A. L. DE LEEUW.

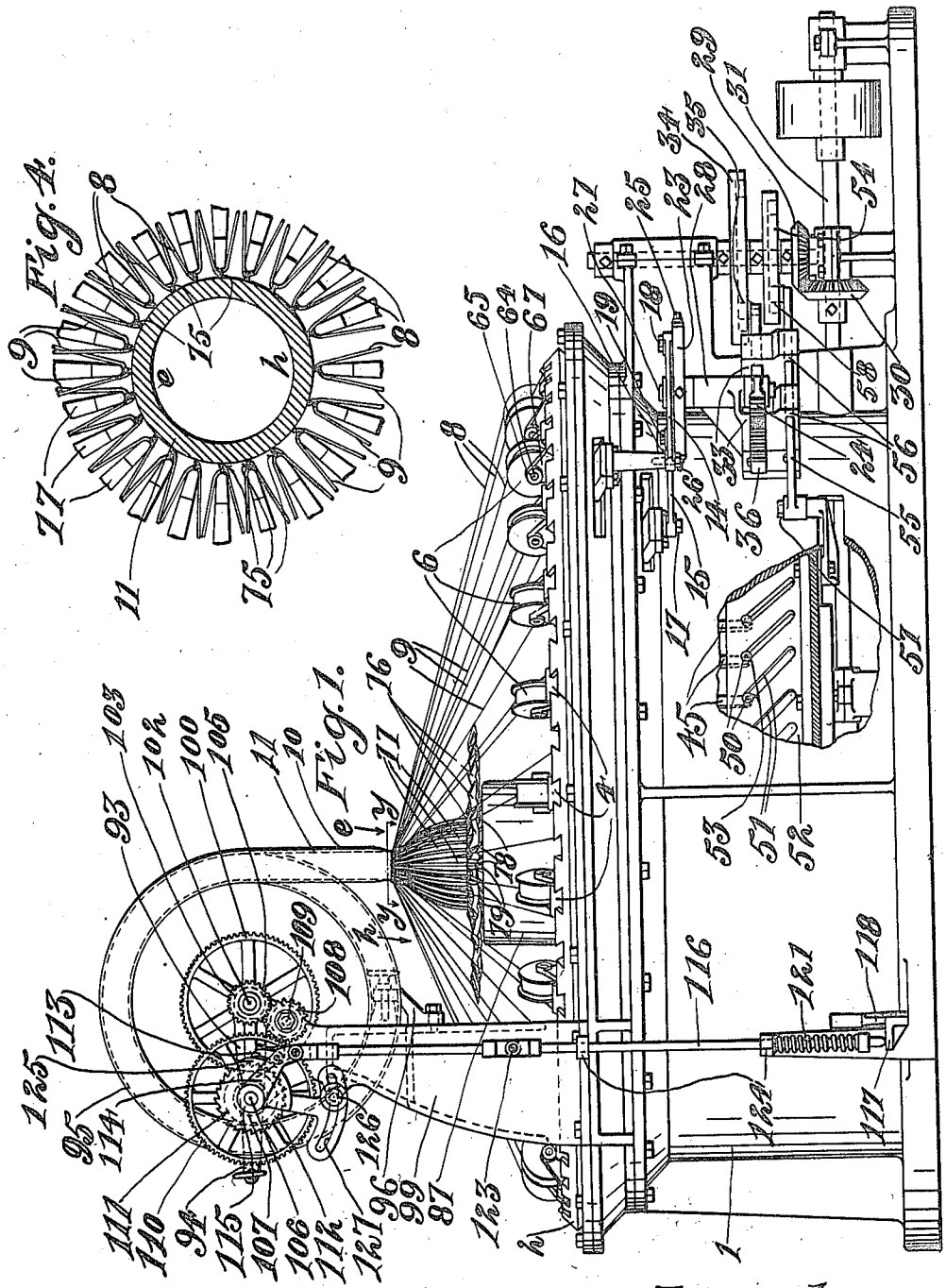
CIRCULAR BRAIDER.

APPLICATION FILED FEB. 6, 1911.

1,141,382.

Patented June 1, 1915.

4 SHEETS—SHEET 1.



Witnesses:
Jacob A. Hollander
Lillian Burnett

Inventor:
Adolph L. De Leeuw,
by D. F. Herbsleb, His Attorney.

A. L. DE LEEUW.

CIRCULAR BRAIDER.

APPLICATION FILED FEB. 6, 1911.

1,141,382.

Patented June 1, 1915.

