6 Sheets—Sheet 1.

M. MARSHALL.

KNITTING-MACHINE.

No. 180,250. Patented July 25, 1876.

Fig. 1.

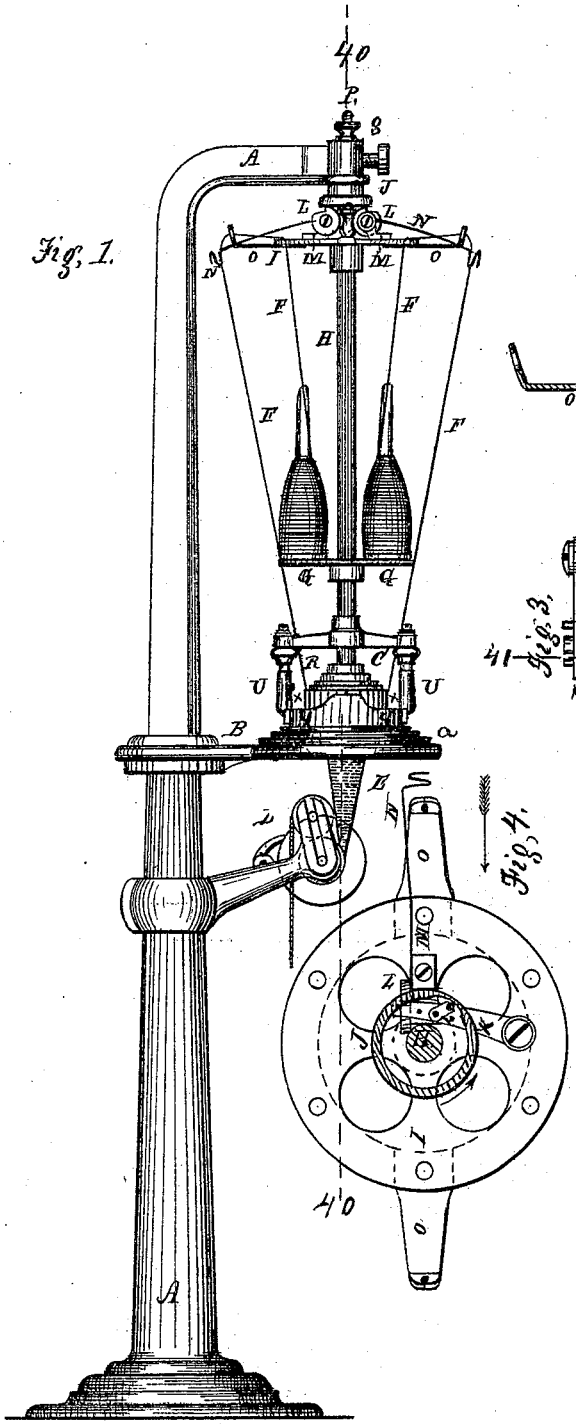

Fig. 4.

Fig. 2.

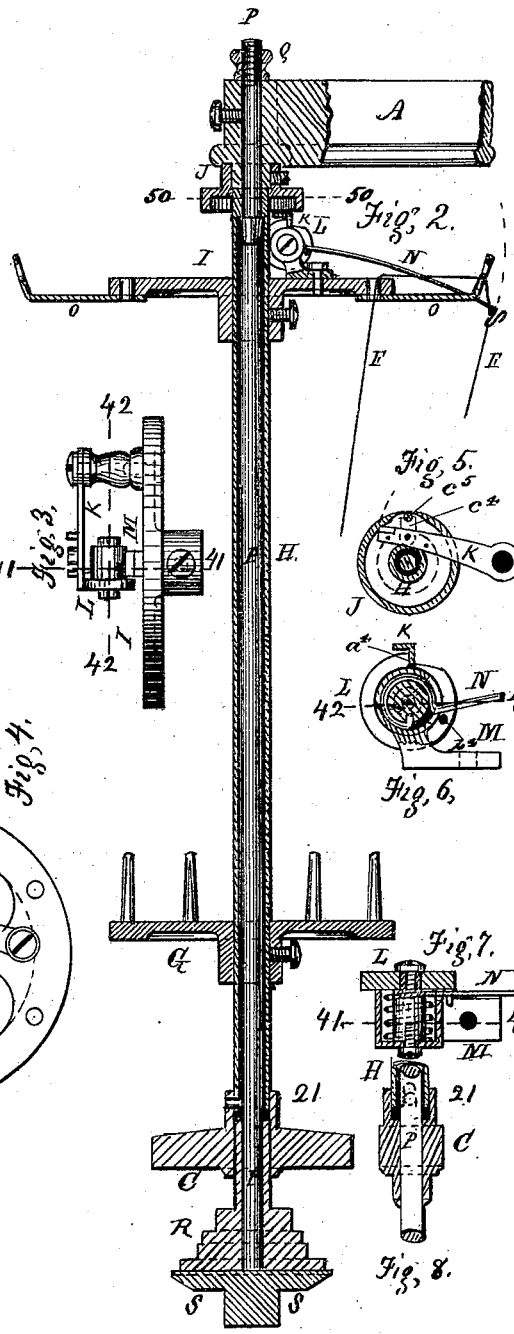

Fig. 3.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

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Fig. 9.

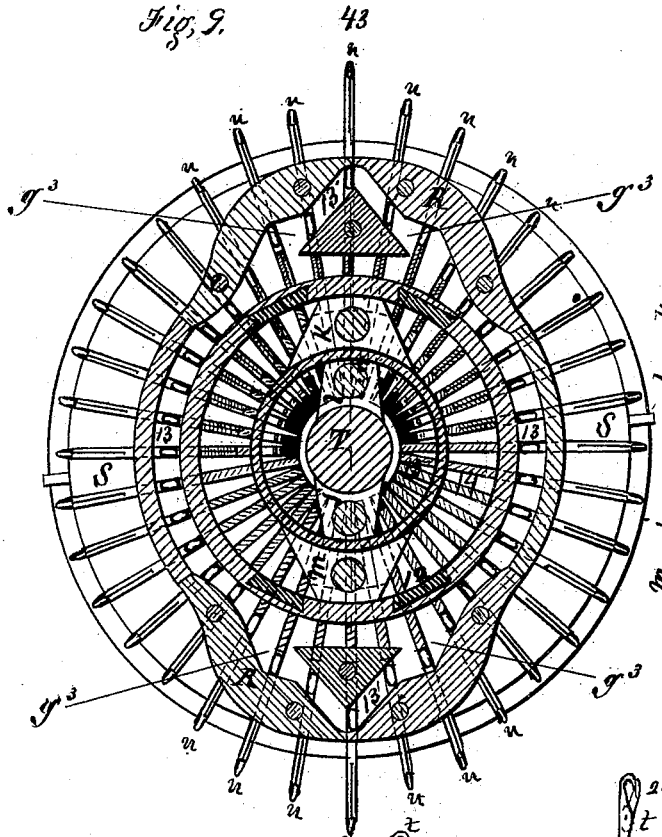


Fig. 10.

