



Sept. 7, 1965

L. M. VALENTINE

3,204,669

MANUFACTURE OF CUT PILE FABRICS

Filed July 3, 1963

3 Sheets-Sheet 2

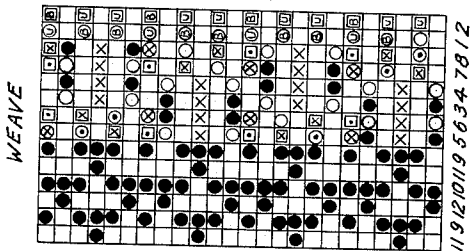
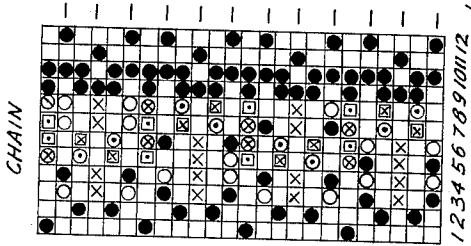
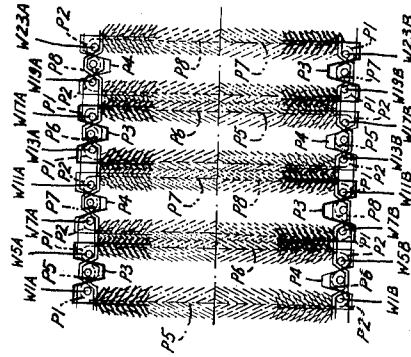


FIG. 2

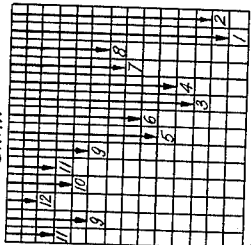


SYMBOLS

- # 1 TOP GAUGE
- # 2 BOTTOM GAUGE
- # 3 SHORT PILE
- # 4 SHORT PILE
- # 5 LONG PILE
- # 6 LONG PILE
- # 7 LONG PILE
- # 8 LONG PILE

- PILE UP WITH GROUND
- × PILE CENTER WITH GROUND
- PILE DOWN WITH GROUND
- ⊙ LONG PILE OVER TOP, PULL OUT TOP GAUGE
- ⊗ LONG PILE UNDER TOP, PULL OUT UNDER TOP GAUGE
- ⊠ LONG PILE OVER BOTTOM, PULL OUT OVER BOTTOM GAUGE
- ⊡ LONG PILE UNDER BOTTOM, PULL OUT UNDER BOTTOM GAUGE
- ⊕ TOP GAUGE UP
- ⊖ TOP GAUGE DOWN
- ⊗ BOTTOM GAUGE UP
- ⊡ BOTTOM GAUGE DOWN

DRAW



REED DENT

FIG. 3

- BOTTOM GROUND
- BOTTOM GROUND
- TOP GROUND
- TOP GROUND
- LONG PILE
- LONG PILE
- LONG PILE
- SHORT PILE
- SHORT PILE
- BOTTOM PILE PILE GAUGE
- TOP PILE PILE GAUGE

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FIG. 4

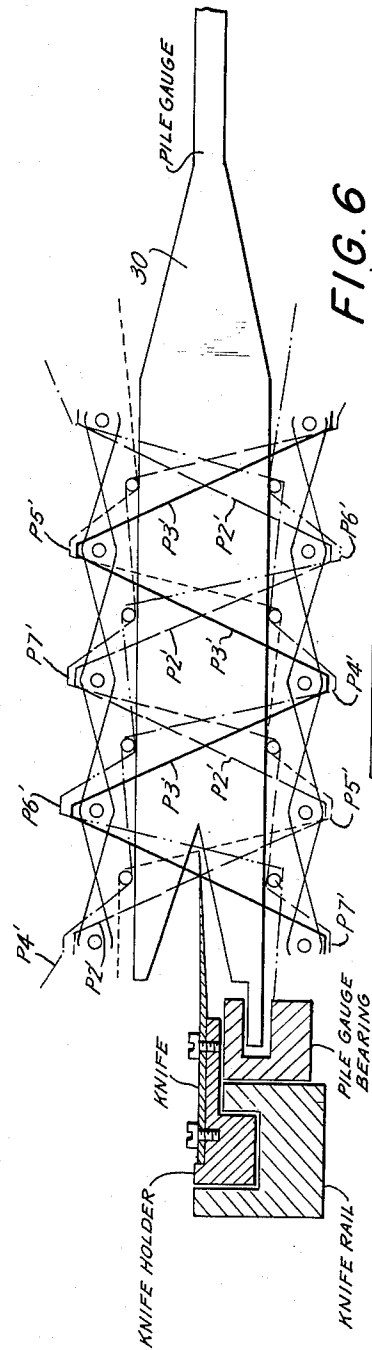


FIG. 6

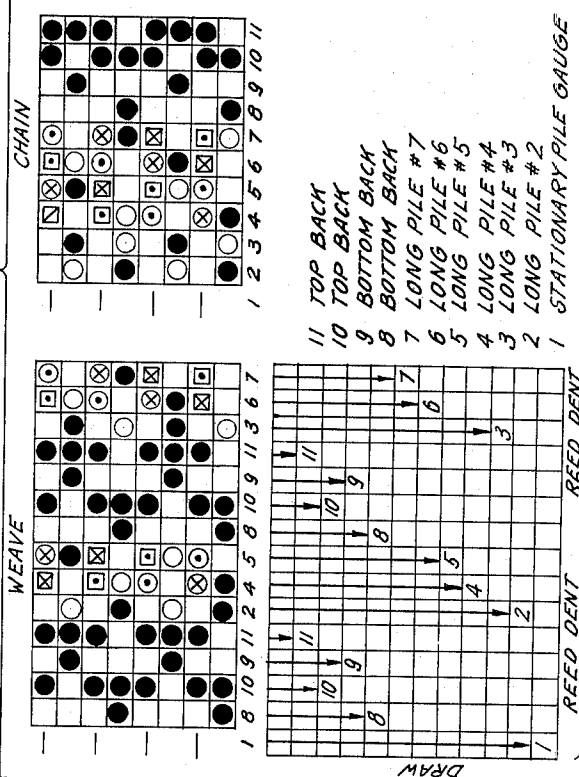
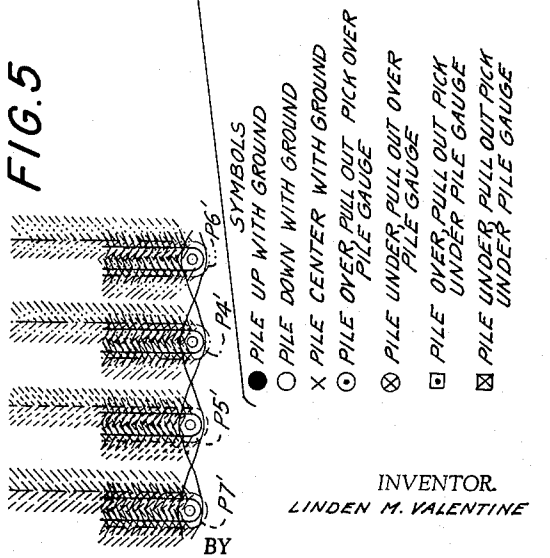


