July 14, 1942. C. F. MANGER ET AL 2,290,058

YARN-CHANGING MECHANISM FOR KNITTING MACHINES

Filed Oct. 25, 1940 5 Sheets-Sheet 1

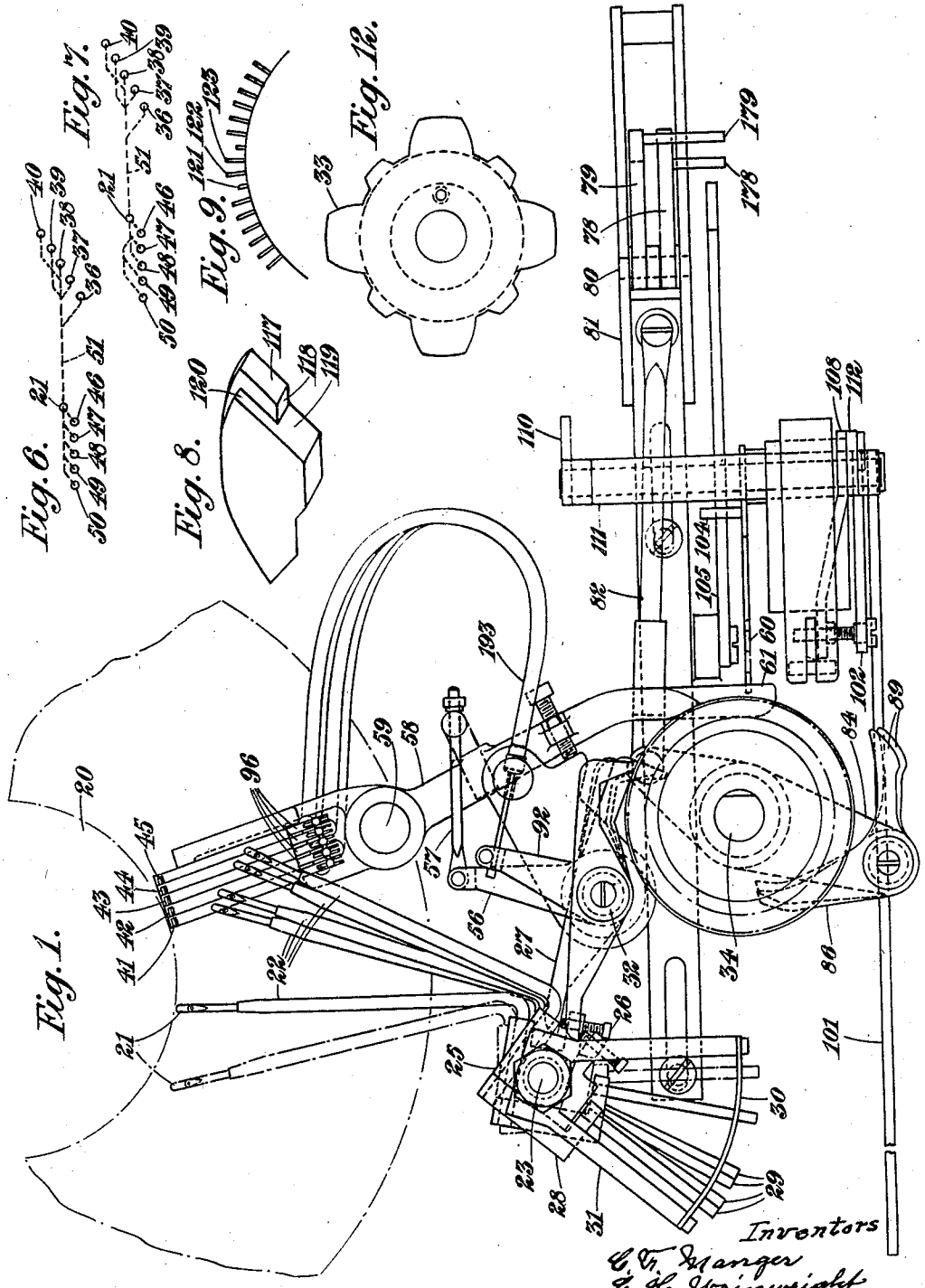


Fig. 1.

Fig. 6.

Fig. 7.

Fig. 9.

Fig. 8.

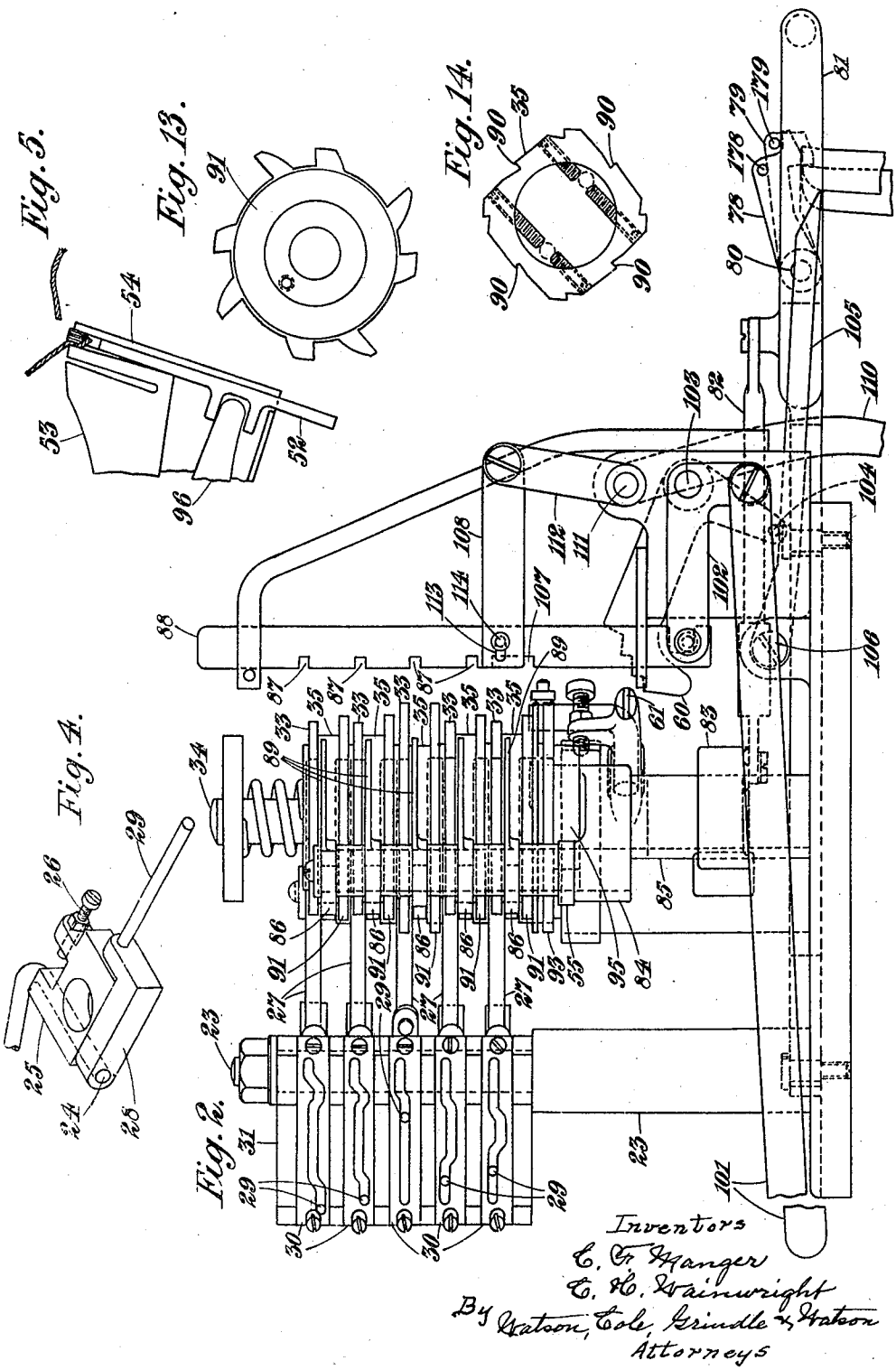
Fig. 12.

