Nov. 8, 1960 A. P. SAUNDERS 2,959,040

CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

Filed Aug. 20, 1958 8 Sheets-Sheet 1

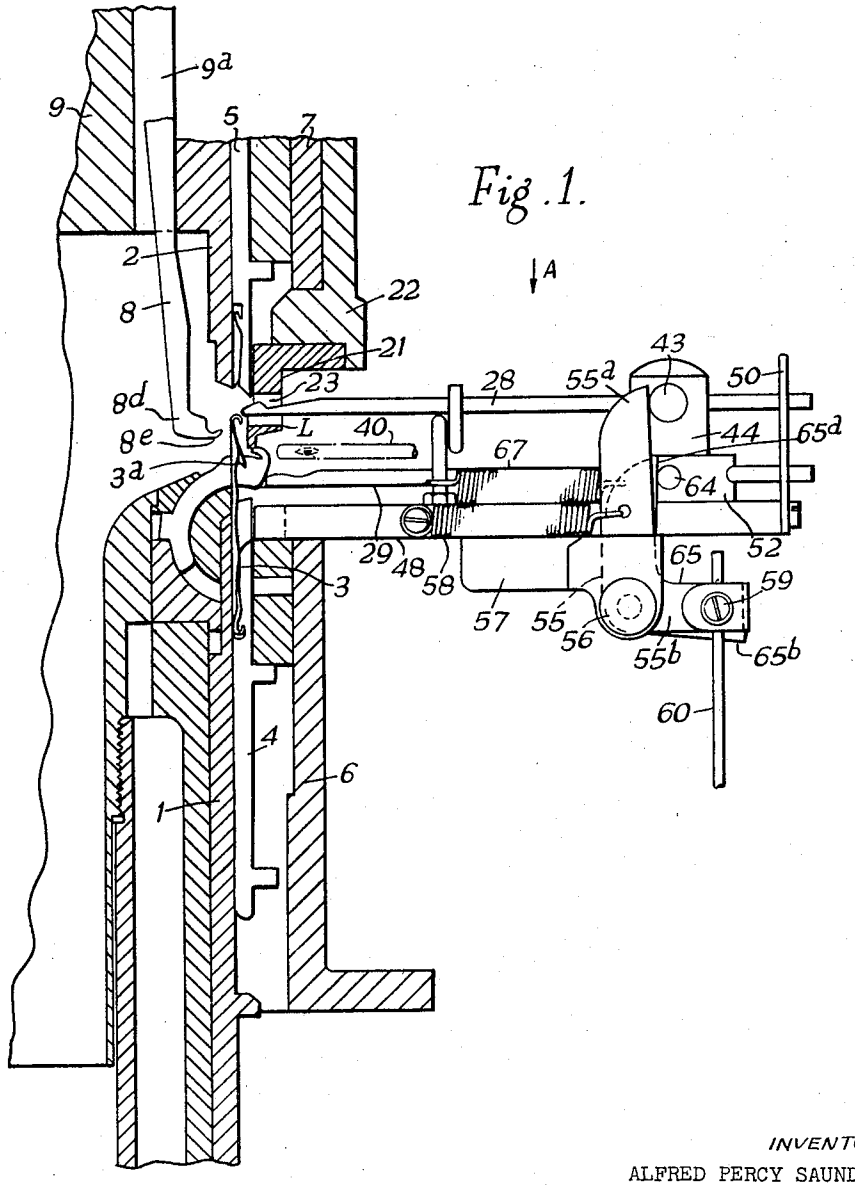

Fig. 1.

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Filed Aug. 20, 1958 8 Sheets-Sheet 2

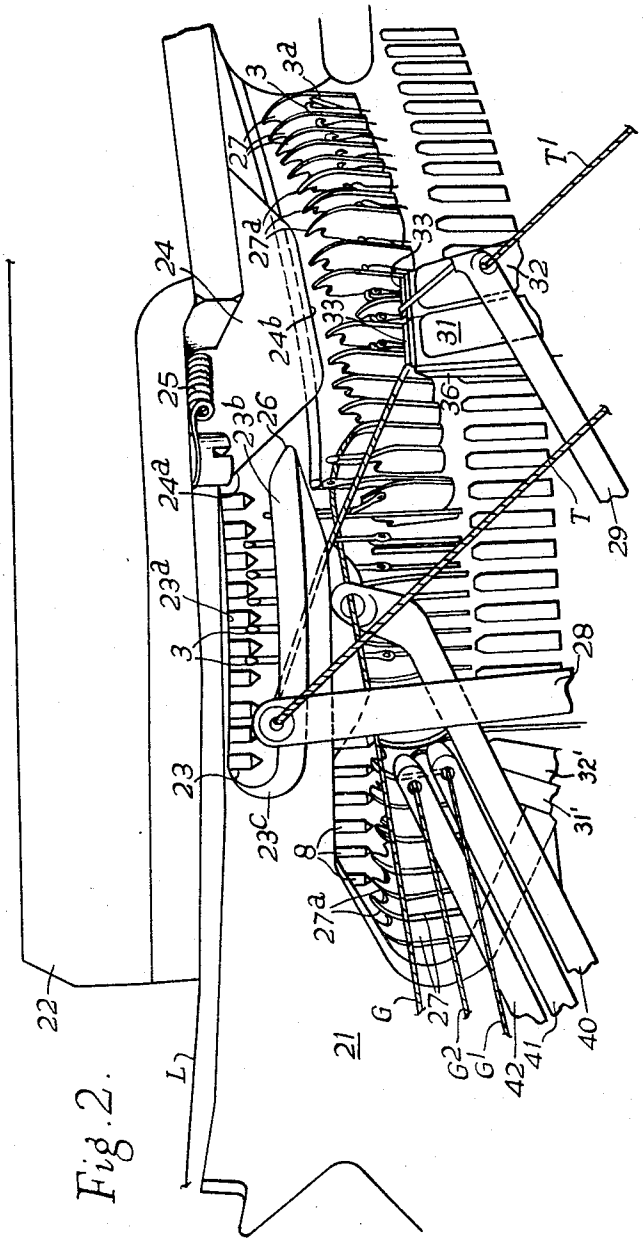

Fig. 2.

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CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

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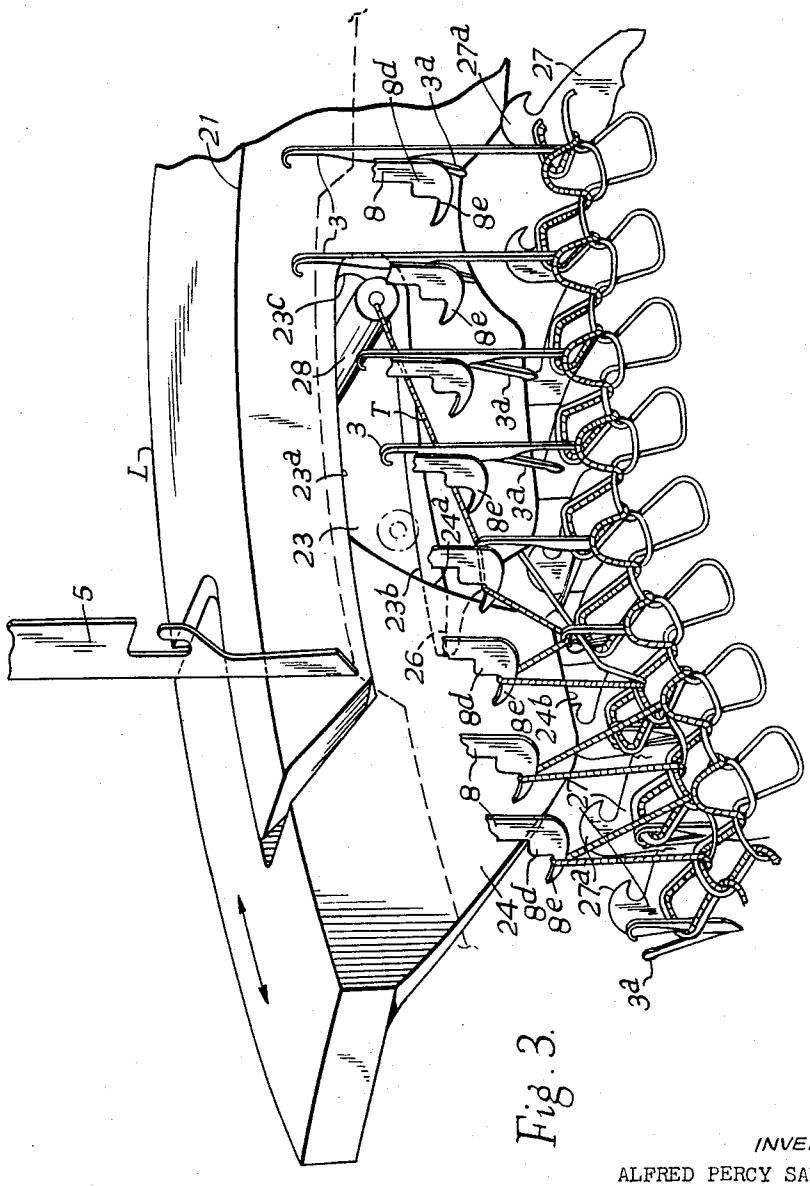

