(No Model.) 5 Sheets—Sheet 1.

N. LOMBARD.

CIRCULAR WEAVING MACHINE.

No. 494,107. Patented Mar. 21, 1893.

Fig. 8.

Fig. 10.

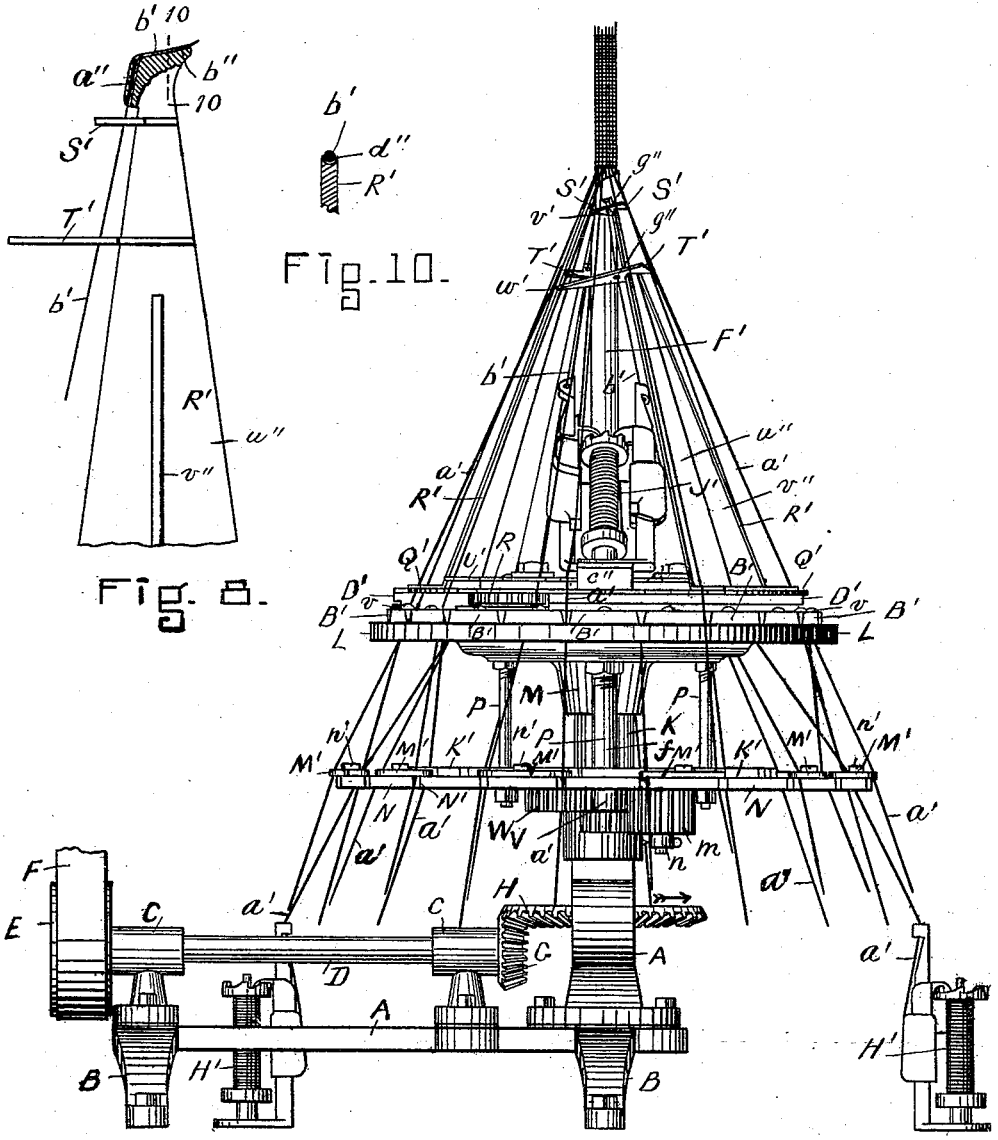


Fig. 1.

WITNESSES.
E. M. Tuttle
Carrie E. Nichols.

INVENTOR
Nathaniel Lombard
Per Edwin W. Brown
Attorney.

(No Model.) 5 Sheets—Sheet 2.

N. LOMBARD.

CIRCULAR WEAVING MACHINE.

No. 494,107. Patented Mar. 21, 1893.

