Sept. 15, 1942. M. C. MILLER ET AL 2,295,597

PATTERN MECHANISM FOR KNITTING MACHINES

Filed Feb. 2, 1939 8 Sheets-Sheet 1

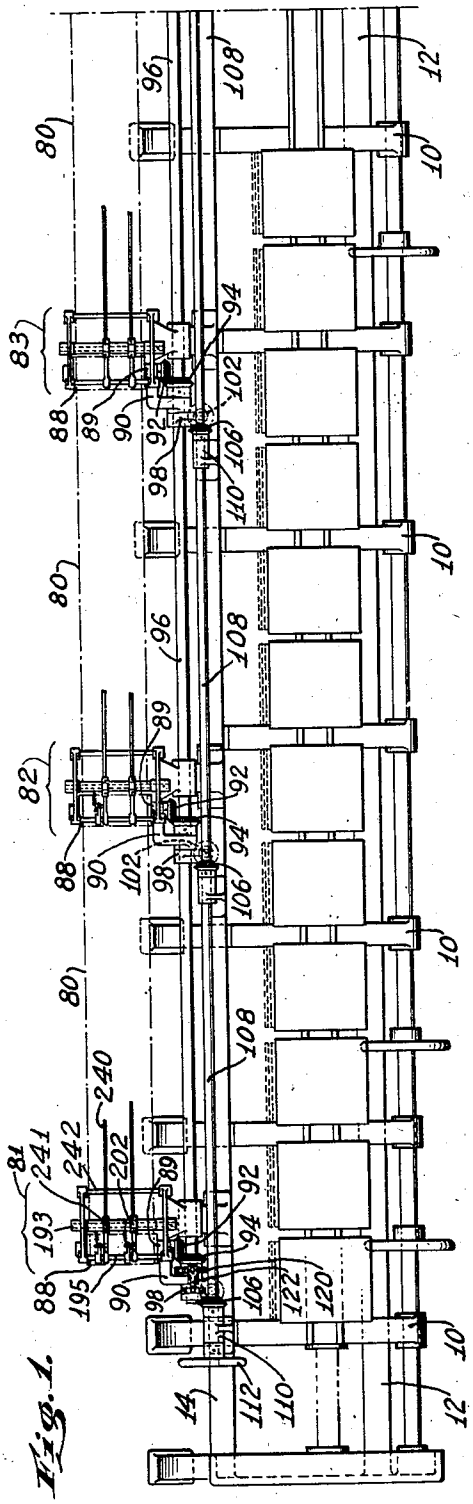


Fig. 1.

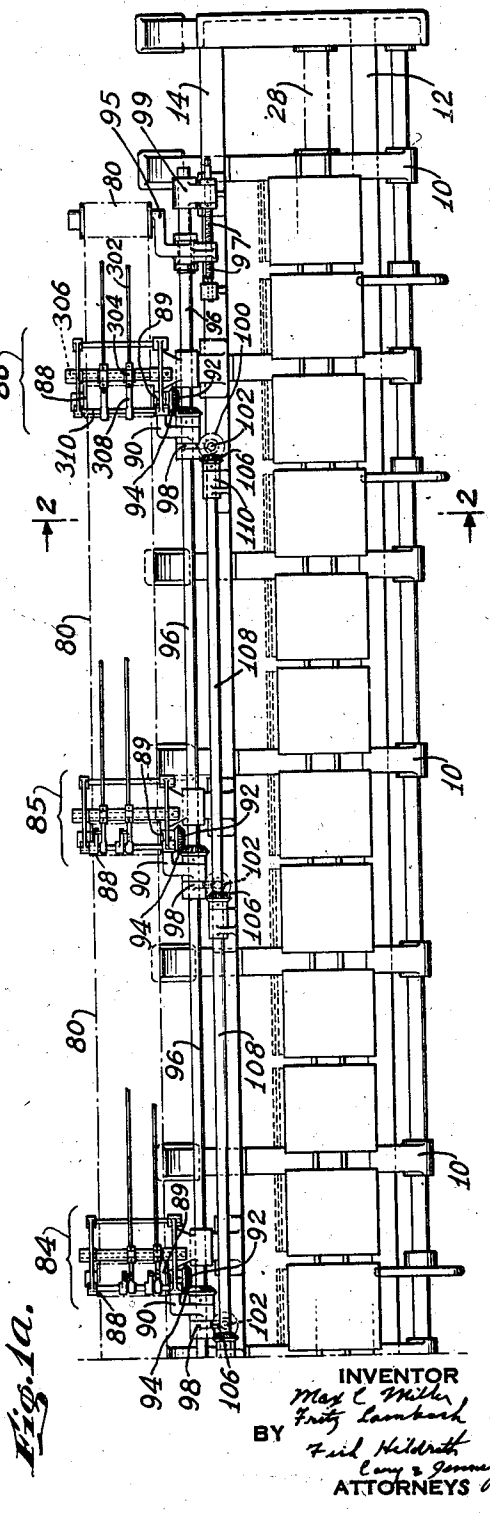


Fig. 1a.

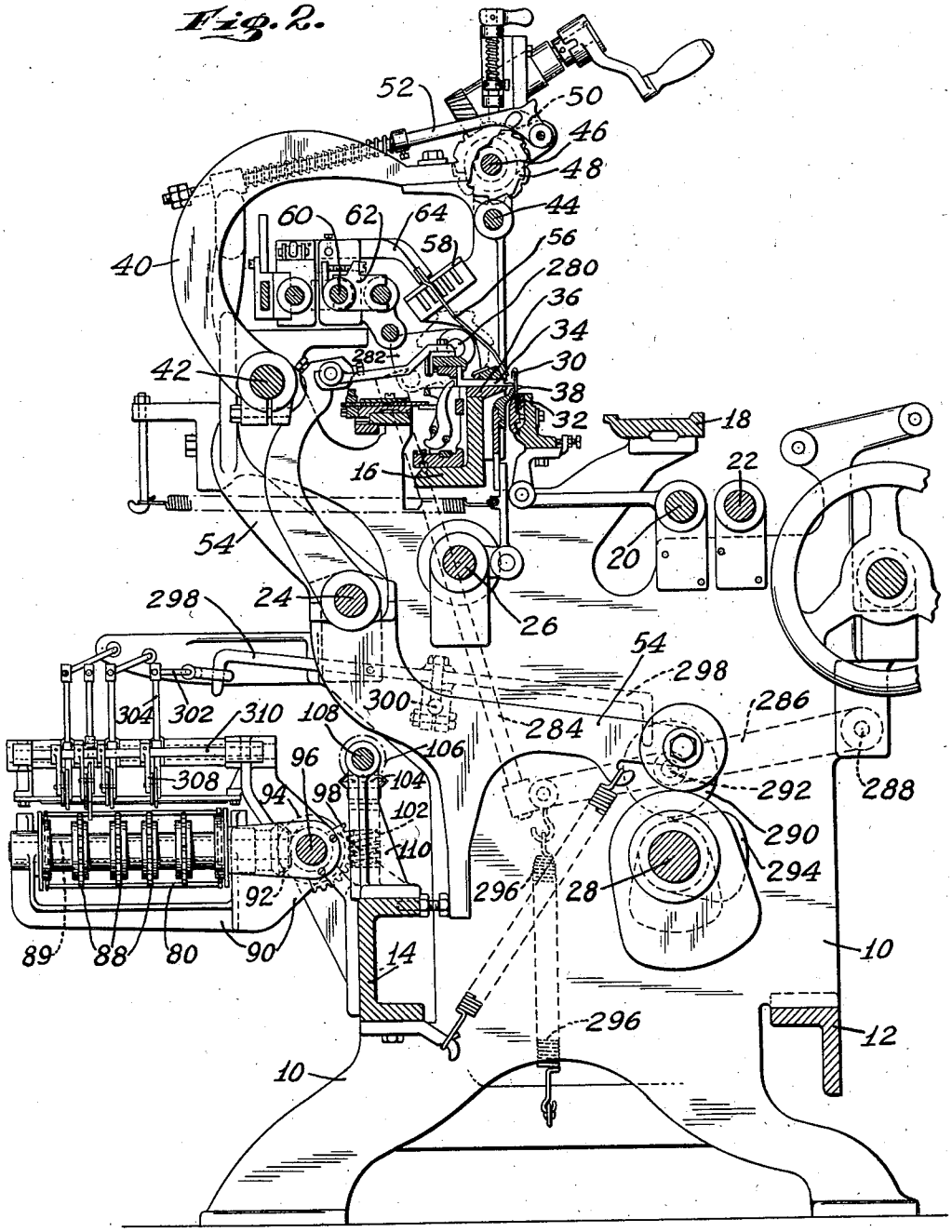
INVENTOR
Max C. Miller
Fritz Lambach
BY Fred Hildreth
Carey & Jenney
ATTORNEYS

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PATTERN MECHANISM FOR KNITTING MACHINES

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Fig. 2.



INVENTOR
Max C. Miller
Fritz Lambach
Erich Hilbert
BY Carey & Jenney
ATTORNEYS

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PATTERN MECHANISM FOR KNITTING MACHINES

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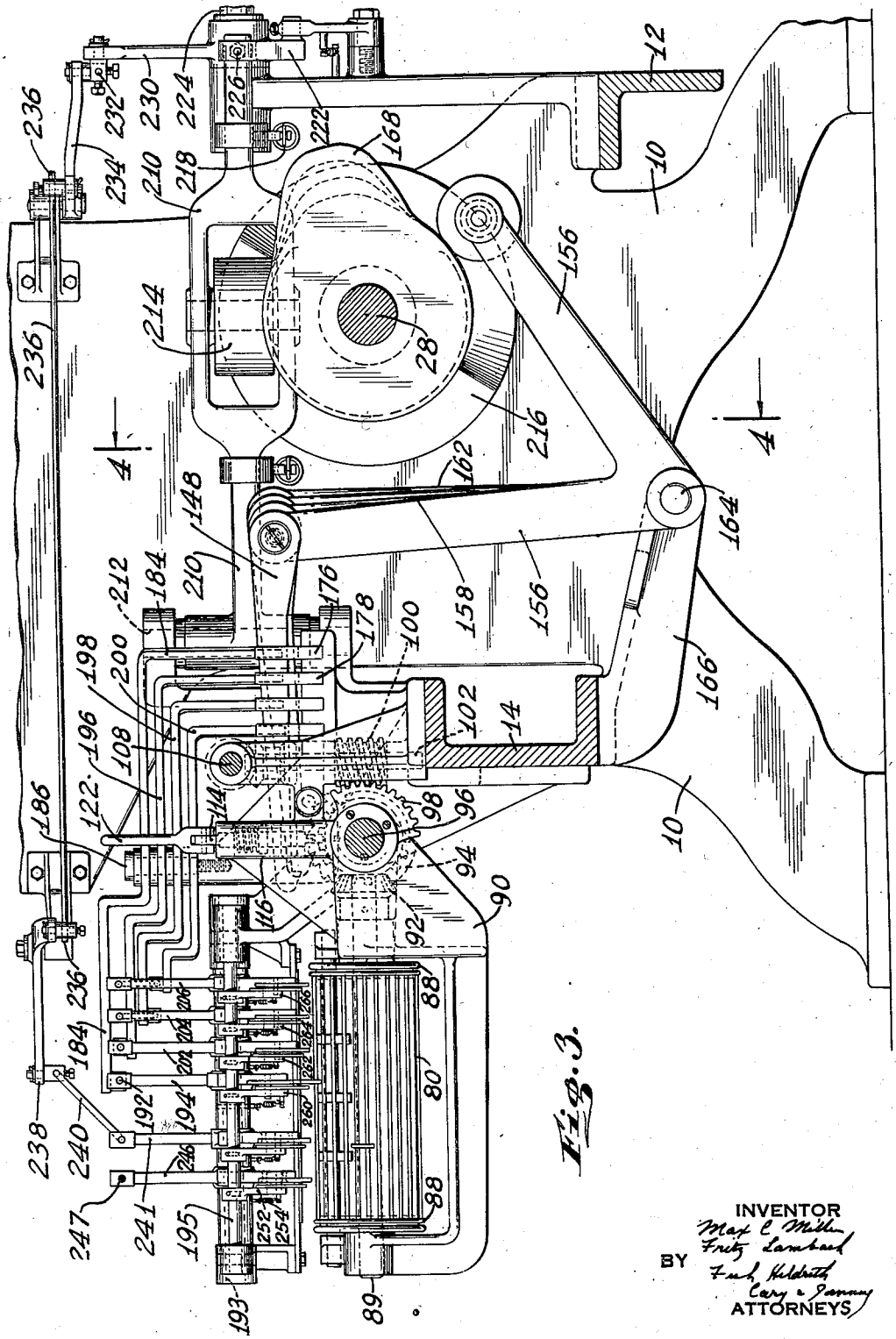


