(No Model.) 7 Sheets—Sheet 1.

J. A. BURLEIGH.

CIRCULAR KNITTING MACHINE.

No. 413,597. Patented Oct. 22, 1889.

Fig. 1

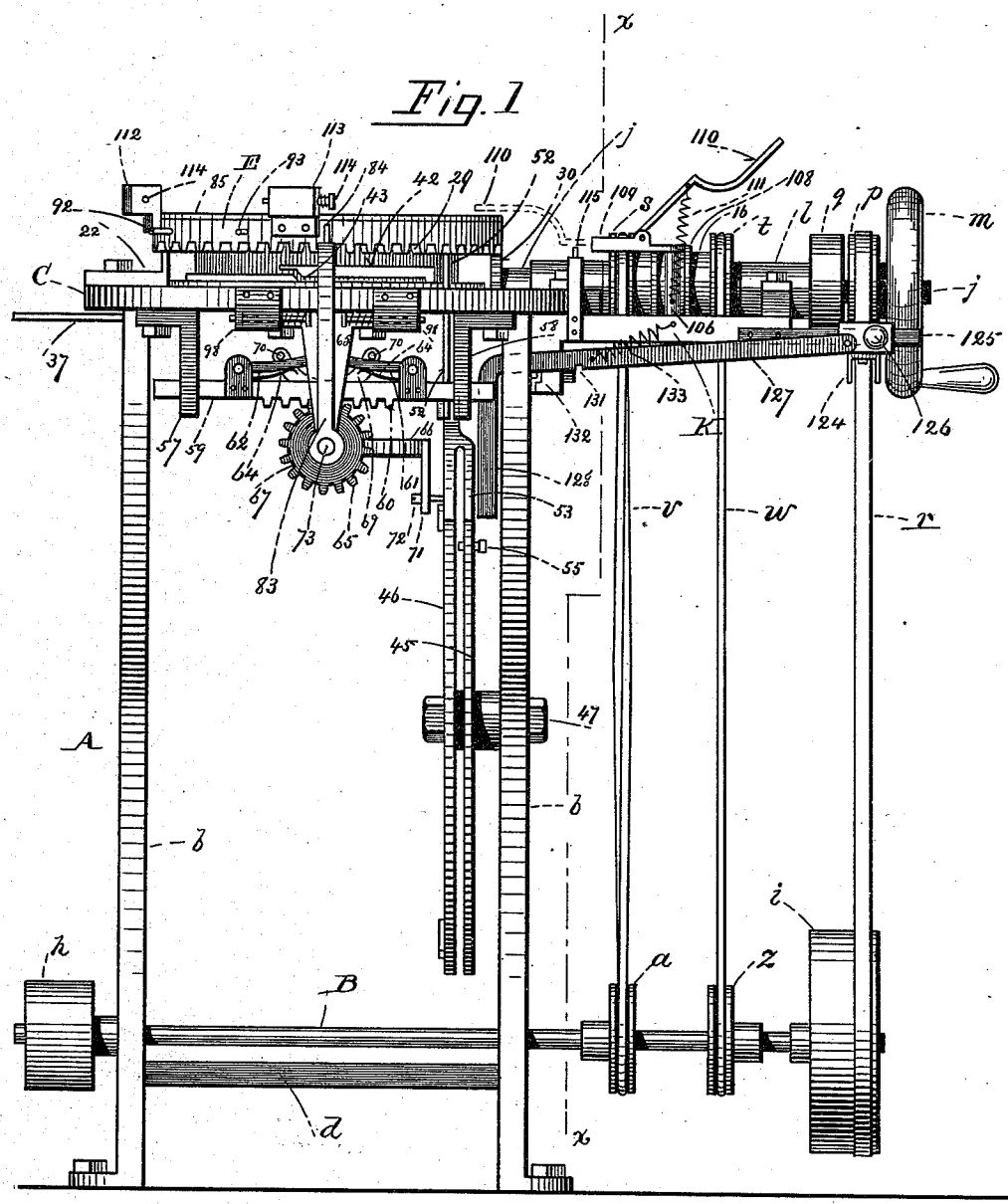

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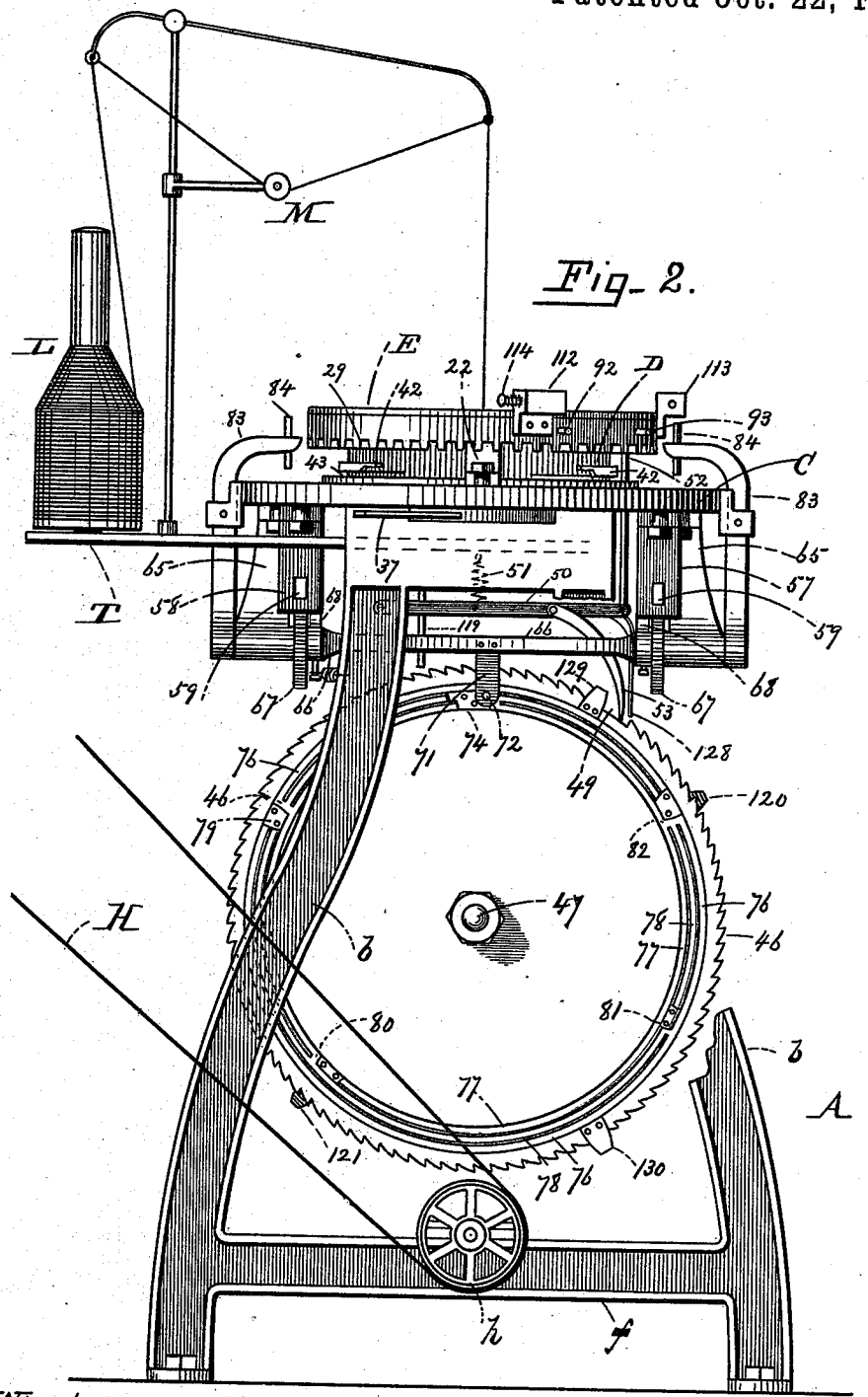
Fig. 2.



