Nov. 16, 1948. G. E. EZBELENT 2,454,146

WEAVING MACHINE

Filed Dec. 15, 1938 5 Sheets-Sheet 1

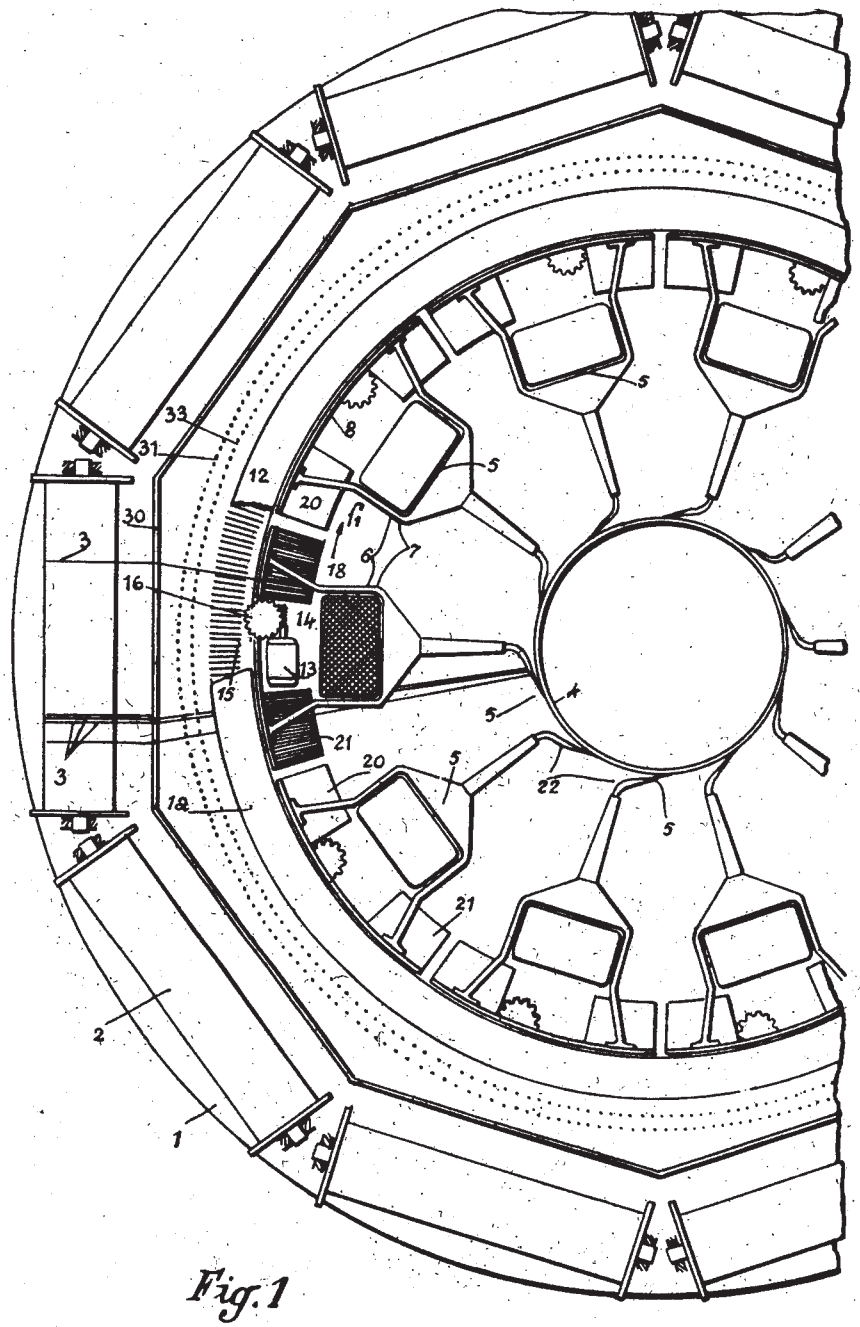

Fig. 1

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Fig 2