Fig. 3.

INVENTOR
Mark C. Miller
Fritz Lambach
Fred Holdrith
BY Cary & Jammy
ATTORNEYS

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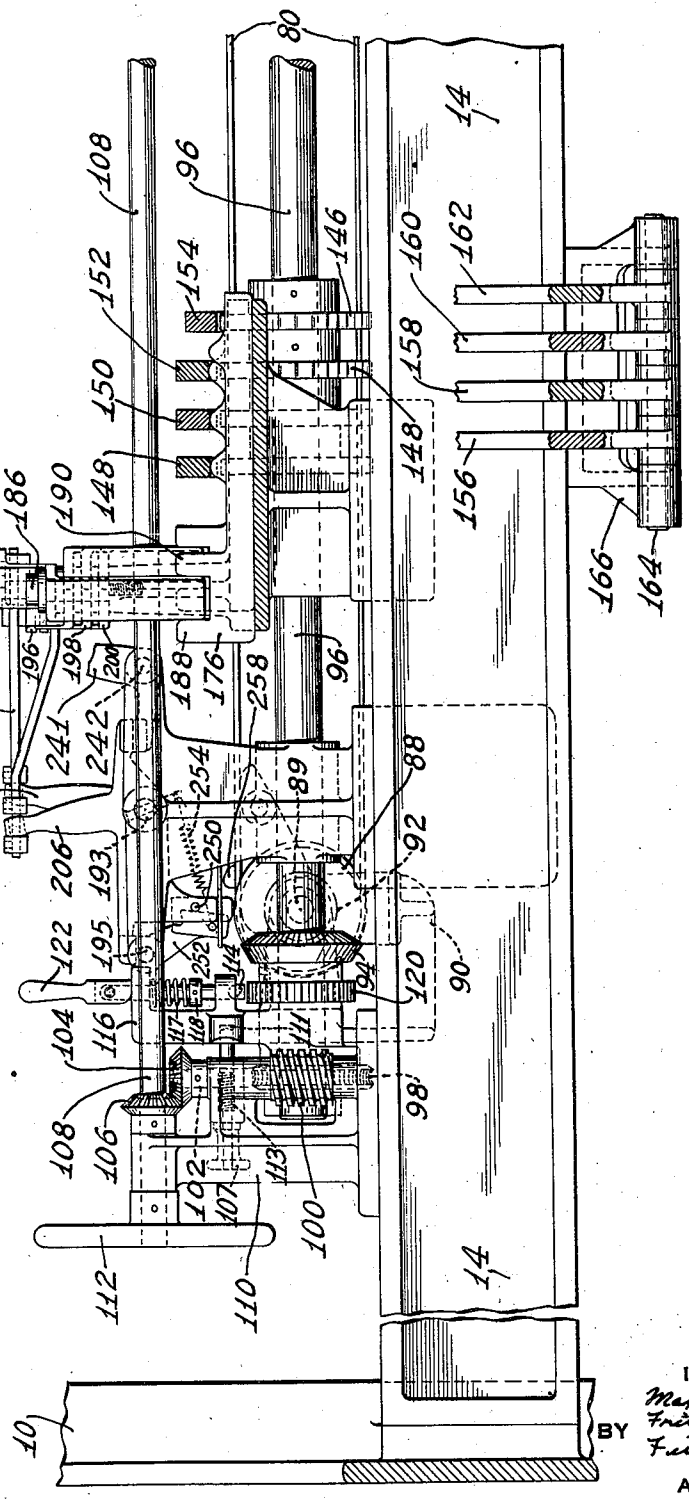


Fig. 4.

INVENTOR
Max C Miller
Fritz Lambach
Fred Hildreth
BY Carr & Penny
ATTORNEYS

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PATTERN MECHANISM FOR KNITTING MACHINES

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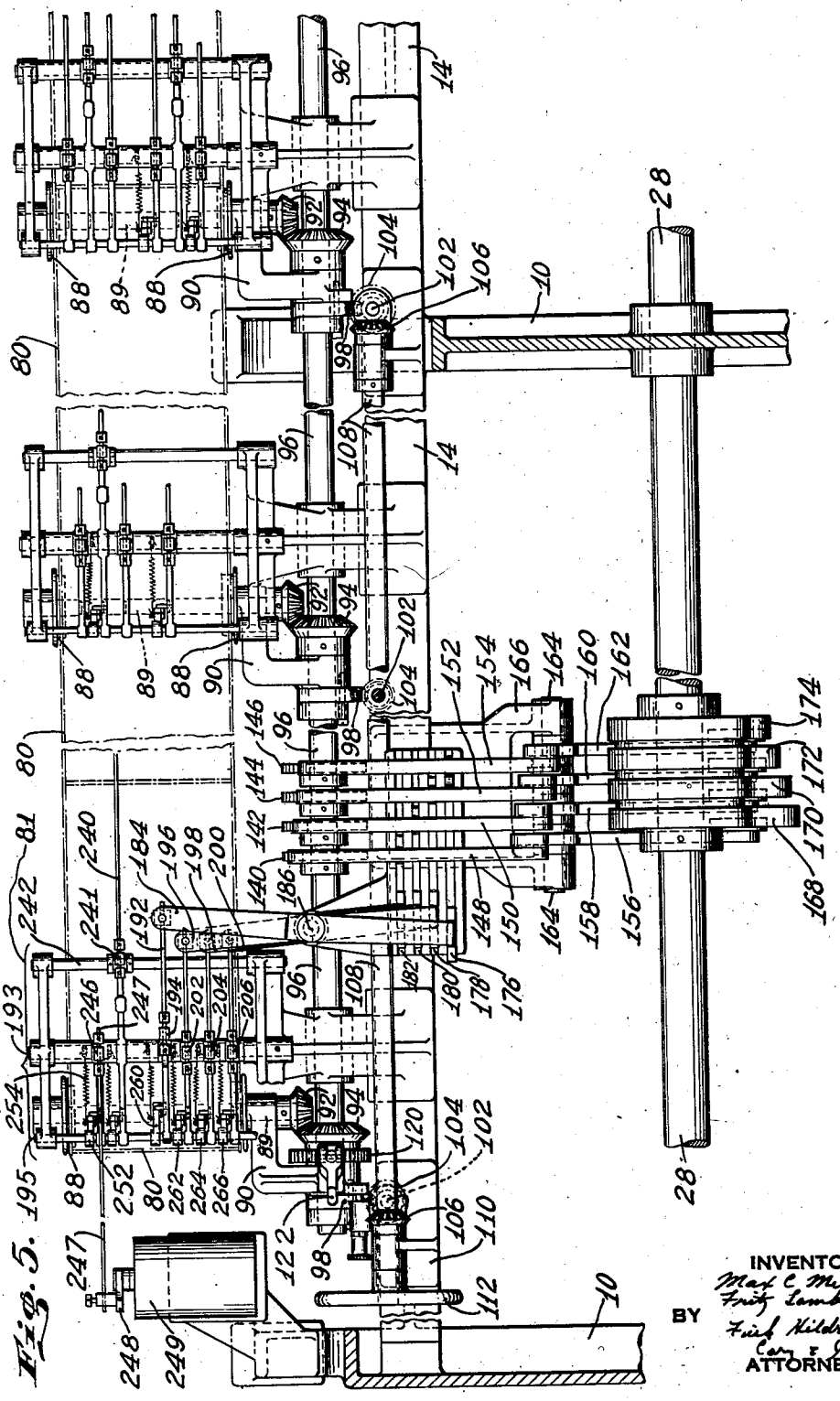


Fig. 5.