Inventors
C. F. Manger
C. H. Wainwright
By Watson, Cole, Grindle & Watson
Attorneys

July 14, 1942. C. F. MANGER ET AL 2,290,058

YARN-CHANGING MECHANISM FOR KNITTING MACHINES

Filed Oct. 25, 1940 5 Sheets-Sheet 2



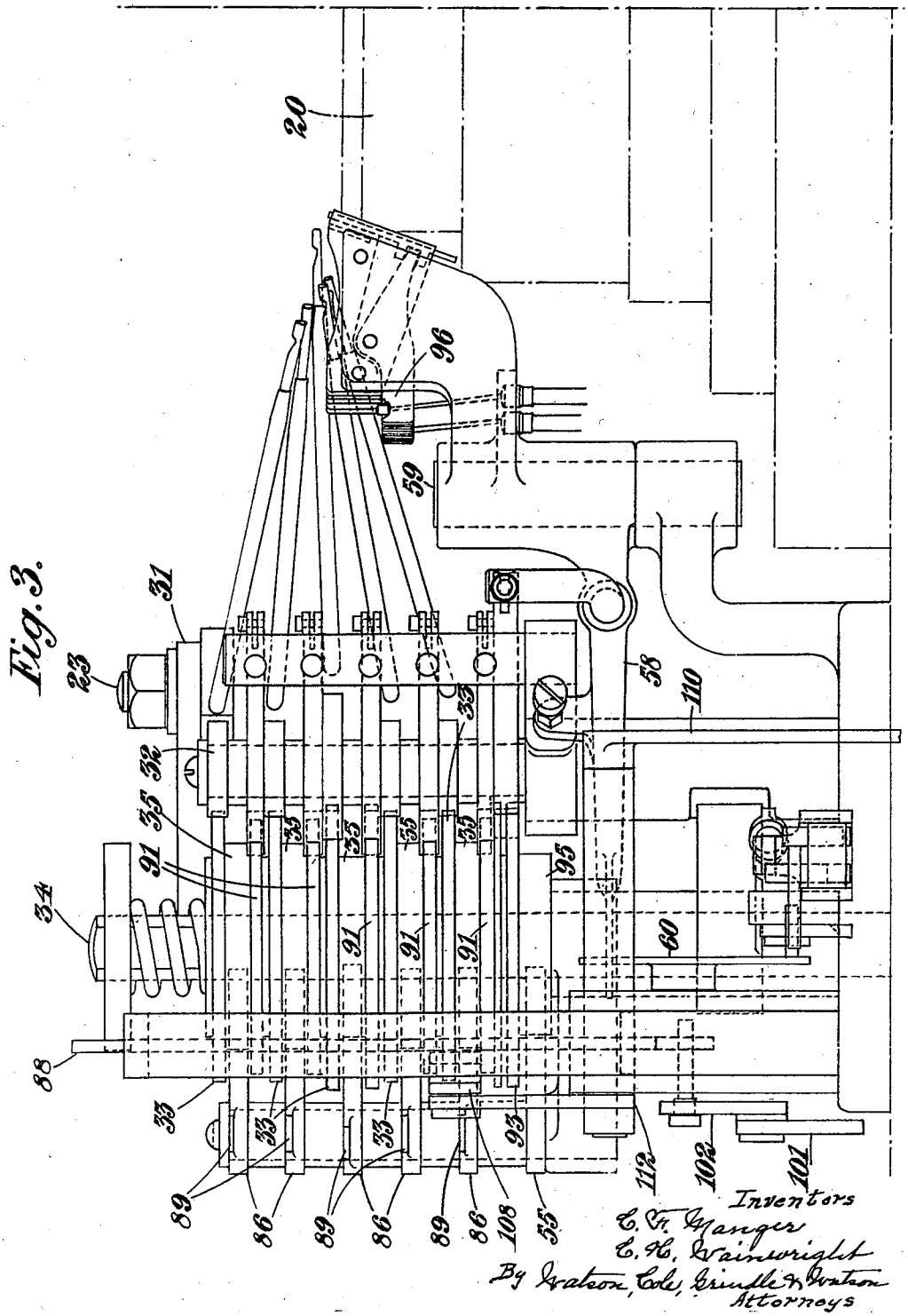
Inventors
C. F. Manger
C. H. Wainwright
By Watson, Cole, Grindle & Watson
Attorneys

July 14, 1942. C. F. MANGER ET AL 2,290,058

YARN-CHANGING MECHANISM FOR KNITTING MACHINES

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Fig. 3.



Inventors
C. F. Manger
C. H. Wainwright
By Watson, Cole, Grindle & Watson
Attorneys

