Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 1

FIG. 1a.

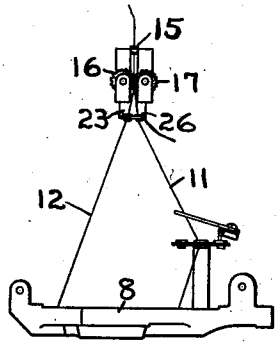
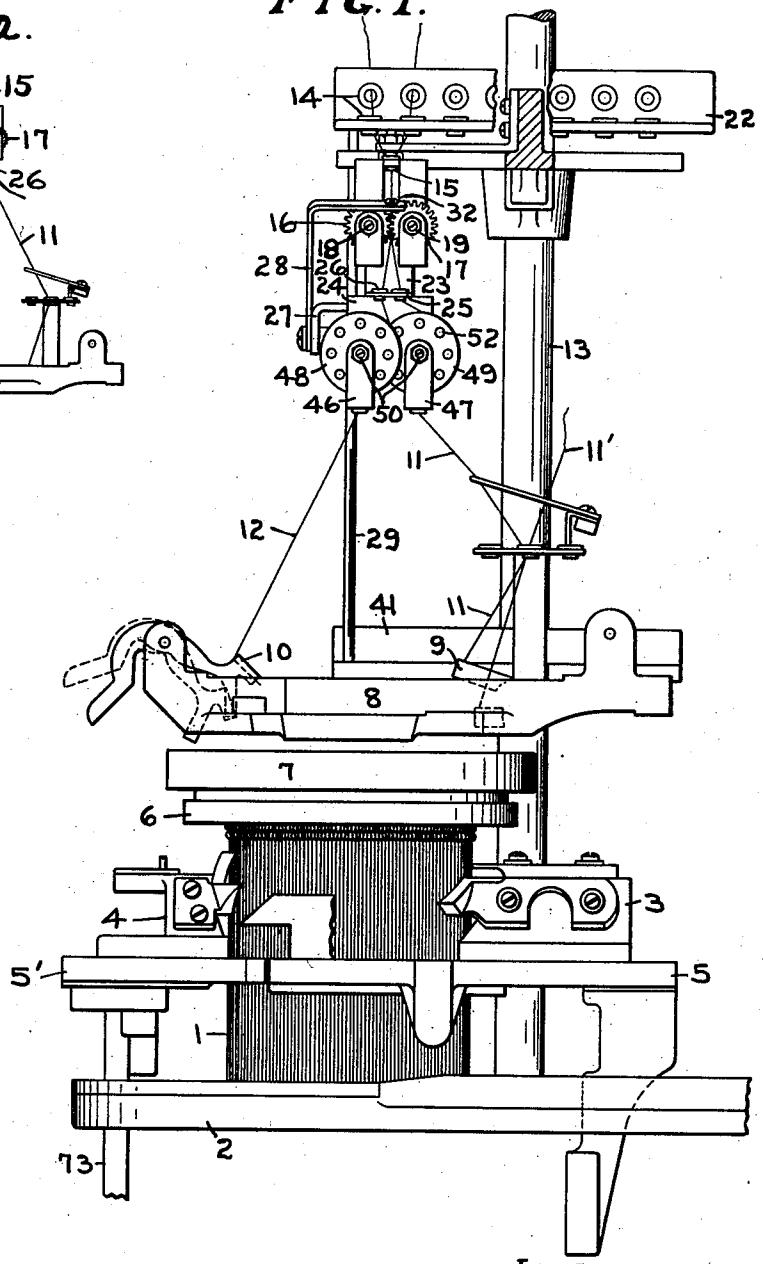


FIG. 1.



INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
By Roy F. Lovell,
ATT'Y.

Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 2

FIG. 2.

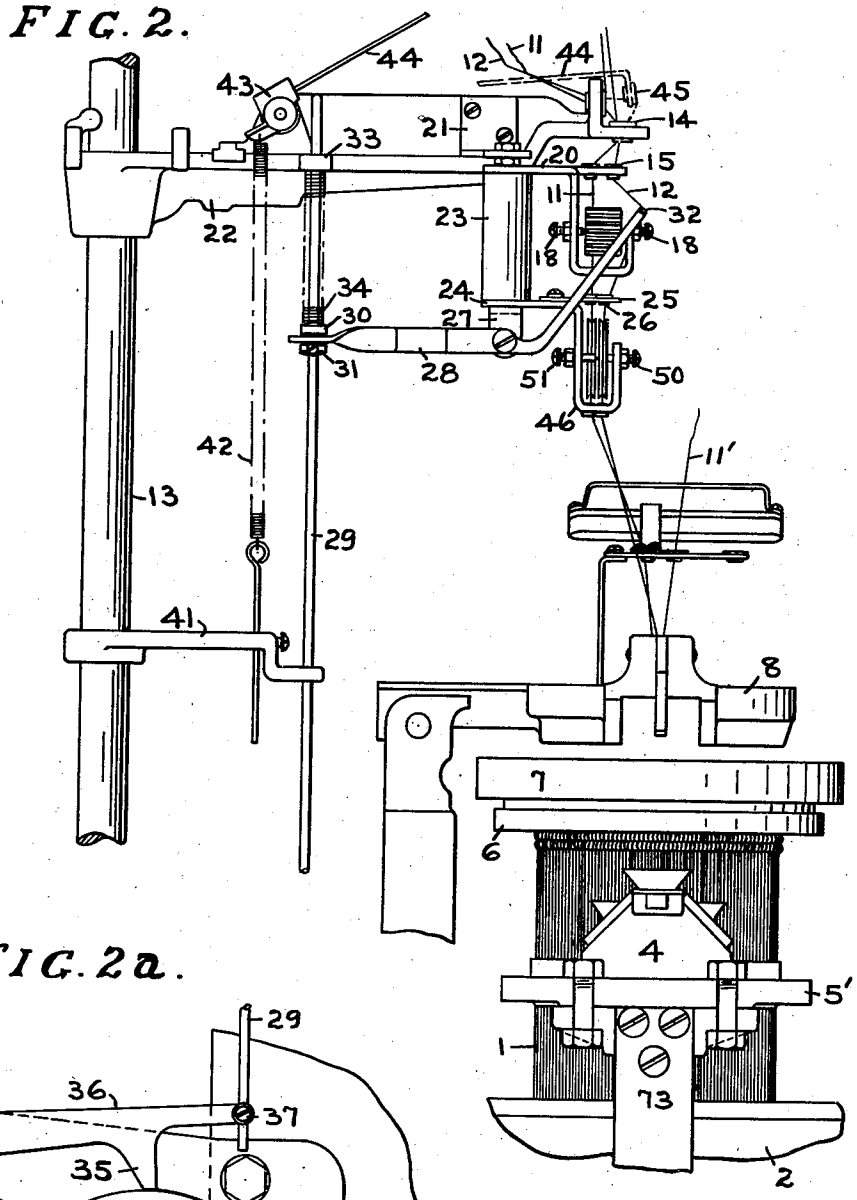
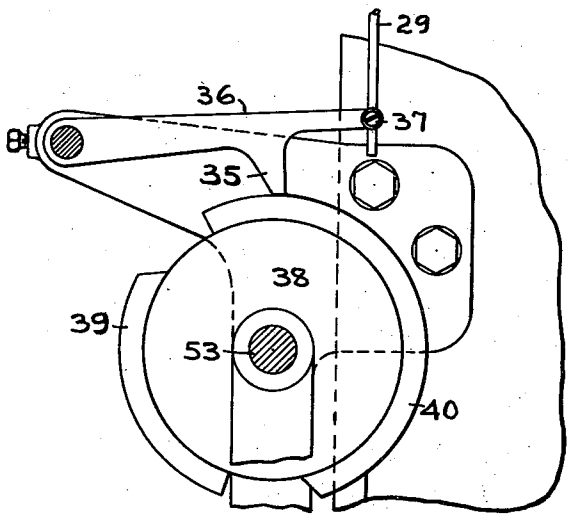


