To all whom it may concern:

Be it known that I, LÉON LOUIS FRANÇOIS MALHÈRE, a citizen of the Republic of France, residing in Beaumont le Royer, (Eure), France, have invented certain new and useful Improvements in Apparatus for Manufacturing Lace and other Like Fabrics upon Circular Frames, of which the following is a specification.

The said invention has been patented in France, No. 238,461, dated May 15, 1894; in Belgium, No. 110,428, dated June 11, 1894; in England, No. 11,411, dated June 12, 1894; in Switzerland, No. 5,484, dated November 5, 1894; in Austria, No. 46,218, dated January 17, 1895; in Hungary, No. 3,031, dated November 18, 1894; in Italy, Vol. 29, No. 37,653, No. 74, dated November 11, 1894, and in Germany, No. 78,028, dated June 5, 1894.

This invention relates to looms for manufacturing lace and like fabrics, and aims to provide certain improvements therein, which will be hereinafter fully set forth.

The invention especially aims to provide an improved construction of circular frames, such as are employed for the production of plaited ribbons, whereby they are adapted to the manufacture of lace and other like fabrics.

In the accompanying drawings, which show one, and the preferred, adaptation of my invention and means for carrying it out, Figure 1 is a fragmentary view of one character of lace, and Fig. 1 is a diagrammatic illustration of the method of weaving the threads for this lace. Fig. 2 is a fragmentary view of another lace fabric, and Fig. 3 is an exaggerated representation of another woven fabric, and Fig. 4 is a diagrammatic view of the method of weaving the threads therefor. Fig. 4 is a fragmentary vertical section, on a reduced scale, of a loom, the view being cut on the line 1 2 in Fig. 5. Fig. 5 is a fragmentary and diagrammatic plan view of a loom, indicating generally the driving-gear thereof. Fig. 6 is a fragmentary enlarged side elevation of a part of the crown of the loom. Fig. 7 is a fragmentary plan view of the part shown in Fig. 6. Fig. 8 is a fragmentary vertical cross-section thereof, cut on the line 3 4 of Figs. 6 and 7 and looking in the direction of the arrow; and Fig. 8 is a like view on a larger scale. Fig. 9 is a fragmentary elevation showing a front view of the mandrel on which the lace is formed. Fig. 10 is a fragmentary vertical section of the endless apron of the counter or pattern mechanism on a larger scale, and Fig. 11 is a fragmentary front elevation thereof. Fig. 12 is a fragmentary horizontal section taken on the line 7 8 of Fig. 8. Fig. 13 is a fragmentary horizontal section, the left-hand side being taken on the line 5 6 of Fig. 8 and the right-hand side being taken on the line 9 10 of Fig. 8. Fig. 14 is a fragmentary horizontal section taken on the line 11 12 of Fig. 8. Fig. 15 is a fragmentary horizontal section showing the disks and rings and the resting-place for the bobbin-spindle opposite one of the blunt edges a'. Fig. 16 is a side elevation, on a larger scale, of one of the columns Z, which support the rings F and F' from the plate A, the plate and one of the rings being shown fragmentarily in vertical section. Fig. 17 is an enlarged side elevation of one of the axles a, showing the adjacent parts in fragmentary vertical section. Fig. 18 is an axial section of the axle a alone. Fig. 19 is an axial section, and Fig. 20 is a plan, of the disk B and its toothed roller C. Fig. 21 is an axial section, and Fig. 22 is a plan, of one of the fixed disks D and its cross-piece E. Fig. 23 is a side elevation, and Fig. 24 is a plan, of one of the cans Q. Fig. 25 shows elevations of the reverse sides of the system of bars k l o n, and Fig. 26 is a plan and horizontal section thereof. Fig. 27 is a longitudinal vertical section, Fig. 28 is a top plan, and Fig. 29 is a bottom plan, of one of the plates I. Fig. 30 is an elevation of the outer side, and Fig. 31 is a top plan, of one of the plates M at the outer side of the bobbins. Figs. 32 and 33 are similar views of one of the opposite plates M. Fig. 34 is a plan, and Fig. 35 is a side elevation, of one of the slotted levers L. Fig. 37 is a fragmentary plan similar to Fig. 7, showing two left-hand spindles inoperative and two right-hand spindles in horizontal section and active. Fig. 38 is a similar view cut on 100.
the three planes of the lines 38 38 in Fig. 36, and Fig. 33 is a similar view cut on the three planes of the lines 39 39 in Fig. 36.

