

Sept. 24, 1935.

T. C. BROMLEY ET AL

2,015,136

YARN SUPPLYING MEANS FOR KNITTING MACHINES

Filed Dec. 14, 1934

6 Sheets-Sheet 1

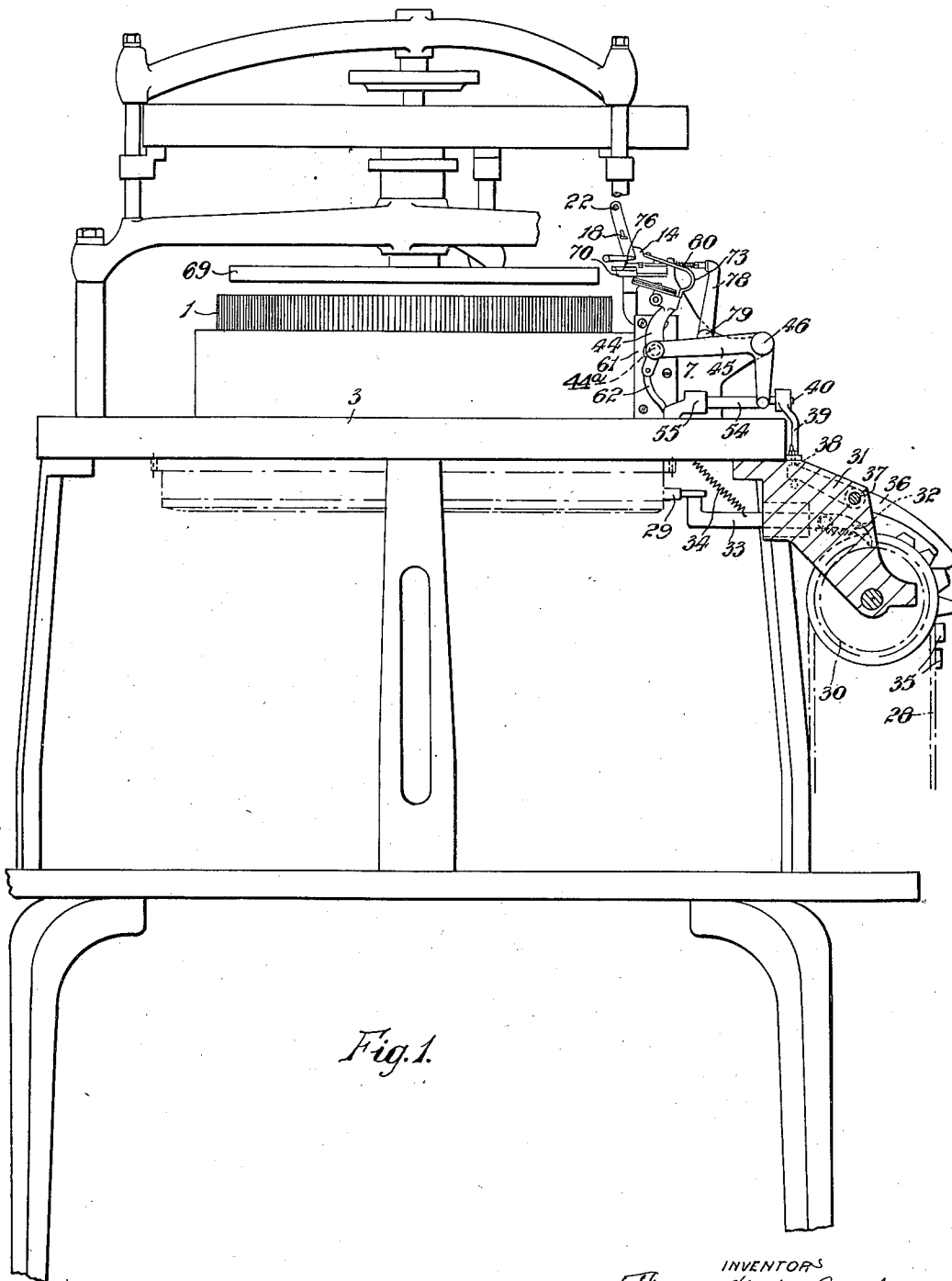


Fig. 1.

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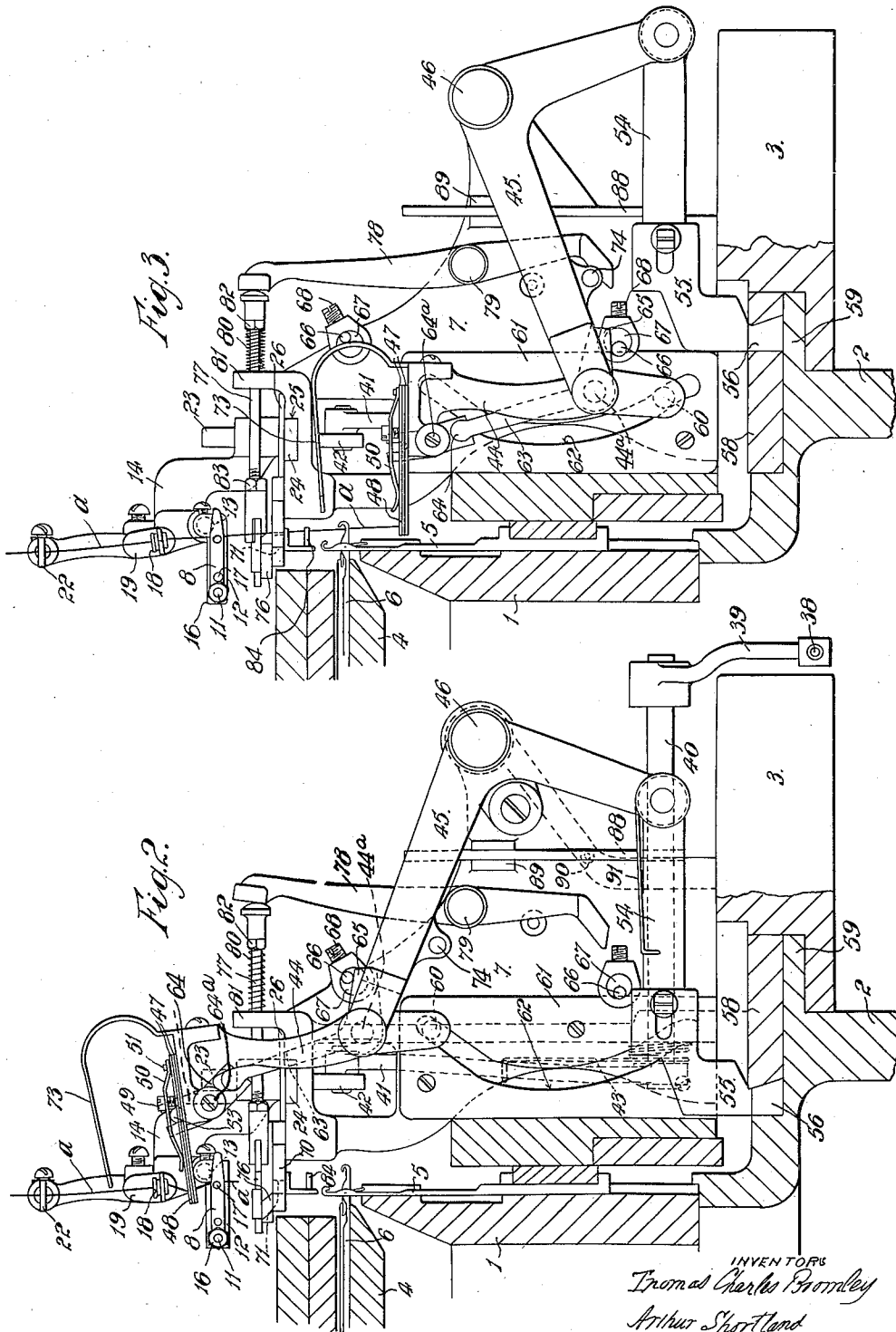
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YARN SUPPLYING MEANS FOR KNITTING MACHINES