FIG. 2a.



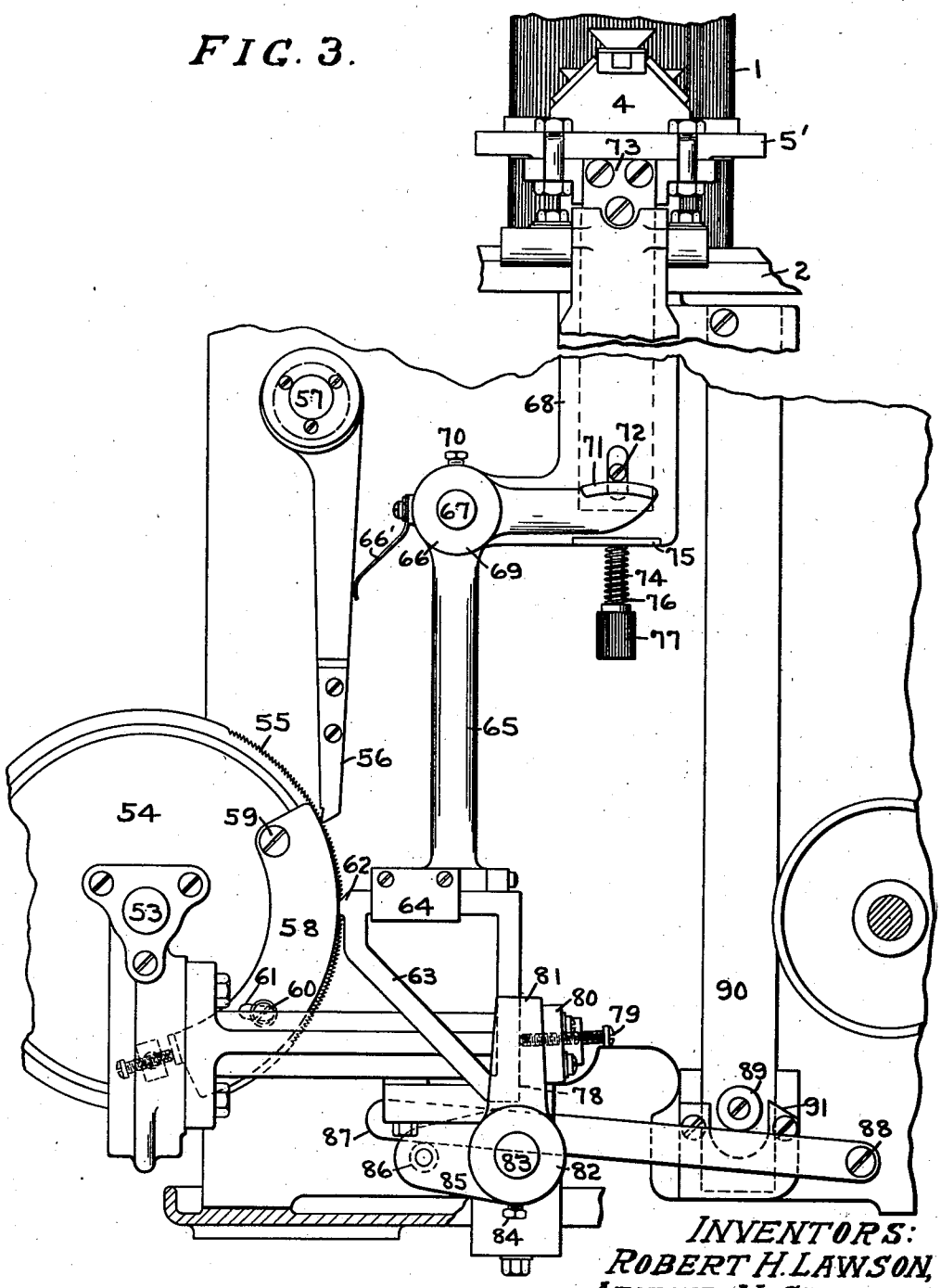
INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
BY Roy F. Lovell,
ATT'Y.

Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 3

FIG. 3.



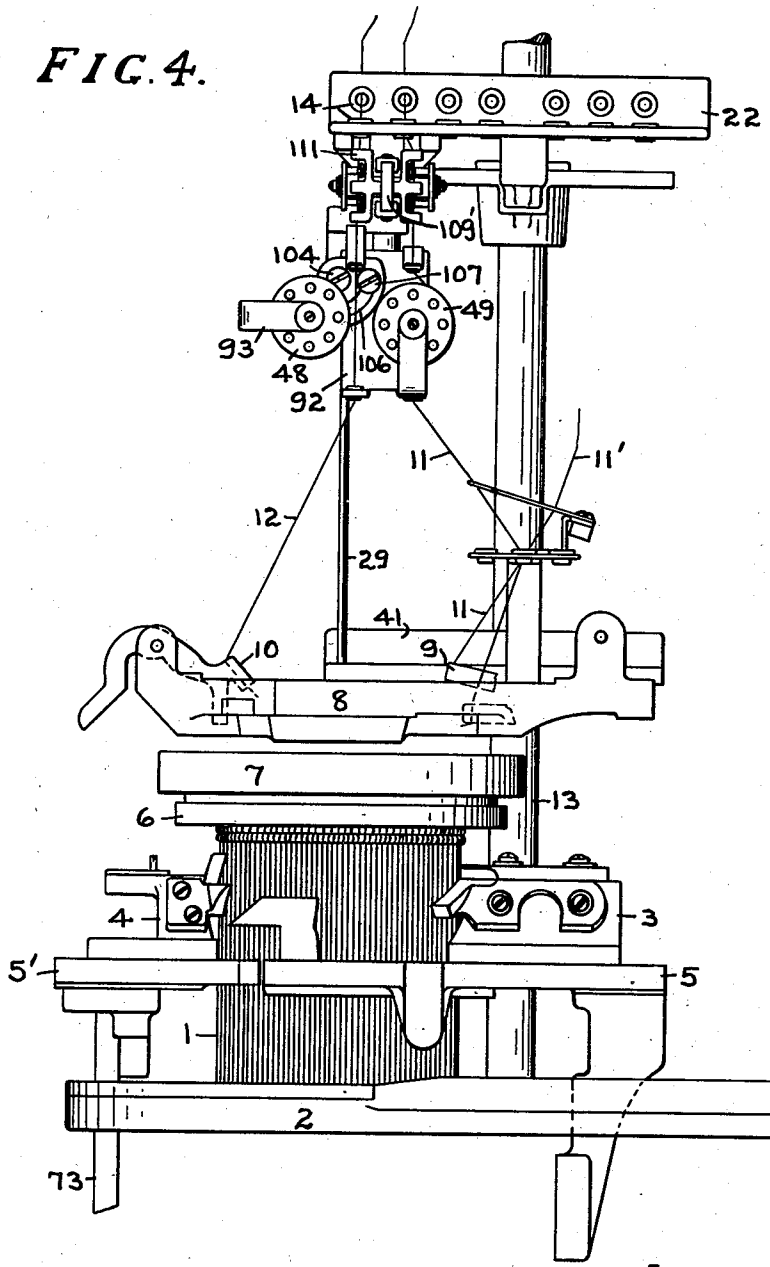
INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
By Roy F. Lovell,
ATT'Y.

Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 4

FIG. 4.



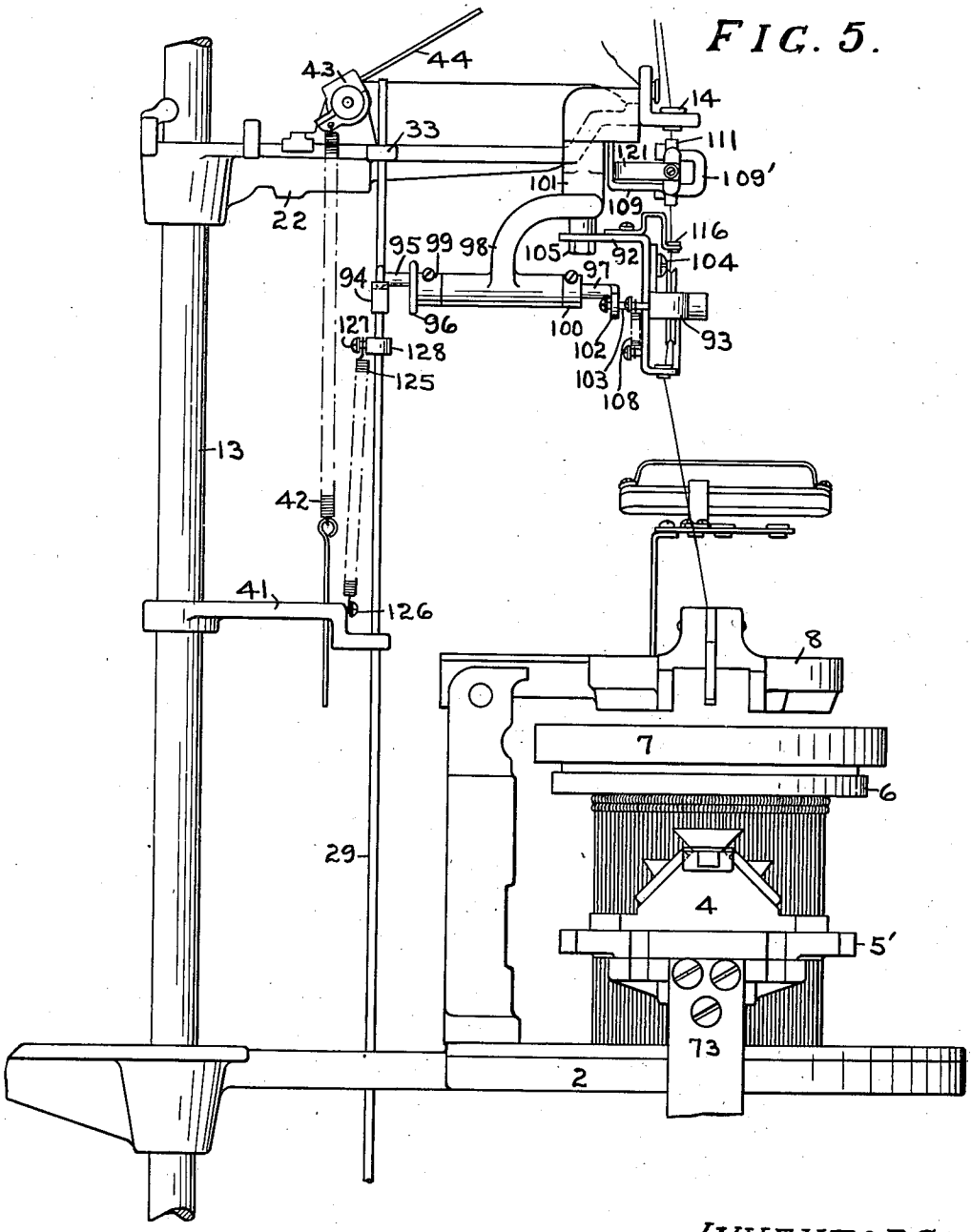
INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
By Roy F. Lovell,
ATT'Y.

Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 5

FIG. 5.



INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
By Roy F. Lovell,
ATT'Y.

Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 6

FIG. 6.

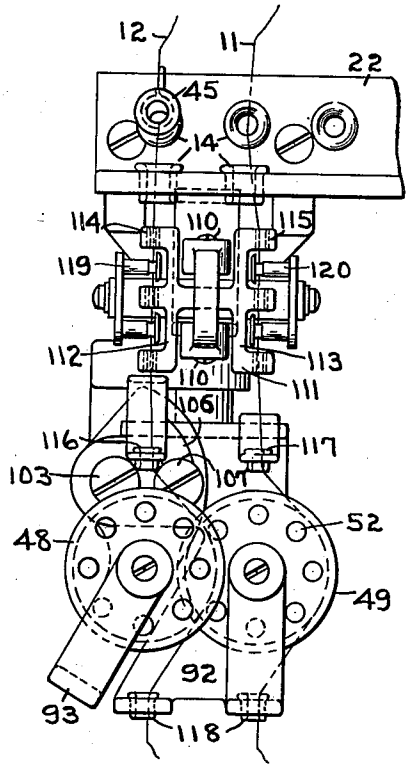


FIG. 7.

