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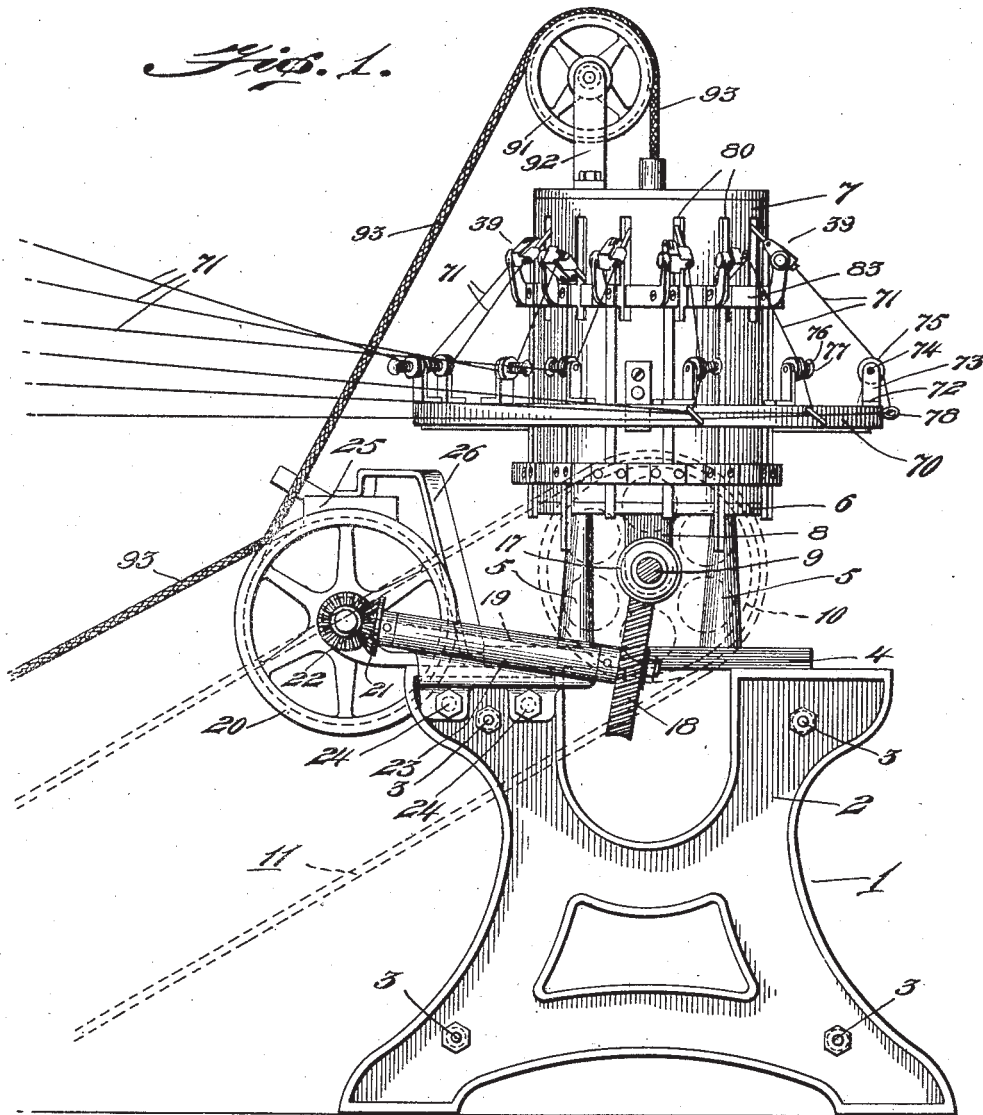
E. NANFELDT

1,872,168

CIRCULAR LOOM

Filed Jan. 6, 1930

4 Sheets-Sheet 1



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Aug. 16, 1932.

