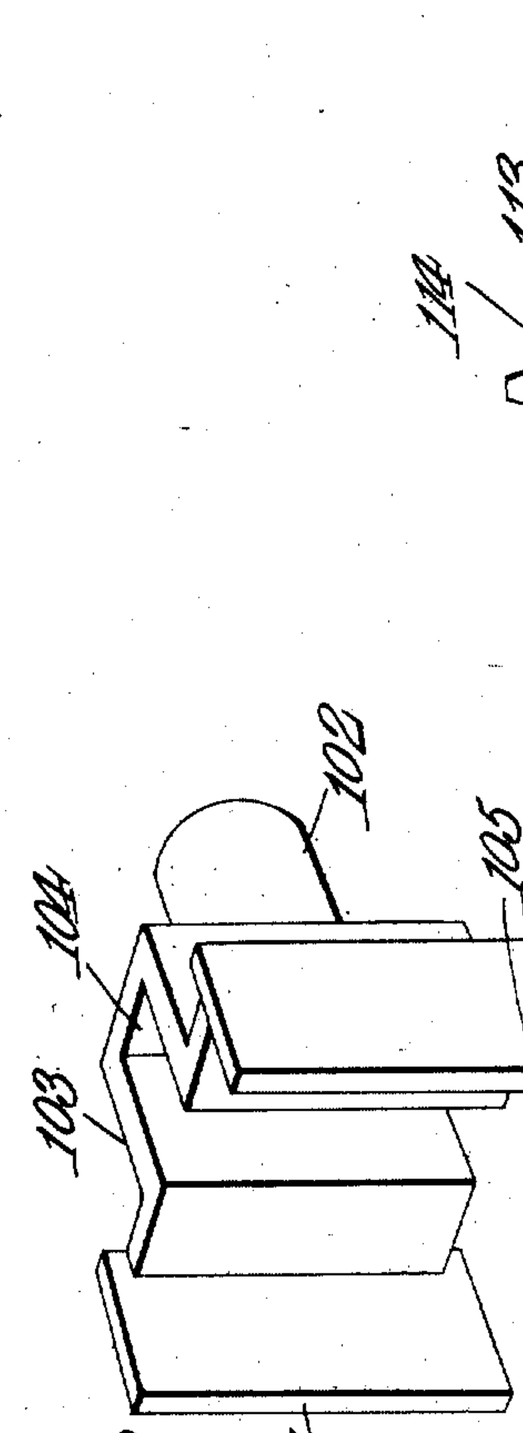


Fig. 22.

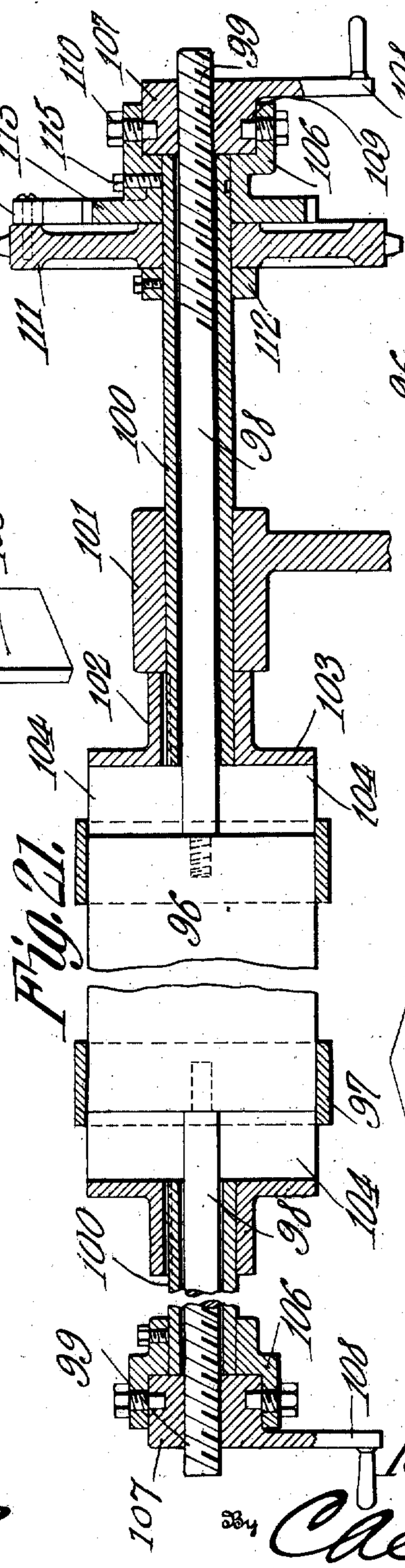


Fig. 21.

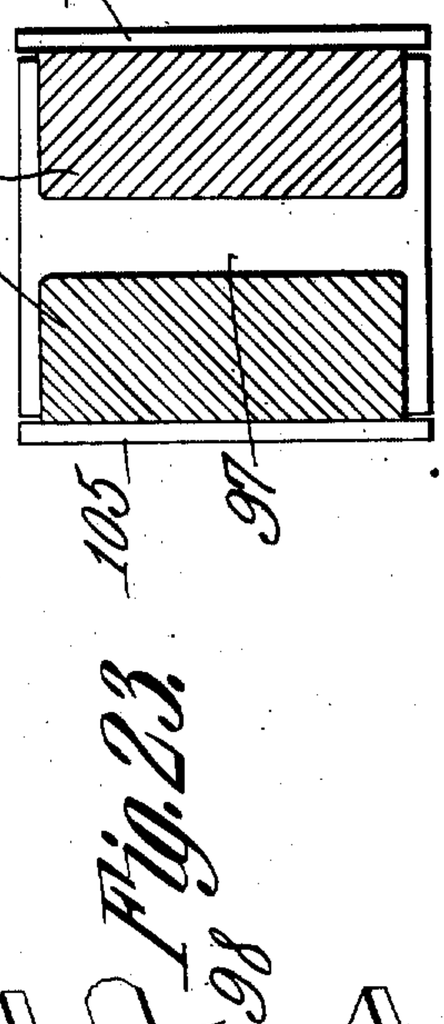


Fig. 23.

Fig. 24.

Witnesses

E. F. Clements

F. T. Chapman.

Inventor

Isaac K. Hollinger,

By C. A. Snow & Co.

Attorneys

I. K. HOLLINGER.

FENCE MACHINE.

APPLICATION FILED DEC. 22, 1909.

990,653.

Patented Apr. 25, 1911.

11 SHEETS—SHEET 11.

Fig. 25.