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CIRCULAR KNITTING MACHINE.

No. 413,597. Patented Oct. 22, 1889.

Fig. 3.

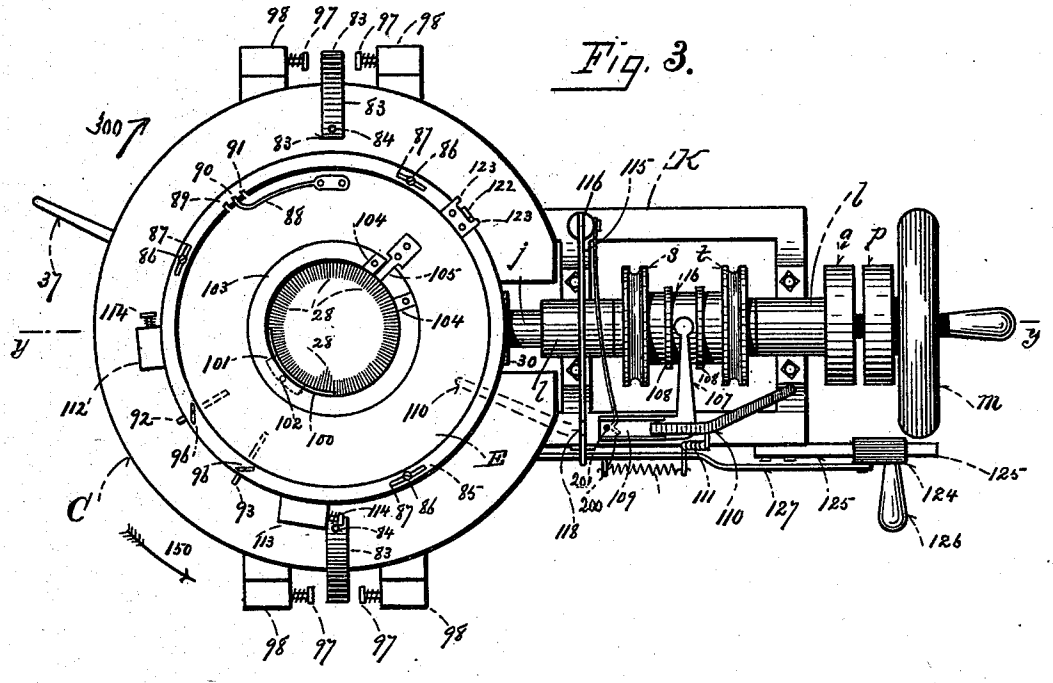
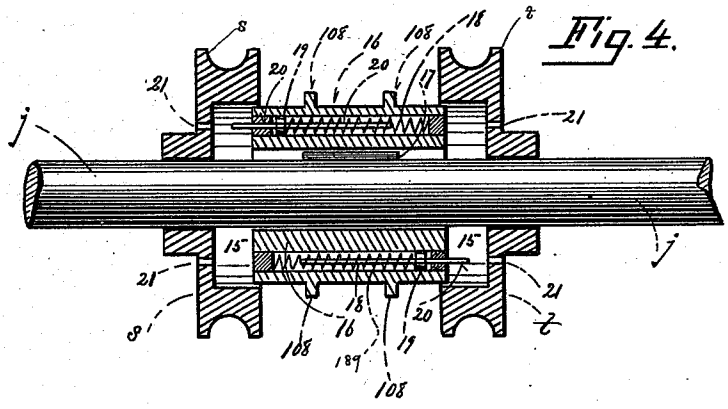


Fig. 4.



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CIRCULAR KNITTING MACHINE.

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Fig. 5

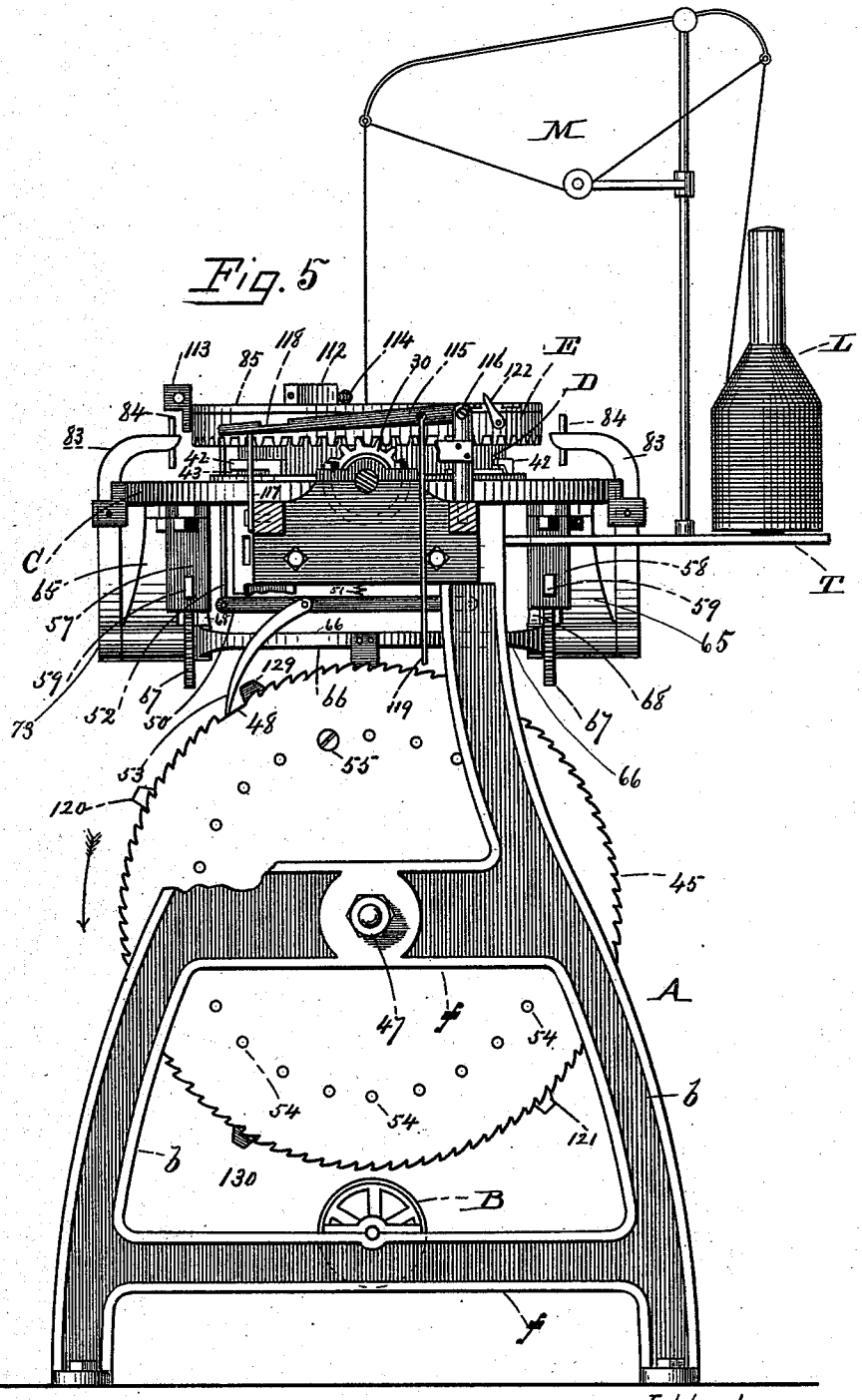

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Fig. 7.

