

June 17, 1969

F. SVOBODA ET AL

3,449,929

NEEDLE SELECTING ASSEMBLIES FOR FLAT-KNITTING MACHINES

Filed Aug. 28, 1967

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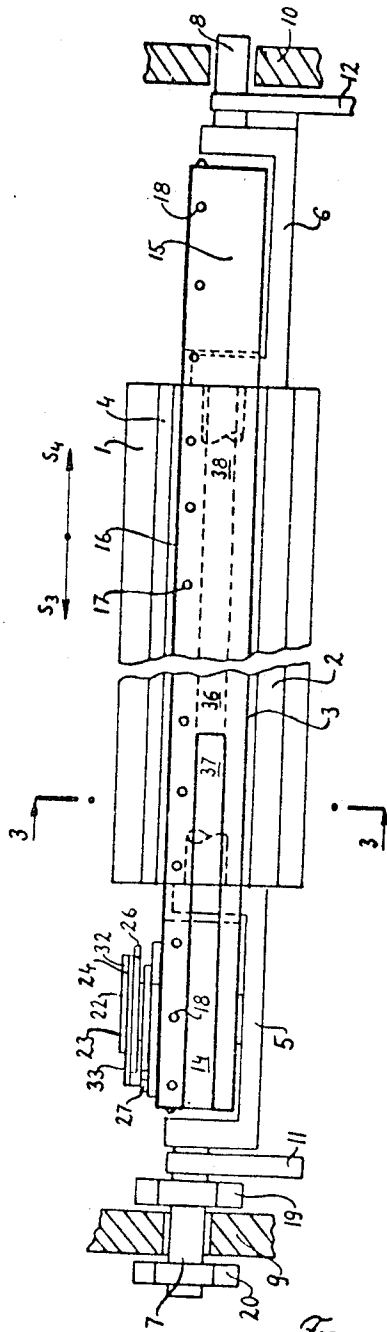


Fig. 1

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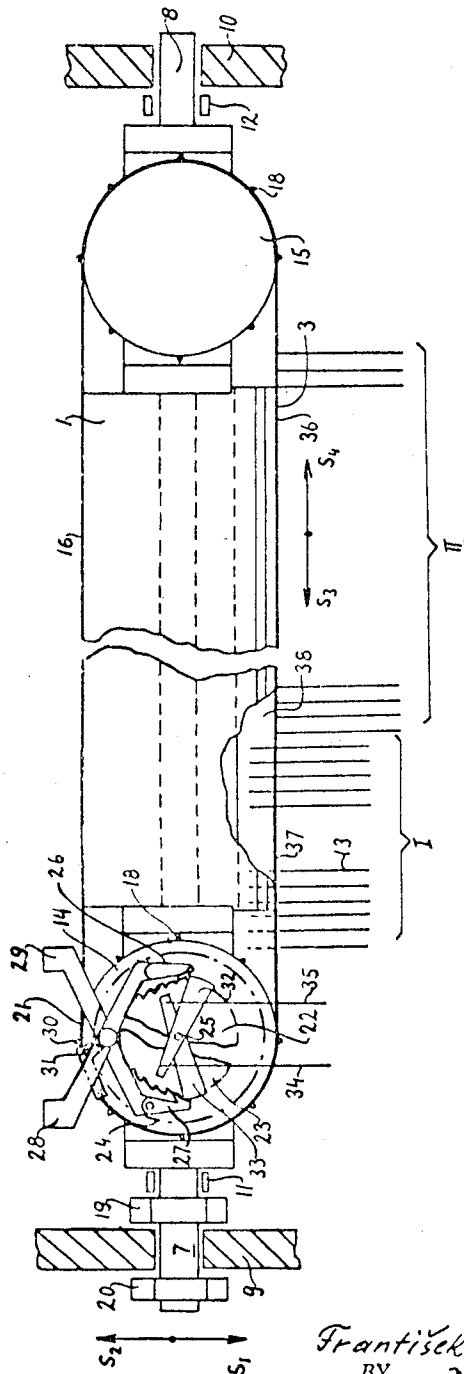


Fig. 2

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Fig. 3

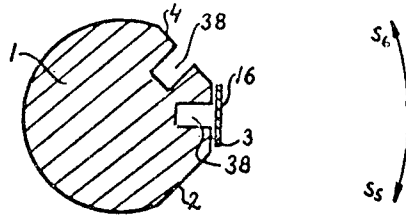
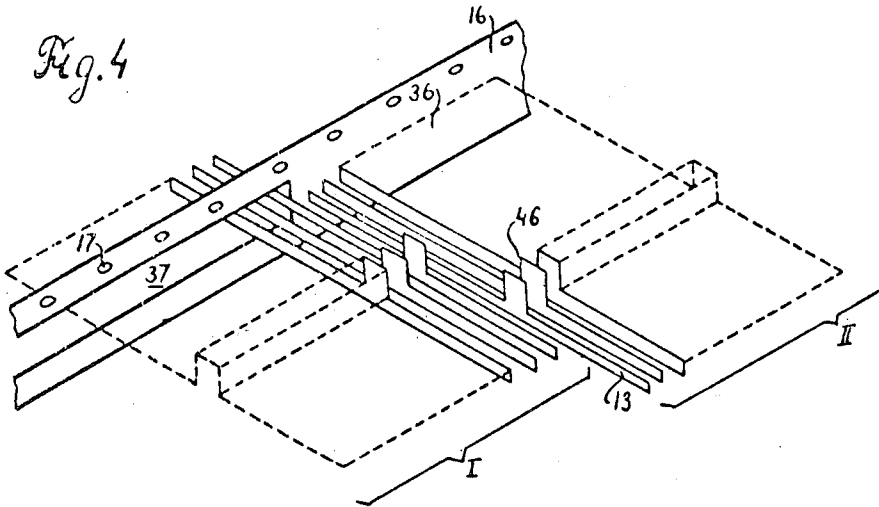


