Jan. 19, 1971 W. L. DIEHL ET AL 3,555,853

GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 1

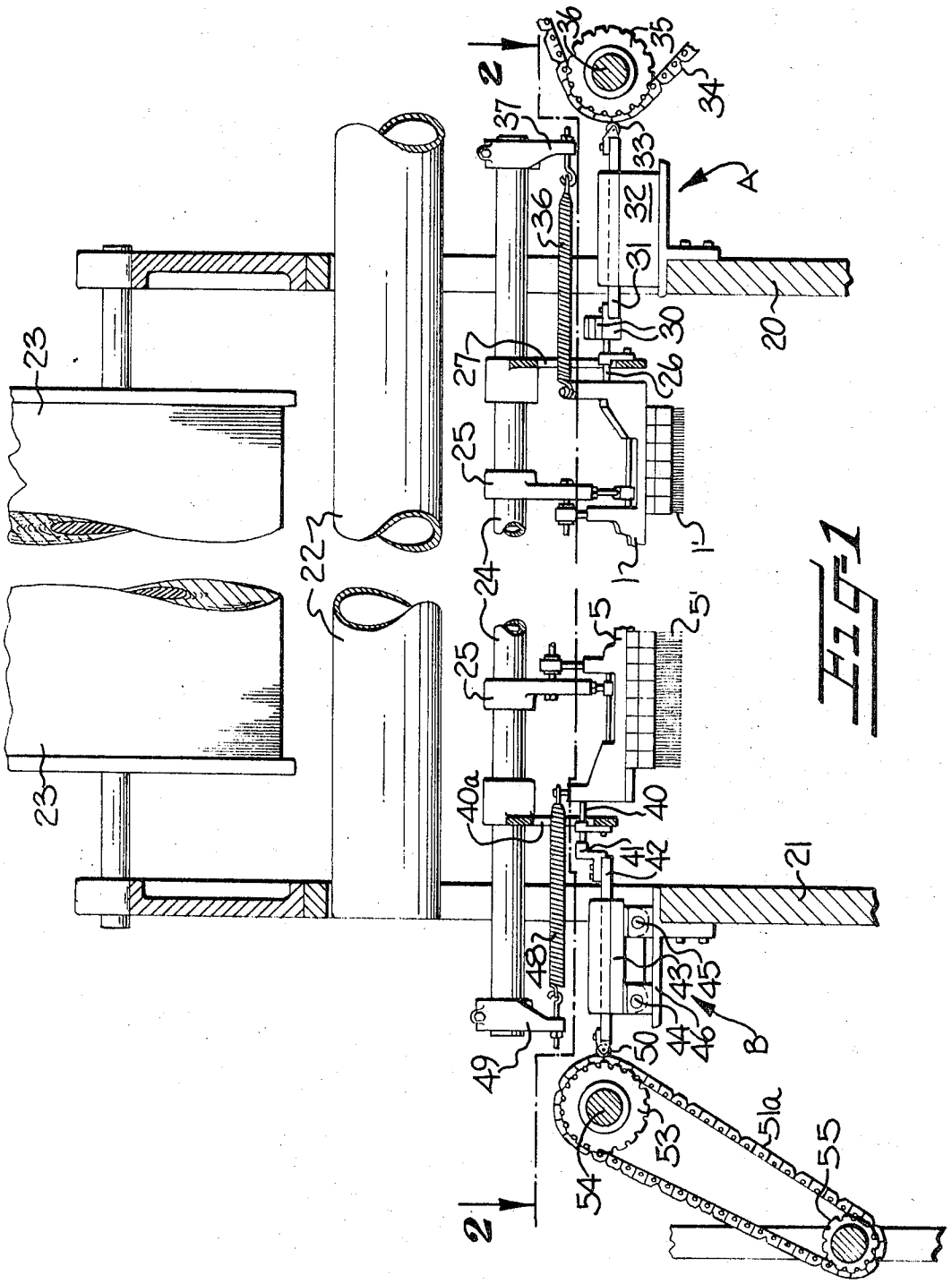

FIG. 1

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GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 2

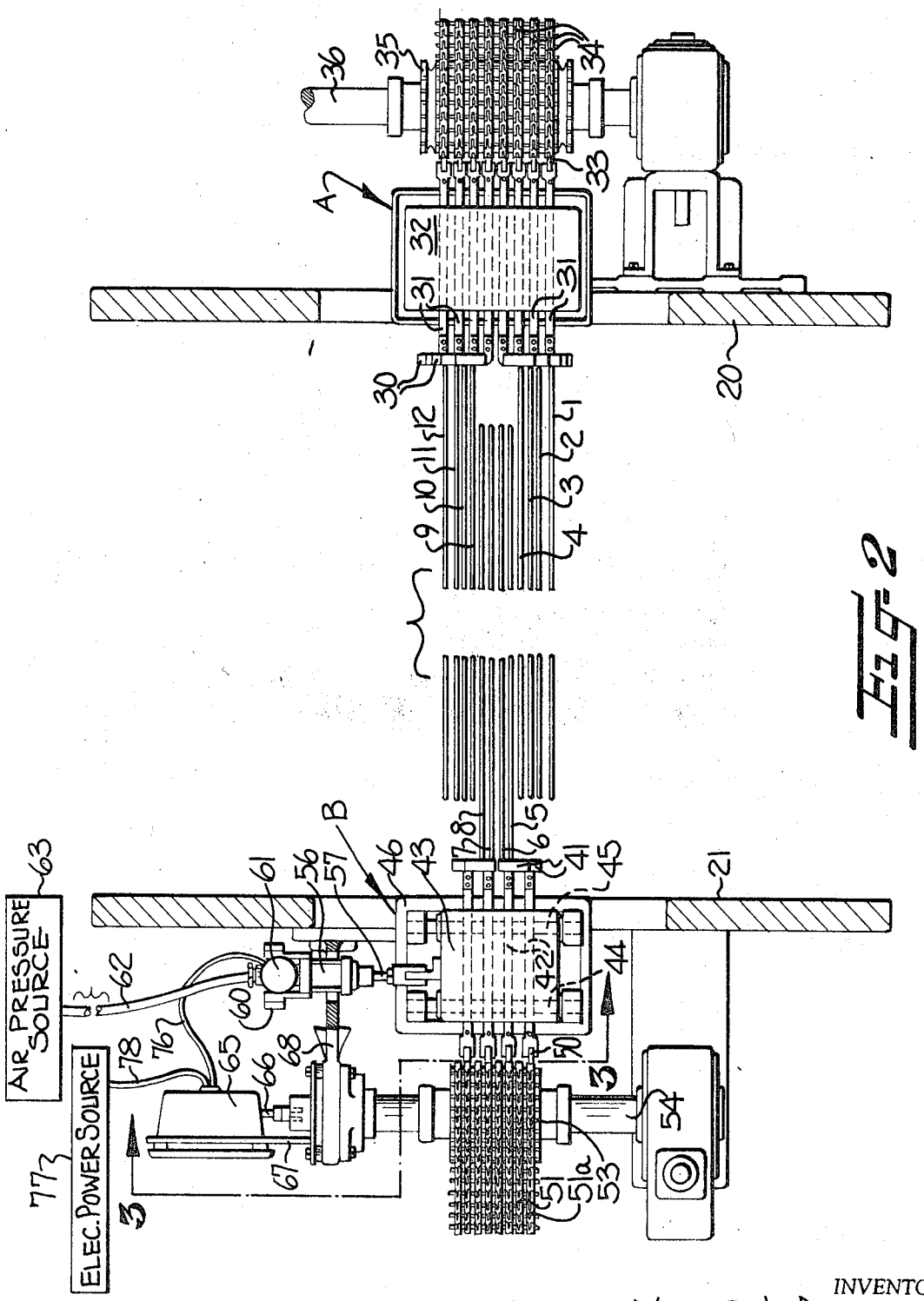

Fig. 2

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GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 3