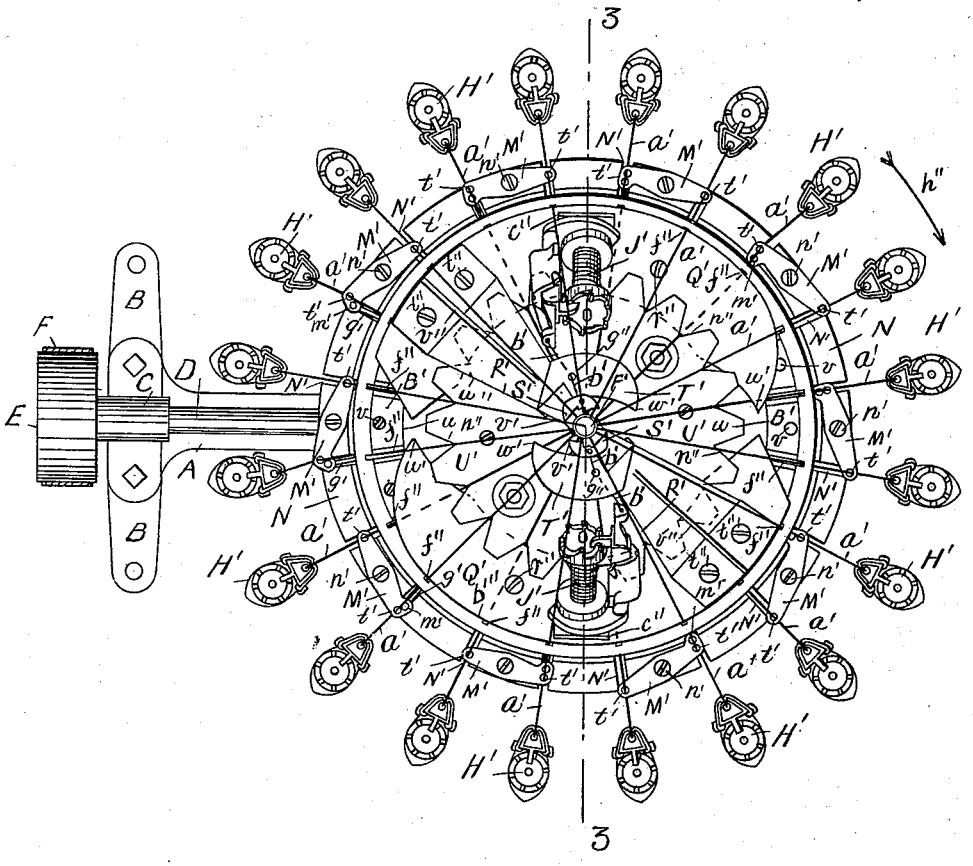


Fig. 2.

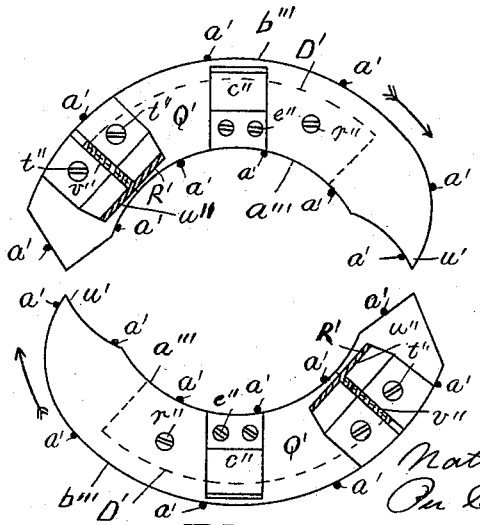


Fig. 9.