FIG. 5



- SYMBOLS
- PILE UP WITH GROUND
  - PILE DOWN WITH GROUND
  - x PILE CENTER WITH GROUND
  - ⊙ PILE OVER, PULL OUT PICK OVER PILE GAUGE
  - ⊗ PILE UNDER, PULL OUT OVER PILE GAUGE
  - ⊠ PILE OVER, PULL OUT PICK UNDER PILE GAUGE
  - ⊡ PILE UNDER, PULL OUT PICK UNDER PILE GAUGE

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## MANUFACTURE OF CUT PILE FABRICS

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Filed July 3, 1963, Ser. No. 292,702

2 Claims. (Cl. 139-46)

My present invention relates to the weaving of different heights of cut pile fabrics and, more particularly, to an improved method of simultaneously weaving two pieces of fabric face to face as disclosed in my issued Patent 3,014,502 granted December 26, 1961. In that patent, I disclose a method of simultaneously weaving two pieces of fabric face to face on a loom equipped with a cutter and adapted to weave two or more lengths of pile evenly distributed over the face of each fabric and then, subsequently, cut by the cutter substantially midway between the top and bottom pieces. A dwell of certain of the pile forming yarns is provided before they are transferred from one piece to the other for increasing the effective length of such yarns relative to others following the cutting step.

In accordance with my present invention, provisions are introduced into the patented method for assuring the taut and relatively fixed position during weaving of the yarn which forms the longer lengths of pile before being transferred between the top and bottom pieces.

It is, therefore, a principal object of my invention to provide an improved technique for firmly interlacing the long pile forming yarns during weaving of two or more heights of cut pile fabrics to thereby minimize and virtually eliminate any tendency of sagging in the dwell that may affect even distribution of the cut piles of controlled heights.

Another object is to control the gauging of yarn in the dwell during the formation of the longer pile during the weaving operation.

A further object is to introduce into the weaving operation pile gauging means both of a sheddable or stationary form for more accurately controlling the length of long pile, such gauging means as contemplated by this invention cooperating to hold the long pile yarns in the dwell, eliminate sagging in the center of the fabrics, and maintain tension of the yarns substantially even and constant throughout the length and width of the pieces; and, at the same time, permits greater lengths of long pile, more different lengths in each tuft of the long pile, both at lower weaving costs and higher loom efficiency with an attendant manufacture of higher standard fabrics.

Thus, two pieces of fabric are woven simultaneously face to face with interconnecting pile yarns. These pile yarns may weave in a U or W manner or any combination of weaves as desired to accomplish the type of fabric wanted. A serpentine or sinuous weaving may be adopted for making pile length by weaving with base-free pull-out picks to hold the pile to the top and bottom edges of respective pile gauges in the top and bottom pieces. As many sequences are woven in this manner as is necessary to take up all the surplus pile yarn delivered by the loom mechanism to produce the desired length of the high pile yarn. Under these circumstances, with weaving performed in this manner with pile gauging means adjacent to the respective top and bottom pieces, the pile yarn is caused to be transferred to the opposite piece for further weaving in accordance with the preset course. My invention also contemplates weaving in the same manner each interconnecting pile yarn thereby producing the same length of cut pile evenly distributed in both pieces of ground fabric.

The length of pile is formed by severing the intercon-

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necting pile yarn by the loom cutter after weaving midway between the top piece and bottom piece. The length of the short pile yarns which form the short pile tufts is determined essentially by the distance that the top and bottom ground pieces or fabrics are set apart in the loom. The required length of pile yarn to produce the amount of yarn necessary for this particular length of pile is furnished by the loom mechanism and, more particularly, by the delivery rollers ordinarily forming part of such machines.

The length of the long pile threads were established by the length of the long pile tufts which may be woven in with the short pile tufts in the base fabric, or separately, as the type of fabric and the compactness of the pile in the fabric requires. The length of this pile is also governed by the number of interlacings into the ground fabric that is determined by the weave used for the long pile. In some cases, it will be found that two or more sets of delivery rollers are necessary to furnish the necessary amount of pile yarn, the use of such rollers being well within the purview of those skilled in the art. In accordance with this invention, the extra length of pile yarn delivered by the loom mechanism to produce the desired height of pile tuft is held in place rather fixedly and tightly by the use of pile gauging means which cooperate with the base-free filling threads, to hold the long pile threads taut and take up all the slack in the yarn. In the event that exceptionally long piles were required, this would be accomplished by weaving several sequences of the serpentine weaving on each side of the pile gauging means before the pile yarns are transferred between the top and bottom pieces. As will be explored in greater detail, my present invention contemplates sheddable pile gauges which serve to hold the long pile threads in conjunction with the operation of the filling threads or so-called pull out picks during the weaving operation until such time as the pile has been severed by the loom cutter thereby assuring positive severance midway between the top and bottom pieces with each pile thread in each series in each piece cut to the desired length. The adaption of conventional looms to practice my invention facilitates the delivery of the cut pile threads and base-free filling threads by the sheddable pile gauges as well as the transfer of the base-free filling threads along with the woven fabrics from the pile gauges. In addition, I propose stationary pile gauges for similar employment during the weaving operation practiced according to my invention.