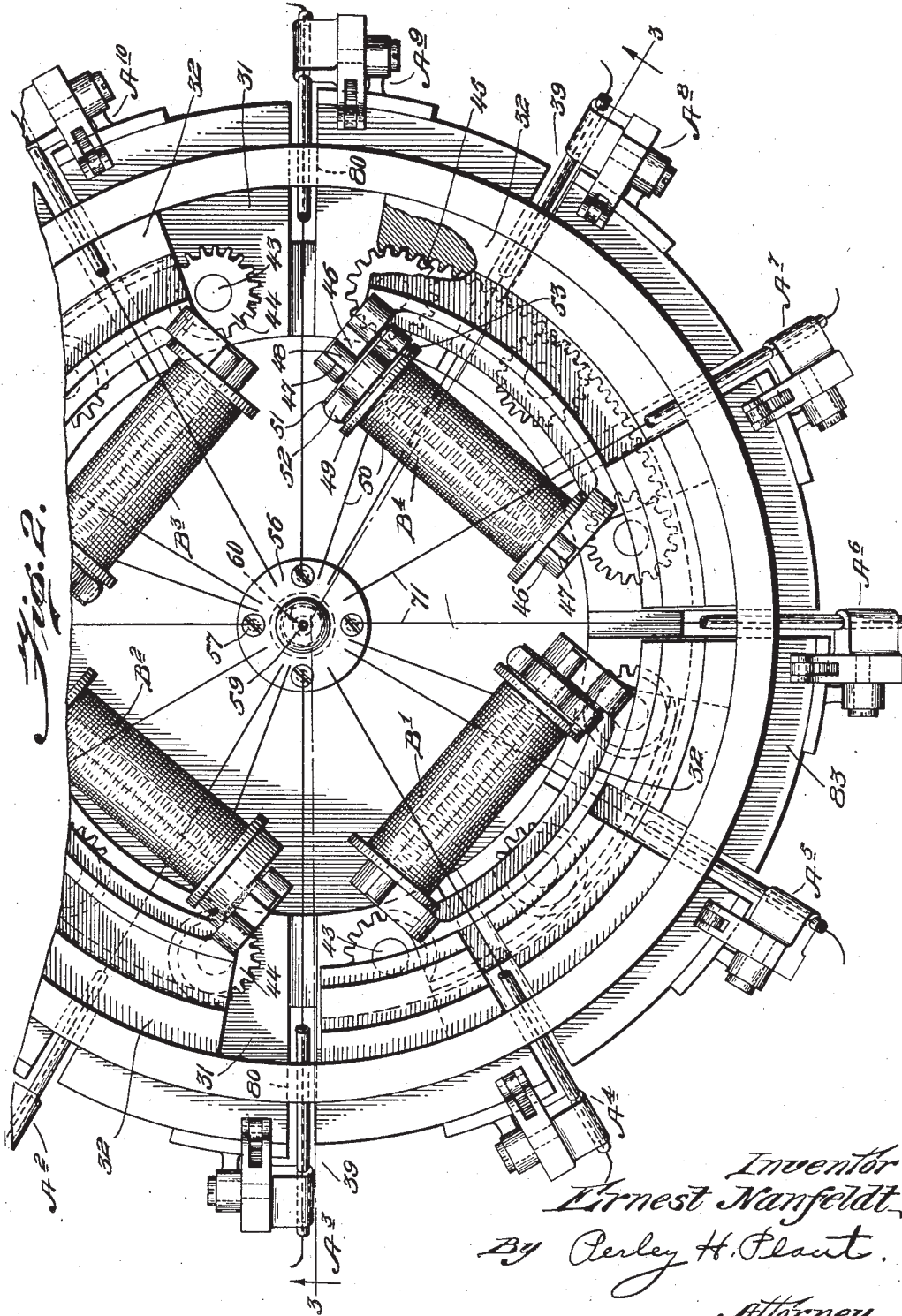
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Filed Jan. 6, 1930

4 Sheets-Sheet 2



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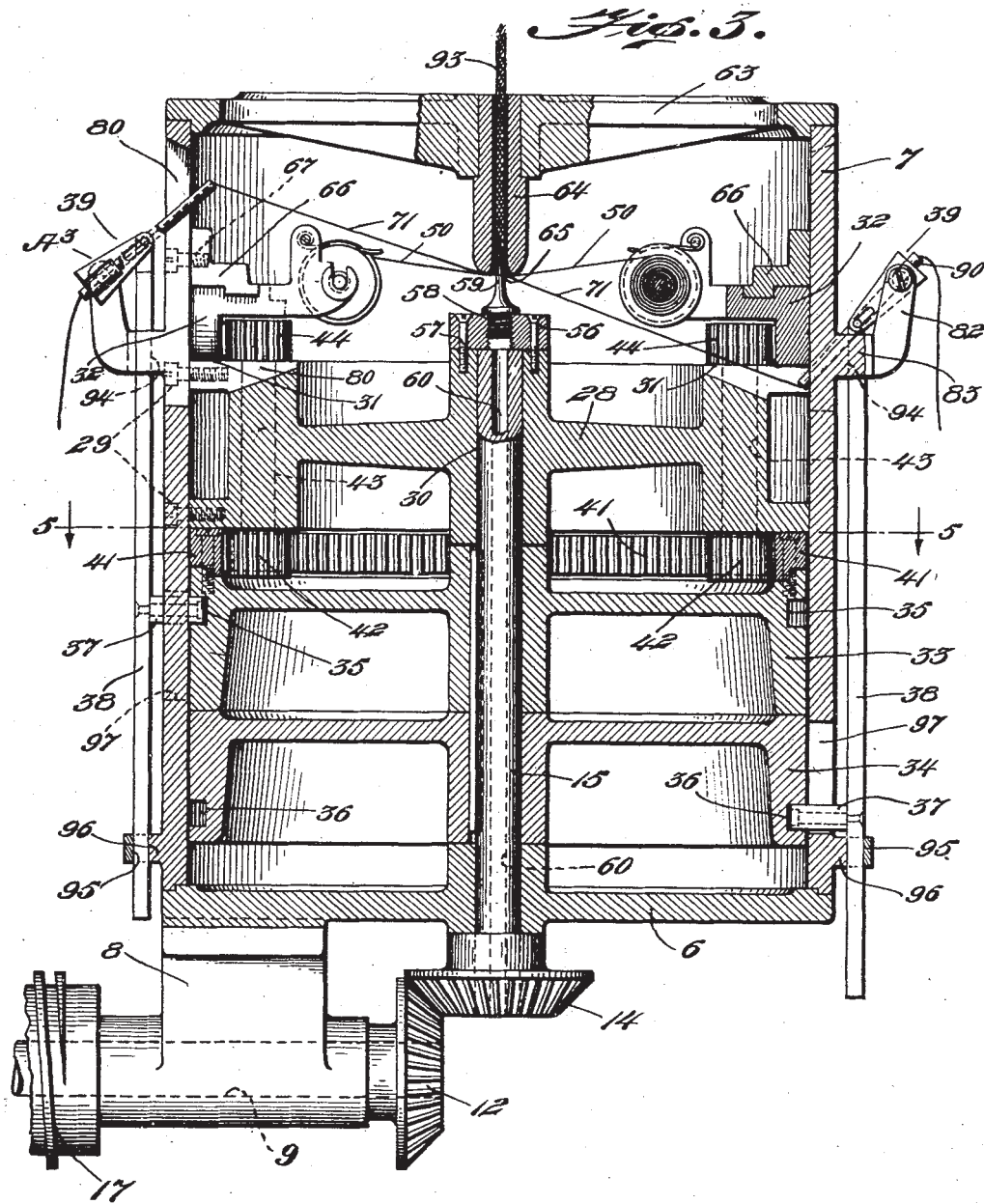
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CIRCULAR LOOM

