

Oct. 16, 1934.

R. K. MILLS

1,977,522

KNITTING MACHINE

Filed April 15, 1932

12 Sheets-Sheet 1

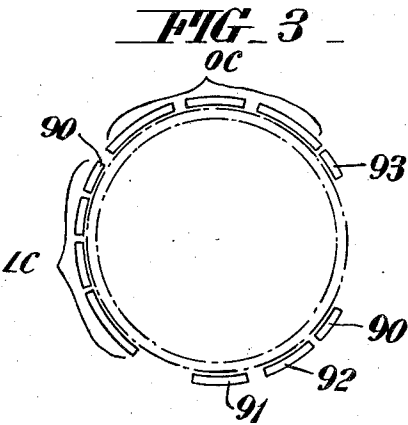
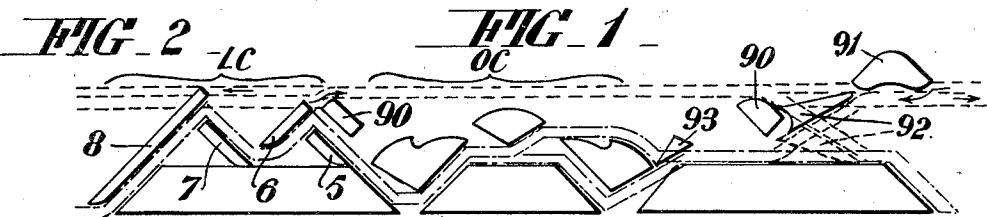
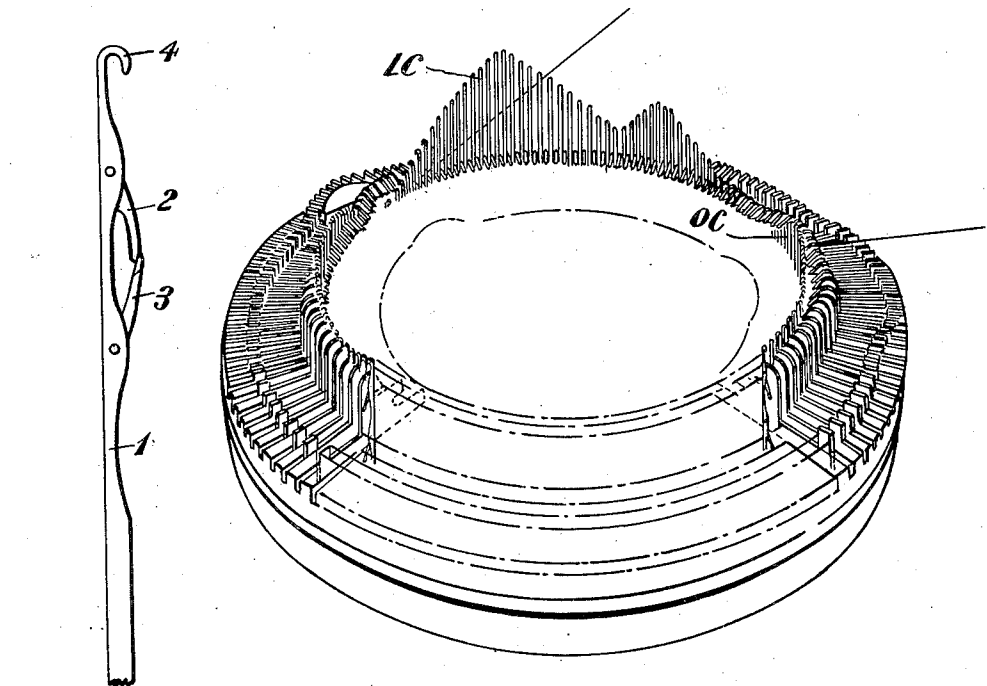


FIG. 4

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FIG 5

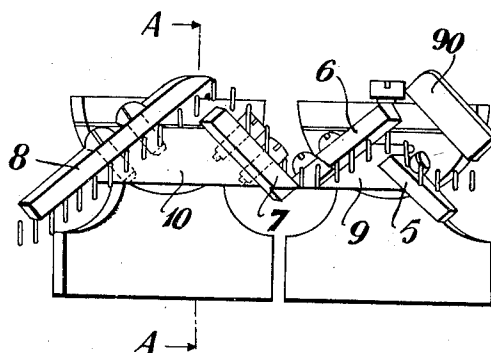
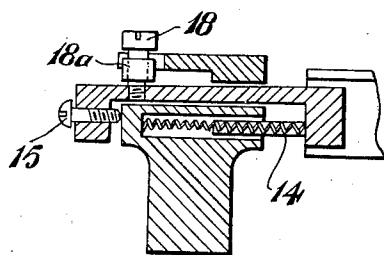
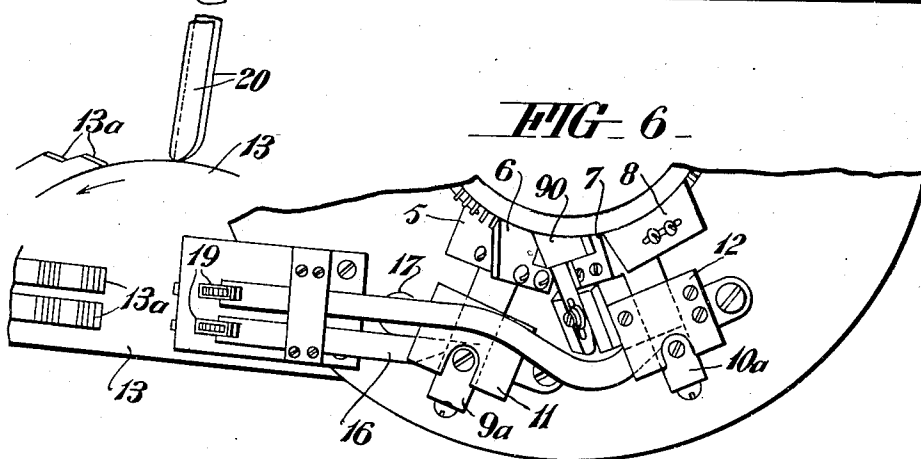
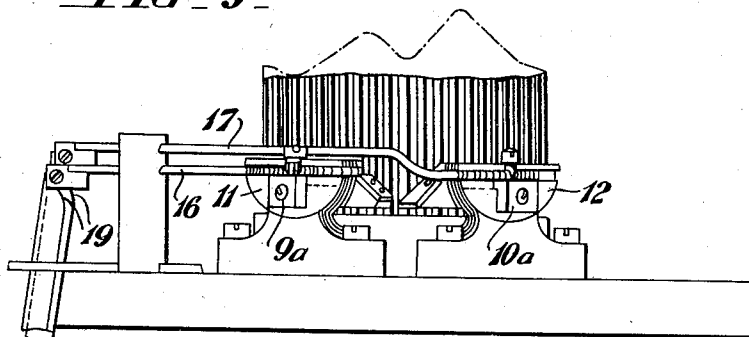


FIG 8

FIG 7 INVENTOR
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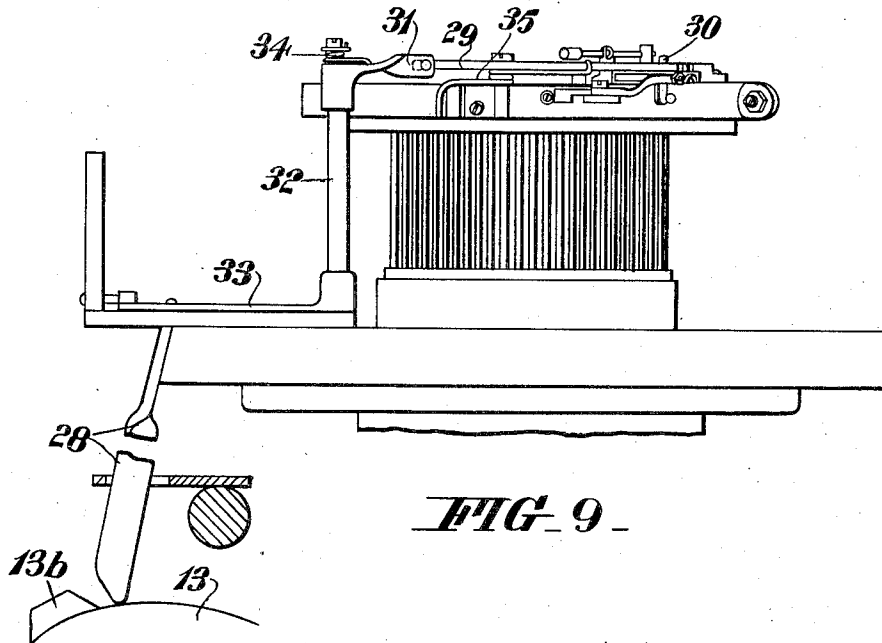


FIG. 9.

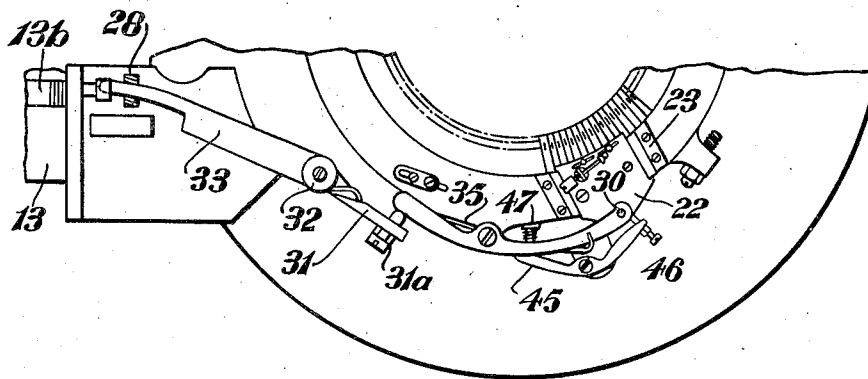


FIG. 10.

