

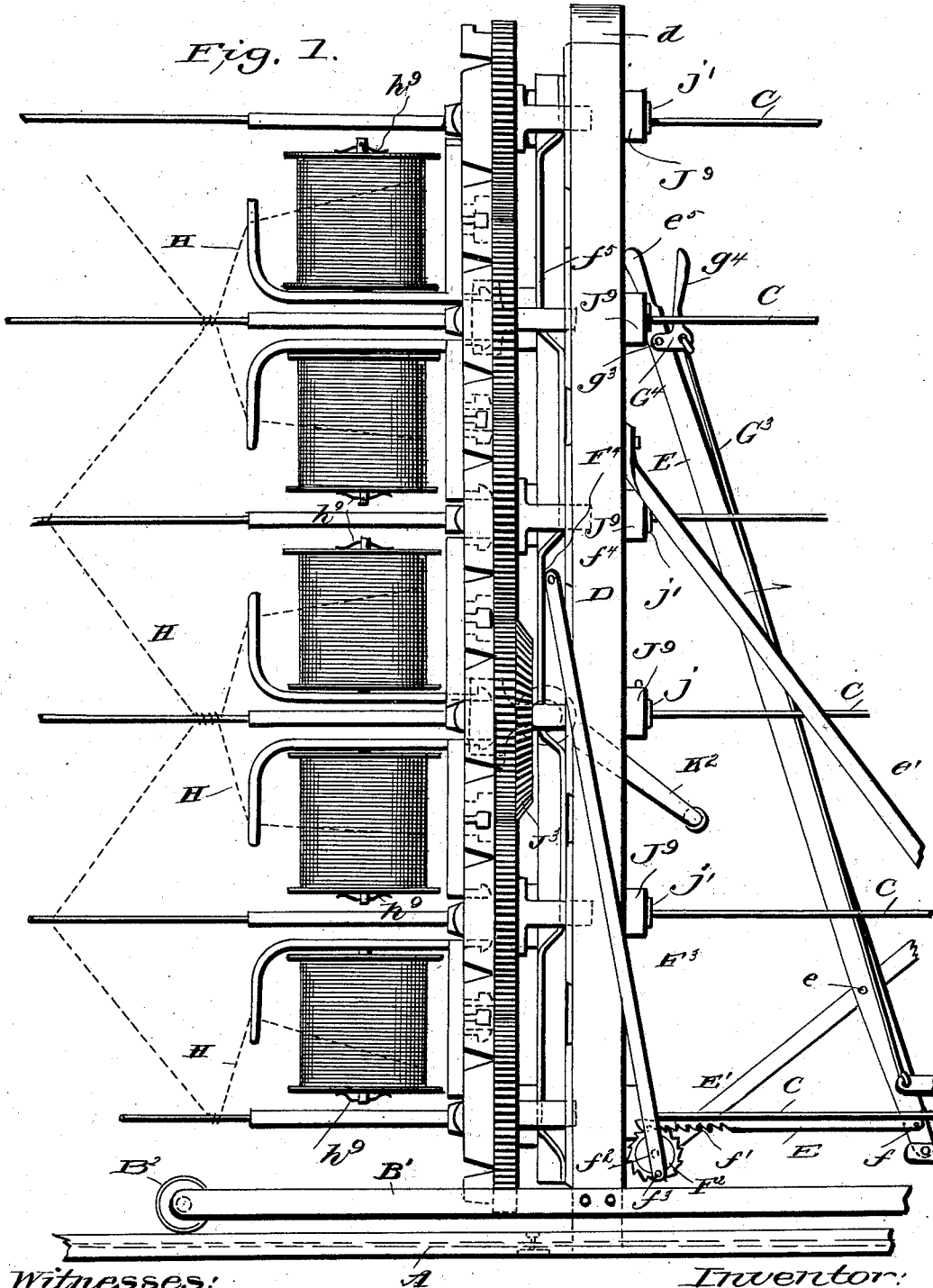
(No Model.)

3 Sheets—Sheet 1.

W. C. AVERY.
WIRE FABRIC MACHINE.

No. 580,750.

Patented Apr. 13, 1897.



