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Plath

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[54] **MACHINE AND METHOD FOR THE CIRCULAR KNITTING OF PLUSH GOODS**

[75] Inventor: **Ernst-Dieter Plath,** Tailfingen, Germany

[73] Assignee: **Mayer & Cie.,** Tailfingen, Germany

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Related U.S. Application Data

[63] Continuation of Ser. No. 878,646, Nov. 21, 1969, abandoned.

[30] **Foreign Application Priority Data**

Dec. 24, 1968 Germany 1816864

[52] **U.S. Cl.** **66/12,** 66/92, 66/116, 66/194

[51] **Int. Cl.** **D04b 9/12**

[58] **Field of Search** ..... 66/9 R, 12, 19, 20, 194, 66/104, 92, 116

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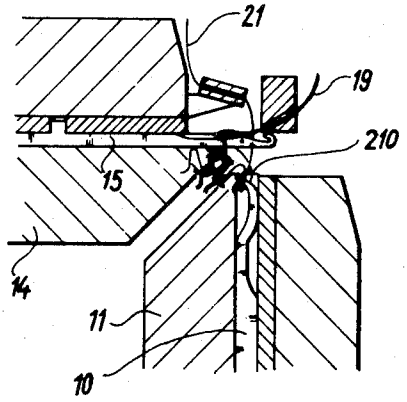
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Primary Examiner—Wm. Carter Reynolds

[57] **ABSTRACT**

A machine and method for circular knitting of plush fabrics. The circular knitting machine has a needle cylinder and dial, and the needle cylinder accommodates spring needles while the dial accommodates latch needles, the two sets of needles coacting to carry out the knitting. During the knitting operations the spring needles coact only with the plush yarn to form plush loops while the latch needles coact both with the plush yarn and with a ground yarn to work both of these yarns.

