March 17, 1964 M. BOND ETAL 3,124,944

CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

Filed Dec. 18, 1959 6 Sheets-Sheet 1

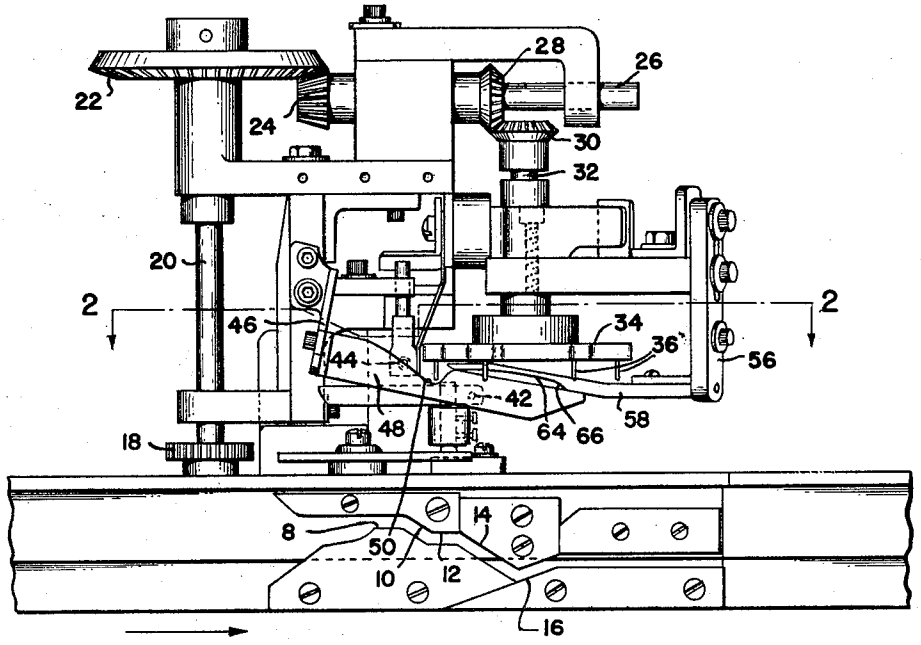


FIG. 1.

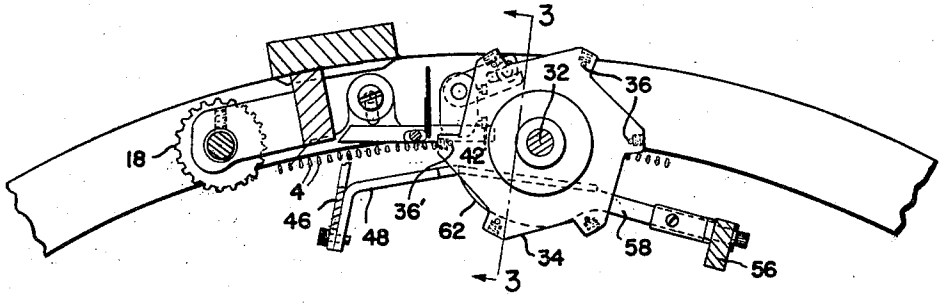


FIG. 2.

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CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

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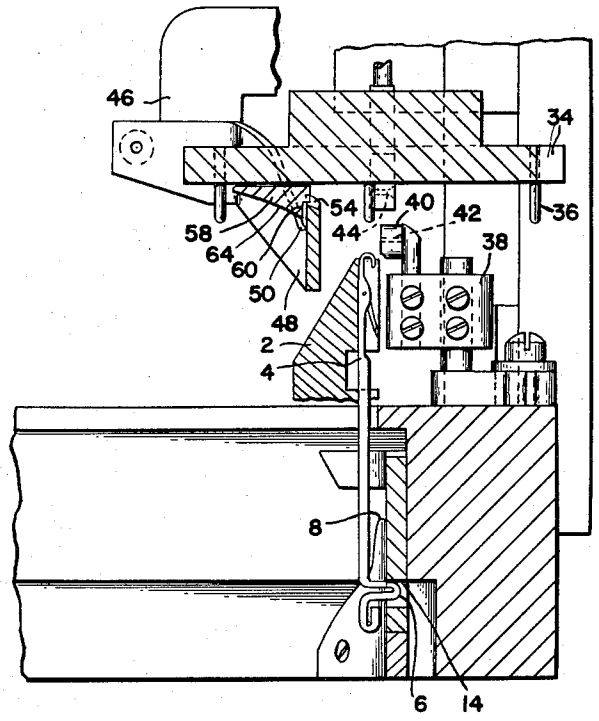


FIG. 3.

