July 31, 1956 S. J. HADDAD 2,756,575

PATTERN JACK CONTROL MECHANISM AND METHOD

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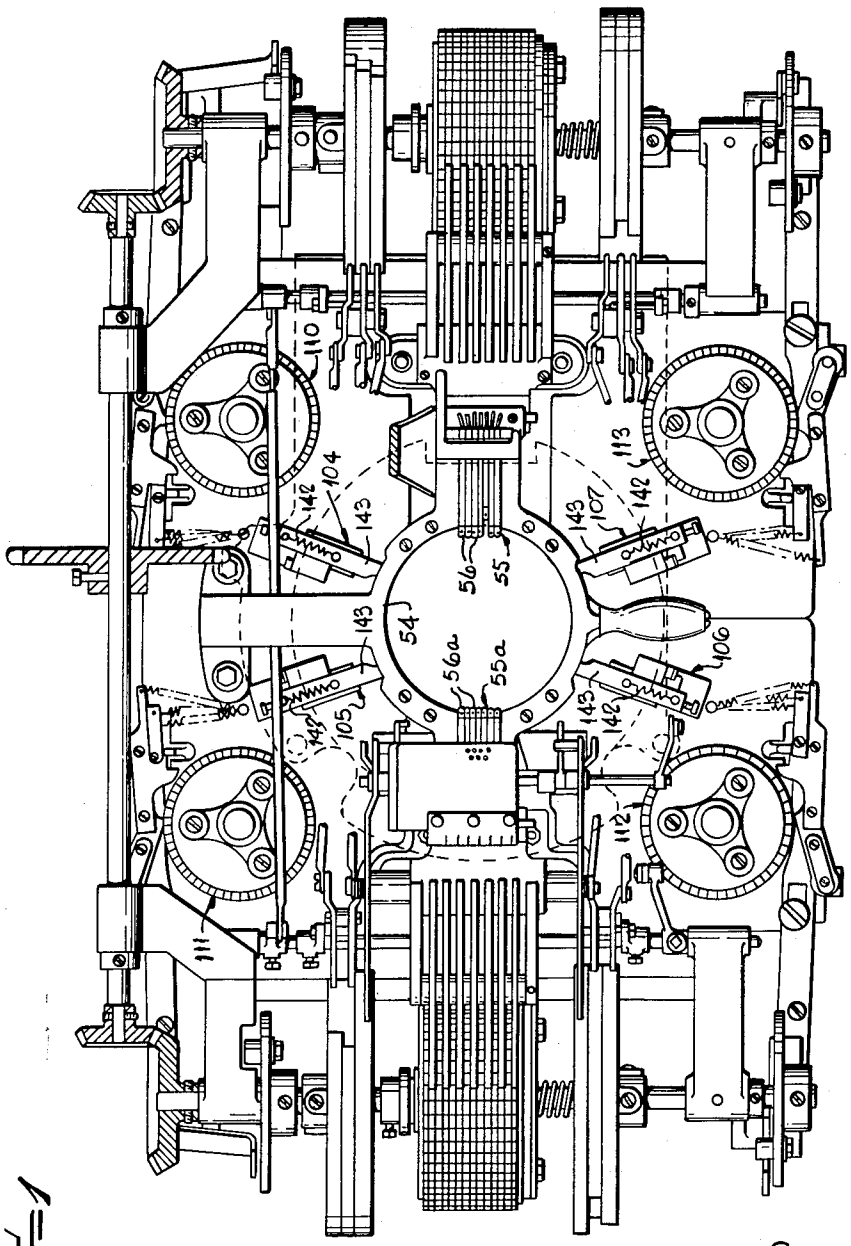


FIG-1

INVENTOR:
SALOMÃO J. HADDAD.

BY Eaton + Bell

ATTORNEYS

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PATTERN JACK CONTROL MECHANISM AND METHOD

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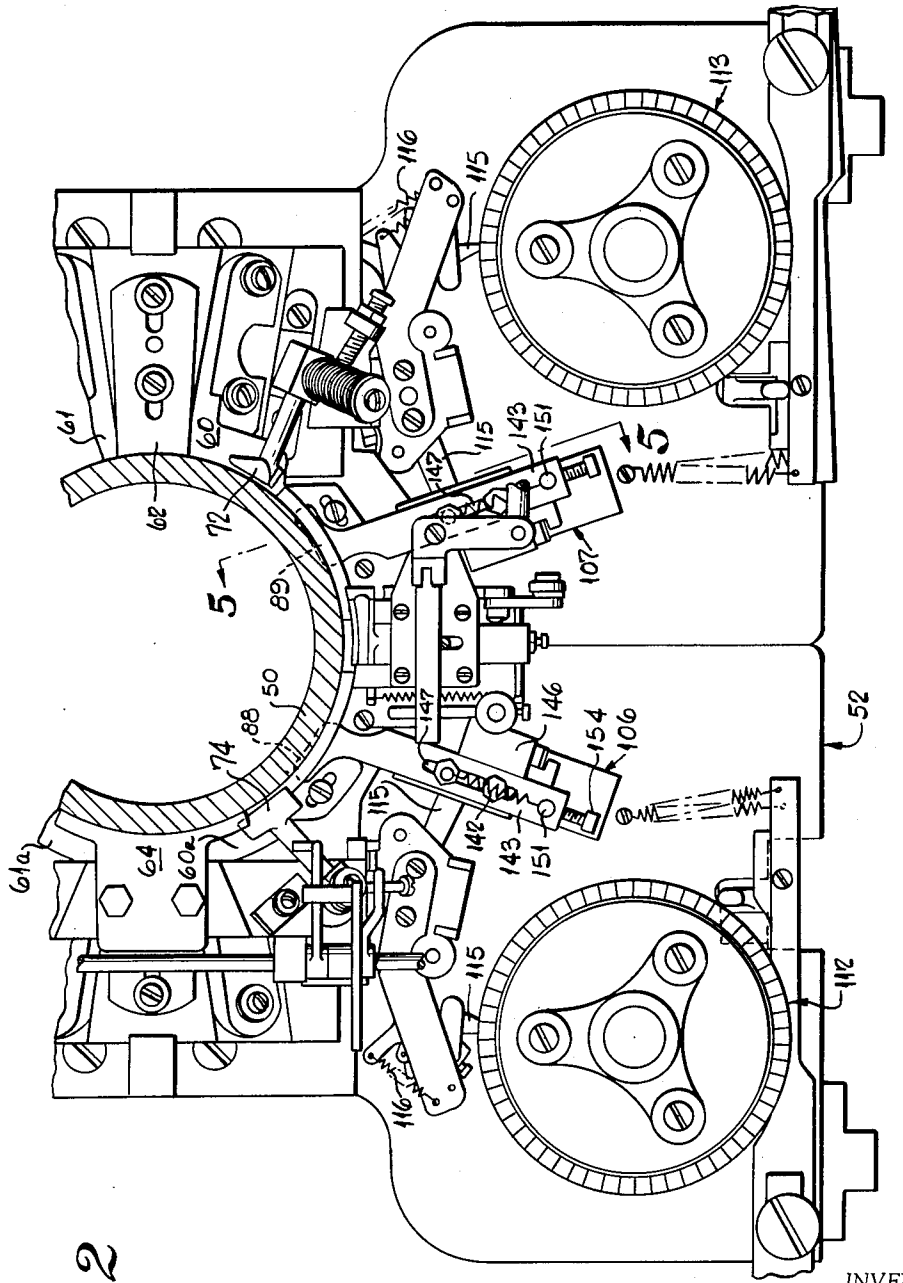


Fig. 2

INVENTOR:
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PATTERN JACK CONTROL MECHANISM AND METHOD

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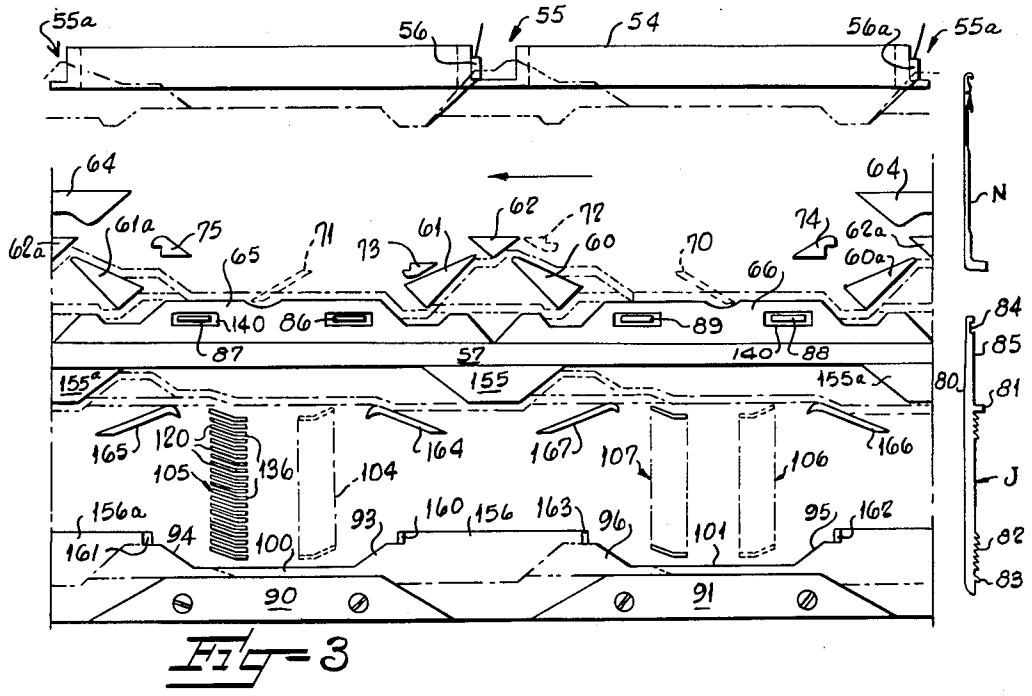