Referring to the drawings, let A indicate the bed-plate of a loom; U, the driving-shaft; R, the pattern mechanism; G, the spindles; S, the finished fabric; and Z the take-off thereof.

As is well known, in the usual braiding-machines or looms having circular frames—

First. The threads are wound on bobbins arranged vertically upon tubular spindles, on issuing from which the threads are united at the center of the frame, forming, together, a more or less sharp cone.

Secondly. The spindles are subject to interrupted movements in circular guideways communicating with each other at their points of contact.

Thirdly. The movements of the spindles are obtained by means of disks having at their peripheries two or four diametrically opposite notches and revolving concentrically with the guideways and in contrary directions in pairs. The arrangement with two diametrically opposite notches will alone be considered here.

Fourthly. During a semirevolution of the disks the spindles are only subject to the motion of the disks turning in the same direction, by which they are moved past each other for producing the crossings of the threads, and they are then moved by the disks turning in the other direction for crossing their threads with those of the next spindles, so that half the spindles move around the frame, one way and the rest the other way. On the completion of this semirevolution—that is to say, when all the spindles are arranged in line at the points of contact of the disks—they leave the first disk and follow another semirevolution the motion of the disks traveling in the contrary direction, so that by this means the direction of the crossings of the threads is changed at each semirevolution.

Fifthly. The guidance of the spindles at the crossing-points of the guideways is obtained in most frames by means of articulated switches which open those guideways through which the spindles are to pass and simultaneously close the others.

Sixthly. The movements of the switches are alternating and in the opposite direction for two consecutive semirevolutions of the disks.

The resulting braid in such machines has of course been of exact regularity in the crossings of its threads.

Referring now to Figs. 1 to 20 inclusive, I will describe the nature of the fabric I desire to produce. If a plaited band and a strip of lace be compared, it will be seen that there is considerable analogy in the modes of interlacement of the threads constituting the same, and it may be said that a piece of lace is a plait of which a certain number of interlacements have been suppressed according to a method adapted to each design of lace, as shown at Figs. 1, 2, 3, and 4 of the drawings, which show, to an exaggerated scale, Figs. 1 and 2, lace fabrics; Fig. 3, a portion of woven fabric, and Figs. 1, 2, and 3 the diagrams in which the thick lines indicate the order of the crossings of the threads, while the fine lines show those which are suppressed.

The order of crossing of the threads is well characterized by the fact that there are only produced at the same time crossings in the same direction—that is to say, that the whole of the threads being supposed to be divided into groups of two threads at the first line of the diagrams, all the threads passing from left to right pass below the threads passing from right to left in each group. At the second line the same process takes place, but in the reverse sense—that is to say, it is the threads passing from right to left which pass underneath those passing from left to right and the order of grouping of the threads is reversed. On examining Figs. 1 and 2 it will be seen, in effect, that a thread situated below the position $c'$, for example, is the left-hand thread of the group which it forms with the thread situated below the position $d'$ for the first line of crossings, and that for the second line the thread below the position $c''$ is the right-hand thread of the group which it forms with the thread below the position $b'$. At the third line the process is the same as at the first line, and at the fourth the same as at the second, and so on. The result of these reversals at each line of crossings is to produce interlacings of which each thread passes alternately above and below those which it meets, whether for forming a plait or an element of lace.

From what has been said it will be seen that for producing lace or a like fabric it will suffice to prevent certain crossings of the threads, or, what is the same thing, to produce in any suitable order only a certain number of the crossings which would constitute a plait if they were entirely carried out.

