YARN PLATING METHOD AND APPARATUS FOR CIRCULAR KNITTING MACHINES

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ABSTRACT

The yarn feed device is adapted to simultaneously feed elastic and non-elastic yarns to the needles of the knitting machine and at predetermined ratios relative to each other. A yarn feed roller is drivenly rotated by the non-elastic yarn as the yarn is consumed by the needles in forming the stitch loops of a knit fabric. The elastic yarn is in engagement with the roller and is fed to the knitting machine needles at a predetermined ratio, relative to the non-elastic yarn. Three different types of yarn feed rollers are disclosed, each being provided with yarn receiving grooves which may be of different diameters so that the yarns are fed at different ratios or under different degrees of tension.

12 Claims, 10 Drawing Figures

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YARN PLATING METHOD AND APPARATUS FOR
CIRCULAR KNITTING MACHINES

This application is a continuation-in-part of my co-
pending application, Ser. No. 89,565, filed Nov. 16,
1970, now abandoned, and relates generally to a
method and apparatus for simultaneously feeding two
or more yarns to the yarn guide means of a knitting ma-

More particularly, the present method and apparatus
is adapted to feed an elastic yarn at the desired rate,
relative to the rate at which a non-elastic yarn is con-
sumed by the knitting machine. The non-elastic yarn
acts as a driving means for rotating a yarn feed roller
and the elastic yarn is fed to the machine at the desired
rate by the rotation imparted to the yarn feed roller by
the non-elastic yarn.

Different types of yarn feeding devices have been
proposed for use with knitting machines. Many of these
feed devices include a roller for each yarn which is
driven by direct connection with a driven part of the
knitting machine so that the feed roller is driven at a
predetermined rate, relative to the driving speed of the
knitting machine. This type of feed device operates sat-
isfactorily when the machine is knitting the same size
stitch throughout the article. However, this type of feed
device does not include means to vary the amount of
yarn fed to compensate for variation in the size of the

Other known types of yarn feeding devices include some type of
variable speed drive for varying the rate of speed the
yarn is fed to the needles in accordance with a prede-
termined pattern. However, these devices are compli-
cated and require accurate timing between the pattern
means and the variable speed drive.

Also, these prior feed devices are not adapted to sat-
isfactorily feed exact ratios, amounts or lengths of an
elastic and a non-elastic yarn where these yarns are knit
together in plated relationship, particularly when the
knitting machine is producing articles which require
the formation of stitch loops of various sizes. The diffi-
culty of feeding elastic yarn, particularly uncovered
spandex, is increased because this type of yarn will not
unwind from the supply package in an even and uni-
form manner so that the tension and stretched condi-
tion of the yarn constantly varies. Spandex yarn is diffi-
cult to unwind from the supply package because it
tends to stick to itself and the endmost winds contract
so that the wound layers overlap each other.

In most cases, various types of tension devices are re-
lied upon to control the platting relationship of two
years as they are fed to the knitting machine so that one
yarn is fed to the needles in a certain relationship with
the other yarn and appears on one face of the fabric
while the other yarn appears on the other face of the
fabric. A constant relationship of tension is difficult to
maintain because these tension devices may accumu-
late lint and cause a variation in tension between the
two yarns. This constant variation in tension on the
yarns is particularly difficult to maintain when one of
the yarns is an elastic yarn and the other yarn is a non-
elastic yarn. Also, it may not be possible to knit the
elastic yarn in the fabric under the desired degree of re-
laxation. For example, when covered or uncovered
rubber or spandex is fed and knit with a nylon or cotton
yarn, any tension applied to the elastic yarn will cause
a certain stretching of this yarn so that the knit fabric
will be drawn inwardly to a degree, which is undesir-
able in many cases.

With the foregoing in mind, it is an object of the pres-
et invention to provide a method and apparatus for
feeding a plurality of yarns to a knitting machine which
is simple to attach to existing knitting machines of vari-
ous types and which operates to maintain the desired
feeding relationship of the yarns to each other uniform
and constant as they are knit in the fabric, both when
knitting fabric with uniform size stitch loops, and when
knitting fabric having different sizes of stitch loops in
different portions thereof.