Fig-3

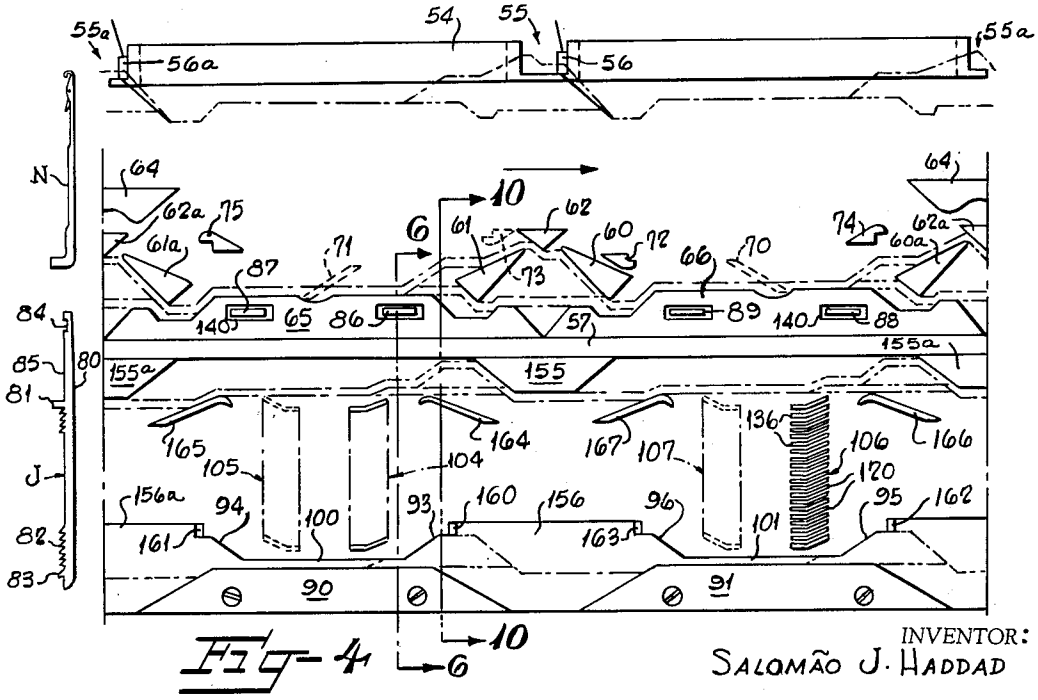


Fig-4

INVENTOR:
SALOMÃO J. HADDAD

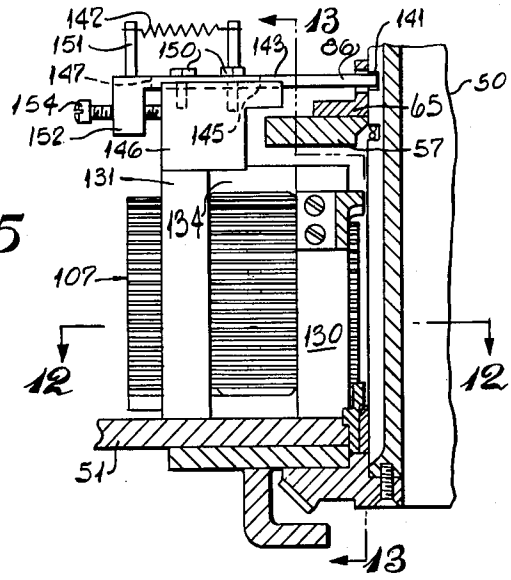
BY Eaton + Bell

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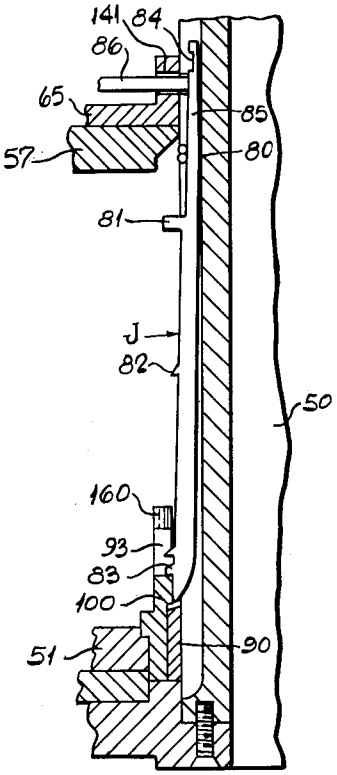
July 31, 1956 S. J. HADDAD 2,756,575

PATTERN JACK CONTROL MECHANISM AND METHOD

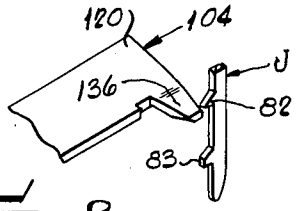
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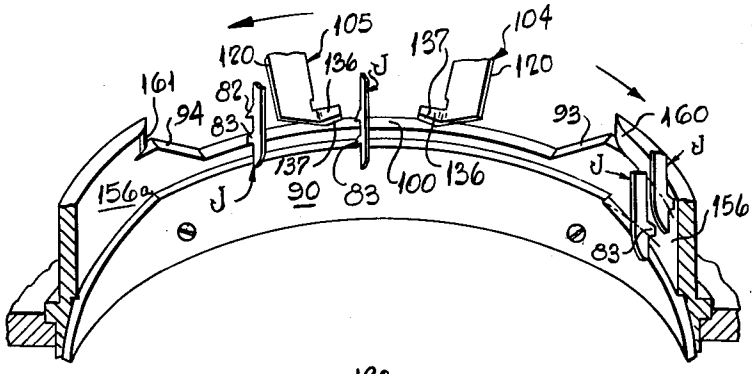
FIG—5



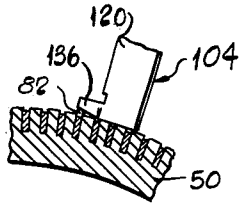
FIG—6



FIG—8



FIG—7



FIG—9

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PATTERN JACK CONTROL MECHANISM AND METHOD

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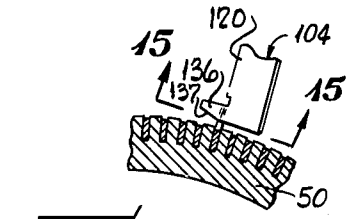