5 Claims, 12 Drawing Figures



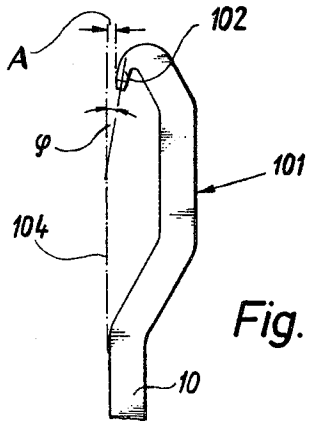


Fig. 1

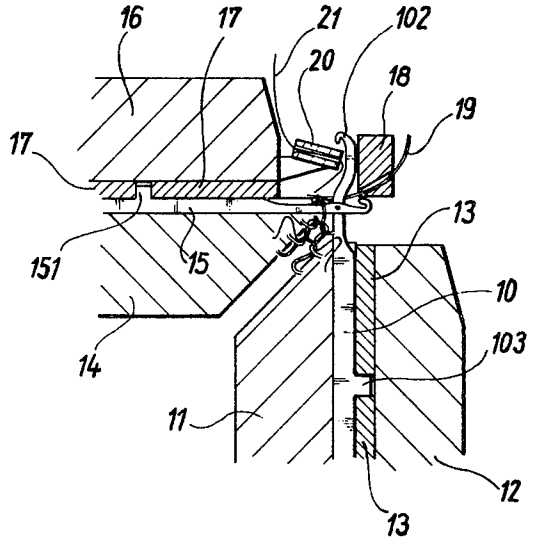


Fig. 2

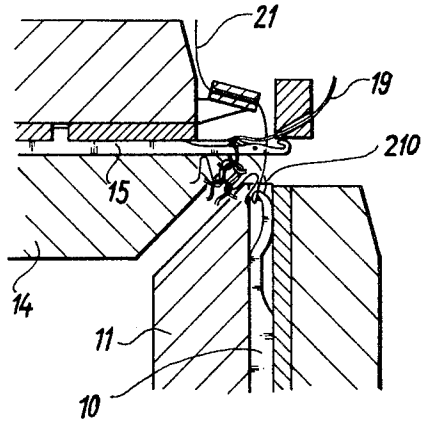


Fig. 3

INVENTOR:
ERNST-DIETER PLATH

BY:
Arthur O. Klein

ATTORNEY

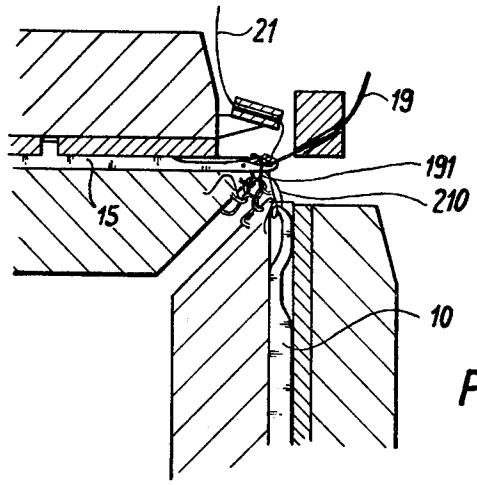


Fig. 4

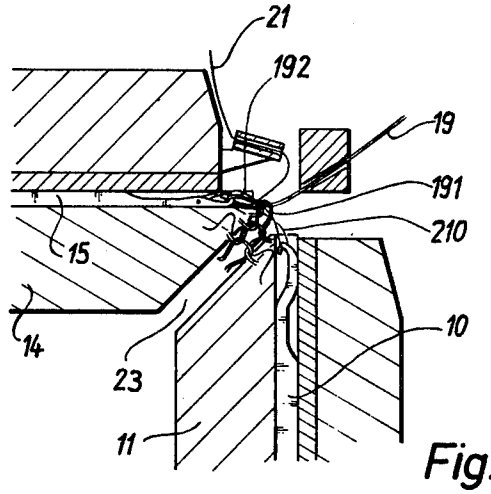


Fig. 5

Fig. 6a

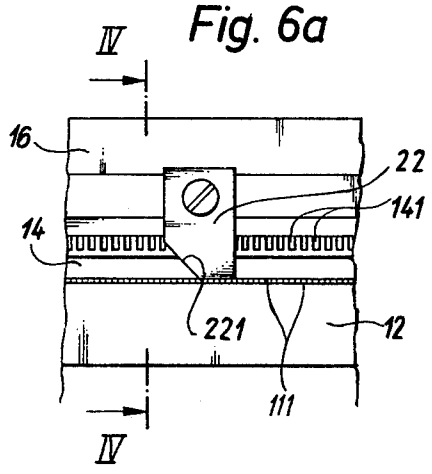
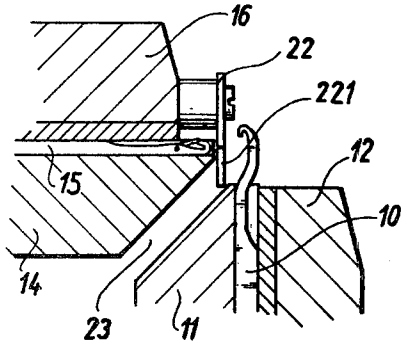