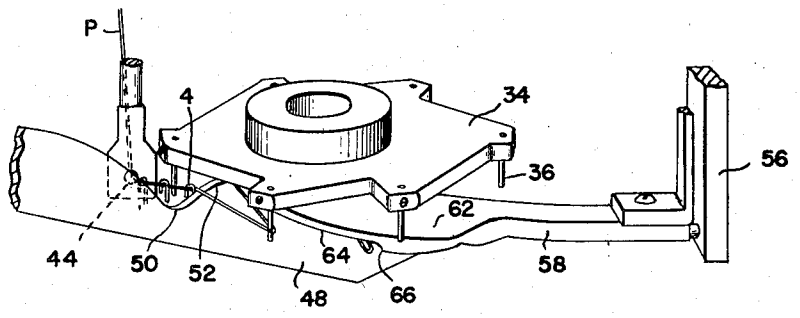


FIG. 6.

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CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

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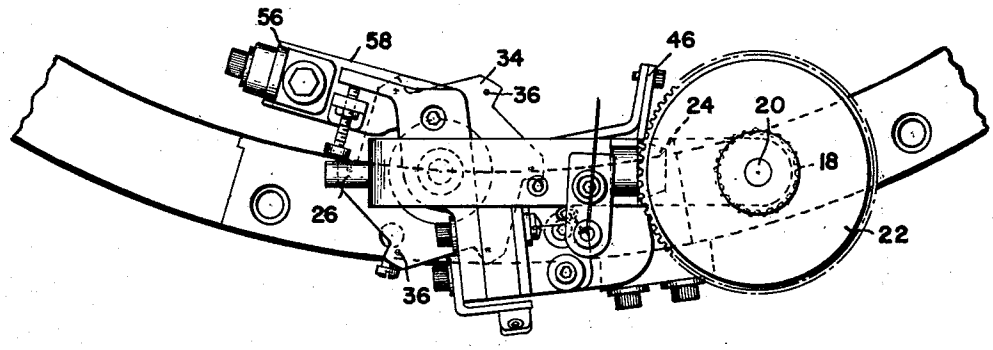


FIG. 5.

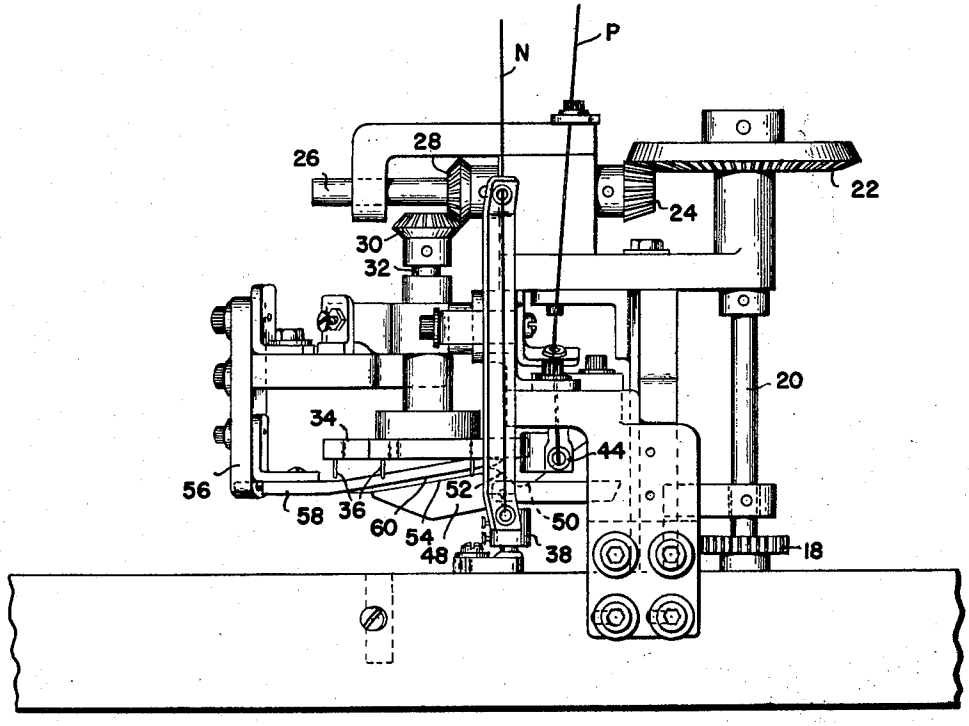


FIG. 4.

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CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

Filed Dec. 18, 1959 6 Sheets-Sheet 4

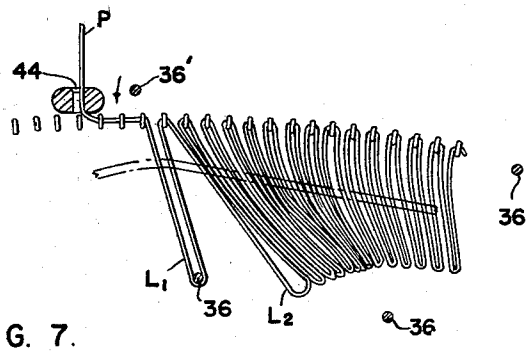


FIG. 7.

