April 26, 1960 R. H. LAWSON ET AL 2,933,907

PILE FABRIC KNITTING APPARATUS

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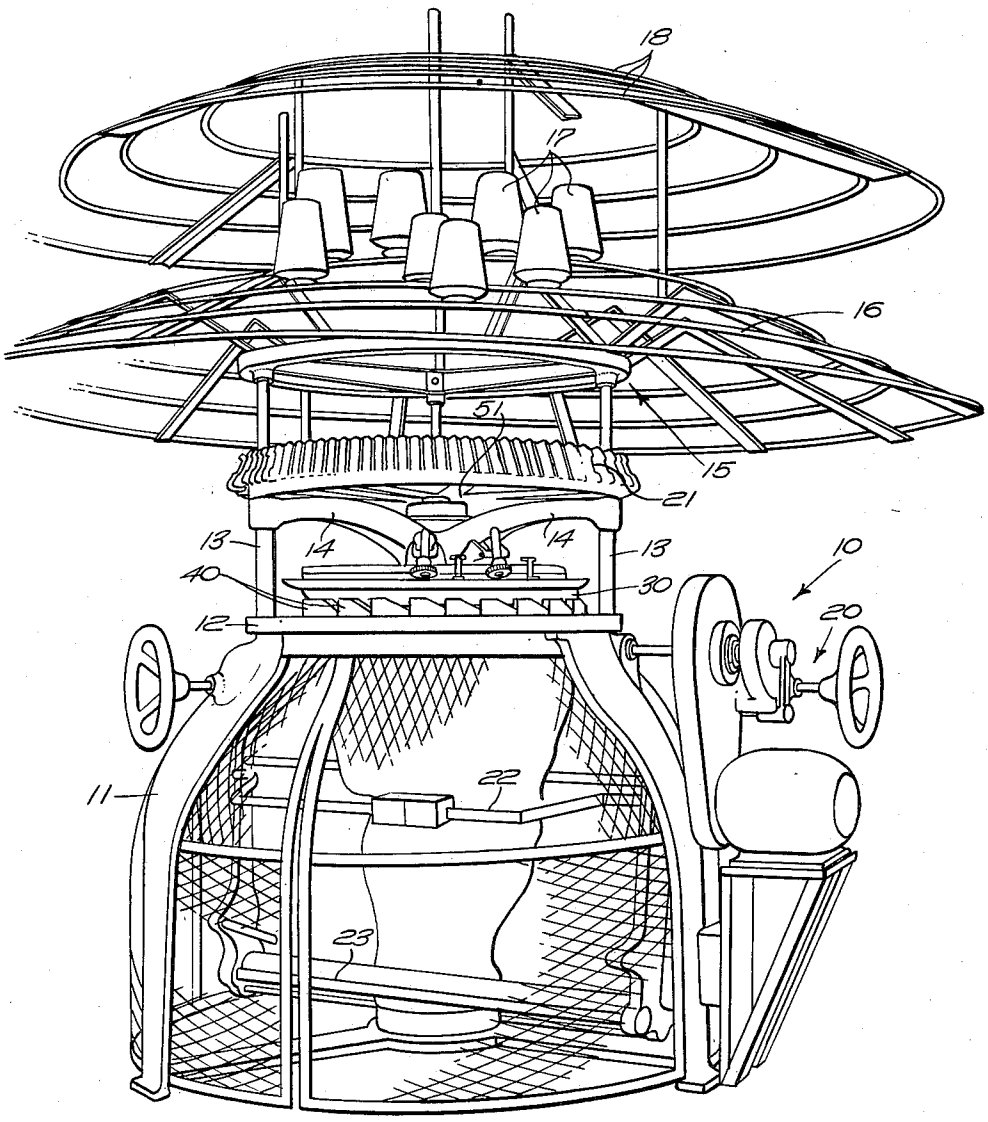


FIG. 1

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PILE FABRIC KNITTING APPARATUS

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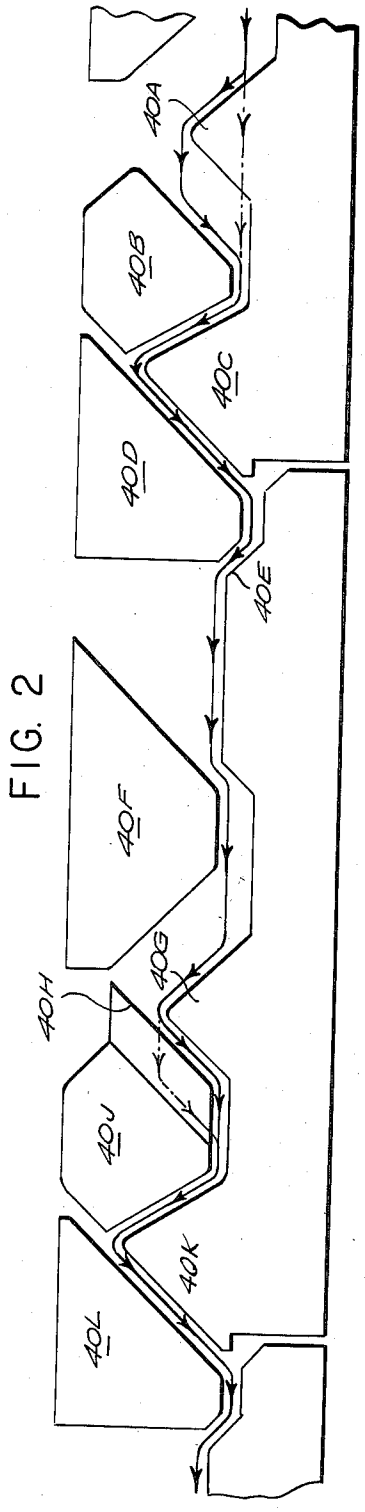


