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Fig. 1.

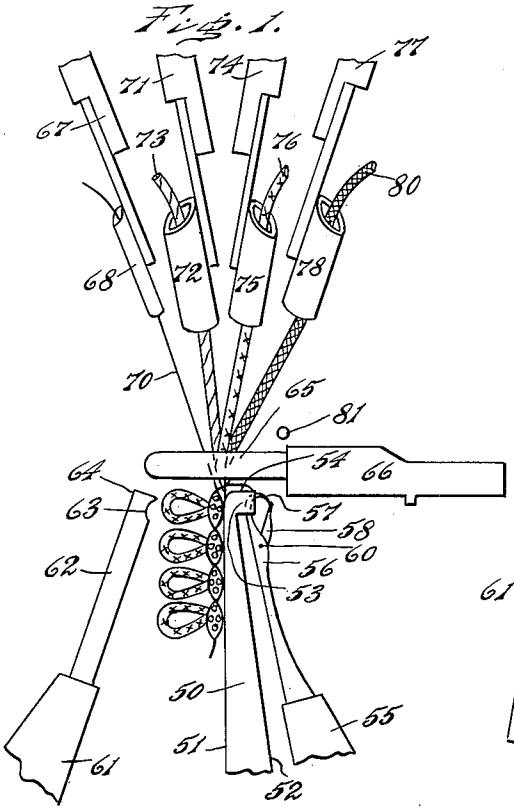

Fig. 2.

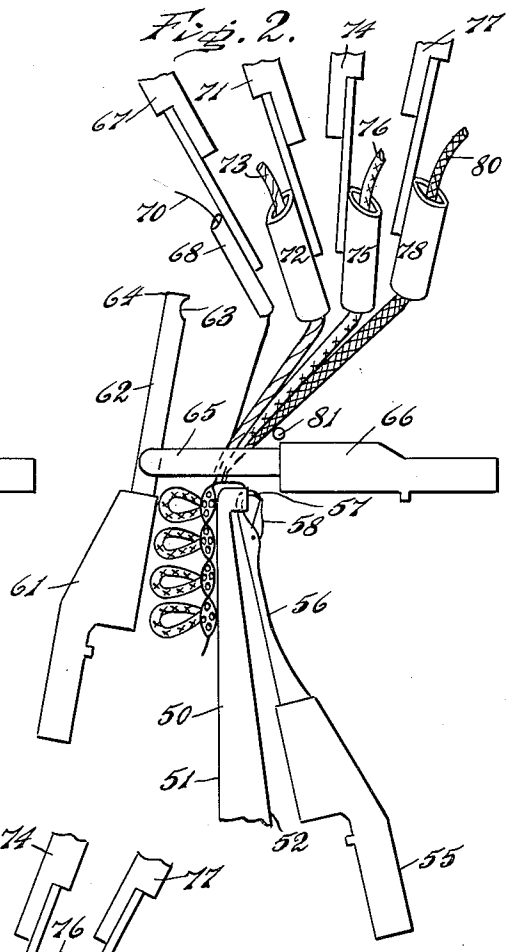

Fig. 3.

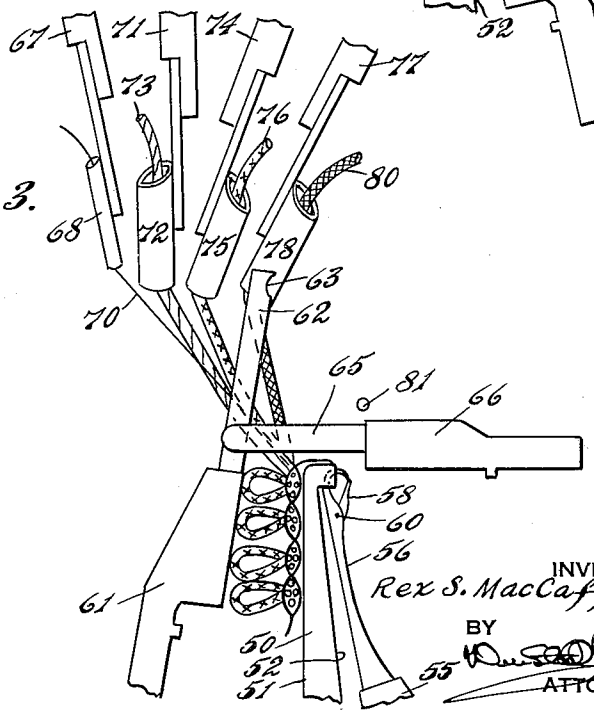

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Fig. 1a.

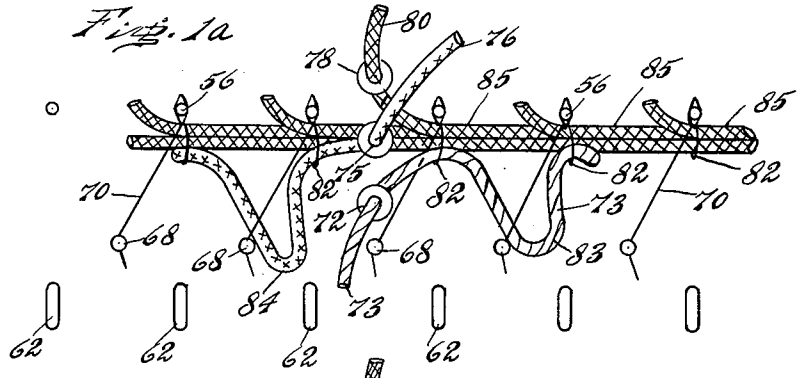

Fig. 2a.

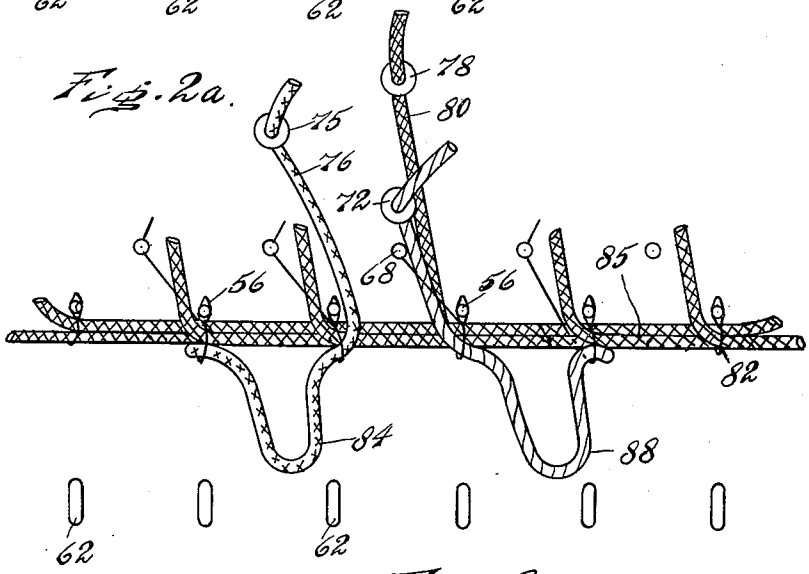

Fig. 3a.

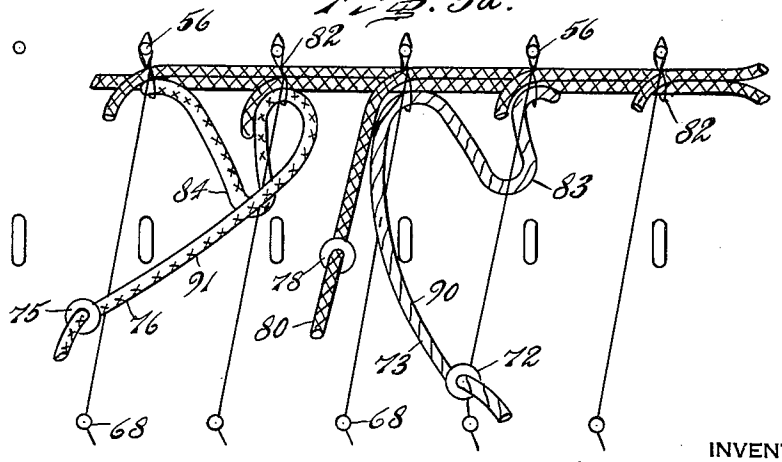

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Fig. 1b.

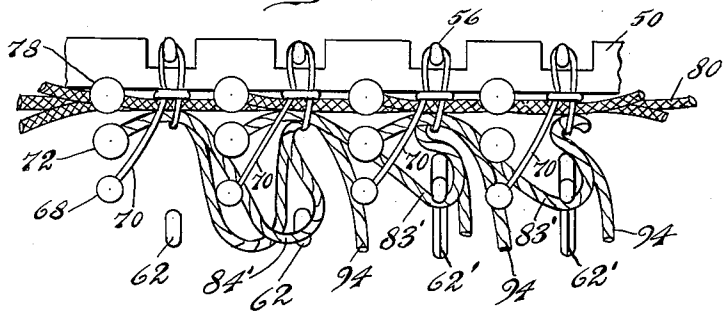

Fig. 2b.

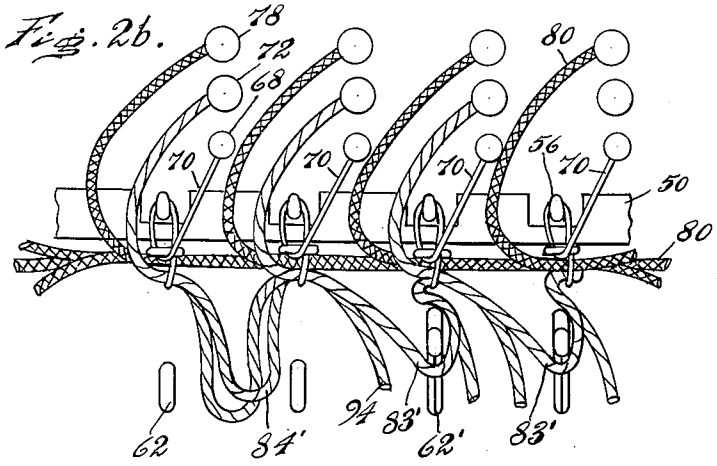

Fig. 3b.

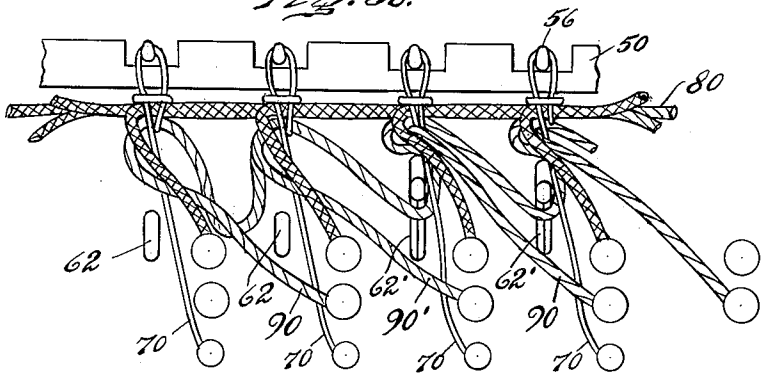

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Fig. 4a.

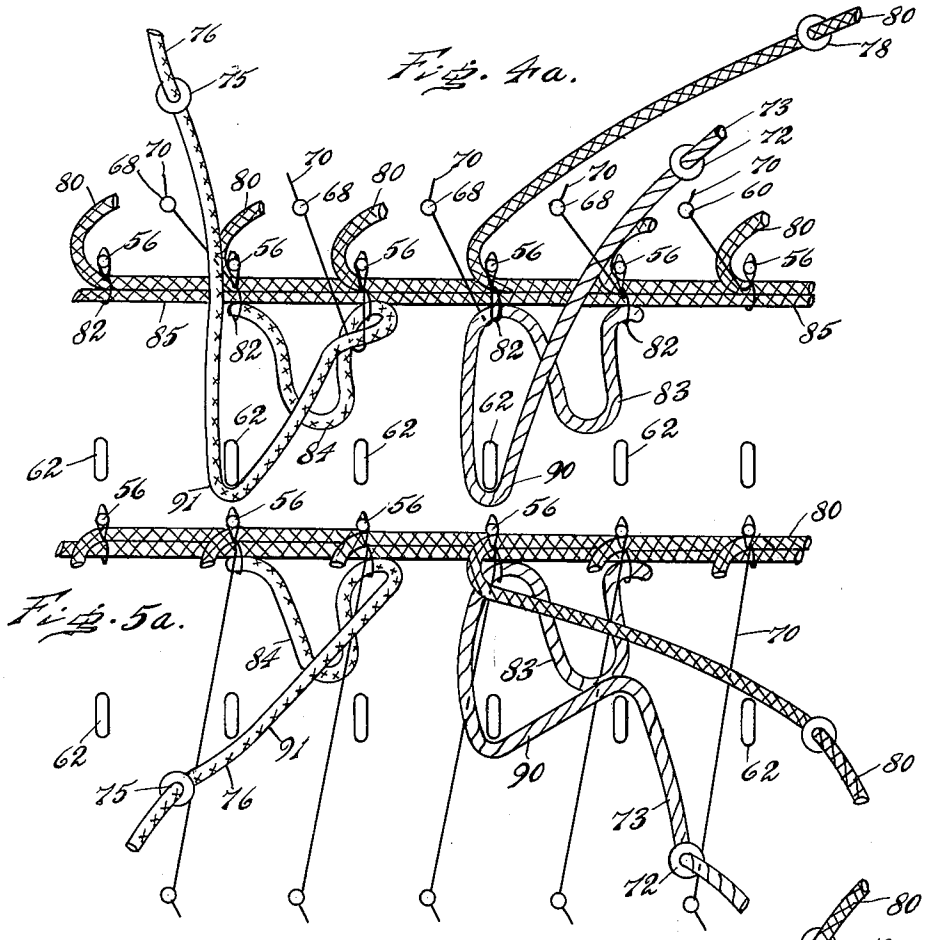

Fig. 5a.

Fig. 6a.

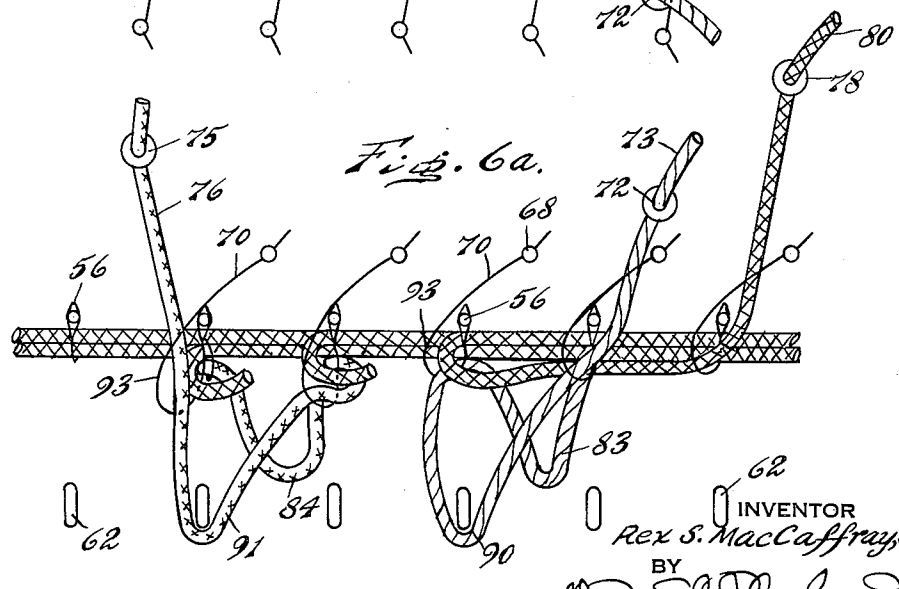

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Fig. 4.

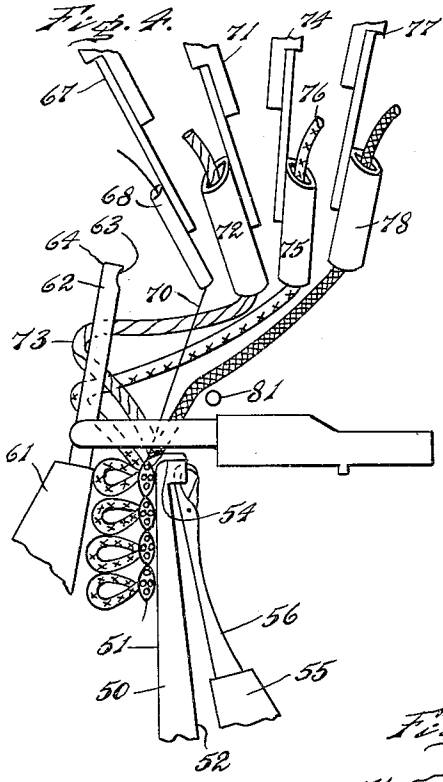

Fig. 5.