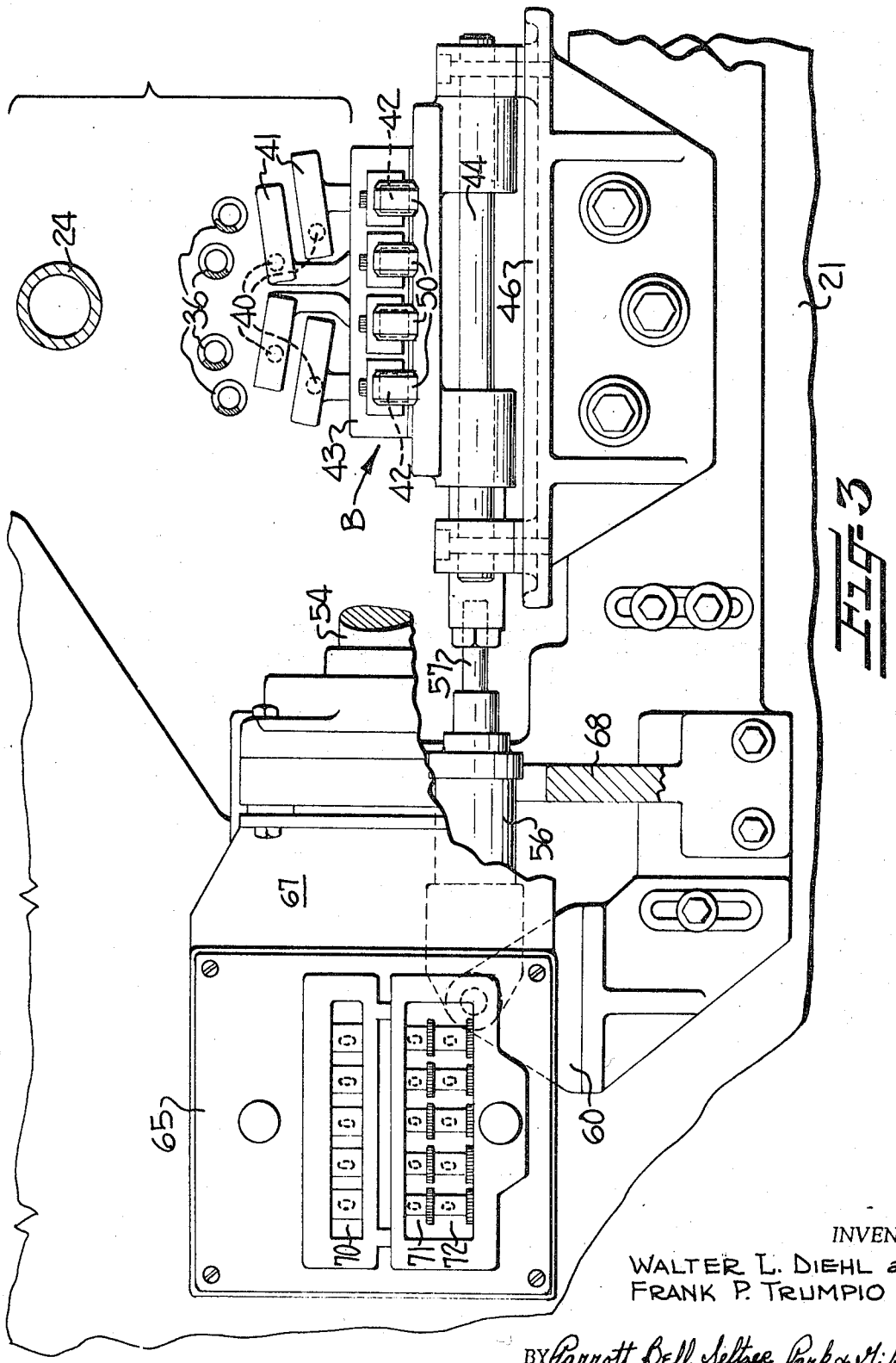

FIG. 3

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GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 4

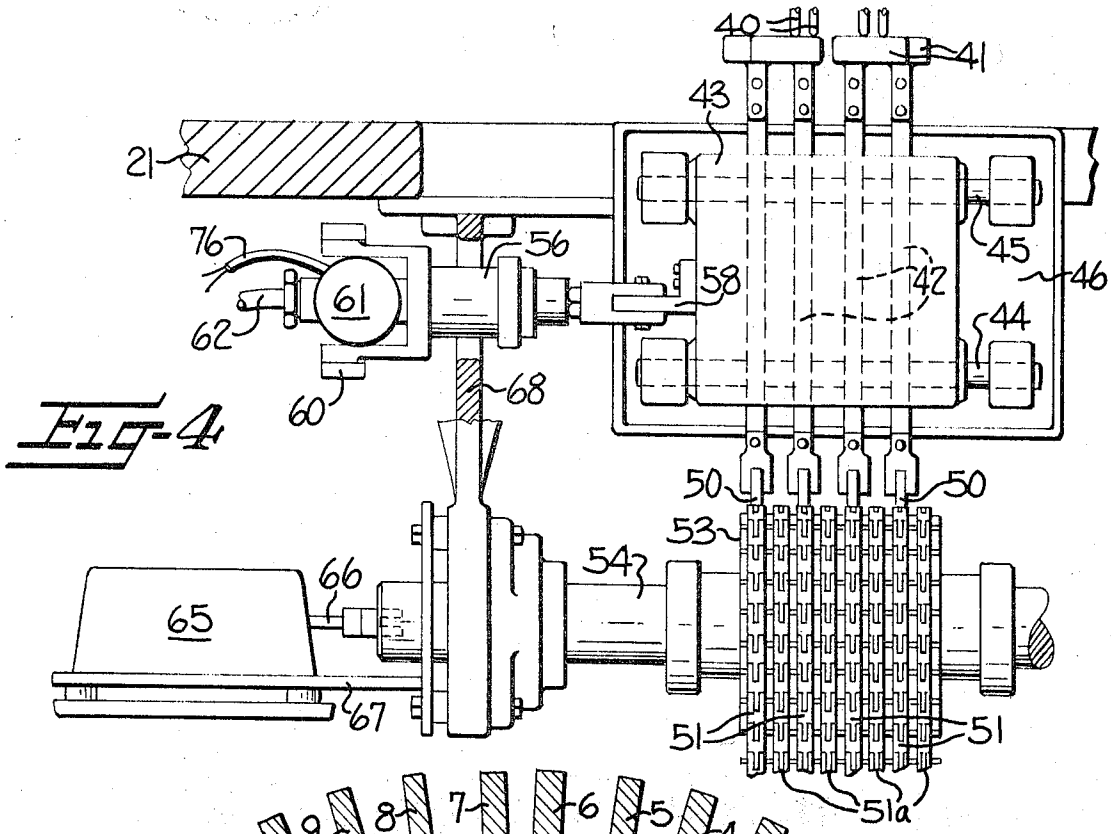


Fig-4

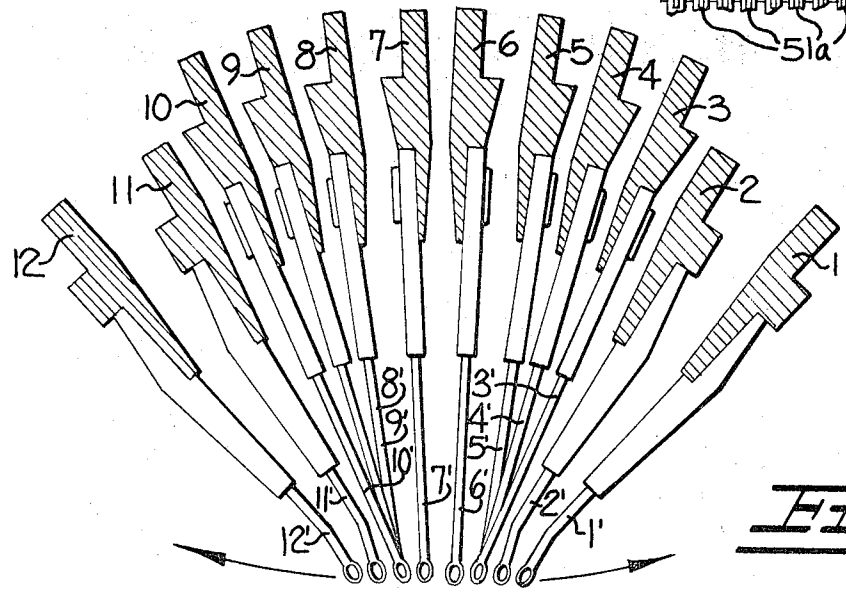
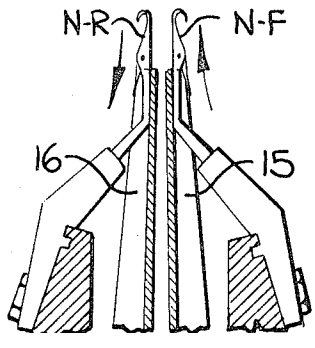