July 14, 1942. C. F. MANGER ET AL 2,290,058

YARN-CHANGING MECHANISM FOR KNITTING MACHINES

Filed Oct. 25, 1940 5 Sheets-Sheet 4

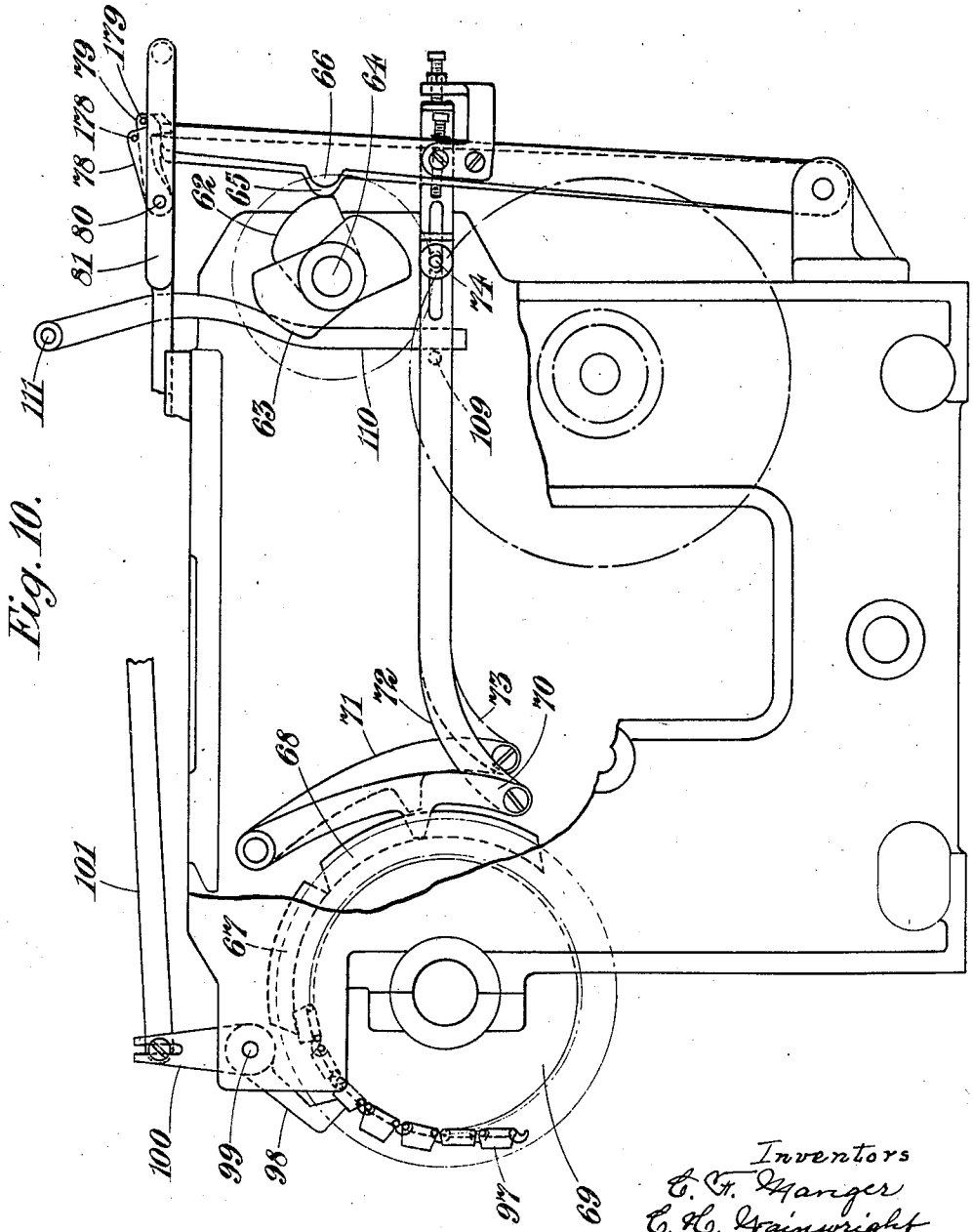


Fig. 10.

Inventors
C. F. Manger
C. H. Grainwright
By Watson, Cole, Grindle & Watson
Attorneys

July 14, 1942. C. F. MANGER ET AL 2,290,058

YARN-CHANGING MECHANISM FOR KNITTING MACHINES

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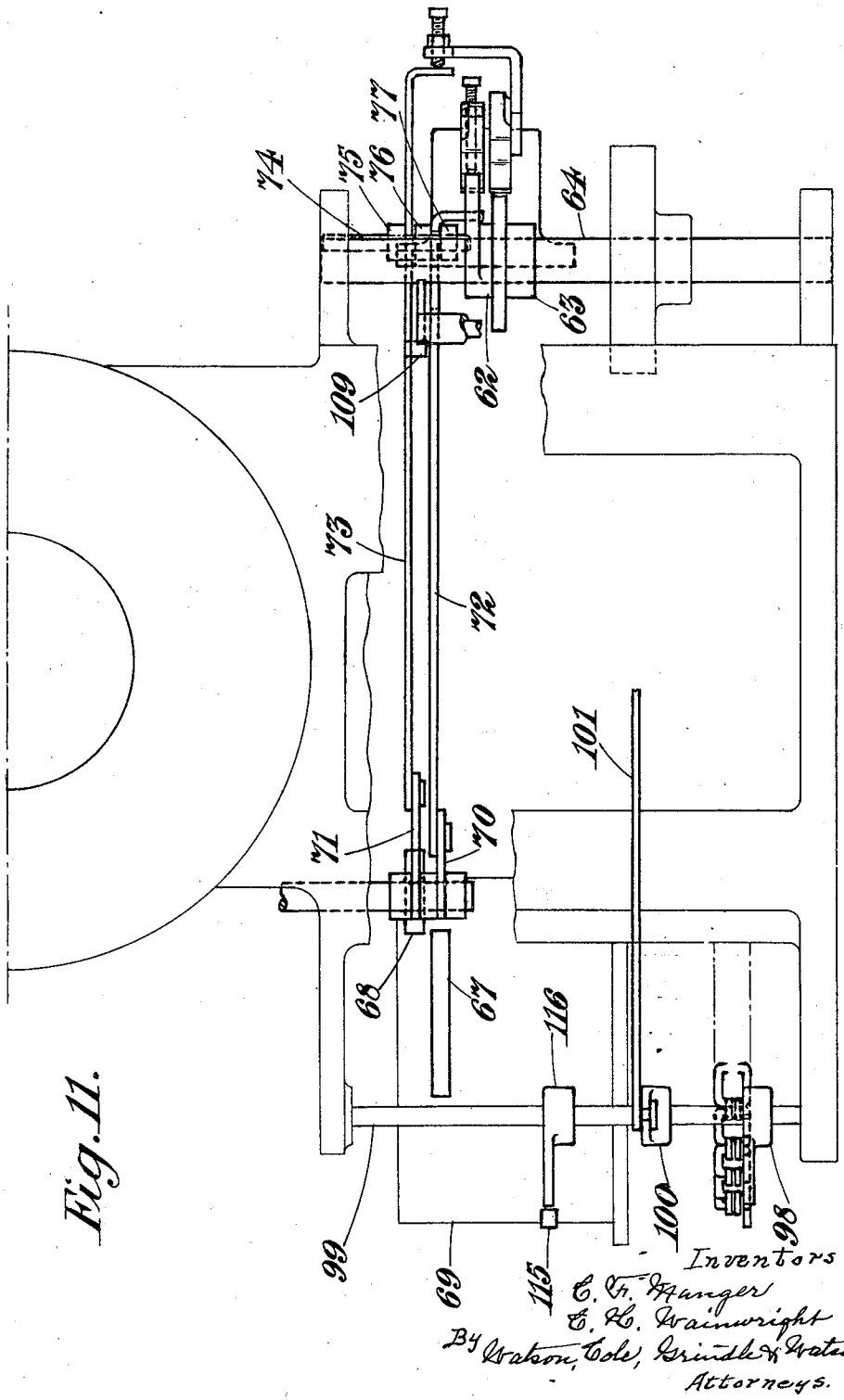


Fig. 11.

Inventors
C. F. Manger
C. H. Wainwright
By Watson, Cole, Grindle & Watson
Attorneys.

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UNITED STATES PATENT OFFICE

2,290,058

YARN-CHANGING MECHANISM FOR KNITTING MACHINES

Charles Frederick Manger and Carlyle Herbert Wainwright, Leicester, England, assignors to The Bentley Engineering Company Limited, Leicester, England, a company of Great Britain

Application October 25, 1940, Serial No. 362,850
In Great Britain October 25, 1939

23 Claims. (Cl. 66—140)

This invention consists in improvements in or relating to yarn-changing mechanism for knitting machines and while it is particularly applicable to circular knitting machines, particularly those of the superposed needle cylinder type, it is not limited thereto.

The invention also includes improvements in yarn-trapping devices particularly such devices for association with the yarn-changing mechanism of the present invention.

The yarn-changing mechanism contemplated herein is concerned mainly, though not exclusively, with mechanism in which the number of yarns to be changed one for the other exceeds two in number and an object of the invention is to provide an improved mechanism whereby the introduction and withdrawal of the yarns will be more accurate than has hitherto been possible and such that the number of successive needles which take both yarns at the change may be reduced to the least number possible consistent with the safety of the knitted fabric at the change. The appearance of the join in the fabric will, in consequence, be improved.

