Feb. 24, 1948. P. W. BRISTOW 2,436,468

PATTERN MECHANISM FOR KNITTING MACHINES

Filed Feb. 21, 1946 3 Sheets-Sheet 1

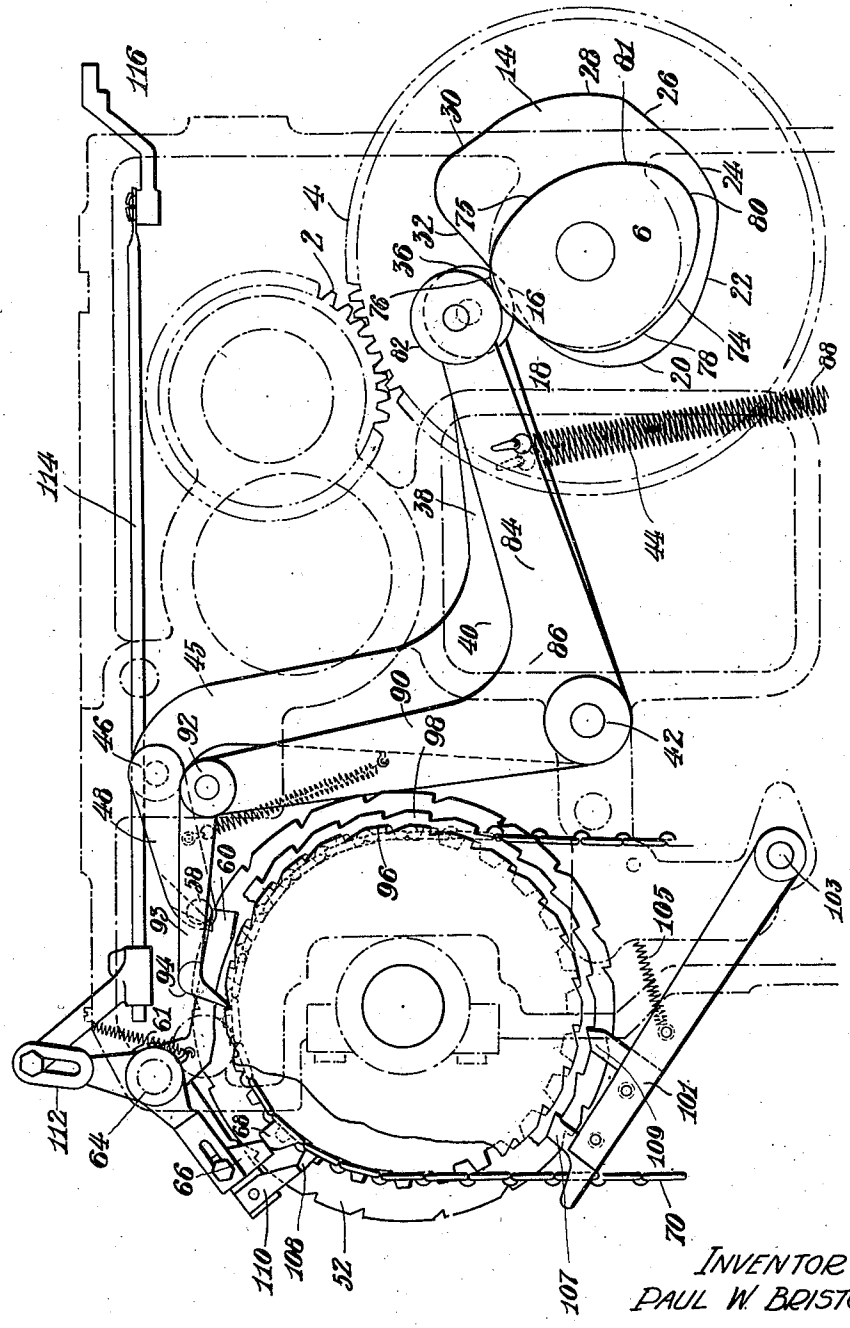


FIG - 1

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PATTERN MECHANISM FOR KNITTING MACHINES