4 SHEETS—SHEET 2.

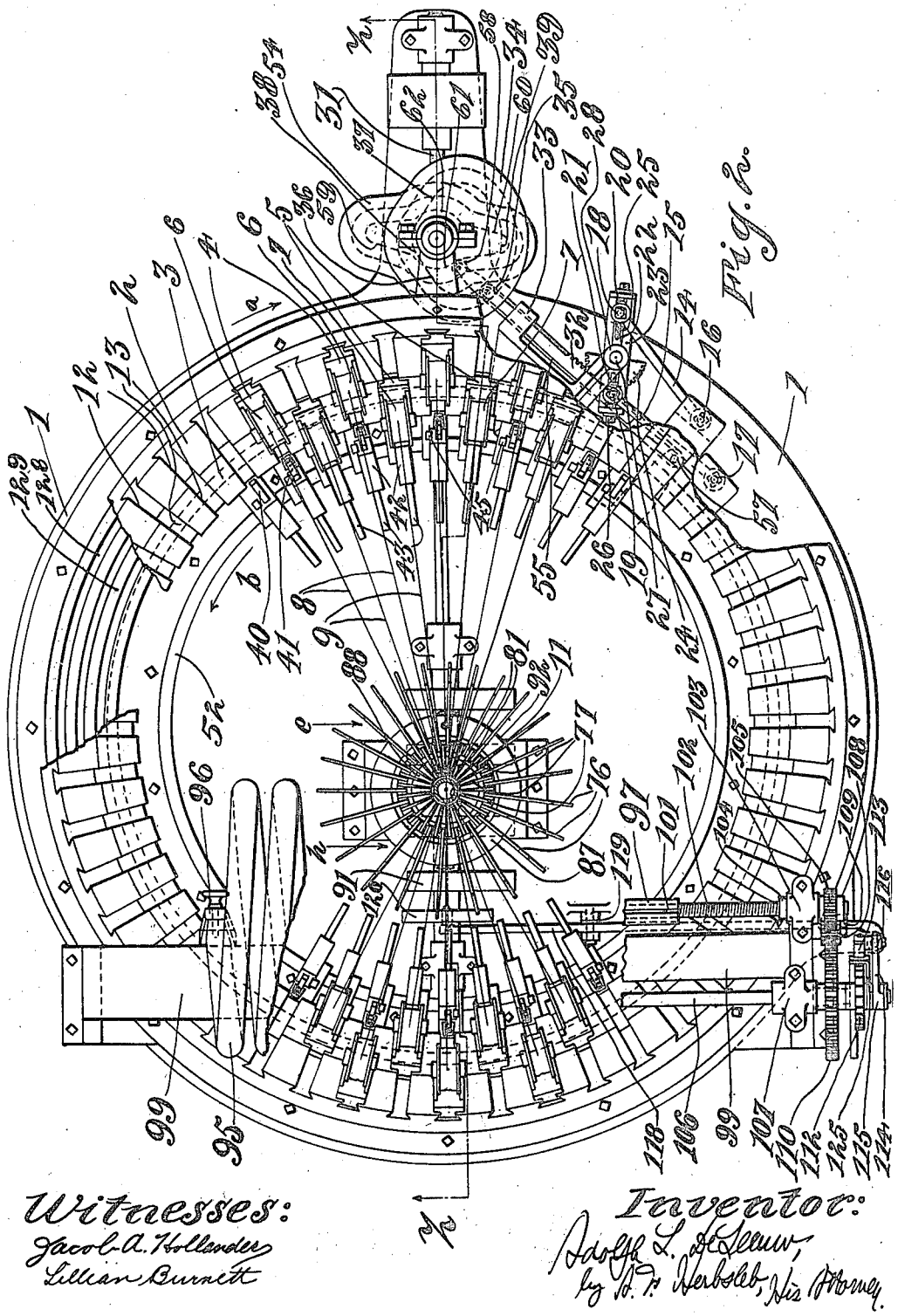


Fig. 2.

Witnesses:
Jacob A. Hollander
Lillian Burnett

Inventor:
Adolph L. de Leeuw,
by H. P. Herbolsheimer, His Attorney.

A. L. DE LEEUW.

CIRCULAR BRAIDER.

APPLICATION FILED FEB. 6, 1911.

1,141,382.

Patented June 1, 1915.

4 SHEETS—SHEET 3.

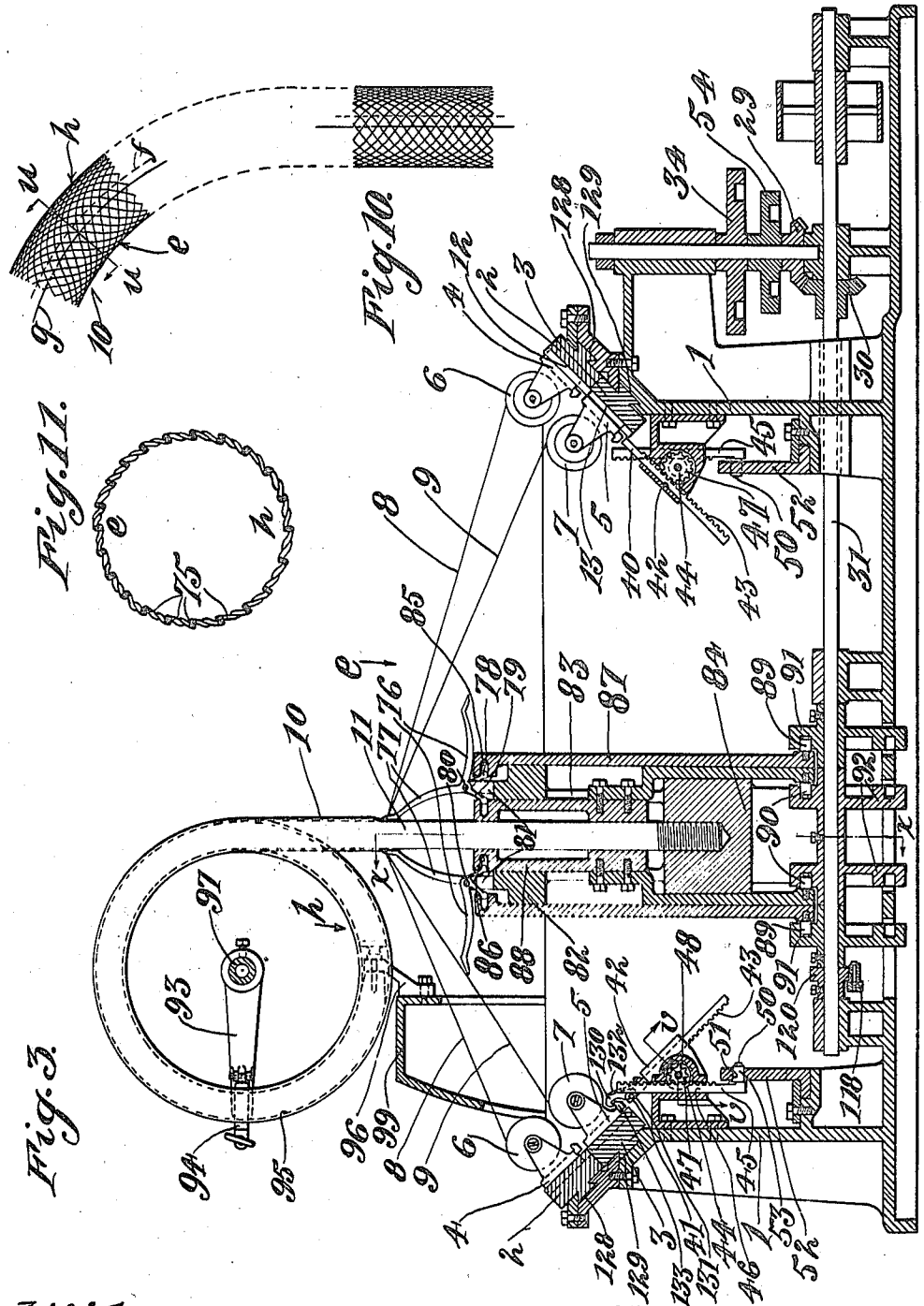


Fig. 10.

