March 21, 1933. S. A. WELCH ET AL 1,902,151

KNITTING MACHINE

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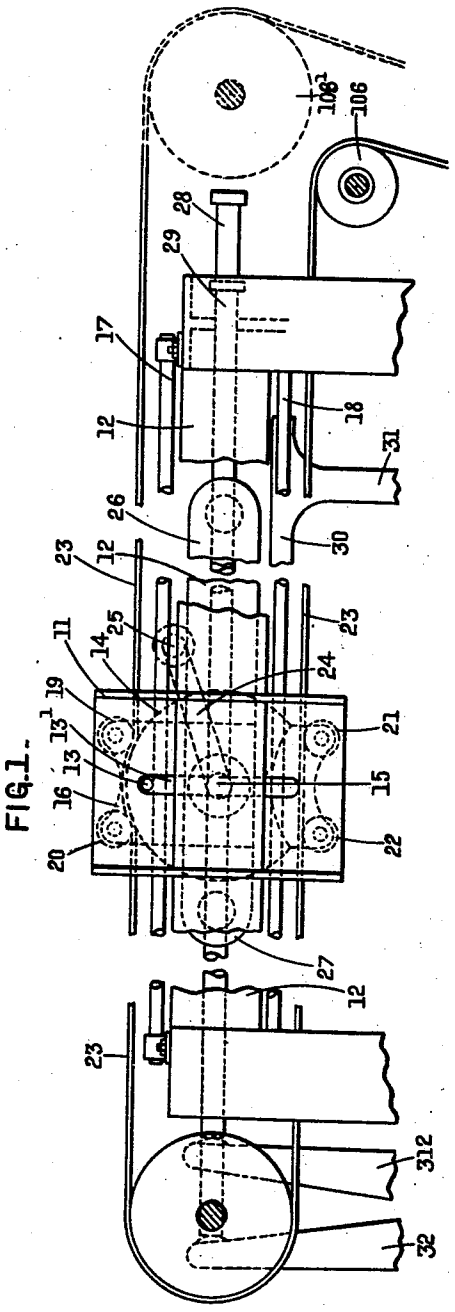


FIG. 1.

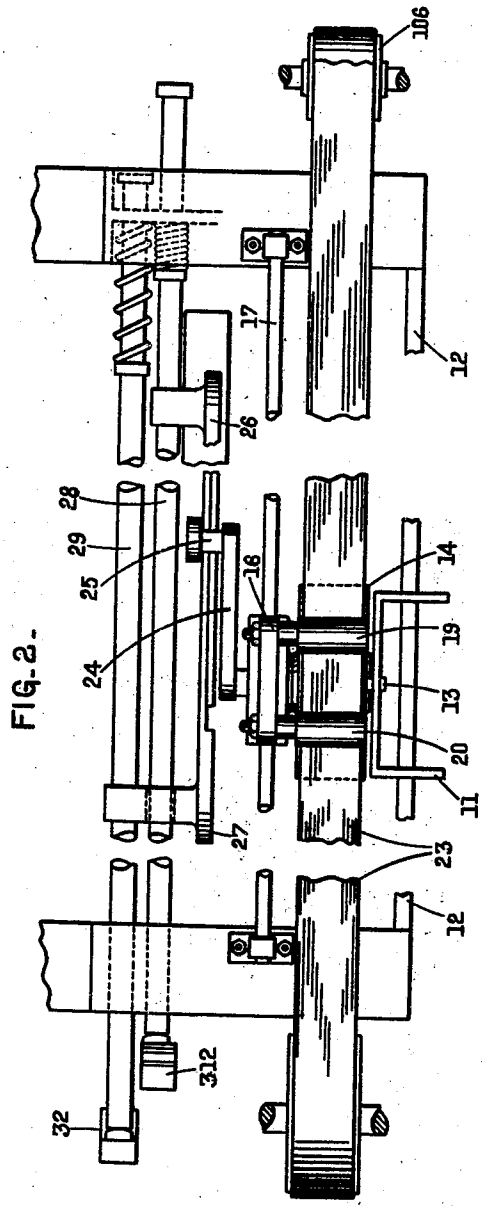


FIG. 2.

