

April 12, 1960

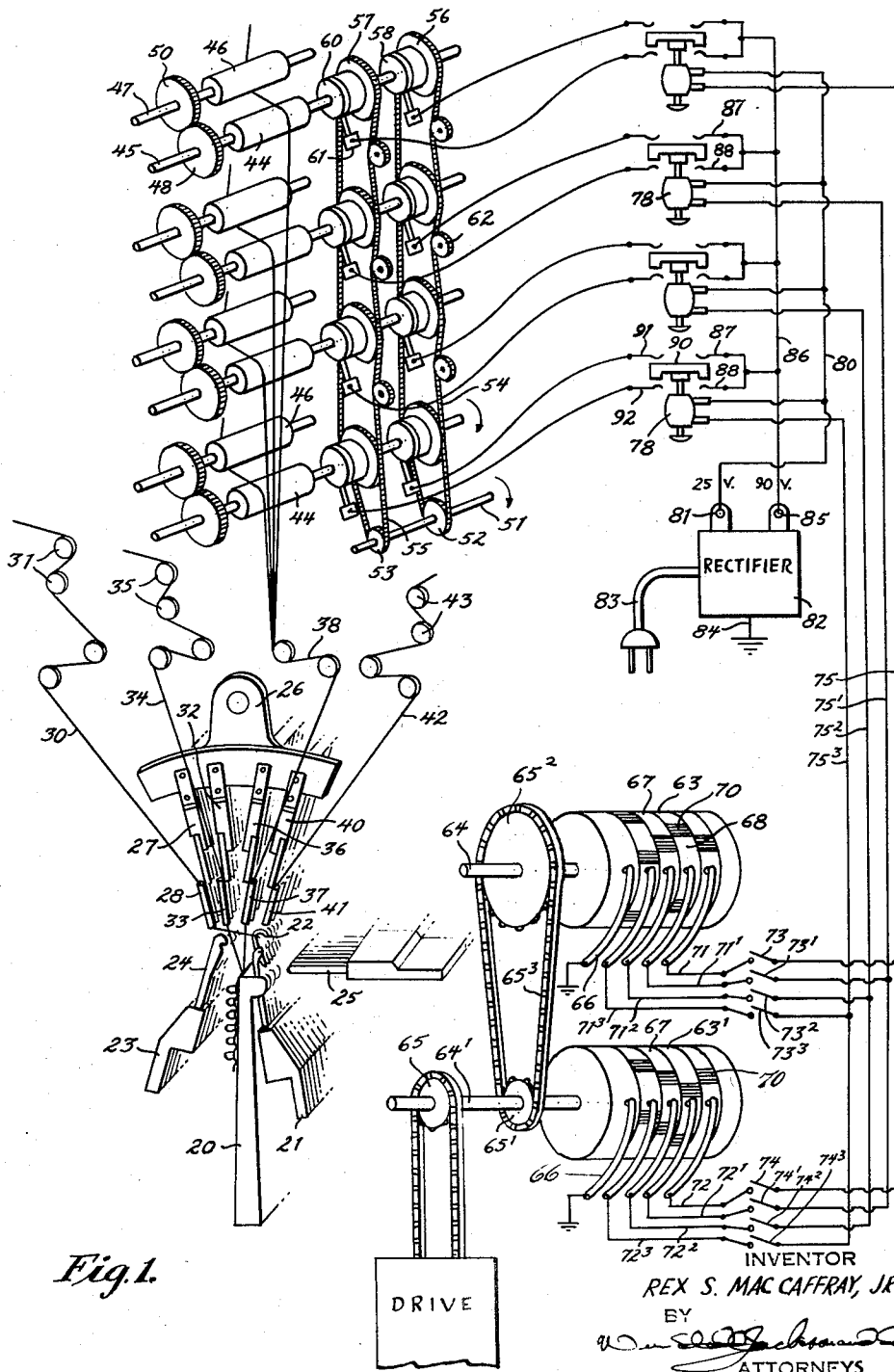
R. S. MacCAFFRAY, JR

2,932,181

MULTIPLE PATTERN PICKUP

Filed Aug. 13, 1958

2 Sheets-Sheet 1



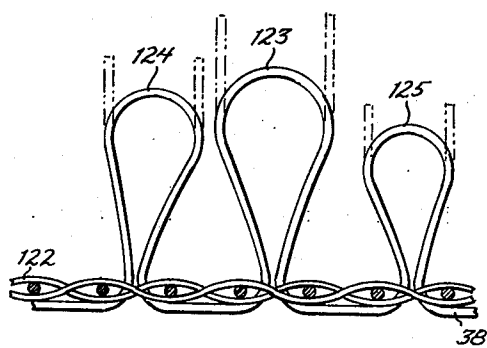
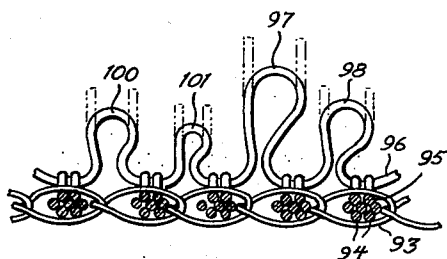
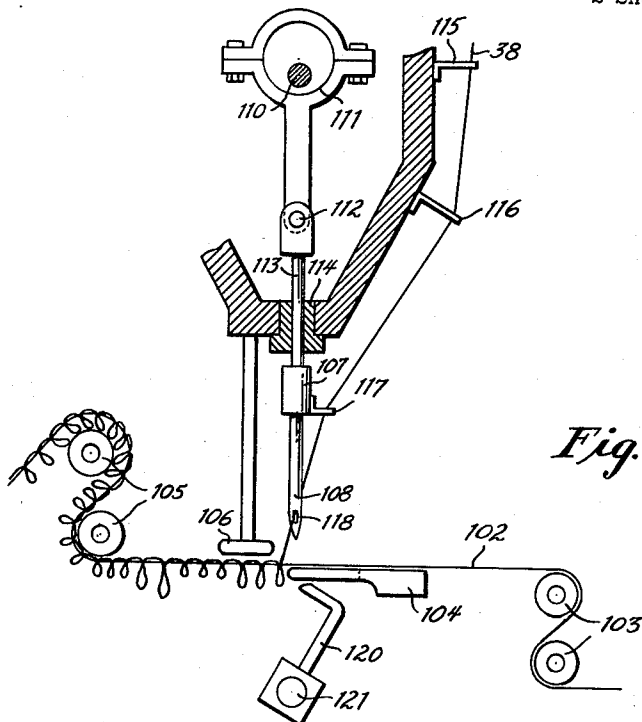
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2 Sheets-Sheet 2



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MULTIPLE PATTERN PICKUP

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8 Claims. (Cl. 66—86)

The present invention relates to the production of pile of varying heights, particularly on pile forming mechanism which produce pile by stitches including warp knitting and needling or tufting.

A purpose of the invention is to create the effect of a pattern repeat of great length without requiring that complex pattern control mechanism be used.

A further purpose is to produce an overall pattern repeat which is the least common multiple of a plurality of relatively much shorter pattern repeats which are cooperating.

A further purpose is to superimpose on the pile a relatively short pattern repeat and also a relatively much longer pattern repeat.

A further purpose is to control the height of different pile yarn ends in the pile of a fabric according to pattern repeats of different lengths, and to employ a lateral threadin repeat of such differently controlled pile yarn ends which may consist of alternating ends of different repeats, or two or more adjoining ends of one repeat, and then two or more adjoining ends of another repeat according to an even or uneven lateral threadin repeat as desired.

A further purpose is to control the height of the same pile yarn end by two pattern repeats of different lengths, and to place the pile yarn ends so controlled optionally in adjoining relation, or interspaced by pile yarn ends which are controlled by only one pattern repeat.

Further purposes appear in the specification and in the claims.