Other objects and advantages will become apparent from the following detailed description which is to be taken in conjunction with the accompanying drawings illustrating practical embodiments of my invention and in which:

FIG. 1 illustrates diagrammatically the weaving face to face of grounds of a double pile fabric wherein the fabric is made by combining a twelve pick short pile W weave with six filling threads woven in the base fabric and six pull out threads or picks, not used in the weaving to the short pile, but necessarily weaving with the short pile for use in the simultaneous weaving of the long pile, together with a twenty-four pick long pile weave in which twelve picks are removed after weaving;

FIG. 2 is a fragmentary diagrammatic view illustrating the fabrics woven in accordance with FIG. 1 after the connecting pile has been cut and the supporting filling threads removed;

FIG. 3 is a graph illustrating a suitable drawing and shedding operation for practicing my invention in accordance with FIGS. 1 and 2;

FIG. 4 illustrates diagrammatically the weaving face to face of grounds of a double pile fabric wherein the fabric is made by combining a short pile U weave with

four filling threads to the repeat with the long pile U weave with eight filling threads to the repeat;

FIG. 5 is a fragmentary diagrammatic view illustrating the fabric woven in accordance with FIG. 4 after the connecting pile has been cut and the supporting weft threads removed; and

FIG. 6 is a graph illustrating a suitable drawing and shedding operation for practicing my invention.

As was the case in my above referenced patent, this invention is concerned with the weaving of cut pile fabrics which are woven face to face such that they will ultimately possess two or more radically different heights of pile, the length of which is readily and accurately controlled. These different lengths of cut pile, accordingly, are adapted to be evenly distributed over the face of the fabric, and thereby permitting the construction of a fabric having all of the characteristics of natural furs. In this connection, the fine short pile simulates the body of such natural furs and the long, coarse fibers resemble the long, coarse guard hairs of such furs.

The principles of my stated invention are applicable to substantially all cut pile fabrics of conventional weaves and are capable of being practiced by the employment of presently known and commercial double shuttle plush looms which weave two pieces simultaneously face to face and on the commercially available single shuttle plush looms which are capable of weaving two pieces at a time face to face; or woven on the three position head motion looms which are capable of accommodating the operation of 16 harnesses. As will be evident to those skilled in the art, this latter loom has particular application to the initial embodiment herein. The invention, however, can also be practiced on cam or gem head motion looms. In connection with either type of loom, the pile is cut in the loom during the operation of weaving. In addition, double lift Jacquard head plush looms could be employed in the event that more different lengths of long pile were desired. As will become evident, the design of the pile gauging means, notably those of the sheddable type fabricated in accordance with this invention, are such that the filling threads can be beaten into the fabric without any obstruction from the pile gauges. The pile gauges are so designed that the long pile threads are suitably placed on the pile gauges before the reed has reached the point of beat-up or the fell of the cloth.

In accomplishing my present invention and with particular reference to the embodiment illustrated in FIGS. 1 to 3 inclusive, sheddable pile gauges and extra base-free filling threads are advantageously employed. These pile gauges are utilized in pairs with one being adjacent to the top ground piece and the other adjacent to the bottom ground. The separation of the loom is determined by the desired distance necessary to make the shorter pile. Under such circumstances, the interposed threads, working in conjunction with the respective pile gauges, function to maintain the long pile threads taut so that the two lengths of pile are effectively woven in a controlled manner at the same time, in the same piece with the knife rail and cutting knife midway between the top and bottom pieces. As will eventually be appreciated, the width of the pile gauge may be a variable governed by the desired length of long pile. Accordingly, after being woven with the base fabrics, the long pile threads or yarn are caused to be interlaced with the base-free filling threads, in accordance with the specific embodiment, located on each side of a particular pile gauge before being transferred to complementary located filling threads associated with the other of the pair of pile gauges. These base-free filling threads, which may be disposed on each side of the individual pile gauges, cooperate therewith in holding the long pile threads in the desired position throughout the entire weaving process and, particularly, at such time as both legs of the woven long pile threads are severed by the loom cutter.

The extra base-free filling threads and the pile gauges

function to maintain the extra amount of pile yarn which is delivered for purposes of forming the long pile relatively tight while the long pile is not weaving with the ground, as well as to hold such pile tight while being transferred between the top and bottom pieces. In addition, these base-free filling threads and the pile gauges serve to maintain the threads away from the cutting knife until the proper time at which the pile is most advantageously cut, as well as to keep them taut when in the cutting range. In cooperation with the normally employed bumper rods, these filling threads and the gauges with which they work keep the pile taut at substantially all times to maintain the weaving sheds clear of loose ends and, thus, permit the shuttles to fly without obstruction. These extra filling threads are woven with their own selvages, so that removal is thereby facilitated after the cutting knife has performed its function. The removal of the threads may be accomplished by the means and techniques usually employed in the making of frieze fabrics. In the making of constructions requiring very long pile, it may be necessary to make several repeats of the serpentine weaving on both the top and bottom pile gauges, accordingly, these long pile threads will be held as a result of several sequences of the serpentine weave to thereby minimize the tendency of the long pile threads from becoming loose and fouling or twisting with other threads. Under these circumstances, the long pile threads will be kept continually taut to permit, among other attributes, proper shedding of the loom.

The manufacture of fabrics in accordance with my present invention may, as stated, be carried out on the usual type of double shuttle plush looms having shuttles S and S' which are simultaneously operable in fixed planes to respectively lay weft threads across the loom. As will be understood by those skilled in the art, the loom is also equipped with the conventional reciprocating cutting knife, as shown, the usual take-up or pin rollers, and the commonly employed pile delivery rollers, either single or double or triple depending on the selected weaves and the required height of the different lengths of pile.

In the weaving of the particular fabric in accordance with the exemplary embodiment of FIGS. 1 to 3, I utilize harnesses H1 and H2 to operate the sheddable pile gauges 10 and 12. I also employ backing warps A and A' and B and B', warps A and A' forming the ground for the upper or top fabric and B and B' the ground for the bottom or lower fabric. As will be evident shortly, the pile warps P3 and P4 form the short pile warps, while the warps P5, P6, P7 and P8 form the long pile, with all of the pile warp ends connecting the grounds of the upper and lower fabrics. These pile yarns, when cut, will form the tufts of both the top and bottom fabrics.

The warp ends of the yarns in a reed dent are drawn through the heddle eye of the heddles mounted in heddle or harness frames 3 to 12 arranged as shown in the diagram of Draw of FIG. 3. In this connection, the draw and weave are for a two and one backing weave.