FIG-14

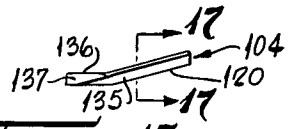


FIG-15

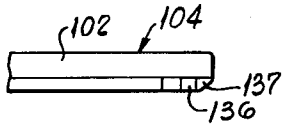


FIG-16

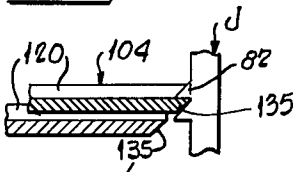


FIG-17

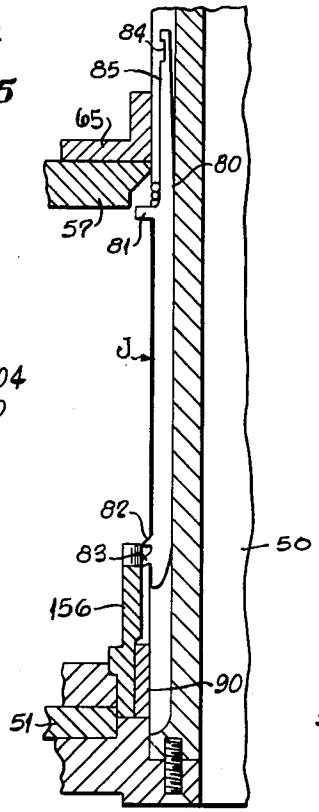


FIG-10

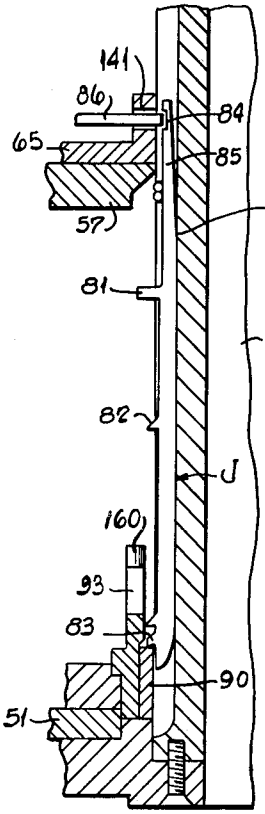


FIG-11

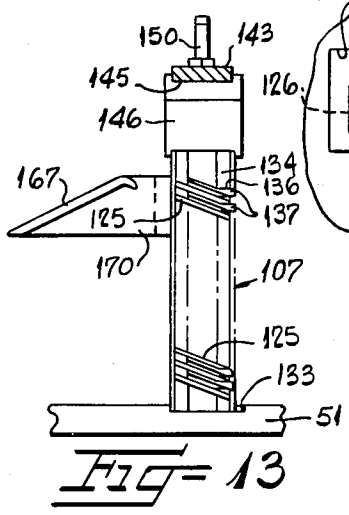


FIG-13

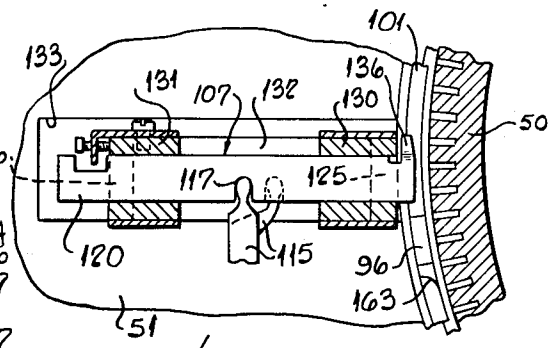


FIG-12

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July 31, 1956 S. J. HADDAD 2,756,575

PATTERN JACK CONTROL MECHANISM AND METHOD

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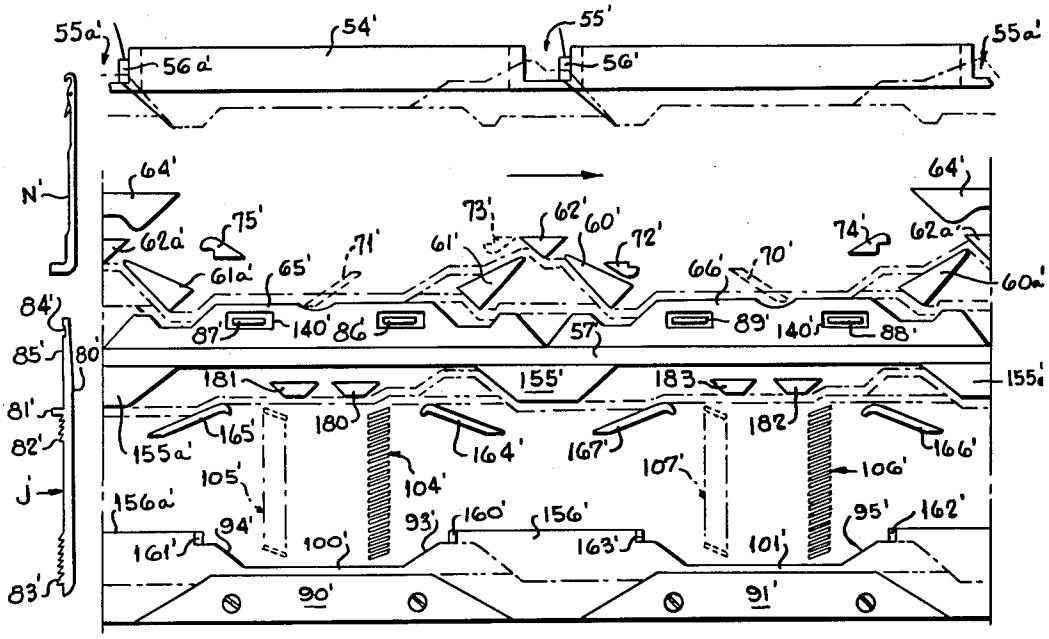


Fig-18

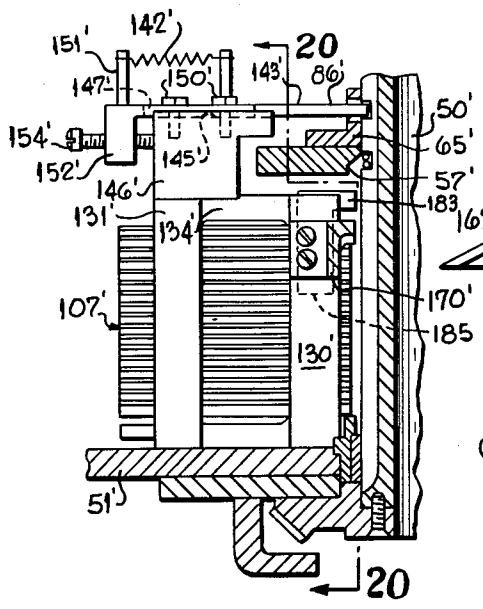


Fig-19

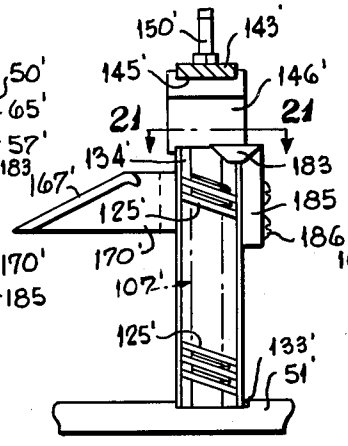


Fig-20

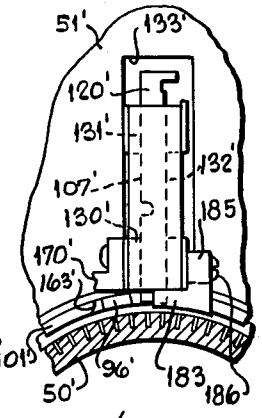


Fig-21

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BY Eaton & Bell

ATTORNEYS

United States Patent Office 2,756,575 Patented July 31, 1956

2,756,575

PATTERN JACK CONTROL MECHANISM AND METHOD

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Application July 21, 1955, Serial No. 523,419

16 Claims. (Cl. 66—43)

This invention relates to circular independent needle knitting machines and more especially to improvements in pattern jacks and control means therefor facilitating increased speed of the knitting instrumentalities, particularly knitting instrumentalities of machines of the character disclosed in U. S. Patent No. 2,217,022, dated October 8, 1940, and issued to R. H. Lawson et al. Such machines are known as Model SCP Knitting Machines, manufactured by Hemphill Company, Central Falls, Rhode Island.

It has been necessary, heretofore, to operate the knitting instrumentalities of machines of the character described at a relatively slow speed due to the fact that relatively rapid movement of the pattern jacks of such machines, at times, cause one or more of the jacks to bounce or jump off of certain cam surfaces supporting the same, thereby raising some of the butts thereon to where they would either engage the ends of succeeding selector plungers or the ends of succeeding cams thereby breaking certain butts on the pattern jacks or damaging the selector plungers or cams whose ends were engaged thereby.

It is an object of this invention to overcome such difficulties by utilizing novel rocking pattern jacks and selector plungers for controlling the same so that, as successive jacks are raised by conventional primary raise cams engaging the lowermost master butts thereon, the master butts on the pattern jacks are restrained from accidentally engaging subsequent jack actuating or secondary raise cams; that is, when jacks are not selected by selector plungers, the lower master butts thereon are maintained inward and pass inwardly of the secondary jack elevating cams disposed subsequent to each set of selector plungers.

On the other hand, upon any selector plungers being projected inwardly into the path of pattern butts on any pattern jacks, they elevate the corresponding jacks slightly to an intermediate position and a push-out cam then engages the upper portion of each jack so selected to swing the lower portion thereof outwardly to where the lower master butt thereon will ride up the secondary jack raise cam.

Also, novel selector plungers are provided whose inner working ends are each provided with a lead tongue which extends horizontally from the inclined body of the plunger and is provided with an angular inner surface thereon so arranged that, when a pattern butt on any jack is not properly alined with a corresponding plunger, the latter butt will engage the angular inner surface of the plunger to force the plunger outwardly so the pattern butt will pass the plunger without colliding with the lower edge of the plunger.

Instead of providing the selector plungers with said lead tongues, it is another object of this invention to provide a safety leveling cam for engaging an upper auxiliary master butt on each successive pattern jack at a point immediately in advance of each series of conventional selector plungers. Each safety leveling cam is spaced above the upper surface of the corresponding primary jack raise cam a distance substantially equal to the distance

from the lower surface of the lower master butt to the upper surface of the auxiliary butt of each jack. Thus, any jacks which may jump as they reach the crest of the primary raise cam will be returned to the proper level by the safety cam. This insures accurate alinement of any pattern butts with corresponding selector plungers.

