March 25, 1958 F. LAMBACH 2,827,781

STRAIGHT BAR KNITTING MACHINE

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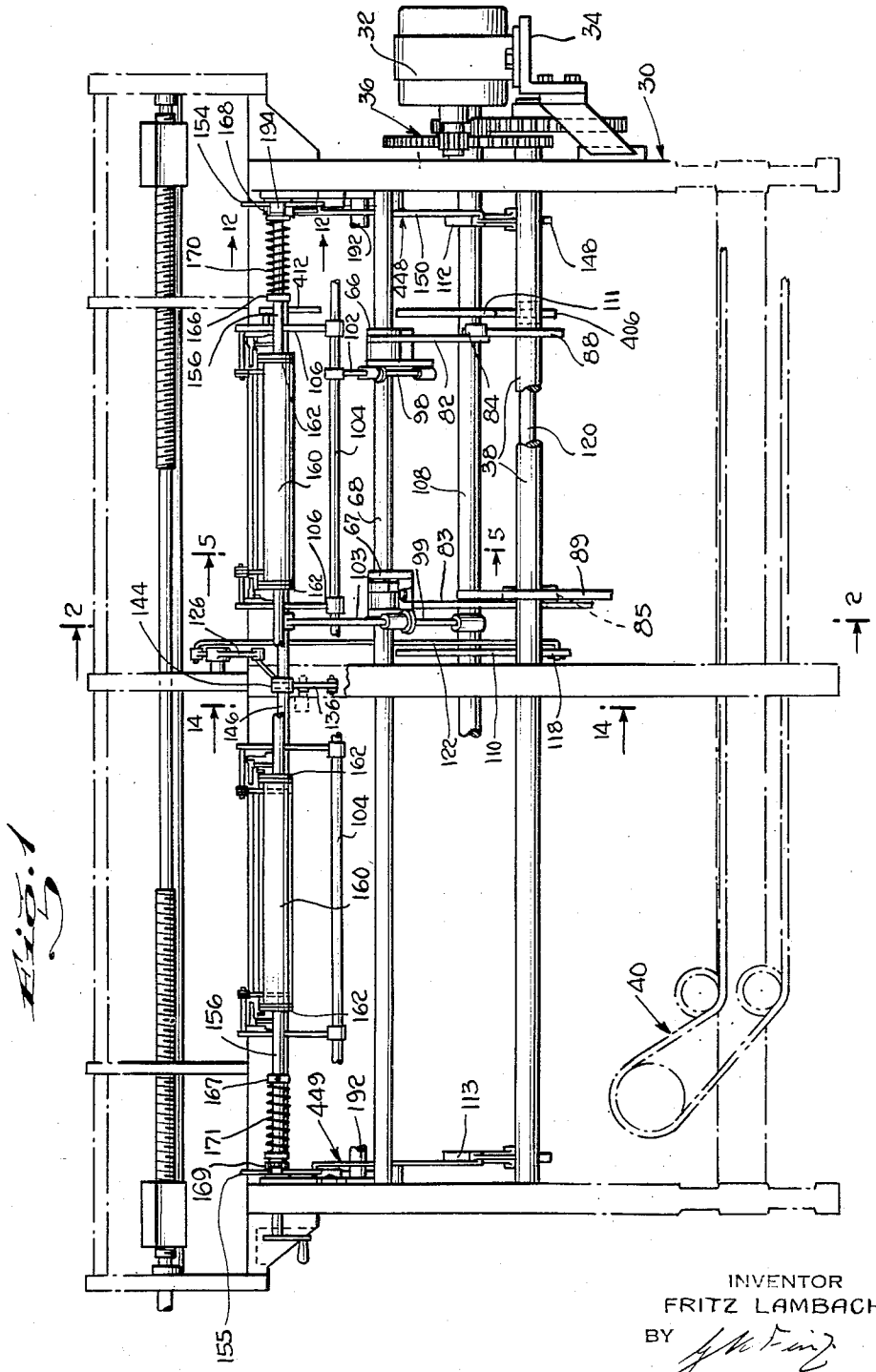


Fig. 1

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Fig. 2.