FIG. 2

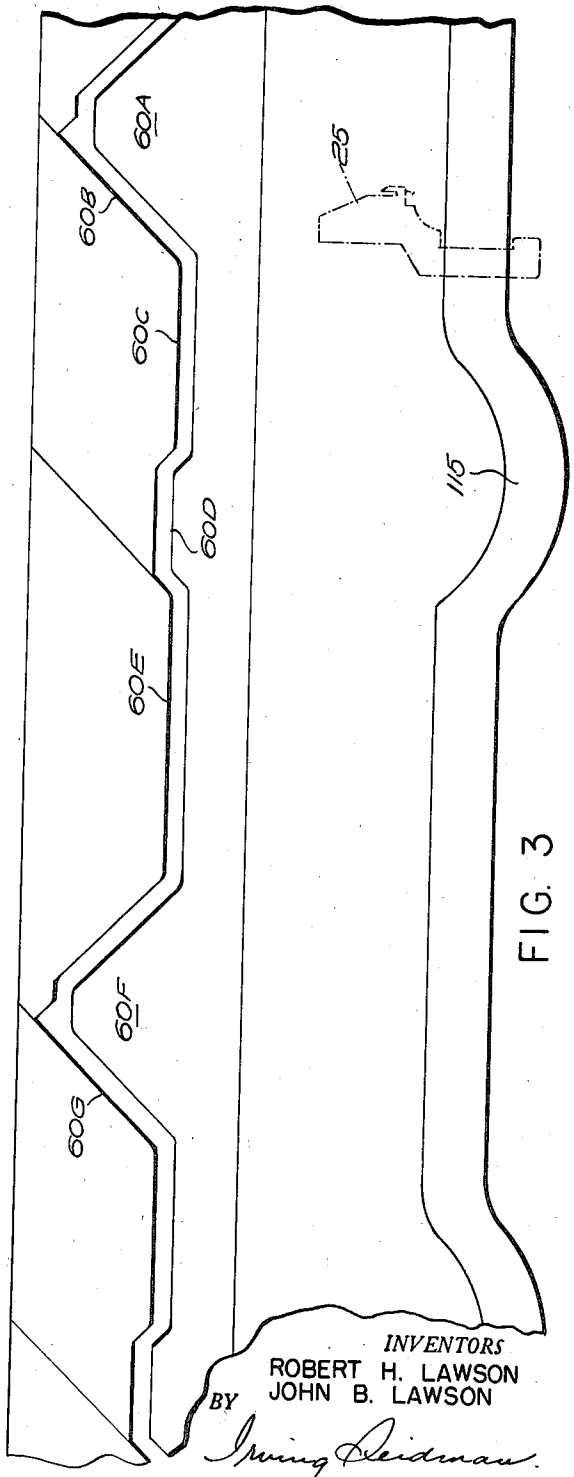


FIG. 3

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FIG. 4