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—

Figure 1 is a plan view of the knitting machine to which the novel jacks and jack control means are applied;

Figure 2 is an enlarged view of the lower central portion of Figure 1 but taken on a lower level than Figure 1 to more clearly disclose the improved selector plungers;

Figure 3 is a diagrammatic view showing the needle cams, stationary jack cams, the narrowing and widening picks, the yarn feeding means and the selector plungers, and particularly illustrating the improved jack controlling cams and showing various paths of needles and jacks during movement thereof from right to left or counter-clockwise movement of the needle cylinder;

Figure 4 is a view similar to Figure 3 but showing various paths of the jacks and needles with movement thereof from left to right or in a clockwise direction;

Figure 5 is a fragmentary vertical sectional view taken substantially along line 5—5 in Figure 2 showing one of the sets of selector plungers with all of the selector plungers in withdrawn or inactive position;

Figure 6 is a view taken substantially along line 6—6 in Figure 4, showing portions of the needle cylinder, the improved jack control cams and the needle cam supporting bed plate, with a jack occupying a position resulting from engagement of a selector plunger with a pattern butt;

Figure 7 is a somewhat schematic perspective view looking outwardly from the needle cylinder at the improved jack controlling cams at the rear of the machine;

Figure 8 is a fragmentary view showing how a mis-alined removable pattern butt on a jack engages the lead tongue of a corresponding selector plunger to move the same outwardly to prevent breakage of contacting parts;

Figure 9 is a fragmentary sectional plan view showing one of the improved selector plungers as its lead tongue is engaged by a mis-alined pattern butt on one of the jacks;

Figure 10 is a view similar to Figure 6 but taken substantially along line 10—10 in Figure 4 and showing the position occupied by a jack after it has been selected, elevated by the adjacent secondary jack raise cam and its lower end has subsequently been pushed inwardly toward the needle cylinder;

Figure 11 is another view similar to Figure 6 showing the position occupied by one of the jacks when a pattern butt thereon has not been engaged by a selector plunger;

Figure 12 is a fragmentary sectional plan view of portions of the selector mechanism taken substantially along line 12—12 in Figure 5;

Figure 13 is a fragmentary vertical sectional view taken substantially along line 13—13 in Figure 5, but omitting the needle and the jack cams and some other parts for purposes of clarity;

Figure 14 is a fragmentary sectional plan view similar to Figure 9 showing how a mis-alined pattern butt of one of the jacks moves the corresponding selector plunger outwardly;

Figure 15 is an enlarged detail view of the operating end of a selector plunger looking substantially along line 15—15 in Figure 14;

Figure 16 is a fragmentary view of the inner portion of one of the selector plungers looking at the left-hand side of Figure 15;

Figure 17 is a fragmentary view through a pair of the

selector plungers taken substantially along the line 17—17 in Figure 15 and also showing a pattern butt on a portion of a jack properly engaged with one of the selector plungers;

Figure 18 is a view similar to Figure 4 showing a modified form of the invention wherein conventional selector plungers are used and an improved jack safety leveling cam is provided for engaging the upper auxiliary butts on successive pattern jacks and for alining pattern butts on the jacks with the succeeding selector plungers;

Figure 19 is a view similar to Figure 5 showing how the improved safety leveling cam is mounted adjacent a corresponding series of selector plungers;

Figure 20 is a view looking at the right-hand side of Figure 19 substantially along line 20—20, with parts in section;

Figure 21 is a fragmentary plan view, partially in section, looking down substantially along line 21—21 in Figure 20.

Referring more specifically to the drawings, a circular knitting machine of the type disclosed in said Patent No. 2,217,022 is shown and, since the present invention is particularly concerned with improvements in the pattern jacks, the selector plungers and cams adjacent the selector plungers for controlling the improved pattern jacks, only a general description of other parts of the machine will be given and reference may be had to said Patent No. 2,217,022 for a complete description of conventional parts of the machine.

The knitting machine disclosed in the present drawings is of the type having a needle cylinder 50 which is supported for rotation in a base 51 which forms a part of the frame of the machine broadly designated at 52. The needle cylinder 50 is provided with the usual vertically extending slots in the periphery thereof which carry a plurality of conventional latch needles N (Figures 3 and 4) which cooperate in drawing stitches with the usual sinkers, not shown, in a sinker head and are controlled by suitable cams in the sinker cap, as fully disclosed in said patent.

The needle cylinder 50 is driven in a conventional manner to, at times, rotate continuously in one direction and to, at other times, reciprocate. The present machine is of the type for producing pattern effects by the so-called solid color method in which the patterned parts of hosiery made by the machine, as well as the heel and toe of such hosiery, are knitted by reciprocation of the needle cylinder and certain other parts, such as the ring top, ring toe and loopers rounds are knit as circular work, that is, while the needle cylinder 50 is rotated continuously in one direction.

The machine is provided with a latch ring 54 arranged to accommodate two diametrically opposed yarn feeding stations, broadly designated at 55 and 55*a*, which may be termed as main and auxiliary yarn feeding stations, respectively.

The usual yarn feed fingers 56, 56*a* are provided at the respective yarn feeding stations, 55, 55*a*. The needle cylinder 50 extends through a circular opening formed in a conventional needle cam plate or needle bed plate 57 which supports the conventional needle cams and other mechanism associated therewith. The needle cams may be identical to, and are shown as being identical to, the needle cams disclosed in Figures 96 and 97 of said patent with the exception that the needle raise cams disposed between adjacent sets of stitch cams are modified to accommodate rocking jack push-out cams as will be later described.

Disposed below the yarn feeding stations, 55, 55*a*, and carried by the needle cam plate or bed plate 57 are respective sets of stitch drawing cams. The main and auxiliary cam sets include respective pairs of stitch cams 60, 61 and 60*a*, 61*a* and respective top center cams 62, 62*a*. The auxiliary set of stitch drawing cams includes a wing cam 64 which is spaced closely above the center cam 62*a*. In diagrammatic views, Figures 3 and 4, the cams are cut at the center of the auxiliary station and, thus, opposite halves of such cams appear at the extreme end of the figures.

The usual needle raise cams are provided between the main and auxiliary sets of stitch cams, the needle raise cam at the back of the machine being indicated at 65 and the needle raise cam at the front of the machine being indicated at 66.

Conventional needle raising switch cams 70, 71 are provided in front and at the back of the machine. These switch cams 70, 71 are movable to and from positions to engage the butts of needles to where they will engage respective narrowing picks 72, 73 adjacent the stitch cams 60, 61. It will be noted that the auxiliary set of stitch cams is provided with a pair of widening picks 74, 75 disposed adjacent and above the respective stitch cams 60*a*, 61*a*. These widening picks 74, 75 cooperate with the respective narrowing picks 72, 73 for moving two needles down for every one that is picked up by the narrowing picks 72, 73 during widening in the heel and toe, as is fully disclosed in said patent.

The improved pattern jacks

Improved pattern jacks broadly designated at J (Figures 3, 4, 6, 7, 8, 10, 11 and 17) are mounted in the slots in the needle cylinder below the needles N. The pattern jacks J are similar to the conventional jacks disclosed in said patent and, as a matter of fact, jacks of the type shown in said patent may be modified into the form of the improved pattern jacks. However, conventional jacks move vertically only while the improved jacks are of the rocking type, the upper portion of each jack J being tapered at its inner end to form a rocking point 80 on a medial portion of each of the jacks J.

Each of the jacks J is provided with an auxiliary butt 81 below the level of the rocking point 80 and below the butt 81 each jack is provided with a plurality of saw-tooth removable pattern butts 82 which may be arranged according to a predetermined pattern such as shown in Figure 47 of said patent. The auxiliary butts 81 and removable butts 82 on the jacks J are of conventional configuration, however, a novel master butt 83 is provided on the lower portion of each jack J below the pattern buts 82 and is spaced upwardly from the lowermost end of each jack J.

This master butt 83 is novel in that it projects outwardly from the body of each jack J substantially the same distance as the pattern butts 82. The upper end of each pattern jack J has a recess or notch 84 in the outer edge thereof forming a shoulder 85 therebeneath. The notches 84 and shoulders 85 on the upper portions of the pattern jacks J are provided for cooperation with push-out cams 86, 87, 88, 89 to be later described, which push-out cams do not affect any jacks which are not selected, because of the notches 84 in the jacks J alining therewith (Figure 11). On the other hand, any selector jacks which are raised slightly by corresponding selector fingers or selector plungers, are raised so the shoulders 86 thereon engage the adjacent corresponding push-out cams which, in turn, rock the jacks J on their points 80 to move the lower portions thereof outwardly so the master butts on corresponding jacks will engage and be elevated by secondary jack raising cams, to be later described, to cause corresponding needles to take yarn in the hooks thereof prior to passage of the butts thereon through the succeeding stitch cams.