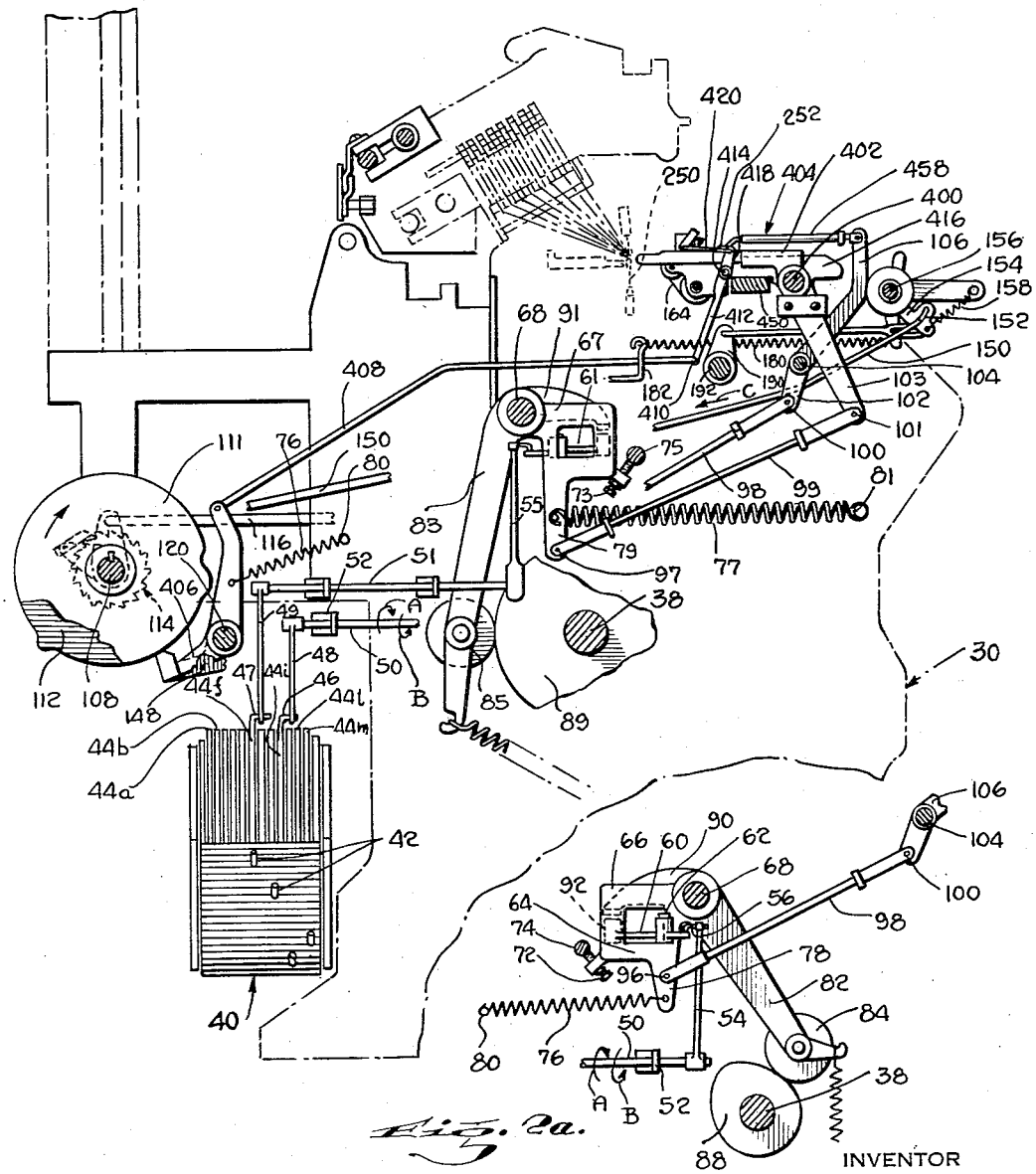


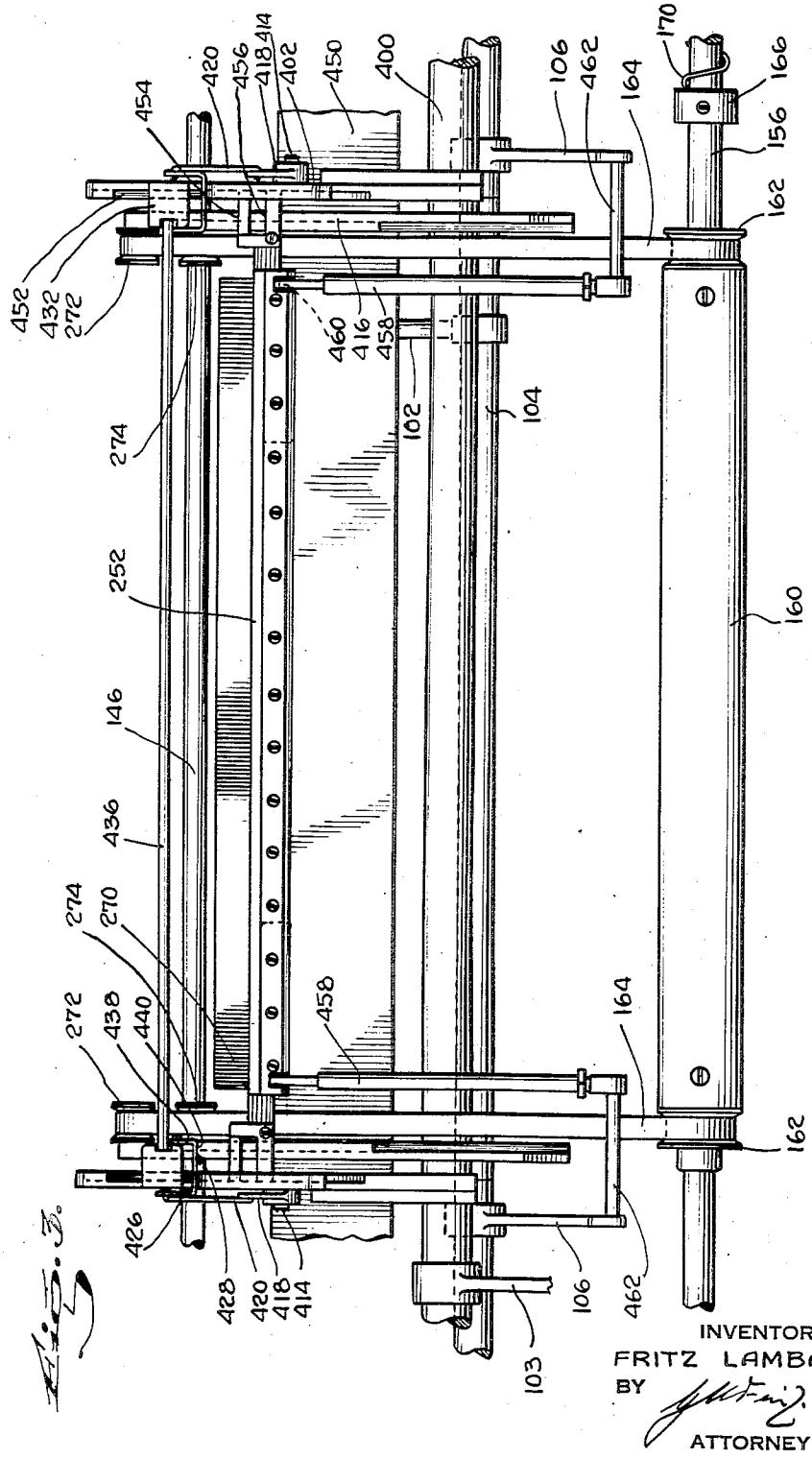
Fig. 2a.

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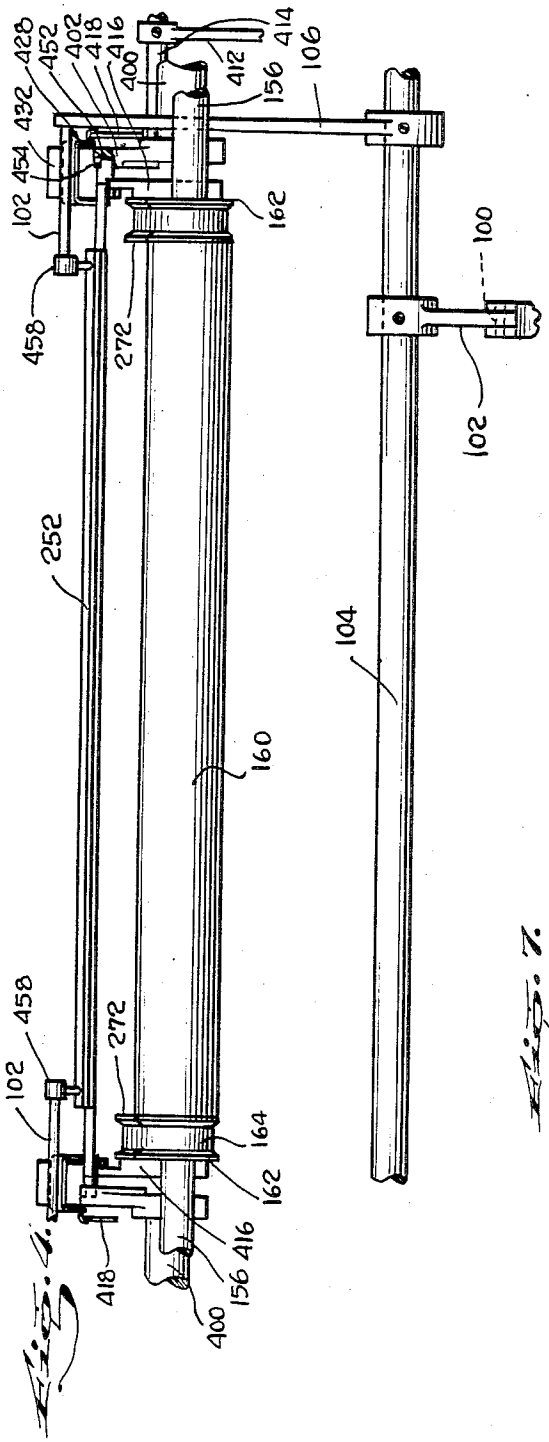


Fig. 4.

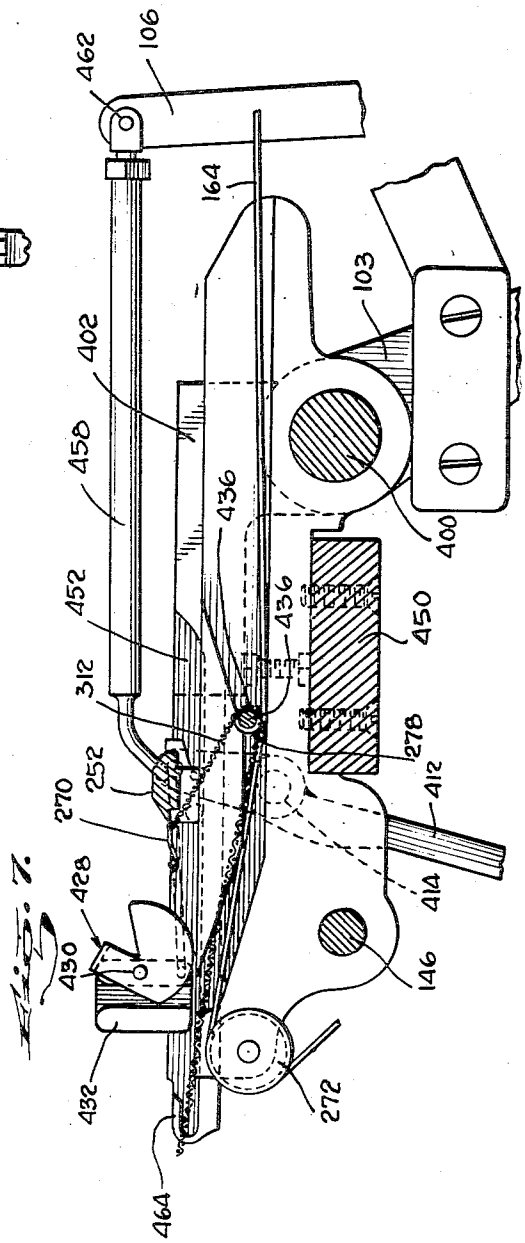


Fig. 7.

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Fig. 5.

