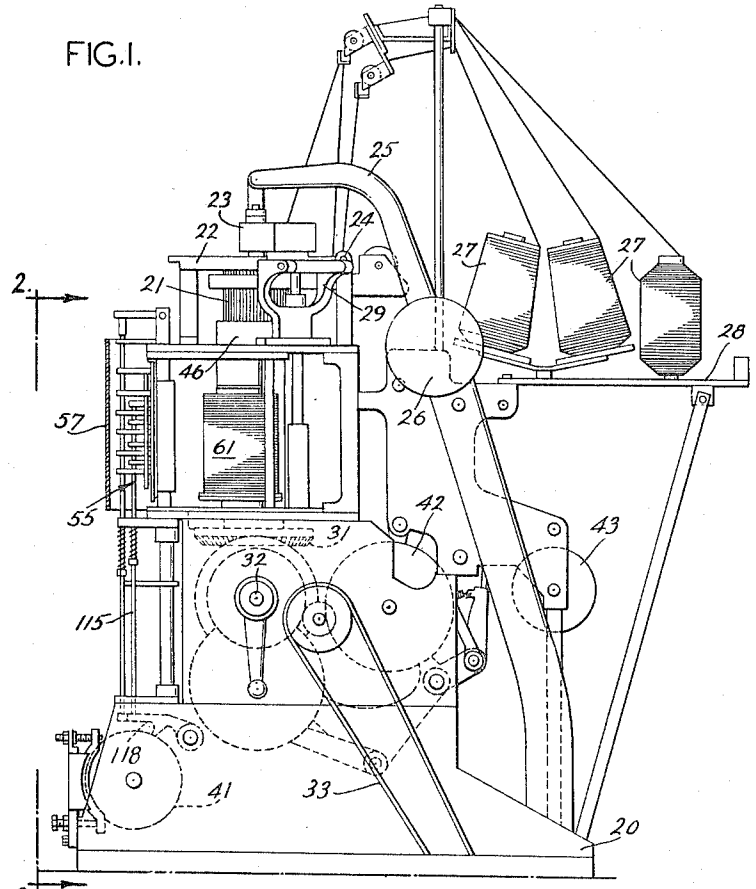
Dec. 6, 1966 P. A. MAHLER 3,289,437

PATTERN DRUM INDEXING FOR CIRCULAR KNITTING MACHINES

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FIG.1.



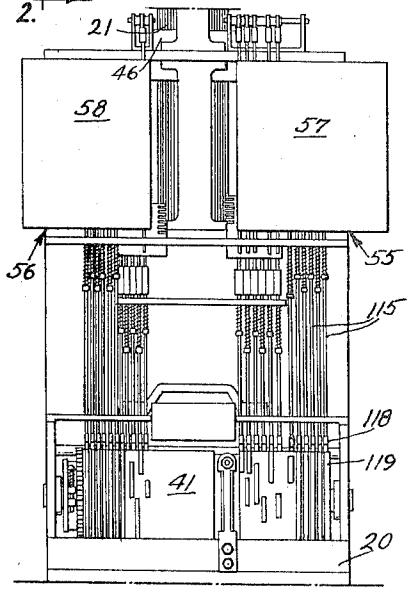


FIG.2.

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PETER A. MAHLER

BY Howson & Howson

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FIG. 3.

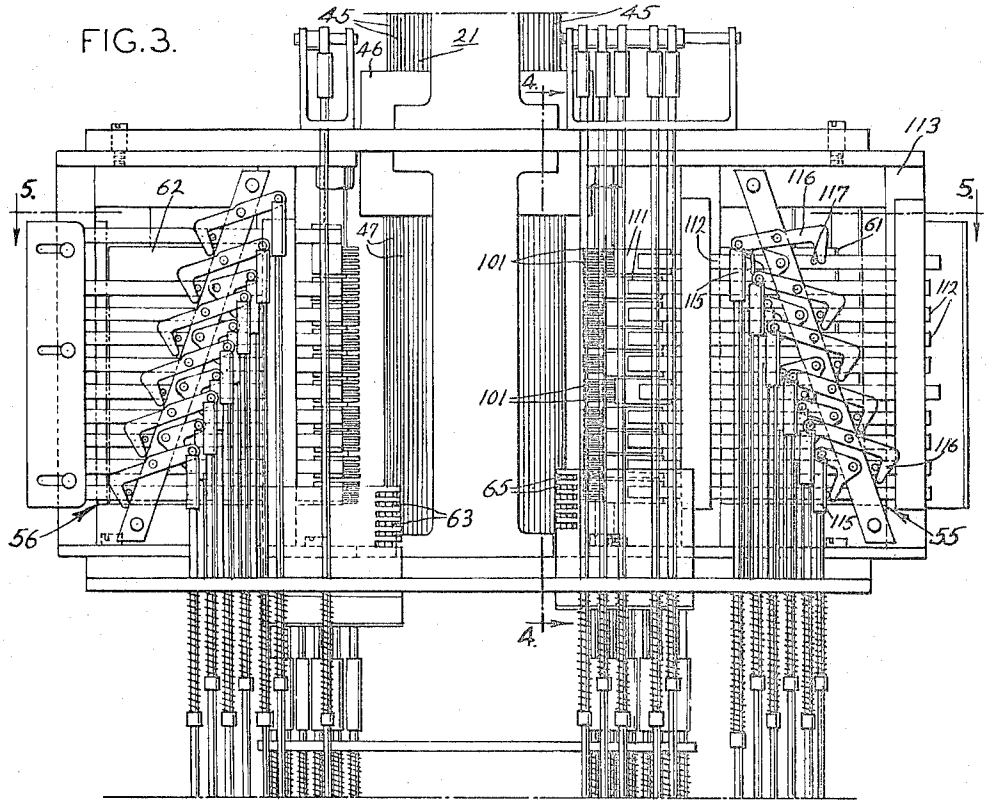
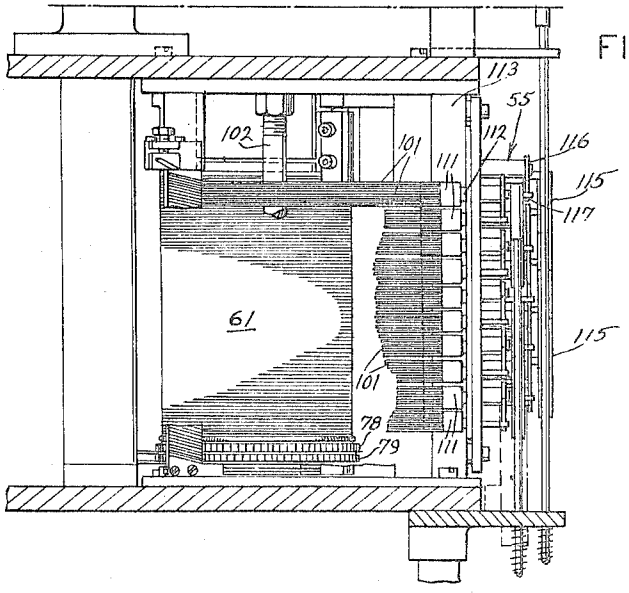


FIG. 4.