Witnesses:
L. C. Hills.
C. R. Bond

Inventor:
William C. Avery,
by E. B. Stocking
Atty

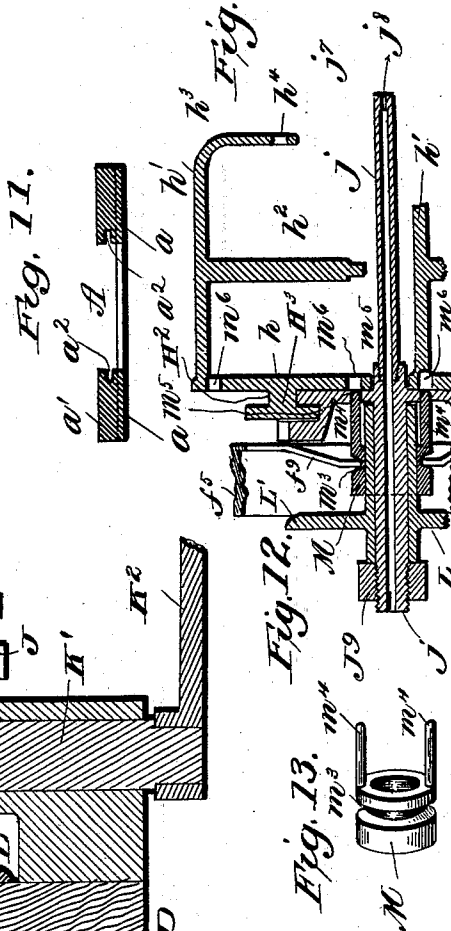
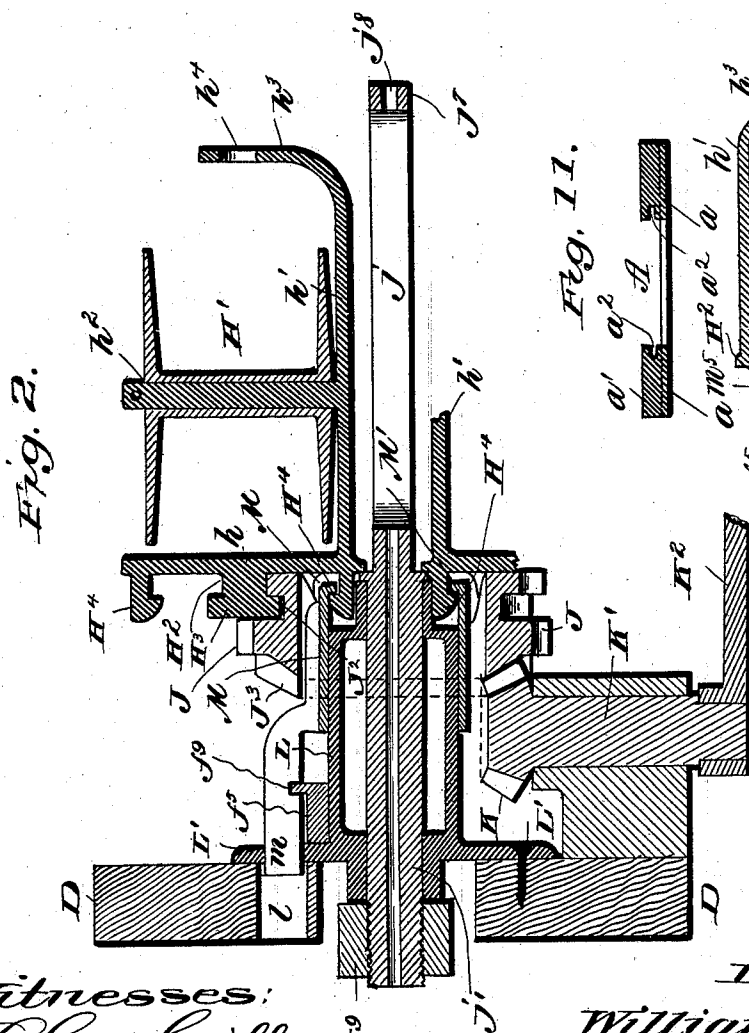
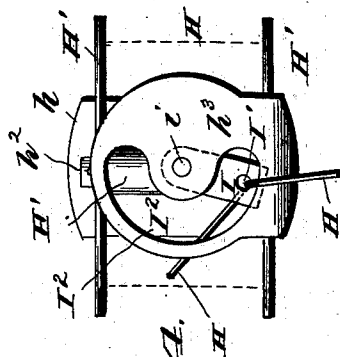
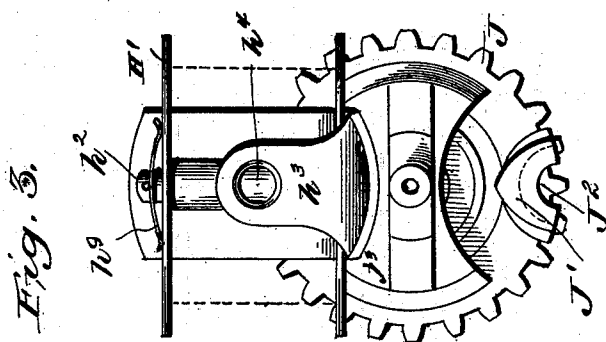
(No Model.)

3 Sheets—Sheet 2.

W. C. AVERY.
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(No Model.)

3 Sheets—Sheet 3.

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Fig. 5.

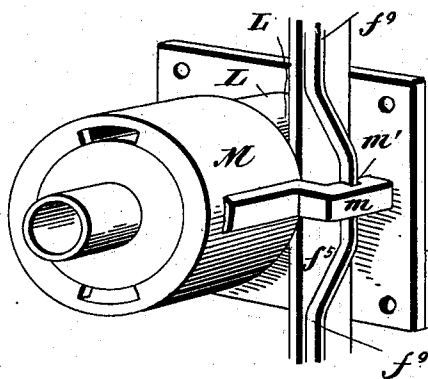


Fig. 6.

