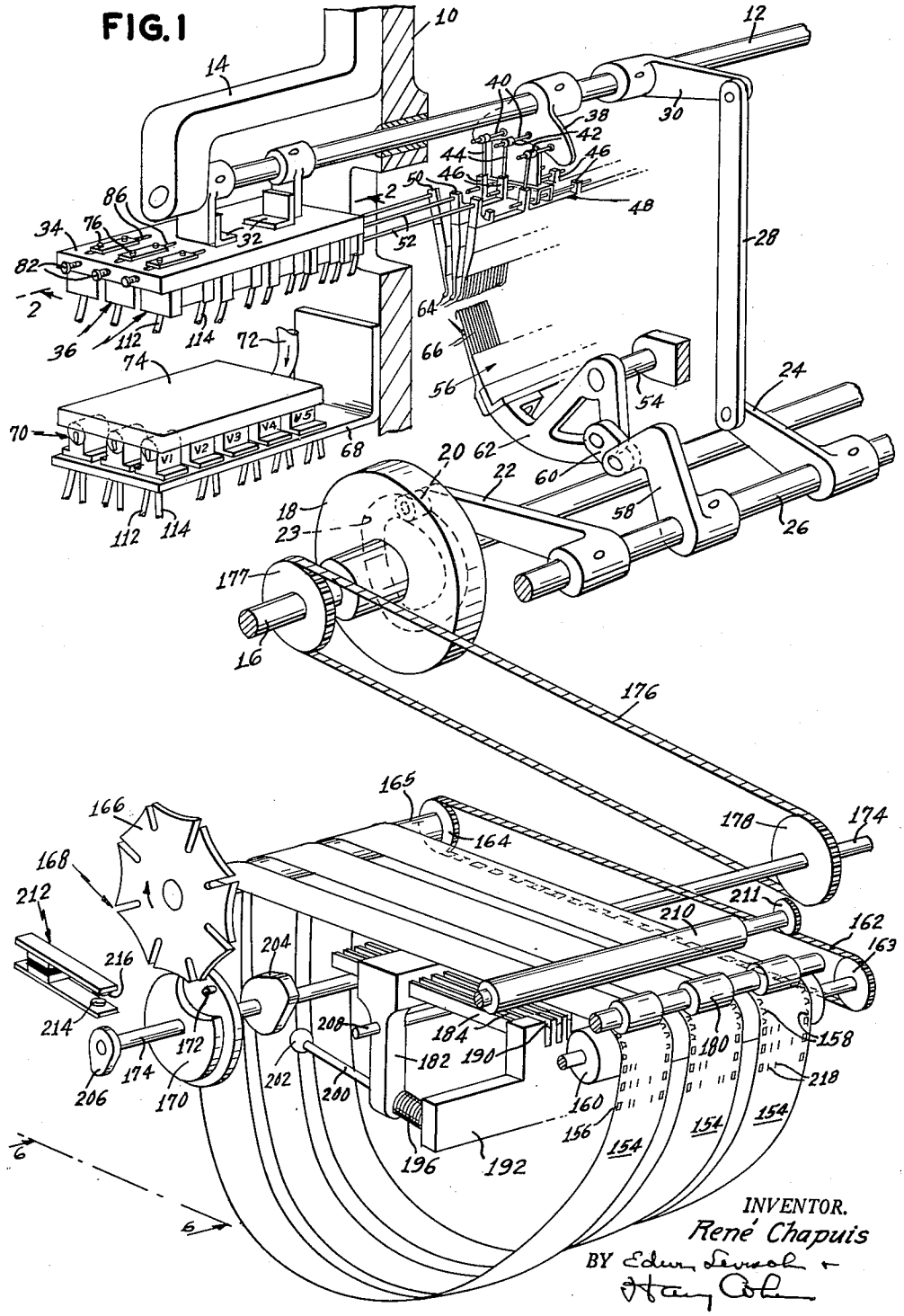
Oct. 31, 1961 R. L. CHAPUIS 3,006,170

SELECTIVE POSITIONING SYSTEM

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FIG. 1



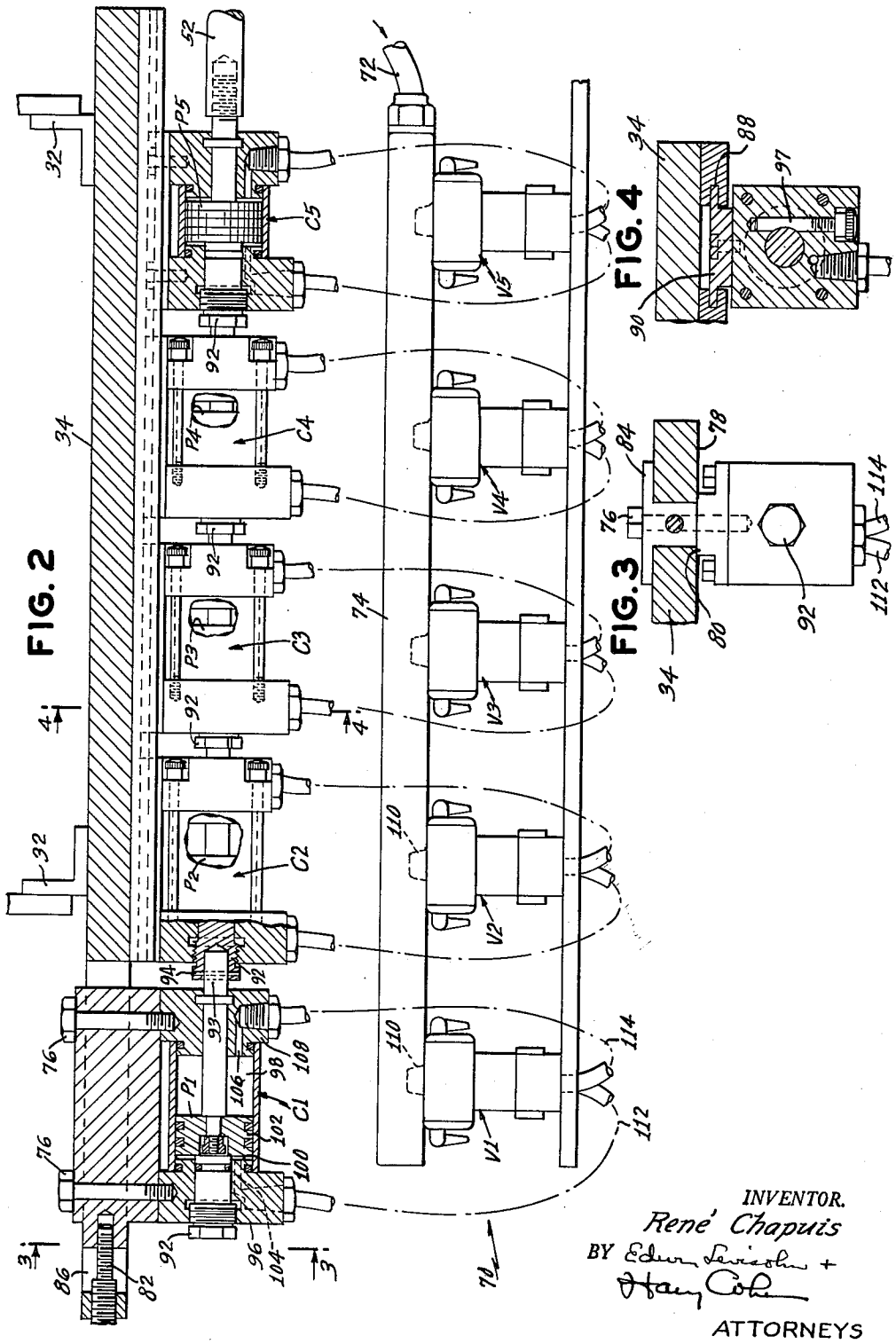