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

Figure 1 is a diagrammatic perspective showing a warp-knitting machine and associated electrical circuits for producing a warp knitted pile fabric having pile of different heights according to the invention.

Figure 2 is a diagrammatic sectional end elevation of a tufting or needling machine which may be used instead of the warp knitting machine of Figure 1.

Figure 3 is a walewise section of a warp knitted pile fabric produced in accordance with the invention.

Figure 4 is a longitudinal section of a tufted or needled pile fabric in accordance with the invention.

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

In the prior art high and low pile has been produced in tufted fabrics where a gang of needles carry pile yarn ends through a backing fabric by electrically controlling the pattern on each stitch by a pattern drum to determine whether a high speed yarn feed roll and a lower speed yard feed roll shall be effective to feed the individual yarn end for that stitch.

I have also in U.S. patent application Serial No. 741,810, filed June 13, 1958, for Pile Fabric Formation With Varying Height, controlled the height of high and low pile in warp knitting to produce varying effects.

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In such controls it is necessary to provide an adequate distance on the pattern drum for each stitch, so that slight errors in pattern drum position will not lead to inaccuracy in the finished fabric. The distance in the fabric produced by a single stitch is relatively short, and within reasonable pattern drum sizes the number of stitches which can make up a pattern drum repeat is therefore relatively small. This, therefore, tends to limit the extent of variation which is possible in warp knitted and tufted fabrics having high and low pile, and tends to encourage sameness in the fabric.

I have discovered that without great increase in bulk or complexity of the control mechanism, I can obtain repeats which are of greatly increased length, and which will introduce a wide diversity of different pile configurations. In accordance with the invention, at least some of the pile yarn ends in the fabric are controlled by pattern drums or other mechanisms which have different time repeats. This can be accomplished by using two pattern drums, which may be of the same size or of a different size as required, but are driven at different speeds so that they complete a rotation in markedly different total times. Accordingly one pile yarn end can be controlled by one pattern drum having one time repeat, and another pile yarn end can be controlled by another pattern drum having a different time repeat.

The pile yarn ends controlled by drum A or by drum B will be arranged across the fabric in any suitable lateral threadin repeat, which may conveniently be one pile yarn end controlled by pattern drum A, one pile yarn end controlled by pattern drum B and so on alternating, or two or three pile yarn ends controlled by pattern drum A and then two or three pile yarn ends controlled by pattern drum B and so on repeating. If desired the threadin repeats can be uneven, for example, two pile yarn ends controlled by pattern drum A, three pile yarn ends controlled by pattern drum B, four pile yarn ends controlled by pattern drum A, three pile yarn ends controlled by pattern drum B and repeat.

In some cases it is desirable to have individual pile yarn ends controlled by both pattern drum A and pattern drum B, so that there will be a repeat which corresponds to the least common mutple of the repeats of the individual drums.

Where the numbers of stitches in the pattern repeat of each drum are readily factorable, it will still be evident that long repeats can be obtained, and where prime numbers are used for the pattern repeats, on the respective drums, the overall pattern repeat may be of extreme length. Thus if one drum has a pattern repeat of 39 stitches and the other drum has a pattern repeat of 87 stitches, the overall pattern repeat will be 3393 stitches.

Considering now the form of Figure 1 in detail, I there illustrate a Raschel warp knitting machine of the character well know in the art, having a trick plate 20, a needle bar 21, carrying latch needles 22, a plush point bar 23 carrying plush points 24 of well know character and a sinker comb 25.

A swing bar 26 carries a series of transversely reciprocating or shoggable guide bars, one being a guide bar 27 having eyes 28 which receive knitting yarn ends 30 from knitting yarn feed rolls 31 as well known in the art. The swing bar also carries a guide bar 32 having eyes 33 which receive a laid-in binding weft 34 from feed rolls 35. The swing bar also carries a guide bar 36 which has eyes 37 which carry face yarn ends 38 from feed roll mechanism to be described. The swing bar also carries a guide bar 40 which carries eyes 41 which guide backing yarn ends 42 from feed rolls 43.