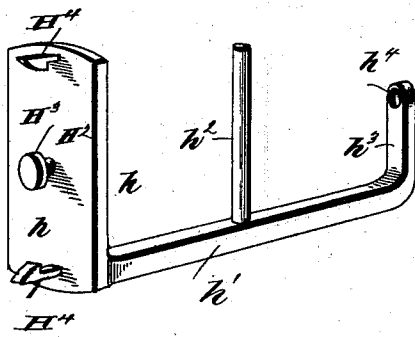


Fig. 7.

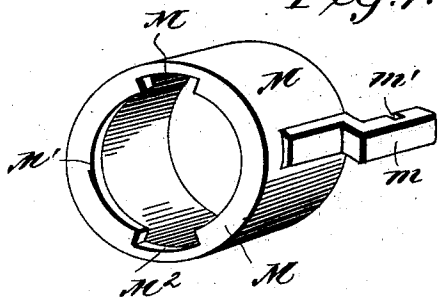


Fig. 8.

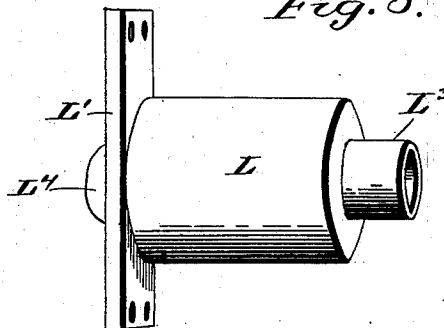


Fig. 9.

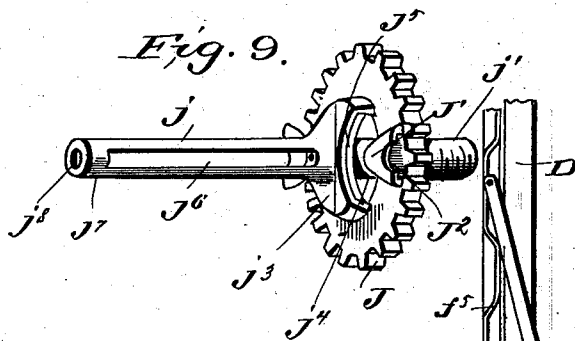
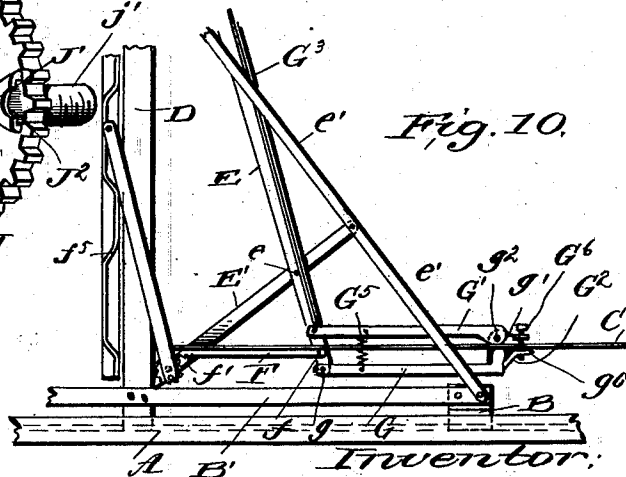


Fig. 10.



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UNITED STATES PATENT OFFICE.

WILLIAM C. AVERY, OF SPRINGFIELD, MISSOURI, ASSIGNOR OF ONE-THIRD
TO MRS. M. J. COX, OF SAME PLACE.

WIRE-FABRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 580,750, dated April 13, 1897.

Application filed July 9, 1896. Serial No. 598,573. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. AVERY, a citizen of the United States, residing at Springfield, in the county of Greene, State of Missouri, have invented certain new and useful Improvements in Wire-Fabric Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in machines for making woven-wire fabrics; and it has for its object, among others, to provide an apparatus of this character which shall be composed of few parts, and those readily assembled and easily operated.

The machine, although designed, primarily, for portable work, as for constructing fences in the field, may be profitably used for factory purposes, if desired. In the present instance it is shown as designed to be moved to the work and held firmly thereto by a lever-gripper with a hand releasing device adapted to operate on and in conjunction with a wire of the fabric, the wheels of the machine running on a light track, which, together with the guides, forms also a novel feature of the construction. I aim, further, to provide a twister-wheel of novel construction whereby more satisfactory results are attained with less labor and care on the part of the operator. The spool-carrier also is of novel construction, being provided in one of its forms with a swivel at its outer or weaving end. I provide a locking-ring which is mounted for end-wise movement upon a bearing-tube with a rearwardly-projecting guide-piece and a cylindrical interior, and other features of construction which tend to give it superiority over prior forms. I provide also a shifting bar having oppositely-inclined surfaces at regular intervals and mounted for lengthwise movement and for engagement with all of the locking-rings, being so spaced as to give an opposite end movement to each succeeding ring of the series. The shifting bar is connected to and designed to be actuated by the backward movement of the advancing lever. I aim, further, at improvements in the details of construction and in the device as a whole whereby more satisfactory results are attained, the machine rendered more useful

and accurate in its work, and capable of performing greater service with less exertion of power and practically no care on the part of the attendant.