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KNITTING MACHINE

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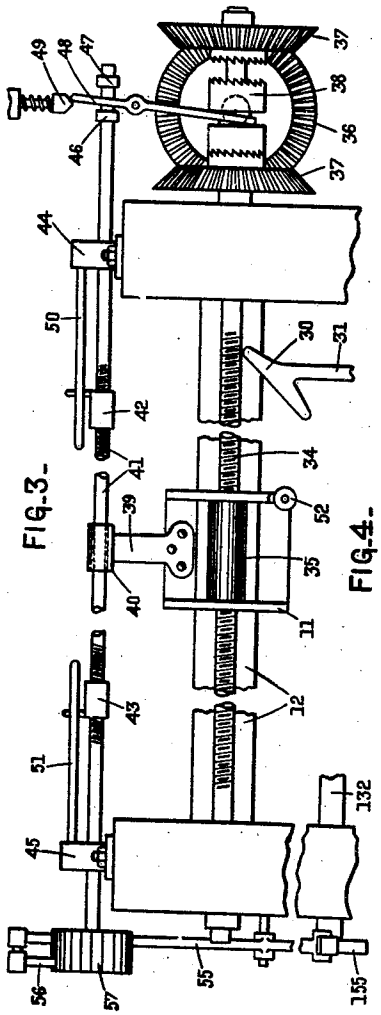


FIG-3-

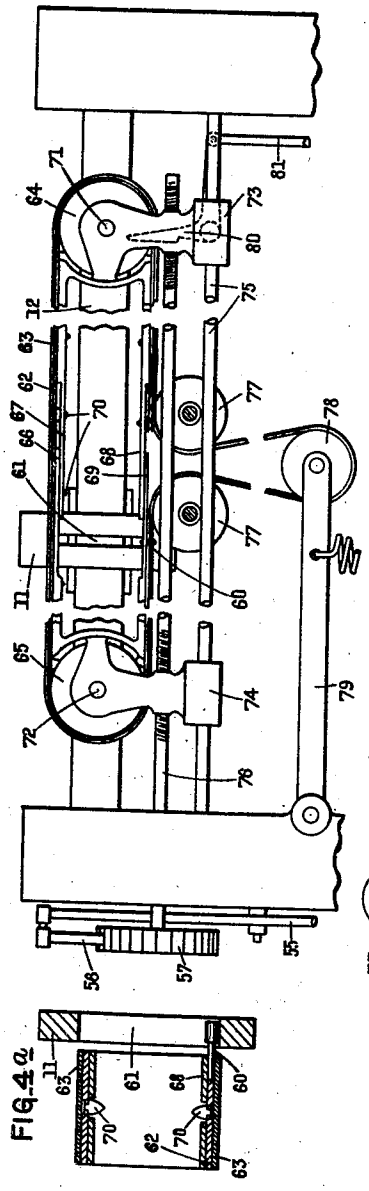


FIG-4-

FIG-4a

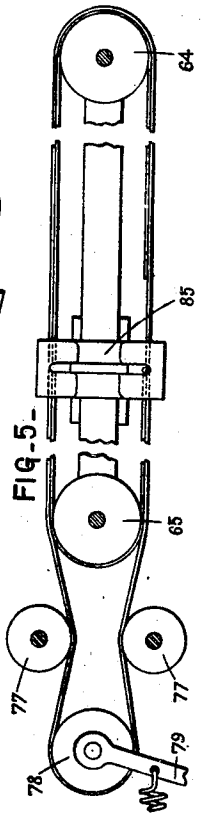


FIG-5-

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KNITTING MACHINE

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FIG. 6.

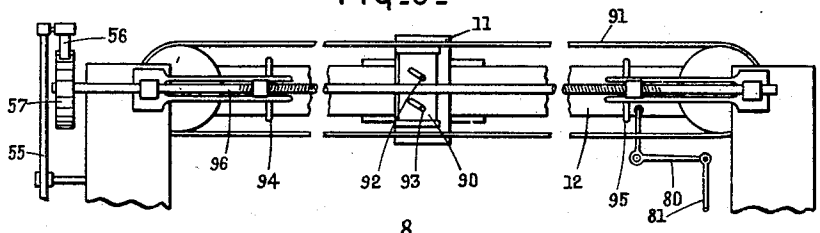


FIG. 7.