Filed Jan. 6, 1930

4 Sheets-Sheet 3



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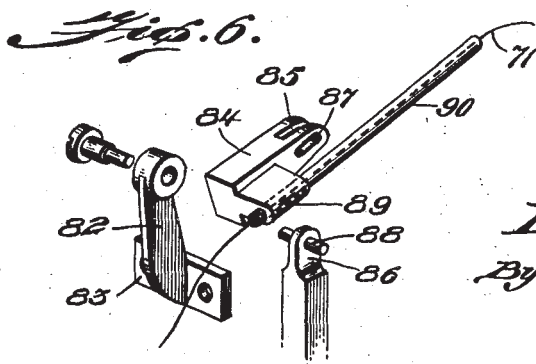
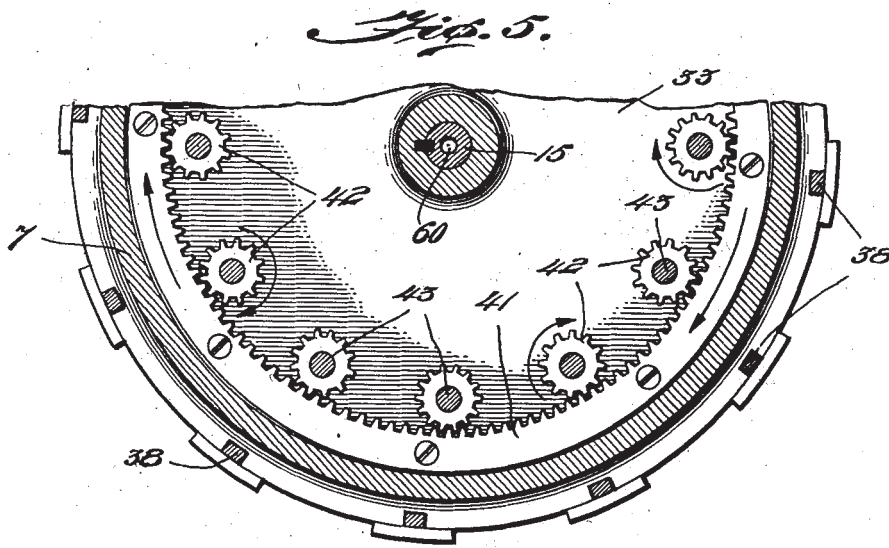
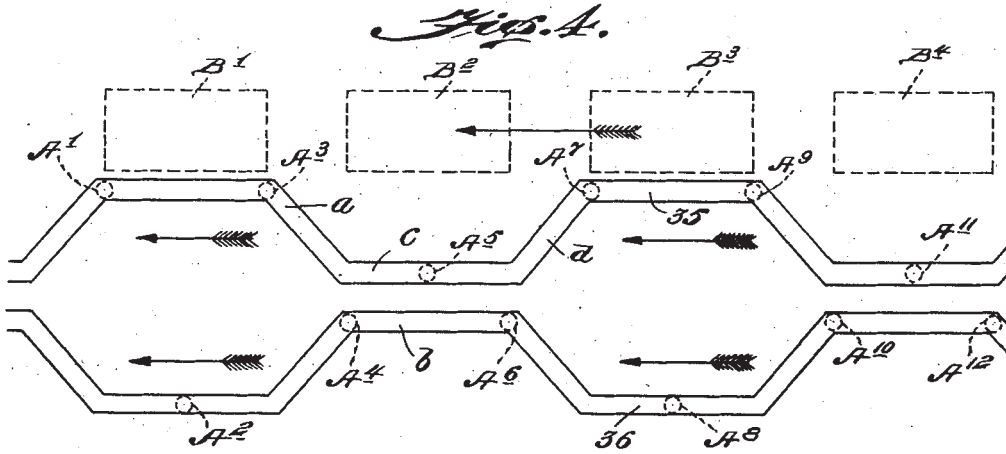
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CIRCULAR LOOM

Filed Jan. 6, 1930

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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CIRCULAR LOOM

Application filed January 6, 1930. Serial No. 418,867.