Another object, applicable to the trapping mechanism, is to provide improved means for severing the outgoing yarns so that the ends which project from the fabric are substantially uniformly short, thereby allowing them to be readily turned to the inside of the knitted tube in the case of a circular machine.

A still further object of the invention is to provide means whereby the yarns can be interchanged once, twice or even more times in each revolution whereby in the case of hose or half-hose these articles may be knitted with all-round coloured stripes in the leg and with half-round coloured stripes in the foot with a plain foot bottom.

Yarn-changing mechanism according to the present invention comprises a plurality of yarn feeders arranged at different heights and each mounted to enable its yarn-feeding end to partake partly of movement towards and away from the needle-bed and partly of movement also in a transverse direction lengthwise of the needles, in combination with guiding means to control movement of the said feeding ends of the feeders whereby all of them, in moving from idle to feeding positions, will traverse the same or approximately the same "intermediate" path. The term "intermediate" path is intended to apply to a portion only of the path traversed by the feeding end of each feeder omitting a portion at least at the beginning of an ingoing feeding movement from an idle position.

Preferably, the intermediate path terminates at the feed position of the feeder.

In one form of the invention the feeders in their idle positions are so situated that their yarn-feeding ends lie respectively at different distances from the needle-bed; and an initial movement of the feeding end of each feeder is so controlled by the guiding means that in approaching the commencement of the intermediate path it will travel clear of all the other feeders and in this initial movement each feeding end traverses a path different from that traversed by all the others.

The movement of the feeding end of an ingoing feeder is first carried beyond the feed position so as to bring it clear of the corresponding end of an outgoing feeder and the ingoing feeder is then returned to the feed position when the outgoing feeder has been moved away therefrom on its return towards an idle position. Preferably, the partial return movement of the ingoing feeder occurs simultaneously with the return movement of the outgoing feeder.

The invention also includes yarn-trapping mechanism comprising a trapper for each feeder and means to move the trappers synchronously with their associated feeders along paths such that for both ingoing and outgoing feeders the relative distances between those feeders and their associated trappers will be constant or substantially constant when the yarns respectively are released to the ingoing feeder and severed at the outgoing feeder.

The lengths of the free ends of the yarns extending beyond the fabric for both the released and severed ends may be the same in all cases or the released ends and the severed ends if not of the same lengths will at least be such that all the lengths of the released ends will be substantially uniform and the lengths of all the severed ends will likewise be substantially uniform.

The foregoing are to be considered as amongst the principal features of the invention and these and other features thereof will be more clearly understood from the following description read in conjunction with the accompanying drawings of one practical embodiment of the invention. In the drawings—

Figure 1 is a plan of those parts of the mechanism necessary for the understanding of the invention;

Figure 2 is an elevation of the mechanism shown in Figure 1;

Figure 3 is an elevational view looking from the right of Figure 2;

Figure 4 is a perspective view of a portion of the mounting of a yarn feeder;

Figure 5 is a longitudinal section through one of the yarn trappers in a plane perpendicular to the plane of the drawings of Figure 1;

Figures 6 and 7 diagrammatically illustrate alternative paths along which the feeding ends of the yarn feeders may be guided;

Figure 8 is a perspective view of a stitch cam suitable for use with the needle arrangement diagrammatically illustrated in Figure 9;

Figure 9 diagrammatically illustrates a portion of the needle-bed and needles therein suitable for a yarn change produced by mechanism according to the present invention;

Figure 10 is an elevational view similar to that of Figure 2 of other parts of the mechanism lying beneath that illustrated in Figure 2;

Figure 11 is a plan of the mechanism illustrated in Figure 10;

Figures 12 and 13 illustrate the forms of two feeder actuating cams, and

Figure 14 illustrates the ratchet wheel employed for rotating the feeder actuating cams illustrated in Figures 12 and 13.

Like reference numerals indicate like parts in the several figures of the drawings.

In Figure 1 the outline of a portion of the needle cylinder is indicated in plan by the chain-line at 20 and the position at which the yarns are normally fed to the needles is indicated at 21. For each of the different yarns to be selectively fed to the machine there is a separate yarn feeder 22 and trapper, the latter being referred to in detail hereinafter. Each yarn feeder is so mounted that its yarn feeding end is movable in both horizontal and vertical planes and for movement in a horizontal plane all the yarn feeders 22 are mounted on a vertical post 23 carried on a fixed part of the machine. In order to move the yarn feeders in a vertical plane each yarn feeder has a cranked tail end portion 24 (see particularly Figure 4) rotatable freely in a block 25 by means of which the yarn feeder is mounted on the post 23. In each block 25 there is an adjusting screw 26 which is adjustable in the block 25 relatively to an actuating lever 27 which will be referred to in greater detail hereinafter. A block 28 is secured to the tail portion 24 of each yarn feeder and from the block 28 is an extension or arm 29 which engages within a slot in a guide plate 30, and it will be seen, particularly from Figure 2, that there is one such guide plate for each yarn guide. The guide plates 30 are carried by a bracket 31 which is attached to post 23 and serves also to locate blocks 25 in their positions on the post.

There will be an actuating lever 27 for each yarn feeder and all these levers 27 are mounted for rotation on a fixed post 32 and engaging with the tail ends of the levers 27, in order to operate them in their appropriate sequences, are cams 33 (Figures 2, 3 and 12) of which a separate cam is allocated to each lever. Cams 33 are all mounted on another fixed post 34 and each cam 33 is associated with and is rotatable by means of the ratchet wheel 35. Cams 33 and ratchet wheels 35 are all freely rotatable on post 34. Each of the cams 33 is shaped to give required movements to its appropriate feeder through a lever 27, the movement thus imparted to the feeder being mainly in a horizontal plane, but this movement will, by engagement of the extension 29 in the slot in the guide plate 30, impose upon the feeders also the necessary vertical movements. Each feeder has a different movement from the others in order to feed the yarns to the needles one at a time and also to take the yarn into the trapper at another time and to move clear of the other feeders during a yarn change. The positions of movements of the yarn feeding ends of the feeders are shown diagrammatically in Figure 6. The normal feeding position in Figure 6 is indicated at 21 to correspond with the reference in Figure 1, and this position is maintained by one or other of the feeders while its yarn is being supplied to the needles and is not disturbed until a yarn change is to be made. The positions of the feeders in their rest or non-feeding positions all differ from one another and are indicated in Figure 6 by the reference numerals 36, 37, 38, 39 and 40, feeder 36 being understood to be the lowermost feeder of the set. In the positions 36 to 40 the yarns lie idle through the feeders and the free ends of the yarns are held normally near the needle circle by corresponding trappers, and the trappers corresponding to the feeders in positions 36 to 40 are indicated in Figure 1 by the reference numerals 41 to 45 respectively.