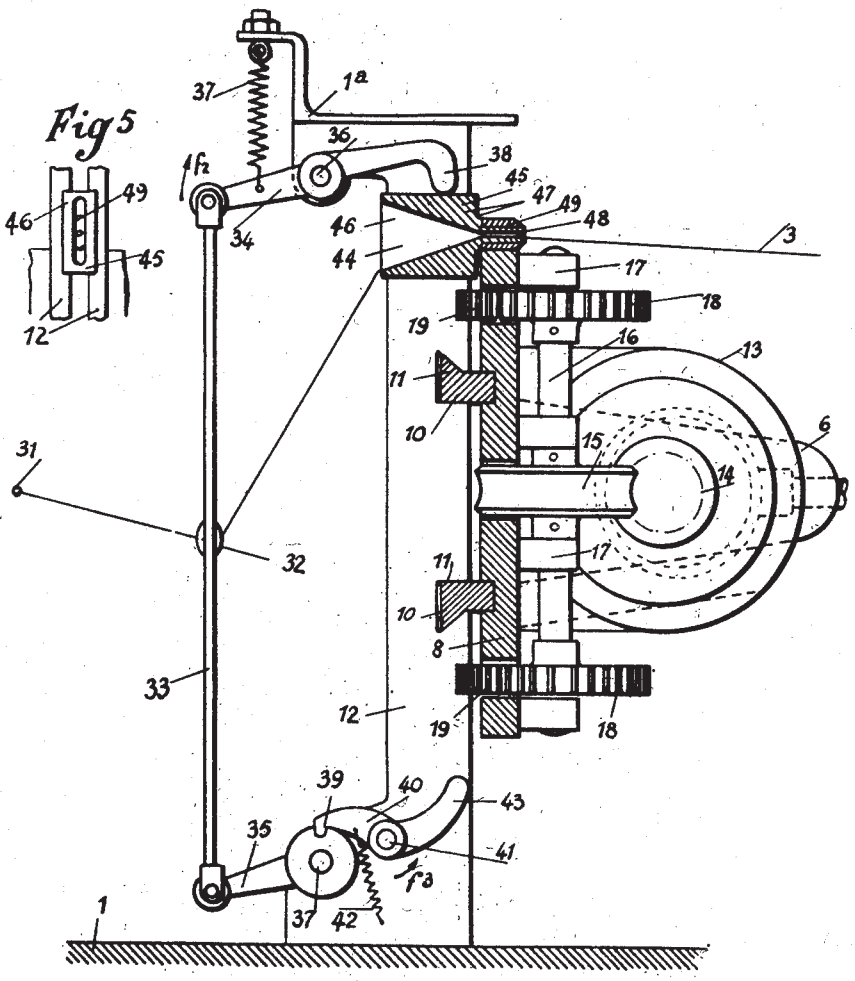

Fig 5

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WEAVING MACHINE

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Fig. 3