Fig. 3.

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CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

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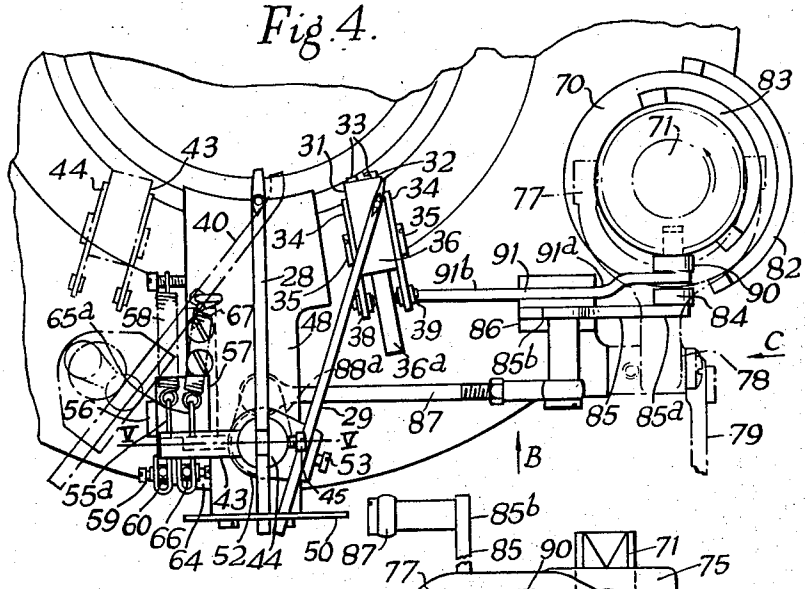
Fig. 4.



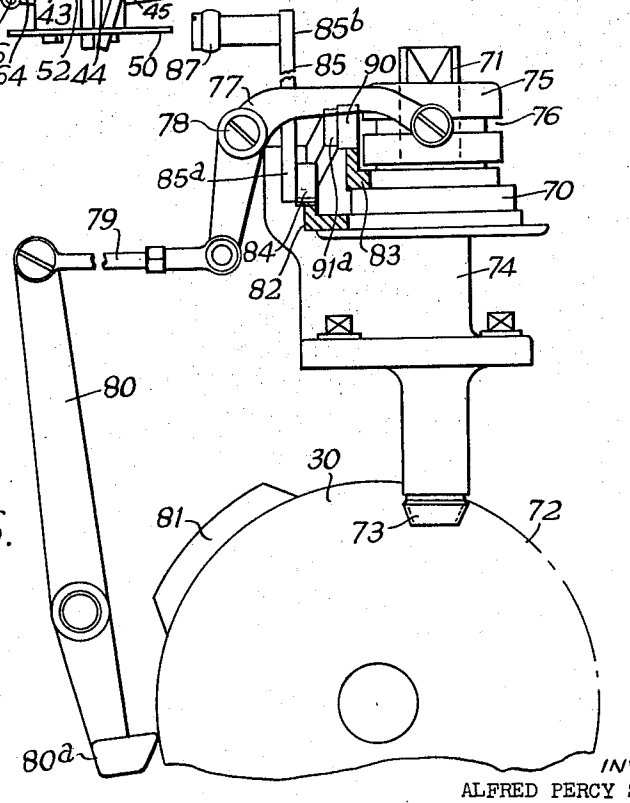


Fig. 6.

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CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

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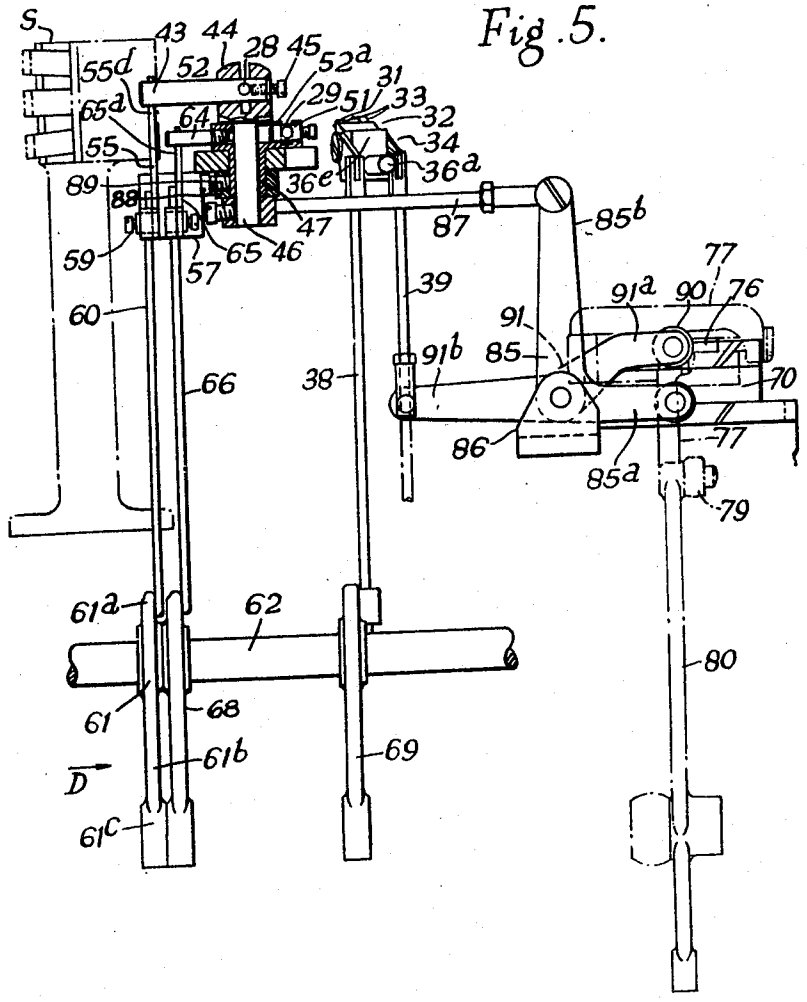
Fig. 5.



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CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

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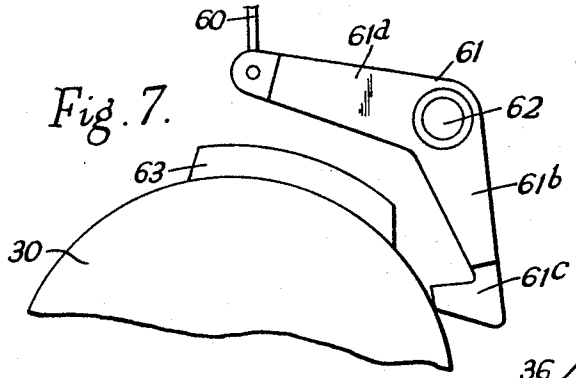
Fig. 7.



