Sept. 14, 1954 C. RIZZO 2,688,862

CIRCULAR KNITTING MACHINE

Filed March 2, 1951 3 Sheets-Sheet 1

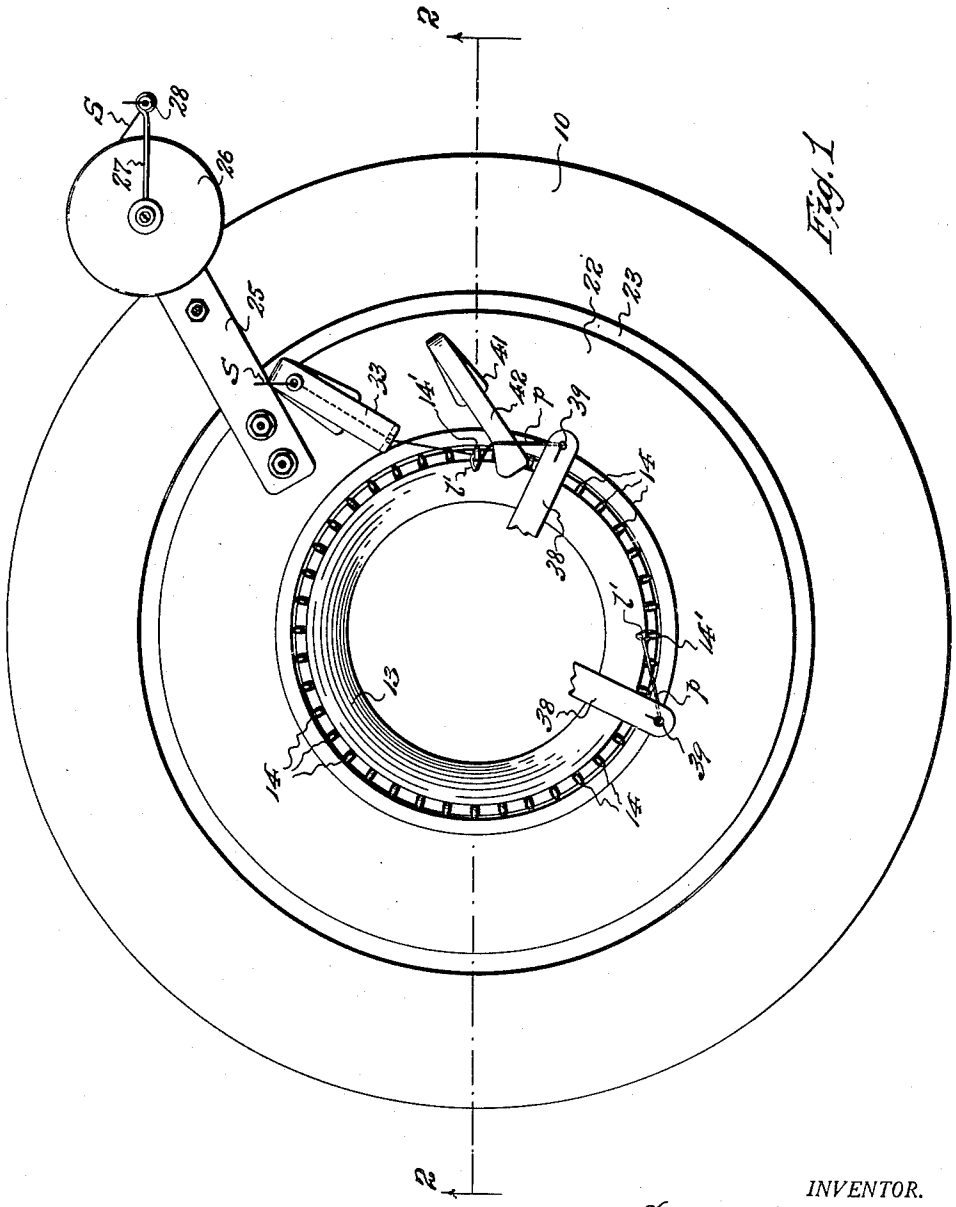



Fig. 1

INVENTOR.
Carmen Rizzo,
BY George S. Richards,
Attorney

Sept. 14, 1954 C. RIZZO 2,688,862

CIRCULAR KNITTING MACHINE

Filed March 2, 1951 3 Sheets-Sheet 2

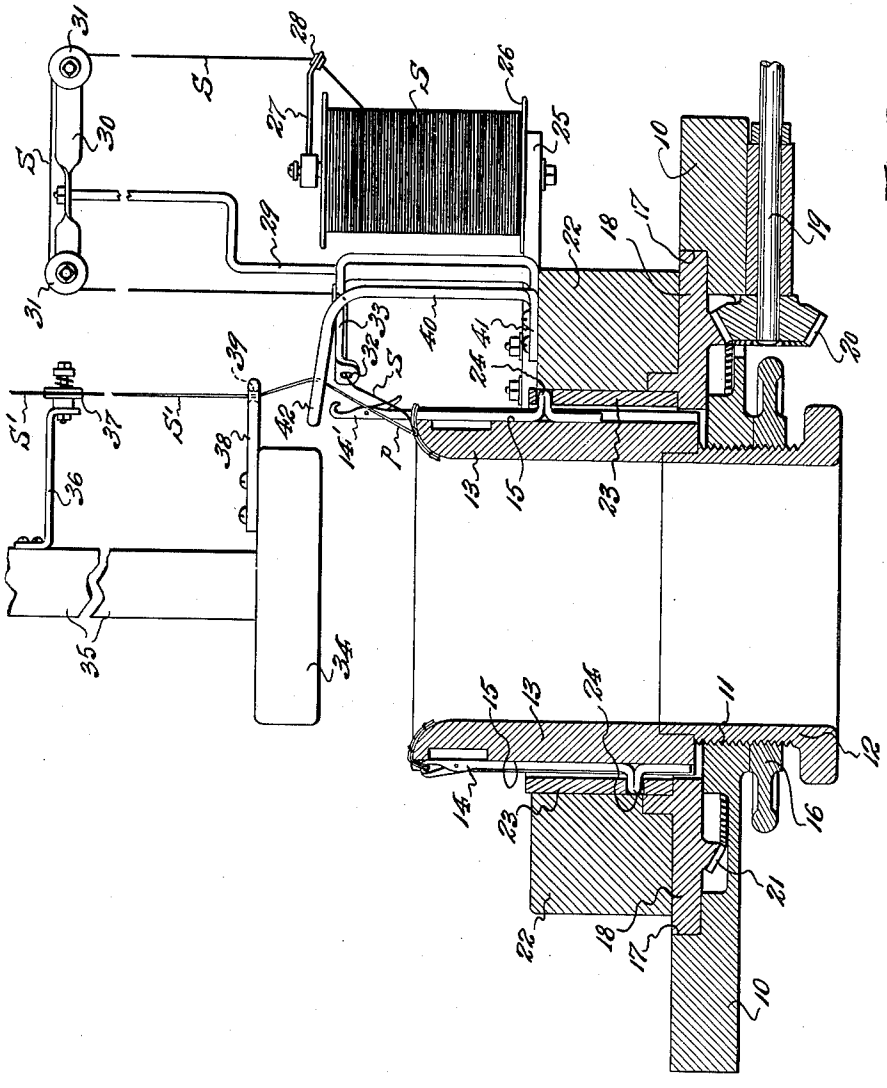


Fig. 2

INVENTOR.
Carmen Rizzo,
BY
George D. Richards
Attorney

Sept. 14, 1954 C. RIZZO 2,688,862

CIRCULAR KNITTING MACHINE

Filed March 2, 1951 3 Sheets-Sheet 3

Fig. 9

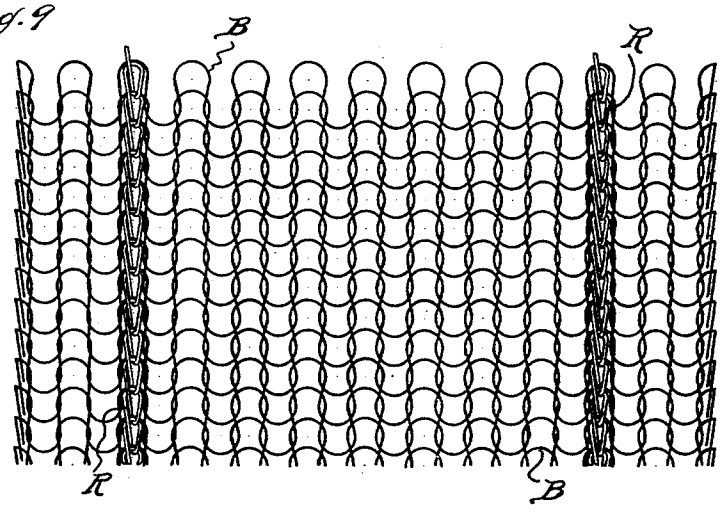



Fig. 3

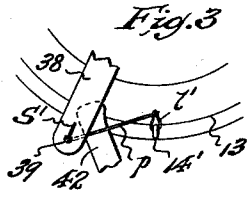



Fig. 5

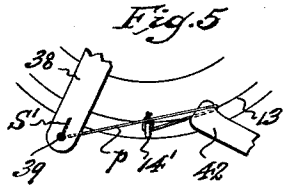
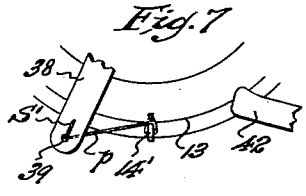



Fig. 7



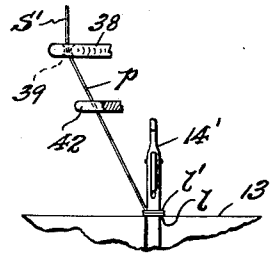




Fig. 4

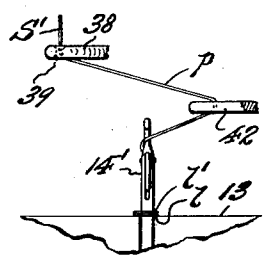



Fig. 6

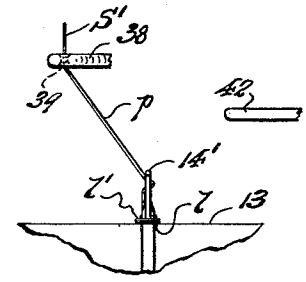



Fig. 8

INVENTOR.
Carmen Rizzo,
BY George D. Richards
Attorney

Patented Sept. 14, 1954

2,688,862

# UNITED STATES PATENT OFFICE

2,688,862

## CIRCULAR KNITTING MACHINE

Carmen Rizzo, Orange, N. J., assignor to Metal Textile Corporation, Roselle, N. J., a corporation of Delaware

Application March 2, 1951, Serial No. 213,642