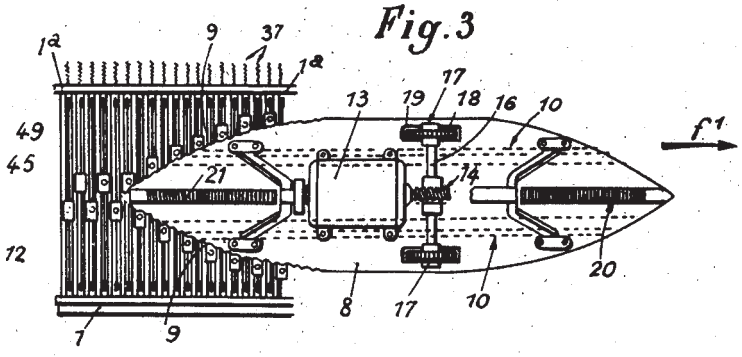

Fig. 4

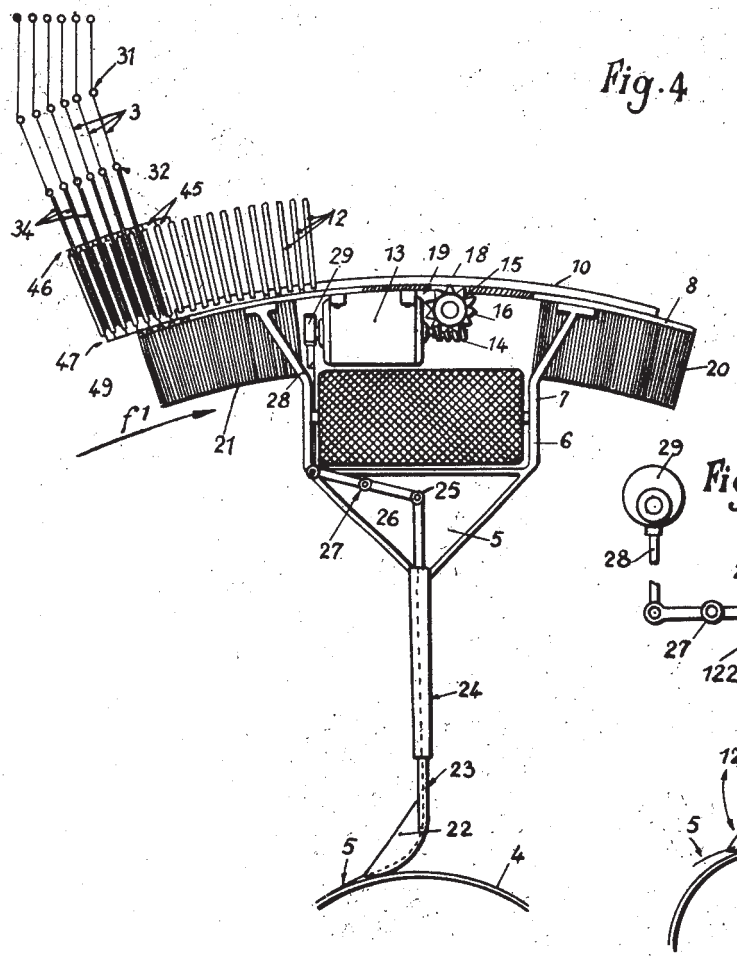

Fig. 11

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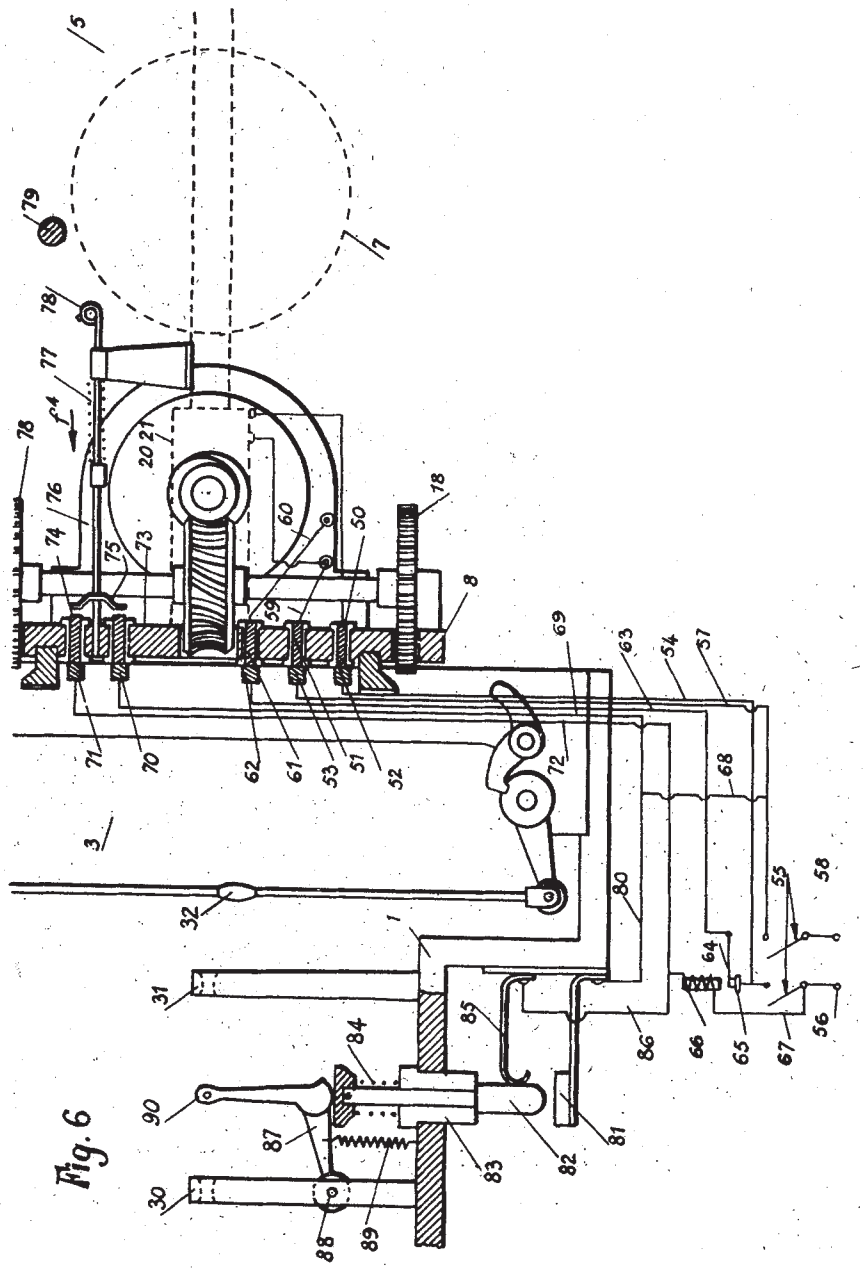