Fig. 11.

Fig. 3.

Witnesses:
Jacob A. Hollander
Lillian Burnett

Inventor:
Adolph L. de Leeuw,
by P. H. Herbsleb, His Attorney

A. L. DE LEEUW.

CIRCULAR BRAIDER.

APPLICATION FILED FEB. 6, 1911.

1,141,382.

Patented June 1, 1915.

4 SHEETS—SHEET 4.

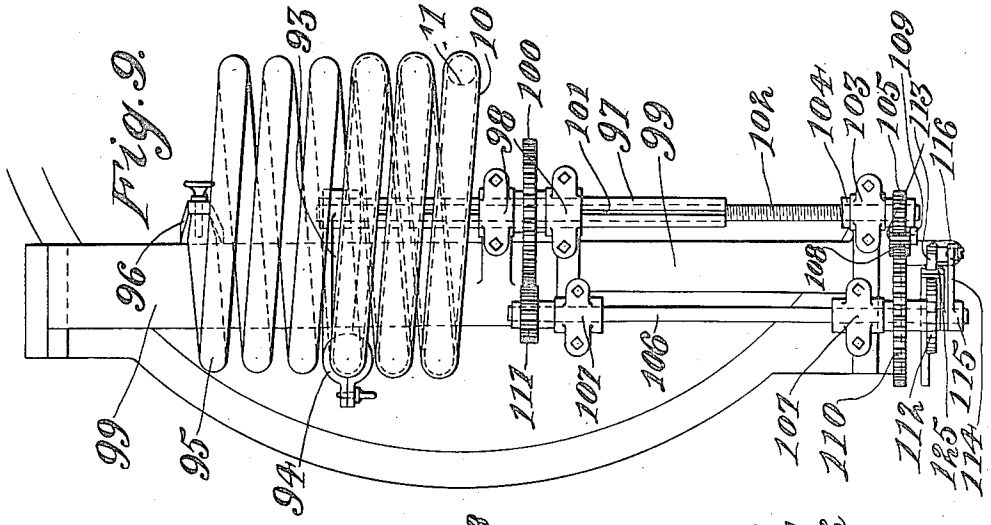


Fig. 9.

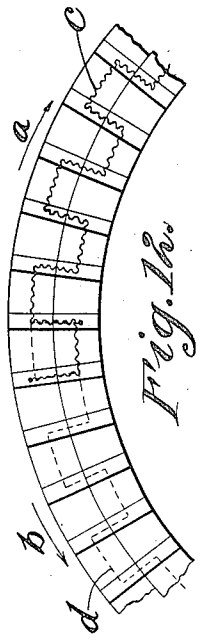


Fig. 12.

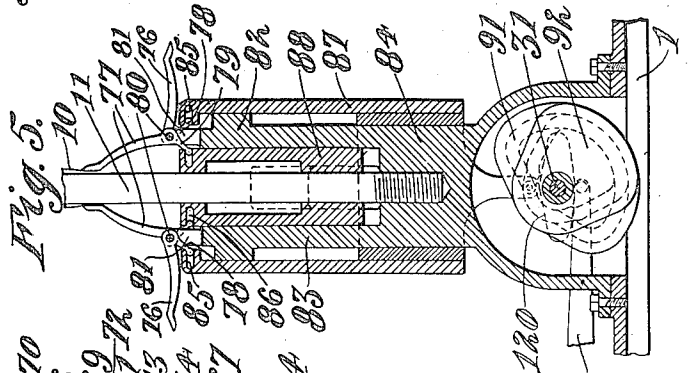


Fig. 5.

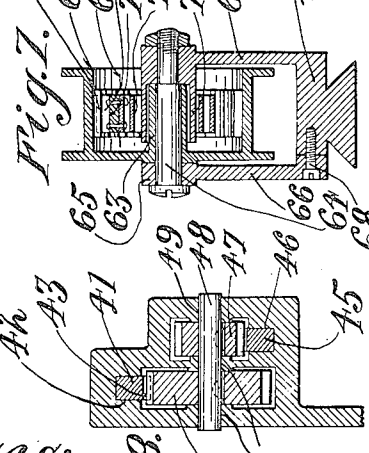


Fig. 7.

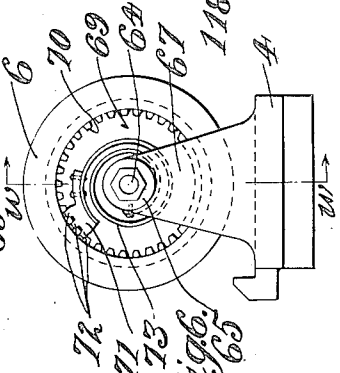


Fig. 6.

Fig. 8.

Witnesses:

Jacob A. Hollander

Lillian Burnett

Inventor:

Adolph L. de Leeuw,

by D. F. Derbyshire, His Attorney.

UNITED STATES PATENT OFFICE.

ADOLPH L. DE LEEUW, OF CINCINNATI, OHIO.

CIRCULAR BRAIDER.

1,141,382. Specification of Letters Patent. Patented June 1, 1915.

Application filed February 6, 1911. Serial No. 606,903.

To all whom it may concern:

Be it known that I, ADOLPH L. DE LEEUW, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Circular Braiders, of which the following is a specification.