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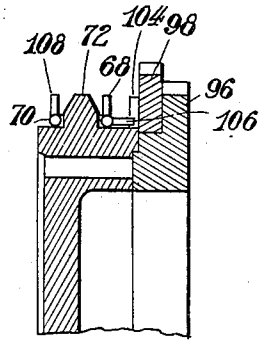


Fig-5

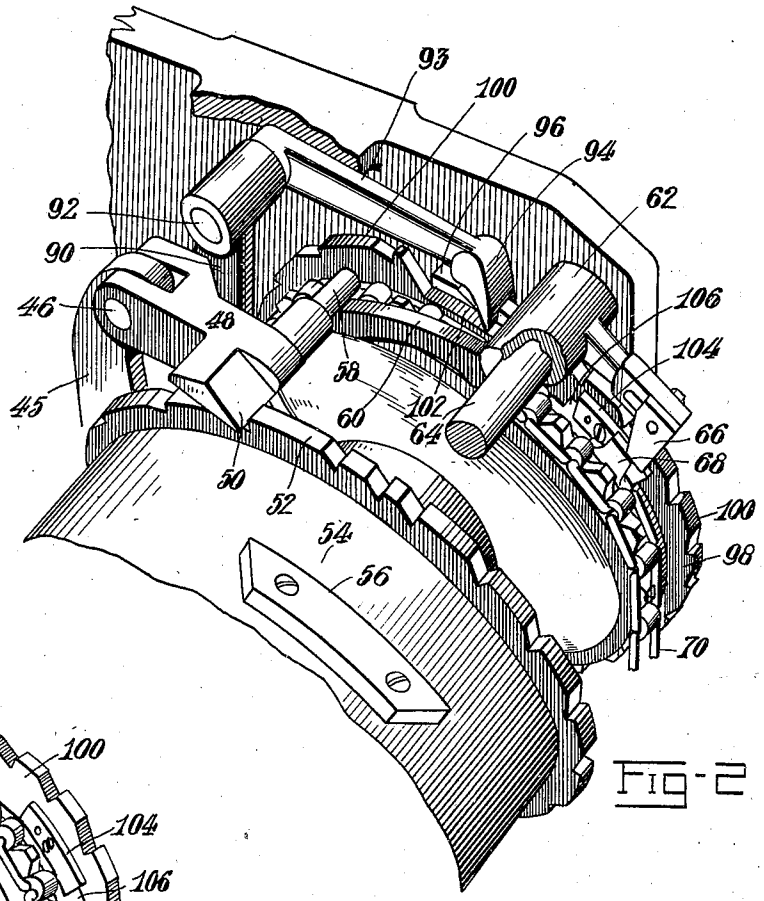


Fig-2

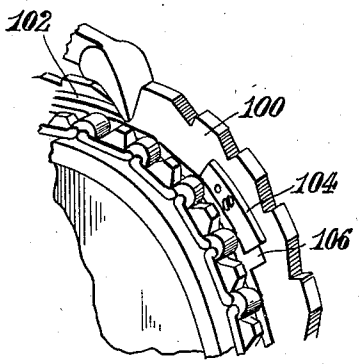


Fig-3

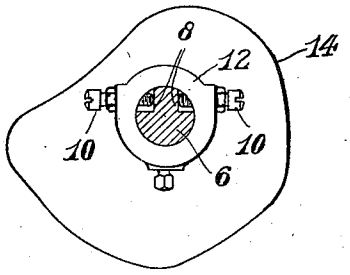


Fig-4

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PATTERN MECHANISM FOR KNITTING MACHINES