When a yarn change is to be made the individual feeders move momentarily from positions 36 to 40 respectively to positions 46 to 50 (Figure 6) before assuming the normal feed position 21. The manner in which a change is made is as follows:

A feeder which is in use is moved from position 21 to its own position amongst the 46 to 50 group, from which position it still continues to feed yarn to the needles, and approximately simultaneously a newly selected ingoing feeder moves from its position in the 36 to 40 group along a path indicated by the appropriate dotted line in Figure 6 and in so doing travels along an intermediate path 51 which is common to all the feeders until it assumes its own position amongst the 46 to 50 group. The outgoing feeder is then moved back along its indicated dotted line traversing in so doing the path 51 common to all the feeders until it reaches its normal position of rest amongst the 36 to 40 group, whereupon its yarn enters its associated trapper and is cut and held in the manner to be described later. As soon as the outgoing feeder has moved out of its way the ingoing feeder is moved back to position 21. The trapper for the ingoing yarn is opened slightly to release the yarn as soon as the latter is safely taken by the needles.

With the arrangement and movements of the feeders just described the feeders all move through different distances and those which move through the greater distances will take a longer time to complete their movements than those moving through a smaller distance so that any yarn change in which a relatively long movement is involved will take a longer time than a yarn change in which only the shorter distances are involved. The time taken for a change involving feeders with the longer distances may be reduced, if desired, by modifying the paths along which the feeders are moved in accordance with the movements indicated by the dotted lines in Figure 7, the same reference numerals being employed as in Figure 6. For instance, if a feeder normally movable to position 48 is to be withdrawn and replaced by a feeder normally movable to position 49 with the move-

ments indicated in Figure 6, the feeder from position 48 cannot start to move towards its trapping position until the ingoing feeder has safely passed into its position 49; but with the paths of movement indicated in Figure 7 the feeder from position 48 can pass that from position 49 approximately in line with the 47 position, a saving of time equivalent to the distance from 46 to 48.

It will be apparent that the combined action of cams 33 and cam slots in the plates 30 will cooperate to give the requisite movements to the feeders as they are brought into and removed from the feeding positions. More particularly, it will be clear, by reference to the shapes of the cam slots for the several feeders and also of the rest positions of those feeders, that a lever 27 for an outgoing feeder is, prior to movement of that feeder, resting on a low tooth of cam 33. On rotation of this cam, this lever will drop into the hollow between the low tooth and the next high tooth during which time the lever corresponding to the ingoing feeder drops from a high tooth upon which it normally rests into a similar depression between that tooth and the next low tooth. This will bring both feeders into their positions amongst the 46 to 50 group in Figure 6, whereafter the newly introduced feeder will ride up to the crest of a low tooth during which time the outgoing feeder rides up to the crest of a high tooth. During these movements the shapes of the slots in the guide plates 30 will impart the rises and falls to the yarn feeding ends of the feeders to position them as already described with reference to Figure 6.

Referring now chiefly to Figures 1 and 5, each trapper will be seen to consist of a sliding member 52 movable between fixed members 53 and 54, the member 54 acting in conjunction with the sliding member 52 to sever the yarn and the member 53 co-operating with member 52 to hold and trap the yarn. In Figure 1 the five sliding members are indicated by reference numerals 41 to 45 above mentioned and these hold the yarn trapped from the feeders when they are in the positions 36 to 40 of Figures 6 and 7, that is to say, the positions of the four feeders shown in Figure 1 lying to the right of that which is shown in the feed position 21.

When an ingoing feeder moves to its position from the 36 to 40 group to the 46 to 50 group, the yarn will lie from its appropriate trapper, across the needles which are descending the stitch cam, to the feeder. As the needles descend, their latches are closed on to the new yarn by the loop already around the needle shank beneath the latch, and the new yarn together with the old one is thus taken into the needle hooks. The length of the free end of the ingoing yarn which will project from the fabric is determined by the distance between the trapper and the needle which first takes the yarn. In the position shown in Figure 1 trapper 41 occupies the position which makes the shortest possible yarn end. The yarns from the other trappers 42 to 45 will therefore have progressively longer ends if the trappers remain in their present positions. In order, however, to avoid this and to make all the ingoing yarn ends of substantially similar lengths the trappers are movable en bloc each time a yarn change occurs so that the trapper for a selected ingoing yarn will on each occasion occupy the position of the trapper 41 in Figure 1. For this purpose trapper movements are as follows:

The movements of the trappers to and from the desired positions are derived from a cam 93 which is attached to and rotates with a ratchet wheel 95 mounted on post 34. The ratchet wheel is partially rotated by a pawl 55 every time a change of yarn takes place. The cam 93 is followed by one end of an arm of bellcrank lever 56 (Figure 1), the other arm of which is connected by a link 57 to the carrier 58. This carrier is freely mounted on post 59 and supports the trappers at one end. A spring, not shown, urges the carrier 58 in a direction which tends to maintain the follower portion of bellcrank 56 in contact with the cam, that is to say, the trappers are spring urged towards the left in Figure 1. Cam 93 is shaped to allow a full movement of the trappers to the left at each yarn change but the amount that they actually do move is determined by the position of a stepped stop plate 60 (Figure 2), the appropriate step of which is selectively brought into line with an extremity 61 of the carrier 58 at each yarn change and acts as a stop for that extremity.

After the trappers have moved to the required position as just described, and the ingoing yarn is released, the trappers are immediately moved back to their original or rest position, that is to say, the position in which trapper 41 occupies the position giving the shortest ingoing yarn end. This movement takes place before the outgoing yarn has reached its trapper and the trappers are therefore always in the rest position at the time a yarn is cut and held. The ends of the outgoing yarns are always short and of a consistent length because each trapper is timed to close just as the last needle which received the outgoing yarns reaches the point nearest the trapper for that yarn, the position of the feeder at that time being such that the yarn has safely entered the trapper. It is desirable for the trappers to have moved back to their rest positions before the outgoing yarn is trapped because if they remained in the position to suit the ingoing yarn trapper the position of the outgoing yarn trapper would vary in accordance with the yarn which had been selected to go in, and as the time at which the trapper is set to close is preferably constant for the sake of simplicity the length of the outgoing yarn end would vary considerably.

The combined feeder and trapper mechanism is driven as a whole by the means illustrated in Figures 10 and 11. Two main cams 62 and 63 are mounted on a running shaft 64 which rotates at the same speed as the needle cylinders. Cam 62 is a single lobe cam and therefore gives one complete movement to a co-operating member or follower for each revolution of the needle cylinders. Cam 63 is a two-lobe cam and therefore gives two complete movements to such a member for each revolution of the needle cylinders. Cam 62 is used in the case in which yarns are required to be changed not more often than once in each revolution, for example, in the leg of a sock or stocking, and cam 63 is used where the yarns are required to be changed twice in a revolution, for example, in the foot of a sock or stocking having a patterned instep and a plain foot bottom. Cams 62 and 63 are followed respectively by co-operating levers 65 and 66. These levers are selected by cams 67 and 68 respectively on the main control drum 69 of the machine acting through levers 70 and 71

and links 72 and 73 respectively. When one of the levers 70 or 71 is lifted by its cam the corresponding lever 65 or 66 is held clear of its associated cam 62 or 63. The links 72 and 73 are guided by a bar 74 which is fixed to the frame of the machine and projects through slots in the links as shown in Figure 10 and the links are located laterally by collars 75, 76, 77 (Figure 11), the outer two at least of which are fixed to bar 74. When a change of yarn is to take place catch levers 78 and 79 are lowered to engage the upper end of whichever of the levers 65 and 66 is rendered operative. The catch levers 78 and 79 are mounted freely on a pin 80 which is fixed in a slide 81 and the latter moves in a slideway in the frame of the mechanism and is connected by a link 82 to an arm 83 (Figure 2) which is thereby oscillated. Another arm 84 supports a spindle parallel with post 34 and this spindle carries the pawl 55 and also similar pawls 86, one for each ratchet wheel 35, by which ratchet wheels 35 are rotated; and the arm 84 moves with arm 83 both of which are attached to a sleeve 85 rotatable on post 34.