PATTERN DRUM INDEXING FOR CIRCULAR KNITTING MACHINES

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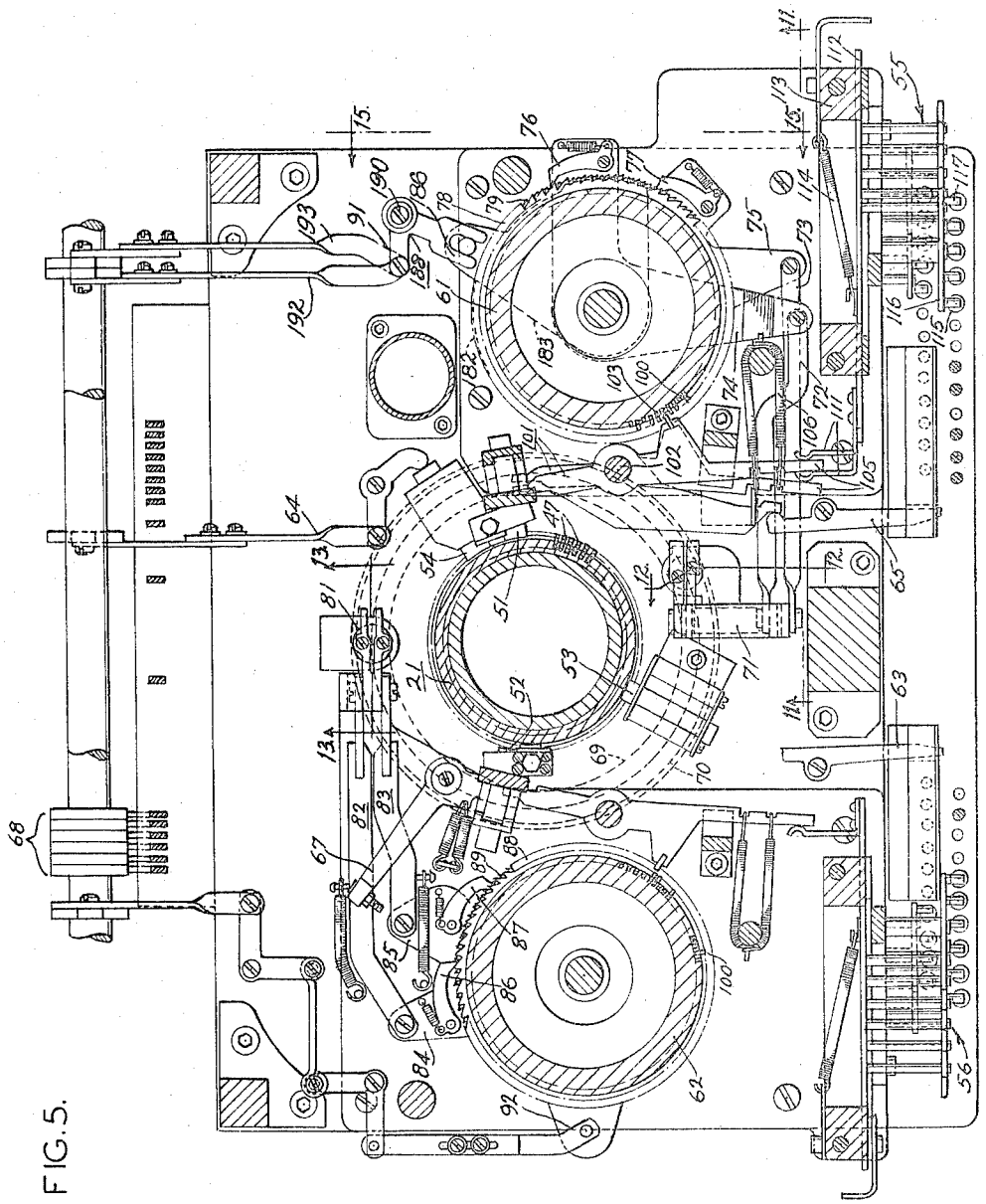


FIG. 5.

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FIG. 6.

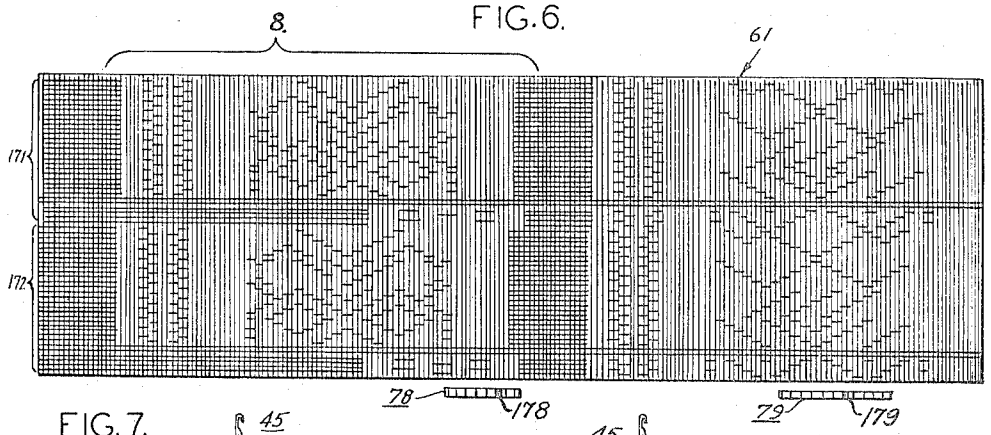
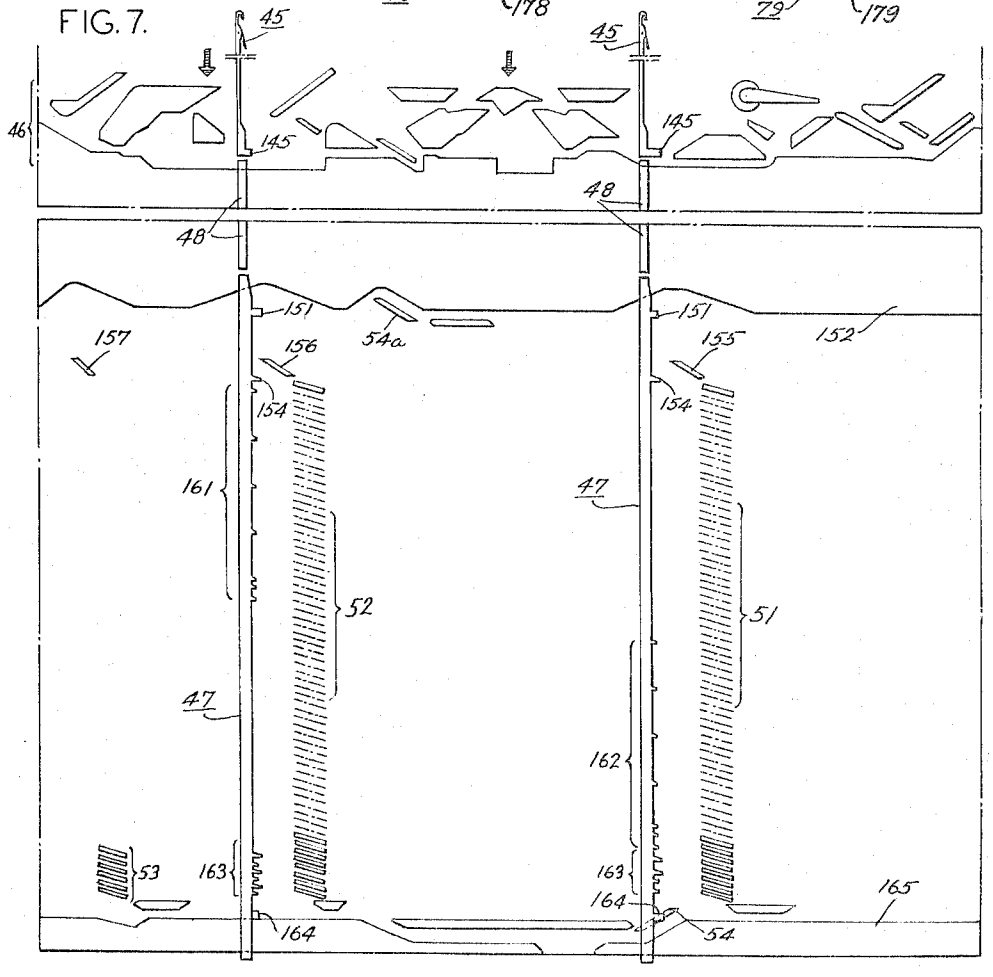


FIG. 7.