Fig. 6

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Fig. 9

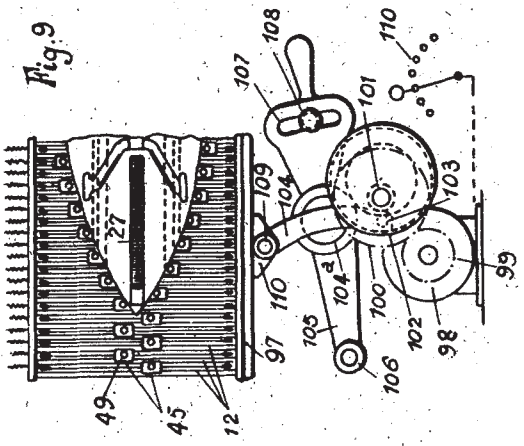
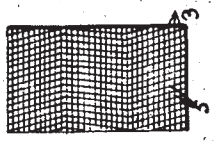


Fig. 10



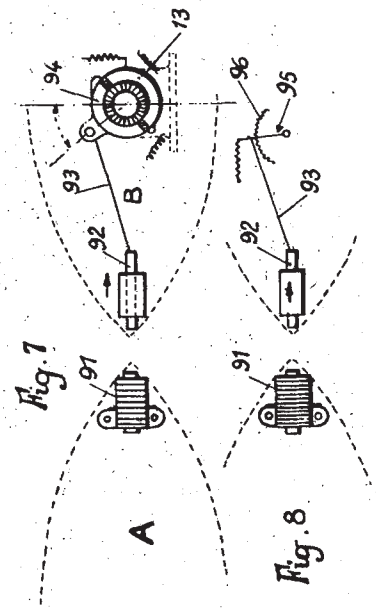


Fig. 7

Fig. 8

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2,454,146

UNITED STATES PATENT OFFICE

2,454,146

WEAVING MACHINE

Georges Eugène Ezbelent, Paris, France

Application December 15, 1938, Serial No. 245,959
In France December 15, 1937

Section 3, Public Law 690, August 8, 1946
Patent expires December 15, 1957

7 Claims. (Cl. 139—13)

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The present invention relates to a circular weaving machine in which the shuttles are given a continuous circular movement between the two sheets formed by the warp threads.

According to the invention, the spacing between the shuttles is controlled and made constant by electric or magnetic devices which are mounted upon the said shuttles and are operated from a distance.

Owing to these characteristics, the shuttles are actuated without requiring the use of mechanical means situated outside of the shuttles, thus greatly simplifying the construction of the machine and providing for a much more steady operation, by relieving the warp threads of all stresses or risks of breakage. Moreover, it is possible to change the number of shuttles on a given machine at will, according to the work to be executed.

Further characteristics will be set forth in the following description.

In the accompanying drawings, which are given solely by way of example:

Fig. 1 is a partial plan view, on a small scale, of an improved machine according to the invention.

Fig. 2 is a vertical radial section on the line 2—2 of Fig. 1, but on a larger scale.

Fig. 3 is a view of the section operated parallelly to the loom axis of one of the shuttles and of a portion of the device for the permutation of the warp threads which is operated and controlled by the shuttles.

Fig. 4 is a corresponding plan view.

Fig. 5 is a partial front view of one of the permutation sliders and of the two corresponding guide plates.

Fig. 6 is a general view of the electric circuits and the stop motion devices.

Fig. 7 shows a modification of the electric devices which serve to maintain a constant spacing of the shuttles.

Fig. 8 shows another modification of the said devices.

Fig. 9 is a partial elevational view of a modified form of the machine, in which the permutation device may be given an alternating circular movement.

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Fig. 10 is a diagrammatic view showing a portion of goods produced by this modified form.

Fig. 11 is a plan view of a modification of the device which is mounted on each shuttle and replaces the lay employed on the known machines.