This invention relates to an improved circular loom for forming tubular fabric material wherein a plurality of weft thread carriers are mounted for movement about a common center and other thread carrying means are provided for interposing warp threads between said weft thread carriers in such a manner as to place the warp threads upon opposite sides of certain of the weft threads in accordance with a predetermined plan of operation.

One object of the invention is the provision of an improved arrangement of the thread carrying means whereby the weft threads are laid spirally in the formed fabric and warp threads are interposed therebetween in accordance with a predetermined plan.

Another object of the invention is to provide an improved device of this character wherein the thread carrying mechanism is positively operated and the threads are maintained under sufficient tension to insure a uniform product wherein the several threads are arranged in close proximity to those next adjacent thereto.

A further object of the invention is the provision of a device of this character which is of simple construction and wherein the several operating elements are positively driven from a common operating shaft.

Another object of the invention is the provision of a device of this character provided with a plurality of thread carriers movable along a circular path and positively operated means for interposing threads at substantially right angles to and extending between certain of the threads drawn from said thread carriers in accordance with a predetermined plan of operation.

A further object of the invention is the provision of improved cam means and thread carrier drive mechanism adapted to be operated as a unit for effecting uniform movement of the thread carriers and actuating the

thread guiding arms in timed relation with the movement of the thread carriers.

Other objects and advantages of the invention relate to various improved details of construction and arrangement of the parts as well as certain novel methods of operation as will be more fully set forth in the detailed description to follow.

Referring to the drawings:

Fig. 1 is a side elevational view of the circular loom showing the drive mechanism for operating the several parts and the means for supporting, guiding and tensioning the warp threads as they enter the casing as well as the tension means for engaging the circular woven fabric as it emerges from the loom mechanism.

Fig. 2 is a top plan view of the loom mechanism with the cover plate and guide tube removed, and with the annular supporting plate for the warp tension devices omitted for the purpose of clearness,

Fig. 3 is a vertical sectional view of the operating mechanism of the loom, taken substantially along the line 3—3 of Fig. 2,

Fig. 4 is a diagrammatic view of the cam grooves for operating the slides which actuate the thread guiding arms, showing the relation of the thread carriers thereto,

Fig. 5 is a detail sectional view showing a portion of the internal driving gear and illustrating its relation to the pinions for driving the thread carriers, taken substantially along the line 5—5 of Fig. 3, and,

Fig. 6 is an enlarged perspective view of one of the thread guiding arms and its associated parts shown in disassembled position.

In the embodiment of the invention illustrated herewith 1 designates generally the lower supporting frame of the loom structure which may be formed of any suitable material and given any desired shape for supporting the operating mechanism, although it is shown as formed from metal castings 2 suitably connected by bracing rods 3 in accord-

ance with the usual practice in forming supporting frames for devices of this character. A table 4 is mounted upon the lower supporting frame 1, and is provided with a plurality of upright posts 5 for supporting the base plate 6 of a substantially cylindrical casing 7 containing a portion of the loom mechanism.

The base plate 6 is provided with a depending bearing 8, which may be formed integral therewith and which rotatably supports a drive shaft 9 having secured thereto a drive pulley 10 adapted to be driven by a belt 11 from any suitable source of power (not shown).

The drive shaft 9 carries a bevel gear 12 which meshes with a bevel gear 14 secured to a hollow vertical shaft 15 journaled in the base plate 6 and adapted to drive certain of the loom mechanism. A spiral gear 17 is also carried by the shaft 9 and engages a spiral pinion 18 carried by a counter-shaft 19 for driving a tensioning pulley 20 through bevel gears 21 and 22, whereby suitable uniform tension may be applied to the circular fabric as it emerges from the loom. The counter-shaft 19 may be journaled in a bearing 23 carried by the supporting frame 1 and secured thereto by bolts 24 or in any other suitable manner. A presser plate 25 may be provided for engaging the several coils of circular fabric material passing around the tensioning pulley 20 to insure the proper positioning of the coils on the surface of the pulley, and a suitable degree of pressure may be maintained on the presser plate by means of a spring arm 26 carried by a portion of the supporting frame 1.

The circular casing 7 has a stationary supporting plate 28 mounted therein and secured to the casing in any suitable manner, as by means of screws 29, the supporting plate 28 being provided with a central opening 30 which serves as a bearing for a portion of the hollow vertical shaft 15. The stationary supporting plate 28 is provided upon its upper face with a substantially continuous circular path 31 extending therearound which serves as a guideway for the thread carrier blocks 32.