Fig. 4



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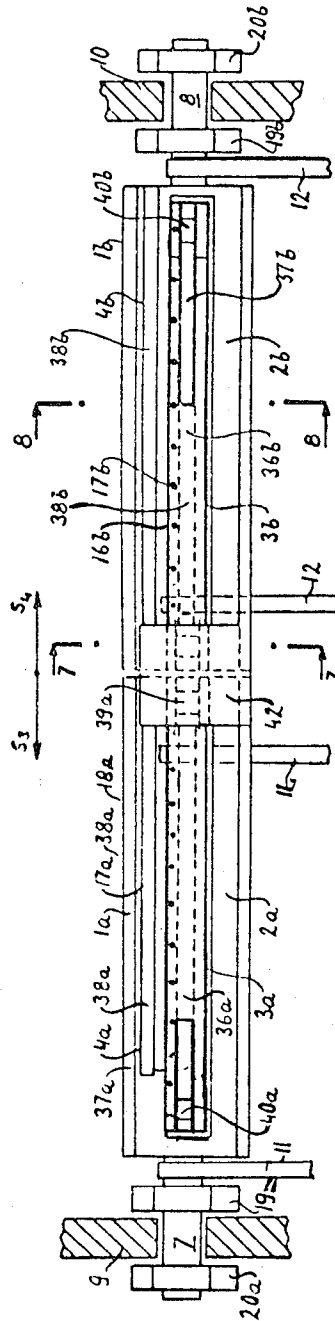
3,449,929

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Fig. 5



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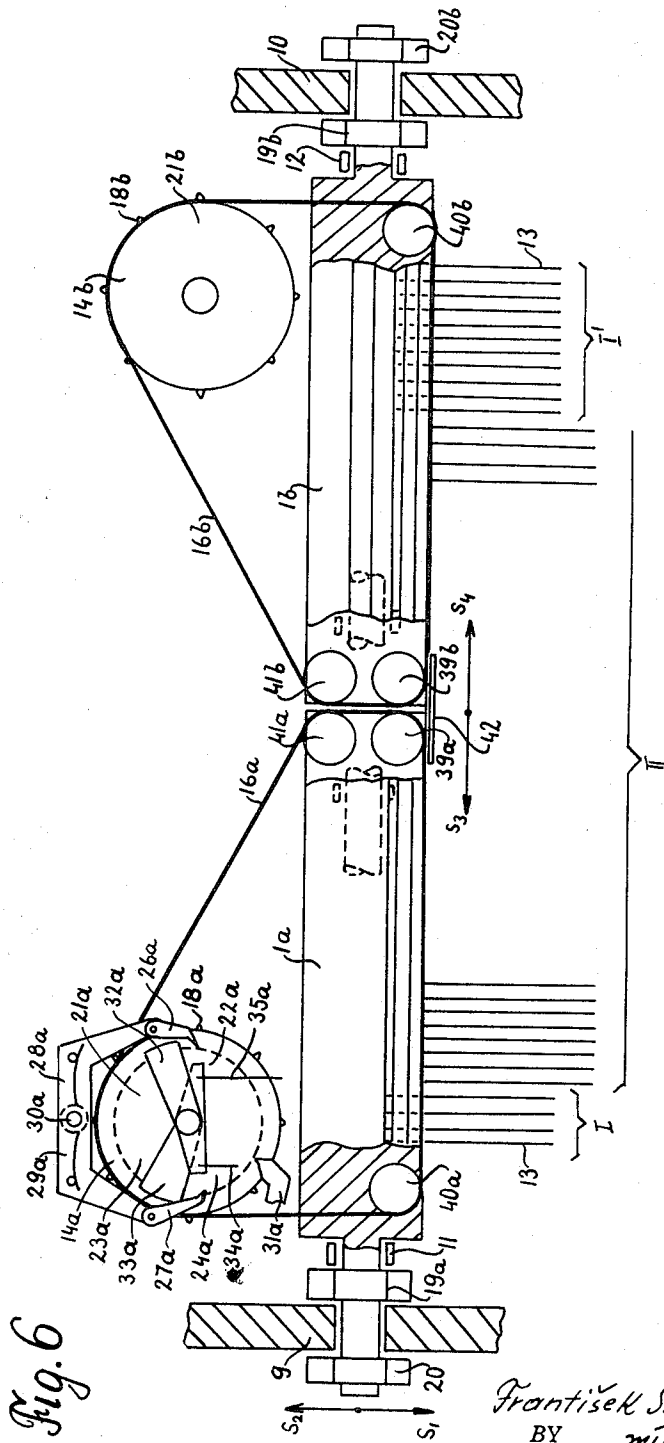


Fig. 6

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Fig. 7

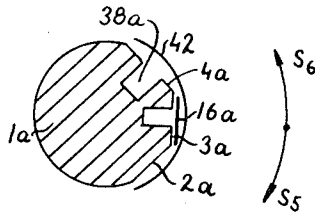
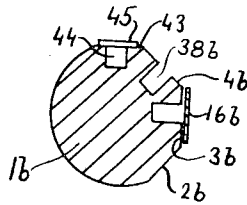