In the embodiment shown in Figs. 1 to 4, the machine is employed for weaving a tubular piece of cylindrical shape, which, as fast as it is formed, is raised by known means substantially towards the upper part of the machine according to its vertical longitudinal axis X (Fig. 1). This fabric consists of longitudinal warp threads and of woof threads which form, while traversing the warp threads, according to any desired pattern, helices of very small pitches, which are entirely flattened around the cylinder which is formed by the said warp threads.

The machine carries—on a suitable frame—a table 1 upon which are rotatably mounted a series of bobbins 2 (or rollers) from which the warp threads 3 are unwound. These threads are radially disposed (Fig. 1) in such manner as to form two sheets which come together upon a central cylinder 4 of circular section which determines the section of the tubular piece to be woven, the weaving taking place against the said cylinder.

The woof threads are delivered around the cylinder 4 by shuttles.

Each shuttle comprises a support 6 carrying the rotatable bobbin 7 upon which one of the woof threads is wound. The support 6 is mounted on a vertical base-plate 8 of cylindrical form, in such manner that its axis coincides with the axis XX of the machine. The said plate has a double ogival or like form (Fig. 3) which is symmetrical with reference to the horizontal plane YY (Figs. 2 and 3). The whole or a part of the outline of this member 8 may comprise, as shown in Fig. 3, slight undulations or striated parts 9, in order that the warp threads will vibrate when they are assembled with the woof threads.

The plate carries at the outer part, two horizontal parallel rails 10 which are secured to it by welding or the like. The rails 10 have a dovetail, a half-dovetail or other section, and are fitted into notches 11 (Fig. 2) formed in the plates 12

which are secured to the ring 1 and are connected together at the top by a ring 1a. The plates 12 have the vertical and radial position, and are mounted in such manner that one or more warp threads may pass in the space between two adjacent plates.

By the use of the plates 12 with their notches 11 (Fig. 2) in which the rails 10 of the shuttles are slidable, with a play in the radial direction, the shuttles are accurately maintained in spite of their overhung position, and are guided during their rotation about the axis XX.

The rotation of the said shuttles is effected as follows.

One or more, or the whole of the shuttles carry an electric motor 13. The said motor is supplied from an outside source of current in a manner which will be further set forth, and it drives, for instance, by a worm 14 and worm-wheel 15, a vertical shaft 16 operating in bearings 17 (Fig. 3) mounted on the base-plate 8 of the shuttle.

The said shaft carries two gear-wheels 18 which extend upon the outer face of the plate 8 of the shuttle through apertures 19 (Figs. 3 and 4) formed in the said plate. The said gear-wheels are engaged with a rack which is formed by the edges of the plates 12.

It will thus be noted that when current is supplied to the motor of the shuttle or of each shuttle, this will provide—by the transmission 14, 15, 18, for the movement of the shuttle in the direction of the arrow f^1, for instance.

The transmission 14, 15 is made irreversible, in order that this transmission will serve as a brake in the case in which, owing to the breakage of a warp or a woof thread or of a slack occurring in one of these threads, the current is cut off as will be further indicated.

The shuttles are held at equal distances apart by means of flat magnets or electro-magnets 20 and 21, which are carried by each shuttle in the plane YY. The electro-magnets 20 and 21 which are adjacent two successive shuttles operate by repulsion, and they are permanently supplied, for instance in series. A further description will be given of a form of circuit for the supply from an outside source of current.

Preferably, the woof thread proceeding from the bobbin 7 of each shuttle is distributed around the cylinder 4 by a member 22 (Figs. 1, 4) forming a lay (Fig. 4), which has an alternate movement in order to press the woof thread 5 into the shed of the warp threads 3.

In the embodiment herein represented (Fig. 4) and described, the lay 22 is rigidly mounted at the end of a tube 23 which is slidable in a sleeve 24 secured rigidly, and in the radial position, to the shuttle-holder. The outer end of the tube 23 is pivoted at 25 to a slotted lever 26 which is pivoted to the shuttle at 27. To the other end of the lever is pivoted a link 28 actuated by an eccentric 29 mounted on the rear end of the motor shaft.

The woof thread proceeding from the bobbin 7 carried by the shuttle, passes through the tube 23 and is then guided by the lay 22, of which it follows the alternate movements, and is thus driven to the bottom of the angle formed by the sheets of warp threads 3.