Cam drums 33 and 34 are carried by the vertical hollow shaft 15 and positioned beneath the stationary supporting plate 28. These cam drums are provided with cam grooves 35 and 36 respectively, with which the rolls 37 mounted upon the vertical slides 38 engage to move the slides vertically for actuating the thread guiding arms 39. The cam drums 33 and 34 are shown as being splined upon the vertical shaft 15 but may be secured thereto in any other suitable or desired manner, and a single cam drum provided upon its face with two cam grooves, may be substituted, if desired, for the two cam drums shown.

In the illustrated embodiment of the in-

vention the upper cam drum 33 is provided with an upwardly extending internal gear 41 secured thereto and engaging a plurality of toothed pinions 42 carried by vertical shafts 43 journaled in the stationary supporting plate 28, each of the shafts 43 being provided with a pinion 44 adapted to engage the rack portion 45 of each of the thread carrier blocks 32 upon rotation of the vertical shaft 15 and the internal drive gear 41 carried thereby, whereby the thread carrier blocks 32 are caused to travel along a circular path within the casing and in the same direction as the direction of the rotation of the vertical shaft 15.

The arcuate thread carrier blocks 32 are each provided with a pair of spaced arms 46 having bearings 47 for the reception of a spool supporting shaft 48 carrying a spool or bobbin 49 upon which is wound the thread 50 forming the weft portion of the circular fabric. Each shaft 48 is provided with a hub 51 located adjacent to one end of the spool 49, and a tension spring 52 is supported by a pin 53 carried by one of the arms 46 and engages the hub 51 to insure that a suitable degree of tension is exerted upon the thread 50 as it is removed from the spool 49 in the formation of the circular fabric.

An annular holding plate 56 is secured to the central portion of the stationary supporting plate 28 as by screws 57 and is provided with a threaded central opening located centrally of the casing 7, in which is threaded the base 58 of a weaving pin 59, when the circular fabric is to be formed as a separate entirety and not applied to a wire or tube in the process of its formation.

The vertical shaft 15 is provided with a central opening 60 extending throughout its length, and when the circular fabric is to be applied directly to a wire or tube as a covering therefor, as it is formed, the weaving pin 59 may be removed from the plate 56 and the wire or tube drawn up through the central opening 60 in the shaft 15 and the circular fabric applied directly thereto as the wire or tube is drawn upwardly by suitable take-up mechanism.

A cover plate 63 is secured to the top of the circular casing 7 in any suitable or desired manner and is provided with a guide tube 64 located centrally thereof and in line with the weaving pin 59 for the passage of the fabric material upon its formation at the weaving point 65. When the circular fabric material is applied to or formed upon a wire or tube, the wire or tube together with its fabric cover is drawn upwardly through the guide tube 64 in a similar manner to that in which the circular fabric material is drawn therethrough when it is formed about the weaving pin 59.

A circular holding plate 66, which may be formed of segmental sections if desired, is

secured to the inner surface of the casing 7, as by screws 67, and holds the thread carrier blocks 32 in position so that the rack portions 45 thereof are engaged by the pinions 44 and the thread carrier blocks thus moved about the casing in a circular path during the operation of the loom mechanism. It will be seen upon reference to Fig. 2 of the drawings, that the pinions 44 are so positioned about the internal circumference of the path 31 that at least two of said pinions are always in mesh with the rack 45 carried by each thread carrier, whereby the possibility of any carrier being temporarily halted or moved out of its path is prevented.

An annular supporting plate 70 is located in proximity to the outer surface of the casing 7 and carries a plurality of tension devices, each of which is adapted to apply tension to one of the warp threads 71. The tension devices each comprises a support 72 having a portion secured to the supporting plate 70, and a portion 73 located at an angle therewith and carrying a rod 74 on which is mounted tension disks 75, which are resiliently held in contact with each other by means of a coiled spring 76 mounted upon the rod, the tension of the coiled spring being capable of being varied by means of an adjusting head 77.

The several warp threads 71 are drawn from spools or bobbins mounted upon a rack (not shown) and the threads are passed between the tension disks 75, being first passed through guide eyes 78 when necessary, and thence to the hollow guide tubes which form a part of the guide arms 39 through which they are adapted to pass and by which they are directed to the weaving point above or below the thread carrier 32 in accordance with a predetermined plan of operation. The number of guide arms 39 employed in forming the circular fabric material may be varied as desired but in the present instance twelve of these guide arms are used and they are equally spaced from each other throughout the circumference of the casing 7, each of the guide arms 39 being mounted in proximity to one of the radial slots 80 formed in the casing cylinder. Each of the guide arms 39 is pivotally supported by an angular supporting member 82 which projects outwardly from and may be secured to or formed integral with the collar 83 carried by upon the outer surface of the casing. Each guide arm comprises a supporting block 84 which is pivotally mounted upon the angular supporting member 82 and provided with a bifurcated portion 85 located adjacent one end thereof to receive the reduced end 86 of one of the slides 38. The bifurcated end portion 85 is slotted as indicated at 87 to receive a pin 88 carried by the reduced end portion 86 of the slide whereby pivotal movement of the supporting block 84 may be effected upon reciprocation of the slide 38. The supporting

block 84 is provided with a boss 89 for supporting a tubular member 90 through which the thread 71 passes as it moves from the tension disks 75 to the weaving point 65.

