May 8, 1945. H. H. HOLMES ET AL 2,375,473

YARN FEEDING AND CHANGING MECHANISM FOR KNITTING MACHINES

Filed April 9, 1943 4 Sheets-Sheet 1

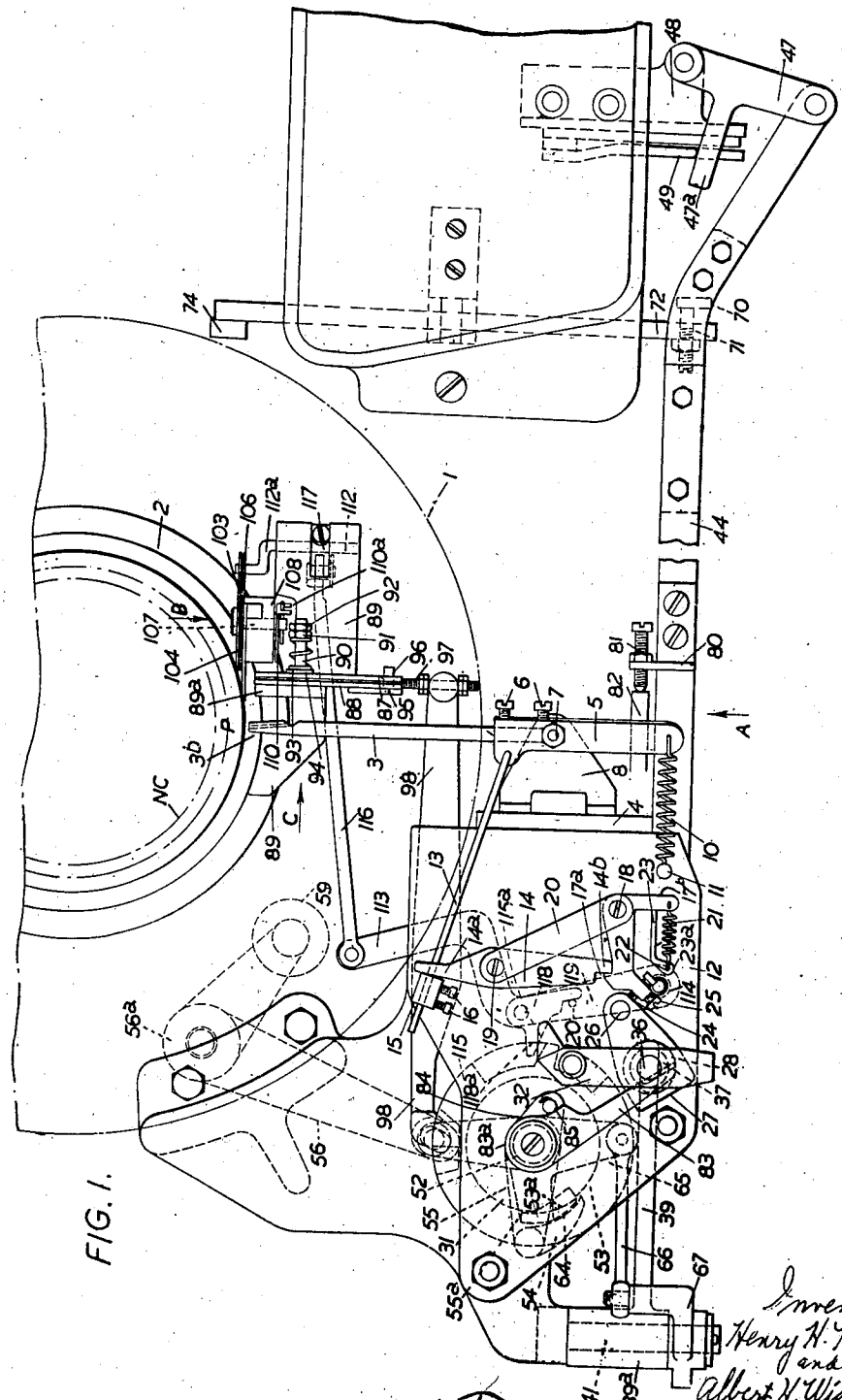


FIG. 1.