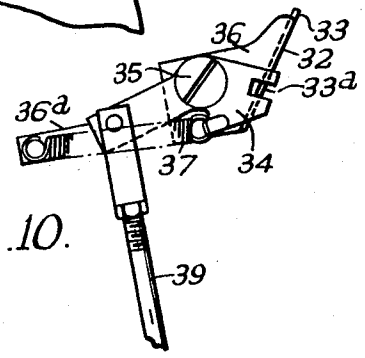
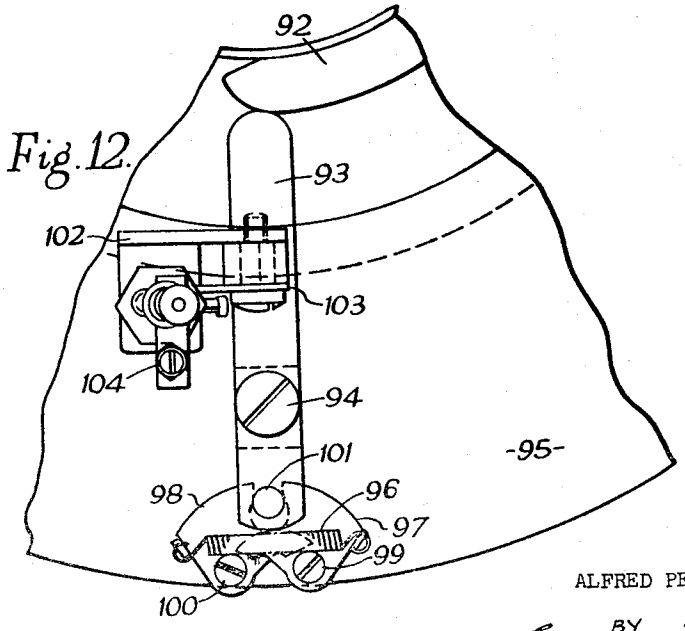


Fig. 10.

Fig. 12.



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CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

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Fig. 8.

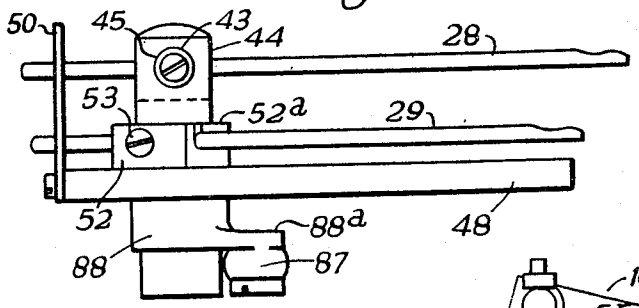

Fig. 11.

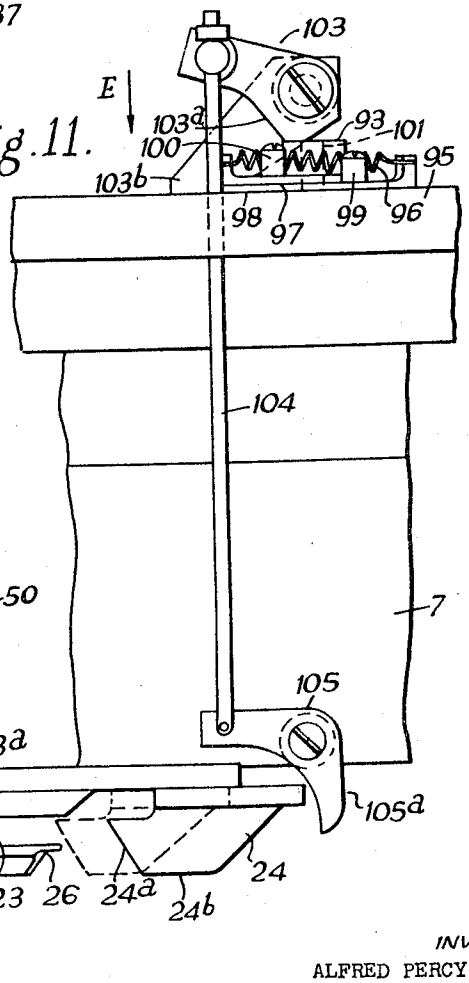

Fig. 9.

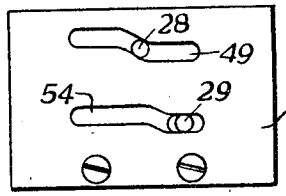

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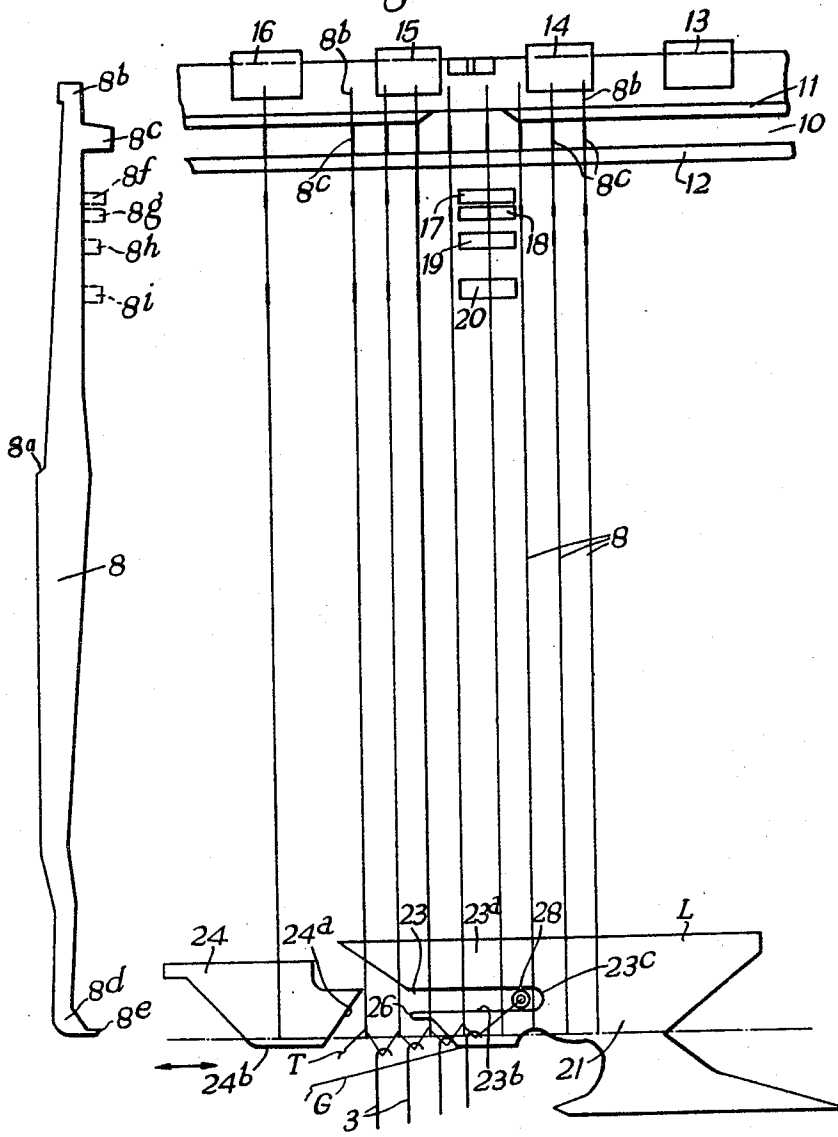
Fig. 13.