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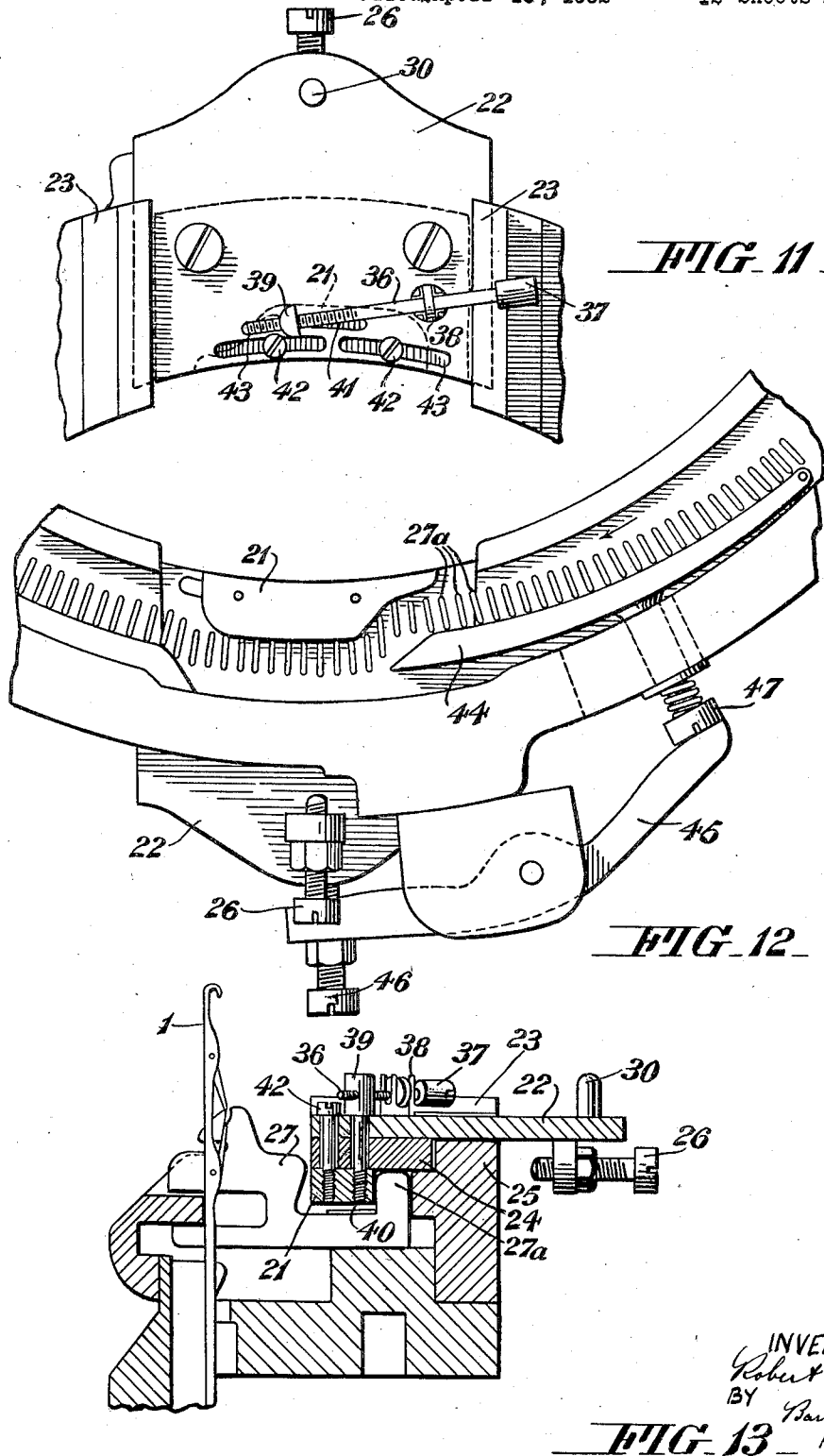
R. K. MILLS

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12 Sheets-Sheet 4



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Filed April 15, 1932

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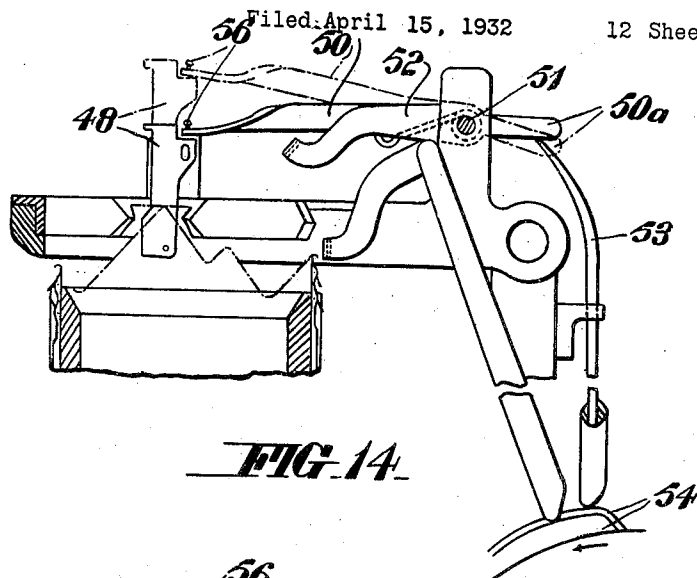


FIG. 14

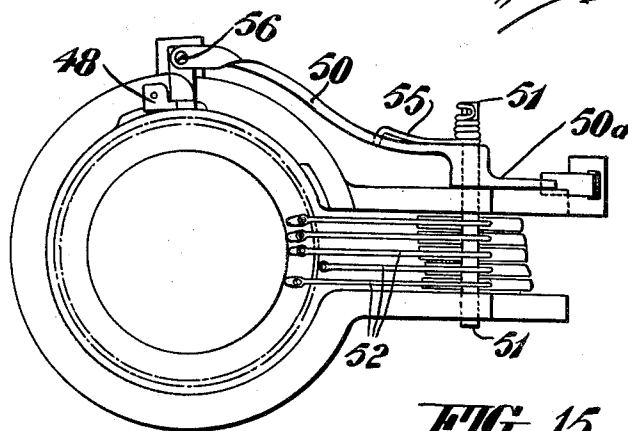


FIG. 15

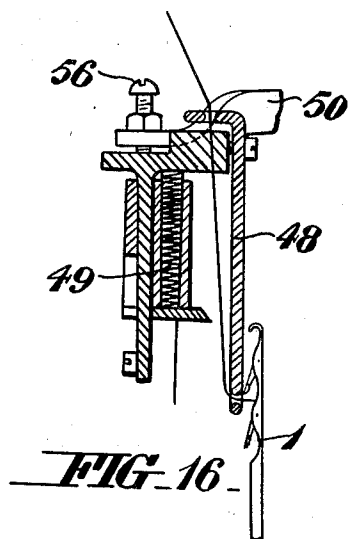


FIG. 16

INVENTOR
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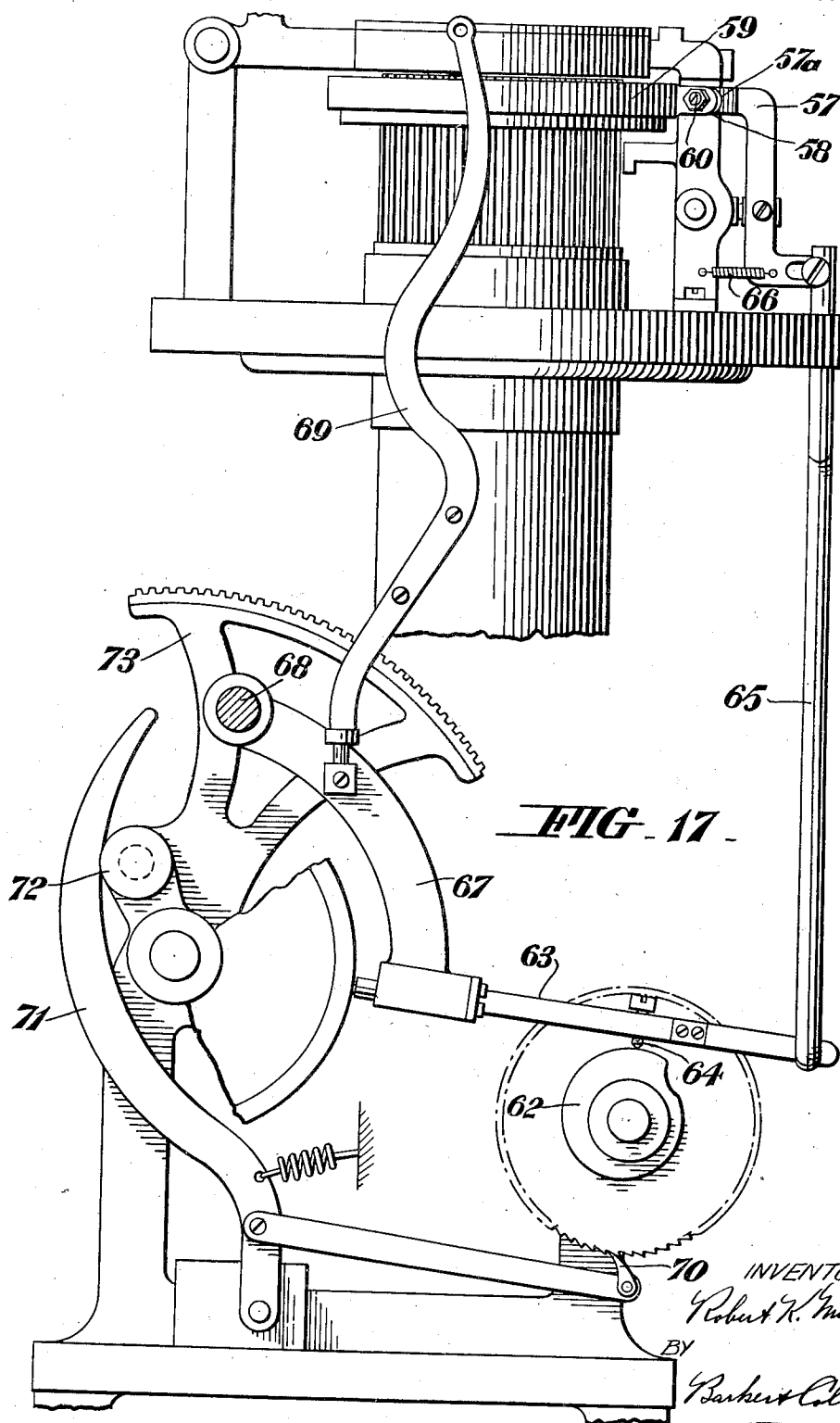
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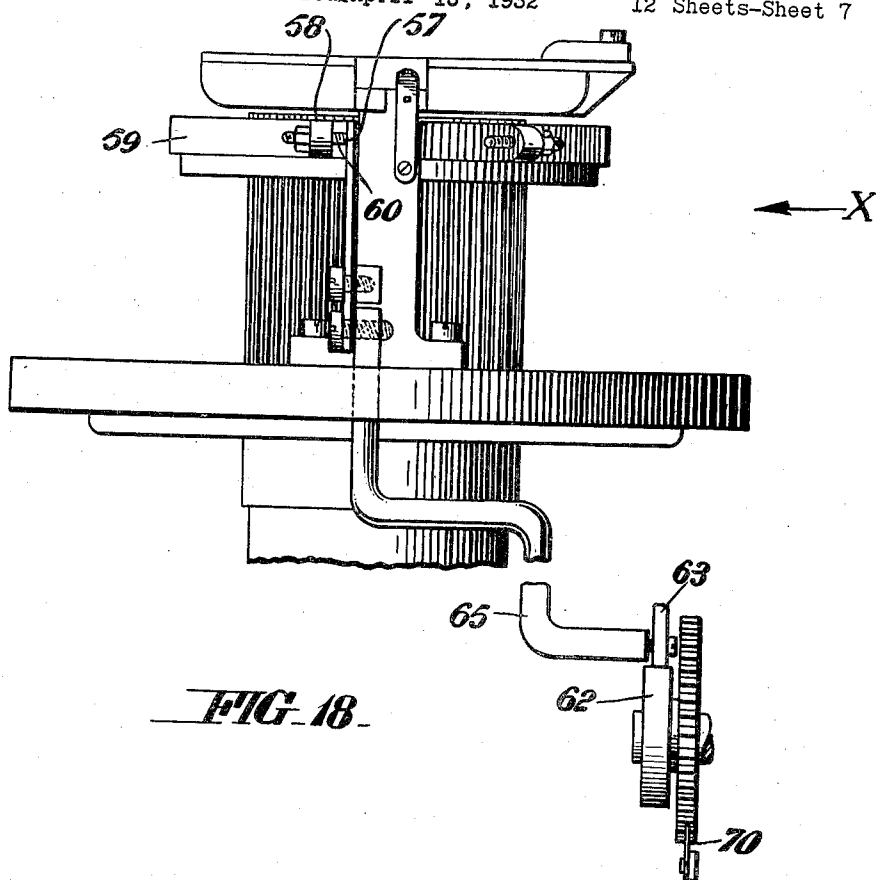