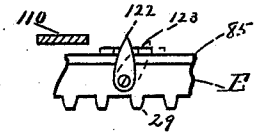


Fig. 6.

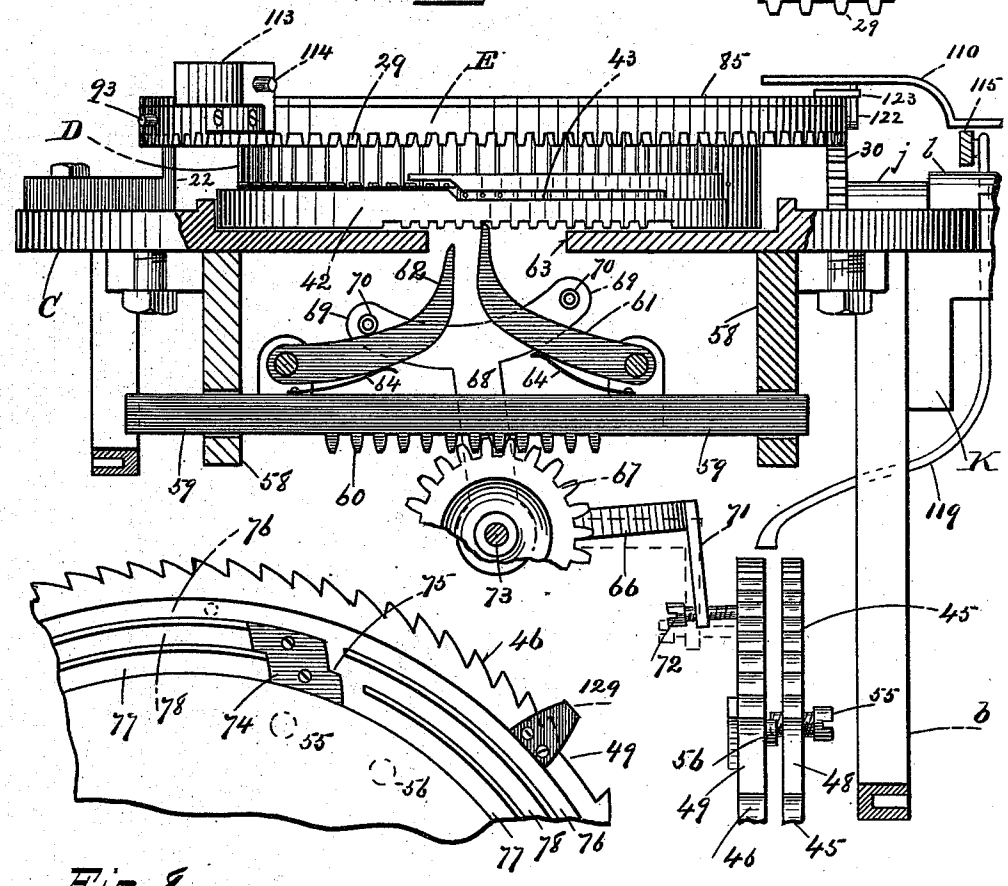
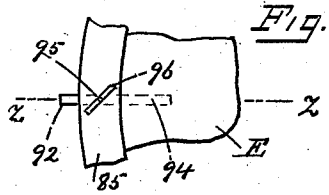


Fig. 8.

Fig. 9.



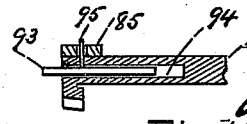


Fig. 10.

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Fig. 11.

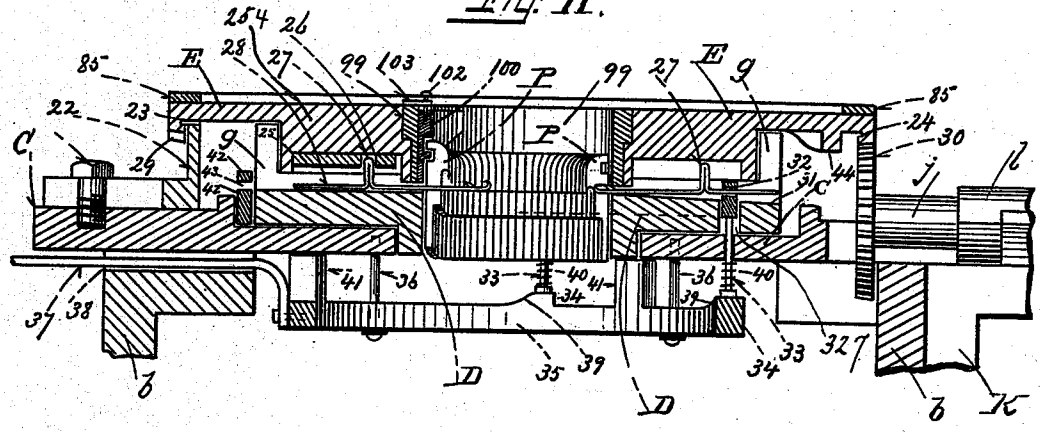
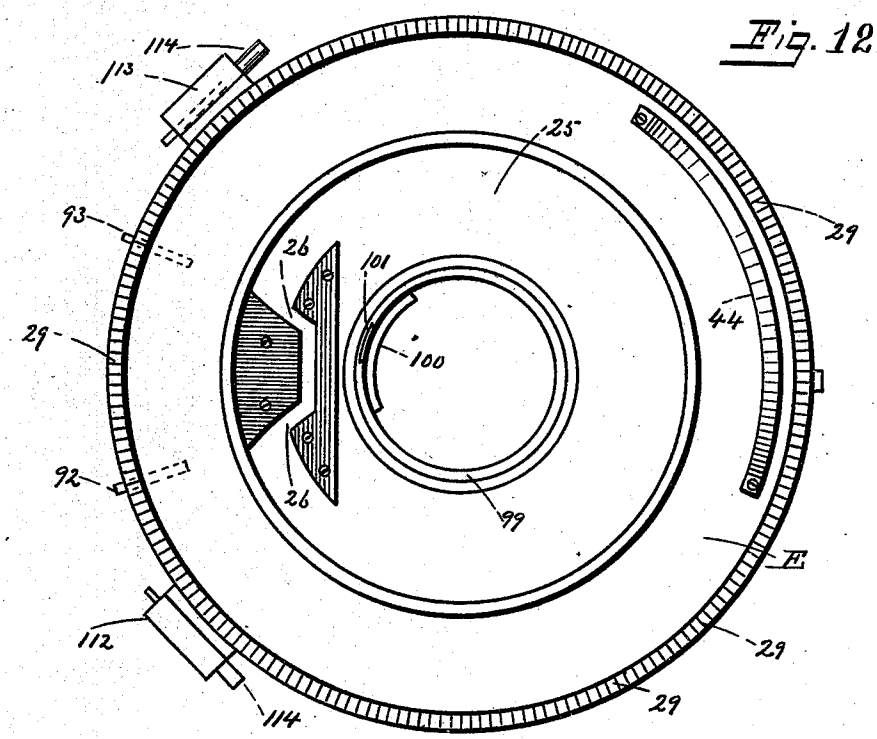


Fig. 12.