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United States Patent Office 2,959,040 Patented Nov. 8, 1960

2,959,040

CIRCULAR KNITTING MACHINES OF THE SUPERIMPOSED NEEDLE CYLINDER TYPE

Alfred Percy Saunders, Leicester, England, assignor to Wildt and Company Limited, Leicester, England, a British company

Filed Aug. 20, 1958, Ser. No. 756,094

Claims priority, application Great Britain Aug. 23, 1957

10 Claims. (Cl. 66—14)

This invention relates to circular knitting machines of the superimposed rotary needle cylinder type, that is to say machines comprising rotary bottom or plain and top or rib needle cylinders, double-ended latch needles for operation in the said cylinders, and, also in the cylinders, bottom and top sliders for actuating the needles, and for transferring the same from one cylinder to the other, according to knitting requirements. Basically, such a machine is accordingly capable of producing plain, ribbed or purl fabrics or any desired combination of the same.

Although primarily intended for application to a circular seamless hose or half hose knitting machine of the type concerned adapted to operate with rotary motion as well as with reciprocatory motion in the production of heel and toe pouches, the invention is not necessarily limited in this respect since, broadly considered, it may also be applied to a body machine.

Moreover, so far as a circular seamless hose or half hose knitting machine is concerned, it is the primary intention to apply the invention to such a machine equipped with needles divided into two groups, viz. a group of instep needles and a complementary group of heel and toe needles, needle operating means so arranged as to be adapted for knitting, in respectively opposite directions of rotation of the needle cylinders, needle loops composed of at least one main or ground yarn and also an associated terry thread, instruments for the production of terry, i.e. elongated sinker, loops, and means for so operating the terry instruments conjointly with the operation of the needles of the heel and toe group as to be capable of producing, in the foot of a knitted article of footwear, a high heel portion, a heel, a foot bottom or sole and a toe in which terry loops are produced within a structure of plain needle loops. In a machine of this kind further terry instruments are usually provided for similar operation in conjunction with the instep groups of needles suchwise as to permit of incorporation into the foot of an article of footwear an all-round terry area, e.g. a ring toe, comprising needle loops and terry loops as aforesaid.

Thus, and as well known to those acquainted with the art, the main or ground yarn and the terry thread are fed to needles in the bottom or plain cylinder in plating relation, and the terry loops, drawn longer than the needle loops, project from the inner surface of the fabric and provide a soft feel, or a "plush" or "pile" cushioning effect, which may be enhanced by combing or brushing the loops.

In a circular knitting machine of the superposed rotary needle cylinder type there is provided a fixed latch guard which is conventionally provided with a smooth unbroken inner face for presentation to latches of needles in both cylinders, and has formed therein a hole through which main or ground yarn is passed in a position most favourable for correct feeding to the needles. When, in such a machine, an additional yarn has heretofore been either temporarily substituted for, or temporarily supplied to the needles, together with the main or ground yarn the said additional yarn has customarily been fed to the needles by a yarn guide or finger arranged, when operative, to feed in below the latch guard from a position on the outside of the latter. However, when a yarn is fed in below the latch guard, the yarn, instead of being fed nicely into the hook of a needle, is fed low down into a portion of the needle where the latch is closing and the yarn tends to become trapped between the cheek of the needle and the closing latch, which tends to cut through the fibres and produce an undesirable furry effect.

Accordingly, the primary object of the present invention is so to modify the latch guard, in a circular knitting machine of the type referred to, as to facilitate favourable positioning of a yarn guide required to feed to the needles, temporarily, either a yarn additional to, or a yarn substituted for, a main or ground yarn or yarns.

Arising from this, a particular aim of the invention is the provision of a circular hose or half hose knitting machine on which can be produced a knitted article of footwear having in the foot terry areas wherein the terry loops are formed of a yarn separate and distinct from the yarn or yarns in the remainder of the article, the terry heel and toe pouches and any half round or like area incorporating terry loops being produced without floats, thereby avoiding the necessity of cutting out such floats after the article has been removed from the machine.

In this regard it is explained that normally, in making a knitted article of footwear having terry areas as aforesaid, the main or ground yarn and the terry thread are knitted together in plating relation throughout the entire article, the terry thread being fed over terry instruments to form the required elongated sinker loops at relevant times only during the knitting cycle. For this reason, whatever yarn is used to produce the terry loops is also incorporated in the leg and the instep of the article. By the adoption of the present invention, however, the leg and the instep of the article can, if desired, be knitted of the main or ground yarn only in which instance the terry thread would be introduced into the foot as an additional thread. But even if the leg and the instep are still knitted of two yarns in plating relation the invention enables the appropriate one of these yarns to be substituted by a terry thread contrasting with both of them.

In this way, the most suitable and best quality terry thread providing maximum comfort and hygenic conditions in the foot can be used without increase in the price of the article.

According to this invention the latch guard in a circular knitting machine of the superimposed rotary needle cylinder type has formed therein a circumferentially extending gap or open-ended slot into which the operative end of a yarn or thread feeding finger (i.e. feeder) can be introduced to take a yarn or thread from a trapping device disposed on the outside of the said guard to a favourable feeding position at the inside of the latter.

The arrangement is, of course, also such that the yarn or thread feeding finger can be readily retracted through the circumferential gap and moved to an inoperative, i.e. non-feeding, position clear of the latch guard when withdrawing from knitting the previously fed yarn or thread, such withdrawal being from the inside of the guard to a position on the outside of the latter at which last mentioned position the yarn or thread is taken into the trapping device and held.

Preferably, the trapping device has associated therewith a cutter or scissors adapted to sever the yarn or thread automatically whenever it is withdrawn from knitting and trapped.

As will be appreciated the principal feature of the in-

vention, broadly considered, therefore, consists in providing, in lieu of the comparatively small and restricted feeder hole normally provided in a conventional latch guard, a movable yarn or thread feeding finger which, when moved into its operative position, through the circumferential gap in the guard, can be accurately located anywhere within the entire circumferential and heightwise extents of the gap. Expressed another way, instead of there being a fixed and restricted feeder hole in the latch guard there is now provided in conjunction with the latter a movable "hole" constituted by the operative tip of the yarn or thread feeding finger working in the circumferential gap.

As a consequence of the modified latch guard being circumferentially gapped by cutting away a portion thereof, the inner face of the guard presented to needle latches is, of course, no longer unbroken, although the size and disposition of the gap are carefully so chosen that the presence of the gap does not interfere with the usual latch guarding functions of the guard whenever the cylinders are rotating in the normal direction of rotation, i.e. in the leg direction of knitting in the case of a circular hose or half hose machine. That is to say, in the stated direction of knitting, the back of the gapped latch guard must still be capable of guarding the latching of needles knitting both rib and plain loops of the main or ground yarn or yarns in the top and bottom cylinders respectively.

It is principally the intention that the yarn or thread feeding finger which is movable into and out of an operative, i.e. feeding, position through the circumferential gap in the latch guard shall be utilised for temporarily supplying to the needles a yarn or thread which is additional to, and is required to be knitted together with, at least one main or ground yarn. In this instance, a yarn guide is provided immediately below the gapped latch guard for feeding in the said main or ground yarn beneath the lower edge of the guard. An additional yarn or thread temporarily supplied to needles at relevant times only and at all other times held withdrawn from knitting in the trapping, or trapping and severing, device may be a terry thread or even a reinforcing thread.

Where a terry thread is involved, the thread feeding finger is arranged for movement from a low position beneath the latch guard, at which position the trapping device is located, to a high position through the latch guard at which the said thread is fed to needles and over operative terry instruments, e.g. terry instruments which have been projected from a cylindrical carrier associated and rotatable together with the top needle cylinder of the machine.

In accordance with an important aspect of the invention, the yarn or thread feeding finger which is movable into and out of its feeding position through the said circumferential gap may form part of a yarn or thread changing, e.g. horizontal striping, mechanism and be used for substituting one yarn or thread, such, for instance, as a terry thread, for another.