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6 Sheets-Sheet 3

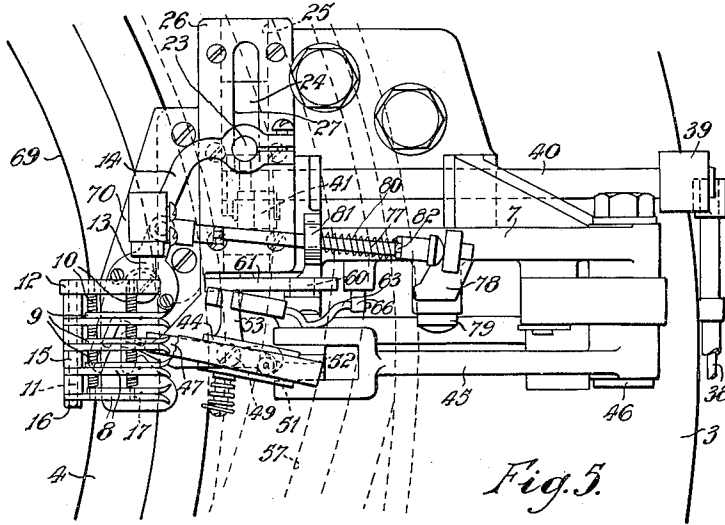


Fig. 5.

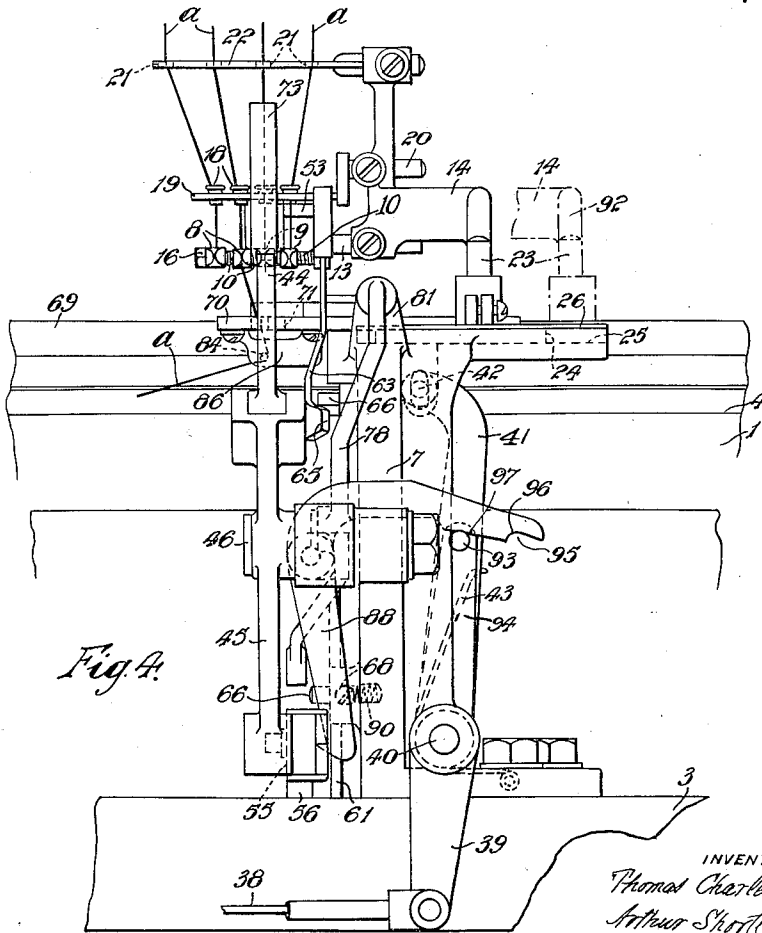


Fig. 4.

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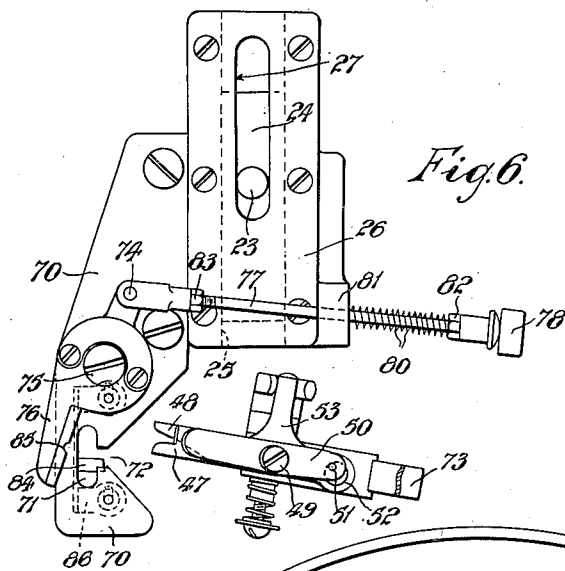


Fig. 6.