It may happen that all the threads or only some of them effect more crossings in one direction than in the opposite direction. This would have for result to increase or decrease the degree of torsion of the threads. In order to remedy this inconvenience, the bobbins-spindles must be prevented from turning on their own axis. The interlacings of the threads being obtained they must be tightened one against the other, as in any woven fabric, and the lace must be fed forward as it is produced.

I have invented means whereby a machine operating on the principle of a circular loom or braiding-machine can be utilized for making lace and other textiles of varying weave, providing means whereby the spindles can be controlled to obtain any desired variation or irregularity of the crossings of the threads, and whereby pattern mechanism can be employed to automatically control the operation of such machines.
I will now proceed to describe, with reference to Figs. 4 to 35 of the accompanying drawings, how I realize the practical carrying out of the method of manufacture by means of the lace-frame invented by me. The general arrangement of the machine is the same as that of frames used for the manufacture of plaits or braid. It is composed of a foundation-plate A, resting on feet on which are fixed tubular axes a, arranged according to a suitable division for forming a circle, or, more correctly, a regular polygon. On each of the axes a is mounted a carrying-disk or flanged sleeve B, formed in one with a toothed wheel C, situated below. All the toothed wheels C gear with each other. They are driven by one, or preferably by four, toothed wheels C'C, Fig. 5. The sleeve-disks B are of such a diameter as to nearly touch each other. They are each provided with two circular notches b, diametrically opposite each other and so arranged that the notches of two contiguous plates when passing through the points of contact form a circular hole as regular as possible. At the upper end of the axes a and slightly above the disk B are fixed disks D, which do not touch tangentially, as the disks B, but leave between them a space more or less equal to the diameter of the circular holes formed by the notches of two contiguous disks, as shown at Fig. 7. These disks D are surmounted by cross-heads E, Fig. 7, having in it plan a lozenge-shaped appearance the large axis of which is about equal in length to the diameter of the disks D. The disks D and the cross-heads E are rigidly connected together by shoulders c, the thickness of which determines the distance between them. (See Figs. 17, 21, and 22.) In the same plane as the disks D and supported by columns Z from the plate A are placed two rings F F' of the same thickness as the disks D and formed, the one internally and the other externally, with curved profiles concentric with the said disks D and so as to leave between them and the disks the same space as that which exists between two contiguous disks. There are consequently formed sharp projections x x', projecting toward the points of contact of the disks B. The one-half of these projections—namely, those marked x—are considerably blunted, so that facing one sharp projection x of the internal ring F there is a blunt point x' of the outer ring F', and vice versa. The circular holes around the disks D are the paths or guideways, which serve to direct the spindles G, of which the foot II, Figs. 7 and 8, forms the characteristic part, the upper part being indifferently made of the one or the other of the arrangements ordinarily employed for facilitating a suitable unwinding of the threads and to give them always the same tension in the various positions which they may occupy in the machine. The feet H are formed of a cylindrical stem d, Fig. 8, carrying at about the middle of its length two large flanges e e. This stem d terminates at the upper end in the thick part H for carrying the tubular spindle G and a diamond-shaped flange f, carrying at each end a small stud g g. If the stems d of the feet be introduced into the circular paths, the flanges e of the feet will embrace the disks D and the rings F F', which will prevent them from moving up or down, and the lower part of the stem d will penetrate into the semicircular notches b of the disks B, so as to receive therefrom the circular motion which is imparted to them in a continuous manner. The whole of the spindles thus set in motion will form a plait by the interlacings of the threads which result from such motion; but, as has been previously stated, all the spindles must not circulate simultaneously for producing a fabric constituting lace of any kind. A certain number of the spindles must consequently be prevented in a suitable order from being acted upon by the disks, or, which is the same thing, only those spindles must be submitted to the action of the disks which are required to circulate for producing a particular design of lace. For this purpose there are arranged below the blunted projections x' plates I, mounted on stems i, which are vertically movable and are guided on the one hand by the rings F F' and on the other hand by the foundation-plate A, through which they pass. Helical springs s (see Figs. 6 and 8) raise these plates I and maintain them in a raised position when the downward-pulling action of the pulls J ceases.