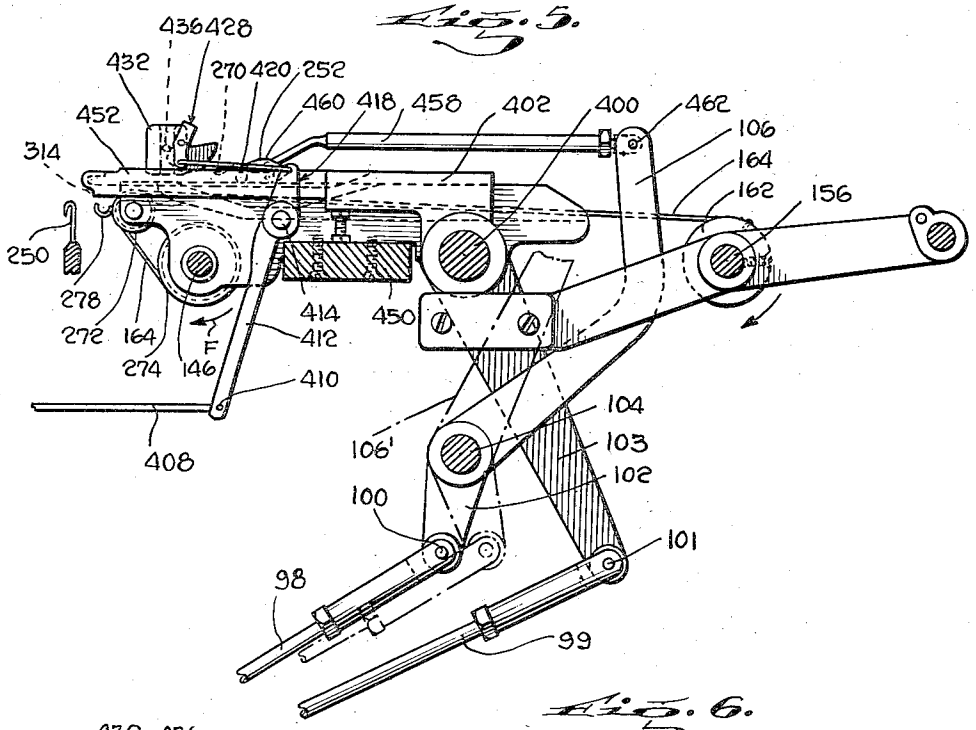
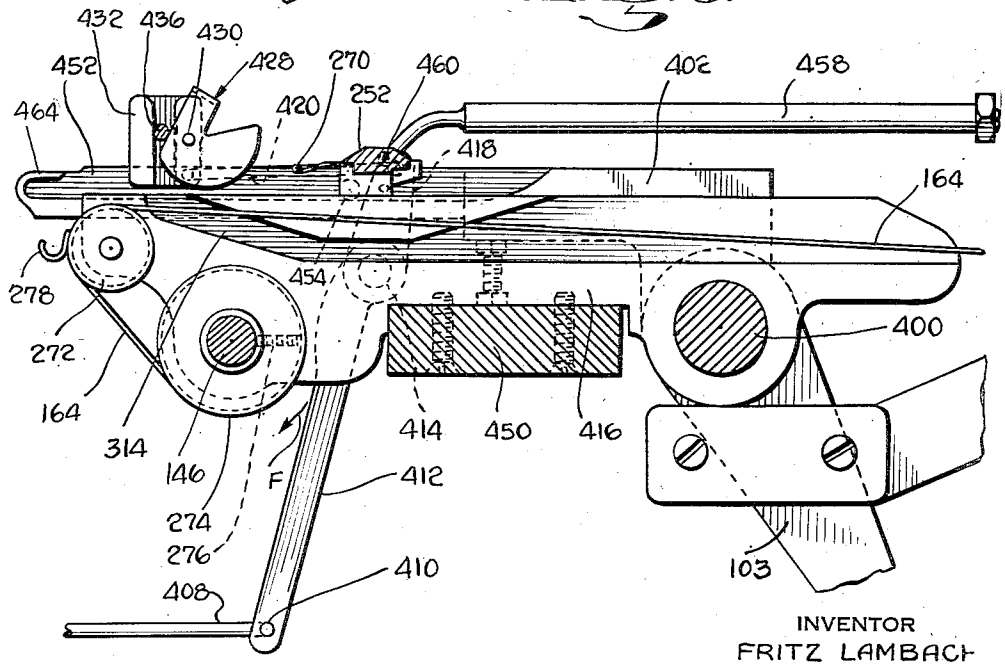


Fig. 6.



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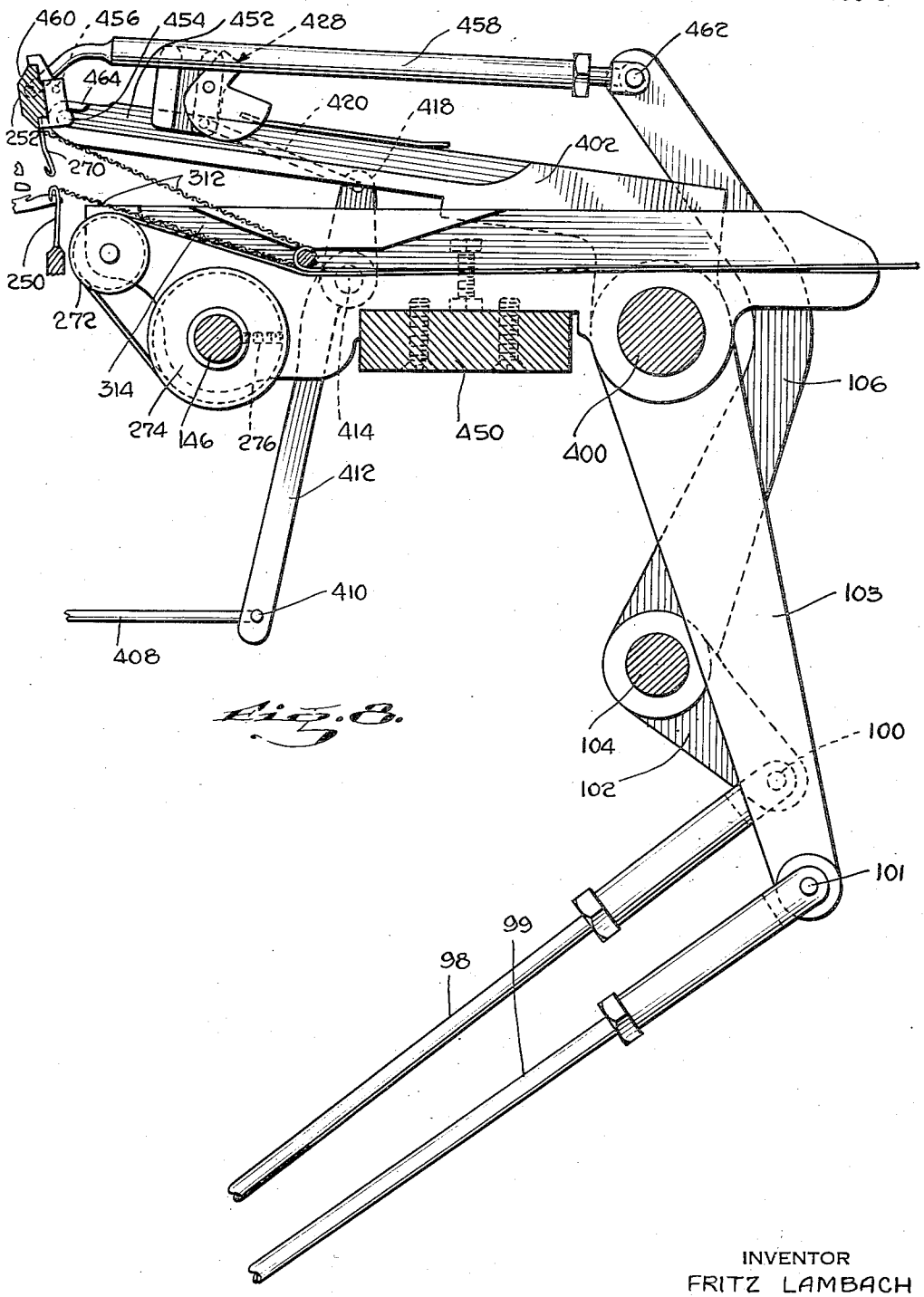


Fig. 8.

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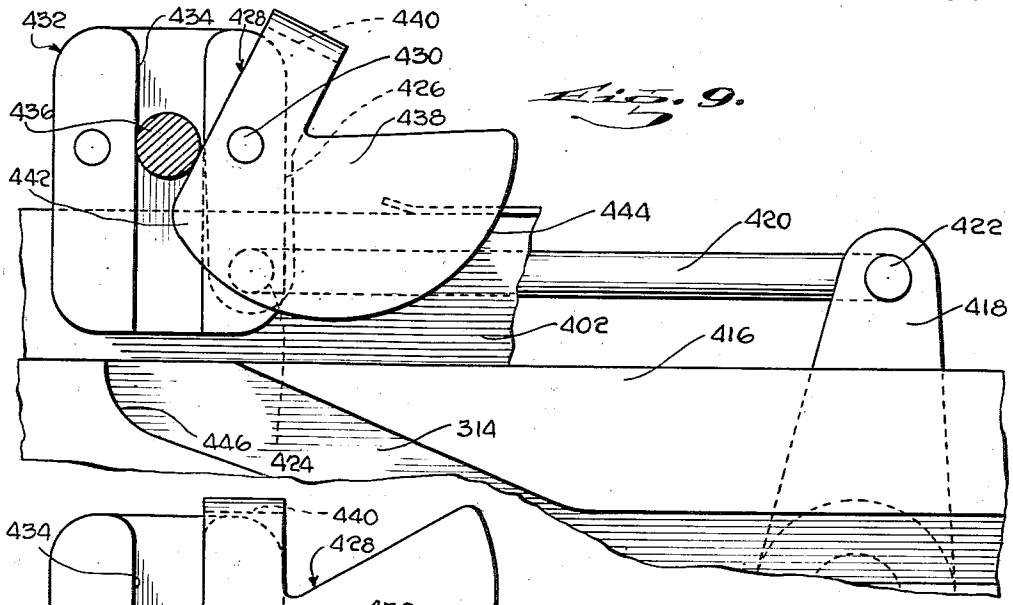


Fig. 9.