PATTERN DRUM INDEXING FOR CIRCULAR KNITTING MACHINES

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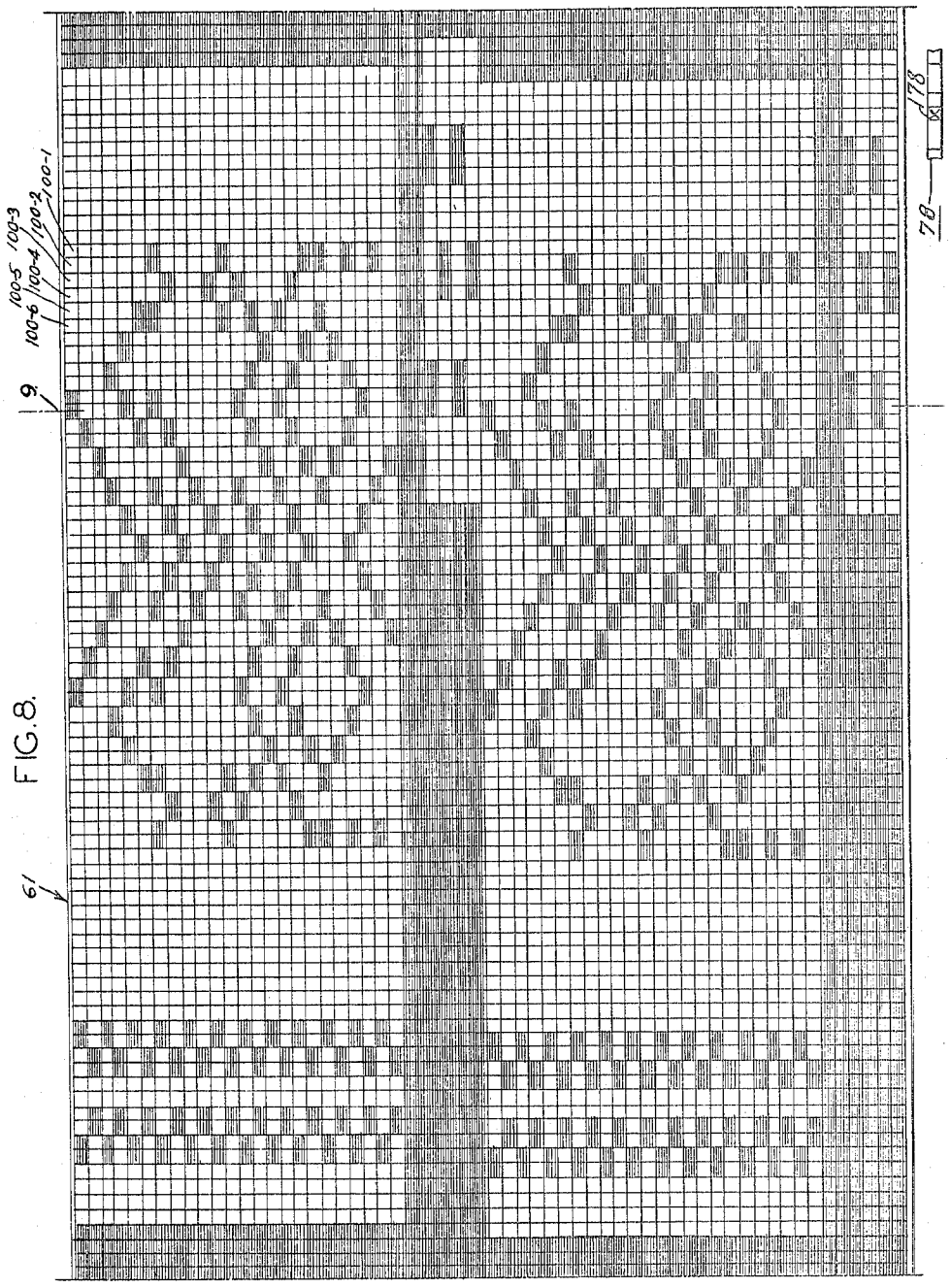


FIG. 8.

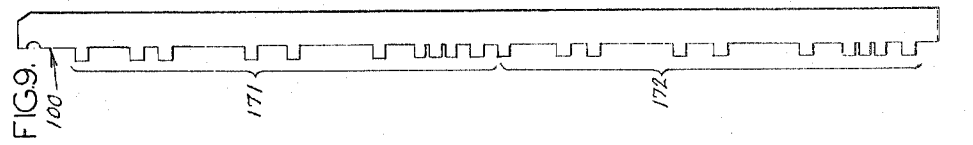
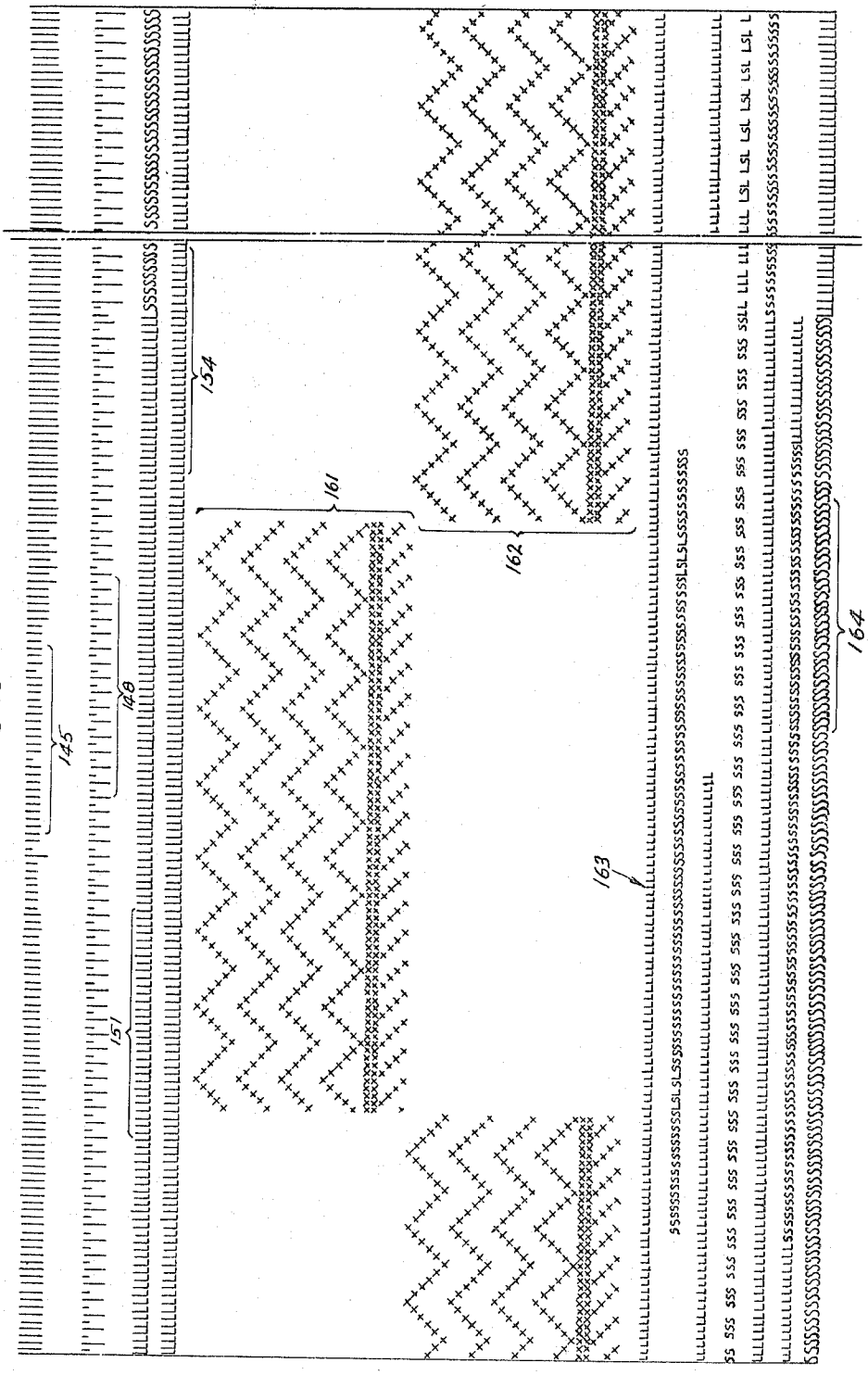


FIG. 9.