For preventing all oscillating motion of the plates I they are maintained by stems i, fixed below at the edges of the rings F F' and which penetrate into grooves formed at one of the ends of the plates. At their other extremity, toward the point of contact of the disks and on their upper faces, the plates I carry a sort of rib j, having an internal profile of a very open V shape and the sides of which are parallel to the sides of the blunted projections x' of the rings F F'. These ribs pass sufficiently under the disks B to cause the lower extremity of the stem d of the foot of the spindle to come in contact therewith if they are raised and to slide along the sides of the V-rib, as on inclined planes. This sliding has the effect of disengaging the stems d from the notches b of the disks B and to bring them to rest in a sort of resting-place formed by the hollow space between the blunted edges of the rings and the bottom of the V-ribs j. (See Fig. 15.) The said spindles remain at rest as long as the plates I are not lowered.

The lowering of the plates I not only has for its object to free the stopped spindles, but also to force them to leave their resting-place at a suitable moment for restitching the notches of the disks B. This result is obtained by a system composed of two parallel bars k l, connected together by a link m, Figs. 8, 12, 13, 17, 25, and 26, and arranged to slide...
between a disk B and its toothed wheel C. The lower bars k carry a stud u, and the upper bars k i the movable plates I carry on their under faces and at their lateral extremities two ribs j, constituting a cam, so arranged that if they are lowered their outer extremities force the studs n of the lower bars k to slide on their profile, and thus cause the bars k to pass outward in order to seize, in their rotary motion with the disks, the feet of the spindle-carriers which are required to be set in motion again. It is to be observed that for setting in motion a stopped spindle the lowering of a plate I acts simultaneously upon a system of bars k i of each of the disks B, situated at the right hand and left hand of the resting-place. This simultaneous action has for its result to cause the two forces to act together for imparting to the foot d the direction which it has to follow for passing through the point of contact of the disks B, as at Figs. 15 and 39.

When the bars of the two contiguous disks are nearly touching each other behind the foot which they push, the cams j cease to draw the said bars outward. These cams are so arranged as to allow the said bars to re-enter under the action of their respective thrusts against the like bars of the adjacent disk as they strike each other while pushing out a spindle. They then stay in until again pulled out by the plate I, which occurs so long as a plate is down. Each plate I is held down until a spindle is to be stopped.

It is to be remarked that the lowering of the plates I therefore not only has to be effected for setting in motion a stopped spindle, but also for preventing the stoppage of the spindles when they should continue in motion. In this case the movable bars k i of the disks operate as above described, and instead of having to set in motion again a stopped spindle they operate, together with the notches b of the disk B, to insure its continued movement at the moment when it passes through the resting-place. While the plate I is down, the bars are drawn out by it as they pass and pushed in as they strike each other. When the plate is up, they are pushed in as they approach it by their cams striking the edge of the plate, and thus are prevented from grasping a spindle when it is stopped on a plate.

From what has been said it will be seen that each system of movable bars is brought back under its disk at the moment of its passage through the points of contact of the disks and that it will only be made to issue again by the lowering of the plate I. I have, however, foreseen that it might issue without this lowering of the plates by an accidental cause—such, for example, as the action of a shock resulting from the sudden stopping of the entire machine. It is necessary in this case that the bars should be forced to re-enter before coming in contact with the foot of the spindle when at rest, which they could not carry with them, because it is retained by the upper rib of the plate I. This is effected by a boss with incline o on the rigid connection m between the bars, Fig. 12, situated below the upper bar l, and consequently situated in the same horizontal plane as the upper rib j of the plates I, (see Figs. 8, 12, 13, 25, and 36,) which rib pushes away at the required time this boss o and the bars k l, to which it is connected, as shown at Figs. 8, 12, and 39.