WITNESSES.
E. W. Tuttle
Carrie E. Nichols

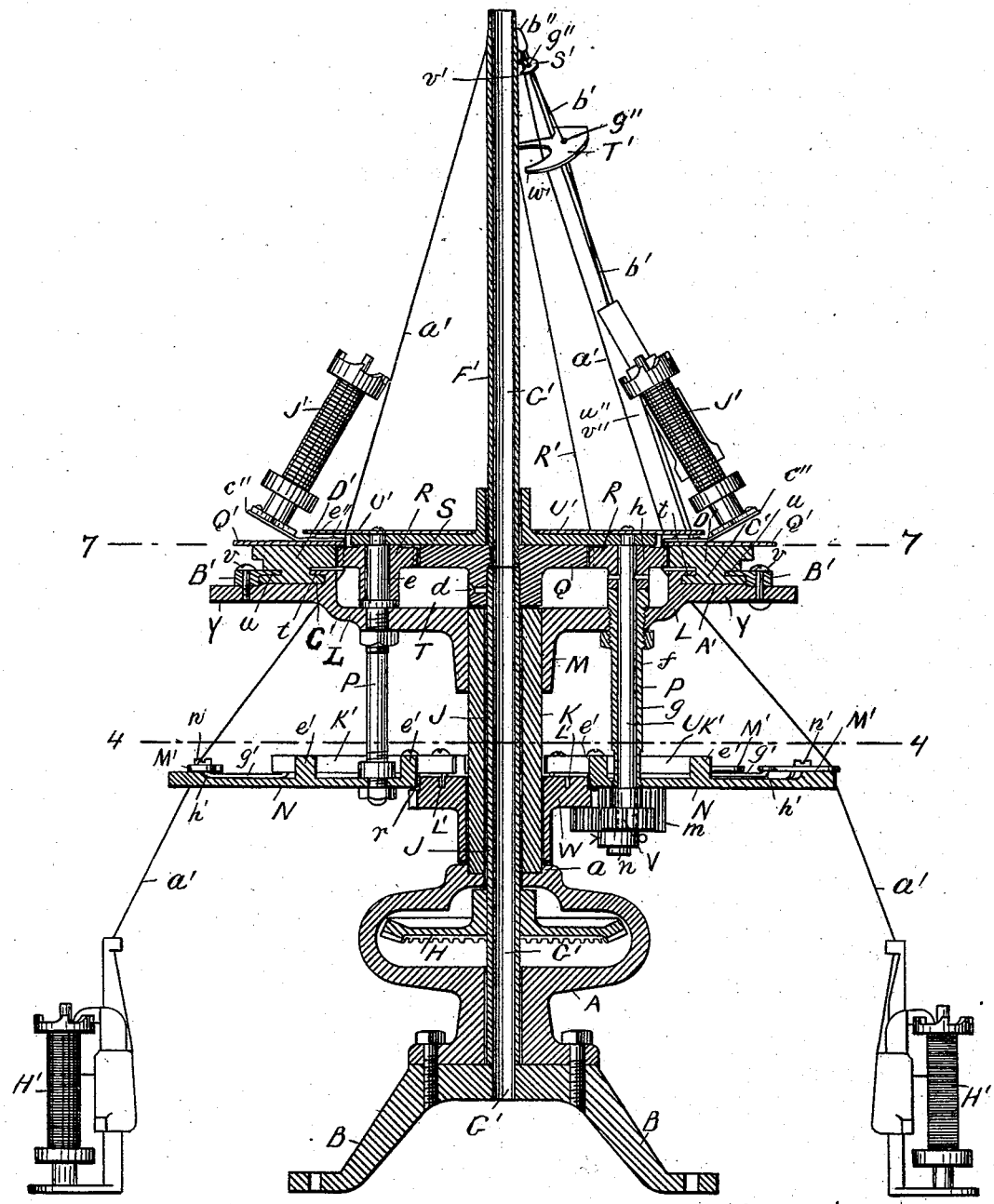
INVENTOR.
Nathaniel Lombard
By Edwin W. Brown
Attorney

(No Model.) 5 Sheets—Sheet 3.

N. LOMBARD.

CIRCULAR WEAVING MACHINE.

No. 494,107. Patented Mar. 21, 1893.



WITNESSES.
E. M. Tuttle
Carrie E. Nichols.

Fig. 3.

INVENTOR.
Nathaniel Lombard
Per Edwin W. Brown
Attorney

(No Model.) 5 Sheets—Sheet 4.

N. LOMBARD.

CIRCULAR WEAVING MACHINE.

No. 494,107. Patented Mar. 21, 1893.