Filed Feb. 21, 1946 3 Sheets-Sheet 3

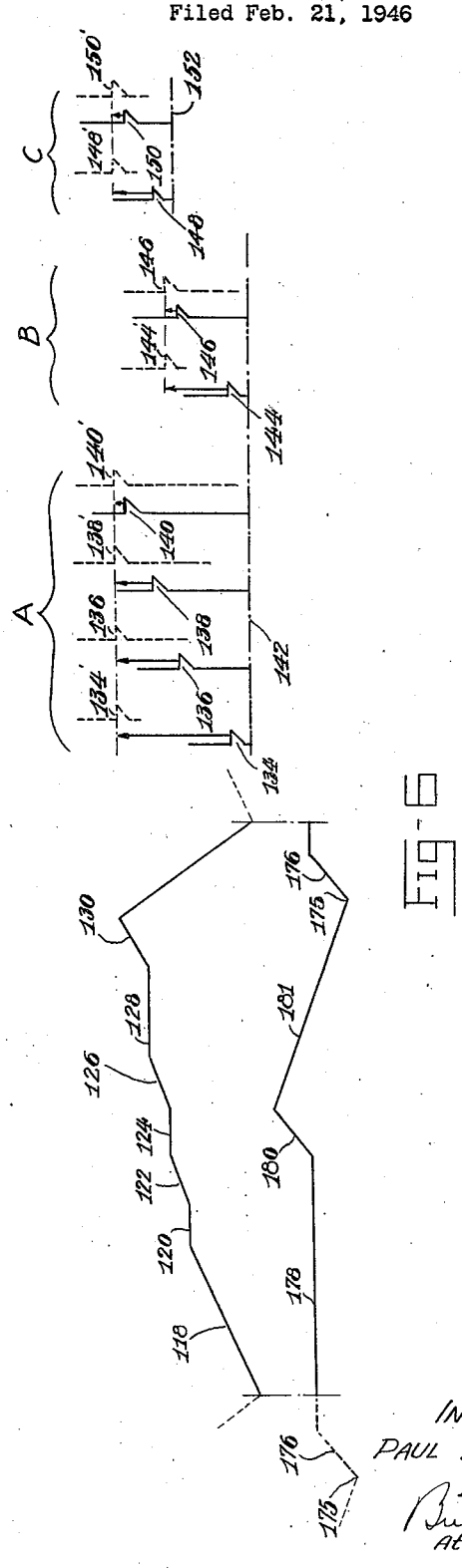


Fig. 6

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Patented Feb. 24, 1948 2,436,468

UNITED STATES PATENT OFFICE

2,436,468

PATTERN MECHANISM FOR KNITTING MACHINES

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Application February 21, 1946, Serial No. 649,259

14 Claims. (Cl. 66—155)

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This invention relates to a knitting machine and has particular reference to the pattern mechanism of such machine.

The main pattern mechanisms of knitting machines, as contrasted with auxiliary pattern devices which are controlled by the main pattern mechanisms, generally comprise two sets of mechanisms. First, there is the usual pattern chain which, except for link-saving means of a type hereafter described, is provided with a link corresponding to each course or to each pair of courses of a stocking or other article knit on the machine. This main pattern chain is advanced one link in each course or in each pair of courses and serves as the master control for all of the events which are involved in the formation of the knitted product. Inasmuch as this chain, consistently with simplicity of construction and arrangement of the controlling lugs which it carries, could not alone effect the complete control of the knitting machine there is associated with it a drum carrying usually, for example in a hosiery knitting machine, a large number of sets of cams for the purpose of controlling the various elements of the machine such as needle actuating cams, yarn fingers, wrapping devices, auxiliary pattern devices and the like. This drum has, of course, a limited circumference much less in extent than the main pattern chain and consequently cannot be stepped ahead in the formation of every course or even at regular more extended intervals since frequently it must advance in each of a plurality of successive courses. Furthermore, in most cases this drum, when the cams are once set up thereon, may be retained unchanged for the formation of a great variety of different products. Accordingly, the drum is controlled by the pattern chain, lugs thereon determining the activity of a pawl arranged to drive a ratchet connected to the pattern drum. Through the major number of courses of a stocking, for example, the pawl for driving the pattern drum ratchet is inactive, being raised out of position to engage a ratchet though continuously oscillated by the driving mechanism of the machine. Only when it is permitted to drop into engagement with the ratchet under the control of the pattern chain does it produce an advance of the drum.