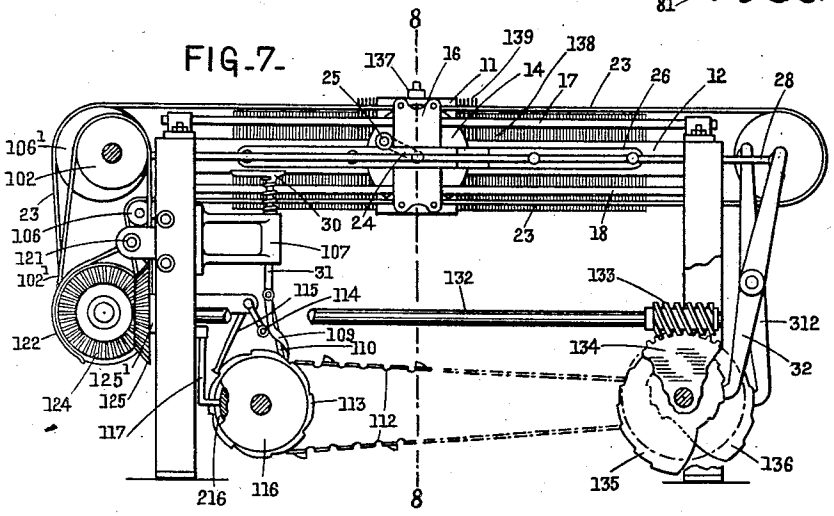
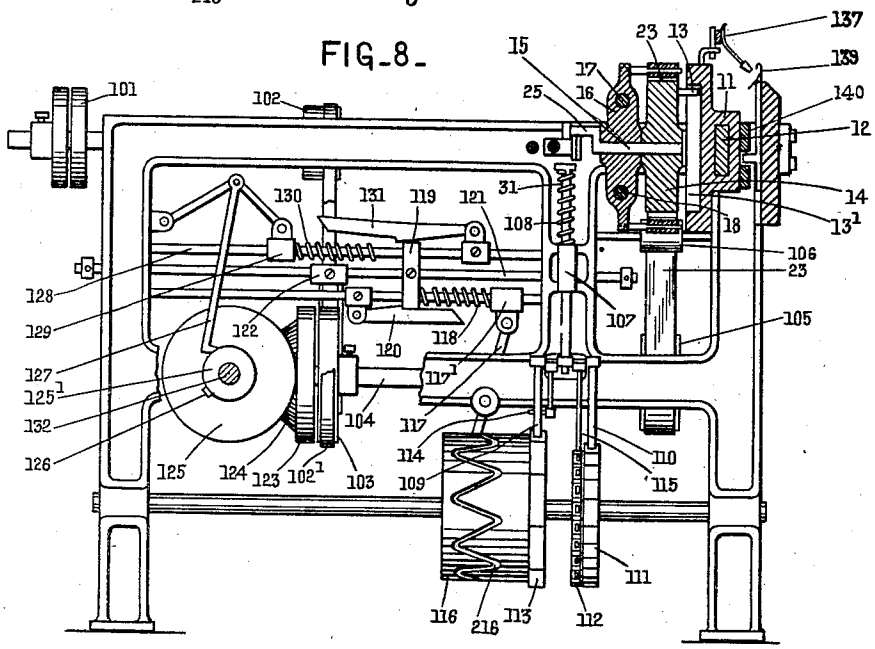


FIG. 8.



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UNITED STATES PATENT OFFICE

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KNITTING MACHINE

Application filed July 21, 1930, Serial No. 469,448, and in Great Britain July 31, 1929.

This invention relates to knitting, and more particularly to the knitting of flat fashioned fabrics or articles.

The principal object of the invention, which is applicable alike to machines employing sliding needles and to machines of the straight bar or "Cotton type", is to accelerate the operation of such machines thereby increasing their output.