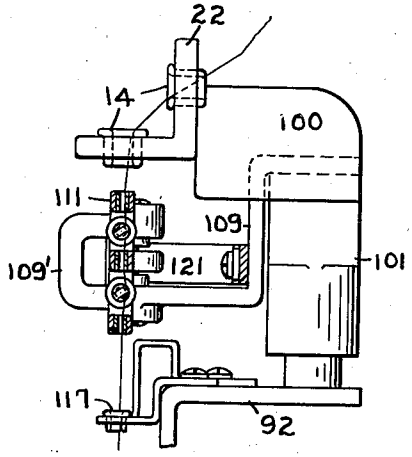


FIG. 8.

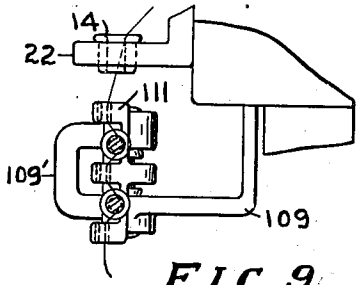


FIG. 9.

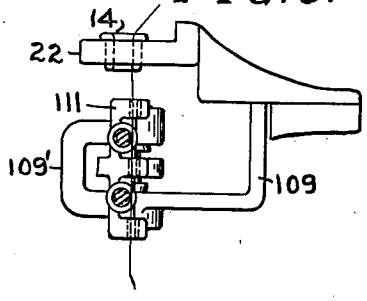
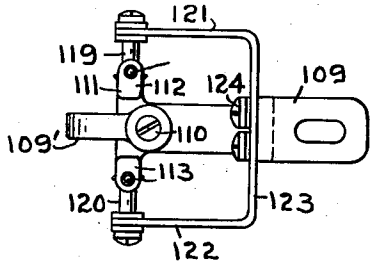


FIG. 10.



INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
By Roy F. Lovell,
ATT'Y.

Nov. 2, 1937. R. H. LAWSON ET AL 2,098,050

KNITTING MACHINE

Filed Aug. 28, 1933 7 Sheets-Sheet 7

FIG. 11.

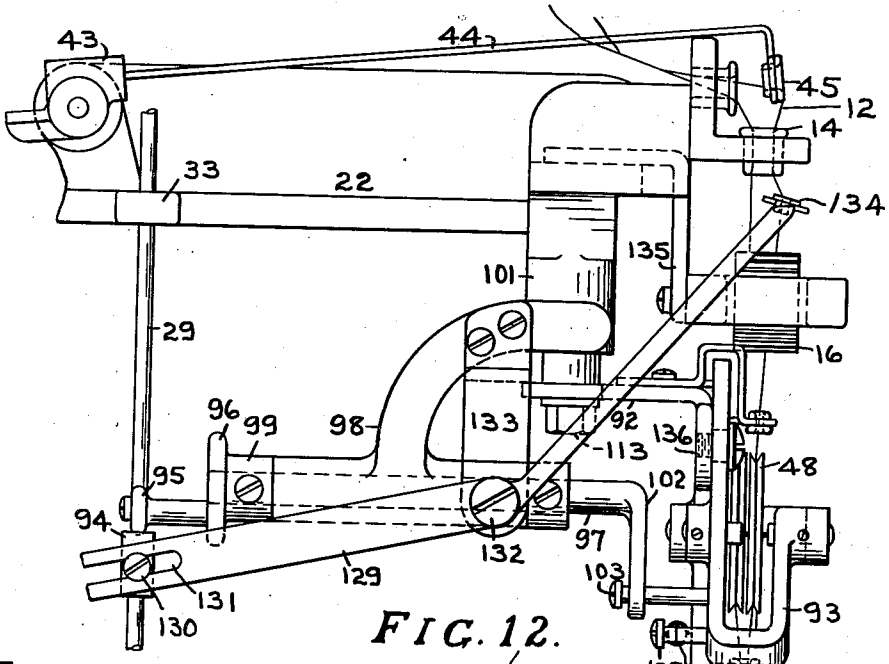


FIG. 12.

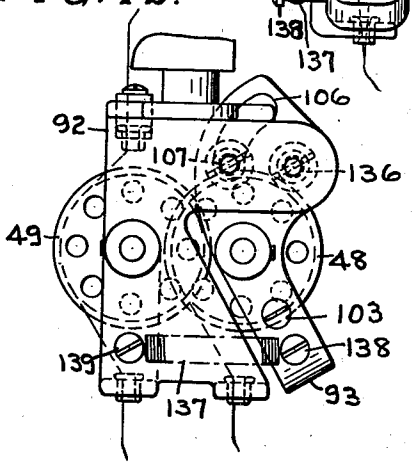
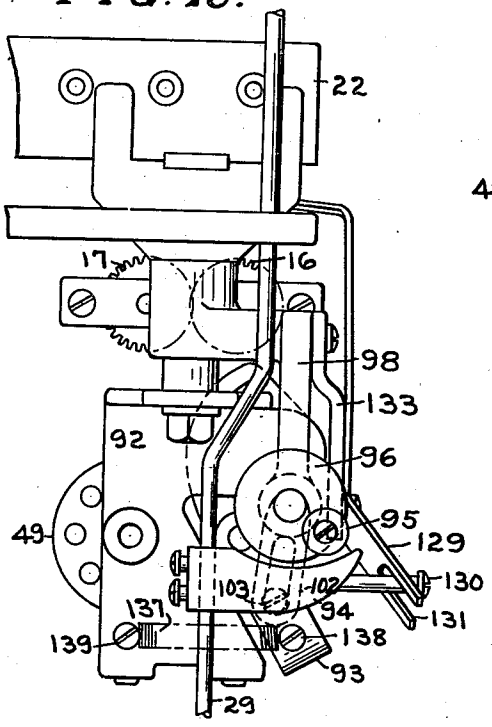


FIG. 13.



INVENTORS:
ROBERT H. LAWSON,
ARTHUR N. CLOUTIER,
By Roy F. Lovell,
ATT'Y.

Patented Nov. 2, 1937 2,098,050

UNITED STATES PATENT OFFICE

2,098,050

KNITTING MACHINE

Robert H. Lawson, Pawtucket, and Arthur N. Cloutier, Lonsdale, R. I., assignors to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Application August 28, 1933, Serial No. 687,102

19 Claims. (Cl. 66—125)

This invention relates primarily to knitting machines and especially to knitting machines of the multi-feed type. In machines of this type it is essential, to knit uniform fabric, that the yarns of the several feeding stations be knitted uniformly into the fabric, i. e., that the stitches knitted at the several feeding stations be of the same length or otherwise what is commonly known as a "washboard" effect is produced in the fabric.