Fig. 6b



INVENTOR:
ERNST-DIETER PLATH

BY:
Arthur O. Klein

ATTORNEY

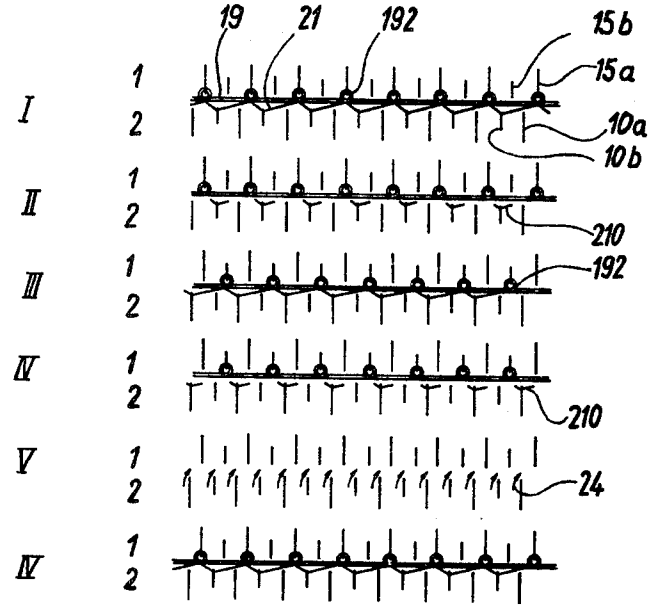


Fig.7

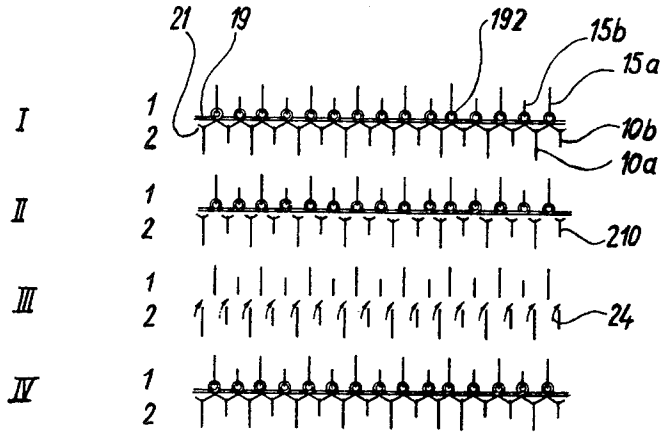


Fig.8

INVENTOR:
ERNST-DIETER PLÄTH

BY :
Arthur O. Klein

ATTORNEY

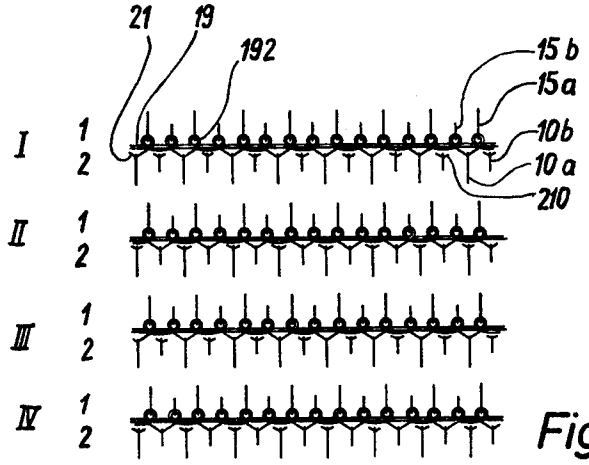


Fig. 9

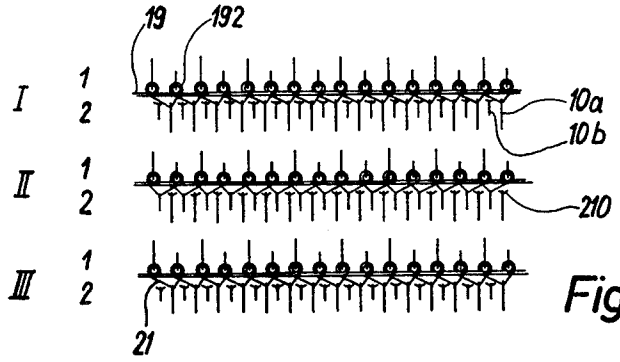


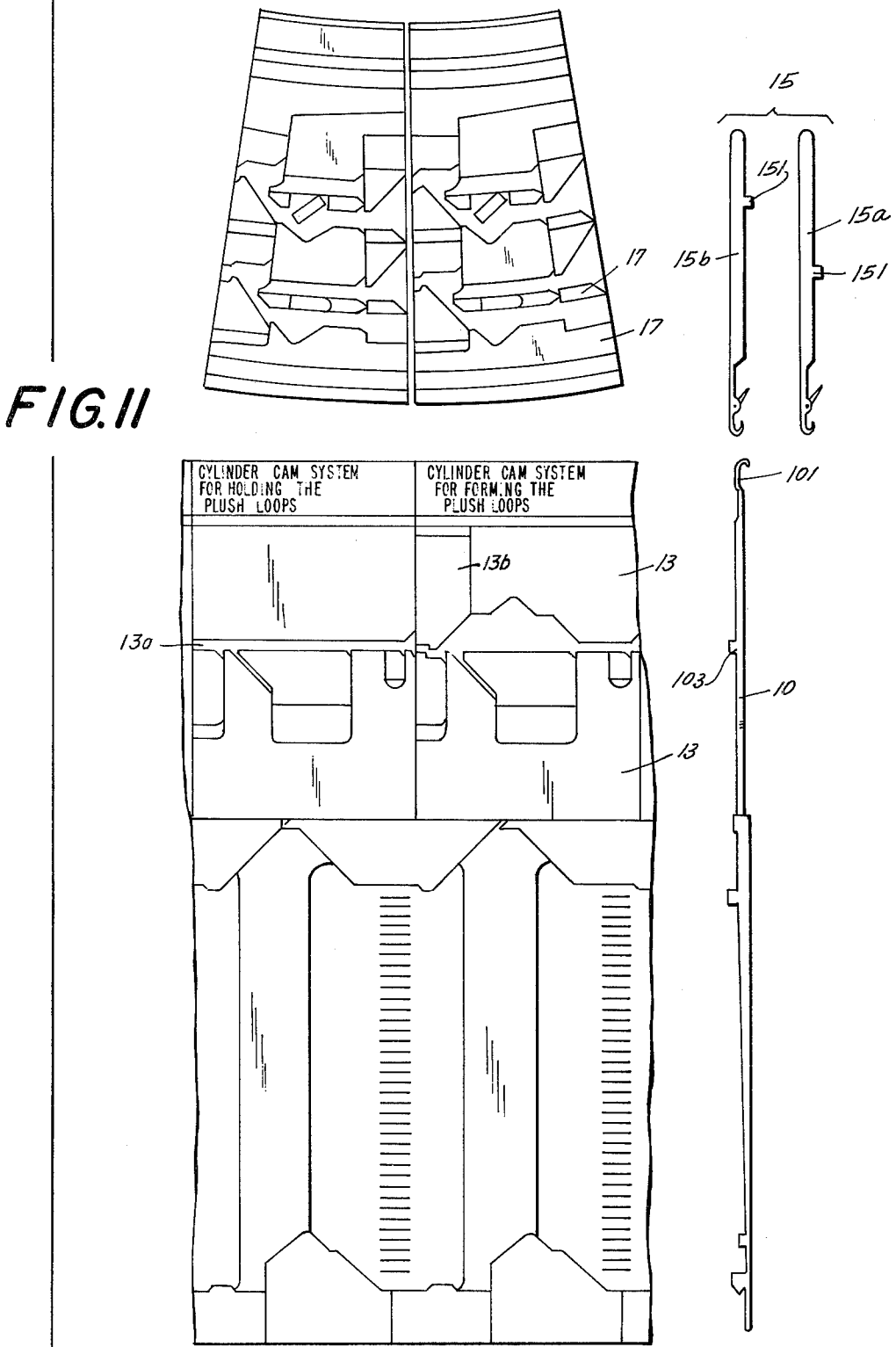
Fig. 10

INVENTOR:
ERNST-DIETER PLATH

BY: Arthur O. Klein

ATTORNEY

FIG. 11


15
151
15a
15b
151
17
17
CYLINDER CAM SYSTEM FOR HOLDING THE PLUSH LOOPS
CYLINDER CAM SYSTEM FOR FORMING THE PLUSH LOOPS
13b
13
13a
13
101
103
10

MACHINE AND METHOD FOR THE CIRCULAR KNITTING OF PLUSH GOODS

BACKGROUND OF THE INVENTION

This is a continuation application of Ser. No. 878,464 filed Nov. 21, 1969 now abandoned.