It is the object of my invention to provide a circular loom whereby a web may be woven in tubular form with closer mesh at one side than at the other side thereof; further, to provide means whereby a web may be woven in tubular form with the woven stretches of the web laid with greater compression at one side than at the other side of the said tubularly formed web; further, to provide means whereby a tubular structure may be formed of woven stretches which are helically arranged, the helices having greater pitch at one side than at the other side of said structure; further, to provide novel means for causing travel of the bodies of weaving material; further, to provide novel means for laying the stretches; further, to provide novel means for weaving a tubular structure comprising woven stretches of metal or spring material; further, to provide means whereby a tubular structure is formed of woven stretches of spring material helically arranged with greater compression at one side than at the other side of said tubular structure whereby the said tubular structure will arrange itself in annular form; further, to provide means for weaving a tubing capable of being arranged in annular form and the stretches whereof are arranged in helical form having greater pitch at the peripheral than at the inner face of said annularly formed tubing; further, to provide means for weaving said tubing with greater weight of material at the peripheral than at the inner face thereof; further, to provide novel means for weaving said annularly formed tubing with meshes at the peripheral face thereof which are smaller than at the inner face thereof; further, to provide novel means for causing feeding movement of the woven structure; and further, to provide novel means for providing tension for the stretches being woven.

The invention will be readily understood from the foregoing and from the following description and claims, and from the drawings, in which latter:

Figure 1 is a side elevation of my improved device, partly broken away. Fig. 2 is a plan view of the same, partly broken away. Fig. 3 is a vertical section of the same on the line *z—z* of Fig. 2. Fig. 4 is a detail in horizontal section on the line *y—y* of Fig. 1, showing the relation of a set of the laying fingers in laying position. Fig. 5 is a vertical section of the laying mechanism taken on the line *x—x* of Fig. 3. Fig. 6 is a side elevation of the spool tension mechanism. Fig. 7 is a cross-section of the same on the line *w—w* of Fig. 6. Fig. 8 is a cross-section of the reciprocating mechanism for the strand carriers, taken on the line *v—v* of Fig. 3. Fig. 9 is a plan view of the take-off mechanism. Fig. 10 is a side elevation showing the woven tubing partly broken away. Fig. 11 is a cross-section of the same on the line *u—u* of Fig. 10; and, Fig. 12 is a diagrammatic representation showing the paths of travel of the strand carriers.

1 represents a suitable main frame in which a pair of annular supports 2, 3, are suitably mounted. These supports are arranged to support a series of slides 4 and a series of slides 5, one of which series is preferably adapted to have movement in one direction and the other in the opposite direction in order to cause the stretches which form the tubular structure to cross each other. The slides 4 are arranged to support spools 6 and the slides 5 are arranged to support spools 7. These spools may be of desirable construction and it is understood that any equivalent thereof would be within the spirit of my invention. Stretches 8, 9 proceed from the spools or carriers for forming the tubular structure indicated at 10 arranged to be formed about a forming mandrel 11.

The slide support 2 is provided with guideways 12, and the slide-support 3 is provided with guideways 13, arranged to accommodate the slides 4 and 5. The slides 4, in the form shown, are arranged to progress in the direction of the arrow *a*, while the slides 5 are arranged to progress in the direction of the arrow *b*, and to have paths of movement, portions of which are respectively indicated by the lines *c* and *d* in Fig. 12, these paths of movement being closed paths. There is relative shifting movement imparted between the slide-supports for causing alternate registry between the slideways on the pair of slide-supports, and re-

ciprocating movement is imparted to the slides for transferring the same from one support to the other when said slideways are in registry. I prefer to accomplish this relative shifting movement by a movement of both slide-supports. When the slideways on the two supports are in registry, the slides which are on each of the respective supports are transferred to the other of said supports, whereupon shifting of said supports takes place for carrying the series of slides 4 and 5 thereon in the directions of the arrows *a* and *b*, respectively, until the guideways on the two supports have passed each other and are again in registry, whereupon the slides will be again transferred from the supports upon which they are located to the opposite supports. This movement takes place successively for causing successive crossings of the stretches and progression of the respective series of slides and the spools thereon about the forming mandrel. There is in each support preferably a number of guideways equal to the entire number of slides provided, alternate guideways in each support during reciprocation of the supports being vacant, the vacant guideways on one support being arranged in line with the guideways having slides therein on the other support during positions of rest of said supports. The shifting movements of the slide-supports are preferably reciprocating movements about a central axis, one of the supports moving in one direction while the other support moves in the opposite direction to a limited extent, the supports then returning to initial positions. The limits of movement are preferably such as to bring the slideways on the respective supports into registry at the ends of said movements, where the supports remain momentarily in rest positions, during which transference of the slides from one support to the other takes place.

Suitable means are provided for causing the reciprocatory shifting movements between the supports, being instanced as a pair of links 14, 15, articulated to the respective supports at 16, 17, and respectively connected with crank-pins 18, 19, mounted on blocks 20, 21, adjustable in a guideway 22 of a crank-housing 23, which oscillates with a segment-gear 24. The blocks 20, 21 are respectively adjustable in said guideway by means of adjusting screws 25, 26, for positioning the blocks respectively at proper distances from the rocking axis of the crank-housing so as to impart the proper relative lengths of movement to the respective slide-supports.

The crank-housing and segment-gear 24 are secured to a shaft 27 journaled in a bearing 28 in the main frame. A cam shaft has a bevel-gear 29 thereon which is meshed by a bevel-gear 30 on a drive-shaft 31, driven in suitable manner.

32 is a rack-rod which meshes with the segment-gear 24, and is slidable in bearing 33, its movement being controlled by a cam 34. The cam is shown in the form of a block provided with a groove in which a pin 35 on the rack-rod is received. The cam-groove is provided with an eccentric portion 36, for causing oscillation of the crank-housing in one direction, and an eccentric portion 37, for causing oscillation of the crank-housing in the opposite direction, thereby causing relative shifting of the slide-supports, and with concentric portions 38, 39, during operation of which upon the rack-rod the crank-housing is stationary, corresponding with the rest-position of the slide-supports.

During the rest-position of the slide-supports, the slides are caused to reciprocate respectively from one support to the other, so as to be located alternately on and shift with the respective slide-supports. For causing this reciprocation of the slides, I provide mechanism which moves in alternation with relation to the support-shifting mechanism. The support-shifting mechanism operates in such manner that the slides 4 will be located alternately on the respective slide-supports during the times that said respective supports have their intervals of movement in a given direction, for instance, in the direction of the arrow *a*, for continuously carrying said slides 4 in said direction, whereas the slides 5 will be located alternately on said respective slide-supports during the intervals of movement thereof in the opposite direction, shown by the arrow *b*. Thus the slides 4 will be located on the support 2 and have an interval of movement in the direction of the arrow *a*, and during the rest positions between the supports will be transferred to the support 3, and with the next movement of the supports will be carried with the support 3 in the direction of the arrow *a*, and be then transferred to the support 2, and again carried in the direction of the arrow *a* with said latter support. Similar but opposite movements will simultaneously affect the slides 5.