Fig. 8



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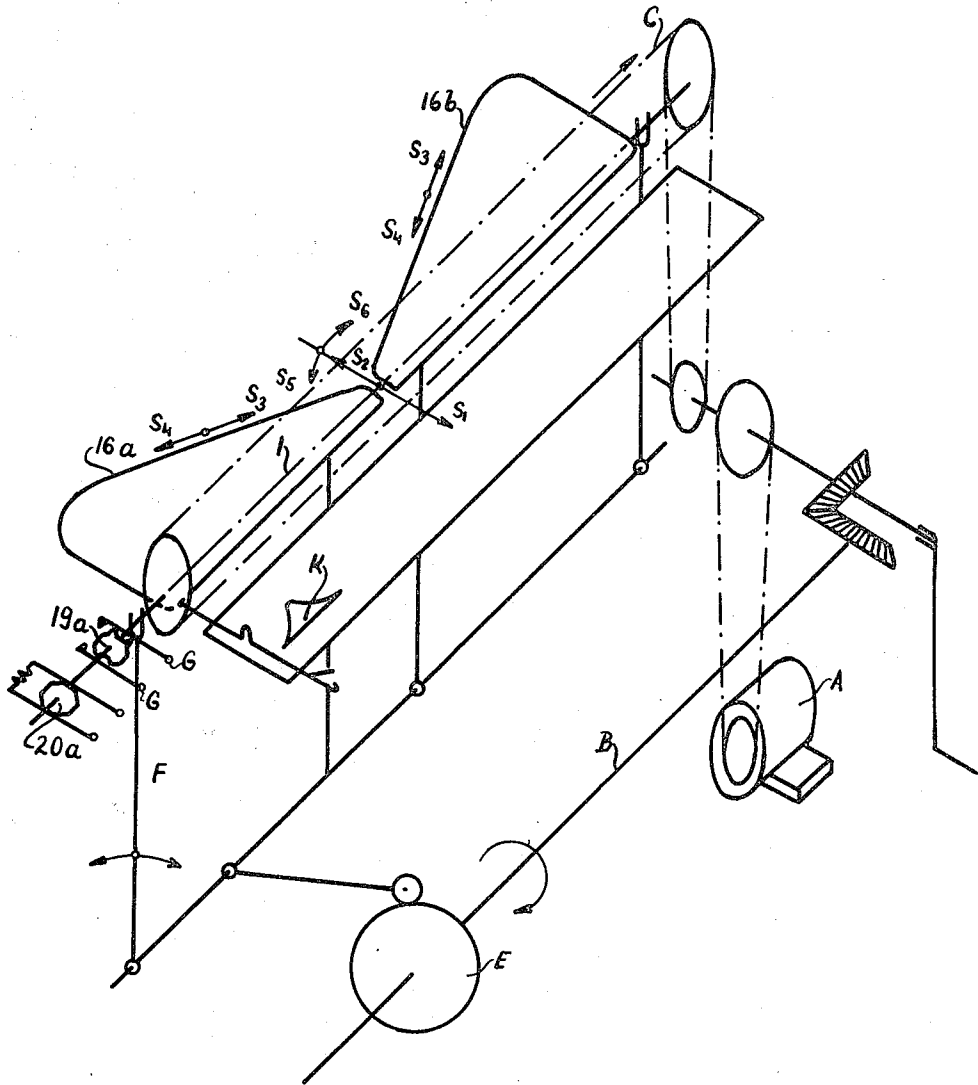


Fig. 9

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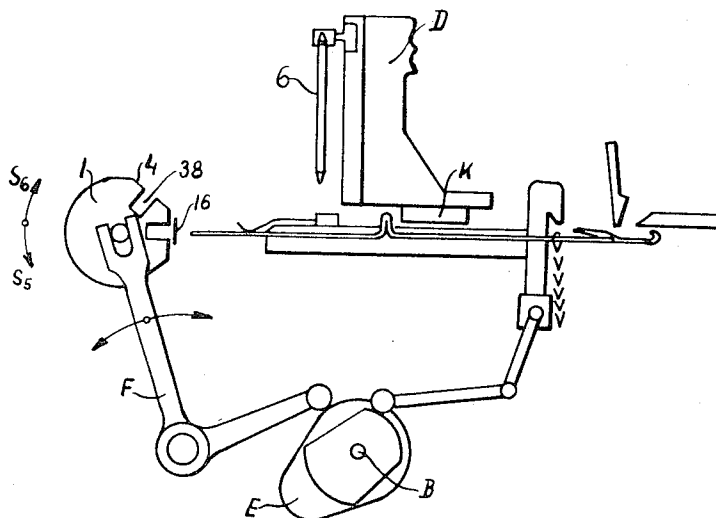


Fig. 10

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NEEDLE SELECTING ASSEMBLIES FOR FLAT-KNITTING MACHINES

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Filed Aug. 28, 1967, Ser. No. 663,814

Claims priority, application Czechoslovakia,

Aug. 26, 1966, 5,552/66

Int. Cl. D04b 15/70, 7/24, 7/10

U.S. Cl. 66—154

8 Claims

ABSTRACT OF THE DISCLOSURE

An assembly for selecting, in a flat-knitting machine, the number of needles which are to operate and the number of needles which are to remain in non-operating positions. The assembly includes an elongated cylinder formed with a longitudinal groove extending axially thereof at its exterior. An elongated endless belt extends longitudinally along this groove and has an elongated portion formed with a slot which is aligned with the groove of the cylinder as well as an adjoining non-slotted portion that covers the groove of the cylinder. A means is provided for selectively positioning the belt longitudinally with respect to the grooved part of the cylinder so that in accordance with the selected longitudinal position of the belt a given part of the slot of the cylinder will be accessible through the slot of the belt while another part of the groove of the cylinder will be covered by the non-slotted portion of the belt. This non-slotted portion of the belt which covers the groove of the cylinder will situate knitting needles in their operating positions while those knitting needles which are not to operate will have components thereof received in the groove of the cylinder through the slot of the belt so that it is possible in this way to have selected needles retracted to their non-operating positions. Thus, in accordance with the longitudinal position of the belt with respect to the cylinder a given number of needles can be retracted through the slot of the belt into the groove of the cylinder to non-operating positions while the non-slotted portion of the belt which covers the cylinder groove will locate the remaining needles in their operating positions.

Background of the invention

The present invention relates to knitting machines.

More specifically, the invention relates to flat-knitting machine in which knitted products can be fashioned while being flat-knitted.

The invention relates in particular to assemblies for selecting the number of needles which at any time during the operations participate in the knitting operations so as to determine the length of the courses which are knitted.

It is already known to knit parts of garments in flat condition, with the knitted courses having different lengths, the courses in the final product extending vertically while the wales extend horizontally. It has also been proposed to provide knitted garments by knitting courses of different lengths on flat-knitted machines during a single cycle of operations, with the individual parts of the article being connected by suitable knitted structure with the wales running horizontally.