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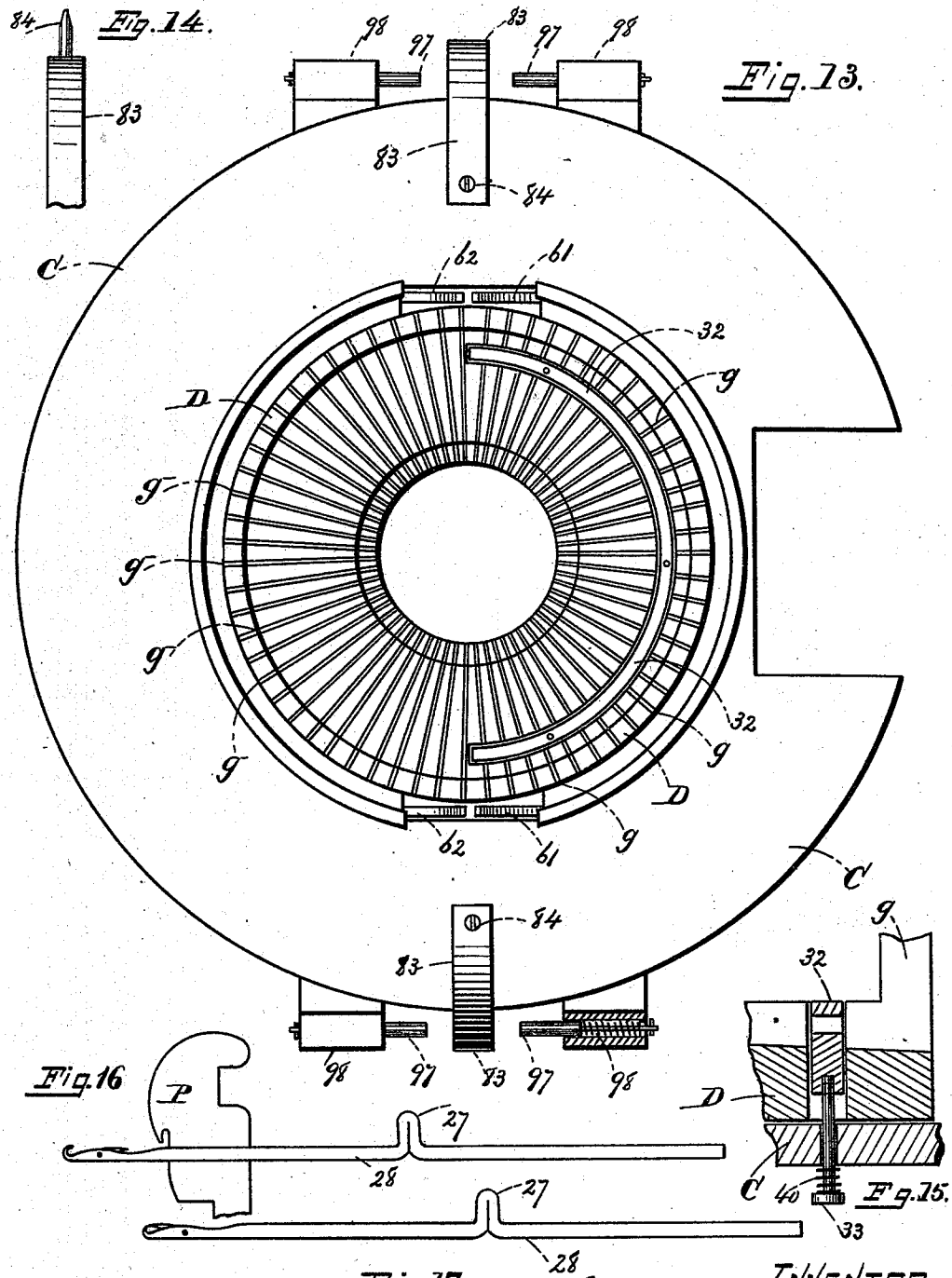

Fig. 14.

Fig. 13.

Fig. 16

Fig. 17.

Fig. 15.

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UNITED STATES PATENT OFFICE.

JOSEPH A. BURLEIGH, OF LAKE VILLAGE, NEW HAMPSHIRE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO HIMSELF, AND GEORGE D. BURTON, OF BOSTON, MASSACHUSETTS.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 413,597, dated October 22, 1889.

Application filed January 10, 1889. Serial No. 295,912. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH A. BURLEIGH, of Lake Village, in the county of Belknap, State of New Hampshire, have invented a certain new and useful Improvement in Circular-Knitting Machines, of which the following is a description sufficiently full, clear, and exact to enable any person skilled in the art or science to which said invention appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front elevation of my improved machine; Fig. 2, an end elevation of the same; Fig. 3, a top plan view; Fig. 4, an enlarged vertical longitudinal section of the clutch, the shaft being represented as broken off; Fig. 5, a transverse section taken on line *x x* in Fig. 1; Fig. 6, an enlarged side elevation showing the needle-plate, a portion of the bed-plate being broken out; Fig. 7, a detail view showing a section of the cam-ring; Fig. 8, an enlarged sectional view of a portion of one of the ratchet-wheels. Figs. 9 and 10 are views of details; Fig. 11, a view in vertical section, taken on line *y y* in Fig. 3; Fig. 12, a plan view showing the under side of the cam-plate; Fig. 13, an enlarged top plan view of the needle-plate; Figs. 14 and 15, sectional views illustrating certain details of construction, and Figs. 16 and 17 enlarged elevations of the needles and sinker.

Like letters and figures of reference indicate corresponding parts in the different figures of the drawings.

My invention relates to that class of knitting-machines which are known as "circular machines;" and it consists in certain features, as hereinafter fully set forth and claimed, the object being to produce a simpler, cheaper, and more effective device of this character than is now in ordinary use.

The nature and operation of the improvement will be readily understood by all conversant with such matters from the following explanation.

In the drawings, A represents the frame of the machine; B, the driving-shaft; C, the bed-plate; D, the needle-plate, and E the cam-plate. The frame A consists of two sets of legs *b*, connected by cross-pieces *d* and girders *f*. The bed-plate C is circular and is secured horizontally to the top of the frame. The needle-plate D, which is of the ordinary circular form and provided with vertical slots *g*, (see Fig. 13,) in which the needles play, is centrally disposed in the bed-plate in the usual manner. The main shaft B is journaled centrally in the lower portion of the frame A, and bears a driving-pulley *h* at one end and a similar pulley *i* on the opposite end, the main belt H passing around the pulley *h*. A horizontally-arranged bracket K is secured at the top of one set of legs *b* (see Fig. 3) and projects laterally therefrom. A horizontal shaft *j* is journaled in suitable bearings *l*, secured to said bracket, said shaft bearing a crank-wheel *m* on its outer end and a loose pulley *p* and fast pulley *q* between said wheel and the adjacent bearing *l*. The pulley *p* is connected with the pulley *i* and the shaft B by a belt *r*. Two locse pulleys *s t* are disposed on the shaft *j* between the bearings *l*, said pulleys being respectively connected by a crossed belt *v* and straight belt *w* with fixed pulleys *a z* on the shaft B. The pulleys *s t* are chambered in their adjacent sides, as shown at 15 in Fig. 4, to receive a sleeve 16, fitted to slide longitudinally on the shaft *j* between said pulleys, a spline 17 on said shaft preventing the sleeve from revolving. Two or more longitudinally-arranged chambers 18 are formed in the body of the sleeve, (see Fig. 4,) and fitted to slide in each of said chambers is a block 19, in which a horizontally-arranged pin 20 is secured, said pins projecting through opposite end walls of said chambers into the chamber 15 of the pulleys *s t*, respectively. The pins 20 register with a series of holes 21, formed in the pulley-bodies to receive them as said sleeve is moved in either direction on the shaft *j*. A coiled spring 189, disposed around each pin 20 between the block 19 and opposite end wall of the chamber 18, acts expansively to keep said pins projecting into the chamber 15 of the pulleys *s t*, said sleeve and pulleys and their adjunctive mechanism form-