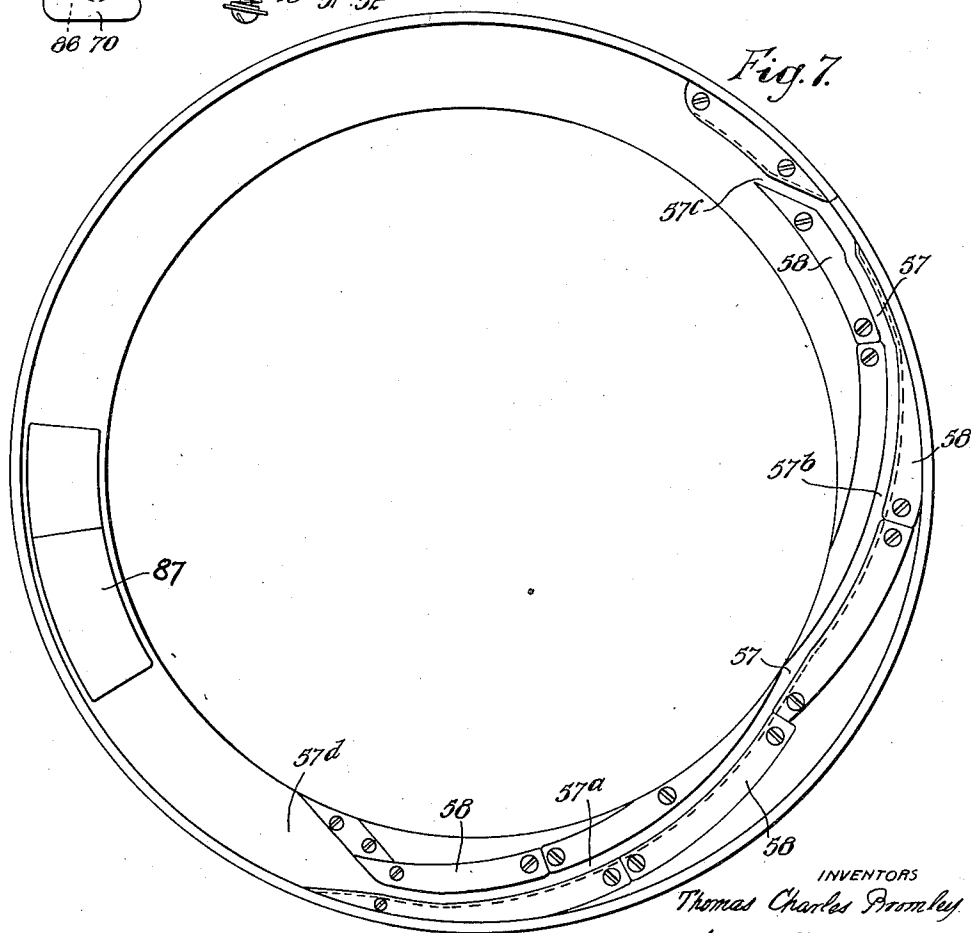


Fig. 7.

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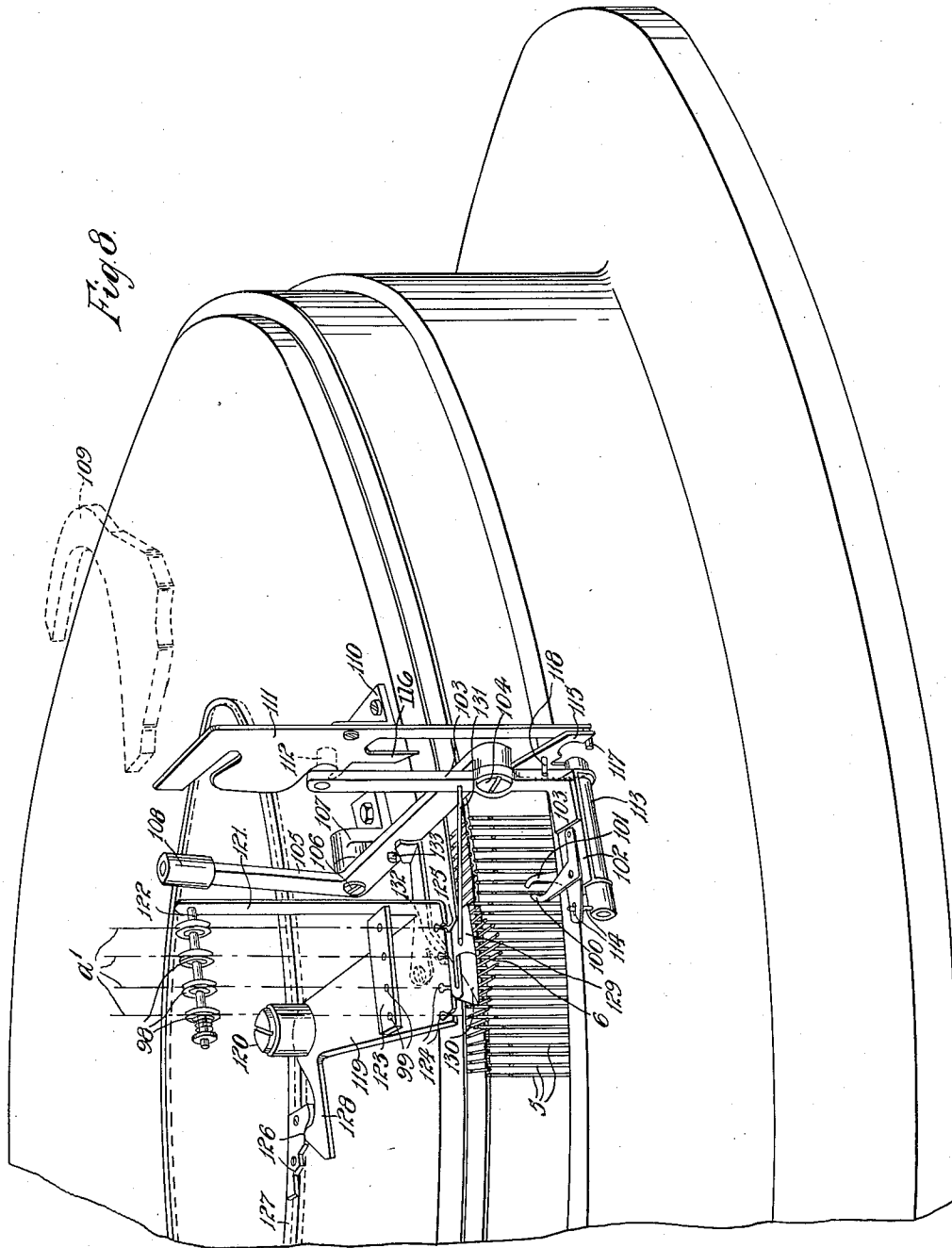
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YARN SUPPLYING MEANS FOR KNITTING MACHINES

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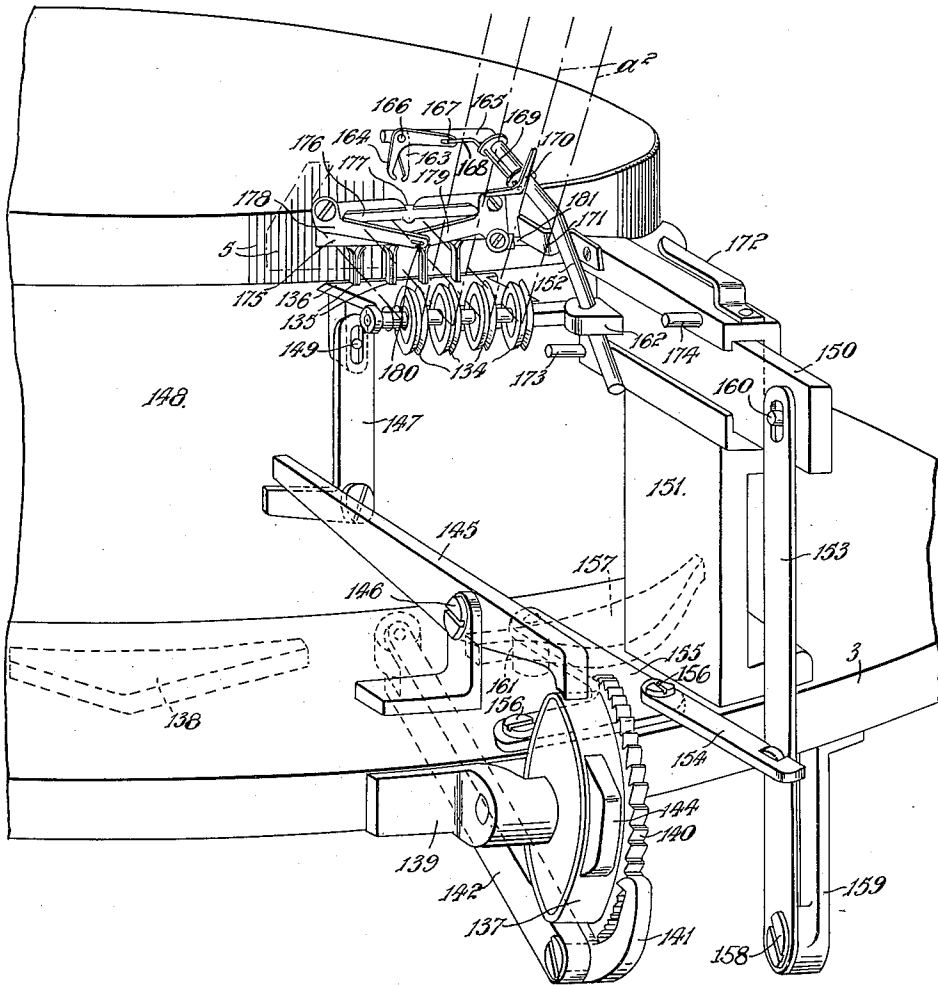
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YARN SUPPLYING MEANS FOR KNITTING MACHINES