FIG. 18.

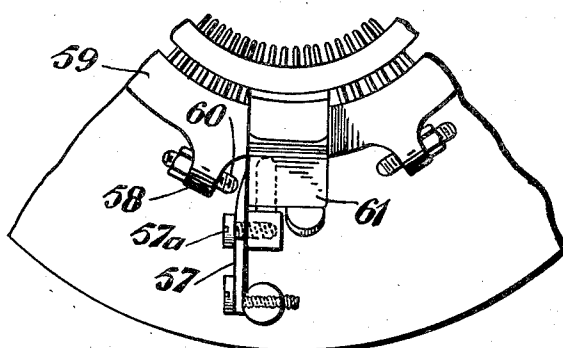


FIG. 19.

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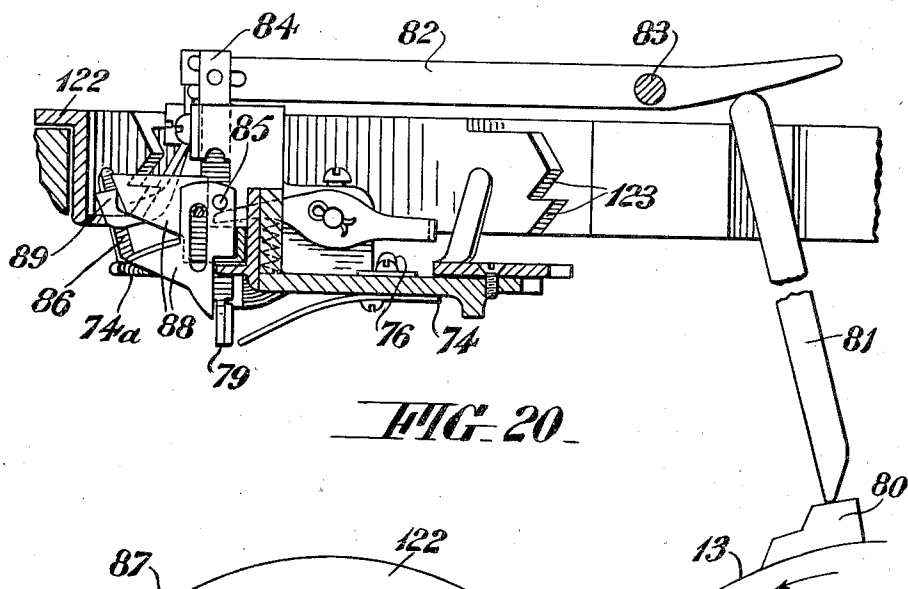


FIG. 20

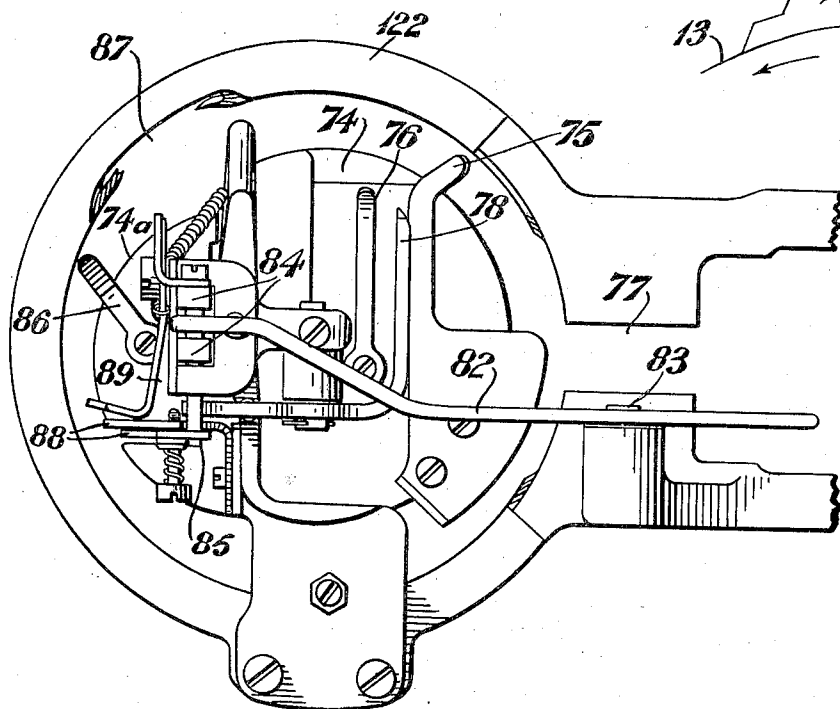


FIG. 21

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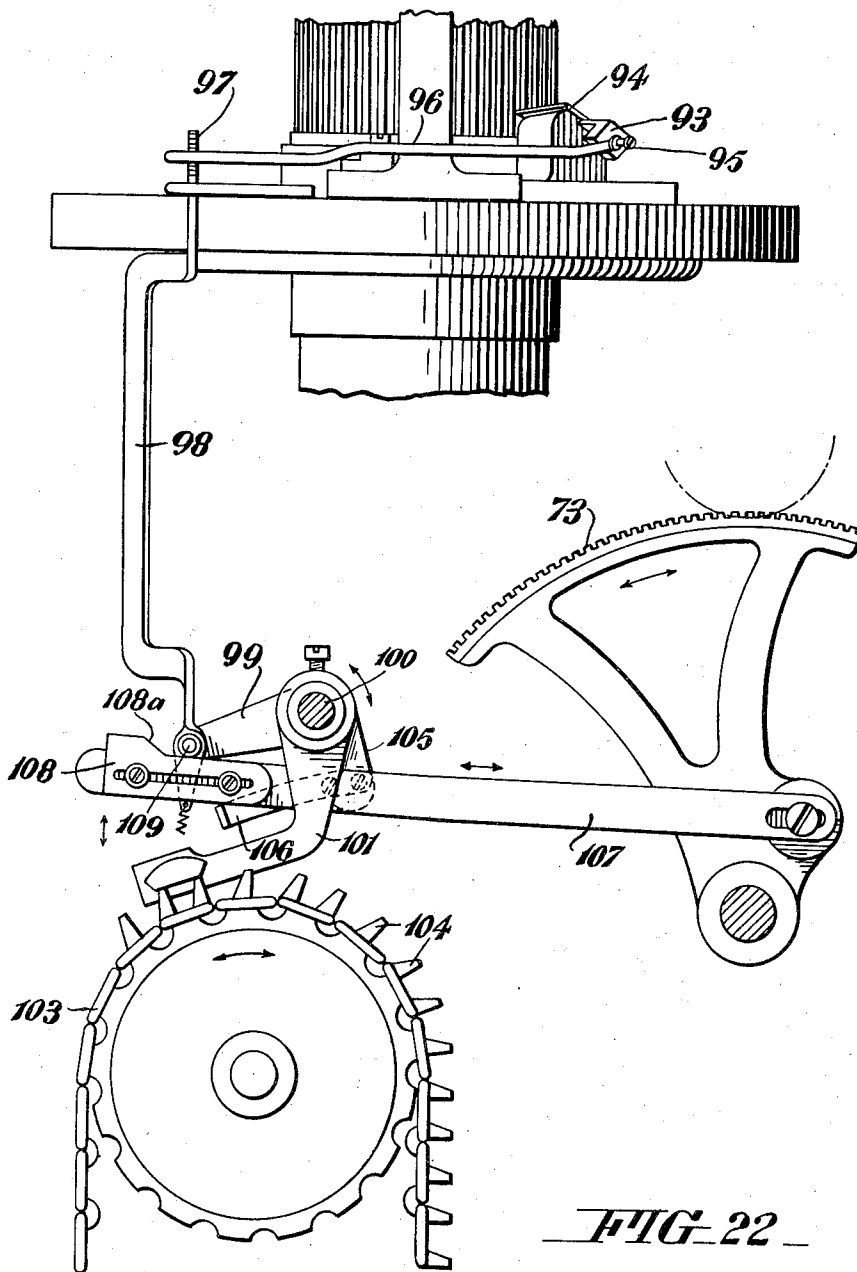