Instead of the total time taken in knitting a fashioned fabric or article depending only on the number of courses in the fabric or article, as is usual in flat knitting machines, a method of knitting according to the present invention comprises making the length of traverse of the machine at any course, substantially equal to the length of such course, and effecting such traverse in a time which is substantially proportional to the length of the course.

The term "traverse" used above and the term "knitting traverse" used hereafter will be understood to refer to the movement of the needle and/or sinker cams along the needles of the machine, a motion during which, but not necessarily over the whole of which, the thread is knitted into loops by the needles and/or sinkers under the influence of the cams.

By operating in this way, the time occupied in knitting any course becomes a function of the length of the course, and the total time occupied in producing a fabric or article is reduced to a minimum.

In the case of sliding needle machines the total time occupied, or in the case of straight bar machines, the time occupied in laying the yarn over the needles, is made more or less proportional to the area of the fabric or articles. Uniform knitting is effected over the whole of the fabric or article, notwithstanding the reduction in the total time taken, since the time occupied in knitting each individual loop is not affected.

The economy of time effected by the invention will be readily apparent by comparison with the operation of sliding-needle machines, in which each knitting cycle suffices for the production of a single course of knitting and the time occupied by the cycle is the same whether the greatest width of the fabric is being knitted or the narrowest. The total time is thus proportional to the number of courses and is dependent on the greatest width of the fabric or article.

In its application to flat machines of the sliding needle type, the invention consists in adjusting the traverse of the knitting cams at any stage in the production of the fabric or article to substantially the width occupied by the needles which are required for knitting the particular course. The traverse of the yarn guide or guides is similarly limited. In actual practice some slight overthrow of the cams and guides may be necessary, but in spite of this the length of traverse is not materially different from the width of the particular course being knitted. At the same time the speed of traverse of the cams and guides is maintained substantially constant, so that uniform knitting is obtained.

Various forms of mechanism may be used in carrying out the invention. Thus, a carriage or frame connected to the yarn guide, and/or cam box may be driven by an endless band passing over pulleys whose distance apart may be varied in accordance with the fashioning to be effected in the fabric or article; or the carriage may be driven by alternate engagements with the runs of an endless band, its run in either direction being controlled by stops adjusted in accordance with the fashioning; or a reversible screw may be used to drive the carriage, adjustable stops engaged by the carriage effecting the reversal of the screw as required by the fashioning. Conveniently, the means for controlling the fashioning may be adapted to effect the adjustment of the length of traverse of the carriage. For example, fashioning is often effected by a number of cams, carried on a shaft which is caused to rotate once when the width of the fabric is to be altered and the rotation of this shaft may be adapted to effect the closing in of the pulleys, or of the stops, the position of which determines the length of the traverse.

The invention may be applied to machines knitting single fabrics, stockings, or other articles, or to machines designed for the simultaneous operation of a number of fabrics

or articles. In the latter case one traversing mechanism according to the invention will suffice for the whole of the machine, regardless of the number of fabrics or articles to be made at once.

Figures 1 and 2 are an elevation and a plan view respectively of the upper half of one form of the machine according to the invention.

Figure 3, Figure 4, 4*a* and 5, and Figure 6 shows three further forms of the upper half of the machine.

Figure 7 is a side elevation of the whole machine according to the invention, and Figure 8 is a section along line 8, 8 of Figure 7.