In the drawings:

Fig. 1 is a view in front elevation of a portion of a knitting machine having two feeding stations at each of which a yarn is fed to the needles which consequently knit two courses during each revolution of a rotary member such as a needle cylinder;

Fig. 1*a* is similar to Fig. 1 of a modification, but not showing the needle cylinder and associated parts;

Fig. 2 is a view in side elevation, showing the automatically controlled means for effecting the knitting of uniform fabric;

Fig. 2*a* is a fragmentary detail view of the pattern drum for effecting automatic actuation of certain of the parts shown in Fig. 2;

Fig. 3 is a view in side elevation of certain parts showing controlling means for simultaneously changing the positions of stitch drawing cams at the main and auxiliary feeding stations thereby to effect uniform variations in the stitches knitted at the two feeding stations;

Fig. 4 is a view similar to Fig. 1 but showing a modification;

Fig. 5 is a view similar to Fig. 2 but of the modification shown in Fig. 4;

Figs. 6–10 inclusive are fragmentary views of the yarn controlling means disclosed in Figs. 4 and 5 but showing the parts relatively enlarged;

Fig. 11 is a fragmentary view of a still further modification, being similar to Fig. 5;

Fig. 12 is a detail fragmentary view, in rear elevation, of a portion of the mechanism shown in Fig. 11; and

Fig. 13 is likewise a fragmentary view, in rear elevation, showing how swinging movements of one of the yarn controlling members are effected, as prior to the knitting of heels and toes.

Only so much of the knitting machine is shown as is directly concerned with the present invention. The needle cylinder 1 is shown as mounted for rotary and reciprocatory movements in a so-called circular base 2. Main and auxiliary cam blocks 3 and 4 are mounted on cam plates 5, 5' respectively, such cam blocks being shown as located substantially opposite one another with respect to the needle cylinder. The needle cylinder is slotted in the usual manner and within such slots are slidable needles. Surmounting the needle cylinder and connected thereto is a sinker head 6 within which are mounted sinkers (not shown) adapted to cooperate with the needles in any desired manner for the formation of knitted stitches. Above the sinker head 6 is a so-called sinker cam cap 7 which is stationarily mounted and in which are cams for controlling the movements of the sinkers. A latch ring 8 is carried by the machine frame and is pivotally mounted so as to be swung up away from the needles when necessary. In the latch ring 8 are mounted thread or yarn guides such as 9 and 10, the yarn guide 9 being one of those located at or adjacent to the main feeding station, one of which guides feeds a thread or yarn 11 to the needles at the said main feeding station, the needles being actuated for knitting such thread by cams comprising the cam block 3. Likewise the yarn lever 10 feeds the thread or yarn 12 to the needles at the auxiliary feeding station, the needles at such station being controlled by cams comprising the cam block 4.

The yarns 11 and 12, as well as other yarns used during the knitting of a stocking or half hose, are supplied from bobbins mounted upon a bobbin stand (not shown) which is mounted upon a rod 13 and adjacent to the upper end thereof. The yarns 11 and 12 pass downwardly from the mentioned bobbins through suitable eyelets such as 14 and 15 and then between intermeshing rolls 16 and 17. The rolls 16 and 17 are mounted in substantially frictionless bearings consisting of pins or screws 18 and 19 which are mounted in the arms of a bracket 20, the eyelets 15 being carried by said bracket. The bracket 20 is connected to and depends from an angle bracket 21 which in turn is connected to the yarn tension bracket 22 which is rigidly mounted upon the rod 13. Connected to and depending from the bracket 20 is a supplemental bracket 23 to the lower end of which is connected an angle bracket 24 and a laterally projecting arm 25 provided with eyelets 26 through which yarns 11 and 12 pass. Pivotally connected to a depending arm of the bracket 27 also connected to bracket 23, is a lever 28, one end of which is bifurcated, the arms thereof straddling a rod 29 upon which are collars 30 and 31, collar 31 being fixed adjustably to rod 29. The other arm of the lever 28 is turned more or less at right angles and in the end thereof is an eyelet 32 through

which passes the yarn 12. The link 29 at its upper end passes through an arm 33 which is connected to and laterally projects from the yarn tension bracket 22. Surrounding the link 29 between the arm 33 and collar 30 is a coil spring 34 which normally urges the link 29 in a downward direction so that a lug 35 on a lever 36 to which the link 29 is pivotally and adjustably connected as at 37, will be maintained in engagement with the surface of the drum 38 or cams 39 and 40 mounted thereon.

Attached to rod 13 below the bracket 22 is a bracket 41 through which passes the rod or link 29. A coil spring 42 is adjustably attached to the bracket 41 and extends upwardly being connected to a yarn tension lever 43 which lever is one of a series of similar levers carried by knitting machines for the purpose of taking up the slack during the knitting of heels, toes and split-foot fabric. At the free end of a wire arm 44 of the said lever 43 is an eyelet 45 through which passes the yarn 12.

Forming part of the bracket arm 24 are U-shaped extensions thereof indicated at 46, 47. Mounted to rotate freely between the arms of the U-shape extensions 46, 47 are wheels or discs 48, 49 the same being supported upon pins such as 50, 51 which pass through and are supported by the arms of the brackets 46, 47.

In operation, the threads or yarns 11 and 12 are passed around the peripheries of the discs 48 and 49 being received in peripheral grooves thereof. As will be evident from inspection of the drawings, the threads 11 and 12 pass around the discs in the same directions thereby causing the overlapping portions of the discs to rotate in opposite directions. Discs 48, 49 are each provided with an equal number of equally spaced holes such as 52 and when the threads or yarns 11 and 12 are being knitted into the fabric by the needles knitting at the main and auxiliary feeding stations, the frictional engagement between the said yarns 11 and 12 and their respective discs 48, 49, causes the holes 52 in the two discs to move past one another at a rapid rate, the optical effect of which depends upon whether the discs 48, 49 are rotating at the same speeds or at different speeds. If the two discs are rotating at the same speeds registering holes 52 in the two discs 48, 49 give the appearance of black or dark spots which remain stationary. If the speed of rotation of one disc be faster than that of another, the holes in such discs gain with respect to the holes in the other thus giving an optical illusion of spots moving in the direction of greater rotation. It is obviously desirable that the two threads or yarns 11 and 12 be fed to the needles at the same rate in order to produce a fabric having a uniform appearance; consequently, if one disc be moving at a faster rate than the other, the yarn rotating the faster moving disc is being fed to the needles at a faster rate than the other yarn. In order to compensate for such difference in the rate of feeding of the one yarn with respect to the other, the stitch drawing cam at the feeding station where the faster moving yarn is being fed to the needles, is elevated slightly to draw a shorter length of stitch and consequently, less yarn per revolution of a rotating needle cylinder if the knitting machine be one having a rotary needle cylinder. Upon effecting a proper adjustment of the stitch cam as aforesaid, inspection of the rapidly rotating discs 48, 49 will show the dark or black spots provided by the registering holes 52 to appear to be stationary or nearly so, although the constant and slight changes in tension due in part to the stickiness of one yarn compared to the other, will cause a slight vibration of the dark or black spots.

In order to effect a more or less automatic adjustment of the threads or yarns 11 and 12, the intermeshing gears or wheels 16 and 17 are provided. It is obvious that due to both yarns 11 and 12 passing between the rolls or gears 16 and 17, that each yarn acts as a means for feeding the other yarn at the same rate that the first yarn is being fed. Thus even though the setting of the stitch drawing cams be not accurately adjusted, nevertheless the compensating effect of the gears or rolls 16 and 17 will be such as to cause the fabric to have a uniform appearance.