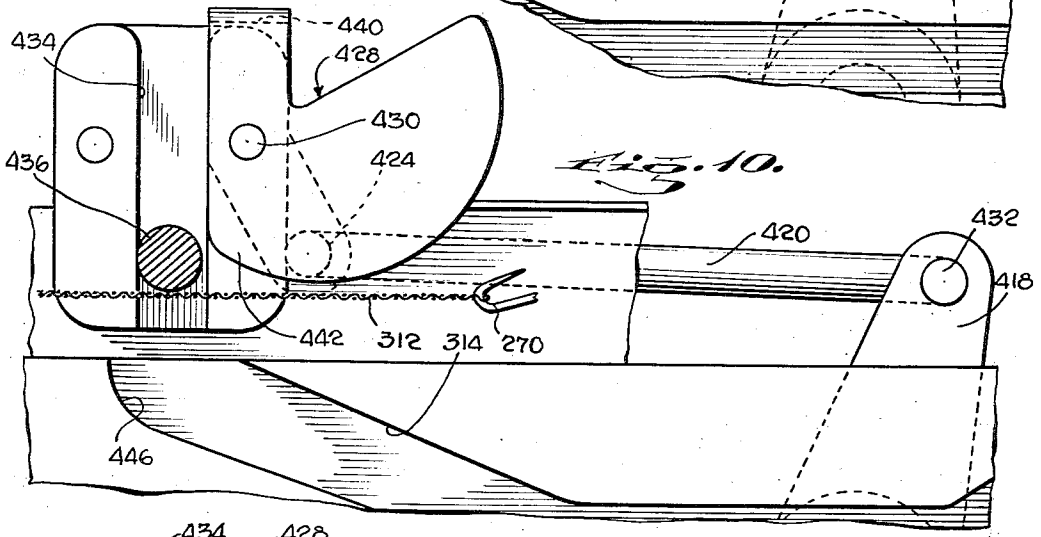


Fig. 10.

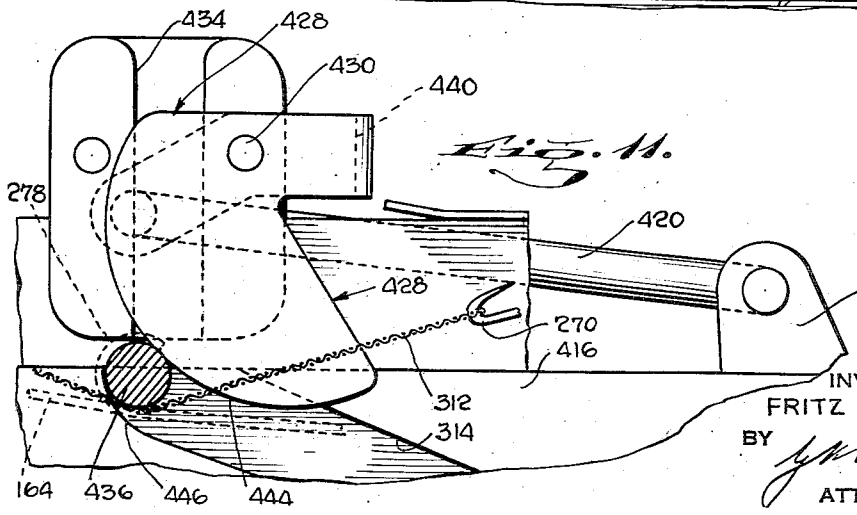


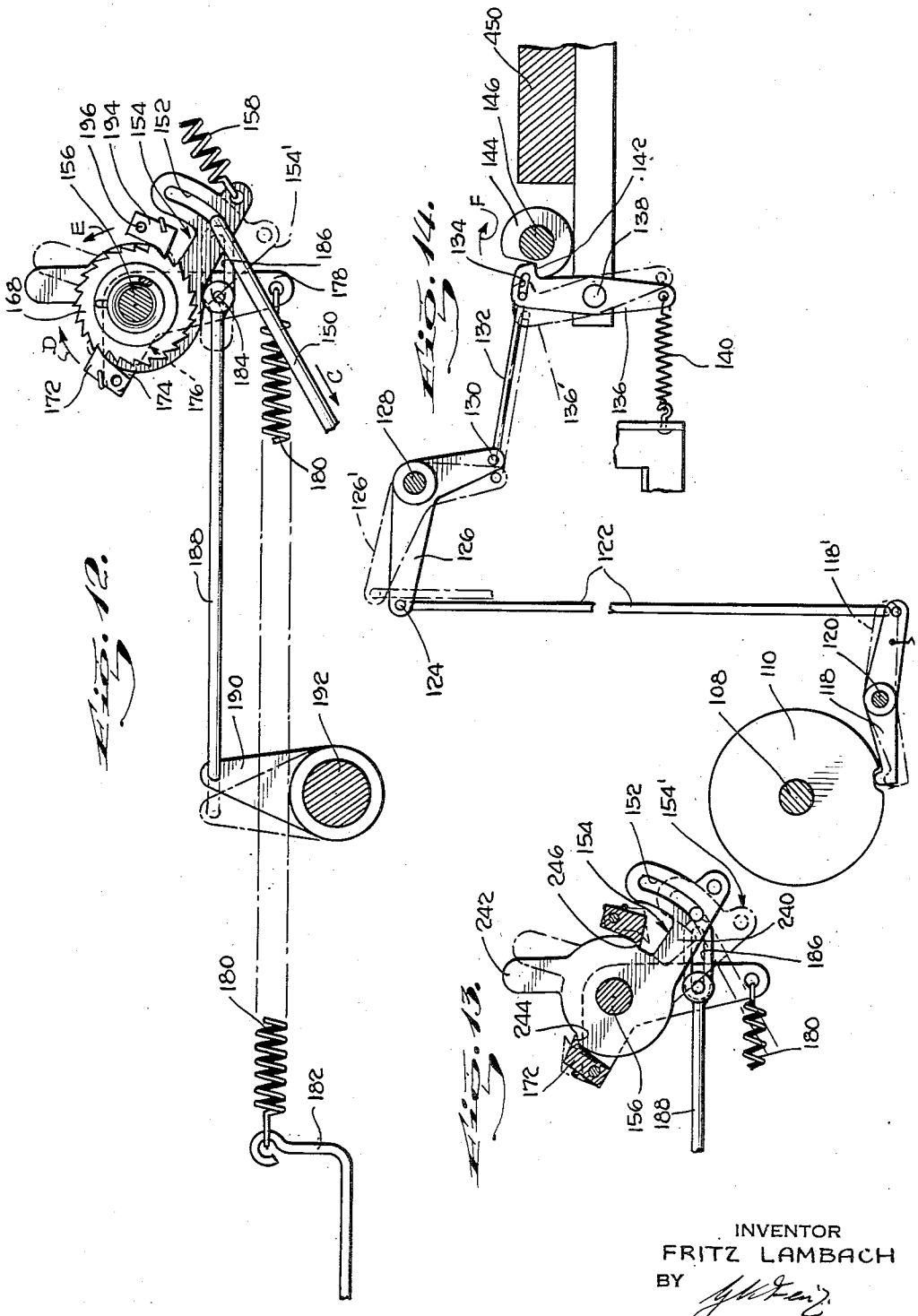
Fig. 11.

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United States Patent Office 2,827,781 Patented Mar. 25, 1958

2,827,781

STRAIGHT BAR KNITTING MACHINE

Fritz Lambach, Tenafly, N. J., assignor to Robert Reiner, Inc., Weehawken, N. J.

Application October 8, 1952, Serial No. 313,698

8 Claims. (Cl. 66—96)

This invention relates to knitting machines, and more particularly to straight bar knitting machines.

An object of the invention is to provide a welt-rod releasing mechanism by means of which the welt-rod may be automatically released at any selected time interval, so that a welt of any desired length may be knitted.

Another object of the invention is to provide a straight bar knitting machine with a fully automatic welt-turning device wherein the release of the welt-rod and the welt-turn itself take place automatically.

A further object of the invention is to provide a straight bar knitting machine with automatic take-up means by means of which the tension applied to the fabric may be automatically reduced to a pre-set value during the performance of the welt-turn.

Another object of the invention is to improve on the art of straight bar knitting machines as now ordinarily made.

Other objects and structural details of the invention will be apparent from the following description when read in conjunction with the accompanying drawings forming part of this specification, wherein:

Fig. 1 is a somewhat diagrammatical front elevational view of a straight bar knitting machine according to the invention, wherein only those parts are shown which are necessary for the understandng of the invention,

Fig. 2 is a vertical sectional view taken on line 2—2 of Fig. 1,

Fig. 2*a* is an elevational view of a detail of the actuating mechanism for actuating the welt-bar,

Fig. 3 is a top elevational view illustrating the welt-turn mechanism, welt-rod releasing mechanism and take-up mechanism of a section of the knitting machine,

Fig. 4 is a front elevational view of the mechanism shown in Fig. 3,

Fig. 5 is a sectional view taken on line 5—5 of Fig. 1,

Fig. 6 is an illustration of the mechanism shown in Fig. 5, however on a somewhat enlarged scale,

Figs. 7 and 8 are illustrations of the same mechanism as shown in Fig. 6, the members of said mechanism, however, are in different positions,

Figs. 9–11 are fragmentary elevational views illustrating the welt-rod holding and releasing mechanism in various positions,

Fig. 12 is a sectional view taken on line 12—12 of Fig. 1, said Fig. 12 illustrating a take-up drive associated with a take-up reel of a section of the knitting machine,

Fig. 13 is a view of a detail of the take-up drive shown in Fig. 12, and

Fig. 14 is a sectional view taken on line 14—14 of Fig. 1, said Fig. 14 illustrating an automatic control for locking and releasing the take-up device.

Referring now to Figs. 1 and 2, 30 generally indicates the frame of a two-section straight bar knitting machine. A motor 32 mounted on a bracket 34 carried by the frame 30 of the knitting machine is connected through a train of gears 36 with the main cam shaft 38 rotatably arranged in suitable bearings of the frame of the machine. 40 generally indicates a pattern chain carrying a section of buttons 42 for the control of certain mechanisms of the knitting machine. During the operation of the machine, the pattern chain is intermittently advanced

in a manner known per se by any suitable mechanism actuated by a cam keyed to the main cam shaft 38.