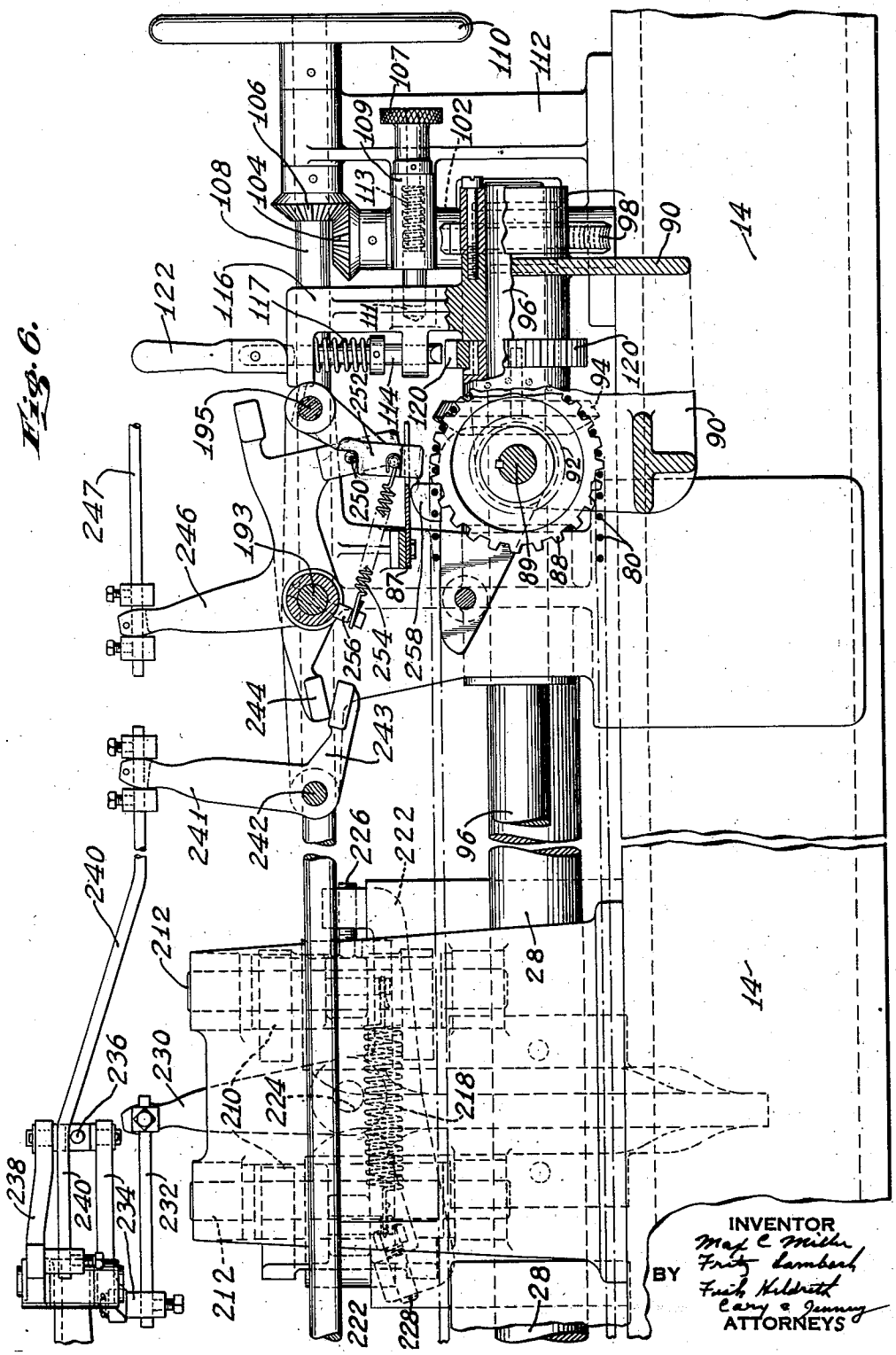
INVENTOR
Mark C. Miller
Fritz Lambach
Fritz Hildrath
Carr & Jenning
BY
ATTORNEYS

Sept. 15, 1942. M. C. MILLER ET AL 2,295,597

PATTERN MECHANISM FOR KNITTING MACHINES

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Fig. 6.



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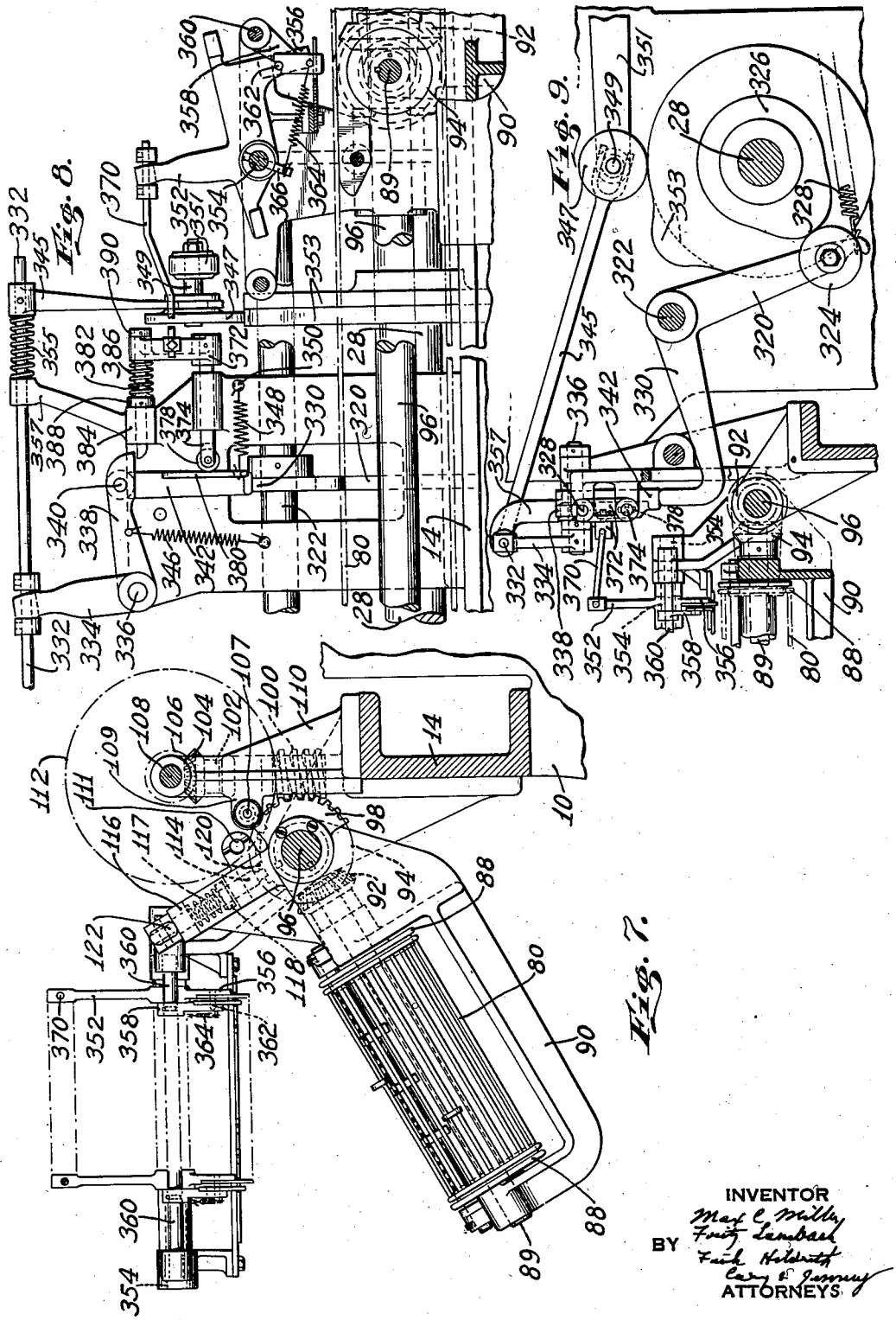


Fig. 8.

Fig. 9.

Fig. 7.

INVENTOR
Mark C. Miller
Fritz Lambach
Frank Holbrook
BY Carey & Janney
ATTORNEYS

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PATTERN MECHANISM FOR KNITTING MACHINES

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Fig. 11.

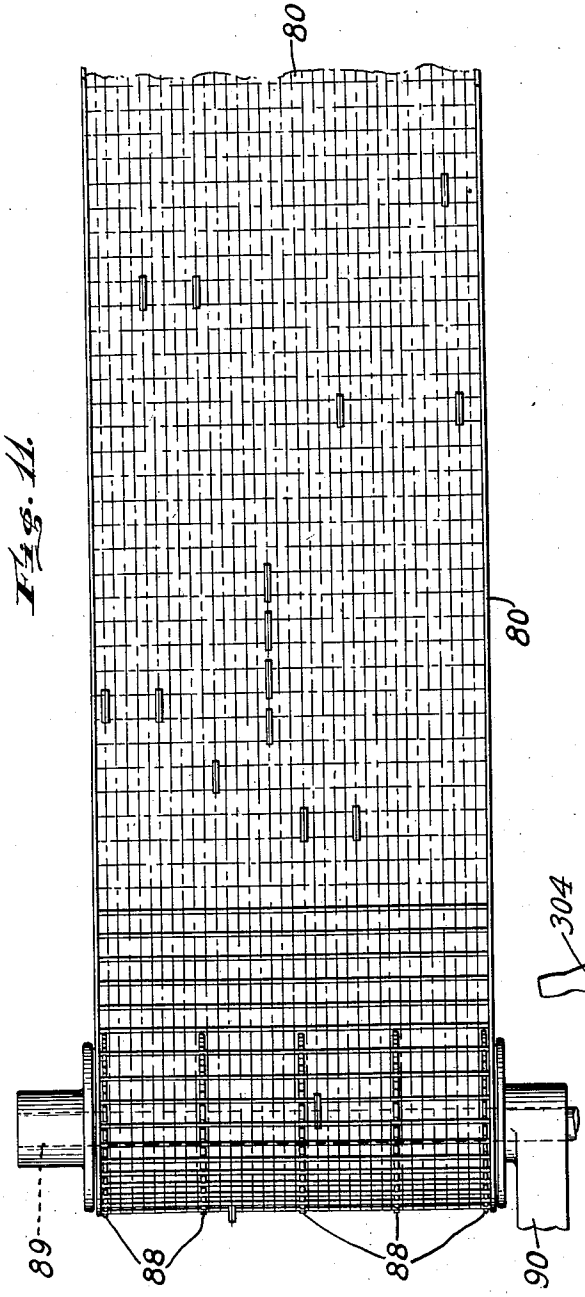
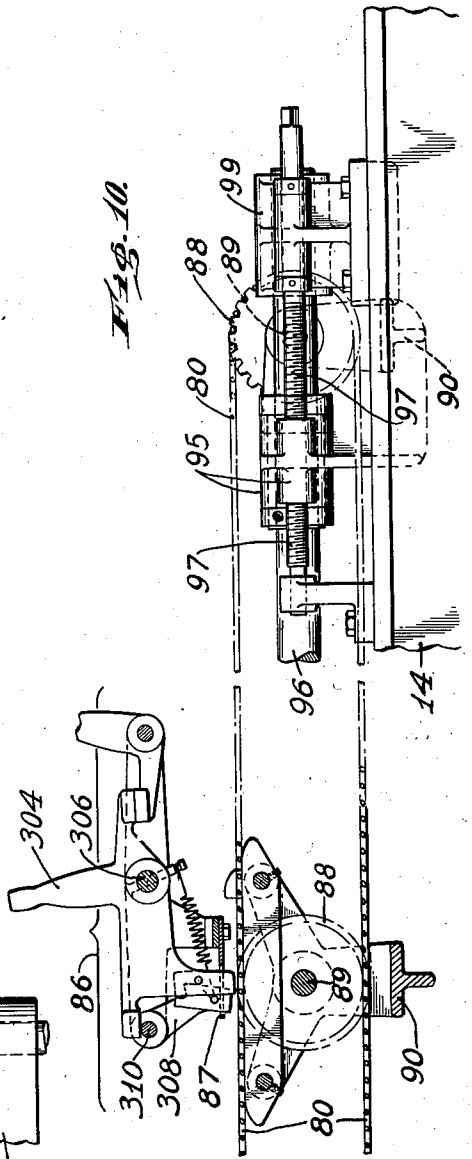


Fig. 10.