As concerns the said warp threads which are unwound in radial directions from the bobbins 2, each thread (or group of several threads) travels, successively, in stationary guides 30, 31 (Figs. 1, 4, 6) and then through the eye 32 of a link 33. The said link is pivoted to two levers 34 and 35

(Fig. 2) which are in turn pivoted to shafts 36 and 37 mounted at the upper and lower ends of the plates 12, between which the said levers can oscillate. The upper lever 34 is urged in the direction of the arrow f^2 by a spring 37', and it has a projecting end 38. The lower lever 35 carries a hub which is concentric with the shaft 37 and has a notch 39 adapted for the engagement of the end of a pawl 40. The said pawl is pivotally mounted on an axle 41 carried by the plates 12; it is urged in the direction of the arrow f^3 by a spring 42, and has a curved end 43. The whole device is regulated in such manner that the spring 37' is stretched when the pawl 40 is engaged in the notch 39 of the lever 35, and the eye 32 is then located at *a* below the horizontal plane YY, as shown in Fig. 2. On the contrary, the eye comes to the point *b* above the plane YY when the pawl 40 is released from the notch 39 and the device 35, 33, 34 is raised by the spring 37.

After passing through the eye 32, each thread (or group of threads) of the warp is now engaged in the tapered aperture 44 (Figs. 2 and 5) of a permutation slider 45 which is vertically movable in the space between two successive plates 12; the outer shoulders 46 and the inner shoulders 47 (Figs. 2 and 4) of the said slider serve as guides for the latter. The tapered aperture 44 of each slider is extended by a cylindrical aperture formed in an axle which is integral with or separately secured to the said slider and carries a loose roller 49 situated adjacent the shuttle plates 8.

The operation is as follows. Before starting the loom, a certain number of the eyes 32 are placed at *a* below the plane YY and the others at *b* above this plane, according to the pattern to be obtained, for instance alternately. As will be observed, the preparation as regards the pattern is readily carried out. When the eyes have been put in place, the warp threads, which are under a certain tension, will form between the eye 32 and the cylinder 4 a certain angle towards the bottom or top, and the corresponding sliders 45 will thus be somewhat below the plane YY or somewhat above the latter, according as the eye 32 is located at *a* or *b*. The machine is then started, first closing the circuit of the electro-magnets 20 and 21, and then the circuit of the shuttle motors 13, as well as the usual raising device which serves to draw up the woven piece according to the axis XX as fast as it is woven, and to stretch the warp threads 3. When the electro-magnets 20 and 21 are excited, they maintain the shuttles at a constant distance apart, owing to the repulsions having the same value which take place between the adjacent electro-magnets. The motors 13 now being supplied, they rotate the gear-wheels 18 by means of the irreversible reducing gear 14, 15. The said gear-wheels which are engaged with the plates 12 forming a rack, will roll upon the said plates, thus drawing the shuttles in the direction of the arrow f^1, for instance. The shuttles are maintained at an equal spacing by the magnets or electro-magnets 20, 21.

According as each shuttle advances, the thread 5 of the bobbin 7 is unwound around the cylinder 4, passing alternately above and below the warp threads 3. This result is obtained by means of the sliders 45 which are driven by their rollers 49 upwardly or downwardly, by the base-plate 8 of the shuttle, which forces its way between the rollers of the sliders which are situated above the plane YY and are driven upwardly, and the

sliders situated below the plane YY and are driven downwardly. Owing to the rollers 49, the sliders are not given any circular stress by the shuttles, and thus the warp threads 3 will always have the same radial position and will not be carried in the direction of the rotation of the shuttles.

The permutation of the positions "above" and "below" of each warp thread 3 takes place automatically in the following manner. When a given slider 45 is about to reach its upper dead center as in Fig. 2, it acts upon the end 38 of the lever 34 and causes it to turn in the contrary direction of the arrow f^2, against the reaction spring 37'. The link 33 is driven downwardly, the eye 32 moves from the position b to the position a (as represented), and the entire movable parallelogram consisting of the members 33, 34, 35 is held in the new position by the pawl 40 which engages the notch of the lever 35. When the shuttle has moved out of the way, the tension of the warp thread 3 causes the descent of the slider 45 whose axis comes below the plane YY on the line determined by the point a and the cylinder 4. When the next shuttle comes into place, it will now drive down the slider 45 by means of the roller 49. At the end of its downward stroke, the slider 45 makes contact with the end 43 of the pawl 40 and removes it against the action of the spring 42. The device 35, 33, 34 is released, and is raised by the action of the spring 37. The eye 32 comes to the point b, and thus owing to the tension of the thread, the slider will come, according as the shuttle moves aside, upon the line connecting the point b with the cylinder 4. The slider 45 is now ready to be raised by the next shuttle, and so on.