When one of the pawls 86 is selected to operate by the presentation of a notch 87 in bar 88 to the tail end 89 of the pawl, the latter engages a low tooth 90 (Figure 14) of its ratchet wheel 35 and rotates the wheel one-eighth of a revolution. It will be understood that normally pawls 86 are controlled, on the post on which they are mounted in the arm 84, by means of springs normally tending to turn them on that post in a clockwise direction as viewed in Figure 1 so as to tend to turn the pawls to a position at which they will engage a low tooth each on its respective cam 35. Thus, when the arm 84 is rocked around the axis of post 34 that pawl 86 whose arm 89 can pass through a slot 87 in plate 88 will spring into the notch of a low tooth 90. On the other hand, those arms 89 that are opposed during this movement by a solid portion of plate 88 will engage that plate with their backs, that is to say, the shaped edges to which the lead lines of the reference numeral 89 in Figure 1 are directed, and in consequence pawls 86 will be raised to a height at which they can only engage behind a high tooth on the return journey of arm 84. The appropriate feeder-operating cam 33 and trapper-operating cam 91 which are both attached to the ratchet wheel rotate with it and thereby move the feeder into feeding position and release the yarn from the trapper at the appropriate time. Moving with each ratchet wheel 35 will be a pair of cams 33 and 91, each trapper operating cam 91 co-operating with a follower portion of a bellcrank 92 (Figure 1), one for each cam. The associated bellcrank 92 is therefore moved by the cam and the free arm of the bellcrank is, as shown in Figure 1, interconnected through a Bowden wire 193 to a lever 96 by which the movable member 52 of the trapper is actuated. It will be appreciated that there is a lever 92 and Bowden wire connection 193 individual to each trapper.

After the pawl 86 has pushed a low tooth of its ratchet wheel 35 as described above, a high tooth of the ratchet wheel will be in position to be pushed next as high and low teeth are arranged alternately around the wheel. The position of selector bar 88 is such as to determine movements of the pawls 86 so that they may engage a high tooth every time they are oscillated, but they may only engage a low tooth when a notch 87 on bar 88 is brought into line with their tail ends 89.

Cams 33 are so shaped that they alternately move their feeders into and out from feeding positions and they are attached to their ratchet wheels in such a position that when a pawl 86 pushes a low tooth on ratchet wheel 35 the feeder is moved by its cam 33 into feeding position, and when the pawl pushes a high tooth on cam 35 the feeder will be moved by its cam 33 out from feeding position. Whichever feeder is in feeding position the appropriate ratchet wheel 35 will therefore have a high tooth in a position to be pushed next while all the other ratchet wheels 35 will have low teeth in that position. Each time pawls 86 are oscillated therefore they will move the feeder which is feeding out from that position since that is the only one whose ratchet wheel has a high tooth in position to be pushed and will also move another feeder into feeding position. The feeder to be moved into feeding position is determined by the vertical adjustment of selector bar 88.

Operation of the mechanism as a whole is initiated by a stud on the main chain 97 of the machine (Figure 10). A stud of a different height is used for each feeder. Thus, in the present instance there are five different heights of studs and the studs are followed by a lever 98 fixed to a rock shaft 99. Another lever 100 fixed to the same rock shaft transmits movement imparted to lever 98 through a link 101 to one arm of a bellcrank lever 102 pivoted at 103. The other arm of this bellcrank lever is pivotally connected to the lower end of selector bar 88 and stop plate 60 moves in synchronism with bar 88 by reason of the fact that the stop plate 60 is mounted to move about the axis of pivot 103 in company with bellcrank lever 102. The stop plate 60 is also formed as a bellcrank having the stepped portion at the extremity of one arm thereof, and in the other arm there is a pin 104 which will be moved into engagement with a lever 105. The latter is pivoted at 106 and when it is lowered by pressure of pin 104 it will free catch levers 78 and 79 allowing them to fall to their operative positions. Normally, lever 105 is held by means of a spring in an upward position in which it will engage beneath pins 178 and 179 to hold catch levers 78 and 79 raised. For example, a spring for this purpose could be coiled around pin 106 one end being anchored to that pin and the other end engaging beneath lever 105 but any other preferred means may be employed normally serving to hold lever 105 in its raised position while permitting it to be depressed by engagement with a pin 104 and to return to the raised position again after pin 104 has released the lever.

In Figures 1 and 2 the parts are shown as having been actuated by one of the levers 65 or 66 so that slide 81 has been moved to the right but it will be appreciated that before any selective movement occurs the slide will have been moved back to its left-hand position and lever 105 will be in a rest position so as to lie beneath pins 178 and 179 extending from catch levers 78 and 79 respectively, thereby holding those catch levers clear of levers 65 and 66 respectively. Thus, a stud 97 when it is moved into operative position will first adjust the relative positions of the stop plate 60 and selector bar 88 and at the same time will lower lever 105 to allow the catch levers 78 and 79 to fall,

whereupon movement of the lever 65 or 66 by means of the cam 62 or 63, in accordance with the selection of levers 70 and 71, will move slide 81 to the right and by the connections above described will actuate pawls 55 and 86 to perform the functions already outlined above.

When changes of yarn are required to be made twice in a revolution, it is invariably for the purpose of making circumferential portions of a knitted tube in plain colour while the remainder of the circumference of the tube contains stripes, as for example the foot of a sock or stocking, having a plain foot bottom and a striped instep. One particular feeder may, therefore, be chosen to be used permanently as the foot bottom feeder. In the present arrangement the lowermost feeder is used for this purpose. It may, of course, be used for other parts of the work as well as the foot bottom, but no other feeder will be used for the foot bottom. This fact is made use of when two selections are to be made in one revolution. Selection for the change to the instep or striped part is made in the usual way from studs in the chain 97, but selection for the change to the plain part (which is, of course, always the same) is made automatically, that is to say, without any special stud being included in chain 97 for this purpose. To enable this to be done, selector bar 88 has a notch 107 for the lowermost feeder, the length of the notch being such that whichever feeder is selected by the notches above, the lowest feeder will also be selected. With the operation of the mechanism the lowermost feeder will, therefore, be moved alternately into and out from feeding position. As it moves out the other selected feeder moves in, and as the last-named feeder moves out the lowermost feeder moves in. This sequence of operations continues throughout the half-round striped part of the work but for the remainder of the work which contains all-round stripes, normal selections from the chain only are required, and notch 107 needs, therefore, to be the same length as all the other notches. Slider bar 88 is, therefore, provided with a movable piece 108 which is held forward by a pin 109 projecting from link 73 and acting through a lever 110 mounted to rotate with a spindle 111 to which one end of a lever 112 is also secured, the other end of that lever being pivotally connected to the movable piece 108. Near the end of the movable piece 108 which serves in the position shown in Figure 2 to close notch 107 there is a slot 113 embracing a pin 114 on the part 108 so that oscillatory movements of the part 108 will be guided by the pin 114. When cam 63 and lever 66 are selected to operate to make yarn changes twice in each revolution, movement of link 73 allows the piece 108 on the selector bar 88 to be withdrawn by means of a spring, not shown.