Referring to Figures 1 and 2 the yarn guides and/or knitting cams of one or a number of flat knitting machines are operated by a carriage comprising a frame 11, sliding on a bar 12, a pin 13, fitting in a slot 13′ in the frame 11, together with a disc 14 to which the pin 13 is attached, a spindle 15 to which the disc 14 is rigidly fixed, and a carrier 16, through a bearing in which the spindle 15 passes. The knitting cams and/or yarn guides are connected to the frame 11 which is actuated to slide on the bar 12 by the pin 13 projecting from the disc 14. The carrier 16 which slides on bars 17, 18 carries, in addition to the disc 14, four rollers 19, 20, 21 and 22, the upper or lower pair of which grip against the disc 14 the upper or lower run of a belt 23 which is driven constantly in one direction. One side of the disc 14 is, however, cut away so that only one run of the belt 23 is gripped between the disc 14 and the rollers. In the view shown, the upper run of the belt is gripped between the disc 14 and the rollers 19, 20, the cut away portion of the disc being below. The spindle 15 carrying the disc 14 terminates in a cranked arm 24, 25, the cranked end 25 of which bears against a guide, consisting of two bars 26, 27. This prevents the disc 14 from rotating and causes it, together with the frame 11, the carrier 16, and the spindle 15 to be carried along from left to right by the upper run of the belt 23. When the end of the cranked arm 25 reaches the end of the guide bar 26, the spindle 15 with the disc 14 is free to rotate, and does so until the arm 25 is brought to bear against the lower edge of the guide bar 26. This causes the cut away portion of the disc 14 to come to the top so that the lower run of the belt 23 is gripped between the disc 14 and the rollers 21, 22. The disc 14 cannot rotate further, and so the carrier 16, frame 11 and disc 14 are carried along from right to left by the lower run of the belt 23, to the other end of the machine, where the motion is again reversed in a similar manner. It will be noted that by the rotation of the pin 13 about the axis 15 the frame 11 is brought to rest and started up again gently, the pin 13 sliding in the vertical slot 13′ in the frame.

The length of run of the frame 11 depends upon the combined length of the guide bars 26, 27, which are adapted to fit one against the other, and are carried by two rods 28, 29. By sliding the rods 28, 29 lengthwise of the machine the distance between the extreme ends of the bars 26, 27 may be adjusted. As the frame 11 comes to the right hand end of the machine the cranked arm 25 in its revolution strikes a plate 30 on the end of bar 31; this bar is pushed down against a spring 108 and actuates mechanism which causes two levers 32, 312 to move in such a way as to actuate the rods 28 and 29 in a predetermined manner, thereby effecting automatically the narrowing required. This mechanism is illustrated in Figures 7 and 8 and is described in detail below.

Figure 3 shows a modification wherein the carriage or frame 11 sliding on the bar 12 is actuated by a screw 34 working in a sleeve 35, the screw being driven, in either direction from a bevel gear 36, 37 through a clutch 38. A sleeve 40 is carried on an arm 39 extending upwardly from the frame 11, the said sleeve fitting over a bar 41 carrying two stops 42, 43. The bar 41 is free to slide a short distance in its bearings 44, 45, and as the sleeve 40 strikes one of the stops 42, 43, it causes the bar 41 to slide. At the end of the bar 41 there are two projections 46, 47 one of which, according to the position of the frame 11 strikes a lever 48, adapted to actuate, with the assistance of a spring plunger 49, the clutch 38 whereby the rotation of the screw 34 is reversed. The shaft 41 is adapted to rotate, and the stops 42 and 43 are placed on right and left hand screwed portions respectively of the shaft 41 so that as the shaft rotates the stops are caused to move inwards along it. The stops 42, 43 are prevented from rotating by means of forks 50, 51. As the frame 11 reaches the right hand end of its run a roller 52 on the lower right hand corner of the frame strikes and pushes down the plate 30 carried on a rod 31. The rod, through a mechanism hereafter tc be described, with reference to Figures 7 and 8 causes a shaft 132 with a cam 157 to make one revolution. The cam oscillates a lever 55 carrying a pawl 56, which causes a ratchet wheel 57, attached to the shaft 41, to rotate, thereby closing in the stops 42, 43, and reducing the run of the frame as desired.

Referring to Figures 4 and 4*a* in this modification the carriage or frame 11 sliding on the bar 12 is actuated by a pin 60 working in a vertical groove 61 in the frame 11. The pin is fixed at one end of a strap 62, which is carried round inside a belt 63 passing round two pulleys 64, 65. The strap 62 is of such a length that it is always in contact with at least one of the pulleys 64, 65. It is guided