In order to change the weaving point, it is simply necessary to modify, by hand, the positions of the eyes 32 in such manner that several consecutive rollers 49 will have the same direction of running.

From an electrical point of view, the dispositions represented are as follows.

The two electro-magnets 20, 21 of each shuttle are connected to two conducting bars 50, 51 mounted on the base-plate 8 from which they are insulated. The said bars extend upon the outer face of the said plate in such way as to make contact with respective conducting pieces 52, 53 which are mounted on certain plates 12, these being suitably distributed upon the whole periphery of the machine in order that each bar 50 or 51 shall be constantly in contact with two or three pieces 52 or 53. The said contact-pieces are insulated from the plates on which they are mounted, unless the said plates consist of insulating material.

The contact-pieces 52 are connected in parallel by a conductor 54 and also—through a double-pole hand switch 55, to one terminal 56 of the source of current. The contact-pieces 53 are connected in parallel by a conductor 57 and also—through a double pole switch 55 to the other terminal 58 of the source of current. It is thus simply necessary to close the switch 55 in order to place the electro-magnets 20, 21 in the circuit.

The motor 13 of the shuttle is connected by conductors 59, 60, on the one hand to the bar 53, i. e., to the terminal 58 of the source of current, and on the other hand, to a bar 61 which cooperates with contact-pieces 62 mounted on the plates 12. The said contact-pieces are connected by a conductor 63 to the armature 64 of a contact device whose fixed contact-piece 65 is connected—

through the switch 55—to the terminal 56 of the source of current.

The switch 64, whose opening stops the motors of all the shuttles, is automatically controlled by the woof stop motion and the warp stop motion which stop the shuttles when a warp or a woof thread becomes slack.

For this purpose, the armature 64 is acted upon by an electro-magnet 66 which is connected on the one hand directly to the terminal 56 of the source of current by a conductor 67, and on the other hand to the terminal 58 of the same source of current by two circuits in parallel, whereof one is controlled by the woof stop motion and the other by the warp stop motion.

The first circuit comprises a conductor 68, a conductor 69, contact-pieces 70 and 71 mounted on the plates 12, and a conductor 72. The contact-pieces 70 and 71 are in friction contact with respective insulated bars 73 and 74, mounted on the shuttles. The two bars of each shuttle may be connected together electrically, in the case of breakage or slack of the corresponding woof thread, by a strip 75 mounted on a rod 76, which is urged towards the contact position (arrow f^4) by a spring 77. The said rod has an eye 78 at its end, carrying the woof thread 5 which is unwound from the bobbin 7 and passes over a supporting spindle 79.

The breakage of the thread 5 of any one of the shuttles, or even a slack in this thread, will release the rod 76, which is brought back by the spring 77 and thus brings the strip 75 upon the bars 73, 74. The circuit of the magnet 66 is closed, the armature 64 is attracted, and the shuttle motors are stopped.

The second exciting circuit of the magnet 66 comprises the conductor 68, a conductor 80, a contact ring 81, a set of contact studs 82, one for each thread of the set of threads, sliding in an insulating socket 83 and separated from the contact-piece 81, in the inoperative position, by a spring 84, a brush 85 in contact with each stud 82, and a conductor 86 which connects each brush 85 to the magnet 66. The stud 82 may be pressed against the contact-piece 81, against the action of the spring 84, by a lever 87 which is pivoted at 88 and is brought back by a spring 89. The lever 87 is normally separated from the stud 82 by the warp thread 3 which is stretched and passes through an eye 90 on the end of this lever. It is simply necessary that the thread 3 shall break or become slack, in order that the lever 87 shall descend, thus pressing the stud against its contact-piece and closing the second circuit of the magnet 66.

Fig. 7 shows by way of example another means for obtaining the equal spacing of the shuttles.

Herein, a magnet coil 91 which is constantly in circuit is mounted on the shuttle A, adjacent a sliding core 92 mounted on the shuttle B preceding or following the same. The said core is connected by a rod 93 with a brush-holder 94, whose movement will increase or reduce the speed of the corresponding motor, and thus when the spacing between the shuttles increases for any reason, the said core will move, and owing to its connection 93 it will actuate the brush-holder, thus increasing or reducing the speed of the motor 13.