Cam 62 is set in such a position on its shaft that it causes a change of yarn to take place at the back of the sock or stocking, whereas cam 63 is so set that it causes changes to take place on each side of the sock or stocking. Movement of chain 97 must take place at such a time that the first of the two lobes of cam 63 to come into operation, when a selection from the chain is made, is one which causes a change to take place at the beginning of the instep half so as to introduce the instep yarn, the second lobe changing from the instep yarn to the foot bottom automatically without selection from the chain. In a striped sock or stocking having a plain foot bottom it is frequently desired to make half-round striped work for a little distance before the heel as well as for the whole of the foot. The two-lobe cam 63 is, therefore, brought into operation. When the heel is reached the yarn must be changed to the heel yarn and the change must take place at the end of the instep half as, if it took place at the beginning of the instep half for which the mechanism is set, the heel yarn would be knitted round the instep. There is, therefore, provided an additional control to operate at the desired time. This control is taken from the main control drum 69 for which purpose a cam 115 is fixed to the drum and is followed by a lever 116 which is attached to a shaft 99 to initiate the mechanism and select the heel feeder instead of the heel feeder being selected from chain 97.

In order to make the join in the fabric as neat as possible, the stitch cam, as shown in Figure 8, may be formed with a step. This stepped path 117, 118, 119 is followed by all the needles or their sliders or jacks, except those which are provided with specially shortened butts. Sliders with these short butts are placed at the position of the join and miss the cam at 117 but engage it at 120. When the butts are on the step 118 the needles are at such a height that their latches are closed by the old loops, but they have not started to draw the new loops. The latches are closed as the butts move down the cam at 117 or at 120. The latch of a needle which has a short butt, therefore, closes a little later than the other latches. The amount later may correspond approximately to the pitch of the needles so that the latch of a needle having a short butt closes at the same time as the next one following it. The regular sequence of closing latches is, therefore, broken by the presence of the aforesaid short butt. A convenient arrangement of butts is shown in Figure 9. This will give a brief interval of time when no latches are closing, that is to say, while the first short butt 121 passes from 117 to 120, then two latches close together (the butt 121 and 120 and the butt 122 at 117), then one follows a normal sequence from butt 123, then another brief interval, and finally two latches close together.

When an ingoing yarn is introduced to the needles it is set to move up to the needles at the moment that no latches are closing. Immediately thereafter the latches on two adjacent needles close simultaneously and take the yarn and the outgoing yarn is moved away just as the second interval takes place. This gives much more latitude for the introduction and withdrawal of the yarns and ensures that they will be introduced and withdrawn at the same needle on each occasion with a greater degree of certainty than is possible by the use of a normal stitch cam without the step described. With the needle arrangement shown in Figure 9 a three-needle join is made, that is to say, three needles take both the ingoing and outgoing yarns. Alternatively, for a two-needle join one butt of normal length instead of the two at 122 and 123 will be placed between two needles having short butts such as 121 and its companion on the other side of the long butt needle.

If the machine were to stop with lever 98 on the top of a chain stud and the main control drum 69 were to be turned by hand as is commonly done to make a fresh start after a fault, cams 67 and 68 may be caused to operate the levers and links 70, 71, 72 and 73 and the levers

65, 66. Consequently, catch levers 78 and 79 will be in the low position and the whole mechanism would thus be operated to make a yarn change. This might, and generally would be, undesirable at such a time and, furthermore, the levers and links 70, 71, 72 and 73 might not prove to be strong enough for this purpose as their normal duty is only to move and hold out levers 65 and 66. A safety device as follows may, therefore, be fitted to overcome this difficulty. This device conveniently consists of an additional lever which is not illustrated in the drawings but which will be operated to lift the catch levers 78 and 79; a vertical rod to lift the additional lever; a cam piece attached to or formed on each of the links 72 and 73 arranged so that the first part of the movement of these links raises the catch levers 78 and 79 before levers 65 and 66 start to move. The second and greater part of the movement of the links moves the levers 65 and 66 to their inoperative positions.

In order further to facilitate the turning of the yarn ends into the inside of the fabric, the machine may be equipped, if desired, with a two-part verge as described in the specification of United States Patent No. 2,085,619.

We claim:

1. For a knitting machine, yarn feeding mechanism comprising in combination a plurality of yarn feeders arranged at different heights, mounting means for the feeders to enable the yarn feeding end of each to move partly towards and away from the needle bed and partly in a transverse direction lengthwise of the needles, means to guide an outgoing feeder first to displace it from its normal feeding position to another position at which it will still continue to feed yarn to the needles, means thereafter to guide an ingoing feeder first from its idle position to a temporary position that is other than the normal feeding position but at which it can introduce and feed its yarn to the needles, and means subsequently to return the outgoing feeder to its idle position along a path clear of the temporary position of the ingoing feeder and also to move the latter feeder into its normal feed position.

2. For a knitting machine, yarn feeding and trapping mechanism comprising in combination a plurality of yarn feeders arranged at different heights, mounting means for the feeders to enable the yarn feeding end of each to move partly towards and away from the needle bed and partly in a transverse direction lengthwise of the needles, means to guide an outgoing feeder first to displace it from its normal feeding position to another position at which it will still continue to feed yarn to the needles, means thereafter to guide an ingoing feeder first from its idle position to a temporary position that is other than the normal feeding position but at which it can introduce and feed its yarn to the needles, and means subsequently to return the outgoing feeder to its idle position along a path clear of the temporary position of the ingoing feeder and also to move the latter feeder into its normal feed position, and in addition a plurality of yarn trappers situated at a position following the normal feed position considered in the knitting direction.

3. For a knitting machine, yarn feeding mechanism comprising the combination according to claim 1 in which the feeders in their idle positions are so situated that their yarn feeding ends lie respectively at different distances from the needle bed and at different heights lengthwise of the needles.

4. For a knitting machine, yarn feeding mechanism comprising the combination according to claim 1 in which all the yarn feeders are pivoted to turn about two axes transverse to one another and one of these axes is substantially parallel with the lengths of the needles.

5. For a knitting machine, yarn feeding mechanism comprising in combination a plurality of yarn feeders arranged at different heights, mounting means for the feeders to enable the yarn feeding end of each to move partly towards and away from the needle bed and partly in a transverse direction lengthwise of the needles, means to guide both ingoing and outgoing feeders along an approximately similar intermediate path of travel, means to guide an outgoing feeder first to displace it from that intermediate path and from its normal feeding position to another at which it will still continue to feed yarn to the needles, means thereafter to guide an ingoing feeder first from its idle position to and along the intermediate path to a temporary position other than the normal feeding position but at which it can introduce and feed its yarn to the needles and means subsequently to return the outgoing feeder to its idle position along the said intermediate path and clear of the temporary position of the intermediate feeder and also to move the latter feeder into its normal feed position.

6. For a knitting machine, yarn feeding mechanism according to claim 5 in which return movement of the ingoing feeder from its temporary to its feeding position is effected simultaneously with the return movement of an outgoing feeder towards its idle position.

7. For a knitting machine, yarn feeding mechanism according to claim 1 in which the feeders comprise in effect double-ended levers mounted coaxially one above the other in a bank, in combination with guides to engage the tail ends of the levers as they are turned about their common axis to impart to any feeder so turned additional movement lengthwise of the needles.