In accordance with the present invention there is provided an association of driving means for the pattern chain and main cam drum having various advantages, the major one of which is to insure such proper cooperation between the chain and drum as to prevent smashes due to

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getting the chain and drum out of step as could be the case in prior arrangements. This is due to the fact that in reciprocation of the needle cylinder a forward reciprocation will take place during a displacement of the driving mechanism which would produce a single rotation of the needle cylinder. The reverse reciprocation occurs during a displacement of the driving mechanism also corresponding to a single rotation of the needle cylinder. In view of this it is evident that if the chain was accidentally displaced the length of one link, or one step which might be a half link, it might happen that the drum would advance during a forward reciprocation to produce a cam change which should only occur during a reverse reciprocation. This might further include an attempt of the pattern drum to shift the clutch to change from reciprocation to rotation or vice versa during an incorrect phase. The result would, of course, be a smashing of the parts.

To avoid this, arrangement is made in accordance with the present invention whereby, during each rotation of a shaft which makes a complete rotation in the time corresponding to two rotations of the needle cylinder, or the time involved in a complete forward and reverse reciprocation of the needle cylinder, the chain is advanced through the length of one link in two steps, there being an advance of a half link length followed by a pause and then an advance of the next half link length without reversal of the movement of the driving pawl. In the same time the pawl which drives the drum ratchet is advanced one stroke but this stroke is made up of an advance, a rest and then several successive short advances with interposed rests. In both cases the pawl is advanced without reverse movement once for every two rotations of the needle cylinder. As will be clear hereafter the result of this is to insure that the second portion of the advance of the cam drum cannot be controlled by the first part of the advance of the chain and vice versa, with the result that irrespective of the position to which the chain might by accident be arbitrarily advanced by hand there will always be a proper correspondence between the movements of the chain and movements of the cam drum which particular chain movements are required to produce. While an incorrect placing of the chain may then result in the formation of improper work nevertheless, there will not result a smashing of the machine parts.

In accordance with the invention there are also eliminated fast moves of the drum so that better

assurance is had of its proper positioning at the end of each pawl stroke. This is due to the fact that by reason of elimination of reverse movements of the pawl at each course more time can be devoted to advance of the pawl, the pawl dropping back only once for every two courses.

A further object of the invention is to save space on the main cam drum by making possible a shortening of the steps required for operation consistent with proper control by the drum.

These and other objects of the invention particularly relating to details of construction and operation will become apparent from the following description read in conjunction with the accompanying drawings in which:

Figure 1 is a diagrammatic elevation of portions of a knitting machine embodying the matters of the present invention, the frame of the machine being indicated in construction lines;

Figure 2 is a fragmentary perspective view showing various parts of Figure 1 having to do with the invention;

Figure 3 is a fragmentary perspective view corresponding to a portion of Figure 2 but showing parts in another position;

Figure 4 is a sectional view showing the adjustable mounting of a cam on a driving shaft;

Figure 5 is a fragmentary axial sectional view showing in particular the fashion in which a masking wheel accomplishes its action; and

Figure 6 is a diagram illustrating the timing of the strokes of the pawls for advancing the chain and the pattern drum and illustrating further the fashions in which various movements of the pattern drum occur.

The drive of the pattern mechanism is accomplished, in the specific instance illustrated, from a gear 2 secured to a shaft which makes one revolution for each rotation of the needle cylinder or for each stroke during reciprocation of the needle cylinder. The knitting machine, may, in general, be conventional, and while for simplicity of description reference will be made consistently to a rotary needle cylinder it will be obvious that the invention is applicable to stationary cylinder machines and, indeed, to knitting machines in general and not solely to rotary machines. The gear 2 drives a gear 4 of twice its diameter which is secured to a shaft 6 from which the movements of the pattern mechanism are derived. The shaft 6 is milled out as indicated at 8 to form flats engageable by screws 10 threaded into the hub 12 of a cam 14 which controls the pawl for driving the pattern drum. By reason of the adjustment indicated the position of this cam may be set so that the timing of the movements of the pattern drum may be fixed properly in relationship to the needle cylinder. The cam 14 has a low point at 16 followed by a rise at 18, a dwell at 20 and then successive rises 22, 26 and 30 with interposed dwells 24 and 28. From the high point following the rise 30 there is a rapid drop 32 to the low point 16. A follower roller 36 is carried by one arm 38 of a bell crank 40 pivoted to the frame at 42 and having a second arm 45 provided with a pivot 46 carrying the pawl 48 which has an engaging nose 50 arranged to drive the teeth 52 of the ratchet of the main cam drum 54 which carries the cams 56 in conventional fashion for control of the various parts of the machine. A laterally extending pin 58 on the pawl overlies an arm 60 of a lever, the hub 62 of which is journaled on a shaft 64 carried by the frame. A second arm of this lever constitutes a follower 66 arranged to be acted upon by lugs 68 on one side of the pattern chain 70. This pattern chain is driven by a sprocket 72 and for the purpose of supporting its length is trained in the usual fashion over a series of idler sprockets which are not illustrated.