ing a shifting device for reversing the motion of the machine, the operation of which is hereinafter described. The cam-plate E is fitted to rotate horizontally on standards 22, (see Fig. 11,) bolted to the bed-plate C, the upper ends of said standards having outwardly-projecting flanges 23, which work in an annular groove 24, formed in said cam-plate. An annular central portion 254 of the cam-plate projects downward (see Figs. 11 and 12) into a corresponding annular socket in the needle-plate and forms the main bearing of said portion, being provided on its under side with a cam-track 26, (see Fig. 12,) into which the knuckles 27 of the needles 28 enter, and by which they are actuated as the cam-plate is revolved, the needles employed being the ordinary latch-needles, as shown in Figs. 16 and 17. The lower edge of the periphery of the cam-plate is toothed at 29, said teeth intermeshing with the teeth of a gear 30 on the inner end of the shaft *j*, by which the cam-plate is actuated. The needles 28 play horizontally in the grooves 25 toward the center of the needle-plate, the bottoms of five-sixths of said grooves at that side of the machine which is at the right hand of Figs. 11, 12, and 13 sloping or inclining outward and downward, as shown at 31 in Fig. 11, the heels of one-half of the needles sliding through a slot in a semicircular horizontally-arranged bar 32, (see Figs. 11 and 13,) which is placed in an arc-shaped slot 327 in the needle-plate, and is supported by vertical rods 33, fitted to slide through openings in the bed-plate C and resting upon upwardly-projecting studs 34 on the periphery of a circular frame 35, supported by and adapted to be rotated horizontally on bolts 36, secured in said bed-plate. A handle 37, secured to the frame 35, projects through a horizontal slot 38 in the frame A at the left of the machine, as illustrated in Fig. 1, whereby the frame 35 may be rotated. The studs 34 slope or incline on one side at 39, (see Fig. 11,) and a coiled spring 40 is disposed around each rod 33 between the lower end thereof and the bed-plate, said springs acting expansively to hold the rods in engagement with said studs. The purpose of the frame 35, bar 32, and connecting mechanism is to depress the heels of the needles which work therein, and thereby lower their knuckles, so that they will not enter the cam-track 26 as the cam-plate revolves, thus throwing said needles out of action. Vertical stops 41 on the frame 35 engage the bed-plate and prevent said frame from lifting on the bolts 36. Two curved rack-bars 42 (see Figs. 2, 6, and 11) are fitted to slide in the bed-plate on the side opposite the bar 32, said rack-bars being provided in their upper portions each with a horizontal slot 43, for receiving and depressing the heels of a certain number of needles at the rear and front of the machine, as illustrated in Fig. 1, thereby throwing them out of action. A downwardly-projecting segmental cam 44 (see Figs. 11 and 12) is secured to the under side of the cam-plate E, near the periphery thereof. Two large ratchet-wheels or disks 45 and 46 (see Figs. 1, 2, 5, and 6) are journaled on a stub-shaft 47, centrally disposed in a girder *f* of the frame A, said wheels being each provided with a "slip" or long tooth 48 and 49 in their periphery. A horizontal lever 50 (see Figs. 2 and 5) is pivoted by one end at the rear of the frame A, and is supported in position by a spring 51, secured to said frame. A vertical rod 52 is pivoted to the free end of said lever and passes upward through the bed-plate, its upper end being in position to be engaged by the cam 44 on the cam-plate. A forked pallet 53 is pivoted to the lever 50, its points respectively engaging the teeth of said ratchet-wheels, whereby they are revolved as the cam 44 forces said lever downward. The wheel 45 is provided with a circular series of holes 54, (see Fig. 5,) adapted to receive a screw 55, which projects through said wheel in position to engage a stud 56 on the inner face of the wheel 46, as shown in Fig. 6. Two sets of downwardly-projecting arms 57 and 58 are bolted to the under side of the bed-plate between the legs *b*, (see Figs. 1, 2, 5, and 6,) and fitted to slide in each set of arms is a horizontally-arranged rack-bar 59, provided centrally on their under side with teeth 60. To the upper side of each rack-bar 59 are pivoted two actuating-pawls 61 and 62, (see Fig. 6,) so disposed that the free ends of each set are adjacent and in position to be projected upward through an opening 63 in the bed-plate into engagement with the teeth of the curved rack-bars 42. Flat springs 64, secured to the rack-bars 59, act to hold said pawls in engagement with the teeth of the curved rack-bars.

The bed-plate is provided with two dependent brackets 65 at diametrically-opposite points, as shown in Fig. 5. Two short shafts 73 are journaled horizontally in bearings at the lower ends of these brackets. The opposite ends of a curved bar 66 are loosely supported on the inner ends of said shafts, and pinions 67 are fixed on said shafts near their inner ends, adjacent to the ends of said curved bar. Each of these pinions meshes with the teeth 60 on one of the rack-bars 59, as shown in Fig. 6. Secured to the ends of the curved bar 66, near each pinion 67, is a vertically-arranged rod 68, provided with laterally-projecting arms 69, having studs 70, adapted to engage the pawls 61 and 62 and force them out of contact with the teeth of the rack-bars 59. (See Fig. 6.) Secured centrally to the curved bar 66 is a downwardly-projecting brace 71, (see Fig. 6,) having a horizontally-arranged screw-stud 72 in its lower end, the point of said stud projecting into cam-tracks formed on the outer face of the ratchet-wheel 46. These cam-tracks (see Figs. 2 and 8) are circular, being three in number and formed parallel with each other. A cam-plate 74, provided with a shoulder 75,