The guidance of the feet d into one path or the other at the moment of arriving at the points of communication is determined by the position occupied by the directing-switches K, Fig. 7, closing the one path and opening the other. These switches K are situated above the sharp projections x of the rings F F', opposite the resting-places j, and in the plane of the cross-heads E E, which serve as abutments to them. They are pivoted at the middle of their length and their position is changed at each semitrotation of the disks B. At the same time that they open and close the path for the feet they operate, together with the slotted levers L, cross-heads E, and the external inclines of the pieces M, to prevent the spindles from turning on their own axes in acting successively upon the studs g, fixed at the extremities and below the oblong flanges f of the feet. The pieces M are mounted on plates fixed to the top of the rings F F', above the flanges e of the spindles. (See Figs. 8 and 30 to 33.) For understanding the working of these several parts it must be borne in mind, first, that they are all situated in the same horizontal plane; secondly, that the cross-heads E and pieces M are fixed, leaving between them and the rings F F' a space sufficient for the free passage of the upper flanges e of the feet; thirdly, that the switches K receive a to-and-fro motion by which they communicate to the levers L through the medium of the links N.

Assuming a spindle to be stopped in its resting-place j, one of the studs g is maintained between the two pieces M M, Figs. 7, 36, and 37, and the other stud g is advanced toward the switch K, which can oscillate in front of it without touching it. At the moment when the spindle should be set in motion the switch is at rest and the right-hand path, for example, is open. When leaving the resting-place, the foot has its rear stud maintained for a certain length of time between the pieces M M. When it leaves these, the front stud can come in contact with the side of the directing-switch, or the rear stud can possibly
come in contact with the cross-head E on the left hand, the foot being capable of oscillating between these two extreme positions. When the foot is sufficiently advanced towards the switch for the rear stud to be necessarily in contact therewith, the front stud engages in the channel formed by the lateral part of the switch and the extremity of the piece M, which faces it, and afterward it engages in the slot p of the lever L. It will now be seen that if at this moment the switch begins to move in the direction of the arrow it will transmit its movement to the slotted lever L, which then assumes a position in which it allows the stud which it has held to leave it and to slide on the incline of the piece M, it being understood that during this movement of the switch, the central stem of the foot is carried in the path by the notch b of the actuating-disk B.

The spindle has thus been held in its entire motion in a position nearly parallel to that which it occupies at the point of departure, and the torsion of the thread will not have experienced any alteration.

All the internal and external switches on a frame operate simultaneously. It is sufficient to actuate a certain number of them, which communicate their motion to the others by means of links O, pivoted to the extremities of the switches. For actuating the first they are mounted on the ends of a vertical axle F, F, F', F'' and taking into the foundation-plate A. Immediately above this plate A the axis carries an arm g, Fig. 8, which has a small roller below the toothed wheels C of the disks B. This roller is pushed alternately from one side to the other by means of bars Q Q (see Figs. 37 and 39), each mounted on one of two adjacent axes a and turning with and fixed below the toothed wheels C. A certain dwell is arranged between each movement, as shown at Fig. 14. A complete motion of the switches is obtained by a complete rotation of the cams Q, and consequently of the disks B. The other switches which receive the movement of the first by means of the links O are mounted on axes a', fixed on the rings F F'.