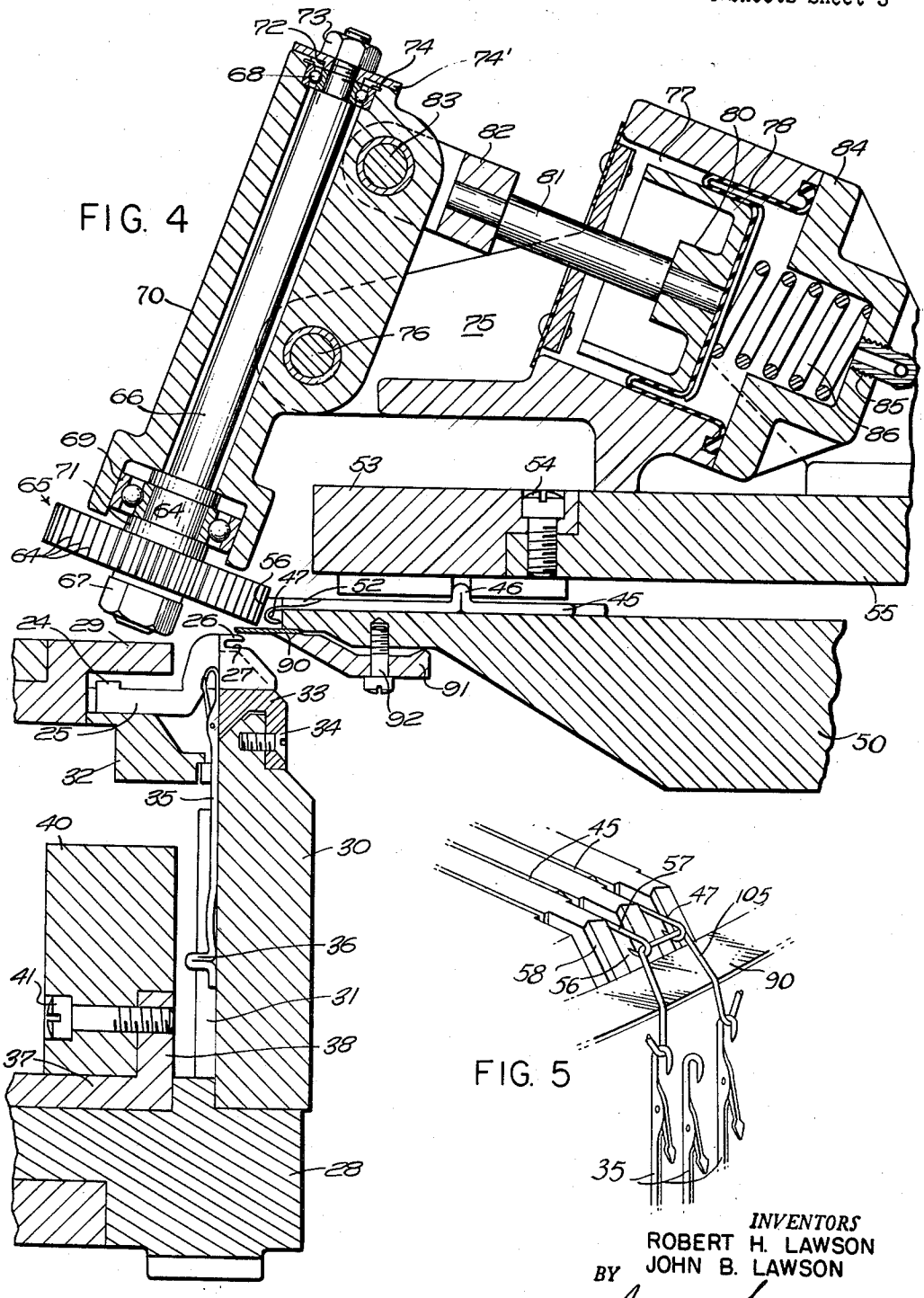


FIG. 5

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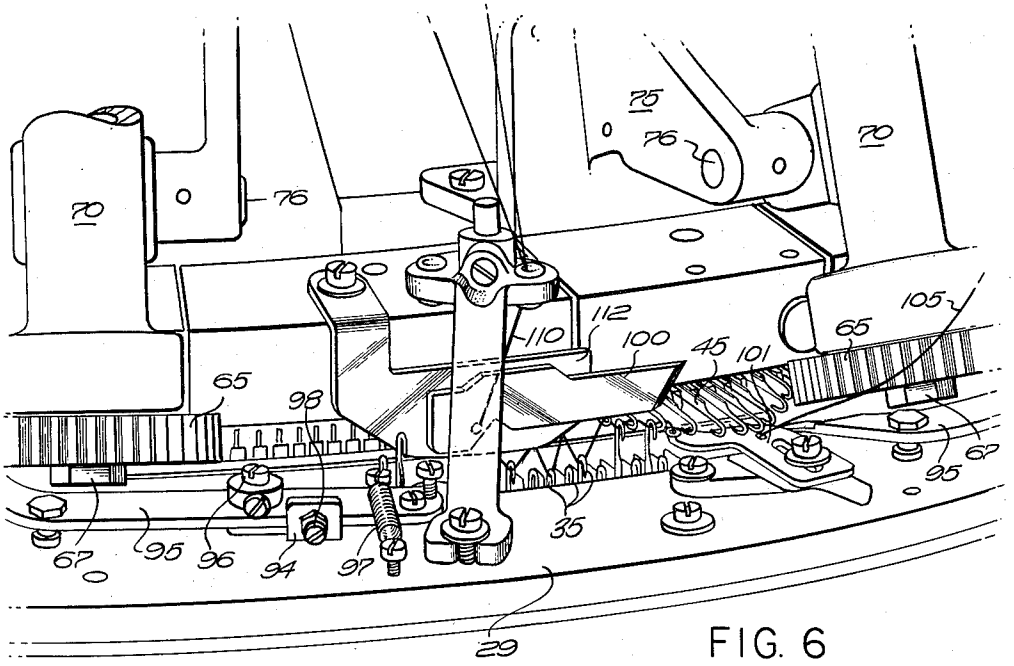