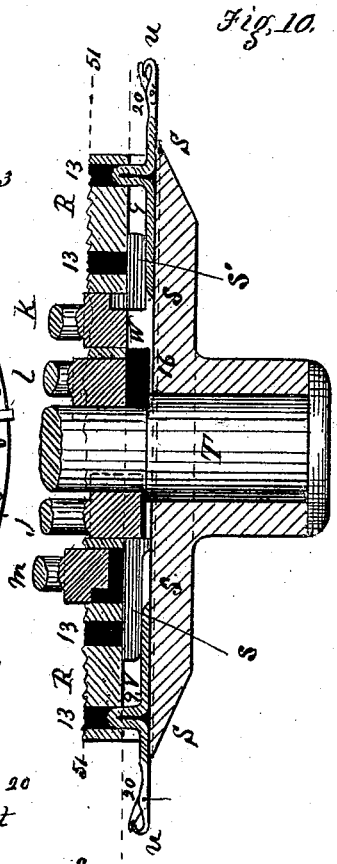


Fig. 11.

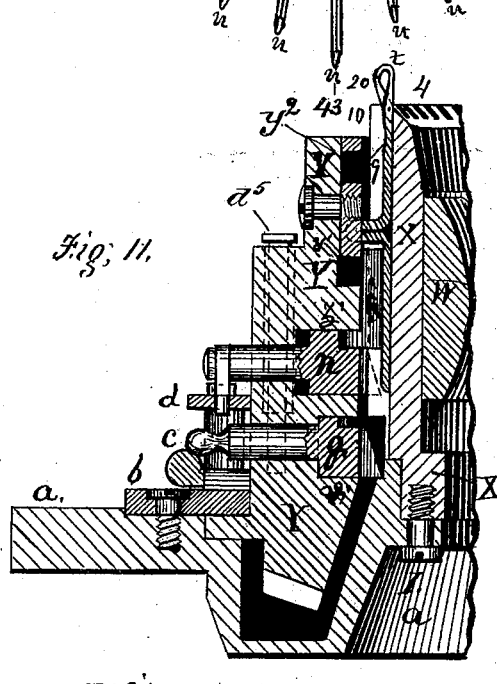
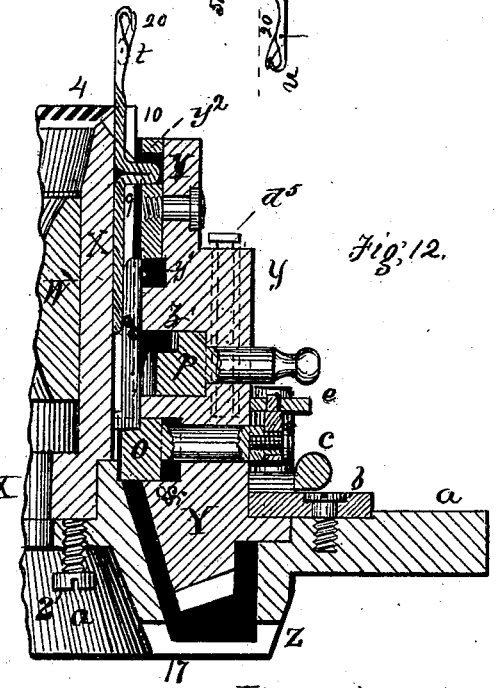


Fig. 12.



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KNITTING-MACHINE.

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Fig. 13.

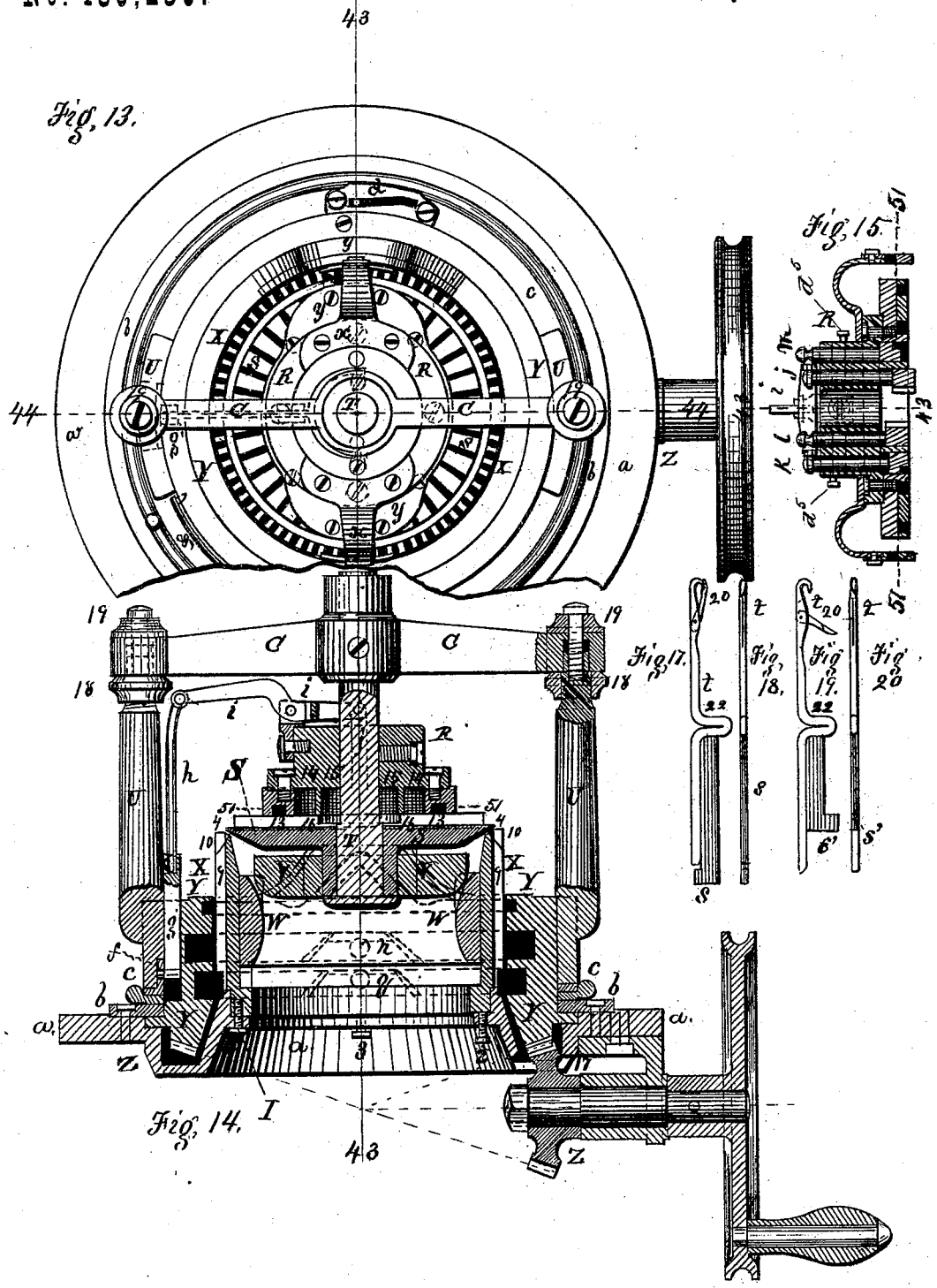

Fig. 15.