It has been stated above that it is necessary to lower the plates I for effecting the putting in motion of the spindles or for the continuation of their motion, that this lowering is obtained by means of the links J, that for producing the desired order of the interlacing of the threads it is necessary to put in motion those of the spindles whose threads are to cross and to arrest those whose threads should not cross. It will be seen that the two adjacent spindles, which are to be passed around each other by one disk, must be released and arrested at the same time in the construction shown and that if one of these is to pass that on its opposite side it must be held out for a half-revolution of the disk, so the switch can reverse, when it and the one it is then to pass must be released. It results from this that as a plate I, carrying a resting-place of the outer ring, for example, must be lowered at the same time as one of its neighboring plates to the right and to the left alternately of the inner ring F, all the stems h of the plates I have two pulls J, connected with two levers s side by side and independent of each other, Figs. 4 and 8. One of these levers s serves to form the grouping of the stoppages considered relatively to its right-hand neighbor, and the other lever s with its left-hand neighbor, as shown at Figs. 4 and 5. The levers s form by their extremities a face more or less serrated, the outer extremity of each lever—that is, the end under the machine—being situated under the axis of the gear-wheel C for moving the disk B above the end of the lever for the posts h adjacent to such disk in each instance. The gears C are represented in the diagram by their pitched lines. The diagram shows in plan, Fig. 5, the two cords J connected each to two levers s, separate and independent the one from the other, and two cords J rising from the end of each lever s, the one of these cords coming to the one post h, situated at the inner side of the gears, and the other cord J coming to the next post h, situated at the outer side of the circle of gears C. Only one of the levers s is shown in Fig. 4. These levers s are of unequal length, but they are all pivoted in such a manner as to have the same proportion of leverage, so that the extremity to which the pulls are connected having a determined motion the other extremity s' has the same amount of motion for all the levers. This extremity s' of each lever s is connected by a wire t to an elbow-lever u, the vertical arm of which is actuated by the rollers s of the endless jacquard-chain R, as shown at Figs. 10 and 11. This chain travels over a driving-drum y. It will be understood that the position of the rollers of this counter causes, when the chain travels, the descent of the pulls J, and consequently of the plates I, which have to effect the putting in motion of the spindles that have to work.

The lace is formed as a tube, being formed upon a mandrel z, Figs. 4 and 9. Supplementary threads z serve to unite the selvage or top and bottom edges of the lace for giving it a tubular form, this connecting-thread being afterward removed to allow the lace to be flattened out. These connecting-threads are shown dotted in Fig. 9. Each has a spindle and is controlled just as described for the other threads. These threads z may be controlled by the pattern mechanism to cross first with the adjacent threads on one side, then with each other, and then with those on the other side, or they may be interlaced with the adjacent threads or any of them in any desired or suitable manner for fastening the edges of the lace together temporarily.

The tightening of the lace produced at X'
is effected by means of beaters \( b' \), divided into two groups and operating alternately in order that the lace may never be let go of and in order that the crossing of the threads that has been effected cannot come undone again.

The beaters \( b' \) are all pivoted on the upper end of a post \( l \), and every second beater is connected by a link \( 2 \) to a rising collar \( 5 \), while the intervening beaters are connected by links \( 4 \) to a rising collar \( 5 \), as seen in Fig. 4. The collar \( 3 \) has a neck surrounding the post \( 1 \), which neck is lettered \( 6 \), and the collar \( 5 \) has a neck \( 7 \) surrounding the neck \( 6 \). The collars are oppositely reciprocated vertically by a groove-cam \( 8 \), mounted on and rotating with the central shaft \( X \), the collar \( 9 \) having a downwardly-projecting arm \( 9 \), carrying a roller \( 10 \), engaging the groove in the cam, and the collar \( 5 \) having a like arm \( 11 \) and like roller \( 12 \) diametrically opposite the arm \( 9 \). As the cam revolves the rollers ride up and down in the groove, thus alternately raising and lowering each collar. The motion of each collar is transmitted to its series of beaters through its links. Thus half the beaters are swinging toward the anvil or mandrel while the other half are moving away therefrom.

As the manufacture of the lace proceeds it advances on the mandrel \( z \), fixed at its lower end upon the stem \( Y \), placed at the center of the circular opening formed by the beaters \( b' \).

The mandrel is first circular at the base and is gradually flattened until at the upper end \( z' \) it assumes the shape of a blade, over which the lace is drawn. For insuring the travel the flattened mandrel \( z' \) is held between two rough carrier-cylinders \( c' e' \) which cause sufficient friction for insuring the regular travel of the lace. This issue at \( Z \) and is coiled upon a drum in the ordinary manner.