In accordance with this invention, non-elastic yarn is
used as a measure or standard to determine the length
of the elastic yarn knitted with it, whereby the ratio of
the two yarns is maintained constant notwithstanding
other variables. To this end, rotatable feed roller means
is provided wherein the non-elastic yarn extends
around the roller in driving relationship to rotate the
roller means, and the elastic yarn is extended around
the roller in driven relationship. This results in the
length of elastic yarn always remaining constant rela-
tive to the length of non-elastic yarn as they are both
being knit into the same stitch loops in the fabric.

In one embodiment of the invention, the feed roll
means comprises a single roller with spaced apart pe-
ripheral grooves for receiving wraps of the yarns. The
diameters of these yarn receiving grooves may be var-
died to feed one or more additional yarns at different
rates from the non-elastic yarn which drivenly rotates
the roller. The feed roller is preferably positioned
closely adjacent the yarn feed finger of the knitting ma-
chine so that the feeding rate of the yarns from the rol-
er to the yarn feed finger and to the needles is not af-
fected by passing over guides, through tension devices,
etc.

In another embodiment of the invention, the feed roll
means comprises a roller having one relatively narrow
peripheral groove for receiving the non-elastic yarn
and a spaced apart relatively wide peripheral portion or
groove for receiving the wraps of the elastic yarn so
that the elastic yarn does not engage itself as it is driven
by the feed roller. Suitable guides are provided at opop-
site sides of the feed roller for maintaining the wraps
of elastic yarn separate from each other.

In another embodiment of the invention, the feed roll
means comprises a pair of spaced apart rollers, each
being provided with a plurality of spaced apart apart-
peripheral grooves for receiving the yarns wrapped there-
around. The non-elastic yarn still operates to drive both
of the yarn feed rolls at the rate at which the non-elastic
yarn is consumed by the knitting machine and the elas-
tic yarn is driven in the proper ratio by the rotation of
the feed rolls.

It is preferred that some type of brake means be pro-
vided to control the rotational speed of the yarn feed
roller or rollers. The brake means also is effective to
stop rotation of the feed roller when the yarns are no
longer being fed to the knitting machine. When feeding
a relatively heavy non-elastic yarn, rotation of the feed
roller is stopped when the non-elastic yarn is no longer
being fed.

Other objects and advantages of the invention will
become apparent in the specification and the claims
and from the following detailed description of the illus-
trated embodiments of the invention shown in the draw-

ings, in which-
FIG. 1 is a fragmentary isometric view of a portion of the lower cylinder of a Komet type circular knitting machine and illustrating one form of the present yarn feeding device associated therewith;

FIG. 2 is an enlarged vertical sectional view through the yarn feed roller, showing one of the yarns drivingly engaging one of the yarn receiving grooves therein;

FIG. 3 is an isometric view of a looped yarn illustrating the manner in which the yarn is wrapped around the feed roller;

FIG. 4 is a front elevation view of the feed roller;

FIG. 5 is a longitudinal sectional view taken substantially along the line 5—5 in FIG. 4 and illustrating the manner in which the feed roller is supported for rotation;

FIG. 6 is an elevation view of a modified form of feed roller and illustrating the manner in which the yarns engage the feed roller;

FIG. 7 is an enlarged view taken substantially along the line 7—7 in FIG. 6, the upper portion being shown in cross-section and the lower portion being shown in elevation;

FIG. 8 is an isometric view of another modified form of feed roll means including a pair of feed rollers and illustrating the manner in which the elastic and non-elastic yarns are wrapped about the two rollers to be fed to the knitting machine;

FIG. 9 is a front elevation view of the feed rollers shown in FIG. 8; and

FIG. 10 is a enlarged fragmentary view of a portion of a typical knit fabric illustrating elastic and non-elastic yarns knit in plated relationship.