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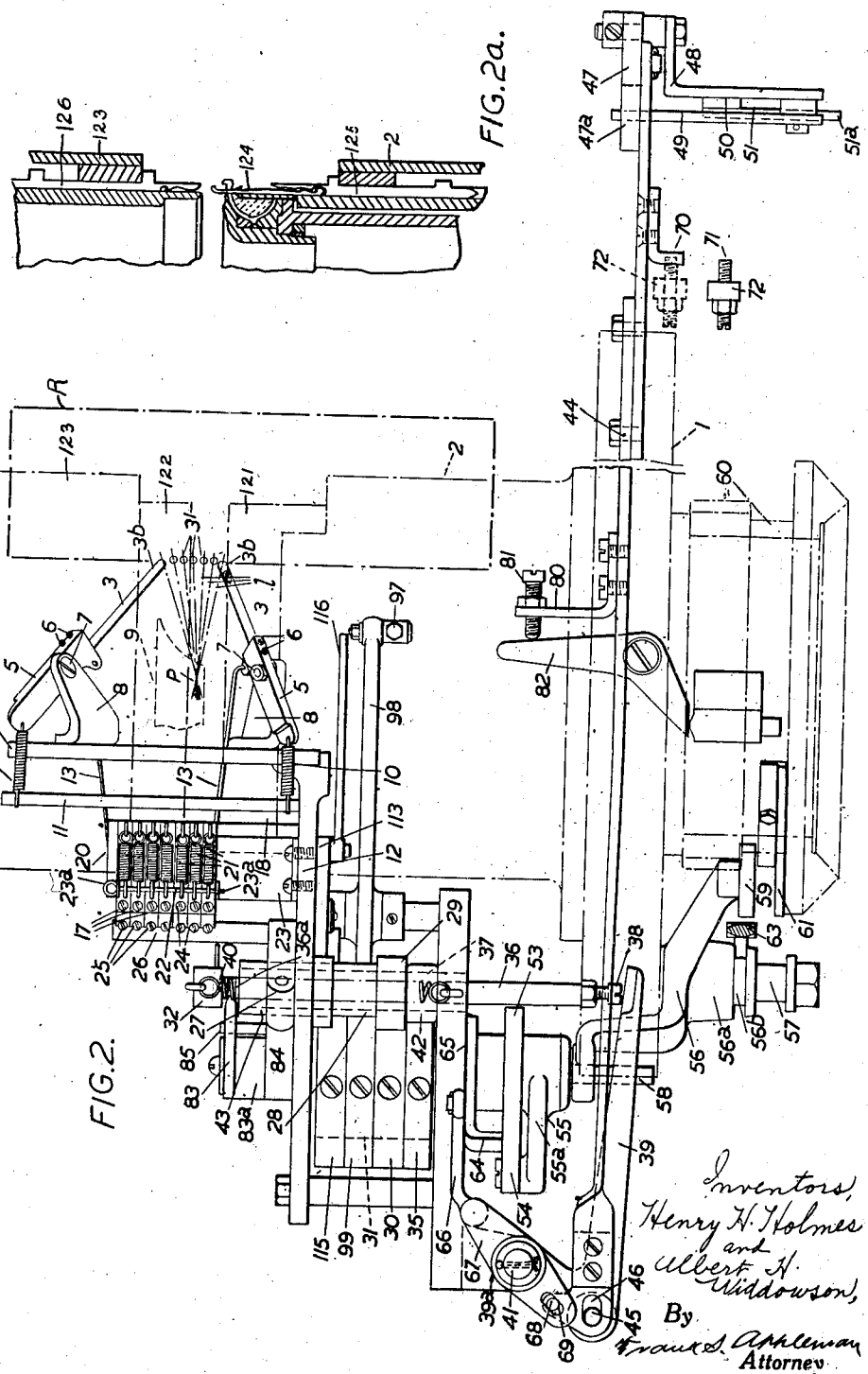


FIG. 2a.

FIG. 2.

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FIG. 3.

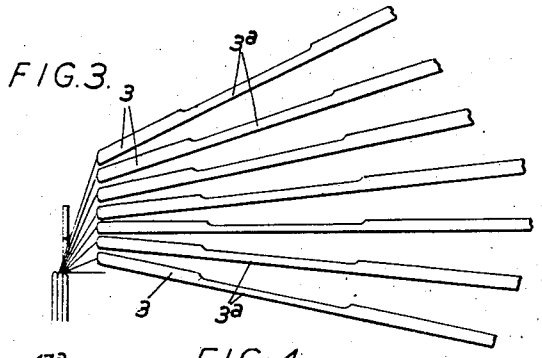


FIG. 4.

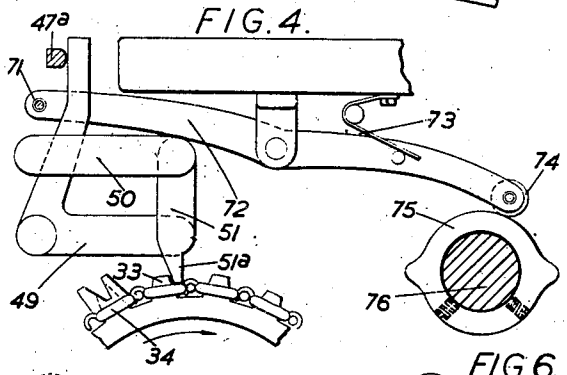


FIG. 5.

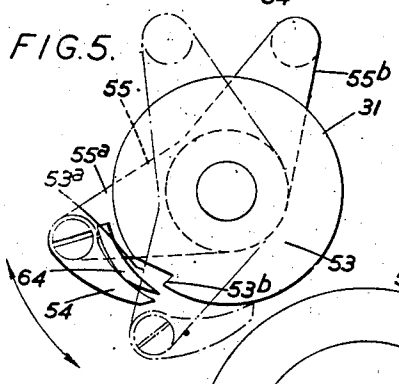


FIG. 6.

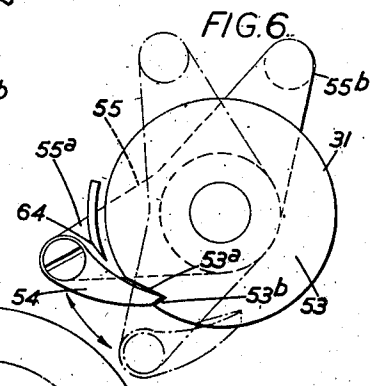
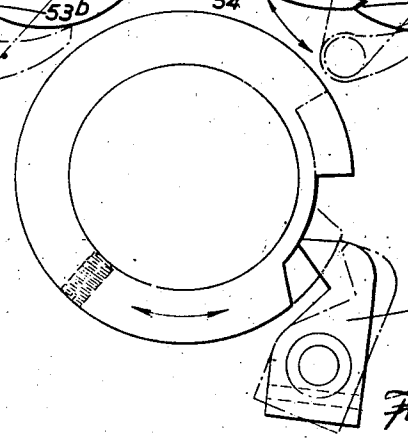


FIG. 7.



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FIG. 8.