FIG. 22

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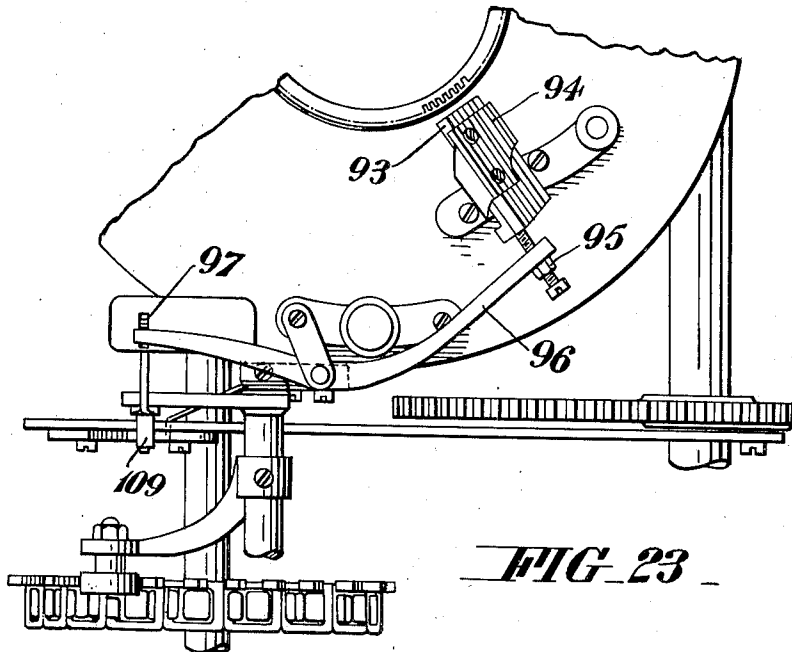


FIG. 23

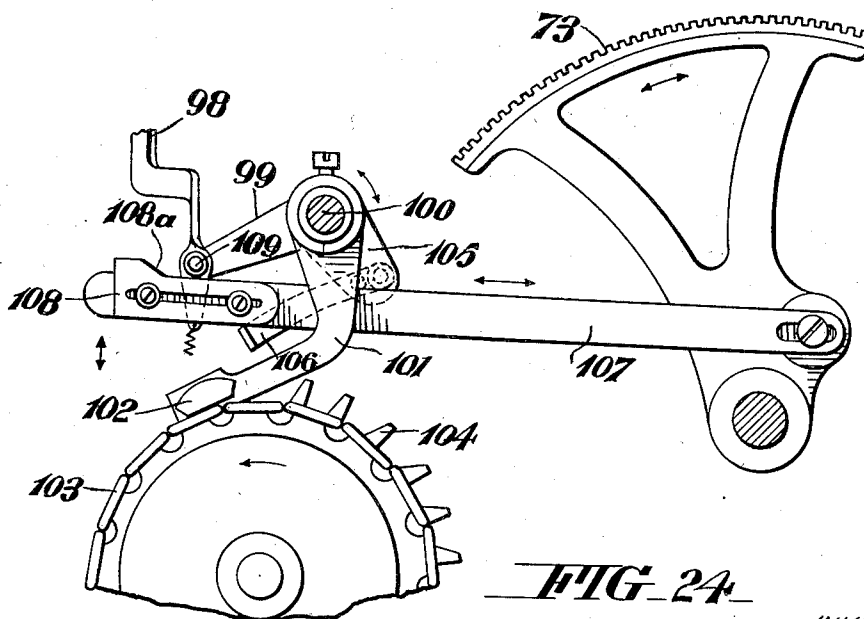


FIG. 24

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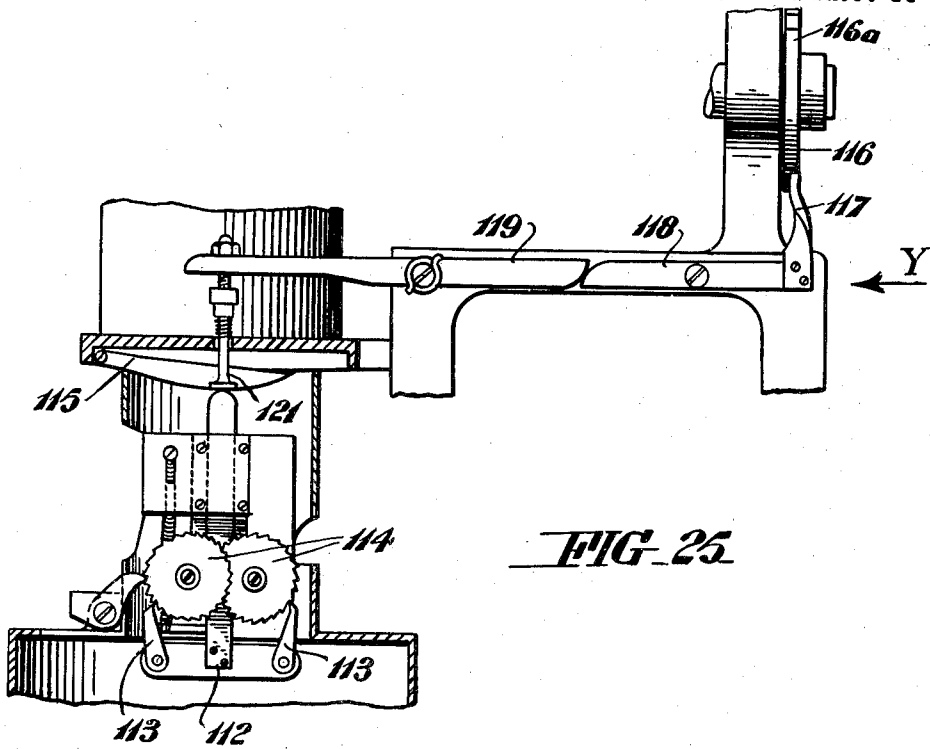


FIG. 25

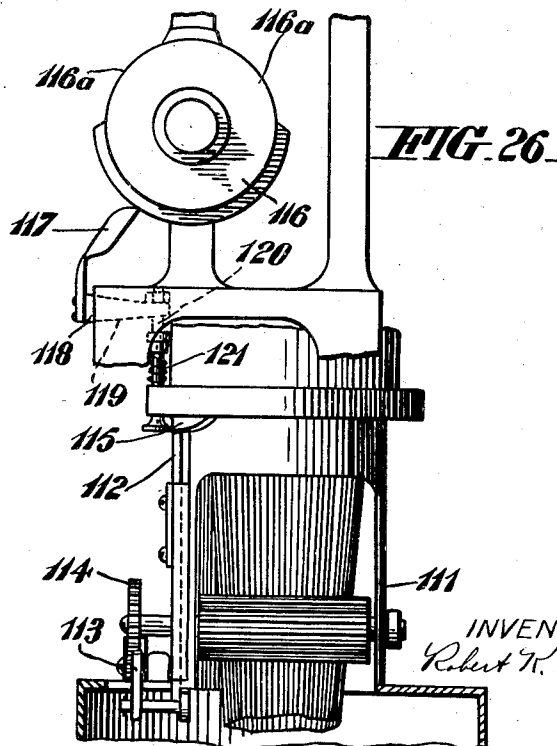


FIG. 26

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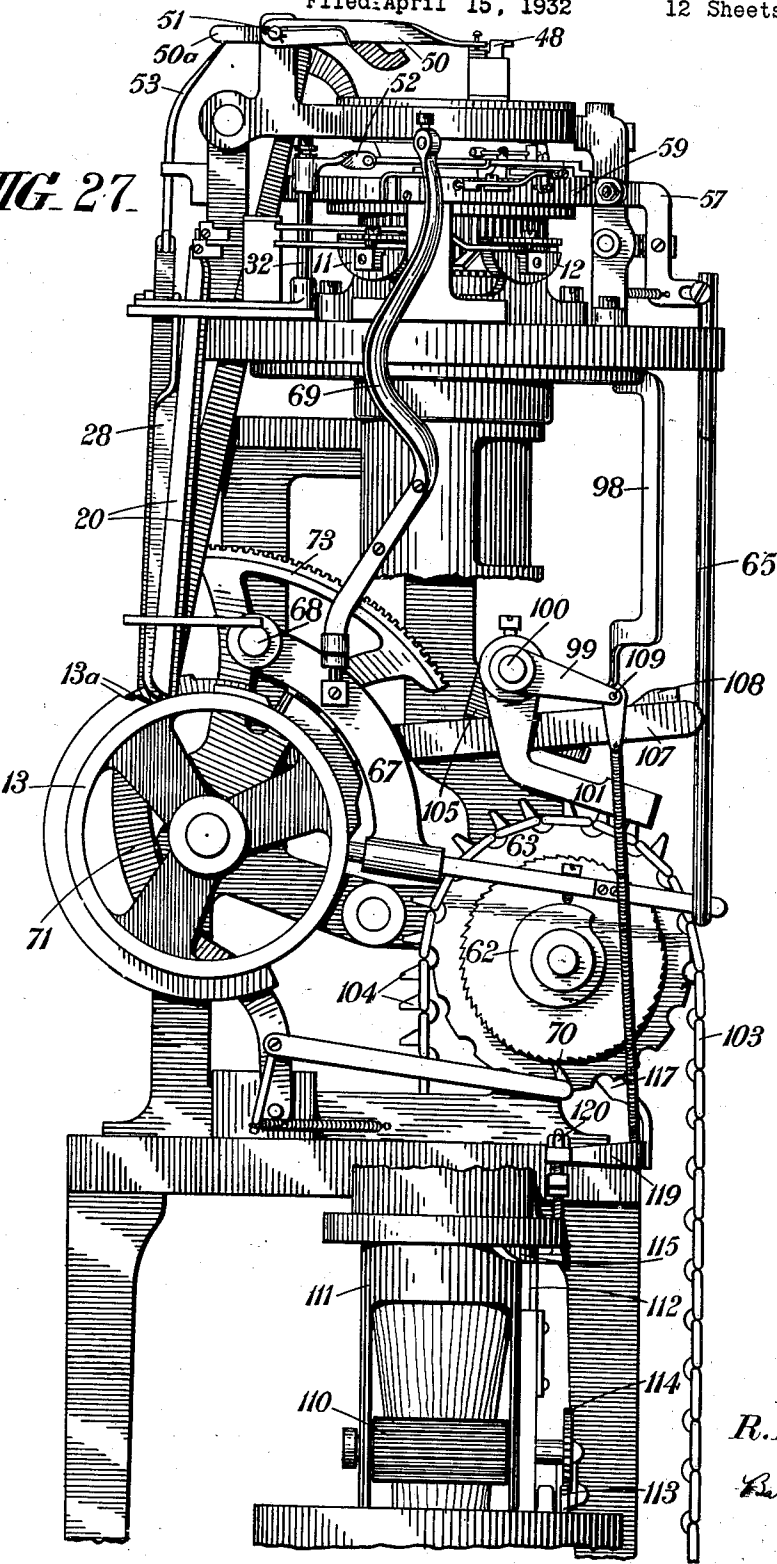
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FIG 27