The present invention relates to a machine and method for manufacturing plush fabrics. In particular, the present invention relates to multiple-system circular knitting machines which can be operated for these purposes.

Plush fabrics have been manufactured up to the present time for the most part on circular knitting machines which in a known way are provided with spring needles. The known machines operate to achieve a single faced material with a pair of yarns where the yarns are knitted in such a way that the loops thereof are sunk to different extents. The yarn which has the relatively short loops provides a relatively strong ground fabric while the other yarn in the form of the longer plush loops extends to one side outwardly beyond the knitted base. Circular knitting machines have, however, the disadvantage that they must operate relatively slowly and have only a relatively small number of operating systems circumferentially distributed about the machine. As a result it is indeed possible with proper care to manufacture a very clean and uniform plush fabric, but the output of such machines is very low, for example, on the order of one-fifth the output of a conventional circular knitting machine of the same diameter because the usual circular knitting machine has a larger number of knitting systems distributed about its periphery and in general can operate at a faster speed.

It has already been proposed to manufacture plush fabrics on circular knitting machines. For this purpose it is conventional to use in general machines with a single set of needles provided with a needle cylinder and with hold down sinkers having stepped knock-over surfaces. The hold down sinkers are guided in a sinker ring controlled by suitable cams and operate synchronously with the needles. Such machines are also operated with a pair of yarns. Thus. the ground yarn is directed to the needles when the sinkers are retracted with the yarn situated closely over the knock-over edges. Then the sinkers are moved to such an extent that tips thereof extend between the needles. Then the needles will first receive the plush yarn which is knocked over the upper edge of the sinkers and forms a long plush loop while the ground yarn is knocked over the lower edge of the sinker to form a short loop.

With this method of knitting of plush fabrics there is the disadvantage that the plush loops do not always have a uniform length and form at the locations of the shorter plush loops projecting plush yarns at the rear side of the knitted fabric, so that the rear side will not have a clean appearance. When the needle is advanced the loop which is at the hook of the needle must open the latch, with the result that the yarn is very greatly stressed since the loop must be moved over the opened latch along the needle shank. Moreover, the plush yarn is relieved of stress in this way so that the plush yarn can be pulled somewhat in the direction of the head of the loop of the knitting. The result is that during the next following sinking operations of the needles the latches extend into the widened loops, so that they are taken along in the knitting of the next series of loops.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the invention to provide a multiple system knitting machine and method capable of providing plush fabrics which will avoid the above drawbacks.

In particular, it is an object of the invention to provide a machine and method which are capable of producing a plush fabric having a clean knitted structure.

Also it is the object of the invention to provide a machine and capable of achieving plush fabrics according to any desired pattern.

According to the invention the machine has in the known way a pair of beds or sets of needles. one of these beds of the machine has latch needles whiled the other has spring needles. The circular knitting machine is, as is conventional, provided with a needle cylinder and a dial. In accordance with the invention the spring needles are situated in the needle cylinder with their hook openings directed toward the axis of the needle cylinder. The machine can be provided with known, conventional pattern selecting devices such as, for example, Jacquard apparatus for pattern selection, capable of operating on the spring needles. The spring needles can for this purpose be provided with pattern butts or can be coupled to control elements provided with pattern butts. In order to achieve a clean plush fabric with plush loops of uniform length, the spring needles have a special construction according to the invention.

For this latter purpose the upper hook ends of the spring needles are cranked in such a way that the tip of the hook is situated to the rear of the innermost portion of the needle shank which is nearest to the axis of the needle cylinder. The innermost part of each needle shank extends along a straight line, the extension of which is situated between the tip of the needle hook and the axis of the cylinder so that the needle hook is outwardly displaced with respect to this line. The tip of the needle is inclined at a relatively sharp angle extending along a line which makes with the innermost line extension an angle of 5°–15°. The cranked upper hook end of the spring needle, with the exception of its tip, can be at least approximately of the same thickness as the shank of the spring needle.

With the circular knitting machines of the invention the plush knitting can take place according to different methods with the machine capable of being adatped to the individual knitting methods. Thus, for example, spring needles of different lengths can be provided which, in a known way also, are directed along different cam paths. When spring needles of different lengths are used, each cam system can have different sinkers especially provided for the needles of different lengths with these sinker components offset with respect to each other in the direction of rotation. In order to form the plush loops, it is possible to use adjustable sinkers or stitch cams while in order to hold the plush loops, which can take place in special cam systems, it is preferred to provide non-adjustable permanent cam paths.

In order to adapt the machine to different predetermined possible knitting methods, the dial and the cylinder of the machine may be provided with different needle distributions. Also, the machine can be provided with a stripper device in order to achieve a reliable casting off of and displacement of the plush loops beyond the region of the needles and hooks of the machine.