is interposed in said tracks centrally at the top of the wheel 46, when in the position shown in Fig. 2. As said wheel is rotated from left to right, when viewed as in Fig. 2, the plate 74 guides the stud 72 into the outer track 76, in which it remains until at determined distances it is directed into the inner track 77 and center track 78 by cam-plates 79, 80, 81, and 82, the action of which on said stud being hereinafter set forth. Secured by its lower end to the outer end of each stub-shaft 73 there is a lever 83, which projects upward and inward over the edge of the bed-plate at the front and rear of the machine as viewed in Fig. 1, a vertically-arranged pin 84 being secured in the upper end of each of said levers, said pins having their ends beveled, as shown in Fig. 14. A flat ring 85 is secured on top of the cam-plate E by screws 86, (see Fig. 3,) which pass through slots 87 in said ring, permitting a reciprocating movement thereof. A flat spring 88, secured to the top of the cam-plate E, has its free end projecting into one of three holes 89, 90, and 91, (see Fig. 3,) formed in the inner edge of the ring 85, whereby it is detachably secured in position on said cam-plate. Two horizontally-arranged pins 92 and 93 (see Figs. 3, 9, 10, and 12) are respectively fitted to slide in a chamber 94, (see Fig. 10,) formed in the body of the cam-plate E. To each pin 92 and 93 is secured a vertically-arranged pin 95, fitted to slide in a diagonal slot 96, formed in the ring 85, said pins projecting above the surface of said ring, and the slots 96 converging outwardly toward each other, as shown in Fig. 3. The pins 92 and 93 project beyond the periphery of the cam-plate E, and are thrown outward into position to engage the pins 84 on the levers 83, and actuate said levers when the pins 95 are moved in the slots 96, as hereinafter set forth. Spring-cushioned bunters 97 are secured in legs 98 at each side of the levers 83 to return said levers into position when moved by a pin 92 or 93. The sinkers P, which are of the ordinary construction, (see Figs. 11 and 16,) are disposed in the needle-plate in a usual manner. A ring 99 (see Fig. 11) rests loosely on a shoulder in the central portion of the cam-plate E, being fitted to rotate therein. The segmental sinker cam-plate 100 is provided on its upper face with a vertical dovetail block which rests in a vertical dovetail groove 101, formed in the ring 99 adjacent to the cam-track 26, as shown in Figs. 11 and 12. A flat ring 103 (shown in plan in Fig. 3 and in section in Fig. 11) rests on the ring 99, and an adjusting-screw 102 passes through and turns loosely in the flat ring 103 and takes into a screw-threaded hole in the upper edge of the sinker-cam 100, said cam being adjusted vertically by turning the screw 102. Two stops 104 are secured to the ring 103, (see Fig. 3,) and a horizontal arm 105 on the cam-plate E projects over said ring between the stops and carries the ring 99 and sinker-cam 100 with said cam-plate as it is rotated in either direction. A bell-crank lever 107 109 is pivoted to work horizontally to the top of a vertical standard 106 (see Fig. 1) on the bracket K, one arm 107 of said lever projecting over the sleeve 16 on the shaft *j* between annular flanges 108 (see Fig. 3) on said sleeve, the purpose of the lever being to move the sleeve on the shaft so that the pins 20 will secure it to a pulley *s* or *t*. The opposite arm 109 of the bell-crank lever is grooved longitudinally on its upper side, (see Fig. 3,) and a curved lever 110 is hinged near the pivotal point of the bell-crank lever in position to fall into said groove, said lever 110 being of sufficient length to project over the top of the cam-plate E when in a horizontal position, as shown by dotted lines in Fig. 1. A coiled spring 111 (see Fig. 1) connects the lever 110 with the standard 106, said spring acting contractively to retain said lever in position when elevated or depressed. Two lugs 112 and 113 are secured to the periphery of the cam-plate E, and a spring-cushioned buffer 114 is disposed in each of said lugs, the purpose of the buffers being to engage the lever 110 at certain intervals and actuate the bell-crank lever. A lever 115 is pivoted by one end to a standard 116 (see Figs. 3 and 5) on the rear side of the bracket K, the free end of said lever resting on a stop 117 (see Fig. 5) on the front of said bracket. A slot 118 is formed in the lever 115 to receive the lever 110 when said lever 115 is elevated. A downwardly-projecting curved rod 119 (see Fig. 6) is secured by its upper end to the lever 115, its lower end projecting inwardly over the wheel 46 in position to be engaged by two radial studs 120 and 121 (see Fig. 2) on the inner side of the periphery of said wheel as it revolves, thereby causing said rod to elevate the lever 115, so that the lever 110 may enter said slot 118, whereby the bell-crank lever may be centered, as hereinafter described, so that its arm 107 will disconnect the sleeve 16 from both pulleys *s t* and permit them to work loosely on the shaft. A flat spring 200 is secured to the standard 116, Fig. 3, its free end engaging a pin 201 on the bell-crank lever, and preventing said lever from being accidentally moved when centered, as described, so as to thereby move said sleeve into engagement with a pulley *s* or *t*. A bar 122, (see Figs. 3, 6, and 7,) beveled on its upper edges, is pivoted by its lower end to the periphery of the cam-plate E, and projects upwardly between the arms of a forked plate 123, secured on the ring 85, the beveled end of said bar being designed to strike the lever 110 when depressed, (see Figs. 6 and 7,) causing the ring 85 to move and actuate the pins 92 and 93 (see Fig. 3) in the cam-plate. An ordinary belt-shipper 124 is fitted to slide on a horizontal bar 125, (see Figs. 1 and 3,) secured to the bracket K, said shipper being provided with a handle 126 and designed to ship the belt *r* on the pulleys *p q*. Pivoted by one

end to the shipper 124 there is a horizontally-arranged lever 127, (see Fig. 1,) having a downwardly-projecting arm 128 on its inner end, said arm being in position to be engaged by one of two studs 129 and 130, secured to the outer face of the ratchet-wheel 46 and projecting beyond the periphery thereof (see Figs. 2, 5, and 8) when the belt *r* is shipped onto the fast pulley *q*. A slot 131 (see Fig. 1) is formed in the edge of the lever 127 to receive a hook 132 on the frame A and detachably secure said lever thereto, and a coiled spring 133 connects the lever 127 with the bracket K, said spring acting contractively to return said lever when released from the hook and automatically ship the belt *r* from the fast pulley *q* onto the loose pulley *p*. The ordinary yarn-spool L, tension mechanism, and guides M are supported on a bracket T, secured to the frame A.