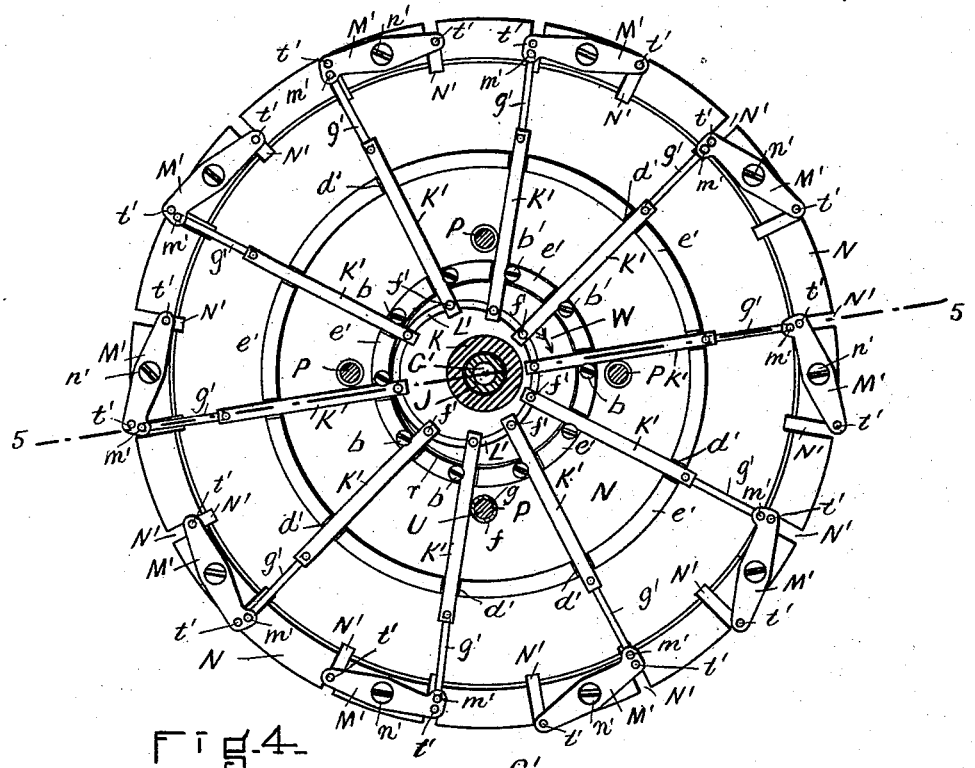


Fig. 4.

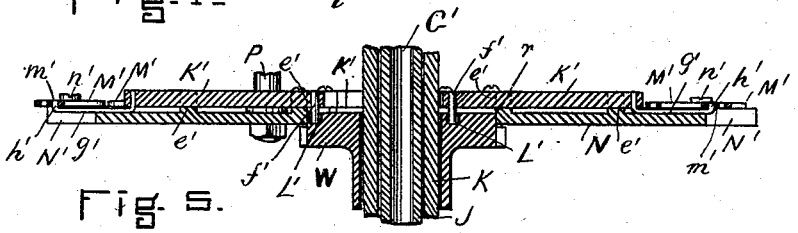


Fig. 5.

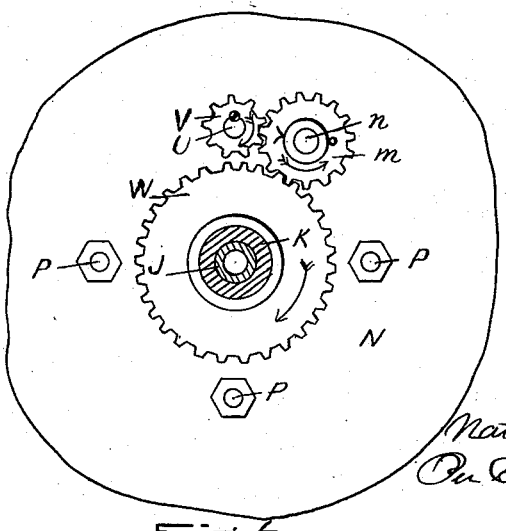


Fig. 6.

WITNESSES.
E. M. Tuttle
Carrie E. Nichols

INVENTOR.
Nathaniel Lombard
By Edwin W. Brown
Attorney.

(No Model.) 5 Sheets—Sheet 5.

N. LOMBARD.

CIRCULAR WEAVING MACHINE.

No. 494,107. Patented Mar. 21, 1893.