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UNITED STATES PATENT OFFICE

1,977,522

KNITTING MACHINE

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Application April 15, 1932, Serial No. 605,520
In Great Britain April 18, 1931

13 Claims. (Cl. 66—42)

This invention comprises improvements in knitting machines and in the production of articles thereon, the main object of the invention being to produce stockings, socks and the like composed of or embodying knitted fabric which is immune or practically immune from laddering or roving.

To this end the present invention provides a knitting machine incorporating means for automatically manufacturing throughout a complete seamless stocking or sock embodying ladder-proof or ladder-resisting, fabric composed of locked or tied knitted stitches.

Advantageously a stocking or sock as above is produced by the following sequential operations, namely, knitting by circular motion a tubular leg embodying locked or tied ladder-resisting stitches, knitting a pocket heel by reciprocation, knitting a tubular foot by circular motion which foot may embody locked stitches, and finally knitting a pocket toe by reciprocation.

The machine in accordance with this invention is preferably of the circular type and embodies, in combination, a knitting cam operating to produce locked or tied stitches, a knitting cam operating to produce ordinary or normal stitches, separate thread feeding means appertaining to each of said knitting cams, and means whereby the knitting cam and the associated thread feed for producing locked stitches are automatically rendered operative and inoperative at predetermined times without interfering with the continued knitting operation by the ordinary knitting mechanism.

Advantageously the cam mechanism for producing the locked or tied stitches and the thread feed associated therewith are withdrawn from operation automatically during reciprocation of the machine, e. g. during the knitting of the heel and toe portions of a stocking or sock.

In a machine as above means are also provided whereby when the needle-operating cam device for producing the locked or tied stitches is moved into and out of an operative position, a sinker cam device associated with said needle-operating cam device is simultaneously and automatically moved into and out of operation. This sinker cam device may advantageously have associated therewith means whereby same can be adjusted both circumferentially and radially of the machine.

Several other improvements are embodied in the machine according to the present invention and are hereinafter fully described and set forth in the appended claims, said improvements in-

cluding means for trapping and severing thread fed by the feeding mechanism associated with the locked stitch cam device when said feeding mechanism is moved to an inoperative or non-feeding position.

For the purpose of more fully describing the nature of this invention reference will now be made to the accompanying drawings, wherein:—

Figure 1 illustrates in perspective the upper side of a needle cylinder and sinker carrier of a circular knitting machine, the sinker cam carrier, latch ring being omitted to show clearly the motion imparted to the needles when producing ordinary and locking stitches in succession.

Figure 2 shows a double latch needle suitable for use on the machine in accordance with this invention.

Figure 3 illustrates diagrammatically a development of a suitable needle-operating cam system for use in the machine.

Figure 4 is a diagrammatic plan view illustrating the relative disposition around the needle cylinder of the cams shown in Figure 3.

Figure 5 illustrates in side elevation one construction of automatically displaceable needle-operating cam mechanism for producing locked or tied stitches.

Figure 6 is a plan view of Figure 5 showing the cam mechanism in the operative position.

Figure 7 is an interior elevation, somewhat enlarged, of the cam mechanism shown in Figures 5 and 6, the path traversed by the needle butts being indicated.

Figure 8 is a sectional elevation on A—A of Figure 7.

Figure 9 illustrates in elevation mechanism for imparting motion to a sinker cam which operates in conjunction with the locked stitch needle-operating cam mechanism shown in Figures 5 to 8.

Figure 10 is a plan of Figure 9.

Figure 11 is an enlarged plan view of a part of the mechanism shown in Figure 10.

Figure 12 is an enlarged underside plan view of the sinker cam ring and cam mechanism operating upon the sinkers at the position of locked stitch production.

Figure 13 is an enlarged detail view in vertical section illustrating a sinker cam coacting with a sinker at that position in the machine where a new thread is being drawn by a retracting needle for producing a locked stitch.

Figure 14 illustrates in part sectional elevation a thread feed associated with a locked stitch needle-operating cam and means for controlling the movement of said feed.

60

65

70

75

80

85

90

95

100

105

110

Figure 15 is a plan of Figure 14.

Figure 16 is an enlarged sectional elevation through the thread feed shown in Figure 14.

Figure 17 illustrates in elevation mechanism applied to a stocking producing machine for automatically adjusting the sinker cam carrier circumferentially relatively to the sinker carrier to maintain a constant feeding position of thread between the needle latches for producing locked stitches.

Figure 18 is a further elevational view of part of the mechanism shown in Figure 17 and looking in the direction indicated by arrow X.

Figure 19 is a plan of Figure 18.

Figure 20 illustrates in vertical section yarn trapping and cutting mechanism for use on the machine.

Figure 21 is a plan view of the trapping and cutting mechanism.

Figure 22 illustrates in elevation mechanism for producing tuck stitch mock fashion marks in stockings knitted on the machine, such mechanism being shown in an operative position.

Figure 23 is a plan view of Figure 22.

Figure 24 is another elevational view of the major part of Figure 22 showing same in the inoperative position.

Figure 25 shows in part-sectional elevation fabric draw-off mechanism with means for automatically discontinuing the draw-off during reciprocation of the machine.

Figure 26 is a part-sectional elevation looking in the direction of arrow Y in Figure 25.

Figure 27 is a view in elevation, illustrating a knitting machine with the several improvements which characterize the present invention, assembled in co-operative relationship with each other.

In a convenient embodiment of the present invention a circular knitting machine is provided wherein all or selected of the needles employed are provided with a plurality, e. g. two independently pivoted latches spaced one below the other on the needle shank, a suitable needle 1 being illustrated in Figure 2 of the drawings, said needle having upper and lower pivoted latches 2 and 3 so arranged that when the top latch 2 is lowered and the bottom latch 3 raised the latter abuts against or overlaps the former and said top latch when raised closes on to the hook 4.

In producing stitches on a double latch needle as above described, if thread is fed into the needle hook in the usual manner the old thread loop on the needle is cleared below the top latch 2 and is subsequently knocked over to produce a normal or unlocked stitch. If, however, instead of feeding the thread into the hook 4 the needle is projected to a comparatively greater extent so as to clear the old loop beneath the lowermost latch 3 and feed new thread between the two open latches 2 and 3 the subsequent retraction of the needle causes a loop of newly fed thread to be drawn through and passed closely around the old loop which is retained in the needle hook.

It will be appreciated that the operation of needles as above to produce locked stitches necessitates a specially designed cam, while the ordinary stitches are produced by a cam of usual construction, and to enable locked stitches to be produced at predetermined intervals means are provided such as hereinafter described for withdrawing the locked stitch cam device and its associated thread feed out of operation so as not to function on the needles, and for replacing same into the operative or needle-

engaging position without discontinuing the production of the ordinary or unlocked stitches.

A machine will now be described by way of example wherein when the locked stitch cam mechanism and its associated feed are in operation, alternate courses of normal and locked stitches are produced, and in Figure 1 the position of the ordinary stitch cam is indicated by the comparatively low needle wave at OC, while the position of the locked stitch cam is indicated by the comparatively high needle wave at LC, a separate thread being fed to the needles at each cam and the two threads being operated on by the needles substantially in succession.

The stitch cam OC for producing the ordinary stitches is of any customary design and consequently needs no particular description here.

As aforesaid, however, the production of locked stitches necessitates a specially constructed or designed cam device, and one suitable construction of such cam device and means for moving same into and out of operative position will now be described with particular reference to Figures 5, 6 and 7 of the accompanying drawings. In these figures the cam device comprises four cam bits 5, 6, 7 and 8 all arranged for displacement radially of the machine, two of said bits 5 and 6 being mounted on a slidable block 9 and the remaining two bits 7 and 8 on a slidable block 10, said blocks 9 and 10 having tail pieces 9a and 10a respectively guided in their radial sliding movement within fixed brackets 11 and 12. When the cam device is in operation, i. e. projected radially inwards, the first cam bit 5 rises to an extent sufficient to clear an old thread loop thereon below the top latch 2, the second cam bit 6 then lowers the needles slightly to bring said old loop between the latches so that upon the needles then being raised by the third cam bit 7 for receiving new thread the old thread loop functions to lower the bottom latch 3 and become cleared below same, the final cam bit 8 then operates to lower or withdraw the needles so as to take the thread between the two latches 2 and 3 and move to the knocking-over position, at which position the new thread has become tied about the old thread loop which is still in the needle hook as aforesaid.