As the device described is particularly designed for knitting stockings, its operation will be explained in that connection. In starting the machine, the parts being in the position shown in Fig. 1, the operator ships the belt *r* onto the fast pulley *q* by means of the shipper 124. This causes the shaft *j* to revolve the cam-plate E from left to right, or in the direction indicated by arrow 300 in Fig. 3. The needles, which are disposed in the needle-plate D as described, are actuated by the cam-track 26 on said cam-plate, all of said needles being in action to knit the leg portion of the stocking. The cam 44 (see Fig. 12) on the cam-plate E at each revolution thereof engages the rod 52, Fig. 5, and forces the pallet-lever 50 downward, causing the pallet 53 to advance the ratchet-wheel 45 the distance of one tooth for each "course" that is knitted. The opposite arm of the pallet 53 meanwhile works in the slip or broad tooth 49 of the ratchet-wheel 46 without moving said wheel. As a tooth on the wheel 45 represents a course on the stocking-leg, the length of said leg is determined by the distance said wheel is permitted to revolve. This is determined by the screw 55, inserted in one of the series of holes 54, so that it shall engage the stud 56 on the wheel 46 at a determined point and start said wheel for the process of narrowing. When the wheel 46 is started, as described, a stud 129 on said wheel will engage the end of the arm 128 of the lever 127, Figs. 1 and 2, freeing said lever from the hook 132. The spring 133 at once draws the lever 127, unshipping the belt *r* from the fixed pulley *q* and stopping the machine, indicating to the operator that the leg is completed. The handle 37 is now forced rearward, revolving the frame 35, Fig. 11, and causing the studs 34 to slide from under the rods 33, the springs 40 lowering said rods and the slotted bar 32, supported thereby, Figs. 11 and 13, said bar depressing the heels of one-half of the needles, so that their knuckles will not enter the cam-track 26, thereby throwing said needles out of action. The operator now depresses the lever 110 into the position shown by dotted lines in Fig. 1 and draws said lever toward the front of the machine, causing the arm 107 of the bell-crank lever, Fig. 3, to force the sleeve 16 toward the body of the machine until the rods 20 therein enter holes 21 in the loose pulley *s*, rendering it a fast pulley. The crossed belt *v*, connecting the pulley *s* with the main shaft, causes the shaft *j* to rotate in the direction opposite to that in which it started, being in a direction from right to left, as indicated by arrow 150 of Fig. 3, and hence the cam-plate to revolve in a corresponding direction. As the cam-plate revolves, a bunter 114 in the lug 113 on said plate engages the lever 110, causing the bell-crank lever to throw the sleeve 16 into engagement with the opposite pulley *t*, fixing said pulley, and again reversing the movement of the shaft *j* by means of the belt W. The bunter on the lug 112 next engages the lever 110 and again reverses the machine. A reciprocating movement is thus imparted to the cam-plate E so long as the lever 110 is depressed or in position to be engaged by the bunters in the lugs 112 and 113. The cam 44 on the cam-plate E actuates the pallet 53 to rotate the wheel 46 in the same manner as it rotated the wheel 45, the arm of said pallet over said wheel 45 meanwhile working in the slip or broad tooth 48 thereof. When the wheel 46 is started by the screw 55 in the wheel 45, as described, the screw-stud 72 is resting on the shoulder 75, Fig. 8, of the cam-plate 74, or in the position shown in Fig. 2. As said wheel advances, the stud 72 works upward on said cam-plate into the outer track 76, thereby forcing the curved bar 66 (see Figs. 2 and 6) upward, and throwing the vertical arms 68, secured at each end thereof, to the left, as viewed in Fig. 6. The studs 70 in the arms 69 of said rods are thus forced into engagement with the pawls 62 at the front and rear of the machine, depressing the same and throwing them out of engagement with the curved rack-bars 42. The companion pawls 61 are at the same time released from the studs of the opposite arms 69 and thrown by their springs 64 into engagement with the curved racks 42, as shown in Fig. 6. During the reciprocating movements of the cam-plate E the beveled end of the pivoted bar 122 engages the lever 110 (see Fig. 6) with sufficient force to move the ring 85 on said cam-plate and slips under said lever without disturbing its position. The movements of the ring 85 alternately project the horizontal pins 92 and 93 from their chambers, Figs. 1, 9, and 10, so that they respectively engage the beveled vertical pins 84 in the levers 83, Figs. 1, 13, and 14, causing them to alternately move the shafts 73, pinions 67, and the horizontal rack-bars 59 the distance of one tooth 60. This movement of the rack-bars 59 causes their actuating-pawls 61 to alternately move the curved rack-bars 42, Fig.

6, a corresponding distance toward each other, and at each such movement the heel of a needle is made to enter the slot 43 in each of said curved rack-bars, and thus be thrown out of action. One hundred and thirty-two needles are employed in the machine, as described, the slotted bar 32 throwing one-half (or sixty-six) of them out of action, and the curved rack-bars 42 throwing out twenty-two each at the front and rear of the machine, leaving twenty-two needles at the central left-hand portion of the needle-plate, as viewed in Fig. 13, continually in action. When the curved rack-bars 42 have thrown the required number of needles out of action, the wheel 46 has advanced so that the stud 72 encounters the cam-plate 79, Fig. 2, and is directed thereby into the inner track 77 on said wheel, the process of narrowing for the heel portion of the stocking having been completed and the process of widening about to begin. As the stud 72 enters the inner track 77 it draws down or depresses the curved bar 66 and causes the studs on the arms of the bars 68 to depress the actuating-pawls 61 and permit the companion pawls 62 to engage the teeth of the curved rack-bars 42, which are alternately moved back in the same manner as they were moved forward until all of the twenty-two needles are released from the slots 43 in both of said rack-bars and put into action again. This completes the process of widening for the heel portion, and the stud 72 meets the cam-plate 80 in the track 77 on the wheel 46, being directed thereby into the central track 78, thereby drawing the bar 66 downward sufficiently to depress both actuating-pawls 61 and 62 and hold them out of engagement with the curved rack-bars, as shown in Fig. 1. At the same time the stud 121 on the inner side of said wheel engages the end of the curved rod 119, Fig. 6, forcing said rod upward, and with it the lever 115, until it engages the lever 110. The bunter 114 in the lug 113 now engages the lever 110, moving it until it reaches the slot 118, into which the tension of its spring 111 draws it. This centers the bell-crank lever, disconnecting the sleeve 16 from both pulleys *s t*, allowing them to slip on the shaft *j* and the machine to stop. The knitting of the straight portion of the stocking-foot is now begun, the operator elevating the lever 110 to prevent the reciprocating movement of the cam-plate and drawing the handle 37 of the frame 35 toward the front of the machine, thereby elevating the heels of the sixty-six needles in the bar 32 in position for action. The belt-shipper 124 is now moved to ship the belt *r* onto the fast pulley *q* again and the knitting proceeded with in the same manner as in forming the leg portion. The ratchet-wheel 46 continuing to advance, a stud 130 thereon, Fig. 2, engages the end of the lever 127, shipping the belt *r* onto the loose pulley *p* and again stopping the machine. The sixty-six needles at the right of the machine are now thrown out of action again, as before, and the lever 110 again depressed, the machine being started by moving said lever and making fast the pulley *s*, as in the first narrowing process. The stud 72 meanwhile is engaged by a cam-plate 81 on the wheel 46 and directed thereby into the outer track 76 again, the curved rack-bars 42 being operated as before, the movement of said stud permitting the pawls 61 to engage them, and the process of narrowing for the toe portion of the stocking is thereby begun. The cam-plate 82 engages the stud 72 as the wheel 46 revolves and directs it into the inner track 77, thereby depressing the pawls 61 and throwing the pawls 62 into engagement with the curved rack-bars 42 to begin the final widening at the toe portion of the stocking. Immediately before the engagement of the stud 72 by the cam-plate 82 the stud 120 on the wheel 46 engages the curved bar 119, centering the sleeve 16 and stopping the machine as before. The machine is again started by the belt-shipper, said belt having been left on the loose pulley *p* after the straight knitting of the foot, as described. This last stopping is not absolutely necessary in the process of knitting; but it serves to notify the operator that the final widening of the toe, which only consists of a very few stitches, has begun and that the stocking is about completed. When the widening of the toe is completed, the stud 129 has again engaged the lever and unshipped the belt *r*, the stud 56, Fig. 6, has engaged the screw-stud 55 in the wheel 45 on the rear side thereof, and the pallet 53 works in the slips or long teeth 48 and 49, which now register, as shown in Fig. 6. The stocking being thus completed, the stud 72 stops on the shoulder 75 of the cam-plate 74 in position to begin the knitting of a new stocking.

Having thus explained my invention, what I claim is—

1. The combination of a needle-plate provided with radial needle-slots and with an arc-shaped slot in its body, the needles, a curved bar, as 32, disposed in said arc-shaped slot and provided with a slot through which the heels of a portion of the needles pass, and means for raising and lowering said curved bar.