In the foregoing description of operation, the yarns 11 and 12 alone have been mentioned. These yarns are operative during the knitting of the circular leg portion of the fabric. If the invention be applied to the knitting of so-called split-foot fabric, at the beginning of the high splice, gears 16, 17 and discs 48, 49 are not operative due to the yarn 11 being thrown into the clamping and cutting mechanism (not shown) by the elevation of a yarn lever 9, in the usual manner. Furthermore, the yarn 12 is moved from its position between the gears 16, 17 by the described operation of the lever 28. For the yarn 11 one or more heavier yarns 11' is or are substituted, the said yarn or yarns being for the purpose of knitting the high splice while at the same time the yarn 12 is being knitted into the instep half or portion of the half hose, knitting of the two yarns continuing until the heel is reached, at which time the yarn lever 10 swings to an upper, inoperative position, the yarn 12 being then held above the needles and consequently not being knitted. At the main side of the knitting machine, a heel and toe yarn, preferably, is substituted for the yarn or yarns used to knit the high splice. The heel or toe "yarn" may constitute a single yarn or plurality of yarns knitted as one yarn.

In Fig. 1*a* is shown a modification wherein the discs 48, 49 are dispensed with, the gears or wheels 16, 17 alone functioning to provide for the knitting of uniform stitches at the two feeding stations.

In Fig. 3 means are shown for automatically and simultaneously controlling the movements of the main and auxiliary cam blocks 3 and 4 whereby variations in the length of stitch as for fashioning, etc. may be effected. Upon the auxiliary cam shaft 53 upon which the drum 38 is also mounted, is mounted a fashioning drum or wheel 54, the said wheel being provided with fine, peripheral ratchet teeth 55 adapted to be periodically engaged as by means of a pawl 56 mounted upon and actuated by a shaft 57 of the "104" gear. Fast to one face of the drum or wheel 54 is a segmental cam 58 the same being attached to the said wheel 54 as by means of screws 59 and 60. The screw 60 passes through an elongated slot 61 in the cam 58 whereby the said cam may be adjusted with respect to the periphery of the wheel or drum 54. Maintained in contact with the outer face of the cam 58 is a lug 62, the said lug being part of a plate or frame 63 adjustably fastened to a bracket 64 itself made fast to a depending arm 65 of the bell crank lever 66 connected to which is a spring 66' for maintaining pawl 56 in operative engagement with ratchet teeth 55. The bell crank lever 66 is loosely mounted upon a pin or shaft 67 car-

ried by the arm of bracket 68, being prevented from endwise movement on the said shaft as by means of a collar 69 made fast to the shaft 67 as by means of a screw 70. The other arm of the bell crank lever 66 is provided with a shoe 71 in contact with which is a screw or pin 72 which latter is fastened to a vertically extending rod 73. The rod 73 is slidably mounted in bracket 68, fastened to the circular base 2, and fastened to the lower face of the rod 73 is a depending pin 74 which passes through a plate 75 connected to and forming part of the bracket 68. A coil spring 76 surrounds the pin 74 and bears against the lower face of the plate 75 and also against one face of a nut 77 adjustably fastened to the pin 74. Thus by the means just described, the pin 72 is maintained in constant engagement with the upper face of the shoe 71. The rod 73 is made fast to the cam plate 5' which carries auxiliary cam block 4.

One face of the plate 63 constitutes a shoe 78 with which a screw 79 is maintained in contact. The said screw 79 adjustably passes through a lug 80 which is fastened to one arm 81 of a bell crank lever which arm is provided with a hub 82 made fast to a shaft 83 as by means of a screw 84. The shaft 83 is loosely mounted in any suitable manner in the machine frame or a bracket connected thereto. Also fixedly mounted on the shaft 83 is a second lever arm 85 which is provided with a laterally extending pin 86 which engages under a lever 87 pivoted at 88 to the machine frame. Resting upon the lever 87, intermediate its ends, is a roll 89 which is made fast to and laterally projects from a rod 90, the latter being guided at its lower end in a bracket 91. At its upper end the rod 90 is fastened to the main cam plates.

By means of the construction just described, the advancing movements imparted to the wheel or drum 54 by means of the pawl 56, as during the fashioning of the leg, rocks the lever arm 65 which effects the raising or lowering of the rod 73 and consequently the auxiliary cam block 4; and at the same time, the face 78 of the shoe 63 which is in constant engagement with the pin 79, effects a rocking of the bell crank lever 81 whereby, through the connections hereinbefore described, the rod 90 and consequently the main cam block 3 are simultaneously raised or lowered with the auxiliary cam block 4. Thus the mechanism disclosed specifically in Fig. 3, comprises automatic means for simultaneously effecting like movements of the main and auxiliary cam blocks whereby the same length of stitch can be knitted at the main and auxiliary cam blocks notwithstanding periodic changes in the length of stitches every four courses or as desired.

Although in the foregoing description, reference has been made to leg fashioning, it will be understood that changes in the length of the stitches for other purposes may be effected by the mechanism disclosed in Fig. 3 or modifications thereof.

In Figs. 4–10 inclusive there is disclosed a modification of the means for automatically maintaining uniform the feeding rates of two yarns or elements, hereinbefore described. In this form of the invention, the discs 48, 49 are mounted upon brackets 92 and 93, the latter being free to swing so that the disc 48 may be swung to the position shown in Fig. 4 for and during heel and toe knitting. To effect the swinging of the bracket 93 and disc 48 to the position shown in Fig. 4, the cams 39 and 40 act upon the lever 36 in the manner hereinbefore described to elevate the link 29 which, in this form of the invention, has attached adjacent to its upper end a laterally extending shoe 94 which engages a pin 95 carried by and laterally projecting from a disc 96. The disc 96 is fast to shaft 97 which shaft is supported in its turning movements by means of a bracket arm 98 being prevented from moving longitudinally in the bracket 98 by a sleeve 99 forming part of disc 96 and a collar 100, the sleeve and collar being made fast to shaft 97. The bracket arm 98 is part of bracket 101 which is carried by the bracket 22.

The shaft 97 has a slotted arm 102 within which slot is received a pin 103. The pin 103 is rigidly connected to the bracket 93 and as a consequence thereof the swinging of the arm 102 causes the bracket 93 to swing upon its pivot 104. One arm of the bracket 93 is pivotally connected by means of the said pivot pin 104 to the fixed bracket 92 which is made fast to the bracket 101 as by means of screw 105. In order to limit the swinging movements of the bracket 93 and disc 48, an arcuate slot 106 is provided in one arm of the bracket 93, a stop pin 107 passing through the said slot and into engagement with one arm of the bracket 92. A coil spring 108 is fastened to the bracket 93 and also to the bracket 92, said spring tending to maintain the two brackets in the relative position shown in Fig. 6.