The individual pile yarn ends of a set or group each pass over a separate set of feed rolls, of which a few of perhaps many required are illustrated.

It will, of course, be evident that the same set of feed roll mechanisms can take care of the feeding of a number of different lateral pattern repeats across the knitting machine.

The feed rolls of an individual set comprise a roll 44 which is suitably keyed on a shaft 45 and roll 46 which is suitably keyed on a parallel shaft 47, the shafts being mounted on suitable bearings, not shown. The pile yarn desirably passes under one roll and over the other roll of the set to obtain firm frictional engagement with the roll surface. The two shafts 45 and 47 are intergeared and driven at the same speed by gears 48 and 50.

The selective speed drive of the rolls 44 and 46 is accomplished preferably by clutches. A main drive shaft 51 has keyed thereon a large sprocket 52 and a small sprocket 53. The sprockets are connected by chains 54 and 55 to a set of sprockets 56 and 57 which are coaxial with but freely turn on the shafts 45 in nonengaging clutch position. The sprockets 56 and 57 are mounted on one of the normally free but electromagnetically engaged co-operating clutch members of electromagnetic clutches 58 and 60, the opposite clutch elements being keyed to the shafts 45 as well known. The electromagnetic clutches may be of any suitable character, an example being those sold on the market by Warner Electric Brake Co.

The electromagnetic clutches have electromagnets which are grounded on one side internally, and have actuating terminals 61 as shown. The chains are guided and maintained in operative relation with the various clutch sprockets by suitable idling sprockets 62.

The pattern control in the present invention is accomplished by a plurality, suitably two, of electrical contact pattern switch drums 63 and 63', suitably of a conducting metal like copper or steel, which are keyed on suitably parallel shafts 64 and 64', mounted on suitable bearings, not shown.

The shafts are conveniently driven from the same drive at different speeds, as by chain and sprocket drive 65, which drives shaft 64' and by small sprocket 65' on shaft 64' and large sprocket 65² on shaft 64, interconnected by chain 65³.

Each of the drums has a spring electric contact finger 66 which is suitably grounded as shown. Each of the drums has a plurality of contact paths or channels 67, of which only a few are shown, and which consist of electric contact making areas 68 and electrically insulated areas 70 conveniently made by attaching electrically insulating tape to the drums for the stitch distance or for a portion of the stitch distance where it is not desired to make contact.

The energizing of the electric clutches is accomplished by leads 71, 71', 71² and 71³ etc. from drum 63, and leads 72, 72', 72² and 72³ etc. from drum 63', each respectively connected through switches 73, 73', 73² and 73³ from drum 63 and through switches 74, 74', 74² and 74³ from drum 63'. The switches 73 and 74 at the far side connect to lead 75 and the switches 73' and 74' connect to lead 75', while the switches 73² and 74² connect with lead 75², and the switches 73³ and 74³ connect to lead 75³.

The leads 75 to 75³ each connect to one terminal of respective relay coils 78, the opposite side of the relay coils being connected to lead 80 which is connected to one side, preferably the low voltage side 81, of rectifier 82 which is connected to an alternating current power source 83 at commercial voltage and frequency. The frame of the rectifier is grounded at 84. The opposite or high voltage terminal 85 of the rectifier is connected by lead 86 to two fixed contacts 87 and 88 which are selectively connected by the movable contact 90 of each relay either with fixed contact 91 which energizes or causes the high speed magnetic clutch to grip, or with fixed contact 92 which energizes or causes the low speed magnetic clutch to grip.

In operation, it will be evident that in accordance with well known procedure in a Raschel warp knitting machine, backing weft yarn is laid-in, and following the procedure of my copending application Serial No. 682,926, filed September 9, 1957, for Knitted Fabric Having Lay-in Weft, I lay in binding weft, wrap pile yarn around plush points and eventually bind the backing yarn and laid-in weft in stitches of knitting chain.

