G. T. NICHOLLS.

KNITTING MACHINE.

APPLICATION FILED MAY 6, 1909.

956,820. Patented May 3, 1910.

3 SHEETS—SHEET 1.

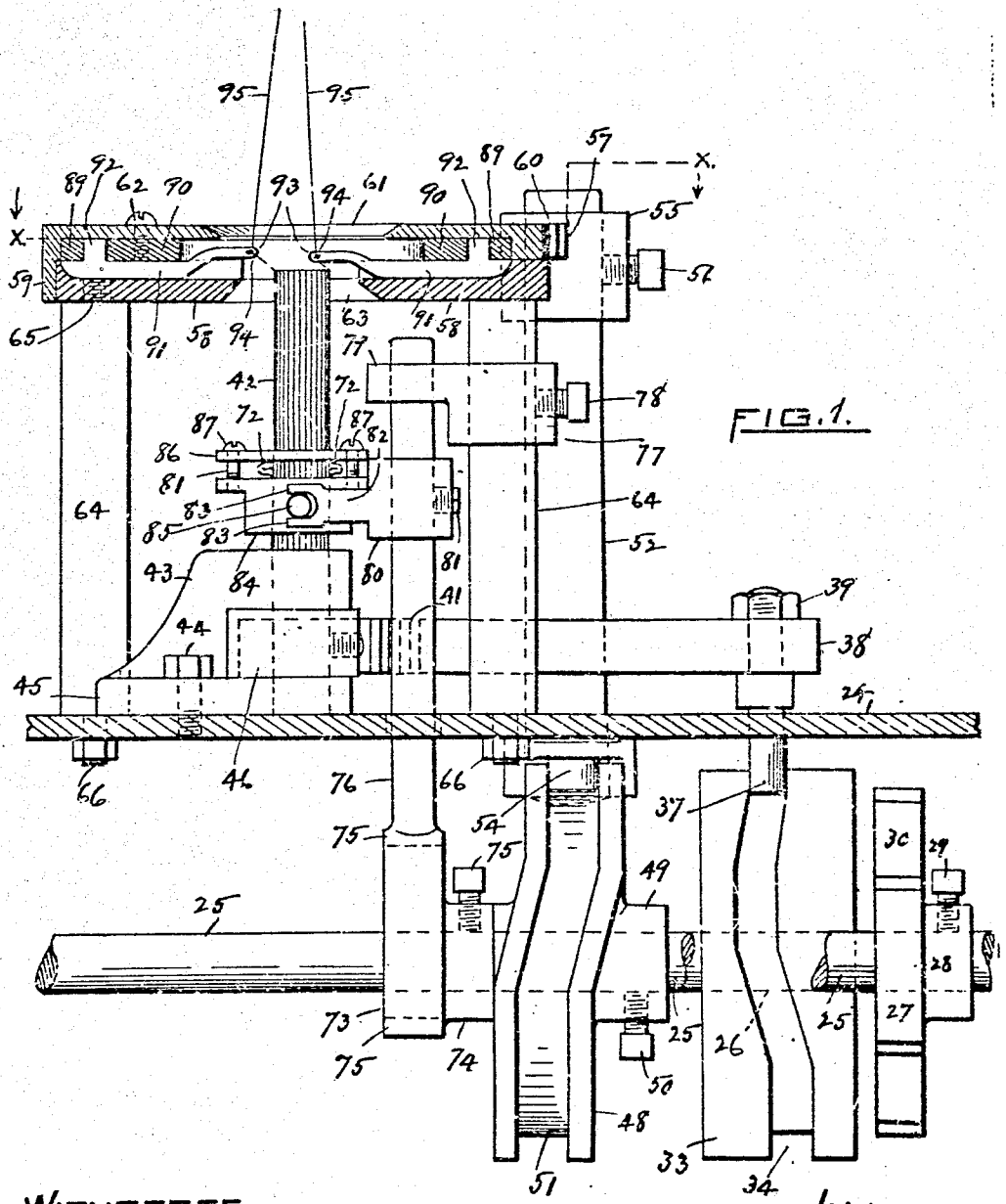

FIG. 1.