The construction just described permits automatic actuation of the bracket 93 and disc 48 in such a way as to move the said disc 48 to the position shown in Fig. 4 for and during heel and toe or other reciprocatory knitting if desired.

During circular work the discs 48, 49 operate in a manner hereinbefore described, to effect the knitting of uniform fabric by the yarns knitted at the two feeding stations, and in cooperation therewith there may be provided supplemental or auxiliary means carried by a bracket 109 made fast to the bracket 101. The bracket 109 terminates in a U-shaped portion 109' through the arms of which pass pins 110 which serve as bearings for a supplemental bracket 111 which thereby swings upon a vertical axis. The bracket 111 consists of two arms 112, 113 each having a series (three being shown) of arms 114, 115. The arms 114, 115 are provided with aligned holes therethrough, through which are adapted to pass the threads or yarns 11, 12 which yarns pass through eyelets 14 provided in the bracket 22 and then through the holes in the arms 114, 115 and from there through eyelets 116, 117 then around the discs 48, 49 in the peripheral grooves thereof and then through eyelets such as 118 and finally to the needles of the knitting machine. Between the arms 114, 115 are, respectively, pins 119, 120 which are carried by arms 121, 122 respectively, said arms being part of the U-shaped bracket 123 which is fastened to the bracket 109 as by screws 124. The pins 119, 120 are grooved near their ends which grooves are, at times, in vertical alignment with the holes in the arms 114, 115.

The pins 110 provide substantially frictionless bearing supports for the bracket 111 thereby permitting the same to oscillate freely on a vertical axis. It will be obvious that when the arms 114 and pins 119 or the arms 115 and pins 120, are in substantial vertical alignment, the threads 11 or 12 as the case may be will be relatively freely movable through the holes in the arms 114, 115 and past the pins 119, 120; however,

both the arms 114 and pins 119, and the arms 115 and pins 120 are never in alignment at the same time, and as a consequence thereof the arms 114 or 115 not in alignment with their pins 119 or 120 will cause the yarn 11 or the yarn 12 as the case may be to pursue a more or less tortuous path thereby imposing a greater tension on the yarn than would be the case if the arms and pins pertaining to said yarn were in alignment. As a consequence of the greater tension imposed upon the yarn as just described, the said yarn is retarded somewhat which retardation of the said yarn tends to swing the bracket 111 to such a position as to release the increased tension on the aforesaid yarn which causes a greater tension to be imposed upon the other yarn due to the movement of its arms 114, 115 as the case may be, out of alignment with their respective pins 119, 120.

The arrangement just described acting in conjunction with the discs 48, 49 effects the knitting of uniform fabric when simultaneously knitting a plurality of yarns at two or more feeding stations as for example at the feeding stations adjacent to the main and auxiliary cam blocks 3 and 4.

The bracket 111, etc. may be used independently of the discs 48, 49 if desired.

As shown in Fig. 5, rod 29 is urged in a downward direction to maintain the toe 35 of the lever 36 in engagement with the surface of the drum 38 or the cams 39, 40 thereon, by means of a coil spring 125 one end of which is made fast to a pin or screw 126 carried by the bracket 41, the other end of which spring is fastened by means of a screw 127 to a collar 128, the said collar being maintained adjustably in position on rod 29 by means of the screw 127.

Maintaining the disc 48 in constant engagement with the thread 12 during heel and toe or other reciprocatory knitting is open to some objection in that if the free rotation of the disc 48 be retarded or impeded to some extent, the take-up acting on the yarn 12 does not operate to pull the yarn 12 back through the eye of the yarn lever 10 as it should during each oscillation of the needle cylinder which results in the yarn 12 not being under proper tension upon the resumption of circular knitting. Furthermore, the constant to and fro movements of partial rotation imparted to the disc 48 by a yarn tends to fray or cut the said yarn. In view of the objections just noted, the hereinbefore described mechanism for causing the disc 48 to be moved to the position shown in Fig. 4 for reciprocatory knitting was adopted.

In Figs. 11, 12 and 13 there is shown a further modification in which the gears or two rolls 16 and 17 are used in conjunction with the mechanism just described for moving the disc 48 to an inoperative position for reciprocatory knitting.

In this form of the invention elevation of the rod 29 causes the arm 102 to rock in the manner hereinbefore described which causes the bracket 93 to move to a position such as that shown in Fig. 4. Furthermore, elevation of the rod 29 causes shoe 94 to rock a lever 129 through the instrumentality of a pin or screw 130 which engages within a bifurcation 131 provided in the outer end of one lever 129. The lever 129 is pivoted at 132 to a plate 133 itself connected to bracket arm 98. The other arm of the lever 129 has therein an eyelet 134 through which the thread 12 passes. Consequently, upon elevation of the rod 29 the disc 48 is moved outwardly, i. e., away from the companion disc 49, and at the same time the lever 129 is rocked and the eyelet 134 is moved to such a position as to withdraw the thread 12 from between the rolls 16 and 17 which are supported in bearings carried by a bracket 135 itself fast to bracket 101.

The movable bracket 93 is pivotally connected to the fixed bracket 92 at 136, a spring 137 being attached at one end to a pin 138 connected to the bracket 93 and at its other end to a screw 139 fastened to bracket 92.

In the foregoing description levers 28 and 29 have been described as being for the purpose of withdrawing the yarn 12 from between the rolls or gears 16, 17. Such withdrawal is especially desirable prior to the knitting of split fabric, immediately preceding the knitting of which the yarns 11 and 12 are both knitted into the fabric in alternate courses, but as the split-foot, high splice and double sole are preferably knitted with a yarn or yarns other than the yarn 11, the said yarn 11 is withdrawn from feeding relation with respect to the needles immediately preceding the beginning of the knitting of the high splice, the withdrawn thread 11 being carried by the needles into the clamp or binder. Obviously if the yarn 12 were not withdrawn from between the rolls 16, 17 the yarn 11, which is maintained between the rolls, would be drawn from the source of supply by the rotation of the rolls 16, 17 occasioned by the traction exerted by the yarn 12.

The gears or rolls 16, 17 have been shown in Fig. 1a as being used independently of the discs 48, 49; likewise the tension members, shown in Figs. 4–10 inclusive, are not necessarily used in conjunction with the discs 48, 49.