by grooved guides 66, 67, 68, 69 which accommodate studs or projections 70 on the inner face of the strap 62. Grooves are also made in the pulleys 64, 65 to accommodate the studs 70. The bearings 71, 72 of the pulleys 64, 65, are carried on brackets 73, 74 sliding on a bar 75 and actuated by a screw bar 76. The belt 63 passes round and between two pulleys 77, and down to a jockey pulley 78 carried on a spring loaded lever 79 which takes up the slack of the belt 63 as the distance between the pulleys 64, 65 is reduced, so as to maintain the belt in tension. As the frame 11 reaches the end of its run it actuates a lever 80 which presses down a rod 81 causing a mechanism described hereafter with reference to Figures 7 and 8 to rotate a ratchet wheel 57 attached to the shaft 76, by means of a lever 55 and a pawl 56. The rotation of the shaft 76 closes in the bearings 73, 74 and reduces the total run of the pin 60 on the strap 62. As the pin 60 passes round either of the pulleys 64, 65, it brings the frame 11 to rest, and reverses its motion without shock.

Figure 5 shows a modification of the arrangement in Figure 4 whereby the carriage or frame 11 may extend right over the belt 63 and be actuated by pins on each side of the strap 62, there being sufficient room in the gap 85 to allow the bearings of the pulleys 64, 65 to pass through. The advantage of having a pin on each side of the strap 62 cannot be realized in the form of mechanism shown in Figure 4, since the frame 11, if it extended under the belt 63 would foul the pulleys 77.

Figure 6 shows a modification wherein the frame 11 and a supplementary part 90 grip the upper and lower runs of the belt 91 alternately. The gripping piece 90 is carried on the frame 11 by two pins 92, 93 fitting in oblique slots in the piece 90. Stops or abutments 94, 95, are provided, which strike the gripping piece 90 and cause it to slide on the pins 92, 93 and at the same time to move vertically in such a manner as to grip the other run of the belt. The stops 94, 95 are carried on a screwed shaft 96 and are adjustable by the means described with reference to Figure 4.

Figure 7 and Figure 8 show views of the complete machine embodying the controlling mechanism described with reference to Figures 1 and 2. The drive to the machine is taken from pulley 101 through a pulley 102 and belt 102′ to a third pulley 103, on a shaft 104. The belt 23 is driven from a pulley 105 of a shaft 104, the lower run being guided by a pulley 106 and the upper by a pulley 106′. The rod 31 is carried in a sleeve 107 and pressed downwardly by the crank 25 against the action of a spring 108 whenever the frame 11 reaches this end of the machine. The rod 31 carries at its lower end two pawls 109, 110, one of which, 110, actuates a ratchet wheel 111 which drives a patterning chain 112. The other pawl 109 is adapted to drive a ratchet wheel 113, but is normally held out of contact with it by a pin 114. Projections are carried by the chain 112, shaped and disposed in accordance with the fashioning required, and these operate to lift a rod 115 in such a manner as to cause the pin 114 to drop and allow the pawl 109 to push round the ratchet wheel 113.

The ratchet wheel 113 drives a drum 116, a groove 216 round the circumference of which actuates through a lever 117 the block 117′. The block 117′ compresses a spring 118 against a block 119 which is held in position by a latch 120. The block 117′ compresses the spring and strikes the end of the latch 120 thereby releasing the block 119 together with the rod 121, to which it is attached. The rod 121 carries a belt fork 122, which, under the action of the spring 118 is adapted to move the belt 102′ from the pulley 103 to a loose pulley 123. The pulley 123 carries on its face a bevel gear which rotates a second bevel gear 125 attached by means of a sleeve 125′ to a shaft 132. The sleeve 125′ carries a pin 126 operating an arm 127 to push a block 129 along a shaft 128; this compresses a spring 130 against the block 119 which is now held by a latch 131. When the spring 130 is compressed, the block 129 releases the latch 131 and returns the shaft 121 to its original position so that the belt fork 122 moves the belt 102′ back to the pulley 103. In this manner the bevel gear 125 together with a shaft 132 to which it is attached is caused to make one complete revolution, stopping always at the same point, i. e. that at which the pin 106 is in such a position as to cause the block 120 to release the latch 131. The means just described for effecting a single revolution of the shaft 132 at intervals determined by the pattern chain 112 are similar to those commonly employed for controlling the fashioning of the fabric or article being knitted, suitable mechanism driven by the shaft 132 being provided to actuate the fashioning means, which, as they do not form part of the present invention have not been illustrated.