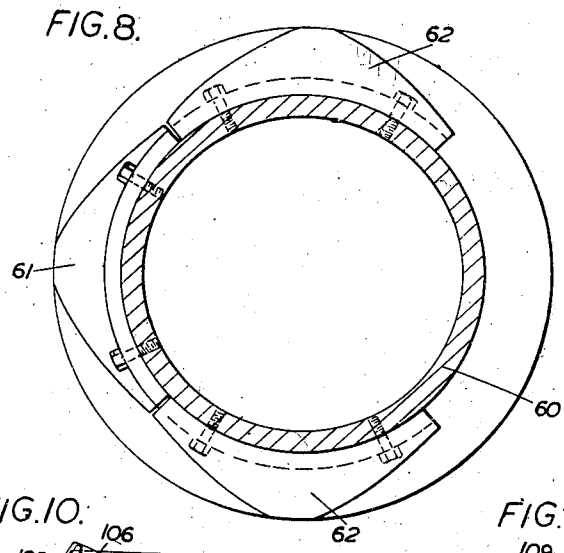


FIG. 10.

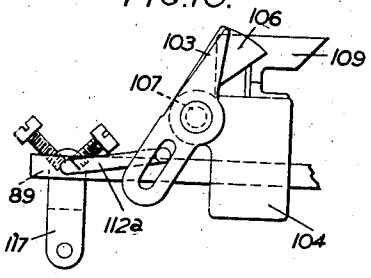


FIG. 11.

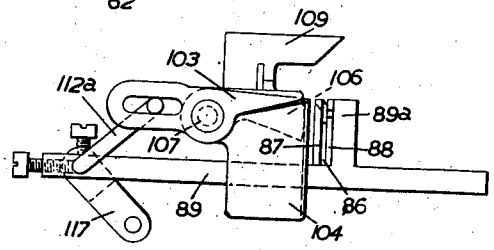


FIG. 9

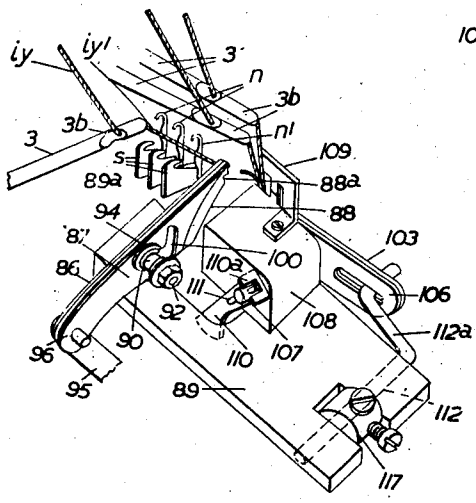


FIG. 12.

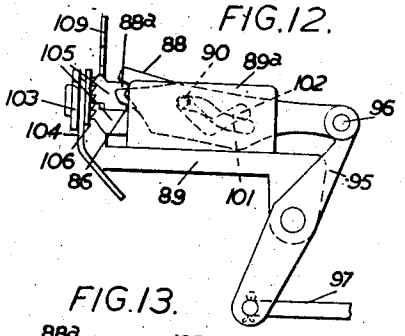
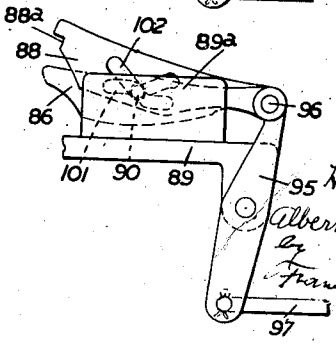


FIG. 13.



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UNITED STATES PATENT OFFICE

2,375,473

YARN FEEDING AND CHANGING MECHANISM FOR KNITTING MACHINES

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Application April 9, 1943, Serial No. 482,450
In Great Britain April 2, 1942

14 Claims. (Cl. 66—140)

This invention appertains to yarn feeding and changing mechanism employed in knitting machines, and has reference more particularly to such mechanism of the kind comprising a plurality of independently movable yarn guides which are operable automatically for the purpose of substituting one yarn for another at a knitting location and have in association therewith yarn trapping and severing means for holding and cutting a yarn when withdrawn from knitting, in the manner well understood in the art.

The principal aim is the provision of an improved form of yarn feeding and changing mechanism capable of producing contrasting, e. g., different coloured, effects such as horizontal stripes and the like in knitted fabric.

Although it is not necessarily limited in this respect, the mechanism constituting the present invention is principally intended for application to circular knitting machines furnished with independent needles. In this connection the invention is advantageously applicable to circular knitting machines of the characteristic type including double axially opposed, e. g., superimposed, needle cylinders.

A disadvantage with yarn feeding and changing mechanisms commonly employed heretofore is that by reason of the relative disposition of the yarn guides and the trapping and severing means, comparatively long "ends" of yarn are produced when yarn changes are made which tend to form somewhat bulky joins at the junctures of the yarns in the knitted fabric. This is accounted for by the fact that when a change is made the leading end of the new yarn is usually turned back or doubled, and also the overlapping lengths of the old and new yarns extend across an appreciable number of the needles, which, of course, impairs the appearance of the knitted fabric.

The present invention comprises an improvement the principal object of which is to provide a yarn feeding and changing mechanism of a comparatively compact form designed to take up a minimum of space at a knitting location and to produce less bulky and consequently much neater joins in the knitted fabric whereby the appearance of the latter is rendered appreciably more attractive.

The characteristic feature of the improved yarn feeding and changing mechanism resides in the provision of a device adapted, whenever a yarn change is effected, to engage and introduce to the needles the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means and thereupon to cut the said yarn.

Broadly, the said device may be arranged to cut the ingoing yarn at any point between the needles to which it is introduced and the yarn trapping and severing means.