INVENTOR
Mat C Miller
Fritz Lambert
Frank Hildreth
BY Carey & Jenney
ATTORNEYS

Patented Sept. 15, 1942 2,295,597

UNITED STATES PATENT OFFICE

2,295,597

PATTERN MECHANISM FOR KNITTING MACHINES

Max C. Miller, Cumberland, R. I., and Fritz Lambach, Fairview, N. J.; said Lambach assignor to Robert Reiner, Incorporated, Weehawken, N. J., a corporation of New Jersey

Application February 2, 1939, Serial No. 254,246

39 Claims. (Cl. 66—154)

The present invention relates to improvements in pattern mechanism for knitting machines.

The invention is herein disclosed in a preferred form as embodied in a flat full-fashioned knitting machine of the general description which includes knitting devices and various auxiliary mechanisms for performing fashioning and other operations incidental to the production of a full-fashioned hosiery blank. While it is expected that the present invention will find its greatest field of usefulness as applied to fully automatic hosiery machines adapted for the knitting of full-fashioned foot and leg hosiery blanks, it will be understood that applicants' improved pattern control may be employed with advantage in flat knitting machines of the same general class which may comprise one or a plurality of knitting sections, and also to machines of other types including circular machines which may be fitted for the performance of all or a portion only of the several functions of which such machines are capable.

Machines of the general class referred to are ordinarily provided with a pattern chain which is given a step-by-step advancing movement during the knitting of the successive courses of the blank, and operates through the cooperation of buttons on the chain and cooperating pattern levers supported adjacent the usual single driving sprocket at one end of the chain, to automatically institute and discontinue various operations of the series. With the increasing demand for complete automaticity, and with the greater complexity of modern full-fashioned machines, the number of individual pattern controls which it is required to operate, has increased far beyond the capacity of the ordinary pattern chain. In modern machines which may require eighty or more individual pattern controls, it has been found necessary to provide additional pattern mechanisms supplemental to the main pattern chain of the machine which may, for example, take the form of supplemental pattern chains or pattern shafts, for the actuation of the many pattern controls. Auxiliary mechanisms of this general description, have been found objectionable in that they are costly and tend to greatly increase the number of operating parts, and also the hazard of failure of the pattern mechanism properly to perform the functions for which it is intended.

It is a principal object of the present invention to provide a novel and improved pattern mechanism including a pattern chain or equivalent form of pattern carrier having actuating bumps thereon, for dictating the operation of the several cooperating mechanisms during the continuance of the knitting operation, and a novel and improved arrangement of the pattern controls, these parts being constructed and arranged to permit the actuation of a very large number of pattern controls directly from the chain without unduly increasing the size and weight of the chain, or the mass and complexity of the pattern controls actuated therefrom.

It is more specifically an object of the invention to provide a novel construction and arrangement of a pattern chain and the driving and control mechanisms associated therewith, to permit the location of pattern levers to be actuated by buttons on the chain at a number of separate control stations located along the length of the machine, whereby a simple and effective arrangement of the pattern chain actuated controls may be effected, with the elimination of long linkage connections in the pattern controls between the several pattern levers and the actuating mechanisms controlled thereby.

It is another object of the invention to provide in a pattern mechanism of this general description comprising a pattern chain for dictating the operation of the several cooperating mechanisms of the machine, a novel construction and arrangement of the chain and the actuating and pattern control mechanisms associated therewith whereby adjustment of the pattern mechanism may readily be made to permit a greater facility in adjustment of the pattern mechanism than is possible with pattern controls known in the art, to adapt the machine for the manufacture of any particular size, shape or design of hosiery blank or other knitted article as the case may be.

With these and other objects in view as may hereinafter appear, a feature of the present invention consists in the provision of a pattern mechanism for a flat knitting machine comprising an endless pattern chain supported along the length of the machine, and a plurality of pattern control stations spaced along the length of the chain, each comprising a number of pattern control elements arranged to be acted upon by the chain.

Another feature of the invention consists in the novel construction and arrangement of the driving and supporting mechanism for the chain comprising a separate driving sprocket associated with each pattern control station, and means for simultaneously driving said sprockets to cause the activating portions of the chain at each control station to be supported and ad-

vanced in an exact timed relation to the operation of the machine.

Another feature of the invention consists in the novel construction and arrangement of the pattern chain and the pattern control elements actuated thereby, whereby narrow gauge control buttons may be employed without complication of said pattern elements to permit a very large number of such pattern buttons and pattern elements controlled thereby to be spaced widthwise of the chain without unduly increasing the width or total weight thereof.

Another feature of the invention consists in the provision of a pattern mechanism including a pattern chain and racking means for advancing the chain one or more unit distances to a new operating position at regularly recurring intervals during the continued rotation of the machine, in which the pattern chain is of sufficient length, so that the number of unit lengths in the chain will be at least equal to or in excess of the greatest number of such intervals which will occur in the knitting of the longest fabric piece which the machine will be called upon to produce.

Another feature of the invention consists in the provision in a pattern mechanism of this description, of a variable racking means which is automatically adjustable to advance the chain one or a plurality of such unit distances during each of said intervals.

Another feature of the invention consists in the provision of a novel and improved form of pattern control actuated from the chain to cause such a pattern control to be moved into and held in operating position during the knitting of a number of successive courses by a single button on the chain, and subsequently to be thrown out of operation by a second button on the chain, whereby the use of the usual series of pattern chain buttons to hold the pattern control in its raised operative position during the knitting of a number of consecutive courses is eliminated, with a consequent simplification of the chain and resulting ease of adjustment.

Other features of the invention consist in the various improvements of the pattern mechanism disclosed, adapted to secure a simple and most efficient construction and operation of the pattern mechanism, and to facilitate adjustment and control of the pattern mechanism by the operator.

The several features of the invention consist also in the devices, combinations and arrangement of parts hereinafter described and claimed, which together with the advantages to be obtained thereby will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a somewhat diagrammatic plan view showing the left half of a twenty-four section full-fashioned knitting machine, to illustrate particularly the improved pattern mechanism including the pattern chain and a number of control stations cooperating therewith spaced along the length of the chain; Fig. 1*a* is a plan view similar to Fig. 1, showing the right hand half of the machine; Fig. 2 is a sectional view in left side elevation, taken on a line 2—2 of Fig. 1*a* illustrating particularly one of the pattern control stations and including the Pointex spindle pattern control associated therewith; Fig. 3 is an enlarged detail cross section of the machine looking from the left, illustrating particularly the left hand control station of Fig. 1 and including the narrowing cam shaft shift control, together with applicants' improved racking mechanism adapted for advancing the chain one or a plurality of unit distance steps for each regularly recurring interval during machine rotation; Fig. 4 is a sectional view in front elevation taken substantially on the line 4—4 of Fig. 3; Fig. 5 is a detail plan view on an enlarged scale and with parts broken away, illustrating three of the control stations comprising applicants' improved pattern mechanism; Fig. 6 is an enlarged detail view in rear elevation and with parts broken away illustrating particularly the narrowing control, together with one specific form of pattern control element for imparting motion from the pattern chain; Fig. 7 is a sectional end view looking from the left of the left hand control station of the machine, showing the chain in its lowered inoperative position to permit resetting or adjustment of the pattern chain; Fig. 8 is a detail view looking from the rear, illustrating a specific form of control associated with one of the intermediate pattern control stations of the machine; Fig. 9 is a view looking from the right, of substantially the parts shown in Fig. 8; Fig. 10 is a detail sectional view in front elevation illustrating particularly the right hand control station and the belt tightening device of Fig. 1*a*; and Fig. 11 is a somewhat diagrammatic plan view showing a portion of the pattern chain, together with the control buttons thereon.

The invention is herein disclosed as embodied in a fully automatic flat full-fashioned knitting machine which may be of ordinary description, only so much of the machine being herein disclosed as is believed necessary to illustrate the connection of the present invention therewith. As best shown in Figs. 1, 1*a* and 2 of the drawings, the machine comprises a twenty-four section machine having the usual cross frames 10 located at spaced intervals along the length of the machine and rigidly connected together by the usual lower front rail 12, rear rail 14, sinker rail 16 and work table 18. The machine is also provided with the usual operating shafts extending along the length of the machine, a number of these shafts including the needle knitting motion shaft 20 and needle press motion shaft 22, the catch bar forward and back motion shaft 24, and the web holder vertical motion rock shaft 26 being shown in Fig. 2 of the drawings. The machine is also provided with the usual main cam shaft 28 which extends throughout the length of the machine and is provided with the usual operating cams for actuating the several co-operating mechanisms of the machine.

The knitting instrumentalities of the machine include a series of knitting needles 30 associated with each knitting section supported for movement en masse on needle bars 32, yarn measuring sinkers 34 slidably supported in sinker bed 36 and knockover bits 38. A narrowing machine frame of ordinary description is shown in Fig. 2 comprising supporting arms 40 secured to rock shaft 42 extending along the length of the machine and lengthwise extending connecting rod 44. A narrowing spindle of ordinary description for controlling the positions of the narrowing points (not shown) is indicated at 46, together with the actuating connections therefor including ratchet 48, pawl 50, pawl link 52, and cam actuated lever 54. The machine is also provided with the usual yarn carriers such as that indicated at 56, secured to carrier rods which are supported for sliding movement in carrier rod supports 58

located at spaced intervals along the length of the machine. Reciprocating movements are imparted to the yarn carriers and advancing movements are imparted to the sinkers by means of the usual friction bar and slur cock mechanism. As shown in Fig. 2, the usual friction driving rod for the machine is designated at 60 having mounted thereon friction boxes such as that designated at 62 connected by arm 64 with a selected carrier rod.

In accordance with the present invention, applicants have provided a novel and improved pattern control mechanism for the machine which comprises a pattern chain 80 and racking mechanism controlled from the main cam shaft of the machine for advancing the chain one or more unit distances at regularly recurring intervals of machine rotation. In the illustrated embodiment of the invention the interval chosen is the rotation of the main cam shaft through one revolution. It will be understood, however, that a different interval may be employed as, for example, the rotation of the cam shaft through a designated number of revolutions. The pattern chain 80 is made up of a large number of unit lengths which may be defined as the length of chain required between centers of buttons located in adjoining positions lengthwise of the chain for controlling the operation of the machine at each recurring interval of machine rotation. In accordance with one feature of the invention, it is proposed to provide a chain of sufficient length so that the number of unit lengths in the chain will be at least equal to or in excess of the greatest number of recurring intervals of machine operation during each of which the pattern chain is moved one or more unit distances from one operating position to another in the knitting of a single foot and leg hosiery blank. For purposes of illustration, it will be assumed that the longest foot and leg stocking blank which the machine will be called upon to knit will require 4800 revolutions of the main camshaft, that the chain is advanced at least one unit distance with each revolution of the cam shaft, and that the total length of the chain employed will, therefore, be the sum of 4800 such unit lengths. In the illustrated construction, the chain is made up of a series of links which are constructed and arranged to permit the supporting of pattern buttons on each of said links. Since an advancing movement of the chain equal to one length of the link will operate to place the next succeeding button on the chain in operating position, the chain will have 4800 links.