Each row of buttons 42 mounted on the pattern chain 40 in a predetermined manner is arranged for cooperation with a swingable spring loaded jack 44*a*, 44*b* . . . 44*m*, of a series of jacks. Each jack is connected through wires, levers and rods with a controlling mechanism of the knitting machine.

According to Figs. 2 and 2*a*, a wire 46 secured to a jack 44*i* is pivotally connected with th lower end of a lever 48 secured to the left hand end (as viewed in Fig. 2) of a rod 50 rockably mounted in bearings 52 (see Figs. 2 and 2*a*) secured to the frame of the machine. A lever 54 (see Fig. 2*a*) secured at its lower end to the right hand end of the rockable rod 50 is pivotally connected at its upper end with one end of a wire 56. The other end of said wire 56 is pivotally connected with one arm of a controlling element or controlling latch 60 swingably mounted on a pivot 62 projecting upwardly from the base 64 of a block 66 being substantially of U-shaped cross section. Said block 66 swingably mounted on a shaft 68 carries an adjustable stop screw 72 capable of cooperation with a shaft 74 of the machine. A spring 76 stretched between a downward extension 78 of said block 66 and a stationary point 80 of the machine tends to urge said stop screw 72 against said shaft 74, whereby the block 66 is held in a substantially horizontal position.

Furthermore, a double-armed spring loaded follower 82 carrying a roller 84 is swingably mounted on the shaft 68 between the side walls of the U-shaped block 66. The roller 84 of the cam follower 82 cooperates with a cam 88 keyed to the main cam shaft 38.

During the operation of the machine the arm 90 of the cam follower 82 may freely rock within the U-shaped block 66 held in its position by the spring 76, in accordance with the shape of the cam 88 enegaged with the roller 84 of the follower 82, as long as the controlling element or latch 60 is in an inactive position out of alignment with the end of the arm. As soon as, however, the rod 50 is rocked in the direction of the arrow A owing to an actuation of the spring loaded jack 44*i* by a button on the pattern chain 40, the lever 54 connected to said rod 50 causes a swinging of the controlling element 60 about its pivot 62 into an active position wherein its upward extension 92 is in register with the end of the arm 90 of the cam follower 82. As soon as said controlling element 60 is thus brought into said active position, the next downward rocking of the arm 90 of the cam follower 82 caused by the rise on the cam 88 results in a swinging of the block 66 against the action of the spring 76 in counter-clockwise direction, as viewed in Fig. 2*a*.

When the cam follower 82 returns into the position shown in Fig. 2*a* and consequently the arm 90 of said cam follower 82 is lifted, the block 66 may follow said movement of the arm 90 in clockwise direction by the action of the spring 76 until the stop screw 72 hits against the shaft 74. Now, when the rod 50 is rocked in the direction of the arrow B owing to a disengagement of the button on the advancing pattern chain from the spring loaded jack 44*i* connected with the rod 50, the lever 54 is returned into its original position, whereby the controlling element 60 is returned into its inactive position wherein its upward extension 92 is out of the path of the end of the arm 90 of the cam follower 82 so that the latter may again freely rock without influence on the block 66.

The downward extensions 78 of the said block 66 is pivotally connected at 96 with one end of a rod 98, the other end of which is pivotally connected at 100 with an arm 102 to a rotatable shaft 104. Two parts of welt-bar pushing elements 106 are secured to said shaft 104 for a

purpose to be described hereinafter. It will be readily understood that an oscillation of the block **66** of the cam follower **82** in the manner described above causes an oscillation of the pushing elements **106**.

In a similar manner another jack **44***f* (see Fig. 2) connected through wires, rods and levers **47**, **49**, **51**, **55** with the controlling element or controlling latch **61** swingably mounted in a block **67** rockably arranged on the shaft **68**. A spring **77** stretched between a downward extension **79** of the block **67** and a stationary point **81** of the machine tends to urge the block **67** into the position shown in Fig. 2 wherein its stop screw **73** abuts against an abutment **75** of the machine. Depending on the position of the controlling element or latch **61** relative to the end of the arm **91** of a spring loaded cam follower **83** carrying a roller **85** cooperating with a cam **89** keyed to the main cam shaft **38**, said cam follower **83** either freely rocks within the block **67** or causes a rocking of the latter through the medium of the controlling latch **61**. The downward extension **79** of the block **67** is pivotally connected at **97** with one end of the rod **99**, the other end of which is pivoted at **101** to an arm **103** secured to a shaft **400** journalled in suitable bearings of the frame of the machine.

A pair of swingable supporting members **402** is secured to said shaft **400** in each section of the machine. As will be described later on, said swingable supporting members **402** constitute elements of the welt-turning device, generally indicated by **404**. As will be readily understood, an oscillation of the block **67** by the cam follower **83** in the manner described above causes an upward and downward rocking of said supporting members **402**.

As best shown in Figs. 1 and 2, a control shaft **108** is rotatably mounted in suitable bearings of the frame **30** of the machine. A series of controlling cams is rigidly connected with said control shaft. Each controlling cam is used for the control of a certain mechanism of the machine. The drawings illustrate only four of said controlling cams, i. e. the controlling cam **110** (see Figs. 1 and 14), the controlling cam **111** (see Figs. 1 and 2) and the controlling cam **112** (see Figs. 1 and 2) and controlling cam **113** (see Fig. 1). The control shaft **108** is intermittently advanced through the medium of a ratchet wheel mechanism **114** which is actuated by a connecting rod **116** connected with a U-shaped block (not shown) of a latch controlled actuating drive of the type described above. For example, the controlling element or controlling latch of this actuating drive could be controlled by the pattern chain **40** through the jack **44***m*.

The controlling cam **110** (see Figs. 1 and 14) cooperates with a spring loaded cam follower **118** swingably mounted on a shaft **120**. Said cam follower **118** is pivotally connected with the lower end of a connecting rod **122**, the upper end of which is pivoted at **124** to one arm of a bell crank lever swingably mounted on a stud **128** carried by the frame of the machine. The other arm of said bell crank lever **126** is pivotally connected at **130** with one end of the rod **132**. The other end of said rod **132** being bent is in slidable engagement with a slot **134** of a locking latch **136** swingably mounted on a stationary part of the machine at **138**. A tension spring **140** stretched between the locking latch **136** and a stationary portion of the machine frame tends to urge the hook of the latch **136** into engagement with a notch **142** of a collar **144** rigidly connected with a locking shaft **146** rotatably mounted in suitable bearings of the frame of the machine, when the linkage **118**, **122**, **126**, **132** is in the position shown in full lines. As soon as, upon an advancing of the control shaft **108**, the high portion of the controlling cams **110** comes into engagement with the cam follower **118**, the latter is brought into the position **118'** shown in dash and dot lines, whereby the bell crank lever **126** is brought into the dash and dot line position **126'** and, consequently, the locking latch **136** is swung against the action of the spring **140** into the releasing position **136'** wherein its hook is disengaged from the notch **142** of the collar **144**. Such a disengagement of the locking latch **136** from the notch **142** of the collar **144** results in a release of the locking shaft **146** for a purpose to be described hereinafter. When, after several intermittent advancing movements of the control shaft **108**, the cam follower **118** comes again into engagement with the dwell of the controlling cam **110**, the linkage **118**, **122**, **126**, **132** is returned into the position shown in full lines in Fig. 14. If at this time the round portion of the collar **144** should be opposite the hook of the locking latch **136**, so that the latter cannot come immediately into engagement with the notch **142**, the spring **140** will urge the locking latch **136** against the collar **144** and the bent portion of the rod **132** may slide into the slot **134**. As soon as the notch **142** will come opposite to the hook of the locking latch **136**, owing to a rotation of the locking shaft **146**, the hook of said locking latch **136** may automatically snap into said notch **142** by the action of the tension spring.

As best shown in Fig. 2, the controlling cam **111** secured to the control shaft **108** cooperates with a spring loaded cam follower **406** swingably mounted on the shaft **120**. The upper arm of said cam follower **406** is pivotally connected with one end of a connecting rod **408**, the other end of which is pivotally connected at **410** to an arm **412** (see Figs. 2, 5 and 6) secured to a shaft **414** journalled in suitable bearings of the stationary supporting elements of the machine. A pair of arms **418** is secured to said shaft **414** in each section of the machine. Each arm **418** is pivotally connected with one end of a rod **420** (see Figs. 5–11) at **422**. The other end of said rod **420** is pivoted at **424** to an arm **426** of an element **428** swingably mounted at **430** on a block **432** rigidly connected with the swingable supporting member **402**. Each block **432** has a channel **434** capable of receiving the end of a welt-rod **436**. Each element **428** has a second arm **438** connected with the first arm **426** by a bridge **440** (see Figs. 3 and 9–11). When the element **428** is in the position shown in Fig. 9, the portion **442** thereof projects beyond the plane of the right hand side (as viewed in Fig. 9) of the channel **434**, so that it may hold a welt-rod **436** in the position shown in said Fig. 9. When the arm **418** is swung in clockwise direction upon an engagement of a rise of the controlling cam **111** (see Fig. 2) with the cam follower **406**, the rockable element **428** is swung into the position shown in Fig. 10, whereby the welt-rod **436** is released for dropping onto the fabric **312**. When, subsequently, the spring loaded cam follower **406** is engaged with a dwell of the controlling cam **111**, the arm **418** is swung in counter-clockwise direction beyond its initial position of Fig. 9 into the position of Fig. 11, whereby the curved portion **444** of the element **428** is engaged with the welt-rod **436** for pressing same against the curved wall **446** at the mouth of a guiding channel **314** of the stationary supporting member **416**. Upon subsequent engagement of the cam follower **406** with the round portion of the controlling cam **111** the arm **418** and the element **428** are returned into the position shown in Fig. 9. Thus, the release of the welt-rod **436** by the releasing mechanism **406**, **408**, **412**, **418**, **420**, **428** is directly controlled by a controlling cam **111** keyed to the control shaft **108** so that said welt-rod release may be effected at any desired interval independent of the movements of the welt-bar to be described hereinafter.