Wider use of this advanced technique of knitting garments having portions shaped in two or three dimensions and having a relatively large number of parts which are interconnected by suitable knitting has been prevented because of a very important factor. The machines which have been used up to the present time to provide knitting

of the above general type during automatic operation are extremely complex and very expensive, particularly in the case where the fashioned article is made from fabric which is patterned by suitable knitted structure. Although in general the greatest part of such fashioned articles will be made of plain jersey-knitted fabric, even such fabrics cannot at the present time be automatically produced on any known machines, except in the case of impractical machines which are so complicated and expensive that they would serve no practical purpose in a commercial sense. It is only in the manufacture of berets, an article which can be considered as fashioned in two and three dimensions and made up of several sections connected to each other by suitable knitting and having their courses extending in a horizontal direction, that a special automatic practical beret-manufacturing machine is known. Such machines are, in principle, tricot warp knitting machines having a single, usually horizontal, latch needle bed of a relatively small operating width of up to 59 cm. With such machines a simple cam which is mounted in a suitable slide operates as a clearing cam, while punched jacquard cards on a movable jacquard cylinder of a length corresponding to the operating width and located in the plane of the knitting needles operate as a loop-forming cam. Before a course is knitted the cylinder carries out a reciprocating motion longitudinally of the knitting needles as well as an intermittent rotary movement around its own axis, if so indicated by the programming structure. In order to hold previously knitted loops on the knitting needles the machines have jacks which are mounted in a special jack bed. Such machines are also equipped with one or two drums having control chains which count the courses.

Berets are manufactured on such machines with from 22 to 24 triangularly shaped sections, each consisting of up to sixty courses, the regular shape of these triangular individual sections being assured by uniform changes in the length of one course with respect to the next course. A punched jacquard card corresponds to each individual course so that the movable cylinder has at its circumference up to sixty punched jacquard cards. Each of these cards accommodates a number of punches, corresponding to the number of knitting needles along the entire machine width. For example, if the operating width is 59 cm., and the gauge is 12, the card should accommodate about 280 punches. During its forward motion, the cylinder pushes all of the knitting needles with a corresponding blank position in the jacquard card for the given course into the working position while all other needles remain inoperative. In other words, the unpunched portion of the jacquard card will push selected needles into the operating positions. The remaining needles pass through the punches of the card. It is, therefore, clear that machines of this type cannot be used for making products other than berets because of the insufficient operating width of the machines and the limited repeating range of the jacquard motion, and as a result of the limited number of jacquard cards which can be accommodated circumferentially of the cylinder.

Thus, the situation is that any known structure for manufacturing multipartite fashioned knitted products is too complex and very narrowly specialized, and the selection of knitting needles by jacquard cards has the very great disadvantage of requiring a single card for each course.

Summary of the invention

It is a primary object of the present invention to provide a needle selecting structure which will eliminate the above mentioned disadvantages.

In particular, it is an object of the invention to provide a needle selecting assembly for knitting fashioned articles

on a flat-knitting machine with an exceedingly simple and reliably operating structure that can be adjusted so as to select the number of needles which are to participate in the knitting and the number of needles which are to be maintained in their nonoperating positions.

Another object of this invention is to provide a simple, inexpensive assembly which will operate reliably to provide a selected number of needles that participate in the knitting operations while at the same time enabling the assembly to be very quickly positioned in such a way that the previously selected number of needles can be changed in accordance with predetermined programming.

Also, it is an object of the present invention to provide a structure which leads itself to an extraordinarily simple movement in order to provide either knitting with all of the needles or in order to position all of the needles in non-operative positions.

With the structure of the invention there is an elongated cylinder formed at its exterior surface with a longitudinal groove capable of receiving components of those needles which are to be retracted to non-operating positions. An elongated belt extends longitudinally of this cylinder along the groove thereof and has a non-slotted portion which covers the cylinder groove. Adjoining its non-slotted portion, this belt is formed with a longitudinal slot which is in registry with the cylinder groove so that by positioning the belt longitudinally of the cylinder a predetermined fraction of the cylinder groove will be accessible through the slot of the belt. A means is provided for selectively positioning the belt longitudinally with respect to the cylinder groove in accordance with suitable programming structure so that in this way, for example, a given fraction of the length of the cylinder groove will be accessible through the belt slot to maintain a preselected number of needles in their non-operating positions where they extend through the belt slot into the cylinder groove, while the non-slotted portion of the belt which extends across and covers part of the cylinder groove will press or push selected needles to their operating positions.

Brief description of drawings

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a schematic partly sectional front elevation of one possible embodiment of a needle-selecting assembly according to the invention;

FIG. 2 is a schematic partly sectional top plan view of the structure of FIG. 1;

FIG. 3 is a transverse section of the structure of FIG. 1, taken along line 3—3 of FIG. 1;

FIG. 4 is a fragmentary perspective illustration of the manner in which the structure of the invention operates;

FIG. 5 is a schematic partly sectional front elevation of another embodiment of a needle-selecting assembly according to the invention;

FIG. 6 is a partly sectional schematic top plan view of the structure of FIG. 5;

FIG. 7 is a transverse section taken along line 7—7 of FIG. 5;

FIG. 8 is a transverse section taken along line 8—8 of FIG. 5;

FIG. 9 is a schematic perspective representation of the embodiment of FIG. 5 with structure of the machine which coacts therewith; and

FIG. 10 is a schematic side view of the structure of FIG. 9.

Description of preferred embodiments

Referring now to the drawings in greater detail, and initially to FIGS. 1-3, the illustrated needle-selecting assembly of the invention includes an elongated movable cylinder 1 for selecting needles of a single-bed flat-knitting machine the conventional components of which are not illustrated since they are well known to those skilled in

the art and do not form part of the invention. The cylinder 1 is provided with three longitudinally extending operating fields 2-4 angularly distributed about the cylinder axis with the main operating field 3 situated between the auxiliary operating fields 2 and 4. Inasmuch as these are the only operating fields of the cylinder 1, the part of the exterior surface thereof which is not required to accommodate operating fields extends in cross section along a circle whose center is in the cylinder axis, while the operating fields 2-4 have flat exterior surfaces angularly arranged with respect to each other in the manner most clearly shown in FIG. 3.

A support means is provided to support the cylinder 1 for movement, this support means including holders 5 and 6 each of which is connected to the cylinder 1 at an end thereof so as to support and carry the cylinder 1. As is apparent from FIG. 1, the holders 5 and 6 which carry the cylinder 1 are each of substantially U-shaped configuration and have their inner ends directly connected to the ends of the cylinder 1. At their outer ends, these holders 5 and 6 are fixed to journals 7 and 8, respectively, which are received in bearings 9 and 10, respectively, capable of shifting forwardly and rearwardly with respect to the machine frame in the direction of the double-headed arrow S_1, S_2 indicated at the left to FIG. 2. In order to shift the cylinder 1 and its supporting structure forwardly and rearwardly in this manner, the journals 7 and 8 are received in bifurcated upper ends of rocking arms 11 and 12, respectively, these arms being rocked to shift the cylinder 1 back and forth longitudinally of the knitting needles in a manner described in greater detail below in connection with FIGS. 9 and 10.