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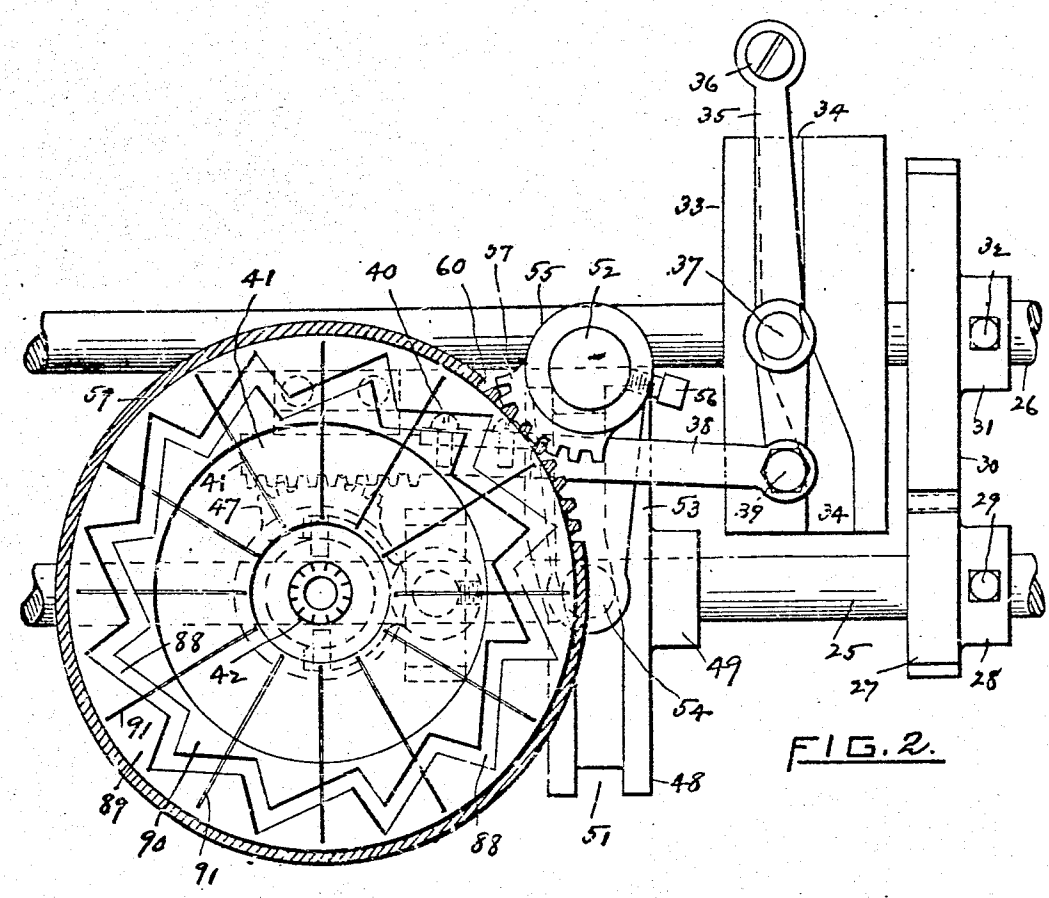

FIG. 2.

FIG. 20

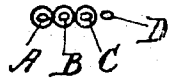

FIG. 21.