As best shown in Fig. 1, the knitting machine is provided with two take-up drives, generally indicated by **448** and **449**, one at each side of the machine. The mechanisms of said two make-up drives are identical, with the only exception that their arrangement is reversed and that the torsion spring **170** of the take-up drive **448** at the right hand side of the machine is weaker than the torsion spring **171** of the take-up drive **449** at the left hand side of the machine. The reason for the difference

in the strength of said two torsion springs **170** and **171** will be explained hereinafter. As said two take-up drives are substantially identical, it will be sufficient to describe only the take-up drive **448** more in detail.

As may be gathered from Figs. 1 and 2, the controlling cam **112** secured to the control shaft **108** cooperates with a spring loaded cam follower **148** swingably mounted on the shaft **120**. The upper arm of said cam follower **148** is pivotally connected with one end of a connecting rod **150**, the other end of which has a bent portion slidably engaged with a slot **152** (see Figs. 2, 13 and 12) of the releasing element **154** swingably but axially immovably arranged on the take-up shaft **156** journalled in suitable bearings of the frame of the machine. The releasing element **154** is under the action of the spring **158** stretched between said releasing element and a stationary point of the machine, which tends to urge said releasing element **154** into the position shown in full lines in Figs. 12 and 13. When during the operation of the machine the rise of the cam **112** is brought into engagement with the cam follower **148**, the latter causes a movement of the connecting rod **150** in the direction of the arrow C, whereby the releasing element **154** is swung from its full line inactive position into its dash and dot line active position **154'** against the action of the spring **158** for a purpose to be described hereinafter. When during the operation of the machine the controlling cam **112** is further advanced so that it causes a disengagement of its rise from its cam follower, the connecting rod **150** is returned into the position shown in Fig. 12 and the releasing element **154** will be returned into its full line inactive position by the action of the spring **158**.

As best shown in Fig. 1, the take-up shaft **156** carries two take-up reels **160**, one for each section of the knitting machine. There is a collar **162** on each side of each take-up reel **160** (see also Figs. 3 and 5). One end of a strap **164** is readily connected with each collar **162** for a purpose to be described hereinafter. Furthermore, each take-up reel **160** and collar **162** is rigidly connected with the take-up shaft **156** by screws or the like. Moreover, as best shown in Fig. 1, a collar **166** is rigidly connected with said take-up shaft **156** by a screw or the like. A ratchet wheel **168** (see Figs. 1 and 2) is rotatably but axially immovably arranged on the take-up shaft **156** at a distance from said collar **166**. The ends of a torsion spring **170** wound around said take-up shaft **156** and interposed between said collar **166** and said ratchet wheel **168** are positively engaged with said collar **166** and ratchet wheel **168**. The ratchet wheel may be advanced step by step in the direction of the arrow D (see Fig. 12) by a spring loaded actuating pawl **172** mounted on an arm **174** of a bell crank actuating lever **176** swingably but axially immovably mounted on the take-up shaft **156**. The other arm **178** of said bell crank actuating lever is connected with one end of the tension actuating spring **180**, the other end of which is connected with a movable hook **182**, which may be adjusted in a manner known per se for adjusting the tension of the tension actuating spring **180**.

The arm **178** of the bell crank actuating lever **176** carries a pin **184** slidably engaged with an elongated slot **186** arranged at one end of a tension restoring rod **188**, the other end of which is pivoted to an arm **190** keyed to a needle bar shaft **192**. Said needle bar shaft **192** is oscillated by a needle bar shaft drive (not shown) in a manner known per se during the operation of the machine so that consequently the arm **190** is reciprocated from the full line position into the dash and dot line position and vice versa.

The ratchet wheel **168** may be held in its position against the action of the torsion spring **170** by means of a spring loaded locking pawl **194** carried by a stud **196** secured to the frame of the machine.

As will be readily understood, the bell crank actuating lever **176** carrying the actuating pawl **172** may be swung in the direction of the arrow D by the action of the tensioned actuating spring **180** when the tension restoring rod **188** is moved in left hand direction (as viewed in Fig. 12) into the position shown in dash and dot lines, and when at this time the tension of said tension actuating spring **180** is larger than the tension of the torsion spring **170** connected with the ratchet wheel **168** and the set collar **166** to the take-up shaft **156** carrying the take-up reel **160** arranged for taking up fabric knitted by the machine. Depending on the degree of the difference in the tension between the tension actuating spring **180** and the torsion spring **170**, the ratchet wheel **168** will be advanced one or more steps corresponding to the tooth caught by the actuating pawl **172** for tensioning the torsion spring **170** and applying tension to the take-up reel **160**. When the tension restoring rod **188** is returned from the dash and dot line position towards the right into the full line position shown in Fig. 12, the bell crank actuating lever **176** will be swung in the direction of the arrow E by the cooperation of the left hand edge of the slot **186** with the pin **184** mounted on the arm **178** whereby the tension of the tension actuating spring **180** is restored. The next advancing of the ratchet wheel **168** will occur only after the tension of the tension actuating spring **180** exceeds the tension of the torsion spring **170**, although the tension restoring rod **188** is permanently reciprocated and the left hand edge of its slot **186** is disengaged from the pin **184** at intervals. Thus, the torsion spring **170** may be tensioned by the described mechanism for applying tension to the fabric for winding same on the take-up reel **160**.

As best shown in Fig. 12, the actuating pawl **172** and the locking pawl **194** are normally held in engagement with the teeth of the ratchet wheel **168** by the springs acting on said pawls. The locking pawl **194** prevents the rotation of the ratchet wheel **168** in the direction of the arrow E under the action of the torsion spring **170** when the locking pawl **194** is engaged with a tooth of the ratchet wheel **168**. The releasing element **154** is rotatably arranged on the take-up shaft **156** for cooperation with said actuating pawl **172** and locking pawl **194**.

As best shown in Fig. 13, said releasing element **154** is substantially in the shape of a disk having an arm **240** provided with the slot **152** and a hand lever **242**. The disk-like portion of said releasing element **154** has a recess **244** for cooperation with the actuating pawl **172** and a recess **246** for cooperation with the locking pawl **194**. As long as the pawls **172** and **194** are in engagement with said recesses **244** and **246**, said pawls may also come into engagement with the disk of the ratchet wheel **168** as shown in Fig. 12. As soon as, in the manner described above the rod **150** is automatically moved in the direction of the arrow C, the releasing element **154** is brought into the dash and dot line's position **154'** whereby the high round portions of the disk-like member adjacent the recesses **244** and **246** come into engagement with the actuating pawl **172** and locking pawl **194**, thus leaving same out of engagement with the disk of the ratchet wheel **168**, so that the take-up reel **160** is released. When the rod **150** is automatically returned into the position shown in Fig. 12 and the spring **158** returns the releasing element **154** into the position shown in full lines in Figs. 12 and 13, the recesses **244** and **246** of the releasing element **154** are again in engagement with the actuating pawl **172** and locking pawl **194** so that the latter may come into engagement with the teeth of the ratchet wheel **168**.

As shown in Fig. 1, the torsion spring **171** of the take-up drive **449** arranged at the left hand side of the machine is arranged between and connected with a collar **167** secured to the take-up shaft **156** and a ratchet wheel **169** rotatably but axially immovably arranged on the take-up shaft **156**. The torsion spring **171** wound in a direction opposite to the direction of winding of the tor-

sion spring 170 is stronger than the latter. The take-up drive 449 is controlled by a controlling cam 113 keyed to the control shaft 108 in the same manner as the take-up drive 448 is controlled by the controlling cam 112. The operation of the take-up drive 449 is the same as the operation of the take-up drive 448.

The controlling cams 112 and 113 can be arranged and designed in such a manner that during the operation of the machine either the strong torsion spring 171 of the take-up drive 449 is tensioned while the weak spring 170 of the take-up drive 448 is released thus being inactive, or that both springs 171 and 170 are tensioned simultaneously thus rendering that spring active wherein the higher degree of tension is accumulated, or that the stronger spring 171 is released while the weaker spring 170 is tensioned thus being rendered active.

As best shown in Figs. 1–4, a pair of swingable supporting members 402 of the welt-turning device 404 is arranged in each section of the machine in front of the series of needles 250. As mentioned above, said swingable supporting members are secured to a shaft 400. Said shaft 400 being journalled in suitable bearings (not shown) of the frame passes through bearings of the stationary supporting elements 416, one part of each being arranged in each section of the machine in front of the series of needles. Said stationary supporting elements 416 are secured to the table 450 of the machine by means of screws or the like.