The several knitting needles 13 are mounted in a suitable needle bed which is only schematically illustrated in FIG. 10. The holders 5 and 6 which form part of the support means for the cylinder 1 also serve to support for rotary movement guide rollers 14 and 15 which carry and guide for longitudinal movement an endless belt 16 made, for example, of sheet steel and provided with a series of opening 17 distributed longitudinally of the belt 16 adjacent an edge thereof, in a manner similar to the perforations along an edge of a strip of photographic film, the guide rollers 14 and 15 having projections 18 which enter into the openings 17 so that in response to the rotary movement of the guide rollers the belt 16 will be advanced and will not slip with respect to the guide rollers which thus coact in the manner of a sprocket wheel with the openings in the endless belt 16. The belt-advancing projections 18 of the guide rollers 14 and 15 are uniformly distributed about the circumference of these rollers, as is particularly apparent from FIG. 2.

The journal 7 carries a toothed wheel 19 which is acted upon by a suitable pawl structure for providing in this way rotary movement of the journals 7 and 8 as well as the cylinder holders 5 and 6 about the axis of the cylinder 1 which is thus compelled to turn with the journals about their common axis, so that in this way the angular position of the cylinder 1 can be determined and thus a selected one of the operating fields 2-4 can be positioned in the plane of the needles 13. A polygonally shaped disc 20 is fixedly carried by the journal 7 to coact with suitable leaf springs which press against the flats at the outer periphery of the polygonal component 20 so that this structure acts as a detent for reliably positioning the cylinder 1 in predetermined angular positions. In this way it is possible to rock the cylinder 1 in the direction of the double-headed arrow S_5, S_6 indicated in FIG. 3.

The roller 15 is simply an idler roller which turns in response to the longitudinal movement of the belt 16 by the roller 14 which is a driving roller as well as a guiding roller. The roller 14 is driven by a means 21 controlled from a suitable programming structure which is not illustrated. By way of this means 21 it is possible to selectively position the endless belt 16 at a preselected longitudinal position with respect to the cylinder 1, and such pre-

selected longitudinal position of the belt 16 will be determined by the control structure of a programming device which, as has already been mentioned, is not illustrated and which is well known per se. The means 21 includes three ratchet wheels 22, 23, and 24 which are positioned on a common journal 25 that is fixed to the guide roller 14. The ratchet wheels are themselves fixed to each other and to the wheel 14. A pawl 26 coacts with the teeth of the ratchet wheel 22, while a pawl 27 coacts with the teeth of the ratchet wheel 23, and the lowermost ratchet wheel 24 which is of the largest diameter coacts with a pawl 31 that serves simply to releasably lock the guide roller 14 in the angular position to which it is turned by one or the other of the ratchet wheels 22 and 23 which are respectively turned by the pawls 26 and 27. The pawls 26 and 27 which are spring-urged into engagement with the teeth of the ratchet wheels 22 and 23 are themselves pivotally carried at the ends of a pair of control levers 28, 29 which are supported for turning movement intermediate their ends on a pivot 30 that is common to the levers 28 and 29 and is carried by any suitable non-illustrated stationary supporting structure which maintains the pin 30 in the position shown in FIG. 2 so that in response to the swinging of the lever 28 or 29 the pawl 26 or 27 will coact with the wheel 22 or 23 so as to turn the roller 14 in one direction or the other.

The central pin 25 which projects from the guide roller 14 supports for free swinging movement with respect to the guide roller 14 a pair of control levers 32 and 33 which are acted upon by a Bowden cable 34 and 35, respectively. These cables, in turn, are controlled by the programming structure which may include suitable drums and control chains. Thus, if the cable 34 is pulled, the control lever 32 will maintain the pawl 26 away from the teeth of the wheel 22, so that the pawl 27 will coact with the teeth of the wheel 23 for turning the roller 14 in a clockwise direction, as viewed in FIG. 2. On the other hand, the programming structure can provide a pull by the cable 35 and action on the control lever 33 to turn the latter in a clockwise direction, again as viewed in FIG. 2, so that lever 33 will engage the pawl 27 and maintain it beyond the range of the teeth of the wheel 23. At this time, the pawl 26 can coact with the ratchet wheel 22 in order to turn the guide roller 14 in a counter-clockwise direction (see FIG. 2). As a result, it becomes possible to move the endless belt 16 longitudinally in the direction of the double-headed arrow S_3 , S_4 indicated in FIG. 1. Inasmuch as a single tooth of each of the ratchet wheels 22 and 23 corresponds to a single pitch of the series of knitting needles 13, it is possible to control the position of the endless belt 16 so that it can be adjusted in both directions within the distance occupied by a single knitting needle 13. The pawl 31 coacts with the ratchet wheel 24 so as to releasably lock the belt 16 in the selected longitudinal position.

This endless belt 16 extends longitudinally along the main operating field 3 of the movable cylinder 1 and has along a part of its length a non-slotted continuous uninterrupted portion 36. It is also provided along a considerable part of its length with a longitudinal slot 37 through which it is possible for components of the knitting needles 13, such as the stems thereof, to pass so as to enable the needles to be retracted to nonoperating positions. The longitudinal slot 37 of the belt 16 has a length which is as great as the entire width of the needle bed so that in a given position of the belt 16 it is possible for all of the stems of all of the knitting needles to pass through the slot 37, and the elongated non-slotted portion 36 of the belt 16 also has a length corresponding to the entire width of the needle bed so that it is possible to position the belt 16 at a location where all of the needles 13 will be simultaneously pushed by the belt 16 into their operating positions by the non-slotted portion 36 of the belt.

The main operating field 3 of the cylinder 1 is formed longitudinally of the cylinder with an elongated groove

38 extending along the entire length of the cylinder and registering with the part of the slot 37, which extends along the operating field 3, so that those needles which are retracted through the slot 37 into their nonoperating positions can be received in the groove 38 of the operating field 3. Thus, by providing a selected longitudinal position of the belt 16 with respect to the cylinder 1, as determined by the programming structure and the means 21, it is possible for a given number of knitting needles 13 to be maintained in their retracted inoperative positions where components of the needles extend through the slot 37 into the groove 38, while the remainder of the needles 13 will be pushed by the non-slotted portion 36 of the belt 16 to the operating positions where they will participate in the knitting of a course of a given length.