Fig. 17.

Fig. 18.

Fig. 19.

Fig. 20

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M. MARSHALL.

KNITTING-MACHINE.

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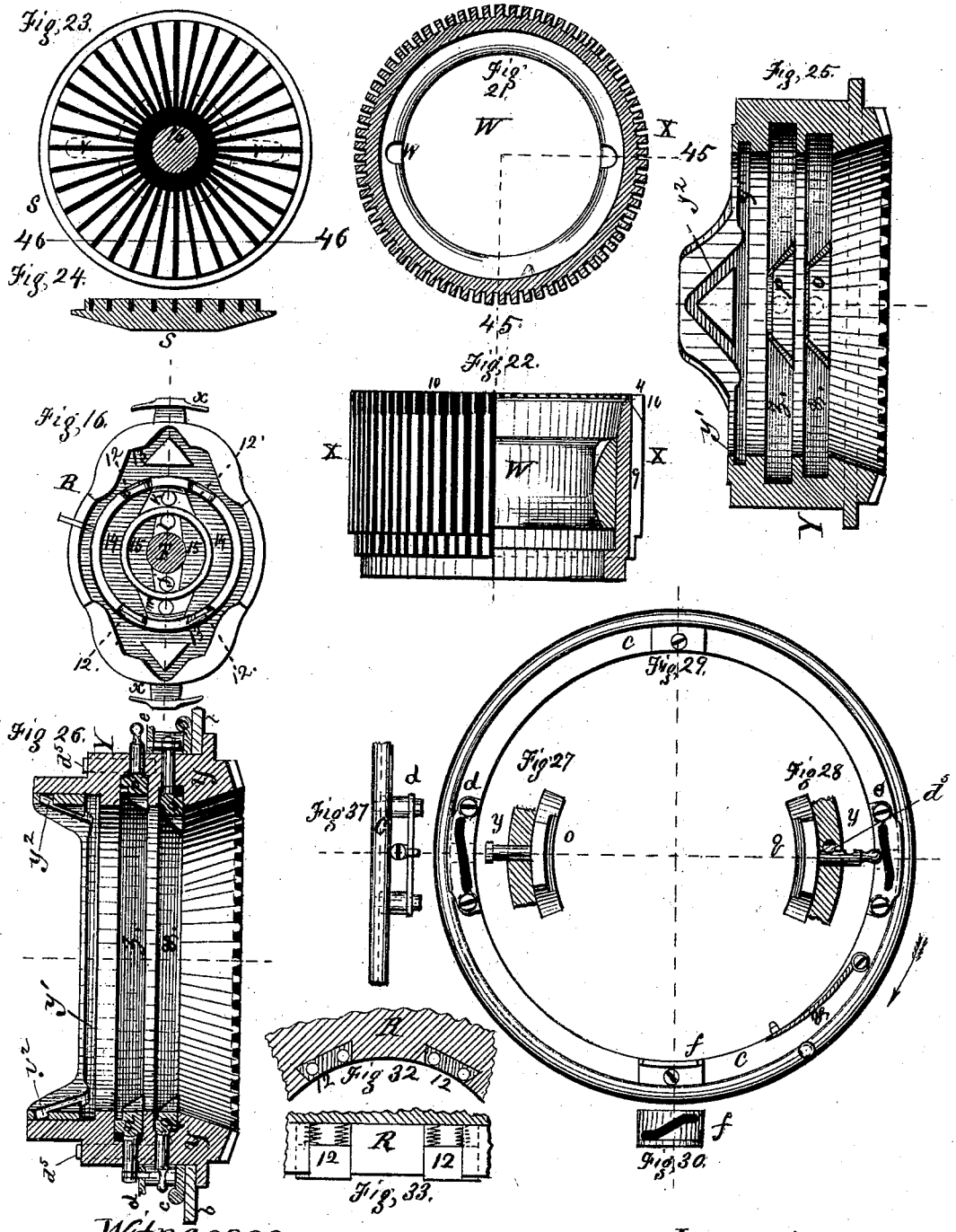

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KNITTING-MACHINE.

No. 180,250. Patented July 25, 1876.

Fig. 34.

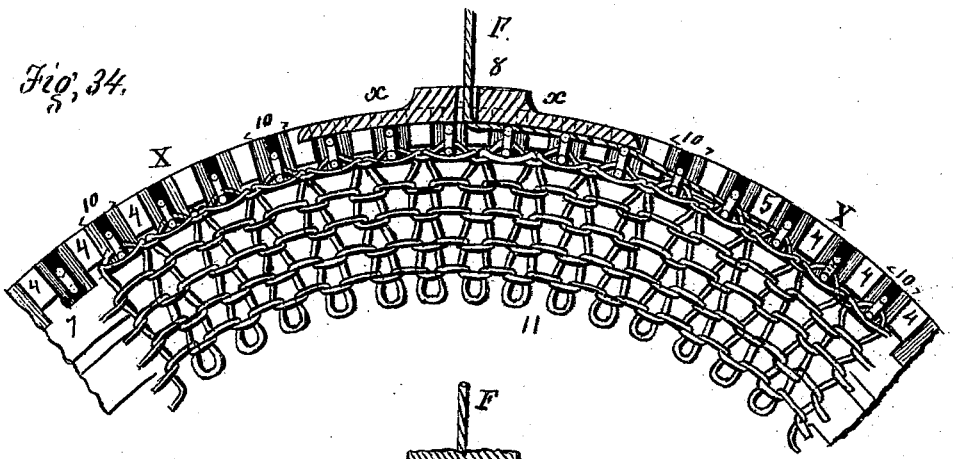

Fig. 35.

