This invention relates to circular, independent needle knitting machines and, in particular, to a yarn controlling device for use in such machines.

It is a principal object of the invention to provide a yarn controlling mechanism for use in machines for knitting solid color pattern hoseities having a number of different colored pattern areas in the same courses around the leg, the different pattern areas being connected together by sutures. In machines of this type a stocking top is normally knitted by circular knitting, then reciprocatory motion is used for the leg portion, and finally the heel, foot and toe portions are knitted in a conventional manner, although the design may, if desired, extend to the toe in which case the reciprocatory motion would be continued to that point.

It is a further object to provide a yarn controlling mechanism effective during such circular knitting of the top portion to prevent interwinding or roping of yarns above that point at which yarns are normally taken by the needles, so that immediately upon commencing reciprocatory knitting of the leg portion the proper yarn may be taken by the needles instead of being missed thereby due to such interwinding taking place to a level well above the reach of the needles.

It is a further object to provide means integrable between the multiple yarns of a particular feeding station, said means being reciprocable between upper and lower positions and effective when in the lower position to limit the upper level of interwinding of yarns.

It is a further object to provide a cutter and binder mechanism which cooperates with the yarn controlling device to produce a stocking having uniform stitches, especially at the beginning of the knitting article.

Further objects will appear from the description to follow.

In United States Patent No. 2,217,022 there is described a fully automatic machine of the type to which the present invention may be applied and having two yarn feeding stations each capable of feeding a plurality of different colored yarns. When the knitting is started as is inlaid glass in the top in the rotary manner, all of the yarns with the exception of the body yarn wind around each other continuously to form a rope. When the top is finished and a yarn lever comes into play to feed a pattern yarn at the beginning of the leg portion of the stocking, it often happens that the roping prevents this pattern yarn from being taken by the needles. Once reciprocatory knitting of the leg portion has begun, the winding is dissipated during each knitting stroke to be followed by a similar winding in the opposite direction and on special control is then required to assure proper feeding of the pattern yarns. In United States Patent No. 2,545,081 a device is disclosed which provides means for pushing the twisted yarns downwardly into the knitting cylinder so that at the finish of rotary knitting of the top portion of the stocking, the pattern yarns will be in position to be taken by the needles and not be missed thereby. This device is not positive in restricting the upper level of roping, however.

According to the present invention reciprocable means including a pointer and stop means thereon have been provided for each yarn feeding station which pointer is integrable between the yarns of its station and which is effective to prevent any interwinding above the level of insertion. The pointers are inserted into the yarns of their respective feeding stations sometime between the completion of reciprocatory knitting of one stocking and the beginning of rotary knitting of the top of the next stocking. They are withdrawn during reciprocatory knitting so that the inactive yarns do not become entangled about them. A binder functions in unison with the pointers and a cutter cooperates therewith to cut the top yarn so as to permit the fabric to be pulled down by the fabric take-up without pulling on the top yarn at that time. If this yarn were not cut then the fabric could be pulled down only at the rate that courses are knitted In the next stocking top, the pulling on the top yarn could be excessive and the initial courses in the stocking top would be puckered.

A more complete understanding of the invention may be had by reference to the accompanying drawings, wherein:

FIG. 1 is a perspective view of the top portion of a knitting machine showing the pointers in raised position;

FIG. 2 is a similar view showing the pointers in lowered position;

FIG. 3 is a perspective view of the mechanism for controlling the pointers, binder and cutter;

FIG. 4 is a top view of the control mechanism;

FIG. 5 is a side view of the control mechanism as seen from the right side of the machine;

FIG. 6 is a front view of a portion of the control mechanism;

FIG. 7 is a side view of the thread cutter cam;

FIG. 8 is a side view of the binder and pointer cam.

In FIGS. 1 and 2 there is shown the top portion of a needle cylinder having the usual sinner cap 11 and carrier ring 12 which supports the yarn feeding fingers, usually eight in number, of each of two feeding stations 13 and 14. Each finger is controlled by known means to lower its yarn at the proper instant to be taken and to be knitted by the needles. As shown at 15 in FIG. 2, during the knitting of the top portion of a stocking when the machine is in rotary knitting, the idle yarns interwind or form a rope with each other, which, if unchecked, would extend nearly to the inactive portion of the yarn fingers. As a result when one of these idle fingers moves its yarn to a feeding position at the beginning of the pattern area of the stocking, the position of the yarn between the roped portion and that feeding finger is such that it is out of reach of the needles and cannot be taken thereby. In the past it has been necessary to limit the pattern, the number of yarns feeding at a side and the mode and sequence of introducing yarns so that the roping of the yarns would not prevent any yarn from being taken with certainty by the proper needles when introduced. Also, the number of yarns which could be fed at a single feeding station was limited in order to minimize the effects of roping.