FIG. 6

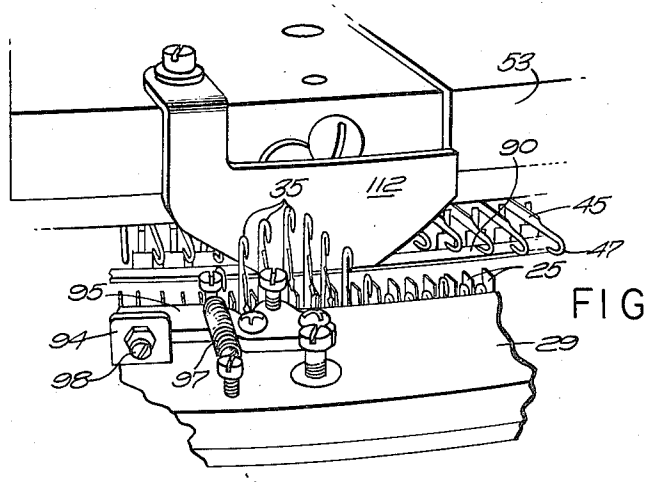


FIG. 7

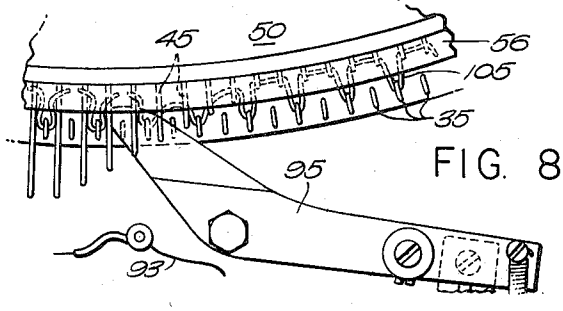


FIG. 8

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2,933,907

PILE FABRIC KNITTING APPARATUS

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Application March 30, 1959, Serial No. 802,971

17 Claims. (Cl. 66—93)

This invention relates to the knitting of pile fabrics and, more particularly, to improved apparatus for drawing pile loops and severing the loops to form cut pile.

Pile fabrics, such as terry cloth, towelling, etc. can be knit as a variation of plain jersey knit fabric, feeding two yarns instead of one. One yarn forms the pile loops, which may later be severed, if desired, and the other yarn forms the body of the fabric. In this case, the pile fabric is formed using latch cylinder needles cooperable with pile forming elements on a dial plate.

One known way of knitting a pile fabric on a jersey fabric knitting machine is to use latch cylinder needles cooperable with sinkers mounted in an outside dial, the needles and sinkers being cooperatively actuated by suitable cams which may have pattern wheels associated therewith. The sinkers are formed with noses and throats, and the needles draw the pile loop forming yarns down over the noses of the sinkers to form the pile loops. The stitch or body forming yarn is fed to the needles below the sinker noses and at the level of the sinker throats.

In another method, an inside dial is equipped with needles, and pile loops are formed by the continued movements of the dial and cylinder needles, the stitch or body yarn being picked up by the cylinder needles below the level of the dial needles. However, when the dial has a diameter of the order of the needle cylinder, the length of loop which can be drawn is seriously limited. On the other hand, relatively longer loops can be drawn by using a smaller diameter dial and by forming the loops by a combined drawing by the cylinder needles and dial hooks.

In many cases, it is desirable to form a cut pile by crushing or otherwise severing the pile loops while the latter are held drawn. Such severing may be effected by a crushing wheel pressed against the drawn loops. When using a relatively large diameter dial, at the expense of the pile loop length, the cut pile ends can be wiped under the dial out of the way of the crushing wheel. However, when using a relatively smaller diameter dial, to produce the more desirable longer pile loops, the cut pile ends cannot be moved under the dial and held there. As a result, the crushing wheel, in severing new loops, mashes the cut ends of previously severed loops with the production of a great excess of lint and of poorly cut loops.

In the present apparatus, the advantages of a relatively small diameter dial, as to drawing longer pile loops, are retained, while the loop severing difficulties mentioned above are eliminated. This is accomplished by positioning a relatively thin disk against the underface of the dial and projecting outwardly of the dial periphery. This disk holds the loops, either cut or uncut, away from the needles and the edge of the dial. The disk permits the use of a small dial enabling a longer loop to be drawn than heretofore possible. The disk provides a ledge over which the loops are drawn by the combined action of the cylinder needles and hooks radially reciprocable in dial slots, thus allowing more yarn to be drawn into the pile loops.

As a further feature of the invention apparatus, the crushing or severing wheels are mounted on the dial cap instead of on the machine base. This eliminates pressure against the dial spindle. In addition, the crushing wheels are biased by fluid pressure rather than by springs and have a substantially frictionless rotation mounting. The combination of these two factors provides a fast acting constant pressure of the cutting wheels against the dial to compensate for normal machining irregularities in the dial edge.