In Figures 7 and 8, which include the mechanism shown in Figures 1 and 2, the shaft 132 is fitted with a worm gear 133, which, through a worm wheel 134 rotates two stepped cams 135, 136 through a small part of a revolution equivalent to one cam step. The stepped cams push on the lower ends of levers 32, 312, the upper ends of which push in or let out step by step the rods 28, 29, which control the lengths of the guide bar 26. In this manner, the guide bar 26 is shortened according to the design of the pattern chain 112, and the cam box, or boxes, together with the thread guides, all operated by the frame

11, are automatically controlled. The frame 11, carrying the cam box 140, together with the thread guide 137, slides along the needle bed 138, and operates the needles 139, of which a few are shown in the neighbourhood of the frame 11.

The modifications shown in Figures 3–6 are controlled in a similar manner, except that, instead of two stepped cams, a single one step cam 155 is used, mounted on the shaft 132 in place of the worm 133. The cam 155, on the revolution of the shaft 132, oscillates the lever 55, and the pawl 56, and rotates the ratchet wheel 57, as described with reference to these modifications.

What we claim and desire to secure by Letters Patent is:—

1. Method of knitting flat fashioned articles, said method comprising effecting knitting traverses at a substantially constant linear speed, automatically making the knitting traverse at each course substantially equal to the length of such course, and completing successive courses with a frequency substantially inversely proportional to the length of the courses.

2. Method of knitting flat fashioned articles, said method comprising feeding yarn at a substantially constant linear speed over a traverse substantially equal to the length of the course, and knitting the yarn on all the needles so fed in such a manner as to complete successive courses with a frequency substantially inversely proportional to the lengths of the courses.

3. Method of knitting flat fashioned articles, said method comprising feeding yarn at a substantially constant linear speed over a traverse substantially equal to the length of the course, and concomitantly with the feeding of the yarn, operating successively the needles to which yarn has been supplied, so as to complete successive courses with a frequency substantially inversely proportional to the lengths of the courses.

4. Knitting machine for knitting flat fashioned articles, said machine comprising means for effecting the knitting traverses at a substantially constant linear speed, means for automatically knitting the length of traverse at any course substantially equal to the length of such course, and means for completing successive courses with a frequency substantially inversely proportional to the lengths of the courses.

5. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide adapted to be driven by such carriage, means for traversing said carriage at a substantially constant linear speed, means for automatically making the length of traverse of said carriage at any course substantially equal to the length of such course, and means for completing successive courses with a frequency substantially inversely proportional to the lengths of the courses.

6. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide and knitting cam means driven by said carriage, means for traversing said carriage at a substantially contant linear speed, means for automatically making the length of traverse of said carriage at each course substantially equal to the length of such course, and means for completing succesive courses with a frequency substantially inversely proportional to the lengths of the courses.

7. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, an endless flexible member having two parallel runs which are adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at a constant linear speed, and means for reversing the direction of travel of the carriage at points which are automatically adjustable according to the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

8. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, an endless flexible member having two parallel runs adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at constant linear speed, means for clamping said carriage to the two runs alternately, and means for releasing the carriage from one run and clamping it to the other at points which are adjustable in accordance with the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

9. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, an endless flexible member having two parallel runs which are adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at a constant linear speed, two sets of rollers carried by the carriage and engaging the outside of the two runs of said flexible member, and a rotatably mounted disc carried by said carriage between the runs of the said flexible member, said disc being cut away on one side so that one run only of the flexible member is clamped between the disc and the rollers at any time, means for preventing said disc from rotating during traversing and means for allowing it to rotate out of clamping engagement with one run into clamping engagement with the other at points which are automatically adjustable in accordance with the fashioning, whereby successive courses are completed with a fre-

quency substantially inversely proportional to the lengths of the courses.

10. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide adapted to be driven by said carriage, an endless flexible member having two parallel runs which are adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at a constant linear speed, two sets of rollers carried by the carriage and engaging the outside of the two runs of said flexible member, and a rotatably mounted disc carried by said carriage between the runs of the said flexible member, said disc being cut away on one side so that one run only of the flexible member is clamped between the disc and the rollers at any time, means for preventing said disc from rotating during traversing and means for allowing it to rotate out of clamping engagement with one run into clamping engagement with the other at points which are automatically adjustable in accordance with the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

11. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide and knitting cam means adapted to be driven by said carriage, an endless flexible member having two parallel runs which are adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at a constant linear speed, two sets of rollers carried by the carriage and engaging the outside of the two runs of said flexible member, and a rotatably mounted disc carried by said carriage between the runs of the said flexible member, said disc being cut away on one side so that one run only of the flexible member is clamped between the disc and the rollers at any time, means for preventing said disc from rotating during traversing and means for allowing it to rotate out of clamping engagement with one run into clamping engagement with the other at points which are automatically adjustable in accordance with the fashioning, whereby successive courses are complete with a frequency substantially inversely proportional to the lengths of the courses.

12. Knitting machine for knitting flat fashioned articles, said machine comprising a pair of pulleys, an endless belt passing round said pulleys, a strap driven between said belt and said pulleys, a pin projecting from the edge of said strap, a traversing carriage adapted to be enegaged by said pin and to be driven thereby alternately in opposite directions, means for driving said belt at a constant linear speed, and means for automatically adjusting the positions of the axes of said pulleys in accordance with the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

13. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a rotatable screwed shaft adapted to drive said carriage alternately in opposite directions, reversible clutch means adapted to drive said shaft in either direction at a constant speed, a rod adapted to operate said reversible clutch means, stops mounted on said rod, and adapted to be engaged by said carriage at the end of its traverse, and means for automatically adjusting the position of the stops on the rod in accordance with the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

14. Knitting machine for knitting flat fashioned articles, said machine comprising means for effecting the knitting traverses at a substantially constant linear speed, means for controlling the fashioning during knitting, means in connection with said controlling means for automatically making the length of traverse at each course substantially equal to the length of such course, and means for completing successive courses with a frequency substantially inversely proportional to the lengths of the courses.

15. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide adapted to be driven by such carriage, means for traversing said carriage at a substantially constant linear speed, means for controlling the fashioning during knitting, means in connection with said controlling means for automatically making the length of traverse at each course substantially equal to the length of such course, and means for completing successive courses with a frequency substantially inversely proportional to the lengths of the courses.

16. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide and knitting cam means driven by said carriage, means for traversing said carriage at a substantially constant linear speed, means for controlling the fashioning during knitting, means in connection with said controlling means for automatically making the length of traverse at each course substantially equal to the length of such course, and means for completing successive courses with a frequency substantially inversely proportional to the lengths of the courses.

17. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, an endless flexible member having two parallel runs which are adapted to drive said carriage alternately in opposite directions, means for driving said

flexible member at a constant linear speed, means for controlling the fashioning during knitting, and means in connection with said controlling means for reversing the direction of travel of the carriage at points which are automatically adjustable according to the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

18. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, an endless flexible member having two parallel runs adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at constant linear speed, means for controlling the fashioning during knitting, means for clamping said carriage to the two runs alternately, and means in connection with said controlling means for releasing the carriage from one run and clamping it to the other at points which are adjustable in accordance with the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

19. Knitting machine for knitting flat fashioned articles, said machine comprising a traversing carriage, a yarn guide and knitting cam means adapted to be driven by said carriage, an endless flexible member having two parallel runs which are adapted to drive said carriage alternately in opposite directions, means for driving said flexible member at a constant linear speed, means for controlling the fashioning during knitting, two sets of rollers carried by the carriage and engaging the outside of the two runs of said flexible member, and a rotatably mounted disc carried by said carriage between the runs of the said flexible member, said disc being cut away on one side so that one run only of the flexible member is clamped between the disc and the rollers at any time, means for preventing said disc from rotating during traversing and means in connection with said controlling means for allowing it to rotate out of clamping engagement with one run into clamping engagement with the other at points which are automatically adjustable in accordance with the fashioning, whereby successive courses are completed with a frequency substantially inversely proportional to the lengths of the courses.

In testimony whereof we have hereunto subscribed our names.

SIDNEY ARTHUR WELCH.
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JOHN THOMAS ASHBY.
WILLIAM HENRY BOALER.