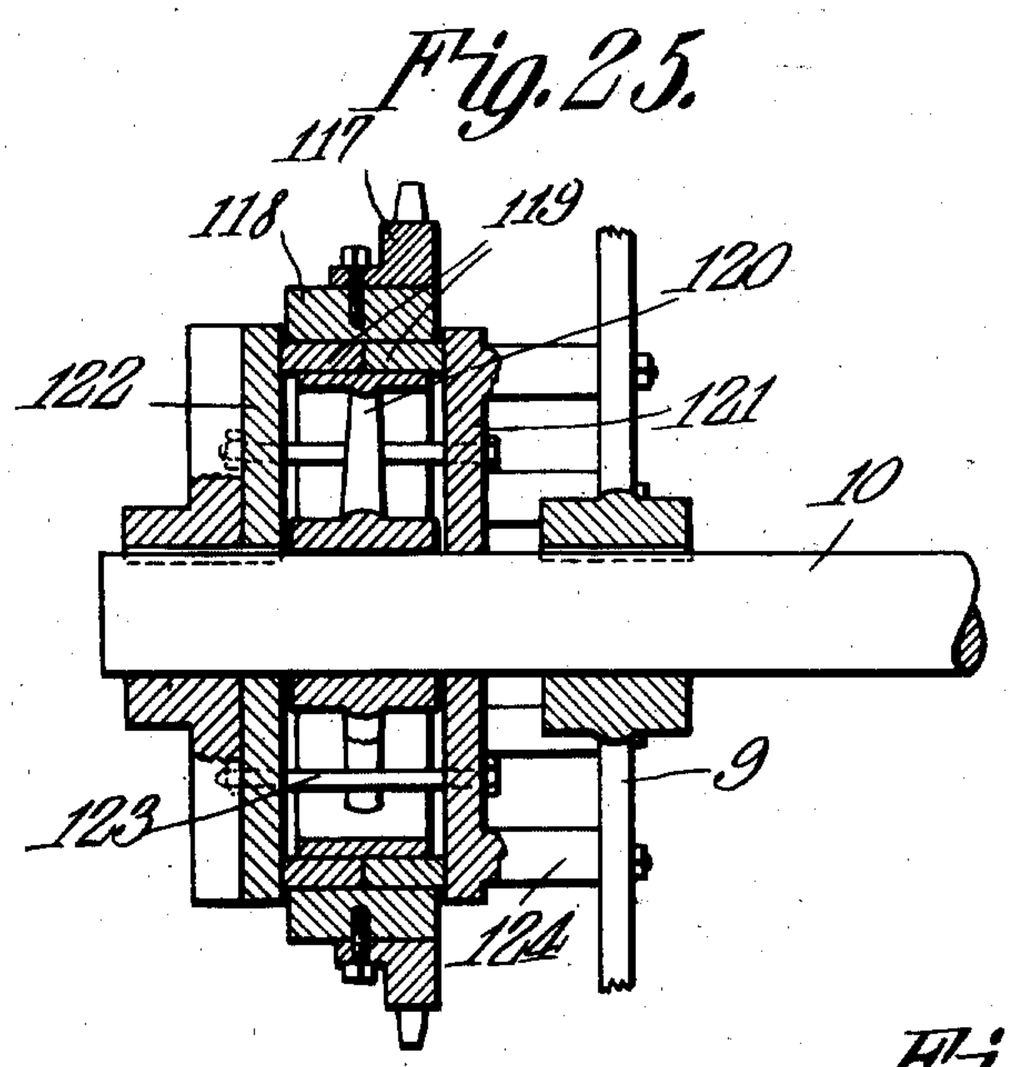


Fig. 28.

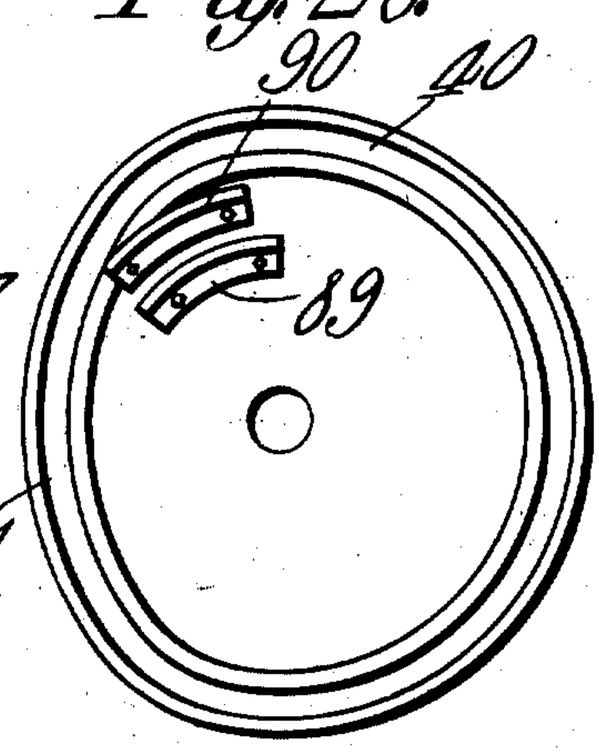


Fig. 26.

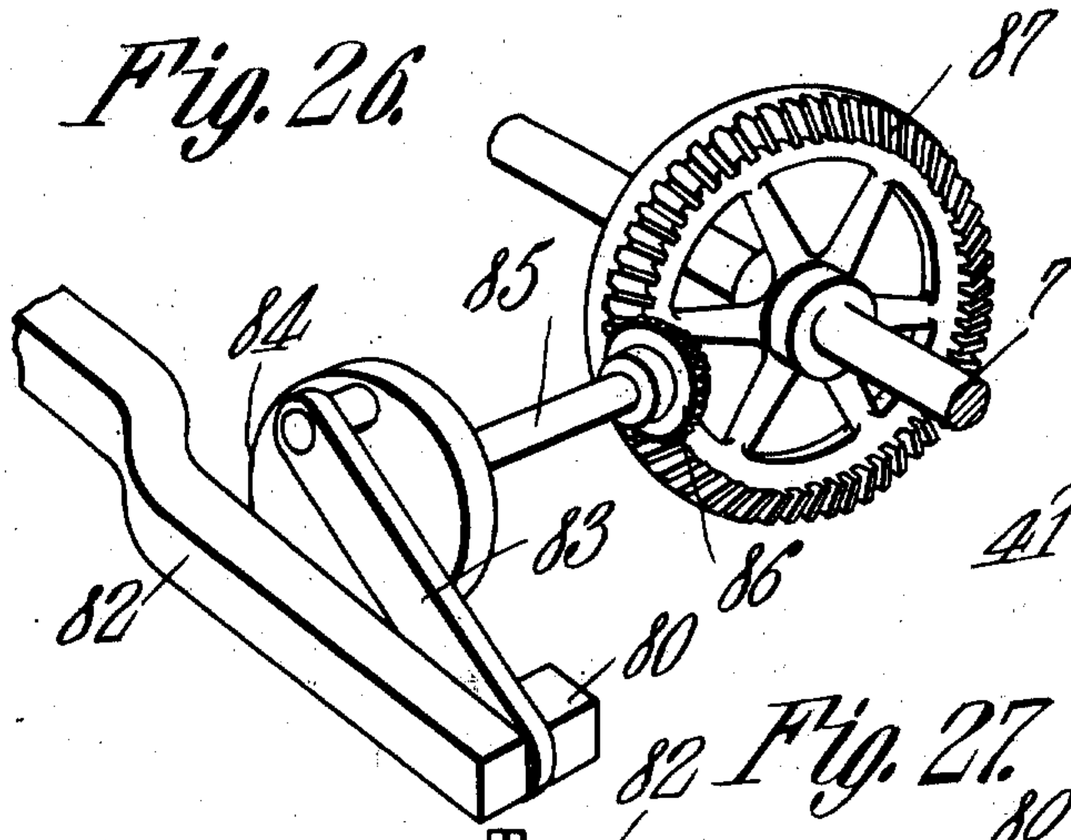
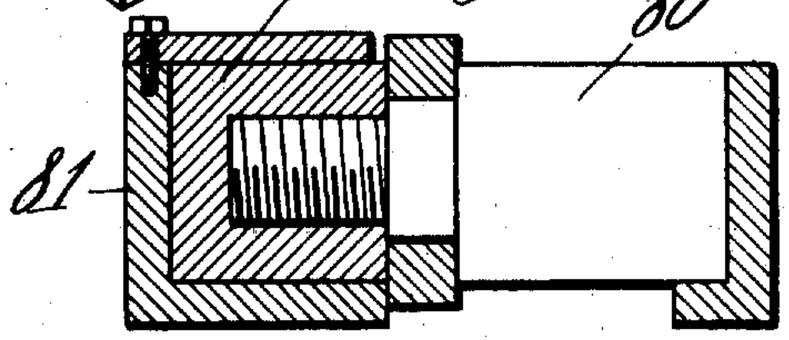


Fig. 27.