In the manufacture of fabrics according to the exemplary specific embodiment of FIGS. 1 and 3, it will be apparent that two sets of delivery rollers will be required to run this fabric since the required length of the long pile yarns is somewhat greater than that capable of being obtained from only one set of delivery rollers. In weaving a repeat of this fabric, the cycle may be considered as starting with the simultaneous laying of the picks or wefts W1A and W1B by the upper shuttle S and the lower S' respectively, with the weft yarn as laid by both shuttles being the same size and count.

The positions occupied by the warp yarns during the laying of the wefts are indicated in FIG. 3 which shows the up, down and center positions which are conventional designations of pile positions for all pile fabrics. In view of the importance of the positions that the pull out picks or weft threads or base-free filling threads occupy, I employ other symbols to illustrate the movement of the long

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pile yarns, namely: ○ denotes over the top pull out and over top pile gauge; ⊗ under top pull out pick and under top pile gauge; □ over bottom pull out pick and over bottom pile gauge; and ⊠ under bottom pull out pick and under bottom pile gauge. In addition, I employ symbols directed to the movement of the pile gauges, namely: ① top pile gauge up to permit top pull out to pass under top pile gauge; ② top pile gauge down to permit top pull out to pass over top pile gauge; ③ bottom pile gauge up to permit bottom pull out to pass under bottom pile gauge; and ④ bottom pile gauge down to permit bottom pull out to pass over the top edge of bottom pile gauge. The usual large dot means pile up of both top and bottom pile warps; and X denotes pile in center under top ground and over bottom ground; and empty white squares or white circle represent pile down under the bottom as well as top filling threads. These positions are for each warp thread during the laying of each pair of wefts or filling threads also known as picks. Each vertical row of squares of the Draw denotes the relative position of each end of the warp; and the raising and lowering of each end is so indicated in the weave and harness chain.

Thus, the arrangement of the ground ends and the pile ends in FIG. 1 is top ground 9, bottom ground 11, top ground 10, bottom ground 12, short pile 3, short pile 4, long pile 5, long pile 6, short pile 7, long pile 8, pile gauges 1 for the top piece and pile gauges 2 for the bottom piece. By this layout, the long pile yarns, short pile yarns and both top and bottom grounds complete each reed dent together with the pile gauges, 1 for the top piece and 2 for the bottom piece.

The warping arrangement, as illustrated in the drawing, is substantially as follows: the first end in the warp being the first end of the bottom ground, being drawn in on the harness 11; the second being the first end of the top ground, drawn in on harness 9; the third end being the second of the bottom ground, being drawn on harness 12; the fourth end being the second of the top ground, being drawn on harness 10; the fifth end being the third end of the bottom ground, being drawn on harness 11; and the sixth end being the third end of the top ground, being drawn on harness 9. Thus, it will be noted that for both the top ground and the bottom grounds only two harness are employed for each. In this two and one weave, two ends weave alike with one being woven in the center of the other two and in opposite weaving arrangement, meaning that the two ends weave two down to one up while the one weaves two up and one down. In continuing the warping arrangement, after the sixth backing end, long pile end P5 is drawn on harness 5, this being warp end 7. End 8 is long pile end P6 drawn on harness 6, end 9 is short pile P3 drawn on harness 3, the tenth end is short pile P4 drawn on harness 4, the eleventh end being long pile end P7 drawn on harness 7 and the twelfth end being long pile P8 drawn on harness 8. The sheddable pile gauges are then set into the harness with harness 1 applied to the top piece gauge 10 and harness 2 for the bottom piece gauge 12. Thus, the complete warping arrangement is established with all of these ends and pile gauges being in a one reed dent.

In connection with the sheddable pile gauges advantageously employed in weaving in accordance with this specific embodiment, it will be noted that each gauge is comprised essentially of three parts, with the third taken as the heddle. The first part 14 is disposed between the grounds and located near the top or bottom ground, as the case may be. This gauge part is essentially an elongated relatively flat plate that is maintained in a substantially fixed position during the weaving operation. End 16 is suitably contoured to cooperate with a fluted elongated shaft or drum 18 which is rotatable during the weaving operation. The end 16 together with the flutes of the drum 18 serve to transfer therebetween the pull

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out picks traveling along the bottom edge of the part in the case of the top gauge and the upper edge of the lower pile gauge. The other end of the gauge bar 14 has pivotally connected therewith a movable gauge part 20 which is provided with a slidable connection with the associated harness. This slidable connection may include a slot 22 of suitable length which conveniently receives the laterally extending pin or stud 24 projecting from the associated harness. As will be appreciated, the dimensioning of the slot 22 should be sufficient to permit the gauge part 20 to pivot between the harness up and down positions. Thus, the gauge part 20 operates in a regular harness frame which is operated to raise and lower to permit the base-free wefts or pull out picks to be passed over the gauge top edge or under the gauge bottom edge. In this fashion, the long pile threads are held securely in a serpentine or sinuous fashion thereby utilizing the permissible space between the top and bottom ground fabrics to advantage. As will be appreciated, the lengths of long pile desired is attained by the utilization of a suitable number of the base-free pull out picks or wefts, the number of which are maintained at a minimum particularly in view of the contemplated widths of the pile gauges. The slide coupling provided by the slot 22 and pin 24, as stated, compensates for the dimensional requirements entered into the raising and lowering of the harness and, more particularly, from a gauge horizontal position at which the reed is in the beat-up position to the inclined gauge position at which the base-free wefts or pull out picks are permitted to be passed over either side edge of the top and bottom gauges. The gauge part 14, as explained, remains in a relatively fixed position in the cloth and is set in the loom such that it does not interfere with the travel of the cutting knife and functions with the fluted roller 18 to remove the base-free pull out picks which, at this point, are interwoven with the long pile cut threads from the pile gauges and pass them along with the woven fabrics to the pin rollers.