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SELECTIVE POSITIONING SYSTEM

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FIG. 6

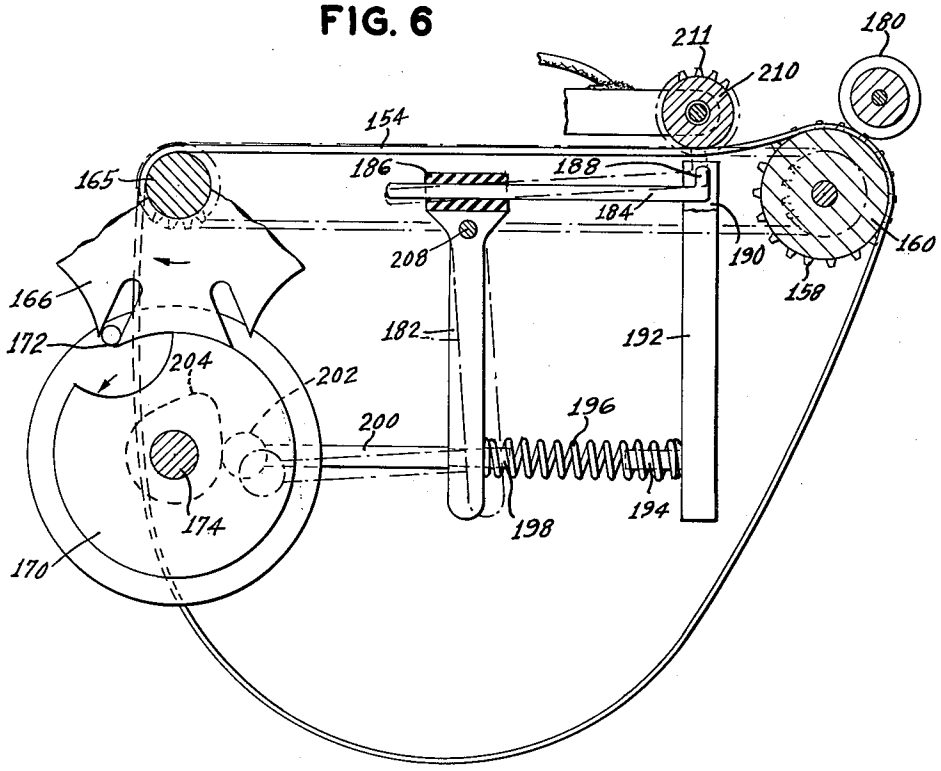
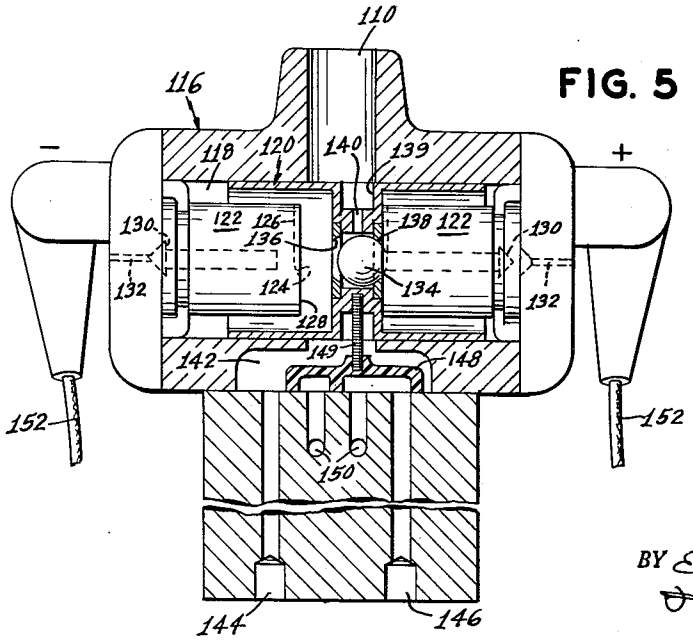