A second cam 74 is secured to the shaft 6 and has a low point 75, a rise 76, a dwell 78, a further rise 80 and then a drop 81 to the low point. The ends of the two rests of this cam are spaced approximately 180°. A follower roller 82 bearing on this cam is carried by an arm 84 of a bell crank 86 also pivoted on the stud 42 and having a second arm 90 to which there is pivoted at 92 a pawl 93 having a ratchet-engaging end 94. Springs 44 and 88, respectively, maintain the bell cranks 40 and 86 in contact with their cams.

The pawl 93 engages the teeth of a ratchet 96 secured to the pattern chain sprocket 72. These teeth are equally spaced about the ratchet and are indexed to correspond with the links of the pattern chain so that the advance through one tooth length corresponds to the advance of a single pattern chain link.

Loosely mounted on the ratchet 96 for independent rotation about the same is a second ratchet 98 provided with equally spaced teeth 100 indexed to correspond with the teeth of the ratchet 96 with the exception of a cut away low portion 102 as indicated in Figures 2 and 3. The pawl 94 is sufficiently broad to overlap the teeth of both ratchets 96 and 98. The ratchet 98, however, is of greater diameter than the ratchet 96 and the depressions between the teeth 100 lie outside the tops of the teeth of the ratchet 96 so that except when the low space 102 is opposite the stroke of the pawl 93, the pawl is prevented from engaging the teeth of ratchet 96. On the other hand, when the low space 102 is aligned with the stroke of the pawl, the pawl may drop sufficiently low to engage the teeth of ratchet 96.

The masking ratchet 98 is provided with a block 104 on the side adjacent to the chain 70. Cooperating with this block 104 are lugs 106 laterally extending from certain links on the pattern chain, these lugs being arranged to engage or to be engaged by the block 104.

Lugs 108 are provided on the links of the pattern chain on the side opposite the lugs 68. These are arranged to act upon a follower arm 110 of a lever also pivoted on the stud 64, another arm 112 of which lever is arranged to drive a thrust rod 114 for rocking a lever 116, the function of which is to move laterally a slide for the control of striping in accordance with the principles illustrated in the patent to Lawson and Bristow, No. 2,388,750, dated November 13, 1945. This patented striping mechanism forms no part of the present invention and hence need not be further described, it being understood that it is merely illustrative of a general class of devices which may be controlled directly from the pattern chain in addition to the function of this chain in controlling the main pattern drum. Additional lugs extending upwardly or laterally from the pattern chain may serve to effect other controls in fashions well known to those skilled in the art.

A lever 101 pivoted at 103 and urged clockwise, as viewed in Figure 1, by a spring 105, carries detents 107 and 109 respectively engageable in the notches between the teeth of ratchet 98. These detents are spaced to straddle the low part 102 with the result that one or the other is always in contact with the ratchet.

Reference will first be made to the general as-

pects of operation of the mechanism heretofore described. Assume first that the low portion 102 of the ratchet 98 is in alignment with the stroke of the pawl 93 so that it may drop sufficiently low to engage the ratchet 96. The reciprocations of the pawl 93 will then advance the pattern chain in such fashion that during the first portion of a stroke the pattern chain will be advanced a half link and then in the second portion of the same stroke a further half link to complete the advance of a full link. Each half link advance corresponds, then, to a single course, or if reciprocation is occurring, to either a forward or a backward reciprocation of the needle cylinder. It will, of course, be understood that the invention is applicable to a stationary cylinder-rotary cam machine, and accordingly where rotations or reciprocation of the needle cylinder are referred to for the purposes of simplicity of description, it will be understood that there are included relative rotations between cams and needles such as might be involved in a stationary cylinder machine. It will be understood that the mechanism is applicable to the control of devices of similar nature in full fashion or other machines.