All of the slides 4 will be simultaneously moving in the direction of the arrow *a* while all of the slides 5 will be simultaneously moving in the direction of the arrow *b*, the stretches of material projecting from said respective slides crossing each other at each of said movements for forming the crossing points or knots between the meshes of the woven structure. The shifting of the slides from one support to the other takes place in order to permit said slides to pass each other. Continuous movements of the respective series of slides in opposite direc-

tions about the axis of the forming mandrel therefore takes place with but a slight reciprocating movement of the supports between closely adjacent limits.

For effecting the reciprocation of the slides I provide pusher-rods 40 and pull-rods 41 arranged alternately about the supports and provide the same with mechanism for operating in unison. The rods are slidable longitudinally in bearings 42 and are provided with racks 43 meshed by a pinion 44. Rack-rods 45 slide in bearings 46 and are meshed by pinions 47. The pinions 44, 47 are arranged in pairs on studs 48 journaled in bearings 49 on the frame, and rotate together. The rods 40, 41, respectively, and the rack-rods 45, are arranged in pairs, the rack on one of the first-named rods and the rack on one of the last-named rods engaging the respective pinions of said pairs of pinions. Each of the rack-rods is provided with a pin 50 received in an inclined slot 51 of a cam-ring 52. The pins may respectively have anti-friction rollers 53 thereon. The ring 52 is reciprocated, its movement in one direction causing movement of the pusher and pull rods in a given direction, and the movement of the ring in the opposite direction causing the movement of said pusher and pull rods in an opposite direction. The reciprocation of the ring is also preferably within narrow limits, instanced as the angular distance between the ends of the inclined or cam slots. When the pusher-rods are moved toward the slide-supports, the slides at the pusher-rod positions are engaged by said pusher-rods and pushed from the inner of said slide-supports upon the outer of said slide-supports. Simultaneously with this movement the pull-rods have moved toward the alternate slides on the outer of said slide-supports, and in the retracting movement of said rods they will pull the said alternate slides on the outer slide-supports upon the inner slide-supports, thereby changing the positions of all of said slides upon said slide-supports. This movement is accomplished during the rest-positions of said slide-supports, while the guideways thereon are in registry, these guideways being shown extending radially from the rocking axes of said supports.

The ring 52 is given movement by a cam 54 through a rod 55 slidable in bearings 56 and articulated to the ring by an articulation 57, the cam being provided with a slot in which a pin 58 on the rod 55 is received for controlling the movement of the rod. The cam-slot has eccentric parts 59, 60, for causing the reciprocating movement of said slotted ring, and concentric parts 61, 62, for controlling the rest-positions of said slotted ring, these rest-positions occurring during the movements of the slide-supports, the pusher and pull rods and the slide supports moving alternately. A preferably quick and complete reciprocation of the pusher and pull rods takes place at each cycle of movement of the slide-supports. The cam 54 is preferably secured to the shaft on which cam 34 is located, the cams 54 and 34 preferably rotating in unison.

The stretches of the material being woven are held under proper tension. I have shown preferable means by which this tension is maintained, these means being particularly applicable where spring material such as spring wire, *e. g.* so-called piano-wire, is being woven to form a tubular structure, such for instance, as is shown in my application for Letters Patent of the United States for improvements in vehicle wheels, filed October 19, 1910, Serial No. 587,859, to which reference is here made. The spool receives the strands of the material for the stretches, and has a bearing 63 journaled about a stud 64 mounted in bearings 65 of uprights 66, 67, on the slides, the upright 66 being shown as detachable and held in place by screws 68. The spool has an annular recess 69 in which an internal gear 70 is located on the spool, a shoe 71 provided with teeth 72 being adapted to engage the teeth of the internal gear. The shoe is mounted on a spring 73, shown as a coil spring, upon one end of which the shoe is located, the other end thereof being secured to a flange 74 received about the bearing 63. As the spool unwinds to feed the stretch of material for the web being woven, it acts to wind the spring, whereby its effective diameter is reduced, and as the angular pressure upon the shoe increases by reason of the coiling of the spring, the effective radial distance of the shoe with relation to the internal gear becomes lessened, so that, when a given pressure upon the spring is reached, the shoe will be released from the gear but at once becomes reëngaged when a given spring-resistance is attained. In this manner a substantially uniform tension upon the strands is provided.

In forming the tubing, the stretches 8, 9 are respectively wound toward the right and left about the forming mandrel 11, with a step by step movement for forming the crossing points or knots 75, the formed tubing being also advanced with a step-by-step movement, the lengths of which latter movement are dependent on the sizes of the meshes being formed. The slide-supports are preferably of annular form located adjacent to each other and are received about the forming mandrel, which is preferably located eccentric with relation to the annular slide-supports.

The combined effect of the annular travel of the spools in opposite directions about the forming mandrel and the step-by-step longitudinal movement of the tubing at the

forming mandrel is to cause a helical laying of all the strands about the forming mandrel. By giving the location of this forming mandrel eccentricity with relation to the slide-supports, and having particular reference to Figs. 2, 4, 10 and 11, it will be noted that the angular distances between the strands adjacent to the mandrel are smallest at that side, *e*, of the forming mandrel which is farthest from the slide-supports. By this means I accomplish a closer laying of the strands at one side of the forming mandrel and the tubing being formed than at the other side thereof, with the result that the stretches are laid with greater compression at that side of the forming mandrel at which the mesh is closest. The center of gravity of the tubing being formed, shown by the dotted line *f*, is therefore at that side of the longitudinal axis of said tubing, shown by the dotted line *g*, at which there is the least angular distance between the stretches. As the tubing is formed it is held temporarily at the crossing points of the stretches while being formed, and the formed tubing is advanced with a step-by-step movement, and freed from the holding means at the forming mandrel. When the tubing is released, that side of it which is under the greatest compression, will be caused to stretch or expand longitudinally of the tubing, and when permitted by the mandrel, bends into annular or curved form. This stretching of the compressed side of the tubing also causes elongation of the mesh at that side, causing the mesh at that side to be comparatively long and narrow and at the opposite side to be comparatively shallow and wide, that is to say, the meshes at that side of the tubing formed under compression have their major axes extending lengthwise of the tubing, while the major axes of the meshes on the opposite side of the tubing extend crosswise of the tubing, as more clearly shown in my aforesaid application, Serial No. 587,859.