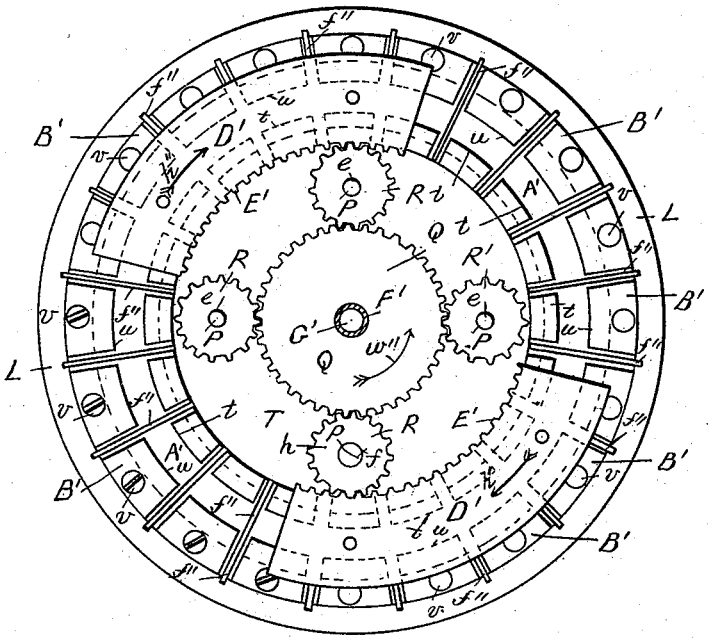


Fig. 7.

WITNESSES.
E. W. Tuttle
Carrie E. Nichols

INVENTOR.
Nathaniel Lombard.
Per Edwin W. Brown
Attorney.

UNITED STATES PATENT OFFICE.

NATHANIEL LOMBARD, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO HENRY A. CLARK, OF SAME PLACE.

CIRCULAR-WEAVING MACHINE.

SPECIFICATION forming part of Letters Patent No. 494,107, dated March 21, 1893.

Application filed May 11, 1892. Serial No. 432,628. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL LOMBARD, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Circular-Weaving Machines, of which the following is a full, clear, and exact description.

This invention relates to a machine for weaving circular tubing from fibrous material and more especially for weaving the same upon an electric wire or electric cable, although applicable as well to weave a covering for hose and other purposes, and the invention consists of a machine for weaving circular tubing from fibrous material, all constructed and arranged for operation substantially as hereinafter fully described and shown, reference being had to the accompanying sheets of drawings in which is represented a machine for weaving circular tubing from fibrous material constructed in accordance with this invention.

Figure 1, represents the machine in front elevation. Fig. 2, is a plan view. Fig. 3, is a central vertical section on line 3—3, Fig. 2. Fig. 4, is a plan view below section line 4—4, Fig. 3. Fig. 5, is a detail cross section on line 5—5, Fig. 4. Fig. 6, is a detail under plan view of Fig. 1. Fig. 7, is a plan view below line 7—7, Fig. 3. Fig. 8, is a detail elevation to be hereinafter referred to. Fig. 9, is a detail plan view to be hereinafter referred to. Fig. 10, is a detail vertical section on line 10—10, Fig. 8.

In the drawings A represents a base having legs B, by which to secure it on a suitable bench or rest, the base having bearings C, C, in which is arranged to turn a horizontal shaft D having on its outer end a pulley E for operation of the shaft by a belt F and on its inner end a vertical miter gear G. This miter gear G engages with a horizontal miter gear H secured to a vertical tubular shaft J which is adapted to turn in an upright tubular post K and the base A, the post being secured at *a*, in the base as shown in Fig. 3, or in any suitable manner, or it can be integral therewith. To the upper end of the tubular post is secured a horizontal circular plate L, by its flange M by which said plate is supported, and N is another horizontal circular plate below and secured to the upper plate L by vertical rods P, secured by bolts, there being four of such rods in the present instance.

Secured by a set screw *d*, to the upper end of the tubular vertical shaft J is a horizontal gear Q which engages with four smaller gears R, at regular distances apart, three of which small gears are adapted to turn upon journals *e*, formed by the upward extension of three of the vertical rods or posts P, to the upper ends of which journals is secured a circular plate S just above the small gears R. The gear Q and its small gears R are disposed in a central recess or depression T in the upper side of the plate L. One, *f*, of the posts is hollow having a central vertical passage *g*, through it, through which extends a shaft U to which shaft the other one *h* of said gears is secured, the shaft extending down through the plate N and having secured to its lower end a small gear V below the plate N which engages with a horizontal gear *m* turning on a journal *n*, secured to the underside of the plate, which gear *m* engages with a larger gear W adapted to turn in a central opening *r* in the plate N and about and around the central tubular post K as a bearing. The flat outer portion Y of the recessed plate L on its upper side has a horizontal circular groove A′ concentric with the tubular shaft J, formed by inwardly extending lips *t*, *u*, the one *t*, by a portion of the plate and the other *u* by blocks B′ secured by screws or bolts *v*, to the plate, in which groove is adapted to fit a correspondingly shaped tongue C′ on the under side of a plate or block D′ which is in the form of a segment of a flat ring or rim, and which supports and carries a bobbin, the plate being arranged to freely travel around in the groove and prevented from escape therefrom by the lips. There are two of these carrier plates, diametrically opposite to each other as shown in Fig. 7, and the inner edge of each has an internal gear E′ which is adapted to engage with the four small gears R, each plate being of a length for its internal gear to extend from the center line of one gear R to the center line of the next or adjacent gear R, so that the movement of each carrier plate in the cir-