Other objects and advantages of the invention will hereinafter appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims.

The invention is clearly illustrated in the accompanying drawings, which, with the letters of reference marked thereon, form a part of this specification, and in which—

Figure 1 is a side elevation showing my improvement. Fig. 2 is an enlarged vertical section through one of the twister-heads and spools. Fig. 3 is an end elevation of the twister-head and spool and its frame. Fig. 4 is an elevation of a modified form of spool-frame. Fig. 5 is a perspective detail of the locking-ring, bearing-tube, and shifter-bar. Fig. 6 is an enlarged perspective detail of the spool-frame. Fig. 7 is a similar view of the locking-ring detached. Fig. 8 is a perspective view looking at the opposite side of Fig. 5. Fig. 9 is a perspective detail of the twister-wheel removed. Fig. 10 is a detail in side elevation showing the gripper, the base, the shifter-bar, and the operating-levers. Fig. 11 is a vertical cross-section through the base. Fig. 12 is a vertical longitudinal section of a modified form of spool-frame, locking-ring, and accessories; and Fig. 13 is a perspective view of the locking-ring removed.

Like letters of reference indicate like parts throughout the several views.

Referring now to the details of the drawings by letter, A designates the base or track, composed of two parallel pieces or strips *a* secured together and held at proper distances apart by the transverse pieces *a'*, secured thereto in any suitable manner, and upon their adjacent edges these pieces *a* are formed with the longitudinal slots or grooves *a''*, as seen best in Fig. 11.

It will be understood that the transverse pieces *a'* are secured to the under sides of the parts *a*, as shown, so as to leave an unobstructed path for the guide-shoes or other devices B, carried by the foundation or base B' of the machine, which at its rearward end carries rollers or wheels B², as seen best in

Fig. 1, and adapted to travel upon the upper face of the track.

C are the longitudinal wires of the fence or fabric and about which the weft-wires are adapted to be twisted.

It will be readily understood that the fabric may have a greater or less number of these longitudinal wires, the machine being guided upon the lowermost one and there being one less spool than there are longitudinal wires, as indicated in Fig. 1.

D are the uprights, jointed at their upper ends in any suitable manner, as by the connecting-piece *d*, (see Fig. 1,) these uprights being arranged at the proper distance apart and extending down between the track-strips, forming a guide.

The movement of the machine in the direction of the length of the fence and the consequent length of mesh is brought about by means of the lever E, pivotally mounted, as at *e*, near its lower end upon the inclined brace-arm E', secured to the base of one of the uprights D, and at its other end to the inclined brace *e'*, as seen in Fig. 10, this brace-arm *e'* being secured at its upper end to the upright and at its lower end to the shoe B. To this lever below its pivot is pivotally mounted, as at *f*, the horizontal arm or bar F, the free end of which is provided with teeth *f'*, which engage with the ratchet-wheel F², carried by the shaft *f*² and provided with a crank-pin *f*³, with which is connected the rod F³, extending substantially vertically, as indicated, and pivotally connected, as at *f*⁴, with the shifter-bar F⁴. This shifter-bar has a continuous zigzag fin or flange *f*⁵, as seen in Figs. 1 and 10 and also in Fig. 5, and which shifter-bar is mounted for vertical reciprocation in suitable guides on or adjacent to the uprights D and operates in a manner which will be hereinafter disclosed.

G is a rod or bar pivotally connected at one end, as at *g*, to the lower end of the lever E and its other end turned upwardly, as indicated at *g*, to form one of the jaws of the gripper. G' is another bar having its outer end formed to constitute the other gripping-jaw and pivotally mounted, as at *g*², on the casting G², its other end being connected in any suitable manner with the release-lever G³, the upper end of which is connected with the bell-crank lever G⁴, pivotally mounted, as at *g*³, on the upper end of the lever E, and its handle *g*⁴ being arranged in proximity to the handle *e*⁵ of the lever E, as shown in Fig. 1, so that both may be readily grasped by the same hand. A spring G⁵ connects these two gripper-arms G G' near their connection with the said levers, as seen in Fig. 10.

G⁶ is a pin or bolt passed through lugs *g*⁶ on the casting G², as seen in Fig. 10, and by which the gripper is held against displacement from the wire C, upon which it is mounted to move, as shown. The construction is such that the wheel F² is given a half-revolution at each backward movement of the

lever E, and the inclined surface of the teeth on the rack-wheel and the inclination of the teeth on the rack-bar F is such that no movement is given to the wheel by the forward movement of said lever, as will be readily understood upon reference to Fig. 1. The arrow in Fig. 1 designates the direction of movement, which I term the "forward" movement. The gripper is intended, by reason of the action of the spring G⁵, to provide a firm engagement with the wire on which it acts at all times, unless released by the supplemental release-lever G³.