5 Claims. (Cl. 66—135)

1

This invention relates to improvements in circular knitting machines and to knitted material which is produced thereby.

The invention has for an object to provide a knitted material comprising longitudinally interconnected knitted loops produced by the operation of a single needle of a circular knitting machine and cooperating means whereby a strand, undergoing the knitting operation, is caused to pass under the hook of the needle so as to be formed into a loop which is pulled through a preceding loop which is then cast off by the operation of the needle, thus producing a straight or longitudinal run of successively interknit loops by which the material is constituted.

The invention has for a further object to provide a circular knitting machine with means for leading a strand to be knitted to a selected needle thereof and cooperative means to cause the strand to pass beneath the hook of said needle and around the needle subject to the looping and knitting operation thereof, whereby to produce a knitted material comprising a straight or longitudinal run of successively interknit loops.

The invention has for another object to provide in a circular knitting machine operative to produce tubular knit material, means for interknitting with the knit loops of one or more selected wales of the tubular knit material a longitudinal run or runs of successively interknit loops of an additional strand or strands which, as thus incorporated in the tubular knit body, serve to reenforce said body against longitudinal stretch and consequent narrowing, or to provide the tubular knit body with other desired characteristics.

The invention also has for an object to provide a tubular knit body having a longitudinal run or runs of successively interknit loops of an additional strand or strands, which loops are knitted together with loops of a selected wale or wales of the tubular knit body, whereby said run or runs are incorporated in said body as a unitary part or parts thereof.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

Illustrative embodiments of the invention are shown in the accompanying drawings, in which:

Fig. 1 is a top plan view, in part, of a circular knitting machine according to this invention; and Fig. 2 is a vertical section through the same, taken on line 2—2 in Fig. 1.