So long as no lug 68 on the pattern chain is acting upon the follower 66 the spring 61 will hold the lever arm 60 in an upper position so that the pin 58 on the pawl 48 will ride over the arm 60 and the pawl will be held high so as not to engage the teeth 52 on the cam drum ratchet. Accordingly, while the chain will continue to advance and will, in effect, count the courses which are being produced and, at the same time, may effect other controls due to lugs thereon, such as the provision of striping, the main cam drum will remain stationary until a lug 68 engages the follower 66 and lowers the arm 60 to permit the pawl 48 to engage the drum ratchet. In the advance of the drum by the pawl the cam 14 provides, as indicated by its shape, an advance followed by a pause and then a series of three further advances with interposed pauses before dropping back to its initial position. As will be pointed out hereafter, the pawl may not be active through all of these advances and, consequently, varied movements of the drum may be effected in the time of formation of either one or both of two successive courses or strokes of the needle cylinder.

The action of the masking wheel occurs in the following fashion. A lug 106 carried by the pattern chain will eventually approach the rear of the block 104 having a fixed position with respect to the low region 102 of the ratchet 98. In the next stroke of the pawl 93 a tooth of the ratchet 96 will be engaged so that the chain will again be driven forwardly. As the chain now advances, however, the lug 106 by engagement with the block 104 will drive the masking ratchet forwardly so that the low space 102 will be carried beyond the position of the stroke of the pawl 93. Accordingly, on the next following backward movement of the pawl, the pawl will rise up over the ratchet 98 and engage one of the teeth 100 immediately following the space 102. In subsequent strokes of the pawl, therefore, the pawl will advance only the masking ratchet 98 without advancing the ratchet 96. The chain then remains stationary until the block 104 reaches the position illustrated in Figure 3 in which it is brought behind the lug 106. In the next stroke of the pawl acting upon the masking ratchet 98 the chain will then be advanced not by engagement of the pawl with the ratchet 96 but by reason of the engagement of the block 104 with the lug 106. This last stroke of the pawl will again bring the low space 102 in alignment with the pawl stroke so that the masking wheel will again come to rest and the normal advance of the ratchet 96 by the pawl will be resumed. This action will then continue until another lug 106 engages the block 104.

As will be evident, in the formation of a portion of the stocking in which the chain would have blank links and ordinarily only the function of counting the courses, the use of the masking ratchet will serve to save links in the chain since the function of counting the courses is assumed by step-by-step revolution of the masking ratchet. This action, for example, may occur during the formation of the leg or of the foot of a stocking during a large number of courses of which there may be no yarn finger substitution nor any necessity for advance of the pattern drum.

There will now be explained the fashion in which the pattern drum is advanced under control of the pattern chain and, in particular, the reason why the two cannot get out of step so that, for example, it will be impossible for the drum to be advanced during a forward reciprocation when the advance should take place during a reverse reciprocation. In Figure 6 the two curves at the left hand portion thereof represent, respectively, the movements of the pattern drum driving pawl and the movements of the chain driving pawl plotted against a scale on which 360° represents a complete cycle of pawl movements corresponding to a single rotation of shaft 6 or two rotations of the needle cylinder. The movements of the drum driving pawl 48 under the action of the cam 14 involve an advance 118, a dwell 120, an advance 122, a dwell 124, an advance 126, a dwell 128 and an advance 130 to the extreme forward position assumed by the pawl followed by a rapid reversal to its fully retracted position. While in the graph of Figure 6 the successive steps are shown as sharply defined, it will be understood that the movements involve gradual accelerations and decelerations and that consequently to present a perfectly accurate picture the various angles in the graph should be rounded. However, for the purpose of explanation a sharp distinction of movements may be assumed.