The upper auxiliary field 4 of the cylinder 1, as shown in FIG. 3, is also provided with a longitudinal groove 38 extending longitudinally of the cylinder 1 along the entire length thereof, while the lower auxiliary operating field 2 has a continuous uninterrupted flat exterior surface portion which is not grooved. When the auxiliary operating field 2 of the cylinder 1 is situated in the plane of the needles 13, all of the needles will be pushed into their operating positions. On the other hand, when the operating field 4 is positioned in the plane of the needles 13, all of the needles can be retracted into the groove 38 of the operating field 4 and none of the needles will participate in the knitting operations. The selection of which of these operating fields is to be situated in the plane of the needles 13 is determined by the programming structure which controls the pawls which act on the toothed wheel 1. Of course, when the cylinder 1 is rocked in the direction of the double-headed arrow S_5 , S_6 of FIG. 3, the supports 5 and 6 as well as the guide roll structure and belt 16 rock together with the cylinder 1 and there is no relative angular motion between these components.

In the embodiment of FIGS. 5-8, the needle-selecting structure of the invention is not provided with a single cylinder 1 but with a pair of coaxial cylinders 1a, 1b which are arranged in an end-to-end relation. Each of the cylinders 1a, 1b is provided with its own endless belt 16a and 16b, respectively, and with a control means 21a, 21b (see FIG. 6) which is actuated by the programming structure so as to determine the longitudinal positions of the belts 16a, 16b with respect to the cylinders 1a, 1b. The endless belt 16a is guided for longitudinal movement by the guide rollers 14a, 39a, 40a, 41a, and the endless belt 16b is guided for longitudinal movement by the guide rollers 14b, 39b, 40b and 41b. The guide rollers 14a and 14b are also driving rollers and are respectively provided with the means 21a and 21b of the same construction as the means 21 of FIGS. 1 and 2 for determining the longitudinal positions of the belts. This structure is indicated schematically for the left guide roller 14a of FIG. 6 where those components of the means 21a which correspond to components of the means 21 are indicated by the same reference characters followed by the letter a. The control means 21a, 21b are individually controlled by the known programming structure of the machine.

The driving and guiding rollers 14a and 14b are respectively carried by brackets which are fixed to and extend from the cylinders 1a and 1b, these brackets being not illustrated. The guide rollers 39a-41a and 39b-41b are supported for rotary movement direction on the cylinder 1a and 1b, respectively.

The endless belts 16a, 16b are respectively provided with non-slotted continuous uninterrupted portions 36a and 36b which will press the stems of the knitting needles 13 into their operating positions, and these belts are also provided with longitudinal slots 37a and 37b through which the stems of the knitting needles 13 can pass so that those needles which pass through the slots 37a and 37b will be retracted to their nonoperating positions.

As is indicated in FIGS. 7 and 8, the cylinders 1a and 1b are provided with operating fields which correspond to

the operating fields of the cylinder 1. The cylinder 1a has the auxiliary operating fields 2a and 4a separated by the main operating field 3a, and each of the fields 3a and 4a is formed with a longitudinal groove 38a, the groove 38a of the operating field 3a being in registry with a slot 37a of the belt 16a. The cylinder 1b has auxiliary operating fields 2b and 4b which are separated by the main operating field 3b that is formed with a groove 38b capable of registering with a slot 37b of the belt 16b, while the groove 38b of the auxiliary field 4b is uncovered so as to enable all of the needles which are situated along the cylinder 1b to be retracted into this groove 38b of the auxiliary field 4b. In the same way, the needles which extend along the cylinder 1a can all be retracted into the groove 38a of the auxiliary field 4a. The fields 2a and 2b are continuous and have a smooth flat exterior surface for pressing all of the needles aligned therewith into their operating positions.

A bridging plate 42 extends across the gap between the cylinders 1a and 1b at the front of the cylinders and is fixed to one of these cylinders at a part thereof to be situated beyond the endless belt carried thereby. The plate 42 will prevent needles situated in the region of the gap between the cylinders from entering into the gap, and will, therefore, act as an extension of the belts 16a and 16b, providing in effect a continuous belt structure across both of the cylinders 1a and 1b. However, if the needles in the region of the plate 42 are not to be pushed to their operating positions, then that cylinder to which the plate 42 is fixed, as by any suitable bolts or the like, is simply turned about its axis to a position which will situate the bridging plate 42 beyond the range of the needles.

While both of the cylinders 1a and 1b may have a cross section as indicated in FIG. 7 where each of the cylinders is provided with three operating fields corresponding to those of FIGS. 1-3, it is also possible to provide one or both of the cylinders 1a and 1b with an additional auxiliary operating field 43 as shown in FIG. 8. At the latter operating field the cylinder is provided with a groove 44 longitudinally extending along the entire length of a cylinder and covered by a selecting bar 45 which has a predetermined length and is fixed in any suitable way to the cylinder as by being releasably bolted thereto, and thus by proper selection of the length of the bar 45 it is possible to preselect the number of needles which will be displaced by the bar 45 to the operating position and the number of needles which will enter into the groove 44 so as to be maintained in their non-operating positions.

Both of the cylinders 1a and 1b are capable of being simultaneously displaced in the direction S_1, S_2 indicated at the left of FIG. 6, and for this purpose the rocker arms 11 are operatively connected with the cylinder 1a, while the rocker arms 12 are operatively connected with the cylinder 1b. While the cylinders 1a, 1b are schematically shown in FIG. 6 as being integral with the journals which project from the ends thereof, actually these journals form parts of shafts which extend through axial bores of the cylinders and are fixed thereto, and at the region of their adjoining ends the cylinders are formed with cutouts which render these shafts accessible and accommodate the upper ends of the right arm 11 and left arm 12 (see FIG. 5), which are operatively connected with the shafts so that the cylinders are supported at their inner ends as well as at their outer ends. The cutouts for accommodating the upper ends of the referred to arms 11 and 12 in the region of the inner ends of the cylinders are made sufficiently large to provide the required clearance for the rocking movement of the individual cylinders about their common axis.