FIG. 5



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SELECTIVE POSITIONING SYSTEM

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FIG. 7

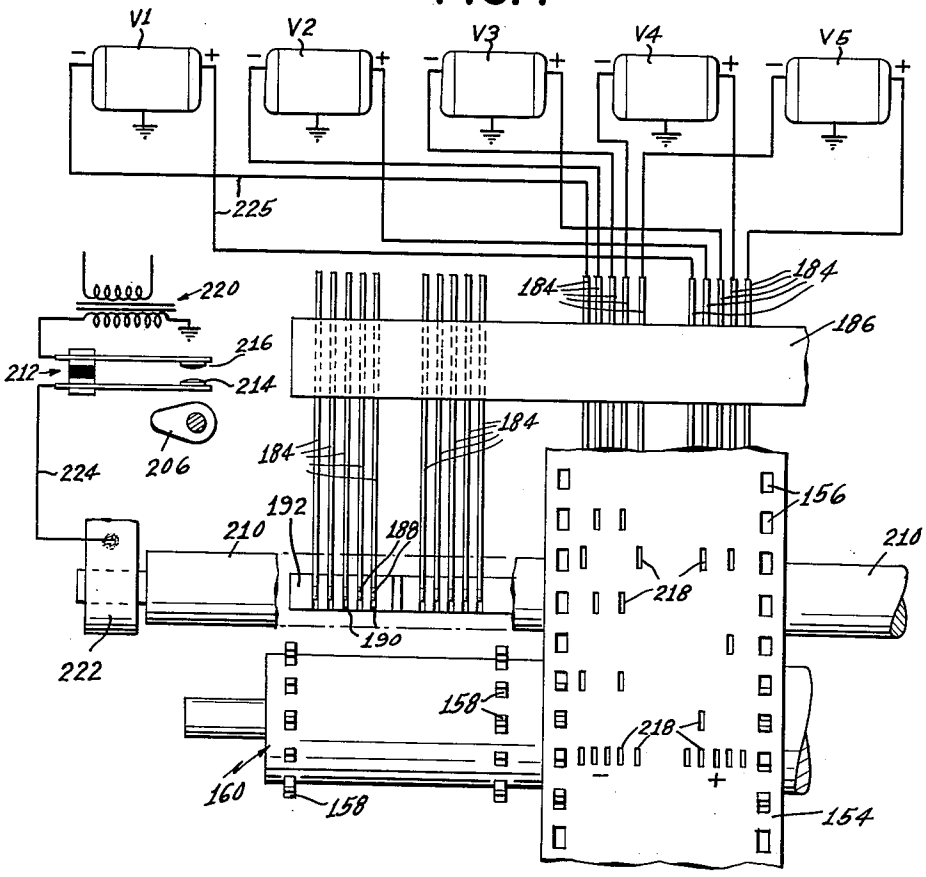
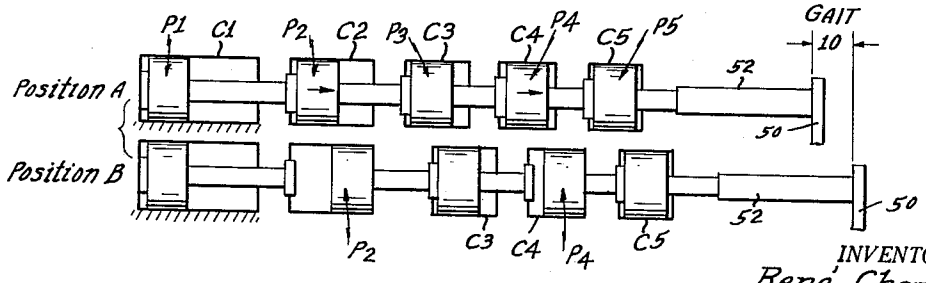


FIG. 8



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United States Patent Office 3,006,170 Patented Oct. 31, 1961

3,006,170

SELECTIVE POSITIONING SYSTEM

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Filed July 17, 1958, Ser. No. 749,174
12 Claims. (Cl. 66—86)

This invention relates to knitting machines, more particularly, this invention relates to a positioning system for yarn guide bars in a warp knitting machine.