The pawl 94, under the action of cam 74, starts from its fully retracted position at 175, advances at 176, dwells at 178, advances at 180 and then moves backwardly to its initial position at 181. It will be noted that the ends of the advances 176 and 180 precede in time the beginnings of the advances 118 and 126 of the drum pawl. The result is that prior to the advances of the drum pawl last mentioned there is set up the lever arm 60 so that at the ends of the advances 176 and 180 of the chain pawl there will be determined whether the next succeeding advances of the drum pawl will or will not engage the cam drum ratchet.

At A in Figure 6 there are diagrammed the various advances which may be imparted to the cam drum assuming that the drum pawl is operative through the entire advance of the drum pawl during a cycle. Suppose a tooth 134 of the cam drum is in position so that the pawl 48 will engage it during the beginning of the advance 118, this tooth having been positioned by the preceding advance of the cam drum just forwardly of the rearmost position assumed by the engaging nose 50 of pawl 48. The cam drum then advances during the stroke from 134 to 134', this advance taking place in a series of steps during the ad-

vances 118, 122, 126 and 130. The result is, of course, a maximum advance of the cam drum. If a double cam change is desired during the corresponding two revolutions of the needle cylinder then this advance of the cylinder may be useful. However, economy of advance of the cam drum may be secured in many cases by a different arrangement of the teeth on the drum. For example, suppose the tooth 136 is to be engaged during a cycle. This would first be engaged during the advance 122 and successive advances would take place corresponding to 126 and 130 so that the tooth would eventually arrive at 136'. If then the first movement of the cylinder during the cycle was required only near the completion of the first half cycle, this arrangement could be used, followed by a possible further cam change in the second half of the same cycle.

Again the tooth might start from either of the positions 138 or 140 to wind up respectively in the same positions 138' and 140'. The total advances thus imparted to the pattern drum would, of course, be much shorter than imparted in the instance first illustrated in the use of the tooth 134.

It may be noted, however, that in the conditions illustrated at A there must not be any tooth subsequent to the tooth to be engaged during the cycle spaced less than the spacing represented from the tooth to the line indicated at 142, otherwise the pawl being active throughout the entire cycle the succeeding tooth would be picked up rather than the desired tooth. The possible waste of movement thus involved in the next advance of the pattern drum may be avoided by adopting the arrangement and operation illustrated at B and C. In the case illustrated in B it is assumed that the chain control is such that the drum pawl is operative through the first half of the cycle but not through the second half, i. e., that a lug is brought into position to lower the lever arm 60 during the advance 176 of the pawl 94 but that this lug is carried out of position to control the arm 60 during the advance 180 of the pawl 94. Under such circumstances the drum pawl will be operative during the advances 118 and 122 but will be raised and inoperative during the advances 126 and 130. As a result a tooth positioned at 144 will reach 144' in the cycle as the result of the two advances, while a tooth 146 will reach the position 146'. If advances are required in the first portion of a cycle, the operation just indicated may be adopted without the wasteful necessity of producing further advance of the drum during the second portion of the cycle. In the case illustrated at C it is assumed that the chain lug arrangement provides that the drum pawl will be inoperative during the advances 118 and 122 but operative during the advances 126 and 130. Under these circumstances a tooth 148 may be advanced to 148' or a tooth 150 may be advanced to 150', the former action occurring in two steps during the advances 126 and 130 and the latter only during the advance 130. Since the pawl 148 will not drop into engagement with the ratchet until the time of the rise 180, it will be evident that it is no longer required that the drum ratchet should be without a subsequent tooth back to a point corresponding to line 142 in relation to the tooth to be acted upon; instead, it is only necessary that there should be no subsequent tooth in advance of a position corresponding to the line 152 which, it may be assumed, corresponds to the angular position at which the pawl first engages the periphery of the ratchet as a lug 68 is moved

beneath the follower 66 in the advance 180 of the chain driving pawl.

The foregoing will make evident the economy of space on the drum which may be secured by a proper arrangement of teeth thereon in combination with pattern chain lugs. It will also be evident that the times of movement of the drum may be chosen quite accurately with respect to phases of rotation of the needle cylinder by a proper location of the teeth and, of course, the cams on the pattern drum.