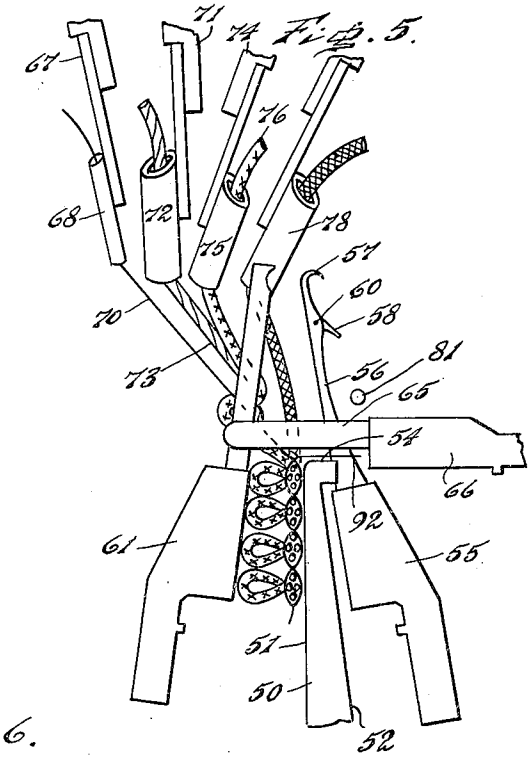

Fig. 6.

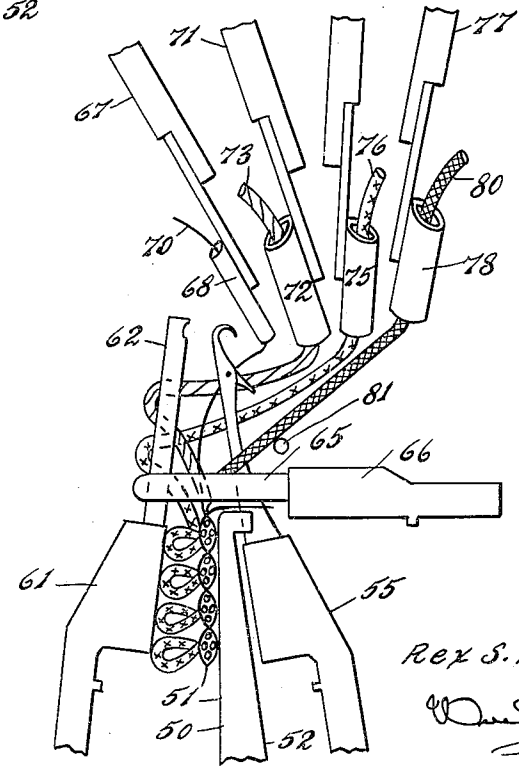

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Fig. 7a.

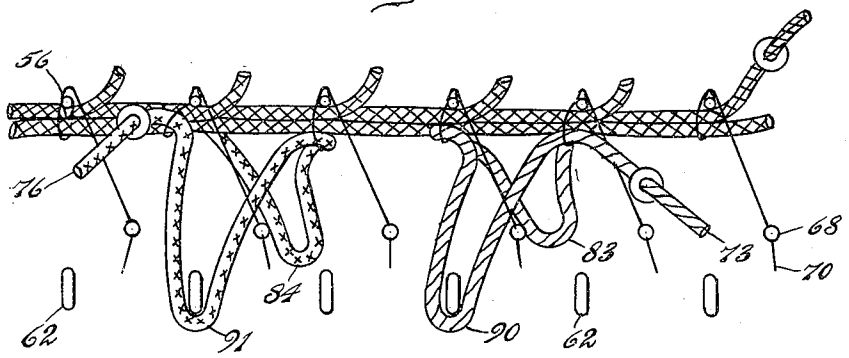

Fig. 8a.

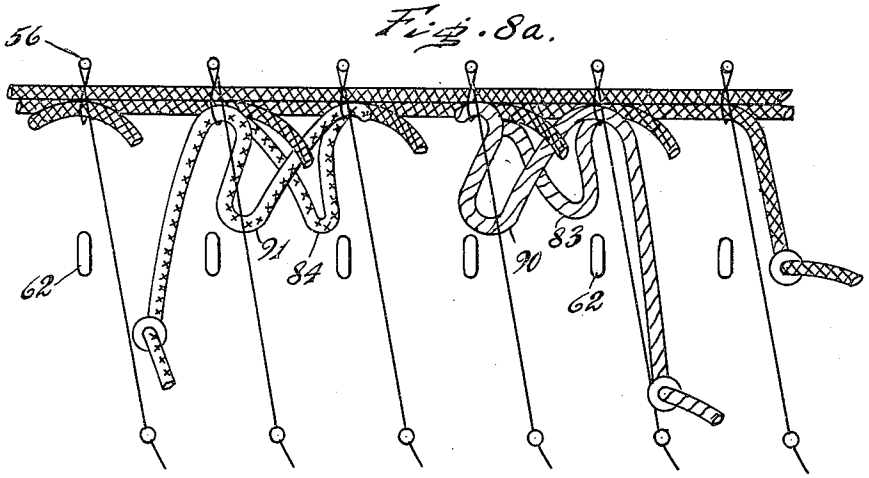

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Fig. 7.

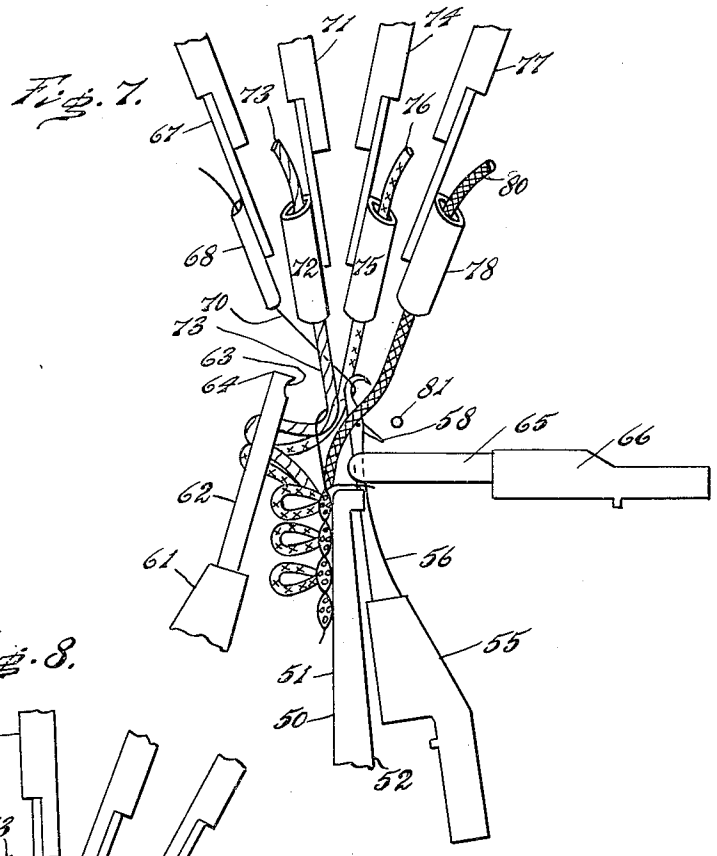

Fig. 8.

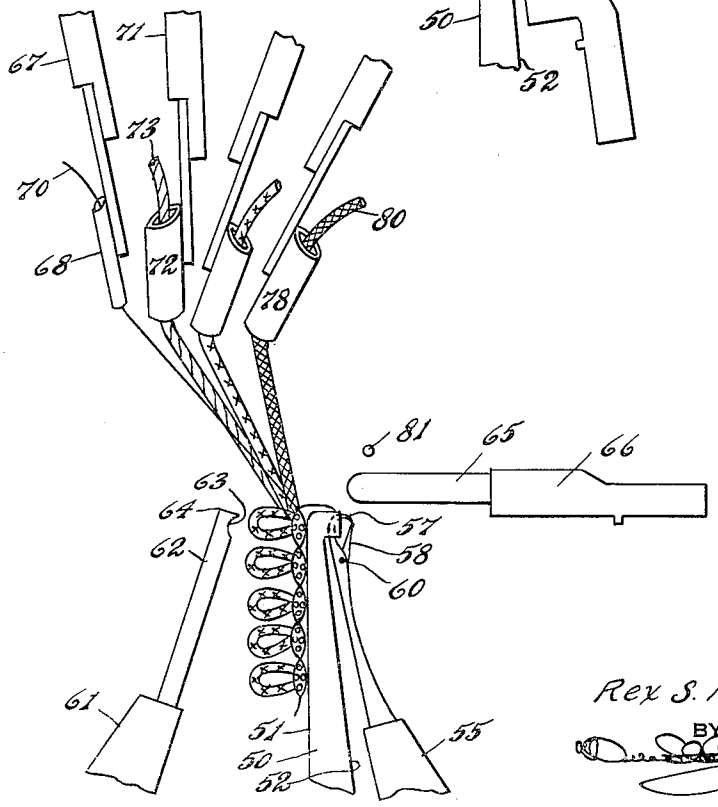

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Fig. 4b.

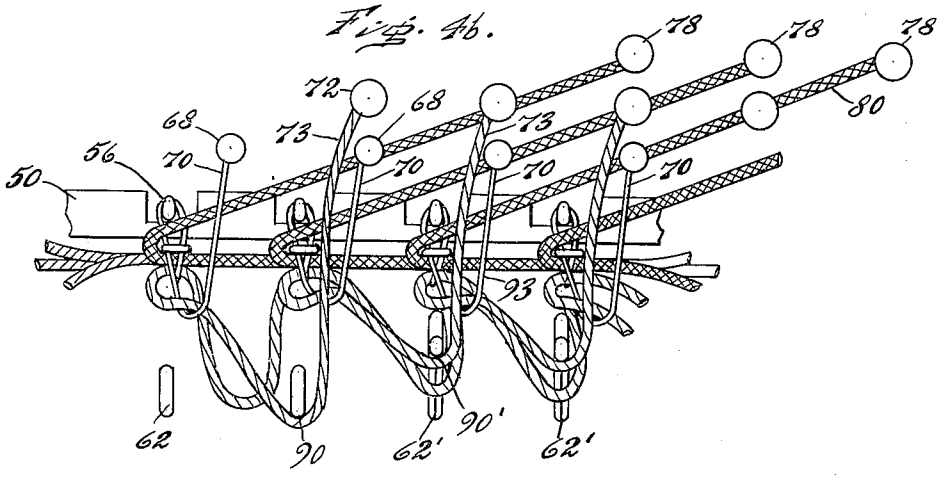

Fig. 5b.

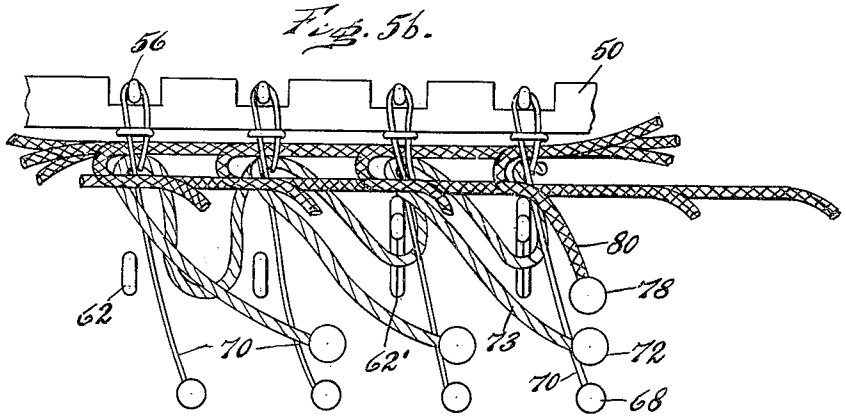

Fig. 6b.

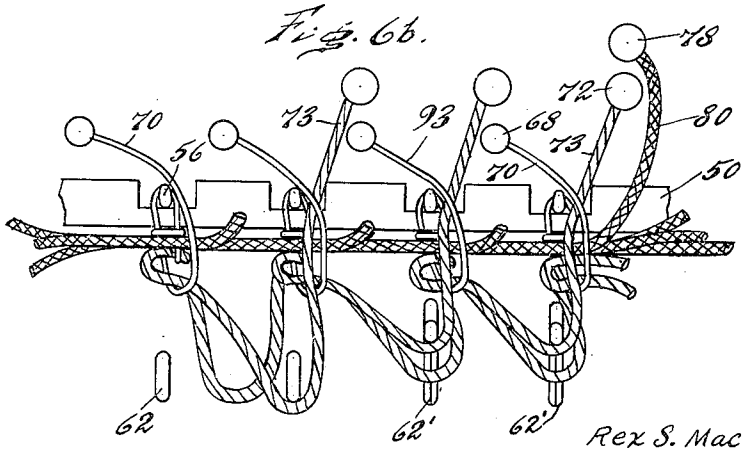

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Fig. 7b.

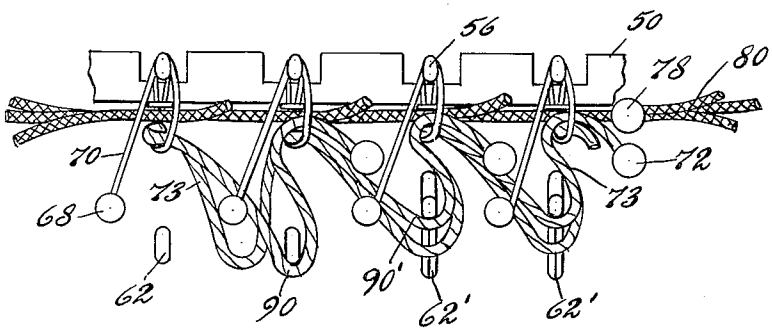

Fig. 8b.

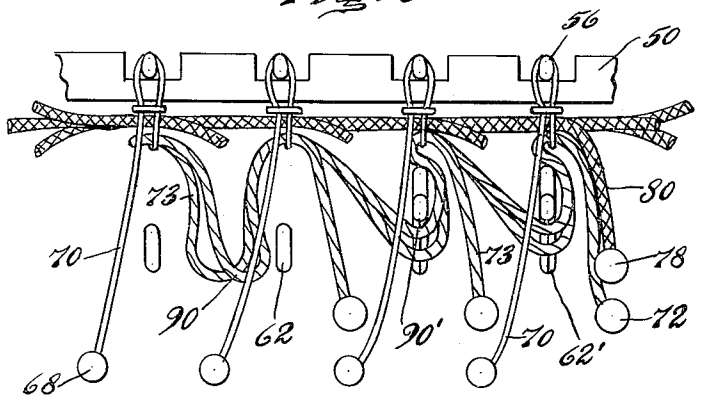

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Fig. 9.

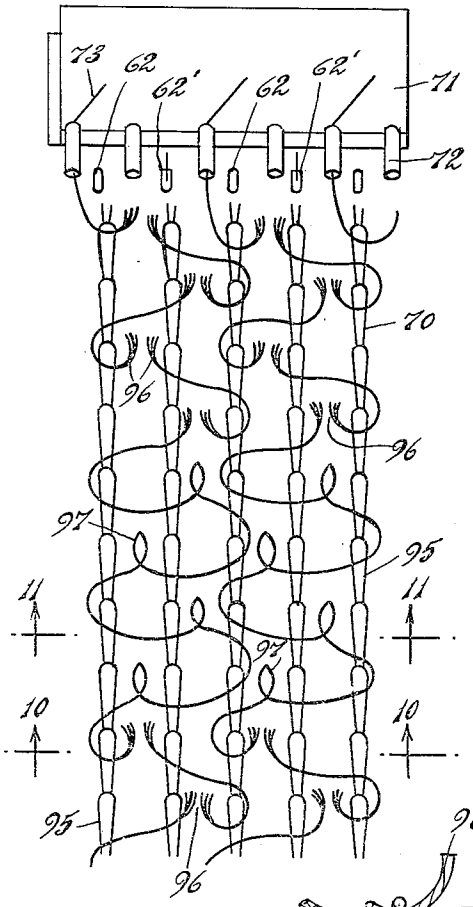

Fig. 12.

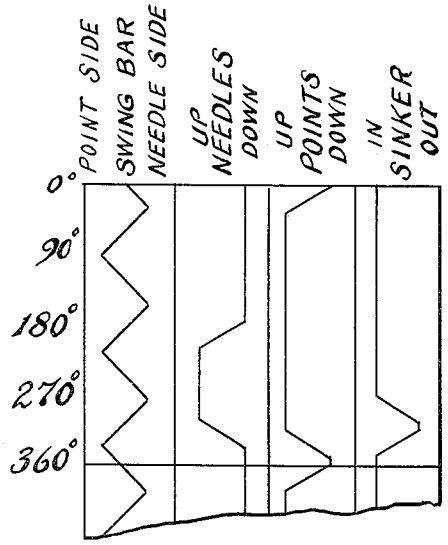

Fig. 10.