In the illustrated embodiment of the invention, the pattern chain 80 is arranged with a relatively large number of patern control stations, six such pattern stations numbered consecutively 81, 82, 83, 84, 85 and 86 being shown in Figs. 1 and 1a of the drawings. It will be understood that a greater or less number of such stations may be employed, as may be found desirable, in the manufacture of individual machines. Each of the pattern control stations generally referred to comprises a supporting frame extending transversely of the chain on which are supported a desired number of pattern levers arranged to be engaged by bumps on the chain. It will be understood that a separate lane considered widthwise of the chain is provided for the button or buttons arranged for actuation of each cooperating pattern lever which may be located at any one of the several pattern control stations. In accordance with one feature of the invention, it is proposed to employ very narrow buttons which will be preferably not more than one-eighth inch in thickness so that a large number of lanes for the pattern buttons may be provided without unduly increasing the width and consequent weight and difficulty in construction of the pattern chain. In the event that the six pattern control stations 81 to 86 inclusive, are employed, it is proposed to arrange the lanes and pattern buttons supported thereon so that every sixth lane considered widthwise of the chain will cooperate with a pattern lever mounted on the same pattern control station. In this manner, it is possible to employ the extremely narrow buttons above noted in combination with pattern levers which may be of the usual relatively heavy construction on each pattern control station. It may be assumed, for example, that the buttons located in lanes 1, 7, 13 and so on, will be acted upon only by pattern levers located at one designated pattern control station of the machine, that lanes 2, 8, 14 etc. will cooperate only with pattern levers located on a second such pattern control station of the machine.

To insure that the narrow engaging portions of the pattern levers will be accurately registered with the cooperating buttons on the chain, there is provided with each control station, a guiding comb 87 through which the button engaging portions of the pattern levers extend.

In order that the chain may be properly supported at each of the several operating stations, and further that the movement of the chain at each station may be properly synchronized with the operation of the machine independently of any slack which may be provided in the chain along its length to take care of contraction or expansion, applicants provide a separate driving sprocket for the chain at each pattern control station, and a single drive through which the sprockets are given a synchronized step-by-step advancing movement. In the preferred construction, there is associated with each driving sprocket, a table support which extends lengthwise of the chain from each side of the associated driving sprocket, so that the chain is supported in a uniformly flat position for an appreciable distance at each driving station. With this construction and arrangement of the driving and supporting means for the chain, it will readily be seen that the positions of the several cooperating pattern levers at any one control station, may be staggered with relation to one another to permit the use of a relatively large number of such pattern controls without interference from one another.

Further in accordance with the invention, applicants provide means for simultaneously moving the several driving sprockets and the chain supported thereon downwardly away from the cooperating pattern levers to permit manual racking or resetting of the chain as may be desired without disturbing the setting of the several pattern controls through the engagement of the buttons with associated pattern levers at any of the several pattern control stations.

As best shown in Figs. 3, 7 and 11 of the drawings, the pattern chain 80 is supported at each driving station upon identical driving sprockets 88 secured to sprocket shafts 89 rotatably supported on brackets 90. Each of the shafts 89 is provided at its forward end with a bevel gear 92 which meshes with a cooperating bevel gear 94 secured to a pattern drive shaft 96 extending along the length of the machine, it being under-

stood that there is one such bevel gear 94 arranged for engagement with a cooperating bevel gear 92 and sprocket shaft 89 for each driving station along the length of the machine. The extreme right hand end of the pattern chain 80, as shown in Figs. 1a and 10, is supported on an additional sprocket 88, which together with its supporting pivot shaft 89, serves as a chain tightening unit. This idler unit including sprocket 88 and shaft 89, is carried on a bracket 95 having sliding engagement with the drive shaft 96. Adjustments in the position of the bracket 95 lengthwise of the shaft 96, in order to tighten or loosen the pattern chain are effected by means of an adjusting screw 97 screw-threaded into a nut formed in an extension of the bracket 95, and rotatably supported against axial movement in a stationary bracket 99.

The supporting brackets 90 for the driving sprockets 88 and chain 80 are pivotally supported on the pattern drive shaft 96 and are controlled to be moved simultaneously into the horizontal operating position shown in Fig. 3 or to the alternative depressed inoperative position shown in Fig. 7 through connections which include a worm gear segment 98 rigidly secured to the hub portion of each bracket 90, and arranged for engagement with a worm 100 on a vertically extending worm shaft 102, one such worm 100 and shaft 102 being provided for each supporting bracket 90. The shafts 102 at their upper ends are provided with bevel gears 104 which mesh with bevel gears 106 secured to a shaft 108 extending along the length of the machine. Fixed bearing brackets 110 spaced along the length of the machine provide bearing support for the shaft 108 which is provided at the left-hand end, as shown in Fig. 1, with a hand wheel 112. The several supporting brackets 90, sprockets 88 and chain 80, are normally locked in their relatively raised operative position by means of a horizontally disposed locking plunger 107 supported in a sleeve jacket 109 formed rigidly with the machine frame (see Figs. 4 and 7). The plunger 107 is arranged for locking engagement with a socket 111 formed on an upwardly extending portion 116 hereinafter more fully to be described, of the bracket 90 associated with the extreme left-hand control station 81 of the machine. The plunger 107 is provided with a knurled head to facilitate actuation thereof by the operator, and is spring-pressed into its locking position by means of a small compression spring 113. When moving the chain to its disengaged position, the operator must first manually withdraw the plunger 107, thereafter turning the hand wheel 112, so that the plunger is moved out of alignment with its socket. The socket 111 is provided with a bevelled edge which contacts with the plunger during the return or upward movement of the chain and associated parts to operating position, to cause the plunger 107 to be retracted against the pressure of its spring 113, and then to be snapped into locking engagement with the socket hole.

In order that the setting of the pattern chain 80 may not be disturbed by the operation of swinging the brackets 90 to and from the operative position shown in Fig. 3, there is provided a locking device under the control of the operator for locking the drive shaft 96 for the pattern chain in a fixed angular position with relation to the brackets 90. The locking device referred to, comprises a spring-pressed detent plunger 114 supported in an upwardly extending sleeve jacket 116 mounted on the bracket 90 associated with the left-hand end pattern control station of the machine, see Figs. 3, 5 and 7. A small compression spring 117 coiled about the plunger 114 between a collar 118 on the plunger and a shouldered portion of the sleeve jacket 116 tends to move the plunger downwardly into engagement with a lock tooth disk 120 on the drive shaft 96. A detent lever 122 pivotally connected to the upper end of the plunger 114 and arranged for engagement against the upper end of the sleeve jacket 116 provides a convenient means for raising the plunger 114 to a normally inoperative position. Movement of the detent lever 122 to the horizontal position shown in Fig. 7 causes the plunger 114 to be moved downwardly under the pressure of its spring 117 into locking engagement with the lock tooth disk 120, thus locking the shaft 96 and driving sprockets 88 in a fixed angular position during rocking movement of the brackets 90 into and out of operating position.

Applicants' improved pattern chain and the racking mechanism therefor, are constructed and arranged to permit variations in the length of the knitted garment to be made, without the necessity of complicated adjustments involving either variation of the total length of the chain or the positions of the many chain buttons mounted thereon.

Features of applicants' improved construction now more particularly to be described, include means for racking the chain at regularly recurring intervals during machine operation, means for varying the operation of the racking means to advance the chain at each interval one or more unit distances as may be desired, a pattern control for this mechanism, a locking device for maintaining any selected pattern lever or levers in their raised operative position during any desired number of successive rackings of the chain, and means controlled from the pattern chain of the machine for controlling the operation of the locking means, and also for controlling the racking means to cause the chain to be advanced one or more unit distances as may be desired each succeeding interval of machine operation at which racking takes place.

With the illustrated construction, applicants preferably provide a pattern chain of sufficient length having a number of unit lengths at least equal to or in excess of the maximum number of such regularly recurring intervals which may be required for the knitting of the longest fabric piece which the machine will be called upon to produce. With the construction shown in the drawings, it is assumed that the chain will be racked once for each full revolution of the main cam shaft, and will therefore be advanced at least one unit distance for each revolution of the main cam shaft. It will be understood, however, that applicants are not to be limited to the specific racking interval employed, and that some other interval of machine operation could be chosen within which the chain is advanced at least one unit distance to its next operating position.

In the illustrated embodiment of the invention, applicants disclose a racking mechanism which is capable of racking the pattern chain from one to four unit distances during each recurring interval. This mechanism is controlled from the pattern chain to reduce or increase as may be desired, the number of rackings which will take place during any desired portion of the knitting operation. For example, if it is assumed that

the longest welt to be knitted is 8", and that 400 courses are required for the knitting of such a welt, the chain will be racked through one unit distance with each recurring interval, or 200 times, prior to the knitting of the picot, and will again be racked through one unit distance with each recurring interval, or 200 additional times, before the operation of closing the welt takes place. Where a shorter length of welt is to be knitted, the variable racking mechanism hereinafter more fully to be described, will be rendered operative during certain of said recurring intervals to cause the racking mechanism to advance the chain at each interval through a plurality of such unit distances, thus causing the chain to be advanced more rapidly to a position at which the picot button and subsequently the welt closing control buttons will be rendered operative to institute each of the picot and welt closing operations, and this without requiring any change in the actual length of the chain or in the position of the usual control buttons thereon.

As best shown in Figs. 3 and 5, four ratchets 140, 142, 144 and 146 are secured to the pattern drive shaft 96 and are arranged to be acted upon respectively by pawls 148, 150, 152 and 154 supported on upwardly extending arms of cam actuated levers 156, 158, 160 and 162 loosely mounted to turn on pivot shaft 164 on a fixed bracket 166. Each of the cam actuated levers above mentioned is provided with a cam roller for engagement with a corresponding cam on the main cam shaft 28 of the machine. These cams are designated respectively at 168, 170, 172 and 174, and are arranged with cam rise portions of different heights for imparting reciprocating movements of different extent to each of the pawls 148 to 154 inclusive. The pawl 154, when engaged with the ratchet 146, operates to advance the pattern chain 80 one unit distance with each racking movement of the pawl. Pawls 152, 150 and 148 are arranged when engaged with their cooperating ratchets to advance the chain two, three and four unit distances respectively each racking movement of the selected pawl.