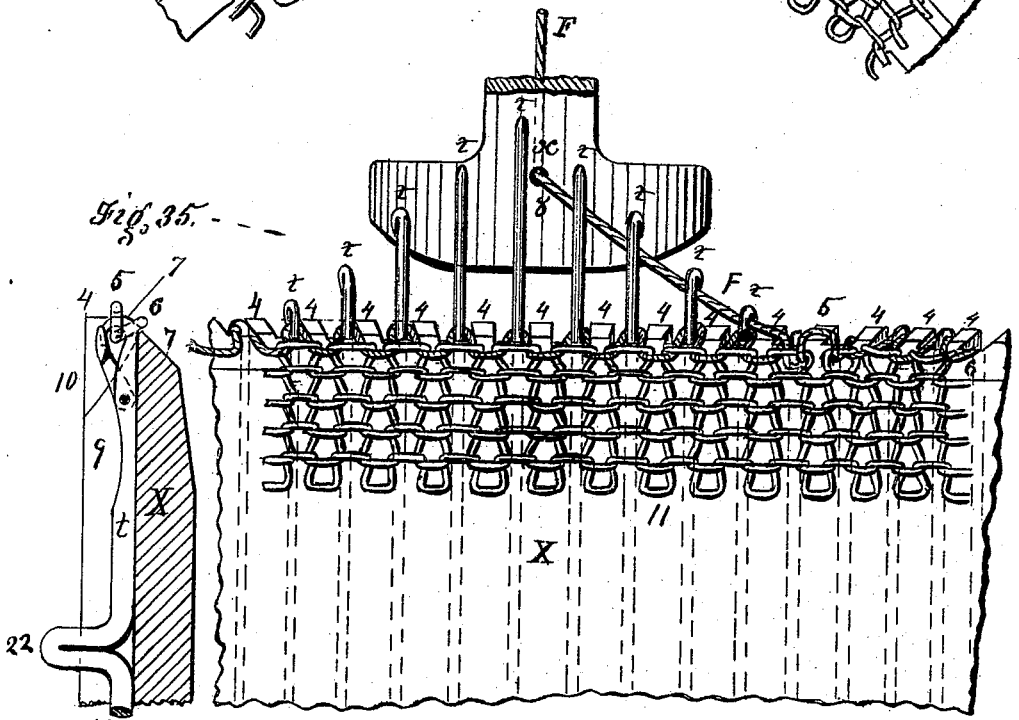

Fig. 36.

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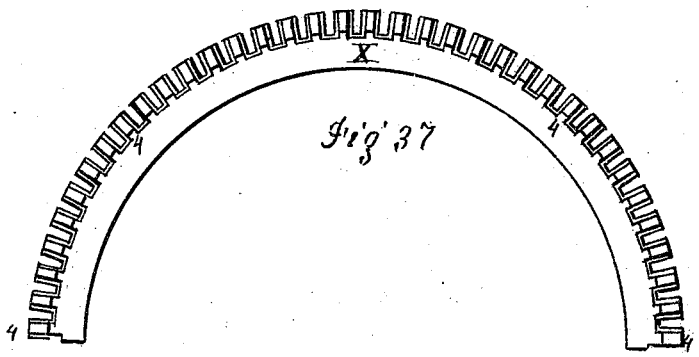

Fig. 37

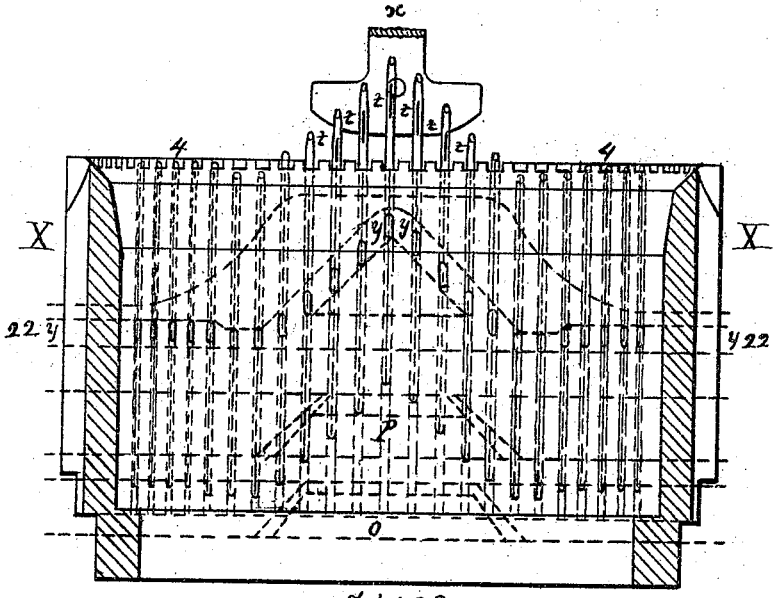

Fig. 38.

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UNITED STATES PATENT OFFICE.

MOSES MARSHALL, OF LOWELL, MASSACHUSETTS.

IMPROVEMENT IN KNITTING-MACHINES.

Specification forming part of Letters Patent No. **180,250**, dated July 25, 1876; application filed January 27, 1876.

To all whom it may concern:

Be it known that I, MOSES MARSHALL, of Lowell, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Knitting-Machines, of which the following is a specification:

My invention consists in various improvements in that class of circular-knitting machines which contain both vertical and horizontal needles for the production of ribbed fabrics. Certain of the features are also applicable to the machines having vertical needles only, for the production of plain fabrics; but as they are considered of secondary importance, I have in the accompanying drawings shown a machine of the first-mentioned class, constructed to lay two threads into the fabric at each revolution, and in the following description I will confine myself thereto.

My first improvement consists in the employment of a suspending-rod, serving to sustain the dial-plate, in which the horizontal needles are mounted to hold the same from turning, and also to adjust it with its needles vertically, the object of this arrangement being to provide for the ready and accurate adjustment of the dial, to render the machine simple and compact, and to dispense with certain devices hitherto used for holding the dial-plate, which were objectionable on account of their producing an injurious strain and friction upon the fabric during its passage down through the machine.

My second improvement consists in mounting the horizontal needle-cams, the bobbin-carrier, and the take-up devices on a sleeve surrounding the above-mentioned suspending-rod, and rotated by the action of the machine, so that the yarn may be fed to the machine from two or more points at once from separate bobbins, and the take-up operated automatically, and maintained in its proper relation to the other parts.

The third improvement consists in the peculiar construction and arrangement of a take-up device, containing a pivoted fly by which the device is operated whenever the motion of the machine is reversed, but at no other time, the object being to take up automatically the slack which occurs in the yarn when the motion of the machine is reversed, as, for example, when knitting a flat web with selvage edges, which is accomplished by giving the needle-cylinder a reciprocating instead of a continuous rotary motion.

The fourth improvement consists in the employment of small slides, technically termed "needle-bits," mounted in the grooves by the side of the needles, and operated by special adjustable cams, for the purpose of setting the needles in the proper position to be acted upon by the fixed operating-cams, as usual. The bits serve simply to move the needles up into the path of the operating-cams, which act entirely independent of the bits advancing and retracting the needles, and causing them to form the stitches in the usual manner. The object in using the bits and their special adjustable cams is to so control the needles that all or a portion of them may be operated in unison, and so that a portion of them may be operated while the remainder are standing idle, whereby the machine is adapted for knitting different fabrics without removing the needles, a simple instantaneous shifting of either bit-cam serving to throw the needles controlled thereby into or out of action, while the remainder continue to operate.