In order to manufacture plush fabrics from at least one plush yarn and at least one ground yarn, it is possible according to the invention to work the spring needles so that they operate exclusively with plush yarn while the latch needles operate both with the plush yarn and the ground yarn. However, the latch needles can alternately work first with plush and ground yarns together and then only with ground yarn. For example, at a first knitting system of the machine of the invention only every second spring needle can be controlled or not controlled according to a predetermined pattern in order to form a plush loop while only every second latch needle operates to form a loop of plush and ground yarns. At the next knitting system the spring needles hold the plush loops which have been formed and all of the latch needles or only every other latch needle knits a loop only of the ground yarn. At the next following pair of systems it is possible in the same way to operate the remaining spring needles according to a given pattern and the remaining latch needles. However, it is also possible, at every first and third knitting system of a group of four systems, to put into operation all of the spring needles and all of the latch needles according to predetermined patterns. A casting off of the plush loops from the spring needles taken place advantageously at a given distance from the several knitting locations.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. **1** is a fragmentary side view at an enlarged scale of the upper region of a spring needle of the invention;

FIGS. **2–5** are respectively fragmentary schematic sectional elevations, taken in a radial plane which contains the axis of the needle cylinder, showing the knitting region of a circular knitting machine provided with a needle cylinder and dial, the needles being shown in different operating positions during the manufacture of a plush fabric;

FIG. **6***a* is a fragmentary front elevation of a loop stripper device of the machine;

FIG. **6***b* is a fragmentary section taken along line VI—VI of FIG. **6***a* in the direction of the arrows; and

FIGS. **7–10** are diagrammatic representations of four different types of knitting methods which may be carried out according to the invention to provide the knitted plush fabric;

FIG. **11** is an exploded diagramatic view of a portion of the dial and cylinder cams showing two adjacent knitting systems, two dial needles and one spring needle with a conventional pattern jack.

DESCRIPTION OF PREFERRED EMBODIMENTS

Reffering now to FIG. **1**, there is illustrated therein at an enlarged scale the upper region of a spring needle **10** of the invention. The spring needle has a head or hook portion **101** which is cranked in the manner illustrated in FIG. **1**. This hook terminates in a tip **102**. As is particularly apparent from FIG. **2**, the shank of the spring needle **10** has a control butt **103**. The cranked upper part **101** which forms the hook end of the spring needle **10** has the same thickness as the shank of the needle, with the possible exception of the tip **102**. The open end of the hook part **101** is directed toward the axis of the needle cylinder **11** in which the spring needles **10** are accommodated in a conventional manner. It is to be noted that the innermost part of the shank of each needle **10** extends along a straight line **104** which is parallel to the cylinder axis and the extension of which extends along the dotted line path indicated at the line **104** in FIG. **1**. Thus, it will be seen that the cranked hook end **101** is retracted rearwardly and displaced outwardly from the extension **104** of the innermost straight-line part of the shank of the needle. The tip **102** is spaced by the distance A outwardly beyond the straight line **104** in the manner shown diagrammatically in FIG. **1**. Moreover, the tip **102** is inclined so that its axis makes a relatively sharp angle ϕ with the straight line **104**. This angle is on the order of 5°–15°.

The distance A can, for example, be on the order of 0.3–0.5 mm. As a result of the illustrated retracted positioning of the tip **102**, the spring needles can, during the knitting operations, carry out a certain elastic swinging movement under the influence of the yarn tension without any danger of striking of the needle tips against the upper edge of the cylinder. The angle of inclination ϕ of the needle tips is important for the reliable introduction of the plush yarn and for a faultless casting off of the plush loops.

In order to manufacture the plush fabric of the invention, the operations illustrated in FIGS. **2–5** are carried out, these figures showing in a section taken in a radial plane the needle cylinder **11** in which the spring needles **10** are axially shiftable. The needle cylinder **11** is surrounded by the cylindrical cam casing **12** provided in its interior with the needle-controlling cams **13**.

The machine also includes the dial **14** in which conventional latch needles **15** are supported for radial movement in the manner of conventional dial needles, and in this case also a cam assembly **16** is provided with the control cams **17** which serve to control the movement of the plush needles **15** by engagement with the butts **151** thereof.

The control cams **17** control the actuation of the needles **15** without rupturing the yarn loop linkages. Two dial needles **15***a* and **15***b* are illustrated in FIG. **11** and all spring needles **10** are of the same length. The cylinder cam system for holding the plush loops includes the permanent non-adjustable cam paths **13***a* and an adjustable stitch cam **13***b*. FIGS. **2–5** also illustrate a conventional yarn guide **18** for the ground yarn **19** which is to be worked and an additional special yarn guide **20** for the plush yarn **21** which is to be worked.

During the loop formation of the plush fabric initially the spring needles **10** in the needle cylinder and the latch needles **15** in the dial **14** are advanced to the position shown in FIG. **2**. Thus, in FIG. **2** the spring needles **10** are raised to their upper positions while the dial needles **15** are radially advanced outwardly to the position illustrated in FIG. **2**. The plush yarn **21** is fed to the yarn guide **20** in such a way that this yarn **21** can be engaged both by the spring needles and the latch needles, while the ground yarn **19** is fed through the yarn guide **18** in such a way that it will only be worked on by the latch needles **15**. Thus, the spring needles **10** work only with plush yarn. While the latch needles **15** initially remain in their yarn-engaging positions illustrated in FIG. **2**, the spring needles **10** are pulled down, as illustrated in FIG. **3**, and in this way the plush yarn **21** is situated in loops around the shanks of the latch needles **15**. Then the latch needles **15** are retracted inwardly and in this way grasp both the plush yarn and the ground