Witnesses

E. F. Clement

F. T. Chapman,

Inventor

Isaac K. Hollinger,

By C. A. Snow & Co.

Attorneys

UNITED STATES PATENT OFFICE.

ISAAC K. HOLLINGER, OF GREENVILLE, OHIO.

FENCE-MACHINE.

990,653. Specification of Letters Patent. Patented Apr. 25, 1911.

Application filed December 22, 1909. Serial No. 534,455.

To all whom it may concern:

Be it known that I, ISAAC K. HOLLINGER, a citizen of the United States, residing at Greenville, in the county of Darke and State of Ohio, have invented a new and useful Fence-Machine, of which the following is a specification.

This invention has reference to machines designed more particularly for the production of wire fences wherein the line wires and the mesh wires are connected in a manner to form substantially triangle-shaped mesh openings, and the invention includes means whereby the mesh openings may be of graded sizes from one edge of the fence toward the other.

In accordance with the present invention, the line wires may be fed from rolls of any size moving in the direction of the fence being woven and the mesh wires may likewise come from rolls of any size and are bound about the line wires at the point of junction of the mesh wires therewith, by forming the mesh wires into loops and twisting such loops about the line wires without, however, necessitating the movement of the mesh wires, except the portion forming the loop only, about the longitudinal axis of the line wires.

The invention comprises a rotatable drum carrying circular series of twisting heads designed to receive both the line wires and the mesh wires, and in connection with this drum there are provided loop-forming fingers related thereto so as to form the mesh wires into loops immediately adjacent to the line wires and then these mesh wires are twisted about the line wires to secure them thereto. Provision is made by the present invention for causing a lateral travel of the mesh wires alternately between two adjacent line wires so that the mesh wires zigzag throughout the length of the fence between adjacent line wires.

It is desirable to form fences having different sized mesh openings, sav small-sized mesh openings at that edge of the fence which will constitute the bottom of the erected fence, and large mesh openings at the top of such a fence, thus bringing the small mesh openings at that part of the fence where it is desirable to prevent the passage of small animals or fowls through the fence near the ground, while larger mesh openings will be effective at a higher point above the ground, thus economizing material in the fence structure.

The invention includes means whereby the fence structure may be woven with graded mesh openings as described and also includes mechanism whereby the fence may be woven in the manner set forth.

The invention will be best understood from a consideration of the following detail description taken in connection with the accompanying drawings, forming a part of this specification, in which drawings,

Figure 1 is a front elevation of the fence machine constructed in accordance with the present invention, some of the parts of the twisting drum being omitted. Fig. 2 is vertical section through the machine from front to rear with parts of the twisting drum omitted. Fig. 3 is an end elevation viewed from the right-hand end of the structure as shown in Fig. 1. Fig. 4 is an end elevation of the left-hand end of the machine as viewed in Fig. 1, with parts omitted. Fig. 5 is a cross section of the twisting drum on a larger scale than in the other figures, the plane of the section being at right angles to the longitudinal axis of rotation of the drum. Fig. 6 is a perspective view of a portion of the mesh wire controlling means and a portion of the driving mechanism therefor. Fig. 7 is a perspective view of one end of one of the carriers for the fingers coacting with the twisting members or heads and the loop forming fingers. Fig. 8 is a detail view of one of the hubs of the twisting drum. Fig. 9 is a detail section of a stop device used in connection with the twisting drum. Fig. 10 is a perspective view of one of the twisting heads and adjacent parts showing one of the rack bars in dotted lines. Fig. 11 is a perspective view of one of the sliding fingers utilized in forming the mesh wires into loops prior to twisting. Fig. 12 is an elevation of one of the twisting bars and parts carried thereby. Figs. 13 to 17 both inclusive are diagrammatic representations of the operation of the twisting heads and loop forming mechanism. Fig. 18 is a perspective view of one of the twists uniting the mesh wires with a line wire. Figs. 19 and 20 are structural diagrams showing the operation of parts during the weaving of the fence. Fig. 21 is a longitudinal section of the woven fence receiving drum.

Fig. 22 is a perspective view of a portion of the same. Fig. 23 is a perspective view of another portion of the same. Fig. 24 is a cross section through the fence receiving drum. Fig. 25 is an axial section, with parts in elevation, of the driving mechanism for the winding drum. Fig. 26 is a perspective view of a portion of the driving mechanism for the rack bars of the twisting drum. Fig. 27 is a detail section of a portion of the structure shown in Fig. 26. Fig. 28 is a view of one of the cam structures.

The working parts of the machine are supported in a suitable frame 1. Mounted in the frame 1 is a power shaft 2 receiving power in any desired manner, as by a pulley 3 and belt 4 connected to any suitable prime mover.

On one end of the shaft 2 is a pinion 5 meshing with a gear wheel 6 on another shaft 7 from which latter motion is transmitted to various movable parts of the machine in a manner to be described hereinafter. The shaft 7 carries a gear wheel 8 meshing with another gear wheel 9 on a shaft 10 mounted in the frame 1 near the front of the machine.

The shaft 10 is the shaft of the twisting drum and carries a series of spaced hubs 11, one of which is shown in detail in Fig. 5 and beyond this series of hubs 11 the shaft 10 carries other hubs 12. Each hub 11 is formed with a circular series of equally spaced radial slots 13 widening toward the periphery of the hub by steps for the purpose of accommodating certain structures seated in the slots.

In each slot 13 and extending the length of the twisting drum is a composite bar made up of a main member 14 and a supplemental member 15 spaced therefrom but of less width and at proper distances along the bar are blocks 16 having a thin body portion with one edge turned at an angle to form a longitudinal flange 17 while the other edge is thickened to form housing members 18—19 for a twisting head 20 provided with a radial slot 21 extending from the periphery of the twisting head to the center thereof. The periphery of the twisting head is formed with a circular series of gear teeth 22 for a purpose which will presently appear.

The housing members 18 and 19 of the block 16 act as spacing blocks for the bar members 14 and 15 and bolts or screws 23 extending through the bars 14 and 15 and through the housing members 18 and 19 serve to unite the several members of the bar into a rigid structure.

The housing members 18 and 19 project from the block 16 in the same direction as the flange 17 and this provides space for a rack bar 24 extending beyond the ends of the composite bar 14—15 and meshing with all the twisting heads 20 carried by the respective bars.

On each side of the composite bar 14—15 close to the outer edge thereof are strips 25 one of which has its ends bent toward the other and fastened thereto as indicated at 26, so that these two strips will move together. Beyond the point of union of these two strips one of the strips has its ends bent at right angles thereto as indicated at 27. The strips 25 are held to the composite bar 14—15 by means of studs or screws 28, but as these strips are designed to have a limited movement longitudinal of the bar 14—15 the studs or screws 28 extend through slots 29 in the strips 25, the length of the slots determining the extent of travel of the strips along the bar 14—15.

At suitable intervals along the top edges or the outer edges of the strips 25 there are notches or recesses 30 matching the twisting heads 20, and secured to each strip 25 at one end of each recess 30 is a block 31 provided at one end with a head 32 from which projects a flat elongated stud 33 having one edge 34 rounded and the other edge 35 beveled as best shown in Fig. 11, the purpose of this construction appearing hereinafter.