A take-up wheel 91 is rotatably supported by a frame 92 carried by the cover plate 63, and the circular fabric 93 is passed over the take-up wheel upon its emergence from the tube 64 and then passed over the tension wheel 20 from which it passes to a suitable spool or reel for winding.

The vertical slides 38 are each mounted in a guideway 94 formed in the collar 83 and in a similar guideway 95 formed in a collar 96 which is secured to or formed integral with the casing 7 adjacent to the base thereof. Radial openings or slots 80 are formed in the upper portion of the casing 7 to receive the hollow tube portion 90 of each pivoted guide arm 39 as it is actuated by its corresponding slide for inserting a warp thread above or below one of the thread carriers 32, and these radial slots are each extended into the upper surface of the stationary supporting plate 28 in order to permit sufficient movement of the guide arm 39 so that the thread 71 may be carried below a thread carrier 32 as the thread carrier is moved about its circular path. Radial slots 97 are formed in the casing 7 adjacent to the base thereof through which the rolls 37 carried by the slides 38 extend to enter the cam grooves 35 and 36 carried by the cam drums 33 and 34 respectively.

It will be noted upon reference to Fig. 2 of the drawings that four thread carriers 32 are employed although the mechanism may be designed for use with eight or sixteen of such carriers if desired. Attention is also called to the fact that in Fig. 3 of the drawings the thread carrier 32 which would occupy a position almost directly back of the weaving pin 59 has been omitted from the showing in the interest of clearness, as well as the vertical shafts 43 and pinions 42 and 44 which are spaced about the circumferential portion of the stationary supporting plate 28, except the vertical shafts 43 and pinions 42 and 44 located at the opposite sides of the supporting plate 28 as seen in the sectional view. These elements have been omitted from the showing in order that the remaining structure may be more clearly shown, the position of the omitted parts being clearly disclosed in Figs. 2 and 5.

In the operation of the above mechanism the spools or bobbins carrying the warp threads 71 may be mounted on a suitable frame or otherwise positioned in proximity to the loom and the several warp threads which are to be incorporated into the fabric led therefrom and passed over tension disks 75 located in spaced relation to each other about the exterior surface of the casing 7. These threads are each passed through one

of the tube members 90 and to the weaving points 65 where they are to be incorporated in the circular fabric material. Spools 49, each carrying thread 50 adapted to form the west portion of the circular fabric, are placed in the thread carriers 32, and the several threads led to the weaving point 65 for incorporation into the fabric.

Upon rotating the hollow shaft 15, through the drive shaft 19 and gears 12 and 14, the cam drums 33 and 34 are rotated, as for example, in a clockwise direction as seen on Fig. 2 of the drawings, and the several thread carriers 32 are also rotated in a clockwise direction as seen in Fig. 2 through the internal gear 41, pinions 42, vertical shafts 43, and pinions 44 which engage the rack portions 45 of the thread carriers. The several thread carriers 32 are thus caused to travel about their circular track 31 within the casing with the several threads 50 carried thereby being drawn to the weaving point and entering into the formed fabric. As the thread carriers 32 move about the circular path 31, the several guide arms 39 are actuated through the cam grooves 35 and 36 and vertical slides 38 to direct the threads 71 below or above the advancing thread carriers in accordance with the predetermined plan of operation.

As shown diagrammatically in Fig. 4 of the drawings, alternate guide arms 39 are controlled from the cam grooves 35 and 36 respectively. The several guide arms as shown in Figs. 2 and 4 are specifically indicated by reference characters A1, A2, A3, etc. and their positions relative to the thread carriers 32 which are individually designated to B1, B2, B3, and B4 in these figures. As illustrative of the movements of these devices relative to each other the guide arm designated as A3 on Figs. 2 and 4 is at the limit of its upward movement as shown in Figs. 2 and 3, and is starting to descend before the advancing thread carrier B1. At this time the roll 37 which controls the operation of the slide actuating the guide arm A3, and which is designated as A3 on Fig. 4 is about to enter the downwardly inclined portion *a* of the cam groove 35.

The next guide arm A4, which is controlled from the cam groove 36 through that roll 37 which is indicated by A4 on Fig. 4 of the drawings, is at the upward limit of its movement, as shown in Fig. 2 with its thread 71 passing over the thread carrier B1, and the roll A4 which controls the movement of this guide arm is entering the horizontal portion *b* of the cam groove 36 whereby the guide arm A4 will be held at its uppermost limit of movement until the thread carrier designated as B1 has passed under the thread 71 carried thereby. The next guide arm 39 which is particularly designated as A5 on Fig. 2 of the drawings is at its lowermost position as shown in Fig. 2 with the thread

71 therefrom passing under the thread carrier 32 which is designated as B1. The roll A5 which moves in the cam groove 35 and controls the movement of the guide arm A5 is shown on Fig. 4 as being located in one of the lower horizontal portions *c* of the cam groove 35 whereby the guide arm A5 is held in its lowered position until the thread carrier particularly designated as B1 passes, when the roll A5 enters the upwardly inclined portion *d* of the cam groove 35 whereby the guide arm 39 designated as A5 is raised before the advancing thread carrier B4 so that the thread 71 carried thereby will pass over the thread carrier B4.