Warp knitting machines have yarn guide bars wherein the control and movement of the yarn guide bars are accomplished by a system of connected links attached to form a pattern chain. Mounted on the warp knitting machine proximate to the pattern chain there is usually provided a guide block in which are slidably mounted a series of slides carrying at their outer ends friction rollers which are adapted to engage the cam surfaces of the links comprising the pattern chain so that the pattern chain will impart the required movement to the slides. The slides are adapted to engage at their inner ends the yarn guide bars thereby imparting the required movement to the yarn guide bars. Spring means are usually provided to return the yarn guide bars to their original positions. Since the yarn guide bars only bear up against the slides mounted in the guide block the yarn guide bars are also able to oscillate thereby providing the required reciprocating and oscillating movement to warp a thread about a needle. The needles are mounted on a needle bar which is mounted for vertical up and down movements which movements are synchronized with the movements of the yarn guide bar. Each yarn guide bar carries a plurality of yarn guides, the usual practice being to provide 18 guides per inch. There are a corresponding number of needles provided per inch along the needle bar. The distance between each needle or yarn guide is known as a gait and is equal to .055 inch.

Because of the nature of the pattern chain the varying height between successive links has been limited to a distance equal to about ten needles. A larger distance in height between successive links often cause the friction rollers of the slides to be caught by the next link and the roller is unable to move onto the link.

Each link is provided with its own individual cam surface and includes a slight incline at the forward part of the link to assist the roller to approach the cam surface of the link. Wearing of the cam surface and the incline varies the position at which the roller will impart movement to the yarn guide bar. In addition, the amount of incline in each link should vary depending upon the size of the preceding link so that often a link which has the proper incline for one pattern chain will not necessarily be appropriate for the next link arrangement in the next pattern chain. Because of this, often a particular link cannot be used over again or requires regrinding resulting in considerable expense.

The individual links are assembled by hand according to a pattern prepared by the fabric designer. The more complicated the pattern the more links are required and the longer the chain will be. This hand operation required to assemble pattern chains is very time consuming and expensive. Also, since the links are assembled to each other at the bottom portion of the link, thereby providing the only support for the link, high links tend to be unstable and do not remain perfectly vertical.

As mentioned above each of the yarn guide bars is under heavy spring tension so that the bar will return to its normal position when not being actuated by a link. Accordingly, when the yarn guide bars are required to be adjusted or moved from their position because of

breakage of yarn and other reasons, it usually is required that the spring force be overcome.

Accordingly, one of the objects of the present invention is to provide a yarn guide bar positioning system wherein the above difficulties are eliminated.

Another object of the invention is to provide a positioning device whereby the length of movement of a member between successive positions is not limited to any set amount.

Another object of the invention is to provide a positioning device for a yarn guide bar which requires no pattern chain.

A still further object of the invention is to provide a positioning device wherein a pattern is recorded on a tape.

A still further object of the invention is to provide a positioning device wherein movements of a member into various positions is effected through movements of pistons within cylinders.

Another object of the invention is to provide a yarn guide positioning device wherein the yarn guide bar is free to move when in an inoperative condition.

Another object of the invention is to provide a positioning device for a member which is controlled by electrical means.

The above and other objects, features and advantages of this invention will be fully understood from the following description considered in connection with the accompanying illustrative drawings of the presently preferred embodiment of this invention.

In the drawings:

FIG. 1 is a diagrammatic view illustrating the preferred embodiment of the invention;

FIF. 2 is a vertical view partly in section taken on line 2—2 of FIGURE 1;

FIG. 3 is a vertical view partly in section taken on line 3—3 of FIGURE 2;

FIG. 4 is a sectional view taken on line 4—4 of FIGURE 2;

FIG. 5 is a view partly in section of a valve for actuating a piston of a cylinder;

FIG. 6 is a view partly in section taken in the direction of line 6—6 of FIGURE 1;

FIG. 7 is a diagrammatic view illustrating the electrical control circuit and arrangement for actuating the various pistons and cylinders; and

FIG. 8 is a diagrammatic view illustrating the various positions of the pistons and cylinders after a yarn guide bar has been moved a distance of 10 gaits.

Referring now to the drawings in detail there is shown a frame **10** of a warp knitting machine which supports a shaft **12** for rocking or oscillating motion, one end of shaft **12** being pivotally supported by depending arm **14** and the other end of shaft **12** being supported at the other end of the knitting machine by suitable means which are not illustrated. Rocking motion is imparted to shaft **12** through a cam and linkage arrangement. Main drive shaft **16** of the knitting machine drives grooved cam **18** which is mounted on shaft **16**. Roller **20**, which is freely mounted on arm **22**, rides in cam grooves **23** of cam **18** thereby imparting a rocking motion to arm **22**. The rocking motion of arm **22** is transmitted to link **24** which is mounted on shaft **26** which also mounts the other end of arm **22**. Shaft **26** is suitably supported by means not shown. The rocking motion of link **24** is imparted to shaft **12** through links **28** and **30**. Mounted to and depending from shaft **12** are brackets **32** to which are fixedly mounted supporting plate **34** which carries power cylinders **36** depending therefrom. Mounted to shaft **12** is a support plate **38** which carries aligning rods **40** extending therefrom. Slidably mounted on aligning rods **40**