2. The combination of a needle-plate provided with radial needle-slots and with an arc-shaped slot in its body, the needles, a curved bar, as 32, disposed in said arc-shaped slot and provided with a slot through which the heels of a portion of the needles pass and with dependent rods, as 33, and a horizontally-adjustable frame, as 35, disposed below said curved bar and provided with cam-surfaces, as 34, for engaging said rods.

3. The combination of a needle-plate provided with radial needle-slots and with an arc-shaped slot in its body, the needles, a curved bar, as 32, disposed in said arc-shaped slot and provided with a slot through which the heels of a portion of the needles pass and

with dependent rods, as 33, a horizontally-adjustable frame, as 35, disposed below said curved bar and provided with cam-surfaces, as 34, for engaging said rods, and springs for depressing said bar when released from said cam-surfaces.

4. The combination of the needle-plate, the needles, two curved rack-bars 42, disposed around the needle-plate and provided with horizontal slots 43, a horizontal sliding rack-bar 59, disposed below each of said curved rack-bars, two spring-pawls pivoted to each of the rack-bars 59, pinions 67 in engagement with rack-bars 59, means for oscillating said pinions, and means for disengaging said pawls from said curved rack-bars.

5. The combination of the needle-bed, the needles, the cam-plate, a main shaft provided with two fixed pulleys, an auxiliary shaft provided with means for driving the cam-plate, two loose pulleys on said auxiliary shaft, crossed and straight belts connecting the fixed and loose pulleys, a longitudinally-movable sleeve splined to the auxiliary shaft between said loose pulleys, spring-cushioned pins in said sleeve for entering holes in said loose pulleys, a pivoted bell-crank lever, one arm of which engages a flanged groove in said sleeve, a curved lever hinged to the opposite end of said bell-crank lever, and bunters on said cam-plate for engaging said curved lever.

6. The combination of the needle-bed, the needles, the cam-plate, a main shaft provided with two fixed pulleys, an auxiliary shaft provided with means for driving the cam-plate, two loose pulleys on said auxiliary shaft, crossed and straight belts connecting the fixed and loose pulleys, a longitudinally-movable sleeve splined to the auxiliary shaft between said loose pulleys, spring-cushioned pins in said sleeve for entering holes in said loose pulleys, a pivoted bell-crank lever, one arm of which engages a flanged groove in said sleeve, a curved lever hinged to the opposite end of said bell-crank lever, bunters on said cam-plate for engaging said curved lever, a horizontal lever pivoted to the frame of the machine at right angles to said curved lever and provided with a slot engaged thereby, and means for raising and lowering said horizontal lever.

7. The combination of a cam-plate provided with radial chambers 94, a sliding ring, as 85, disposed on said cam-plate and provided with diagonal slots 96, a pivoted bar, as 122, for actuating said ring, a lever or stop, as 110, against which said pivoted bar abuts to move the ring in the rotation of the cam-plate, and horizontal pins disposed in the chambers of the cam-plate and provided with vertical studs engaging the slots of the sliding ring.

8. The combination of the needle-plate, the needles, curved rack-bars outside the needle-plate provided with slots for raising the heels of a number of the needles, straight rack-bars bearing actuating-pawls for moving said curved bars, vertical levers, pinions on the journals of said levers for actuating said straight rack-bars, and a cam-plate provided with pins for tripping said levers and alternately moving said curved rack-bars.

9. The combination of a curved bar, as 32, provided with a needle-slot, a horizontally-movable frame provided with projections having inclined sides, rods secured to said bar and resting on said stud, and springs for forcing said rods downward when the frame is revolved.

10. The combination of a ratchet-wheel, as 46, provided on one face with cam-plates and tracks, operative devices therefor, a pivoted bar provided with a stud working in said tracks, curved rack-bars having needle-slots, straight rack-bars provided with actuating-pawls engaging said curved bars, pinions for operating said straight rack-bars, means for actuating said pinions, bars connected to said pivoted bar, and provided with laterally-projecting arms having studs for engaging said pawls to release them from said curved rack-bars.

11. The combination of a belt-shipper for shipping the main driving-belt, a ratchet-wheel, a pallet for driving said ratchet-wheel, mechanism for operating said pallet, a cam-plate provided with a cam for actuating said mechanism, a bar pivoted to said belt-shipper and projecting over said ratchet-wheel, said bar being provided with a notch, a hook for engaging said notch, a stud on said ratchet-wheel for engaging said bar at a determined point in the revolution of said wheel to release said bar from said hook, and a spring for sliding said bar when released to operate the belt-shipper.

12. The combination of the needle-plate, the needles, curved rack-bars 42, provided with slots 43, for receiving the heels of a number of the needles, straight rack-bars 59, spring-actuated pawls 61 and 62, supported on said straight rack-bars and adapted to engage said curved rack-bars, shaft 73, provided with pinions 67, engaging said straight rack-bars, vertical levers 83, rigidly connected with said pinions, a rotary cam-plate provided with radial chambers 94, a sliding ring 85, disposed on said cam-plate and provided with diagonal slots 96, a pivoted bar 122, for actuating said rings, a lever or stop 110, against which said pivoted bar abuts to move the ring in the rotation of the cam-plate, and horizontal pins disposed in the chambers of the cam-plate and adapted to engage said vertical levers, said pinions being provided with vertical studs engaging the diagonal slots of the sliding ring.

13. The combination of the ratchet-wheel 46, having the concentric tracks 76 77 78 and the cam-plates 74, 79, 80, 81, and 82, disposed at intervals in said tracks, a pivoted bar provided with a stud traveling in said tracks, and a widening and narrowing mechanism controlled by said pivoted bar.

14. The combination of the needle-plate, the needles, the curved rack-bars 42, provided

with slots 43, the straight rack-bars 59, provided with pawls 61 and 62, the springs 64, the pinions 67, for operating said straight rack-bars, means for actuating said pinions, the pivoted bar 66, having the stud 72, the bars 68, provided with arms 69, having pins 70, for engaging said pawls, the ratchet-wheel 46, having tracks in which said stud travels, and cam-plates disposed at intervals in said tracks, a pallet for moving said ratchet-wheel, and means for actuating said pallet.

15. The combination of the needle-bed, the needles, the cam-plate, a shaft provided with means for driving the cam-plate, two loose pulleys on said shaft, means for driving said pulleys in opposite directions, a longitudinally-movable sleeve splined to said shaft between said pulleys, a pivoted bell-crank lever, one arm of which engages a flanged groove in said sleeve, a curved lever hinged to the opposite end of said bell-crank lever and projecting over the cam-plate when depressed, and bunters on the cam-plate for engaging said hinged lever and moving the sleeve to secure said pulleys, whereby a reciprocating motion may be imparted to the cam-plate.

16. The combination of the needle-plate, the needles, a horizontal rotary cam-plate provided with a cam-track for actuating the needles, a slotted curved bar in said needle-plate, means for depressing said bar and throwing a determinate number of needles out of action, two sliding curved rack-bars disposed around said needle-plate and provided with needle-slots, straight rack-bars having pawls for actuating said curved bars, pivoted levers having pinions on the pivots thereof for actuating said straight bars, a sliding ring on said cam-plate, a pivoted lever for actuating said ring, a stop for engaging said pivoted lever, pins in said cam-plate provided with vertical studs working in slots in said ring, whereby the pins are projected when the rings move, and adjunctive mechanism for imparting a reciprocating motion to said cam-plate.

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Witnesses:
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