yarn **19**. The last ground loop **191** made up of the plush yarn **21** and the ground yarn **19** closes the latch of the needle **15**, as illustrated in FIG. **4**, and the latch needles **15** are further retracted inwardly to their sinker positions while forming new short ground loops **192**. This operation is apparent from FIG. **5**. In order to avoid an overstressing of the plush yarn **21**, the spring needles are raised slightly during formation of the ground loops **192** by the latch needles **15**, so that the tension of the plush yarn in the plush loops **210** held by the spring needles **10** can be maintained within acceptable limits. The movement of the spring needles **10** in order to form the plush loops **210** takes place as the result of known controls in the cylinder cam assembly including eccentric sinker cams mounted therein. Such eccentric sinker or loop-forming cams **13** can also be made adjustable so that in this way it is possible to adjust via coaction of cams **13** and butts **103** of spring needles **10** the length of the plush loops of the plush fabric which is knitted. The holding of the formed plush loops by the latch needles **15** supported in the dial **14** takes place between the needles **10** which are controlled by the cam components **13** of the cam assembly **12**.

The plush loops formed with the spring needles **10** are preferably cast off by way of a special cam control system of the machine, with the needles **10** being advanced to such an extent that the ends of the plush loops hang outwardly beyond the tips **102** of the spring needles **10**. This casting off operation is rendered more reliable by the use of a stripper device **22** which is fixed to the cam casing **16** of the dial and which is illustrated in FIGS. **6***a* and **6***b*. This stripper **22** has an inclined stripping edge **221** which extends into the knitting gap **23** between the cylinder **11** and the dial **14**, the knitted loops being drawn downwardly through this gap **23** as is well known. In FIG. **6***a*, in contrast to the sectional illustration of FIG. **6***b*, the latch needles **15** and spring needles **10** are not illustrated. There are shown in FIG. **6***a* only the guide grooves **141** for the latch needles and the upper ends of the guide grooves **111** for the spring needles **10**.

Referring now to FIGS. **7–10**, there are four different embodiments of knitted plush fabrics of the invention, FIGS. **7–10** respectively illustrating schematically the methods according to which these four different fabrics may be knitted on the circular knitting machine of the invention. The yarn is illustrated in the manner in which it is treated along a pair of double knitting rows **1** and **2**, of which the upper knitting row represents the latch needles and the lower row **2** represents the spring needles in the knitting cylinder. The longer strokes represent the relatively long and the shorter strokes represent the relatively short needles or hooks, so that through this schematic illustration needles or hooks with relatively long or relatively short shanks are illustrated, as well as the corresponding different arrangement of the control butts thereof. The double knitting rows are arranged at different sequential knitting systems I, II, III, etc. at the circumference of the knitting machine.

According to a first possible embodiment which is illustrated schematically in FIG. **7**, the plush knitting of the invention takes place at a first knitting system I where plush loops are formed by every second relatively short spring needle **10***b* symbolized by the relatively short strokes. Every second spring needle **10***a* represented by the longer strokes remains in the idle position and does not participate in the knitting operations. At the latch needles, also every second latch needle is set into operation and thus all of those latch needles designated by the longer strokes, namely the needles **15***a*, form the loops **192** from the ground yarn **19** and the plush yarn **21** together. The knitting operations go forward in the manner described above in connection with FIGS. **2–5**. At the second knitting system II all of the spring needles remain idle while the spring needles **10***b* hold the plush loops **210** which were formed thereby at the system I, so that these plush loops **210** are unable to be pulled out at the rear side of the knitted fabric. The spring needles **10** are controlled so that they are in their idle positions in such as way that they cannot be pulled up as a result of the tension at the plush yarn **21**. At the dial in the system II, as was the case with the system I, all of the latch needles **15***a* are moved out and form loops, this time, however, only from the ground yarn **19** without any plush yarn **21**. Thus, undesired tuck loops and an unclean reverse side of the knitted fabric are avoided in this way.

At the next following systems III and IV all of those latch and spring needles operate which were idle during the operations carried out at systems I and II. Thus, at system III all of the spring needles **10***a* form plush loops while all of the latch needles **15***b* form loops out of the ground and plush yarns **19** and **21** together. At system IV the plush loops formed at system III are held by the spring needles **10***a* which remain in the idle position while the latch needles **15***b* again form loops, but this time only from the ground yarn **19**.

At the next following system V, which can be considered as a control system, all of the latch needles are held at an idle position and all of the spring needles **10***a* and **10***b* are moved upwardly through a relatively short distance so that the plush loops **210** can be cast off therefrom, as is symbolized in FIG. **7** by way of the arrows **24**. At the region of the system V the stripper **22** of FIG. **6***a* and **6***b* is situated so as to bring about the reliable displacement of the cast off loops from the knitting locations. At system VI all of the operations of system I are again repeated, so that the above cycle starts over again.

FIG. **8** illustrates a second embodiment for the manufacture of a plush fabric according to the invention. According to this method of manufacture at system I all of the spring needles **10***a* and **10***b* operate to form plush loops **210** and all of the latch needles **15***a* and **15***b* operate to form loops from the combined ground yarn **19** and plush yarn **21**. At the second system II all of the spring needles **10***a* and **10***b* remain idle and hold the plush loops formed thereon while again all of the latch needles **15***a* and **15***b* operate to form loops only from the ground yarn **19**. At the third system III all of the latch needles are held idle while all of the spring needles are raised lightly for casing off the plush loops formed thereon. The casting off of the plush loops is again symbolized by the arrows **24**. At the next following system IV all of the operations of system I are again repeated with all of the spring needles and all of the latch needles, so that the cycle now repeats.