The weaving of the fabric according to the embodiment of FIGS. 1 to 3 is as follows, by the laying of wefts W1A and W1B simultaneously by shuttles S and S', the harness of the loom positions the heddles, through which the warp yarns passed such that: ground warp A is held in a down position; warp A' is held in an up position in the top piece; ground warp B is held in the up position; ground warp B' is held in the down position in the bottom piece; short pile warp P3 is held in the up position in the top piece; short pile warp P4 is held in the down position in the bottom piece; long pile P5 is held in the up position in the top piece; and long pile P6 is held in the down position in the bottom piece, thus completing all the weaving of all yarns with wefts W1A and W1B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W2A and W2B, ground warps A and A' do not weave with weft W2A in the top piece and warps B and B' do not weave with weft W2B in the bottom piece. All wefts of even number weave only with long pile warp yarns, either over or under the pile gauges. In this manner, the wefts hold the long pile yarns securely to the top or bottom edge of the pile gauges, as the case may be, to form the serpentine weaving of the long pile yarns. Long pile P8 is held in the center position, under all ground threads in the top piece and over weft 2A as well as over pile gauge 10. In this connection, pile gauge 10 was placed in the down position to permit weft W2A to be passed over its top edge to form the serpentine weaving of long pile 8 by holding it to the top edge of the pile gauge in the top piece. Long pile P7 is held in the center position, over all ground yarns in the bottom piece, and in the down position, under weft W2B, and under pile gauge 12, inasmuch as pile gauge 12 was placed in the up position to permit weft W2B to be passed under pile gauge 12 and thus form the serpentine weaving of long pile P7 by holding

this pile to the bottom edge of this pile gauge 2 in the bottom piece. Thus, the weaving of all yarns with wefts W2A and W2B is completed.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W3A and W3B, ground warp A is held in the up position, and ground warp A' is held in the down position in the top piece; and ground warp B is held in the down position and ground warp B' is held in the up position in the bottom piece. Short pile warp P3 is held in the down position in the top piece; short pile warp P4 is held in the up position in the bottom piece, long pile warp P5 is held in the down position in the top piece, and long pile warp P6 is held in the up position in the bottom piece, thus completing all the weaving of all the yarns with wefts W3A and W3B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W4A and W4B, ground warps A and A' do not weave with wefts W4A in the top piece and grounds B and B' do not weave with weft W4B in the bottom piece. There is no weaving of short pile P1 in the top piece, and no weaving of short pile P2 in the bottom piece. Long pile yarn P7 is held in the center position, under all ground threads in the top piece; and long pile P8 is held in the center position over all ground threads in the bottom piece. Long pile 7 is held in the up position with weft W4A over pile gauge 10. Pile gauge 10 was placed in the down position to permit weft W4A to be passed thereover and thus form the serpentine weaving of long pile P7 by holding this pile 7 to the top edge of pile gauge 10 in the top piece. Long pile P8 is held in the down position with weft W4B and in the down position with pile gauge 12 inasmuch as pile gauge 12 was placed in the up position to permit weft W4B to be passed under pile gauge 20 and thus form the serpentine weaving of long pile P8 by holding long pile 8 under the bottom edge of pile gauge 12 in the bottom piece. Thus, all of the weaving of all yarns with wefts W4A and W4B is complete.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W5A and W5B, ground warp A is held in the down position, and ground warp A' is held in the up position in the top piece; and ground warp B is held in the up position and ground warp B' is held in the down position in the bottom piece. Short pile P3 is held in the up position in the top piece, and short pile P4 is held down position in the bottom piece. Long pile P5 is held in the up position in the top piece, and long pile P6 is held in the down position in the bottom piece, thus completing all weaving of all yarns with wefts W5A and W5B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W6A and W6B, ground warps A and A' do not weave with weft W6A in the top piece and ground warps B and B' do not weave with weft W6B in the bottom piece. There is no weaving with short pile P3 in the top piece or with short pile P4 in the bottom piece. Long pile P5 and long pile P7 are held in the center position to all ground yarn in the top piece. Long pile P6 and long pile P8 are held in the center position to all ground yarns in the bottom piece. Long pile yarns P5 and long pile P7 are held in the down position with weft W6A and in the down position with pile gauge 10, as pile gauge 10 was placed in the up position to permit weft W6A to be passed under pile gauge 10; and thus form the serpentine weaving of long pile yarn P5 and long pile yarn P7 by holding these long pile threads to the bottom edge of pile gauge 10 in the top piece. Long pile threads P6 and long pile thread P8 are held in the up position with weft W6B and up position of pile gauge 12, as pile gauge was placed in the down position to permit weft W6B to be passed over the top edge of pile gauge 12 and thus form the serpentine weaving of long pile yarns P6 and long pile P8 by holding these long pile yarns to the top edge of pile gauge 12 in the bottom piece.

Thus, all of the weaving of all yarns with wefts W6A and W6B is complete.

By the reverse of movement of shuttles S and S' to lay, respectively, wefts W7A and W7B, ground warp A is held in the down position and ground warp A' is held in the up position in the top piece, and ground warp B is held in the up position and ground warp B' is held in the down position in the bottom piece. Short pile P4 is held in the up position in the top piece and short pile P3 is held in the down position in the bottom piece. Long pile warp P7 is held in the up position in the top piece, and long pile warp P8 is held in the down position in the bottom piece, thus, completing all the weaving of all yarns wefts W7A and W7B.

By reversing the movement of shuttles S and S' to lay, respectively, wefts W8A and W8B, ground warps A and A' do not weave the weft W8A in the top piece and ground warps B and B' do not weave with weft W8B in the bottom piece. There is also no weaving of short pile P4 in the top piece and no weaving of short pile P3 in the bottom piece. Long pile P5 is held in the center position, under all ground yarns, in the top piece. Long pile P6 is held in the center position to all ground yarns in the bottom piece. Long pile P5 is in the up position, over weft W8A, and in the up position over pile gauge 10, since the pile gauge 10 was placed in the down position to permit weft W8A to be passed over its top edge and thus form the serpentine weaving of long pile P5 by holding this pile to the top edge of pile gauge 10 in the top piece. Long pile P6 is held in the down position under weft W8B and in the down position with pile gauge 12, inasmuch as pile gauge was placed in the up position to permit weft W8B to be passed under pile gauge 12 and thus form the serpentine weaving of long pile P6 by holding long pile P6 under the bottom edge of pile gauge 12 in the bottom piece. Thus all the weaving of all yarns with wefts W8A and W8B is completed.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W9A and W9B, ground warp A is held in the up position, and ground warp A' is held in the down position in the top piece, and ground warp B is held in the down position and ground warp B' is held in the up position in the bottom piece. Short pile P4 is held in the down position in the top piece and short pile P3 is held in the up position in the bottom piece. Long pile P7 is held down position in the top piece, and long pile P8 is held in the up position in the bottom piece, thus completing all the weaving of all yarns with wefts W9A and W9B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W10A and W10B, ground warps A and A' do not weave with wefts W10A in the top piece and ground warps B and B' do not weave with W10B in the bottom piece. There is also no weaving with short pile P4 in the top piece or short pile P3 in the bottom piece. Long pile P6 is held in the center position with ground warp in the top piece, and long pile P5 is in the center position with ground warps B and B' in the bottom piece. Long Pile P6 is held in the up position with weft W10A in the top piece and over pile gauge 10; since pile gauge 10 was placed in the down position to permit weft W10A to be passed over the gauge top edge and thus form the serpentine weaving of this long pile by holding it to the top edge of the pile gauge in the top piece. Long pile P5 is held in the down position with weft W10B in the bottom piece and under pile gauge 12, pile gauge was placed in the up position to allow weft W10B to be passed thereunder and thus form the serpentine weaving of long pile P5 by holding the pile to the gauge bottom edge. Thus all the weaving of all yarns with wefts W10A and W10B is complete.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W11A and W11B, ground warp A is held in the down position and ground warp A' is held in the up position in the top piece; and ground warp B