To achieve the principal object of the invention, however, the device is preferably so arranged and operated that the ingoing yarn is cut as near as is practicable to the appropriate side of the first needle to receive it. The effect of this is to produce a particularly short, unknitted leading end of new yarn, and to leave a free portion of the yarn projecting from the trapper for eventual removal as waste. This, of course, is in contra-distinction to yarn feeding and changing mechanisms of the form most commonly employed heretofore, wherein whenever a yarn guide was moved into its feeding position the ingoing yarn was caught by certain needles and the whole of the appreciable length of yarn then extending between the said needles and the trapper was pulled out from the latter and turned back or doubled, thereby contributing to the formation of a bulky join.

It is to be clearly understood that the point where the ingoing yarn is cut by the improved device must in any event be such as to leave a sufficient length of yarn beyond the first needle to engage it to ensure that the yarn is safely taken into and knitted by that needle. But, providing this requirement is satisfied, the nearer to the needle the yarn is cut the better for the success of the ultimate results to be achieved.

The improved device, which for the sake of convenience will hereinafter be referred to as the "yarn placing and cutting device" is operated during each yarn change at a point where needles are retracted for stitch forming purposes and in appropriate timed relation with the ingoing and outgoing guides.

The yarn placing and cutting device is also adapted to trap the appropriate portion of the ingoing yarn before cutting it. In this connection the said device may therefore be regarded as constituting auxiliary trapping and severing means employed in association with the main trapping and severing device of the mechanism.

The main trapping and severing device is arranged as near as possible to the needles so that, whenever a yarn guide is withdrawn from its feeding position, the outgoing, i. e., old, yarn after being trapped will be severed close to the needles to leave a short end. Moreover, the overlap (by which is meant the overlapping lengths

of the old and new yarns) is advantageously controlled so as to be rendered as short as possible by arranging the timing or controlling mechanism of the machine to give a changing period as short as practicable. In this way there is produced in the knitted fabric a particularly neat join with but short unknitted ends of the old and new yarns projecting from the inside of the fabric.

In order that the invention may be more clearly understood and readily carried into practical effect, a multi-colour striping attachment and associated operating mechanism as applied to a seamless hose machine of the superimposed rotary needle cylinder type will now be described, by way of example, with reference to the accompanying drawings, wherein,

Figure 1 is a plan view of the said attachment and operating mechanism,

Figure 2 is a front elevation of the yarn guides and operating mechanism as seen in the direction of the arrow A in Figure 1,

Figure 2A is a fragmentary vertical sectional view of that portion of Figure 1 enclosed in the chain line rectangle R.

Figure 3 is a detail view showing the yarn guides in their non-feeding positions—with all of the corresponding yarns in the main trapper,

Figure 4 is a fragmentary side view showing cam means and intermediate connections for controlling the attachment for half round striping,

Figure 5 is a detail plan view depicting the pawl and ratchet mechanism employed for effecting reciprocation of the striping control drum, the pawl being shown in its bluffed position,

Figure 6 is a similar view, but with the bluff moved to such a position as to allow co-operation of the pawl with the associated rack wheel,

Figure 7 is a plan view of one of a plurality of cams on the striping control drum, and shows the manner in which it acts upon and operates the associated lever,

Figure 8 is a part sectional plan view showing cams arranged beneath the bottom plate of the machine for controlling the mechanism during both instep and rear striping, as will be hereinafter described,

Figure 9 is a perspective view of the main trapping and severing device and the yarn placing and cutting device, the latter having been operated to cut an ingoing yarn,

Figures 10 and 11 are two views of the main trapping and severing device, with its yarn "gatherer" in the open and closed positions respectively, the said device being viewed in the direction of the arrow B in Figure 1,

Figure 12 is a side view of the yarn placing and cutting device per se, as seen in the direction of the arrow C in Figure 1, the elements of the device being shown inoperative, and

Figure 13 is a somewhat similar view showing the said elements in the course of being advanced to cut and hold a yarn.

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

Referring to Figures 1 and 2, the reference numeral 1 designates the bottom or bed plate of the machine, while the bottom cam box is indicated at 2. In this example there are seven yarn guides 3 for multi-color striping, these guides being pivotally mounted to swing one above another on a support 4. The number of yarn guides provided may, of course, vary according to requirements. For the sake of clarity in Figure 2 only two of the said yarn guides are fully shown, i. e., the uppermost and the lowermost, the feeding ends or throats of the remaining five guides being merely indicated by small circles 3^1; the full complement of guides is, however, shown in Figure 3. Each of the yarn guides 3 consists of a comparatively thin rod-like or similar member which is reduced in thickness or relieved as at 3*a* (Figure 3) to render the guide yieldable at its feeding end or throat 3*b*. The yarn guides are inserted in the ends of carrier levers 5 and secured therein by means of screws 6. These levers are pivoted at 7 upon brackets 8 the formation and disposition of which are such as to enable all of the yarn guides, except one, to swing on axes obliquely disposed in two directions. This will be clear from a consideration of Figure 2. The brackets 8 are secured to an upright fixed plate—constituting the support 4—and are so disposed that the feeding ends or throats 3*b* of the yarn guides all converge in the direction of a common feeding point P (Figures 1 and 2) somewhat in advance of the knitting location. In Figure 2 it will be seen that this point is adjacent to the customary latch guard which is indicated at 9. The guides are normally in their respective inoperative, i. e., non-feeding, positions, shown in Figure 2. The guide shown in Figure 1 is, however, in the feeding position, with its feeding end or throat 3*b* located at the point P. When the guides are moved to assume the feeding position, their feeding ends or throats will follow the paths represented by the straight lines *l* in Figure 2. The arrangement is such that when an inoperative guide is moved to the feeding point P its feeding end or throat 3*b* makes contact with the feeding end or throat of the then operative guide which latter thereupon yields to make way for the ingoing guide.