H are the weft-wires. They are carried by the spools H', each of which is mounted to revolve under a tension-spring *h*¹ on the spool-spindle of a spool-carrier. Each carrier, except when constructed as shown in Fig. 12, which will be hereinafter described, comprises a butt-piece *h* of a length to easily pass between the warp-wire tubes of two adjacent twister-wheels and a forwardly-extending horizontal portion or frame *h'*, from which extends upwardly the spool-spindle *h*², as seen best in Fig. 2, and the front end of which frame is turned upwardly, as seen at *h*³, and has an eye *h*⁴ or analogous device for guiding the passing weft-wire H. The vertical portion *h* has a centrally-located and rearwardly-extending neck or lug H², having a head or button H³, (seen best in Fig. 2,) and at opposite ends of the portion *h* and upon the same side as the neck and button are the rearwardly-extending lugs H⁴, which are substantially hook-shaped, with their rounded ends or faces adjacent to each other, these lugs being located at opposite extremities of the butt-piece or vertical portion *h*. The device at the weaving end of the spool-carrier for guiding the weft-wire may have an eye *h*⁴, as shown in Figs. 2 and 3, located in said upturned end on a level with the center of the spool, but I sometimes may use and prefer a construction shown in Fig. 4, in which a short arm I is pivoted, as at *i*, to the inner face of this upturned end *h*³ of the frame, the pivot being located on a level with the center of the spool longitudinally, and the arm having an opening or eye I' near its free end, through which passes the weft-wire H, (seen in Fig. 4,) the arm being free to describe a half-circle whose diameter may be the length of the spool. It being understood that the carrier and spool change ends toward the new twist during the first half-rotation and each succeeding new twist turning the carrier back over the same side it will be readily understood that this pivoted arm at the weaving end of the spool-carrier will act as a swivel and thus greatly relieve the passing weft-wire by its free half-rotation upon a pivot. The upturned end of this frame has the semicircular substantially vertically-disposed slot I², through which the weft-wire passes, as seen in Fig. 4, and which thus permits of the required movement of the arm and weft-wire.

There may be any desired number of twister-

wheels. Each twister-wheel comprises a toothed periphery J, being practically a gear-wheel constituting one of a vertical series of intermeshing gearing by which the rotary motion is transmitted to all carrying parts. This has upon one face two pockets J' at diametrically opposite points, being shown upon what I term the "front" or "outer" side, and which in the assembled machine faces rearwardly or toward the weaving end of the machine, and each pocket having its opening on the pitch-line of the toothed periphery to which it is affixed, having a practically semi-circular notch J² in its level front wall, and the side outline practically of a semiellipse, as seen best in Fig. 9. Extending from this gear-wheel is a forwardly-extending or, more correctly, outwardly-extending warp-wire tube or guide j and a rearwardly or inwardly extending hollow hub or shaft j', (see Figs. 2 and 9,) all being made integral by a web j³, extending forwardly and centrally and a part of whose surface is level with the flat front wall of the pockets on the periphery and forming around the connected end of the hollow shaft and inside the periphery a wide and deep annular recess j⁴. The end of this shaft is screw-threaded and receives a nut J⁵, as seen in Figs. 1 and 2. This annular recess is entirely open from the rear and also partly open from the front by reason of a cut-away portion of the web, as seen at j⁵ in Fig. 9, forming a passage on the front side around each pocket, allowing the free lugs H⁴ of the passing spool-carrier frame to pass through between the pockets and warp-wire tubes during rotation. The rearwardly open annular recess allows the locking-ring, hereinafter described, to slide over and engage the two lugs H⁴, that lie within the recess during alinement of the machine. A drive twister-wheel therefore comprises all of the above-described parts, and in addition thereto the gear J has formed on the inner side of the periphery thereof the beveled gear-teeth J³, as seen best in Fig. 2, which are designed to be engaged by a small beveled gear K on the crank-shaft K', mounted in a suitable bearing in the frame of the machine and provided with the crank K², as seen in Figs. 1 and 2, and by the rotation of which the desired number of twists of the weft-wires are formed. The advance of the machine and the length of mesh are brought about by the manipulation of the lever E and its connection with the stationary fabric-wire C, upon which the gripper is designed to act, the said lever being moved in the direction of the advance.

The forwardly-extending portion j of the twister-wheel is slotted longitudinally, as seen at j⁶ in Fig. 9, the boss or tubular portion j⁷ at the end being provided with an opening j⁸, through which the longitudinal wire C of the fence or fabric passes and upon which the fence is guided in its movements.

The neck H² and the head or button H³ of the butt-piece of the spool-carrier are for en-

gagement with the pockets J' and the notches J² of the twister-wheel and are substantially cylindrical in cross-section, as shown in Fig. 6. The lugs H⁴ are of a convex segmental cross-section with the reduced portion next to the butt-piece, thus forming a shoulder facing the same, the outer enlargement being rounded off toward the point, as hereinbefore mentioned.

L is a bearing-tube having at one end the flange L', through which passes the means which secure the same to the uprights D. The cylindrical portion of this bearing-tube forms a bearing for the rearwardly-extending shaft j' of the twister-wheel, as seen best in Fig. 2. This flange L' has an opening or perforation l, as seen best in Fig. 2, which serves as a guide for the projection m on the locking-ring M, which is shown detached in Fig. 7. This locking-ring comprises the cylindrical portion made to slide upon the bearing-tube and the lugs H⁴ of the adjacent spool-carriers when in alinement. The guide portion or projection m of this locking-ring has a vertical slot m', as seen best in Fig. 7, which receives the zigzag fin or flange f⁹ of the shifter-bar f⁵, as seen in Fig. 5, and by which fin it is moved. The outer front end of this locking-ring is partially closed by two segments M' of an annular flange, located upon opposite sides of the interior of said ring. These two segmental flanges have between their adjacent ends the openings or notches M², as seen in Fig. 7, which are diametrically oppositely disposed.