is held in the up position, and ground warp B is held in the down position in the bottom piece. Short pile P4 is held in the up position in the top piece, and short pile P3 is held in the down position in the bottom piece. Long pile P7 is held in the up position in the top piece, and long pile P8 is held in the down position in the bottom piece, thus completing all the weaving of all yarns with wefts W11A and W11B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W12A and W12B, ground warps A and A' do not weave with weft W12A in the top piece, and ground warps B and B' do not weave with weft W12B in the bottom piece. There is no weaving of short pile P4 with weft W12A in the top piece, and there is no weaving of short pile P3 with weft W12B in the bottom piece. Long pile P7 is held in the center position under ground warps A and A' in the top piece, and long pile P8 is held in the center position over ground warps B and B' in the bottom piece. Long pile P7 and long pile P6 are held in the down position with weft W12A and under pile gauge 10, inasmuch as this pile gauge was placed in the up position to permit this weft to be passed under the gauge and thus form the serpentine weaving of long pile yarns P7 and P6. These long pile yarns are, accordingly, held under the bottom edge of pile gauge 10 in the top piece. Long pile P8 and P5 are held in the up over weft W12B and over the top edge of pile gauge 12 to thus form the serpentine weaving of long pile yarns P5 and P8 by holding these long pile yarns on the top edge of pile gauge 12 in the bottom piece, thus completing all the weaving of all yarns with wefts W12A and W12B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W13A and W13B, ground warp A is held in the down position, and ground warp A' is held in the up position in the top piece; and ground warp B is held in the up position, and ground warp B' is held in the down position in the bottom piece. Short pile P3 is held in the up position in the top piece, and short pile P4 is held in the down position in the bottom piece, long pile P6 is held in the up position of the top piece and long pile P5 is held in the down position in the bottom piece, thus completing all the weaving of all the yarns with wefts W13A and W13B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W14A and W14B, ground warps A and A' do not weave with weft W14A in the top piece and ground warps B and B' do not weave with weft W14B in the bottom piece. There is also no weaving of short pile P3 in the top piece, and there is no weaving of short pile P4 in the bottom piece. Long pile P7 is in the center position with ground warps A and A' in the top piece, and long pile P8 is in the center position with ground warps B and B' in the bottom piece. Long pile P7 is held in the up position with weft W14A and over pile gauge 10. In this connection, pile gauge 10 was placed in the down position to permit weft W14A to be passed thereover and thus form the serpentine weaving of long pile P7 by holding this pile onto the gauge top edge. Long pile P8 is held in the down position with weft W14B and under pile gauge 12 since this pile gauge was placed in the up position to permit weft W14B to be passed thereunder. Thus the serpentine weaving of long pile P8 is formed by holding this long pile onto the bottom edge of pile gauge 12 in the bottom piece. Accordingly, all the weaving of all yarns with wefts W14A and W14B is completed.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W15A and W15B, ground warp A is held in the up position, and ground warp A' is held in the down position in the top piece; and ground warp B is held in the down position, and ground warp B' is held in the up position in the bottom piece. Short pile P3 is held in the down position in the top piece, and short pile P4 is held in the up position in the bottom piece. Long pile P6 is held in the down position in the top piece, 75

and long pile P5 is held in the up position in the bottom piece, thus completing the weaving of all yarns with wefts W15A and W15B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W16A and W16B, ground warps A and A' do not weave with weft W16A in the top piece and ground warps B and B' do not weave with weft W16B in the bottom piece. There is no weaving of short pile P4 in the top piece, and no weaving of short pile P3 in the bottom piece. Long pile P8 is held in the center position with ground warps A and A' in the top piece and long pile P7 is held in the center position with ground warps B and B' in the bottom piece. Long pile P8 is held in the up position with weft W16A and over pile gauge 10 since pile gauge was placed in the down position to permit weft W16A to be passed thereover; and thus form the serpentine weaving of long pile P8 by holding it onto the top edge of pile gauge 10 in the top piece. Long pile P7 is held in the down position with weft W16B and under the bottom edge of pile gauge 12 because pile gauge 2 was placed in the up position to permit weft W16B to be passed under its bottom edge and thus form the serpentine weaving of long pile P7 by holding it onto the gauge bottom edge in the bottom piece, thus completing all the weaving of all yarns with wefts W16A and W16B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W17A and W17B, ground warp A is held in the down position, and ground warp A' is held in the up position in the top piece; and ground warp B is held in the up position, and ground warp B' is held in the down position in the bottom piece. Short pile P3 is held in the up position in the top piece, and short pile P4 is held in the down position in the bottom piece. Long pile P6 is held in the up position in the top piece, and long pile P5 is held in the down position in the bottom piece, thus completing all of the weaving of all yarns with wefts W17A and W17B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W18A and W18B, ground warps A and A' do not weave with weft W18A in the top piece, and ground warps B and B' do not weave with weft W18B in the bottom piece. There is no weaving of short pile P4 in the top piece, and no weaving of short pile P3 in the bottom piece. Long pile P6 and long pile P8 are held in center position with ground warps A and A' in the top piece, and long pile yarns P5 and P7 are held in the center position with ground warps B and B' in the bottom piece. Long piles P6 and P8 are held in the down position with weft W18A and under pile gauge 10, as pile gauge was placed in the up position to permit weft W18A to be passed under the bottom edge of pile gauge 10 and thus form the serpentine weaving of long pile yarns P6 and P8 by holding these pile yarns onto the bottom edge of pile gauge 10 in the top piece. Long pile yarns P5 and P7 are held in the up position with weft W18B and over the top edge of pile gauge 12, as pile gauge 12 was placed in the down position with weft W18B to permit weft W18B to be over pile gauge 12 and thus form the serpentine weaving of long pile yarns P5 and P7 by holding these long pile yarns onto the top edge of pile gauge 12 in the bottom piece, thus completing all the weaving of all yarns with wefts W18A and W18B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W19A and W19B, ground warp A is held in the down position, and ground warp A' is held in the up position in the top piece, and ground warp B is held in the up position, and ground warp B' is held in the down position in the bottom piece. Short pile P4 is held in the up position in the top piece, and short pile P3 is held in the down position in the bottom piece. Long pile P8 is held in the up position in the top piece, and long pile P7 is held in the down position in the bottom piece, thus completing all weaving of all yarns with wefts W19A and W19B.