As best shown in Figs. 3 and 4, the swingable supporting members 402 are arranged outside the stationary supporting elements 416 in each section of the machine. Each swingable supporting member 402 is provided at its inner side with a recess 452 capable of receiving and guiding a pin 454 projecting from the end of the welt-bar 252 at each side thereof. The welt-bar carries the welt-hooks 270 in a manner known per se. Each of said recesses 452 receives also a guiding lug 456 projecting from the welt-bar 252 at a distance from the pin 454. Thus the welt-bar 252 is guided in said recesses 452 of the swingable supporting members 402 during its movements towards and away from the needles of the machine imparted to the welt-bar 252 by means of connecting rods 458. One end of each connecting rod 458 is pivoted to the welt-bar 252 at 460, the other end of each connecting rod 458 is rotatably engaged with one end of a connecting pin 462 the other end of which is engaged with a pushing element 105 secured to the rockable shaft 104 as described above.

As best shown in Figs. 7 and 8, the left hand end of each recess 452 is covered by the portion 464 so that a bearing for the pin 454 of the welt-bar 252 is formed when the latter reaches its extreme position as shown in Fig. 8 for the performance of the welt-turn.

As best shown in Figs. 3–8, the straps 164 attached at one of their ends to the collars 162 rigidly connected with the take-up shaft 156 are arranged adjacent to the inside of the stationary supporting elements 416 and somewhat below the guiding recesses 452 of the swingable supporting members 402 determining the path of the welt-bar 252. Each strap is trained around an idle roller 272 rotatably mounted on one of the stationary supporting elements 416 and has its other end attached to a roller 274 rigidly connected with the locking shaft 146 (see Figs. 5, 6 and 14) by a set screw 276. A gripping element or hook 278 is secured to each flexible strap 164 for gripping the welt-rod 436 upon the release and driving of the latter.

It will be readily understood that a step by step advancing of the ratchet wheel 168 or of the ratchet wheel 169 of the take-up drives 448 and 449 described above in connection with Figs. 1 and 12 cannot cause a rotation of the take-up reel 160 and the collars 162 as long as the locking shaft 146 (Figs. 5, 6 and 14) is locked by the automatically controlled locking latch 136. During this period, therefore, the hooks 278 attached to the straps 164 will remain in the position shown in Figs. 5 and 6, and the step by step advancing of the ratchet wheel 168 and/or ratchet wheel 169 (Figs. 1 and 12) will merely cause a tensioning of the torsion spring 170 and/or torsion spring 171 interposed between the ratchet wheels 168 and 169 and the set collars 166 and 167 respectively attached to the take-up shaft 156.

The operation of the machine is as follows:

Prior to the start of the knitting machine welt-rods 436 taken from suitable brackets (not shown) are placed in each section of the machine into the channels 434 of the blocks 432. The elements 428 are in the position shown in Figs. 5, 6 and 9, so that the portions 442 of said elements 428 being engaged with the ends of the welt-rods 436 hold the latter in the position shown in Figs. 6 and 9.

The locking latch 136 (see Fig. 14) is in the locking position shown in full lines in said Fig. 14, whereby the locking shaft 146 is prevented from rotation in the direction of the arrow F. Consequently, the rollers 274 (see Figs. 5 and 6) connected to one end of the straps 164 are likewise prevented from rotation in the direction of the arrow F and the take-up shaft 156 connected to the other ends of the straps 164 through the medium of the collars 162 is prevented from rotation in the direction of the arrow D (see Fig. 12). When the knitting machine is started for operation, the locking latch 136 (Fig. 5) controlled by the controlling cam 110 remains in its locking position.

At the beginning of the knitting cycle a button 42 (see Fig. 2) on the pattern chain 40 renders the actuating drive 66, 82, 88 (Fig. 2a) of the pushing elements 106 active, so that the latter are swung into the position 106' shown in dash and dot lines in Fig. 5, whereby the welt-bar 252 is pushed through the medium of the connecting rods 458 towards the needles 250 into an advanced hook-up position. During this movement of the welt-bar 252 the swingable supporting members 402 guiding the welt-bar 252 by the recesses 452 remain in their horizontal position shown in Figs. 5 and 6.

As soon as during the knitting of the first course the fabric has been hooked-up to the welt-hooks 270 of the welt-bar 252, the actuating drive 66, 82, 88 (Fig. 2a) of the pushing elements 106 is rendered inactive by the pattern chain causing a change of the position of the controlling latch 60 and the spring 76 acting on the extension 78 of the block 66 now tends to return the pushing elements 106 into their original position, whereby the welt-bar 252 is moved away from the needles thus applying the necessary tension to the fabric for drawing same off.

Furthermore, at the beginning of the knitting cycle, preferably during the knitting of the first course, the releasing element 155 of the take-up drive 449 including the strong torsion spring 171 (see Fig. 1) is automatically returned by the controlling cam 113 from its releasing position into its operative position wherein the spring loaded actuating pawl and locking pawl are automatically brought into engagement with teeth of the ratchet wheel 169. The releasing element 154 of the take-up drive 448 including the weaker torsion spring 170, however, remains at this time in its releasing position. Thus, as soon as at the beginning of the knitting cycle the releasing element 155 of the take-up drive 449 is brought into its operative position, the ratchet wheel 169 is advanced step by step. This step by step rotation of the ratchet wheel 169, however, does not result in a rotation of the take-up shaft 156 and take-up reel 160 in the direction of the arrow D, as, at this time, the locking shaft 146 (see Figs. 5, 6 and 14) is still locked. The step by step rotation of the ratchet wheel 169 causes at this time only a tensioning of the strong torsion spring 171 introduced between the ratchet wheel 169 and the set collar 167. Consequently, the straps 164 carrying the hooks 278 remain in the position shown in Figs. 5 and 6. During the above described

period of operation the take-up drive **448** including the weaker torsion spring **170** has no influence on the take-up shaft **156**.

Thus at the beginning of the knitting cycle, tension is accumulated in the stronger torsion spring **171** in the take-up drive **449** while the fabric hooked-up to the hooks of the welt-bar **252** is drawn off by said welt-bar under the action of the springs **76** (Fig. 2*a*). After the knitting of a predetermined number of courses of the welt the welt rod releasing mechanism **406, 408, 412, 418, 420, 428** (Figs. 2 and 9–11) is actuated by the action of the controlling cam **111**. This actuation of the releasing mechanism taking place independently on the movement of the welt-bar **252** causes a swinging of the element **428** in counter-clockwise direction from the position shown in Fig. 9 into the position shown in Fig. 10 whereby the welt-rod **436** is released for dropping onto the fabric **312**. The fabric **312**, at this time still drawn off by the welt-bar **252**, is somewhat above the plane of the mouth of the guiding channel **314** for the welt-rod **436**. Therefore, by means of a further actuation of the controlling cam **111** the element **428** is swung in clockwise direction from the position shown in Fig. 10 into the position shown in Fig. 11, whereby the curved portion **444** of the element **428** comes into engagement with the welt-rod **436** pressing same downwardly into the mouth of the guiding channel **314** for engagement with the curved wall **446** of the latter.

Thereafter, and preferably shortly before the welt-bar **252** reaches its end position shown in Fig. 7, the locking latch **136** (Fig. 14) is automatically brought into the releasing position **136'** by the controlling cam **110**. Now the previously tensioned torsion spring **171** of the take-up drive **449** (see Fig. 1) may cause a sudden rotation of the take-up shaft **156** in the direction of the arrow **D** (Figs. 5 and 12) so that the hooks **278** attached to the straps **164** are suddenly moved from the position shown in Figs. 5 and 6 into a position wherein they engage the welt-rod **436** located at the mouth of the guiding channel **314** as shown in Fig. 11. Now the drawing off of the fabric is caused by the take-up drive **449** through the medium of the straps **164**, hooks **278** and welt-rod **436**.

As the portion **446** of the mouth of the guiding channel **314** is curved for a slight widening of the mouth, the hooks **278** may draw the welt-rod **436** into a guiding channel **314** proper, even if the element **428** is still in the position shown in Fig. 11. Preferably, however, the element **428** is returned into the position shown in Fig. 9 by another action of the controlling cam **111** shortly after the engagement of the welt-rod **436** by the hooks **278**. During the remaining portion of the knitting cycle the element **428** remains in said position of Fig. 9, so that at any time a new welt-rod **436** may be inserted into the channels **434** of the blocks **432** for readiness for the next knitting cycle.

After above describing release of the welt-rod **436**, the tensioning of the strong torsion spring **171** of the take-up drive **449** continues, while upon movement of the releasing element **154** of the other take-up drive **448** by an action of the controlling cam **112** from its releasing position **154'** (see Figs. 12 and 13) into the position shown in full lines in said Figs. 12 and 13, the tensioning of the weaker torsion spring **170** takes place at the same time. As the action of the torsion spring **171** on the take-up shaft **156** is stronger than the action of the torsion spring **170**, the drawing off of the fabric takes place by the action of the take-up drive **449**. As soon as after the completion of the knitting of the welt the elements are in the position shown in Fig. 7, the automatic welt-turn takes place. By the action of buttons **42** on the pattern chain the actuating drive **66, 82, 88** (Fig. 2*a*) of the pushing elements **106** and the actuating drive **67, 83, 89** (Fig. 2) of the swingable supporting members **402** are rendered active, so that the welt-bar **252** is advanced towards the needles **250** and turned into the position shown in Fig. 8 while the swingable supporting members **402** are lifted into the position shown in said Fig. 8.