In any event, it may be desirable, in the case of a circular hose or half hose knitting machine, for the yarn or thread feeding finger, when feeding a yarn or thread only to the group of heel and toe needles during reciprocatory knitting to produce either a heel pouch or a toe pouch, to be moved sideways alternately towards respectively opposite ends of the circumferential gap, each such movement of the finger being in the opposite direction to that in which the cylinders are turning at the time, and the purpose of the movement being to locate the operative tip of the finger in a suitable feeding position. When feeding in a terry thread during the formation of a heel or toe this suitable feeding position is one in which the thread is fed into needles in the bottom cylinder and over projected terry elements in a carrier associated with the top cylinder. Conveniently for this purpose the said yarn or thread feeding finger is pivotally mounted and may be adapted to be swung aside automatically in alternate directions during reciprocatory knitting through the medium of cam-influenced connections operating in timed relation with the reciprocatory motion of the knitting head of the machine. But there is no limitation in this respect, since a finger feeding in a terry thread during formation of a heel or a toe by reciprocatory knitting may remain stationary in a suitable feeding position in the circumferential gap or slot in the latch guard.

Now while, in a circular hose or half hose machine, the presence of the circumferential gap in the latch guard does not interfere with the latch guarding functions of this guard whenever the cylinders are continuously rotating in the leg direction, provision must be made for effectively closing the entrance to the gap at each stroke of the cylinders in the reverse direction during reciprocatory knitting to produce a heel or a toe; otherwise the latches of some of the needles performing the reverse knitting, owing to the disposition of the heel and toe stitch cam, would be likely to enter the gap and become damaged.

To prevent this possibility, the modified latch guard may, in accordance with a further feature of this invention, have associated therewith a movable portion or element which is automatically operable to close the entrance to the circumferential gap and to present an unbroken guarding face to needle latches at each reverse stroke of the cylinders.

Thus, during normal knitting in the forward or leg direction, the movable portion or element associated with the latch guard is held in an inoperative position separated from the circumferentially gapped main portion thereof. During reciprocatory knitting, however, the said movable portion or element is moved back and forth in such a way that each time reverse knitting takes place, the movable portion or element will move to close the circumferential gap, whereas each time knitting is performed in the leg direction, the movable portion or element will move back again to "open gap" position.

The movements of the movable portion of the latch guard may advantageously be derived from a cam fixed to a part of the knitting head through the medium of biassed connections of any suitable character.

In order that the invention may be more clearly understood and readily carried into practical effect, a specific example thereof applied to a circular seamless hose or half hose knitting machine of the superposed rotary needle cylinder type adapted to produce knitted articles of footwear with terry areas in the foot will now be described, with reference to the accompanying drawings, wherein

Figure 1 is a vertical sectional view of so much of such machine as is necessary to illustrate the application thereto of a circumferentially gapped latch guard, the figure showing two interchangeable terry thread feeding fingers, i.e. feeders, in their feeding and "out" positions respectively,

Figure 2 is a perspective view of the said latch guard, greatly magnified and as seen from the outside of the machine, and shows, in addition to the two terry thread feeders, a ground yarn guide and other associated yarn guides of a yarn changing mechanism,

Figure 3 is another similar view of the latch guard, but as seen from the inside instead of the outside of the machine, a terry thread feeder being shown feeding a terry thread to needles and over operative terry instruments,

Figure 4 is a plan view of a part of the machine as seen in the direction of the arrow A in Figure 1 and illustrates rotary cam means whereby the appropriate terry thread feeder and the associated trapping and severing device are operated and controlled for the production of half-round terry,

Figure 5 is an elevational view as seen in the direction of the arrow B in Figure 4 and partly in section, as taken on the line V—V of the last mentioned figure, showing

connections for controlling the interchangeable terry thread feeders from the main control drum,

Figure 6 is a view as seen in the direction of the arrow C in Figure 4,

Figure 7 is a detail view, as seen in the direction of the arrow D in Figure 5, showing one of the drum levers in the terry thread feeder control connections,

Figure 8 is a detail side view of the two interchangeable terry thread feeders as seen from the righthand side of Figure 4,

Figure 9 is a detail front view of a slotted guide plate for guiding the terry thread feeders to and from their feeding positions,

Figure 10 is a detail side view of one of the trapping and severing devices associated with the terry thread feeders,

Figure 11 is a fragmentary view illustrating the connections for operating the movable portion of the latch guard suchwise as to close and open the circumferential gap therein,

Figure 12 is a plan view of the same as seen in the direction of the arrow E in Figure 11, and

Figure 13 is a diagram illustrating the manner of operation of the terry instruments during the formation of terry loops with plain knitted loops.

Like parts are designated by similar reference characters throughout the drawings.

Referring to Figure 1, the reference numeral **1** indicates the bottom or plain needle cylinder of the machine, whilst the superimposed top or rib needle cylinder is indicated at **2**. Double-ended latch needles, such as **3**, are provided for operation in the cylinders, and bottom and top sliders **4** and **5** respectively are employed to actuate the needles and transfer the same from one cylinder to the other, according to knitting requirements. The numeral **6** indicates the bottom cam box and **7** the top cam box of the machine.

In association with the top cylinder component there is provided a circular series of elongated blade-like terry instruments **8** arranged vertically in a longitudinally tricked cylindrical carrier **9** rigidly secured within the top needle cylinder **2**.

As shown in Figure 13, each terry instrument is formed, about midway between its ends, with a fulcrum *8a*, which contacts the back of the corresponding longitudinal trick *9a* in the carrier **9** and enables the instrument to pivot in this trick. At the upper end, each instrument **8** is shaped to provide a vertical butt *8b* and a horizontal butt *8c*. At the lower end each terry instrument is shaped to provide a foot-like portion *8d* with a toe or tip *8e* for the purpose of holding a terry thread T in the formation of a terry loop. A cam race **10** provided between vertically spaced cams **11** and **12** (Figure 13) is arranged for engagement with the butts *8c* for the purpose of supporting the terry instruments **8** at the elevation more clearly shown in Figure 3 and at which the thread T is fed to the needles **3** and over the toes or tips *8e*. Cams such as **13**, **14**, **15** and **16** are provided for action on the backs of the vertical butts 8^b for effecting retraction of the terry instruments at their lower ends *8d* to an inoperative position. Further horizontal butts, such as those indicated at *8f*, *8g*, *8h* and *8i* are provided on the terry instruments for co-operation with presser levers or cams **17**, **18**, **19** and **20** adapted to press back the upper portions of the instruments and so effect outward projection of their lower ends *8d* to an operative position for various purposes with which the present invention is not concerned.

The latch guard of the machine is indicated at L. In the particular example of the invention illustrated, this guard is made in two parts, viz. a main part **21** which is fixed to the conventional guard block **22** (Figure 1) and is cut away and right through at one end so as to provide therein a circumferential open-ended slot or gap **23**, and a circumferentially slidable part **24** which is mounted for movement back and forth on the latch guard block **22** under the control of a spring **25** (see Figure 2). The circumferential gap **23** in the main part **21** is immediately below the guard block **22**, and has horizontally disposed upper and lower sides *23a* and *23b*, suitably spaced apart heightwise, and a suitably rounded closed inner end *23c*. At the opposite open end of, or entrance into, the gap **23** the lower side *23b* of the latter is fashioned to provide a relatively thin lip **26** which is suitably radiused to provide a cam-like edge around which a terry thread such as T, moved into a feeding position by the appropriate terry feeder (i.e. thread feeding finger designed to supply terry thread to nedles and terry instruments) is drawn and by which this thread is slidably displaced to the inside of the gapped latch guard L. The spring-controlled slidable part **24** of the latch guard is formed with a downwardly inclined leading edge *24a* and a horizontal lower edge *24b* located immediately above nibs *27a* of the web holding-down sinkers **27** of the machine. Whenever the slidable part **24** is moved circumferentially to close the entrance to the circumferential gap **23** (in the manner depicted in Figure 3), the inclined leading edge *24a* of the said part makes contact with the radiused lip **26**.