Pattern jack controls

The jack operating cams shown in the lower portions of Figures 3 and 4 are suitably supported on the machine base 51 and include two conventional primary jack raising cams 90, 91 which serve to aline the jacks for proper passage through the selector plungers. The primary jack raising cams 90, 91 are spaced below the needle raising cams 65, 66, respectively.

At the rear of the machine, two spaced secondary jack raising cams **93, 94** serve to engage the master butts **83** of any selected jacks and raise these jacks and their needles to where the needles will take yarn from the next succeeding yarn feeding station **55** or **55***a* as the case may be. At the front of the machine, another pair of secondary jack elevating cams **95, 96** is provided which also serve to raise any selected jacks to where the needles thereabove will take the yarn from the next succeeding yarn feeding station. Disposed between and below the respective pairs of cams **93, 94, 95** and **96** are respective jack restraining guide cams **100, 101** which are important novel elements of the present invention and serve, primarily, to prevent the lower ends of any selected jacks from swinging outwardly excessively since the portions of the jacks J below the master butts **83** then engage the inner surfaces of the corresponding restraining guide cams **100, 101** as shown in Figure 6. These restraining guide cams **100, 101** also insure that the master butts **83** of any selected jacks are maintained in proper alinement with the corresponding secondary jack raising cams **93, 94, 95, 96**.

The use of the rocking type of jacks and jack restraining and guiding cams **100, 101** between adjacent secondary jack elevating cams **93, 94** and **95, 96** eliminates one of the primary reasons why the master butts on the conventional types of jacks are quite often broken, especially if the machine is operated at a higher than normal speed. Heretofore, the cams replaced by the improved secondary jack raising cams **93, 94, 95, 96** have each been made in the form of an inwardly projecting relatively thin inclined member and the master butts on the conventional jacks would, upon being elevated by the conventional primary jack elevating cams **90, 91**, normally pass between the upper surfaces of the cams **90, 91** and the lower surfaces of the cams replaced by the improved secondary jack raising cams **93, 94, 95, 96**.

However, in increasing the speed of the machine, it would often happen that the jacks would bounce as the master butts thereof would ride up the inclined surfaces of the primary jack raising cams and, consequently, the butts would subsequently engage the lower ends of the relatively thin inclined cams heretofore used for this purpose and this would either break the master butts on the corresponding jacks or would damage the types of secondary jack raising cams heretofore employed. Of course, since rocking type selector jacks are used in the present instance, the cams **90, 94, 95, 96** do not overlie the primary jack raising cams **90, 91**.

In order to further insure smooth operation of the machine and minimize damaging the jacks while operating the machine at relatively high speed, novel selector plungers **120** are provided there being four series or groups of plungers shown in Figures 1, 3 and 4 indicated at **104, 105, 106, 107**. The series of plungers **104, 106** are disposed adjacent the respective secondary jack raising cams **93, 95** and impart selections to jacks just before they strike these cams as they pass through rotating in clockwise direction, while the series of plungers **105, 107** perform the same functions with respect to cams **94, 96** but, in the opposite direction.

The series of selector plungers **104—107** are mounted in a conventional manner and the novelty therein resides in the manner in which the operating ends or inner ends of the selector plungers are formed. Since all of the series of selector plungers are identical, with the exception of the selector plungers **104, 106** being angled in an opposite direction from the plungers **105, 107**, and, since the series of selector plungers **107** are shown better in detail than the others in Figures 5, 12 and 13, only the series of plungers **107** will be described in detail and like parts shown associated with the other series of plungers will bear the same reference characters.

The series of selector plungers **104, 105, 106, 107** are controlled as to radial inward and outward movement

by respective selector pattern drums or trick wheels **110, 111, 112, 113** which are supported, driven and constructed in a conventional manner and a detailed description of which is deemed unnecessary. The patterning on each trick wheel or selector pattern drum **110—113**, operates upon a corresponding set or series of levers **115**, whose medial portions are pivoted on the base **51** in a conventional manner and whose outer ends are urged, by springs **116**, into engagement with the patterning on the corresponding selector pattern drums and whose other ends each engage a notch **117** in one of the adjacent selector plungers **120** (Figure 12).

Each of the selector plungers is individually designated at **120** while the series of plungers are broadly designated at **104** to **107**, inclusive, as heretofore stated. It is apparent that, since the springs **116** urge the levers **115** toward the corresponding selector pattern drums or trick wheels, these springs **116**, in turn, normally bias each of the selector plungers **120** inwardly against the needle cylinder as shown in Figure 9, for example. The springs **116** also allow a plunger **120** to be moved outwardly when a mis-alined pattern butt **82** engages the same as will be later described (Figures 9 and 14). Of course, whenever any one of the levers **115** rides up on one of the butts on the corresponding selector drum, the corresponding selector plunger **120** occupies withdrawn or inoperative position as shown in Figures 5 and 12.

Referring to Figures 5, 12 and 13, the series of selector plungers **107** are arranged to be guided and slidably held between a plurality of inclined spacers **125, 125** secured in suitable slots formed in respective inner and outer upright posts **130, 131**. The lower ends of the posts **130, 131** are fixed to a bar or plate **132** secured in a groove **133** (Figure 12) formed in the base **51**. The upper ends of the posts **130, 131** are fixed to a bar **134**.

As heretofore stated, the body of each of the selector plungers **120** is in the form of a relatively thin flat strip of material which strips extend at an angle and, since the saw-tooth type of pattern butts **82** are provided on the pattern jacks J the inner end of each selector plunger **120** is beveled downwardly and outwardly, as at **135** (Figures 15, 16 and 17). The novelty of the improved selector plungers resides in a lead tongue or projection **136** which is preferably a relatively small projection as shown in Figures 8, 9, 12, 14 and 15 and which necessarily projects in a substantially horizontal plane from the angular body of each selector plunger **120** and from the lowermost portion of the inclined body of each selector plunger **120**. However, it is to be distinctly understood that the projections **136** may extend throughout the length of the corresponding selector plungers **120**.

The innermost end of each projection or lead tongue **136** is provided with an outwardly flaring cam surface **137** which is particularly arranged so that, whenever a pattern butt **82** or any one of the jacks J is supposed to engage and be elevated by an active selector plunger **120**, the latter pattern butt initially passes inwardly of the cam surface **137** on the lead tongue **136** and engages the same and forces the corresponding selector plunger outwardly slightly until the pattern butt **82** properly registers with the beveled and inclined inner edge **135** of the body of the corresponding plunger **120**. Of course, when a butt **82** does register properly with the inclined beveled inner edge **135** of the body of a plunger **120**, the plunger then moves inwardly and returns to fully operative position to thereby properly operate upon the corresponding jack J. This is particularly true in the event of a pattern butt **82** being mis-alined with respect to the lowermost portion of the body of an active selector plunger **120**, although the vertical thickness of each lead tongue **136** may be

such as to engage butts 82 whether or not they may be mis-alined.

In operating the knitting machine at a relatively high speed, it quite often happens that the sudden upward movement imparted to each successive jack J by the cams 90, 91 in Figures 3 and 4 causes them to rise slightly above the upper horizontal surfaces of these cams with consequent mis-alinement of pattern butts 82 relative to the succeeding set of selector plungers to be engaged thereby. Such misalinement may also result from the added vibration of the machine resulting from the increased speed of the knitting instrumentalities thereof. It is thus seen that, regardless of the position of the pattern jacks J and their pattern butts 82, the cam surface 137 on each of the selector plungers 120 insures that the butts 82 will not, under any circumstances, collide with the lower edges of subsequent selector plungers thereby eliminating one of the most prevalent reasons why machines of the character described could not be operated at relatively high speeds.

Now, as best shown in Figures 3 and 4, the push-out cams 86, 89 are positioned in vertical planes between the main set of stitch cams and the sets of selector plungers 104, 107, and the push-out cams 87, 88 are positioned between the auxiliary set of stitch cams and the sets of selector plungers 105, 106. Since all of the push-out cams 86—89 are identical, only the push-out cam 89, adjacent the series of selector plungers 107 will be described in detail and like parts associated with the other push-out cams will bear the same reference characters.

Referring again to Figures 3 and 4 and Figures 5 and 6, it will be observed that the needle raise cams 65, 66 each has a pair of openings therein, each opening being indicated at 140 and, through each of these openings, one of the push-out cams loosely extends. Referring particularly to Figure 5, it will be observed that the needle cylinder 50 is provided with a peripheral groove 141 therein into which the operating or inward ends of the push-out cams 86—89 are each urged by a corresponding spring 142 to insure that the shoulder 85 on any jacks which are selected by the corresponding selector plungers 104—107 will be engaged by the next succeeding push-out cam, depending upon the direction of movement of the needle cylinder, to thereby move the selector jacks from, say, the position shown in Figure 11, to the position shown in Figure 6.

It will be observed in Figures 1 and 2 that each of the push-out cams 86—89 is provided with an off-set outwardly projecting stem 143 which, as shown in Figures 5 and 15, is mounted for radial movement in a groove 145 formed in the upper surface of a block 146 suitably secured to or formed integral with the corresponding post 131. It will be observed in Figure 5 that the block 46 is disposed outwardly of the circular needle cam supporting plate 57.