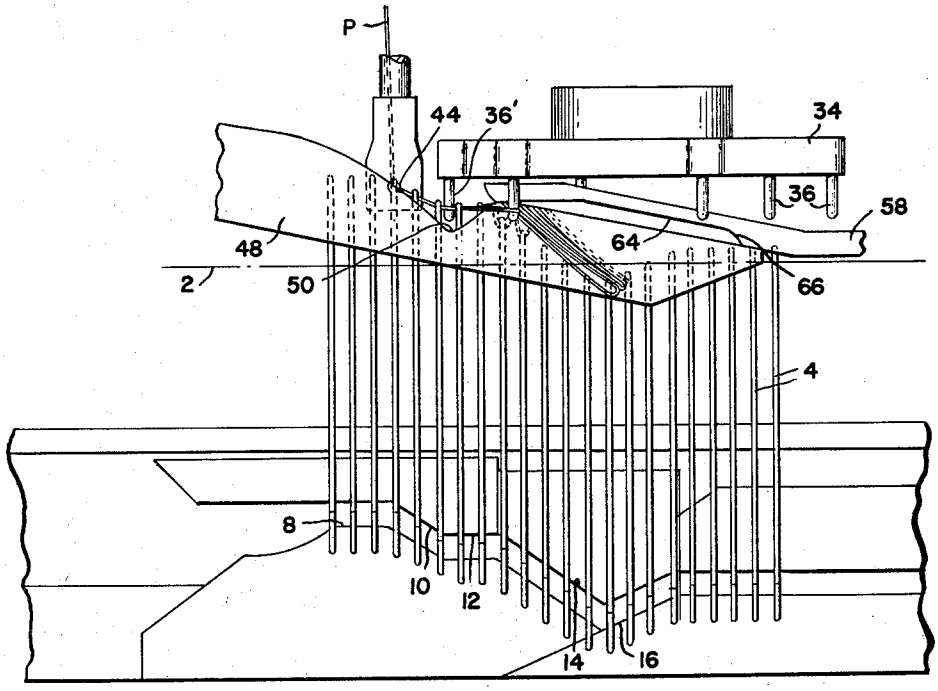


FIG. 8.

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CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

Filed Dec. 18, 1959 6 Sheets-Sheet 5

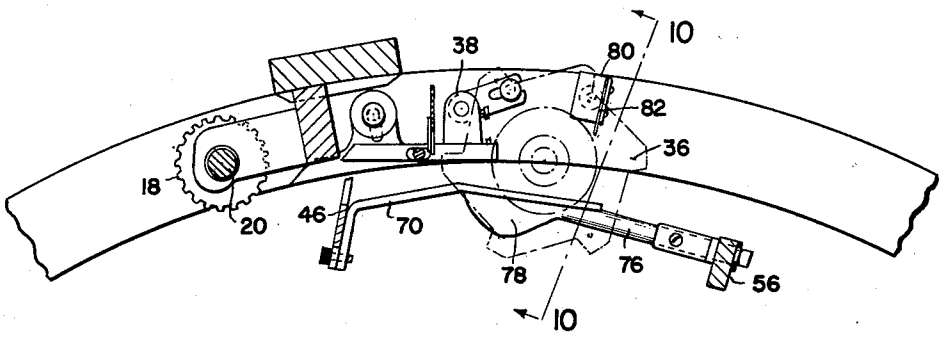


FIG. 9

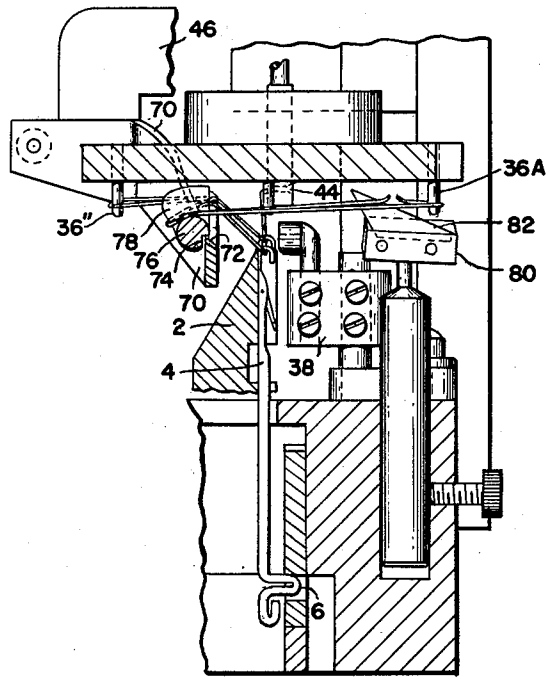


FIG. 10.