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FIG. 10.



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FIG.11.

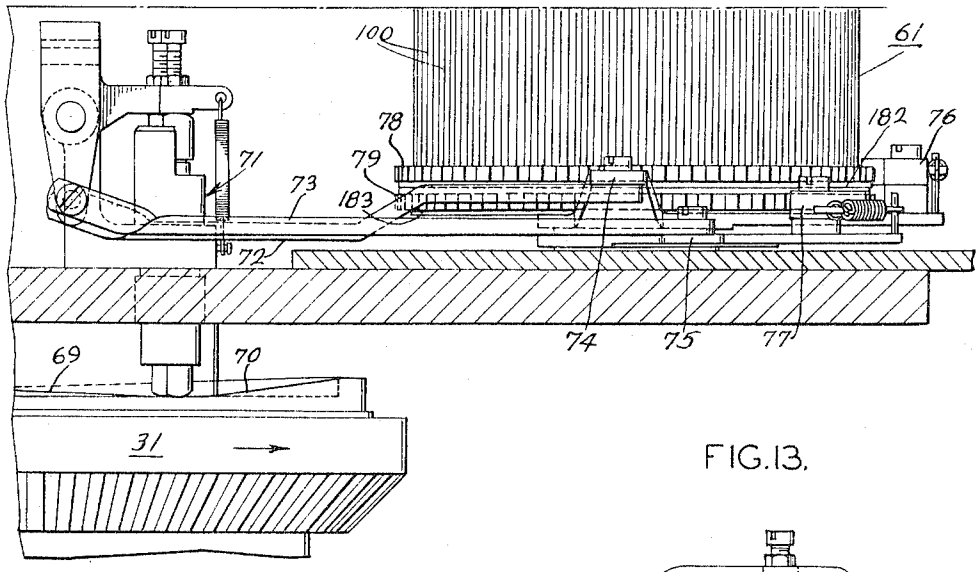


FIG.13.

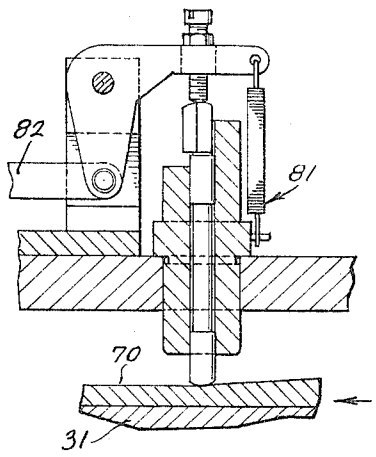
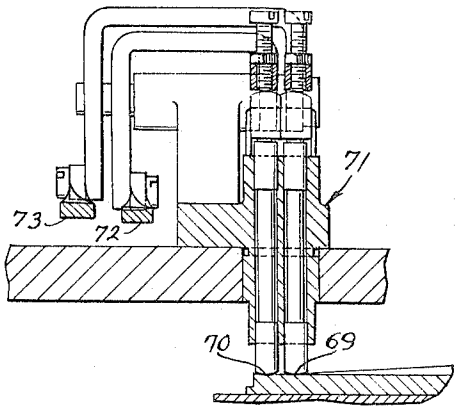


FIG.12.



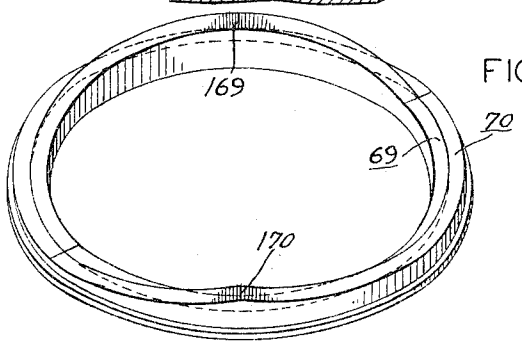


FIG.14.

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FIG.15.

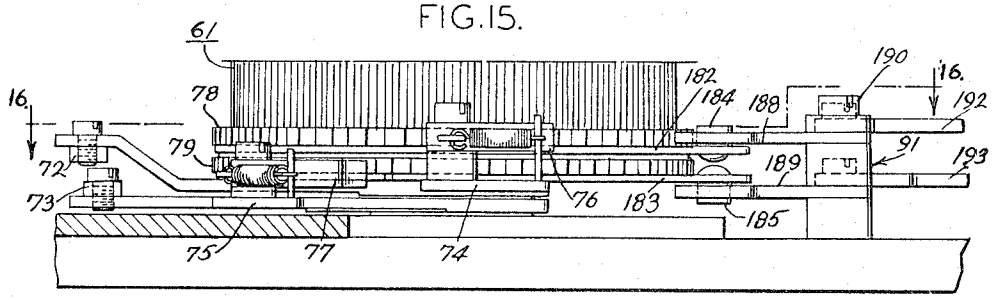


FIG.16.

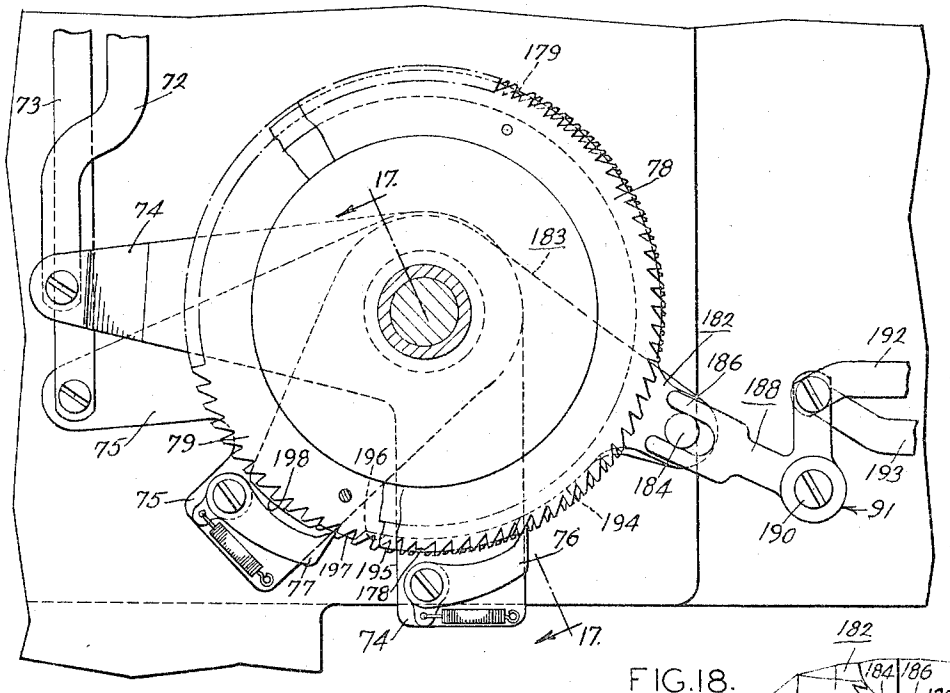


FIG.17.

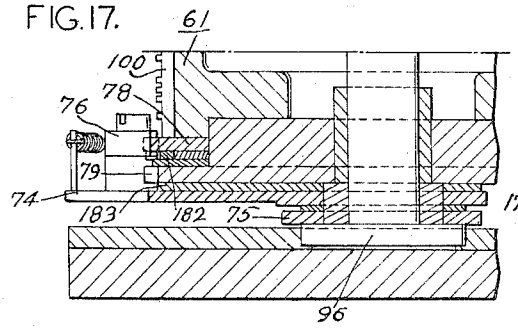
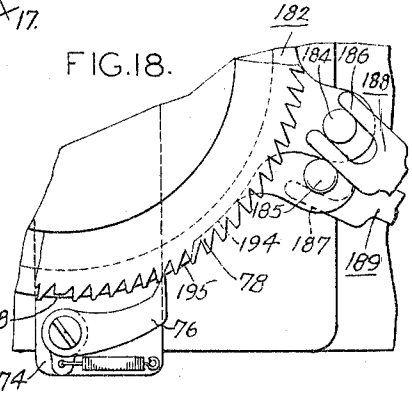


FIG.18.