Figs. 3, 5, and 7 are respectively schematic plan views showing successive steps in feeding a strand

2

to a single needle of the knitting machine, whereby to engage the strand under the hook of the needle and around the needle preparatory to production of a knitted loop by the operation of said needle; and Figs. 4, 6 and 8 are respectively schematic elevational views corresponding to the respective plan views of Figs. 3, 5 and 7.

Fig. 9 is a face view of a tubular knit body having runs of successively interknit loops of additional strands interknitted with the loops of selected wales of the tubular knit body.

Similar characters of reference are employed in the hereinabove described views, to indicate corresponding parts.

Referring to the drawings, the reference character 10 indicates the base of a circular knitting machine, which is usually supported upon a suitable framework (not shown). Formed in said base is a central, internally screw threaded opening 11, into which is threaded an adjusting sleeve 12. Upon the upper end of sleeve 12 is carried the vertical needle cylinder 13, which is thus subject to raising and lowering movements for adjusting the operative position of the needles 14, which needles are vertically reciprocable in guide channels 15 formed in the cylinder 13 around the exterior thereof. The needle cylinder 13 is suitably held against rotation, and is secured in desired vertically adjusted position by a jamb-nut wheel 16 which is threaded on the adjusting sleeve 12, to abut and jamb against the underside of the base 10.

Formed in the top side of the base 10 is a bearing recess 17 concentric to the vertical axis of the needle cylinder 13. Mounted to rotate in said bearing recess 17 and about the needle cylinder 13 is a turn-table 18. Said turn-table is driven by a power transmission shaft 19 through a pinion 20 adapted to mesh with a bevel gear 21 with which the underside of the turn-table is provided. Fixed on the turn-table 18, to upstand therefrom concentric to the needle cylinder 13, is a cam cylinder 22 which is rotated by and with the turn-table about the needle cylinder and its needles 14. Said cam cylinder carries suitable cam means 23 by which the needles 14 are operatively reciprocated. The needles 14 are provided with the usual laterally projecting foot-portions or butts 24 which are operatively engaged by the cam means 23.

When used for producing a tubular knit body, the machine may be provided with any known means for feeding and applying the strand S to be knitted to the machine needles 14. Illustrative of one means for feeding the strand S, the

same (as shown) comprises a supporting bracket 25 which is carried by the cam cylinder 22 so as to move therewith about the needle cylinder 13. Supported by the bracket 25 is a spool 26 that is loaded with a supply of the strand S. Cooperative with the supported supply spool 26 is a flier 27 that is adapted to revolve about the axis of said spool. Said flier is provided at its free end with a guide eye 28 through which the strand S is led from the supply spool 26. Mounted in connection with the cam cylinder 22 is an upwardly extending standard 29 which supports a cross-arm 30 at a suitable level above the supply spool 26. Carried by the cross-arm 30, at respective end portions thereof, are strand tensioning devices 31. The strand S is unwound from the supply spool 26 by the revolving flier 27, and, as thus issued from said supply spool, is led upwardly to and through one tensioning device to the other tensioning device, passing from the latter downwardly and through the eye 32 of a guide arm 33. Said guide arm 33 is mounted on the cam cylinder 22 so as to move therewith about the needle cylinder 13, and is so disposed relative to the latter as to lay the strand S across raised needles 14 subject to be engaged by the hooks of the latter when the needles are caused to descend in the operation of forming and interknitting the loops which produce the tubular knit body.

Means is provided to feed and guide an additional strand S' to the machine for application to a selected single needle 14', and means is further provided for engaging this additional strand S' beneath the hook of said needle and around the needle subject to the looping and knitting operation thereof.