The stem 143 of each push out cam 86—89 has a longitudinally extending slot 147 therein (Figures 2 and 5) which is penetrated by a pair of headed guide members or screws 150, one of which projects upwardly and has the inner end of spring 142 connected thereto. The outer end of the spring 142 (Figure 5) is connected to a spring anchor 151 suitably secured to and projecting upwardly from the outer portion of the corresponding stem 143. The stem 143 has a downwardly projecting portion 152 on its outer end which is penetrated by an adjustable abutment or screw 154 which is adapted to engage the outer surface of the corresponding block 146 to thereby limit inward movement of the corresponding push-out cam. As shown in Figure 2, it is preferable that opposite ends of each push-out cam 86—89 are rounded so the shoulders 85 of any selected jacks J readily pass inwardly of and in engagement with the inner surfaces of corresponding push-out cams 86—89.

In order to return any selected jacks to inactive or lowered position, preparatory to being subsequently engaged by the next succeeding one of the primary jack raising cams 90, 91 after the jacks have been raised by any one of the secondary jack raising cams 93—96, the conventional stationary jack lowering cams 155, 155*a* are employed for engaging the auxiliary butts 81 and lowering successive jacks J with movement of the needle cylinder 50 in either direction. However, since the jacks J are of the rocking type, they must be projected inwardly so the master butts and any pattern butts on the lower portions thereof may be lowered inwardly of the inner surfaces of the secondary jack raising cams 93—96 and intervening jack retaining wall portions 156, 156*a*. The conventional jack lowering cams 155, 155*a* and the novel intervening jack retaining wall portions 156, 156*a* are disposed in the vertical planes of the respective main and auxiliary sets of stitch drawing cams, the conventional jack lowering cams 155, 155*a* being suitably secured to and depending from the needle cam-supporting plate 57 and the intervening jack retaining wall portions 156, 156*a* preferably being formed integral with the secondary jack raising cams 93—96.

The selected jacks are pushed inwardly, following lifting movement thereof by the corresponding secondary elevating cams 93—96, by respective inwardly curved push-in cams 160—163 which are in the form of upwardly projecting shoulders on the uppermost portions of the respective jack raising cams 93—96 and are formed integral with the intervening jack retaining wall portions 156 and 156*a*; that is, the push-in cams 160, 163 are formed on the upper portion 156*a* at opposite ends thereof.

Since the master butts 83 on the pattern jacks J are relatively short, it is preferable that there is spaced above the opposite inclined surfaces of each of the primary jack raising cams 90, 91, a pair of jack-assist raising cams which are particularly provided for engaging the upper or auxiliary butts 81 of successive jacks to assist in properly alining the pattern butts 82 with the selector plungers and to also insure that the auxiliary butts 81 do not engage the uppermost edges of succeeding series of selector plungers. These jack-assist raising cams are indicated at 164—167 in Figures 3 and 4. All of the jack-assist raising cams 164—167 are supported by the posts 130 supporting the respective series of selector plungers 104—107 and, as shown in Figures 5 and 15, the cam 167 projects inwardly from a block 170 suitably secured to the inner post 130 in which the selector plungers 120 of the series 107 are guided.

Method of operation

Generally, the knitting machine disclosed herein functions in substantially the same manner disclosed in said Patent No. 2,217,022. Accordingly, only the peculiar manner in which the improved pattern jacks J are controlled for raising the corresponding needles N thereabove will be described and in the first steps in the function of the improved jacks, it shall be considered that they are moving from right to left in Figure 3 or, in other words, that the needle cylinder is rotating in a counterclockwise direction, as shown in Figure 3.

As needles N pass through the auxiliary set of stitch cams from right to left in Figure 3, the previously lowered corresponding jacks J move in a straight horizontal path in a lowered position whereupon the master butt 83 and the auxiliary butt 81 on each successive jack engage and are elevated by the respective cams 91, 166. All of the jacks J move in a straight horizontal path, with their butts 83 in engagement with the upper surface of cam 91, past the series of selector plungers 106, which are then withdrawn or in active position, and past the push-out cam 88, because of the notches 84 in the jacks J registering therewith. The series of selector plungers 107 is then in operative position and any jack J whose

pattern butts 82 are not alined with an active selector plunger 120 in the series 107 continue to move in a horizontal path past the series of selector plungers 107 and, of course, the notches 84 in the latter nonselected jacks register with the push-out cam 89 so the lower portions of these jacks remain in inward position.

On the other hand, any jacks having butts 82 which are engaged by selector fingers 120 in the series 107 are elevated slightly thereby so the shoulders 85 thereon engage the push-out cam 89, thus pushing the lower portions of these jacks outwardly to occupy substantially the position shown in Figure 6. It is apparent that any butts 82 which engage plungers 120 in the series 107 are elevated to where the master butts 83 thereon will move outwardly above the jack restraining and guiding cam 101 so that, thereafter, the master butts 83 on selected jacks ride up the cam 96 to elevate corresponding needles to where they will take the yarn from the main yarn feeding station 55 and form stitches therewith as the butts thereof subsequently engage and are lowered by the stitch cam 61. In the meantime, the master butts 83 on the jacks J, which have been raised by the cam 96, engage the push-in cam 163 which returns the lower portions of the selected jacks to inward position so they ride inwardly of the intervening jack guiding wall portion 156 and whereupon the auxiliary butts on the jacks engage the cam 155 to return the previously selected jacks 83 to their lowermost positions.

With continued movement of the needles N and jacks J from right to left, it is apparent that the selector plungers 120 in series 104 occupy withdrawn or inactive position and the primary jack raising cam 90 and the jack-assist raising cam 164, the series of selector plungers 105, push-out cam 86 and the cams 94 and 161 function in the same manner as that described for the primary jack raising cam 91, the jack-assist raising cam 166, the series of selector plungers 107, the push-out cam 89, the secondary jack raising cam and the push-in cam 163, respectively. Of course, any selected jacks cause the corresponding needles N raised in advance of the auxiliary set of stitch cams to take yarn from the auxiliary yarn feeding station 55*a* and to subsequently be lowered by the stitch cam 60*a* to draw stitches therewith.

Now, as the needle cylinder moves in a clockwise direction or, in other words, as the needles and jacks N and J move from left to right in Figure 4, it is apparent that the jacks J occupy lowermost positions and are elevated by the primary jack raising cam 90 and, since the series of selector plungers 105, 107 are in withdrawn position and the series of selector plungers 104, 106 are, at least in part, in active position, the jacks J will then move in a straight horizontal path until they approach the series of selector plungers 104. Then, any jacks having pattern butts 82 thereon which are engaged by corresponding selector plungers 120 in the series 104 are elevated slightly. Thereafter, the push-out cam 86 pushes the lower ends of the selected pattern jacks J outwardly to the position shown in Figure 6 so their master butts 83 ride up the cam 93 to raise corresponding needles to where they will take yarn from the main yarn feeding station 55 and will subsequently be lowered by the stitch cam 60. In the meantime, the master butts on each successive previously selected jack J will engage push-in cam 160 and the auxiliary butts 81 thereon will subsequently engage cam 155 to return the corresponding jacks to the lowermost position.

Here again, with further movement of the jacks from left to right in Figure 4, cam 91, the series of selector plungers 106, the push-out cam 88, the secondary jack raising cam 93, the push-in cam 160 and the jack lowering cam 155 to thereby cause needles corresponding to selected jacks to take the yarn from the auxiliary yarn feeding station 55*a* to subsequently draw stitches therewith as the butts thereof are lowered by the stitch cam 61*a*.

Modified form of jack alining means for the selector plungers

In Figures 18, 19, 20 and 21 a modified form of means is disclosed for accurately alining the pattern butts on the pattern jacks with selector plungers wherein conventional selector plungers are utilized instead of plungers having the lead tongues thereon as heretofore described. In Figure 18, it will be noted that the improved rocking pattern jacks, jack restraining cams, push-out cams, secondary jack raise cams and jack push-in cams are used and, in order to avoid repetitive description, those parts shown in Figures 18, 19, 20 and 21 corresponding to the respective Figures 4, 5, 12 and 13 will bear the same reference characters with the prime notation added.

As heretofore stated, the speed at which a knitting machine of the character described could be operated heretofore has been severely limited due to the jacks bouncing upwardly as they reached crests of the primary jack raise cams 90, 91 in Figure 4 and 90', 91' in Figure 18. In the form of the invention illustrated in Figure 4, for example, this difficulty is overcome by providing the lead tongues 136 on the inner or operating ends of the selector plungers with the angularly arranged cam surfaces 137 thereon. Now, in the form of the invention shown in Figures 18, 19, 20 and 21, the selector plungers in each series 104', 105', 106', 107' are conventional in that they are devoid of lead tongues, such as the lead tongues 136 shown in Figures 7, 8 and 9. In other words, the selector plungers shown in Figures 18 through 21 are substantially the same as disclosed in said Patent No. 2,217,022.