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6 Sheets-Sheet 6

Fig. 9.



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UNITED STATES PATENT OFFICE

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YARN SUPPLYING MEANS FOR KNITTING MACHINES

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Application December 14, 1934, Serial No. 757,506
In Great Britain November 15, 1933

9 Claims. (Cl. 66—140)

This invention relates to yarn or thread supplying means for knitting machines and its general object is to provide improved means for this purpose.

The yarn or thread supplying means constituting the invention are primarily intended for use as yarn changing means for the purpose of producing horizontal or/and vertical stripes, or for making pattern or design formations in the knitted fabric, but they may also be adapted and used for supplying one or more rubber threads.

The said yarn supplying means may be used to supply yarn or thread to the needles of a knitting machine to be knitted into loops, or to be laid in or incorporated into the fabric without being knitted. When used for yarn changing purposes, such as for making stripes, the said yarn supplying means will in most cases supply the yarns to the needles to be knitted by them, but when used for supplying rubber thread the said means may introduce this to the needles for either knitting or to form a non-knitted weft.

The improved means are, for yarn changing purposes, constructed to deal with two or more yarns, but the means may be constructed to deal with a single yarn or thread.

For the sake of brevity the term yarn will be hereinafter used as denoting any kind of yarn or thread which may be dealt with.

The yarn supplying means according to the invention are characterized by a device which picks a yarn presented or held in a non-feeding position and takes it to the needles of the machine.

For supplying any one of several yarns the invention includes an arrangement wherein the yarn picking and laying device can be caused to select and pick the yarns in pre-arranged order and take them to the needles.

Associated with the yarn supplying means are yarn severing means of suitable form and there may also be means to guide the yarns as they are taken to the needles by the yarn picking and laying device.

To enable the invention to be clearly and readily understood yarn changing means constituting practical examples will now be described with reference to the accompanying drawings wherein,

Figure 1 is a side elevation of a circular rib knitting machine of the rotary cylinder and dial type furnished with yarn changing means constituting one of such examples, part of the mechanism being shown in section.

Figure 2 is a sectional side elevation of the said means with the yarn picking and laying device

and associated mechanism in the yarn picking position.

Figure 3 is a similar elevation of the said device and mechanism in the yarn laying position.

Figure 4 is an end elevation of the yarn changing means in the position shown in Figure 2.

Figure 5 is a plan of the yarn changing means in the same position.

Figure 6 is a plan of the yarn picking and laying device, in the position shown in Figure 1, and an associated feeder plate and yarn cutting mechanism.

Figure 7 is a plan view of the cam means for operating the said yarn changing means.

Figure 8 is a perspective view of another example of the invention as applied to a circular knitting machine of the rotary cylinder and dial type, and

Figure 9 is a perspective view of a further example of the invention applied to a circular plain (non-rib) knitting machine having a rotary needle cylinder.

Figures 1 and 7 are drawn to a smaller scale, and Figure 6 is drawn to a larger scale than Figures 2 to 5, 8 and 9, which are all drawn to substantially the same scale.

Referring to the drawings, the machine comprises as usual a cylinder 1 mounted on a gear ring 2 driven in customary manner and rotatably carried in a bed plate 3, and a dial 4 mounted in known manner and driven in unison with the needle cylinder. The cylinder and dial are furnished respectively with needles 5, 6. The yarn changing means are carried by a single bracket 7 fixedly mounted upon the bed plate 3. For holding the yarn ends there are provided tension devices each comprising blade-like members 8, 9 pressed together by springs 10 and having outturned ends as shown in Figure 5. The members 8 are mounted upon a rod 11 carried by a small arm 12 which is attached to a pin 13 fixed in another arm 14, and are maintained in the required spaced relation laterally by distance collars 15 on the rod. The fixed members 8 and the distance collars 15 are clamped on the rod 11 by means of a nut 16. The movable members 9 are slidably mounted on rods 17 fixed in the arm 12, and the springs 10 are also mounted on these rods. Above the tension devices is a corresponding number of yarn guiding eyes 18 carried by an arm 19 attached to a pin 20 fixed in the arm 14. Another series of guides 21, conveniently of open-sided form, is formed in a blade 22 also fixed in the arm 14 above the guides 18. The arm 14 is clipped on a pin

23 projecting vertically from a slide 24 disposed and movable tangentially to the needle circle in a guide 25 formed in the upper part of the bracket 7. The slide is maintained in the guide 25 by means of a cover plate 26 formed with a slot 27 for the pin 23.

There may be two or more of the tension devices and guides according to the number of yarns to be dealt with; about four yarns as shown is a useful number but there may be a greater or less number. The slide 24 is capable of movement to as many different positions as the number of yarns it is to carry.

Referring to Figure 1 for shifting this slide there is provided a pattern chain 28 adapted to be intermittently rotated by ratchet means operated by a cam 29 revolving with the needle cylinder i. e. mounted on the gear ring 2. Conveniently the chain is carried by a combined ratchet and sprocket wheel 30 mounted on a bracket 31 fixed on the bed 3 and the ratchet wheel is acted upon by a pawl 32 on a slide bar 33 moved in one direction by the cam 29 and in the other direction by a spring 34. The slide bar is mounted in the bracket 31. The cam 29 turns the wheel 30 one or more teeth at a time and the chain has upon it cam bits 35 of different height which as they are carried round by the chain pass under and lift a lever 36 pivoted at 37 on the bracket 31 and connected to one end of a wire or cable 38 which extends along the periphery of the bed 3 and at the other end is connected to a lever 39 mounted on a rockshaft 40 carried by the bracket 7 and having thereon another lever 41 which has connection at 42 with the slide 24. The lever 41 is moved in one direction by the cam bits e. g. to the right viewing Figure 4, and in the opposite direction by a spring 43. The position taken by the slide 24 is determined by the height of the cam bit acting under the lever 36.