The disposition of the studs 33 is such that when the strips 25 are at one limit of their travel the free ends of the studs 33 are to one side of the axis of the twisting heads 20 and when the strips 25 have moved to the other limit of their travel then these free ends of the studs 33 have passed to the other side of the axis of rotation of the twisting heads 20, but the beveled edge 35 is at a greater distance from the axis of rotation of the twisting drum than is the axis of rotation of the corresponding head 20. The housings 18 and 19 override the corresponding twisting heads 20 and have their free ends spaced apart a distance substantially equal to the thickness of the slots 21, and these free ends recede one from the other as they leave the twisting head. Furthermore the side walls of those portions of the housings 18 and 19 adjacent to their free ends are beveled toward the outer edges of the housings as indicated at 36. Furthermore the housing 18 is thickened laterally adjacent to its free end to a greater extent than the housing 19 for a purpose which will hereinafter appear. This extended overhang of the housing 18 is indicated at 37 and is best shown in Fig. 10.

The opposite ends of the bar 14 are formed with or have attached to them longitudinally extending arms 38, each terminating in a roller 39. Fast on the main frame but in position to be engaged by the roller ends of the arms 38 are cams 40 which may be made of parallel metal bars bent to appropriate shape. Each cam is concentric with the

axis of rotation of the shaft 10 for the greater portion of its circumference, but at one portion, indicated at 41, the course of the cam approaches the axis of rotation of the shaft 10.

The rollers 39 traveling in the cams 40 constrain the bars 14—15 to follow a path when rotated by the hubs 11 which are keyed to the shaft 10, concentric for the greater portion of its length with the axis of rotation of the shaft 10 and then these bars are moved toward the axis of rotation of the shaft 10 for a distance agreeable with the inset of the cam at the part 41 thereof. The shape of the cam is such that during the greater portion of the rotation of the drum, the bars 14—15 and with them the twisting heads 20 are at the most extended position with relation to the axis of rotation while the inward movement of these bars and the twisting heads carried thereby is confined to a comparatively small portion of the length of the travel of the drum about the axis of the shaft 10.

Each bar 14—15 carries a suitable number of twisting heads 20 depending upon the number of line wires to be used in the fence. For reasons which will hereinafter appear the twisting heads carried by one bar are intermediate of the twisting heads carried by the next succeeding or preceding bar so that the twisting heads are in staggered relation about the twisting drum.

In Figs. 19 and 20 line wires are indicated at 42 and in the particular illustration of these figures there are eleven such line wires and consequently one bar 14—15 carries five twisting heads, while the next succeeding or preceding bar carries six twisting heads. Of course the number of twisting heads to a bar carrying the same will depend upon the number of line wires 42 which will enter into the fence. In these same figures the mesh wires are indicated at 43.

In the weaving of the fence an appropriate number of line wires 42 is used and the spacing of these wires will depend upon the character of the fence to be woven. These line wires are carried from a suitable supply, usually located at a point below the floor upon which the machine is mounted, up through the floor, and through a guide rod 44 mounted in the frame of the machine and provided with perforations or passages 45 designed to guide the line wires spaced in accordance with the relative positions of the line wires in the woven fence.

In the normal position of the twisting heads all the slots 21 have their open ends coincident with the space between the adjacent free ends of the housings 18 and 19 so that the line wires may freely enter the slots and be carried around the twisting drum to ultimately receive and have secured thereto the mesh wires 43 in a manner to be described. The mesh wires 43 also come from suitable sources of supply below the floor upon which the machine is mounted and after passing through the floor are continued upward in front of the machine over a guide strip 46 mounted in the frame work of the machine and from thence through eyes 47 or other suitable guiding means carried by two rods 48 and 49 respectively and from thence these mesh wires are carried into the twisting heads 20, each twisting head except those at the selvage edges of the woven fabric receiving two mesh wires 43.

In accordance with the present invention the mesh wires 43 are formed into open loops in the twisting heads 20 and are then wrapped about the line wires so as to be secured thereto.

In order to cause the looping of the mesh wires the strips 25 are moved in the proper direction and at the proper time period to cause the studs 33 to over-ride the line wires within the twisting head and the position of the bars 48—49 is such that the mesh wires 43 will enter into the slots 21 only after the studs 33 have been moved into their path and are thus interposed between the line wires and the mesh wires on each side of each twisting head.

To form the mesh wires into the required loops after they have been positioned there is provided a rotatable series of fingers 50—51. There are as many circular series of these fingers as there are twisting heads 20 in the direction of the length of the twisting drum, which number of twisting heads agrees with the number of line wires 42. Thus if the machine is designed to make a fence having eleven line wires as in Figs. 19 and 20 then there will be eleven circular series of fingers 50—51. The fingers 50—51 are secured in circular series to disk 52 mounted on a shaft or arbor 53 at an appropriate distance above the shaft 10, and having bearings in the frame 1. Since, as will hereinafter appear, the circular series of fingers 50—51 are given rotative movement by the twisting drum about the axis of the shaft 53, the latter is not otherwise connected up to the power side of the machine. If now it be assumed that the twisting drum is rotating in the proper direction, which is clock-wise as viewed in Figs. 2, 3, and 5, and considering the passage of the line and mesh wires through one of the twisting heads only, then a line wire will enter the slot 21 of a twisting head 20 to the axis of the latter as indicated in Fig. 13. At the proper point in the rotative movement of the twisting drum the strips 25 are actuated to bring the studs 33 across the slot 21 so as to cover the line wire 42 and the mesh wires 43 are brought into engagement with the edge 34 of the studs 33. In the meantime the ends

36 of the housings 18 and 19 engage a finger 51 and the continued rotative movement of the twisting drum causes this finger to move along the corresponding face of the housings 18 and 19 toward the mesh wires 43, but the overhang 37 prevents the engagement of the fingers 51 with the corresponding studs 33, the latter underriding the overhang 37. The beveled ends 36 facilitate the movement of the fingers 50 and 51 toward and from the axis of the twisting head 20.

The relation of the parts is such that the rotative movement of the twisting drum imparts a rotative movement to the series of fingers 50—51 and when the free ends of these fingers are in the closest relation to the axis of rotation of the twisting drum, the said free ends are about coincident with the axis of rotation of the corresponding twisting heads but these free ends are sufficiently separated to straddle the studs 33 then traversing the slots 21 of the particular twisting head under consideration. The movement of the finger 51 followed by a corresponding movement of the finger 50 on the opposite side of the twisting head causes a bending down of the mesh wires 43 until they are in contact with the line wire 42, but there is formed a loop 43′, shown in Figs. 15 and 16, caused by the intervention of the studs 33.

As soon as the loop 43′ has been formed the studs 33 are withdrawn out of the path of such loop and then rotative movement is imparted to the twisting head 20 by a proper movement of the rack 24 in a manner to be described hereinafter, and the mesh wires 43 are twisted about the line wire 42 in close relation thereto in a manner to lock these mesh wires firmly to the line wires. While the operations described have been progressing the twisting drum is rotating about the axis of the shaft 10, and consequently the fingers 50—51 are moving away from the axis of the twisting head 20, until finally the head 20 is entirely removed from between these twisting fingers and ultimately the twisted loop of wires moves out of the twisting head through the slot 21 to be subsequently treated in a manner to be described. In Fig. 17 the completed loop is shown and the fingers 50—51 are indicated as moving away from their active positions.

In Fig. 18 the completed loop is shown, there being indicated a single line wire and mesh wires approaching from either side of the said line wire to form the meshes.