The means for feeding and guiding the strand S' comprises a stationary support 34, which is suitably suspended above the needle cylinder 13 of the machine, as. e. g. by a hanger bar or rod 35. Affixed to the hanger bar or rod 35, to project laterally therefrom above support 34, is a bracket arm 36 upon which is mounted a tensioning device 37. Attached to the support 34, to project radially therefrom, is a stationary guide arm 38 having an eye 39 in its free end portion. This guide arm is so disposed in a plane above the machine needles and relative to the selected needle 14' to which the additional strand S' is supplied, that the eye 39 is positioned in outwardly and rearwardly offset relation to said needle 14'. The strand S' is led from any suitable source of supply thereof (not shown) downwardly through the tensioning device 37, and thence through the eye 39 of stationary guide arm 38 to the selected needle 14'.

The means for applying the strand S' to the selected needle 14' of the machine is provided by an applicator device comprising a post 40, the foot 41 of which is suitably secured to the cam cylinder 22 so that said post upstands from the latter. Extending inwardly from the post 40, in substantially horizontal plane spaced above the needle cylinder 13 and its needles, is an applicator arm 42. This applicator arm is disposed oblique to the radial vertical plane of the needle cylinder 13 in which the needle 14' lies, and said applicator arm is of such length that its free end portion will intersect the vertical axis of the needle 14' when moved above the latter and across said vertical axis thereof.

The applicator device, being carried by the rotatable cam cylinder 22, will be caused, by the rotative movement of the latter, to travel around the needle cylinder 13 when the machine is operated. The outwardly and rearwardly offset position of the eye 39 of the guide arm 38 relative to the selected needle 14' is such that the portion $p$ of the strand S' which extends from the guide arm to said needle is disposed across the path of movement of the applicator arm 42 as said arm is moved toward said needle by the rotating cam cylinder 22.

When the machine is operated to produce from a strand S a tubular knit body provided with a run of longitudinally linked loops of an additional strand S' interknitted with the loops of a selected wale of said tubular body, the strand S is fed to and applied to successive needles 14, including a selected needle 14', subject to the knitting operations of said needles in manner well known to the art. In such operation, a loop $l$ of strand S (see Figs. 4, 6 and 8) is formed on the selected single needle 14' ready to be cast off during the operation of forming and knitting thereto a succeeding loop. The portion $p$ of strand S' extends between the guide arm 38 and a loop $l'$ previously formed therefrom (see Figs. 3 and 4) on the selected single needle 14' in company with said loop $l$ of strand S, and also ready to be cast off with the latter. The loops $l$ and $l'$ provide a composite loop structure to which a like succeeding composite loop structure, when formed, can be knitted. To form the succeeding composite loop structure, the strand S is laid across the raised and open selected needle 14' (see Fig. 2), whereupon the strand S' is applied to the latter as follows:

As the applicator arm 42, in its circuit, approaches the selected needle 14', its free end portion engages the portion $p$ of strand S' (see Figs. 2, 3 and 4), whereupon continued advance of the applicator arm carries said portion $p$ of strand S' across the raised and open needle 14' so as to engage the same with the latter below its hook $h$ (see Figs. 5 and 6). The needle 14' is now timed to begin its operative descent. Due to the oblique disposition of the applicator arm 42, as it passes the needle 14' and continues on its circular orbit of travel, the longitudinal axis of said arm tends to approach alignment with said portion $p$ of strand S' as then extending between the same and the guide arm 38, which portion $p$ of strand S' by that time has been swung into a plane behind the descending needle 14'. As a consequence of this, under the pull of the descending needle 14', said portion $p$ of strand S' will pull away from the end of the applicator arm 42, and will thus release itself for disposition behind said needle 14', whereby to loop the strand S' about the latter (see Figs. 7 and 8). As the needle 14' thereafter continues its descent, its latch will be closed as the needle pulls through the previously formed composite loop $l$—$l'$, and will thus enclose the succeeding composite loop so that the latter will be drawn through the former and thus knitted thereto. After this, the previously formed composite loop will be cast off the needle 14', whereafter said needle, upon its upward movement to initial raised and open condition, will pass through and hold said succeeding composite loop subject to repetition of the above described operations.

From the above it will be understood that a longitudinal run of relatively tight knit loops of additional strand material will be interknit with and strongly attached to corresponding longitudinal knit loops of a selected wale of the produced tubular knit body. It will be understood

that the tubular knit body may be provided with a plurality of runs of relatively tight knit loops of additional strand material interknit with selected additional wale loops of said body, which runs may be relatively laterally spaced in connection with the body as may be desired. Such additional runs can be produced by providing the machine with additional guide arms 38 for cooperation with additional selected needles of the machine and additional means for supplying strands S' through said guide arms to the selected needles. The application of the strands S' to the additional selected needles will be successively carried out in the manner above described by the single applicator arm 42 which will be common to all additional strands S'.