Fig-5



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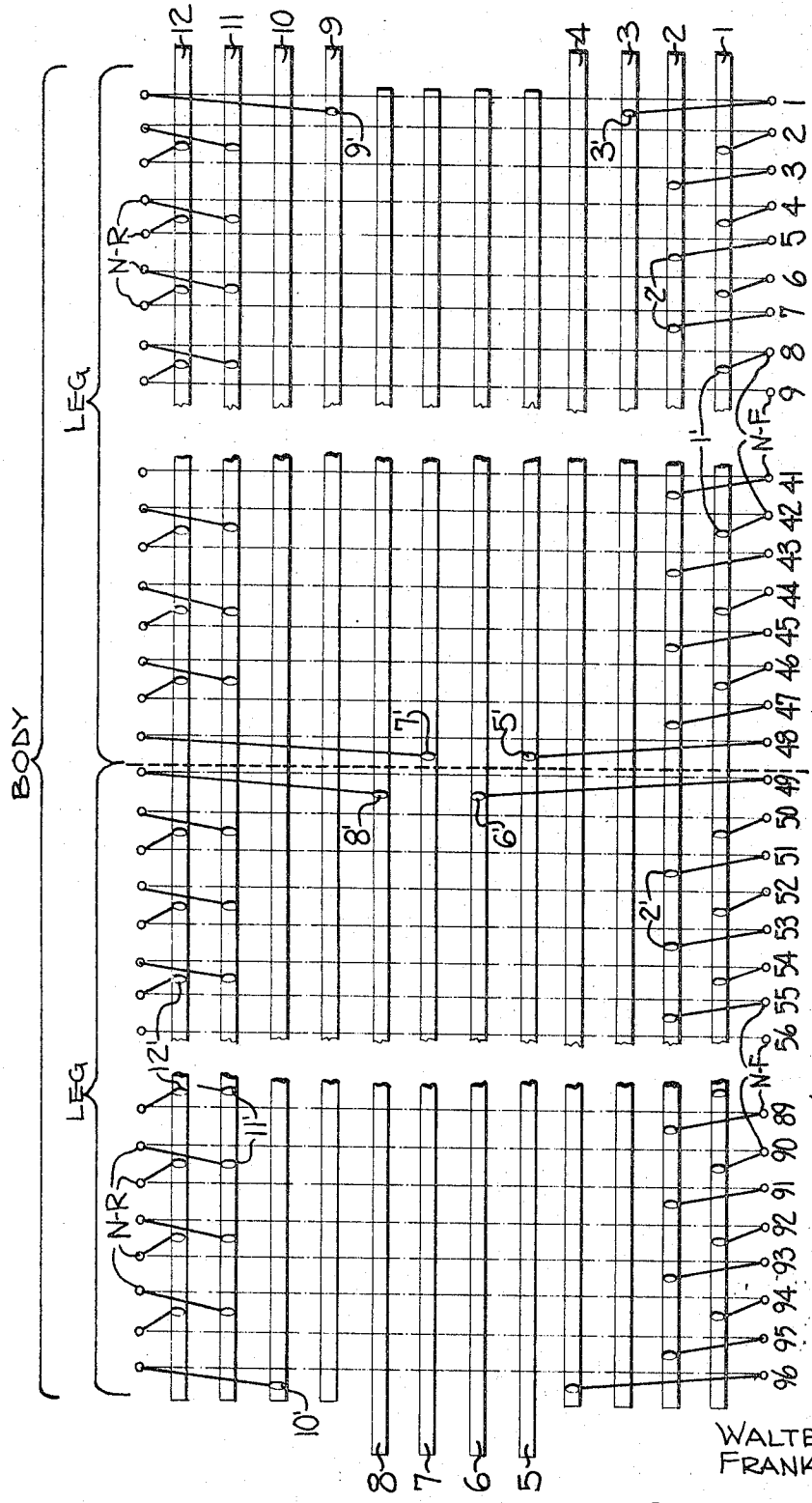
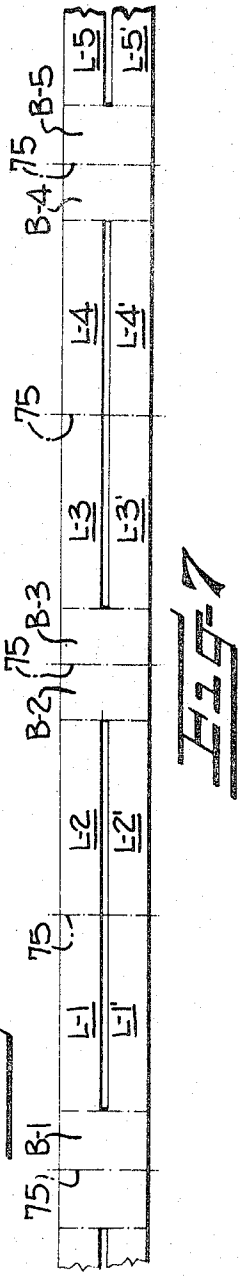
GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 5





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GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 6

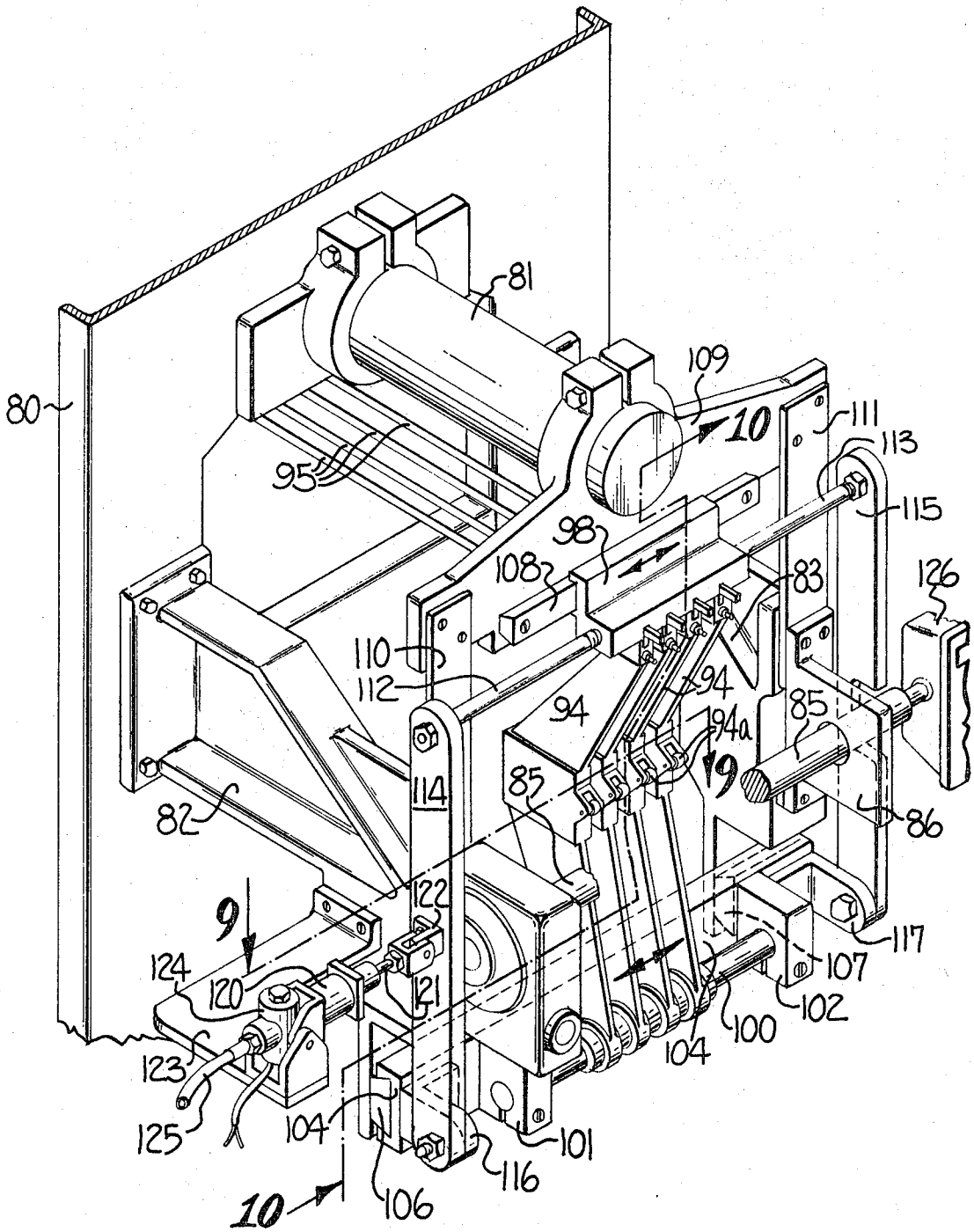

Fig-8

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GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