The operation just described takes place simultaneously at alternate line wires and is followed by a like operation simultaneously performed on the remaining line wires at a suitable distance farther along the last named wires, to be followed by a like operation on the first named line wires to complete the mesh openings, and these operations are repeated in order so long as the machine is running and there is a supply of wire fed to the machine.

The fingers 50—51 have their free or working ends laterally expanded and formed with a central notch or recess 54 designed to receive and center the mesh wires upon the line wire at a distance from the twisting heads, thus facilitating the twisting of the mesh wires about the line wire, since as will hereinafter appear the mesh wires approach the line wire at an angle thereto. Were it not for the holding of the mesh wires at a distance from the twisting heads during the operation of twisting an imperfect mesh would result.

In the manufacture of the fence the mesh wires are each secured alternately to two adjacent line wires thus forming substantially triangular meshes. The machine forming the subject matter of the present invention is provided with means for causing the alternate movement of the mesh wires from one line wire to the next adjacent one as the weaving progresses.

Extending longitudinally through the twisting drum between each two adjacent bars 14—15 are flat rods 55 each provided with an appropriate number of pins 56 in radial relation thereto, each pin being so disposed as to engage a chosen one of the mesh wires as the latter enter the slot in the appropriate twisting head 20. These bars 55 terminate at the ends in angle extensions 57 to be engaged by appropriate mechanism hereinafter described for moving the bars longitudinally. There are always two mesh wires approaching or receding from a line wire, except the edge or selvage line wires and consequently there must be at least two bars 55 moving in opposite directions simultaneously to cause the desired lateral movement of the mesh wires. However in the drawing the machine is shown adapted to produce several graded sizes of mesh openings in the same fence structure. The particular showing is that of three different sizes of mesh in order from one edge of the fence structure to the other edge thereof. Consequently there are three pairs of rods 55. The movement of each rod 55 is sufficient to carry a pin 56 from one line wire to the next adjacent wire in either direction of movement of the rods, these rods having reciprocatory movement.

To cause the movement of the rods 55 there are provided at each end of the machine pivoted levers 58, these levers being shown as substantially pendant and carried by brackets 59 on a suitable cross piece 60 of the main frame. To actuate the levers 58 there is provided a shaft 61 upon which there are secured cams 62 one for each lever 58. The cams 62 engage the levers 58 at a point between their pivot supports 59 and

the other ends of the levers, which latter ends are formed into heads 63 adapted to engage the extensions 57 of the rods 55 when the said extensions are brought into the path of the levers 58 by the rotative movement of the twisting drum. The heads 63 have sufficient lateral extension with relation to the length of the levers 58 to permit the actuation of the rods without the necessity of stopping the progressive rotation of the twisting drum. There are like sets of levers 58 at each end of the machine, one set of levers engaging the ends 57 of one of each pair of rods 55, and the other set of levers at the other end of the machine engaging the ends 57 of the other members of each pair of rods 55. The movement of the parts is so timed that the alternate rods 55 of each complete set are moved together, one rod of a pair being moved in one direction and the other rod of the pair being moved in the other direction.

Let it be assumed that the parts are in the position shown in Fig. 19, so far as the showing of this figure goes, and that the intermediate row of twisting heads there shown are about to move with the line wires to the point in the rotative movement of the twisting drum where the twisting operation occurs. Let it further be assumed that the intermediate set of rods 55 shown in Fig. 19 are about to be moved longitudinally, the cams 62 being primed to actively engage the levers 58 so as to actuate the rods 55 referred to at this time. It is to be noted that the cams 62 are of different sizes so that the levers 58 are moved to correspondingly different extents. Three of the rods 55 are moved toward the left as view in Figs. 19 and 20 to different extents and the matching rods 55 of the same group or set are moved toward the right to corresponding different extents. The result of this is that the pins 56 carried by the several rods will engage behind the mesh wires then in their paths and cause them to move toward the line wires toward which the pins are actuated by the movement of the rods 55. The mesh wires are therefore carried into close relation to the corresponding line wires so that on the continued rotation of the twisting drum these mesh wires will fall into the slots of the twisting heads receiving the line wires toward which the mesh wires have been carried. In the meantime the fingers 50 and 51 have moved into embracing relation to the twisting heads which are immediately in advance, in the direction of rotation, of the rods 55 referred to, and the twisting of the mesh wires about the line wires proceeds, the mesh wires on each side of each active twisting head being then at an angle to the line wires, being there held on the one side by the finished twist and on the other side by the pins 56 of the actuated rods 55. The continued rotation of the twisting drum carries the rods 55 already actuated out of the paths of the levers 58 and the progressive rotation of the shaft 61 carries the cams 62 away from the levers 58 which fall to their pendant position out of the path of the oncoming ends 57 of the next series of rods 55 so that when these latter rods have been carried to the proper position by the continued rotation of the twisting drum, the next actuation of the levers 58 will cause the movement of the rods 55 of the succeeding sets in the manner already described with relation to the first mentioned set.

In order to facilitate the carrying of the mesh wires from one line wire to the other the rods 48 and 49 are also made reciprocatory so that the guiding eyes or staples 47 for the mesh wires travel to an extent with the movement of the mesh wires from line wire to line wire thus bringing the mesh wires more nearly into coincidence with the slots in the twisting heads than would be the case were the rods 48 and 49 stationary, and with the eyes 47 intermediately positioned with relation to the line wires. By reciprocating the rods 48 and 49 the mesh wires are brought into sufficiently close relation to the corresponding line wires to readily drop into the slots in the proper ones of the twisting heads at the proper time. In order to cause the reciprocation of the rods or bars 48 and 49 there are provided levers 64 carried at one end by brackets 65 which may be fast to the same cross piece 60 as are the brackets 59 and these levers 64 are under the control of cams 66 which may be mounted on the shaft 61. The free ends of the levers 64 engage pins 67 on the respective rods 48 and 49. There are levers 64 at each end of the machine so that the reciprocatory movement of the rods 48 and 49 is positively caused in each direction. Each shaft 61 carries another cam 68 in the path of which is a lever 69 pendantly supported by the cross piece 60 and at its free end engaging the angle extension 27 of the strips 25, the cams 68 and levers 69 operating to cause the reciprocation of the strips 25 in timed relation to the movement of the other parts. The strips 25 being carried by the twisting drum are brought successively into coincidence with the levers 69 and reciprocatory movement is imparted to these strips at the proper time in the rotative movement of the twisting drum.

In order to cause the rotation of the shaft 61, each shaft terminates in a beveled pinion 70 meshing with another beveled pinion 71 on a counter shaft 72 which in turn carries a second pinion 73 meshing with a corresponding gear wheel 74 on the shaft 7, the gearing being proportioned to cause the proper movement of the shaft 61.

The composite bars 14—15 carrying sets of the twisting heads are carried about the axis of the shaft 10 by the hubs 11 and are caused to move radially with relation to the hubs by the engagement of the rollers 39 on the arms 38 in the cams 40.

The rack bars 24 are made longer than the composite bars 14—15 so that they may be reciprocated by suitable means to be described engaging the ends of the rack bars, and because of this reciprocatory movement the rack bars are longer than the composite bars 14—15. The frictional engagement of the rack bars with the composite bars tends to cause the latter to move longitudinally, but this movement is prevented by the hubs 12 at each end of the composite bars and each one of these hubs carries adjustable plates 75 held to the hub by a suitable set screw or screws 76 (see Fig. 9) each passing through a slot 77 in the plate 75 while abutting screws 78 carried by the plates 75 and engaging shoulders formed in the hubs 12 serve to determine the position of the plates 75 with relation to the hubs. By this means the bars 14—15 may be confined very strictly to a path about the axis of the shaft 10 without any material movement parallel therewith.