It will, of course, be evident that the same principle will apply to any other warp knitting construction.

During the cycle of the warp knitting machine, depending upon the feed, the loops, when cast off by the plush points or when cut on the plush points, will have a low tension if the high speed feed has been used, or higher tension if the low speed feed has been used on the particular loops for that stitch. Thus the loop as cast off or as cut by the plush points will have a more or less pronounced tendency to pull down or pull back, and the final pile will be of varying height.

It will be evident that by the choice of which switches 73, 73', 73² 73³ etc. and 74, 74', 74², 74³ etc. are closed, the operator of the knitting machine can determine whether the pile yarn ends threaded over a particular yarn feed roll will be controlled as to speed of feed by pattern drum 63 or by pattern drum 63' or by both pattern drums. Thus by closing switch 73 and by leaving switch 74 open all of the pile yarn ends fed by the yarn feed rolls controlled by lead 75 will respond entirely to the sequence of contacting areas and insulated areas on pattern drum 63 connected to lead 71.

On the other hand, if switch 73 is open and switch 74 is closed, all of the pile yarn ends which are fed by the feed rolls controlled by lead 75 will respond to the contact areas and insulating areas on the contact path connected to lead 72 on drum 63'. Since these drums have different time repeats, and since, as shown, they are turning at different speeds, by opening switch 73 and closing switch 74 or vice versa, the operator of the knitting machine can make particular pile yarn ends correspond to one or another selected pattern time repeat.

If the threadin weftwise of the machine alternates ends which have the time repeat of pattern drum 63 with ends which have the time repeat of pattern drum 63', it will be evident that different pattern repeats will be applied to alternating ends. In some cases, however, the threadin weftwise of the machine may place two or three ends controlled by drum 63 side by side and then two or three ends controlled by pattern drum 63' and so on throughout the repeat. The number of ends controlled by pattern drum 63 which are adjoining and the number of ends controlled by pattern drum 63' which are adjoining will suitably be uneven in some cases, so that the repeat may be 1, 3, 5, 2, 4, 7 etc., as desired.

In some cases, it is desirable to superimpose different pattern repeats on one another. This is accomplished by closing switches which connect pattern control paths on two or more drums to the same lead. Thus, if switches 73 and 74 are both closed, the pile yarn ends carried over the feed mechanism controlled by lead 75 will respond to a pattern repeat of contact areas and insulated areas on drum 63 and a different pattern repeat of contact areas and insulated areas of drum 63' so that the total pattern repeat is the least common multiple of the two pattern repeats on drums 63 and 63'.

As soon as the contact finger ceases to make contact, the appropriate relay deenergizes and contacts 88, 90 and 92 close, which energizes electromagnetic clutch 60, which applies the slow moving sprocket drive to the corresponding shafts 45 and 47.

The result in accordance with the present invention is the production of a warp knitted pile fabric of Figure 3 which has knitting chain 93 which grips lay-in backing wefts 94 and binding wefts 95 to form a tuft bind for pile yarn 96 which extends in the form of pile projections 97, 98, 100 and 101 at different heights. While these pile

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projections are shown as uncut loops, there are dot-and-dash lines showing the tufts to illustrate that the loops may be cut, if desired.

The principles of the invention are applicable to a needled or tufted fabric as shown in Figure 2.

In this construction, it will be understood that all the features of Figure 1 apply except the detail of the warp knitting machine which is substituted by the tufting machine of Figure 2. Backing fabric 102 such as burlap or Osnaburg is drawn from a suitable source over guide rolls 103 and fed across a needle plate 104, and withdrawn by take off rolls 105, as well known, the backing fabric being held down by guiding foot 106.

A needle bar 107 carries a gang of needles 108 arranged in line, the needle bar being reciprocated by an eccentric 110 which is acting on an eccentric strap 111 which is pivotally connected at 112 with reciprocating rods 113 which are guided at 114 on the frame, and support the needle bar.