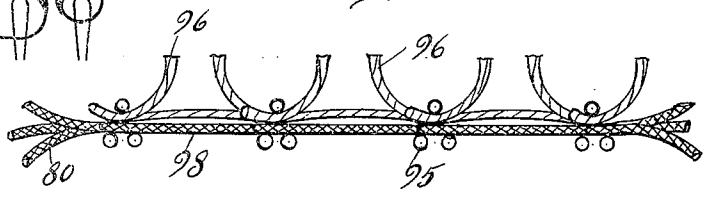

Fig. 11.

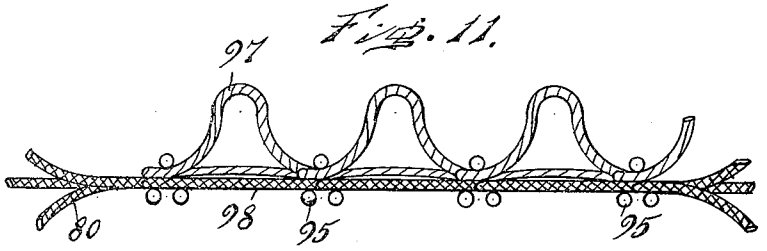

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Fig. 13.

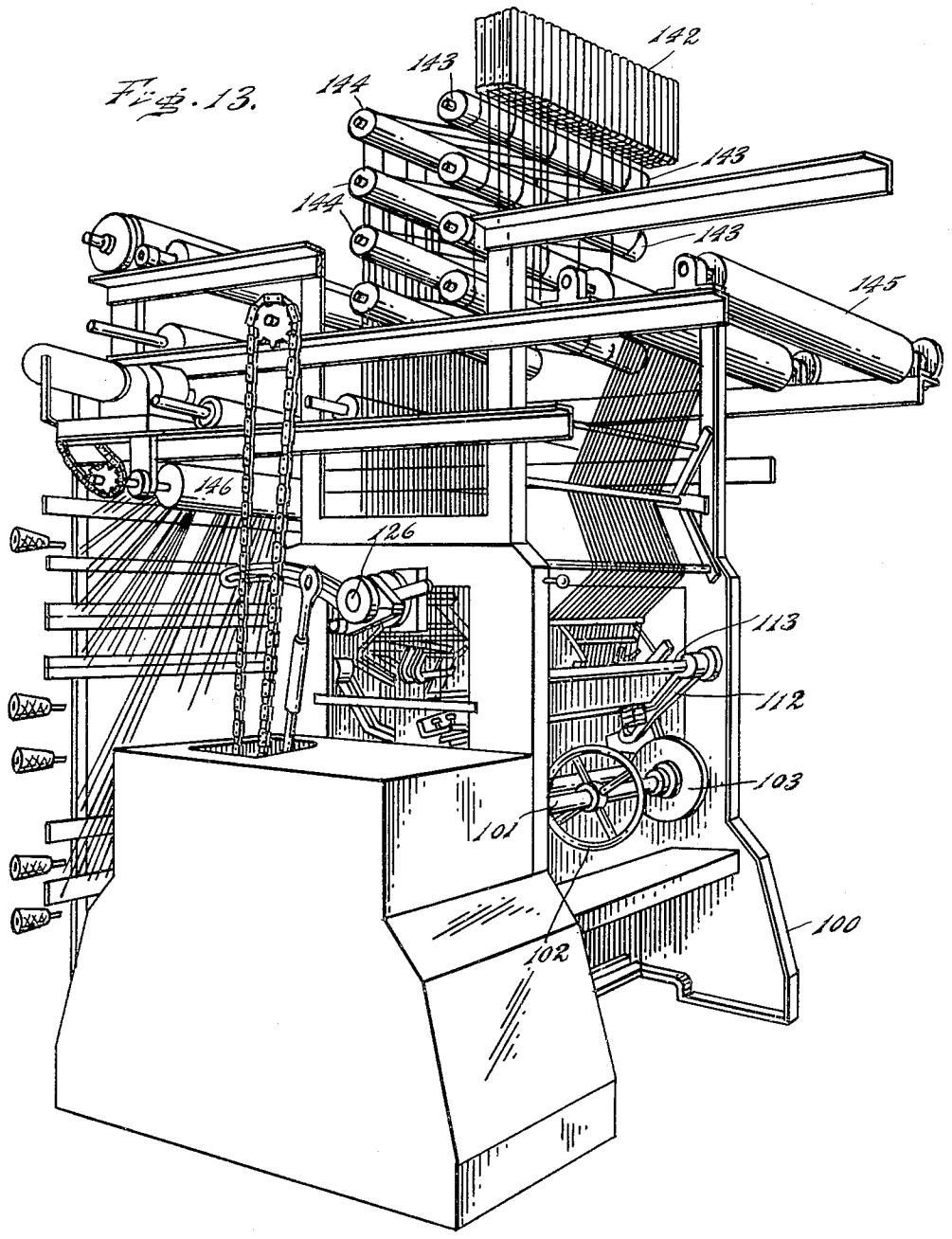

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Fig. 14.

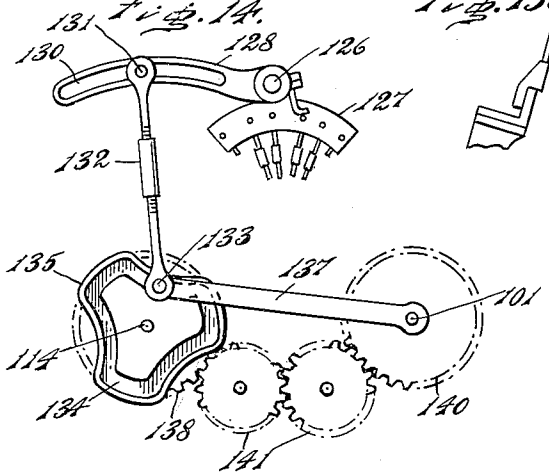

Fig. 15a.

Fig. 15.

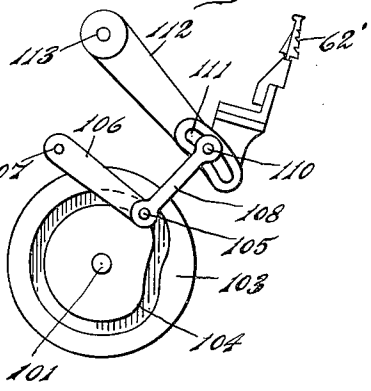

Fig. 17.

Fig. 16.

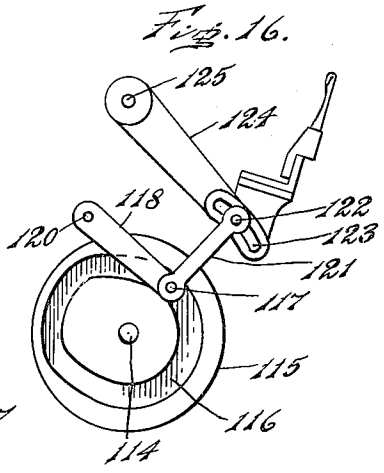

Fig. 18.

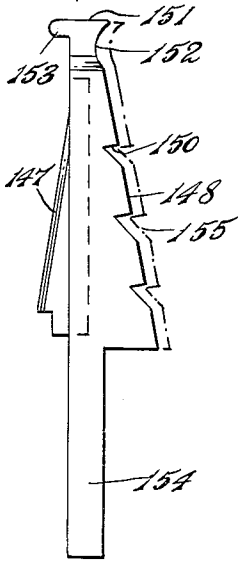

Fig. 19.

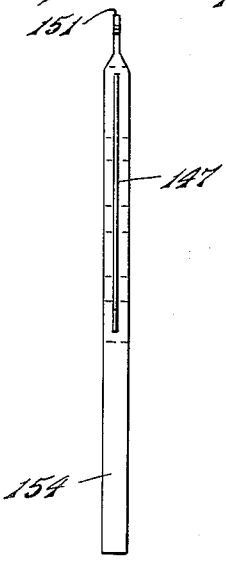

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Fig. 20.

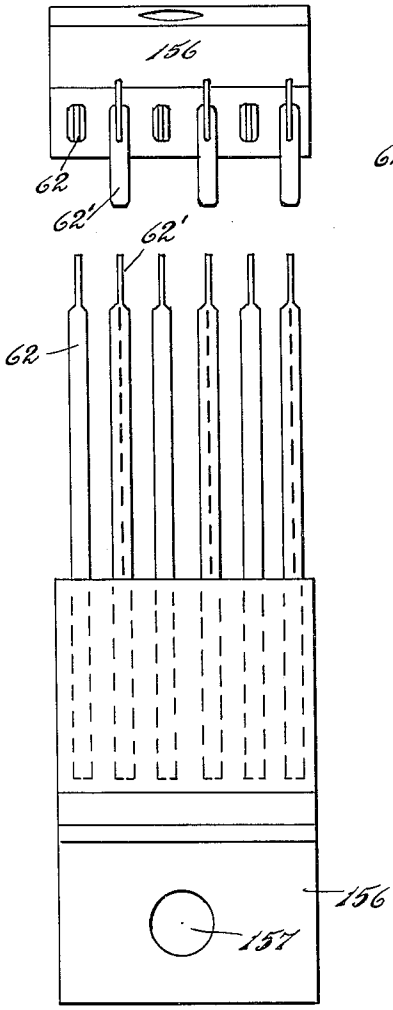

Fig. 21.

Fig. 22.

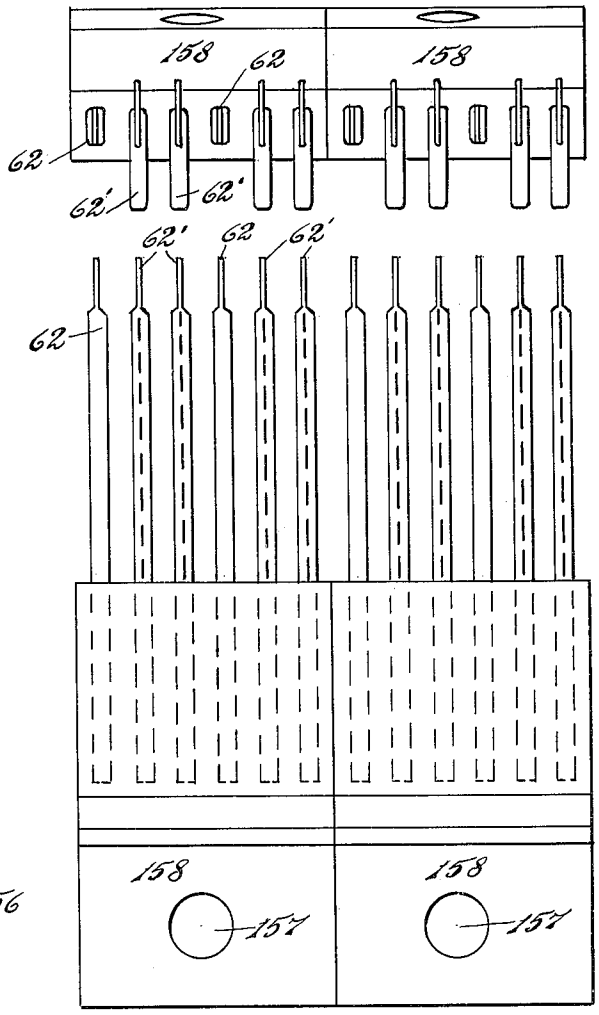

Fig. 22a.

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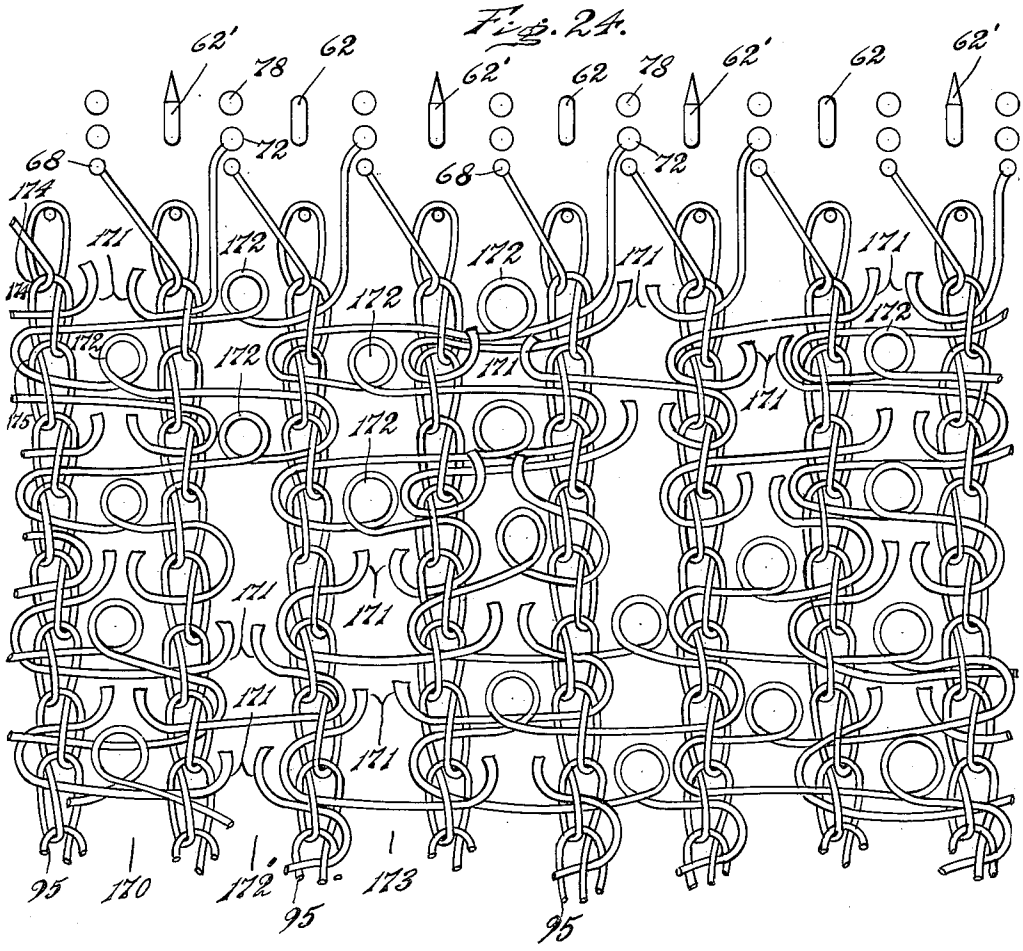
Fig. 24.



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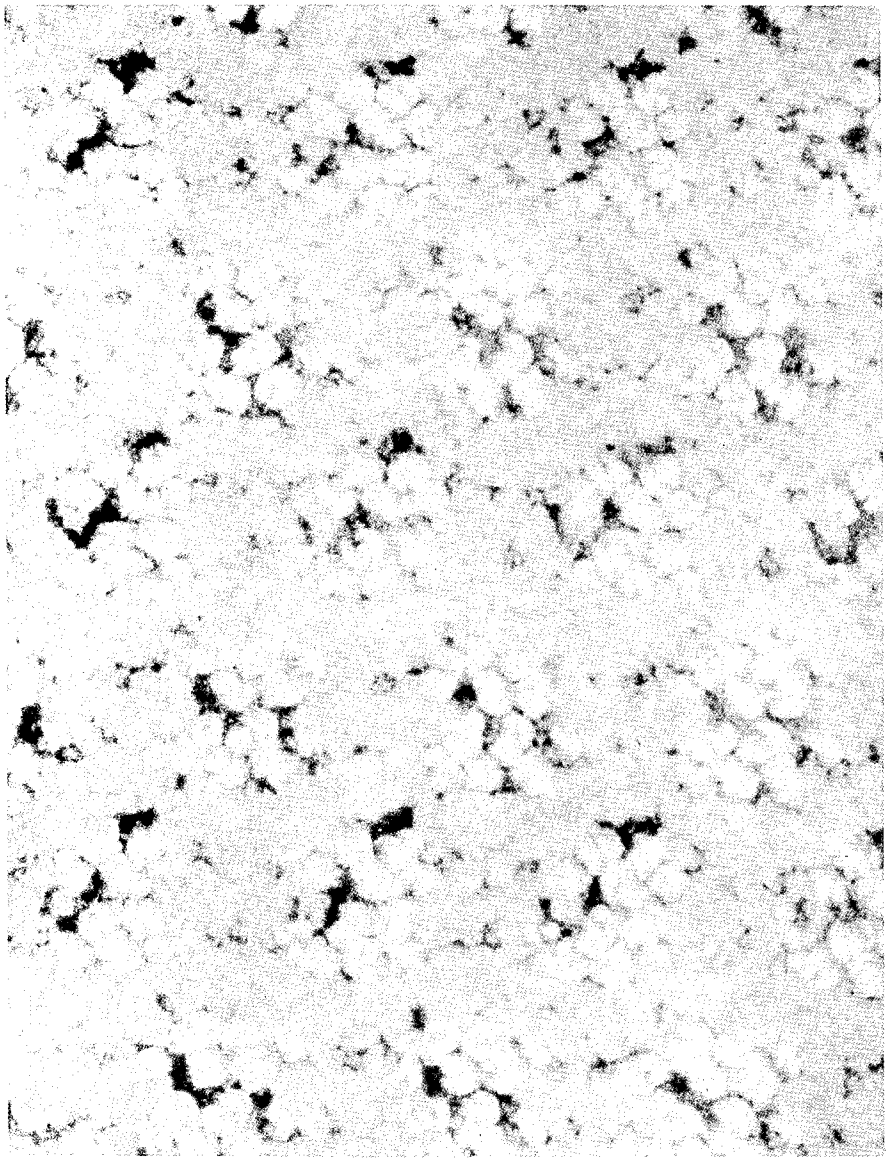

Fig. 25.

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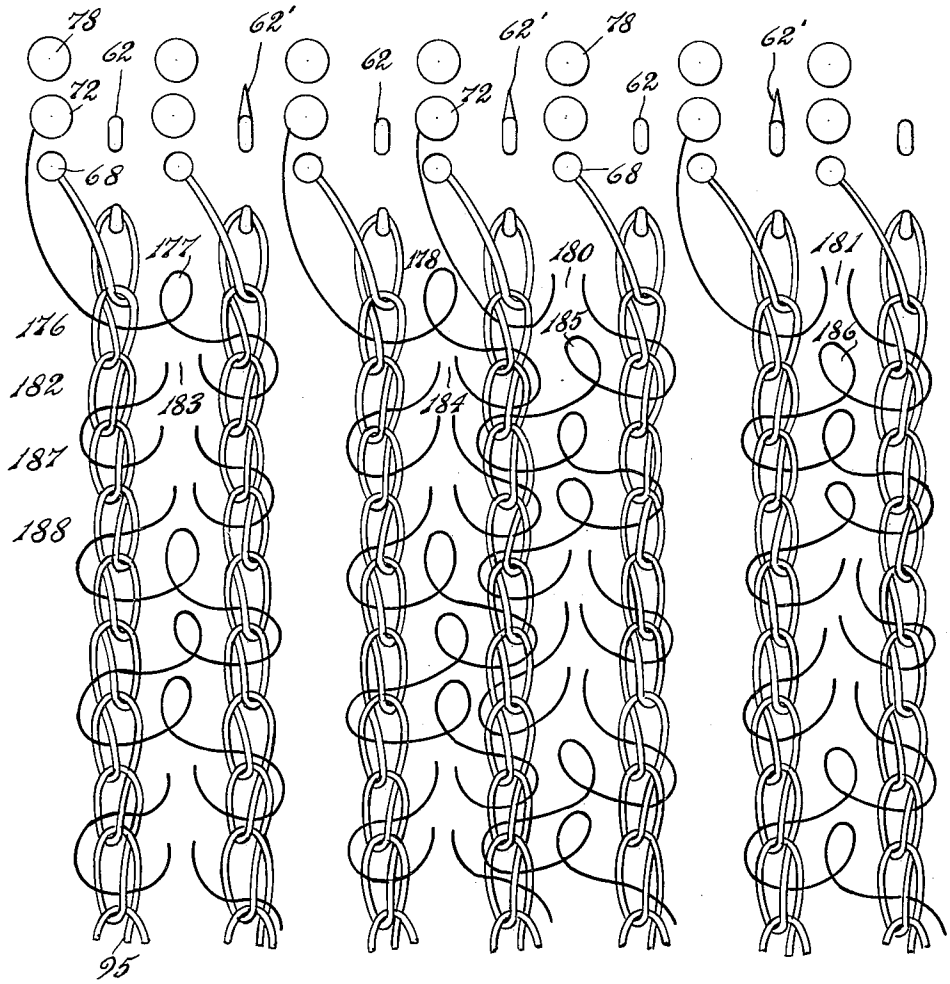
Fig. 26.



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Even Sequence of Points with Uneven Threading

Fig. 23.

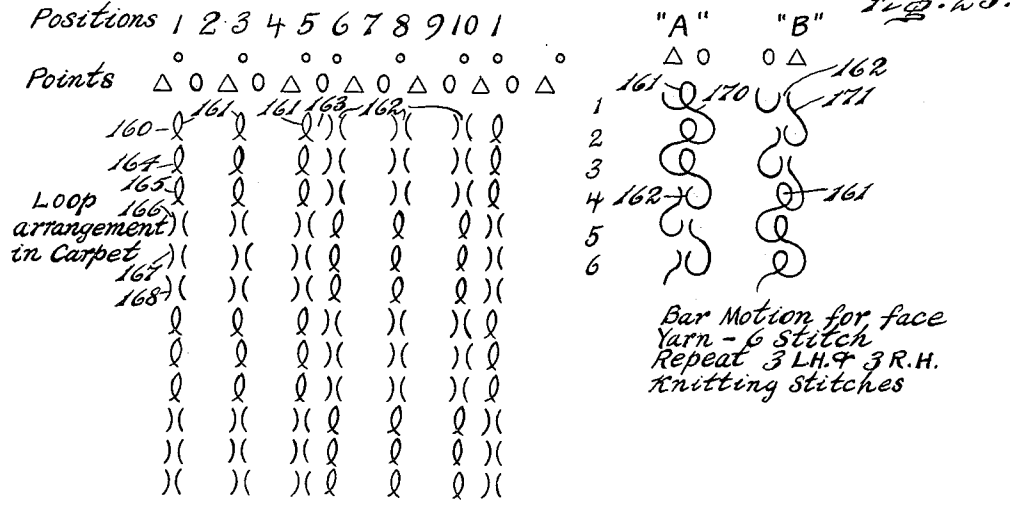
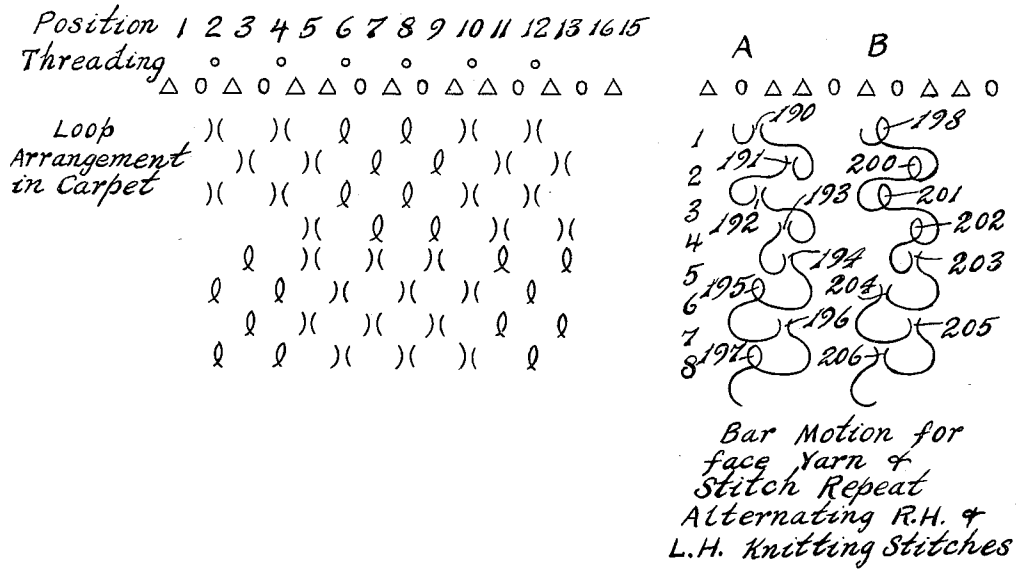


Fig. 27.



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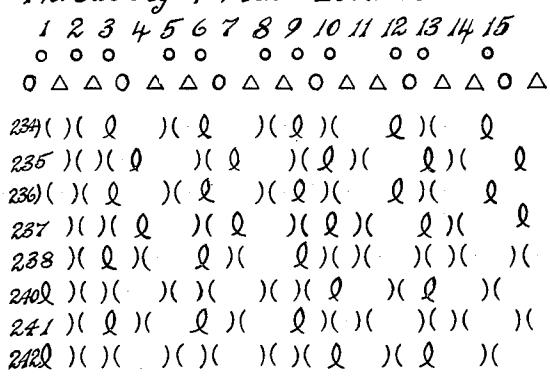
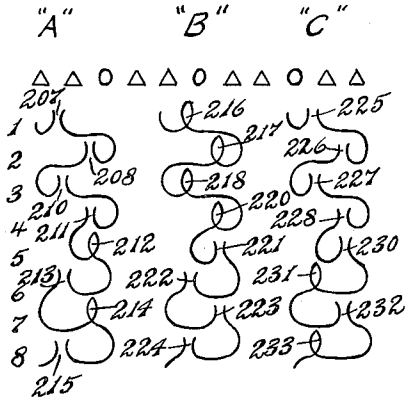
Uneven Sequence Points & Threading

Loop Arrangement

Threading & Point Location





△ Indicates cutting Point

○ " " Loop Point

Threaded in Locations 1, 2, 3, 5, 6, 8, 9, 10, 12, 13, Etc.

Plush Point Set 1 Loop to 2 Cut Type.

"A" Location of Cut & Loop Pile with Threading in position #2.

"B" In position #3.

"C" In position #1.

Fig. 28.

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Fig. 29.

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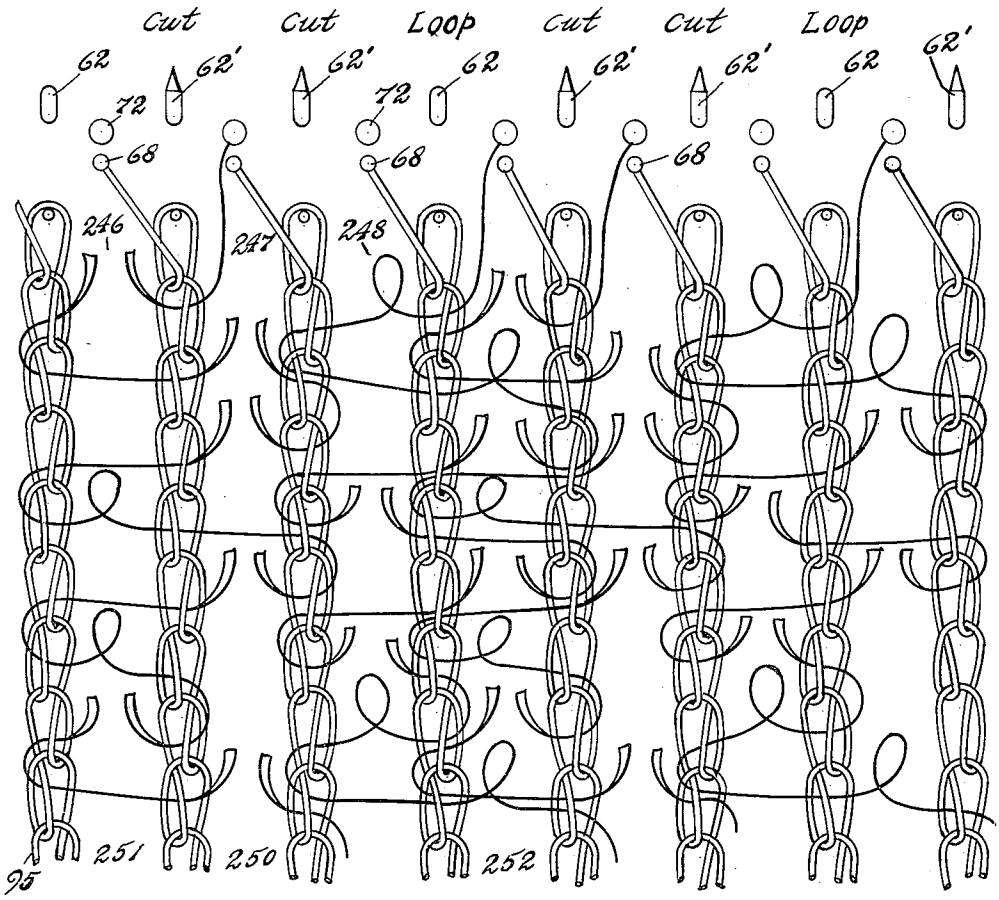

Uneven Threading with uneven Point arrangement
2 cut to 1 Loop
Alternating R. & L. stitches

Fig. 30.

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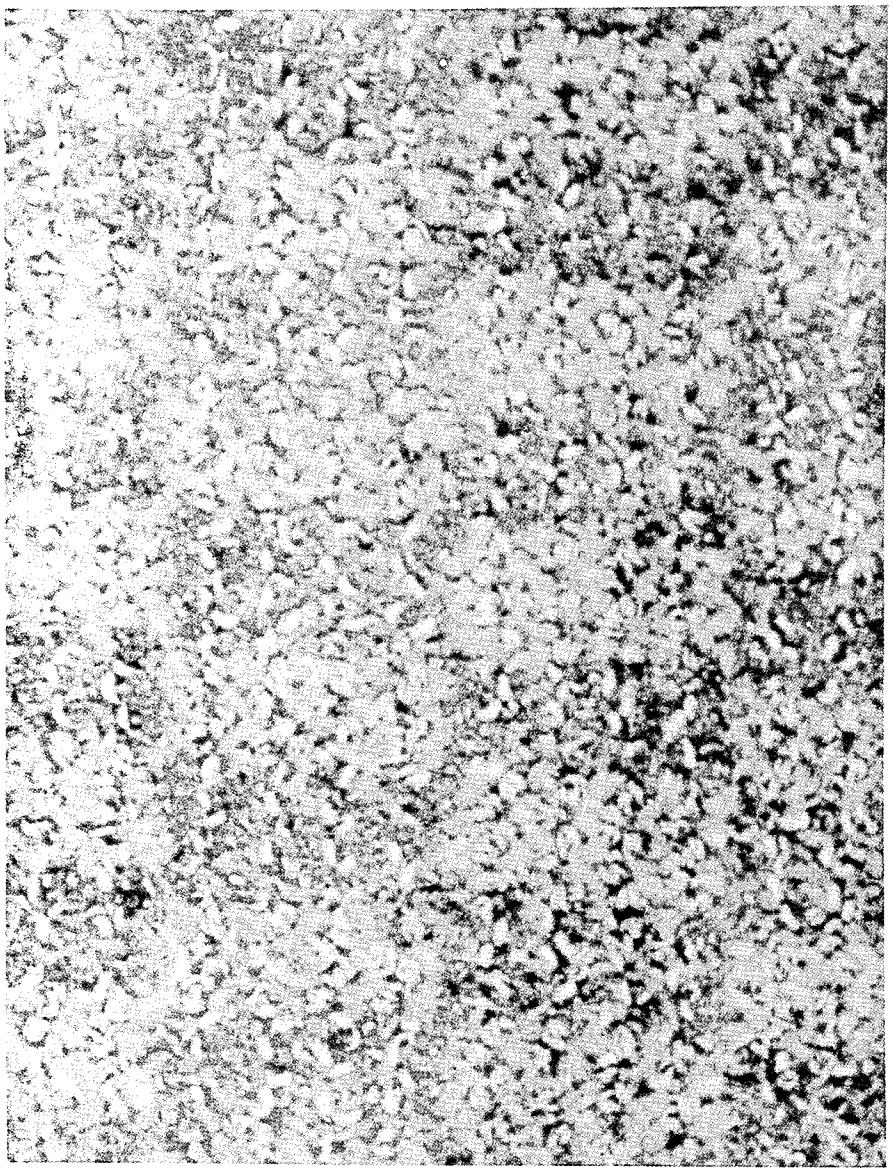

Fig. 31.

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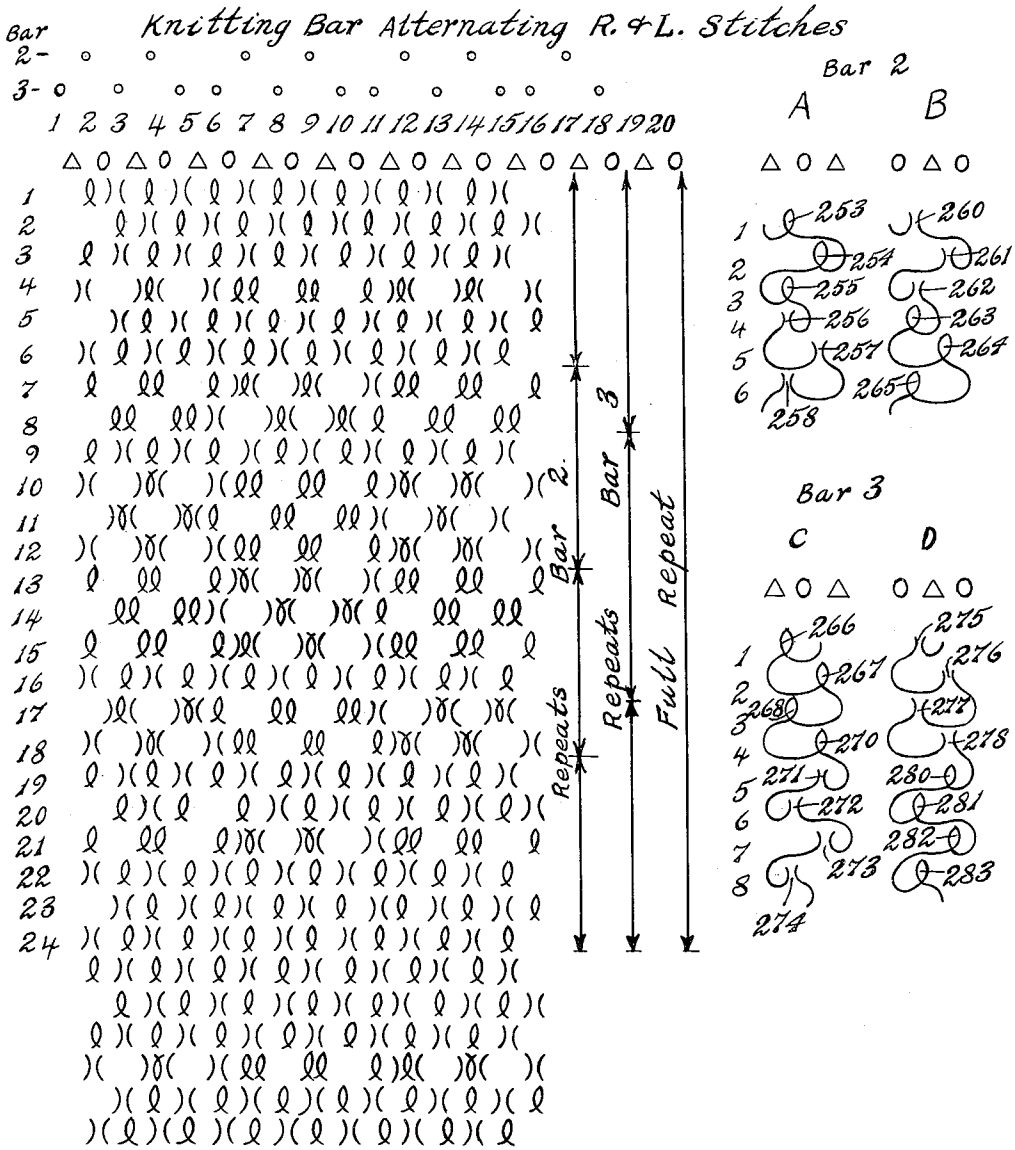
Fig. 32.

Plush Points Alternate Cut & Loop

Knitting Bar Alternating R. & L. Stitches



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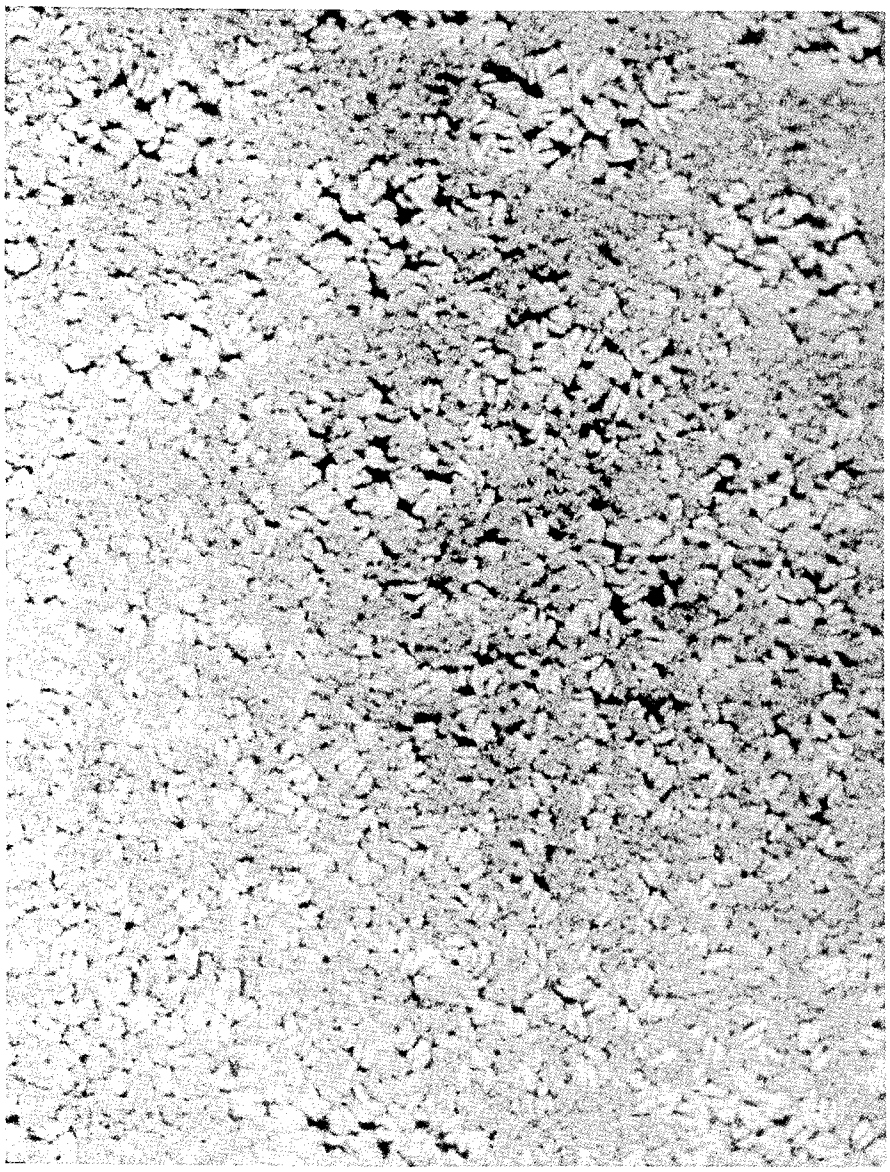

Fig. 33.

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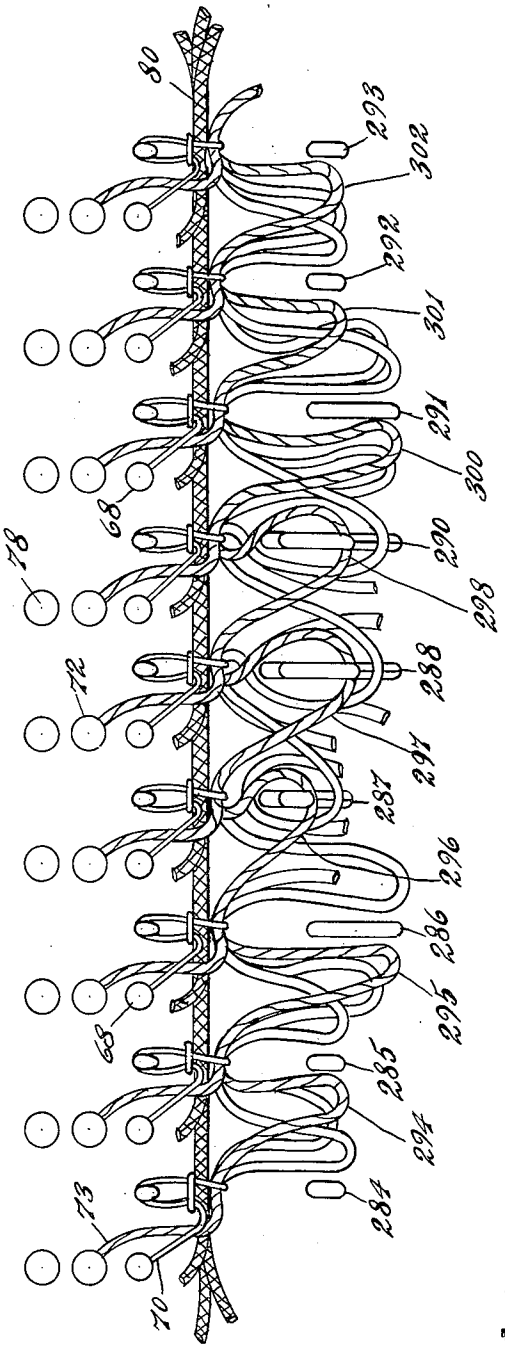
Fig. 34.



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WARP KNITTING METHOD

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The present invention relates to warp knitting processes, warp knitting looms and warp knitted fabrics, especially carpets and rugs.

This application has been divided and the subject matter relating to the machine is embodied in my application Serial No. 840,356, filed September 16, 1959, for Warp Knitting Machine, now Patent No. 2,959,947, and the subject matter relating to the fabric has been embodied in my application No. 840,368, filed September 16, 1959, for Warp Knitted Fabric.

A purpose of the invention is to permit selective warp knitting of a cut pile fabric, or of an uncut pile fabric, or of a fabric having cut and uncut loops, on the same mechanism, by mere change of the pattern chain.

A further purpose is to provide on opposite sides of the space between two needles, plush points of different characters, suitably some cutting and some noncutting, or some cutting high or low and others noncutting high or low of different height in terms of depth, and to selectively wrap the pile yarn end around the plush point at the left of the space or wrap the pile yarn end around the plush point at the right of the space.

A further purpose is to arrange plush points of different characters, such as cutting and noncutting, in the form of pattern repeat sequences, which may for example involve two cutting plush points and one noncutting in sequence, or for example two noncutting plush points and one cutting in sequence, and to form the pile over plush points some of which are of one character and some of which are of another character so that they will consist of cut and uncut pile projections in different wales of the same course.

A further purpose is to form two or more succeeding courses of cut pile projections, and then at least one course of uncut loops so there will be in the same wale a succession of cut pile projections and then at least one and in some cases a succession of uncut loops.

A further purpose is in different courses and according to a pattern control to wrap knitting yarn around needles from left to right, and in other courses from right to left, so that stitches formed of the same character will appear in a succession of adjoining courses, followed by stitches of opposite character, thus creating selective texturing effects in the face of the fabric by variations in preferred orientation of loops.

A further purpose is to employ a selective thread-in of pile yarn ends with ends out in certain of the tubes of the pile yarn guide bar or bars.

A further purpose is to omit alternate pile yarn ends in the thread-in.

A further purpose is to use an uneven or nonuniform thread-in repeat sequence on the pile yarn guide bar, with ends out at uneven or nonuniform positions.

A further purpose is to combine an uneven or nonuniform thread-in repeat with an arrangement of plush points which is either alternating, even or uneven as desired.

A further purpose is to employ in any of the above

procedures two frames of pile yarn ends, preferably of different colors, in warp knitting pile fabric.

A further purpose is to plant different colors along the pile yarn guide bar so that a single frame of pile yarn is made up of a multiplicity of different colors arranged in different positions on the guide bar.

A further purpose is to combine a planted frame or frames of pile yarn with a pattern repeat of different kinds of plush points so that pile projections of different colors are formed into pile of different characters, such as cut and uncut and high and low.

A further purpose is to organize the different colors of planted ends in a pattern color repeat.

A further purpose is to use thread-in repeats on two or more pile yarn guide bars which interrelate or cooperate in the ultimate fabric, by virtue of the difference in the character of the thread-in repeats and the way in which they complement or supplement one another.

A further purpose is to provide alternating one end in and one end out thread-in of pile yarn on two or more pile yarn guide bars, permitting selective placement of the yarn of such guide bars on the same plush points or different plush points.

A further purpose is to permit selective production of loops which are all cut in the same course, or all uncut in the same course, or all cut in the same wale or uncut in the same wale by mere change in pattern control.

A further purpose is to permit production of adjoining areas which are all cut in successive courses or all uncut in successive courses, or which are all cut in adjoining wales or uncut in adjoining wales.

A further purpose is to combine with any of the areas mentioned above areas which are a combination of cut and uncut loops either in the same courses or in the same wales.

A further purpose is to provide combinations of a high cut pile and a low loop pile or a high uncut pile and a low cut pile, and to permit combination of such areas with any of the areas mentioned above.

A further purpose is to provide areas of any of the characters mentioned above which are all of one color, combined with areas of any of the characters mentioned above which are all of another color, or combined with any of the areas mentioned above which comprise a combination of colors of which the high pile produces the dominant color.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of a very wide variety of embodiments of the invention, choosing the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figures 1 to 8 inclusive are diagrammatic vertical sectional views showing steps in formation of an uncut pile fabric in accordance with the invention.

Figures 1*a* to 8*a* inclusive are diagrammatic fragmentary top plan views showing the formation of the fabric in the successive positions of Figures 1 to 8.

Figures 1*b* to 8*b* inclusive are diagrammatic top plan views corresponding to Figures 1*a* to 8*a* insofar as position is concerned, and illustrating a sequence showing selective production of cut and uncut loops in the same course.

Figure 9 is a diagrammatic fragmentary view showing a completed fabric according to Figures 1 to 8 and 1*a* to 8*a* or 1*b* to 8*b*, with a pile yarn carrier having an alternate thread-in and alternating cutting and noncutting plush points, for the formation of an area of a fabric which includes both cut and uncut pile projections. While the stitches are shown, the backing of the fabric has been omitted in Figure 9 to facilitate illustration.

Figure 10 is a section of Figure 9 on the line 10—10, including the showing of the backing.

Figure 11 is a section of Figure 9 on the line 11—11, including the backing.

Figure 12 is a fragmentary cam diaphragm showing the cam positions for the production of the fabric according to Figures 1 to 8, 1*a* to 8*a*, and 1*b* to 8*b*.

Figure 13 is a diagrammatic perspective of a warp knitting loom according to the invention.

Figure 14 is a diagram showing the swing bar cam and operating mechanism according to the invention.

Figure 15 is a diagrammatic end elevation showing the plush point cam and operating mechanism according to the invention, and illustrating a cutting plush point.

Figure 15*a* is a fragmentary view corresponding to Figure 15 showing a noncutting plush point.

Fig. 16 is a diagrammatic end elevation showing the needle bar cam and operating mechanism according to the invention.

Figure 17 is a top plan view of a cutting plush point employed in the invention.

Figure 18 is a side elevation of Figure 17.

Figure 19 is a front elevation of Figure 17.

Figure 20 is a top plan view of one plush point repeat arrangement according to the invention.

Figure 21 is a rear elevation of Figure 20.

Figure 22 is a view similar to Figure 20 showing a variation.

Figure 22*a* is a rear elevation of Figure 22.

Figure 23 is a diagram showing the relation of plush points to thread-in for an even alternating sequence of plush points and an uneven thread-in according to the invention.

Figure 24 is a diagram showing the fabric and also the plush points and guide bar tube positions for producing the fabric, for an even sequence of cutting and noncutting plush points with an uneven thread-in of pile yarn ends.

Figure 25 is a photographic view of the face of a fabric employing the invention and using an even sequence of cutting and noncutting plush points and an uneven thread-in repeat.

Figure 26 is a diagram of a fabric, along with the plush points, needles and guide bars, with alternating cutting and noncutting plush points, and successive formation of three right-hand and then three left-hand knitting stitches forming three cut pile projections and then three uncut loops and so on in each wale.

Figure 27 is a diagram of the face of a fabric according to the invention, with an uneven repeat of plush points of different characters, and an even thread-in repeat.

Figure 28 is a diagram according to the invention, showing an uneven plush point repeat and an uneven thread-in repeat.

Figure 29 is a photographic view of a fabric according to the invention, made with an uneven plush point repeat and an uneven thread-in repeat.

Figure 30 is a diagram showing a fabric according to the invention, along with the plush points, needles and guide bars, for an uneven plush point repeat and an uneven thread-in using alternating right and left hand stitches.

Figure 31 is a photographic view of the face of a fabric according to the invention, using an alternating cut and uncut plush point arrangement and an uneven thread-in, and employing two frames of different colors in the knitting.

Figure 32 is a diagram showing the fabric and information as to its construction, where the plush points are alternating cutting and noncutting, and the uneven thread-in repeats on two pile yarn guide bars are of different lengths so that the resultant overall pattern becomes a combination and in some instances a least common denominator of the two uneven repeats.

Figure 33 is a photographic view of the face of a fabric of the character shown by the diagram of Figure 32.

Figure 34 is a fragmentary plan view of a fabric which shows a composite of high and low and cut and uncut pile according to the invention.

Describing in illustration but not in limitation and referring to the drawings:

In the prior art extensive use has been made of warp knitting to produce pile fabrics, including carpets and rugs. The variety of construction has, however, been limited due to the fact that it has not been possible to produce a warp knitted pile fabric which is cut without using a different warp in the loom from that producing a warp knitted pile fabric which is uncut, or at least changing the plush point bar. Furthermore, it has not been possible in the prior art to produce warp knitted pile fabrics having both cut and uncut loops either in the same course or different courses or in the same wale or different wales.

One of the important advantages of the present invention is that from the standpoint of the process and also from the standpoint of the loom, it is possible to shift from the production of pile having cut and uncut loops distributed in a suitable manner on the same machine without making any change except in the pattern chain. As a consequence a wide diversity of different fabrics can be produced, including those having either in individual courses or in individual wales, or in groups of courses or in groups of wales, or in groups of courses and in groups of wales, a pile fabric which is cut in one location and uncut in another location, or which is a combination of cut and uncut in the same locations, or which is high cut in one location and low cut in another location, or which is a combination of high and low cut in one location, or which is high uncut in one location and low cut in another location, or a combination of these in the same location.

Not only is it possible to employ pile projections of different characters in respect to cut and uncut loops, but this feature can very desirably be combined, in accordance with the invention, with thread-in repeats in which ends are left out in selected pile yarn guide bar tubes, the repeats being either even or uneven as desired. Furthermore, by planting ends of different colors in the same pile yarn frame a wide diversity of fabrics can be produced.

Also, by using two frames of pile yarn preferably of different colors, and preferably also with thread-in repeats which will desirably be of different lengths or of different characters or both, it is possible to produce a great diversity of different fabric constructions, especially when the thread-in repeats cooperate with repeats of plush points of different characters.

The invention finds its best application on a warp knitting loom of the so-called double needle bar Raschel type. Reference for the description of such a loom in detail may be had to D. F. Paling, Warp Knitting Technology (1952), chapter 11, Raschel Warp Looms, and chapter 12, Raschel Warp Loom Mechanism.

Considering now the operating steps of Figures 1 to 8 inclusive, supported by Figures 1*a* to 8*a*, and considered in connection with Figures 9 to 12, ignoring for the moment the drives for the mechanism, the steps are suitably as follows:

A vertically extending trick plate **50**, as well known in looms of this character, is generally of tapered cross section with a side **51** extending generally vertically and supporting the fabric being formed and removed by a take-off mechanism, and a side **52** suitably slightly converging and adjoining the needles. The trick plate at the top has a suitably notched needle guide comb portion **53** and a blunt top **54** as shown in Figure 1.

One needle bar mounting of the loom carries supports **55** for a series of latch needles **56**, as well known, which extend generally at a slight angle to the trick plate.

The latch needles as shown in Figure 1 have hook ends 57 at the top directed away from the trick plate and latches 58 pivoted at 60 and in one position closed against the hook ends. The other needle bar in the device of the invention at the opposite side of the trick plate is equipped with plush points mounted on a support 61. As later explained, the loom of the invention includes plush points of different characters, but in Figures 1 to 8I illustrate noncutting plush points 62, notched at the side toward the needles at 63 and desirably slightly filleted at the upper corner 64 remote from the needles.

Positioned immediately above the trick plate and adapted to move across it, is a sinker comb 65 mounted on sinker supports 66 on a sinker bar as well known.

Positioned above the sinkers and extending clear across the machine there is a swing bar which carries, suitably positioned thereon in order from front to back, a horizontally slidable mounting which supports a knitting yarn guide bar 67 which carries a series of eyes or tubes 68 which guide knitting yarn 70; then a horizontally slidable mounting for pile yarn guide bar 71 which carries a series of eyes or tubes 72 for pile yarn ends 73 of pile frame A; next toward the back there is a horizontally slidable support which mounts in slidable relation a second pile yarn guide bar 74 which carries eyes or tubes 75, one for each end 76 of pile frame B; and finally at the rear there is a horizontally slidable support which mounts in sliding relation a backing yarn guide bar 77 which carries a series of eyes or tubes 78, one for each backing yarn end 80. A latch wire 81 extends across the back of the machine.

Considering first Figures 1 and 1*a*, to be considered particularly in reference to Figure 12, showing the cam positions, the machine is at zero degrees or 360 degrees and is taking the first step after completion of the last stitch. The needles 56 and the plush points 62 are down or retracted, the sinker comb is advanced or forward, and the swing bar with the guide bars 67, 71, 74 and 77 is in midposition and moving back. When desired, in fabric design, the guide bars can shog in either direction any reasonable distance at this position. The condition encountered in Figure 1 is shown in more detail in Figure 1*a*. In Figure 1*a* knitting yarn 70, fed by tubes 68, is locking in the stitch 82 including backing yarn 80, and pile yarn 73 of frame A, fed by tube 72 to form pile loops 83 and also pile yarn 76, fed by tubes 75 to form pile loops 84. The backing yarn forms bundles 85 extending across from one line of stitches to the next, an individual end of backing yarn being suitably bound in three or more adjoining lines of stitches, as well known.

Figures 2 and 2*a* correspond to an advance of 30 degrees in the cycle. The position of the needles and the sinkers is the same as that of Figure 1. The guide bars are all the way back, out of line with the needles and plush points, and the plush points 62 have just completed their advance or upward motion, preparatory to the formation of pile projections.

As seen in Figure 2*a*, the position of the fabric components is substantially the same as that of Figure 1*a*, except that the guide bar tubes have changed their position by shogging pile yarn ends 76 as indicated. The backing yarn 80 will permissively also shog at this position if desired.

Figures 3 and 3*a* correspond to the position at 90 degrees in the cycle. The swing bar and the guide bars with it have moved to the front so that the pile yarn guide bars are past the plush points and the pile yarn now shogs in the preferred embodiment in either direction so that in the next step loops will be formed around the plush points to produce pile. The formation of such loops by shogging is shown on pile yarn ends 73 at 90 and on pile yarn ends 76 at 91 in Figure 3*a*.

In the step illustrated in Figures 4 and 4*a*, at 150 degrees in the cycle, the swing bar has moved back and

carried with it the guide bars, while the needles, plush points and sinker comb remain in the same position as they were previously. The backward swing of the swing bar completes the formation of the loops 90 and 91 previously referred to around the plush points, as shown in Figure 4*a*, while similar loops, not shown, are formed around other plush points which are similarly placed with respect to the eyes of the guide bars. As soon as the guide bars have cleared the plush points, the guide bar carrying pile yarn ends 73 is desirably shogged as shown in Figure 4*a*, and the backing yarn guide bar also shogged to form the lay-in, as shown in Figure 4*a*. The question of whether the backing yarn is shogged at this point in the same direction as the pile yarn as shown, or in the opposite direction, is immaterial.

The position of Figures 5 and 5*a* at 210 degrees in the cycle corresponds to the completion of the shogging except for the knitting yarn. The guide bars have all moved forward past the needle position at the plush point side, and needles 56 have advanced or raised in Figures 5 and 5*a* and the needle latches 58 have been opened by the previous knitting stitch as shown at 92 of Figure 5, while such previous knitting stitch has moved down on the needle below the latch, leaving the hook of the needle open. Figure 5*a* shows the arrangement of the needles 56 in the position of Figure 5 as the needles come up.

The position of Figures 6 and 6*a* corresponds to 270 degrees in the cycle. This position shows all guide bars moved back of the plush points and needles, with the new stitch ready to be formed when it enters the hooks of the needles in the next step. The pile yarn ends are now formed in loops 90 and 91 around the plush points as shown in Figure 6*a*. The knitting yarn guide bar now shogs, forming loops 93 of knitting yarn 70 which are about to enter the hooks of the needles and wrap around the needles at a position above the latches and below the hooks.

Figures 7 and 7*a* at 300 degrees in the cycle show the guide bars moving to the front and midway in their swing. The sinker comb 65 which has been in position across the fell and across the upper end of the trick plate, is now retracted to clear the end of the needles, the needles have engaged the knitting yarn in their hooks and are beginning to retract, and the latch is being closed by the previous stitch, while the plush points are also retracting. The previous stitch now casts off as the needles retract. Actually the casting off takes place between the step of Figure 7 and the step of Figure 8, and once the stitch is cast off, the previous pile yarn loop is bound.

It will be evident that in Figures 7 and 7*a* loops of knitting yarn previously formed at 93 have now entered the needles to form a stitch which grips together in a bundle the pile loops and the backing yarn to integrate the fabric and form a new course.

Figures 8 and 8*a* correspond to 330 degrees in the cycle, and show the stitch completed and locked. The sinker comb 65 is now fully retracted and about to be advanced again to the position of zero or 360 degrees as shown in Figure 1. The pile yarn loops have been cast off by the plush points and new completed loops 90 and 91 have now been formed as shown in Figures 8 and 8*a*. However, since loops 90 and 91 were formed around plush points to the left of the space between needles and the previous loops 83 and 84 were formed around plush points to the right of this space, the loops in the successive course are differently oriented and will be even more markedly different as later explained when the plush points are of different characters.

Figure 12 is a chart which conveniently summarizes the positions of the various elements in a single cycle. Thus it is evident that the swing bar moves back and forth between the point side and the needle side, the needles move up and down, the points move up and down, and the sinker moves in and out at different angular positions in the cycle as there shown. It will of course be evident that

as soon as the operative motions are obtained the various elements can move in a different manner from that shown in Figure 12, as set out by my copending application Serial No. 686,720, filed September 27, 1957, for Warp Knitting Machine and Method, now Patent No. 2,949,754.

In accordance with the present invention, the plush points are desirably of different characters at different positions across the fabric, and this makes possible the production of a wide variety of different fabrics as shown in Figures 1*b* to 8*b* inclusive, which correspond to Figures 1*a* to 8*a* except that the operation is shown on a number of plush points, and on plush points of different characters.

Considering first Figure 1*b*, I there illustrate a pair of noncutting plush points **62** and then a pair of cutting plush points **62'**, and a similar repeat sequence is carried across the machine.

Figures 1*b* to 8*b* have been modified by showing only one pile yarn guide bar as the views would be made extremely complicated by including a second pile yarn guide bar.

In Figure 1*b* the previous loop formed over noncutting plush point **62** is cast off at **84'**, and the previous loop formed over cutting plush point **62'** is shown at **83'**, where it will be cut at a later operation of the cycle.

It is possible to observe cut pile tufts **94** from previous loops formed over cutting plush points which have already been cut.

In Figure 2*b* the condition as far as loop formation is concerned is similar to that previously shown, except that the plush points **62** and **62'** have advanced or raised. This may or may not cut the loop **83'** at this point depending on the tightness.

As shown in Figure 3*b* and as previously described in connection with Figures 3 and 3*a*, the pile yarn has shogged in Figure 3*b*, forming loops **90** around the noncutting plush points **62** and loops **90'** around the cutting plush points **62'**.

In Figure 4*b* as already described in Figures 4 and 4*a*, the further motion of the swing bar has completed the loops **90** around the noncutting plush points and the loops **90'** around the cutting plush points.

Next as shown in Figure 5*b*, the needles start up. This has been more fully described in reference to Figures 5 and 5*a*.

Now as shown in Figure 6*b* and as described more fully in connection with Figures 6 and 6*a*, the knitting yarn forms loops **93** which when the switches are completed will bind the pile projections and hold together the back of the fabric.

Figure 7*b* shows the condition previously described in connection with Figures 7 and 7*a* in which the newly formed stitch is about to be bound, and there will be completed pile loops **90** over noncutting plush points **62** and loops **90'** over cutting plush points **62'**. As enough loops accumulate on the cutting plush points, they are moved out on the taper to be described and cut by the knives.

Figure 8*b* illustrates the result previously described in connection with Figures 8 and 8*a*, in which loops **90** have been cast off by the noncutting plush points and loops **90'** are about to be cut on the cutting plush points.

The capabilities of one embodiment of the invention will be best understood by reference to Figures 9, 10, and 11, illustrating the face of a fabric according to the invention, which has been formed using alternating cutting plush points **62'** and noncutting plush points **62** and a pile yarn guide bar **71** with tubes **72** and pile yarn **73** threaded only in alternate tubes. The stitches, arranged in chains **95**, lock or bind the pile yarn **73** which in certain courses forms cut pile tufts **96** best seen in Figures 9 and 10, and in other courses form uncut pile loops **97** best seen in Figures 9 and 11, the selection of the formation of cut tufts or uncut loops being made depending upon whether the pile yarn is wrapped around the plush points on one side or the other side of the space between needles. Of course these stitches of the chains **95** also hold together the bundles of backing yarn **98**, to integrate together the fabric as shown.

Considering now the mechanism of the present invention as set forth in Figures 13 to 16 inclusive, a frame **100** (Figure 13) journals a driven shaft **101** having a hand wheel **102** carrying plush point drive cams **103** which are best seen in Figure 15, which has a cam track **104** cooperating with a cam follower **105** which pivotally connects to the free end of a lever **106** pivoted at **107** on the frame.

The pivotal connection of the follower **105** also pivotally connects to one end of a link **108**, which at the far end has a pin **110** which adjustably pivotally connects in an arcuate slot **111** on plush point arm **112** which is keyed on plush point bar shaft **113** journaled in the frame. The plush point cam **103** conforms to the cam layout set forth in Figure 12.

The needle operating mechanism is shown best in Figure 16, as it is at the back of the machine, being in effect identical with the plush point mechanism. A rear drive shaft **114**, journaled in the frame and extending across it, turns needle bar cams **115** having tracks **116** which receive cam follower **117** pivotally connected to one end of an arm **118** having fixed pivotal mounting at **120** on the frame.

The follower **117** also pivotally connects to one end of the link **121**, which at the other end has a pin **122** adjustably pivotally connected in an arcuate slot **123** in the outer end of a needle arm **124** which is keyed on needle bar shaft **125** extending across and journaled in the frame. The layout of cam **115** is set forth in Figure 12.

Above the plush points and needles, a swing bar shaft **126** extends across the machine and is journaled in the frame and carries swing bar brackets **127** carrying the respective guide bars previously described, as well known in the art. The guide bars are shown in connection with the pattern control mechanism of Paling, supra, beginning at page 145. The swing bar has secured thereto at one end swing bar arm **128** having an arcuate adjustment slot **130** which receives an adjustment stud **131** which pivotally connects to one end of adjustable link **132** which at the other end carries a cam follower **133** which engages in a cam track **134** on a swing bar cam **135** operating on rear shaft **114** of the machine. The follower **133** pivotally connects with one end of link **137**, the other end of which is loosely pivoted on front shaft **101**. To maintain proper opposite driving relation between the follower and front shafts, gear **138** on rear shaft **114** and gear **140** on the front shaft **101** are interconnected by gearing **141**, the front shaft suitably being driven from the rear shaft.

The layout of the swing bar cam is shown in Figure 12.

The face yarn is taken to the appropriate guide bars from a suitable creel or beam feed through tubes **142**. Each face yarn end passes under one feed roll **143** and over one feed roll **144** and thence to the eye or tube of the appropriate guide bar. As well known, the pairs of feed rolls for the different face yarn ends may run at the same speed or selectively at different speeds at different times according to pattern control in making high and low pile.

The kitting yarn is brought in over feed mechanism **145**, and the backing yarn is brought in over feed mechanism **146**, each of the mechanisms being suitably conventional.

The sequence of knitting with cutting plush points **62'** as shown in Figure 15 or with noncutting plush points **62** as shown in Figure 15*a* is essentially the same, except that in the case of the noncutting plush points the loops are cast off, while in the case of the cutting plush points the loops travel down the plush points and are eventually cut.

Figures 17 to 19 illustrate the details of a desirable form of cutting plush points which conforms with the

subject matter of my copending application Serial No. 666,312, filed June 18, 1957, for Cutting Plush Point for Carpet Knitting, now Patent No. 2,907,191. The plush point as shown diverges from its axis on the side remote from the fabric and has a tapering knife **147**, and desirably also tapers on the opposite side or heel **148** in the opposite direction, so that as the pile loop moves down the plush point the tension is increased until cutting takes place.

The heel is also desirably equipped with notches or tooth recesses **150** having gradual slopes downward and generally transverse formation at the top, tending to grip the fabric and prevent the fabric from moving upward when the needles advance, especially in heavy fabrics. The plush point is desirably blunt at the top at **151**, and has a recess **152** on the heel side near the top which avoids having unwanted yarn get on the cutter side, but desirably has a hook end **153** on the cutter side which prevents unintended casting off.

The cutting plush point suitably has a standard shank **154** which is desirably interchangeable with the shank on a noncutting plush point so that at the desire of the operator either cutting or noncutting plush points can be placed on any position in the plush point bar.

It will further be evident that the depth of both the cutting and noncutting plush points will be varied as desired, this being suggested by dotted line **155** in Figure 18, so that the cutting and noncutting plush points will form loops of selectively different heights as desired.

One suitable arrangement of plush points or plush point repeat is suggested in Figures 20 and 21. In this form a so-called "casting" or plush point mounting **156**, suitably of type metal or organic plastic, has a sequence of noncutting plush points **62** alternating with cutting plush point **62'**, and is provided with a bolt receiving mounting recess **157**. It will be understood that the plush point bar carries a long series of casings each holding a group of plush points.

Thus in the form of Figures 20 and 21 there is always a noncutting plush point on one side of the space between two needles and a cutting plush point on the other side of the space between two needles. With an alternate thread-in on a given pile yarn guide bar, having ends-in only in the alternate tubes, it is possible by shogging to determine that either cut or uncut pile projections will be formed.

Of course on the other hand it will be evident that if there is an end-in in every tube of a pile yarn guide bar, then of course both cut and uncut pile will be formed using the plush point repeat of Figures 20 and 21.

On the other hand where there are two frames, it is possible to wrap the pile yarn ends of one frame about one type of plush point (say noncutting) and the pile yarn ends of the other frame around the other type of plush point, with alternate thread-in, or the pile yarn ends of both frames with alternate thread-in can be placed around either one of the types of plush points.

In some cases, however, it is preferable to employ a plush point repeat which will produce both cut and uncut pile projections on the same frame in the same course. Such an arrangement is shown in Figures 22 and 22*a*, where each of the castings **158** (which are typical of many extending the length of the plush point bar) has a single noncutting plush point **62** and then two cutting plush points **62'** and then again a single noncutting plush point **62** and two cutting plush points **62'** and so on.

It will therefore be evident in this form that if there is an end-in in each alternate tube on a particular pile yarn guide bar, that guide bar whether forming loops to the left or to the right of the space between two needles, will always form some uncut loops and some cut tufts. If there is a thread-in with an end-in in every tube of a particular pile yarn guide bar, of course there will be formed one uncut loop and two sets of cut tufts and so on in sequence.

If, however, there is a thread-in of some other form, for example a nonuniform arrangement of ends-in and ends-out, there can be reoccurring sequences of cut and uncut pile projections in the same course as later explained.

In the various figures of the drawings following, I illustrate typical fabrics embodying features of the present invention obtained with different plush point repeats and in some cases with special thread-ins.

Figure 23 shows in diagrammatic form the relations of plush points to thread-in for an even sequence of plush points and an uneven thread-in according to the invention. In this case as shown in the chart at the left, the plush points are alternately cutting and noncutting throughout. Ten wales are shown, for a single frame in which the thread-in places ends-in in tubes 1, 3 and 5 as shown at the right in column A for six courses and then in tubes 6, 8 and 10 as shown by column B on the right for six courses. With wale 11 it will start again with the 1, 3 and 5 sequence which, in that case would be 11, 13 and 15, and then shift to the 6, 8 and 10 sequence which would be 16, 18 and 20. It is evident that in this form in any course **160** there will be a succession of uncut adjoining loops **161** in three spaced wales, and then a succession of cut tufts **162** in three spaced wales, but the end of the sequence of uncut loops **161** is close spaced at **163** with respect to the beginning of the sequence of the spaced tufts **162**.

This arrangement in course **160** follows in the succeeding courses **164** and **165**, but then by shifting the guide bar to form loops around the plush points at the opposite sides of the needles spaces, a new sequence occurs in courses **166**, **167** and **168**, in which the tufts appear in the wales which formerly had loops and the loops appear in the wales that formerly had tufts.

The way in which a given end of pile yarn **170** follows through the six courses just discussed, forming first an uncut loop **161** in each course for three courses and then cut tufts **162** in each course for three courses in shown at column A at the right and the manner in which a pile yarn end **171** behaves in six courses beginning with course **160** is shown at column B, with formation first of tufts **162** in each course of the same wale and then formation of uncut loops **161** in three succeeding courses of the same wale.

The dimensions walewise of the blocks or areas of cut pile and uncut pile formed in Figure 23 are determined by the pattern chain, and the dimensions course-wise of these blocks or areas are determined by the combination of plush point repeat and thread-in.

One feature that is of significance in connection with the present invention is that the direction of formation of knitting stitches must be compatible with the direction of formation of the loops around the plush points. By this it is intended to indicate that the direction of formation of the knitting stitch must be related with the direction of motion of the face yarn and the choice of plush points on which the face yarn is to form a loop at that particular stitch.

This may be stated more explicitly as follows:

(1) If the face yarn is moving from left to right, and the face yarn is to form a loop around the plush point to the left of the space between two needles, the knitting stitch must be formed by wrapping the knitting yarn around the needle from left to right.

(2) If the face yarn is moving from left to right, and it is desired to form a loop of face yarn around a plush point to the right of the space between two needles, then the knitting stitch must be formed by wrapping the knitting yarn around the needle from right to left.

(3) If the face yarn is moving from right to left, and a loop is to be formed by wrapping the face yarn around a plush point at the left of the space between two needles, then the knitting stitch must be formed by wrapping the knitting yarn around the needles from left to right.

(4) If the face yarn is moving from right to left, and a loop is to be formed by wrapping the face yarn around a plush point on the right of the space between two needles, then the stitch must be formed by wrapping the knitting yarn around the needles from right to left.

Applying this principle to Figure 23, it will be evident that a sequence of three left-hand and then three right-hand knitting stitches will be used in the corresponding six courses shown.

In Figure 24 I illustrate a diagram showing the fabric and the plush points and guide bar tube positions for producing the fabric for an even sequence of cutting and noncutting plush points with an uneven thread-in of pile yarn ends. This figure omits the backing yarn, but shows knitting chains **95** which are binding a single frame of pile yarn ends which have ends-in in pile yarn tubes 2, 3, 5 and 6, with ends-out in tubes 1, 4 and 7 and then repeat. The alternate stitches are formed left-hand and right-hand and the face yarn is shogged so that the pile loop is formed around the desired plush point, which may be selectively either a cutting or noncutting plush point in either row. Thus, following the principles of compatibility set forth above, it will be evident that since the direction of stitch in any particular row is predetermined (left-hand or right-hand), the choice of the cutting (or noncutting) plush point to be used is the plush point at the side on which the direction of pile yarn motion will be compatible with the direction of stitch.

Accordingly it will be evident that in the fabric there are in wale **170** a sequence of alternate cut pile tufts **171** and uncut pile loops **172** in successive courses, while in wale **172'** there is a succession of two uncut pile loops **172** and then two sets of pile tufts **171**, and in the next wale **173** there is a succession of two uncut pile loops **172** and then two sets of cut pile tufts **171**. The next wales involve a repeat of the combination found in wales **171**, **172'** and **173**. The repeat, however, shifts upwards (walewise), because in the next wales the corresponding pile projections are in different alternate courses. Thus, following course **174** there are first cut pile tufts **171**, then uncut loop **172**, then a pile projection omitted, then uncut pile loop **172**, then cut pile tufts **171**, then a pile projection omitted and then cut pile tufts **171**. In the next course **175**, there is an uncut pile loop **172**, then a pile projection omitted, then an uncut pile loop **172**, then cut pile tufts **171**, then a pile projection omitted, then cut pile tufts **171**, and then uncut pile loop **172**.

The next course is a repeat of course **174**.

The actual effect produced, using an even sequence of cutting and noncutting plush points (alternately cutting and noncutting) and an uneven thread-in, when applied to a two frame fabric knitted with two pile yarn guide bars, is shown in Figure 25. The thread-in in pile yarn guide bar A is 1, 3, 5, 6, 8 and 10 tubes having ends-in and intervening tubes having ends-out, with repeat. The thread-in in pile yarn guide bar B is 3, 5, 8 and 10 tubes having ends-in, and other tubes having ends-out, with repeat. The effect is to produce clusters of cut and loop pile, with the cut pile in the clusters masking the loop pile, and, therefore, masking out color of the pile frame which forms loop pile at that point. The clusters are in this case nonsymmetrical, giving a pleasing effect, due to the thread-in. The cut pile tends to open up and cover any spaces where pile projections are not present, giving uniform converage.

Figure 26 illustrates a fabric and the plush points and guide bar tubes, but omits the backing which will be of any well known character. For purposes of clarity, only one face yarn guide bar is shown, the remaining face yarn guide bars being omitted.

In this case the face yarn is threaded-in in the 1st, 3rd, 4th and 6th tubes of the face yarn guide bar, with ends out in the 2d, 5th and 7th tubes, and then repeat. As shown, course **176** includes a sequence of uncut pile loops **177**, then no pile projection in the next wale, then uncut pile loop **178**, then cut pile tufts **180**, then no pile projection in the next wale, and then cut pile tufts **181**. The next course **182** includes a sequence of cut pile tufts **183**, then no pile projection in the next wale and then cut pile tufts **184**, then uncut pile loop **185**, then no pile projection in the next wale, and then uncut pile loop **186**. The next course **187** and **188** duplicate course **182**, and there are then three courses duplicating course **176** and so on throughout the fabric.

It will be evident that in this fabric, the face yarn always remains in a single wale, instead of shogging across two wales as in Figure 9 or Figure 24. Instead the knitting yarn is shifted from an even sequence of alternate right and left-hand stitches, previously used, to a succession of stitches fitting the compatibility principle, thus forming three left-hand stitches in courses **182**, **187** and **188**, and then three right-hand stitches and so on.

In some cases it is preferable to use uneven plush point repeats instead of even plush point repeats as previously discussed.

Figure 27 illustrates at the left a diagram showing a succession of plush points in the following order: cutting, noncutting, cutting, noncutting, cutting, cutting and repeat. The thread-in in this case is an even alternate thread-in, with ends-in in face yarn tubes 2, 4, 6, 8, 10, 12, etc., and ends-out in the intervening face yarn tubes for the single frame shown.

As a result, there are two different sequences of face yarn in different wales, which are designated at the right-hand portion of the diagram as columns A and B, showing 8 courses which constitute the full repeat. Pile yarn ends in column A form uncut pile tufts **190** in course 1, then cut pile tufts **191** in the next wale in course 2, then cut pile tufts **192** in the first wale in course 3, then cut pile tufts **193** in the next wale in course 4, then cut pile tufts **194** in said next wale in course 5, then uncut pile loop **195** in the first wale in course 6, then cut pile tufts **196** in the next wale in course 7, and finally uncut pile loop **197** in the first wale in course 8.

The next adjoining pile warp end whose sequence is shown at column B forms uncut pile loop **198** in its first wale in course 1, then uncut pile loop **200** in course 2 in the next wale, then uncut pile loop **201** in course 3 in the first wale, then uncut pile loop **202** in course 4 in the next wale, then cut pile tufts **203** in course 5 in said next wale, then cut pile tufts **204** in course 6 in said first wale, then cut pile tufts **205** in course 7 in said next wale, and finally cut pile tufts **206** in course 8 in the first wale.

As a result, the fabric shown at the left in Figure 27 has in each course two adjoining pile projections of similar character, but in some wales the pile projections vary their character to produce clump areas of loops and other clump areas of tufts.

It will be evident that by the cooperation of the uneven sequences of the plush points with an even sequence of thread-in, and intervening ends-out, it is possible to obtain very substantial areas of one kind of pile exclusively which have a contour or shape which can be predetermined.

Very interesting and often quite complicated effects can be obtained by using a combination of an uneven sequence of plush point repeat and uneven thread-in as shown in the diagram of Figure 28 and as shown in the fabric of Figure 29.

As indicated at the left in Figure 28, the plush point repeat is as follows: noncutting, cutting, cutting. The thread-in repeat places ends-in in pile yarn guide bar tubes 1, 2, 3, 5 and 6, with ends out in tubes 4 and 7, and repeat. This creates three typical situations regarding the paths of pile yarn ends designated respectively at the right as columns A, B and C for 8 courses which constitute a repeat. Each pile yarn end appears sometimes in one wale and sometimes in the next wale.

Considering first column A, in course 1 these pile yarn ends form cut pile tufts **207** in its left-hand wale, in course 2, it forms cut pile tufts **208** in its right-hand wale, in course 3, it forms cut pile tufts **210** in its left-hand wale, in course 4, it forms cut pile tufts **211** in its right-hand wale, in course 5, it forms uncut pile loop **212** in its right-hand wale, in course 6, it forms cut pile tufts **213** in its left-hand wale, in course 7, it forms uncut pile loop **214** in its right-hand wale, and in course 8, it forms cut pile tufts **215** in its left-hand wale.

Pile yarn ends which follow the path indicated by column B form cut pile loop **216** in course 1 in the left-hand wale, uncut pile loop **217** in course 2 in the right-hand wale, uncut pile loop **218** in course 3 in the left-hand wale, uncut pile loop **220** in course 4 in the right-hand wale, cut pile tufts **221** in course 5 in the right-hand wale, cut pile tufts **222** in course 6 in the left-hand wale, cut pile tufts **223** in course 7 in the right-hand wale and cut pile tufts **224** in course 8 in the left-hand wale.

The pile yarn ends following the path indicated at column C in Figure 28, form cut pile loop **225** in the first course in the left-hand wale, form cut pile tufts **226** in the second course in the right hand wale, form cut pile tufts **227** in the third course in the left-hand wale, form cut pile tufts **228** in course 4 in the right-hand wale, form cut pile tufts **230** in course 5 in the right-hand wale, form uncut pile loop **231** in course 6 in the left-hand wale, form cut pile tufts **232** in course 7 in the right-hand wale, and form uncut pile loop **233** in course 8 in the left-hand wale.

Considering now the left-hand diagram in Figure 28, it will be noted that column A corresponds to pile yarn guide bar tube 2, column B corresponds to pile yarn guide bar tube 3 and column C corresponds to pile yarn guide bar tube 1.

The resulting effect across the fabric is to produce the following sequence of cut and uncut pile projections and pile projections omitted: cut tufts, cut tufts, uncut loop, pile projection omitted, cut tufts, uncut loop, pile projection omitted, and so on as shown by the diagram. This condition prevails in courses **234**, **235**, **236** and **237** with staggered relation of cut and uncut pile with respect to the wales. In courses **238** and **241** the sequence is: pile projection omitted, cut pile tufts, uncut pile loop, cut pile tufts, pile projection omitted, uncut pile loop, cut pile tufts, pile projection omitted, and so on, as shown in the digaram. In courses **240** and **242**, the sequence is: uncut pile loop, cut pile tufts, cut pile tufts, pile projection omitted, cut pile tufts, cut pile tufts, pile projection omitted, cut pile tufts, cut pile tufts, uncut pile loop, and so on, as shown in the diagram.

The effect produced by applying the plush point sequence and the thread-in repeats of Figure 28 on two pile frames is shown in Figure 29, where a series of cross lines of cut pile are formed with intermediate blocks giving a longitudinal and transverse striping effect.

When a combination of uneven plush point repeat and uneven thread-in repeat is used with alternating right and left-hand stitches, the effect is as shown in Figure 30. The plush point repeat involves two cutting plush points and one noncutting plush point. The thread-in involves ends-in in face yarn guide bar tubes 2, 4, 5, and 7 and ends-out in face yarn guide bar tubes 1, 3, and 6, and repeat. The face yarn shogs across two wales, and forms a predetermined but uneven sequence of cut pile tufts **246**, pile projection omitted at **247**, and an uncut pile loop at **248**, the cut and uncut pile projections in some cases being in adjoining wales and in some cases in spaced wales, in some cases two cut pile projections being closest together in the same course, and in other cases one cut and one uncut pile projection being closest together in the same course. Walewise, in some wales and fabric areas as for example in wale **250**, there are sequences of a plurality of cut pile projections, and in other cases as in wale **251** there is a plurality of uncut pile projections. In other wales in a particular pattern areas, as in wale **252**, cut and uncut pile projections alternate.

Figure 31 shows photographically the face of a fabric where two pile frames of different colors have been used with alternating cutting and noncutting plush points and an uneven thread-in as in Figure 24. It will be noted that the concentrations of a particular color appear in areas distributed unevenly across the fabric, tending to break up any lining effects and creating preferable color distribution. The cut pile tends to mask the uncut pile even though they are of the same height, and the color of the uncut pile in a particular area is therefore subordinated or suppressed.

The principles which have been discussed have been applied to relatively simple embodiments, but they can in some cases be applied in relatively more complex forms, of which a somewhat simplified example is shown in Figure 32. In this case, the plush points are alternating cutting and noncutting, and two pile yarn guide bars are used, each of which has a different uneven thread-in. Thus face yarn guide bar 2 has ends-in in guide tubes 2 and 4 and ends-out in tubes 1, 3, 5 and 6 and repeat. Face yarn guide bar 3 has ends-in in tubes 1, 3, 5 and 6, and ends-out in tubes 2 and 4.

The diagrams at the right show the paths followed by face yarn ends on bar 2 and bar 3. On bar 2 face yarn ends produce pile of two different characteristics indicated by columns A and B. The end of column A which is in tube 2 position in course 1, forms uncut pile loop **253** in the left-hand wale, and in course 2 it forms uncut pile loop **254** in the right-hand wale, in course 3 it forms uncut pile loop **255** in the left-hand wale, in course 4 it forms cut pile tufts **256** in the left-hand wale, in course 5 it forms cut pile tufts **257** in the right-hand wale, and in course 6 it forms cut pile tufts **258** in the left-hand wale.

In bar 2 and column B, which corresponds to tube 7, in course 1 the pile yarn end forms cut pile tufts **260** in the left-hand wale, in course 2 it forms cut pile tufts **261** in the right-hand wale, in course 3 it forms cut pile tufts **262** in the left-hand wale, in course 4 it forms uncut pile loop **263** in the left-hand wale, in course 5 it forms uncut pile loop **264** in the right-hand wale and in course 6 it forms uncut pile loop **265** in the left-hand wale.

After these courses there is a repeat of the formation of the pile yarn ends on bar 2.

In bar 3 pile yarn ends follow column C which corresponds to tube position 6. In course 1 this forms uncut pile loop **266** in the left-hand wale, in course 2 it forms uncut pile loop **267** in the right-hand wale, in course 3 it forms uncut pile loop **268** in the left-hand wale, in course 4 it forms uncut pile loop **270** in the right-hand wale, in course 5 it forms cut pile tufts **271** in the right-hand wale, in course 6 it forms cut pile tufts **272** in the left-hand wale, in course 7 it forms cut pile tufts **273** in the right-hand wale, and in course 8 it forms cut pile tufts **274** in the left-hand wale.

Column D corresponds to pile yarn ends in bar 3 at tube 3. In course 1 it forms cut pile tufts **275** in the left-hand wale, in course 2 it forms cut pile tufts **276** in the right-hand wale, in course 3 it forms cut pile tufts **277** in the left-hand wale, in course 4 it forms cut pile tufts **278** in the right-hand wale, in course 5 it forms uncut pile loop **280** in the right-hand wale, in course 6 it forms uncut pile loop **281** in the left-hand wale, in course 7 it forms uncut pile loop **282** in the right-hand wale and in course 8 it forms uncut pile loop **283** in the left-hand wale.

At the end of 8 courses there is a repeat of the forms of bar 3.

Thus, considering the fabric as shown at the left in Figure 32, the full repeat takes 24 courses, which is the position at which the repeat of bar 2 and the repeat of

bar 3 coincide. A fairly complicated relationship of placement of cut and uncut pile projections in the various courses prevails, and it varies throughout the 24 courses. Thus in some cases cut and uncut pile projections alternate while in other cases there are successions of cut or successions of uncut pile projections, so that there are areas in the fabric which are predominately cut pile of both frames and areas which are predominately uncut pile of both frames, as shown.

Figure 33 shows the photograph of the face of the fabric produced in accordance with the diagram of Figure 32, and it will be evident that there are nonsymmetrical clumps of cut and of uncut pile, throughout the repeat area.

It will be evident that the very simple embodiment of Figures 32 and 33 can be amplified to produce relatively complex fabrics following the same principles. As suggestive of the type of variation which can be accomplished, I illustrate in Figure 34 a fabric being made with a plush point repeat consisting of relatively shallow noncutting plush point **284**, relatively shallow noncutting plush point **285**, deep noncutting plush point **286**, relatively shallow cutting plush point **287**, deep cutting plush point **288**, deep cutting plush point **290**, deep noncutting plush point **291**, relatively shallow noncutting plush point **292**, and relatively shallow noncutting plush point **293**, and repeat across the plush point bar.

With a face yarn end in every tube of a single frame face yarn guide bar, it will be evident that the fabric includes low uncut pile loop **294**, high uncut pile loop **295**, low cut pile tufts **296**, high cut pile tufts **297**, high cut pile tufts **298**, high uncut pile loop **300**, low uncut pile loop **301** and low uncut pile loop **302** across this course and every other similar course. It will accordingly be evident that by utilizing a combination of several different depths of cutting plush points, several different depths of noncutting plush points, uneven sequences of such plush points, uneven thread-ins on a single frame, and several different frames, fabrics can be produced having extremely intricate repeats, which will give the impression to the observer that every part of the fabric is different.

It will be evident that the principles of the invention can be applied in various different combinations, of which a few examples are the following:

(1) Using alternate pattern repeat of cutting and noncutting plush points, face yarn guide bar 2 is provided with alternate thread-in of ends-in and ends-out in even sequence and face yarn bar 3 is provided with alternate thread-in of ends-in and ends-out in even sequence. Instead of ends-out, ends-in of a different color will in some cases be used, or the ends-in, used with ends-out, will be of different planted colors as desired. This form of the invention will also be used with a single frame.

(2) Using an alternate pattern repeat of cutting and noncutting plush points, face yarn guide bar 2 will be provided with an uneven sequence of ends-in and ends-out, and face yarn guide bar 3 will be provided with an uneven sequence of ends-in and ends-out. Instead of ends-out, ends-in of a different color will in some cases be used, or where ends-out are used, the ends-in will be planted of different colors. This form of the invention will also be used with a single frame.

(3) With an uneven pattern repeat sequence of cutting and noncutting plush points, face yarn guide bar 2 will be provided with an even sequence of ends-in and ends-out and face yarn guide bar 3 will be provided with an even sequence of ends-in and ends-out.

(4) With an uneven pattern repeat sequence of cutting and noncutting plush points, face yarn guide bar 2 will have an uneven sequence of ends-in and ends-out, and face yarn guide bar 3 will have an uneven sequence of ends-in and ends-out. Instead of ends-out, ends-in of a different color will in some cases be used, or with ends-out, the ends-in will be planted of different colors. This form of the invention will also be used in a single frame.

(5) Any of the forms referred to in paragraphs (1) to (4) inclusive above will be used with different lengths of pattern repeats of the thread-in on face yarn guide bar 2 and face yarn guide bar 3.

(6) Any of the features of paragraphs (1) to (5) above will be used with plush points which include high (deep) and low (shallow) plush points, such plush points being either all cutting, all noncutting, or some cutting and some noncutting and of different depths.

(7) By varying the feed tension as applied by the yarn feed mechanism in Figure 13, or by any other variable yarn feed mechanism, the pile loop height can be changed on various stitches or on various loops in a particular course as desired.

(8) In any of the forms referred to above, where two or more guide bars of face yarn are used, the pattern repeat for one frame will be different in number of stitches from the pattern repeat of a different guide bar, or, if there are several face yarn guide bars the pattern repeat of each of the face yarn guide bars will be of a different number of stitches, so that the total repeat will be very much longer than the pattern repeat of any of the individual face yarn guide bars. This will produce effects of great complexity, in which each area of the carpet will appear to be different from each other area, the total repeat in some cases being the least common denominator of the repeats for the individual face yarn guide bars.

It will be evident that the principles of the invention can be applied to any other variation of characters of plush points as desired.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art to obtain all or part of the benefits of my invention without copying the structure, method and fabric shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of warp knitting a pile fabric on a warp knitting machine having a trick plate, a gang of united latch needles on one side of the trick plate having an advanced position and a retracted position, a gang of united plush points of a plurality of different characters on the opposite side of the trick plate having an advanced position and a retracted position and operable independently of the needles, a sinker comb having an advanced position above the needles and the plush points and a retracted position out of line with the needles and the plush points, and having a pile yarn guide bar, a backing yarn guide bar, and a knitting yarn guide bar, all of which guide bars are supplied with suitable warp yarn and swing together over the needles and plush points from the needle side to the plush point side and vice versa, and also shog in the direction of the line of needles and plush points, which comprises advancing and then retracting the needles and forming walewise extending parallel chains of knitted stitches by swinging and shogging the knitted yarn guide bar to place knitting yarn in the hook of each needle when advanced, shogging the backing yarn guide bar to inlay backing yarn sinuously in the knitted stitches, advancing the plush points, swinging and shogging the pile yarn guide bar to cross lines of chain stitches while the stitches are being formed and from loops of pile yarn around only certain selected plush points of the gang, which selected plush points are of a selected character, and forming an inlay of the base legs of the pile loops thus formed into the stitches of the knitting chain, thus producing from each yarn end of the pile yarn pile projections each having characteristics produced by the selected plush points around which the pile projections were formed, and retracting the plush points to release the loops, and then repeating the knitting procedure as above set forth in the next succeeding

course except that the loops of pile yarn are formed over other selected plush points in the gang which have different characteristics from the plush points used in forming loops in the preceding course, and thus producing pile projections in this succeeding course which conform to the characteristics of the plush points used in said succeeding course, the character of pile produced in a particular wale and course being different from the character of pile produced in the same wale in a succeeding course.

2. The method of claim 1, in which some of the plush points of the gang are of the cutting type and some are of the noncutting type.

3. The method of claim 1, in which some of the plush points of the gang are of cutting type alternating with plush points of noncutting type.

4. The method of claim 1, in which the united gang of plush points includes two adjoining cutting type plush points and then one noncutting type plush point in a repeat sequence.

5. The method of claim 1, in which the united gang of plush points includes two adjoining plush points of the noncutting type and then one plush point of the cutting type in a repeat sequence.

6. The method of claim 1, in which said gang of plush points includes a pattern repeat sequence of variably arranged cutting and noncutting plush points.

7. The method of claim 1, in which some of said plush points are mounted to form high pile loops and others of said plush points being mounted to form low pile loops.

8. The method of claim 1, in which the gang of plush points are of alternating different characters coursewise, so that in each wale between two needles the plush points in gauge with the aforesaid two needles are of different character, which method further comprises forming pile loops of pile warp yarn selectively around only one of said two plush points which adjoin each wale and laying the legs of the pile loops into the knitted stitches according to the following procedure:

(1) where the pile yarn is moved from left to right to form inlaid legs and a loop around the plush point which is to the left of the space between the two lines of knitted chains into which the legs of the loop are bound by the knitting yarn which forms a stitch, wrapping the knitting yarn around the hook of the needle from left to right;

(2) where the pile yarn is moved from left to right to form inlaid legs and a loop around the plush point which is to the right of the space between the two lines of knitted chains into which the legs of the loop are bound by the knitting yarn which forms the stitch, wrapping the knitting yarn around the hook of the needle from right to left;

(3) where the pile yarn is moved from right to left to form inlaid legs and a loop around the plush point which is to the left of the space between two lines of knitted chains into which the legs of the loop are bound by the knitting yarn which forms the stitch, wrapping the knitting yarn around the hook of the needle from left to right;

(4) where the pile yarn is moved from right to left to form inlaid legs and a loop around the plush point which is to the right of the space between two lines of knitted chains into which the legs of the loop are bound by the knitting yarn which forms the stitch, wrapping the knitting yarn around the hook of the needle from right to left.

9. The method of warp knitting a pile fabric on a knitting machine having a trick plate, a gang of united latch needles on one side of the trick plate having an advanced position and a retracted position, a gang of united plush points of a plurality of different characters on the opposite side of the trick plate having an advanced position and a retracted position and operating independently of said needles, a sinker comb having an advanced position above the needles and the plush points and a retracted position out of line with the needles and the plush points, and having a pile yarn guide bar, a backing yarn guide bar and a knitting yarn guide bar, all of which guide bars swing together over the needles and the plush points, from the needle side to the plush point side and vice versa, and which guide bars have guide tubes furnished with warp yarn, which comprises advancing the needles and swinging and shogging the knitting yarn guide bar to knit walewise extending parallel chains of knitted chain stitches by introducing the knitting yarn into the hooks of the various needles and retracting the needles, laying in backing yarn sinuously in the knitted chain stitches while they are being formed by shogging the backing yarn guide bar, advancing the plush points, swinging and shogging the pile yarn guide bar coursewise to cross lines of chain stitches being formed and to form loops of pile warp yarn around only certain selected plush points which are of a particular character among the gang of plush points, certain of the guide tubes of the pile yarn guide bars being vacant and thereby forming pile projections around plush points in only part of the wales, and retracting the plush points to release the loops, and then repeating the procedure of knitting on the next course to shog the pile yarn around plush points of selectively different character and thereby form different characters of pile.

10. The method of claim 9, in which only alternate guide tubes of the pile yarn guide bar are occupied by yarn.

11. The method of claim 9, in which in each wale cut pile and loop pile are formed by shogging pile yarn ends around both cutting and noncutting plush points in a repeat sequence.

12. The method of warp knitting a pile fabric on a knitting machine having a trick plate, a gang of united latch needles on one side of the trick plate having an advanced position and a retracted position, a gang of united plush points of a plurality of different types on the other side of the trick plate having an advanced position and a retracted position and movable independently of said needles, a sinker comb having an advanced position above the needles and the plush points and a retracted position out of line with the needles and the plush points, and having a pile yarn guide bar, a backing yarn guide bar and a knitting yarn guide bar, swinging together over the needles and plush points from the needle side to the plush point side and vice versa, and which guide bars shog in the direction of the line of needles and plush points, said guide bars having guide tubes provided with warp yarn, which method comprises advancing and retracting the needles and swinging and shogging the knitting yarn guide bar to place knitting yarn in the hooks of the needles when advanced and form walewise extending parallel chains of knitted stitches, prior to the completion of each stitch laying backing yarn sinuously into the knitted stitch by shogging the backing yarn guide bar, advancing the plush points, prior to completion of each stitch swinging and shogging the pile yarn guide bar weftwise across the line of chain stitches and forming loops of pile yarn around the plush points and forming an inlay of base legs of the loops of pile yarn thus formed into the stitches being formed from the knitted chain, thus producing pile projections from each yarn end of pile yarn, and forming the pile loops carrying the pile yarn selectively around either one of two different types of plush points which adjoin each wale, and in doing so moving the pile yarn from right to left and from left to right as required to place the pile yarn around the selected plush point, and at the same time forming the knitted stitch by shogging the chain from right to left and from left to right as required by the position of the pile loop being formed, the direction of forming the pile loop and the direction of forming the

knitted stitch being compatible on each successive course.

13. The method of claim 12, which comprises forming the pile projections around the plush point on one side of each wale space between two adjoining needles, forming the knitted stitches in the direction compatible with the pile loop thus formed, in a succeeding course again forming pile loops around the plush points on said one side of said wale space and continuing to form the knitting stitches in the direction compatible with said pile loop, and then in a succeeding course forming the pile loops around the plush point which is on the other side of the same wale space and wrapping the knitting yarn around the hook of the needle in the opposite direction with respect to the previous courses so as to be compatible with the direction of pile loop formation.

14. The method of claim 13, in which some of the plush points are of cutting type and some are of noncutting type, which comprises forming a series of right hand and left hand knitting stitches with pile projections in each wale consisting of a series of walewise continuous cut pile tufts adjoining in the next wale continuous uncut pile loops, then changing in the first wale to a seres of continuous uncut pile loops adjoining in the next wale a series of cut pile tufts.

15. The method of claim 14, in which the plush points are alternately of cutting and noncutting types.

16. The method of claim 14, in which the plush points in the gang vary in respect to cutting and noncutting character coursewise in a pattern repeat with at least two plush points of one character adjoining.

17. The method of claim 14, in which some of the plush points of the gang are set to produce higher pile loops and other plush points of the gang are set to produce lower pile loops.

18. The method of warp knitting a pile fabric on a warp knitting machine having a trick plate, a gang of united latch needles on one side of the trick plate having an advanced position and a retracted position, a gang of united plush points of a plurality of different characters on the opposite side of the trick plate having an advanced position and a retracted position and independently movable with respect to the trick plate, a sinker comb having an advanced position above the needles and a retracted position out of line with the needles and the plush points, and having a plurality of pile yarn guide bars, a backing yarn guide bar and a knitting yarn guide bar, all of which guide bars swing together over the needles and plush points from the needle side to the plush point side and vice versa, and which guide bars shog in the direction of the line of needles and plush points, there being warps in guide tubes of the guide bars, there being on one pile yarn guide bar pile yarn ends threaded in alternate guide tubes and omitted in intermediate guide tubes, and there being in the other pile yarn guide bar pile yarn ends threaded in guide tubes which correspond to the intermediate guide tubes and pile yarn ends omitted in guide tubes which correspond to the alternate guide tubes, which method comprises advancing the latch needles and swinging and shogging the knitting yarn guide bar to place knitting yarn in the hooks of the needles when they are advanced, and retracting the needles to form walewise extending parallel chains of knitted stitches, before the completion of the knitted stitch shogging the backing yarn guide bar and laying sinuous stretches of backing yarn in the knitted stitches, advancing the plush points, before the completion of the knitted stitch shogging the pile yarn guide bars coursewise and moving the pile yarn ends weftwise to cross lines of chain stitches being formed and to form loops of pile yarn around certain plush points which are of a particular character among the gang of plush points and forming an inlay of base legs of the pile loops thus formed in the stitches of the knitted chains, producing from each pile yarn end pile projections which correspond to the characteristics of the plush point around which the pile projection is formed, and retracting the plush points to release the pile, and repeating the knitting procedure in the next course with the loops formed around other selected plush points of the gang which have different characteristics from those used in the preceding course and producing pile projections of different characteristics in such succeeding course, the character of pile produced in a particular wale and course being different from the pile produced in the same wale in a succeeding course.

19. The method of claim 18, which comprises knitting according to that claim with two pile yarn guide bars.

20. The method of claim 1, which comprises knitting according to that claim with two pile yarn guide bars.

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