The yarn guides 3 are normally held in their nonfeeding positions by springs. For this purpose each carrier lever 5 has connected to it a tension spring 10 which is suitably anchored to an upright post 11 secured in the fixed plate 12. Each carrier lever 5, moreover, has connected to it a link 13 which is slidable through one arm 14*a* of a pivoted yarn guide operating lever 14. A collar 15, which is secured upon the link 13 by set screws 16, is arranged to impinge upon the arm 14*a* in the manner depicted in Figure 1. The tail end 14*b* of each guide operating lever 14 is formed for engagement at appropriate times with a shouldered portion 17*a* of a spring-influenced catch member 17. As will be seen in Figure 2, these catch members and the corresponding levers 14 are mounted horizontally one above another. In this connection the said catch members 17 are pivotally mounted to swing upon a common pivot pin 18, while the levers 14 are similarly mounted upon a pin 19, the two pins being rigidly connected together at their upper ends by means of a bridge piece 20. Each catch member 17 is formed with a tail 17*b* to which is connected one end of a small tension spring 21 the opposite end of which is anchored to a vertically disposed pin 22 carried in lugs 23*a* formed on an upstanding plate 23. This spring serves normally to hold the catch member in its catch position, shown more clearly in Figure 1, this position being determined by reason of contact of the tail 17*b* with the opposing edge of the plate 23. Normally, the yarn guide operating levers 14 are clear of the respective catch members 17—with their tail ends 14*b* located to the left of the

position shown in Figure 1. Thus, whenever any one of the levers 14 is acted upon suchwise as to move its tail end 14b to the right, said tail end will first press upon the protuberant portion 17a of the relevant catch member 17 and press the latter outwardly against its spring 21, whereupon the parts will immediately snap into engagement; in this way the yarn guide operating lever will be caught and maintained in the position indicated in Figure 1. During movement of a lever 14 in the sense just described the arm 14a thereof will, of course, swing to the left and, in so doing, will press upon the corresponding collar 15, thereby causing the relevant yarn guide 3 to move into the feeding position against the action of its spring 10. It will be noted that the free end of each catch member 17 carries an abutment screw 24 which can be secured, after adjustment, by a set screw 25. For action upon all of the screws 24 simultaneously there is provided an upright pin 26 carried by a lever 27 which is formed on or secured to a hollow shaft 28. This shaft is mounted in suitable bearings in the main bracket of the attachment, and also has rigidly secured thereto another lever 29 (like the lever L depicted in Figure 7) adapted for co-operation with a cam 30, see Figure 2, provided on a striping control drum 31. As will be readily appreciated, whenever the toe of the lever 29 is acted upon by the cam 30, the lever 27 will be turned in a clockwise direction to trip all of the catch members 17 simultaneously. Consequently any one of the guide operating levers 14 which happens at that time to be held in the position shown in Figure 1 will be released to permit the corresponding yarn guide to swing to its non-feeding position under the influence of its spring 10. As a result of this movement of the guide, the corresponding collar 15 will act upon the lever 14, thereby causing the latter to assume its normal inoperative position—with its tail end 14b disposed to the left as aforesaid.

The guide operating levers 14 are selectively operated. For this purpose there is provided a selector member 32 which is movable up and down into different horizontal planes for action selectively upon the levers 14, adjacent to their tail ends 14b, at the dictates of studs such as 33 (Figure 4) on a timing chain 34, the said member being adapted to be actuated from a cam 35 provided on the striping control drum 31. The member 32 is secured to the upper end of a push rod 36 which is arranged for vertical sliding movement through a hollow shaft 37. This shaft is mounted within the outer hollow shaft 28 concentrically therewith. The rod 36 is furnished at its lower end with an abutment screw 38 which rests upon the free end of the selector operating lever 39. A tension spring 40 arranged as shown in Figure 1 serves to maintain the rod in contact with the said operating lever. The latter is suitably bossed at 39a and mounted for pivotal movement upon a fixed spindle 41. By swinging the lever 39 to various angular extents the push rod 36 can be raised or lowered to move the selector member 32 into the appropriate horizontal plane for subsequent action upon the desired yarn guide operating lever 14. A lever 42, similar in form to the lever L shown in Figure 7, is secured upon the lower end of the hollow shaft 37 for co-operation with the cam 35. A further lever 43 (see Figure 2) is secured upon the upper end of the shaft 37 and arranged for action upon the selector member 32. Thus, whenever the cam 35 functions to move the lever 42 outwards, such movement is transmitted, through the medium of the shaft 37, to the lever 43 which latter thereupon effects a turning motion of the selector member 32. In this way the said member is caused to act upon the desired operating lever 14 so that the corresponding yarn guide 3 is drawn to the feeding position P. For operating the lever 39 and thereby varying the height of the push rod 36 in accordance with patterning requirements, there is provided a link 44 which has a pin-and-slot connection 45, 46 with the said lever and is arranged for movement longitudinally to varying extents at the dictates of studs on the chain 34. The end of the link 44 remote from the selector operating lever 39 is pivotally connected to a lever 47 which is in turn pivoted upon a fixed bracket 48. The lever 47 is formed with an arm 47a arranged in the path of a chain stud lever 49 which is suitably associated with and actuated by linkage comprising a parallel movement link 50 and a link 51 formed with a toe 51a for co-operation with the studs on the chain 34. The arrangement is therefore such that in following studs of respectively different heights the linkage actuates the chain stud lever 49 and, through the medium of the lever 47, shifts the link 44 to the extent required in the desired direction.