Fig. 9 represents in its actual nature a piece of lace surrounding the mandrel on which it is formed, whereas Figs. 1, 2, and 3 represent in a very exaggerated scale some elements of the same lace. Fig. 1, for example, represents four tresses of threads of four threads each, connected the one thread to the other thread at points and more or less intertwined. The same thing is represented in the right in Fig. 9, with the difference that the tresses are represented by single straight lines crossing at their point of junction.

The machine receives its motion by means of a pulley \( T \) on the main shaft \( U \), to which it is connected by a clutch. The shaft \( U \) transmits the motion through bevel-pinions \( c' \) to a horizontal shaft \( V' \), which actuates the parallel shaft \( V \), Fig. 5, through the medium of the shaft \( V' \) and pinions \( e' \) \( e' \) \( e' \), \( c' \) \( e' \) \( c' \).

The shaft \( V' \) actuates at its middle the central vertical axis \( X \), which operates the beaters. The shafts \( V \) \( V' \) impart motion through the pinions \( f' \) \( f' \) \( f' \) \( f' \) \( f' \) \( f' \) to the four toothed wheels \( C' \), which actuate the wheels \( C \) of the disks \( B \). The shaft \( V \) has at its one end a worm \( q' \), which actuates a worm-wheel \( q^2 \), fixed on the shaft \( h' \) of the counter \( y \).

It will be seen that my invention provides improvements in the method of using apparatus for manufacturing lace and other fabrics which can be advantageously availed of, and it will be understood that the invention is not limited to the particular details of construction, arrangement, or character of the apparatus, nor to the precise combination of features hereinafter set forth as constituting the preferred form of my invention, but that it can be availed of in whole or in part, according to such modifications of construction, arrangement, or combination for such purposes and in connection with such suitable apparatus as circumstances or the judgment of those skilled in the art may dictate without departing from the spirit of the invention.

It will be seen that my invention provides means whereby a loom of the class known as "braiding-machines" (in which there are two circuitous guideways crossing each other at successive points, spindles traveling in opposite directions therein, and continuously operating driving mechanism propelling the spindles) can be used to manufacture fabrics in which there is not a continuous regularity of crossings of the threads and in which these crossings can be varied automatically from time to time to produce the desired pattern or changes in the grouping and crossing of the threads. It will be understood that this is accomplished by the means I provide for disengaging or freeing certain of the spindles from the driving mechanism so that while the crossing of other threads proceeds the threads of these spindles are not crossed. The plates serve as the arresting mechanism by the engagement of their flange \( j \) with the spindles. By operating this mechanism from a pattern mechanism any desired pattern can be produced. I also provide means for insuring the restoration of inactive spindles to engagement with the driving mechanism. The bars \( l \), operated by the flanges \( j' \), are employed for this mechanism. Thus by arresting any group of spindles the loom can continue to twist the threads of the other, and by arresting and releasing spindles according to the position of the switches the direction of travel of the spindles can be controlled, so that, if desired, two adjacent spindles can be caused to travel continuously around the same driving-disk for twisting their threads on each other for a certain time, and then they can be separated and each pass to an adjacent disk for twisting with other spindles. For example, should the pulls \( J \) be held down the spindles would continue to operate as in an ordinary braiding-machine; but should one pull be released the two adjacent plates I connected to it would arrest their spindles. If these spindles were held...
out of the disk for a half-revolution, the switches would by that time have reversed in position, so that upon releasing the spindles and letting them again engage with the disk they would be carried around with each other a half-revolution. If they are to make another twist, they should be arrested at the end of this movement and held out for another half-revolution to enable the switches to again reach the position for guiding them again around the disk. If they are to be separated, so that each shall engage another spindle, they would not be arrested at the end of the half-revolution, but would be carried past the switches, which, having reversed during the half-revolution, would direct them to the adjacent disks respectively. With the construction shown, therefore, it will be seen that the spindles are controlled by arresting or releasing them, according to the position of the switches. It will also be seen that any desired grouping of the spindles can be accomplished and that any desired pattern can be produced.