It will be seen from the above that the cam grooves are so formed and the rolls 37 so positioned therein with reference to the location of the thread carriers that alternate thread guide arms 39 are caused to move above each thread carrier as it moves about its circular path while the remaining guide arms are moved to pass below each thread carrier during its travel about its circular path.

The circular fabric material formed in the operation of the mechanism is led upwardly from the weaving point 65 through the tube 64 and over the take-up wheel 91 to the tensioning wheel 20 from which it passes to a reel or bobbin upon which it is to be wound. The circular fabric material follows the same course from the weaving point 65 whether the fabric is formed about the weaving pin 59 or about a wire or tube which is moved upwardly as the fabric is formed in such a manner that the circular fabric material is formed as a covering for such wire or tube.

While I have shown and described one form which my improved structure may assume in practice it is to be understood that various changes may be made in the form, arrangement and proportions of the parts without departing from the spirit and scope of my invention as set forth in the appended claims, which are to be broadly construed in the light of my disclosure.

What I claim is:—

1. In a circular loom, a stationary casing of substantially circular cross-section comprising a base plate serving as a closure for one end thereof, the cylindrical portion of said casing being provided with a plurality of radial slots, a stationary supporting plate positioned within said casing, aligned bearings carried by said base plate and said supporting plate and located centrally thereof, a shaft rotatably mounted in said bearings, thread carriers mounted upon said supporting plate for travel within said casing along a substantially circular path, arms pivotally supported outwardly of said casing adjacent to said slots for movement within said slots, and means operated by said shaft for imparting movement to said thread carriers and for

actuating said arms about their respective pivots in timed relation with the movement of said thread carriers.

2. In a circular loom structure, a stationary cylindrical casing comprising a base plate serving as a closure for one end thereof, a stationary supporting plate positioned within said cylindrical casing and spaced from said base plate, said cylindrical casing being provided with a plurality of parallel slots located above said supporting plate, a shaft rotatably supported by said base plate and said supporting plate, the axis of said shaft coinciding substantially with the axis of said casing, thread carriers mounted upon said supporting plate for travel thereon within said cylindrical casing along a substantially circular path, arms pivotally supported outwardly of said casing adjacent to said slots for movement in said slots, and driving means carried by said shaft between said base plate and supporting plate for driving said thread carriers and arms in timed relation with each other.

3. A circular loom comprising a stationary cylindrical casing having a cylindrical wall and end plates secured to the opposite ends thereof, a stationary supporting plate located within said casing and secured to said cylindrical wall to separate said casing into compartments, a shaft rotatably mounted in one of said end plates and said supporting plate, thread carriers mounted on said supporting plate for movement in a substantially circular path, said cylindrical casing being provided with parallel slots extending there-through, warp carrying arms pivotally mounted externally of said casing and having portions thereof movable within said slots in timed relation with said thread carriers, and means carried by said shaft for moving said thread carriers continuously and for actuating said warp carrying arms in timed relation with the movement of said thread carriers.

4. A circular loom structure comprising a vertical cylindrical stationary casing provided with a base plate serving as a closure for one end thereof, a supporting plate located within said casing and spaced from said base plate to separate the casing into upper and lower compartments, a holding plate spaced from said supporting plate, arcuate thread carrier members positioned between and guided by said supporting plate and holding plate for movement in a circular path, a central shaft rotatably supported by said supporting plate and base plate, a plurality of vertical shafts mounted in said supporting plate for imparting movement to said thread carriers, arms pivotally supported from the cylindrical portion of said casing and movable in timed relation with said thread carriers, and means carried by said

central shaft for rotating said vertical shafts and actuating said arms.

5. In a circular loom structure, a stationary vertical casing of circular cross section provided with a stationary supporting plate secured to the casing and separating the casing into upper and lower compartments, said casing having a plurality of vertical slots extending through the cylindrical wall thereof and located above and below said stationary supporting plate, a plurality of thread carriers mounted upon said supporting plate and movable upon said supporting plate in a substantially circular path within said casing, a plurality of thread carrying arms supported outwardly of the cylindrical walls of said casing and movable through the slots located above said stationary plate to direct threads upon opposite sides of said thread carriers, driving means positioned within said casing below said supporting plate, means for effecting movement of said thread carriers along a circular path through said driving means, and means located outwardly of said cylindrical wall and projecting through the slots below said stationary plate for cooperation with said driving means to actuate said carrying arms in timed relation with said thread carriers.

6. A circular loom structure comprising a stationary casing of circular cross section, a supporting plate located within said casing and dividing the interior thereof into separate compartments, thread carrier members mounted upon said supporting plate within said casing and movable in a circular path, a plurality of thread carrying arms pivotally supported by said casing exteriorly thereof and having portions movable through slots formed in said casing to guide threads above and below said thread carriers, an annular supporting plate located exteriorly of said casing and extending therearound, tension mechanisms carried by said annular plate for applying tension to the threads guided by said thread carrying arms, and means for moving said thread carriers along their circular path within the casing and actuating said thread carrying arms in timed relation with said thread carriers.