The dial is formed with an inwardly and upwardly sloping bevelled edge, in contrast to the usual vertical edge. The bevelled edge provides additional room for the web holder mechanism when crush cutting wheels are used. Such web holders are desirable as they permit a tighter fabric to be knitted as well as providing for starting the fabric on bare needles rather than running the fabric on.

For an understanding of the invention principles, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawings. In the drawings:

Fig. 1 is an elevation view of the apparatus in the partly disassembled condition;

Fig. 2 is a developed elevation view of the cams for operating the cylinder needles;

Fig. 3 is a combined partial bottom plan view of the dial and sinker cams shown as developed into rectilinear cams rather than annular as actually constructed;

Fig. 4 is a vertical sectional view radially through the apparatus, illustrating the crush cutting wheels, their fluid pressure biasing means, and associated pile forming and severing components;

Fig. 5 is a partial perspective elevation view illustrating the interrelation of the cylinder needles, the disk, and the dial edge;

Fig. 6 is a perspective elevation view of a knitting section illustrating the various guides used therewith;

Fig. 7 is a perspective elevation view illustrating the guide for lowering the pile loops below the latches of the cylinder needles; and

Fig. 8 is a perspective plan view illustrating the means for laying the dial loops under the dial ring.

Referring to Figs. 1 through 4, the apparatus **10** is illustrated as comprising a framework **11** supporting a bed plate **12** from which extend upright posts **13**. Radial arms **14** extend inwardly from posts **13** to support the dial, and the posts also support the superstructure, generally indicated at **15**, including the bobbin stand **16** carrying the cones of yarns **17**. Superstructure **15** also includes yarn guide and upper stop motion supporting means **18** and the lower stop motions **21**.

A suitable driving means **20** for the apparatus is mounted on framework **11**, and a web take-up **22** within the framework tensions the fabric to improve its quality. The fabric is wound up by suitable means indicated at **23**. All the elements so far described are included in modern large diameter circular knitting machines.

The bed plate **12** rotatably supports an annular gear **28** to which is suitably secured the cylinder **30** having axially extending slots **31** in its outer periphery slidably receiving and guiding latch needles **35** having operating butts **36**. In the illustrated apparatus, cylinder **30** is rotated by driving means **20**, but the invention is applicable equally to machines having stationary cylinders. An annular cover plate **37** overlies gear **28** and its outer rim is secured to bed plate **12**, this cover plate having an upstanding inner edge **38** on which are mounted the cam blocks **40** described more fully hereinafter and secured to edge **38** by screws **41**.

An annular sinker or web holder bed 32 is mounted near the upper end of cylinder 30 and has radial slots in its upper surface slidably receiving and guiding web holders or sinkers 25. An annular inner sinker dial 33 is secured on the upper end of cylinder 30 by screws 34, and it has radial slots in its upper surface. Dial 33 acts as an inner guide for the sinkers 25. Each sinker 25 has an upper nose 26 and a throat defined by nose 26 and a ledge 27, as well as having a cam engaging butt 24 engaged by sinker cams secured to a sinker cap 29 fitting over and about sinker bed 32.

A dial 50, having a diameter substantially less than the outer diameter of cylinder 30, is mounted coaxially within the cylinder on a shaft (not shown) rotatable in a bearing at the intersection of arms 14. A large gear 51 is keyed to the upper end of this shaft and driven at the same angular velocity as cylinder 30, so that the cylinder 30 and dial 50 rotate in exact synchronism with each other. A hand wheel (not shown) is secured to the dial shaft above gear 51 for raising and lowering the dial, as one means for changing the length of the pile loops. For accurate registry of the dial implements with the cylinder needles 35 there is provided adjusting means between the cylinder 30 and gear 28 such that the cylinder may be moved slightly angularly with respect to gear 28 and thus to dial 50 which latter is driven thru the necessary gearing in synchronism with gear 28.

Dial 50 has radial slots 52 in its upper surface slidably receiving and guiding the dial implements 45 which have butts 46 operated by cams 60 on the underside of dial cap sections 53 secured to dial cap 55 by screws 54. In the illustrated apparatus, dial cap 55 is stationary so that cams 60 are stationary. The dial implements 45 have upside down hooks 47 at their outer ends.

The outer peripheral face 56 of dial 50 is bevelled and extends at an angle of the order of 110 degrees to the upper surface of the dial. Countercuts 57 extend radially through edge 56 in line with but somewhat wider than the slots 52. These countercuts enable the hooks 47 of implements 45 to be withdrawn into the dial while retaining pile loops yarn, without such counter cuts or enlargements of the outer end of the slots the yarn would be pinched or otherwise harmed.