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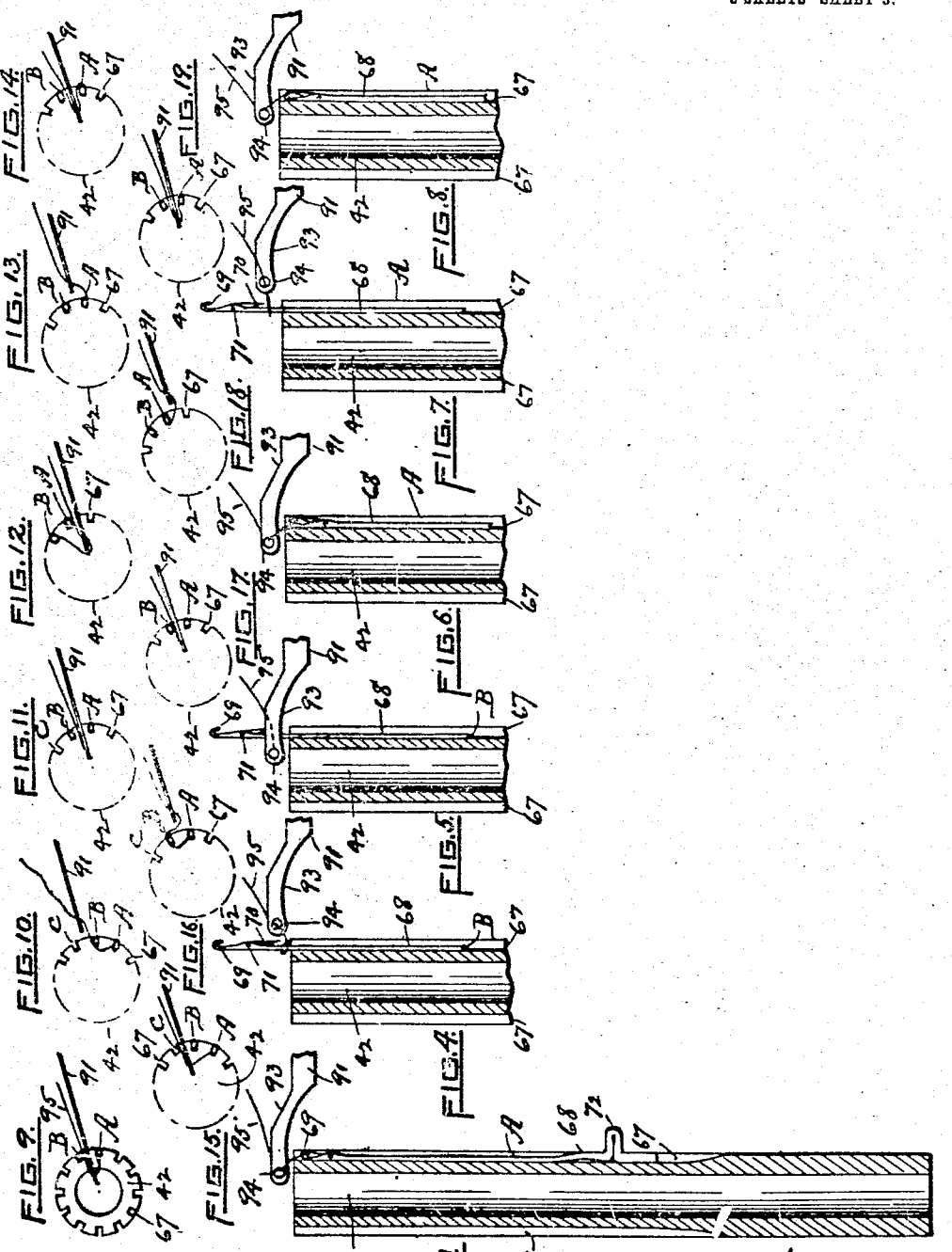

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GEORGE T. NICHOLLS, OF PROVIDENCE, RHODE ISLAND.

KNITTING-MACHINE.

956,820. Specification of Letters Patent. Patented May 3, 1910.

Application filed May 6, 1909. Serial No. 494,484.

To all whom it may concern:

Be it known that I, GEORGE T. NICHOLLS, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

Like reference characters indicate like parts.

Figure 1 is a front elevation of my improved knitting machine. Fig. 2 is a view of the same, as seen partly in top plan and partly in section on line *x x* of Fig. 1. Fig. 3 is a view in longitudinal, diametrical section of the needle tube, constituting an element of my said machine, and showing in combination therewith the thread and the thread carrier, and also one of the needles, as seen in the positions of these parts at a certain time during the knitting operation, said thread carrier and needle being represented in side elevation. Figs. 4, 5, 6, 7 and 8 are similar views of the needle, needle tube, thread and thread carriers in certain other positions during their operation. Figs. 9, 10, 11, 12, 13 and 14 are top plan views of said needle, needle tube, thread and thread carriers, corresponding, respectively, to Figs. 3, 4, 5, 6, 7 and 8. Figs. 15, 16, 17, 18 and 19 are views similar to Figs. 9, 10, 11, 12, 13 and 14, but represent intermediate positions of the needle, needle tube, thread and thread carrier, that is to say:—Fig. 15 represents a position between those shown in Figs. 9 and 10; Fig. 16 represents a position between those shown in Figs. 10 and 11; Fig. 17 represents a position between those shown in Figs. 11 and 12; Fig. 18 represents a position between those shown in Figs. 12 and 13; and Fig. 19 represents a position between those shown in Figs. 13 and 14. Figs. 20 and 21 are diagrammatic views showing the interlocked stitches formed by this machine.

My invention relates to the class of knitting machines, and consists of the novel construction and combination of the several elements as hereinafter described and claimed.

In the drawings, the reference numeral 24 represents the bed of the machine. There are two horizontal operating shafts. Of these, the main shaft, driven by power, is designated as 25, and a second shaft, parallel to the main shaft 25, is marked 26. The bearings of these shafts are not shown in the drawings. The main shaft 25 has a driving gear 27, whose hub 28 is fastened on the main shaft 25 by a set screw 29. The shaft 26 is turned by a gear 30, whose hub 31 is secured to the shaft 26 by the set screw 32. The gears 27 and 30 have such relation to each other that the gear 27 rotates twice while the gear 30 rotates once.

On the shaft 26 is secured a cam drum 33, having on its periphery a cam way 34, shown in Figs. 1 and 2. A cam lever 35 is mounted at one end by a pivot 36 on the bed 24 of the machine, and is provided with a cam stud 37, which is located midway its ends and projects loosely in the cam way 34. A link bar 38 is connected at one end to the cam lever 35 by a pivot 39, and is connected at its opposite end by screws 40 to a rack gear 41.

A vertical needle tube 42 rests at its lower end on the bed 24 of the machine and is supported in a standard 43. Screws 44 pass through flanges 45 of the standard 43 and fasten it upon the bed 24. The standard 43 is shown only in Fig. 1. The needle tube 42 is rotatable in a bore of the standard 43.

A collar 46 surrounds the needle tube 42, and is held in position thereon by a set screw (Fig. 1). The collar 46 is provided with a segmental gear 47, which engages with the rack gear 41. Thus the rotation of the shaft 25 and its gear 27, causes the rotation of the gear 30 and its shaft 26. The cam drum 33 rotates with the shaft 26 and by its cam way 34 and the cam stud 37, which projects therein, gives an oscillating movement to the cam lever 35, which movement is communicated by the link bar 38 to the rack gear 41, and by the engagement of the rack gear 41 with the segmental gear 47, the needle tube 42 has a slight periodical oscillation.

On the main shaft 25 is a cam drum 48, which has a hub 49. A set screw 50 passing through the hub 49 secures the cam drum 48 upon the shaft 25. The cam drum 48 has a peripheral cam way 51.

A vertical shaft 52 is rotatably mounted in proper supports or bearings (not shown). At its lower end the shaft 52 has a fixed arm or crank 53, at whose free end is a cam stud

54, entering loosely in the cam way 51. At the upper end of the vertical shaft 52 a collar 55 is fastened by a set screw 56, and this collar 55 is provided with a segmental gear 57.

The head of the machine comprises two parts—a ring-shaped base 58 and a cap or cover 59 having an annular flange, which fits over the same and engages the peripheral rim thereof. The cover 59 has a segmental gear 60, which meshes with the segmental gear 57. The cover 59 has a central opening 61, whose edge is beveled, as seen in Fig. 1, and is loose upon the base 58 and capable of a slight oscillatory movement thereon. The base 58 has a central opening 63, whose edge is beveled.

There are several rods or standards 64, upon whose upper ends the base 58 is rigidly supported, being fastened thereon by screws 65, and has a plurality of radial grooves, as illustrated in Fig. 1. The standards 64 are fastened to the bed 24 by bolts 66. Thus the rotation of the main shaft 25 causes the rotation of the cam drum 48 with it, which, by its cam way 51 and the cam stud 54 therein, gives an oscillating movement to the radial arm or crank 53, and this movement is communicated by the vertical shaft 52 and segmental gears 57 and 60 to the cap 59 of the machine.

The needle tube 42 has a plurality of equispaced, exterior, longitudinal grooves 67, in each of which grooves a needle 68 is slidably mounted. At the upper end of each needle 68 is a hook 69, and a latch 70 is mounted by a pivot 71 on the needle 68. When the latch 70 is in contact with the end of the hook 69, they form a closed needle eye, as illustrated in Figs. 3, 6 and 8; but when the latch 70 is directed downward, as in Figs. 4, 5 and 7, there is no needle eye, but the stitch or loop is dropped. As these needles and their operation are well-known in the art they need not here be further explained. Each needle 68 has a needle hub 72. The lower end of each needle groove tapers outwardly so as to facilitate the insertion of the needles 68 in said grooves and their withdrawal therefrom. The mechanism for giving the proper and timely vertical movement to these needles 61 is as follows: On the main shaft 25 is an eccentric wheel 73, which has a hub 74. A set screw 75 secures the hub 74 on the shaft 25. A strap or collar 75 is loosely fitted upon the rim of the eccentric wheel 73. A vertical rod 76 extends up from and is carried by the collar or strap. On one of the supports 64 a bracket or collar 77 is fastened by a set screw 78, and this bracket has a bearing 79 extending therefrom, through which the rod 76 passes loosely. A collar 80 is adjustably mounted upon the rod 76 by a set screw 81 and has a yoke 82, whose ends are bifurcated, as shown at 83. A collar 84 surrounds the needle tube 42 loosely and has two diametrically opposite trunnions 85, which extend loosely into the bifurcated ends of the yoke 82 of the collar 84. A ring 86, concentric with the collar 84, is mounted parallel with the upper surface of the collar 84 by means of screws 87. The needle hubs 72 extend loosely beneath the ring 86 and above the collar 84. Thus, the rotation of the shaft 25 causes the eccentric wheel 73 to rotate therewith, and so imparts to the rod 76 a reciprocating vertical movement. The collar 80, fastened to the rod 76, rises and descends with it, and by the yoke 82 causes the collar 84, (whose trunnions 85 engage with said yoke) to move up and down accordingly, together with the ring 86. This movement of the collar 84 and ring 86, as they engage with the hubs 72 of all the needles 68, causes all said needles to rise and descend at the same time, periodically and to the same extent, the limit to such reciprocating movement being equal to the eccentricity of the wheel 73.

In the head of the machine, in the space between the base 58 and the cover 59, is a cam way 88, which forms a series of angularly directed or zigzag communicating channels. This cam way or channel is formed by two cam rings 89, 90, which are attached to the cover 59, and is best illustrated in Fig. 2, where it is shown in plan or top view. In this cam way are loosely mounted radially movable thread carriers 91, whose form and position are best seen in Fig. 1. These thread carriers are movable in the radial grooves of the base 58 by means of the cam rings 89, 90. Each thread carrier has a straight body or central portion, which is slidable in a groove in the upper surface of the base 58, and also has an upwardly extending projection 92, which is of such length in the plane of the center or body as to be equal to the width of the cam way 88, but to be in loose contact with the cam rings 89, 90. As the base is immovably held by the screws 65 upon the standard 64, and the cover 59 has an oscillatory movement, and the thread carriers are confined to a straight movement by the radial slots in the base 58 as shown in Fig. 1, a radially-directed reciprocating movement is imparted to the thread carriers by the oscillation of the cover 59, caused by the operation of the segmental gearing 57 and 60. The inwardly directed end of the carrier 91 is formed into a thread-feeder arm 93, which is parallel to the central part or body of the carrier, but slightly above the same in the same vertical plane. This thread-feeder arm has an eye 94. Threads 95 (from a reel, not shown) pass through the eyes 94 of the thread feeder arms 93 of these thread carriers, and pass thence to the needles 68.

Having thus described the different parts

of my improved knitting machine, I will proceed to explain the manner of its operation.

The product of this machine is a knit tube, useful for shoe lacings, corset lacings, for the textile coverings of electric wires, and other similar purposes. By a method presently explained it is adapted also to knit flat, textile fabrics, such as tapes, carpet braids, dress braids, and similar goods. First, I will describe its usual operation in the manufacture of tubular textiles, the formation of the stitches being illustrated by Figs. 3 to 19, inclusive.

In Fig. 3 and its companion Fig. 9, the needles 68 are down, the hook 69 of each needle being below the upper end of the needle tube 42 in the groove 67 thereof. The thread carrier 91, 93, is in position to begin the operation. The thread 95 passes through the eye 94 of the thread-feeder arm 93 and also between the needle hook 69 and the needle latch 70; the latter two being then together and constituting a closed eye. The thread-feeder arm at that time extends between two needles designated in the drawings as A and B, as shown in Fig. 9. The needle tube oscillates until the needle B has passed under the thread carrier, as shown in Fig. 15. The needles then rise, as shown in Fig. 4, and the thread carrier moves outwardly, as shown in Figs. 4 and 10. The thread has now passed around the needle B, and the previous loop has been cleared from the latch by the upward movement of the needle A thereof, and hangs upon the shaft of the needle. The needles still remain in their elevated position and the needle tube oscillates so that the thread carrier comes into position clear of the needles A and B, but in a line directed radially between them, as shown in Fig. 16. The needle tube then moves back to the position shown in Fig. 9. The thread carrier then moves inwardly between the needles A and B, as seen in Figs. 5 and 11, the needles still being in their elevated position. At this time the thread has been looped around the needle B, as indicated in Fig. 17. The needles then descend below the top of the needle tube and operation is completed on the needle B. The needle tube then oscillates and passes beneath the thread carrier, as shown in Figs. 6 and 12, to the position shown in Fig. 12, whereupon the thread carrier withdraws until clear of the needles A and B, as seen in Fig. 18. The thread has now been passed around the needle A. The needles then rise and the needle tube oscillates until the thread carrier is directed radially between the needles A and B, as shown in Figs. 7 and 13. The thread carrier then moves inwardly between the needles A and B, as shown in Fig. 19. The needles then descend, as in Figs. 8 and 14, which is the same position as in Figs. 3 and 8. This operation is continuous, the carrier (as the tube oscillates) carrying the same thread alternately to the needles B and A, others to C and B, D and C, etc. These periodical vertical movements of the needles, up and down, result from the rotation of the eccentric wheel 73 on the shaft 25, and said rotation is converted by the strap or collar 75 and rod 76 into a reciprocating movement which is converted, as already explained, into a rise and fall of the collar 84 and ring 86, and these operate the needles 68 by their hubs 72.

The periodical oscillations of the needle tube 42 are caused by the rotation of the cam drum 33, which by its cam way 34 rocks the lever 35 and so gives a reciprocating movement to the link bar 38 and the rack gear 41, the latter moving the segmental gear 47 of the collar 46, which is fastened to the needle tube.

The periodical movements of the thread carriers 91, 93, are caused by the rotation of the cam drum 48, whose cam way 51 rocks the crank arm 53 and gives a corresponding oscillation to the vertical shaft 52. The same movement, being communicated to the segmental gear 57, operates the segmental gear 60 of the circular cover or cap 59 and the cam way 88, formed by the cam rings 89 and 90. This oscillating movement of the cover or cap 59 and its cam way 88 moves the thread carriers 91 radially, in and out, by the loose engagement of the projections 92 thereof in the cam way 88. These movements of the needle tube 42, needles 68 and thread carriers 91 are carefully timed to cooperate as described. As the tubular fabric is thus knit, it is drawn down through the bore of the needle tube 42, by the usual drawing rolls and take-up mechanism in the manner usual and well-known in this class of machines and which therefore I have not deemed it necessary to illustrate in the drawings.

The stitch, made as hereinbefore described, is in the form of a figure 8, as shown in Fig. 24. In this figure and in the explanation of the stitch-forming I have assumed that the needles are worked in gangs of two each, the needles being designated as A and B. It is to be understood, however, that while said needles A and B are so knitting, the needles B and C (and C and D, and so on all around the needle tube are knitting also); and that while an 8-shaped stitch is forming upon the needles A and B, another 8-shaped stitch is forming, at the same time, upon the needles B and C, as shown in Fig. 25, and so on. The result is that the stitches interlock and cannot be unraveled, and the fabric is stronger and less stretchable than knitted fabrics generally are.

It is obvious that instead of forming stitches by gangs of two needles each, the

gangs may have three needles each, or any desired number of needles, provided the cam way operating the needle tube is modified to cause the requisite oscillations of the needle tube, but the mechanical principle involved is the same.

The shape and extent of the loop or stitch upon the needles is seen in Figs. 20 and 21, and a continuous series of such loops or stitches necessarily results in the formation of a tubular fabric.

In Figs. 24 and 25 the stitches are represented as round and separated a little space from the needles, which they respectively inclose. This, however, is for the purpose of showing the 8-shape of the stitches, but it is to be understood that in practice the stitches hug the needles closely. When, however, any two adjacent needles 68 are withdrawn from its groove 67 in the needle tube 42, the continuity of the fabric is broken, and the product of the machine is a flat tape, with two selvages.

It is evident that these knitting mechanisms are interchangeable, and parts which are of different sizes or diameters and which carry and operate a different number of needles and threads, or a different style or pattern in knitting, whether a simple spiral, continuous, or straight, or diamond-shaped, or other design, may be substituted from time to time, thus making the machines capable of great variety of work, with but little loss of time and with no increase of floor space. Thus one machine can do the work, which hitherto has required several different machines, of different sizes, styles and capacities.

I claim as a new and useful invention and desire to secure by Letters Patent:—

1. In a knitting machine, the combination of a rotatable shaft; a needle tube; means to oscillate the tube operated from the shaft; needles slidably mounted on the tube; means actuated by the shaft for giving alternately up and down movements to the needles upon the tube; a stationary ring-shaped base concentric with but above the needle tube and supported by standards from the bed of the machine and provided with a plurality of radial grooves; a ring-shaped cover concentric with said base and mounted movably on the base and having a zigzag cam way disposed in a circle concentric with said cover; means actuated by the shaft and adapted to give an oscillatory movement to said cover; and a plurality of radially directed thread carriers slidably mounted respectively in said radial grooves of the base each having a projection slidably mounted in said cam way and each provided at its inner end with an eye for carrying thread.

2. In a knitting machine, the combination of a rotatable shaft; a needle tube; needles movably mounted on the tube; a horizontally supported base with a central aperture and provided with a plurality of radially directed grooves; a plurality of thread carriers radially directed and slidable in said grooves; means actuated by the shaft to give oscillatory movement to the needle tube; means actuated by the shaft to give vertical reciprocation to the needles; and means actuated by the shaft to give periodical movements to the thread carriers in said grooves alternately to and from the needles but above the needle tube.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE T. NICHOLLS.

Witnesses:
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ALFRED S. JOHNSON.