Further in accordance with the invention, mechanism is provided which is controlled from the pattern chain of the machine for controlling the positions of the pawls 148 to 154 inclusive to cause any one of the four pawls to be brought into operative relation to its cooperating ratchet and to maintain the others of said pawls in inoperative position. This mechanism, as best shown in Figs. 3, 4 and 5, comprises four slide control members 176, 178, 180 and 182 extending transversely of and beneath the pawls 148 to 154 inclusive, each having formed thereon a cam rise portion which operates when brought beneath the cooperating pawl to move the same to raised inoperative position. The slide 176 is moved to cause the rise portion thereof to engage beneath and move the pawl 154 to inoperative position, or alternatively to permit the engagement of the pawl with its ratchet 146 through connections controlled from the pattern chain of the machine, which include a lever 184 supported intermediate its length on a vertically extending pivot shaft 186, and provided at its forward end with a downward extension for engagement between two upwardly extending lugs formed on the slide 176. The positions of the slides 178, 180 and 182, are similarly controlled by means of levers 196, 198 and 200 supported on the vertically extending pivot shaft 186. Each of these levers 184, 196, 198 and 200 is arranged to be controlled by means of a pattern lever associated with the left hand control station 81 as best shown in Figs. 4 and 5. The lever 184 is connected by means of a link 192 with a pattern lever 194 pivotally supported on a pivot shaft 193, and provided with a thin downwardly extending contact portion which passes through the teeth of the comb 87 for engagement with an associated button or buttons on the pattern chain 80. A horizontal extension of the pattern lever 194 is arranged for engagement with a second pivot shaft 195 forming part of the control station 81 to positively limit the downward movement of the pattern lever toward the chain. Identical pattern levers 202, 204 and 206 supported on the rock shaft 193, are similarly connected to control the positions of the respective levers 196, 198 and 200. The pivot shaft 195 also provides support for a series of locking levers, one such locking lever being provided to cooperate with each of the pattern levers 194, 202, 204 and 206. These locking levers are identical in construction and mode of operation with locking lever 252 also supported on the shaft 195, and will be referred to in connection with the enlarged illustration of Fig. 6, and description thereof, for controlling the operation of pattern lever 246.

While one specific form of pattern control racking mechanism has been illustrated in the drawings, which is capable of automatic operation from the pattern chain of the machine for causing the chain to be advanced with each racking movement through one, two, three or four unit distances with each racking movement of the chain, it will be understood that other forms of such racking mechanism may be employed, and that such mechanism may be employed to effect a greater movement of the chain with each racking movement, if so desired.

With the construction and arrangement of the pattern chain above described having a plurality of pattern operating stations spaced along the length of the machine, it will be understood that any desired selection of the several pattern controls may be associated with any particular station. An important advantage which accrues from the provision of a plurality of pattern control stations, spaced along the length of the machine as above described, consists in the fact that any designated pattern control may be operated from a pattern control station which is located adjacent to the mechanism to be controlled, thus eliminating the necessity for the usual long connecting rods and links usually found on such machines equipped with a pattern chain and a single pattern control station associated therewith. Because of the great complexity of modern full-fashioned type knitting machines, which are currently provided with as many as eighty or more individual pattern controls, it has been found impracticable and it is believed unnecessary, to illustrate in detail all of the pattern controls normally associated with these machines. In order to illustrate the application of the present invention for fully automatic control of an automatic machine of the type described, a few selected pattern controls have been illustrated and will hereinafter be described to illustrate the manner in which any number of such desired controls may be actuated from the pattern chain 80 of the machine.

In Figs. 3 and 6 of the drawings is shown the usual pattern control for shifting the main cam shaft 28 of the machine from its usual knitting to a narrowing position. In view of the location of the cam shaft shifting mechanism at the left-

hand end of the machine, the narrowing shift control is illustrated in connection with the left-hand or first pattern control station 81 of the machine. The cam shaft shift mechanism, which may be of ordinary construction, comprises the usual pair of shift roller levers 210 supported on vertically extending pivots 212 and provided with shift rollers 214 for engagement with the usual narrowing shift face cam 216 on the main cam shaft 28 of the machine. A tension spring 218 connected between the levers 210 tends to engage the rollers 214 with opposite sides of the cam 216. The operation of the shift levers 210 to cause the shifting of the cam shaft 28 to and from narrowing position is controlled by means of a rocker lever 222 pivotally supported at 224 on the machine and provided at opposite ends with adjustable stop pins 226 and 228 for alternative engagement with one or the other of the shift levers 210. An upwardly extending arm 230 of the rocker lever 222 is connected by a link 232 with a bell crank 234 pivotally supported on the machine frame. The laterally extending arm of the bell crank 234 is connected through a link 236 to a bell crank 238 which is in turn connected through a link 240 to a narrowing control lever 241 supporting on the pivot shaft 242. The lever 241 is provided with a laterally extending arm 243 which underlies a laterally extending arm 244 of a pattern lever 246 on pivot shaft 193 associated with the left-hand pattern control station 86 of the machine.

As best shown in Figs. 5 and 6, pattern mechanism is also provided controlled from the pattern lever 246 for slowing the machine motor to drive the machine at a reduced rate. This mechanism comprises a link 247 which is connected at one end to an upwardly extending arm of the pattern lever 246, and at its other end to a crank arm 248 of a motor slow-down switch 249, which is thus rendered operative when the cam shaft is shifted to narrowing position to cause the machine to operate at a relatively slow rate.

In the operation of a flat full-fashioned type machine in knitting foot and leg hosiery blanks, certain of the mechanisms for performing fashioning and other operations auxiliary to knitting, are maintained in active operation during a number of successive revolutions of the main cam shaft of the machine, or through a number of successive rackings of the pattern chain. These operations, may be controlled from pattern mechanism which in the present instance comprises the pattern chain 80 of the machine, and pattern levers which are arranged to be moved into operative position, and to be maintained in such operative position during the continuance of the auxilliary operation. It is the usual practice to provide a row of buttons on the pattern chain for this purpose.

In accordance with another feature of the present invention, each of the pattern levers associated with the pattern chain which is to be maintained in operating position during a number of successive rackings of the pattern chain, is constructed and arranged to be moved into operating position by a button on the chain, and to be held in this position by means of a latching device which is released to permit the return of the pattern lever and the connections actuated thereby by means of a second button located on the pattern chain. With this construction and arrangement of the pattern mechanism, the use of the usual pattern chain buttons serially located on the chain for holding a pattern lever in its raised operative position during the knitting of a number of consecutive courses is eliminated, with a consequent simplification of the chain and resulting ease of adjustment. This improvement is of particular advantage in connection with applicant's variable distance racking mechanism for the chain to effect a rapid and easy adjustment of the chain for the knitting of fabrics of different lengths. Assuming, for example, that a series of identical operations are to be performed during the knitting of a number of consecutive courses, so that the pattern control lever associated therewith must be held in its raised operative position during the knitting of these courses, an adjustment in the number of courses in which this operation will be effected is readily obtained by a similar adjustment of the pattern control buttons to produce relatively fast or slower racking, as may be desired, while this operation is being performed.

As best shown in Figs. 3, 5 and 6 of the drawings, the cam shaft shift pattern lever 246 has formed on the button engaging extension thereof, a laterally extending pin 250 which is arranged for engagement with a notched detent lever 252 loosely supported on pivot shaft 195. A tension spring 254 connected at one end to the latch 252, and at its other end to a pin 256 on the pivot shaft 293, tends to maintain the latch in engagement with the pin 250. The latch lever 252 is further provided with a narrow gauge downward extension passing through the aligning comb 87 for engagement with pattern buttons located in a lane provided for this purpose on the pattern chain 80. Movement of the narrowing pattern lever 246 to its raised operative shown in Fig. 6, causes the pin 250 to ride in the notched portion of the latch lever 252 to lock the pattern lever 246 in its raised position. In instances where it is desired to maintain the cam shaft 28 in its narrowing position for one revolution of the cam shaft only, a pattern button such as that designated at 258 will be located on the chain to act simultaneously with the shifting of the pattern lever 246 to its operative position to move the latch lever 252 against the pressure of its spring 254 to inoperative position, thus permitting the return of the pattern lever 246 as the chain is again racked. Where the pattern shaft 28 is to be maintained in its narrowing position during a series of successive revolutions of the cam shaft 28 as, for example, to permit the performance of a series of lace point loop transfer operations, the pattern lever 246 will be maintained in its narrowing position by the latch lever 252 during the entire series of operations, and is permitted to return the cam shaft to its normal knitting position only when a properly located button 258 on the pattern chain 80 is brought into engagement with the detent lever 252. It will be understood that the mechanism above described in its broader aspects is not limited to the use of separate lanes for controlling the associated pattern levers and detent levers. It will be further understood that applicants propose to provide similar detent levers to cooperate with other pattern control levers of the machine. As illustrated, for example, in Figs. 3, 5 and 6 of the drawings, the pattern levers 194, 202, 204 and 206 associated with the variable racking mechanism, are each similarly provided with latch control levers identified at 260, 262, 264 and 266 pivotally mounted on pivot shaft 195 of the left-hand pattern control station 81 of the machine.

The pattern control for controlling the rack-

ing of the usual Pointex spindle of these machines, is shown in Fig. 2 of the drawings. The Pointex spindle is generally indicated at 280, and is given a step-by-step racking movement through the usual pawl and ratchet racking mechanism including the pawl lever 282 and link 284 which is connected at its lower end to the rear end of a cam lever 286 pivoted at 288 on the machine frame. A cam roller 290 supported to be axially shiftable on pivot pin 292 is arranged to be moved into and out of engagement with an actuating cam 294 on the main cam shaft 28 of the machine. A tension spring 296 tends to hold the roller 290 in engagement with its cam 294. The roller 290 is shifted into and out of operative position with relation to the cam 294 to start and stop the racking of the Pointex spindle through connections controlled from the pattern shaft 80 which comprise a cam shift lever 298 supported on a stationary pivot 300, and provided at one end with a fork engaging the roller 290. At its other end the lever 298 is connected by means of a link 302 to an upwardly extending arm of a pattern lever 304 carried on the pivot shaft 306 associated with the right-hand pattern control station 86 of the machine (see Fig. 10). Inasmuch as this mechanism is maintained in active operation during the knitting of a large number of successive courses, a latch lever 308 is mounted on pivot shaft 310 for engagement with the pattern lever 304 to maintain the lever in operating position until such time as the latch is operated by a button on the pattern chain to release the pattern lever 304. Inasmuch as the construction and operation of the latch 308 is identical with that of the latch 252 previously described, no further description thereof is believed necessary.

Further in accordance with the invention, applicants disclose in Figs. 8 and 9, another form of pattern control mechanism constructed and arranged to be actuated from the pattern chain of the machine, and including a relay mechanism positively actuated from the main cam shaft 28 of the machine adapted for the shifting of pattern controlled parts against a strong resistance such as may occur for example in the shifting of a number of identical cam rollers spaced along the length of the machine, each of such rollers being frictioned against its operating cam by a heavy spring. This mechanism comprises a cam actuated lever 320 supported on a rock shaft 322, and provided at its lower end with a cam roller 324 adapted to ride against an actuating cam 326 on the main cam shaft 28 of the machine. A tension spring 328 attached to the lever 320, serves to maintain the roller 324 in engagement with its cam. With this construction, it will readily be seen that the cam actuated lever 320 and shaft 322 have imparted thereto a rocking movement in timed relation to each knitting cycle of the machine. It is contemplated that the rock shaft 322 will extend along the length of the machine, and will provide convenient means for power operation of any desired pattern control which may be associated with any of the pattern control stations 81 to 86 inclusive. The rock shaft 322 has secured thereto, one or more rearwardly extending actuating arms 330, one being provided for the actuation of each power actuated control. For convenience of construction, the illustrated actuating arm 330 is formed integrally with the cam lever 320. It will be understood that the entire assembly including cam 326 and cam lever 320 may be repeated at intervals along the length of the machine if so desired, to avoid excessive torsional strains on shaft 322.