Instead of providing lead tongues on the selector plungers, I have provided an improved jack safety leveling cam above the level of and in advance of the uppermost selector plunger in each series 104' to 107', inclusive, relative to the direction of movement of the corresponding pattern jacks. The safety leveling cams associated with the four series of plungers 104' to 107', inclusive, are respectively designated at 180 to 183, inclusive. Since the two series of selector plungers 104', 105' are disposed in closely spaced relationship and the two series of selector plungers 106', 107' are also disposed in closely spaced relationship, it is apparent that the cams 180, 181 may be formed integral with each other, or as a single cam, and that the cams 182, 183 may also be formed integral with each other, or as a single cam. The cams 180, 181 and 182, 183 are shown as being formed separately in Figure 18 merely for convenience in mounting the same relative to the corresponding series of selector plungers.

Since the views shown in Figures 19, 20 and 21 correspond to the respective Figures 5, 13 and 12, the series of selector plungers 107' are shown in Figures 19, 20 and 21 and, accordingly, the jack safety leveling cam 183 is shown in Figures 19, 20 and 21. The cams 180, 181 and 182 may be constructed and mounted in substantially the same manner as the cam 183 as will be presently described.

It will be observed in Figures 20 and 21 that the cam 183 is positioned against the inner surface of the post 130' and extends outwardly and has a downwardly projecting portion 185 thereon which fits against one side of the post 130' and is secured thereto, as by screws 186. It is particularly important to note that opposed sides of the cam 183 converge downwardly and the lower surface thereof is spaced above the upper surface of the corresponding primary jack raise cam 91' a distance only slightly greater than the distance from the lowermost surfaces of the main or master butts 83' to the upper surfaces of the uppermost or auxiliary butts 81' of the rocking jacks J'. It will also be noted that the inclined lower surface on the cam 183 nearest the series of selector plungers 107' originates at its lower end in a vertical plane substantially the same as that of the lower leading edges of the plungers in the series 107'.

As the butt 83' of each successive jack J' engages and is elevated by the primary jack raise cam 90', for example, and as the jacks and needles move from left to right in Figure 18 and, of course, as the auxiliary butt 81' on each successive jack J' engages and rides up the cam 165', the pattern butts 82' thereon would normally be properly alined with the selector jacks in the series 104'. However, in the event of the jacks J' bouncing as the butts 83' reached the crest of the primary jack raise cam 90' or the butts 81' reached the crest of the jack-assist raising cam 165', it is apparent that the butts 81' on the latter jacks J' would then engage the safety leveling cam 181 to be returned to proper position for alinement with the series of selector plungers 104'.

Also, in the event of the jacks J' becoming raised, due to vibration of the machine, in the course of their movement between the cams 181 and 180, it is apparent that the safety leveling cam 180 will again return the jacks to the proper position for alinement with the plungers in the series 104'. Since the inclined right-hand surface of the cam 180 in Figure 18 originates in substantially the same vertical plane as the left-hand edges of the selector plungers in the series 104', it is apparent that the jacks are retained in alinement with the plungers 104' until pattern butts 82' thereon have engaged one or more of the selector plungers 104'.

It is thus seen that, although the speed of movement of the pattern jacks J' as they are elevated by the primary jack raise cam 90', or the vibration of the machine due to the increased speed thereof, may cause the master butts 83' to move upwardly out of engagement with the upper surface of the primary jack raised cam 90', it is apparent that the safety leveling cam 180 will insure that any pattern butts 82' on the jacks J' are properly alined with the next succeeding or adjacent series of selector plungers 104'. It is apparent from the foregoing description that all of the cams 180, 181, 182, 183 operate in a similar manner relative to the respective series of selector plungers 104', 105', 106', 107' during reciprocatory knitting.

It is thus seen that I have provided novel rocking jacks and control means therefor wherein the jacks are initially alined with series of selector plungers and their lower ends are retained in inward position until they approach the selector plungers and, also, wherein two forms of means are provided to insure that the pattern butts on the jacks are maintained in accurate alinement with each succeeding series of selector plungers.

Also, it is apparent that the lower ends of the rocking jacks are retained in inward position until they approach these selector plungers and are elevated to intermediate position thereby after which each successive selector jack is pushed inwardly at its upper end and outwardly at its lower end, about its rocking point 80, to aline the master butts 83 for subsequent engagement with a secondary jack elevating cam which elevates selected jacks to where the needles will take yarn in the hooks thereof and form stitches therefrom. It will also be noted that a push-in cam is provided subsequent to the push-out cam and the corresponding secondary jack raising cam for returning the lower ends of the jacks to inward position for subsequently permitting the jacks to be lowered to said lowermost position preparatory to a repeat operation thereby facilitating smooth and high speed operation of the knitting machine.

In the drawings and specification there has been set forth a preferred embodiment 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.

I claim:

1. In a circular knitting machine having at least one feeding station, needles, jacks below the needles, butts on the jacks, means for rotating said needles and jacks adjacent said feeding station and selecting means adjacent the feeding station including resiliently inwardly biased selector plungers; the combination of a substantially horizontal projection on the leading inner end of each plunger, and the inner surface of said projection being formed at an angle to the rotary path of butts on said jacks whereby engagement of any one of said projections by a butt deflects the corresponding plunger outwardly.

2. In a circular knitting machine having a circular series of needles, pattern jacks for the needles having pattern butts thereon and at least one series of resiliently inwardly biased selector plungers having angularly disposed bodies for operation upon pattern butts of certain pattern jacks; improvements in the selector plungers including a horizontally extending lead tongue projecting from the lower edge of the body of each plunger and away from the direction toward which the selector jacks cooperating therewith move, and the inner end of said lead tongue adjacent the path of travel of the jacks having a cam surface thereon so arranged that pattern butts of any jacks corresponding to selector plungers will engage said cam surface and force corresponding selector plungers outwardly and, as corresponding pattern butts subsequently pass into the vertical plane of the bodies of the selector plungers, the selector plungers return to inward position to engage pattern butts of and raise the corresponding pattern jacks thereby preventing the pattern butts from colliding with the leading edges of any of the selector plungers.

3. A structure according to claim 2 wherein the pattern butts are of the saw-tooth type, each body having its inner end beveled according to the shape of each pattern butt, and the cam surface on the tongue being vertically straight at least at its end initially engaged by a pattern butt.

4. In a circular independent needle knitting machine having at least one knitting station, a rotary needle cylinder and selecting means adjacent the knitting station including a plurality of inclined selector plungers; the combination of a rocking pattern jack beneath each needle in the needle cylinder, means to aline each successive pattern jack with the inner ends of the plungers, pattern butts on the jacks for engaging active selector plungers, means to restrain outward movement of the lower portions of any pattern jacks whose pattern butts are not engaged by selector plungers, a jack raise cam spaced between the selector plungers and the knitting station and spaced outwardly from the needle cylinder, means to push out the lower ends of any pattern jacks whose pattern butts are selected by selector plungers for vertically alining the latter pattern jacks with the jack raise cam whereby selected jacks and corresponding needles are raised to pass through the knitting station, means to push in the lower ends of the previously selected pattern jacks upon the latter pattern jacks being raised by the jack raise cam, and means for then returning the selected pattern jacks to lowered position.

5. In a circular independent needle knitting machine having at least one knitting station, a rotary needle cylinder and selecting means adjacent the knitting station including a plurality of inclined selector plungers; the combination of a rocking pattern jack beneath each needle in the needle cylinder, means to aline each successive pattern jack with the inner ends of the plungers, pattern butts on the jacks for engaging active selector plungers, a master butt on the lower portion of each jack, restraining means to limit outward movement of the lower portions of any pattern jacks whose pattern butts are not engaged by selector plungers, a jack raise cam spaced between the selector plungers and the knitting station and spaced outwardly from the needle cylinder, said plungers being arranged to raise selected jacks so the master butts thereon are clear of the restraining means, means to push out the lower ends of any pattern jacks whose pattern butts are engaged by selector plungers only for alining the master butts on the latter pat-

tern jacks with the jack raise cam whereby selected jacks and corresponding needles are raised in passing the knitting station, means to push in the lower ends of the previously selected pattern jacks upon the latter pattern jacks being raised by the jack raise cam, and means for then returning the selected pattern jacks to lowered position.

6. A structure according to claim 5 wherein each inclined selector plunger has a substantially horizontal projection on its leading edge and the inner surface of said projection being formed at an angle to the path of any pattern butt substantially alined therewith whereby pattern butts deflect corresponding plungers outwardly as they engage said inner surface until they reach the inclined portions of the selector plungers thereby preventing the pattern butts from colliding with the leading edges of corresponding selector plungers.