are collars 42 which carry rods 44 which are fastened to projections 46 that extend upwardly from yarn guide bars 48. Mounted at the end of yarn guide bars 48 are upwardly extending projections 50 to which are mounted one of the ends of rods 52. The other ends of rods 52 are attached to the piston of the last cylinders of each group as best shown in FIGURE 2. Power cylinders 36 move the yarn guides horizontally into predetermined positions as will be discussed more fully hereinafter. From the foregoing it will be apparent that the yarn guide bars and the power cylinders will oscillate or rock together with motion of shaft 12.

Suitably supported in frame 10 is rod 54 which carries and supports needle bar 56. Vertical up and down motion is imparted to needle bar 56 through links 58, 60 and 62 driven by the rocking motion of shaft 26 as previously described. It will be apparent from the foregoing that the oscillating or rocking motion imparted to the yarn guides 64 carried by the yarn guide bars 48 and the horizontal reciprocating motion imparted to the yarn guides by the power cylinders 36, hereinafter discussed in detail, plus the vertical up and down motion of the needles 66 carried by the needle bar 56 will provide the necessary movements for warping the yarn about the needles.

Supported by frame 10 of the knitting machine is bracket 68 to which is mounted valves 70 which actuate the pistons of power cylinders 36. Fluid pressure is furnished to valves 70 through conduit 72 which supplies manifold 74. It will be understod that the fluid pressure may be pneumatic or hydraulic, although pneumatic is preferred. It will be noted that power cylinders 36 comprise three rows or groups of cylinders, each group comprising the positioning means for a yarn guide bar. Depending upon how many yarn guide bars are employed in a particular knitting machine will determine the number of rows of cylinders 36, there being one row or group of cylinders for each yarn guide bar. Similarly, valve 70 comprise three rows or groups of valves each group comprising the actuating means for a group of cylinders. Each cylinder is provided with a valve.

Referring now to FIGURES 2 and 3 there is disclosed a group of cylinders depending from supporting plate 34. There are five cylinders indicated in FIGURE 2, though it will be understood that any number of cylinders may be employed. The cylinders have been designated C1, C2, C3, C4 and C5, respectively. Cylinder C1 is normally fixedly mounted to supporting plate 34 through screws 76 which upon tightening will cause cylinder C1 to bear up against the underside 78 of supporting plate 34 at shoulder 80. When screws 76 are loosened, the position of the entire row or group of cylinders C1 through C5 may be adjusted along the supporting plate by adjusting screw 82, bracket 84 being adapted to slide, when being adjusted, in slot 86 in supporting plate 34.

The succeeding cylinders, namely C2, C3, C4 and C5 are mounted for sliding movement in ways 88 in the under part of supporting plate 34, as best seen in FIGURE 4. Each of succeeding cylinders C2–C5 has an extending member 90 mounted thereto which is adapted to be mounted in ways 88.

Each of the respective pistons P1 through P4 of cylinders C1 through C4 is connected to the next succeeding cylinder by a plug 92, pins 94 connecting each of the ends of the piston rods 93 to the plugs 92. The last piston P5 is mounted to one end of the rod 52 which is mounted at its other end to a yarn guide bar 48. Plugs 92 are adjustably mounted in the forward ends 96 of each of the cylinders. Plugs 92 extend into chambers 98 of each of the cylinders, projecting outwardly from forward cylinder wall 100 to provide a bearing surface and stop for the piston head 102 of each of the cylinders. Adjustment of plugs 92 by screwing the plug into or out of the forward end 96 of the cylinder adjusts the position of the piston within the cylinder. After adjustment, plugs 92 are locked into position by locking pins 97. Passageways 104 and 106 are provided in the forward end 96 and the rear end 108, respectively, of each of the cylinders. These passageways provide conduits for conveying fluid pressure to either side of the piston heads 102 as will be discussed more fully hereinafter.