The yarn picking and laying device comprises a nipper mechanism and a two-armed lever 44 which is pivotally mounted in a vertical position 44a on one arm of a bellcrank lever 45 in turn pivoted on a pin 46 fixed in the bracket 7. The nipper device comprises a pair of small fingers 47 fixed horizontally one above another on the upper end of the lever 44, and an intermediate finger 48, pivoted so as to be movable relatively to its companion fingers 47. The fingers 47 and 48 are held in position on the lever by means of a substantially central screw 49 and are pressed upon for yarn nipping purposes by a blade spring 50 located under the head of the screw. The fingers 47 are prevented from turning on the screw by means of a pin 51 passed through the rear ends of said fingers into the lever 44. The movable finger 48 is adapted to turn on the screw 49 and for this purpose has an enlarged rear end formed with a slot 52 (Fig. 6) so as to enable it to turn without obstruction by the pin 51. The movable finger has thereon a lateral projection 53 for operating it. The other arm of the bellcrank lever 45 has pivotally connected thereto an arm 54 having thereon an adjustable end piece 55 having a rounded toe 56 or fitted with a roller to work in a cam track 57 formed by cam pieces 58, see particularly Figure 7, attached to the horizontal portion 59 of the cylinder gear ring 2. By reason of this arrangement when the said gear ring revolves, with the toe 56 or the roller in the track 57, the arm 54 is positively reciprocated horizontally, i. e. outwards and inwards in relation to the needle cylinder, and the lever 45 is correspondingly oscillated vertically. When oscillated the lever

45 moves the aforesaid lever 44 and the associated nipper device bodily up and down so that the nippers traverse between positions above, (Figure 2) and below (Figure 3) the dial needles 6.

The nipper carrying lever 44 is fitted with a truck or roller 60 at its lower end and fixed upon the bracket 7 is an upright cam plate 61 formed with a cam slot 62 in which the truck or roller 60 works. This cam slot is so shaped that as the lever 44 is moved bodily up and down as aforesaid it is turned upon the bell-crank lever 45 thus swinging the nippers outwards and inwards to enable them to pass the dial needles. The outward and inward swing of the nippers imparted by the means described enable them to occupy, 15 when down as shown in Figure 3, a position underneath the dial needles i. e. nearer to the centre of the machine than the hooks of the dial needles, and, when moved up, to swing outwards to pass the dial needles and then move inwards over them towards the selected yarn as shown in Figure 2.

For opening and closing the nippers there is provided on the same pivot 44a as the lever 44 a lever 63 having engagement with a bifurcated member 64 pivoted at 64a on the lever 44 for engagement with the laterally projecting part 53 of the finger 48. The lever 63 has a tail 65 adapted to make contact with pins or abutments 66, adjustably fixed in the bracket 7. The pins or abutments 66 are conveniently formed on or inserted eccentrically in other pins 67 inserted in the bracket 7 at vertically separated points, as shown in Figures 2 and 3, and fixed in position after adjustment by screws 68. Upon upward movement of the lever 44 as already described the tail end 65 of the lever 63 makes contact with the upper one of the pins or abutments 66, near the end of this movement, so that the lever 63 is turned on its pivot, and by action of its bifurcated upper end piece 64 on the projection 53 moves the finger 48 in relation to the fixed fingers 47 and closes the nipper device as shown in Figure 5. At or near the end of the downward movement of the lever 44 the tail end of the lever 63 makes contact with the lower pin or abutment so that the lever is turned in the opposite direction to open the nipper device, as shown in Figure 6, at the appropriate time by action upon the member 64.

The tension devices act as spring clips to hold the ends of the yarns *a*.

In the yarn changing means, constituting the aforesaid example of the invention, the tension devices 8, 9 and guides 18, 21 for the several yarns are disposed above the dial cam plate or cap 69, and as already described the associated nipper device for picking the selected yarn has movement in a vertical plane in which it traverses an arc i. e. it moves up and down and in and out so as to travel from a position below the dial needles to a position above them and vice versa.

The tension devices 8, 9 and guides 18 are aligned vertically as shown in Figure 4 so that the yarns *a* pass vertically downwards from the guides and through the tension devices which latter and the guides 18 are spaced apart to expose sufficient length of the yarns to enable the nippers to take hold of it when brought into position to do so.

To enable the different yarns to be taken by the nippers as predetermined, the slide 24 is moved tangentially by the lever 39. The several yarns are spaced apart laterally and held by the tension devices and guides and by moving the slide by the means described the range of yarns can be moved horizontally in relation to the plane of movement of the nippers; by suitably positioning the slide

24 any of the yarns as predetermined can be selected and positioned in register with the nipper device to be taken by the nippers as determined by the prearrangement of the cam bits 35 on the chain 28. The height of the cam bit acting on the lever 36 determines the position to which the slide is moved, and consequently the particular yarn presented for being taken by the nippers.

In the action of this mechanism the nippers normally occupy a position down below the dial needles, as shown in Figure 1. After selection of the yarn effected automatically by shifting the slide as aforesaid, e. g. to the position shown in Figure 4, the nippers, in the open position, move upwards and outwards past the dial needles and then inwards over the said needles to the selected yarn—as shown in Figure 2—which they close upon and take hold of between the corresponding guide 18 and tension device, as the result of the action of the upper one of the pins or abutments 66 on the lever 63. They then move downwards and outwards over the dial needles pulling the selected yarn through the corresponding guide and pulling the end of the yarn from the tension device. The nippers, continuing to move down, then swing inwards below the dial needles towards the cylinder needles thus laying the yarn between adjacent dial needles, as shown in Figure 3, and into the tension device via the outturned ends. The nippers retain their hold upon the end of the yarn until the latter has been taken by the needles whereupon they are opened to release the end, as the result of the action of the lower pin or abutment 66 on the lever 63 at the proper time, and the yarn is drawn into the machine through the two guides 18, 21 and the tension device. The nipper device is returned i. e. moved upwards somewhat to its normal position shown in Figure 1.

Referring to Figure 7, when the toe 56 or roller is in the portion 57a of the cam track 57 the nipper device is moved from its normal position to the uppermost position. The portion 57b of the track moves the nipper device down to its lowest position, and the portion 57c returns the said device to its normal position. The track is provided with a wide mouth 57d to facilitate entrance of the toe 56 or roller when the latter is in its normal position.

In association with the mechanism just described there is provided a feeder plate 70 fixed on the bracket 7 adjacent to the needles, said plate having in it a horizontal slot 71 into which the yarn can enter through a gap 72 in the front edge of the plate, the said gap being flared, as shown in Figure 6, to facilitate entrance of the yarn.

The gap in the feeder plate is located in the plane of the movement of the nippers so that when these, carrying the end of the selected yarn, lay the yarn down between the needles said yarn will also be laid in the gap and thus enter the feed slot. The tension device or spring clip and gap are in line vertically; consequently when the yarn, which was held by the tension device, is passed through the gap it will also be replaced in the tension device. To effect or assist proper positioning of the laid yarn in relation to the slot in the feeder plate and the needles, there may be a projecting wire or finger 73 on the nipper carrying lever 44 which, as the latter turns to swing the nippers inwards will act upon or serve as a guide for the said yarn.