The hubs 12 are provided with radial slots 79 for receiving and guiding the corresponding ends of the rack bars 24.

In order to cause the active movements of the rack bars 24 to rotate the twisting heads 20 in a direction to cause the twisting of the mesh wires about the line wires, there is provided at one end of the machine, this being the right hand end of the machine as viewed in Fig. 1 in the particular structure shown, a slide block 80 mounted for reciprocation in a guide 81. This block 80 carries a push bar 82 so located as to engage the corresponding end of a rack bar 24 at the proper time in the rotation of the twisting drum to move said rack bar longitudinally and cause the active rotation of the twisting head.

The block 80 is reciprocated by a pitman 83 connected at one end to the block and the other end to a crank disk 84 on a countershaft 85, which countershaft carries a pinion 86 on the end remote from the crank disk 84 and this pinion is in mesh with the gear wheel 87 on the shaft 7. The push bar 82 causes the movement of the rack bars in one direction only while the return movement of these rack bars to normal position ready to be again actively moved is caused by a cam 88 located in the path of the rack bars at any point in the rotative travel of the twisting drum after the wires have left the twisting heads.

Because of the strain incurred it is desirable that the active movement of the rack bars under the control of the push bar 82 should be less than sufficient to complete the full necessary movement of the twisting head. To complete the full active movement of the twisting head there is provided a cam 89 which is so located that each rack bar comes under its control as soon as the rack bar moves from engagement with the push bar 82 and a further longitudinal movement of the rack bar is caused by the action of this cam, it being a stationary cam, thus imparting the final movement to the twisting heads necessary to complete the twist of the mesh wires about the line wires.

The active movement of the bars or rods 55 has left these bars in a position from which it is necessary they should be moved to the initial position. For this purpose there is provided at each end of the machine in the path of the extensions 57, a stationary cam 90 serving to return all the rods 55 to their initial positions.

The woven fence indicated at 91 in Fig. 2 is carried around an idler drum 92, thence through the frame of the machine to the upper portion thereof where it is carried over and around a crimping drum 93, this being an idle member of the crimping structure, thence under and around another crimping drum 94, this being the power member of the crimping device, and thence over and around another idler crimping drum 95, these several drums being of known construction and designed to impart a crimp to the line wires and to the mesh wires, thus making the completed fence longitudinally elastic. The finished fencing is now carried to a winding drum, shown best in Figs. 21 to 24 both inclusive. The body of the winding drum, that portion receiving the completed fencing, is made up of two parallel spaced timbers 96 which in cross section define substantially a square body. At each end these timbers 96 are seated in an I-block 97 to which is secured a rod 98 terminating in a screw-threaded extremity 99.

Each rod 98 is housed for the greater portion of its length in a sleeve or hollow shaft 100 rotatable in a suitable bearing 101, forming part of the main frame of the machine.

Keyed to each hollow shaft 100 at the inner side of the bearing 101 is a hub 102 having formed thereon a frame 103 open on two opposite sides and closed the other two opposite sides at right angles to the open sides. This frame has a recess 104 in line with the hub 102 and adapted to receive the connecting member of the I-block 97 with the top and bottom lateral extensions thereof resting on the frame 103 on each side of the recess 104. The frame 103 is provided with side wings 105 which, when the block 97 is in position in the frame 103 and moved away from the hub end

102, span the spaces between the laterally extended ends of the I-block and so retain the timbers 96 in place therein. The I-block may be moved into the recess of the frame 103 and so carry the I-block 97 away from the corresponding ends of the timbers 96 thus permitting the same to be withdrawn through the spaces between the ends of the wings 105. Each hollow shaft 100 terminates in an enlarged sleeve 106 housing one end of a nut 107 applied to the threaded end 99 of the corresponding rod 98. Each nut 107 is formed with a handle 108 and with a circumferential groove 109 entered by the ends of set-screws 110 serving to confine the nut in the enlarged end 106 on the shaft 100 but at the same time permitting rotative movement of the nut 107 by means of the crank handle 108. By this means the rods 98 may be moved longitudinally in the shaft 100 and the blocks 97 may be moved toward one another or away one from the other to cause the locking of the timbers 96 in place or their release as the case may be.

The end of the finished fencing is introduced in the space between the timbers 96 and then rotative movement is imparted to the shaft 100 to cause the timbers 96 to rotate and thus wind the fence thereon. When a sufficient roll of fencing has been thus formed on the timbers 96 the rods 98 may be moved longitudinally in a direction to carry the blocks 97 away from the timbers 96 which cannot follow these blocks because the timbers abut against the frame 103, and so the timbers with the roll of fencing are released so that the timbers and fencing roll may be removed from the machine, after which because of the space between the timbers 96 the said timbers may be loosened and removed from the roll and replaced in the blocks 97 to be again fastened in place preparatory to forming another roll of finished fencing.

In order to drive the winding roll for the fencing there is mounted on one of the shafts 100 a sprocket gear wheel 111. This wheel is held on the shaft by a collar 112 on one side and a ratchet wheel 113 on the other side, this ratchet wheel being coupled to the sprocket wheel 111 by a pawl 114. The ratchet wheel is made fast to the shaft 100 by a set-screw 115 or otherwise. The hub of the ratchet wheel and the sleeve 106 may be formed in one piece if so desired.

The winding drum for the finished fencing is rotated through the sprocket wheel 111 by means of a sprocket chain 116 leading to a sprocket wheel 117 carried by the shaft 10. The sprocket wheel 117 is in the form of an annulus made fast on a sleeve 118 in turn carried by friction rings 119 supported by a pulley 120 on the shaft 10.

On one side of the pulley 120 is a disk 121 and on the other side of the pulley 120 is a disk 122. These two disks are keyed to the shaft 10 and are held together by bolts 123 serving to clamp the rings 119 between them. The disk 121 is provided with lugs 124 for attachment to the spokes of the gear wheel 9 keyed to the shaft 10, this serving to key the disk 121 to the shaft 10 through the gear wheel 9.

The connection between the shaft 10 and the sprocket wheel 117 is a friction connection which will yield on the exertion of a sufficient force or the presentation to the sprocket wheel 117 of a sufficient resistance to its rotation.

When the finished fencing is rolled upon the winding drum therefor the increasing diameter of the roll will cause a greater peripheral speed than when the roll is smaller unless provision be made for compensating this increasing diameter of the roll and this is done by the slip of the sprocket wheel 117 upon its support, but the frictional engagement of the rings 119 with the member 118 is sufficient to wind the fencing upon the winding drum under the desired tension, the parts yielding or slipping before the tension becomes too great.

The shaft 7 carries a sprocket pinion 125 connected by a sprocket chain 126 to a sprocket pinion 127 on the crimping drum 94. A tightener sprocket pinion 128 mounted on an adjustable bracket 129 serves to maintain the chain 126 in the desired tightened condition.