8. For a knitting machine, yarn feeding mechanism according to claim 1 having a plurality of blocks pivoted one above the other about a common axis, a feeder mounted in each block to turn about an axis transverse to the said common axis, a projection from each feeder and an arcuate guide for each such projection so shaped that when a feeder and block is turned about the aforesaid common axis the arcuate guide will tilt the feeder in a transverse direction lengthwise of the needles.

9. For a knitting machine, yarn feeding mechanism according to claim 1 comprising for each feeder a rotatable actuating cam, a plurality of ratchets allocated one to each cam to turn with its associated cam, a plurality of pawls, one for each ratchet and a rocking carrier on which all the pawls are mounted, said carrier turning about an axis common to the cams and their ratchets.

10. For a knitting machine, yarn feeding mechanism according to claim 1 comprising for each feeder a rotatable actuating cam, a plurality of ratchets allocated one to each cam to turn with its associated cam, a plurality of pawls, one for each ratchet, a rocking carrier on which all the pawls are mounted, said carrier turning about an axis common to the cams and their ratchets, an adjustable intercepter for the several pawls, a pattern controlled selector for the intercepter

and means operating from the pattern control to move the intercepter to positions for selectively controlling the engagement of the pawls with their ratchets or, alternatively, to hold the pawls free from their ratchets.

11. For a knitting machine, yarn feeding mechanism according to claim 1 comprising for each feeder a rotatable actuating cam, a plurality of ratchets allocated one to each cam to turn with its associated cam, a plurality of pawls, one for each ratchet, a rocking carrier on which all the pawls are mounted, said carrier turning about an axis common to the cams and their ratchets, and a single adjustable intercepter having spaced slots therein, one for each pawl, and movable to different positions to permit a selected space to be presented to a selected pawl, tails on the pawls, each of which tails will either pass into a space in the selector to enable that pawl to engage its ratchet or, alternatively, into engagement with a solid portion of the selector to hold it from cooperation with its ratchet and pattern controlled means for actuating the selector.

12. For a knitting machine, yarn feeding mechanism according to claim 1 comprising for each feeder a rotatable actuating cam, a plurality of ratchets each allocated to and rotatable with a cam and comprising alternate high and low teeth, a plurality of pawls, one for each ratchet, a rocking carrier on which all the pawls are mounted, the said rocking carrier turning about an axis common to the cams and their ratchets, a pattern controlled adjustable intercepter for the pawls which is operative by selection to hold the pawls from engagement with a low tooth but not from a high tooth.

13. For a knitting machine, yarn feeding mechanism according to claim 1 having in addition driving means comprising in combination pattern projections movable by means of a pattern carrier, a rock shaft having on it a lever to engage the projections and also an arm connected to an oscillating member, an oscillating member therefor, a mechanical coupling between said member and the feeder actuating mechanism, a main driving cam shaft having at least two cams corresponding to at least two different operations of the machine, followers for said cams, selective means carried by the pattern drum or its equivalent to select one or other of the followers to operate and an automatic coupling to engage the active follower with the aforesaid oscillating member.

14. For a knitting machine, yarn feeding mechanism according to claim 1 comprising in each feeder a rotatable actuating cam, a ratchet for each cam rotatable with the said cam, a plurality of pawls, one for each ratchet, a rocking carrier on which all the pawls are mounted and which turns about an axis common to the cams and their ratchets, and driving means comprising in combination pattern projections movable by means of a pattern carrier, a rock shaft having on it a lever to engage the projections and also an arm connected to an oscillating member, and an oscillating member therefor which is also operatively connected with the rocking carrier to oscillate the latter, a mechanical coupling between said member and the feeder actuating mechanism, a main driving cam shaft having at least two cams corresponding to at least two different operations of the machine, followers for said cams, selective means carried by the pattern drum or its equivalent to select one or other of the followers to operate and an automatic coupling to engage the active follower with the aforesaid oscillating member.

15. For a knitting machine, yarn feeding and trapping mechanism according to claim 2 combined with means to move the trappers synchronously with their associated feeders in corresponding directions.

16. For a knitting machine, yarn feeding and trapping mechanism according to claim 2 in combination with means to move the trappers synchronously with their associated feeders in corresponding directions and through such relative distances that the free ends of the yarns extending beyond the fabric for both the released and severed ends are substantially the same in all cases.

17. For a knitting machine, yarn feeding and trapping mechanism according to claim 2 in combination with means to move the trappers synchronously with their associated feeders in corresponding directions and through such relative distances that the free ends of the yarns extending beyond the fabric for both the released and severed ends are substantially the same in all cases but the lengths of the free ends of the released yarns are different from the lengths of the released yarns although all the released ends are substantially of uniform lengths and all the severed ends are in their turn of substantially uniform lengths.

18. For a knitting machine, yarn feeding and trapping mechanism according to claim 2 in which the trappers are arranged side by side in a plane substantially transverse to the lengths of the needles and are combined with a swinging carrier by which they are all moved simultaneously about an axis substantially parallel with the lengths of the needles, and selectively operated movement limiting means for said swinging carrier whereby its movement is controlled in conformity with the particular feeder selected.

19. For a knitting machine, yarn feeding mechanism according to claim 1 having means for actuating the feeders to effect a yarn change selectively either once or twice in each revolution.

20. For a knitting machine, yarn feeding mechanism according to claim 2 having means for actuating the feeders to effect a yarn change selectively either once or twice in each revolution.

21. For a knitting machine, yarn feeding mechanism according to claim 1 and comprising for each feeder a rotatable actuating cam, a ratchet for each cam rotatable therewith, a plurality of pawls, one for each ratchet, a rocking carrier in which all the pawls are mounted and which turns about an axis common to the cams and their ratchets, a pattern controlled intercepter for the pawls permitting them by selection to engage or to be held free from their ratchets and a part on the intercepter which is displaceable under a pattern control and is such that when displaced one of the pawls will be freed, irrespective of other selective adjustment imparted to the intercepter, to engage and turn its ratchet each time the mechanism is operated to make a yarn change.

22. For a knitting machine, yarn feeding mechanism according to claim 1 comprising for each feeder a rotatable actuating cam, a plurality of ratchets allocated one to each cam to turn with its associated cam, a plurality of pawls, one for each ratchet, a rocking carrier on which all the pawls are mounted, said carrier turning about an axis common to the cams and their ratchets, and a pattern controlled actuating member operatively connected with the rocking carrier to

actuate it and a pattern control means for said actuating member comprising at least two cams driven synchronously with the machine one of which cams is operative to actuate the carrier once in each revolution and the other is operative to actuate the carrier twice in each revolution whereby a yarn change may be optionally effected once or twice in each revolution of the machine.

23. For a knitting machine, yarn feeding mechanism according to claim 1 comprising for each feeder a rotatable actuating cam, a plurality of ratchets allocated one to each cam to turn with its associated cam, a plurality of pawls, one for each ratchet, a rocking carrier on which all the pawls are mounted, said carrier turning about an axis common to the cams and their ratchets, and a coupling between the cams of the said pattern control and the rocking carrier which carries the pawls for the actuating cams, the said coupling comprising two actuating levers operatively connected to the rocking carrier and allocated respectively one to each of the pattern control cams, and means selected from a pattern controlling element for selectively bringing one or the other of the levers into position to engage its associated cam.

CHARLES FREDERICK MANGER.
CARLYLE HERBERT WAINWRIGHT.