One example of the pattern control which it is proposed to operate in connection with relay or power booster mechanism above described, is specifically illustrated in Figs. 8 and 9, and comprises a pattern link 332 forming a connection between a bell-crank 334 supported on a stationary pivot 336 and the part or parts to be actuated. A horizontally extending arm 338 of the bell-crank has pivotally connected thereto at 340, a depending arm 342 which is adapted for the vertical position of the arm 342 shown in Figs. 8 and 9, to be engaged by the contacting end of one such actuating lever 330, so that during the upward rocking movement of the arm 330, the bell-crank 334 will be rocked in a counterclockwise direction to the operating position shown in Fig. 8, against the pressure of a light tension spring 346. A tension spring 348 connected at one end to the depending lever arm 342, and at its other end to a stationary pin 350, tends to swing the arm 342 in a counterclockwise direction from the position shown in Fig. 8, out of engaging contact with the actuating arm 330.

As shown in Figs. 8 and 9, applicants' booster mechanism has been applied to aid in the shifting of a cam roller between idling and operating positions on its cooperating idling and operating cams. Since the cam and follower connections comprise an operating mechanism of a type common in full-fashioned machines, only so much of this mechanism is shown as is believed necessary to illustrate the manner of operation of applicants' booster mechanism as applied thereto. Connected to the pattern link 332 is a roller shifting fork 345 which engages with the grooved hub of a cam follower roller 347 mounted for axial adjustment on a pin 349 carried on the rear end of a cam lever 351. The roller 347 is shiftable with relation to cams 353 on the main cam shaft 28 of the machine between an operating and an idling position. A heavy compression spring 355 coiled about the pattern link 332 engaging at one end against a supporting bracket 357 and at its other end against the shifting fork 345 tends normally to maintain the several cooperating parts including the shiftable roller 347 in idling position.

The operation of the parts above described, including the lever 342, is controlled from the pattern chain 80 of the machine, through connections which include a pattern lever 352 (see Fig. 8) supported on a pivot shaft 354 associated with one of the intermediate control stations, for example, that designated generally at 85 in Fig. 1a, and having a downwardly extending portion 356 arranged to be engaged by a button on the pattern chain 80. The pattern lever 352 is arranged to be held in operating position during the knitting of any desired number of successive courses, by means of a latch 358 pivotally supported on a shaft 360, and having formed therein a recess adapted for engagement with a latch pin 362 on the pattern lever 352. A tension spring 364 connected between the latch 358 and a fixed pin 366, tends to move the latch into the latching position shown in Fig. 8. An upwardly extending arm of the pattern lever 352 is connected by means of a link 370 with a slide consisting of a yoke 372 and a plunger 374 rigidly secured thereto, slidably supported in a fixed bracket 376, and provided at its opposite end with a roller 378 which engages with a contacting surface 380

of the depending lever arm 342. Movement of the pattern lever 352 in a counterclockwise direction to the position shown in Fig. 8, will cause the plunger 374 to be moved to the left to the position shown in Fig. 8, to move the depending lever arm 342 into operating position in alignment with the actuating lever 330. In order that the bell-crank 334, link 332, and parts controlled thereby, may be maintained in operative position during the knitting of a number of successive courses, there is also provided a second plunger 382 which is supported in a sleeve bearing formed in the yoke 372, and also in a sleeve bearing formed in a stationary bracket 384. A compression spring 386 coiled about the plunger 382 between a collar 388 secured to the plunger and the yoke 372, tends to force the latch plunger 382 to the left to the limiting operative position shown in Fig. 8, in which the collar 388 is engaged against the bracket 384, and the left hand end of the latch is located in locking position beneath the horizontally extending arm 338 of the bell-crank 334, when the bell-crank has been moved to operative position under the influence of the actuating arm 330. A collar 390 secured to the right-hand end of the plunger 382 engages against a corresponding portion of the yoke 372, to cause the plunger 382 to be retracted and advanced with the yoke 372 and plunger 374. When it is desired to discontinue the pattern controlled operation, a button on the chain 80 is brought into engagement with and releases the latch 358, thus permitting the pattern lever 352 to move in a clockwise direction to its inoperative position. The movement of the yoke 372 to the right, causes the latch plunger 382 to be withdrawn against the pressure of its spring 386, and the plunger 374 to be similarly withdrawn, so that the depending lever 342 is permitted to move to the right out of alignment with the actuating lever 330, and the bell-crank 334 to move in a clockwise direction under the pressure of its spring 346 to move the pattern controls to inoperative position.

It will be understood that the invention is not limited to the specific embodiment shown, and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a hosiery knitting machine for knitting fabric pieces operable in accordance with a recurring knitting cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting and arranged to produce stockings of different lengths, a pattern mechanism for the machine which comprises a carrier having actuating bumps thereon, pattern elements actuated by the carrier bumps for controlling said devices, means to rack the carrier the number of times necessary for controlling said devices to produce a garment having a maximum number of courses while the carrier is being moved through one cycle, and means controlled from said carrier for causing said racking means to rack the carrier through its cycle at a faster rate to produce fabric pieces having fewer courses.

2. In a hosiery knitting machine for knitting fabric pieces operable in accordance with a recurring knitting cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting and arranged to produce stockings of different lengths, a pattern mechanism for the machine which comprises a carrier having actuating bumps thereon, pattern elements actuated by the carrier bumps for controlling said devices, means for advancing the carrier through a uniform minimum distance to position succeeding portions thereof in operative relation to said pattern elements at regularly recurring intervals of machine operation to produce a stocking of maximum length, and means for controlling said advancing means to increase the length of advance of said carrier and bumps supported thereon in each of a plurality of selected intervals, and thereby to shorten the stocking.

3. In a flat hosiery knitting machine operable in accordance with a knitting cycle for the knitting of successive courses to produce stockings of different lengths, a pattern control for the machine comprising, in combination, a pattern chain and pattern control elements actuated from the chain, means for advancing the chain through a minimum uniform distance to position succeeding portions thereof in operative relation to said pattern control elements at regularly recurring intervals of machine operation to produce a stocking of maximum length, and means for controlling said advancing means to increase the distance through which the chain is advanced in each of a plurality of selected recurring intervals of machine operation, and thereby to shorten the stocking.

4. In a flat hosiery knitting machine operable in accordance with a knitting cycle for the knitting of successive courses to produce stockings of different lengths, a pattern control mechanism for the machine comprising, in combination, a pattern chain and pattern control elements actuated from the chain, means for imparting a step-by-step advancing movement to the chain through a uniform minimum distance at regularly recurring intervals of machine operation to produce a stocking of maximum length, and control means for increasing the length of such stepped advancing movement effected at each of a plurality of selected recurring intervals, and thereby to shorten the stocking.

5. In a flat hosiery knitting machine operable in accordance with a knitting cycle for the knitting of successive courses and arranged to produce stockings of different lengths, a pattern control mechanism for the machine comprising, in combination, a pattern chain and buttons thereon, said chain consisting of a series of button supporting segments considered lengthwise of the chain, and pattern control elements arranged to be actuated by buttons on any selected segments of said chain, and racking mechanism adapted for imparting stepped advancing movements to the chain through a uniform minimum distance equal to one segment at regularly recurring intervals of machine operation, said racking mechanism having provision for adjustment to cause the chain to be advanced through a distance equal to one or a plurality of such segments for each of a plurality of selected recurring intervals, and thereby to shorten the stocking.

6. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern control mechanism for the machine comprising, in combination, a pattern chain and pattern control elements actuated from the chain, and racking mechanism adapted for imparting a stepped

advancing movement to the chain for each knitting cycle, and means controlled from the pattern chain for causing said racking mechanism to advance the chain one or a plurality of such steps for each knitting cycle of the machine.

7. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern control mechanism for the machine comprising, in combination, a pattern chain and pattern control elements actuated from the chain, a variable step racking mechanism including a plurality of racking devices selectively operable for imparting a different length step advance to the chain, and means controlled from the pattern chain for selectively operating said racking devices.

8. In a flat knitting machine for knitting fabric pieces operable in accordance with a recurring knitting cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine which comprises an endless pattern chain having pattern buttons thereon, said chain having pattern supporting links at least equal in number to the number of recurring knitting cycles of the machine required for the knitting of the longest fabric piece which the machine will be called upon to knit, pattern elements actuated by the chain buttons for controlling said devices, racking mechanism adapted for imparting a stepped advancing movement to the chain with each knitting cycle, and means for causing said racking mechanism to advance the chain one or a plurality of such steps for each knitting cycle of the machine to vary the length of the fabric piece.

9. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, having knitting devices and cooperating mechanisms adapted for performing various operations auxiliary to knitting, a pattern control mechanism for the machine comprising, in combination, a pattern chain and buttons thereon, said chain consisting of a series of button supporting segments considered lengthwise of the chain, pattern control elements arranged to be actuated by buttons on any selected segments of said chain, means for advancing the chain one or more segments at regularly recurring intervals of machine operation, and means controlled from the pattern chain for predetermining the number of segments through which the chain will be advanced during each of said recurring intervals of machine operation.

10. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern control mechanism for the machine comprising, in combination, a pattern chain and buttons thereon, said chain consisting of a series of button supporting segments considered lengthwise of the chain, means for advancing the chain one or more segments at regularly recurring intervals during continued machine operation, pattern control elements arranged to be actuated by buttons on any selected segments of said chain, and means controlled from the pattern chain for predetermining the number of segments through which the chain will be advanced during each of said recurring intervals, said chain having a number of segments at least equal to the greatest number of such intervals which will occur in the knitting of the longest fabric piece which the machine will be called upon to knit.

11. In a flat knitting machine operable in accordance with a recurring cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, a pattern chain extending along the length of the machine, a plurality of pattern control stations spaced along the length of the chain, each comprising pattern control elements arranged to be acted upon by the chain, supporting and advancing means for the chain including individual supports over which the chain passes for cooperative engagement with the pattern control elements at each of said stations, and means for simultaneously moving said supports and the chain supported thereon to and from operative position with relation to said control elements.

12. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported for movement lengthwise of the machine, pattern control elements arranged to be actuated from the chain, a support over which the chain passes for cooperative engagement with said pattern control elements, means for imparting positioning movements to said support and chain away from said pattern control elements to permit resetting of the pattern mechanism, and means for locking the chain against inadvertent movement on its support during said positioning movements.

13. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine, a plurality of pattern control stations spaced along the length of said chain, each comprising pattern control elements arranged to be acted upon by the chain, and a driving sprocket engaging the chain, means for synchronously driving said sprockets, a movable support for each of said sprockets, and means for simultaneously moving said supports and the chain supported thereon to and from operative position with relation to said control elements.

14. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine, a plurality of pattern control stations spaced along the length of said chain, each comprising pattern control elements arranged to be acted upon by the chain, and a driving sprocket engaging the chain, means for synchronously driving said sprockets, a pivotally mounted support for each of said sprockets, a control shaft extending lengthwise of the machine, and connections controlled by the rotation of said shaft to move said supports and the chain carried thereby into and out of operative engagement with said pattern control elements.

15. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, pattern mechanism for the machine comprising, in combination, an endless pattern chain extending lengthwise of the machine, pattern control elements arranged to be actuated from the chain, a driving sprocket over which the chain passes substantially at the operating point of said pat-

tern control elements, a driving shaft extending lengthwise of the machine, a supporting bracket for the sprocket pivotally mounted on said shaft, gear connections between the shaft and the sprocket for rotating the sprocket, means for imparting a stepped rotational movement to the shaft to advance the sprocket and chain supported thereon, and manually operable means including a worm and worm gear for moving said bracket about the shaft into and out of operative position with relation to said control elements.

16. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, pattern mechanism for the machine comprising, in combination, an endless pattern chain extending lengthwise of the machine, pattern control elements arranged to be actuated from the chain, a driving sprocket over which the chain passes substantially at the operating point of said pattern control elements, a driving shaft extending lengthwise of the machine, a supporting bracket for the sprocket pivotally mounted on said shaft, gear connections between the shaft and the sprocket for rotating the sprocket, means for imparting a stepped rotational movement to the shaft to advance the sprocket and chain supported thereon, manually operable means including a worm and worm gear for moving said bracket about the shaft into and out of operative position with relation to said control elements, and means under the control of the operator to lock the shaft against rotational movement.

17. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, pattern mechanism for the machine comprising, in combination, an endless pattern chain extending lengthwise of the machine, pattern control elements arranged to be actuated from the chain, a driving sprocket over which the chain passes substantially at the operating point of said pattern control elements, a driving shaft extending lengthwise of the machine, a supporting bracket for the sprocket pivotally mounted on said shaft, gear connections between the shaft and the sprocket for rotating the sprocket, means for imparting a stepped rotational movement to the shaft to advance the sprocket and chain supported thereon, manually operable means including a worm and worm gear for moving said bracket about the shaft into and out of operative position with relation to said control elements, and a locking device for locking the bracket in its operative position.

18. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine, a plurality of driving sprockets for the chain spaced along the length thereof, a drive shaft extending lengthwise of the machine and bevel gear connections therefrom with each of said sprockets, and racking means for imparting a step-by-step rotational movement to said drive.

19. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain, and individual supporting means for supporting the chain at intervals along the length of the machine, and a plurality of pattern control stations spaced along the length of said chain, each comprising with one of said supporting means a plurality of pattern control elements arranged to be acted upon by said chain.

20. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain, and individual supporting means for supporting the chain at intervals along the length of the machine, a plurality of pattern operating stations spaced along the length of the chain, each comprising with one of said supporting means, a plurality of pattern control elements, and buttons on the chain positioned laterally thereof for engagement with the selected pattern control elements only of said several stations.

21. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine, and pattern buttons supported on the chain in closely adjacent lanes, a plurality of pattern control stations spaced along the length of said chain, each comprising pattern control elements spaced to cooperate with buttons in selected lanes, a driving sprocket for the chain associated with each control station, and means for synchronously driving said sprockets.

22. In a flat knitting machine operable in accordance with a recurring cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine, and pattern buttons supported on the chain in closely adjacent lanes, a plurality of pattern control stations spaced along the length of said chain, each comprising pattern control elements spaced to cooperate with buttons in selected lanes, a driving sprocket for the chain associated with each control station, means for synchronously driving said sprockets to position succeeding portions of the chain in operative relation to said pattern control elements at regularly recurring intervals of machine operation, and means for controlling said advancing means to vary the distance through which the chain is advanced between said recurring intervals of machine operation.

23. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain, and pattern buttons supported on the chain in closely adjacent lanes, a plurality of pattern control elements, one such pattern control element being associated with each of said lanes, and the pattern control elements of adjacent lanes being staggered lengthwise of the chain, and means for supporting the chain at the operating point of each of said staggered control elements.

24. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combina-

tion, an endless pattern chain, and narrow gauge pattern buttons supported on the chain in closely adjacent lanes, a plurality of pattern control elements each having the button engaging portion thereof narrowed to the gauge of the buttons, one such pattern control element being associated with each of said lanes, and the pattern control elements of adjacent lanes being staggered lengthwise of the chain, and means for supporting the chain at the operating point of each of said staggered control elements.

25. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain, and narrow gauge pattern buttons supported on the chain in closely adjacent lanes, a plurality of pattern control elements each having the button engaging portion thereof narrowed to the gauge of the buttons, one such pattern control element being associated with each of said lanes, and the pattern control elements of adjacent lanes being staggered lengthwise of the chain, guiding means engaging with the narrowed portion of each of said pattern control elements to accurately register the same with associated buttons on the chain, and means for supporting the chain at the operating point of each of said staggered control elements.

26. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine and pattern buttons supported on the chain in closely adjacent lanes, and a plurality of pattern control stations spaced along the length of said machine, each comprising a plurality of pattern control elements spaced to cooperate with buttons in non-adjacent lanes.

27. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported along the length of the machine and narrow gauge pattern buttons supported on the chain in closely adjacent lanes, a plurality of pattern control stations spaced along the length of said machine, each comprising a plurality of pattern control elements spaced to cooperate with buttons in selected lanes, and guiding combs associated with each station for accurately registering the buttons with the associated control elements.

28. In a flat knitting machine operable in accordance with a recurring cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, a pattern chain and narrow gauge pattern buttons supported in adjacent lanes considered widthwise of the chain, a control station comprising a plurality of pattern control elements arranged to be acted upon by buttons in said lanes, each of said pattern control elements having the button engaging portion thereof narrowed to the gauge of the associated buttons, and guiding means engaging said narrowed portions for accurately registering said control elements with associated buttons.

29. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, a pattern chain, and pattern buttons on the chain, means for advancing the chain from one to another operating position at regularly recurring intervals of machine operation, means controlled from the chain for controlling the distance advance of the chain during each of said intervals, a pattern control element arranged to be moved into operating position by a button on the chain, and means for locking said element in operating position, said locking means being arranged to be operated by a second button on the chain to permit the return of said element to inoperative position.

30. In a flat knitting machine operated in accordance with a recurring cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported for movement lengthwise of the machine, a plurality of pattern control stations spaced along the length of said chain, each comprising with a driving sprocket, pattern control elements arranged to be acted upon by the chain, and a support on which the chain is guided to cooperate with said pattern control elements.

31. In a flat knitting machine operated in accordance with a recurring cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting, a pattern mechanism for the machine comprising, in combination, an endless pattern chain supported for movement lengthwise of the chain, and pattern buttons supported on the chain in adjacent lanes considered widthwise of the chain, a plurality of control stations, each such station having with a driving sprocket, a plurality of pattern control elements arranged to be acted upon by buttons in said lanes, supporting means for guiding the chain with relation to said control elements, and a guiding comb associated with said control elements for accurately registering said elements with associated buttons.

32. In a flat knitting machine adapted for knitting shaped fabrics having knitting devices and devices for performing various operations auxiliary to knitting, a cam shaft, cams on the cam shaft, and actuating devices including cam levers and rollers shiftable into and out of operative relation to said cams for actuating certain of said devices, a pattern chain, a pattern element actuated by said chain, a roller shifting device driven from the cam shaft, and means controlled by said pattern element to render said shifting device operative to shift the roller.

33. In a flat knitting machine adapted for knitting shaped fabrics having knitting devices and devices for performing various operations auxiliary to knitting, a cam shaft, cams on the cam shaft, and actuating devices including cam levers and rollers shiftable into and out of operative relation to said cams for actuating certain of said devices, a pattern chain, a pattern element actuated by said chain, a roller shifting device comprising a shifting element continuously

oscillated by said cam shaft, a connecting member movable into the path of said shifting element to shift the roller, and an operating connection between the pattern element and connecting member.

34. In a flat knitting machine adapted for knitting shaped fabrics having knitting devices and devices for performing various operations auxiliary to knitting, a cam shaft, cams on the cam shaft, and actuating devices including cam levers and rollers shiftable into and out of operative relation to said cams for actuating certain of said devices, a pattern chain, a pattern element arranged to be moved into operating position by the chain, means controlled from the chain for locking and for releasing said element from its operative position, a roller shifting device driven from the cam shaft, and means controlled by said pattern element to render said shifting device operative to shift the roller.

35. In a flat knitting machine adapted for knitting shaped fabrics having knitting devices and devices for performing various operations auxiliary to knitting, a cam shaft, cams on the cam shaft, and actuating devices including cam levers and rollers shiftable into and out of operative relation to said cams for actuating certain of said devices, a pattern chain, a pattern element actuated by said chain, a roller shifting device comprising a shifting element continuously oscillated by said cam shaft, a connecting member movable into the path of said shifting element to shift the roller, and operating connections rendered operative by movement of the pattern element to operative position to shift the connecting member into the path of the shifting element to shift the roller and thereafter to lock the roller in operative position, and by the return of said pattern element to inoperative position to permit the return of the roller to inoperative position and the movement of the connecting member out of the path of said shifting element.

36. In a flat knitting machine adapted for knitting shaped fabrics having knitting devices and devices for performing various operations auxiliary to knitting, a cam shaft, cams on the cam shaft, and actuating devices including cam levers and rollers shiftable into and out of operative relation to said cams for actuating certain of said devices, a pattern chain and narrow gauge pattern buttons supported in adjacent lanes considered widthwise of the chain, a pattern element having the button engaging portion thereof narrowed to the gauge of the associated button, a roller shifting device driven from the cam shaft, and means controlled by said pattern element to render said shifting device operative to shift the roller.

37. In a flat knitting machine operable in accordance with a recurring knitting cycle for the knitting of successive courses, a pattern mechanism for the machine comprising, in combination, an endless pattern chain extending lengthwise of the machine, a plurality of driving sprockets for the chain spaced along the length thereof, means for synchronously driving said sprockets, and a chain tightening device including an idler roller on which the chain is supported at one end thereof, and an idler support adjustable lengthwise of the machine.

38. In a hosiery knitting machine for knitting stockings of different lengths, a pattern chain for controlling the length of stocking being knitted, means for racking said chain through a complete cycle by a maximum number of chain racking movements to produce a stocking of maximum length, and means controlled by said chain for racking said chain through a complete cycle by a lesser number of chain racking movements to produce a stocking of shorter length.

39. In a flat hosiery knitting machine operable in accordance with a knitting cycle for the knitting of successive courses having knitting devices and cooperating devices adapted for performing various operations auxiliary to knitting and arranged to produce stockings of different lengths, a pattern chain for controlling the operation of said knitting and auxiliary devices and the length of stocking being knitted, operating means for said chain providing a uniform step-by-step operation thereof for producing a stocking of maximum length, means for increasing the length of a plurality of selected steps of the uniform operation of the chain to reduce the length of selected portions of the stocking.

MAX C. MILLER.
FRITZ LAMBACH.