7. A circular loom structure comprising a cylindrical casing, a supporting plate located within said casing to separate the casing into upper and lower compartments, thread carrier members mounted upon said supporting plate and movable in a substantially circular path within said casing, said casing being provided with a plurality of vertical slots located above said supporting plate and adjacent to the path of movement of said thread carriers, a plurality of thread carrying arms pivotally supported exteriorly of said casing and adjacent to said slots, vertical slides located exteriorly of said casing for actuating said thread carrying arms, means

carried by said casing for guiding said vertical slides, said casing being provided with slots extending therethrough beneath said supporting plate, means carried by said slides and projecting through said last named slots for actuating said slides, and means located within said casing and beneath said supporting plate for driving said thread carriers and moving said slide actuating means to actuate said thread carrying arms in timed relation with said thread carriers.

8. In a circular loom, a casing of substantially circular cross-section provided with a plurality of radial openings, thread carriers movably mounted for travel in a substantially circular path within said casing and past the radial openings formed therein, tubular thread carrying arms pivotally supported outwardly of said casing and each located adjacent to and mounted for pivotal movement within one of the radial openings for receiving and guiding a thread through the tubular portion thereof in such a manner as to position the thread above and below certain of said thread carriers while guarding the thread against injury, means for moving said thread carriers, and means for actuating said thread carrying arms about their respective pivots in timed relation with the movement of said thread carriers.

9. In a circular loom, a casing of substantially circular cross-section provided with openings extending therethrough, thread carriers mounted in said casing for movement in a substantially circular path past the openings formed in said casing, each of said thread carriers being provided with an arcuate portion normally engaging the internal surface of the casing, means for moving said thread carriers, a plurality of tubular thread guiding arms positioned outwardly of said casing and each located in operative position relative to one of the openings in said casing for receiving and guiding a thread passing through the tubular portion of said arm across the path of movement of said thread carriers whereby the threads are protected against breakage, means for imparting movement to said thread carriers, and means for actuating said thread guiding arms in timed relation with the movement of said thread carriers.

10. A circular loom comprising a stationary cylindrical casing having a vertical cylindrical wall and stationary end plates carried by the opposite ends of said cylindrical wall, a stationary supporting plate located within said cylindrical casing and positioned intermediate the ends thereof, a shaft rotatably mounted in said supporting plate and in one of said end plates, arcuate thread carriers mounted on said supporting plate and engaging said cylindrical wall for movement in a substantially circular path within said casing, pivotally mounted

thread carrying arms located outwardly of said casing and movable into and out of radial slots formed in said casing in timed relation with the movement of said thread carriers, and means carried by said shaft and located within said casing upon that side of said supporting plate opposite to said thread carriers for driving said thread carriers and actuating said thread carrying arms.

11. In a circular loom structure, a stationary cylindrical casing, a stationary circular supporting plate mounted within said casing, a plurality of thread carrying members movably supported by said supporting plate and each provided with a curved face engaging said casing, means carried by said casing and co-operating with said supporting plate for guiding said thread carrying members in their travel within the casing, and means carried by said supporting plate for moving said thread carrying members about said supporting plate.

12. In a circular loom structure, a stationary cylindrical casing, a stationary supporting plate mounted within said casing, a plurality of thread carrying members movably supported by said supporting plate, means carried by said casing and spaced from said supporting plate to provide with said supporting plate a circular pathway for receiving and guiding said thread carrying members, and means carried by said supporting plate for engaging said thread carrying members and causing them to move about said arcuate pathway.

13. In a circular loom structure, a stationary cylindrical casing, a circular supporting plate positioned within said casing intermediate the ends of said casing, said casing being provided with radial slots arranged parallel with the axis thereof and located above and below said supporting plate, a drive shaft rotatably mounted in said casing, the axis of said shaft coinciding substantially with the axis of said casing, thread guiding arms pivotally mounted outwardly of said casing and located adjacent to the slots formed in said casing upon one side of said supporting plate for movement into and out of said slots, slides carried by said casing and located outwardly thereof for operatively engaging said thread guiding arms, means carried by said slides and extending through the slots formed in said casing on the opposite side of said supporting plate from said arm receiving slots, and means carried by said drive shaft and engaging said first named means for reciprocating said slides and actuating said thread guiding arms to move them into and out of their corresponding slots.

14. In a circular loom structure, an enclosing casing provided with a stationary supporting plate located intermediate the

ends of said casing and dividing the casing into upper and lower chambers, thread carriers movably positioned in one of said chambers, pivoted thread guiding arms mounted outwardly of said casing, driving means located in the other of said chambers for imparting movement to said thread carriers and said thread guiding arms, means carried by said supporting plate and located interiorly of said casing for moving said thread carriers from said driving means, and means located exteriorly of said casing for actuating said thread guiding arms from said driving means.

15 In testimony whereof I have affixed my signature.

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