United States Patent Office

3,289,437

Patented Dec. 6, 1966

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PATTERN DRUM INDEXING FOR CIRCULAR KNITTING MACHINES

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Filed Apr. 27, 1964, Ser. No. 363,024
8 Claims. (Cl. 66—50)

The present invention relates to circular knitting machines having pattern selection drums for controlling the needles thereof to produce patterns by means of preselected arrangements of varied stitch forms, and more particularly to improved indexing mechanism for such drums.

The character of the stitch form produced on a needle at a knitting station is determined by the elevation of the needle as it enters the yarn feed station to take yarn. The fundamental stitch forms for producing a plain knitted tube, for use as the stocking blank for example, are obtained by cams operating directly on the needles through the conventional needle butts. In order to produce a pattern in the tube, the elevation of the needles is controlled by individual selector jacks associated with the needles and having a plurality of butt levels which determine the production of patterns by the presence or absence of a butt at selected levels on a particular jack. The jack is displaced by the engagement of a butt thereon with a jack actuator in the form of a slide controlled from a pattern selection drum which is conventionally common to all of the actuators. To vary the selection of jacks, the pattern selection drum is rotated in timed relation to the needle cylinder, for example by indexing the selection drum once or twice for each revolution of the needle cylinder.

Conventionally, in knitting a tubular stocking blank, the pattern drum is indexed from its starting point following completion of the turned welt at the start of the knitting of the blank, and completes one revolution during each knitting cycle wherein a complete tube is knitted, so that the drum is returned to its starting point for the start of the succeeding tube. Thus, when it is desired to knit tubes having a certain pattern sequence throughout its length, the pattern drum must be jacked or set up, to produce a particular pattern sequence.

With the foregoing in mind, the present invention provides a knitting machine wherein a single pattern drum may be set up or jacked to provide different patterns about its circumference, any one or more of which may be selected for knitting by a relatively simple alteration or adjustment in related mechanism.

More specifically, the present invention provides a knitting machine having a pattern selection drum operable to produce a variety of patterns and including separate mechanism operable to index the drum to activate a particular pattern, the timing of the drum being automatically correlated to the needle cylinder to insure proper actuation of the jack actuator slides.

The present invention provides drum indexing mechanism for a knitting machine which is readily adjustable to change the patterns which may be knit thereon, the mechanism being operable to insure properly timed relationship between the pattern drum and the cylinder thereby reducing substantially the down-time which is normally required for changes in pattern.

More specifically, the present invention provides a pattern selection drum indexing mechanism which insures displacement of the jack selector slides at the time when the needle cylinder is presenting jacks which are devoid of butts in registry with the selector slides which would interfere with the displacement of the slides.

The present invention provides for a pattern drum designed to be indexed at least twice for every revolution of the needle cylinder, indexing mechanism which insures that the first index of the drum occurs with the first portion of cylinder movement, and that the second index of the drum occurs with the second portion of cylinder movement.

All of the objects of the present invention are more fully set forth hereinafter with reference to the accompanying drawings wherein:

FIG. 1 is a view in side elevation of the upper portion of a circular knitting machine embodying the present invention;

FIG. 2 is a view in front elevation of a portion of the machine, as seen from the line **2—2** in FIG. 1, certain parts of the machine being hidden by cover members;

FIG. 3 is an enlarged view similar to FIG. 2, but with the cover members and certain other elements removed for the purpose of illustration;

FIG. 4 is a fragmentary sectional view of the right hand pattern drum with a portion of the associated mechanism broken away, as viewed from the line **4—4** in FIG. 3;

FIG. 5 is an enlarged transverse sectional view taken on the line **5—5** of FIG. 3, and illustrating selected mechanism associated with the rear pattern drum;

FIG. 6 is a diagrammatic development of the right hand pattern selection drum shown in FIGS. 1 to 5, and illustrating schematically a portion of the driving ratchet wheels associated therewith;

FIG. 7 is a cam development showing the cams operative on the needle butts and the selector jack actuator slides operative on the selector jacks associated with the needles, as seen from the interior of the cylinder;

FIG. 8 is a fragmentary enlargement of a portion of the diagram of the pattern jack layout in the right hand pattern drum as indicated by the bracket **8** in FIG. 6;

FIG. 9 is a view in side elevation of a pattern jack indicated at **9** in the diagram of FIG. 8;

FIG. 10 is a diagram of the butt arrangement for the needles, lifter jacks, and selector jacks in the needle cylinder, as seen from the outside of the cylinder.

FIG. 11 is an enlarged fragmentary sectional view taken on the line **11—11** of FIG. 5;

FIG. 12 is an enlarged sectional view taken on the line **12—12** of FIG. 5;

FIG.13 is an enlarged sectional view taken on the line **13—13** of FIG. 5;

FIG. 14 is a detached perspective view of a cam track controlling the indexing of the right and left hand pattern drums;

FIG. 15 is an enlarged fragmentary sectional view taken on the line **15—15** of FIG. 5;

FIG. 16 is a fragmentary sectional plan view taken on the line **16—16** of FIG. 15;

FIG. 17 is a fragmentary sectional view taken on the line **17—17** of FIG. 16; and

FIG. 18 is an enlarged fragmentary plan view illustrating the operation of the indexing mechanism of the present invention.

Referring now to FIG. 1, the knitting machine illustrated therein comprises a frame **20** having at its upper end a needle cylinder **21** rotatably mounted therein. A yarn guide ring **22**, pivotally secured to the frame at **24**, surrounds the upper end of the cylinder and mounts thereon a plurality of groups of yarn feed fingers, in the present instance, two. A rotary dial (not shown) overlies the open upper end of the needle cylinder **21** for simultaneous rotation with the needle cylinder through dial superstructure **23** mounted on the frame through a pivotal yoke **29**. The dial is covered by a stationary dial cap which mounts the usual dial cams, yarn trimmer, and yarn control elements including a yarn-end suction take-

off which is connected to the suction side of a blower in the lower part of the frame **20** through a suction duct **25** including a yarn-end collector or trap **26**. The knitting yarns are fed to the knitting stations from yarn packages **27** mounted on suitable creels or package supports **28** at the rear of the upper portion of the frame.

The needle cylinder **21** and the dial are driven by a conventional ring gear **31** connected to the main drive shaft **32** through suitable gearing including a clutch (not shown) for shifting between unidirectional rotation and reciprocatory rotation respectively. The main drive shaft **32** is driven from a drive motor in the lower portion of the frame **20** through suitable driving connections **33**.

The sequential operations of the knitting instrumentalities of the knitting machine are controlled by pattern mechanism including in the present instance, three pattern control drums, a front drum **41**, a rear drum **42**, and an auxiliary drum **43**, all of which are selectively indexed in timed relation to the rotation of the needle cylinder under the control of a conventional pattern chain or other master pattern control mechanism. During the course of the knitting of a complete stocking, blank, the needles **45** are individually controlled by a needle cam box **46** including cams operable on the butts of the needles, and by selector jacks **47** mounted in the cylinder **21** underlying the needles **45** and operable to selectively elevate the needles through lifter jacks **48** mounted in the needle cylinder intermediate the needles **45** and the selector jacks **47**. The selector jacks, in turn, are actuated by actuators in the form of selector slides, in the present instance arranged in three arrays **51**, **52**, and **53** (see FIGS. 5 and 7). The slides **51** are controlled from a right hand pattern selection drum **61** and the slides **52** are controlled from a left hand pattern selection drum **62**. The slides **53** which constitute an array of six slides, are controlled separately through mechanism shown in part at **63** by one of the control drums, in the present instance, the front drum **41**. In like manner, the lowermost six slides of the array **51** are controlled from the front drum **41** through linkages shown at **65** in FIG. 5, and the lowermost six slides of the array **52** are controlled from the rear drum **42** through linkages shown in part at **68**, operating bell cranks **67**. An individual draw-down slide **54** adjacent the group **51** is controlled from the rear drum **42** through a linkage **64**.