Filed Feb. 2, 1968 7 Sheets-Sheet 7

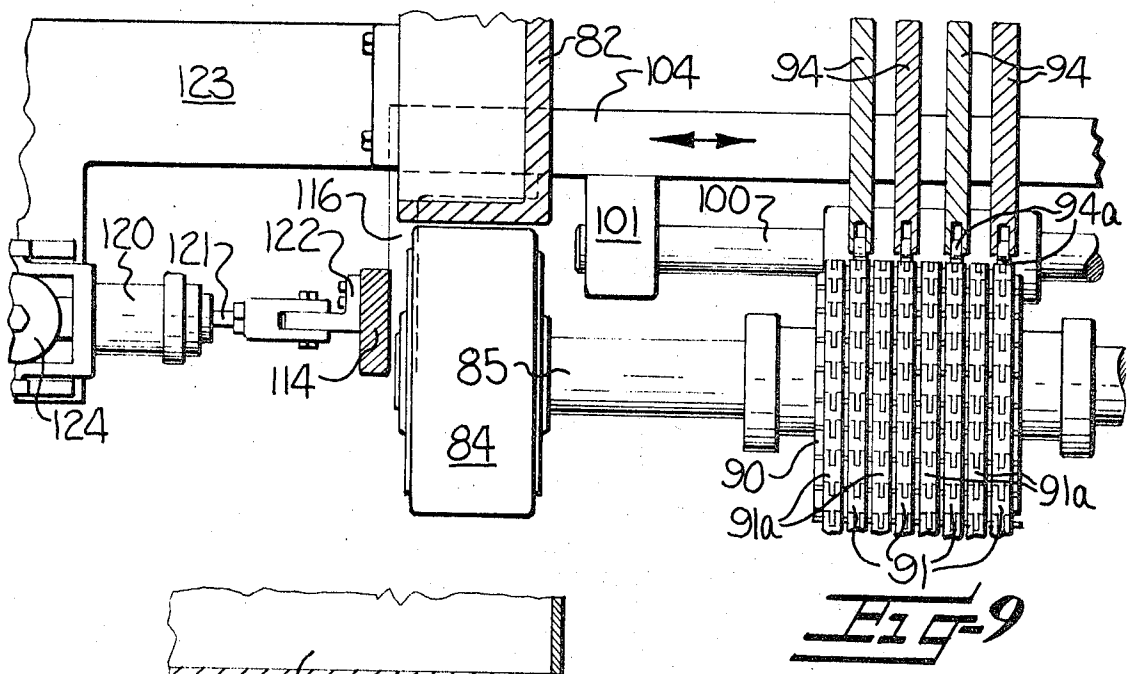

Fig-9

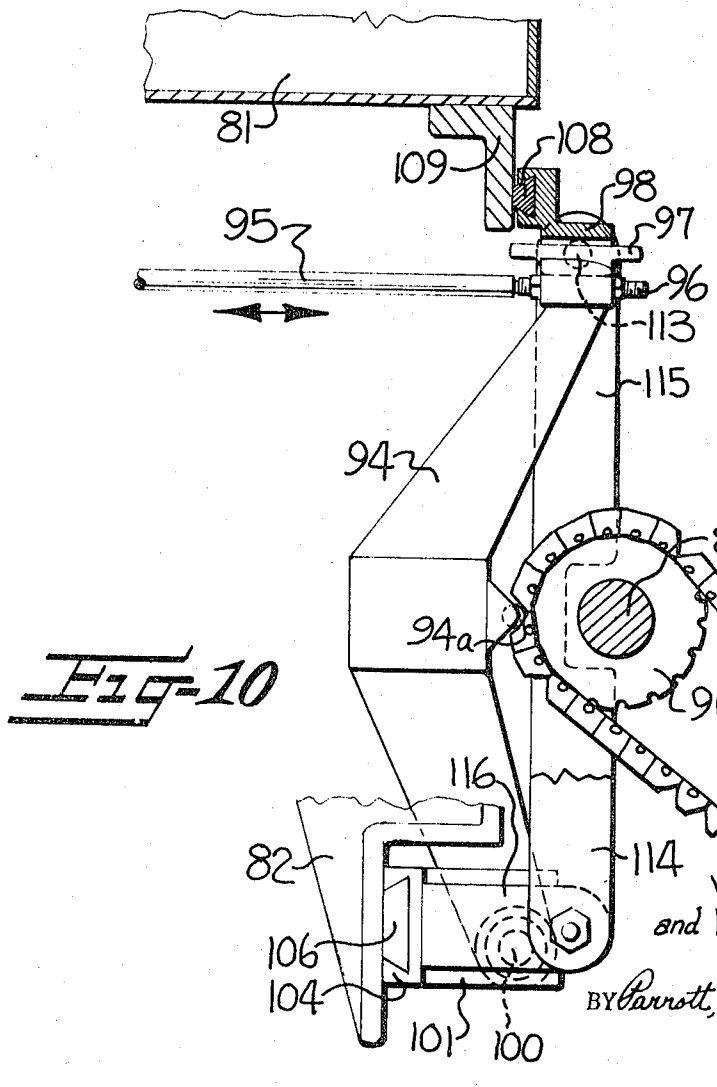

Fig-10

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United States Patent Office 3,555,853 Patented Jan. 19, 1971

3,555,853

GUIDE CONTROL MEANS FOR RASCHEL KNITTING MACHINE

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Continuation-in-part of application Ser. No. 681,800, Nov. 9, 1967. This application Feb. 2, 1968, Ser. No. 702,628

Int. Cl. D04b 23/02

U.S. Cl. 66—87 12 Claims

ABSTRACT OF THE DISCLOSURE

Main pattern control means is provided for imparting patterning motions to certain of the guide bars and an auxiliary pattern control means is provided for imparting patterning motions to the remaining guide bars. The main and auxiliary pattern control means cooperate to at times cause the guide bars to feed the yarns to single groups of adjacent needles of the front and rear needle beds and to knit a plurality of relatively large single tubes. At other times, the control means cooperate to feed the yarns to pairs of groups of adjacent needles of the front and rear needle beds and to knit pairs of closely spaced fabric tubes as continuations of each large tube.

This is a continuation-in-part of our prior application Ser. No. 681,800, filed Nov. 9, 1967, now abandoned, and relates generally to pattern control means for the yarn guides of a warp knitting machine and more particularly to guide bar control means for Raschel machines when applied to a two-needle bed Raschel machine. The guide bar control means of this invention makes it possible to knit seamless blanks for tights, leotards, panty hose of the like, which blanks include a relatively large tube adapted to form the body portion of the garment and a pair of smaller tubes knit integral with the large tube and adapted to form the leg portions of the garment.

The yarn guide bars of a warp knitting machine are usually shogged longitudinally of the needles by means of control links, in the form of slide bars or levers, which are moved by pattern elements in the form of pattern drums or pattern chains. The pattern elements are moved in timed relationship to operation of the machine and must be set up to impart a predetermined sequence of pattern shogging movements to the guide bars. With this conventional arrangement, it is not possible to vary the pre-arranged shogging pattern while the machine is operating and any change in the pattern requires a rearrangement of the links of the pattern chain or changing the pattern plates on the pattern drum.

It is generally known to knit tubular fabrics on a two-needle bed Raschel machine by knitting one-half of the tube on a group of adjacent needles in one needle bed and the other half of the tube on a group of adjacent needles in the other needle bed while joining the halves together by forming a connection across the two beds and at the endmost needles of the groups. These tubular blanks have been knit with an open lace or fishnet type stitch and used to form ladies' stockings, leotards, tights and the like. When forming tights or leotards of these tubular blanks, it is the general practice to longitudinally slit the tubular blanks at one end and then sew together the slit edges of a pair of adjacent blanks to form a U-shaped connection seam extending from the front to the rear of the garment and through the crotch. In some instances, a diamond-shaped crotch patch is sewn between the blanks and, in other instances, a shaped crotch panel is sewn between the blanks and extends from the front to the rear of the garment. The joined together upper ends

of the tubular blanks form a single enlarged tubular body portion and the separate tubular lower portions form leg and foot covering portions. This method of forming leotards or tights requires separate slitting and sewing operations and also forms unsightly seams extending through the body of the garment which may be uncomfortable.