The striping control drum 31 is normally quiescent, but is brought into operation whenever a yarn change is to be effected, through the stud-operated link 44. The said drum is secured upon an axle 52 to which is also rigidly attached a rack wheel 53 having formed therein a single notch 53a to provide a shouldered portion 53b (see Figures 5 and 6) for co-operation with a pawl 54. This pawl is carried by one arm 55a of a lever 55 which is adapted to be continuously reciprocated by a cam-actuated bell crank 56. The bell crank is formed with a boss 56a which is slidable up and down upon an axle 57 depending from the bottom or bed plate 1. At its forward end the bell crank is slidably engaged with a pin 58 projecting downwards from the arm 55b of the pawl lever 55, and at its opposite end is furnished with a roller 59 adapted to be acted upon by cams bolted to the hub 60 of the customary cylinder-driving gear. As shown in Figure 8, there are three of these cams, viz. a single cam 61 for effecting a reciprocation of the pawl lever once per revolution, and a pair of diametrically opposed cams 62 for reciprocating the said lever twice per revolution of the needle cylinders. The cam 61 is located in a horizontal plane beneath that in which the cams 62 are arranged and the bell crank 56 is movable heightwise to bring the roller 59 into either of these planes, according to requirements. For this purpose the boss 56a is circumferentially recessed at 56b for reception of the appropriate end of a lever 63 (see Figure 2) operated from the main control drum (not shown), the construction and arrangement being such that according to the height of the roller 59, which height will be determined by cams on the main drum, the pawl 54 has imparted to it either one or two working strokes per revolution of the needle cylinders. It is to be understood that the pawl lever 55 is continuously oscillating whenever the machine is in operation, but is normally rendered ineffective by means of a bluff 64 which, when operative as shown in Figures 1 and 5, serves to prevent engagement of the pawl 54 with the rack wheel 53. This bluff is formed on a bell crank 65 which is connected by means of a link 66 with a bluff-operating lever 67 mounted pivotally upon the fixed spindle

41 aforesaid. The lever 67 has a pin and slot connection 68, 69 with the link 44, so that whenever the latter is shifted to initiate selection of a yarn guide the bluff will be actuated and swung away from the notch 53a to permit co-operation of the pawl with the rack wheel, in the manner shown in Figure 6, and vice versa. Thus it is only when a yarn change is to be effected that the striping control drum 31 will be racked.

For producing half round effects such as instep striping, the drum 31 will be racked twice per revolution of the machine from the cams 62, whereas for all round striping the said drum will be racked only once per revolution from the cam 61. The drum has a spring return action so that, during operation, it is automatically restored to its original position after each rack, that is to say at each idle stroke of the pawl 54.

When racking on cams 62 for half round striping the link 44 is released but again caused to take up a position to determine selection of the appropriate, e. g., foot bottom, yarn guide at each revolution of the machine. In this connection the link 44 is furnished with a lug 70 for co-operation at appropriate times with a screw abutment 71 carried at the free end of a pivoted lever 72. This lever is influenced by a spring 73 (see Figure 4) tending normally to hold the lever with the abutment 71 in the raised position indicated in dotted lines in Figure 2; at this height the said abutment is disposed in the path of the lug 70 to check the link 44 and temporarily maintain the latter in the position at which it determines selection of the appropriate half round, e. g., foot bottom, striping yarn guide. The lever 72 is, however, furnished with a roller 74 for contact with a 2-lobe cam 75 secured upon a layshaft 76 running at half cylinder speed. Consequently at suitable regular intervals during half round striping the link 44 will be released by reason of the lever 72 being positively cam actuated against the spring action to lower the screw abutment 71 clear of the lug 70 (see full line position in Figure 2).

The guide for the heel and toe yarn is controlled from the main drum of the machine and not from the chain 34 as are the remainder of the yarn guides 3. To enable this to be done the link 44 is furnished with a stop 80 which carries an adjustable abutment screw 81 adapted to be acted upon at appropriate times by a pivoted bell crank lever 82 operated from the main drum. Thus, whenever the heel and toe yarn guide is to be selected for operation, the bell crank lever 82 is turned in a clockwise direction, thereby shifting the link 44 to the right, the extent of these movements being just sufficient to raise the selector member 32 to a height corresponding with the particular lever 14 for operating the said guide.

Reverting to the description of the push rod 36, the height of this and hence also of the selector member 32 at each selection is checked by means of a spring loaded indexing finger 83 which is bossed at 83a and pivotally mounted to turn freely about the axle 52. The free, i. e., operative, end of the finger 83 is suitably formed for engagement in circumferential grooves such as that indicated at 36a in Figure 2. A lever 84 furnished with an upstanding pin 85 is provided for actuating the indexing finger 83, this lever being made fast on the striping control drum spindle. The construction is accordingly such that each time the control drum 31 is restored to its normal position after being racked by the pawl 54, the pin 85 acts upon the indexing finger 83 to swing it away clear of the push rod 36. Conversely, at each rack of the drum 31, the finger 83 is permitted to engage the appropriate one of the grooves 36a to check the height of the selector member 32.