The slides **51** and **52** are arranged insets of from four to eight slides each in the present instance six, and each set may be inactivated independently of its associated pattern selection drum by control mechanism operated from the front drum **41**. The control mechanism for the array of slides **51**, is designated generally **55**, and the control mechanism for the array **52** is designated generally **56**. In FIGS. 1 and 2, the control mechanism **55** and **56** are protected by cover members **57** and **58**.

In accordance with the invention, means is provided to index the pattern drums **61** and **62** twice for every revolution of the needle cylinder so that two adjacent pattern jacks **100** in the pattern selection drum effect a selection of needles at the associated selector stations for one complete revolution of the needle cylinder which, in the present two-feed machine, embodies two courses of knitting. For example, the array **51** may select needles for knitting in the odd-numbered courses of the stocking and the array **52** may select needles for the even-numbered courses. If desired, the slide **54** and an upper slide **54***a* (see FIG. 7) may be used to repeat the selection previously made by the slides **51** in lieu of reselecting by means of the slides **52**. The slides of array **53** correspond to the conventional gusset selector slides for use in knitting a reciprocated contoured heel and toe. Preferably, the slides **52** are used to control the jacks to produce overall patterns, such as meshes and the like which are normally produced on alternate courses only. The slides **51** may be controlled to produce "spot" patterns which are of short length and which appear at one or more localized areas along the length of the stocking blank.

In accordance with the invention the indexing of the pattern selection drums **61** and **62** is effected by ratchet devices controlled from an annular cam surface carried by the ring gear **31** of the knitting machine. The cam surface comprises a double cam track shown at **69** and **70** in FIGS. 5 and 14, each track having a single vertical rise about its circumference, the rise **169** for the track **69** being displaced 180° from the rise **170** for the track **70**. As shown in FIG. 5, follower mechanism operates from the double cam track to index the pattern drums **61** and **62**. The follower mechanism for the pattern drum **61** is designated **71** and includes a pair of connectors **72** and **73** respectively connected to pawl carriers **74** and **75** which are pivoted on the axis of the pattern drum **61** to cooperate with the ratchet wheels **78** and **79** fixed to the drum **61**. As shown, the teeth of the ratchet wheels correspond in length to the spacing of two pattern jacks **100** and the pawls are displaced only the distance of a half-tooth. When the rise of the inner cam track **69** of the double cam track passes into registry with the follower mechanism **71**, the connector **73** operates the pawl carrier **75** a distance to cause the associated pawl **77** to advance the drum **61** one step corresponding to the space of one pattern jack. After 180° of the needle cylinder's revolution, the rise on the outer track **70** of the double cam track operates through the follower mechanism **71** including the connector **72** to displace the pawl carrier **74** a distance to cause its associated pawl **76** to index the drum **61** one step corresponding to the space of one pattern jack. A friction brake is provided on the drum **61** at **96** (see FIG. 17) to prevent the drum from overriding the pawl drive. Similar ratchet mechanism for the drum **62** is provided at **81** including connectors **82** and **83** and pawl carriers **84** and **85** having pawls **86** and **87** respectively operating on ratchet wheels **88** and **89** to index the drum **62** in a manner similar to the indexing of the drum **61**.

In accordance with another feature of the invention stop mechanism is provided to interrupt the indexing of each drum, the stop mechanism for interrupting the indexing of the drum **61** being illustrated at **91**, and the mechanism for interrupting the indexing of the drum **62** being illustrated at **92**. As described more fully hereinafter, the stop mechanism is designed to arrest the drum at a predetermined point in its rotation, as determined by a foreshortened tooth in a selected one of the ratchet wheels. The stop mechanism displaces the pawl associated with the selected ratchet wheel to a position where it does not engage the foreshortened tooth and consequently, interrupts the advance of the ratchet wheel at that tooth. Since both pawls must be effective to cause continued indexing of the drum, interruption by either pawl arrests the indexing of the drum.

As pointed out previously, the slides in the arrays **51** and **52** are controlled by pattern jacks **100** in the pattern selection drums **61** and **62** respectively, and further are capable of being rendered inactive in sets by the control mechanism **55** and **56** respectively. With reference to the slides **51**, each slide is controlled by an operator in the form of a lever **101** pivoted on an upright shaft **102** and having a follower portion **103** operable to be engaged by a butt of the pattern jack **100** mounted in the selection drum **61**. Each lever **101** is further provided with an extension **105** having a spring **106** associated therewith for biasing the follower portion **103** inwardly toward the pattern drum **61**. Thus, for each half revolution of the needle cylinder, the position of the slide in the array **51** is determined by the absence or presence of a butt at the corresponding level on the pattern jack **100** in the pattern drum **61**.

When it is desired to maintain a set of slides in inactive position, i.e., withdrawn from engagement with the butts on the selector jacks **47**, the control mechanism **55** oper-

ates to displace the levers **101** associated with that set. To this end, the control mechanism includes a plurality of stops **111**, equal in number to the number of sets of slides and operable to engage the extensions **105** of the levers **101**. Each stop **111** is mounted on a bar **112** which is mounted for horizontal slidable movement in a support **113**. The bar **112** is biased rearwardly by a spring **114** to a position normally affording actuation of the levers **101** by the pattern jacks **100** in the pattern drum **61**. As shown in FIG. 3, the bar **112** is operated from the front drum **41** by means of a follower **118** and push rod **115** operating on a bell crank **116** pivoted to the support **113** and engaging at its opposite end a pin **117** on the bar **112**. When a cam **119** on the drum **41** (see FIGS. 1 and 2) is in registry with the follower **118**, the rod **115** is displaced upwardly, thereby pivoting the bell crank **116** clockwise to displace the bar **112** to the left against the bias of the spring **114**. In the basence of a cam **119** on the drum **41** in registry with a follower **118**, the associated push rod **115** permits counterclockwise movement of the corresponding bell crank **116**, affording rightward displacement of the bar **112** by the spring **114**, thereby rendering the levers **101** associated with the stop **111** in condition for actuation by the pattern drum. The control mechanism **56** comprises similar elements. With the foregoing arrangement, it is possible to provide several patterns on the selector drum **61** and **62**, and to activate a particular pattern by proper arrangement of cams **119** on the front control drum **41**.

FIGS. 6 to 10 inclusive illustrate typical selector jack and pattern jack arrangements for providing pattern selectivity. For example, FIG. 10 illustrates a butt arrangement for the needles and jacks on the cylinder **21**. Reading from the top of the figure, the first row indicates the needle butts **145** which vary in length about the circumference of the cylinder to cooperate with the needle cams in the cam box **46**. The second row indicates the butts **148** of the lifter jacks **48** which cooperate with lifter jack cams (not shown) in a bed **152** intermediate the needle cam box **46** and the selector jack slides **51** and **52**. In each of these rows in FIG. 10, each line indicates an individual butt, the length of the line indicating the length of the butt. The remainder of FIG. 10 indicates the butt arrangement on the selector jacks **47**.

Adjacent the upper end of each of the selector jacks **47** is an upper guide butt **151** which rides on the underedge of the bed **152** and may selectively control needles through the medium of the slide **54***a* when the latter is displaced into active position. The butts **151** are arranged in two sectors, one sector comprising long butts designated "L" and the other sector comprising short butts designated "S." It should be noted that with radially slidable cams, such as the slide **54***a*, the slide is advanced stepwise into active position. The first step of the advance occurs during the time when the sector of short butts is advancing past the slide, and the final step occurs during the period when the sector of long butts is advancing past and upwardly upon the slide so that when the short butts again pass the slides, the slide is fully inserted to elevate the short butts.