In order to overcome these difficulties pointers 16 and 17 have been provided which are integrable between the yarns of their respective feeding stations. These pointers are fixed to a member 18 which is fixed to rod 19. The pointers 16 and 17 each have a stop member 20 and 21, respectively, which are vertically adjustable by means of set screws and which act to limit movement of the yarns along the pointers when the latter are lowered into active position.

Although not necessarily so, the pointers are preferably used in conjunction with a binder and cutter attachment indicated generally at 22 in FIG. 3. In such a case the pointers are preferably fixed with respect to the binder and both are controlled by a common means to be described. The cutter mechanism is independently controlled. The binder and cutter may be of the type disclosed in United States Patent No. 2,702,452, to which reference may be had for a more complete description thereof.

In FIG. 3 there is shown a perspective view of the con-
trol mechanism for the pointers, binder and cutter. The cutter blade 23 is vertically slidable in member 43 and is controlled by means of lever arm 25 pivoted at 26, one end of which acts upon pin 27 fixed on blade 23. The other end of arm 25 has fixed thereto a pin 29 receivable in slot 30 of a second lever arm 30 pivoted intermediate its ends. The arm 30 at its opposite end is pivotally connected to linking rod 32. The latter is adjutably mounted to a lever 33 pivoted at 34 to the frame of the knitting machine. The free end of the lever is attached to a connecting rod 35 which is further pivoted to an extension 36 fixed to one end of a rocker arm 37 which is pivoted at 38. The opposite end of the rocker arm acts as a cam follower 39 and is biased toward the cutter cam 40 and its drum 41 by means of a spring 42. When the rocker arm 37 is riding upon cam 40, it will be seen that cutter blade 23 is lowered to receive a yarn and as the arm falls off its cam the blade is raised to cut and bind that yarn by means of springs S and 42. As shown in FIG. 1, spring S has one end thereof suitably attached to the upper end of blade 23, the other end thereof being connected to any stationary means (not shown).

The binder unit 43 is fixed with respect to the pointers and both binder and pointers are controlled in their vertical intermeshment through lever arms 44 and 45 similar in construction to the cutter control arms and which are pivoted about the same points. The arm 45 is connected to a rod 46 which is pivoted to a second rocker arm 47 also pivoted at 38 and having a cam follower portion 48 at its free end. Cam follower 48 is influenced by cams 49 and 50 fixed to the drum 51. The pointers are therefore movable to three positions as determined by these cams for reasons to be explained. The springs S' and 53 maintain cam follower 48 in contact with its drum and cams.

The pointer in FIGS. 3 to 6 the rod 46 has a collar 53 having a pin 54 attached thereto which is adapted to engage a latch 55 formed on one arm of a pivoted bell crank lever 56. A drum 58 is adapted to rotate at the same angular speed as the needle cylinder and is provided with a roller 59 for releasing the latch by acting upon the other arm of the bell crank lever. A spring 60 tends to maintain engagement between the pin 54 and latch 55.

FIGS. 7 and 8 show an elevational view of the cutter cam drum and the binder and pointer cam drum respectively. The two drums are mounted on their common shaft so that the pointers designated 0 coincide. As cam follower 39 is raised by cam 40 the cutter blade 23 is lowered and as the drum 41 rotates further the follower leaves the cam 40 and is urged toward the drum by springs S and 42 thereby raising the cutter blade and cutting and binding the top yarn. This takes place just prior to the knitting of the top of the next sock.

The point B on drum 51 in FIG. 8 represents the beginning of the top of a stocking and is that point at which the binder and pointers are lowered to their lowermost position due to raising of follower 48 by cam 50. The latter terminates at point C when the pointers are raised up out of action at the beginning of the knitting of the pattern in the leg portion. Point A is the beginning of the foot portion when the pointers are lowered to an intermediate position.

In operation, a completed stocking is run off, the top yarn (which may also be used in other parts of the stocking) goes into the binder and is cut. If an elastic yarn is to be knitted into the top, about four courses of this yarn are run before the needles start to take the top yarn to complete the selavage and to commence knitting of the top. The binder and pointers are lowered from an intermediate to their lowermost position to position the top yarn to be taken by a leading long butt needle. The yarn is merely pulled from the binder and goes in to knit with the needles taking that yarn and incorporating the elastic. During this time the idle yarns of each feeding station are interwinding about each other to form a rope but the upper limit of this roping is controlled by the pointers. At the completion of the top or start of the pattern, a yarn finger lowers a colored yarn forming a part of the leg portion which can now be easily taken by the needles. The needle cylinder begins reciprocatory motion and the binder and pointers are raised out of use to prevent interwinding of the yarns with them and also for the reason that the pointers are no longer needed since reciprocation periodically unwinds the idle yarns.