cular groove A′ will be made continuous by the engagement of its internal gear with the small gears, one after another.

Screwing into the center of the gear Q engaging with the bobbin carrier plate gears R and passing freely through plate S is a vertical tubular rod F′ which although independent of the vertical tubular shaft J forms practically a continuation of the same, so that there is a vertical central passage G′ which extends through the rod and the tubular shaft J and through the base as shown in section in Fig. 3. Up through this passage G′ in the operation of the machine the electric wire or cable, or hose, or other article travels to be covered with the circular woven fabric.

H′ are the lower or stationary bobbins which are secured in suitable position preferably in the form of a circle below the machine on the bench supporting the machine, or on any suitable support, each carrying a thread *a′* making the warp thread, and J′ are the upper bobbins, one to each bobbin carrier plate and carrying a thread *b′* making the woof threads.

K′ is a series of radial bars, preferably square in cross section, equal in number to one half of the warp thread bobbins of which, in the present machine there are twenty, and each is adapted to move freely forward and back radially in slots *d′* in two sets of circular ribs *e′* secured to or forming part of the plate N, the bars being secured from accidental detachment, by screws *b*.

On the under side of the inner end of each bar K′ is a downwardly extending pin or projection *f′* which pins are freely disposed in a circular groove L′ in the upper side of the gear W which circular groove is eccentric to the central tube J, as shown more particularly in Fig. 4 in plan. Each bar K′ has an extension wire *g′* its end *h′* being bent upwardly at right angles and is disposed in a socket *m′* in one end of a horizontal lever M′ centrally pivoted at *n′* near the outer edge of the plate N. Each of these horizontal pivoted levers M′ has in each end a hole *t′* through which extends a warp thread *a′* from one of the lower bobbins H′ as shown more particularly in Fig. 2. In line vertically with and below each hole *t′* in the end of these levers M′ is an open radial slot N′ in the edge of the plate N which slots leave room for the warp threads to move in the operation of the machine.

Secured by screws *r″* to the upper side of each bobbin carrier plate is a switch plate Q′ made of sheet metal having a pointed end *u′* and its two edges extending back therefrom in two circular lines concentric with the tubular shaft J, as shown in plan in Figs. 2 and 9.

Each carrier plate has secured to it by screws *t″* above the switch plate Q′ an upright arm R′, which consists of a flat tapering strip *u″* having on its outer side a central rib *v″* to stiffen it, the arm lying in an inclined direction toward, and bearing by its upper end close against the tubular rod F′.

Attached to the inclined arm R′ or near its top is another switch plate S′ but quite small or short, having a pointed end *v′* and its edges being circular, as shown and a short distance below this upper switch plate S′ is another switch plate T′ but larger having a pointed end *w′*, the pointed ends of the three switch plates being substantially in the same inclined line. The upper end of each of these bobbin carrier arms has a vertical passage *a″* at one side, through which passes a woof thread *b′* and its upper edge *b″* above such passage extends therefrom slightly rising, as shown in Fig. 8, and it is hollow or concave in cross section as shown at *d″* in Fig. 10.

The bobbin J′ is attached to a plate *c″* secured to the switch plate at *e″* and it is bent upward at an angle for the bobbin to lie in an inclined direction inwardly toward the rod F′ to be substantially in the same inclined direction as the arm R′, as shown in Fig. 3.

Each bobbin of the warp threads and woof threads has the usual weight and tension arrangement for the proper delivery of its thread and they are all constructed and arranged as usual in braiding machines, to deliver and keep the proper tension on the threads, and as the bobbins and their adjustment can be of any suitable construction and being no part of this invention it is not deemed necessary to herein particularly describe such.