To sever the previously knitting yarn after the newly introduced yarn has been taken by

the needles, a shearing or severing device is arranged above the feed plate. This device may be operated by a pin 74 carried by the lever 45, or by cam or other means and suitable intermediate connections.

In the example shown there is mounted on a pivot 75 in the feeder plate a shear blade 76 situated above the feed slot 71 but adapted to move horizontally across and to cooperate with the upper edge of said slot to sever any yarn or yarns passing through the slot on one side or the other of the gap 72. For cutting purposes the shear blade is actuated by connections comprising a push rod 77 connected to the shear blade, and a two-armed lever 78 operated by the aforesaid pin 74 at the appropriate time, i. e. near the end of the outward movement of the arm 54. The push rod is moved inwards by the lever 78, vertically disposed on a pivot 79 in the bracket 7, and is moved in the opposite direction, to restore the shear blade to the inoperative position, by a compression spring 80. This spring is mounted on the push rod between a lug 81 on the bracket 7 and a locknut 82 associated with an adjusting nut 83 acted upon by the upper arm of the lever. The spring is put under pressure when the lever pushes the rod inwards upon actuation by the pin 74 acting on the lower arm of the lever as aforesaid. To prevent severance of the new yarn after entrance into the slot 71 there is provided under the feeder plate a pin 84 whereby the yarn is maintained centrally in the slot, and the shear blade has a central notch 85 in its cutting edge which is entered by the yarn when the shear blade is operated. When the slide 24 is moved to present a new yarn to the nipper device the old yarn is carried towards one end or the other of the slot 71 according to the direction of movement of the slide, and it is this yarn which is here severed when the shear blade is actuated by the push rod 77. The pin 84 is inserted in a carrier part 86 attached to the feed plate 70 on the underside.

To enable the yarn changing means to be rendered inoperative between changes means are provided for lifting the arm 54 to move the toe 56 or roller thereon out of the range of the cam track 57. In the arrangement shown a cam 87, Figure 7, is provided between the ends of the track 57 e. g. near the mouth 57d for action upon the toe 56 or roller so as to lift the arm 54, and a detent 88, Figure 4, is pivoted on a lug 89 on the bracket 7 for movement under the arm by a spring 90, so as to hold the arm raised against the action of gravity, or a spring 91, when the yarn holding means are moved to the position indicated by dot and dash lines 92 in Figure 4, after a yarn changing action. When operative the detent 88 is tripped upon initial movement of the yarn holding means from the said position, by a pin 93 in a lever 94. This lever is on the rockshaft 40 so as to be operated at the same time as the lever 39 by spring 43 and the wire or cable 38. The detent is formed with a recess 95 at the tail end for reception of the pin 93, and to provide a shoulder 96 against which the pin presses to trip the detent. After tripping the detent the pin 93 holds it inoperative by contact with an arcuate portion 97 thereof until the yarn holding means are moved back to the said position whereupon the pin is located under the recess and permits the detent to move under the action of its spring

to engage the arm 54 when this is next lifted by the cam 87.

In another example of the invention shown in Figure 8, tension discs 98 and guide holes 99 for the several yarns *a'* (of which there may be two or more) are disposed above the dial cam plate or cap 69 and the associated nipper device for picking the selected yarn is arranged to have movement up and down and in and out so as to travel from a position below the dial needles to a position above them, and vice versa.

The nippers comprise a pair of fingers 100, 101 and they are carried by a laterally projecting part 102 on a vertically disposed spring-controlled lever 103 pivoted at 104 upon one arm of a bell-crank lever 105 mounted, to turn on a horizontal pin 106 in a bracket 107, on the top of the dial cam plate or cap. The other arm of this bell-crank lever has a truck or roller 108 to be acted upon by a cam 109 attached to the dial driving means. The bell-crank is spring-actuated in one direction and moved by the cam in the other direction. When oscillated, the bell-crank lever moves the aforesaid nipper carrying lever, which it carries, bodily up and down so that the nippers which are at the lower end of their carrying lever traverse between positions below and above the dial needles.

Fixed upon a bracket 110 attached to the dial cam plate or cap is an upright cam 111 with which a truck or roller 112 on the nipper carrying lever 103 is kept in contact. This cam is so shaped that as the lever 103 is moved bodily up and down as aforesaid it is turned upon the bell-crank lever 105 which carries it, thus swinging the nippers outwards and inwards to enable them to pass the dial needles 6. The outward and inward swing of the nippers imparted by the means described enable them to occupy, when down, a position underneath the dial needles i. e. nearer to the centre of the machine than the hooks of the dial needles, and when moved up to swing outwards to pass the dial needles and then move inwards over them towards the selected yarn.

For opening and closing the nippers there is a rockshaft 113 on the part 102 which rockshaft at one end has a pin and slot connection 114 with the movable finger 101 and at the other end has an arm 115 adapted to be operated by abutments 116, 117 on the fixed cam 111. The arm 115 has a pin 118 therein for engagement with the upper abutment 116.

In this mechanism the tension devices and the associated guides for the several yarns are carried by a spring controlled quadrant 119 mounted to turn on a vertical pivot 120 on the top of the dial cam plate or cap 69. The quadrant conveniently of flat plate form is disposed horizontally with its periphery situated within the circle of the cylinder needles 5 and its pivot inwards from the said periphery. That is to say the quadrant is disposed on a radial line with its periphery outwards. At its outer end the quadrant has integral with it an upright part 121 which at the top carries a rod 122 carrying the tension devices, and between said tension devices and the quadrant the upright part has a laterally projecting plate 123 provided with the guide holes 99. Formed through the quadrant near its periphery are holes 124 corresponding in number to the yarns and formed in the peripheral edge of the quadrant are gaps 125 which break into the said holes the gaps are flared or made V-shape to facilitate entrance of the yarns for passage into the holes in the quadrant. The tension devices,

holes in the plate and holes in the quadrant are aligned so that the yarns pass vertically downwards from the tension devices through the holes in the two series. The said two series of holes are spaced apart to expose sufficient length of the yarns to enable the nippers to take hold of it when brought into position to do so.

The nippers 100, 101 move in a vertical plane in which they traverse an arc and to enable the different yarns *a'* to be taken by the nippers the quadrant is turned upon its axis. The several yarns are spaced apart and held by the tension devices 98 and guide holes 99, 124 and by turning the quadrant on its pivot the range of yarns can be moved in relation to the plane of movement of the nippers and by suitably positioning the quadrant any of the yarns as predetermined can be selected and positioned to be taken by the nippers.

While any suitable pattern means may be provided to shift the quadrant 119, to select the yarns in prearranged manner it is convenient to adopt for this purpose cams 126 on a ring 127 adapted to be shogged or intermittently rotated on the dial cam plate or cap by appropriate means. As shown the cams on the ring are of different heights and act upon an arm 128 on the quadrant. The height of the cam acting on the arm 128 determines the position to which the quadrant is turned and consequently the particular yarn presented for being taken by the nippers.