The needles in one half of the cylinder may be provided with long butts and the remainder with half butts in the manner customary in circular machines for knitting stockings where a proportion of the needles are raised out of action for knitting by reciprocation during the heel and toe. When the radially displaceable cam device is required to be brought into operation after having been withdrawn, the inward movement is accomplished in two steps through lever mechanism from the main cam drum 13 of the machine. The first step is effected during the time the short butts are passing the cam and causes said cam first to coact with and operate the long butt needles, the second step being effected to complete the inward movement while the cam is coacting with said full butts, thus causing said cam to operate both long and short butt needles. If desired the locked switch cam may be approximately half the thickness of the normal stitch cam. The withdrawal of the cam is effected in one motion.

The locked stitch cam device is projected into and normally retained in its operative position by springs 14 (Figure 8), a screw adjustment 15 accurately determining the extent to which the cams are projected, and the radial displacement

of the two cam blocks 9 and 10 to withdraw the cams out of operation may be effected through the intermediary of two longitudinally slidable bars 16, 17 each having a bevelled end face co-acting with an upstanding stop or the like 18 associated with each tail piece 9a. 10a of the sliding blocks 9, 10, or with a roller 18a on said stop. The opposite end of each of the two bars 16, 17 is furnished with a roller or truck 19, each truck coacting with the upper curved or bevelled end of a vertically or substantially vertical lifting rod 20, two of such rods being provided, one appertaining to the bar 16 and the other to the bar 17. The lower end of each lifting rod 20 (which may be bevelled) coacts with the cam drum 13 on which are provided two suitably spaced cam rises 13a. The cam rises 13a as aforesaid, furnish two steps so that the falling movement of the lifting rods 20 from their respective cam rises 13a is accomplished in two steps and permits of the cam springs 14 effecting an initial movement of the locked stitch cam device while same coacts with the short butts and a final movement while said cam coacts with the long butts.

A sinker cam is also moved radially into and out of operation in synchronism with the radially displaceable locked stitch cam above-described. To this end the sinker cam 21 (Figures 11, 12 and 13) is secured on the underside of a radially displaceable carrier plate 22 which is guided in its movement in fixed guides 23, a plate or portion 24 intermediate the carrier 22 and cam 21 coacting with a peripheral flange 25 to determine the degree of outward movement of the carrier and cam, while an adjustable screw step 26 on the carrier 22 is also adapted to coact with said flange 25 to determine the degree of inward movement of the sinker cam. The sinker cam is so shaped that when same is fully projected inwardly the butts 27a of the sinkers 27 travel round the machine without being effected by said cam, it being understood that the sinker cam is moved to its inwardly projected or inoperative position when the locked stitch cam before-described is inoperative.

To withdraw the sinker cam to its operative position, i. e. to a position wherein the sinker butts 27a are caused to traverse the curved face of said cam, pivoted lever mechanism is provided operated by a lifting rod 28 from the aforesaid cam drum 13. In the arrangement illustrated in the drawings a centrally pivoted lever 29 is connected at its one extremity to an upstanding pin 30 on the sinker cam carrier 22 and coacts at its other extremity with an adjustable screw stop 31a provided on an arm 31 connected to a vertical pivot or rotatable member 32 to the lower end of which member is connected a second arm 33 coacting at its extremity with the upper curved or bevelled end of the lifting rod 28. A spring 34 associated with the upstanding pivot 32 serves to maintain the arm 33 in engagement with the upper end of the lifting rod 28, while a second spring 35 associated with the pivot of the lever 29 maintains one end of said lever in engagement with the stop on the arm 31 and also functions normally to press the sinker cam 21 and its carrier into the inwardly projected position. When, however, the lifting rod 28 coacts with a rise 13b on the cam 13 the aforesaid lever mechanism is displaced to withdraw the sinker cam 21 into the operative position.

Additionally, fine adjustment of the sinker cam is effected in a circumferential direction,

preferably by screw mechanism, thus enabling the length of thread loops drawn and the tightness of stitches produced to be controlled. In one method of doing this, (Figures 11 and 13) a screw-threaded spindle 36 terminating in a head 37 is mounted within an axially rotatable element 38 on the carrier plate 22, the threaded portion of said spindle 36 being screwed through an enlarged head 39 of a pin 40 which projects down through an arcuate slot 41 in the carrier 22 and is screwed into the sinker cam 21. By rotating the spindle 36 the head 39 of the pin 40 is traversed axially on said spindle and the cam 21 thereby adjusted circumferentially of the machine. One or more additional headed screws 42 passing through an elongated slot or slots 43 in the carrier 22 and screwed to the cam 21 function to assist in the guiding of said cam during its adjustment.

In order to ensure that, during the production of locked stitches, the old stitch loops cleared below the bottom needle latches are pressed tightly against the needle shanks and positively pass up at the back of said latches during the lowering of the needles to take thread, an auxiliary sinker cam 44 may be provided (Figure 12) adapted to operate on the sinkers at or adjacent to the position where the needles commence their downward or thread-drawing motion on the lock stitch cam.

This auxiliary cam 44 conveniently comprises a small arm or lever pivoted at its one end and having a curved or inclined inner face adapted, when said arm is pressed inwardly, to coact with and push forward the sinkers to a small degree so as to press the old loops firmly on to the needle shanks.

The inward movement of this auxiliary sinker cam 44 is advantageously effected automatically by the radial movement of the main sinker cam 21 acting in conjunction with the locked stitch cam. This may be effected through a short centrally-pivoted lever 45 coacting at its one end, preferably by an adjustable screw 46, with the radially guided sinker cam carrier 22, and bearing at its other end upon a spring-pressed plunger 47 connected to the auxiliary sinker cam 44. By this means, when the said cam-carrying plate 22 is moved radially outwards to bring the locked stitch sinker cam 21 into operation, the auxiliary cam 44 is pressed inwards against the spring associated with said plunger 47.

Simultaneously with the radial movement of the locked stitch cam and sinker cam, a thread feed associated with said cams is moved into and out of operation. In one method of accomplishing this the thread feeder may comprise a vertically guided and displaceable plate member 48 adapted to be depressed from the non-feeding position to the feeding position against resistance of a spring 49 (Figure 16) by a lever 50 which extends substantially horizontally from and is pivoted about a spindle 51 which constitutes the common axis or fulcrum for pivotally displaceable thread feeders 52 serving to feed thread to the needles at the position of the ordinary or unlocked stitch cam.

While the locked stitch cam is in operation, the feeder 48 associated therewith is maintained depressed by causing a lifting lever 53 to coact with and ride upon a cam rise 54 on the aforesaid cam drum and press upwardly upon a tail portion 50a of the aforesaid pivoted lever 50 coacting with the said feeder. When, however, the cam and feeder are to be withdrawn from operation,—say for example when the machine recipro-

cates for producing the heel and toe of a stocking,—the lifting lever 53 moves off the cam rise 54, thus permitting the pivoted lever 50 to swing up under the influence of a spring 55 and releasing the thread feed 48 which is raised by its associated spring 49. The movement of the feeder can be adjusted by a screw device 56 on the co-acting pivoted lever 50.

As is well known, when knitting stockings on a circular seamless machine it is the custom gradually and progressively to tighten the knitted web during the knitting of the panel or leg towards the feet so as to effect shaping of the leg, this being accomplished by gradually lowering the needle cylinder and sinker carrier or ring relatively to the cylinder needles, or alternatively by suitably displacing the needles and their operating cams relatively to the tricked needle cylinder and sinkers, during the process of knitting. This operation necessarily varies to a certain degree the exact position at which thread being fed to needles is actually laid upon said needles by virtue of the fact that, as the sinkers are lowered relatively to the needles, the thread extending down from the feeder bears upon the inclined nebs or noses of a lesser number of sinkers, and the height of the thread-bearing portions of said sinkers relatively to the needles receiving the thread constantly and progressively varies.

This variation in the exact feeding position of thread on the needles is in no way detrimental when feeding thread into the needle hooks in ordinary knitting, but when producing locked or tied stitches as before-described it is very desirable that the position at which thread is fed between the latches of double latch needles should be constant. Additionally, when producing locked or tied stitches it is advantageous and expedient that the draw of thread for said stitches is maintained uniform or substantially so throughout the stocking and it will be appreciated that the gradual lowering of the sinkers relatively to the needles inevitably varies or gradually reduces said draw.

With the object of maintaining constant the feeding position of thread on to the needles between the latches 2 and 3 when producing locked stitches, irrespective of variations in the height of the needles relatively to the cylinder and sinkers when feeding, and also to maintain a constant or uniform draw of said thread, the present invention includes means whereby simultaneously with the aforesaid progressive vertical adjustment of the needle cylinder and sinkers relatively to the needles and needle-operating cams, or vice versa, a gradual and progressive motion circumferentially of the machine is automatically imparted to the sinker cam at the locked stitch position relatively to the sinker carrier.

The thread fed from the feeder associated with the locked stitch cam LC extends down at an incline and bears upon or coacts at the feeding position with the top inclined edge or face of a certain number of sinker nebs or noses, which sinkers are at this position being gradually retracted from the needles by the sinker cam 21. It will, therefore, be appreciated that the degree of advancement of the sinkers, i. e. the radial position of the sinkers relatively to the needles, determines the height at which the thread is laid on the needles, it being understood that the further the inclined thread-engaging sinker nebs project radially inwards, the higher will be the position at which the thread is fed on the needles, and the greater will be the amount of thread

drawn by sinker nebs due to said thread being drawn over a greater number of sinkers. When, therefore, the needle cylinder and sinkers are gradually moved down relatively to the needles during knitting of a stocking panel towards the foot for the purpose of tightening the stitches, the height of the feeding position of thread between the needle latches is varied and a gradually decreasing amount of said thread drawn. To obviate this, the sinker cam 21 which effects the retraction of the sinkers at the feeding position is gradually displaced circumferentially of the machine during the aforesaid stitch-tightening operation, said circumferential displacement being such that as the height of the sinkers is varied the degree of radial projection thereof is adjusted so that the actual feeding height of the thread over the sinkers on a needle and the draw of said thread is maintained constant.

In a convenient method of accomplishing this (Figures 17 to 19) a tapered nose 57a on a lever 57 is gradually projected in between the face of a projecting lug 58 on the circumference of the sinker cam carrying ring 59, or an adjustable screw 60 carried by the said lug 58, and an opposed face of a fixed part 61 such as the vertical bracket carrying the customary latch ring, the projection of said tapered member 57a causing the said cam ring 59 to be rotated gradually to a comparatively small extent simultaneously with the vertical adjustment of the needle cylinder and sinkers.