The machine as a whole operates as follows: The line wires 42 coming from a suitable source of supply are carried through the guide 44, thence around the twisting drum passing through appropriate ones of the twisting heads 20 by way of the slots 21. The mesh wires 43 coming from a suitable source of supply are carried through the eyes 47 on the bars 48—49 and from thence to the twisting heads on the twisting drum. Considering the drum as rotating, each pair of mesh wires, these wires being arranged in pairs, are first to be considered as lodged in a twisting head near the open end of the slot 21, the studs 33 at this time lying along side of the twisting head in traversing relation to the portion thereon in which the slot 21 is formed. The continued rotation of the drum causes an engagement of the fingers 50—51 with the mesh wires 43 in a manner to form them in loops about the fingers 33 until these mesh wires are brought into engagement with the line wires 42 traversing the slot 21 coincident with the axis of rotation of the twisting head 22. As soon as the loops have been formed in the mesh wires the cams 68 and levers 69 become active to move the strips 25 and with them the studs 33 out of active relation to the twisting head. Immediately after this the rack bar 24 controlling the twisting heads in line

therewith is actuated by the push bar 82 to which reciprocatory movement is imparted by the crank disk 84, driven by the pinion 86, and gear 87 on the shaft 7. The rotation of the twisting heads causes the loops of the mesh wire, which loops are in eccentric relation to the axis of rotation of the twisting heads, to be wound about the line wires in the manner shown in Fig. 18, the parts being so proportioned that the twisting heads come to rest with the slots 21 directed radially outward. The rotary movement of the drum continuing, the next series of twisting heads in order is brought to the position occupied by the twisting heads just considered, but in the meantime the mesh wires are carried away from the line wires to which they have just been connected toward the adjacent line wires there meeting other mesh wires similarly treated, this being brought about by the proper movement of the rods 55 under the action of the cams 62 and levers 58. The appropriate strips 25 are now moved to bring the studs 33 into crossing relation to the slots 21 of the new set of twisting heads and the rotation of the twisting drum has caused a like rotation of the shaft carrying the fingers 50—51 so that the fingers in order are brought into operative relation to the mesh wires and force the latter toward the line wires in a direction toward the axis of rotation of the drum to form the loops in these mesh wires prior to the action of the twisting heads which act in timed relation to the movements of the other elements as, already described. On the further rotative movement of the drum the mesh wires are returned toward the line wires with which they were first connected and are twisted thereabout and are then carried to and twisted about the second set of line wires and so on so long as the machine is in operation.

As the rotative movement of the drum progresses the twisting heads and parts carrying the same are moved radially toward the axis of rotation of the drum to withdraw the twisting heads from the finished fabric, this being accomplished by the cams 40 engaging the arms 38 and these parts are again returned to the former position by the same cams. After the fence is woven, which woven fence is indicated at 91 in Fig. 2, it is carried about the idler drum 92 and thence through the frame of the machine to the upper part thereof and between the crimping rollers 93, 94, 95 and finally passes to the winding drum which is driven in proper timed relation to the rest of the mechanism so that the finished fabric is wound upon the drum at a speed to maintain the fence in a taut condition and draw the same through the machine as rapidly as necessary. When the roll of fencing on the winding drum is completed the blocks 97 are moved one away from the other thus releasing the timbers 96 for the withdrawal of the roll.

The treatment of the fence after being woven forms no part of the present invention, but it will be understood that if so desired the fence may be galvanized after the usual practice thus cementing the strands securely together.

What is claimed is:

1. In a machine of the class described, a twister for mesh wires, and a looper for the mesh wires in operative relation to the twister to form the mesh wires into loops in traversing eccentric relation to the twister and timed to act prior to the action of the twisters on the loops.

2. In a machine of the class described, a twister for mesh wires in position to be axially traversed by a line wire, and a looper for the mesh wires in operative relation to the twister to form the loop in eccentric traversing relation to the twister, said looper being timed in action to form the loop prior to the active movement of the twister.

3. In a machine of the class described, twisters for the mesh wires in position to be axially traversed by the line wires, loopers for the mesh wires in operative relation to the twisters to form the loops in eccentric traversing relation to the twisters and timed in action to form the loops prior to the active movement of the twisters, and diverters for the mesh wires movable transversely to the length of the line wires to carry the mesh wires alternately into operative relation to the line wires.

4. In a machine of the class described, a rotatable drum having thereon twisting heads movable radially with relation to the drum, said twisting heads being in staggered relation and rotatable on an axis tangential to the path of rotation of the twisting head about the axis of the drum.

5. In a machine of the class described, diverters for mesh wires for alternating them between adjacent line wires, loopers for the mesh wires acting thereon when the mesh wires are adjacent to the line wires, and twisters for wrapping the loops of the mesh wires about the line wires.

6. In a machine of the class described, a twisting device comprising a rotatable member, twisting heads, carriers for said heads mounted in said rotatable member and movable radially with relation thereto, means for causing the active movement of the twisting heads, said means being carried by the rotatable member, and means independent of the rotatable member for causing the actuation of the means for moving the twisting heads actively in timed relation to the rotative movement of the rotatable member.

7. In a machine of the class described, a circular series of radially movable twisting heads in sets parallel with the axis of rota-

tion, an actuating mechanism for causing the radial movement of all of the twisting heads of a set at a predetermined point in the rotation of the series, and actuating mechanism engaging all the twisting heads of a set simultaneously at a predetermined point in the rotative movement of the series of twisting heads to cause the simultaneous twisting movement of the twisting heads of a set.

8. In a machine of the class described, a group of twisting heads each provided with a radial slot open at the outer end and with peripheral teeth, a bar carrying all the twisting heads of a group in spaced relation, and a rack bar carried by the first-named bar with its teeth in mesh with the peripheral teeth of all the twisting heads of the group, said rack-bar being capable of movement longitudinal to the carrying bar.

9. In a machine of the class described, twisting heads, a bar carrying a group thereof in spaced relation, each twisting head being provided with a radial slot open at the outer end, means for causing the rotative movement of the twisting heads on their own axes, spacing members movable across the slots in the twisting heads, means for introducing wires or strands into the slots of the twisting heads with the spacing members interposed, and means for bending the radially outer wires around the interposed members toward the inner wires.

10. In a machine of the class described, twisting heads each provided with a radial slot open at the outer end, spacing members movable across the slot on each side of the twisting heads, means for introducing a wire or strand into the slot in each twisting head to the inner end thereof, means for introducing other wires or strands into the slots in the twisting heads with the spacing members interposed between the latter-named wires and the first-named wires, and means for carrying the last-named wires around the interposed members and toward the first-named wires.

11. In a machine of the class described, rotatable twisting heads, each having a radial slot extending from its axis of rotation to and opening at the periphery of the head, and a housing for said head having a passage leading to the slot in the twisting head when the latter is in normal position, said housing extending beyond the twisting head in the direction of the axis of rotation of the latter, and spacing members movable across the slot in the twisting head in close relation to the opposite sides of the said twisting head and within the space defined by the lateral extension of the housing.

12. In a machine of the class described, a rotatable twisting drum, bars carried thereby and extending parallel with the axis of rotation of the said twisting drum, sets of twisting heads carried by the bars, spacing members carried by the bars and movable into and out of operative relation to the twisting heads, and rotatable series of fingers adapted to move along the spacing members in a direction to and from the axes of rotation individual to the twisting heads.

13. In a machine of the class described, a rotatable series of twisting heads made up of sets of twisting heads longitudinal to the axis of rotation of the series and each individually rotatable, spacing members movable in operative relation to the twisting heads in a direction longitudinal to the axis of rotation of the series, and looping fingers movable in operative relation to the spacing members in a direction to and from the axis of rotation of the series.

14. In a machine of the class described, a rotatable drum or carrier, twisting heads thereon disposed in a circular series of sets or groups of twisting heads, each set being longitudinal to the drum and in staggered relation to the next adjacent set, means for feeding line and mesh wires to the drum, and means carried by the drum for engaging the mesh wires and moving them alternately into operative relation to the staggered twisting heads of successive groups thereof.