In the action of this mechanism the nippers 100, 101 normally occupy a position down below the dial needles. After selection of the yarn effected automatically by shifting the quadrant 119, the nippers, in the open position, move upwards and outwards past the dial needles 5 and then inwards over the said needles to the selected yarn which they close upon and take hold of between the two series of guide holes. They then move downwards and outwards over the dial needles pulling the selected yarn through the tension device and upper guide hole and having pulled the end of the yarn from the lower guide hole. The nippers, continuing to move down then swing inwards below the dial needles towards the cylinder needles 5 thus laying the yarn between adjacent dial needles and into the lower guide hole via the gap. The nippers retain their hold upon the end of the yarn until the latter has been taken by the needles whereupon they are opened to release the end and the yarn is drawn into the machine through the two guide holes and the tension device.

Fixed upon the dial cam plate or cap and disposed between the quadrant and the dial needles is a feeder plate 129 having a projecting lip 130 behind which the yarn passes when laid in between the needles by the nippers as already described. To effect or assist proper positioning of the laid yarn in relation to the lip of the feeder plate and the needles, there is a projecting wire or finger 131 on the lever 103 which finger or wire, as the lever turns to swing the nippers inwards will act upon or serve as a guide for the said yarn.

To sever the previously knitting yarn after the newly introduced yarn has been taken by the needles, a shearing or severing device 132 is arranged under the quadrant. This device may be operated by a pin 133 on the bell-crank lever 105.

Referring to Figure 9, in a further practical form of yarn changing means applied to a circular plain (non-rib) knitting machine of the kind having a rotary needle cylinder, there is provided for holding each end of yarn a tension device,

conveniently of the known type consisting of a pair of spring-pressed discs 134, and a guide consisting of a bifurcated member 135 into which the yarn can be placed and from whence it can be lifted. These tension devices and guides are carried by a slide 136 disposed and movable tangentially to the needle circle.

As in the previous examples there may be two or more e. g. four of the tension devices and guides according to the number of yarns a^2 to be dealt with. The slide is capable of movement to as many different positions as the number of yarns it is to carry.

For shifting this slide there is provided a cam drum 137 adapted to be intermittently rotated by ratchet means operated by a cam 138 revolving with the needle cylinder 1. Conveniently the drum 137 is carried by a bracket 139 on the bed 3 and has a ratchet wheel 140 acted upon by a pawl 141 on a spring controlled slide bar 142 moved by the cam 138. The cam turns the drum one or more teeth at a time, and the drum has upon it cams, such as 144, of different height which as they are carried round by the drum pass under and lift a lever 145 which is pivoted on a bracket 146 on the bed 3 and acts upon one arm of a bell-crank lever 147 pivoted on the cam box 143. The other arm of the lever has a pin and slot connection 148 with the slide. The position taken by the slide is determined by the height of the cam on the drum acting under the lever 145.

Carried by a slide bar 150 having movement in a bracket 151 fixed upon the bed 3 is an arm 152. The slide bar 150 moves in a path radial to the needle cylinder and is operated by a spring-controlled lever 153 connected by a link 154 with a lever 155 pivoted at 156 on the bed 3 and actuated by a cam 157 on the needle cylinder. The lever 153 is pivoted at 158 on a bracket 159 attached to the bed 3 and has a pin and slot connection 160 with the slide bar 150. The lever 155 is fitted with a roller 161 for contact with the cam 157.

The arm 152 extends upwardly and forwardly towards the needle cylinder from a swivel eye 162 in the slide bar so that it can oscillate up and down, and at its upper or forward end it carries a dependent nipper device consisting of a small pair of fingers 163, 164 one fixed on a laterally projecting part 165 of the arm and the other pivoted at 166 so as to be movable relatively to its companion member. The pivoted finger 164, which is in the form of a small bell-crank lever, has a pin and slot connection 167 with and is moved by an arm 168 on a rockshaft 169 on the arm, the rockshaft having a bell-crank 170 fixed thereon for contact with cams 171 and 172, fixed on the bracket 151, to open and close the nippers.

In the bracket 151 are two projecting pins 173, 174 with which the arm 152 makes contact as the slide bar moves to and fro. The arm is spring controlled and it is so arranged that when the slide bar occupies a normal inward position it is in contact with the projecting pin 173 and is thereby held down so that the nippers are positioned on the inside of the needles 5 and below the level of the needle hooks. When the slide bar moves outwards carrying the arm with it, the latter moves upwards under spring action as it leaves the projecting pin 173 but when it strikes the other projecting pin 174 it is thereby moved downward again. The combined outward, upward and downward movements of the arm cause

the nippers to pass from the inside of the needle circle, over the needles and down on the outside of said circle. The downward movement of the nippers on the outside of the needle circle brings them into position to pick up whichever yarn has been previously selected and brought to the appropriate position by shifting of the slide 136. As the nippers move outwards they are open as shown but upon descending to a position where the fingers come on opposite sides of the selected yarn, the nippers are closed to nip said yarn, this closure being effected by contact of one arm of the bell-crank 170 with the fixed cam 172 which causes the rockshaft 169 to turn and move the pivoted finger 164.

The bifurcated guides 135 act as spring clips to hold the ends of yarn and when the nippers descend they close upon the length of yarn, between the clip and tension device. When the nippers have closed upon the selected yarn, the slide bar 150 moves inwards with the result that the arm 152 is carried forward towards the needles and also rises so that the nippers pick up the selected yarn and carry the end forward over the needles to the inside of the needle circle where, by reason of contact of the arm with the projecting pin 173, they descend and thus lay the yarn down between adjacent needles in the needle circle.

The action of the nippers in picking up the selected yarn and carrying it to and over the needles draws the end of the yarn from the guide clip and also draws a further length of yarn through the tension device, but by the descent of the nippers on the inside of the needle circle to lay the yarn between the needles the yarn is brought down again into the guide clip the upper part of which is flared or V-shaped as shown for reception of the yarn. The nippers hold the end of the yarn introduced to the needles until the latter have securely taken the yarn in whereupon the arm descends slightly further to cause the bell-crank 170 to make contact with and be moved by the other fixed cam 171 thus opening the nippers and releasing the end of the yarn.

In association with the mechanism just described there is provided a feeder plate 175 fixed on the cam box adjacent to the needles said plate having in it a horizontal slot 176 into which the yarn can enter through a gap 177 in the top edge of the plate, the said gap being flared to facilitate entrance of the yarn.

The gap 177 is located in the plane of the movement of the nippers so that when these, carrying the end of the selected yarn, lay the yarn down between the needles said yarn will also be laid in the gap and thus enter the feed slot 176. The corresponding guide 135, gap and tension devices 134 are in line, consequently when the yarn which is held by the tension device is passed through the gap it will also be laid into the guide.

On the side of the feeder plate nearest to the guides 135 are a pair of pivoted shear blades 178, 179 normally situated below the feed slot but adapted to move upwards and co-operate with the upper edge of said slot to sever any previously knitting yarn passing through the slot. The adjacent ends of the shear blades are connected by pin and slot means 180 so that the blades will move up and down together. For cutting purposes the shear blades may be actuated at an appropriate time by a connection 181 operated by the slide bar 150.