With the foregoing in mind, it is an object of the present invention to provide improved yarn guide bar control means for a warp knitting machine wherein alternate patterns of shogging movements may be imparted to selected groups of the guide bars while the machine is operating. The present guide bar control means is provided with means for shifting between alternate pattern shogging movements without stopping the machine and for varying the periods of time that the shogging of the guide bars are controlled by each of the alternate patterns.

It is a further object to provide improved yarn guide bar control means for a two-needle bed Raschel knitting machine whereby the yarn guides may be operated to at times feed yarns to single groups of adjacent needles of the front and rear needle beds while forming a connection across the endmost needles of each group to form a relatively large single tube, and at other times to feed yarns to pairs of groups of adjacent needles in each needle bed while forming connections across the endmost needles of opposed groups of needles to form a pair of relatively small tubes. The present guide bar control is particularly useful in the knitting of blanks for the formation of tights, leotards, panty hose and the like wherein the single large tube is adapted to provide the body portion and the pairs of tubes are adapted to form the leg and foot portions of the garment.

The present guide bar control means may be advantageously employed on single needle bed warp knitting machines or on two-needle bed Raschel knitting machines. When employed on a two-needle bed Raschel machine for knitting seamless blanks for the formation of tights, leotards, panty hose and the like, the control means generally includes main pattern control means for imparting patterning motions to certain of the guide bars in such a manner that they continuously lap yarns over adjacent needles in a plurality of closely spaced groups of opposed needles along each needle bar and auxiliary pattern control means for controlling the operation of the remaining guide bars. During the knitting of the large tubular body portions, yarns are lapped between the needles at corresponding ends of alternate pairs of groups of needles in each needle bar to form relatively wide panels on each needle bed while yarns are lapped between endmost needles at opposite ends of the alternate groups of adjacent needles to connect the ends of the wide panels. Then, during the knitting of the pairs of small tubular leg and foot portions, certain of said remaining guide bars continue to lap yarns between opposed endmost needles in each needle bed and at opposite ends of the alternate groups of adjacent needles while other guide bars lap yarns between opposed needles at corresponding ends of the alternate groups of adjacent needles.

The yarn guide bar control means of the present invention is illustrated and described in association with a two-needle bed Raschel machine and preferably includes a main pattern chain drum positioned at one end of the machine and having a series of pattern chains for controlling the longitudinal shogging or shifting movement of certain of the yarn guide bars. An auxiliary pattern drum is positioned at the opposite end of the knitting machine and has pairs of adjacent pattern chains for alternately controlling the longitudinal shogging or shifting of the remaining yarn guide bars. Automatic means is provided for selectively controlling certain of the guide bars by means of either of the adjacent pattern chains at the auxiliary pattern drum to provide different shogging

movements thereto. However, it is to be understood that both pattern chain drums may be positioned at one end of the machine and the alternate controls may be provided for both pattern chain drums.

In one embodiment of the invention, the guide bars are operated by slide bars and the slide bars for certain of the guide bars are supported in a shifting slide box which is moved by means of an air cylinder, operated in response to automatic control means comprising a course counting sequence timing device. This course counting device may be set to cause the slide box to shift from one position to another after predetermined numbers of courses and to thereby cause the guide bars to be controlled by the desired pattern chain for a predetermined number of courses.

In another embodiment of the invention, the guide bars are operated by levers and the levers for certain of the guide bars are supported in a shifting frame so that the levers can be laterally shifted to be engaged by the desired pattern chain.

The conventional guide bar control mechanism of a warp knitting machine is designed to permit the repeated knitting of a particular pattern during a continuous sequence of operation, and is not constructed to permit shifting from one type or sequence of knitting operations to another type or sequence of knitting operations while the machine is in continuous operation. The guide bar control means of this invention permits certain of the guide bars to be utilized for continuously carrying out a particular sequence of knitting steps while the sequence of operation of other bars may be periodically varied during a continuous knitting operation and without the necessity of stopping the machine to modify the guide bar pattern control means.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

FIG. 1 is a somewhat schematic vertical sectional view through a two-needle bed Raschel knitting machine and showing one embodiment of the present guide bar control means associated therewith;

FIG. 2 is a horizontal sectional view taken substantially aolng line **2—2** in FIG. 1 and schematically illustrating the guide bars with the main and auxiliary pattern control means positioned at opposite ends of the knitting machine;

FIG. 3 is an enlarged fragmentary vertical sectional view taken substantially along line **3—3** in FIG. 2 and showing the counter control in elevation;

FIG. 4 is an enlarged plan view of the left-hand end of FIG. 2 with the yarn guide slide bars moved to the opposite position from that shown in FIG. 2 and being turned 90°;

FIG. 5 is a greatly enlarged fragmentary view of the upper ends of each needle bed and illustrating the nesting of the yarn guides;

FIG. 6 is a schematic diagram illustrating the arrangement of the yarn guides on the yarn guide bars, relative to the needles of the front and back beds and encompassing the groups of needles required to knit one seamless garment blank;

FIG. 7 is a plan view of a continuous strip of the garment blanks, illustrating the manner in which single large tubes and pairs of small tubes are successively knit;

FIG. 8 is a fragmentary isometric view of one end of a warp knitting machine of the type which includes levers for controlling the shogging of the guide bars, with the pattern chain drum broken away, and illustrating the levers being supported for lateral shifting movement;

FIG. 9 is a horizontal sectional view taken along line **9—9** in FIG. 8 and showing the pairs of pattern chains for each lever; and

FIG. 10 is a vertical sectional view taken along line **10—10** in FIG. 9.

Generally, the embodiment of guide bar control means shown in FIGS. 1–7 includes main pattern control means A (FIG. 1) positioned at one end of the machine and auxiliary pattern control means B positioned at the opposite end of the machine. The guide bar control means A and B control the longitudinal or shifting movements of the guide bars of the machine, indicated at **1–12** in FIGS. 2, 5 and 6. The guide bars **1–12** are provided with corresponding yarn guides **1'–12'** (FIG. 5) which have suitable yarn guide eyes at their lower ends. In the usual Raschel knitting machine, pattern control means is provided at only one end of the machine and it operates to properly position all of the guide bars of the knitting machine.

In accordance with the present invention, the pattern control means A (FIG. 2) controls only the group of front guide bars **1–4** and the group of rear guide bars **9–12** to impart the required patterning motion thereto. The auxiliary pattern control means B is operable to impart alternate patterning motions to the four center guide bars **5–8** so that two completely different types of shogging movements are imparted to these four guide bars during the knitting of different portions of the garment blanks. This guide bar control means permits the continuous knitting of seamless blanks for forming tights, leotards, panty hose or the like, wherein large single tubes and smaller pairs of tubes are integrally knit.

This alternate operation of the auxiliary pattern control means B causes the guide bars **5, 6** to lap yarns between adjacent needles N–F of the front trick plate **15** (FIG. 5) and the guide bars **7, 8** to lap yarns between adjacent needles N–R of the rear trick plate **16** during the knitting of the large tubular body portion of each garment blank. During the knitting of the small tubular leg portions of the garment blank, the guide bars **5–8** operate to form connections between the needles of the front and rear beds. While the pattern control means A and B are shown supported at opposite ends of the machine, it is to be understood that they might be supported at the same end of the machine, if desired.

As shown in FIGS. 1 and 2, the machine includes a right-hand end frame **20** and a left-hand end frame **21** which are supported in spaced apart relationship by conventional supporting members, including a support tube **22**. The upper ends of the end frames **20, 21** suitably support warp yarn beams **23**, only portions of which are shown in FIG. 1. A guide bar rock shaft **24** is suitably supported beneath the tube **22** to oscillate in timed relationship to operation of the machine and yarn guide bar hangers **25** are fixed in spaced relationship along the rock shaft **24** (FIG. 1). The guide bars **1–12** are supported in a conventional manner on the hangers **25** to swing through the needles with oscillation of the hangers **25** and for longitudinal or shogging movement along the needle beds. Pusher rods **26** (FIG. 1) are supported for horizontal sliding movement in pusher rod hanger **27** and their inner ends are suitably connected to the guide bars **1–4** and **9–12** while their outer ends engage pusher pads **30** which are in turn fixed on the inner ends of corresponding slide bars **31**.

The slide bars **31** are supported for horizontal sliding movement in a slide box **32** which is suitably secured to the end frame **20**. The outer ends of the slide bars **31** are provided with pattern chain engaging rollers **33** which ride on the outer surface of endless pattern chains **34**. The chains **34** are moved in timed relationship to operation of the machine and in a conventional manner by rotation of a chain drum **35** which is fixed on a drive shaft **36** (FIG. 2). The drive shaft **36** is connected to the usual drive means of the knitting machine and the chains **34** extend around and are supported on idler rollers, not shown.

As shown in FIG. 2, there are eight pattern chains **34** which control the shogging or longitudinal movement of the four front guide bars **1–4** and the four rear guide bars **9–12**. The rollers **33** are urged into engagement with the chains **34** and the guide bars **1–4** and **9–12** are re-

siliently urged to the right in FIG. 2 by springs **36***a*, the inner ends of which are connected to the corresponding guide bars and the outer ends of which are connected to a spring-holding bracket **37** (FIG. 1) secured to the end of the guide bar rock shaft **24**.

The auxiliary pattern control means B includes pusher rods **40** which are supported for horizontal sliding movement in a pusher rod hanger **40***a* that is fixed on the guide bar rock shaft **24**. The inner ends of the pusher rods **40** engage the corresponding guide bars **5–8** and the outer ends engage pusher pads **41** (FIGS. 3 and 4) that are in turn connected to the inner ends of slide bars **42**. The slide bars **42** are supported for horizontal sliding movement in a slide box **43** which is in turn supported for lateral sliding movement on a pair of guide rods **44, 45** (FIG. 3). Opposite ends of the guide rods **44, 45** are supported in upstanding bearing portions of a support bracket **46** which is fixed on the left-hand end frame **21**.

The outer ends of the slide bars **42** are provided with chain-engaging rollers **50** (FIG. 4) which selectively engage pattern chains **51** or **51***a*, depending upon the position of the slide box **43**. The guide bars **5–8** are resiliently urged to the left in FIG. 1 by springs **48** which are connected at their inner ends to the guide bars and at their outer ends to a spring-holder bracket **49**, fixed on the guide bar rock shaft **24**. In FIG. 4, the rollers **50** are shown in engagement with the pattern chains **51** so that the corresponding guide bars **5–8** are controlled by these chains **51**. In FIG. 2, the slide box **43** is shown in shifted position so that the rollers **50** are in engagement with the pattern chains **51***a* and the corresponding guide bars **5–8** are then controlled by these chains **51***a*.

The chains **51, 51***a* are supported on a chain drum **53** which is fixed on a drive shaft **54** that is rotated in timed relationship with operation of the machine. As shown in FIG. 1, the chains **51, 51***a* extend downwardly and pass around an idler support roll **55**. Thus, when the slide box **43** is shifted in one direction, for example to the right as shown in FIGS. 2 and 3, the corresponding guide bars **5–8** are controlled by the pattern chains **51***a*. When the slide box **43** is shifted to the opposite position, to the left as shown in FIG. 4, the guide bars **5–8** are controlled by the pattern chains **51**.

Suitable means is provided for shifting the slide box **43** from one position to the other. The shifting means for the slide box **43** is illustrated as an air cylinder **56** (FIGS. 2–4) having a piston rod **57** at one end (FIG. 3) which is connected to the slide box **43** by an L-shaped bracket **58** (FIG. 4). The opposite end of the air cylinder **56** is suitably supported on a bracket **60** fixed on the left-hand end frame **21**. A solenoid-operated valve **61** is supported on the air cylinder **56** and is connected to one end of an air pressure line **62** that is connected at its opposite end to a source of air pressure; schematically indicated at **63** in FIG. 2.

Means is provided for periodically controlling the operation of the air cylinder **56** to shift the slide box **43** between the positions shown in FIGS. 2 and 4 at predetermined times during the knitting of the garment blanks, such as after the knitting of a selected number of courses. In the present instance, the shifting control means comprises a counter **65** which is operatively connected to the pattern chain drive shaft **54** by means of a coupling shaft **66** (FIG. 4). The counter **65** is supported on a bracket **67** which is fixed to a bearing support **68** for the pattern chain drive shaft **54** (FIG. 4).

The counter **65** (FIG. 3) includes a course counting dial **70** which shows the total number of courses which have been knit with the slide box **43** in either position. When the slide box **43** is shifted, the course counting dial **70** automatically returns to zero. The counter **65** also includes a first control dial **71** and a second control dial **72** which are manually set to the desired number of courses to be knit with the slide box **43** in each position. After the desired number of courses is knit in one position, the slide box **43** is shifted to the opposite position to thereby control the number of courses that the guide bars **5–8** will be controlled by the pattern chains **51** and the number of courses that they will be controlled by the pattern chains **51***a*.

The counter **65** is connected to the solenoid valve **61** by wires **76** (FIG. 2) and to a suitable source of electrical energy, shown schematically at **77**, by wires **78**. The counter **65** contains conventional electrical switches, not shown, which are operated by the counter to control the operation of the solenoid valve **61** and to thereby control the operation of the air cylinder **56** and shifting of the slide box **43**.

For example, the number of courses to be knit in the large tubular body portion is set on the dial **72** and the number of courses to be knit in the small tubular leg portions is set on the dial **71**. When the number on the course counting total dial **70** reaches the number of courses set on the dial **72**, the solenoid valve **61** will operate and the cylinder **56** will shift the slide box **43** to the position shown in FIG. 4. At the same time, the total dial **70** will be reset to zero to start counting the number of courses required to be knit. When the total dial **70** reaches the number of courses set on the dial **71**, the solenoid valve **61** will operate and the cylinder **56** will shift the slide box **43** to the position shown in FIG. 2.

METHOD OF OPERATION

The operation of the present guide bar control means will be described in conjunction with the knitting of seamless blanks for ladies' tights which include relatively large tubular body portions and integrally knit smaller tubular leg and foot portions. The blank will be described as it is knit throughout of an open mesh, fishnet type stitch construction. However, it is to be understood that the seamless blank may be knit with other stitch patterns and different stitch patterns may be knit in different portions of the blank. For example, the body portion may be a close knit construction and the legs may be open mesh. Also, the legs may be of a plain sheer stitch construction while the body portion may be of a more dense stitch construction.

A strip of the seamless blanks is schematically illustrated in FIG. 7 and the large tubular body portions are indicated at B–1 through B–5 while the smaller tubular leg portions are indicated at L–1 and L–1′ through L–5 and L–5′. The tubular blank is cut transversely along dash-dot cut lines **75** to form individual garment blanks which may be finished by closing the lower ends of the tubular portions to form toe end portions and finishing the waist in any suitable manner, such as by sewing a hem or adding an elastic waist band. The method will be described in connection with the knitting of a particular type and size of blank; however, it is to be understood that the present guide bar control means may be utilized in knitting different types and sizes of blanks.

As is well known, the Raschel type machine is provided with long front and rear needle beds and a plurality of garment blanks may be simultaneously knit on groups of needles across the width of the machine. In the present instance, the needle beds are 112 inches wide and 21 garment blanks are knit at one time. The ninety-six needles required to knit one garment blank are shown in FIG. 6 and the operation of the guide bars will be described in conjunction with these needles. While eight guide bars are controlled by the main pattern control means A and four guide bars are controlled by the auxiliary pattern control means B, it is to be understood that a greater or lesser number of guide bars could be controlled by either one or both of the pattern control means, if desired. Also, the shifting slider box may be used at each end of the machine to provide alternate patterns for each guide bar.

The nesting of the guide bars is illustrated in FIG. 5, where it will be noted that the yarn guides **3′, 4′, 5′** and **8′, 9′, 10′** are aligned longitudinally at their lower ends.

Since there is only one yarn guide on each of the guide bars **3**, **4**, **5** and **8**, **9**, **10**, as shown schematically in FIG. 6, it is possible to position the yarn guides to operate in the same longitudinal row. As shown in FIG. 6, the guide bars **6** and **7** also have single yarn guides **6'**, **7'**; however, these guides **6' 7'** are not longitudinally aligned.

Generally, the knitting of the seamless garment blank is carried out on the ninety-six needles of the front and rear beds (FIG. 6) by operating the yarn guides to at times knit a single large tube by forming a continuous front panel of fabric on the needles **1–96**, knitting a continuous rear panel on the rear needles **1–96**, and connecting opposite ends of the front and rear panels by knitting between the front to rear beds and at the endmost needles **1** and **96**. During the knitting of the separate small tubes forming the leg portions, the yarn guides are operated to knit separate front and rear panels on the needles **2–47** and **50–95** which are connected at their outer extremities by continuing the connection from the front to rear needle beds on needles **1** and **96** while forming additional connections between the front and rear beds on the needles **48**, **49**. Thus, as indicated by the brackets at the upper portion of FIG. 6, the body portion is knit as one seamless tube on the needles **1–96**, while the separate tubular leg portions are knit on the needles **1–48** and **49–96**.

During the knitting of the large body tube, the yarn guides **4'** and **10'** (FIG. 6) alternately knit on the front and rear needles **96** to form the connection while the yarn guides **3'** and **9'** alternately knit on the front and rear needles **1** to form the opposite side connection. The yarn guides **5'**, **6'** fill in for the missing yarn guides on the guide bars **1** and **2** and knit on the front needles **48**, **49** while the yarn guides **7'**, **8'** fill in for the missing yarn guides in the guide bars **11**, **12** and knit on the rear needles **48**, **49**.

During the knitting of the small tubular leg portions, the yarn guides **4'**, **10'** continue to form the connection on the needles **96** and the yarn guides **3'**, **9'** continue to form the connection between the front and rear needles **1** while the operation of the yarn guides **5'–8'** is changed so that the guides **5'**, **7'** alternately lap the front and rear needles **48** to form a connection therebetween and the yarn guides **6'**, **8'** alternately lap the front and rear needles **49** to form a connection therebetween.

To knit a fishnet type fabric having diamond-shaped openings therein, the yarn guides continuously feed the yarns to the same needles for a predetermined number of courses and form independent stitch chains thereon, and then the yarns are cross-lapped to adjacent needles to form connections between the stitch chains. Such a fabric is knit as a tube on the two-needle bed Raschel machine by alternately raising and lowering the front and rear needle beds to form a course along one bed and then along the other bed while forming connections between the front and rear beds at opposite ends of the tube.

To aid in describing the knitting operation, yarns are shown in FIG. 6 extending from the guides to the needles on which the stitch chains are usually formed when the large tube is being knit. During one knitting cycle, the yarn guides swing forwardly through the raised needles of the front bed, the guide bars **1–6** are then shogged to form the required overlap, and the guides swing back through the needles to wrap the yarns around the hook side and above the latches of the needles of the front bed. The front needles N–F are then lowered to knock over the old loops and to form a new course of stitch loops thereon. With the front needle bed in a lowered position, the guides swing back to the front and make any desired underlap shogging movement which is necessary as the rear needles N-R are raised in preparation for passage of the yarn guides through the same as they swing in the rearward direction.

As the yarn guides reach the limit of their rearward swinging movement, any required shogging overlap movement is made and they again swing forwardly to wrap the yarns around the hook side and above the latches of the needles of the rear bed. The rear needle bed is then lowered to form a course of stitch loops on this rear needle bed. While a course is being formed on the front needles, the guides feeding the rear needles are not shogged so that they do not wrap the yarns around any needles and then during the knitting of a course on the rear needles, the guides feeding the front needles are not shogged so that they do not wrap any needles.

During the knitting of the chain stitch portions, the yarn guides continuously shog to feed yarn to the same needle for a plurality of courses; e.g., four courses, and then the yarn guides are shogged and cross to feed yarns to adjacent needles and form a connection between the stitch chains for a single course. Then, the yarn guides again feed yarn to the same needle for a plurality of courses to form another stitch chain portion. The connector guides **4'** and **10'** (FIG. 6) normally feed their yarns to the respective front and rear needles **96** to form separate stitch chains and to make the connection, the guide **4'** is shogged to feed its yarn to the rear needle **96** while the guide **10'** is shogged to feed its yarn to the front needle **96** to thereby join the front and rear stitch chains, knit on the needles **96**.

The guides **3'**, **9'** and **4'**, **10'** are operated in the same manner throughout the knitting of both the body and leg portions of successive garment blanks and the shogging movements of their respective guide bars are controlled by the slide bars **31** and corresponding pattern chains **34** of the main pattern control means A. On the other hand, the shogging movements of the guides **5'**, **6'** and **7'**, **8'** must be varied, depending upon whether a single large tube is being knit or whether two small tubes are being knit. When the slide box **43** is moved to the position shown in FIG. 4, the guide bars **5'–8'** are controlled by the pattern chains **51** so that the guides **5'**, **6'** feed yarns to the front needles only while the guides **7'**, **8'** feed yarns to the rear needles only and a single large tubular body portion is formed.

The slide box **43** is shifted to the position shown in FIG. 2 at the proper time so that the guides **5'–8'** are then controlled by the pattern chains **51***a*. The shogging movements then imparted by the pattern chains **51***a* cause the guides **6'** to periodically feed its yarn to the rear needle **49** while the guide **8'** periodically feeds its yarn to the front needle **49** to form the connection at the inner side of one small tubular leg portion. The guide **5'** also periodically feeds its yarn to the rear needle **48** while the guide **7'** feeds its yarn to the front needle **48** to form a connection on the inner side of the other small tubular leg portion.

Thus, during the knitting of the body portions, the shogging movements of the guide bars **5–8** are controlled by certain groups of pattern chains; e.g., pattern chains **51**, and then during the knitting of the separate tubular leg portions, the shogging movements of the guide bars **5–8** are controlled by the other pattern chains **51***a*. In order to permit switching of the slide bar rollers **50** from one pattern chain to the adjacent pattern chain, the pattern chains **51**, **51***a* are set up with links of the same height in certain areas, where the shifting action will occur.

While the shifting of the slide box **43** is shown and described as being operated by an air cylinder **56**, it is to be undesrtood that the shifting could be effected by a hydraulic cylinder, solenoid, or other siutable means. The control of the shifting of the slide box **43** is shown and described as being carried out by a course counter device **65**; however, it is to be understood that other types of control devices may be utilized for shifting the slide box **43** from one position to another after a predetermined number of courses have been knit in each position. The pattern chains **51**, **51***a* may be replaced by pattern rings for controlling the shogging movements of the guide bars **5–8**, when knitting certain types of fabrics.

MODIFIED FORM

A modified form of the guide bar control means of this invention is illustrated in FIGS. 8–10 wherein the guide bar control means is illustrated associated with a warp knitting machine of the type in which the control links controlling the shogging movement of the yarn guide bars are in the form of levers. A portion of one end frame **80** is shown in FIG. 8 and a longitudinally extending support tube **81** is suitably secured thereto and extends outwardly therefrom.

This modified form of guide bar control means is supported on a framework attached to the end frame **80** and support tube **81** and which includes a pair of outwardly extending brackets **82, 83** suitably connected at their inner ends to the frame **80**. The outer end of the support bracket **82** supports a right-angle drive housing **84** which is connected to the drive of the machine and imparts rotation to one end oif a pattern chain drive shaft **85**, the opposite end portion of which is suitably supported for rotation in a bearing plate **86** fixed on the outer end of the support bracket **83** (FIG. 8). A chain drum **90** is fixed on the medial portion of the drive shaft **85** so that it is rotated in timed relationship with operation of the machine. Four pairs of endless pattern chains **91, 91***a* are supported on the chain drum **90** and extend outwardly for any desired distance (FIG. 10) and pass around suitable idler rollers, not shown.

The control links which impart movement to the guide bars from the pattern chains comprise pattern levers **94** operatively connected at their upper ends to corresponding guide bars, not shown, by push rods **95**. The push rods **95** are provided with concave ends which engage the rounded ends of adjustable screws **96** threaded in the upper ends of the levers **94**. The upper portions of the levers **94** are provided with guide plates **97** which slidably engage grooves in a slide bar **98** which is normally supported in a fixed position but, in accordance with the present invention, the slide bar **98** is supported for lateral shifting movement, in a manner to be presently described. The medial portions of the levers **94** are provided with cam rollers **94***a* which ride on the corresponding pattern chains **91, 91***a* (FIG. 9).

The lower ends of the pattern levers **94** are pivotally supported on a shaft **100** and longitudinal movement therealong is prevented by suitable collars and spacers. Opposite end portions of the shaft **100** are suitably supported in blocks **101, 102** there are, in turn, fixed adjacent opposite end portions of a transverse slide bar **104**. The transverse slide bar **104** is normally supported in a fixed position on the outer ends of the support brackets **82, 83**, but, in accordance with the present invention, this slide bar **104** is supported for lateral shifting movement.