Spaced below the butts **151** on the jacks **47** are drive butts **154**. As shown in FIG. 10, the drive butts **154** are of uniform length to cooperate with fixed cams **155**, **156** and **157** immediately beyond the selector slides **51**, **52** and **53**. The butts **154** are engaged with the cams **155**, **156** or **157** by displacement of the jacks **47** through the medium of one or more of the selector slides **51**, **52** or **53**.

Below the drive butts **154** are selector butts arranged in three groups **161**, **162** and **163**. Each of the groups **161** and **162** comprise butts at thirty (30) patterning levels, the presence of a butt at a particular level being indicated by an *X*, and the absence of a butt being indicated by a blank. The group **163** comprises butts at six (6) other levels and the length of the butts are indicated in FIG. 10 by the designations "L" and "S," the absence of a butt being indicated by a blank. The group **161** cooperates with the upper thirty slides and the group **162** arrays **51** and **52**. The group **163** cooperates with the lower six (6) slides of the arrays **51** and **52** and also the entire array **53**.

Below the group **163** and adjacent the bottom of the jack is a lower guide butt **164** which rides on the upper edge of a lower bed **165** and may be selectively engaged by the slide **54**. It should be noted that the butts **164** are arranged in sectors of long and short butts which are opposite to the sectors of long and short butts of the butts **151**.

The slides cooperating with the butts **151**, **163** and **164** are inserted into action stepwise as noted above so that the butts may be arranged about the full circumference of the cylinder. The selector slides cooperating with the butts **161** and **162** at the patterning levels, on the other hand, are not displaced into their inserted position stepwise, but are displaced between their fully inserted and fully retracted position in one movement. In order to enable such movement without damaging the butts on the selector jacks, the butts in the groups **161** and **162** are confined to limited circumferential sectors of the cylinder. In the present instance, there are four hundred and one (401) selector jacks **47** disposed about the circumference of the cylinder and the group of butts **161** embraces one hundred and thirty-nine (139) of these jacks. The group **162**, on the other hand, embraces the remaining two hundred and sixty-two (262) jacks. In this way, the slides for the groups **161** may be displaced freely without damage to the butts during that portion of the cycle when the **262** jacks are passing these slides. The slides for the butts **162** on the other hand, are displaced in that period when the **139** jacks are passing those butts.

The cams and slides which operate on the butts **145**, **148**, **151**, **163**, and **164** are all controlled from the pattern control drums **41**, **42** and **43** whereas the selector slides which operate on the butts **161** and **162** are controlled from the pattern selector drums **61** and **62**. As noted above, taking the selector drum **61** as an example, each slide **51** is controlled by a lever **101** having a follower portion **103** which may ride on a butt of a pattern jack **100** mounted in the drum **61**. The drum **61** is indexed a distance corresponding to the spacing of one pattern jack **100** each half revolution of the needle cylinder **21**. One such index of the pattern drum **61** is effected when the **139** jacks are passing the slides **51** and the other index is effected when the **262** jacks are passing the slides **51**.

FIG. 8 is a diagram of a portion of the pattern selector drum **61** wherein a vertical line of squares indicates a single pattern jack, each square representing a butt level thereon, the darkened squares indicating the presence of a butt and the blank squares indicating the absence of a butt. As shown, the butts on the pattern jacks **100** are arranged in upper and lower groups **171** and **172** respectively corresponding to the groups **161** and **162** at the patterning levels of the selector jacks. Since there are two pattern jacks for each revolution of the cylinder, the butts in each group are arranged in pairs on adjoining jacks. The pairs in the group **171** are offset from the pairs in the group **172** by one jack. Thus, in the major pattern area in the drum **61**, the jacks are numbered **100–1**, **100–2**, **100–3**, etc., reading from the right hand side. As shown in FIG. 8, the butts in the group **171** are identical on the jacks **100–1** and **100–2**; and also on the jacks **100–3** and **100–4**, and so forth. On the other hand, the butts in the group **172** are identical on the jacks **100–2** and **100–3**, and also on the jacks **100–4** and **100–5**, and so forth. It should also be noted that the arrangement and sequence of butts in the group **171** is identical to the arrangement and sequence in the group **172**.

In accordance with the invention, as noted above, the drum **61** is indexed every half cycle of the cylinder. To

this end, the rises **169** and **170** are displaced 180° from one another. The rise **169** displaces the connector **73** a distance sufficient to displace the pawl carrier **75** an angular distance corresponding to a half tooth of the ratchet wheel **79**. As the follower falls off of the rise **169**, the pawl carrier is retracted a half tooth so that the pawl **77** rides half way up the next tooth. The displacement of the pawl indexes the drum the distance of the spacing of one pattern jack **100** and causes the ratchet **78** to advance so that the pawl **76** engages behind the tooth on the ratchet. After 180° of rotation of the cylinder, the rise **170** on the track **70** displaces the pawl carrier **74** the distance of a half tooth to thereby index the pattern drum the distance of the spacing of one pattern jack **100**. This carries the ratchet wheel **79** the remaining half of its tooth spacing so that the pawl **77** engages behind the next tooth.

The teeth of the ratchet wheel **78** are in registry with the pattern jacks **100–1**, **100–3**, **100–5**, etc. whereas the teeth of the ratchet wheel **79** are in registry with the pattern jacks **100–2**, **100–4**, **100–6** etc. Thus, indexing of the drum by the pawl **76** and ratchet wheel **78** displaces the pattern drum so that the follower portion **103** of the lever **101** travels from the odd-numbered pattern jacks onto the even-numbered pattern jacks. In like manner, indexing of the drum by the pawl **77** and ratchet wheel **79** causes the follower portions **103** to travel from the even-numbered pattern jacks to the odd-numbered pattern jacks.

It is noted that when the drum is indexed by the pawl **76** and ratchet **78** so that the follower portions **103** of the levers **101** shift from the pattern jack **100–1** to the pattern jack **100–2**, the levers associated with the group **171** do not change whereas the levers associated with the group **172** do change. This index occurs during passage of the **139** selector jacks past the selector slide array **51** when there are no butts in the group **162**, and accordingly, no interference with the changing of the levers by the pattern jack butts **172**. The index by the pawl **77** and ratchet **79**, which causes the follower portions **103** to travel from the pattern jack **100–2** to the jack **100–3**, occurs when the **262** jacks are passing the slide array **51**. This latter index of the drum displaces the levers associated with the group **171** but maintains stationary the levers associated with the group **172**. Thus, the butts on the selector jacks do not interfere with the displacement of the slides.

Since the indexing noted above is effected by the rises **169** and **170** on the cam tracks carried by the ring gear **31** of the knitting machine which also carries the needle cylinder **21**, the pawl **76** and ratchet **78** operate only when the **139** selector jacks pass the slide array **51**. By the same token, the pawl **77** and ratchet **79** are effective to index the drum only when the **262** jacks are passing the slide array **51**. Thus, if one of the pawls is inactivated, or is ineffective to index the drum, during any portion of the knitting cycle, the drum **61** will not be indexed since both pawls **76** and **77** must be activated to index the drum. When both pawls are again activated, the indexing of the drum will resume automatically in properly timed relation to the needle cylinder.

Means is provided to arrest indexing of the pattern drum at predetermined points in its rotation. In the present instance, provision is made for arresting the drum at two predetermined points spaced approximately 180° from one another. To this end the ratchet sheel **78** is provided with a foreshortened tooth **178** and the ratchet sheel **79** is provided with a foreshortened tooth **179**. And the stop mechanism is operated to position the poles **76** and **77** to avoid engagement of the foreshortened tooth.

As best shown in FIGS. 15–18, the stop mechanism **91** comprises upper and lower stop plates **182** and **183** respectively. The plate **182** carries an upstanding pin **184** operable to engage the yoked end **186** of a bell crank **188** pivoted on a post **190** and operated by an operator **192** from a pattern control drum. The stop plate **183** has a depending pin **185** adopted to engage the yoked end **187** of a bell crank **189** pivoted on the post **190** and operated by an operator **193** controlled by a pattern control drum.