In the illustrated example there are two interchangeable terry thread feeders **28** and **29**, one for supplying a terry thread T to the needles **3** and terry instruments **8** and the other for similarly supplying another terry thread T′ (see Figure 2). The threads T and T′ may be of contrasting colours so that by selectively actuating the feeders **28** and **29** either of the said two yarns can be supplied to the needles and the terry instruments and substituted by the other e.g. in the production of horizontally striped terry fabric, according to requirements. Alternatively, the threads T and T′ may contrast as regards type, character or/and quality. In any event, both terry thread feeders **28** and **29** are adapted to be operated, under suitable control, from the main control drum **30** (Figures 6 and 7) of the machine; in addition, the feeder **29** is operable, as occasion demands, from a separate control for half-round terry only—all as will be hereinafter fully described.

Immediately below the slidable part **24** of the gapped latch guard L there are provided two vertically disposed or nearly upright terry thread trapping and severing devices **31** and **32**. Of these two devices that designated **31** is for trapping and severing the thread T, while the device **32** is for similarly trapping and severing the thread T′. Each such device includes a displaceable combined trapper and cutter blade **33** which, as depicted in Figure 10, is provided with a laterally extending butt *33a* engaged by a slotted actuating lever **34**. Each lever **34** is fulcrumed at **35** upon one side of a suitably grooved block **36** in which the corresponding blade **33** is slidably accommodated. The block **36** is common to both trapping and severing devices **31** and **32**, and each of the actuating levers **34** is influenced by a tension spring **37** (see Figure 10) and is articulated at its tail end to an operating link. The operating links for the two devices **31** and **32** are designated **38** and **39** respectively. The common block **36** is provided with a rearwardly extending pin *36a* or the like to which the rear ends of the springs **37** are anchored. Whenever either terry thread is withdrawn from knitting, it slides down the inclined leading edge *24a* of the slidable part **24** of the latch guard L and is guided thereby into the corresponding trapping and severing device **31** or **32**. This slidable part **24** also functions to present an unbroken inner face to open frame needle latches *3a* to prevent closure of such latches during reverse knitting, and to close the entrance to the circumferential gap **23** for the purpose previously described herein.

It is convenient here to mention that a main or ground yarn guide **40** is provided immediately below the gapped latch guard L for feeding in the said yarn G beneath the

lower edge of the guard. As illustrated in Figure 2, there are associated with the yarn guide 40 two further guides 41 and 42 of a conventional yarn changing, e.g. horizontal striping, mechanism incorporating yarn trapping and severing devices 31' and 32' which may be of a similar construction to, and operated in much the same manner as, the terry thread trapping and severing devices 31 and 32. The guides 41 and 42 supply yarns G' and G². As will be appreciated from a consideration of Figures 2 and 4, the thread trapping and severing devices 31 and 32 associated with the terry thread feeders 28 and 29 are disposed at a location in the needle circle where the needles 3 have just passed the stitch cam (not shown) at the feed, while the yarn trapping and severing devices associated with the guides 40, 41 and 42 are disposed at a location in the said circle where the needles are approaching this stitch cam.

The rear portion of the terry thread feeder 28 extends through a hole drilled transversely through a horizontal pin 43 which is free to turn about its axis within a vertically slotted component 44. After initial adjustment within the pin 43, the feeder 28 is fixed in position therein by means of a set screw 45. The slotted component 44 is itself mounted to turn about a vertical axis for which purpose it is formed with a depending and co-axial shank 46 arranged to turn freely within a bush or sleeve 47 supported in a horizontal bracket 48 which is mounted upon the bottom cam box 6. Thus, the feeder 28 fulcrums for movement up and down about the axis of the pin 43 and is thereby permitted conjoint vertical and horizontal movement whenever it is moved into, or withdrawn from, the circumferential gap 23 in the latch guard L during introduction of the terry thread T to, and its withdrawal from, frame needles and terry instruments 8. These conjoint vertical and horizontal movements of the terry thread finger 28 are controlled by an appropriately contoured cam slot 49 or track formed in a fixed vertical plate 50 (Figure 9) and through which the tail end of the said feeder extends. The plate 50 is attached to the outer end of the bracket 48. When moved from its non-feeding position into a feeding position, the feeder 28 moves first upwards from the trapping and severing device 31, clears the radiused lip 26 at the lower side 23*b* of the then open circumferential gap 23 in the main part 21 of the latch guard and then moves into and along the gap as close as possible to the said lower side thereof. The feeder 28 travels along the same path but, of course, in the reverse direction whenever it is retracted to its non-feeding position.

In a somewhat similar way, the rear portion of the second terry thread feeder 29 extends through a hole drilled transversely through a short pin 51 which is free to rock about its axis within a vertically slotted laterally extending portion 52*a* of a component 52. A set screw 53 is employed to fix the feeder 29 in position within this component. This last mentioned component seats upon the top surface of the bracket 48 and is formed integrally with the upper end of the bush or sleeve 47 which latter is arranged to turn about its vertical axis within the said bracket. The vertically slotted component 44 seats upon the top of the component 52. Thus, the shank 46 and the bush or sleeve 47 are concentrically arranged for turning movement relatively and independently together with the slotted components 44 and 52 carried thereby. By virtue of this construction and arrangement, the terry thread feeder 29 fulcrums for movement up and down about the axis of the pin 51 and is accordingly permitted conjoint vertical and horizontal movement whenever it, like the feeder 28, is moved into or withdrawn from the circumferential gap 23 during introduction of the terry thread T' to, and its withdrawal from, needles and terry instruments. In this case, the said conjoint movements of the feeder 29 are controlled by a second cam slot 54 formed in the vertical plate 50.

As previously mentioned, both terry feeders are operable and controlled, as occasion demands, from the main control drum 30 of the machine. In this regard it will be seen in Figures 4 and 5 that one end of the pin 43 turnable within the vertically slotted component 44 projects radially right through the latter to provide an element whereby the said component can be turned to and fro to move the terry thread feeder 28 into and to withdraw it from its feeding position within the gap 23 in the latch guard. For action upon this extension of the pin 43 there is provided a bell-crank 55 which is fulcrumed at 56 upon a block 57 associated with the bracket 48, and is influenced by a tension spring 58 arranged as shown. One arm 55*a* of the bell crank 55 is in contact with the pin 43 while the other arm 55*b* thereof is articulated at 59 to the upper end of a vertical operating link 60. The lower extremity of this link is connected to one arm 61*a* of a two-armed control lever 61 which is mounted to turn about a horizontal shaft 62 (Figure 5). The other arm 61*b* of the said control lever is, as depicted in Figure 7, provided with a toe 61*c* arranged to be acted upon by a cam or cams such as 63 on the main control drum.

In a similar way, the component 52 has secured therein a radially extending pin 64 whereby the component can be turned to and fro to move the feeder 29 into, and withdraw it from, its feeding position. The pin 64 is acted upon by the arm 65*a* of another bell crank 65 fulcrumed in the block 57 and the arm 65*b* of which is articulated to an operating link 66. A tension spring 67 suitably biasses the bell crank 65, and the link 66 is connected to a control lever 68 (Figure 5) which, like the lever 61, is mounted upon the shaft 62 and adapted to be actuated by a cam or cams on the control drum 30.

The trapping and severing devices 31 and 32 associated with the terry thread feeders 28 and 29 respectively are also adapted to be operated and controlled from the main control drum 30 in such a way that each time either of the feeders is withdrawn from the circumferential gap 23 in the latch guard to its non-feeding position the corresponding terry thread will be trapped and severed. Thus, the operating link 38 of the device 31 is connected to a control lever 69 which is mounted on the common control lever shaft 62 is arranged to be actuated by a cam or cams on the main control drum. Although for simplicity in illustration this is not shown, the operating link 39 of the terry thread trapping and severing device 32 is also extended downwards and connected to a main drum-actuated control lever.