Between the countercuts 57, edge 56 is formed with shallow V cuts 58 which mesh with the teeth 64 of a cutting wheel 65. The diameter and number of teeth of wheel 65 are selected for proper meshing of teeth 64 with V cuts or notches 58, so that wheel 65 is rotated by the dial 50. The edges of teeth 64 form dull knife edges which cut the pile loops as the hooks 47 of implements 45 stretch the pile yarn loops across the ends of countercuts 57.

To effect such severing by teeth 64, it is necessary to exert considerable pressure between wheel 65 and dial edge 56. Pressure or crushing wheel 65 is secured on the end of a shaft 66 by means of a nut 67 drawing wheel 65 tightly against a shoulder on the shaft. Shaft 66 is rotatable in anti-friction bearings 68, 69 set into a casing 70, collars 71, 72 separating wheel 65 and an upper nut 73, on shaft 66, from the bearings. End play of shaft 66 is eliminated by virtue of upper bearing 68 being clamped between a shoulder in casing 70 and a snap ring 74 which is placed below a washer 74' acting also as a dust cover. Lower bearing 69 floats to avoid cramping.

Casing 70 is pivotally secured by a pivot 76 to a casing 75 fastened by suitable means to dial cap 55. Pivot 76 extends through holes in the casing which latter is fastened to dial cap 55 by screws passing thru slotted holes in said casing 75 to provide for adjustment and alignment of wheel 65 relative to dial edge 56. The upper side of casing 75 is bored to form a cylinder 77 in which is mounted a piston 80 having a piston rod 81 carrying a fork 82 pivotally connected to casing 70 by a pivot 83. Piston 80 is hermetically sealed to cylinder 77 by a flexible diaphragm 78 of synthetic rubber, known as a "Bellofram." Diaphragm 78 allows very free movement of piston 80 while still sealing the space between the cylinder and piston.

Cylinder 77 is closed by an end cover 84 having an opening receiving a connection 85 for supplying pressure fluid, such as compressed air, against piston 80 to bias wheel 65 to engage dial edge 56. A spring 86 provides a holding bias against piston 80, when air pressure is cut off, to maintain wheel 65 meshed with V cuts 58.

A thin flat metal ring or annular disk 90 is clamped to the underside of dial 50 by clamps 91 operated by screws 92. Disk 90 projects beyond edge 56 toward cylinder 30, and provides a surface under which the pile loop either cut or uncut may be laid by a guide blade 95 pivoted to sinker cap 29, as at 96, between its ends. Blade 95 is biased inwardly, as best seen in Figs. 6 and 8, by a spring 97, and adjustment of the correct amount of inward movement between the cylinder and dial is effected by a stop 94 and an adjusting screw 98 therein. Any outward movement of blade 95, due to an uncut loop, in the event these loops are cut, imperfection in the knitting, a broken cylinder needle, or other cause results in the blade contacting a resilient electrical contact 93 to close an electric circuit to stop the machine.

In knitting pile fabric with apparatus 10, two feeds are required for a complete repetitive knitting sequence. Yarns are taken from the cones 17 up through guides (not shown) on upper members 18, through upper stop motions (not shown), then through lower stop motions 21 into yarn guides 100 and 101 shown in Fig. 6.

The cams 40 operate on the cylinder needles butts 36, which are in two lengths—long butts and short butts. Referring to Figs. 2 and 6, the needles pass from right to left in both cases, their butts following the arrows of Fig. 2. At cam 40A, the long butt needles are raised to tuck height, while the short butt needles continue at the low level. The long butt needles rising on cam 40A pass between dial implements 45 that are projected at this time by cam 60A. As the cylinder needles 35 are lowered by cam 40B, the dial implements are being retracted by cam 60B, and a pile loop yarn 105 is fed to hooks 47 by guide 101 in such a way as to be taken by both the cylinder needles and hooks 47, as shown in Fig. 5. The simultaneous lowering of cylinder needles 35 and retraction of implements 45 causes pile loops to be drawn across ring or disk 90.

Following the drawing of the pile loops, all the cylinder needles rise on cam 40C to the clear level, with the loops on the long butt needles 35 being held down by guide 112 (Figs. 6 and 7), positioned in back of needles 35 opposite yarn guide 100. The lower edge of guide 112 forces the loops under the latches of needles 35 while the loops are held fully retracted by the dial implements 45, due to the butts of the latter riding along cam edge 60C.

With needles 35 having risen to the clear level on cam surface 40C, and with the drawn pile loops under the latches of circumferentially spaced long butt needles 35, the cylinder needles ride down stitch cam 40D, taking a knitting yarn 110 from guide 100 on the way down.

Just before needles 35 reach the bottom of stitch cam 40D, the sinkers or web holders 25 are withdrawn by sinker cam 115, and dial implements 45 are projected slightly by cam 60D. Retraction of sinkers 25 allows yarn 110 to be drawn over ledge or platform 27 below nose or neb 26, while projection of dial implements 45 permits the pile loops about the cylinder needles to lower so that yarn 110 may be drawn over ledge 27 without being given an artificial length by the pile loops. Following the forming of the stitch by cam 40D the dial implements may be further projected to release the pile loop if it is desired to leave said loop uncut.