The various embodiments of the feed rolls illustrated in FIGS. 1—5, 6 and 7, and 8 and 9 may each be utilized with various types of knitting machines and are preferably used where it is desired to knit elastic and non-elastic yarns in plated relationship in the knit fabric. This type of knit fabric has been particularly difficult to produce with the correct length of unpowered spandex yarn in the fabric and with the spandex stretched to the degree throughout the fabric.

As illustrated in FIG. 1, the feed roll means includes a single feed roller, broadly referred to as R, which is illustrated in association with a circular hosiery knitting machine of the Komet type having a lower needle cylinder 10 with double ended latch needles 11 supported for vertical sliding movement therein. An upper needle cylinder not shown, is supported in axial alignment above the lower cylinder 10 and the machine is provided with suitable stitch cams, not shown, for operating the needles in either cylinder to selectively form plain or ribbed fabric. Yarn guide means, in the form of a yarn feed finger 12, is provided for directing one or more yarns to the needles 11 to be formed into stitch loops of the knit fabric. In the present instance, the yarn feed finger 12 is provided with a pair of yarn guide openings or eyes 13, 14 so that yarns fed thereto will be simultaneously fed to the hooks of the needles 11 and form stitch loops with the two yarns in plated relationship to each other, in the manner illustrated in FIG. 10 and which will be presently described.

In the embodiment illustrated in FIGS. 1—5, the feed roller R is supported for rotation on a reduced shaft portion 20 by spaced ball bearings 21, 22 (FIG. 5) and held in position thereon by a pair of lock nuts 23. The inner race of the ball bearing 21 rests against a shoulder formed at the junction of a support shaft 25 and the reduced shaft portion 20. The inner lock nut 23 bears against the inner race of the bearing 22 to thereby prevent endwise movement of the roller R on the reduced shaft portion 20 and to permit free rotation of the roller R. A brake disc 26 surrounds the support shaft 25 and its inner planar surface engages the end surface of the roller R. A compression spring 27 surrounds the shaft 25 and one end engages the outer surface of the brake disc 26. The other end of the compression spring 27 engages a collar 30 which is supported for longitudinal adjustment on the shaft 25 by a set screw 31. Movement of the collar 30 toward the roller R increases the force of the compression spring 27 against the brake disc 26 and thereby produces an increased braking effect on the roller R. Movement of the collar 30 away from the roller R will decrease the braking effect of the brake disc 26 against the roller R and the braking effect may be completely eliminated with sufficient movement of the collar 30 away from the roller R.

The support shaft 25 is bent at a right angle and is supported adjacent its free end in the lower portion of a support post 32 (FIG. 1), the lower end of which is suitably supported on a bed plate, not shown of the knitting machine. The illustrated supporting means of the roller R is merely representative of one of many different types of supporting means which may be provided, depending upon the type of machine with which the roller R is to be employed.

The roller R is provided with a first yarn receiving peripheral groove 35 (FIGS. 4 and 5) for receiving a non-elastic yarn Y—1 wrapped one time thereabout, as illustrated in FIGS. 2 and 3. A second spaced peripheral yarn feeding groove 36 is provided on the roller R for receiving an additional yarn Y—2 which is preferably elastic, such as raw spandex or the like, and which is preferably wrapped one time thereabout.

The yarn feed roller R has been found to be of particular value in the knitting of ribbed socks on a Komet type hosiery knitting machine wherein the foot portion of the sock is knitting with the yarn Y—1 being a 24/2 count (50 percent dacron and 50 percent cotton), non-elastic yarn and the yarn Y—2 being a 40 denier uncovered spandex of the type sold under the tradename “LYCRA.” These two yarns are withdrawn from suitable supply packages, not shown, and directed through the usual yarn tension devices and guides downwardly to the feed roller R where they are lapped with one turn in respective yarn receiving grooves 35, 36 and then directed forwardly through the yarn guide eyes 13, 14 of the yarn feed finger 12. In this manner, both yarns are simultaneously fed to the same needles at a knitting station of the machine to form stitch loops with the yarns Y—1 and Y—2 in plated relationship.