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CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

Filed Dec. 18, 1959 6 Sheets-Sheet 6

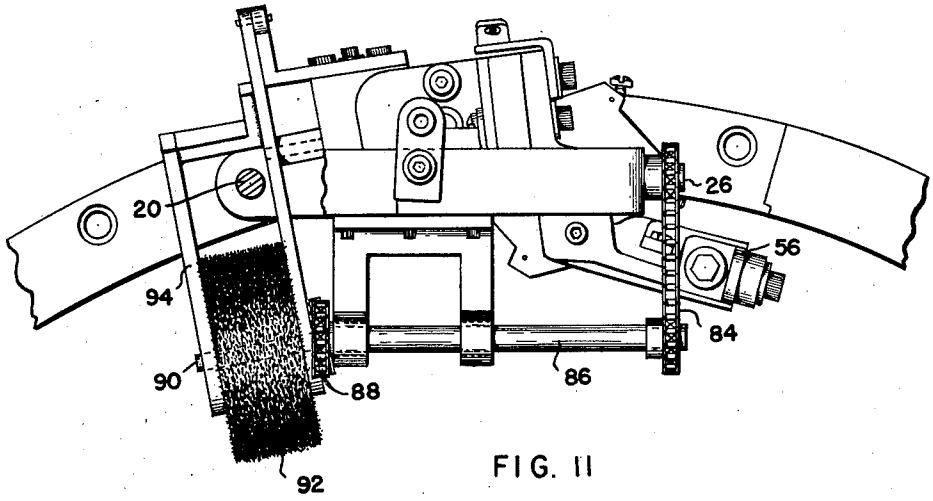


FIG. 11

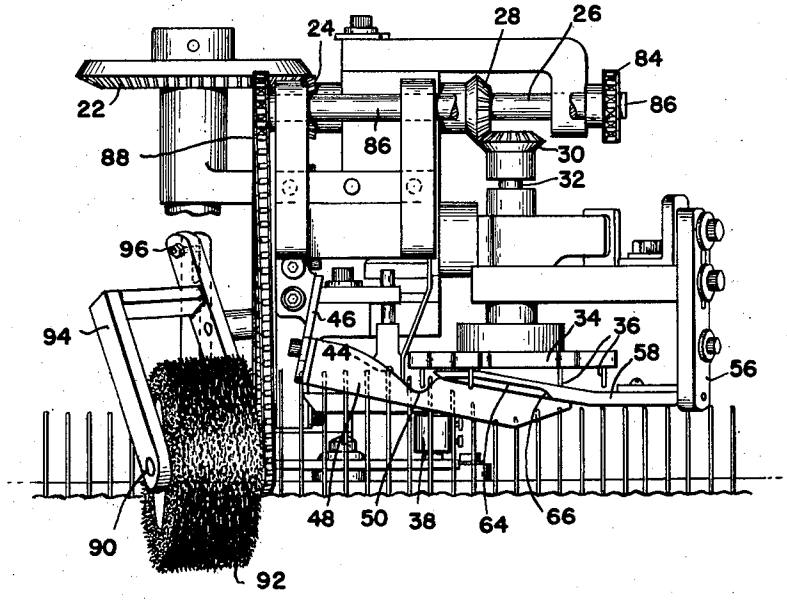


FIG. 12

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3,124,944

CIRCULAR KNITTING MACHINE FOR KNITTING PILE FABRICS

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Filed Dec. 18, 1959, Ser. No. 860,430
9 Claims. (Cl. 66—9)

This invention relates to knitting machines and methods for the production of pile fabrics for rugs, upholstery, imitation fur, etc.

Recently it has been found that rug and similar fabrics having closely spaced pile loops of a wide variety of lengths could be made on circular knitting machines which may produce a base fabric and heavy pile loops in the same operation. Since this method requires the use of only a pile yarn and a restraining yarn at each knitting station of a multifeed machine, the yarn supplies have been reduced to a minimum. As the knitted material drapes easily, it may be more readily used as upholstery fabric than that made by tufting in a woven base. Also, if the pile loops are sheared or properly torn and treated, plush or simulated fur will result.

As practiced heretofore, the method involved comprised feeding the pile loop yarn high and a relatively light but strong restraining base yarn low to cylinder needles, so that jacks could be moved radially outwardly from a dial between the two yarns. As the needles were lowered to knit they drew long pile loops over the jacks, while the restraining yarn was taken in the usual manner and knit to from essentially normal stitches of the combined yarns.

It will be understood that without the restraining yarn there would be no means to prevent adjacent needle wales in the fabric from separating to the extent permitted by the long pile loops. It was therefore desirable to use the lightest possible restraining yarn that has sufficient strength to satisfactorily prevent separation of the needle wales, in order that when knit with the relatively heavy pile yarn the base fabric would be of minimum weight. By reason of the inclusion of both yarn in stitches formed at each feed, the pile loops were securely anchored, and, even if broken, their end portions were locked into the fabric.