To illustrate the laying of the stretches upon the forming mandrel I have shown in Figs. 4 and 11 a cross-section thereof taken at the crossing points of the stretches, from which it will be noticed that the distances between the crossing points of the stretches are greatest at that side, *h*, corresponding to the side of the closest approach to the slide-supports, and become increasingly less toward the other side, *e*, of said forming mandrel. The crossing points or knots are laid about the forming mandrel preferably by fingers 76, 77. There is a series of each of these fingers which operate alternately for laying alternate crossing points or knots located at the apices of alternate webs. These crossing points or knots are respectively located in alternate radial planes with relation to the mandrel, and where the mandrel is located eccentric to the paths of travel of the strand-supports, there are a greater number of the fingers at one side than at the other side of said mandrel, as see Figs. 2 and 4. For operating the fingers I have provided the same respectively with heels 78, 79, the fingers being pivoted on studs 80 journaled in bearings 81 of an annular bearing-member 82, shown supported on uprights 83 extending from a base 84 mounted on the frame. The heels are respectively received in recesses 85, 86, of sleeves 87, 88, having longitudinal movement imparted thereto for causing the fingers to approach and recede from the forming mandrel with a movement which is comparatively slow adjacent to the forming mandrel, and rapid when distanced from said forming mandrel. For imparting longitudinal movement to the sleeves, I provide the same with pins 89 90 received in the cam-grooves of cams 91, 92, secured to the drive-shaft.

As hereinbefore explained the weaving of the tubing with greater compression on the one side than on the other side thereof forces extension of the compressed side longitudinally of the tubing, and thereby arranges the formed tubing in curved or annular form. I provide novel take-off mechanism for taking off this curved tubing, and I accomplish this preferably by providing an arm 93 having a clamp 94 thereon arranged to be attached to the tubing. This arm swings about a rotary axis and preferably also has movement imparted thereto longitudinally of said rotary axis so that when the arm shall have made a complete revolution it will have advanced in order that the formed tubing held thereby will be located in advance of a subsequently formed part of said tubing without interference. In other words, the formed tubing will be taken off in a spiral path. For supporting the tubing in its spiral path I provide a spiral extension 95 for the mandrel, the outer end of which has support on a releasable bracket 96, for permitting the formed tubing to be removed.

For accomplishing the movement of the arm, I mount the same upon a shaft 97 journaled in bearing 98 of a bridge-piece 99 supported by the frame and received over the strand mechanism at that side of the machine at which the shorter stretches are located. The shaft 97 is rotatable, and also slidable longitudinally, being rotated by a gear 100 which has spline-connection 101 therewith. For advancing the shaft longitudinally I provide the same with an internally threaded bore in which a screw-rod 102 is received. The screw-rod is journaled in a bearing 103 but held against longitudinal movement by a collar 104 and gear 105. The shaft 97 and the screw-rod are rotated

with a step-by-step or intermittent motion and the screw-rod is preferably given a faster speed of rotation than the shaft and preferably rotated in opposite direction to it owing to the slight longitudinal advance accomplished by the lead of the screw that would otherwise be imparted to the shaft. I therefore secure the gear 105 to the screw-rod.

106 is a shaft journaled in bearings 107 on the bridge-piece.

108 is an idler-gear which meshes with the gear 105 and is journaled on a stud 109 on said bridge-piece. The shaft 106 has a gear 110 thereon which meshes with the gear 108 and also has a pinion 111 thereon which meshes with the gear 100. The shaft 106 has a ratchet-wheel 112 thereon.

113 is a pawl adapted to engage the ratchet-wheel and is pivoted on a rocker-arm 114 having a bearing 115 about the shaft 106.

116 is a reciprocating rod operated in suitable manner, as by a step 117 on a lever 118 pivoted to the frame at 119, a spring 121 normally retracting the rod. This rod is jointed at 123 and slides in bearings 124.

It is desirable to take off the formed tubing with a step by step movement, timed with relation to the formation of the crossing points or knots at the forming mandrel, and to advance the formed tubing a distance corresponding to the distance, longitudinal of the forming mandrel, between the knots, so that as the laying fingers act upon the crossing points or knots, they may act upon the same points at each successive formation with relation to the forming mandrel, the tubing having meanwhile advanced the distance of the formed crossing points or knots. This distance of movement will depend on the longitudinal distance between the crossing points or knots. If a close mesh is being formed the step by step take-off will take place for shorter distances than if a larger mesh is being formed. For regulating these distances of take-off, I provide a shield 125 which is adjustably placed about the teeth of the ratchet-wheel for regulating the number of teeth which shall be free to the action of the pawl, the shield being held in adjusted position by a clamp-screw 126 received through a slot 127 in the shield and into the bridge-piece. The number of teeth exposed determines the extent of rotation of the ratchet-wheel at each reciprocation of the pawl and the consequent extent of movement of the gears 100 and 105, and the consequent extent of movement of the arm 93 about its axis and longitudinally of its rotary axis.

My improved device is particularly applicable for weaving spring-metal.

The annular supports preferably have reciprocation in annular guideways 128 129 of the frame. The pull-rods may be provided with hooks 130 pivoted at 131 to the rods and pressed into engaging positions by springs 132 and arranged to engage hooks 133 on the slides.

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

1. A tire-weaving machine of the nature disclosed combining a mandrel providing a curved weaving surface contoured like the section of the tire to be woven, a plurality of strand carriers arranged about said mandrel to feed spring wire strands to said weaving surface at angles progressively increased to the center of said mandrel from one side to the other thereof, means for producing a systematic shift in the relation of one series of said carriers to another series thereof to effect an interweaving of the strands, and means for maintaining said strands under tension.