In the modification shown in Fig. 8, the sliding core 92 changes the position of a lever 95 which controls a rheostat, and this will also increase or reduce the speed of the motor.

Fig. 9 shows a modification, in which the plates 12 are mounted on a movable ring 97 which can

be given an alternate movement of rotation in order to obtain a woven sheath or tube of the new type represented in Fig. 10, in which the warp threads 3 form zigzags set at an angle, whose dimensions can be regulated at will, and which provides for a subsequent torsion of the goods in either direction, without subjecting the warp threads to a stress which might break them or prevent the desired torsion.

As shown in Fig. 9, an electric motor 98 has keyed to its shaft a gear-wheel 99 engaging a gear-wheel 100 which drives a shaft 101 to which is keyed an outlined cam 102 controlling—through a roller 103—a link 104 having a curved or other suitable form. The said link is pivoted on an axle 104a mounted on a lever 105 which is pivoted at 106. The oscillations of the said lever about the axle 106, which can be regulated by a guide 107 and a bolt 108, will modify, for a given course of the cam 102, the degree of motion of the link 104. The end of the said link is pivoted at 109 to a lug 110 secured to the ring 97 supporting the plates 12. The link 104 will thus give to the said plates an alternate movement having a variable degree, by means of the lever 105, and their speed can be varied by a rhoestat 111 adapted to regulate the speed of the motor 98.

Fig. 13 represents another form of construction of the lay 22 which serves to press the woof thread between the warp threads. In this construction, the lay 22 is rotatable at 121 and is operated by a rod 122 which is pivoted to the lay at 123 and is slidable in the support 24. The lay 22 turns about the axis 121 with alternate movements of oscillation, it being controlled by a lever 26 which is pivoted at 27 and is connected by a link 28 with an eccentric 29 mounted on the shaft of the motor 13 whose amplitude is determined by the eccentric 29.

Obviously, the invention is not limited to the embodiments herein described and represented, which are given solely by way of example.

I claim:

1. A circular loom, comprising self-operated shuttles movable upon a circular track, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between the shuttles, the said electric means consisting of magnets adapted to act upon regulating devices mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles.

2. A circular loom, comprising self-operated shuttles movable upon a circular track consisting of plates which are spaced at a short distance apart, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between the shuttles, the said electric means consisting of magnets adapted to act upon regulating devices mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles.

3. A circular loom, comprising self-operated shuttles movable upon a circular track consisting of plates which are spaced at a short distance apart, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between the shuttles, the said electric means consisting of magnets adapted to act upon regulating devices

mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles and irreversible driving means located between the motor of the self-operated shuttle and the means for the propulsion of the shuttle.

4. A circular loom, comprising self-operated shuttles movable upon a circular track consisting of plates which are spaced at a short distance apart, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between shuttles, the said electric means consisting of magnets adapted to act upon regulating devices mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles and irreversible driving means located between the motor of the self-operated shuttle and the means for the propulsion of the shuttle, the said means for propulsion consisting of gear wheels adapted for engagement with the plates of the circular track, which serve as a rack.

5. A circular loom, comprising self-operated shuttles movable upon a circular track, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between the shuttles, the said electric means consisting of magnets adapted to act upon regulating devices mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles, the shuttle further comprising a member which serves the same purpose as the lay, and which is adapted to be actuated by the motor of the shuttle.

6. A circular loom, comprising self-operated shuttles movable upon a circular track, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between the shuttles, the said electric means consisting of magnets adapted to act upon regulating devices mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles, the said plates comprising guides for permutation cooperating with guiding eyes which are also traversed by the woof threads in such manner that they are situated in front of the shuttle alternately in two extreme positions, on either side of the trajectory to be followed by the pointed ends of the shuttle.

7. A circular loom, comprising self-operated shuttles movable upon a circular track, in which the said self-operated shuttles comprise electric controlling means operating through the distance between shuttles and adapted to maintain a constant spacing between the shuttles, the said electric means consisting of magnets adapted to act upon regulating devices mounted in the circuit of the motor or motors of the self-operated shuttles and adapted to maintain a constant spacing between the shuttles, the said plates comprising guides for permutation cooperating with guiding eyes which are also traversed by the woof threads in such manner that they are situated in front of the shuttle alternately in two extreme positions, on either side of the trajectory to be followed by the pointed ends of the shuttle, the said guiding orifices being mounted on a device forming a deformable parallelogram, ratchet means

being provided for holding the said parallelogram in one of its extreme positions.

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