7. In a circular knitting machine having a circular series of needles, pattern jacks for the needles having pattern butts thereon, at least one series of inwardly biased selector plungers for operating upon butts of certain pattern jacks and each plunger having a body provided with an inclined inner end thereon; improvements in the selector plungers including a horizontally extending lead portion projecting from the lower edge of the body of each plunger and toward the direction from which the selector jacks cooperating therewith move, and the inner surface of said lead portion adjacent the path of travel of the jacks having a cam surface thereon so arranged that pattern butts of any jacks corresponding to the selector plungers will engage said cam surfaces and force corresponding selector plungers outwardly so that, as the corresponding pattern butts consequently pass into the vertical plane of the inclined inner ends of the selector plungers, the selector plungers return to inward position to engage the pattern butts of and raise corresponding pattern jacks, thereby preventing the pattern butts from colliding with the leading edges of any of the selector plungers.

8. In a circular knitting machine having at least two knitting stations, a needle cylinder, means for reciprocating said needle cylinder to and fro past the knitting stations, a circular series of latch needles carried by the cylinder, a pair of spaced selecting means disposed between adjacent knitting stations and each including a plurality of inclined selector plungers; the combination of a normally lowered rocking jack carried by the needle cylinder below each needle, a master butt on the lower portion of each jack, pattern butts on said jacks, a pair of jack raise cams spaced from the needle cylinder and straddling the pair of selecting means and also disposed between the knitting stations, a jack restraining cam connecting the lower proximal ends of said pair of jack raise cams, means engageable by said master butts to aline each successive jack with the selector plungers, the master butts on said jacks being engageable with the jack restraining cam for preventing outward movement of the lower ends of the jacks until pattern butts thereon engage plungers of the respective selecting means corresponding to the direction of movement of the jacks whereby selected jacks are raised to an intermediate position, said master butts being so arranged as to be elevated above the jack restraining cam upon corresponding jacks being selected, means for pushing out the lower portions of selected jacks after selected jacks have passed the corresponding selecting means whereby the master butts previously engaging the jack restraining cam ride upon the upper surface of the jack restraining cam and in engagement with the succeeding jack raise cam to raise corresponding needles at the knitting station, means operable thereafter to push in the lower ends of said selected jacks, and means operable thereafter to return said selected jacks to their original lowered position.

9. In a circular knitting machine having at least two knitting stations, a needle cylinder, means for reciprocating said needle cylinder to and fro past the knitting stations, a circular series of latch needles carried by the cylinder, a pair of spaced selecting means disposed between adjacent knitting stations and each including a plurality of inclined selector plungers; the combination of a normally lowered rocking jaw carried by the needle cylinder below each needle, pattern butts on said jacks, a pair of jack raise cams spaced from the needle cylinder and straddling the pair of selecting means and also disposed between the knitting stations, a jack restraining cam connecting the lower proximal ends of said pair of jack raise cams, means to aline each successive jack with the selector plungers, means on said jacks engageable with the jack restraining cam for preventing outward movement of the lower ends of the jacks until they engage plungers of the respective selecting means corresponding to the direction of movement of the jacks whereby selected jacks are raised to intermediate position, said means engageable with the jack restraining cam being so arranged as to be elevated above the jack restraining cam upon a corresponding jack being selected, means for pushing out the lower portions of selected jacks after selected jacks have passed the corresponding selecting means whereby the means previously engaging the jack restraining cam rides upon the upper surface of the jack restraining cam and in engagement with the corresponding jack raise cam to raise corresponding needles at the corresponding knitting station, means operable thereafter to push in the lower ends of said selected jacks, and means operable thereafter to return said selected jacks to their original lowered position.

10. In a circular independent knitting machine having at least one yarn feeding station, a stitch drawing station spaced below the yarn feeding station, and at least one series of selector plungers spaced below the level of and in advance of the vertical plane of the stitch drawing station; the combination of improved pattern jacks for the needles, each pattern jack having a plurality of pattern butts thereon and a lower master butt thereon and an upper auxiliary butt thereon and each pattern jack also having a rocking point on its inner medial portion, a primary jack raising cam engageable with each successive master butt for elevating each successive jack from a lowermost position to aline the same with the selector plungers, a jack restraining cam to restrain the lower portion of each successive jack from outward movement about its rocking point during its course of movement to the selector plungers after it has been elevated by the primary jack raising cam, each selector plunger having a cam surface thereon engageable by pattern butts on certain jacks for moving the plunger outwardly to thereby insure proper registration of pattern butts with active selector plungers whereby selected jacks are raised by corresponding active plungers, a push-out cam for engaging the upper portion of each successive selected jack to swing the master butts thereon outwardly above the jack restraining cam, a secondary jack raising cam disposed subsequent to the vertical plane of the push-out cam and inclining upwardly from the jack restraining cam for elevating successive selected jacks to where the needles thereabove will take yarn from the yarn feed station and will form stitches therefrom at the stitch drawing station, a push-in cam engageable with the master butt of each successive jack so elevated by the secondary jack raising cam to return the lower portions of said selected jacks to inward position, and means for lowering the jacks to said lowermost position preparatory to a repeat operation.

11. A structure according to claim 10 wherein the upper portion of each jack is provided with a recess therein which registers with the push-out cam in the absence of a pattern butt on a pattern jack engaging a selector plunger.

12. In a circular independent knitting machine having at least one yarn feeding station, a stitch drawing station

spaced below the yarn feeding station, and at least one series of selector plungers spaced below the level of and in advance of the vertical plane of the stitch drawing station; the combination of improved pattern jacks for the needles, each pattern jack having a plurality of pattern butts thereon and a lower master butt thereon and an auxiliary butt thereon and each pattern jack also having a notch in its upper end and having a rocking point on its inner medial portion, primary jack raising cam means engageable with each successive master butt for elevating each successive jack from a lowermost position to aline the same with the selector plungers, means to restrain the lower portion of each successive jack from outward movement about its rocking point during its course of movement to the selector plungers after it has been elevated by the primary jack raising cam means, each selector plunger having a cam surface thereon engageable by pattern butts on successive jacks for moving the plunger outwardly to thereby insure proper subsequent registration of the pattern butts with active selector plungers whereby selected jacks are raised by corresponding plungers, a push-out cam for engaging each successive selected jack below said notch to swing the master butts thereon outwardly above the jack restraining means, a secondary jack raising cam disposed subsequent to the vertical plane of the push-out cam for elevating successive selected jacks to where the needles thereabove will take the yarn from the yarn feed station and will form stitches therefrom at the stitch drawing station, a push-in cam engageable with the master butt of each successive jack elevated by the secondary jack raising cam to return the lower portions of selected jacks to inward position, and means for lowering the jacks to said lowermost position preparatory to a repeat operation.

13. In a circular knitting machine having at least one feeding station, needles, jacks below the needles, butts on the jacks, means for rotating said needles and jacks adjacent said feeding station, at least one substantially vertical series of inclined selector plungers in advance of the feeding station, and said machine having at least one primary jack raise cam for raising each successive jack to aline its butts with the selector plungers, the combination therewith of means interposed between the inclined selector plungers and the point at which the jacks are raised by the primary jack raise cam for alining butts on any pattern jacks, which become inadvertently raised above the level to which they should be raised by the primary jack raise cam, with the series of selector plungers.

14. A structure according to claim 13 wherein each of said plungers is resiliently biased inwardly to operative position and wherein the last-named means includes a substantially horizontal tongue projecting laterally from the leading end of each plunger, and the inner surface of each tongue being formed at an angle to the rotary path of butts on said jacks whereby engagement of any one of said tongues by a butt deflects the corresponding plunger outwardly.

15. A structure according to claim 13 wherein the butts of each of said jacks includes a lower master butt, an auxiliary butt spaced substantially above the master butt and certain jacks having one or more pattern butts between the master butt and the auxiliary butt, a safety leveling cam disposed above and immediately in advance of the series of selector plungers and having its lower surface spaced above the crest of the primary jack raise cam a distance minutely greater than the distance from the lower surface of the master butt on each jack to the upper surface of the auxiliary butt, opposite ends of said safety leveling cam diverging upwardly from the lower surface thereof, and said safety leveling cam being so positioned relative to the selector plungers that engagement of the lower surface thereof by the auxiliary butt of each successive jack alines any pattern butts on the jacks with the selector plungers.

16. A structure according to claim 13 wherein the butts of each of said jacks includes a lower master butt, an auxiliary butt spaced substantially above the master butt and certain jacks having one or more pattern butts between the master butt and the auxiliary butt, a safety leveling cam disposed above and immediately in advance of the series of selector plungers and having its lower surface spaced above the crest of the primary jack raise cam a distance slightly greater than the distance from the lower surface of the master butt on each jack to the upper surface of the auxiliary butt, at least the end of said safety leveling cam remote from the series of plungers being inclined upwardly from the lower surface thereof and away from the plungers, the lower surface of said safety leveling cam adjacent the series of plungers terminating in substantially the same vertical plane as the leading lower edges of the inclined plungers, and said safety leveling cam being so positioned relative to the selector plungers that engagement of the lower surface thereof by the auxiliary butt of each successive jack alines any pattern butts on the jacks with the selector plungers.

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