The shifter-bar f⁵ is a continuous vertically-disposed bar or rod with a web or flange or member upon its side having an oppositely-inclined surface occurring at places along its length equal to the distances from center to center of the bearing-tubes. This shifter rod or bar is held perpendicularly movable by the side of the alined bearing-tubes and against the base-flanges of the same. The continuous fin or flange having the oppositely-inclined surfaces at regular intervals is engaged with the notches m' of the guide projections m of each of the locking-rings, the construction being such that upon endwise movement of the shifter-bar, through the medium of the wheel f² and the bar or rod F opposite, horizontal sliding movement is given to each succeeding locking-ring in the machine.

The backlash or movement of the lever E, by its rack connection with the wheel F² and the rod F, acting upon this zigzag shifting bar, which, it will be remembered, has engagement with all of the locking-rings, operates to relieve one set of rearwardly-projecting lugs H⁴ and engage the opposite set, thereby holding the spools of weft-wire to rotate upon adjacent and oppositely-revolving twister-wheels, thus forming the intermediate and advance row of twists in the fabric. Thus after each row of twists is completed the routine of operations consists in the two

described movements of the lever E. It will thus be seen that the spool-carriers are automatically retained with the alternate twister-wheels of the machine by the backlash of the advancing lever E. It will be understood that the largest inside diameter of the locking-rings will be presented to the lugs H^4 only upon alinement of the machine, and therefore they can only be engaged or disengaged therefrom at such point of alinement, which is at $M^2 M^2$, the partial annular flanges $M' M'$ forming barriers at all other points of their rotation. It will be noticed that the bearing-tube has at each end the tubular extensions $L^3 L^4$, which form bearings for the rearwardly-projecting tubular extensions j' of the twister-wheels, as seen in Fig. 2.

It will be understood from the foregoing description that in my construction the locking-rings is the main instrumentality in holding the pairs of spool-carriers to their twister-centers during the operation of forming the twists about the main wires by the weft-wires.

It is considered an important feature of the construction that two spool-carriers are held and caused to rotate with a given twister by reason of an engagement of their two contiguous shouldered rearwardly-projecting lugs H^4 within one annularly-ribbed shiftable locking-ring, which surrounds the center of rotation and allows the lugs to rotate within the ring and removable only at one point in such rotation. It is also considered important that in the act of forming the twists the inner ends of the butts of the spool-carriers are thrust inward toward the center of rotation and the outer or free ends will rotate in a plane slightly removed from the faces of the adjacent twisters. The lugs H^4 on the free outer ends will also easily pass through the curved slot on the faces of the adjacent twister-wheels and across in front of the locking-rings at the point $M^2 M^2$, and the head or button H^3 will mesh into the pockets J' of the oppositely-rotating peripheries without material frictional contact.

It will be observed that I employ no guides for the moving spool-carriers except the central rotatable engagement within the locking-ring of small diameter and consequently short travel at the frictional contact. The head H^3 of the neck H^2 , by which the spool-carrier receives its rotary movement, is held in the proper pocket by engagement of the inner lug within the locking-ring.

In Figs. 12 and 13 I have shown a slightly different construction in which the locking-ring M is sleeved upon the bearing-tube L, as above, but has a groove m^3 extending entirely around the same and in which the fin f^9 of the shifting bar f^5 works. This locking-ring is provided with the pins m^4 , disposed upon diametrically opposite sides of the locking-ring and projecting from the end thereof in the direction of the length of said ring. These two pins are engaged in opening m^5 in the twister head or wheel and the latter

rotates the ring upon the bearing-tube L. In this construction the pins entering the slots m^5 in the butt-pieces of the spool-carrier frames perform the same function as the rearwardly-projecting lugs H^4 (shown in Fig. 2) entering the locking-rings in the other form of construction perform. The twister-wheel instead of being cut away around the pockets simply has the openings for the pins. The ring in this instance rotates by reason of the engagement of the pins in the twister-head upon the bearing-tube and under and in engagement with the shifting bar. At the proper alinement of the spool-carrier butts with their slots, as shown, the ring and pins may be shifted outwardly, entering and retaining adjacent ends of the butts to rotate with the carrying parts, each alternate ring of the series moving and acting in a reverse manner, respectively. In Fig. 12 the warp-wire tube or guide j is shown as formed independent of the hollow hub or shaft j' and engaged therein by screw-threads, as it may be found convenient at times to remove the same to replace it with a new one.

Modifications in detail may be resorted to without departing from the spirit of my invention or sacrificing any of its advantages.