It will be noted that each cylinder has a different length so that the length of travel of each of the pistons will differ from each other. The various lengths of the cylinders are schematically indicated in FIGURE 8. Cylinder C1 is the longest cylinder and is of such a length that the length of travel of its piston P1 is 16 gaits. Cylinder C2 is of such a length that its piston P2 will travel a distance of eight gaits. Piston P3 of cylinder C3 travels a distance of four gaits. Piston P4 of cylinder C4 travels a distance of two gaits and piston P5 of cylinder C5 travels a distance of one gait. It will be understood that the travel of each piston and the length of each cylinder need not be as indicated but may be any distance or length desired. Also, the number of cylinders need not be as indicated but may be any desired number. Position A shows the piston and cylinders in the position of FIGURE 2. If it is desired to move the yarn guide bar a distance of ten gaits cylinders C2 and C4 are actuated and the cylinders and pistons will take the positions indicated in position B. It will be noted that piston P2 has moved to the right a distance of eight gaits thereby causing the succeeding cylinders namely C3, C4 and C5 to also move a distance of eight gaits since each piston is mounted to its succeeding cylinder as discussed above. In addition piston P4 has moved to the right a distance of two gaits thereby causing its succeeding cylinder, namely C5, to also move a distance of two gaits, the total movement of piston P5 adding up to a distance of ten gaits. From the foregoing it will be seen that because each piston is attached to its succeeding cylinder movement of any piston will cause the succeeding cylinders to move an equal amount. If it is desired to move the yarn guide bar a distance of seventeen gaits, cylinders C1 and C5 are actuated; piston P1 will move to the right a distance of 16 gaits thereby carrying its succeeding cylinders namely C2 through C5 a corresponding and equal distance of sixteen gaits. Actuation of cylinder C5 will cause its piston P5 to move to the right a distance of one gait thereby making the total movement a distance of seventeen gaits. If, after having moved the yarn guide bar to the right a distance of seventeen gaits, it is desired to position the yarn guide bar to the right a distance of ten gaits from the initial position it will be necessary to move pistons P1 and P5 to the left thereby returning them to their normal position and then actuate piston P2 and P4, the total movement of these pistons being ten gaits. However, it is not always necessary to return the pistons to their initial or starting positions. For example in position B, shown in FIGURE 8, the yarn guide bar has been moved to the right a distance of ten gaits. If it is desired that the next position of the yarn guide bar be to the right of the initial position a distance of 8 gaits it would only be necessary to move piston P4 back to its normal position at the extreme left in its cylinder. By moving piston P4 back the yarn guide bar will move to the left a distance of two gaits and the total movement now will be a distance of eight gaits to the right. Once actuated, a piston may remain in its actuated position or may be moved back to the left to its normal position depending upon the final total movement and position desired for the yarn guide bar. With the number and lengths of cylinders shown a total of 31 different positions are possible for the yarn guide bar.

Fluid pressure is conducted through conduit 72 into manifold 74 and then into inlets 110 in each valve. From each valve fluid is conducted through conduits 112 and 114 leading to passageways 104 and 106, respectively, in each of the cylinders. Each of the valves V is identical to the other and only one valve will be described. The

valve illustrated in FIG. 5 is a Bellows Electroaire Valve manufactured by The Bellows Company of Akron, Ohio. Valves other than the one illustrated may be used. The valve has a body 116 which has a cylindrical chamber 118 in which a piston 120 is slidably mounted. Mounted at both ends of cylindrical chamber 118 are solenoids 122, each having a communicating opening 124 and a passageway 126 in its face 128. Each solenoid opens and closes a valve 130 which covers passageway 132 in body 116 of the valve. Piston 120 has a ball valve 134 mounted therein for covering ports 136 and 138 respectively as will be described more fully hereinafter. Fluid from inlet 110 passes around circumferential groove 139 in piston 120 into passageway 142 then to ports 144 or 146 which are in fluid communication with conduits 112 or 114 respectively, depending upon the position of D-shaped slide valve 148 which is carried by piston 120 via spring 149. Exhaust passageways 150 are provided in the valve body which lead to atmosphere. Electric power is conducted to each solenoid 122 through lead 152. In the valve shown in FIGURE 5, piston 120 has moved to the extreme right thereby permitting fluid to be conducted from port 144 through conduit 112 to the left side of the piston head as viewed in FIGURE 2. In this position of the valve the right solenoid 122 was actuated thereby causing right valve 130 to uncover right passageway 132. If it is desired to move the valve to the left so that port 144 may be covered and port 146 uncovered whereby fluid pressure will be delivered to the right side of the piston through conduit 114, the right valve 130 will be actuated thereby closing right passageway 132. Left valve 130 will be actuated so that left passageway 132 will be open permitting fluid to pass out through left passageway 132, fluid passing from inlet 110, through passageway 140, port 136 and communicating opening 124. This passage of fluid through left passageway 132 will cause a reduction in pressure to occur in the left half of chamber 118 causing ball valve 134 to move to the left closing off port 136 and opening port 138. Fluid will now flow into the right half of cylindrical chamber 118 via passageway 140, port 138, and passageway 126 in face 128 of the right solenoid. The build-up of pressure in the right half of cylindrical chamber 118 will cause the piston 120 to move to the left carrying D-shaped slide valve 148 to the left, opening port 146 and closing port 144. It will be noted that fluid is continuously supplied to the valve while it is in either position and that actuation of either solenoid is required to move the valve into and out of any position. It will be seen that actuation of the right solenoid moves the piston to the right and actuation of the left solenoid moves the piston to the left.