Advantageously the movement of the tapered member 57a is effected from the same mechanism as that by which the vertical adjustment of the cylinder and sinkers relatively to the needles is accomplished. For example, in machines where this adjustment is produced from an intermittently rotatable cam 62, a lever 63 having a screw or part 64 coacting with said cam has pivotally connected thereto the lower end of an upwardly extending rod 65 which passes at its upper part freely through the bed-plate of the machine. The upper end of this rod 65 is adjustably pivoted by pin and slot connection to the lower part of the lever 57 which may be of substantially Z-shape which is pivoted between its ends to a relatively stationary part, the upper part of said lever projecting inwards radially of the machine cylinder and terminating in the aforesaid tapered or bevelled nose 57a.

As the aforesaid cam rotates the Z-shaped lever 57 is gradually turned on its pivot to project the tapered nose 57a with a wedging action in between the opposed faces of the number 60 on the sinker cam ring 59 and the latch ring bracket 61. A spring 66 assists in withdrawing the tapered nose from its projected position.

The progressive vertical adjustment of the needle cylinder and sinker carrier may be effected in the known manner from the cam 62 through the lever 63 which is suitably connected to an arcuate lever 67 pivotal about a shaft or spindle 68, the arcuate lever 67 having adjustably connected thereto the lower end of an upwardly extending member 69, which in turn is suitably connected to the needle cylinder and to the sinker carrier. The cam 62 is intermittently rotated by pawl and ratchet device 70 operated from a spring influenced curved arm or lever 71, which coacts with a crank arm or equivalent part 72, said part 72 being carried by and oscillating with the usual quadrant 73, employed for producing reciprocatory motion of the machine. The continued oscillation of the quad-

rant 73 thereby produced oscillation of the lever 71 to operate the pawl and ratchet device 70.

When the locked stitch cam mechanism and associated thread feed are thrown out of operation (e. g. when knitting the heel and toe of a stocking) it is advisable that the thread fed by the locked stitch feeder 48 be trapped and severed. To this end when said feeder is raised out of operation the thread therefrom is carried round by the needles beneath a trapper device which is additional to the existing trapper, and is passed between a pair of cutters or shears and severed.

In Figures 20 and 21 the trapper plate is shown at 74 on which are mounted the customary spring or resilient trapping elements 75, 76, beneath which threads fed from ordinary thread feeders operating in the usual feeding throat 77 are passed and trapped, an additional pivotally mounted trapping element 78 being also provided for said threads. The cutters operating to sever these threads are provided at 79, and the operation of said cutters is effected in the known manner from a rise or step 80 on the main cam drum or its equivalent through a suitable rod or lever 81 adapted to coact with said step 80 and the end of a lever 82 pivoted between its extremities at 83 and having connected thereto a vertically slidable member 84. This slide 84 carries one of the cutting elements and the pair of cutters 79, the other element of said pair being stationary. When the rod 81 rises upon the step 80 the lever 82 is displaced to lower the slide 84 and by means of a pin 85 moving with said slide oscillate the pivoted trapping member 78 to lift same and permit thread to pass thereunder; the cutters 79 being simultaneously opened. When the rod 81 falls from the rise 80 the pivoted spring-influenced trapper 78 is released to trap the thread and the cutters 79 are operated to sever same.

At a part or extension 74a of the trapper plate 74 is mounted an additional resilient trapping strip or element 86 having an upturned end which permits of the thread fed from the locked stitch feeder 48, located at the throat 87 passing beneath said element 86 so as to be trapped thereby. The additional cutter device for the locked stitch thread is constituted by a pair of cutter blades 88 one of which is stationary, while the other is suitably connected to the aforesaid vertically sliding member 84. When the locking thread feeder is thrown out of operation the rise or step 80 operates through the rod 81, lever 82 and slide 84 to open the cutters 88 and simultaneously lift a pivotally displaceable spring-influenced trapper 89, the thread being drawn round beneath the two trapping elements 86 and 89 and between the cutter blades 88. The falling of the rod 81 from the step 80 then operates the pivoted trapper 89 and cutters 88 as before-described with reference to the ordinary thread trapping and cutting device.

As is well known, during reciprocation of the machine in producing the heel and toe of a stocking, a fraction of the complete row of needles, say one half, is raised above the feeding height, and picking elements are brought into operation for sequentially raising the remainder of the needles and subsequently lowering same in the customary manner. By reason of the employment of double latch needles in a machine according to this invention the possibility exists that during reciprocation the fed thread may be engaged by or foul the bottom latch of certain of the raised needles,

and in order positively to avoid this, two small auxiliary cam elements 90 are employed adapted, during reciprocation, to coact with the butts on the raised needles a short distance prior to the thread feeding position of the ordinary stitch cam CC (see Figures 3 and 4). These cams 90 function to lift the already raised needles to a slightly higher position, and thereby prevent the thread coming in contact with the bottom needle latch 3. It is to be understood that one of the aforesaid small auxiliary cams operates on the needles when moving in one direction, while the second cam operates on the needles when moving in the opposite direction, and said cams 90 necessarily function at each motion because the customary needle-levelling cam 91 lowers the raised needles slightly at each motion.

The raising of the aforesaid half or fraction of the row of needles to the inoperative position during reciprocation and the subsequent lowering of same to the operative position is effected by the customary pivotally mounted switch cam 92, said switch cam being shown in full in Figure 3 of the drawings in a position for lowering the needles after reciprocation, and in dotted lines in a position for raising same at the commencement of reciprocation.

The invention also includes the production of tuck stitch mock fashion marks in a stocking or the like, by locking or tying the tuck stitches forming said marks. The selected needles on which the tuck stitches are to be produced, are provided with long butts which at the required time are engaged by an inwardly projected inclined cam element 93 which is located at the position immediately in front of the thread feed appertaining to the ordinary or unlocked stitch cams OC and operates to impart a downward movement to said selected needles so that same will not rise to a clearing height but will take new thread and also retain the old loops, said selected needles carrying the two loops then passing on to the second or lock stitch cam LC and feeder so as to lock or tie the tuck stitch produced at the preceding cam OC.

One convenient method of moving the mock-fashion cam element 93 into and out of operation is illustrated in Figures 22, 23 and 24 wherein the cam 93 is radially slidable within a fixed bracket 94 carried on the needle bed. Normally the cam 93 is retained withdrawn by associated spring means, not shown, and with the outer face of said cam coacts an adjustable screw 95 at the one end of a centrally pivoted lever 96, the other end of said lever bearing upon an upper bevelled portion or face 97 of a downwardly extending bar or rod 98, said bar being pivoted at its lower extremity to a freely mounted crank arm 99 adapted to oscillate about an oscillatory spindle 100. On the spindle 100 is keyed or otherwise fixed a crank arm 101 having a lug or nose portion 102 at its free end adapted to coact with a travelling chain 103, on which chain is provided a series of upstanding links or bits 104. On the spindle 100 is also fixed a further crank arm 105 on which is formed or provided an arm or extension 106 suitably shaped so as to project at its free end beneath a horizontal or substantially horizontal bar 107 to which reciprocation is continually imparted from the customary toothed quadrant 73 provided on the machine. The reciprocating bar 107 has adjustably or otherwise secured thereto a plate portion 108 with bevelled face 108a.

Normally, when the cam bit 93 is not required to operate the nose 102 of the crank arm 101

coacts with the chain 103 at a position void of the upstanding bits 104, and during this operation the reciprocating bar 107 moves to and fro at such a level that, although the bevelled portion 108 thereon coacts with the truck 109 on the bar 98 so as vertically to reciprocate said bar at each motion of the bar 107, the height to which the bar 98 is moved is insufficient to operate upon and pivotally displace the lever 96 coacting with the cam 93. When, however, the cam 93 is to be moved into operation the nose 102 on the crank arm 101 coacts with the upstanding bits 104 on the chain 103 and by so doing the oscillatory spindle 100 is partially rotated so as to lift the reciprocating bar 107 to a higher level through the medium of arms 105, 106. This, of course, also raises the bar 98, and the reciprocation of the bar 107 will then, by reason of the traverse of the truck 109 up and down the bevelled face 108a, oscillate the lever 96, and on each alternate motion of said bar 107 the cam 93 will be projected into operation to act upon the selected needles.

The toothed quadrant 73 is customarily provided on a seamless stocking machine for imparting reciprocating motion to the needle cylinder during the production of the stocking heel and toe, and the motion imparted to said quadrant is usually such that the time taken in completing a to and fro movement of the quadrant is equal or approximately equal to the time taken for four complete revolutions of the cylinder when circular or tubular knitting is being effected. By reason of this comparatively slow movement of the quadrant, it will be appreciated that the cam 93 can be timed to operate on the selected needles on every fourth course during tubular or circular knitting.

Means are also incorporated in the present invention for interrupting the drawing-off or take-up of the knitted fabric during the reciprocation of the machine, e. g. during the production of the heel and toe of a stocking, thereby preventing drag on said fabric and possible distortion thereof.

The drawing-off mechanism is advantageously of the known type comprising a pair of circumferentially-engaged rollers 110, either or both of which may be felt covered and/or plated, said rollers being rotatably mounted at the lower part of the usual fabric or web tube 111 so that the said fabric passes between same. These rollers 110 are intermittently rotated during the circular motion of the machine so as to withdraw the fabric step by step down the tube. The intermittent rotation of the take-up rollers in opposite directions may be effected by the known mechanism embodying a vertically slidable T-plate or bar 112 carrying a pair of suitable pawls 113 which coact with a pair of ratchet wheels 114 mounted one at the extremity of each of the take-up roller spindles. During the full circular motion of the machine the pawl-carrying member 112 is vertically reciprocated to rotate the ratchets and rollers associated therewith in opposite directions and thereby draw the fabric downwardly between said rollers. The take-up rollers are resiliently pressed into engagement with each other by spring plungers or the like. It will be appreciated that in a machine where the needles are rotated relatively to non-rotating cams the fabric produced is also rotated together with the take-up rollers, and during such rotation the aforesaid vertically displaceable pawl carrying member 112 coacts once at each revolution with

a cam element 115 which functions to effect reciprocation of said member 112.