The cylinders 1a and 1b are indeed capable of being individually turned about their common axis through the programming structure which acts on the toothed wheels 19a and 19b that are respectively fixed to the journals

of the cylinders 1a and 1b. Polygonal prisms 20a and 20b are also fixed to the journals so that the cylinders can be precisely located in predetermined angular positions by way of leaf springs which engage the flats at the exterior peripheries of the polygonal elements 20a and 20b. The bearings 9 and 10 for the journals 7 and 8 are shiftably mounted on the frame of the machine so that it is possible for the entire structure to shift forwardly and rearwardly longitudinally of the needles 13 and in the direction indicated by the double-headed arrow S_1, S_2 of FIG. 6.

The structure of the invention which is illustrated in FIGS. 1-4 is suitable for the knitting of fashioned articles which have course lengths that vary at one side of the article. During operation of the machine of this embodiment, the movable cylinder 1 intermittently reciprocates longitudinally of the needles 13 in the direction indicated by the double-headed arrow S_1, S_2 . When the cylinder 1 is at its rear dead center position it is turned about its axis since at that time it is displaced rearwardly from the needles 13. During the forward movement of the cylinder 1 in the direction of the arrow S_1 , the cylinder approaches the knitting needles 13 and the endless belt 16 has a predetermined position, in accordance with the signals received from the programming structure, so that in the section I (FIG. 2) the stems of the needles 13 will extend through the slot 37 into the groove 38 of the cylinder while the remaining needles 13 in the section II will be pushed by the continuous surface 36 of the belt 16 in the direction of the arrow S_1 to their operating positions where they will knit a course in a well known manner. If the next course is to be longer, then the control means 21 is actuated by the programming structure so as to longitudinally displace the endless belt 16 according to the signal received from the programming structure in the direction of the arrow S_2 through a certain distance with respect to the cylinder 1 while the latter is at its rearmost position displaced rearwardly away from the needles, and thus at the next forward movement of the cylinder 1 toward the knitting needles 13 the corresponding group of needles 13 which now form the section I will pass through the slot 37 and will be retracted in their nonoperating positions, while the remaining needles which constitute the section II will be pressed forwardly to their operating positions. If the next following course is to be shorter, then the endless belt 16 is moved in the direction of the arrow S_4 indicated in FIG. 2.

Where the course length increases or decreases by relatively small increments, the course length in the knitted fabric can be regulated simply by movement of the endless belt 16. In this case the operating field 3 remains active and the cylinder 1 is not turned about its axis.

However, in the case where there will be relatively large differences from one course to the next the cylinder can be turned about its axis so as to situate either of the auxiliary operating fields 2 and 4 in the plane of the needles 13. Where all of the knitting needles 13 are to operate, the cylinder 1 is turned in the direction of arrow S_6 of FIG. 3 so as to situate the operating field 2 in the plane of the needles 13 when the cylinder is at its rear position displaced away from the needles 13, and then during the next forward movement of the cylinder all of the needles will be pushed into their operating positions. In the event that none of the needles are to be displaced to the operating position, the cylinder 1 is turned in the direction of the arrow S_5 of FIG. 3 so as to situate the operating field 4 in the plane of the needles 13, and now all of the stems of the needles will be received in the groove 38 of the field 4. Thus, the groove 38 of field 4 will permit all of the stems of the knitting needles 13 to pass.

The auxiliary operating fields 2 and 4 are used only in those cases where after a given course is knitted with a

given number of loops there follows a course in which loops are simultaneously formed on all knitting needles in which case auxiliary field 2 is used, or no loops are knitted in which case auxiliary field 4 is used.

The butts 46 of the needles 13, which have been pushed into the working position, are retracted after the course is knitted to a predetermined starting position by a non-illustrated stitch cam so that after each course the needles are retracted to a given starting position.

FIG. 4 schematically illustrates in a perspective view the control of the needles 13 by the endless belt 16 when the cylinder 1 is in its extreme forward position indicated by the arrow S_1 of FIG. 2. The butts 46 of the needles 13 in section II of FIG. 4 are retracted, after the selection of knitting needles 13 during the knitting of the particular course, back to the starting position by the stitch cam in the slide. After retraction, all of the needles 13 are again prepared for further selection by the repositioning of the endless belt 16.

With the embodiments of FIGS. 5-8, the structure of the invention will provide knitted fashioned articles where the length of the courses change at both ends or sides of the needle bed with needles added at one side and withdrawn at the other side. The endless belts 16a and 16b operate in the same way as the belt 16 of FIGS. 1 and 2, but in the case of the belts 16a, 16b each of the belts is individually controlled by the programming structure. The cylinders 1a and 1b operate identically as the cylinder 1 of FIGS. 1 and 2. As is indicated in FIGS. 5 and 6, both of the cylinders 1a and 1b are in their extreme forward position, indicated by the arrow S_1 . The stems of the needles 13 which have passed through the longitudinal slots 37a and 37b of the belts 16a and 16b are shown as being situated in the sections I and I' of the needle bed, while in the intermediate continuous section II all of the knitting needles 13 have been pushed forward to their operating positions by the continuous surface portions 36a and 36b and the bridging plate 42. If required, the auxiliary fields 4a, 4b and 2a, 2b can be used.

When it is desired to knit fashioned articles which have a relatively large number of courses of equal length that are, however, shorter than the total width of the knitting machine, then the auxiliary operating field 43 of the cylinder 1b with the selecting bar 45 is used. This bar 45 selects the needles 13 along a predetermined width of the needle bed, which are to be pressed into the operating positions.

The structure of the invention can also be used for selecting knitting needles for patterning purposes, particularly in combination with known patterning devices.

The cylinders 1, 1a, and 1b of the invention may have various different forms and designs and need not necessarily have a cylindrical configuration. For example, they may take the form of hollow shafts or drums provided with side walls or longitudinal slots and continuous surfaces which will give the structure of the main and/or auxiliary fields referred to above. Part of the cylinder beyond the operating fields may be circumferentially rounded, but it can also have the configuration of a shaft carrying ribs which support walls that form the operating fields. The intermittent motion of the cylinder, which may take place either by reciprocation longitudinally of the knitting needles or by clockwise or counterclockwise turning of a cylinder around its own axis, is analogous to the movement of a conventional jacquard cylinder on a flat knitting machine.