Means are provided whereby the valves will be actuated according to a predetermined pattern so that yarn guide bars 48 are positioned in accordance with this predetermined pattern. With particular reference to FIGURES 1, 6 and 7 there is disclosed pattern tapes 154, each tape having recorded therein a predetermined pattern. FIGURE 1 discloses three tapes, it being understood that each tape controls the actuation of one group or row of valves which in turn control the movements of one group or row of pistons and cylinders. For each yarn guide bar there is provided one pattern tape. Each tape has a series of sprocket holes 156 along its outer edges which engage sprocket teeth 158 on a sprocket roller 160. It will be noted that sprocket roller 160 has three sets of sprocket teeth mounted thereon each set driving one tape. Sprocket roller 160 is driven by chain 162, through follower sprocket wheel 163, the driving sprocket wheel 164 being mounted on the shaft 165 which also mounts follower 166 of Geneva mechanism 168. Wheel 170 carrying driving pin 172 is the driver for the Geneva mechanism. Driver 170 is mounted on shaft 174 which is driven by chain 176 from main drive shaft 16 through sprocket wheels 177 and 178. Sprocket roller 160 which drives tapes 154 has a continuous intermittent motion as a result of employing the Geneva mechanism 168 permitting the tapes to be indexed into position periodically and to provide dwell periods for the tape. Tapes 154 are also supported on shaft 165 which carries the follower 166 of the Geneva mechanism and driving sprocket wheel 164. Non-conducting roller 180 suitably supported by means not shown prevents the tapes 154 from coming off the sprocket teeth 158 on the roller 160.

Mounted below the tapes 154 is a supporting member 182 which is pivotally mounted to a convenient supporting means such as shaft 208 which may be fixed to the frame of the knitting machine. Suitably mounted to member 182 are a plurality of contact fingers 184, for each tape there being a set of contact fingers, as may be clearly seen in FIG. 7. A set of contact fingers includes two groups of five contact fingers each. Contact fingers 184 are suitably insulated from supporting member 182 by insulating member 186 on the upper part of supporting member 182. The contacting parts 188 of contacting fingers 184 are supported in insulated slits 190 in supporting member 192. It will be understood that supporting member 192 may be mounted to the frame of the knitting machine if desired. Projecting from member 192 is a pin 194 which supports one end of compression spring 196. Extending from the lower part of supporting member 182 is a pin 198 which supports the other end of compression spring 196. Extending from the other side of supporting member 182 is a rod 200 having an enlarged head 202 thereon. Mounted on shaft 174 are two cams 204 and 206. Engagement of cam 204 with enlarged head 202 of rod 200 will cause supporting member 182 to pivot on shaft 208 causing finger contacts 184 to engage conducting roller 210. Conducting roller 210 is driven by sprocket chain 162 through sprocket wheel 211 and is supported by member 222 (see FIGURE 7). Roller 210 is insulated from sprocket wheel 211 by suitable means. Cam 206 is provided to actuate switch 212 to close contacts 214 and 216 and complete the electrical circuit to the valves whih is more fully discussed hereinafter.

With particular reference to FIGURE 7, there is disclosed the electric circuitry for valves V1 through V5. It will be noted that there is one set of contact fingers 184 for each group of valves and each set of contact fingers include two groups of five contact fingers each. One set of contact fingers has been shown as positive, the other set of contact fingers being shown as negative, it being understood that these designations indicate a direction, plus being to the right and minus being to the left. Tapes 154 are made from a non-conducting plastic material and have a predetermined pattern recorded thereon by punching holes 218 at predetermined positions in the tape. When finger contacts 184 are actuated by engagement of cam 204 with rod 200, contacting parts 188 of the contact fingers will move up and engage conducting roller 210, wherever a hol 218 has been punched previously in the tape, lifting roller 210 slightly, thus completing a circuit and actuating the proper valve. Power is provided from a transformer 220 through switch 212, lead 224, support 222, conducting roller 210, finger contacts 184 and then through leads 225 to the valves. In order to prevent sparking between the contact fingers 184 and the conducting roller 210 the circuit is operated in sequence. First, the tape is indexed into position upon movement of the Geneva mechanism 168. Next, the cam 204 will cause contact fingers 184 to move into position abutting against conducting roller 210. Finally the circuit will be closed by engagement of cam 206 with switch 212 causing contacts 214 and 216 to come together. After the circuit is closed and power has been delivered to the valve thereby actuating the valve and causing the resultant movement of the piston as discussed above, switch 212 will open first thereby open-

ing the circuit. Next, cam **204** will move away from enlarged head **202** of rod **200** causing supporting member **182** to return to its normal position under the action of spring **196** and contact fingers **184** will return to a horizontal position away from conducting roller **210**. Finally the tape **154** will be indexed into its next position by Geneva mechanism **168**.

From the foregoing it will be seen that there has been provided a positioning system for a yarn guide bar or a member wherein a plurality of cylinders having pistons mounted therein, each piston being connected to the next succeeding cylinder, imparts movement to the yarn guide bar or member in accordance with a predetermined pattern. The difficulties discussed above with respect to the use of pattern chains in warp knitting machines to actuate and control movements of a yarn guide bar have been eliminated.

While I have shown and described the presently preferred embodiment of the invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described and that in the illustrated embodiment certain changes in the details of construction and in the form and arrangement of parts may be made without departing from the underlying idea of the invention. Accordingly, I do not wish to be limited to the precise construction which is shown or described herein, except as may be required by the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is:

1. Means for positioning a member in a predetermined pattern, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means connecting said member to the last of said pistons, and control means for actuating any one of said pistons independently of the others for positioning said member in said predetermined pattern.

2. Means for positioning a member in a predetermined pattern, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means connecting said member to the last of said pistons, and control means for actuating at least one of said pistons for positioning said member in accordance with said predetermined pattern comprising valve means for controlling movements of an associated piston, tape means having said predetermined pattern recorded thereon, and means responsive to said recorded pattern for actuating said valve means.

3. Means for positioning a member in a predetermined pattern, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means connecting said member to the last of said pistons, and control means for actuating at least one of said pistons for positioning said member in accordance with said predetermined pattern comprising valve means for controlling movements of an associated piston, tape means having said predetermined pattern recorded thereon, and means responsive to said recorded pattern for actuating said valve means comprising electric circuit means having a power source and including conducting means mounted above said tape, contacting finger means mounted below said tape, and leads connecting said contacting finger means to said valves whereby upon contact of one of said finger means with said conducting means a valve is actuated.

4. A yarn guide bar positioning system for a knitting machine, comprising a plurality of aligned cylinders having pistons mounted therein, means connecting each of said pistons to the next succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, a yarn guide bar operatively connected to one of said pistons, and control means for actuating any one of said pistons independently of the others for positioning said yarn guide bar in a predetermined pattern.

5. A yarn guide bar positioning system for a knitting machine, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means connecting said yarn guide bar to the last of said pistons, and control means for actuating any one of said pistons independently of the others for positioning said guide bar in a predetermined pattern.

6. A yarn guide bar positioning device for a knitting machine, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means connecting said yarn guide bar to the last of said pistons, and control means for actuating at least one of said pistons for positioning said guide bar in a predetermined pattern comprising valve means for controlling movements of an associated piston, tape means having said predetermined pattern recorded thereon, and means responsive to said recorded pattern for actuating said valve means.

7. In a warp knitting machine wherein a plurality of yarn guide bars are mounted for oscillating and reciprocating movement; means for positioning said yarn guide bars in a plurality of positions according to a predetermined pattern, comprising groups of cylinders, each group comprising a plurality of aligned cylinders having pistons mounted therein, means connecting each of said pistons to the next succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means mounting each of said yarn guide bars to one of said pistons in each one of said groups. control means for actuating said pistons in response to said predetermined pattern comprising valve means for controlling movement of an associated piston, a pattern tape, and means responsive to positions recorded on said pattern tape for actuating said valve means.

8. In a warp knitting machine wherein a plurality of yarn guide bars are mounted for oscillating and reciprocating movement; means for positioning said yarn guide bars in a plurality of positions according to a predetermined pattern, comprising groups of cylinders, each group comprising a plurality of aligned cylinders having pistons mounted therein, means connecting each of said pistons to the next succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means mounting each of said yarn guide bars to one of said pistons in each one of said groups, control means for actuating said pistons in response to said pre-

determined pattern comprising valve means for controlling movement of an associated piston, a pattern tape, and means responsive to positions recorded on said pattern tape for actuating said valve means, comprising electric circuit means having a power source and including conducting means mounted above said tape, contacting finger means mounted below said tape, and leads connecting said finger contact means to said valves whereby upon contact of one of said finger means with said conducting means a valve is actuated.

9. A yarn guide bar positioning device for a knitting machine, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, means connecting said yarn guide bar to the last of said pistons, and control means for actuating at least one of said pistons for positioning said guide bar in a predetermined pattern comprising valve means for controlling movements of an associated piston, tape means having said predetermined pattern recorded thereon, and means responsive to said recorded pattern for actuating said valve means comprising electric circuit means having a power source and including conducting means mounted above said tape, contacting finger means mounted below said tape, and leads connecting said finger contact means to said valves whereby upon contact of one of said finger means with said conducting means a valve is actuated.

10. In a warp knitting machine wherein a plurality of yarn guide bars are mounted for reciprocating movement; means for positioning said yarn guide bars in a plurality of positions according to a predetermined pattern, comprising a plurality of aligned cylinders having pistons mounted therein, means connecting each of said pistons to the next succeeding cylinder whereby movement of a piston imparts to the suceeding cylinders a corresponding movement, means mounting one of said yarn guide bars to one of said pistons, and control means for actuating said pistons in accordance with said predetermined pattern whereby said yarn guide bar is positioned.

11. In a warp knitting machine wherein a plurality of yarn guide bars are mounted for reciprocating movement; means for positioning said yarn guide bars in a plurality of positions according to a predetermined pattern, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, valve means for controlling movements of an associated piston, a pattern tape, and means responsive to positions recorded on said pattern tape for actuating said valve means.

12. In a warp knitting machine wherein a plurality of yarn guide bars are mounted for reciprocating movement; means for positioning said yarn guide bars in a plurality of positions according to a predetermined pattern, comprising a plurality of axially aligned cylinders having pistons mounted therein, support means for said cylinders, means fixing the first of said cylinders to said support means, means mounting the remainder of said cylinders for sliding movement on said support means, means connecting each of said pistons to a succeeding cylinder whereby movement of a piston imparts to the succeeding cylinders a corresponding movement, valve means for controlling movements of an associated piston, a pattern tape, and means responsive to positions recorded on said pattern tape for actuating said valve means comprising electric circuit means having a power source and including conducting means mounted above said tape, contacting finger means mounted below said tape, and leads connecting said finger contact means to said valves whereby upon contact of one of said finger means with said conducting means a valve is actuated.

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2,444,894	Miller	July 6, 1948
2,688,860	Lambach	Sept. 14, 1954
2,699,757	Tornkuist et al.	Jan. 18, 1955