The fifth improvement consists in a special manner of arranging certain of the adjustable needle-bit cams, and in connecting the cams of the vertical needle-bits with those of the horizontal needle-bits, in such manner that the two may be adjusted simultaneously.

The sixth improvement consists in a special arrangement of the remaining needle-bit cams other than those above mentioned, so that they may be adjusted separately, so as to operate the needles in conjunction with the main operating-cams and the other needle-bit cams, in the special manner required for the production of different fabrics.

The seventh improvement consists in the employment of spring pressure-feet in the cam-plate of the horizontal needles, to press the needle-bits down upon the needles and holding the latter in place, so that when the needles are not required to operate there will be no danger of their being accidentally moved so as to be caught by the operating-cams.

The eighth improvement consists in giving

the cam-groove, by which the horizontal needles are operated, a peculiar form at certain points, in order to arrest the inward or backward movement of each of said needles until the adjoining vertical needles have completed their downward movement and drawn over the stationary needle a sufficient amount of yarn to form the stitch. This arrangement, in addition to its other advantages, admits of the cam-groove in the dial-plate being contracted, so as to afford room for from two to four cams, where heretofore only one could be used in machines of small size.

The ninth improvement consists in beveling the upper inner edge of the vertical needle-cylinder and the jacks or ribs between the vertical needles, in order to have them cast the stitches over inside of and below the tops of the jacks as fast as they are formed, in order to avoid the usual strain of drawing the fabric down over the jacks, and apply the strain and tension to the working-needles while the stitch is being formed.

The tenth improvement consists in making the needle-cylinder adjustable vertically, in order to raise and lower the jacks, and thereby change the length of the stitches without changing the adjustment of the needle-operating cams or the movement of the needles.

Figure 1 represents a side elevation of my complete machine, and illustrates its general form and construction, and the manner in which the dial-plate, the horizontal cam-plate, the bobbin-holder, and the take-up devices are sustained. Fig. 2 is a vertical central section on the line 40 of Fig. 1, showing the suspension-rod with the dial-plate attached to its lower end, the sleeve surrounding said rod, and carrying the bobbin-holder, the take-up devices, and the cams by which the horizontal needles are operated. Fig. 3 is a side elevation of one of the take-up devices and its actuating mechanism. Fig. 4 is a horizontal section on the line 50 of Fig. 2, looking downward, and showing the take-up device and yarn guides or carriers. Fig. 5 is another section on the same line as the last, looking upward instead of downward, and illustrating the action of the pivoted fly, by which the take-up arm is operated. Fig. 6 is a vertical setion on the line 41 of Fig. 3, showing the manner in which the spring take-up arm is attached and supported; Fig. 7, a horizontal cross-section of the same on the line 42 of Fig. 3; Fig. 8, a vertical section through the lower end of the suspension rod and sleeve, and the cam-plate by which the horizontal needles are operated, illustrating the manner in which said plate is attached to the sleeve and rendered capable of a vertical adjustment to correspond with the adjustment of the dial-plate. Fig. 9 is an enlarged horizontal section, taken on the line 51 51 of Figs. 10, 14, and 15, showing the form and arrangement of the cams by which the horizontal needles and needle-bits are operated, the arrangement and action of the needles and bits, and the spring pressure-feet, by which the needles and bits are prevented from moving accidentally. Fig. 10 represents a vertical central section on the line 43 43 of Fig. 9, illustrating clearly the form and arrangement of the needle-bits, and the difference between the long and short bits used on opposite sides of the machine. Fig. 11, a vertical radial section through the left-hand side of the machine on the line 44 of Fig. 13, showing the needle partially raised by the operating-cam. Fig. 12 is a vertical radial section through the right-hand side of the machine, showing the vertical needle at its highest point; Fig. 13, a top-plan view of the knitting-machine proper complete, the bobbin-carrier and take-up not being included; Fig. 14, a vertical central section of the machine on the line 44 of Fig. 13, with the dial-plate sustained and held by the usual devices instead of my suspending-rod. Fig. 15 is a vertical central section through the cam-plate by which the horizontal needles and needle-bits are operated, showing the manner in which the needle-bit cams are mounted and adjusted, and also the arms which serve as pressers, yarn-carriers, and latch-openers. Fig. 16 is a bottom-plan view of said cam-plate, showing the cams, cam-grooves, latch-openers, and spring pressure-feet. Fig. 17 is a side view of one of the needles and a long needle-bit. Fig. 18 is an edge view of the same. Fig. 19 is a side view of one of the needles and a short needle-bit. Fig. 20 is an edge view of the same. Fig. 21 is a horizontal cross-section of the stationary vertical cylinder, in which the vertical needles are mounted as usual. Fig. 22 is a side elevation of the same, partly in section. Fig. 23 is a top-plan view of the dial-plate, in which the horizontal needles are mounted; Fig. 24, a cross-section of the same on the line 46. Fig. 25 is a vertical sectional elevation of the external revolving cam-ring, by which the vertical needles and needle-bits are operated, taken on the line 44 of Fig. 13. Fig. 26 is a similar section of the said cylinder, taken at right angles to the first, on the line 43 of Figs. 13 and 14. Fig. 27 is a top-plan view, showing one of the needle-bit-operating cams attached to the revolving ring, illustrating the manner in which it is mounted, so that it can be thrown into and out of action at will. Fig. 28 is a plan view of the needle-bit cam situated on the opposite side of the machine from the one shown in the last figure, showing the manner in which it is adjusted and held in position. Fig. 29 is a plan view of a shifting-ring, carrying three slot-cams and a spring-arm, for the purpose of making the required changes in the position of the needle-bit cams, and securing them in position. Fig. 30 is a side elevation of the cam, by means of which motion is communicated from the shifting-ring to the devices employed for moving the horizontal needle-bit cams. Fig. 31 is a side or edge view of a portion of the annular shifting-ring and one of its slot-cams for operating the bits

of the vertical needles. Fig. 32 is an enlarged horizontal section, taken on the line 51 51, Figs. 10, 14, and 15, showing the spring pressure-feet to retain the bits and needles in position; Fig. 33, an elevation of the same, partly in section. Fig. 34 is a top-plan view of a portion of the internal stationary cylinder, showing the yarn-guide or latch-opener in section, and also the tops of the jacks and the needles, and the manner of forming stitches with the same. Fig. 35 is a partial elevation of the inside of the stationary needle-cylinder, with a portion of the needles in place for receiving the yarn and forming the loop. Fig. 36 is a vertical section through the upper edge of the needle-cylinder, showing the jacks and needles and the first and last positions of the stitches upon the same. Fig. 37 is a plan view of a portion of the needle-cylinder, showing the manner in which it is beveled on the inside, in order to aid the downward movement of the stitches as fast as they are formed. Fig. 38 is a vertical cross-section of the needle-cylinder, showing the form of the jacks, and, in dotted lines, the form and location of the needle and needle-bit cams, and the needles.

In its general construction and mode of operation the machine is similar to those now in use, consisting essentially of a series of vertical needles mounted in grooves in a vertical cylinder, and of a series of horizontal needles mounted in radial grooves in a dial-plate, and arranged to pass between the ends of the vertical needles, the needle-cylinder and dial-plate being held stationary, and motion communicated to the needles by moving cams.

In Fig. 1, A represents a standard or pillar to support the machine, having its upper end bent to one side to sustain the suspending-rod of the dial-plate, as hereinafter described. B represents a shelf secured rigidly to the pillar to support the knitting-machine proper; C, the said machine fastened upon the shelf; D, rolls arranged on the pillar below the machine to receive the fabric and draw it down through the machine; and F, the web or fabric passing down the center of the machine. X represents the stationary cylinder, in which the vertical needles are mounted, and S the dial-plate, in which the radial horizontal needles are mounted, arranged in the upper end of the cylinder, so that the ends of the horizontal needles pass outward between the ends of the vertical needles in the usual manner. The dial-plate S and the cylinder are both held stationary, and their needles operated by cams, the cams which operate the horizontal needles being located in the under side of a rotating plate, R, which is situated upon the dial-plate, while the cams which operate the vertical needles are located on the inside of a ring, Y, which encircles and revolves about the needle-cylinder X, as usual. Instead of sustaining the dial-plate S and cam-plate in the usual manner, I secure the dial-plate to the lower end of a suspension-rod, P, having its upper end secured to the upper end of the standard A, as shown in Figs. 1 and 2, and secure the cam-plate R to the lower end of a rotating sleeve, H, surrounding the suspension-rod, and connected by a bar, C, and posts U with the rotating cam-ring of the machine, so as to receive motion therefrom. The rod P holds the dial-plate firmly and rigidly in position, while the sleeve H, receiving a rotary motion from the machine, rotates the cam-plate R, and causes the proper action of the horizontal needles. The suspension-rod P is prevented from rotating by a set-screw or a feather at its upper end, and is sustained by a thumb-nut, Q, applied to said end, as shown in Figs. 1 and 2, so that by turning said nut the dial-plate and its horizontal needles may be raised and lowered, as required. In order to allow the cam-plate to rise and fall with the dial-plate it will be attached to the sleeve by a set-screw or by a loose slotted connection, as shown in Figs. 2 and 8, so that it can rise and fall without moving the sleeve or disengaging therefrom.

On the middle or lower portion of the sleeve H I secure a plate, G, provided with spindles which receive the bobbins and carry them around with the machine, so that they are always held in the same relative position thereto, while at the same time they are above the same, out of the way of the attendant, so as not to interfere with the control of the machine or its work. On the upper end of the sleeve H I secure a plate, I, carrying the thread-guiding arms O, and the take-up arms N, which take up the slack thread when the motion of the machine is reversed. The take-up arms have their outer ends provided with eyes or hooks, to carry the thread, and their inner ends wound spirally upon a hub on the side of a bracket or plate, M, secured upon the plate I, as shown in Figs. 6 and 7, so that the tendency of the outer end is to spring downward. By the side of the take-up arm at its inner end, and concentric therewith, I mount a disk, L, provided with a pin, b^4, extending under the arm, and with a shoulder, a^4, engaging with a lip on the free end of a horizontal arm, K, pivoted on the plate I, as shown, so that when the arm K is moved backward its lip turns the disk L, and causes the pin thereon to raise the take-up arm N, and take up the thread or yarn.

The movement of the arm K is effected by providing it on the upper side with a pivoted horizontally-swinging fly, c^4, having a notch or recess in its outer end, and providing the standard A with a fixed plate, J, having in its under side a circular concentric groove, to receive the fly c^4, and a stud, c^5, to engage therewith, as shown in Figs. 2, 4, and 5. The rotation of the disk I with the arm K thereon, carries the fly c^4 round and round within the grooved plate J past the stud c^5. When the machine is running forward continuously in one direction the fly is turned to one side, and the stud passes the same from its pivoted end toward its free end without causing any

material movement of the arm K, but when the motion is reversed and the stud carried toward the free end of the fly, as shown in Fig. 4, it engages therein, and turns the fly over upon its pivot, and in so doing causes the fly to push the arm K back, as shown in Fig. 5, and thereby operate the take-up arm N. After the fly is turned the parts may continue their motion in the new direction without causing any further action of the fly or take-up, but the instant the motion is reversed the fly and take-up will be again operated.

It will thus be seen that, although the machine can run continuously in either direction without operating the take-up, the latter is automatically brought into action each and every time the reversal of the motion occurs to produce a slack thread.

The essential feature of the take-up is the pivoted fly, acting as described, and it is obvious that it may be used with take up devices of any suitable construction other than that shown.

In order to provide for the adjustment and operation of the needles to produce different fabrics and accomplish results not attainable in other circular machines, hereinafter described, I employ a series of small slides called needle-bits, operated by a special set of cams, for the purpose of moving the needles into such position that they will be operated and caused to form stitches by the usual cams in the usual manner.

Instead of arranging the parts as usual, so that the needles always remain in position to be caught and moved by their operating-cams, I so arrange them that, although the motion of the operating-cams continues, they will not move the needles until the latter have first been moved up thereto by means of the needle-bits actuated by the special cams. The cams which operate the needle-bits are arranged so that they can be thrown into and out of action at will, so that in order to have the needles remain at rest out of action it is only necessary to throw the needle-bit cams out of action, the result of which is that the bits are not moved, and, consequently, the needles not pushed up into the path of their operating-cams. By this arrangement I am enabled to throw the needles out of action instantly without removing them from the machine.

In order to permit a portion of the needles to be thrown out of action without affecting the operation of the others, I use bits of different forms operated by different cams, so that although one series of cams and bits may be thrown out of operation the remainder will be unaffected thereby. By this arrangement the machine is adapted for the production of either a tubular web or a single or two separate flat webs with selvage edges, either of them with a plain or a ribbed surface, as preferred.

The construction and operation of the needle-bits will be readily understood upon reference to Figs. 9, 10, 11, 12, 17, 18, 19, and 20. The needles are made of the usual form, as shown in Figs. 17 and 19, with a lateral projection or heel, 22, at the middle, to engage with the operating-cam, and, as usual in this class of machines, they are simply placed loosely in grooves in the cylinder and the dial-plate, so as to slide freely therein.

The bits for setting the needles consist simply of small metal slides *s s'*, such as shown in Figs. 17, 18, 19, and 20, of such size and form as to fit into the needle-grooves upon the back ends of the needles, and fill said grooves out flush with the surface of the dial and cylinder, as shown in Figs. 9, 10, 11, and 12. The needles and the bits are free to slide in the grooves independently of each other, except when the forward ends of the bits strike against the heels 22 of the needles.