The gear or rolls 16, 17, and the tension bracket 111 serve so to control the feeding of two or more yarns as to cause them to be knitted into the fabric in such a manner that the lengths of the loops knitted with one yarn are substantially of the same length as the loops knitted with another yarn. Both the rolls 16, 17 and bracket member 111 act as yarn tension members in that they serve to equalize the tensions exerted on the yarns which are subject to constant changes due, in part, to uneven windings of the yarn cones, e. g. if one yarn be subjected to a greater drag, due to a relatively tight cone winding, than another yarn, the first yarn will tend to retard the rotary movements of the rolls 16, 17, or to swing the bracket 111, in either case equalizing the yarn tensions. If the rolls 16, 17 be employed, a relatively tight cone winding of one yarn will tend to retard the rotation of the said rolls which will subject the other yarn to a somewhat greater tension from the needles, which will tend to rotate the rolls 16, 17 somewhat faster than they would rotate under the influence of the first yarn only. If the bracket member 111 and associated parts be used, a relatively tight cone winding will cause the bracket 111 to rotate in a direction to decrease the tension exerted by the said bracket upon the said yarn which will, at the same time, cause an increased tension to be placed upon the other yarn; in other words, the tension bracket 111 serves as a tension equalizer. Furthermore, the other conditions being equal, if the stitch drawing cam at one feeding station be set to draw a slightly longer stitch than the cam at the other feeding station, the first yarn will tend to rotate the rolls 16, 17 somewhat faster than they would be rotated if they were under the influence of the

second yarn only; and the increased speed of rotation of the rolls 16, 17 will be resisted by the second yarn. In other words, the two yarns affect each other, the first yarn tending to feed the second yarn at a faster rate than dictated by its stitch drawing cam, and the second yarn tending to retard the rotations of the rolls 16, 17, the result being that the stitches knitted at the two feeding stations are of substantially the same length thereby resulting in substantially uniform fabric.

In the several modifications hereinbefore disclosed the same reference characters are used to designate identical parts, and prime characters are used to designate corresponding but not identical parts.

Although in the foregoing description the parts and combinations thereof have been specifically described, such specific description has been for illustrative purposes only and not with the intention of limiting the invention to the precise details of construction or combinations thereof, it not being the intention to limit the invention by the specific recitations in the claims themselves.

We claim:

1. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled elements so associated that the tendency of one such yarn to be fed to the needles at a faster rate is resisted thereby causing two adjacent courses of a resultant fabric to be substantially uniform with respect to each other.

2. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled elements so associated with one another that the tendency of one such yarn to be fed to the needles at a rate different from that of the feeding of the other yarn is resisted thereby causing two adjacent courses of a resultant fabric to be substantially uniform with respect to each other.

3. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled elements consisting of opposed rotary members, the yarns passing between the opposed members and so controlling the rotary movements thereof that any tendency of one yarn to be fed to the needles at a faster rate than another yarn causes the two yarns to be fed at substantially the same rate.

4. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled tension elements so acted upon by the yarns that a tendency to change the tension on one such yarn is resisted whereby adjacent courses are substantially uniformly knitted.

5. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled elements consisting of intermeshing rotary members, the yarns passing between the intermeshing members and so controlling the rotary movements thereof that any tendency of one yarn to be fed to the needles at a faster rate than another yarn is resisted thus causing both yarns to be knitted into loops of substantially the same length.

6. In a multi-feed knitting machine, means for separately knitting two or more yarns at the same time, means for indicating which of two yarns is being fed at the faster rate whereby adjustments can be readily made to cause adjacent courses to be uniformly knitted, in combination with auxiliary means for automatically effecting the knitting of adjacent courses substantially uniformly.

7. In a multi-feed knitting machine, means for separately knitting two or more yarns at the same time, means for indicating which of two yarns is being fed at the faster rate whereby adjustments can be readily made to cause adjacent courses to be uniformly knitted, in combination with auxiliary means consisting of rolls between which the yarns pass for automatically effecting the knitting of adjacent courses substantially uniformly.

8. In a multi-feed knitting machine, means for separately knitting two or more yarns at the same time, means for indicating which of two yarns is being fed at the faster rate whereby adjustments can be readily made to cause adjacent courses to be uniformly knitted, in combination with auxiliary means consisting of yarn-controlled tension members for automatically effecting the knitting of adjacent courses substantially uniformly.

9. In a multi-feed knitting machine, means for separately knitting two or more yarns at the same time, in combination with yarn controlled elements consisting of opposed rotary members, the yarns passing between the opposed members and so controlling the rotary movements thereof that any tendency of one yarn to be fed to the needles at a faster rate than another yarn causes the two yarns to be fed at substantially the same rate in combination with means for, at times, withdrawing one such yarn from between the rotary members.

10. A multi-feed knitting machine having a plurality of feeding stations at which yarns are independently and simultaneously knitted into the fabric, means for detecting when two of such yarns are not being fed to the needles of the knitting machine at the same rate, said means consisting of yarn movable members in contact with the respective yarns, in combination with means for moving one of such members out of contact with its yarn following the knitting of fabric at the two feeding stations simultaneously.

11. A multi-feed knitting machine at which feed yarns are independently fed to the needles of the knitting machine, the courses knitted at each feeding station alternating with the courses knitted at another feeding station, means, in contact with the yarns, for detecting when one such yarn is being fed to the needles at a faster rate than another such yarn whereby adjustments can be readily effected, and auxiliary means consisting of rotary members between which the yarns pass on their way to the needles for effecting automatic adjustments of the relative feeding of the yarns, in combination with means for, at times, withdrawing one such yarn from between the rotary members and for moving a detector means out of contact with its yarn.

12. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time including a stitch drawing cam at each

feed, in combination with yarn controlled elements so associated that if one stitch drawing cam draw slightly longer stitches than another stitch drawing cam, the yarn controlled elements will cause the second yarn to be knitted into loops slightly longer than would be drawn by the second stitch cam, thereby effecting the knitting of substantially uniform fabric.

13. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with means for causing all of the said yarns to be fed to the needles of the knitting machine at substantially the same rate so that two adjacent courses are uniformly knitted.

14. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled means for causing all of the said yarns to be fed to the needles of the knitting machine at substantially the same rate so that two adjacent courses are uniformly knitted.

15. In a multi-feed knitting machine, means for feeding two or more yarns to the needles, two feeding stations at each of which, one, at least, of the yarns, is knitted in combination with means for causing all of the said yarns to be fed to the needles of the knitting machine at substantially the same rate so that two adjacent courses are uniformly knitted.

16. In a multi-feed knitting machine, means for feeding two or more yarns to the needles, two feeding stations at each of which, one, at least, of the yarns, is knitted in combination with yarn controlled means for causing all of the said yarns to be fed to the needles of the knitting machine at substantially the same rate so that two adjacent courses are uniformly knitted.

17. In a knitting machine in which two or more yarns are each in position to be fed to all the needles thereof, and in combination therewith yarn rotatable means so acting upon the yarns that the tendency of one of the yarns to feed faster than the other is compensated for by the traction exerted on the other of the yarns by the yarn rotatable means.

18. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with automatic means including opposed and freely rotatable members for causing the two or more yarns to be drawn at the same rate.

19. In a multi-feed knitting machine having at least two feeding stations, means for separately knitting two or more yarns at the same time, in combination with yarn controlled means including opposed and freely rotatable members for causing the two or more yarns to be drawn at the same rate.

ROBERT H. LAWSON.
ARTHUR N. CLOUTIER.