In order to enable the movement of the welt-bar **252** towards the needles requiring a temporary return movement of the welt-rod **436** from the position shown in Fig. 7 into the position shown in Fig. 8, the tension applied to the take-up reel **160** is reduced in the following manner:

By an action of the controlling cam **113** (Fig. 1) the strong torsion spring **171** is entirely released, so that now the previously tensioned weaker torsion spring **170** acts on the take-up reel **160**. Owing to the weaker tension thus applied to the take-up reel **160**, the welt-bar **252** and welt-rod **436** may be moved towards the needles into the position of Fig. 8 as described above.

After the loops of the fabric have been transferred from the welt-hooks **270** to the needles **250** during the automatic welt-turn, the fabric is again drawn off by means of the welt-rod **436**, gripped by the hooks **278** secured to the straps **164**. However, at first, this drawing off is caused by the take-up drive **448** including the weaker spring **170**.

The welt-bar **252** is returned and the swingable supporting members **402** are lowered into their initial positions shown in Figs. 5 and 6 by means of their associated actuating drives **66, 82, 88** and **67, 83, 89** respectively.

The releasing element **155** of the take-up drive **449** is again brought into its operative position by a further action of the controlling cam **113**, so that now the torsion spring **171** is again tensioned. As soon as the tension of the spring **171** becomes higher than the tension of the weaker torsion spring **170**, the drawing off of the fabric is taken over by the take-up drive **449**.

At any suitable interval during the knitting operation the releasing element **154** of the take-up drive **448** may be returned into its releasing position **154'** whereby the weaker torsion spring **170** is released.

At the end of the knitting cycle preferably during the drawing off of the fabric the controlling cam **110** (see Fig. 14) is again advanced, so that the cam follower **118** may come into engagement with the dwell of said controlling cam **110** as shown in full lines in said Fig. 14. Thus, the mechanism **118, 122, 126, 132** is returned into the position shown in full lines in Fig. 14, so that the locking latch **136** may be returned towards the locking collar **144** by the action of the spring **149**. Thus, the locking latch **136** is made ready for a locking action and may snap into the notch **142** of the locking collar **144** when the latter is brought into a position opposite the notch of the locking latch **136** at the beginning of the next cycle.

Furthermore, likewise at the end of a knitting cycle and preferably simultaneously with above described actuation of the mechanism **118, 122, 126, 132** associated with the locking latch **136**, the releasing element **155** of the take-up drive **449** (see Fig. 1) is automatically brought into its releasing position by an actuation of its associated controlling cam **113**. As mentioned above, the releasing element **154** of the take-up drive **448** has been brought into its releasing position **154'** already during the knitting cycle after the performance of the welt-turn. Thus the actuating pawls and locking pawls of the take-up drives **448** and **449** are disengaged from the teeth of the associated ratchet wheels **168** and **169** respectively so that, when the machine is stopped, the fabric may be readily wound off from the take-up reel **160** which is now free for rotation in the direction of the arrow **E** (Fig. 12).

When the fabric is wound off from the take-up reel the machine is ready for a new knitting cycle taking place in the same manner as the knitting cycle described above.

I have described a preferred embodiment of my invention but it is understood that numerous changes and omis-

sions in shape, proportion and arrangement of parts, as well as the substitution of equivalent elements for those, herein shown and described may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

For example, the invention may also be applied to a straight bar knitting machine having more than two sections. Furthermore, the automatic welt-rod release mechanism and/or the take-up mechanism using two take-up drives applying different tensions to the fabric may be used in knitting machines which are not equipped with an automatic welt-turning device.

What I claim is:

1. A welt-rod releasing mechanism, for use in a straight bar knitting machine provided with automatically controlled means for engaging automatic take-up means with a welt-rod at a predetermined interval after an initial drawing-off of knitted fabric by a welt-bar having actuating means, so as to transfer the drawing-off of the fabric from the welt-bar to the take-up means through the welt-rod engaged with the fabric; said welt-rod releasing mechanism comprising in combination: supporting means, actuatable welt-rod operating means capable of receiving, holding and releasing a welt-rod, said welt-rod operating means being mounted on said supporting means, automatic controlling means including a movable controlling element and means for moving the latter in a predetermined manner, and an actuating mechanism engaged with said controlling element and said welt-rod operating means for actuating the latter in dependence on the movements of said controlling element at a predetermined interval whereby the welt-rod may be released, the welt-rod releasing mechanism being operable independently of the welt-bar and the welt-bar actuating means.

2. In a welt-rod releasing mechanism as claimed in claim 1, said actuating mechanism including a linkage connected with said controlling means and said welt-rod operating means, the movable controlling element comprising a rotatable cam, and means for adjusting the position of said cam for selectively varying the controlling movement thereof independently of the operation of said welt-bar.

3. A straight bar knitting machine comprising in combination: welt-rod operating means capable of holding and releasing a welt-rod, automatic welt-rod releasing means operatively engaged with said welt-rod operating means for causing a welt-rod release, automatic take-up means including engaging means for engaging the welt-rod upon its release, an automatic welt-turning device, and automatic controlling means including first, second and third controlling elements and drive means for moving said controlling elements in a predetermined manner, said controlling elements being respectively associated with said welt-rod releasing means, said take-up means and said welt-turning device for rendering same active at predetermined intervals in predetermined relationship to each other, said first, second and third control elements being operable independently of each other for independent operation of the welt-rod releasing means, take-up means, and welt-turning device.

4. A straight bar knitting machine comprising in combination: a stationary support, an automatic welt-turning device including swingable supporting means rockably mounted on said stationary support, actuatable welt-rod operating means capable of receiving, holding and releasing a welt-rod, said welt-rod operating means being mounted on said swingable supporting means, a welt-bar movably mounted on said swingable supporting means, automatic take-up means including engaging means for engaging the welt-rod upon its release, said engaging means being mounted on said stationary support, and automatic controlling means including first, second, third and fourth controlling elements and drive means for moving the same in a predetermined manner, said first, second, third and fourth controlling elements being respectively associated with said welt-turning device, said welt-bar, said welt-rod operating means and said take-up means for actuating same at predetermined intervals in predetermined relationship to each other, said controlling elements being operable independently of each other.

5. A welt-rod releasing mechanism, for use in a straight bar knitting machine provided with automatically controlled means for engaging automatic take-up means with a welt-rod at a predetermined interval after an initial drawing-off of knitted fabric by a welt-bar so as to transfer the drawing-off of the fabric from the welt-bar to the take-up means through the welt-rod engaged by the fabric; said welt-rod releasing mechanism comprising in combination; supporting means having a welt-rod guiding channel, actuatable welt-rod operating means mounted on said supporting means above the mouth of said guiding channel and including a rockable member settable in a first position for holding the welt-rod, in a second position for releasing said welt-rod so as to drop freely into the mouth of said guiding channel, and in a third position for presenting said welt-rod against a wall of said guiding channel, automatic controlling means including a movable controlling element and drive means for moving the latter in a predetermined manner, and an actuating mechanism engaged with said controlling element and said welt-rod operating means for setting the rockable lever successively in said three positions at predetermined intervals in dependence on the movements of said controlling element, whereby the welt-rod may be released.

6. A welt-rod releasing mechanism, according to claim 5 in which the mouth of said guiding channel has a widened portion so as to permit a movement of said welt-rod into the guiding channel by the take-up means while said rockable lever is in its third position.

7. A straight bar knitting machine comprising in combination: a stationary support having a guiding channel, an automatic welt-turning device including swingable supporting means rockably mounted on said stationary support, actuatable welt-rod operating means capable of receiving, holding and releasing a welt-rod, said welt-rod operating means being mounted on said swingable supporting means above the mouth of the guiding channel and including a rockable lever settable in a first position for holding a welt-rod, in a second position for releasing the welt-rod so as to drop freely into the mouth of said guiding channel, and in a third position for pressing the welt-rod against a wall of the mouth of said guiding channel, automatic take-up means including engaging means for engaging the welt-rod upon its release, and automatic controlling means including a movable controlling element and means for moving the latter in a predetermined manner, said controlling element of the automatic controlling means being associated with said welt-turning device, said welt-rod operating means and said take-up means for actuating same at predetermined intervals in predetermined relationship to each other.

8. A welt-rod releasing mechanism according to claim 7 in which the mouth of said guiding channel has a widened portion so as to permit a movement of said welt-rod into the guiding channel by the engaging means of said take-up means while said rockable lever is in its third position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,300,830	Hoffman et al.	Nov. 3, 1942
2,429,230	Lambach	Oct. 21, 1947
2,519,991	Zesch	Aug. 22, 1950
2,569,394	Zesch	Sept. 25, 1951
2,584,136	Lambach	Feb. 5, 1952
2,618,947	Brown et al.	Nov. 25, 1952
2,622,422	Vaclavik et al.	Dec. 23, 1952
2,680,362	Vaclavik	June 8, 1954