The operation of the machine is as follows:—Each warp thread *a′* from a lower bobbin is passed up through an eye hole *t′* in the pivoted lever M′ lying in the slot N′. From thence they all pass upward through separate radial slots *f″* in the upper plate L between the blocks B′ to a point near the upper end of the tubular rod F′ where they are all held temporarily in any suitable manner more or less taut together. The blocks B′ are separated sufficiently to leave a narrow space between them over each radial slot to allow free passage for the warp threads. The thread from each shuttle bobbin J′ passes up through holes *g″* in the two switch plates S′ T′ and then through the hole *a″* in the upper end of the arm R′ lying in the groove *d″*, in such end, and in starting the machine such threads are held by hand until the machine has made one or more revolutions when it carries them along itself. Turning the pulley in the right direction the miter gear H is revolved in the direction of the arrow Fig. 1, which turns the tubular shaft J and its gear Q in the same direction, (see arrow *w″* Fig. 7,) turning the small gears R in the reverse direction which correspondingly causes by their connection with the internal gears E′ of the bobbin carrier plates D′, the carrier plates to travel along their circular raceway A′ in the direction of the arrow *h″*, Figs. 2, and 7. The gear W by its gear connection with the tubular shaft U, is turned in the opposite direction to the gear Q, carrying the eccentric cam groove L′ in the same direction, see arrow Fig. 4, which cam groove causes the radial bars K′ to move radially forward and backward in their guide

slots and in such movements their respective pivoted levers M′ are swung on their pivots, alternately moving each arm outward and inward, and in such movements alternately moving outward and inward their respective warp threads a' so that as the pointed end u' of a switch plate Q′ of a bobbin carrier plate arrives at such threads it passes between the two, carrying with it the woof thread b' of its bobbin, which is carried round the upper part of the tubular rod F′ and is woven in and out with the warp threads. In Fig. 9, are shown in their relative positions in plan view the two switch plates Q′, the bobbin being removed and the vertical arms R′ in cross section the warp threads also being in cross section and bearing against the two edges a''' b''' of the switch plates, and opened or separated from each other forming the shed through which its respective bobbin is carried, and as they so travel each passes between each two warp threads of each pivoted lever, one after another. At the same time the eccentric groove L′ moves round and causes the radial bars K′ to gradually move in a direction to swing their pivoted levers M′ so as to move the warp threads connected therewith, for the outer one of each two, to be moved inward, and the inner one of each two to be moved outward, so that as the next bobbin carrier plate and its bobbin come round they will pass between each two warp threads, but the reverse from the other, so that as the warp and woof threads are woven together at the upper end of the tubular rod, each warp thread will alternately be outside of and inside of the woof threads by which the warp and woof threads will be woven together in a similar manner to that in which cloth is woven, except in the present machine two woof threads are used and the shed is operated so that each woof thread passes alternately in front and back of a warp thread in each revolution or passage around the machine. The warp threads as they leave the rear end of each switch plate pass as follows: the inner threads on to the outer curved edge, and the outer threads on to the inner curved edge of the next switch plate one after the other. The levers M′ acted upon by the radially moving bars K′ from the movement of the cam groove L′ cause the warp threads to separate or open from each other laterally sufficiently for the ends of each switch plate Q′ to enter between them to form the proper sheds, and to still further insure that the threads shall open from each other at the upper part the switch plates S′ and T′ are added to act upon the upper portions of the threads so that with the three switch plates attached to the bobbin carrier plate and its arm, the warp threads will be fully opened or separated from each other for that carrier plate its arm and bobbin to freely pass between and not interfere with the warp threads. As the woof thread leaves the carrier arm the upward incline b'' of its upper end lays it closely up against the woof thread just above acting somewhat as the frame in a loom and also as a feed to the circular tube, as it is woven in the machine; it is well however to have the woven tube as it leaves the rod secured to a device which will assist the feed and pull it upward as fast as it is woven. The shed of the warp threads for the woof threads is thus made alternately by the movements of the pivoted levers M′ caused by the turning of the eccentric groove operating upon its connecting bars K′ in the operation of the machine. If an electric wire or cable or hose or any desired article is to be covered with the woven circular tube it is passed up through the central passage G′ and fed through the same by any suitable feeding device and with the speed required, so that as it emerges from the upper end of the tube the threads will be woven upon it as fast as it travels upward, the speed of the movement of the wire being governed by the speed in which the tube is woven, and the closeness in which it is desired for the threads to lie upon the wire &c.

U′ is a horizontal plate rigidly secured by screws to the circular plate S and having V shaped openings n'' in its edge at certain intervals apart, respectively radially opposite to the open slots N′ in plate N as shown in Fig. 2 more particularly, into which openings the warp threads respectively pass as they are moved backward by the levers to steady them somewhat laterally, to facilitate the passage of the bobbin carrier plate and parts between them. The gear W is cut away on its upper side around its edge for such portion to fit in the central opening r, in the plate N as shown more particularly in Figs. 3 and 4. The pivoted levers M′ serve to separate the warp threads sufficiently to be in position for the pointed end of the switch plate to enter between them to still further separate them for the bobbin and other parts to freely pass between them.

Having thus described my invention, what I claim is—

1. In a circular weaving machine in combination, a revolving plate having a circular eccentric groove, radial arms extending therefrom adapted to engage with said groove and to slide back and forth in suitable guideways, and levers pivoted to a support and each connected to a radial arm and having holes or openings diametrically opposite to each other through each of which holes or openings a warp thread passes.

2. In a circular weaving machine in combination, a vertical tubular revolving shaft, a gear on the upper end of said tubular shaft, a series of gears engaging with said gear, and a bobbin carrier plate adapted to travel in a circular raceway and having a segment of an internal gear adapted to engage with said gears, a vertical shaft on one of said series of gears, another gear on said shaft, a revolving gear having an eccentric groove in its side and engaging with and operated by said shaft

gear, radial arms extending therefrom and engaging with said groove and adapted to slide back and forth in suitable guideways and levers pivoted to a support and each connected to a radial arm and having holes or openings diametrically opposite to each other, through each of which holes or openings a warp thread passes.

3. In a circular weaving machine, a bobbin carrier plate adapted to travel in a circular raceway having attached thereto a switch plate having a pointed end, an inclined arm, a smaller pointed switch plate at its upper end and an intermediate pointed switch plate secured to said arm, said arm at its upper end having an eye or passage and its upper surface having a longitudinal groove and extending in an inclined direction for the passage of a woof thread.

4. In a circular weaving machine, in combination a central revolving gear, a vertical revolving shaft, a gear on said shaft engaging with said central gear another gear on said shaft, another central gear engaging with said other shaft gear, said last named central gear having an eccentric groove in its upper surface, radial arms engaging with said eccentric groove and extending therefrom and adapted to slide back and forth in suitable guideways and levers pivoted to a support each connected to a radial arm and having holes or openings diametrically opposite to each other through each of which holes or openings a warp thread passes.

5. In a circular weaving machine in combination, a revolving gear, a series of gears engaging with said gear, a bobbin carrier plate adapted to travel in a circular raceway and having a segment of an internal gear adapted to engage with said series of gears, a vertical shaft on one of said series of gears, another gear on said shaft, another central gear engaging with said other shaft gear and having an eccentric groove in its side, radial arms extending from and adapted to engage with said groove and adapted to slide back and forth in suitable guideways, levers pivoted to a support, each connected to a radial arm and having holes or openings diametrically opposite to each other through each of which holes or openings a warp thread passes.

6. In a circular weaving machine, a bobbin carrier plate adapted to travel in a circular raceway having attached thereto a switch plate having a pointed end, an inclined arm, a smaller pointed switch plate at its upper end and an intermediate pointed switch plate secured to said arm, said arm at its upper end having an eye or passage for a woof thread to pass through it.

7. In a circular weaving machine, a bobbin carrier plate adapted to travel in a circular raceway having attached thereto a switch plate having a pointed end, an inclined arm, a smaller pointed switch plate at its upper end and an intermediate pointed switch plate secured to said arm, the upper end of the arm being inclined.

8. In a circular weaving machine, a bobbin carrier plate adapted to travel in a circular raceway having attached thereto a switch plate having a pointed end, an inclined arm, a smaller pointed switch plate at its upper end and an intermediate pointed switch plate secured to said arm, said arm at its upper end or edge being inclined and grooved along its length.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

NATHANIEL LOMBARD.

Witnesses:
EDWIN W. BROWN,
CARRIE E. NICHOLS.