As the needles 11 consume the non-elastic yarn Y—1 in forming the stitch loops, this non-elastic yarn Y—1 acts as a driver to impart rotation to the roller R at a predetermined rate. The rate at which the roller R is rotated by the yarn Y—1 depends upon the speed of operation of the machine, the size of stitch loops being knit, and the diameter of the yarn engaging peripheral groove 35. With rotation of the roller R the uncovered spandex yarn Y—2 is positively fed by the roller R to the needles at a predetermined ratio relative to the non-elastic yarn Y—1 and under the desired degree of tension so that it assumes the proper plated relationship.
with the non-elastic yarn Y-1 as stitch loops are simultaneously formed from both yarns. As illustrated in FIG. 10, the proper feeding of the non-elastic yarn Y-1 and the elastic yarn Y-2 insures that the plated stitch loops of each yarn will be maintained in the same relationship throughout the knit fabric. Also, the length of elastic yarn Y-2 will always remain in the proper proportion and ratio to the length of non-elastic yarn Y-1 in the fabric.

The relative rate of speed and the tension of the elastic yarn Y-2 is determined by the diameter of the yarn receiving groove 36 and by the amount of tension initially placed on the elastic yarn between the roller R and the needles 11 of the knitting machine. The feeding ratio between the non-elastic yarn Y-1 and the elastic yarn Y-2 may be varied by varying the diameter of the yarn receiving groove 35, relative to the diameter of the yarn receiving groove 36. It is to be understood that this ratio may vary throughout a wide range, depending upon the result desired in the knit fabric. In any event, this feeding relationship between the elastic yarn and the non-elastic yarn will be maintained throughout the knitting of the article, regardless of the size of stitch loops being formed. For example, when the length of the stitch loops being formed is increased, a greater length of non-elastic yarn Y-1 will be drawn into the knitting machine and the roller R will be rotated at a faster rate so that the length of the elastic yarn Y-2 will be increased by the same amount.

The embodiment of the feed roller means shown in FIGS. 6 and 7 may also be utilized with the knitting of two or more yarns in any desired type of knitting machine and is substantially identical to the feed roll means shown in the first embodiment illustrated in FIGS. 1-5, except that the wraps of the elastic yarn are maintained separate from each other so that there is less tendency for the yarn to become wound about the feed roller. Since many parts of the feed roller illustrated in FIGS. 6 and 7 are identical to the parts illustrated in FIGS. 1-5, the same reference characters will be applied to corresponding parts with the prime notation added.

The roller R' is supported for rotation on a reduced shaft portion 20' by spaced ball bearings 21', 22' (FIG. 7) and held in position thereon by a pair of lock nuts 23'. The inner race of the ball bearing 21' rests against a shoulder formed at the junction of a support shaft 25' and the reduced shaft portion 20'. The inner lock nut 23' bears against the inner race of the bearing 22' to thereby prevent endwise movement of the roller R' on the reduced shaft portion 20' and to permit free rotation of the roller R'.

A brake disc 26' surrounds the support shaft 25' and its inner planar surface engages the end surface of the roller R'. A compression spring 27' engages a collar 30' which is supported for longitudinal adjustment on the shaft 25' by a set screw 31'. Movement of the collar 30' toward the roller R' increases the force of the compression spring 27' against the brake disc 26' and thereby produces an increased braking effect of the roller R'. Movement of the collar 30' away from the roller R' will decrease the braking effect of the brake disc 26' against the roller R' and the braking effect may be completely eliminated with sufficient movement of the collar 30' away from the roller R'.

A yarn guide support plate 40 is held in position by a nut 40a on the threaded end of the shaft 20' and opposite end portions support the outer ends of suitable yarn guide eyes 41, 42. The guide eyes 41, 42 are offset (FIG. 6) so that the elastic yarn Y-2' does not engage itself as it is wound about the roller R'.