The solid color pattern and reciprocation usually terminate with the knitting of the heel and the cylinder again goes into rotary knitting. At this point the pointers are introduced between the yarns at their intermediate position before any appreciable amount of roping has taken place because it is easiest to do so at this time. The pointers are not fully lowered at this time because in the event of needle breakage, the yarns would wrap all around the binder mechanism. At completion of the toe the pointers are fully lowered and a new sock is ready to be knit.

If so few yarns are being used at a particular feeding station that roping is not a problem, the pointer at that station may be twisted up out of action. Although not necessary, cam 50 on the binder and pointer control drum is of such length as to release the pointers as soon as a few needles have taken the first colored yarn at feeding station 14 at the commencement of reciprocatory knitting. In the event that only two yarns are being fed at station 12 as shown in FIGS. 1 and 2, then the bell crank lever 56 and its latch mechanism are not necessary since winding is not severe and the pointer at that station is not required. Thus, the spring 60 may be disconnected to release the latch when only the pointer at feeding station 14 is to be utilized. However, whenever the pointer 16 is to be used to permit proper feeding of a leg yarn, then it is necessary to keep this pointer lowered for a slightly longer period in order to enable the first few needles knitting at the beginning of reciprocation to take the leg yarn at that feeding station.

The latch mechanism keeps this pointer lowered until this takes place. Otherwise, rotation of the drum 51 would have caused a release of the pointers as soon as cam 50 had passed beyond cam follower 48.

Although the binder and cutter are not entirely necessary for the operation of the pointers, the cutting of the top yarn permits that stocking to be made more rapidly and evenly thereby lessening the concentration of the twisting as the next top is knitted resulting in more uniform stitches and a better and stronger selvage at the top.

While the invention described herein of particular advantage when used in machines in which the fabric is taken up positively, the pulling of the top yarn, for example, and also the twisting or roping of the pattern yarns being more pronounced and troublesome due to the take-up action, it is to be understood that the invention is to be used with or without a take-up and in all types of machine and for knitting any fabrics wherein it may be found useful.

While one embodiment of the invention has been disclosed, it is to be understood that the inventive concept may be carried out in a number of ways. This invention is, therefore, not to be limited to the precise details described, but is intended to embrace all varieties and modifications thereof falling within the spirit of the invention and the scope of the claims.

I claim:
1. In a circular, independent needle knitting machine having a rotatable and reciprocable needle cylinder, needles, a feeding station and yarn feeding means at said station for presenting yarns to the needles, said yarns being so controlled that during rotary knitting a plurality of them twist back toward a point of divergence adjacent said feeding means, and periodically operable means engageable between said yarns at their point of divergence
and movable downwardly to displace the twisted portion of said yarns to a position so that any one of said yarns being introduced will be positioned to be readily taken by the needles.

2. The mechanism of claim 1 wherein said periodically operable means comprises a pointer having a stop means mounted thereon, said pointer being movable between an upper, an intermediate and a lower position.

3. The mechanism of claim 1 wherein said periodically operable means comprises a pointer having a stop means mounted thereon, and a cam operated lever means adapted to introduce said pointer between said yarns prior to rotary knitting, to raise said pointer out of said yarns at the completion of rotary knitting, and to introduce said pointer at an intermediate position between said yarns at the completion of said reciprocatory knitting.

4. In a circular, independent needle knitting machine having a rotatable and reciprocable needle cylinder, needles, a feeding station and yarn feeding means at said station for presenting yarns to the needles, said yarns being so controlled that during rotary knitting a plurality of them twist back toward a point of divergence adjacent said feeding means, and periodically operable means engageable between said yarns at their point of divergence which comprises a pointer having a yarn stop means mounted thereon, a cam operated lever means for introducing said pointer between said yarns prior to rotary knitting, to raise said pointer out of said yarns at the completion of rotary knitting and to introduce it at an intermediate position between said yarns at the completion of rotary knitting, and a cutter and binder means mounted adjacent said pointer, and means to control said cutter in unison with said pointer by a second cam operated lever means operable independently of that means which controls the pointer.

5. For use in a circular knitting machine having a cylinder, needles and yarn levers and in which yarns from said levers become wound together during the knitting cycle so that individual yarns tend to be prevented from being taken by needles when their respective yarn levers are brought into action, that improvement which comprises reciprocable cam-controlled means insertable between adjacent yarns which converge to a point at which they are wound together for preventing the interwinding of said yarns above a point at which yarn is normally taken by said needles, said means being reciprocable between a lower active position and an upper inactive position and comprising a vertically reciprocable pointer and means adjustable thereon for limiting movement of yarns along said pointer.

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