As will be appreciated, each of the two terry thread feeders 28 and 29 (either of which can be substituted for the other in a thread changing operation) can be used:

(*a*) When producing all-round terrying, such as in a terry top or a terry ring toe, by knitting in the leg direction, or

(*b*) When producing a terry heel or toe, by reciprocatory knitting.

As to (*b*), the selected terry thread feeder is moved into the gap 23 at the commencement of the heel or toe pouch and is allowed to stay in the said gap (in which it may either be stationary in a suitable feeding position or oscillate from side to side) until the completion of the pouch when the feeder is retracted to withdraw the terry thread from knitting. The selected terry thread is, therefore, knitted together with a main or ground yarn, fed in beneath the latch guard L, continuously throughout the heel or toe and is trapped and severed only at the completion of the latter.

If either of the feeders 28 and 29 is to be laterally oscillated within the circumferential gap 23 during the reciprocatory knitting, any convenient mechanism may be provided for effecting such oscillation. For example, the oscillation may be effected from a lobe cam fitted to the drive shaft of the machine through intermediate connections.

But for the knitting of a half round terry area, such as

a high heel portion or a foot bottom or sole of a sock, only the terry thread feeder **29**, supplying the thread T', and the associated trapping and severing device **32** are used, these being operated and controlled for this purpose and in suitable timed relation not from the main control drum **30** but from a small and independent rotary cam unit such as that indicated at **70** in Figures 4, 5 and 6 which unit is adapted to be driven, at the appropriate times only, at a rotational speed of 1:1 with respect to the rotary knitting head of the machine.

During the knitting of a half round terry area the terry finger **29** is moved into the circumferential gap **23** to supply the terry thread T' to the heel and toe group of frame needles and the associated terry instruments **8** once during each successive course of knitting and is retracted from the gap course by course to withdraw the said thread and take it into the trapping and severing device in which it is cut out at the end of this group of needles.

Referring to Figures 4, 5 and 6 it will be seen that the small rotary cam unit **70** is freely mounted upon a vertical drive spindle **71** which is adapted to be driven from a main gear at **72** (Figure 6) through the medium of a pinion **73**. The unit **70** is supported upon a bracket **74** in which the spindle **71** is suitably journalled. Keyed upon the upper end of the said spindle is a rotating clutch component **75** which is adapted to be lowered into and raised out of co-operative relationship with a complementary clutch portion of the cam unit **70** at appropriate times under the control of the main control drum **30**. For this purpose, the clutch component **75** is circumferentially grooved at **76** to receive pins or rollers carried by a forked clutch-operating lever **77** (Figure 6). This lever is fulcrumed at **78** and is connected, by a link **79**, with a control lever **80** furnished with a toe **80***a* for engagement by a cam or cams such as **81** on the main control drum. Accordingly, each time a half round terry area is to be produced, the clutch component **75** is moved to connect the cam unit **70** with the spindle **71**. The unit **70** is of stepped formation and is provided with appropriately contoured outer and inner cams **82** and **83** respectively. The outer cam **82** is arranged for action upon a roller **84** carried by one arm **85***a* of a bell crank **85** which is fulcrumed in a bracket **86** mounted on or integral with the bracket **74**. The other arm **85***b* of such bell crank is connected, through the medium of a link **87**, with an arm **88***a* (Figure 8) formed on a collar **88** rigidly secured, by a screw **89** upon the lower end of the bush or sleeve **47** integral with the turnable component **52** carrying the feeder **29**. The inner cam **83**, on the other hand, is arranged for action upon a roller **90** carried by one arm **91***a* of a two-armed lever **91** the other arm **91***b* of which is articulated to the lower end of the operating link **39** of the trapping and severing device **32**.

With regard to the hereinbefore described movable part **24** of the latch guard L this is operated, during reciprocatory knitting, from a cam **92** fixed to the rotary top cylinder 2 (see Figure 12). This cam **92** acts upon a self-positioning lever **93** which is pivotally mounted at **94** upon the top plate **95** of the machine and is so controlled by a spring **96** as normally to be maintained in a central position and to be returned to this position after being turned aside by the cam **92** in either direction and released. The spring **96**, which is of the tension type, is anchored to and stretched between lugs on two small overlapped levers **97** and **98** which are respectively pivoted at **99** and **100** upon the top plate **95** and are arranged to act at their operative ends upon opposite sides of a pin **101** secured in the end of the lever **93** remote from the cam **92**. Mounted on a bracket **102** upon the top plate **95** adjacent to this centralised lever **93** is a two-armed lever **103** one arm **103***a* of which is so located as to be tapped by and turned each time the centralised lever **93** is laterally deflected in the appropriate direction by the cam **92** during a reverse stroke of the top cylinder **2**. As will be appreciated each forward stroke of the top cylinder **2** also deflects the centralised lever **93** (in the opposite direction), but in this case the deflection takes place idly. The two-armed lever **103**, which is furnished with a foot **103***b* arranged to impinge on the top plate **95** to determine the normal position of said lever and hence also the "open gap" position of the movable part **24** of the latch guard L, is connected, by a downwardly extending link **104** with a bell-crank lever **105** (Figure 11) mounted on the top cam box **7**. The arm **105***a* of this bell-crank lever **105** acts upon the movable part **24** to move it to its "closed gap" position at each reverse stroke of the cylinders during reciprocatory knitting.

The conventional striper for feeding in a selected main or ground yarn is indicated in a general way at S in Figure 5.

The main or ground yarn guide (**40**, **41** or **42**) located beneath the latch guard L may be arranged to spring to a position coincident with the centre of the latch guard during the making of a heel or a toe. During the knitting of the remaining portions of the article the main guide which happens to be feeding may be automatically moved, by connections controlled from the main control drum, to the left of its heel and toe position.

I claim:

1. A circular knitting machine comprising, in combination, a rotary bottom needle cylinder, a superimposed rotary top needle cylinder, double-ended latch needles for operation in the said cylinders, bottom and top sliders in the cylinders for actuating the needles and for transferring the same from one cylinder to the other according to knitting requirements, terry instruments for the production of elongated sinker loops, a bed located concentrically within the top needle cylinder for accommodation of the said terry instruments, means for operating the terry instruments conjointly with the operation of needles in the bottom cylinder, a fixed latch guard presenting an inner face for engagement with open latches of needles in both cylinders for the purpose of preventing closure of such latches, said latch guard having formed therein a circumferentially extending gap, at least one yarn guide provided below the latch guard for feeding in beneath the lower edge thereof a main yarn for engagement by needles in the bottom cylinder, at least one thread feeder in the form of a finger for temporarily supplying to needles in the bottom cylinder and over operative terry instruments a terry thread to be knitted together with the said main yarn, a terry thread trapping and severing device disposed at the outside of the gapped latch guard and in a low position beneath the latter, automatically actuated and controlled means for moving the terry thread feeder from the low position at which the trapping and severing device is provided to a high feeding position in which the terry thread is fed through the gap in the latch guard to appropriate needles and over the said operative terry instruments, and also for retracting the said feeder away from the circumferential gap to the low non-feeding position to effect withdrawal of the terry thread from knitting, such withdrawal being from the inside of the latch guard to the low position on the outside thereof where the terry thread is taken into the trapping and severing device, and means for automatically actuating the said device so as to trap and sever the withdrawn thread.