In order to manufacture a third embodiment of a plush fabric of the invention with a circular knitting machine having short and long latch needles and short and long spring needles, in each system all of the latch needles **15***a* and **15***b* are brought to the knitting location and form the knitted loops **192** from the ground

yarn **19** and plush yarn **21**. The short and long spring needles, however, operate only in 1 + 1 sequence at the tucking location where no loop formation occurs. Since, however, the spring needles are fully projected (beyond tucking level) at this location, it could also be referred to as a knitting location, but no loops are formed. Thus at the first system I of FIG. **9** all of the long spring needles **10***a* are brought to the tucking position to form the plush loops while the short spring needles **10***b* hold the plush loops **210** which were formed at the previous knitting system. In the next following system II all of the long spring needles **10***a* remain idle while the short spring needles form plush loops, after the loops previously held by them at system I have been cast off. This casting off operation is possible because the hooks of the needles are inwardly directed. Since during formation of the new plush loops by the short spring needles **10***b* the plush loops formed at system I are held by the long needles **10***a* and remain under tension, it is possible for the plush loops to be pulled out at the rear side of the fabric. At the next following pair of knitting systems III and IV the knitting operations of system I and II are repeated. With this embodiment plush loops are formed at every course of the fabric, so that an extremely dense plush fabric is achieved.

According to a fourth embodiment, illustrated in FIG. **10**, the plush fabric is also manufactured with long and short spring needles **10***a* and **10***b*. However, in this case each groove of the needle cylinder accommodater both a long and a short needle. The same result can be achieved also if use is made of a needle cylinder which as compared to the dial has twice as many needle grooves so that the needle distribution for the needle cylinder is different from that of the dial. At the knitting system I all of the long spring needles **10***a* form plush loops while at the system II all of the short needles **10***b* form the plush loops. At system II the long spring needles remain idle and hold the plush loops formed at system I. At the knitting system III all of the longer spring needles **10***a* will again form plush loops, after the previously formed plush loops have been cast off. The latch needles are set into operation at each system with all of the latch needles operating to form loops from both the ground yarn **19** and the plush yarn **21**. Inasmuch as there are twice as many spring needles as latch needles, plush loops are always formed between a pair of latch needles so that an extremely dense plush fabric ressults.

It is to be understood that the above-described examples of FIGS. **7–10** are only some of the possible types of knitted fabrics which can be achieved according to the method and machine of the invention. As has already been pointed out above, the circular knitting machine of the invention can be provided with pattern selecting devices for the purpose of selecting the spring needles according to a predetermined pattern so that plush fabric can be knitted with any desired pattern. Also, the circular knitting machines constructed according to the invention can be provided with yarn changing devices.

In the foregoing, the invention has been described in connection with several preferred arrangements thereof. Since many other variations and modifications will now become obvious to those skilled in the art, it is desired that the breadth of the claims not be limited to the specific disclosure therein contained.

What is claimed is:

1. In a multiple system circular knitting machine for manufacturing plush knitted fabric with spring needles disposed around a cylindrical needle bed and latch needles disposed around a dial bed, said spring needles are guided along different cam paths of cam systems in said circular knitting machine, the cam paths of the cam systems for the spring needles have special cam elements which are offset with respect to each other in the direction of rotation of the circular knitting machine, said latch needles and spring needles coacting to knit said plush fabric according to a predetermined pattern, the improvement comprising a special configuration for all spring needles, wherein each spring needle has an upper hook end and a shank extending downwardly therefrom and provided with an innermost portion extending parallel to the axis of the cylindrical needle bed along a straight line which extends from the shank upwardly past the upper hook end of each spring needle, said upper hook end being situated beyond said straight line on the side thereof opposite from the cylinder axis and each hook terminating in a downwardly directed inclined tip which extends along a line which makes with the straight line extension of said innermost portion of said shank a relatively sharp angle on the order of 5° to 15°, said cam systems include a special cam system for forming and holding plush loops with the formation of the plush loops being effected by adjustable stitch cam means of said special cam system while the holding of the plush loops is effected by stationary cam means of said special cam system, said latch and spring needles respectively having different distributions in said dial and needle cylinder, respectively, and stripping means operatively mounted in said circular knitting machine for assuring the displacement of the formed plush loops from the region of the needles and hooks.

2. In a multiple system circular knitting machine for manufacturing plush knitted fabric with a plush yarn and a ground yarn with spring needles disposed around a cylindrical needle bed and latch needles disposed around a dial bed, said latch needles and spring needles coacting to knit said plush fabric according to a predetermined pattern, said spring needles having special configurations wherein each spring needle has an upper hook end and a shank extending downwardly therefrom and provided with an innermost portion extending parallel to the axis of the cylindrical needle bed along a straight line which extends from the shank upwardly past the upper hook end of each spring needle, said upper hook end being situated beyond said straight line one the side thereof opposite from the cylinder axis and each hook terminating in a downwardly directed inclined tip which extends along a line which makes with the straight line extension of said innermost portion of said shank a relatively sharp angle on the order of 5° to 15°, the improvement comprising a method of knitting a plush fabric with said spring and latch needles, which includes the steps of operating on the plush yarn only with spring needles and operating on the plush yarn and the ground yarn jointly with latch needles, wherein at a first knitting system of the knitting machine every second spring needle works to form a plush loop and every second latch needle works to form a loop of plush and ground yarn, while at a next-following knitting system all of the spring needles remain idle and said every second spring needle holds the thus-formed plush loops and at least every second latch needle knits a loop of

ground yarn only, and at the next-following third and fourth systems the remaining spring needles and latch needles operate in the same way, and in the fifth system all plush loops are cast off.