By the reverse movement of shuttles S and S' to lay, respectively, wefts W20A and W20B, ground warps A and A' do not weave with weft W20A in the top piece, and ground warps B and B' do not weave with weft W20B in the bottom piece. There is no weaving of short pile 4 in the top piece and no weaving of short pile P3 in the bottom piece. Long pile P6 is held in the center position with ground warps A and A' in the top piece, and long pile P5 is held in the center position with ground warps B and B' in the bottom piece. Long pile P6 is held in the up position with weft W20A and over pile gauge 10 as pile gauge 10 was placed in the down position to permit weft W20A to be passed over pile gauge 10 and thus form the serpentine weaving of long pile P6 by holding long pile P6 to the top edge of pile gauge 10 in the top piece. Long pile P5 is held in the down position with weft W20B and under the bottom edge of pile gauge 12, pile gauge 12 having been placed in the up position to permit weft W20B to be passed under pile gauge 12 and thus form the serpentine weaving of long pile P5 by holding long pile P5 to the bottom edge of pile gauge 12 in the bottom piece, thus completing the weaving of all yarns with wefts W20A and W20B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W21A and W21B, ground warp A is held in the up position and ground warp A' is held in the down position in the top piece; and ground warp B is held in the down position, and ground warp B' is held in the up position in the bottom piece. Short pile P4 is held in the down position in top piece, and short pile P3 is held in the up position in the bottom piece. Long pile P8 is held in the down position in the top piece, and long pile P7 is held in the up position in the bottom piece, thus completing all the weaving of all yarns with wefts W21A and W21B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W22A and W22B, ground warps A and A' do not weave with weft W22A in the top piece, and ground warps B and B' do not weave with weft W22B in the bottom piece. There is also no weaving of short pile P4 in the top piece, and there is no weaving of short pile P3 in the bottom piece. Long pile P5 is held in the center position with ground warps A and A' in the top piece, and long pile P6 is held in the center position with ground warps B and B' in the bottom piece. Long pile P5 is held in the up position with weft W22A and over the top edge of pile gauge 10. Pile gauge 10 was placed in the down position to permit weft W22A to pass thereover to form the serpentine weaving of long pile P5 by holding the pile to the gauge top edge. Long pile P6 is held in the down position with weft W22B and under the bottom edge of pile gauge 12 inasmuch as pile gauge 12 was placed in the up position to permit weft W22B to be passed under the gauge bottom edge to thereby form the serpentine weaving of the long pile. Thus, the weaving of all yarns with wefts W22A and W22B is complete.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W23A and W23B, ground warp A is placed in the down position, and ground warp A' is placed in the up position in the top piece; and ground warp B is placed in the up position, and ground warp B' is placed in the down position in the bottom piece. Short pile P4 is placed in the up position in the top piece and short pile P3 is placed in the down position in the bottom piece. Long pile P8 is held in the up position in the top piece and long pile P7 is held in the down position in the bottom piece, thus completing all of the weaving of all yarns with wefts W23A and W23B.

By the reverse movement of shuttles S and S' to lay, respectively, wefts W24A and W24B, ground warps A and A' do not weave with weft W24A in the top piece, and ground warps B and B' do not weave with weft W24B in the bottom piece. There is also no weaving with short pile P4 in the top piece or with short pile

P3 in the bottom piece. Long pile P8 and long pile P5 are held in the center position with ground warps A and A' in the top piece; and long pile P7 and P6 are held in the center position with ground warps B and B' in the bottom piece. Long pile threads 8 and 5 are held in the down position with wefts W24A and under pile gauge 10 since this gauge was placed in the up position to permit the weft to be passed thereunder to form the serpentine weaving with these long piles by holding them to the bottom edge of the pile gauge 10 in the top piece. Long pile 6 and 7 are held in the up position with weft W24B and over the top edge of pile gauge 12. Pile gauge 2 was placed in the down position to permit weft W24B to be passed over the top edge of pile gauge 12 and thus form the serpentine weaving of long pile 6 and 7 by holding these long pile threads to the top edge of pile gauge 12 in the bottom piece. The weaving of all yarns with wefts W24A and W24B are now completed.

Accordingly, the cycle of the repeat of the weave is accomplished and all warps are in the same position that they originally occupied during the weaving of wefts W1A and W1B. It will be noted that the short piles P3 and P4 have been weaving in a regular six pick two harness arrangement having a two-and-one binder arrangement for the ground weave for both the top and bottom pieces. Furthermore, the long pile threads P5, P6, P7 and P8 have been weaving in a twelve pick-four harness arrangement with each tuft of six pick accompanying a tuft of the twelve pick weave. As will be appreciated, the use of the six pick weave and the twelve pick weave, as previously mentioned, follows the removal of the base-free filling threads and the removal of the fabric from the pile gauges. In other words, the fabric is made by combining a twelve pick short pile weave in which six picks are removed after weaving together with a twenty four pick long pile weave in which twelve picks are removed after weaving.

It will be understood that, by the use of the pile gauges, uneven tension across the width of the pieces is advantageously avoided. In this connection, a firm interlock of the long pile ends occurs with the weft filling threads and through the support provided by the pile gauges at short intervals a firm and even tension of all pile ends is developed across the pieces. Thus, a product is capable of being produced by my invention having evenly cut pile ends across the sides to the center and from one side to the other because the firm interlacing and the elimination of sagging in the wefts.