If the loops are to be cut, thereafter yarn 110 is drawn into the stitch by the action of stitch cam 40D on needles

35, these needles are raised slightly on cam surface 40E, and the dial implements 45 are simultaneously fully retracted by cam surface 60E. Sinkers 25 are projected inwardly by cam 115 so that nebs 26 will hold down the newly formed stitches which will be pushed over the tops of needles 35 by the partition formed at the juncture of neb 26 and ledge 27. At this time, wheel 65 crush cuts the pile loops of yarn 105 against dial edge 56. Thereafter, needles 35 are lowered by cam surface 40F and blade 95 sweeps the cut ends under disk or ring 90.

All needles 35 are then raised to tuck height by cam surface 40G, after which the long butt needles are lowered by cam surface 40H with the short butt needles passing at tuck level to be lowered by cam surface 40J. Dial implements 45 are projected by cam surface 60F, and then withdrawn by cam surface 60G simultaneously with the lowering of needles 35 by cam surface 40J.

Yarn is fed to implements 45 as before by a guide 101, and pile loops are formed by the short butt cylinder needles in the same way as described for the long butt cylinder needles. Thereafter, and in the same manner as before, all needles 35 are raised by cam 40K and lowered by a stitch cam 40L. The same interaction of needles 35, implements 45, and sinkers or web holders 25 takes place as previously described. The only difference is that pile loops are interlaced into the fabric by the short butt needles rather than by the long butt needles.

If it is desired to knit pile loops into alternate (circumferentially spaced) needles 35 while knitting with all needles 35, one way of effecting this action is to remove guide 112 while lowering the clear height to which the needles are raised by cutting a little off the tops of cams 40C and 40K. Friction between the pile loops and needles 35 will carry the loops upwardly and prevent them getting under the latches of needles 35. Dial 50 may be raised somewhat and cams 40B and 40J adjusted to lower needles 35 to a lesser extent to assist in keeping the pile loops above the ends of the latches of needles 35. It should be understood that the term "alternate needles" means "circumferentially spaced" needles separated by one or more "intermediate" needles.

Particular attention is directed to the bevelled or sloped dial periphery 56 permitting wheel 65 to extend over sinkers 25 and sinker cap 29 with plenty of clearance. This clearance is an important aid in designing the loop crushing unit.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles. One example of this is that the cylinder needles 35 have been described as being selected by a difference in length of their butts, whereas they could have been selected by pattern wheels.

What is claimed is:

1. Apparatus for knitting pile fabric comprising, in combination, a needle cylinder formed with longitudinally extending needle slots; a dial coaxially within said cylinder and having a diameter substantially smaller than the cylinder diameter, said dial having radial slots in its upper surface; latch knitting needles slidably mounted in the cylinder slots; dial implements slidably mounted in the dial slots; a relatively thin annular disk secured concentrically to the undersurface of said dial and projecting beyond the dial periphery toward said cylinder; cam means operable to raise and lower said needles and extend and retract said implements; means operable to feed a pile yarn to said needles in a raised position and said implements in a projected position; said cam means, following such pile yarn feeding, lowering said needles and retracting said implements to draw pile yarn loops over said disk by the conjoint action of said needles and implements; and means operable to feed a body yarn to said needles; said cam means holding said implements

retracted to maintain said loops drawn while activating said needles to receive the body yarn and knit stitches therewith; said cam means subsequently activating said needles and implements to release said pile yarn loops.

2. Apparatus as claimed in claim 1 including guide means laying the released pile yarn loops beneath said dial.

3. Apparatus as claimed in claim 1 including guide means restraining upward movement of the pile yarn on the needles while the latter are raised to receive the body yarn.

4. Apparatus for knitting pile fabric comprising, in combination, a needle cylinder formed with longitudinally extending needle slots; a dial coaxially within said cylinder and having a diameter substantially smaller than the cylinder diameter, said dial having radial slots in its upper surface; latch knitting needles slidably mounted in the cylinder slots; dial implements slidably mounted in the dial slots; a relatively thin annular disk secured concentrically to the undersurface of said dial and projecting beyond the dial periphery toward said cylinder; cam means operable to raise and lower said needles and extend and retract said implements; means operable to feed a pile yarn to said needles in a raised position and said implements in a projected position; said cam means, following such pile yarn feeding, lowering said needles and retracting said implements completely into the dial slots to draw pile yarn loops over said disk by the conjoint action of said needles and implements; and means operable to feed a body yarn to said needles; said cam means holding said implements retracted to maintain said loops drawn while activating said needles to receive the body yarn and knit stitches therewith; said cam means subsequently activating said needles and implements to release said pile yarn loops.

5. Apparatus as claimed in claim 4 in which said dial slots have enlarged outer ends to provide clearance for the drawn pile yarn loops.