Despite these advantages, nevertheless, the chain and pattern drum cannot get out of step even though the chain may be pulled about on its sprocket. So long as it winds up with a detent in a notch, there cannot possibly occur in one of a pair of successive half cycles a movement of the drum which should occur in the other. Of course, the disturbance of a pattern chain in such fashion would give rise to the production of a stocking or other article which would not be desired, the product possibly being too short or having yarn changes occurring at the wrong times or the like. Nevertheless, such an accidental disturbance of the pattern chain cannot, in particular, produce a smash of the parts of the machine, such as would be the case, for example, if an advance of a pattern drum which should take place during a forward reciprocation would actually take place during a reverse reciprocation.

On the other hand, by the use of teeth on the pattern drum sufficiently long so the pattern drum pawl cannot drop behind more than one tooth during the moves of the chain, any possible false timing between pattern drum and cylinder is avoided, providing no recessions are allowed of the pattern drum pawl between moves which recession would allow the pattern drum pawl to fall out of a tooth before its complete cycle had been made due to the lever control arm 60 rising out of time.

It will be evident that the principles of the invention may be applied otherwise than as specifically illustrated without departing from the scope thereof as defined in the following claims.

What I claim and desire to protect by Letters Patent is:

1. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of

the advancing means for the secondary controlling device.

2. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, means for rendering said advancing means inoperative to advance the primary controlling device during certain of said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

3. In combination with a knitting machine capable of reciprocatory knitting, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, means for rendering said advancing means inoperative to advance the primary controlling device during certain of said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency and at the frequency of a complete reciprocation during reciprocatory knitting, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

4. In combination with a knitting machine capable of reciprocatory knitting, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency and at the frequency of a complete reciprocation during reciprocatory knitting, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

5. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions consisting of two forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

6. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions consisting of two forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, means for rendering said advancing means inoperative to advance the primary controlling device during certain of said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the ad-

vancing means for the secondary controlling device.

7. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, the primary controlling device comprising a main pattern chain and the secondary pattern device comprising a cam-carrying drum, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

8. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, the primary controlling device comprising a main pattern chain and the secondary pattern device comprising a cam-carrying drum, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, means for rendering said advancing means inoperative to advance the primary controlling device during certain of said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

9. In combination with a knitting machine capable of reciprocating knitting, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions consisting of two forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency and at the frequency of a complete reciprocation during reciprocatory knitting, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

10. In combination with a knitting machine capable of reciprocatory knitting, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for advancing the primary controlling device, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions consisting of two forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the primary controlling device occurring in said steps, means for rendering said advancing means inoperative to advance the primary controlling device during certain of said steps, cyclically operating means for advancing the secondary controlling device, said advancing means for the secondary controlling device having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, said cycles of operation of the two advancing means occurring at the same frequency and at the frequency of a complete reciprocation during reciprocatory knitting, and means controlled by the primary controlling device for selectively determining the operativeness or inoperativeness, to advance the secondary controlling device, of the forward steps of the advancing means for the secondary controlling device.

11. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, and cyclically operating means for advancing one of said controlling devices, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advance of the last mentioned controlling device occurring intermittently during said steps.

12. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, and cyclically operating means for advancing both of said controlling devices, each of said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps without substantial reversal of its movement between the steps, followed by a return movement between its extreme positions, advances of the controlling de-

vices occurring intermittently during said steps.

13. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, and cyclically operating means for advancing one of said controlling devices, said advancing means having, in each cycle of its operation, a forward movement between its extreme positions comprising a plurality of forward steps with a dwell between the steps, followed by a return movement between its extreme positions, advance of the last mentioned controlling device occurring intermittently during said steps.

14. In combination with a knitting machine, controlling mechanism comprising primary and secondary controlling devices, cyclically operating means for imparting to the secondary controlling device a plurality of advancing steps during a single cycle of said cyclically operating means, said cyclically operating means being controlled by said primary controlling device, and cyclically operated means for imparting to the

primary controlling device a plurality of advancing steps during a single cycle of the last mentioned cyclically operating means, the last mentioned cyclically operating means operating to retime during each of its cycles the primary controlling device so that the advancing steps of the primary and secondary controlling devices continuously bear predetermined relationships to each other during operation of the machine.

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