It will also be understood that runs of longitudinally linked knit loops may, if desired, be produced by the machine as a separate material, i. e. independently of a tubular knit body, by utilizing one or more of the machine needles, each served by a supply of strand S' to be knitted, and omitting service of strand S to the machine needles.

An example of a tubular knit body provided with runs of relatively tight knit loops of additional strand material interknitted with and attached to knit loops of selected wales of the body is shown in Fig. 9, wherein the tubular knit body is indicated by the reference character B, and the incorporated runs of additional strand material by the reference character R. In a tubular knit body so characterized, the incorporated runs R reenforce the tubular knit body B against distortion or deformation due to longitudinal stretching and consequent narrowing. Being thus reenforced against distortion or deformation, the tubular knit body provides e. g. a very desirable means for backing brake linings, whereby to firmly hold the brake lining material or compound in place until cured, and after curing to reenforce the same against deformation. The reenforced tubular knit body is also adapted for many other uses, wherein a tubular knit body which will resist stretching and narrowing is desirable.

The novel tubular knit body with the incorporated runs R can be produced from strands S and S' of any kind best suited to give the material desired characteristics. For example, the body B may be knitted from a metallic strand S with the incorporated run or runs R knitted from a textile or like strand S', or vice versa; or both the body B and run or runs R may be knitted from metallic strands or from textile or like strands. The strands S and/or strands S' may be of composite character if desired. In fact, many variations in the specific types of strand materials may be used, accordingly as best suited to provide a finished material having characteristics best suited to the ultimate use to which the knitted body is to be put. For example, the strand forming the run or runs R may comprise an absorbent material adapted to absorb and thereafter supply oil to the meshes of the body B when the body is used as an air filter screen, or is similarly used.

It is frequently desirable to furnish a knitted mesh of single ply, and yet to initially produce such mesh in tubular form by the rapid and economical operation of a circular knitting machine. To obtain a single ply mesh from a tubular knit body, it is necessary to split the tubular body longitudinally. The result, however, is not satisfactory for the reason that the severed edges of the split body will quickly ravel, and thus impair integrity of the produced single ply material. If, however, the tubular knit body is provided with suitably disposed runs R of tight knit longitudinally linked loops interknit with wale loops of said body, the body may be severed adjacent to such runs R, which runs will thereupon serve as selvage bindings which will securely hold the edges of the mesh of the tubular knit body against raveling or like disintegration.

From the above it will now be evident that this invention provides a tubular knit material of novel characteristics, as well as a novel knitting mechanism by means of which such material can be produced. Changes could be made in both the machine and its product without departing from the scope of this invention as defined by the here following claims.

I claim:

1. In a circular knitting machine having hooked needles, a stationary needle cylinder in which said needles are mounted for reciprocation, a rotatable cam cylinder for reciprocating the needles, and means to supply to said needles a strand to be knitted thereby into a tubular knit body; the combination with the foregoing of means to supply an additional strand to a selected single needle of the machine including a stationary guide means disposed in a plane spaced above the needle cylinder and its needles and having a strand guide eye rearwardly and outwardly offset relative to said selected single needle, and applicator means mounted on the cam cylinder so as to be moved thereby in a circuit about and externally of the machine needles in a plane intermediate the needles and said stationary guide means, said applicator means being operative, after the first mentioned strand has been applied to said selected needle, to engage said additional strand between the guide means and the selected needle so as to carry the same under the hook of the selected needle and looped around the same, and then to release the thus looped additional strand subject to the knitting action of said selected needle, whereby to knit said additional strand into a longitudinal run of successively linked loops interknitted with the loops of a wale of the tubular knit body formed from the first mentioned strand.

2. A circular knitting machine according to claim 1 wherein the applicator means comprises a substantially horizontal applicator arm disposed to project inwardly across and above the circular row of machine needles and obliquely to the radial plane in which the selected single needle lies.