The roller R' is provided a first yarn receiving peripheral groove 35' (FIGS. 6 and 7) for receiving a non-elastic yarn Y-1' wrapped one turn thereabout, as illustrated in FIG. 6. A second spaced peripheral yarn feeding groove 36' is provided on the roller R' for receiving the elastic yarn Y-2' which is preferably wrapped one turn thereabout. However, it will be noted that the yarn receiving groove 36' is much wider than the yarn receiving groove 36 in the first form of feed roller and the yarn guides 41, 42 direct the yarn Y-2' coming into and leaving the groove so that the incoming and outgoing portions of the yarn Y-2' do not touch as they pass around the relatively wide groove 36'. Also, the surface of the relatively wide receiving groove 36' is preferably roughened, as by sand blasting or the like, to provide a frictional surface on which the elastic yarn Y-2' is received. If desired, the surface engaged by the elastic yarn Y-2' may be in the form of a chrome plated sleeve having a matte finish.

In the embodiment illustrated in FIGS. 8 and 9, a pair of yarn feed rollers, indicated at R-1 and R-2, are supported on a suitable bracket 45 and in spaced apart, vertical alignment. The upper and lower rollers R-1, R-2 are identical except that the lower roller R-2 is smaller in diameter than the upper roller R-1 and each of the rollers is provided with a plurality of yarn receiving grooves 46 therein. The upper and lower rollers are supported on shafts 47, 48 which are fixed at one end on the bracket 45 and support ball bearings, not shown, for rotatably supporting the rollers thereon. Braking means is also provided for both of the rollers and includes respective brake discs 50, 51 which bear against the ends of the rollers and are adjustable by means of compression springs 52, 53.

As illustrated in FIGS. 8 and 9, a non-elastic yarn Y-1' is withdrawn from a yarn supply source, not shown, and is directed downwardly through a yarn guide eye 55 in the upper end of the support bracket 45 and passes downwardly in engagement with one of the grooves 46 in the upper roller R-1, downwardly beneath the lower roller R-2 and around one of the grooves 46 therein, then upwardly over and through a groove in the upper roller R-1, and downwardly in engagement with a groove 46 in the lower roller R-2. The elastic yarn Y-2' is also withdrawn from a suitable supply source, not shown, passes downwardly through a yarn guide eye 56 in the support bracket 45, downwardly through a groove in the upper roller R-1, beneath the lower roller R-2 and around in one of the grooves 46, then upwardly and over and through one of the grooves in the upper roller R-1, and downwardly through one of the grooves in the lower roller R-2, and then to the knitting machine.

In this embodiment, the non-elastic yarn Y-1' still acts as the driver for rotating both of the upper and lower rollers R-1 and R-2 and the elastic yarn Y-2' is fed to the knitting machine to be knit in platted relationship in an amount which is determined by the speed of movement of the non-elastic yarn Y-1' and the speed of the rollers R-1 and R-2. Also, the length and tension under which the elastic yarn Y-2' is knit is directly controlled by the speed of movement of the non-elastic yarn Y-1'. With this double roll arrangement, the
yarns Y-1" and Y-2" do not contact each other as they are wound thereabout so that there is no chance that the yarns will stick together and wind up on the rollers R-1 or R-2.

The fabric in FIG. 10 is shown as it would appear when looking at the inside face and each of the stitch loops in wales W-1 and W-2 and courses C-1 and C-2 contains a strand of the non-elastic yarn Y-1 and the elastic yarn Y-2, with each of these yarns having been fed to the stitch loops in the desired relationship, relative to each other. In the present instance, the elastic yarn Y-2 is maintained inside of the non-elastic yarn Y-1 so that only the non-elastic yarn Y-1 is visible from the outside face of the fabric. If the size of the stitch loops is varied by the knitting machine, a greater or lesser length of non-elastic yarn Y-1 will be drawn into each stitch loop which is knit and, since the length of the elastic yarn in the fabric is controlled by the length of the non-elastic yarn, the length of the non-elastic yarn Y-2 will also be varied in the correct proportion.