2. A tire-weaving machine of the nature disclosed combining a mandrel providing a suitably contoured weaving surface, a plurality of strand carriers located at progressively greater distances from said mandrel and each adapted to feed spring wire strands to said mandrel under tension, and means for producing an interweaving shift of said strand-carriers relative to one another to effect an interweaving of said strands progressively varying from one side of said mandrel to the other.

3. A tire-weaving machine of the nature disclosed combining a mandrel providing an annular weaving surface, a first and a second series of strand carriers, the members of each series being equispaced in an orbit eccentrically related to said mandrel and each adapted to feed a spring wire strand to the surface of said mandrel, and means for producing a relative progressive movement between said mandrel and the first series in one direction and the second series in the opposite direction while effecting an interweaving of the members of said series.

4. In a machine of the character described, the combination of a mandrel and strand carriers moving in opposite directions about said mandrel, said mandrel located eccentric to the paths of movement of said strand carriers.

5. In a machine of the character described, the combination of reversely moving strand carriers moving about central axes, and a forming mandrel eccentric thereto, whereby the stretches between said forming mandrel and carriers are shorter at one side than at the other side of said mandrel.

6. In a machine of the character described, the combination of reversely moving strand carriers moving about central axes, and a forming mandrel eccentric thereto, whereby the angular distances between adjacent

strands at one side of said mandrel are less than at the other side thereof.

7. In a machine of the character described, the combination of reversely moving strand carriers having closed paths of movement, a forming mandrel located eccentric thereto, whereby the mesh formed by the stretches of said strands are closer at one side than at the other side of said mandrel.

8. In a machine of the character described, the combination of reversely moving strand carriers having closed paths of movement, a forming mandrel located eccentric thereto, whereby the mesh formed by the stretches of said strands are closer at one side than at the other side of said mandrel, and laying mechanism comprising laying fingers of which there are a greater number at said one side than at said other side of said mandrel.

9. In a machine of the character described, the combination of strand-carriers, means for moving said strand-carriers in opposite directions in closed paths, and a forming mandrel about which said strand-carriers move located eccentric to said closed paths, whereby greater amount of strand material is laid upon one side than upon the other side of said mandrel.

10. In a machine of the character described, the combination of strand-carriers, means for reversely moving said strand-carriers in closed paths, and a forming mandrel about which said strand-carriers move located eccentric to said closed paths, the stretches between said strand carriers and forming mandrel being at smaller angles to a line perpendicular to said forming mandrel at points of equal distance from said mandrel at one side than at the other side of said mandrel, for laying said stretches with greater compression at one side than at the other side of said forming mandrel.

11. In a machine of the character described, the combination of annular supports, carriers therefor, and means for moving said carriers between said supports comprising longitudinally movable rods, and a reciprocating cam-ring having operative connection with said rods.

12. In a machine of the character described, the combination of annular supports, carriers thereon, said supports having guideways for said carriers, longitudinally movable rods for reciprocating said carriers between said supports, a cam-ring having operative connection with said rods, and means for causing reciprocation of said cam-ring and reciprocation between said supports in alternation.

13. In a machine of the character described, the combination of a pair of annular supports, a pair of series of strand carriers, said supports having guideways for said carriers, means for causing reciprocation between said supports for causing registry of said guideways at the ends of said reciprocations, means for transferring each of said series of carriers from its support to the other of said supports, and means for operating said last-named means in alternation with said first-named reciprocating means.

14. In a machine of the character described, the combination of a pair of annular supports, a pair of series of strand carriers, said supports having guideways for said carriers, means for causing reciprocation between said supports for causing reverse movements in closed paths of said series of strand carriers and for causing registry of said guideways, and means for moving said respective series of carriers in reverse directions along said guideways for transferring said carriers upon said supports, said last-named means comprising a ring-member within said annular supports.

15. In a machine of the character described, the combination of annular supports, strand carriers mounted thereon, means for causing reciprocation between said supports, means for transferring said carriers from one to the other of said supports for causing given ones of said carriers to move in opposite directions, and a forming mandrel mounted eccentric to said supports, operating for the purpose described.

16. In a machine for weaving spring material, the combination of annular supports, a plurality of series of strand carriers, means for causing reciprocation between said supports, means for transferring said respective series of carriers to opposite supports for causing each of said series to move in closed paths in the same direction and alternate series to move in closed paths in opposite directions, a forming mandrel eccentric to said annular supports, a strand-spool on each carrier for the stretch extending therefrom, and tensioning means for said stretch mounted on and moving with said carrier.

17. In a machine for spirally weaving spring material in tubular form, the combination of annular supports provided with guideways, a plurality of series of strand carriers, means for causing reciprocation between said supports and thereby moving said series in opposite directions and means for transferring said series alternately to opposite supports whereby the strands from said carriers are caused to cross each other, and a mandrel eccentrically located with relation to said supports.

18. In a machine for spirally weaving spring material in tubular form, the combination of annular supports, means for causing reciprocation between said supports, carriers for the spring material stretches arranged in oppositely moving series, said supports having guideways for said carriers,

means for moving said carriers along said guideways to opposite supports, a forming mandrel eccentric to said supports, and a rotatable and longitudinally movable take-off adjacent to said forming mandrel.

19. In a machine for spirally weaving spring material in tubular form, the combination of annular supports, means for causing reciprocation between said supports, carriers for the spring material stretches arranged in oppositely moving series, said supports having guideways for said carriers, means for moving said carriers along said guideways to opposite supports, a forming mandrel eccentric to said supports a rotatable and longitudinaly movable take-off adjacent to said forming mandrel, and a spiral take-off support for the spirally woven tubing.

20. In a machine for spirally weaving spring material in tubular form, the combination of oppositely moving series of carriers having closed paths of movement, a mandrel having a forming part at one side of the plane in which said carriers are located and eccentric to said carriers, the stretches between said forming part and carriers being arranged at greater angles at one side than at the other side of said forming part, and laying means operable between said forming part and carriers laying the successive longitudinally arranged crossing points of said stretches at said forming part equal longitudinal distances apart, for forming a tubing having greater weight of material and compression at one side than at the other side thereof.