The bits are used in the same manner with both the vertical and horizontal needles, although the difference in location, of course, necessitates a corresponding difference in the form and arrangement of the operating-cams.

In order to permit the operation of the bits and needles on one side of the machine, while those on the other side are idle, I provide two different sets of bits and corresponding cams, so that each cam, while operating one set of bits and needles, will permit the others to pass by without moving them, so that both sets of needles may be operated at once, or either set operated alone, or the two operated alternately, as will be hereinafter more fully explained.

Figs. 9, 10, 14, 15, and 16 illustrate the manner in which the horizontal needles and their bits are moved. R, Fig. 9, represents the horrizontal cam-plate, and 13 the cam-groove therein, made of a circular concentric form and provided on opposite sides of the machine with the two eccentric or cam portions 13′, by which the needles are advanced and retracted, as usual. The office of the cams is to push the needles outward until their heels enter the eccentric or cam portions 13′, for unless this is done the heels will continue to travel within the circular groove, and the needles will remain at rest in the dial-plate, notwithstanding the rotation of the cam-plate. The needles on one side of the dial-plate are provided with long bits *s* of the form shown in Fig. 17, while those on the other side are provided with the short bits *s'* of the form shown in Fig. 19, as will be clearly seen in both Figs. 9 and 10. The cam-plate R is provided with grooves for the ends of the bits to travel in, and in these grooves there are mounted two cams, *k* and *m*, on opposite sides of the center, to act upon the short bits *s'*, and two cams, *j* and *l*, also on opposite sides of the center, to act upon the short bits *s'*, as clearly represented in Figs. 9 and 10.

As the needles and bits are carried around by the rotation of the dial-plate, the cams *j*, *k*, *l*, and *m* act against the bits, and pushing

them outward, cause them to push the needles outward far enough to be caught and operated by the main operating cams 13′. The bits do not move the needles far enough to cause them to operate, but simply set them so that they can be operated by the usual cams, as before stated. The special bit-operating cams are all of them attached to vertically-sliding rods, as shown in Fig. 10, so that they can be drawn up out of action independently of each other. By adjusting the cams, all the needles may be advanced and retracted twice during each rotation of the dial, or either set operated in this manner while the others are at rest, or either set caused to operate twice while the others are operating once, or both sets caused to operate once at each revolution, or, finally, both sets stopped entirely.

The manner in which the above cams are held and adjusted, and their connection with the cams of the vertical needles, will be hereinafter explained. The cams and needle-bits of the vertical needles are arranged and operate in the same manner as those of the horizontal needles, although, as before stated, the cams are differently shaped, owing to the fact that, instead of being in a flat plate, they are in the inner face of the ring Y surrounding the needle-cylinder, as shown in Figs. 11, 12, 25, and 26.

The vertical needles, like the horizontal, are divided into two equal sets, those on one side of the machine being provided with the long bits, and those on the opposite side with short bits, as shown in Figs. 11 and 12, in which figures *n* and *p* represent the cams for operating the short bits; *o* and *q* the cams for operating the long bits, and y^1 the main operating-cam groove, by which the needles are operated after being raised by the bits. The cam-groove y^1 extends around within the ring Y, in a continuous straight line, so that the ring can rotate without operating the needles; but on opposite sides of the machine the groove is provided with deviating portions y^2, forming cams, as shown in Figs. 11, 12, 25, and 26, which serve to operate the needles whenever they are started up therein by the action of the bits. When the bits fail to raise the needles out of the straight portion of the groove, the cams pass by without moving the needles. The bit-operating cams *n*, *p*, *o*, and *q* are so arranged that they can slide outward clear of the bits, so as not to act thereon, and are each provided with an operating stem or rod extending through the ring, and protruding on the outside, as shown in Figs. 11, 12, 26, 27, and 28, by means of which rods the cams may be thrown into and out of action at will, independently of each other, so as to obtain the same action of the needles as before described, in speaking of the horizontal needles.

It will be observed that there are in the machine four pairs of needle-bit cams, one pair for the long, and another pair for the short, bits of the horizontal needles, and the same for the long and short bits of the vertical needles. Four of the cams, one of each pair, are entirely independent of each other, and may be thrown into and out of action without reference to each other, while the remaining four are connected in such manner as to be thrown into and out of action all at the same time. This is effected by placing around the cam-ring Y a loose ring or plate, *c*, provided with slotted cam-plates *d* and *e*, as shown in Fig. 29, one of said plates operating a long bit-cam, *o*, on one side of the machine, while the other operates a short bit-cam, *n*, on the opposite side of the machine. The ring *c*, termed the shifting-ring, is also provided with a vertical slotted cam-plate, *f*, as shown in Figs. 29 and 30, which engages, as shown in Fig. 14, with the lower end of a vertically-sliding rod, *h*, pivoted at its top to a lever, *i*, which is pivoted at its middle to the horizontal cam-plate R, and provided at its inner end with two arms, which are pivoted, as shown in Fig. 15, to the shifting rods or stems of the two horizontal needle-bit cams *j* and *k*.

Upon turning the ring *c* around the cam-ring Y, the slot-cams *d* and *e* shift the cams *o* and *q* of the vertical needles, while the cam *f*, through the rod *h* and lever *i*, shifts the cams *j* and *k* of the horizontal needles, all four cams being thus shifted simultaneously by simply turning the ring. In order to hold the ring from turning accidentally, it is provided, as shown in Fig. 29, with a spring-arm, &, to engage in notches in the cam-ring Y. The cams *l*, *m*, *p*, and *q* need not, necessarily, be provided with fastening devices, but it is preferred to provide the stem of each cam with two notches, and to lock the same by a rotating pin, flattened on one side, as shown in Fig. 28.

By the above-described arrangement of long and short bits, and the various cams for operating them, I am enabled to so control the needles as to produce a ribbed or a plain fabric, and to knit the same in a tubular seamless web, or in a single or two separate flat webs with selvage edges. When the machine is not required to perform all the operations above named the parts may be modified accordingly. The essential and important feature is the bits arranged in the grooves by the side of the needles, so that the length of the grooves and the size of the machine need not be increased.

I am aware that an attempt has been made to use false shanks, sliding in the groove behind and against the ends of the needles, to push them up and leave them standing, the parts being operated by the usual cam, divided into two parts, which were separated from each other in such manner that the shank was raised to push the needle upward, and then drawn down and the needle left standing with the stitches thereon. In their purpose and operation these shanks were totally different from the bits of my machine; and, moreover, as they required an increased space behind

the needles, they were impracticable in rotary machines, in which the working parts are necessarily limited to a very small space. While I have shown and described the vertical and the horizontal series of needles as each divided by long and short bits into two sets, operated by different cams independently of each other, it is obvious that all the needles in each series may have bits of the same form, and all be operated by the same cam or cams. Instead of simply dividing each series into two sets, they may be divided into as many sets as desired by providing a corresponding number of different bits and cams. The different bits may be distributed among the needles at will, and thereby the needles divided into independently-operating sets or groups in such manner as to produce fabrics of various styles and forms, the arrangement shown in the drawings being intended more especially for the production of stocking-legs made of a tubular seamless form down to a certain point, and below that point provided with a slit and selvage edges on each side.