Thus, in each embodiment of the present invention, the feed roller means is rotated by the non-elastic yarn and one or more elastic yarns are fed at a predetermined rate relative to the non-elastic yarn which rotates the feed roller means. Therefore, any variations in consumption of the non-elastic yarn by the knitting machine will automatically vary the rotational speed of the feed roller means and correspondingly vary the rate of feed of the elastic yarn so that the predetermined variations in feed rate between the yarns will remain constant.

Although several embodiments of the feed roller means are illustrated in the present application, it is understood that other types of feed roll means may also be utilized. The feed rollers may be coated with various types of material to aid in frictional engagement of the yarn therewith, to increase the wear resistance of the rollers, and/or to prevent the build-up of static, lint, and the like. Also, in certain instances, it may be desirable to feed yarns of like characteristics to obtain even feeding of the yarn. Therefore, although the terms elastic and non-elastic are used herein, they are intended to include yarns which are both non-elastic, yarns which are both elastic, or yarns in which one yarn may be more elastic than the other.

In the drawings and specification, there has been set forth a preferred embodiment of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

That which is claimed is:

1. In a knitting machine including needles and yarn guide means for directing an elastic yarn and a non-elastic yarn to said needles to be knit in plaited relationship into stitch loops of a knitted fabric, the combination therewith of yarn feeding means comprising rotatable means positioned in advance of said yarn guide and adapted to be driven by said non-elastic yarn wrapped thereabout, and said rotatable means drivingly engaging said elastic yarn for feeding said elastic yarn to said yarn guide means and said needles at a predetermined ratio relative to said non-elastic yarn so that said elastic yarn is constantly delivered to said needles and is stretched to the desired degree as long as said rotatable means is being driven by said non-elastic yarn.

2. Yarn feeding means according to claim 1 wherein said rotatable means comprises at least one rotatable roller.

3. Yarn feeding means according to claim 2 including brake means supported adjacent said one roller and engageable therewith for retarding rotation of said one roller.

4. Yarn feeding means according to claim 3 wherein said brake means comprises a brake disc in engagement with one end of said one roller, a compression spring supported for engagement at one end with said brake disc, and adjustment means at the other end of said spring for varying the pressure of said spring against said brake disc to thereby vary the braking force against said one roller.

5. Yarn feeding means according to claim 2 wherein said one roller has a first peripheral groove for receiving said non-elastic yarn wrapped thereabout.

6. Yarn feeding means according to claim 5 wherein said one roller has a second peripheral groove spaced from said first groove for receiving said elastic yarn wrapped thereabout.

7. Yarn feeding means according to claim 6 wherein said first and second grooves are of the same width.

8. Yarn feeding means according to claim 6 wherein said second groove is substantially wider than said first groove and including yarn guide means adjacent opposite sides of said wide groove to prevent the wraps of said elastic yarn from engaging each other.

9. Yarn feeding means according to claim 1 wherein said rotatable means comprises first and second rotatable rollers, and including support means for maintaining said rollers in space apart position, and each of said rollers having a plurality of peripheral grooves for receiving and maintaining said one yarn and said additional yarn separate as they are wrapped at least one time about said rollers.

10. Yarn feeding means according to claim 9 including brake means supported adjacent at least one of said rollers and engageable therewith for retarding rotation of said one roller.

11. Yarn feeding means according to claim 10 including brake means supported adjacent each of said first and second rotatable rollers.

12. A method of feeding yarns to the needles of a knitting machine comprising the steps of knitting fabric while forming stitch loops of an elastic yarn and a non-elastic yarn in plaited relationship and while, directing said non-elastic yarn around rotatable means in its path of travel to the needles to impart rotation to said rotatable means at a predetermined rate relative to the rate at which said non-elastic yarn is consumed in forming the stitch loops of the knitted fabric, and directing said elastic yarn around said rotatable means in its path of movement to the needles to feed said elastic yarn to said needles in accordance with the rate of rotation of said rotatable means as it is rotated by said non-elastic yarn so that said elastic yarn is constantly delivered to said needles and is stretched to the desired degree as long as said rotatable means is being driven by said non-elastic yarn.

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