21. In a machine for spirally weaving spring material in tubular form, the combination of oppositely moving series of annularly moving carriers, a forming mandrel eccentric thereto, spools on said carriers, and tension means on said carriers resiliently acting on said spools.

22. In a machine for spirally weaving spring material in tubular form, the combination of annular supports, a forming mandrel eccentric thereto, means for causing reciprocation between said supports, carriers for the spring material stretches arranged in oppositely moving series moving about said mandrel, means for transferring said respective series alternately to said respective supports, and means for advancing the formed tubing, whereby all said stretches are helically laid about said forming mandrel with greater compression at one side than at the other side of said mandrel for causing stretching of said side of said tubing laid with greater compression and annularly arranging said tubing with greater pitch to the helices thereof at the peripheral face of said tubing.

23. In a machine of the character described, the combination of a pair of annular supports, a pair of series of strand carriers, said supports provided with guideways for said carriers, a crank-housing, links articulated with said respective supports and crank-housing, shifting parts for shifting said carriers on said guideways, a cam having operative connection with said crank-housing, and a cam having operative connection with said shifting parts, said cams mounted for rotating in unison and having their cam-faces in alternation.

24. In a machine of the character described, the combination of a pair of annular supports provided with guideways, means for causing reciprocation between said supports, a pair of series of strand carriers respectively mounted on said supports and annularly arranged, alternate pusher and pull rods annularly arranged, said rods and carriers provided with coöperating means, operating rods having operative connection with said pusher and pull rods for moving the same, a ring provided with cam-slots and with which said operating rods have operative engagement, and means for reciprocating said ring, substantially as described.

25. In a machine of the character described, the combination of a pair of annular supports provided with guideways, means for causing reciprocation between said supports, a pair of series of strand carriers respectively mounted on said supports and annularly arranged, alternate pusher and pull rods annularly arranged, said rods and carriers provided with coöperating means, said rods provided with racks, pinions in mesh therewith, operating rods provided with racks, pinions rigid with said first-named pinions and in mesh with said operating rods, and a cam-ring provided with cam-faces with which said operating rods have operative engagement, substantially as described.

26. In a machine of the character described, the combination of a pair of annular supports, means for causing reciprocation between said supports, a pair of series of strand carriers on said supports moving in opposite directions, a forming mandrel about which the stretches from said strand carriers are spirally wound in the movements of said carriers, take-off mechanism for said forming mandrel, and means for moving said take-off mechanism comprising a rotatively and axially movable part, substantially for the purpose described.

27. In a machine of the character described, the combination of a pair of annular supports, means for causing reciprocation between said supports, a pair of series of strand carriers on said supports moving in opposite directions, a forming mandrel about which the stretches from said strand carriers are spirally wound in the movement of said carriers, take-off mechanism

operative adjacent to said forming mandrel comprising a rotatively and axially movable part, and means for moving said part embracing a member for causing said rotative movement and a member for causing said axial movement with gearing between said members.

28. In a machine of the character described, the combination of a pair of annular supports, means for causing reciprocation between said supports, a pair of series of strand carriers on said supports moving in opposite directions, a forming mandrel about which the stretches from said strand carriers are spirally wound in the movements of said carriers, and take-off mechanism operating adjacent to said forming mandrel comprising a longitudinally and axially movable part, and speed changing mechanism for controlling the speeds of said movements.

29. In a machine of the character described, the combination of a pair of annular supports, means for causing reciprocation between said supports, a pair of series of strand carriers on said supports moving in opposite directions, a forming mandrel about which the stretches from said strand carriers are spirally wound in the movements of said carriers, take-off mechanism embracing a rotatively and axially movable arm adjacent to said forming mandrel, and means having operative connection with said carrier moving parts for causing intermittent movements of said arm.

30. In a machine of the character described, the combination of a pair of annular supports, means for causing reciprocation between said supports, a pair of series of strand carriers on said supports moving in opposite directions, a forming mandrel about which the stretches from said strand carriers are spirally wound in the movements of said carriers, take-off mechanism embracing a rotatively and axially movable arm, and means for moving said arm embracing a ratchet-wheel, a pawl therefor, a shield arranged to be selectively placed over the teeth of said ratchet-wheel, and operating means for said pawl and ratchet-wheel having connection with said carrier moving means, substantially as described.

31. In a machine of the character described, the combination of a pair of annular supports, means for causing reciprocation between said supports, a pair of series of strand carriers on said supports moving in opposite directions, a forming mandrel about which the stretches from said strand carriers are spirally wound in the movements of said carriers, take-off mechanism comprising a rotatively and axially movable arm operative adjacent to said forming mandrel, a rotative member for effecting said rotative movement, a rotating member for effecting said axial movement, gearing between said members, and driving means for the latter having operative connection with said carrier moving means and comprising a ratchet-wheel and pawl, and a shield selectively placed between the teeth of said ratchet-wheel and said pawl.

32. In a machine of the character described, laying mechanism comprising a pair of sets of laying fingers, a pair of co-axial sleeves having operative connections with said laying fingers, said operative connections extending in reverse directions toward said respective sleeves, and means moving said sleeves in similar directions for effecting reverse movement of the fingers of said respective sets of fingers.

33. In a machine of the character described, laying mechanism comprising a pair of sets of laying fingers, a pair of co-axial sleeves having operative connections with said laying fingers, said operative connections extending in reverse directions toward said respective sleeves, and cams for moving said sleeves in similar directions for effecting reverse movements of the fingers of said respective sets of fingers, for the purpose described.

34. In a machine of the character described, laying mechanism comprising a pair of sets of fingers provided with heels projecting in opposite directions, an annular support on which said fingers are pivoted, and two co-axial sleeves at the respective sides of the longitudinal projection of said annular support, operating substantially as described.

35. In a machine of the character described, laying mechanism comprising a pair of sets of fingers provided with heels projecting in opposite directions, an annular support on which said fingers are pivoted, two co-axial sleeves at the respective sides of the longitudinal projection of said annular support, and cams for moving said sleeves in similar directions at selectively different speeds.

In testimony whereof, I have signed my name hereto in the presence of two subscribing witnesses.

ADOLPH L. DE LEEUW.

Witnesses:
JACOB A. HOLLANDER,
LILLIAN BURNETT.