In drawing the loops of abnormal length, the heavy pile yarn was necessarily engaged by several adjacent needles and reeved over nearly as many dial jacks, thus creating sufficient friction to prevent its free movement, and it was therefore under such extreme tension that at times the completion of stitches became quite difficult, imposing great stresses on the needles.

The last mentioned difficulty may be avoided to some extent by elevating the jacks over which the pile yarn passes while the needles are being lowered to draw, measure and hold the pile loops, and then lowering the jacks as the stitches are finally drawn to provide sufficient yarn, free of excessive tension, for their proper formation.

However, the last mentioned expedient still involves the limitation that only relatively short pile loops may be properly drawn in view of the fact that in the formation of larger loops corresponding extensive reeving action would be required with the exertion of excessive tension on the needles and yarn, only capable of being minimized by imparting unusually and impractical large movements to the jacks.

In many instances, quite long pile loops are desirably formed. It is one general object of the present invention to make provision for the formation of quite long pile loops. This is effected in accordance with the invention by passing between adjacent needles at a quite high speed pin elements which, shortly after the needles seize the pile yarn, will engage the yarn and draw long loops, such yarns being either fully drawn or drawn to at least a considerable portion of their lengths before needle movements occur producing additional edges over which the pile yarn would have to be drawn in a tortuous path. For example, the loops are either fully or to a major extent drawn before the needles move beyond verges such as are provided by the walls between needle slots in a cylinder.

In accordance with one form of the invention, when the pile loops are not extremely long, the loop is completed to its full length before the next loop has its formation started. However, according to another embodiment of the invention in which very long loops are to be produced from the pile-forming yarn, there may be some overlap in the formations of successive loops, but their formations occur at such a rapid rate that they are completed before their corresponding needles are caused to enter a stitch-drawing phase of operation.

A further object of the present invention is to provide means whereby the loops are severed in the knitting machine concurrently with or immediately following their formation. Such severing of the loops is generally desirable in any event, and is usually accomplished during the finishing operation performed on the completed knitted fabric after it leaves the knitting machine. As will hereafter appear, this severing actually collaborates with the fabric formation in effecting the release of the loops from loop-drawing elements.

Still another object of the invention is the provision of convenient means for brushing the fabric as the loops thereof are completed to break and/or comb out the fibers of the pile loops. Heretofore this step has been performed upon the completed fabric after its removal from the knitting machine.

The foregoing and other objects of the invention particularly relating to details of construction and operation will become apparent from the following description, read in conjunction with the accompanying drawings, in which:

FIGURE 1 is an elevation looking outwardly from the axis of a needle cylinder and showing needle operating cams and the elements provided in accordance with the invention at a single feed of a multiple feed machine, though it will be understood that the invention may also be utilized in a single feed machine;

FIGURE 2 is a horizontal section taken on the plane indicated 2—2 in FIGURE 1;

FIGURE 3 is a section taken on the vertical plane indicated at 3—3 in FIGURE 2, the section being on an enlarged scale for clarity;

FIGURE 4 is an elevation looking from the outside at the parts illustrated in FIGURE 1;

FIGURE 5 is a plan view of the parts illustrated in FIGURES 1 and 4;

FIGURE 6 is a perspective view showing, in particular, separated from the other parts of the mechanism, the elements particularly concerned in the drawing and handling of the pile loops;

FIGURE 7 is a diagrammatic plan view illustrative of the fashion in which loops are formed and handled;

FIGURE 8 is a diagrammatic elevation of the loop formation and handling involved in FIGURE 7;

FIGURE 9 is a horizontal sectional view showing a modification of what is shown in the preceding view and particularly adapted to the formation of quite long pile loops;

FIGURE 10 is a vertical section on the surface indicated at 10—10 in FIGURE 9;

FIGURE 11 is a plan view generally corresponding to

FIGURE 5 but showing the mounting and operating arrangement for a brush provided to sever and comb out the pile loops; and

FIGURE 12 is an inside elevation of the elements shown in FIGURE 11.

Referring first to the modification illustrated in FIGURES 1 to 8, inclusive, it may be first pointed out that the basic circular, latch needle knitting machine desirably used for carrying out the invention is generally known as an open top or jersey machine, and is multi-feed and of larger diameter. The cams in this machine generally rotate while the needle cylinder remains stationary, but it will become evident that the invention may equally well be carried out using a machine in which the needle cylinder revolves and in which the cams and other elements and the yarn supplies are stationary. For consistency, however, the following description will be carried out on the assumption that the machine is of the rotary cam type, in which the cams rotate counterclockwise. The basic machine may be of the type disclosed in Swinglehurst Patent 1,115,128, dated October 27, 1914, with its dial removed. Only so much of the machine is shown as will be necessary to understand the invention, and this only at one knitting station, it being understood that what is described is repeated at each of the many knitting stations which may be involved. The only limitation on the number of stations or feeds is that established by the circumference of the needle cylinder.

It will also become apparent that the needles might well be carried by a dial rather than a more conventional cylinder, the parts being, then, effectively moved through 90° with respect to the axis of rotation.

A needle cylinder is indicated at 2 and carries in axial slots the conventional latch needles 4 which are provided with butts 6 arranged to be acted upon by cams. Since the basic stitch drawing operations are of an elementary nature, the walls between the needle slots provide, at their upper ends, verges over which the yarns are drawn for the formation of the stitches. Sinkers are unnecessary in the knitting herein described, but may be used if special controls of yarn are desired. It will be understood that a conventional fabric takeup is used to impart tension to the fabric to withdraw it from the needles as it is formed and to cause the loops to cast off properly.

The needle operating cams, which are duplicated at each feed, are illustrated in FIGURE 1 and are essentially conventional, comprising the cam portion 8 which effects clearing, the slope 10 which moves needles downwardly following their engagement with the pile yarn, a dwell portion 12, at the location of which the pile loops are drawn, the stitch cam 14, which serves to draw loops of both yarns, and the rise 16 which relieves tension and leaves the needles at a level from which they are raised to clearing height at the following feed. The arrow in FIGURE 1 indicates the relative direction of needle movement with respect to the cams, since for consideration of operation it is more convinient to assume that what is illustrated in FIGURE 1 is stationary, though in actual fact this revolves counterclockwise, the needle cylinder being stationary.

Since a rotary drive is required for various elements, there is utilized a pinion 18 which engages the shanks of the needles which, in effect, form a stationary driving gear for the pinion. It will, of course, the evident that a pinion of similar type could engage a stationary rack secured to the needle cylinder. The pinion 18 drives through a vertical shaft 20 a beveled gear 22 which meshes with a beveled pinion 24 carried by a shaft 26, the shaft 26, in turn, driving through the beveled gears 28 and 30 a vertical shaft 32 which carries what may be referred to as a disc 34, though as illustrated, this disc is desirably cut away for proper clearances to form a multi-lobed element. It will be understood that the various driving elements already described and other elements about to be

described are carried through the medium of bracket or frame elements by the cam ring. Details of the mountings need not be described since they are quite arbitrary.

Projecting downwardly from the disc 34 are pins 36 which, as will more fully appear, engage portions of the pile yarn extending between needles at the location of the cam dwell 12. The pile loops are drawn by these pins in a direction inwardly of the needle circle.

An adjustable bracket 38 mounts a member 40 through which there extends the eye 42 for the base yarn N which will normally consist of a quite lightweight nylon yarn, or similar synthetic yarn having high tensile strength, this yarn being led to the eye 42 through suitable guides, being fed also through conventional tensioning devices which need not be described. This yarn N is fed to the needles at a relatively low level and is knit in what may be considered completely conventional fashion with the sole exception that drawn simultaneously with its loops are loops of the pile yarn P. Tight loops of the yarn N are formed and constitute the effective backing of the fabric, forming a fabric of high tensile strength binding the elongated pile loops.

The pile yarn P passes from its supply through suitable tensioning devices (not shown) and through suitable guides to the yarn feeding eye 44. As will be clear from the various figures, the eye 44 feeds the yarn P at a relatively high level so that it is engaged by needles immediately under their hooks as they pass the clearing cam 8 and move down the cam slope 10.

An adjustable bracket 46 supports inside the circle of needles a blade element 48 which slopes downwardly in the direction of relative needle movement and is provided at its upper edge at the circumferential location of the dwell 12 with a notch 50 to clear the paths of the pins 36. The trailing edge 52 of the notch (in the direction of relative needle movement) slopes as shown to guide the pile loops upwardly over the beveled edge 54 of the element 48.

An adjustable bracket 56 supports an element 58 which extends above the beveled edge 54 of the element 48 and has a rectangular step 60 formed therein which, as illustrated in FIGURE 3, partially embraces the sharp beveled edge 54 and the inner vertical surface of the element 48. The arrangement thus provided imparts to loops a right angle bend and serves, in particular, to restrain them against outward movement once they enter the clearance. Desirably the clearance between the elements 48 and 58 corresponds closely to the diameter of the pile yarn so that, as will appear, the pile loops push each other along the clearance. The element 58 has a horizontally broad upper surface as indicated at 62, and as shown at 64, its underside slopes upwardly and inwardly over a considerable portion of this broadened top of the element, this sloping portion, however, terminating in a downward trailing end 66 which effects camming action on the loops to push them downwardly and release them from the pins 36. It will be noted that the element 58 at its broad portion 62 is approximately concentric with the shaft 32 inwardly of the pins 36.

The operation of what has just been described is as follows, with particular reference to the diagrammatic FIGURES 7 and 8 which show the formation and progress of the loops of the pile yarn P. As already stated, the base yarn N is formed in conventional fashion into relatively tight loops to produce the effect of a base fabric. Included with this yarn in the loops are the base portions of the pile loops which are thus incorporated in the fabric. Since the basic loop forming operations are quite conventional as they would be for the ordinary feeding of a pair of yarns at a feed point, they need not be particularly described. Accordingly, there will be stressed primarily only the special handling of the yarn P to form the elongated pile loops.

Six pins 36 are provided, and the gear drive thereof is such that one of the pins passes between each pair of

needles during operation. As will be evident, the pins rotate necessarily at a quite rapid rate as compared with the rate of circumferential needle travel, and accordingly draw the pile loops correspondingly rapidly. Referring particularly to FIGURE 7, it will be noted that the particular pin 36' is about to engage the portion of the yarn P extending between a pair of needles which are, at the time of such engagement, at the position of the cam dwell 12.

The pin preceding 36' is still drawing its loop L_1 and this loop is shown in a position in which it is about to enter the clearance between the elements 48 and 58, i.e. the clearance defined by the beveled edge 54 and the step 60. As this loop is carried still further around it will be engaged by the edge 66 of the top portion 62 of element 58 and will be cammed down thereby so as to be pushed off the lower end of its pin. In FIGURE 7 the loop L_2 has been shown as already released by the next preceding pin. As each newly formed loop enters the clearance, being drawn therein by its pin, it will push the preceding loop along the clearance where they will be held with substantial friction, particularly against any movement thereof in a direction outwardly of the cylinder axis. They thus become bunched tightly together as indicated in FIGURE 7 with some release of this bunching effected as the needles which hold them advance relatively to the elements. During the pushing and other advance the needles are lowered by the stitch cam 14 so that the bases of the pile loops are incorporated in knit stitches with the yarn N, thus becoming securely locked. Control on the pile loops is effected by the frictional action of the clearance between 54 and 60, looseness of the pile yarn at the needle being thus prevented. Proper drawing of loops accordingly occurs over the upper edges of the needle slot walls. By the time the pile loops are released from the clearance they are fully formed and locked.

It will now be evident that the formation of the long pile loops is not attended with the yarn being dragged over numerous edges to produce such friction as might result in breakage. It will be apparent that the loops in this modification of the invention are almost successively formed with little overlap of their formation period. This is due to the high speed of loop drawing effected by the pins 36. It might appear that a subsequently formed loop may involve robbing of yarn from a preceeding loop; i.e. it might seem that in the further elongation, though slight) of the loop L_1, there might be some robbing of yarn from the previously formed loop L_2 which has been released by its pin. However, there is little or no such robbing in view of the fact that the clearance at 54, 60 imposes substantial friction on all loops within this clearance (including L_2) and due to the dwell at 12 the friction imposed on the feed of yarn from the eye 44 is relatively small and due primarily merely to such tension as may be applied to the yarn P in advance of the eye 44. Thus, the yarn is freely available from the supply to form the elongate loop. It will also be noted that at this time the loop which is being drawn has not yet been lowered by a needle so that it must reeve over the upper edge of a needle slot wall. Engagement with this edge occurs only after the needle has approached the lower end of the stitch cam.

It will be evident from the above that the lengths of the pile loops which are provided are determined by two factors: the radius of the circle of movement of the pins 36 and the location of the point, 66, at which the loops are pushed off the pins 36 so that drawing of the loops terminates. Clearly, loops of various lengths may be drawn merely by changing the dimensional arrangement. For a great variety of fabrics, only a single set-up of the machine is necessary since generally in the ultimate finishing of the pile fabric the loops are sheared to a desired height of the final pile.

However, it is sometimes desirable to provide an extremely high pile, and in such cases the arrangement described may be modified as illustrated particularly in FIGURES 9 and 10, the arrangement therein shown being capable of producing very long pile loops of the order, for example, of six to eight inches, simulating fur or the like.

Since this modification may involve only the substitution of other elements for those designated 48 and 58, FIGURES 9 and 10 illustrate only the substituted elements plus a cutter which is desirably used, and the elements which are the same as those previously described are designated by the same reference numerals.

The bracket 46 carries an element 70 which, except for a somewhat steeper angle is essentially the same as the element 48 previously described, being provided with a bevelled upper edge 72 which is embraced, with slight slight clearance, by a step 74 formed in an element 76 which corresponds closely to the element 58 previously described, being mounted in the bracket 56. The shank of the element 76 is cylindrical and supports an extension portion 78 which has a continuation of the step 74 formed at its radially outward edge. The extension portion 78 differs from the enlargement 62 of the earlier modification in that it is formed with a substantially greater slope in the direction of relative needle movement and has a shape such that instead of camming loops off the pins 36 it acts as a retainer about which the loops are folded.

The operation involved in this modification will be evident from FIGURE 10 in particular. As previously described with reference to the first modification, the pins 36 enter between each pair of needles to draw pile loops. As their loops are enlarged, however, the extension 78, due to its contour shape, does not cam the loops off the pins but rather, as the pins pass approximately through 90° of their rotations, holds the loops so that they are folded about the extension 78 and are drawn over the cylindrical shank 76. FIGURE 10 indicates diagrammatically paths of loops as they are held by one of the pins 36'' and by the second pin preceding this indicated at 36A, the loop carried by the intermediate pin being omitted for the sake of clarity.

As will be evident from the paths of the loops, the loop passing to the pin shown at 36A is considerably elongated, in excess of any loop formed in accordance with the first modification. This means that several loops are being drawn simultaneously, but due to the rapid movement of the pins 36, and the passage of the pins between the needles at the location of the cam dwell 12, this multiple drawing of loops occurs while the hooks of the needles are well above the top of the needle cylinder and since the shanks are smooth the reeving of yarn which occurs involves little friction despite the tortuous path imparted to the yarn. It is only after the loops are drawn to their full lengths that the needles are lowered to draw stitches, under which latter situation the reeving would no longer be free.

Release of the loops in this modification is not effected by pushing the loop ends off the pins, though this may be done by providing a suitable pushing cam, but by severing the loops, for which purpose there is provided an adjustable carrier 80 of a knife 82 which upon engagement by the tensioned loop severs its leading side effecting release. While the two ends of the loop will thus be of slightly different lengths, this is generally unobjectionable even if no further shearing is involved. Usually, however, the pile loops are ultimately sheared to a desired approximately constant length.

When it is desirable not only to sever the pile loops but to brush or comb them to separate the fibers to form a soft or fluffy pile, there may be used the attachment illustrated in FIGURES 11 and 12 which is illustrated as associated with the pile forming elements described with reference to FIGURES 1 to 8, inclusive.

The shaft 26 is provided at its end with a sprocket

which drives through a chain 84 a corresponding sprocket on one end of a countershaft 86. A sprocket at the other end of the latter shaft drives through chain 88, a sprocket mounted on a shaft 90 which carries a suitable brush 92 formed, for example, of stiff metallic wires. The shaft 90 is mounted in a bracket 94 pivoted at 96 to another bracket secured to the cam ring. The brush 92 and bracket 94 of their own weight product the desired pressure of the brush on the fabric interiorly of the needles and at the location of the last formed pile loops. These are brushed downwardly and concurrently severed with fraying of their component filaments.

The pile-forming yarn P may obviously be of any type desired to produce the ultimate results which are required. Whatever the results may be, there is the common aspect of the pile fabrics that the pile strands are incorporated in the knitted base fabric and are therefore securely locked against removal or slippage. The final fabric has elasticity characteristics corresponding to those of other knit fabrics, and accordingly the fabrics are particularly advantageous where, as in upholstering there is the requirement that they should conform to curved surfaces.

It will be evident that various changes may be made in details without departing from the scope of the invention as defined in the following claims.

What is claimed is:

1. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movement of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, and means for effecting disengagement of said bights from said elements, the last mentioned means comprising a cam for engaging the bights to move them from said elements.

2. In a circular knitting machine a cylinder mounting independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, and means for effecting disengagement of said bights from said elements, said elements being in the form of pins secured in fixed relation to a rotary carrier mounted on an axis parallel to the needle cylinder.

3. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, means for effecting disengagement of said bights from said elements, and means for holding and guiding said drawn bight following said disengagement for progressive movement in a direction transverse to their lengths.

4. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, means for effecting disengagement of said bights from said elements, and means for holding and guiding said drawn bights following said disengagement for progressive movement in a direction transverse to their lengths and restraining them against lengthwise movements.

5. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, means for effecting disengagement of said bights from said elements, and means for holding and guiding said bights following said disengagement for progressive movement and restraining them against lengthwise movements, the last mentioned means comprising elements providing a clearance imparting a tortuous path for the bights.

6. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, and means for holding and guiding said drawn bights in lateral engagement with each other for progressive movement in a direction transverse to their lengths.

7. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, and means for holding and guiding said drawn bights in lateral engagement with each other for progressive movement in a direction transverse to their lengths and restraining them against lengthwise movements.

8. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, and means for holding and guiding said bights for progressive movement and restraining them against lengthwise movements, the last mentioned means comprising elements providing a clearance imparting a tortuous path for the individual bights.

9. In a circular knitting machine having independent needles, means for feeding a base yarn to the needles, means for feeding a pile-forming yarn to the needles, means for effecting longitudinal movements of the needles to draw stitches of both the base and pile-forming yarns, elements movable in succession between pairs of needles to engage and draw bights of said pile-forming yarn, means for so moving said elements, means for effecting disengagement of said bights from said elements, and a brush for brushing said bights in the direction of their free ends.

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