Another of my improvements consists in so shaping the horizontal needle-operating cam that the needles pause during their inward movement until the adjoining vertical needles have descended past them and drawn over them sufficient thread to form the stitches. This is accomplished, as shown in Fig. 9, by widening the cam-groove 13′ at the points g^3 so that, although the movement of the dial-plate continues, the needles remain at rest therein while their heels are passing through the widened spaces. By thus arranging the parts so that the vertical needles take the thread or yarn for the stitches or loops of the horizontal needles also, I am enabled to increase the length of the stitches for ribbed work to any extent required in practice by simply raising the dial-plate without changing the cams or the movement of the needles.

Another of my improvements consists in the employment of spring pressure-feet in the horizontal cam-plate, bearing upon the needle-bits, and preventing any accidental movement of the bits or needles. These feet are made of a dovetail form, and arranged to slide in vertical grooves, and are pressed down by spiral springs, as shown at 12, Figs. 9 and 32, upon top of the bits, and pressing them upon the needles; but any other form of parts may be used.

Another of my improvements consists in a peculiar manner of adjusting the needle-cylinder vertically without giving it a rotation, in order to raise and lower the jacks, for the purpose of changing the length of the stitches, with or without a corresponding adjustment of the dial-plate. As shown in Figs. 11, 12, and 14 the needle-cylinder is arranged so that it can be raised and lowered in the frame or base-plate of the machine, and is secured by screws 1 and 2 passing through said plate. The screws are distributed at suitable distances apart, and half of them arranged to bear upward against the cylinder, while the others are arranged to draw the same downward, so that by turning one set upward and the other downward the cylinder can be readily adjusted, as required.

Another of my improvements consists in beveling off the inner upper edge of the needle-cylinder, and the inner corners of the jacks, as the ribs between the needles are technically termed.

Heretofore it has been customary to bevel the inside of the cylinder in order to facilitate the downward passage of the fabric, as it is produced by the needles; but the inner or back corners of the jacks have been left square and flat on top, the consequence of which was that one or two loops always rested on top of the jacks, and that there was great friction upon the fabric in drawing it down over the inner corners of the jacks; and also that instead of the strain and tension being received upon the operating-needles, and the stitches in course of formation, it was received upon the stitches or loops resting on the jacks. These difficulties I overcome by beveling off not only the cylinder, as usual, but also the inner or rear corners of the jacks, as shown at 7, Fig. 36, thus giving each jack an inclined rear face at the upper end, and bringing the upper rear corner of the jacks forward of the rear side of the needles.

When the jacks are thus constructed the loop or stitches are cast down over and below their tops as fast as formed, the usual friction avoided, and the strain applied to the fabric received upon the working-needles.

Having thus described my invention, what I claim is—

1. In combination with the stationary standard A and the knitting-machine C, having a stationary needle-cylinder, the vertical non-rotating suspension-rod P, having its lower end secured rigidly to the dial-plate S, and its upper end sustained in the standard by means of the thumb-nut Q, as shown, whereby the dial-plate is held from rotating without obstructing the interior of the needle-cylinder, and rendered capable of a vertical adjustment by simply turning the nut.

2. In combination with the rigid rod P, having the dial-plate S attached, the rotating sleeve H surrounding said rod, and provided with the cam-plate R, bobbin-carriers G, and take-up N, substantially as shown and described.

3. In combination with the rotating sleeve H, having the thread-guiding arms *o* and take-up N attached thereto, the stationary plate J, and mechanism for operating the take-up, said parts being constructed and arranged to operate substantially as shown and described.

4. The combination, in a take-up mechanism, of a grooved plate, J, provided with a stud or shoulder, c^5, and a vibratory arm, K, provided with a pivoted fly, c^4, substantially as shown and described.

5. The take-up mechanism consisting of the

stationary grooved plate J, provided with the stud c^5, and the rotating plate I, provided with the arm N, disk L, and lever or arm K, having the pivoted fly c^4 thereon.

6. In combination with a sliding knitting-machine needle, a sliding bit mounted by the side thereof and acting thereon, substantially as shown and described, whereby the needle is brought into position to be acted upon by the operating-cam.

7. The long and short needle-bits s and s', constructed as shown, in combination with the needles of a knitting-machine, as set forth.

8. In a knitting-machine, the combination of a series of needles and a cam or cams, to operate the same when knitting, with a series of sliding bits and special cams, for operating the same to set the needles in position to be acted upon by such operating-cams, substantially as shown and described.

9. The combination, in a knitting-machine, of a series of needles, all operated, when in action, by the same cam or cams, with two or more sets of different needle-bits for moving the needles into the path of the operating-cams, and special cams for operating each set of bits, substantially as shown and described, whereby each set of bits and their needles are operated independently of the others.

10. In a knitting-machine, the combination of a series of needles and a cam or cams for operating them when in action, with needle-setting bits for bringing the needles into position for action, and special adjustable cams for operating said bits, substantially as shown and described.

11. In combination with the adjustable ring c, connected with the cams d and e, as shown, the cam f, attached to said ring, and connected by the rod h and lever i with the cams j and k, as shown, whereby the turning of the ring serves to shift all four cams, substantially as described.

12. In combination with the sliding needles and the bits resting thereon, spring presser-feet 12, bearing on the bits, substantially as shown and described.

13. In combination with the vertical and horizontal needles, operating in connection with each other, the plate R, provided with the horizontal cam-groove, having the widened or concentric portions g^3, for permitting the horizontal needles to pause in their inward movement until the adjoining vertical needles have completed their descent, as and for the purpose stated.

14. The combination, in a knitting-machine, of the vertical and the horizontal needles and operating mechanism, substantially such as described and shown, whereby the horizontal needles are permitted to pause in their inward movement until the vertical needles have descended past them, in order that the vertical needles may take the thread for both sets of needles, as and for the purposes described.

15. In combination with the base-plate Z and the vertically-adjustable needle-cylinder X, the screws 1 and 2, the former drawing downward, and the latter bearing upward, on the cylinder, as shown.

16. The needle-cylinder X, having its inner edge and the inner edges of the jacks beveled, as shown.

17. The needle-cylinder X, provided with the jacks having their upper ends beveled on the inner or rear side to a point forward of the rear side of the needles, as shown and described, whereby the tension applied to the web is thrown directly and wholly upon the stitches held by the needles.

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