6. Apparatus as claimed in claim 4 in which said implements have downwardly facing hooks on their outer ends.

7. Apparatus as claimed in claim 6 in which said dial slots have enlarged outer ends to provide clearance for the drawn pile yarn loops in the hooks of said implements.

8. Apparatus as claimed in claim 1 including radially slotted web holder means at the upper end of said cylinder; and web holders slidably mounted in the slots of said web holder means and operable by said cam means in coacting relation with said needles in knitting the body yarn.

9. Apparatus as claimed in claim 1 including crush cutting means supported with said dial and coacting with the dial periphery to crush cut the drawn pile loops prior to the release from said dial implements.

10. Apparatus as claimed in claim 1 including crush cutting means supported with said dial and coacting with the dial periphery to crush cut the drawn pile loops; and fluid pressure actuator means biasing said cutting means toward the dial periphery.

11. Apparatus for knitting pile fabric comprising, in combination, a needle cylinder formed with longitudinally extending needle slots in its outer surface; a dial coaxially within said cylinder and having a diameter substantially smaller than the cylinder outer diameter, said dial having radial slots in its upper surface and an upwardly and inwardly sloping bevelled periphery; latch knitting needles slidably mounted in the cylinder slots; dial implements slidably mounted in the dial slots; a relatively thin annular disk secured concentrically to the undersurface of said dial and projecting beyond the dial periphery toward said cylinder; cam means operable to raise and lower said needles and extend and retract said implements; means operable to feed a pile yarn to said needles in a raised position and said implements in a projected position; said cam means, following such pile yarn feeding, lowering said needles and retracting said

implements to draw pile yarn loops over said disk by the conjoint action of said needles and implements; means operable to feed a body yarn to said needles; said cam means holding said implements retracted to maintain said loops drawn while activating said needles to receive the body yarn and knit stitches therewith; said cam means subsequently activating said needles and implements to release said pile yarn loops; and crush cutting means supported with said dial and coacting with the dial periphery to crush cut the drawn pile loops prior to the release from said dial implements.

12. Apparatus as claimed in claim 11 including fluid pressure actuator means biasing said cutting means toward the dial periphery.

13. Apparatus as claimed in claim 11 including fluid pressure actuator means biasing said cutting means toward the dial periphery; and guide means laying the cut pile yarn beneath said dial.

14. Apparatus for knitting pile fabric comprising, in combination, a needle cylinder formed with longitudinally extending needle slots in its outer surface; a dial coaxially within said cylinder and having a diameter substantially smaller than the cylinder outer diameter, said dial having radial slots in its upper surface and an upwardly and inwardly sloping bevelled periphery; latch knitting needles slidably mounted in the cylinder slots; dial implements slidably mounted in the dial slots; a relatively thin annular disk secured concentrically to the undersurface of said dial and projecting beyond the dial periphery toward said cylinder; cam means operable to raise and lower said needles and extend and retract said implements; means operable to feed a pile yarn to said needles in a raised position and said implements in a projected position; said cam means, following such pile yarn feeding, lowering said needles and retracting said implements to draw pile yarn loops over said disk by the conjoint action of said needles and implements; means operable to feed a body yarn to said needles; said cam means holding said implements retracted to maintain said loops drawn while activating said needles to receive the body yarn and knit stitches therewith; said cam means subsequently activating said needles and implements to release said pile yarn loops; a dial cap on said dial; casings pivotally supported on said dial caps; shafts rotatably supported in said casings; crush cutting wheels secured on the ends of said shafts and having teeth engaged in notches in said bevelled periphery and coacting therewith for rotation of said wheels and to crush cut the drawn pile loops prior to the release from said dial implements; and fluid pressure actuator means operating on said casings to bias said wheels toward said bevelled dial periphery.

15. Apparatus for severing pile loops in a circular knitting machine having independently movable needles and equipped with an inside dial in which loop forming implements are supported for radial movement, comprising, in combination, a circular and rotatable cutter capable of cooperative engagement with the dial periphery and capable of crush cutting the pile loops held by the loop forming implements in said dial; and fluid pressure means biasing said cutter against said dial and including a flexible diaphragm to provide substantially uniform pressure of the cutter against the dial periphery irrespective of irregularities in the circumference of said dial.

16. In a circular knitting machine equipped with independently movable needles and with web holders having a movement substantially perpendicular to the movement of said needles, an inner dial for supporting independently movable implements for forming pile loops from a yarn independent of the normal knitting yarn, said dial having a bevelled edge cooperable with a rotatable crush cutting wheel to sever the pile loops; said bevel being at an angle to the movement of the web holders and pile loop implements such that the crush cutting wheel will extend outward and upward over the web holders, thus forming a space between the underside of the wheel and the web holders for cams and their holding surface to operate the web holders.

17. Apparatus as claimed in claim 1 including crush cutting means coacting with the dial periphery to crush cut the drawn pile loops prior to their being released from the dial implements.

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