The slide bar **104** is supported for lateral shifting movement by means of dove-tail guide blocks **106, 107** which are in turn fixed on the outer ends of the respective support brackets **82, 83**. The slide bar **98** is supported for lateral shifting movement on a dove-tail guide bar **108** (FIG. 8) which is in turn fixed on the lower portion of a support plate **109**, the upper end of which is suitably secured to the support tube **81**. Braces **110, 111** are connected between the opposite ends of the support plate **109** and the respective support brackets **82, 83** to maintain the support plate **109** in the proper position.

The slide bar **98** and the slide bar **104** form part of a lever shifting frame which also includes a pair of rods **112, 113**, the inner ends of which are threadably embedded in opposite ends of the slide bar **98** and the outer ends of which are suitably connected to the upper ends of vertical frame members **114, 115**. The lower ends of the frame members **114, 115** are suitably secured to the outer ends of respective L-shaped brackets **116, 117**, the inner ends being fixed on opposite end portions of the slide bar **104**.

Suitable means is provided for laterally shifting the lever frame so that the cam rollers **94***a* can be moved between the pattern chains **91, 91***a*. This shifting means preferably includes an air cylinder **120** of the same type which is described in connection with the first embodiment. The air cylinder **120** is provided with a piston rod **121** which is connected to the frame member **114** by an L-shaped bracket **122**. The opposite end of the air cylinder **120** is suitably supported on a bracket **123** fixed on the support bracket **82**.

A solenoid-operated valve **124** is supported on the air cylinder **120** and is connected to one end of an air pressure line **125**. Operation of the air cylinder **120** is controlled by suitable pattern means, such as a course counter **126**, only a portion of which is shown in FIG. 8. The course counter **126** is connected to the shaft **85** and is identical to the course counter **65** described in connection with the first embodiment, being operated in the same manner to control the air cylinder **120** and import shifting movements to the pattern levers **94**.

Thus, the counter control **126** may be set so that any desired number of courses may be knit with the pattern levers **94** being operated from the pattern chains **91**, as shown in FIG. 9, and then the air cylinder **120** will shift the slide bar **98** and slide bar **104** to the left so that the cam rollers **94***a* on the levers **94** are then engaged by the pattern chains **91***a* and an alternate pattern of shogging motions may be imparted to the push rods **95** and the corresponding guide bars.

While this modified form of guide bar control means is shown associated with only one end of the machine, it is to be understood that it may also be applied to the opposite end of the machine. Also, while only four pattern levers are shown being controlled by the shifting guide bar control means, a greater or lesser number of pattern levers and corresponding guide bars may be controlled thereby.

The guide bar control means of this invention is described in connection with a two-needle bar Raschel type machine which is operated to produce seamless blanks to be used in the manufacture of panty hose, tights or the like having an enlarged tubular portion and two smaller depending tubular portions. However, it is to be understood that the guide bar control means permits a number of variations in knitting sequences to be utilized for making different types of articles or for forming various stitch patterns in different portions of the same article, as will be apparent to one skilled in the art. Also, this guide bar control means is not limited to use on a two-needle bar machine but may be used on single needle bar warp knitting machines.

In the drawings and specification there have been set forth several embodiments of the invention and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. In a warp knitting machine including a pair of spaced needle bars supporting needles therein, guide bars having yarn guides swingable through the needles, said guide bars being movable longitudinally along said needle bars to shog said guides and feed yarns to the needles, and main guide bar control means for imparting shogging motions to selected ones of said guide bars to lap yarns over adjacent needles in two groups along each needle bar, the combination therewithin of auxiliary guide bar control means for imparting shogging motions to the remaining guide bars, and sequence timing means operatively connected to said auxiliary guide bar control means, said auxiliary guide bar control means being operable to at times lap yarns between opposed needles in each needle bar and at each end of the groups of adjacent needles and to also lap yarns between adjacent terminal needles of each group in each needle bed and to thereby produce a single relatively large tube of knit fabric, said auxiliary guide bar control means being operable at other times to lap yarns between opposed

needles in each needle bed and at each end of the groups of adjacent needles and also lap yarns between opposed needles in each needle bed and in a medial portion of said groups and to thereby produce a pair of fabric tubes knit as continuations of said large tube, said sequence timing means being operable to automatically change the operation of said auxiliary guide bar control means after the knitting of predetermined numbers of courses.

2. In a warp knitting machine according to claim 1 wherein said sequence timing means comprises a course counting device including first means for selectively setting the number of courses to be knit when forming the single relatively large tube, and second means for selectively setting the number of courses to be knit when forming the pair of tubes.

3. In a warp knitting machine according to claim 2 wherein said course counting device also includes a total dial operable to count the courses as they are knit, and wherein said first and second setting means each comprise manually settable control dials, said first and second setting dials being alternately operable to automatically return said total dial to zero when the number of courses knit equals the numbers manually set on said first and second setting dials.

4. In a warp knitting machine according to claim 1 wherein said main guide bar control means is positioned at one end of said machine and said auxiliary guide bar control means is positioned at the other end of said machine.

5. In a warp knitting machine according to claim 1 wherein said knitting machine includes slide bars operatively connected at one end to said guide bars and free opposite ends adapted to be engaged by pattern elements, and a slide box supporting the medial portions of said slide bars for longitudinal movement therein, and wherein said auxiliary guide bar control means includes means supporting said slide box for movement laterally of said slide bars, pairs of pattern elements supported adjacent the free ends of each of said slide bars and being movable in timed relationship to operation of the machine, and means for laterally shifting said slide box to align the free ends of said slide bars with selected ones of said pairs of pattern elements.

6. In a warp knitting machine including a pair of spaced needle bars supporting needles therein, guide bars having yarn guides swingable through the needles, said guide bars being supported for movement longitudinally along said needles to shog said yarn guides and to feed yarns to the needles, pattern elements movable in timed relationship to operation of the knitting machine, and control links operatively connected to said guide bars and being operable by said pattern elements to impart movement to said guide bars, the combination therewith of improved guide bar control means for imparting alternate shogging movements to a selected group of said guide bars, said selected group of said guide bars comprising less than all of said guide bars, said guide bars control means comprising pairs of pattern elements supported adjacent each of a selected group of said control links, said selected group of said control links corresponding to said selected group of said guide bars, means supporting said selected group of said control links for lateral movement, and means for laterally shifting said control links to align said control links with selected ones of said pairs of pattern elements.

7. In a warp knitting machine according to claim 6 wherein said pairs of pattern elements comprise pattern chains made up of links of varying heights, and wherein certain sections of said pairs of chains have identical links to permit the shifting of said control links from one chain to the other.

8. In a warp knitting machine according to claim 7 wherein said laterally shifting means comprises a fluid cylinder supported on said machine and having a piston rod operatively connected to said control link support means.

9. In a warp knitting machine according to claim 8 including sequence timing means for automatically operating said fluid cylinder to control the shifting of said control links from one pattern chain to the other.

10. In a warp knitting machine according to claim 6 wherein said control links comprise slide bars operatively connected at one end to said guide bars and having free opposite ends adapted to be engaged by said pattern elements, and wherein said support means comprises a slide box supporting the medial portions of said slide bars for longitudinal movement therein, said slide box being supported for lateral shifting movement to align the free ends of said slide bars with selected ones of said pairs of pattern elements.

11. In a warp knitting machine according to claim 6 wherein said control links comprise pattern levers operatively connected at one end to said guide bars and having medial portions adapted to be engaged by said pattern elements, and wherein said support means comprises a pivot shaft supporting the other ends of said levers, said pivot shaft being supported for lateral shifting movement to align the medial portions of said levers with selected ones of said pairs of pattern elements.

12. In a warp knitting machine including needles, guide bars having yarn guides swingable through the needles, said guide bars being supported for movement longitudinally along said needles to shog said yarn guides and to feed yarns to the needles, and main guide bar control means for imparting shogging movements to selected ones of said guide bars, said main guide bar control means comprising pattern elements movable in timed relationship to operation of the knitting machine, and control links operatively connected to said selected guide bars and being operable by said pattern elements to impart movement to said selected guide bars, the combination therewith of auxiliary guide bar control means for imparting alternate shogging movements to the remaining guide bars, said auxiliary guide bar control means comprising pairs of pattern elements for each of said remaining guide bars, a group of control links operatively connected to said remaining guide bars and being operable by said pattern elements to impart movement to said remaining guide bars, a selected group of said means supporting said group of said control links for lateral movement, and means for laterally shifting said group of control links to align said group of control links with selected ones of said pairs of pattern elements.

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