In the example illustrated, the yarn placing and cutting device comprises a pair of thin, flat cutter blades 86 and 87 and an associated blade-like placer and trapper element 88 which are slidably mounted at one side of an upstanding part 89a on a bracket 89 attached to the bottom cam box 2. The three elements of the placing and cutting device are arranged side by side with the cutter blades 86 and 87 on the outside and the placer and trapper element 88 disposed immediately adjacent to the said upstanding part. Each of the two cutter blades and also the placer and trapper element has formed therein a slot through which extends a pin 90 projecting laterally from the upstanding part 89a; the slots will be hereinafter described. The outer end of this pin is screw-threaded for engagement with a nut 91 and an associated lock-nut 92. As shown in Figure 1, a light compression spring 93 is interposed between the nuts and a washer 94 located on the pin adjacent to the outer cutter blade 87; in this way the co-operating elements are spring-pressed together. The device extends in a substantially radial direction with respect to the needle circle. At its operative end each of the cutter blades 86 and 87 is of a generally pointed character, being outwardly bevelled and inwardly curved on its underside. The operative end of the placer and trapper element 88 is of a somewhat similar shape with the exception that it has therein a small recess 88a so formed as to provide at the inner extremity of the element a yarn engaging formation. The cutter blades and associated placer and trapper element are intended to be moved toward and away from the needles *n* simultaneously, for which purpose they are pivotally mounted at their outer or tail ends upon a common actuating lever 95. For instance, all three elements may, as shown, be of the same length—or approximately so—and each have in its tail end a small hole through which extends a pin 96 projecting laterally from the actuating lever in the manner depicted more clearly in Figure 1. The said actuating lever 95 is operated through the medium of a link 97 and a lever 98 from a cam 99 on the striping control drum 31. The construction and arrangement is such that whenever the two cutter blades 86 and 87 and the placer and trapper element 88 are caused to slide forwards, they are also moved independently to co-operate with each other in such a manner as to engage, trap and cut an ingoing yarn such as that indicated *iy* in Figure 9. These independent movements and the timing of the elements are achieved by reason of the pin 90 working in the aforesaid slots. As shown in Figure 9, the slot 100 in the outer cutter blade 87 is of V form so that as the said blade is projected towards the needles *n* it first rises sharply and then quickly moves downwards again to co-operate with the inner cutter blade 86 after the manner of a pair of scissors. The slot 101 in the inner cutter blade 86, on the other hand, comprises practically straight end portions and an intermediate slightly upwardly curved portion, so that during projection of the said blade towards the needles it first moves forward in a straight low path to miss the yarn *iy* then rises slightly before proceeding to the full extent of its move-

ment. The placer and trapper element **88**, although adapted to rise together with the outer cutter blade **87**, moves downwardly a little earlier than the latter to trap the engaged ingoing yarn *iy* before it is cut. This movement is achieved by forming in the placer and trapper element a V-shaped slot **102** (see Figures 12 and 13) which is somewhat shallower than the slot **100** formed in the outer cutter blade **87**.

The main trapping and severing device in this example comprises a pivoted cutting member **103**, a co-operating fixed cutter plate **104**, spring influenced yarn gripping plungers **105** (Figure 12) and a pivoted placer element **106** adapted to engage an outgoing yarn for the purpose of placing it into the trapper. The plungers **105** are of the saw tooth type to permit of yarn in one direction only. As will be seen from a consideration of Figure 1, the pivoted cutting member **103** and the yarn placing element extend more or less tangentially to the needle circle NC substantially at right angles to the hereinbefore described yarn placing and cutting device, and are both rigidly secured to a common pivot pin **107** mounted to turn in a block **108** on the bracket **89**. An upstanding plate **109** secured to the block **108** functions as a guide to facilitate entry of an outgoing yarn into the main trapper. In association with the main trapping and severing device there is provided a yarn "clearer" consisting of an element **110** which is mounted on the inner end of the pivot pin **107** and adapted to function in conjunction with the device to clear waste portions of yarn therefrom. In this connection the clearer is formed with an angularly disposed extension **110***a* which is forked for engagement with a pin **111** inserted in the end of the pivot **107**. The waste yarn may be received in a receptacle of channel form (not shown) attached to the underside of the bracket **89**. The tall ends of the cutting member **103** and the yarn placing element **106** are slotted for engagement with a cranked portion **112***a* of a rod **112** mounted to turn in the bracket **89**. Appropriate turning movements are imparted to this rod through the medium of a lever **113** which is pivoted at **114** and adapted to be actuated by a cam **115** provided on the striping control drum **31**. A link **116** connects the lever **113** with a forked arm **117** which is adjustably secured upon the rod **112**. As shown in Figure 1, the lever **113** is furnished with a pivoted detent **118** which is formed with a nose **118***a* arranged to be acted upon by a tooth-like formation **115***a* on the cam **115**. The said detent is controlled by a spring **119** by which it is normally held against a fixed stop **120** carried by the lever **113**. The arrangement is therefore such that actuation of the lever **113** is permitted upon movement of the control drum **31** in one direction only. This is in contra-distinction to all of the remaining movements on the said drum for each of which the cam and lever action is similar to that shown in Figure 7, so that the forward movement of the cam becomes the trailing end of movement of the return stroke.

The operative portion of the main trapping and severing device is arranged in fairly close proximity to the leading ends of the elements of the yarn placing and cutting device.

In Figure 9 the yarn placing and cutting device has just cut the ingoing yarn *iy* at a point near to the first needle n^1 to receive it, and is holding the portion iy^1 of the said yarn for introduction to the needles. The free portion iy^2 of the yarn projecting from the main trapper is left for removal as waste in the manner previously described. Figure 12 shows all three elements **86**, **87** and **88** of the device fully withdrawn from action, whereas in Figure 13 the elements **86** and **88** are shown as they appear in the course of being advanced to cut and hold an ingoing yarn.

In Figure 2 the plain needle cylinder and the superimposed rib needle cylinder are indicated at **121** and **122**, respectively. The reference numeral **123** indicates the top cam box of the machine. As will be seen in Figure 2A, the machine illustrated is of the type including double-ended needles **124** for operation in the cylinders and sliders such as **125** and **126** in said cylinders for operating the needles and transferring same from one cylinder to the other, according to requirements.