2. A circular knitting machine comprising, in combination, a rotary bottom needle cylinder, a superimposed rotary top needle cylinder, independent latch needles operating in said cylinders, a fixed latch guard for guarding open latches of needles in the cylinders, said latch guard having formed therein a circumferentially extending gap, thread trapping devices disposed at the outside of the latch guard, a corresponding number of thread feeders each in the form of a finger for supplying a thread to needles in the bottom cylinder, said

feeders being selectively operable to substitute one thread for another, and automatically actuated and controlled means for selectively moving the feeders each from the corresponding trapping device and through the gap in the latch guard to a favourable thread feeding position at the inside of the latter, and also for retracting the appropriate feeder through the said gap to a non-feeding position clear of the latch guard to effect withdrawal of a previously fed thread, such withdrawal being from the inside of the guard to a position on the outside thereof where the thread is taken into the corresponding trapping device and held.

3. A circular knitting machine comprising, in combination, a rotary bottom needle cylinder, a superimposed rotary top needle cylinder, double-ended latch needles for operation in the said cylinders, bottom and top sliders in the cylinders for actuating the needles and for transferring the same from one cylinder to the other according to knitting requirements, terry instruments for the production of elongated sinker loops, a bed located concentrically within the top needle cylinder for accommodation of the said terry instruments, means for operating the terry instruments conjointly with the operation of needles in the bottom cylinder, a fixed latch guard presenting an inner face for engagement with open latches of needles in both cylinders for the purpose of preventing undesired closure of such latches, said latch guard having formed therein a circumferentially extending gap, at least one yarn guide provided below the latch guard for feeding in beneath the lower edge thereof a main yarn for engagement by needles in the bottom cylinder, at least two thread feeders each in the form of a finger for temporarily supplying to needles in the bottom cylinder and over operative terry instruments a terry thread to be knitted together with the said main yarn, the terry threads contrasting with one another and the said feeders being selectively operable to substitute one thread for another, a corresponding number of terry thread trapping and severing devices disposed at the outside of the gapped latch guard and in low positions beneath the latter, automatically actuated and controlled means for selectively moving the terry thread feeders each from the low position at which the corresponding trapping and severing device is provided to a high position through the gap in the latch guard to the inside thereof where the terry thread is fed to appropriate needles and over aperative terry instruments, and also for retracting a relevant feeder through the circumferential gap to the appropriate low non-feeding position to effect withdrawal of the corresponding terry thread from knitting, such withdrawal being from the inside of the latch guard to the relevant low position on the outside thereof where the said terry thread is taken into the corresponding trapping and severing device, and means for automatically and selectively actuating the said devices so as to trap and sever a withdrawn thread.

4. A circular seamless hose knitting machine comprising superimposed bottom and top needle cylinders which are rotatable together in the forward direction to produce a leg or a foot and are arranged to reciprocate together to produce a heel or a toe, double-ended latch needles for operation in the said cylinders, bottom and top sliders in the cylinders for actuating the needles and for transferring the same from one cylinder to the other according to knitting requirements, a fixed latch guard for guarding open latches of needles in the cylinders, said latch guard having formed therein a circumferentially extending gap, having an entrance thereinto, a thread trapping device disposed at the outside of the latch guard, at least one thread feeder in the form of a finger for supplying thread to needles in the bottom cylinder, automatically actuated and controlled means for moving said feeder from the trapping device and through the gap in the latch guard to a favourable thread feeding position at the inside of the latter, and also for retracting the said feeder through the said gap to a non-feeding position clear of the latch guard to effect withdrawal from knitting of the previously fed thread, such withdrawal being from the inside of the guard to a position on the outside thereof where the thread is taken into the trapping device and held, and means for closing the entrance to the circumferential gap in the latch guard at each reverse stroke of the needle cylinders in a direction opposite to the aforesaid forward direction during reciprocatory knitting.

5. A circular knitting machine according to claim 4, wherein the gapped latch guard comprises a main fixed portion having associated therewith a movable portion which is automatically operable to close the entrance to the circumferential gap and to present an unbroken guarding face to needle latches at each reverse stroke of the cylinders, the arrangement being such that during normal knitting in the forward direction, the said movable portion of the latch guard is held in an inoperative position separated from the gapped main portion thereof, but that during reciprocatory knitting the movable portion is moved back and forth in such a way that each time reverse knitting takes place the movable portion will move to close the circumferential gap whereas each time knitting is performed in the forward direction the movable portion will move back again to open the gap.

6. A circular knitting machine according to claim 5, wherein the said movable portion is actuated from a cam fixed to a part of the knitting head of the machine through the medium of biassed connections.

7. A circular knitting machine comprising, in combination, a rotary bottom needle cylinder, a superimposed rotary top needle cylinder, independent latch needles operating in said cylinders, a fixed latch guard for guarding open latches of needles in the cylinders, said latch guard having formed therein a circumferentially extending gap, a thread trapping device disposed at the outside of the latch guard, at least one thread feeder in the form of a finger for supplying thread to needles in the bottom cylinder, a vertically slotted component in which the said thread feeder is pivotally mounted for movement up and down about a horizontal axis, a bracket attached to the machine and serving as a carrier for the said slotted component which is mounted to turn about a vertical axis, the feeder being thereby permitted conjoint vertical and horizontal movements, a feeder control plate which is attached to the said bracket and has formed therein a cam slot through which the tail end of the feeder extends so that the feeder is movable from the trapping device and through the gap in the latch guard to a favourable thread feeding position at the inside of the latter and is also retractible through the gap to a non-feeding position clear of the latch guard to effect withdrawal from knitting of the previously fed thread, such withdrawal being from the inside of the guard to a position on the outside thereof where the thread is taken is taken into the trapping device and held, automatically actuated and controlled means for turning the vertically slotted component first in one direction and then the other suchwise as to move the feeder into and withdraw it from the feeding position, and means for automatically opening and closing the trapping device in time with the movements of the thread feeder.

8. A circular seamless hose knitting machine comprising superimposed bottom and top needle cylinders which rotate together in the forward direction when producing circularly knitted portions of a seamless hose and are arranged to reciprocate together to produce a heel or a toe of such hose, double-ended latch needles for operation in said cylinders, bottom and top sliders in the cylinders for actuating the needles and for transferring the same from one cylinder to the other according to knitting requirements, terry instruments for the production of elongated sinker loops, a bed located concentrically within the top needle cylinder for accommodation of

the said terry instruments, means for operating the terry instruments conjointly with the operation of needles in the bottom cylinder, a fixed latch guard for guarding open latches of needles in the cylinders, the said latch guard having formed therein a circumferentially extending gap, at least one yarn guide provided below the latch guard for feeding in below the lower edge thereof a main yarn for engagement by needles in the bottom cylinder, at least one thread feeder in the form of a finger for temporarily supplying to the appropriate needles in the bottom cylinder and over operative terry instruments a terry thread to be knitted together with the said main yarn in the production of a half round terry area, a terry thread trapping and severing device disposed at the outside of the gapped latch guard, a rotary cam unit driven at a rotational speed of 1:1 with respect to the rotary needle cylinders, connections between the said unit and the terry thread feeder whereby the latter is automatically movable from the trapping and severing device and through the circumferential gap in the latch guard to the inside of the latter to feed the terry thread to the aforementioned needles and associated terry instruments only once during each successive course of knitting, and is retracted through the said gap to a non-feeding position course by course to withdraw the said thread from the inside of the latch guard and take it into the trapping and severing device at the outside of the said guard where said thread is cut and trapped at the

end of said needles, and further connections between the aforesaid rotary cam unit and the trapping and severing device whereby the latter is automatically actuated in time with the movements of the terry thread feeder.

9. A circular knitting machine according to claim 8, wherein the said terry thread feeder is also adapted to be operated and controlled from a main control drum of the machine both when producing all-round terrying during rotation of the needle cylinders in the forward direction and also when producing a terry heel or terry toe during reciprocation of the said cylinders.

10. A circular knitting machine according to claim 9, wherein for the production of a terry heel or a terry toe pouch by reciprocatory knitting the terry thread feeder is moved into the gap in the latch guard at the commencement of the pouch and remains there until completion of the pouch when the feeder is retracted to withdraw the terry thread from the inside to the outside of the latch guard and take it into the trapping and severing device.

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