3. In a multiple system circular knitting machine for manufacturing plush knitted fabric with a plush yarn and a ground yarn with spring needles disposed around a cylindrical needle bed and latch needles disposed around a dial bed, said latch needles and spring needles coacting to knit said plush fabric according to a predetermined pattern, said spring needles having special configurations wherein each spring needle has an upper hook end and a shank extending downwardly therefrom and provided with an innermost portion extending parallel to the axis of the cylindrical needle bed along a straight line which extends from the shank upwardly past the upper hook end of each spring needle, said upper hook end being situated beyond said straight line on the side thereof opposite from the cylinder axis and each hook terminating in a downwardly directed inclined tip which extends along a line which makes with the straight line extension of said innermost portion of said shank a relatively sharp angle on the order of 5° to 15°, the improvement comprising a method of knitting a plush fabric with said spring and latch needles, which includes the steps of operating on the plush yarn only with spring needles and operating on the plush yarn and the ground yarn jointly only with latch needles, said spring needles being alternately long and short, all of the long spring needles operating at the first knitting system of the machine to form plush loops at a position wherein said spring needles are moved upwardly into a thread receiving position and the short spring needles remain idle to hold the plush loops formed at the preceding knitting systems, while in a second following system of the machine all of the short spring needles operate to form plush loops in a position wherein said spring needles are moved upwardly into a thread receiving position after the plush loops previously held by them at the first system have been cast off, and the long spring needles remain idle and hold the plush loops formed in the first knitting system while all the latch needles operate in both systems at knitting positions to form knitted loops.

4. In a multiple system circular knitting machine for manufacturing plush knitted fabric with a plush yarn and a ground yarn with spring needles disposed around a cylindrical needle bed and latch needles disposed around a dial bed, said latch needles and spring needles coacting to knit said plush fabric according to a predetermined pattern, said spring needles having special configurations wherein each spring needle has an upper hook end and a shank extending downwardly therefrom and provided with an innermost portion extending parallel to the axis of the cylindrical needle bed along a straight line which extends from the shank upwardly past the upper hook end of each spring needle, said upper hook end being situated beyond said straight line on the side thereof opposite from the cylinder axis and each hook terminating in a downwardly directed inclined tip which extends along a line which makes with the straight line extension of said innermost portion of said shank a relatively sharp angle on the order to 5° to 15°, the improvement comprising a method of knitting plush fabric with said spring and latch needles, which includes the steps of operating on the plush yarn only with spring needles and operating on the plush yarn and the ground yarn jointly with latch needles, wherein all the spring needles and latch needles are alternately short and long and wherein at the first knitting system of the knitting machine every short and long spring needle operatse to form plush loops and all short and long latch needles operate to form jointly with the plush yarn and ground yarn knitted loops, while at a second knitting system of the knitting machine, all of the spring needles remain idle and hold the plush loops formed thereon while again all of the latch needles operate to form loops only from the ground yarn, at the next following system all of the latch needles are held idle while all of the spring needles are raised slightly for casting off the plush loops formed thereon, and the operative cycle then repeats itself in the following systems of the knitting machine.

5. In a multiple system circular knitting machine for manufacturing plush knitted fabric with a plush yarn and a ground yarn with spring needles disposed around a cylindrical needle bed and latch needles disposed around a dial bed, said latch needles and spring needles coacting to knit said plush fabric according to a predetermined pattern, said spring needles having special configurations wherein each spring needle has an upper hook end and a shank extending downwardly therefrom and provided with an innermost portion extending parallel to the axis of the cylindrical needle bed along a straight line which extends from the shank upwardly past the upper hook end of each spring needle, said upper hook end being situated beyond said straight line on the side thereof opposite from the cylinder axis and each hook terminating in a downwardly directed inclined tip which extends along a line which makes with the straight line extension of said innermost portion of said shank a relatively sharp angle on the order of 5° to 15°, the improvement comprising a method of knitting a plush fabric with said spring and latch needles, which includes the steps of operating on the plush yarn only with spring needles and operating on the plush yarn and the ground yarn jointly with latch needles, wherein all of the spring needles are alternately long and short and all of the latch needles are alternately long and short, and wherein there are disposed around the cylinder of the circular knitting machine twice as many spring needles as there are disposed latch needles around the dial of the circular knitting machine, at a first knitting system of the knitting machine all of the long spring needles form plush loops while at the next system of the circular knitting machine all of the short spring needles form plush loops while all of the long spring needles remain idle and hold the plush loops formed at the first knitting system, all of the latch needles operating at each system to form both loops from the ground yarn and the plush yarn, whereby due to the fact that there are twice as many spring needles as latch needles the plush loops are always formed between a pair of adjacent latch needles.

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