The sizes and relative proportions of the different parts may be changed at will within reasonable limits, and although the shifter-bar has been described as designed for automatic actuation by the return movement of the advancing lever it is evident that the connections may be varied, and under some conditions it may be preferable to arrange for the actuation of this shifting bar by a special lever.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a wire-fabric machine, a twister-wheel formed with oppositely-disposed, peripheral pockets upon its face, and a forwardly-curved, connecting-web cut away upon opposite sides adjacent to said pockets; substantially as described.

2. In a wire-fabric machine, a twister-wheel formed with oppositely-disposed, peripheral pockets, a forwardly-curved, connecting-web cut away upon opposite sides upon curved lines to near the center leaving a curved opening or recess through the body portion of the wheel; substantially as described.

3. In a wire-fabric machine, a twister-wheel formed with oppositely-disposed, peripheral pockets, a forwardly-curved, connecting-web cut away upon opposite sides upon curved lines to near the center leaving a curved opening or recess through the body portion of the wheel, the forward curve of said web forming an annular passage, and a bearing-shaft extending centrally therefrom; substantially as described.

4. In a wire-fabric machine, a twister-wheel formed with oppositely-disposed pockets upon one face open upon the sides toward the

periphery, a centrally-disposed bearing-shaft extending rearwardly to a point in front of the plane of the peripheral toothed portion, and a connected front tube in line with said shaft; substantially as described.

5. In a wire-fabric machine, a twister-wheel formed with oppositely-disposed pockets upon one face open upon the sides toward the periphery, a centrally-disposed bearing-shaft extending rearwardly to a point in front of the plane of the peripheral toothed portion, a connected front tube in line with said shaft, and a centrally-curved and partly cut-away web connecting said shaft and tube; substantially as described.

6. In a wire-fabric machine, a twister-wheel formed with oppositely-disposed pockets upon one face open upon the sides toward the periphery, a centrally-disposed bearing-shaft extending rearwardly to a point in front of the plane of the peripheral toothed portion, a connected front tube in line with said shaft, a centrally-curved and partly cut-away web connecting said shaft and said tube, and a second toothed rim back of the first for engagement with a driving-gear; substantially as described.

7. In a wire-fabric machine, a spool-carrier comprising a frame having a spindle, and an upturned outer end, and a rotating arm having an eye for the weft-wire; substantially as described.

8. In a wire-fabric machine, a spool-carrier formed with a vertical portion having laterally-projecting lugs, and a centrally-disposed neck having a button; substantially as described.

9. In a wire-fabric machine, the combination with a bearing-tube, of a locking-ring mounted for movement endwise thereon; substantially as described.

10. In a wire-fabric machine, a locking-ring provided with a rearwardly-extending guide-piece; substantially as described.

11. In a wire-fabric machine, a locking-ring provided with a rearwardly-extending guide-piece, having a vertically-disposed notch to receive a flange on the shifter-bar; substantially as described.

12. In a wire-fabric machine, a locking-ring having a rearwardly-projecting guide-arm and an inwardly-extending flange at its other end having diametrically-disposed notches; substantially as described.

13. In a wire-fabric machine, a shifting bar disposed vertically, and having a zigzag fin disposed lengthwise thereof; substantially as described.

14. In a wire-fabric machine, a track composed of side pieces formed upon their adjacent edges with longitudinal grooves, and transverse pieces connecting the said side pieces, and holding them at the proper distance apart; substantially as described.

15. In a wire-fabric machine, the combination with a spool-carrier, having lugs, of a locking-ring having a segmental interior flange

with oppositely-disposed notches, a bearing-tube, a twister-head, and means for rotating the latter; substantially as described.

16. In a wire-fabric machine, the combination with two adjacent tubes, twister-wheels, and locking-rings, of a spool-carrier provided with the butt-piece disposed to come between two adjacent tubes; substantially as described.

17. In a wire-fabric machine, the combination with two adjacent tubes, twister-wheels, and locking-rings, of a spool-carrier provided with the butt-piece disposed to come between two adjacent tubes, and provided with a central neck and button and a shouldered lug on opposite extremities of the butt-piece; substantially as described.

18. The combination with two adjacent bearing-tubes, twister-heads, and locking-rings, of a spool-carrier having a butt-piece with centrally-disposed neck and head and lugs parallel therewith upon opposite sides thereof either of said lugs being engageable within the locking-ring of its adjacent twisting device, and rotatable within said ring when fully entered therein; substantially as described.

19. The combination with a twister-wheel having oppositely-disposed pockets and a web with cut-away portions opposite the pockets, and a hollow tube extending upon both sides of the web, of a locking-ring having a guide-lug with a notch, and a vertically-disposed shifter-bar having a flange engaging said notch; substantially as described.

20. The combination with a twister-wheel having oppositely-disposed pockets and a web with cut-away portions opposite the pockets, and a hollow tube extending upon both sides of the web, of a locking-ring having a guide-lug with a notch, and a vertically-disposed shifter-bar having a flange engaging said notch, and a bearing-tube having a flange with an opening to receive the guide-lug of the locking-ring; substantially as described.