From the foregoing description it will be seen that the invention includes as one of its features yarn changing means comprising means to hold

a series of ends of yarn, means automatically to shift said series of yarns bodily in a predetermined manner to select and position a yarn preparatory to being introduced to the needles of the knitting machine, a bodily movable nipper device adapted to operate in one path or plane and when operated to take hold of the prepositioned yarn, carry it across the series of needles and lay it between adjacent needles in said series, and means operated automatically to sever the previously knitting yarn when the newly introduced yarn has been taken by the needles.

With each of the practical forms of yarn changing mechanism herein described horizontal stripes may be made in the knitted fabric by changing the knitting yarn after one or more complete courses have been made. The same mechanism may be used to produce vertical stripes by so operating it as to change the knitting yarn during the knitting of the courses; for instance if during the knitting of successive courses two or more yarn changes are made at the same place in each course vertical stripes will be produced. By suitably actuating the yarn changing means for yarn selection and changing, pattern effects or formations can be produced. The hereindescribed means may also be employed to introduce a rubber thread either for knitting or as a weft such, for example, as to make an elastic waist in a garment. This might be done by introducing an elastic thread say at every third, fourth or other course during knitting of the waist portion.

The yarn supplying means constituting the invention may be applied to knitting machines having one or more feeders.

In a multi-feeder machine having a yarn changing unit of the kind herein described at two or more of the feeders a corresponding number of intermediate connections, such as wires or cables and associated levers, may be provided in connection with pattern means common to both or all of said units for controlling same. Alternatively there may be more than one set of patterning means each adapted to control one or more yarn changing units according to the number employed.

In the previously described forms where the series of yarn holding means are carried by a movable part such as the slide or quadrant, the said movable part is intended to be shifted as determined by the pattern mechanism in order to bring the predetermined yarn of the series into position to be picked by the nippers in which case the yarns would not necessarily be taken in the same order as that in which they are arranged in the series.

Instead of shifting the series of yarns to select the yarn for introduction to the needles a plurality of yarns may be provided and their ends held by means such as herein described, said means being shifted step by step to bring the yarns in turn one after another to the yarn picking and laying device for introduction to the needles.

The herein described yarn changing means is mainly intended to introduce one yarn at a time but it may be arranged and actuated to introduce or change more than one at a time and/or to allow more than one yarn to feed into the machine at one and the same time.

Instead of having a single yarn picking and laying device for dealing with all the yarns in the series as herein described the mechanism may be equipped with a picking and laying de-

vice of the kind described for each yarn to be introduced to the needles.

The yarn severing means may be actuated and controlled so that if desired it will not sever a feeding yarn when another is introduced as may be required when two yarns are to feed at the same time. The yarn severing means may be operated partly or wholly independently of the other mechanism for introducing the yarns so that if desired two or more yarns can be introduced one after another and feed in together.

What we claim then is:—

1. In a knitting machine, a series of needles and yarn supplying mechanism, which includes means for holding yarns in a non-feeding inert position, means for moving said holding means substantially tangential to the needle circle, a yarn picking device constructed and movably arranged so as to enable it to selectively take yarns from the non-feeding position to the needles of such series and means for operating the said device.

2. In a knitting machine, a series of needles and yarn supplying mechanism which includes means for holding yarns in a non-feeding position, means for moving said holding means substantially tangential to the needle circle, a yarn picking device constructed and movably arranged so as to enable it to selectively take yarns from the non-feeding position and to lay them between adjacent needles in the said series and means for operating said device.

3. In a knitting machine, a series of needles and yarn supplying mechanism which includes means for holding yarns in a non-feeding position, means for moving said holding means substantially tangential to the needle circle, a yarn picking device constructed and movably arranged so as to take yarns from the non-feeding position and lay them between adjacent needles, means for operating said device and means for severing the yarns when the supply thereof to the needles is to cease.

4. In a knitting machine, a series of needles and yarn supplying mechanism comprising means for holding a plurality of yarns in a non-feeding position, means for moving said holding means substantially tangential to the needle circle, a yarn picking device constructed and arranged for movement to take a yarn from the non-feeding position, carry it across the series of needles and lay it between adjacent needles in said series, said yarn holding means and picking device being relatively movable so as to enable said device to pick the yarns in prearranged order and take them to the needles, means for automatically effecting movement of the yarn holding means, means for operating the picking device and means for severing a previously knitting yarn after a newly introduced yarn has been taken to the needles.

5. In a knitting machine, a series of needles and yarn supplying mechanism comprising means for holding a plurality of yarns in a non-feeding position, means for moving said holding means substantially tangential to the needle circle, a yarn picking device constructed and arranged for movement in one plane so as to enable it to take a yarn from a non-feeding position carry it across the series of needles and lay it between adjacent needles in said series, said holding means being movable in relation to the picking device in prearranged manner to as many positions as there are yarns in order to preposition a desired yarn in the plane of the pick-

ing device, means for automatically moving the said holding means, means for operating the picking device and means for automatically serving the previously knitting yarn after the newly introduced yarn has been taken by the needles.

6. In a knitting machine, a series of needles and yarn supplying mechanism, which includes means for holding yarns in a non-feeding position and means for moving said holding means substantially tangential of the needle circle, a movable nipper device and means for operating said nipper device so as to cause the same to close upon a yarn held in the non-feeding position, then to take the yarn from such position and lay it across the series of needles between adjacent needles therein and finally to open and release the yarn.

7. In a knitting machine, a series of needles and yarn supplying mechanism comprising means for holding yarns in a non-feeding position, and means for moving said holding means substantially tangential to the needle circle, a movable nipper device; means for operating said nipper device so as to cause the same to close upon a yarn held in the non-feeding position, then to take the yarn from such position and lay it across the series of needles between adjacent needles therein and finally to open and release the yarn, said holding means and nipper device being relatively movable so as to enable said device to pick the yarns in prearranged order and take them to the needles in that order; means for automatically effecting relative movement of the holding means and picker device, and means for severing the previously knitting yarn after the newly introduced yarn has been taken by the needles.

8. In a knitting machine, a series of needles and yarn changing mechanism comprising means for holding a plurality of yarns in a non-feeding position, and means for moving said holding means substantially tangential of the needle circle; a nipper device movable in one plane, means for operating said device so as to cause the same to close upon a yarn in a non-feeding position, then to take the yarn from such position and lay it across the needle series between adjacent needles and finally to open to release the yarn; said yarn holding means being movable to as many positions as there are yarns in order to preposition a desired yarn in the plane of the nipper device; means for automatically moving said holding means and means for automatically severing the previously knitting yarn after the newly introduced yarn has been taken to the needles.

9. In a knitting machine of the character described, a series of needles and yarn supplying mechanism, which includes means for holding yarns in inert position wholly apart from and non-engageable with the needles, a co-operative yarn picking device adapted to be brought with a yarn so held and thereafter moved so as to take yarn from said position to the needles, means for moving said holding means in a direction substantially tangential of the needle circle to bring the picking device and the different yarns selectively into yarn picking relation without feeding any of the yarns to the needles and means for effecting the movements of the yarn picking device between the holding means and the needles.

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