The structure and operation of the device of the invention is simple and a reliable needle selection is assured. The relatively great number of cards conventionally required is replaced by the movable endless belt. The weight of the machine, the floor space required, and the power consumed are all substantially reduced. The cost of manufacturing the machine provided with the structure of the invention is far lower than the cost of manu-

facturing a comparable machine with a different type of needle selection. A further advantage of the structure of the invention resides in the fact that it is highly versatile whereas, for example, jacquard cards can only be used for a predetermined product and pattern. However, the primary advantage of the structure of the invention resides in the fact that it is capable of manufacturing on a flat-knitting machine, and by a method known from the beret manufacturing practice, fashioned knitted products such as, for example, multipartite garments by producing in a single continuous operating cycle courses of different length, with the individual knitted sections being interconnected by a suitable knitted structure and with the courses running in a horizontal direction.

While FIGS. 5-8 show a construction where the cylinder structure has been divided into a pair of cylinder components, it is also possible to provide a construction where three or more cylinder sections are used for needle selection. With such constructions it is possible to knit garments or parts of garments, such as ladies' bathing suits, which are fully fashioned in two or three dimensions.

For producing other types of fabrics, the cylinder may advantageously be divided into a pair of cylinder sections which have different lengths in accordance with the configuration of the article that is to be knitted. As was indicated above, after a given course is knitted the needles which were previously in their operating positions are retracted in a known way back to their predetermined starting positions by the stitch cam which is in the machine slide. At the conventional high speed of automatic knitting machines it is clear that the movement of the endless belt which must be carried out in a relatively short time between the knitting of two successive courses of different lengths will necessarily be limited. If necessary, the machine can be provided with a switch which will automatically disengage the stitch cam for a predetermined number of slide strokes. Such a construction is of particular benefit if a substantially longer course is to be succeeded by a very short course, or vice versa. In this case the endless belt shifts gradually to the desired position while the stitch cam in the slide is inoperative.

If desired, the endless belt or the operating field of the cylinder can select knitting needles by means of auxiliary needle-engaging members, such as auxiliary pins, buttons, plugs, or the like. The elevation of the openings in the endless belts and the operating fields in this case is adjusted to conform to the elevation of the stems of the auxiliary members.

The structure of the invention can be used either on a single-bed flat-knitting machine or on other knitting machines, such as those which are provided with more than one bed.

As is indicated schematically in FIGS. 9 and 10, the machine includes a cam shaft B and a chain C both of which have their drives taken through suitable transmissions from an electric motor A. The chain C carries a carriage D together with a lock K. The cam shaft B is provided with a cam E which acts to rock arms F which correspond to the arms 11 and 12 referred to above, and in this way the cylinders are shifted in the directions S_1 , S_2 . A ratchet structure 19a coacts with pawls G to determine the angular positions of the cylinders in the direction of the arrow S_5 , S_6 . The angular position is maintained through polygonal elements 20a which are acted upon by spring-pressed plates which engage the flats at the peripheries of the polygonal members.

It will be apparent that while we have shown and described our invention in a few forms only, and have indicated possible changes, many more changes and modifications may be made without departing from the spirit of the invention defined in the appended claims.

We claim:

1. In a needle selecting assembly for flat-knitting machines, an elongated cylinder formed with a longitudinally extending groove for receiving components of nee-

dles which are retracted to nonoperating positions, an elongated belt extending longitudinally of said cylinder across said groove thereof and being formed with a longitudinal slot in register with said groove so that in accordance with the longitudinal position of said belt with respect to said cylinder a given part of the groove of the latter will be covered by a nonslotted portion of said belt while another part of said cylinder groove will be rendered accessible through said slot of said belt, said nonslotted portion of said belt which extends across said groove preventing retraction of needles to nonoperating positions in said groove so that said nonslotted portion which covers said groove will position needles engaged thereby in operating positions, and means coacting with said belt for adjusting the longitudinal position thereof with respect to said cylinder so as to control the number of needle components which will be received in said groove through said slot of said belt and the number of needles which will be maintained in the operative position by said nonslotted portion which covers said groove.

2. The combination of claim 1 and wherein said belt is endless, guide rollers coacting with said belt to guide the latter for longitudinal movement, and said means for determining the longitudinal position of said belt coacting with at least one of said guide rollers for turning the latter and moving said belt to a predetermined position.

3. The combination of claim 2 and wherein a support means coacts with said cylinder for supporting the latter, and said support means carrying at least some of said guide rollers.

4. The combination of claim 3 and wherein said cylinder is provided beyond said belt with an elongated nongrooved continuous exterior surface portion for engaging all of the needles to maintain them in their operating positions, and positioning means coacting with said cylinder for positioning said nongrooved continuous surface portion thereof in the region of the needles for maintaining them all in their operating positions.

5. The combination of claim 4 and wherein said cylinder is also provided beyond said belt with a longitudinal groove extending along the entire length of said cylinder, and said positioning means coacting with said cylinder for positioning said longitudinal groove thereof which is situated beyond said belt in the operating range of the needles for receiving components of all of the needles when none of the needles are to be located in an operating position.

6. The combination of claim 5 and wherein said belt at

its portion which covers said first-mentioned groove of said cylinder, at least in part, is situated between said nongrooved portion and said longitudinally grooved portion of said cylinder which is situated beyond said belt, and said positioning means coacting with said cylinder for rocking the latter to a selected one of the three angular positions locating either said belt, said nongrooved continuous surface portion, or said longitudinally grooved portion which is situated beyond said belt in the operating range of the needles.

7. The combination of claim 6 and wherein said cylinder is formed with an additional longitudinally grooved portion carrying a bar which covers a preselected fraction of the length of the groove of said additional longitudinally grooved portion of said cylinder, so that by way of the latter bar a selected number of needles will be situated in the operating position and a selected number of needles will be situated in a nonoperating position.

8. The combination of claim 1 and wherein a pair of cylinders and belts as well as means for respectively positioning the latter longitudinally with respect to said cylinder grooves are provided in end-to-end coaxial relation.

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