The pile yarn 38 is taken from feed mechanism as shown in Figure 1 through guiding eyes 115 and 116 on the frame and guiding eyes 117 on the needle bar to the eyes 118 in the needles 108.

After the loops are formed, they are engaged by synchronized loopers 120 which are oscillated as well known by a looper shaft 121.

The operation in the device of Figure 2 is the same as that of Figure 1 except that the pull-back action which produces variant loop heights, depending upon the extent of feed during the stitch, may be made effective on the previous loops which have been formed in the last previous stitch. The resulting product as shown in Figure 4 comprises a backing fabric 122, which has loops 123, 124 and 125 of different heights formed from suitable pile yarn 38. The loops may be cut as shown.

Of course, the same variations already discussed by selective manipulation of repeat selector switches 73, 73', 73² and 73³ etc. and repeat selector switches 74, 74', 74² and 74³ etc. can be accomplished as already explained, in respect to the needling or tufting of Figure 2.

It will be evident that the high loops are formed when contact is made throughout the entire time of the stitch, and lower loops may be made when contact is preserved for a lesser time, as explained in my copending application Serial No. 741,810 aforesaid.

It will be evident that while it is preferable in accordance with the invention to utilize two clutches, one of which drives the roll shafts at a high speed and the other of which drives the roll shafts at a low speed, the machine will not fail to operate if the yarn feed does not function for as short a duration as one stitch. In this case the alternative conditions may be obtained by repeated energization of one clutch.

It will be evident that the feed rolls of the different sets will extend across the machine, and be duplicated where the width of the machine is so great that the feed roll length becomes excessive. There will normally be a pattern repeat length widthwise of the machine which will be uniform. For example, if the pattern repeat length is 20 pile yarn ends, then the first, the 21st, the 41st and the 61st ends etc. will be carried over the same feed roll set, and the 2nd, 22nd, 42nd and 62nd etc. pile yarn ends will be carried over another feed roll set, and the 3d, 23d, 43d and 63d etc. pile yarn ends will be carried over another feed roll set, and so on. Of course, if two ends in the repeat behave alike throughout, for example, the first and the 19th, they can be fed the same feed roll set.

In view of 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 shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

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

1. In a device for forming pile fabric having pile projections of different heights formed in stitches, a plurality of separate electrical pickup pattern control drums which complete electric circuits in different time repeats, yarn feed means carrying individual pile yarn ends for producing the pile of the fabric, electrically operating driving mechanism interconnected to and controlled by the pattern control drums, the drive mechanism being operatively connected to different yarn feed means, and the drive mechanism for the yarn feed means of different yarn ends at different positions laterally across the fabric being interconnected to pattern control drums having different time repeats, and fabric producing mechanism including pile stitch formation mechanism for producing pile fabric receiving yarn from the yarn feed means and incorporating said pile yarn ends in the pile at different lateral positions.

2. In a device for forming pile fabric having pile projections of different heights formed in stitches, a plurality of separate electrical pickup pattern control drums which complete electric circuits in different time repeats, yarn feed rolls carrying individual pile yarn ends for producing the pile projections of the fabric, electrically operated drive mechanism effective on the yarn feed rolls and interconnected to and controlled by the pattern control drums, the drive mechanism for the yarn feed rolls of different yarn ends at different positions laterally across the fabric being interconnected to pattern control drums of different time repeats, and fabric producing mechanism including pile stitch formation mechanism producing pile fabric receiving yarn from the yarn feed means and incorporating said pile yarn ends in the pile at different lateral positions.

3. In a device for forming pile fabric having pile projections of different heights, a plurality of electric impulse drum circuit controls each having a plurality of switch channels and including insulating elements and contact elements which close the respective circuits, feed roll devices for feeding pile yarn ends, drives at two different speeds, electric clutches mechanically connected at the drives of the different speeds and selectively operative on the feed roll devices to permit driving at one speed or the other speed, electric circuit means interconnecting the drum circuit controllers to different clutches and operative to energize one or the other of the clutches in accordance with the control exerted by the contact path of one controller in some cases and another controller in other cases, and a fabric making machine forming pile stitches and receiving yarn from the feed roll device at different positions laterally across the fabric.

4. In a device for forming pile fabric having pile of different height, a plurality of separate electric impulse pattern control drums which complete electric circuits in different time repeats, relay mechanism actuated by the drums for selectively switching, electric circuit means including the drums operatively connected to the relay mechanism to selectively energize the relay mechanism, different relay mechanism being connected to pattern control drums of different time repeats, yarn feed means carrying individual pile yarn ends for producing the pile of the fabric, electrically operating drive mechanism interconnected to and controlled by the relay mechanism for driving the yarn feed means selectively at different speeds, and fabric producing mechanism including pile stitch formation mechanism for producing pile fabric receiving yarn from the yarn feed means and incorporating said pile yarn ends in the pile at different positions laterally across the fabric.

5. In a device for forming pile fabric of different heights, a plurality of separate electric impulse pattern control drums which complete electric circuits in different time repeats, yarn feed means carrying individual yarn ends for producing the pile of the fabric, electrically operating drive mechanism interconnected to and con-

trolled by different pattern control drums and driving the yarn feed means, the pile yarn ends across the fabric being taken from yarn feed means which are interconnected to pattern control drums of different time repeats according to a lateral threadin repeat, so that certain ends in repeat sequence are controlled by pattern control drums of one time repeat and intervening ends are controlled by pattern control drums of a different time repeat, and fabric producing mechanism including stitch formation mechanism receiving yarn from the yarn feed means and producing pile fabric incorporating said pile yarn ends in the pile at different lateral positions.

6. In a device for forming pile fabric having pile of different heights, a plurality of separate electric impulse pattern control drums which complete electric circuits in different time repeats, yarn feed means carrying individual pile yarn ends for producing the pile of the fabric, electrically operating drive mechanism interconnected to and controlled by the pattern control drums and driving the yarn feed means, the drive mechanism for the yarn feed means of at least some of the pile yarn ends in the fabric being interconnected to pattern control drums of a plurality of different time repeats, and responding to the combined overlapping operations of the two time repeats, and fabric producing mechanism including pile stitch formation mechanism receiving yarn from the yarn feed means and producing pile fabric incorporating said pile yarn ends in the pile at different lateral positions.

7. In a device for forming pile fabric having pile of different heights, a plurality of separate control switch drum means having separate contact paths which make and break contact as the drums turn, means for driving the respective drums at a speed so that they complete a single rotation at different times, a device for producing pile fabric progressively in successive stitches including feed roll means over which different pile yarn ends pass, drives driving the yarn feed roll means at different speeds, electric clutches mechanically interconnected to the drives

at the two different speeds and selectively operative to permit driving the yarn feed roll means at one speed or at the other speed, and electric circuit means interconnecting both drums and operative to energize one or the other of the electric clutches according to the opening and closing of the circuits of a combination of pattern drums controlling the same pile yarn ends, but with different time repeats corresponding to the rotations of the drums.

8. In a device for forming pile fabric having pile projections of different heights formed in stitches, a plurality of separate pattern control drums which complete circuit contacts in different time repeats, yarn feed means carrying individual pile yarn ends for producing the pile projections of the fabric, electrically operating drive mechanism interconnected to and controlled by the pattern control drums and driving the yarn feed means, repeat selector switch means interposed between the pattern control switch means and the electrical drive mechanism to permit alternate connection of a particular drive mechanism to operate under the control of a pattern control drum having a first time repeat or a pattern control drum having a second time repeat, or under the control of both the pattern control drum having the first time repeat and also the pattern control drum having the second time repeat, and fabric producing mechanism including a pile stitch forming mechanism receiving yarn from the yarn feed means and producing pile fabric incorporating said pile yarn ends in the pile at different lateral positions in the fabric.

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