The stop plate **182** has a two-stepped cam surface at **194** and **195** operable to engage the pawl **76**. When in the position shown in FIG. 16, with the surface **194** in registry with the pawl **76**, the pawl is free to fully engage the teeth of the ratchet **78**. When the stop plate **182** is displaced counterclockwise, as shown in FIG. 18, the surface **195** engages under the pawl **76** so as to cause it to partially disengage the teeth on the ratchet **78**. This partial disengagement of the teeth does not affect the normal indexing of the ratchet by the pawl **76** until the foreshortened tooth **178** passes into registry with the pawl **76**. When this occurs, the pawl **76** cannot engage the foreshortened tooth **178** because of the stop surface **195**, and the indexing of the pattern drum is arrested. When it is desired to resume indexing of the drum **61**, the stop plate **182** is displaced to the position shown in FIG. 16 which places the surface **194** in registry with the pawl, permitting it to engage the foreshortened tooth **178**, whereupon normal indexing of the pattern drum resumes.

The stop plate **183**, on the other hand, is provided with a three-stepped cam surface identified at **196**, **197**, and **198**. The surfaces **196** and **197** perform the same function with respect to the pawl **77** as the surfaces **194** and **195** perform with the pawl **76**. The surface **198**, on the other hand, serves to instantaneously arrest indexing of the pattern drum by disengaging the pawl **77** from all of the teeth of the ratchet **79**. Thus when the pawl **77** is in registry with the surface **196**, the pattern drum indexes continuously so long as the pawl **76** is operated. When the surface **197** is registered with the pawl **77**, the indexing continues until the half tooth **179** passes into registry with the pawl **77**. When the surface **198** is in registry with the pawl **77**, the indexing of the pattern drum is arrested.

In order to provide for wide pattern selectivity in the knitting machine without need for changing the jack arrangement in the cylinder or in the pattern drum, plural patterns are set up into the pattern drums to be selected by suitable camming on the front drum.

A particular pattern is rendered operative when the associated stops **111** are withdrawn to permit the levers **101** associated with said stops to engage against the pattern jack butts. The stops **111** which are not withdrawn inactivate the remaining levers **101** so as to cancel the remaining patterns. Inasmuch as fancy patterns embrace only a limited number of courses, it is necessary to use only a segment of the circumference of the pattern drum to provide such patterns. In the present instance, as shown in the development of the drum shown in FIG. 6, the fancy patterns are confined to half segments of the drum.

To prevent the pattern from both pattern beds of the pattern drum **61** from appearing inadvertently, the foreshortened teeth **178** and **179** on the ratchet wheels **78** and **79**, which normally arrest the indexing of the drum as discussed above, are positioned in advance of each pattern segment of the drum to stop the drum in advance of the pattern. Thus, to re-initiate the indexing of the drum, the pawl stop **91** must be actuated to permit the pawl **76** or **77** to engage the foreshortened tooth. The pawls **76** and **77** are actuated to initiate the formation of the desired fancy pattern, and the indexing of the drum automatically stops at the next foreshortened tooth. Thus, at the end of the formation of the desired fancy pattern, the pattern drum **61** is 180° from the desired starting point in the next stocking. This 180° displacement of the pattern drum may be accomplished any time during the formation of the remainder of the stocking simply by actuating the stops **111** associated with the

selector slides so that all of the steps are effective to prevent actuation of the slides as the drum is indexed back to the desired starting point.

Thus, it is apparent that a single pattern drum **61** provides a selection of fancy patterns simply by changing the cams associated with the push rods **115** to actuate the stops **111**, and the cams controlling the pawl stop mechanism **91**. A similar arrangement may be provided on the pattern drum **62**, but it is preferred to set up patterns on the drum **62** which are of infinite length and therefore are continuous about the entire circumference of the pattern drum.

Thus, the present invention provides means for indexing a pattern drum of a knitting machine in accurately timed relation to the needle cylinder so as to enable displacement of the cams or slides controlling the knitting instrumentalities at the proper times in relation to the rotational position of the needle cylinder. The invention enables removal and replacement of the drum for changing the set-up thereof, the replacement being effective automatically to assure properly timed relationship between the drum and the cylinder. The novel indexing arrangement enables stopping of the pattern drum at any selected point and resumption of indexing of the drum automatically in properly timed relation.

The invention has been described in connection with an embodiment wherein the pattern drum controls the selection of jacks by the operation of selector slides, the drum including two pattern jacks for each revolution of the needle cylinder. By the same token there are two ratchet wheels. It is within the scope of the invention to provide a greater number of pattern jacks for each revolution of the cylinder with a like number of ratchet wheels, each controlled from a separate cam track carried for rotation in synchronism with the knitting needle cylinder. The invention may also be used for controlling other pattern drums which must be accurately timed with relation to the needle cylinder and which may be removed from the knitting machine for changing the set-up thereof.

While a particular embodiment of the present invention has been herein illustrated and described it is not intended to limit the invention to such disclosure but changes and modifications may be made therein and thereto within the scope of the following claims.

I claim:

1. In a circular knitting machine having a rotary needle cylinder with a driving gear therefor, needles and jacks carried by said cylinder and having butts, actuators in the form of cams and slides selectively engaging said butts for displacing said needles, selected actuators being mounted for selective displacement radially of said cylinder, and at least one pattern drum for operating said selected actuators; means for indexing said drum at least twice for a revolution of said cylinder comprising at least two drum-advancing devices, each device comprising a ratchet wheel fixed to said drum and having a tooth length corresponding to the distance said drum is indexed for each revolution of the cylinder, and a separate pawl engageable with said teeth and operable to advance the ratchet wheel and drum a distance less than the distance of one tooth, means to operate the pawls of said devices in sequence so that the drum is indexed the distance of one tooth in steps, whereby disengagement of any pawl from the teeth prevents completion of the indexing and arrests the indexing of said drum.

2. A circular knitting machine according to claim **1** wherein each pawl is indexed the distance of one-half tooth, so that the drum is indexed a full tooth in two steps, the displacement of the drum by each pawl effecting engagement of the other pawl behind its next tooth on the ratchet.

3. A circular knitting machine according to claim **2** wherein said means to operate the pawls comprises a separate cam track for each pawl carried on said driving gear, the cam tracks having a single rise, a follower for each cam track connected to the associated pawl and operable to effect said half-tooth displacement, said rises and followers being positioned to effect an index of said drum every half-revolution of said cylinder.

4. A circular knitting machine according to claim **3** wherein the butts engaged by said selected actuators are disposed in groups extending about a portion of said cylinder, said pattern being indexed to displace each actuator during the portion of said cylinder revolution when the group, which would otherwise interfere with the displacement, is out of registry therewith.

5. In a circular knitting machine having a rotary needle cylinder, and a pattern drum operable to be indexed twice for every revolution of said cylinder; means to index said drum comprising two ratchets fixed to said drum, each ratchet having teeth of a length corresponding to twice the distance of each index, a pawl for each ratchet, separate means to displace each pawl the distance of a half tooth comprising a pawl carrier, and means to operate said carriers in alternation every half revolution of said cylinder whereby one pawl and ratchet is effective only during alternate half-revolutions of said cylinder and the other pawl and ratchet is effective only during the remaining half-revolutions of said cylinder.

6. A circular knitting machine according to claim **5** wherein said means to operate the pawl carriers comprise cam means fixed relative to said cylinder for simultaneous rotation therewith, each cam means operating to displace its associated pawl at a predetermined point in the revolution of said cylinder.

7. A circular knitting machine according to claim **5** wherein at least one of said ratchets includes a radially foreshortened tooth, and including stop means to displace the associated pawl out of the path of said foreshortened tooth whereby the indexing of said drum is arrested when said pawl passes into registry with said foreshortened tooth.

8. A circular knitting machine according to claim **6** including stop means to displace one of said pawls out of the path of the teeth of said ratchet to thereby arrest indexing of said drum.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,289,437 December 6, 1966

Peter A. Mahler

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 3, after "162" insert -- cooperates with the next thirty slides of the selector slide --.

Signed and sealed this 26th day of September 1967.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents