United States Patent

[11] 3,590,604

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Division of Ser. No. 525,554, Feb. 7, 1966, Pat. No. 3,413,823.
[45] Patented **July 6, 1971**

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[54] **KNITTED PILE FABRIC**
3 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **66/191,** 66/194
[51] **Int. Cl.** **D04b 9/14**
[50] **Field of Search** ..... 66/9 B, 191, 194

[56] **References Cited**

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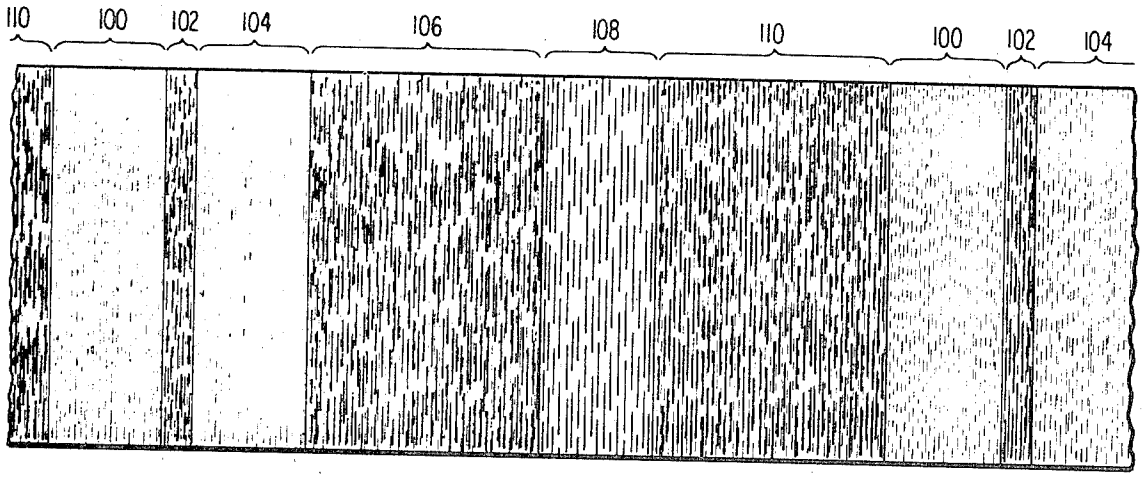
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Primary Examiner—Robert R. Mackey
Attorney—Burns, Doane, Swecker & Mathis

ABSTRACT: A circular knit, deep pile fabric simulating in appearance and texture a natural furpiece formed by seaming together animal pelts. The pile is made up of long, dark-colored fibers and short, light-colored fibers. Wale-to-wale differences in total numbers of pile fibers and in the relative proportions of two types of fibers provide color shading and texture effects simulating not only the pelts of animals but also the seaming characteristics associated with garments formed from pelts.



LEGEND

RELATIVELY SHORT, RELATIVELY LIGHTWEIGHT FIBERS OF LIGHTER SHADE SUPPLIED BY THE SLIVERS 26.

RELATIVELY LONG, RELATIVELY HEAVY FIBERS OF DARKER SHADE SUPPLIED BY THE SLIVERS 28.

HIGH DENSITY BLEND OF SHORT AND LONG FIBERS.

FIG. 1

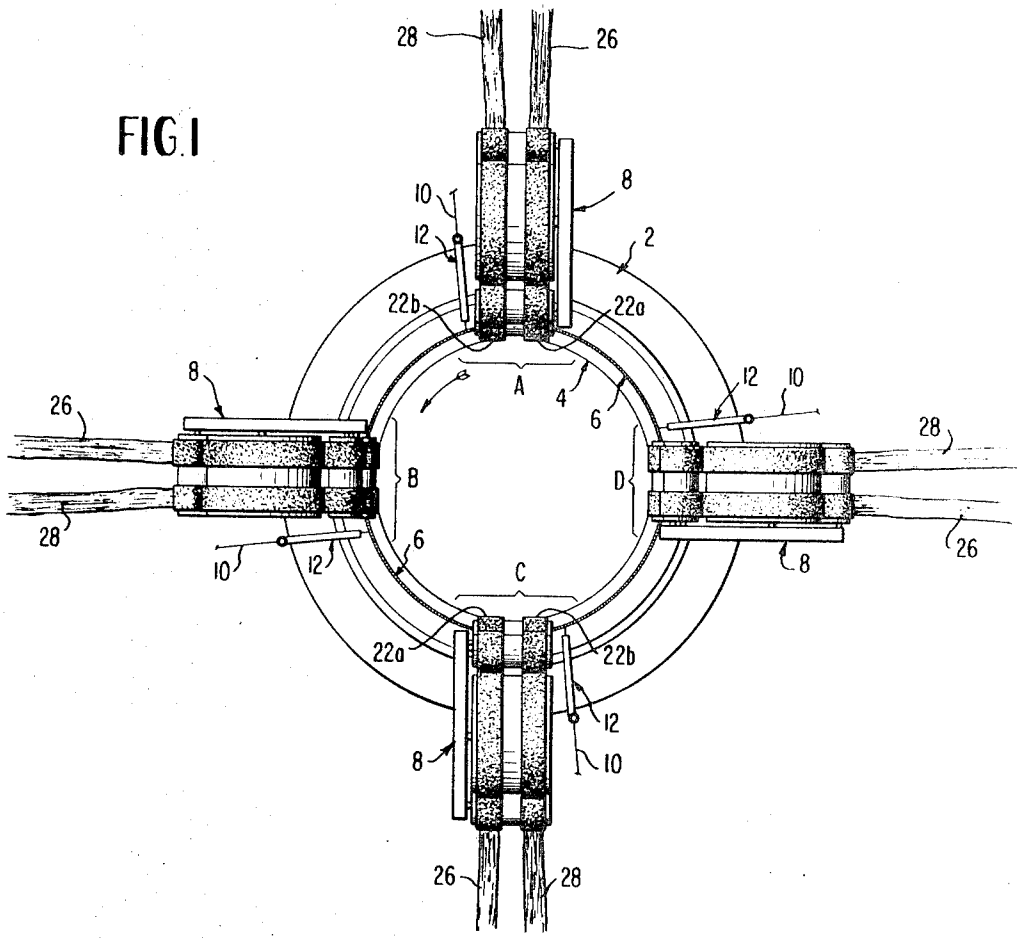
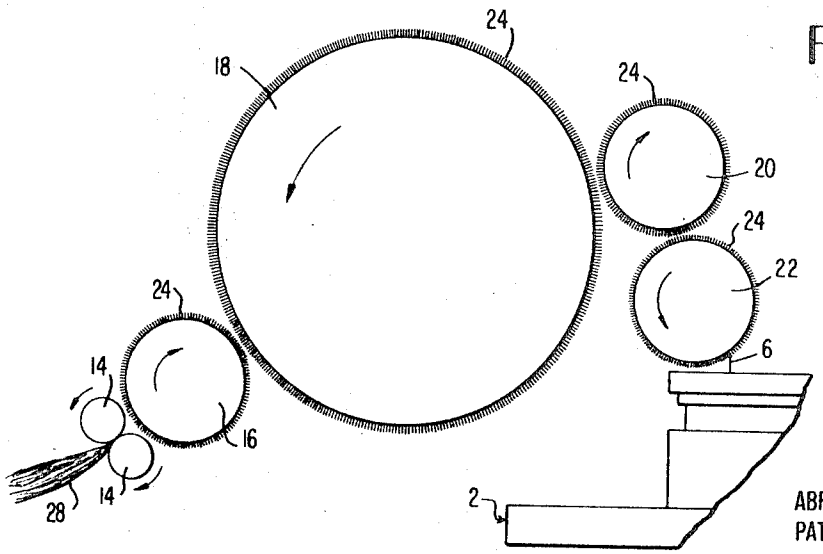


FIG. 2



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FIG.4

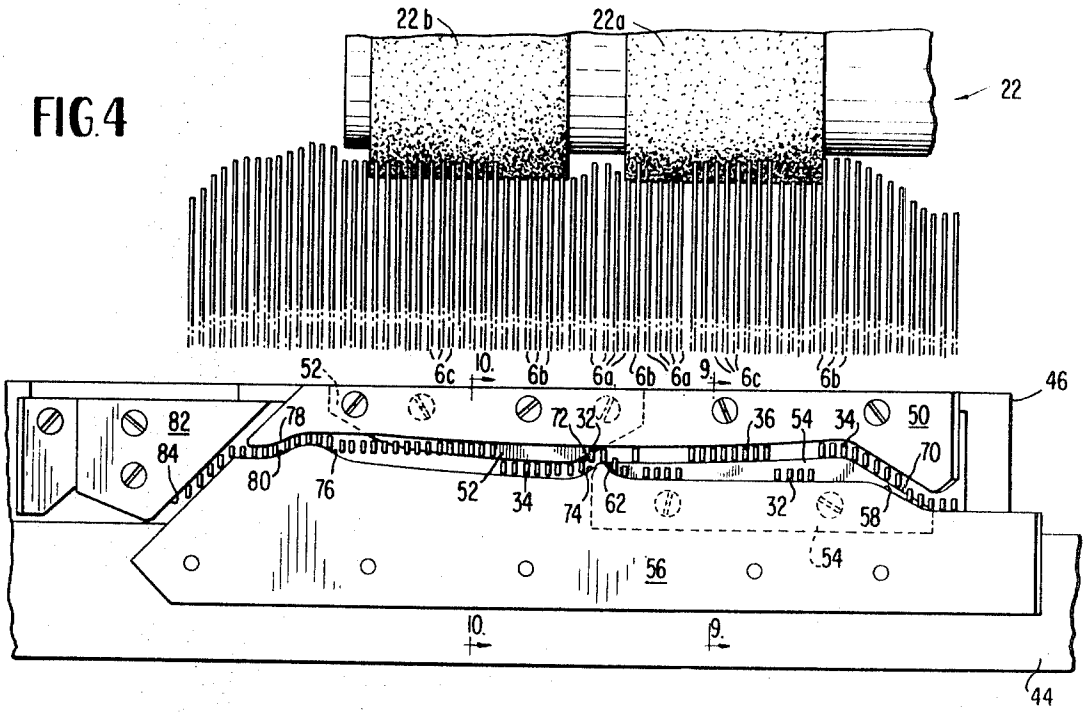
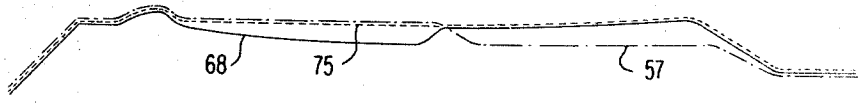


FIG.5



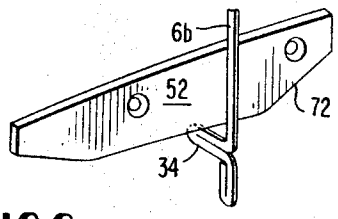


FIG.6

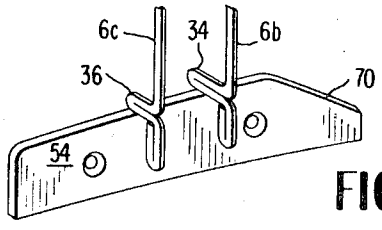
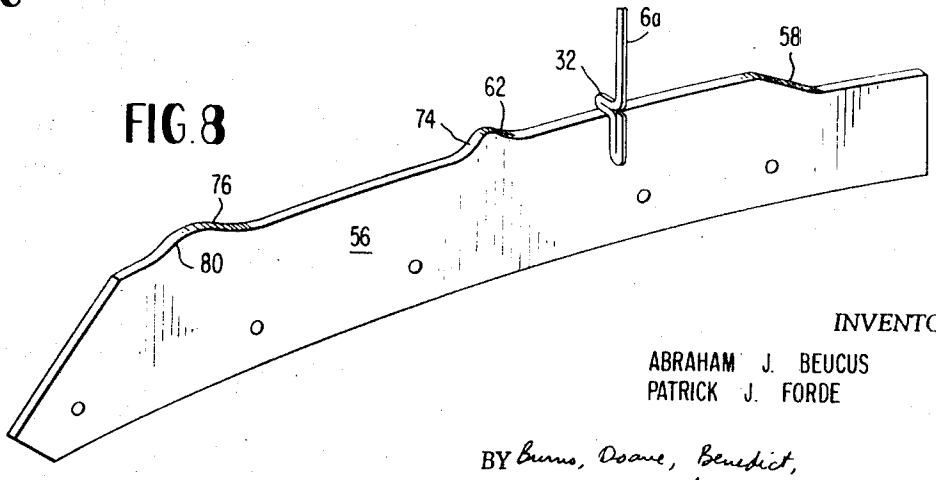


FIG.7

FIG.8



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FIG.3

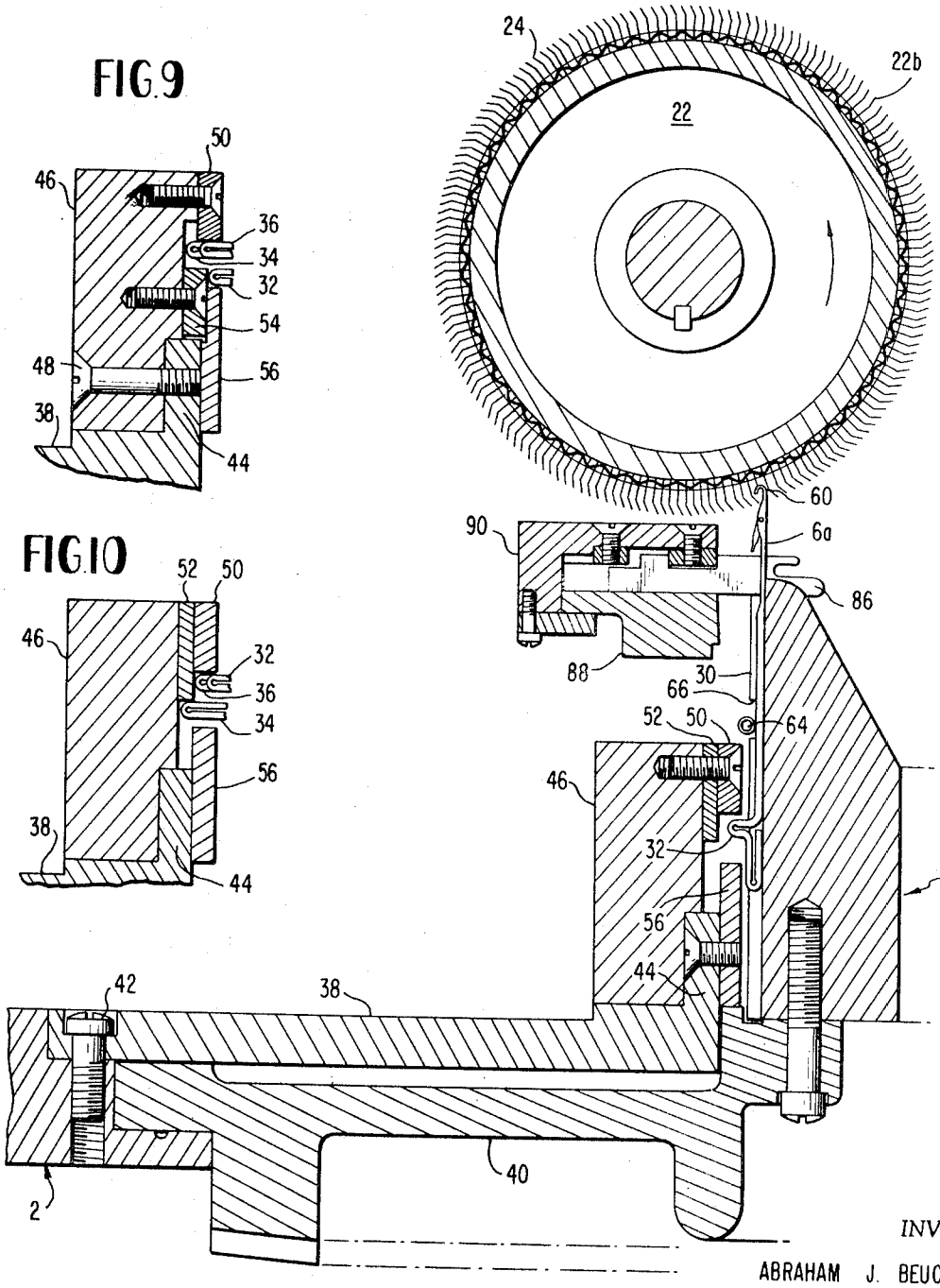


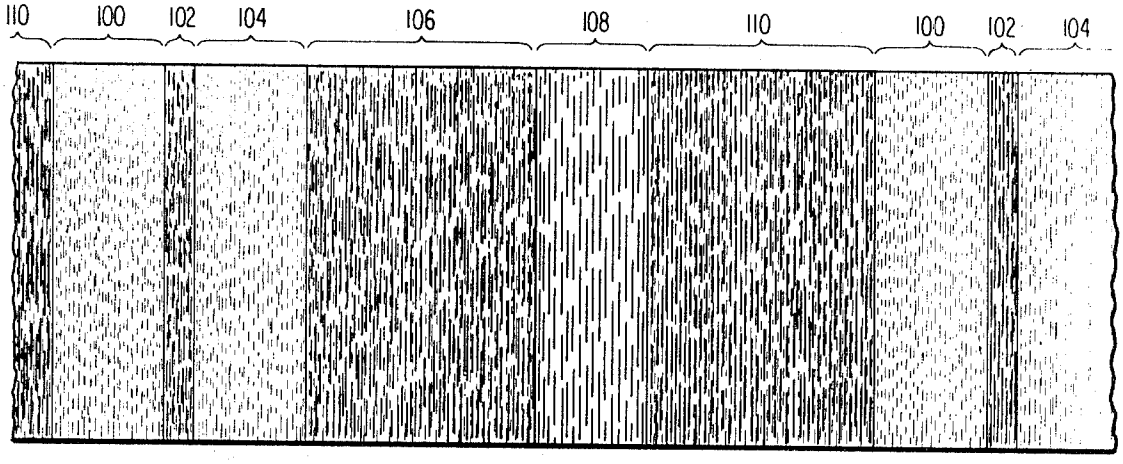
FIG.9

FIG.10

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FIG. 11



LEGEND

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KNITTED PILE FABRIC

This is a division of application Ser. No. 525,554, filed Feb. 7, 1966, and now U.S. Pat. No. 3,413,823.

This invention relates to novel fabric constructions simulating furs and adapted to be manufactured commercially through the use of improved deep pile knitting apparatus.

In a typical commercial installation, deep pile fabrics are manufactured on circular knotting machines equipped with carding means that take fibers from slivers, or other loosely bound fiber assemblies, and supply these fibers to the hook portions of the knitting needles. Body yarns also are supplied to the hook portions of the knitting needles, and as the needles are manipulated to draw the body yarns into interlocked loops, the pile fibers supplied by the carding means are bound in with the body yarn loops. The end portions of the fibers project from the body yarn loops to form a pile surface on the knitted fabric. Ordinarily, airjets are directed toward the hook portions of the needles so as to dispose the pile fibers on the inside surface of the circular knit fabric. After the knitting operation, the tubular fabric is slit longitudinally and subjected to suitable finishing treatments such as shearing and the like.

Proposals for the production of longitudinally extending pattern effects such as stripes in these knitted pile fabrics have been advanced heretofore. See for example U.S. Pat. No. 1,894,596 to Moore and U.S. Pat. No. 2,953,002 to Hill. However, these proposals were not entirely adequate and a need for improved apparatus continued to exist.

Such improved apparatus is disclosed in said U.S. Pat. No. 3,413,823. This apparatus is capable of knitting at high production rates pile fabrics having a wide variety of carefully controlled longitudinal pattern effects. Through use of the improved apparatus one can achieve a high degree of precision in patterning without any sacrifice in knitting machine production capacity.

Another object of this invention is the provision of novel fabric constructions, particularly artificial fur fabrics, embodying improved patterning effects. These fabrics can advantageously be manufactured through the use of the apparatus of said U.S. Pat. No. 3,413,823.

In this apparatus, body yarns are supplied to the hook portions of the knitting needles of a circular knitting machine at each of a plurality of feed stations located at intervals about the periphery of the needle cylinder and pile fibers having different characteristics are selectively supplied to the hook portions of individual ones of the needles just prior to the point at which each body yarn is supplied. Just after receiving a body yarn, each needle is actuated in the conventional manner to form a body yarn stitch having the pile fibers protruding therefrom. Carding apparatus located at each feed station takes fibers from a plurality of slivers and delivers fibers from the respective slivers to axially spaced portions of a doffer disposed adjacent the periphery of the needle cylinder. As the needle cylinder rotates, the individual knitting needles move successively past one portion of the doffer and then the other portion of the doffer in their travel toward the adjacent body yarn feed station. The individual knitting needles are provided with laterally protruding butt portions, and stationary cam means are disposed in proximity to the periphery of the rotating needle cylinder at each feed station in position to be contacted by the needle butts to control the positions of the needle hooks with respect to the doffer.

Selectively in fiber pickup is achieved through the use of needle butts of different lengths and an arrangement of cam surfaces capable of causing the needles to follow different paths. For example, long butt needles may be moved into contact with one portion of the doffer to pick up fibers therefrom, short butt needles may be moved into contact with the other doffer portion, and needles bearing butts of an intermediate length may be brought into contact with both of the doffer portions.

One of the novel fabrics capable of being produced through the use of this apparatus is a deep pile fabric that simulates in appearance and texture a natural fur piece formed by seaming together animal pelts. The desired effects are achieved by attaching to different wales of the base fabric different pile fiber contents. Some wales have projecting therefrom only short, light-colored fibers; some have only long, dark-colored pile fibers; and some have both the short, light-colored fibers and the long, dark-colored fibers. Controlled wale-to-wale pile density variations also play an important role in giving the fabric the proper "feel" characteristics.

A more complete understanding of the invention will be gained from a consideration of the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a somewhat diagrammatic plan view illustrating a circular knitting machine equipped for the production of fabrics in accordance with the invention;

FIG. 2 is a diagrammatic elevational view depicting one of the pile fiber carding and feeding units of the apparatus shown in FIG. 1;

FIG. 3 is an enlarged vertical cross-sectional view through a portion of the needle cylinder of the apparatus of FIG. 1, illustrating the operative relationship between a knitting needle and the doffer of one of the pile fiber carding and feeding units;

FIG. 4 is an elevational view of the cam means for controlling the positions of the knitting needles relative to the fiber supplying doffer at one of the feed stations, portions of the needles and the doffer being shown to indicate the effects produced by the various cam surfaces;

FIG. 5 is a line diagram shoeing the paths followed by the different types of knitting needles as they pass through one of the feed stations on the machine;

FIGS. 6, 7 and 8 are perspective views of individual ones of the cam members of the assembly shown in FIG. 4;

FIGS. 9 and 10 are vertical cross-sectional views illustrating the effects produced by the various cam surfaces on needle butts of different lengths; and

FIG. 11 is a diagrammatic view illustrating a repeat of a pattern of walewise bands of different pile fiber contents in a novel artificial fur fabric of this invention.

The general arrangement of the components of the apparatus will be evident from FIGS. 1 and 2. Stationary frame means suggested at 2 serves to support a rotating needle cylinder 4 carrying vertically reciprocable knitting needles 6 in slots or grooves on its periphery. As the needle cylinder 4 rotates past a feed station A, the knitting needles 6 are moved upwardly in sequence to receive in their hook portions pile fibers from a carding and feeding unit 8 and a body yarn 10 from supply means indicated at 12. Then each needle is moved downwardly to draw a loop of the body yarn 10 through a previously formed body yarn loop, to cast off such previously formed loop, and to cause the pile fibers to become interlocked with the body yarn loops. This sequence is repeated at each of the remaining stations B, C and D, so that four courses of body yarn stitches are formed during each revolution of the cylinder. Airjets, not shown, are directed toward the needles 6 in the customary manner to orient the pile fibers so that they protrude from the body yarn loops toward the interior of the knitted tube.

The number of the stations A, B, etc., should be as great as is permitted by space limitations and the like, because the rate of fabric production is a function of the number of feeds and economy is of utmost importance in the manufacture of deep pile knitted fabrics. Four feed stations have been illustrated in FIG. 1 as exemplary of suitable high-production equipment. In practice the invention has been made successfully on machines having as many as five feeds and operated to produce five courses of knitted stitches during each revolution of the cylinder.

Each of the pile fiber carding and feeding units 8 includes a pair of sliver feed rollers 14, a lickerin 16, a main drum 18, a

transfer roll 20, and a doffer 22. These components are rotated in the directions indicated by the arrows in FIG. 2, and all of them except the sliver feed rollers 14 bear conventional card clothing 24 on their peripheries. However, as indicated in FIG. 1, there is a centrally located gap in the card clothing on each of the components 16, 18, 20 and 22. By reason of these gaps in the card clothing, the unit 8 is divided into two axially spaced-apart fiber paths.

In accordance with the invention, slivers of different types are supplied to each of the units 8. In FIG. 1 the numerals 26 and 28 have been applied to two slivers that differ from one another in color and/or in some other characteristic. For purposes of explanation, it will be convenient to assume that the fibers of the slivers 26 are white and that the fibers in the slivers 28 are gray. The two types of slivers are delivered to axially spaced portions of the feed rolls 14 and the gaps in the card clothing serve to keep the fibers from the respective slivers in spaced paths as they move through the unit 8. Hence, the card clothing at one end portion 22*a* of the doffer 22 will be supplied continuously with white fibers from the sliver 26 and the card clothing at the other end portion 22*b* of the doffer will be supplied continuously with gray fibers from the sliver 28.

The manner in which the knitting needles 6 are caused to cooperate with the doffers 22 of the various fiber carding and feeding units 8 will now be explained in connection with FIGS. 3 through 10. These views illustrate in some detail the structures located at one of the feed stations, and it will be understood that the other stations are similar.

In the illustrated apparatus, three types of knitting needles are positioned in the slots 30 at the periphery of the needle cylinder 4. All of these needles are provided with laterally extending portions called "butts." However some of the butts are longer than others. Some needles 6*a* have short butts 32, some needles 6*b* have long butts 34, and some needles 6*c* have butts 36 of intermediate length.

The vertical positions of the knitting needles are controlled by stationary cam means disposed adjacent the periphery of the rotating needle cylinder 4 at each of the stations A, B, etc. As is conventional, a base casting 38 overlies the radially projecting portion of the ring gear 40 to which the needle cylinder 4 is attached. The base casting 38 is fixed, as by screw means 42, to the machine frame 2. At its inner edge the base casting 38 is provided with an upwardly extending annular flange 44 to which the cam means serving the various stations A, B, etc., may be secured.

An arcuate cam block 46 is fixed on the base casting 38 at each station as by means of screws 48 (FIG. 9). The cam block in turn serves as a support for arcuate cams 50, 52 and 54. Another arcuate cam 56 is fastened directly to the inner face of the flange 44 on the base casting 38 at each of the stations A, B, etc. The spacial relationships between the edges of the cams 50, 52, 54 and 56 and the periphery of the needle cylinder 4 are related to the lengths of the needle butts 32, 34 and 36. The short needle butts 32 can be acted upon only by the surfaces of the innermost cams 50 and 56. The intermediate length needle butts 36 protrude outwardly from the cylinder far enough to be acted upon by the surfaces of an additional cam 54, and the long needle butts 34 extend into the zone of action of still another cam 52.

The effects attributable to the various cam surfaces can best be explained by tracing the paths of various types of needles through the assembly shown in FIG. 4. As the needle cylinder rotates the individual knitting needles will move from right to left in FIG. 4.

The path of a needle 6*a* having a short butt 32 will be considered first. This path is designated 57 in FIG. 5. As the needle 6*a* moves into the vicinity of the doffer 22, its butt 32 will contact an inclined surface 58 on the cam 56 and the needle 6*a* will be moved upwardly in its slot 30 (FIG. 3) on the needle cylinder 4 to a position such that the hook portion 60 at the upper end of the needle is just below the card clothing 24 on the doffer section 22*a*. The needle 6*a* retains this elevation throughout its traverse of the doffer section 22*a*, so that its hook portion 60 does not enter the card clothing to pick up white pile fibers therefrom. In the zone where there is no card clothing 24 on the doffer 22, the needle 6*a* is given another lift as its butt 32 rides up along an inclined surface 62 of the cam 56. This additional lift positions the hook portion 60 of the needle 6*a* at a level such that it may enter the card clothing 25 on the doffer section 22*b* to pick up gray fibers therefrom. During its traverse across the doffer section 22*b*, the needle 6*a* is retained in its fully elevated position by frictional engagement with the walls of its slot 30 in the needle cylinder and by the holding action of a spring 64 disposed in a circumferential slot 66 (FIG. 3) in the needle cylinder 4.

The path followed by a needle 6*b* having a long butt 34 is designated 68 in FIG. 5. As the needle 6*b* moves into the vicinity of the doffer 22, its butt 34 will contact an inclined surface 70 on the cam 54 and the needle will be moved upwardly in its slot 30 on the needle cylinder 4 far enough to permit its hook portion to enter the card clothing 24 on the doffer section 22*a*, so that white pile fibers will be picked up by the hook portion of the needle. In the central zone where there is no card clothing 24 on the doffer 22, the butt 34 of the needle 6*b* will contact a downwardly inclined surface 72 on the cam 52 and the needle 6*b* will be lowered in its slot 30 sufficiently to permit its hook portion 60 to pass beneath the card clothing 24 on the doffer 22*b* without picking up pile fibers therefrom. It should be observed that the cam 56 is relieved at 74 so as not to interfere with the desired downward movements of the needles 6*b*.

The path of a needle 6*c* having a butt 36 of intermediate length is designated 75 in FIG. 5. The initial portion of the path 75 is the same as the initial portion of the path 68 followed by the long butt needles 6*b*. The butt 36 on each needle 8*c* contacts the inclined surface 70 on the cam 54 and the needle 6*c* is elevated far enough to permit entry of its hook portion into the card clothing 24 on the doffer section 22*a*. However, the intermediate length butt 36 is not long enough to reach to the cam 52. Consequently, the needle 6*c* is not lowered by the inclined surface 72 on the cam 52 and such needle remains in an elevated position as it moves by the second doffer section 22*b*. Although there is no cam surface beneath the butt 36 in the zone of the doffer section 22*b*, the frictional forces between the needle 6*c* and the walls of its slot 30 in the needle cylinder 4 and the forces exerted by the spring 64 (FIG. 3) are sufficient to retain the hook portion 60 of the needle at the elevation required for proper pile fiber pickup action.

It will now be understood that the knitting needles of the different types 6*a*, 6*b*, and 6*c*, acquire different pile fiber loads as they traverse the doffer 22. Since effective fiber pickup can be achieved only when the hook portions of the needles are actually inserted into the card clothing on the doffer, the short butt needles 6*a* acquire a few if any of the white fibers carried by the doffer section 22*a* but they do pick up the gray fibers carried by the doffer section 22*b*. Similarly, the fiber load acquired by each of the long butt needles 6*b* consist substantially of the white fibers supplied by the doffer section 22*a*. The needles 6*c* of the third type cooperate effectively with both of the doffer sections 22*a* and 22*b*, picking up both white fibers and gray fibers.

After leaving the fiber pickup zone, all of the knitting needles are given motions appropriate for effective body yarn pickup and stitch formation. An upwardly inclined surface 76 on the cam 56 contacts all of the needle butts 32, 34 and 36, and the various knitting needles are raised in whatever amounts may be required to position them at the proper level for receiving the body yarn 10 in their hook portions 60. A downwardly inclined surface 78 on the upper cam 50 guides all of the needle butts down along a similarly inclined surface 80 on the cam 56, and then a conventional stitch cam 82 is contacted by all of the needle butts. As the needle butts 32, 34 and 36 are guided along the downwardly inclined surface 84 on the stitch cam 82, the hook portions of the knitting needles

move downwardly between adjacent ones of the sinkers **86** carried by the sinker ring **88** in the conventional manner, so that a loop portion of the newly supplied body yarn **10** will be drawn through a previously formed loop which rides up over the needle latch and is cast off. The sinker cap **90** and the other components associated with the sinkers **86** are conventional and they need not be described here in detail.

The particular longitudinally extending, or walewise, pattern effects achieved during use of the illustrated apparatus will depend upon the order or sequence of the needles of the various types **6***a*, **6***b* and **6***c* on the periphery of the needle cylinder and also upon the nature of the slivers **26** and **28** fed to the various supply units **8**. A detailed description of the mode of production of the novel simulated fur fabric of this invention will serve to clarify the patterning capabilities of the equipment.

In setting up the machine for the production of the simulated fur fabric, the needles **6** are disposed about the periphery of the needle cylinder **4** in repeating groups of 25 needles each. Within each group or "repeat" the order or sequence of needles of different types is as follows:

Four long butt needles **6***b*;
One medium butt needle **6***c*;
Four long butt needles **6***b*;
Eight medium butt needles **6***c*;
Four short butt needles **6***a*; and
Eight medium butt needles **6***c*.

The slivers **26** are made up of 3-denier artificial fibers cut to 1-inch staple lengths and having a white or very light gray color. The slivers **28** are made up of 24-denier artificial fibers cut to 2-inch staple lengths and having a darker gray color. The use of acrylic or modified acrylic fibers has been found to be particularly suitable. In one embodiment fibers of the type sold under the trade designation "ORLON" were used in the sliver **26**, and fibers of the types sold under the trade designation "VEREL" were used for the sliver **28**. In this particular embodiment, the "ORLON" sliver **26** was slightly heavier than the "VEREL" sliver **28**, the weight ratio being approximately 60 to 40. A 10-ounce "DYNEL" body yarn **10** may be employed.

With the apparatus set up in the manner just described, the short butt needles **6***a* pick up only the relatively long and relatively heavy fibers of the darker shade supplied by the slivers **28**. The long butt needles **6***b* pick up only the relatively short and relatively lightweight fibers of lighter shade supplied by the slivers **26**. The medium butt needles **6***c* pick up fibers from both of the slivers **26** and **28**, so that they are loaded with a fiber blend. Being in contact with the fiber supplying portions of the doffer **22** for a much longer time interval than the needles **6***a* or **6***b*, the medium butt needles **6***c* acquire changes of significantly greater density than the charges acquired by the short butt needles **6***a* or the long butt needles **6***b*.

In visualizing the pattern effects produced, one must keep in mind the fact that the knitted stitches formed by any given knitting needle in the machine define precisely a wale, or longitudinally extending row of stitches, in the fabric. Moreover, since any given needle till acquire the same type of pile fiber charge each time it passes one of the feed stations on the knitting machine, the pile also will be oriented in longitudinally extending rows.

The knitted tube formed on the knitting machine will have the pile fibers disposed on the interior face of the tube. This pile will vary in fiber content in accordance with the needle sequence described above. Specifically, a single coursewise repeat of the pattern will, as illustrated in FIG. **11**, include longitudinal rows or walewise bands of the following widths and fiber contents: a band **100**, four wales in width and containing only the short white fibers from the slivers **26**; a band **102** one wale in width and containing a greater fiber content made up of fibers from both the slivers **26** and the slivers **28**; a band **104**, four wales in width and containing only the short white fibers from the slivers **26**; a band **106**, eight wales in width and containing the heavy blend; a band **108**, four wales in width and containing only the long darker fibers from the sliver **28**; and a band **110**, eight wales in width and containing the blend.

This tubular fabric is slit longitudinally and then subjected to suitable finishing treatments. Although these treatments are individually well known and need not be described in detail here, it may be helpful to refer briefly to a particular sequence of treatments that has been found suitable in the production of the simulated fur fabric. The backing or body fabric should first be stabilized, as by a heat-setting treatment. Then the pile surface is processed to enhance its appearance. For example, the pile may be sheared, then polished, sheared again, subjected to a silicone spray, polished again, and then given a final shearing treatment.

The finished fabric has many desirable characteristics. The pile fibers of different lengths and shades give blend effects much like those which are observed in the natural pelts used for fur garments. Also, there are variations in pile density which appeal to the sense of touch. Most of the fabric wales are formed on the medium butt needles **6***c*, and the pile in these wales is composed of short fibers underlying and supporting the longer fibers. The density of the pile carried by the wales formed on the long butt needles **6***b* and the short butt needles **6***a* is substantially less. By interspersing the rows of relatively low density pile among the rows of relatively high density pile in the manner described, a lining effect is attained. This lining effect is not unlike that produced by the seaming together of natural pelts, as far as the sense of touch is concerned.

As will be apparent to persons skilled in the art, many other pattern effects can be achieved through the use of the principles of the invention. For example, if it be desired to produce a fabric in which there are color or texture variations within a given wale, the illustrated apparatus may be set up to deliver to a particular doffer section at one of the feed stations fibers that differ from those delivered to the corresponding doffer section at another feed station. Also, the nature of the fibers supplied to a given doffer section may be varied from time to time during operation of the equipment, as for example through the use of the techniques described in the U.S. Pat. No. 3,122,904 to Brandt.

Still other modifications and variations will suggest themselves to persons skilled in the art. It is intended therefore that the foregoing detailed description be considered as exemplary only.

What we claim is:

1. A knitted pile fabric comprising mutually interlocked body yarn loops forming courses and wales, said fabric including in a coursewise pattern repeat a first narrow walewise band carrying only short, fine pile fibers of one shade; a second wider walewise band adjacent said first band carrying a mixture of said short, fine pile fibers and long, coarse pile fibers of a different shade; a third narrow walewise band adjacent said second band carrying only said long, coarse pile fibers; and a fourth walewise band narrower than said first and third bands and being disposed adjacent said first band and carrying a mixture of said short, fine pile fibers and said long, coarse pile fibers; the quantity of pile fibers in the individual wales of said first and third bands being less than the quantity of pile fibers in the individual wales of said second and fourth bands, the plural shades producing blend effects and the variation in density producing touch and lining effects simulating an assembly of natural seamed pelts.

2. A knitted pile fabric according to claim **1** additionally including in said coursewise pattern repeat a fifth narrow walewise band adjacent said fourth band carrying only said short, fine pile fibers; and a sixth wider walewise band adjacent said third band carrying a mixture of said short, fine pile fibers and said long, coarse pile fibers; the quantity of pile fibers in the individual wales of said fifth band being less than the quantity of pile fibers in said sixth band.

3. A knitted pile fabric according to claim **2** wherein each of said first, third and fifth bands is about four wales in width, wherein each of said second and sixth bands is about eight wales in width, and wherein said fourth band is about one wale in width.