15. In a machine of the class described, a rotatable twisting drum provided with a circular series of longitudinal sets of twisting heads, the heads of one set being in staggered relation to the heads of the next adjacent sets, means for directing line and mesh wires or strands to the twisting drum, means carried by the twisting drum for directing the mesh wires into operative relation to adjacent line wires and the twisting heads receiving the latter, in alternation, means for forming the mesh wires into loops when in operative relation to the line wires, and means for causing the active movement of the twisting heads to wrap the loops of mesh wires about the line wires.

16. In a machine of the class described, a rotatable twisting drum, bars longitudinal thereof and capable of moving radially with relation to said drum, twisting heads carried by said bars, means carried by the bars for imparting rotative movement to the twisting heads on the bars, means for directing line and mesh wires or strands to the twisting heads, rods or bars individual to each bar carrying a set of twisting heads and also mounted on the drum, said last-named bars being provided with means for engaging the mesh wires and moving them between adjacent line wires, and means for causing the active movement of the rods or bars engaging the mesh wires.

17. In a machine of the class described, a rotatable twisting drum, bars longitudinal thereof, and movable radially in said drum, a group or set of twisting heads carried by

each bar, spacing members carried by the drum in operative relation to the twisting heads of each bar, means for directing line and mesh wires or strands to the twisting heads, sliding bars carried by the drum and individual to the twisting heads carried by the respective bars, means co-acting with the spacing members for forming the mesh wires into loops within the twisting heads, means for actuating the bars controlling the mesh wires, and means for imparting individual rotation to the twisting heads to cause the wrapping of the mesh wire loops about the line wires.

18. In a machine of the class described, a rotatable twisting drum, means for directing line and mesh wires thereto, and a rotatable series of looping fingers for the mesh wires coacting with the twisting drum and actuated by the latter.

19. In a machine of the class described, a rotatable twisting drum, a circular series of twisting heads carried thereby in longitudinal groups or sets, each twisting head being provided with a circumferential series of gear teeth, rack-bars, one for each set or group of twisting heads, said rack-bars being mounted on the twisting drum, and means for actuating the rack-bars movable into engagement with each rack-bar in succession at a predetermined point in the rotative movement of the drum.

20. In a machine of the class described, a rotatable twisting drum, a circular series of twisting heads carried thereby in longitudinal groups or sets, each twisting head being provided with a circumferential series of gear teeth, rack-bars, one for each set or group of twisting heads, said rack-bars being mounted on the twisting drum, and means for actuating the rack-bars movable into engagement with each rack-bar in succession at a predetermined point in the rotative movement of the drum, said means comprising a push-bar movable into engagement with one end of the rack-bar, and means for actuating said push-bar in timed relation with the operation of the other parts of the machine.

21. In a machine of the class described, a rotatable series of twisting heads in sets longitudinal to the axis of rotation of the series, a rack-bar for each set of twisting heads, the rack-bars being rotatable with the series of twisting heads, and means for actuating the rack-bars one at a time comprising a non-rotatable member movable to actuate the rack-bars in timed relation to the rotation of the series of twisting heads, and a cam in the path of the rack-bars for completing the active movement of the latter.

22. In a machine of the class described, a rotatable series of twisting heads in sets or groups longitudinal to the axis of rotation, a carrier for the twisting heads and rotatable with the series, rack-bars, one for each set or group of twisting heads and movable in a direction parallel with the axis of rotation of the carrier, a reciprocating member movable into engagement with one end of the rack-bars in succession, a cam for completing the movement of the rack-bars in the same direction as caused by the reciprocating member, and a cam in the path of the other ends of the rack-bars for returning them to initial position.

23. In a machine of the class described, a rotatable carrier, bars longitudinal thereto and each carrying a series of twisting heads, said bars being movable in the carrier in a direction radial to the axis of rotation of the latter, adjustable stop members at the ends of the bars, fixed cams engaging the bars and causing the radial movement thereof, a rack-bar in each bar supporting the twisting heads and movable longitudinally thereof, and means for causing the longitudinal movement of the rack-bars in timed relation to the rotative movement of the carrier.

24. In a machine of the class described, twisting heads, bars each carrying a set or group of twisting heads, strips carried by the bars on each side thereof and capable of independent movement longitudinal of the bars, and elongated studs carried by the strips and movable across the twisting heads with relation to the axis of rotation of the latter.

25. In a machine of the class described, a rotatable twisting drum, twisting heads carried thereby, members carried by the twisting drum and movable longitudinally thereof, and means for operating said longitudinally movable members comprising levers carried by fixed portions of the structure and movable to engagement with the longitudinally movable members carried by the drum at predetermined points in the rotative movement of the drum, and means for causing the movement of the levers in timed relation to the rotative movement of the drum.

26. In a machine of the class described, a rotatable twisting drum, wire directing means coacting with the twisting drum to move mesh wires toward the axis of rotation of the drum, and wire engaging means on the drum movable in opposite directions lengthwise of the drum to carry the mesh wires alternately into operative relation to adjacent line wires.

27. In a machine of the class described, a rotatable twisting drum, twisting heads carried thereby, means for directing line and mesh wires to the twisting heads on the drum, diverters on the drum for carrying the mesh wires alternately into operative relation to adjacent line wires, and loopers in coactive relation to the drum and located in

the path of the mesh wires to engage and move them in a direction lateral to their longitudinal travel simultaneously with the movement of the mesh wires toward adjacent line wires.

28. In a machine of the class described, a rotatable twisting drum and a circular series of looping fingers in operative relation thereto and actuated by the rotative movement of the twisting drum.

29. In a machine of the class described, a rotatable twisting drum, and a rotatable series of looping fingers actuated by said drum, each finger having a terminal notch for engaging wires fed to the twisting drum.

30. In a machine of the class described, a twisting drum, means for directing line and mesh wires thereto, and means for moving the mesh wires alternately into operative relation to adjacent line wires, comprising longitudinally movable bars or rods carried by the drum, said rods or bars being movable simultaneously in opposite directions and provided with engaging means for the mesh wires.

31. In a machine of the class described, a rotatable twisting drum, means for directing line and mesh wires thereto, and means for moving the mesh wires alternately into operative relation to adjacent line wires comprising longitudinally movable bars or rods carried by the drum and provided with means for engaging said mesh wires, and means for moving said longitudinally movable rods or bars to different extents.

32. In a machine of the class described, a twisting drum, means for directing line and mesh wires thereto, and means for moving the mesh wires alternately into operative relation to adjacent line wires comprising longitudinally movable rods or bars carried by the twisting drum and having means for engaging the mesh wires, the said longitudinally movable bars being disposed in oppositely movable sets, means for moving the bars of a set to different extents, and means for returning all the bars of a set to the same initial position.

33. In a machine of the class described, a winding drum for the finished fencing comprising separated members, an I-block for sustaining the ends of the timbers, a housing frame for the I-block in which it is movable in the direction of the axis of rotation of the drum, and means for moving the I-block to release the timbers.

34. In a machine of the class described, a winding drum for the finished fencing comprising spaced timbers, an I-block at each end thereof sustaining the timbers in spaced relation, a housing frame for the I-block in which the latter is movable in the direction of the axis of rotation, a hollow shaft supporting the housing frame, a rod connected to each I-block and extending through the corresponding portion of the hollow shaft, and means for moving the rods longitudinally in the hollow shaft to cause a corresponding movement of the I-block to lock or release the timbers in accordance with the direction of movement of the said block.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

ISAAC K. HOLLINGER.

Witnesses:
GEO. A. KATZENBERGER,
HAZEL N. ARENS.