If now, when the machine is reciprocating, the cam element 115 is retained in a position wherein same does not engage with the member 112, the take-up rollers 110 are retained from rotation on their axes and the drawing off of the fabric is discontinued. To accomplish this a suitably mounted cam disc 116 or the like is provided which rotates once during the production of a complete stocking or sock, said cam having circumferential recesses 116a therein. Adapted to ride on the circumferential face of this cam disc 116 is an arm or part 117 connected at the one end of an approximately horizontally disposed lever 118 pivoted between its extremities, the opposite end of the said lever 118 being bevelled and coacting with an oppositely bevelled end of a further approximately horizontal lever 119 also pivoted between its extremities. This last named lever carries at its opposite end an adjustable pin or stud 120 which is adapted to bear upon a spring-pressed plunger 121 carried by and projecting up from the pivoted cam lever or arm 115 which is adapted to coact with the before-mentioned vertically displaceable pawl carrying member 112 coacting with the ratchets on the take-up rollers 110.

When the machine commences to reciprocate, say for producing the heel or toe of a stocking, the arm 117 coacting with the rotating cam disc 116 enters one of the recesses or depressions 116a in the circumferential face of said disc, and in so doing the pivoted cam element 115 is raised under the influence of a spring associated with the plunger 121 to a position wherein the pawl-carrying member 112 will not be engaged by said cam; and in this way the reciprocation of the pawl-carrying member is prevented and the take-up of the fabric is interrupted.

The take-up recommences as soon as the arm 117 or the like coacting with the cam disc 116 is moved out of a recess 116a in said disc.

By reason of needles being employed having two latches as before described, it is preferable to provide the throat ring 122 with two inclined or bevelled faces 123 operating to lower any of the latches 2, 3, which may be swung outwardly while passing a throat during reciprocatory motion in either direction.

It will, of course, be appreciated that additional or reinforcing threads can be introduced at predetermined intervals by the employment in the machine of additional displaceable thread feeders in a manner well-known in seamless stocking and other knitting machines. For example one or more splicing threads can be introduced in the heel and toe of a stocking and a different re-inforcing thread or threads in the sole in accordance with customary practice.

So also, a machine according to the present invention may embody well-known mechanism and automatically produce a pocket heel and a pocket toe, the machine operating to produce sequentially a tubular leg, a pocket heel, a tubular foot, and a pocket toe, all in the order stated; and in a stocking or sock, so produced, it will be understood that the part or parts of the article to be composed of non-ladder or locked stitch fabric can be variably determined to suit desired requirements. For example, the entire stocking or sock, with the exception of the heel or toe, may be composed of locked stitch fabric.

I claim:—

1. A circular knitting machine for manufacturing seamless stockings, socks and the like comprising, in combination, a knitting cam operating to produce locked or tied stitches, a knitting cam operating to produce ordinary or normal stitches, a separate thread feed appertaining to each of said knitting cams, means whereby the knitting cam for producing locked stitches and its associated thread feed are automatically displaced to an inoperative position when the machine commences reciprocation, e. g. when commencing to knit the heel and toe portions of a stocking or sock, and means whereby said locked stitch knitting cam and associated thread feed are automatically brought into operation at the termination of said reciprocatory motion, the knitting operation by the ordinary stitch mechanism being uninterrupted by the displacement of the locked stitch knitting cam.

2. A circular knitting machine comprising in combination a plurality of latches pivoted one below the other on the needle shank, a knitting cam operating upon said needles to produce locked or tied stitches, a knitting cam operating upon the needles to produce ordinary or normal stitches, a thread feed associated with each knitting cam, a sinker cam associated with a locked stitch knitting cam, means for radially displacing the locked stitch knitting cam and its associated sinker cam into and out of operative position, and means for moving into and out of operation in synchronism the locked stitch knitting cam and its associated sinker cam and thread feed at predetermined intervals without interfering with the continued knitting operation by the ordinary stitch cam.

3. In a circular knitting machine as claimed in claim 2 an auxiliary cam operated automatically by the radial movement of the main sinker cam associated with the locked stitch knitting cam, said auxiliary cam coacting with the sinkers to cause same to press stitch loops cleared below the bottom latches of the needles tightly against the needle shanks at the time said needles are being retracted or lowered.

4. A circular knitting machine as claimed in claim 2 and including means for gradually and progressively adjusting the height of the needle-cylinder and sinker carrier relatively to the cylinder needles during the knitting process in combination with means whereby simultaneously with said progressive vertical adjustment the sinker cam appertaining to the locked stitch knitting cam is automatically adjusted relatively to the sinker carrier by a gradual and progressive motion circumferentially of the machine for the purpose specified.

5. In a circular knitting machine as claimed in claim 2, means for gradually and progressively adjusting the height of the needle cylinder and sinker carrier relatively to the cylinder needles during the knitting of a stocking leg for producing a gradual stiffening or tightening-up of the knitted stitches, means whereby simultaneously with the said progressive vertical adjustment the sinker cam associated with the locked stitch knitting cam is adjusted relatively to the sinker carrier by gradual and progressive motion circumferentially of the machine, said circumferential adjustment of the sinker cam being automatically effected by a gradual radial movement of a tapered element between a part moving with the sinker cam carrier and a relatively stationary part, and said radial displacement of the tapered member

being effected through lever mechanism from a rotary cam device which also controls the progressive vertical adjustment of the needle cylinder and sinkers relatively to the needles.

6. A circular knitting machine as claimed in claim 2 and including trapping and severing means for the thread fed by the feeder or feeders associated with the locked stitch knitting cam in addition to trapping and severing means for the thread associated with the ordinary or normal knitting cam, the additional thread cutter device being operated through the same mechanism as that operating the cutter which severs the ordinary knitting yarn or yarns.

7. In a circular knitting machine as claimed in claim 2 adapted for the production of stockings and socks, means for raising and maintaining in an inoperative position a fraction of the complete row of needles during reciprocation of the machine, two additional radially projecting cam elements adapted during reciprocation to coact with butts on the raised inoperative needles and lift same to a higher level prior to thread feeding, one of said cam elements operating on the needles when moving in one direction and the second cam operating on the needles when moving in an opposite direction, and said two cam elements being radially adjustable or displaceable.

8. In a circular knitting machine as claimed in claim 2 for the production of stockings and socks, means whereby at predetermined intervals selected of the needles operate to produce tuck stitches adjacent to the position of the thread feed appertaining to the ordinary or normal knitting cam, said selected needles being subsequently operated upon by the locked stitch knitting cam so as to lock or tie the tuck stitches produced, the operation of the selected needles for producing tuck stitches being effected by a radially displaceable cam, lever mechanism functioning to move said cam into operation at predetermined or selected knitted courses, said lever mechanism being intermittently operated by a continuously reciprocating member, and said reciprocating member being moved into and out of position for operating upon said lever mechanism by an arm or like coacting with a travelling chain or equivalent member.

9. A circular knitting machine comprising needles having a plurality of latches pivoted one below the other on the needle shank, a knitting cam operating upon said needles to produce locked or tied stitches, a knitting cam operating upon the needles to produce ordinary or normal stitches, a thread feed associated with each knitting cam, a sinker cam associated with a locked stitch knitting cam, the locked stitch knitting cam and its associated sinker cam being radially displaceable into and out of operative position, means for moving into and out of operation in synchronism the locked stitch knitting cam and its associated sinker cam and thread feed at predetermined intervals without interfering with the continued knitting operation by the ordinary stitch cams and means for interrupting the drawing-off or take-up of the knitted fabric during reciprocatory motion of the machine.

10. A circular knitting machine as claimed in claim 9 including intermittently and oppositely rotating rollers between which the fabric is drawn off, cam-operated lever mechanism functioning periodically to interrupt the rotation of said rollers, said cam-operating lever mechanism functioning normally to press a spring-influenced

cam element to a position wherein same is engaged at each revolution of the machine by a spring-influenced sliding member carrying a pawl or pawls coacting with ratchets to impart
 5 intermittent rotation to the drawing-off rollers, and said cam-operated lever mechanism also functioning at predetermined intervals to release said spring-influenced cam element and allow same to move to a position wherein the said pawl
 10 and ratchet device is rendered inoperable and the fabric draw-off stopped.

11. A circular knitting machine for the automatic production of seamless stockings or socks, embodying needles, a knitting cam operating
 15 upon said needles to produce locked or tied stitches, a knitting cam operating upon the needles to produce ordinary or normal stitches, a thread feed associated with each knitting cam, a
 20 sinker cam associated with a locked stitch knitting cam, the locked stitch knitting cam and its associated sinker cam being radially displaceable into and out of operative position, means for
 25 moving into and out of operation in synchronism the locked stitch knitting cam and its associated sinker cam and thread feed at predetermined intervals without interfering with the continued
 30 knitting operation by the ordinary stitch cam, trapping and severing means for the thread fed at the ordinary knitting cam, separate trapping and severing means for the thread fed at the
 locked stitch knitting cam, and means for automatically interrupting the fabric draw-off during reciprocation of the machine.

12. A circular knitting machine for automatically manufacturing throughout a seamless stocking, sock or the like and comprising, in combination, a knitting cam operating to produce
 80 ordinary or normal stitches, a knitting cam operating to produce locked or tied stitches, separate thread feeding means appertaining to each of said knitting cams, means whereby said two knitting cams and their thread feeds co-
 85 operate to produce normal stitches and locking or tying stitches on the same needles, and means whereby the knitting cam and its associated thread feed for producing locked stitches are automatically rendered operative and inoperative
 90 at predetermined times without interfering with the continued knitting operation by the ordinary knitting cam.

13. A circular knitting machine for automatically manufacturing throughout a seamless stocking, sock or the like and comprising, in combination, two knitting cams and a separate
 95 thread feed associated with each cam, said two cams operating in succession on the same needles to produce normal stitches and stitches which lock or tie said normal stitches by passing thread
 100 loops through and closely around other thread loops, and means whereby the knitting cam and its associated thread feed for producing locked stitches are automatically rendered operative and
 105 inoperative at predetermined times without interfering with the continued knitting operation by the ordinary knitting cam.

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