With the improved mechanism, when a guide is advanced to its feeding position the appropriate portion of the new yarn may be introduced to the needles either directly into the hooks in the case of a machine equipped with latch needles, or may be locked in by the latches of the needles descending at the knitting location, or both.

The improved yarn feeding and changing mechanism may be applied to circular plain knitting machines as well as to circular rib knitting machines for producing fabric in continuous lengths for manufacture into garments, or for producing stockings, three-quarter hose, sports hose, half-hose, socks and other knitted articles, or garments or garment lengths.

Moreover, the said mechanism may be applied to circular knitting machines of the stationary cylinder type as well as to machines of the rotary cylinder type, and to machines having either latch or bearded needles.

The timing or controlling mechanism may be designed and operated for yarn changes to take place at the rear of a half-hose when making the leg, and the yarn changes automatically controlled to change at each side of the foot to produce a garment with a plain foot and striped instep.

What we claim then is:

1. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means, said device comprising a pair of relatively movable cutting elements, and a co-operating placer element which latter, besides being formed at its operative end to receive an ingoing yarn, also functions as part of a trapper.

2. In a knitting machine, in combination, a bed, needles in said bed, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, a bracket fixed exteriorly of the needle bed, and a yarn placing and cutting device which is mounted to slide on the bracket towards and from the needles and is operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means, said device comprising a pair of relatively movable cutting elements, and a co-operat-

ing placer element which latter, besides being formed at its operative end to receive an ingoing yarn, also functions as part of a trapper.

3. In a knitting machine, in combination, a bed, needles in said bed, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, a bracket which is fixed exteriorly of the needle bed and has a pin projecting therefrom, and a yarn placing and cutting device operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means, said device comprising relatively movable cutting elements formed with slots for co-operation with the pin on the bracket and a co-operating placer element which latter, besides being formed with a further slot for co-operation with the said pin, is adapted at its operative end to receive an ingoing yarn and also functions as part of a trapper, and the slots being so shaped and relatively disposed that upon all three elements of the device being projected together, in a direction towards the needles, they are moved independently to co-operate with each other in timed relation, for the purposes specified.

4. In a circular knitting machine, in combination, a circle of needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means, the said elements of the device being so mounted on the outside of the needle circle as to extend and move in a practically radial direction with respect thereto.

5. In a circular knitting machine, in combination, a circle of needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, the said means being located on the outside of the needle circle and extending substantially tangentially with respect to the latter, and a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means, the said elements of the device being so mounted on the outside of the needle circle as to extend and move in a practically radial direction with respect thereto.

6. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for operating the guides selectively, said guides being so formed, mounted and operable that when a yarn change is made the ingoing guide takes up substantially the feeding position previously occupied by the guide to be withdrawn so that as the yarns are changed each is eventually fed from the same feeding point as its predecessor, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means.

7. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for operating the guides selectively, said guides being so formed and mounted that their feeding ends extend in the general direction of a feeding location common to all of them and are capable of yielding suchwise that when an inoperative guide is rendered operative it displaces the then operative guide so that its feeding end is eventually caused to assume the position vacated by the feeding end of the outgoing guide, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means.

8. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means, a drum furnished with cams, means for effecting reciprocation of said drum, and intermediate connections respectively between cams on the drum and the main trapping and severing means, the yarn placing and cutting device and the yarn guides whereby all of these parts are operated conjointly in appropriate timed relation.

9. In a knitting machine, in combination, a bed, needles in said bed, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, a bracket which is fixed exteriorly of the needle bed and has a pin projecting therefrom, and a yarn placing and cutting device operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means, said device comprising a cutting element formed with a slot which is so shaped for co-operation with the pin on the bracket that as the said element is projected towards the needles it first rises and moves downwards again, a companion cutting element which is also formed with a slot for co-operation with the pin suchwise that said companion element moves first in a straight low path to avoid the ingoing yarn and then rises somewhat before completing the extent of its movement towards the needles, and a co-operating yarn placer and trapper element having therein a slot for co-operation with the same pin so that, upon being projected forwardly, it rises together with the first mentioned cut-

ting element but moves downwards a little earlier than the latter to trap an engaged ingoing yarn before it is cut, all for the purposes specified.

10. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, a single device common to all of the yarn guides for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means.

11. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, a single device common to all of the yarn guides for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, a yarn placing and cutting device furnished with elements operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing means, and, in association with the first mentioned yarn trapping and severing device, a yarn clearer adapted to function in conjunction therewith to clear waste portions of yarn therefrom.

12. In a circular knitting machine, in combination, a circle of needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, a single device common to all of the yarn guides for trapping and severing a yarn withdrawn from knitting by an outgoing yarn guide, the members of said device extending tangentially to the needle circle, and a yarn placing and cutting device furnished with elements which extend substantially radially with respect to the needle circle and are operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the first mentioned trapping and severing device.

13. In a knitting machine, in combination, needles, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means, said device comprising relatively movable cutting elements and a cooperating placer element also functioning as part of a trapper.

14. In a knitting machine, in combination, a plain needle cylinder, a superimposed rib needle cylinder, double-ended needles for operation in said cylinders, sliders in said cylinders for operating the needles and transferring same from one cylinder to the other according to requirements, a plurality of yarn guides for feeding yarns interchangeably to said needles, means for trapping and severing a yarn whenever it is withdrawn from knitting by an outgoing yarn guide, and a yarn placing and cutting device operable at each yarn change for engaging and introducing to the needles and thereupon trapping and cutting the portion of the ingoing yarn extending between the feeding end of its guide and the aforesaid trapping and severing means, said device comprising relatively movable cutting elements and a cooperating placer element also functioning as part of a trapper.

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