In FIGS. 4, 5 and 6, I disclosed a further exemplary specific embodiment of this invention in which a relatively stationary pile gauge is employed. For the sake of brevity, those skilled in the art should refer to my previously mentioned issued patent in view of the foregoing disclosure in connection with the embodiment of FIGS. 1 to 3 herein for teachings of weaving and shuttle movement which will enable them to follow and pursue the practice of my invention in accordance with this specific embodiment of FIGS. 4 to 6. Suffice it to say in connection with the latter embodiment, the stationary pile gauges 30 are securely anchored to the loom frame in back of the harnesses. The bearings holding these gauges advantageously holds them in a substantially perpendicular position so that both top and bottom edges of the gauges present a bearing surface for the pull out picks which interlace with the long pile threads during the weaving operation. From a bearing in back of the harnesses, these gauges 30 pass through the heddles in this substantially flat condition and then from the harness through a reed dent. The gauges are so designed that both the top and bottom shuttles will pass on their respective race plates without being interfered with particularly by these gauges. In the reed, the gauges will either run one in a dent or one in every other dent depending on the construction of the fabric. From the

reed, the gauges will pass through the cloth between the top and bottom pieces at which the pull out picks are properly supported. As shown in FIG. 4, the other end of the pile gauges rest in a bearing attached to the loom frame and situated under the cutting knife. It should be understood that the bearings for the stationary pile gauges should serve to maintain these gauges in a substantially vertical position so that they will not move from side to side or up or down or twist to thereby hold the long pile threads in their fixed and desired interlaced position. The top and bottom edges of the stationary pile gauge form a firm bearing to which the pull out picks hold the long pile threads securely in position, by interlacing with these long pile threads. This position is controlled by the design of the weaving and, in this fashion, the long pile threads are held in this position of dwell for as many weaving picks as are dictated by the length or requirements of the long pile. These stationary pile gauges are also designed as will be evidenced from the figures of this embodiment until such time as both legs of the tuft have been severed by the loom cutter. This is accomplished by means of the cut-away provided in the central portion of the outer end of the stationary gauge adjacent the knife. The reciprocating cutting knife is thusly permitted to traverse forwardly and back in its usual manner. As a result of the securement of the long pile threads onto the gauges by the internal lacing arrangement with the pull out picks along both the top and bottom gauge edges, all of the long pile threads will be cut midway between the top and bottom pieces.

Furthermore, by the use of the stationary pile gauges, any possibility of sagging in the center of the pieces will be eliminated and, accordingly, no uneven lengths of pile will result particularly if sagging were to take place in the center of the pieces. By the use of these pile gauges, detention on all of the long pile threads will be substantially the same in both the center and the sides of the pieces and thus enable the production of more uniform goods both from piece to piece and in each piece.

In view of the foregoing, those skilled in the art are now provided with an improved weaving technique whereby two different weaves are woven in the same piece at the same time. Under these circumstances, a weave can be employed to produce compactness resembling the finer short body of natural fur along with the weave to produce the long open guard fiber of the fur. For example, the fine soft wool can be employed in one case while the other may constitute a monofilament nylon, rayon, mohair or coarse wool. In any event, my invention is not dependent upon or restricted to any particular type of fiber used in the making of yarns whether twisted, curled, textured, plain woolen spun, worsted spun, cotton spun or formed by some other system.

Thus, I have improved upon my prior patented teaching for the production of two or more lengths of pile, notwithstanding the type of yarn employed. Certain different weaves can be introduced into the same piece to obtain different lengths as well as different effects of pile. My present invention affords the making of far greater lengths of long pile at much less weaving cost and greater loom efficiency is also possible through the use of a wide range of different widths of sheddable pile gauges. In this connection, the desired lengths of the long pile can be obtained by selecting a particular width of pile gauge and serpentine weave of long pile. Such lengths can be accomplished without necessarily opening the width of the setting between the top and bottom piece.

Thus, the numerous aforementioned objects and advantages, among others, are most effectively attained. Although

several embodiments have been specifically disclosed herein, they are in no sense limiting in the present invention and will be defined by the scope of the appended claims.

I claim:

1. In the manufacture of cut pile fabrics having more than one height of cut pile in a loom adapted to weave a top and bottom fabric face to face and having upper and lower sets of sheddable pile gauging members disposed between and adjacent the respective fabrics, the steps which comprise weaving the top and bottom fabrics spaced from one another on opposite sides of said members, laying upper and lower sets of removable wefts above and below each of said sets of members to be spaced apart thereby, anchoring pile yarns in said upper and lower fabrics, and interlacing said pile yarns there between, certain of said pile yarns extending in a substantially straight path between said fabrics and others of said pile yarns being interlaced in a serpentine weave extending over and under a plurality of upper and lower wefts associated with at least one of said sets of pile gauging members in their path between the upper and lower fabrics, advancing the fabrics and wefts along said pile gauging members, cutting the pile yarns in the zone between the upper and lower sets of members while the wefts are supported by said members to hold the pile yarns taut and removing the removable wefts to leave sets of long and short cut pile anchored in each of said fabrics.

2. In the manufacture of cut pile fabrics having relatively long cut pile in a loom adapted to weave spaced parallel top and bottom fabrics face to face and having upper and lower sets of sheddable pile gauging members therebetween, said sets being disposed parallel to and adjacent the top and bottom fabrics respectively and being spaced apart to provide a cutting zone therebetween with the pile gauging members of each set extending warp-wise of the fabric, the steps which comprise weaving the top and bottom fabrics spaced from one another and disposed respectively above and below said upper and lower sets of pile gauging members, laying upper and lower sets of removable wefts above and below each of said sets of members to be spaced apart thereby, anchoring pile yarns in said upper and lower fabrics and interlacing said pile yarns therebetween, at least some of said pile yarns being interlaced in a serpentine weave extending over and under a plurality of upper and lower wefts associated with at least one of said sets of pile gauging members in their path between the upper and lower fabrics, advancing the fabrics and wefts along said pile gauging members, cutting the pile yarns in the zone between the upper and lower sets of members while the wefts are supported by said members to hold the pile yarns taut and removing the removable wefts to leave sets of cut pile which are substantially longer than the spacing between said top and bottom fabrics anchored in at least one of said fabrics.

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