3. In a circular knitting machine having hooked needles, a stationary needle cylinder in which said needles are mounted for vertical reciprocation and an external rotatable cam cylinder for reciprocating the needles together with means to supply to said needles a strand to be knitted thereby into a tubular knit fabric; the combination with said machine of means to supply an additional strand to a raised selected single needle to be incorporated in a tubular knit fabric produced by the machine, said means including a stationary guide means disposed in a plane spaced above the machine needles and having a guide eye rearwardly and outwardly offset relative to said selected single needle, from which guide eye said additional strand is to be delivered across said selected needle, and means mounted on the rotatable cam cylinder so as to be carried thereby in a circuit around the needle cylinder and its

needles, said latter means including a substantially horizontal applicator arm disposed in a plane intermediate the top of the needle cylinder and said stationary guide means to project inwardly and rearwardly across and above the circular row of machine needles and obliquely to the radial plane in which the selected single needle lies, said applicator arm, during its advancing movement toward the raised selected needle, operating to engage said additional strand between the guide means and said selected needle so as to carry the same under the hook of the latter, and thence rearwardly of said hook into looped relation to said needle, and then, by its continuing advancing movement, to release the thus looped strand subject to the downward knitting action of said selected needle, whereby to knit the strand into a wale of the tubular knit fabric.

4. In combination with a circular knitting machine having reciprocable needles and a rotatable cam cylinder for reciprocating said needles together with means to supply to said needles a strand to be knitted thereby into a tubular knit fabric, means to supply an additional strand to a selected single needle of the machine including a stationary guide arm disposed in a plane spaced above the machine needles and having a strand guide eye rearwardly and outwardly offset relative to said selected single needle, and means carried by said cam cylinder to be moved thereby in a circuit about and externally of the machine needles in a plane intermediate the needles and said stationary guide arm, said latter means being operative, after the first mentioned strand has been applied to said selected needle, to engage said additional strand between the stationary guide arm and the selected needle so as to loop said strand around the latter and beneath the hook thereof, and thereafter to release the thus looped additional strand subject to the downward knitting action of said selected needle, whereby to knit said additional strand into a longitudinal succession of linked loops interknitted with the loops of a wale of the tubular knit fabric formed from the first mentioned strand.

5. In a circular knitting machine having hooked needles, a stationary needle cylinder in which said needles are mounted for vertical reciprocation and an external rotatable cam cylinder for reciprocating the needles together with means to supply to said needles a strand to be knitted thereby into a tubular knit fabric, the combination with the foregoing of means to supply an additional strand to a selected needle including a stationary guide arm disposed to extend radially across the needle cylinder and its needles in a plane spaced above the same, said guide arm having in its outer end a strand guide eye rearwardly and outwardly offset relative to said selected single needle, and an applicator means mounted on the rotatable cam cylinder so as to be carried thereby in a circuit around the needle cylinder and its needles, said applicator means including a substantially horizontal applicator arm disposed in a plane intermediate the top of the needle cylinder and said stationary guide arm to project inwardly across and above the circular row of machine needles and obliquely to the radial plane in which the selected single needle lies, said applicator arm, during its advancing movement toward the selected needle, operating to engage said additional strand between the guide arm and said selected needle so as to carry the same under the hook of the latter, and thence rearwardly of said hook into looped relation to said needle, and thereafter, by its continuing advancing movement, to release the thus looped strand subject to the downward knitting action of said selected needle, whereby to knit said additional strand into a longitudinal succession of linked loops interknitted with the loops of a wale of the tubular knit fabric formed from the first mentioned strand.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 1,772,400 | Larkin | Aug. 5, 1930 |
| 1,886,521 | Bristow et al. | Nov. 8, 1932 |
| 1,992,119 | Bristow et al. | Aug. 15, 1933 |
| 2,018,164 | Wildt et al. | Oct. 22, 1935 |
| 2,018,166 | Wildt et al. | Oct. 22, 1935 |
| 2,025,913 | Taggart | Dec. 31, 1935 |
| 2,130,769 | Lombardi | Sept. 20, 1938 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 348,904 | France | Feb. 25, 1905 |
| 428,953 | Germany | May 14, 1926 |