21. The combination with a twister-wheel having oppositely-disposed pockets and a web with cut-away portions opposite the pockets, and a hollow tube extending upon both sides of the web, of a locking-ring having a guide-lug with a notch, and a vertically-disposed shifter-bar having a flange engaging said notch, a bearing-tube having a flange with an opening to receive the guide-lug of the locking-ring, and a spool-carrier having lugs to be entered into the locking-ring; substantially as described.

22. The combination with a twister-wheel having oppositely-disposed pockets and a web with cut-away portions opposite the pockets, and a hollow tube extending upon both sides of the web, of a locking-ring having a guide-lug with a notch, a vertically-disposed shifter-bar having a flange engaging said notch, a bearing-tube having a flange with an opening to receive the guide-lug of the locking-ring, and a spool-carrier having lugs to be entered

into the locking-rings, the latter being provided at one end with an interior flange having oppositely-disposed notches; substantially as described.

5 23. The combination with a spool-carrier having a butt-piece with a neck with a head and lugs upon opposite sides thereof, of a twister-head having peripheral pockets, and a web cut away upon opposite sides adjacent
10 to said pockets; substantially as described.

24. The combination with a bearing-tube, of a locking-ring mounted for endwise movement thereon and having a rearwardly-projecting guide-piece with a vertical notch, and
15 a vertically-disposed shifter-bar having a flange engaging said notch; substantially as described.

25. The combination with a plurality of twister-heads, bearing-tubes and locking-
20 rings having guide-pieces with notches, of a vertically-disposed shifter-bar having a flange with oppositely-disposed inclined portions engaging the notches of the guide-pieces to simultaneously shift all of the locking-
25 rings; substantially as described.

26. The combination with the machine and its twisting devices, of a gripper adapted to engage one of the longitudinal wires of the fabric, a lever connected with and adapted
30 to operate said gripper, and a release-lever mounted upon the operating-lever; substantially as described.

27. The combination with a twisting device and a shifter-bar, of a gripper, a pivoted lever connected therewith, and a connection
35 between the same and the shifter-bar; substantially as described.

28. The combination with the shifter-bar and a rod pivotally connected therewith, of a
40 toothed wheel to which said rod is eccentrically connected, a gripper, and an operating-lever therefor, and a connection between the same and said wheel; substantially as described.

29. The combination with the shifter-bar and the rod pivotally connected therewith, of a
45 toothed wheel to which said rod is eccentrically connected, a gripper, an operating-lever therefor, a connection between the same and said wheel, and a release-lever connected
50 with the operating-lever and with the gripper; substantially as described.

30. The combination with the twister-heads and bearing-tubes and locking-rings, of a
55 shifter-bar and a lever, and intermediate connections whereby the locking-rings are given an endwise movement by the movement of said lever; substantially as described.

31. The combination with the twister-heads,
60 the bearing-tubes and locking-rings, of a shifter-bar, a gripper, an operating-lever connected therewith, and a connection between said lever and the shifter-bar; substantially as described.

65 32. The combination with the twister-heads,

the bearing-tubes, and locking-rings, of a shifter-bar, a gripper, an operating-lever connected therewith, a connection between said lever and the shifter-bar, and a supplemental lever connected with the operating-lever and
70 with the gripper; substantially as described.

33. The combination with the twister-heads, the bearing-tubes and locking-rings, of a shifter-bar, a gripper, an operating-lever connected therewith, a connection between said
75 lever and the shifter-bar, a supplemental lever connected with the operating-lever and with the gripper, and a spring connecting the two arms of the gripper; substantially as described.
80

34. The combination with the shifter-bar having zigzag flange, of a rod pivotally connected with said bar, a toothed wheel to which the rod is eccentrically connected, a gripper,
85 a lever connected therewith for operating the same, and a toothed bar pivotally mounted on the operating-lever and adapted to engage said wheel; substantially as described.

35. The combination with the shifter-bar having a zigzag flange, of a rod pivotally connected with said bar, a toothed wheel to which the rod is eccentrically connected, a gripper,
90 a lever connected therewith for operating the same, a toothed bar pivotally mounted on the operating-lever and adapted to engage said wheel, and a supplemental lever mounted on the operating-lever, and connected with the gripper; substantially as described.
95

36. The combination with the shifter-bar having a zigzag flange, of a rod pivotally connected with said bar, a toothed wheel to which the rod is eccentrically connected, a gripper,
100 a lever connected therewith for operating the same, a toothed bar, pivotally mounted on the operating-lever and adapted to engage said wheel, a supplemental lever mounted on the operating-lever, and connected with the gripper, and a spring connecting the two arms of the gripper; substantially as described.
105

37. The combination with a spool-carrier frame, a twister-head, bearing-tube and a locking-ring upon the bearing-tube, of means for engaging the carrier-frame and locking-ring, whereby they are rotatable together;
110 substantially as described.

38. The combination with a spool-carrier frame, a twister-head, bearing-tube and a locking-ring upon the bearing-tube, of means for engaging the carrier-frame and locking-ring whereby they are rotatable together, and
120 a shifter-bar mounted for vertical movement to move said locking-ring to and from the spool-carrier frame; substantially as described.

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

WILLIAM C. AVERY.

Witnesses:

H. T. NORMAN,

C. E. SCHWEITZER.