What I claim is, in apparatus for manufacturing lace and other looped fabrics and for analogous purposes, the following-defined novel features and combinations, substantially as and for the purpose hereinbefore set forth, namely:

1. In frames for making lace and other looped fabrics, a plurality of movable bobbin-spindles, means moving them, and a plurality of plates I controlling movement thereof, in combination with pattern mechanism controlling said plates, levers having like pulls, connected to and between said mechanism and plates operating the latter from the former, said plates arranged in groups of two, and means tending to move said plates into engagement with said spindles.

2. In frames for making lace and other looped fabrics, a plurality of movable bobbin-spindles, and a plurality of plates I provided with ribs j, the ribs j causing the stoppage of the spindles when the said plates i are in the raised position, and the ribs j controlling the coming out from the disks B of the movable bars k l when the said plates I are in the lowered position, said bars l adapted to engage and move the spindles in combination with pattern mechanism controlling said plates in groups of two by means of bent levers u, wires l, right levers z and pulls J, and means for raising said plates.

3. The disk D, and the rings F F', the rings F F' forming curved paths, with projections x x' formed by the intersection of the curved paths, the alternate projections x' being blunted, and permitting resting of the spindles in the space in front of them, substantially as and for the purpose described.

4. The bobbin-spindles G having a foot formed with two flanges e e embracing disks D, in combination with said disks D fixed on the axes above the carrying-plates B, such plates B, the rings F F', and a flange f on said spindles, having at its ends studs g g serving as guides to the feet of the spindles when they are set in motion, and switches engaging said studs and preventing their rotation on their axes, substantially as described.

5. The bobbin-spindles G, having a foot formed of two flanges e e embracing disks D and rings F F', in combination with said disks D fixed on the axes above the carrying-plates B, such plates B, the rings F F' and a diamond-shaped flange f on the said spindles having at its ends studs g g serving to guide the feet of the spindles in concurrence with switches K, slotted levers L, pieces M and cross-heads E, when the said spindles are set in motion, in order to prevent their rotation on their axes, substantially as described.

6. The combination with bobbin-spindles, of the carrying-disks B and the plates I having the cams j and j' arranged above and below each other and formed substantially as shown, so that when one of the plates I is lowered and thus liberates the corresponding spindle the cams j' cause the issue of the connected movable bars k l by the sliding of the studs n of these bars upon the outer profile of cams j and said bars and studs, which bars projecting beyond the disks D impart initial motion to the stationary spindles, substantially as described.

7. The combination with plates I having upper rib j, the carrying-disks B and the connected movable bars k l, of a boss with incline o secured below the upper bars l which comes in contact with the upper rib j of the plates I so as to be pushed back thereby and the said movable bars k l are thus brought back under the disks B in case of accidental issue of these bars when the plates I are in raised position, substantially as described.

8. In combination with movable spindles provided with flanges e e embracing the disks D and the rings F F', and parts f having studs g g, the oscillating switches K, the slotted levers L, cross-heads E and pieces M, for guiding the spindles by acting upon their studs g for preventing their rotation and consequent twisting or untwisting of the threads, substantially as described.

9. The combination with switches K and slotted levers L connected together by links N, of cams Q situated below and turning with the toothed wheels C of the carrying-disks B, levers q mounted on the axes P of certain of the switches and actuated backward and forward by said cams Q, the motions of these levers and corresponding switches being imparted to the other switches by means of links O in such manner that all inner switches form one series and all outer switches another series the motion of which are simultaneous but in reverse direction, substantially as described.

10. In circular frames for manufacturing lace and the like in weaving the lace in tubu-
lar form, a mandrel $Z$ fixed at its lower end upon stem $Y$, the said mandrel first circular at its base and gradually flattened until at the upper end in which it assumes the shape of a blade wound around the two carrier-cylinders $C' C''$, substantially as shown and for the purpose described.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

LÉON LOUIS FRANÇOIS MALHÈRE.

Witnesses:
Clyde Shropshire,
Auguste Mathieu.