Nov. 18, 1958 E. F. CLARK 2,860,666

METHOD OF WEAVING AND COMPOSITE PILE WIRE FOR LOOMS

Filed Dec. 19, 1956 3 Sheets-Sheet 1

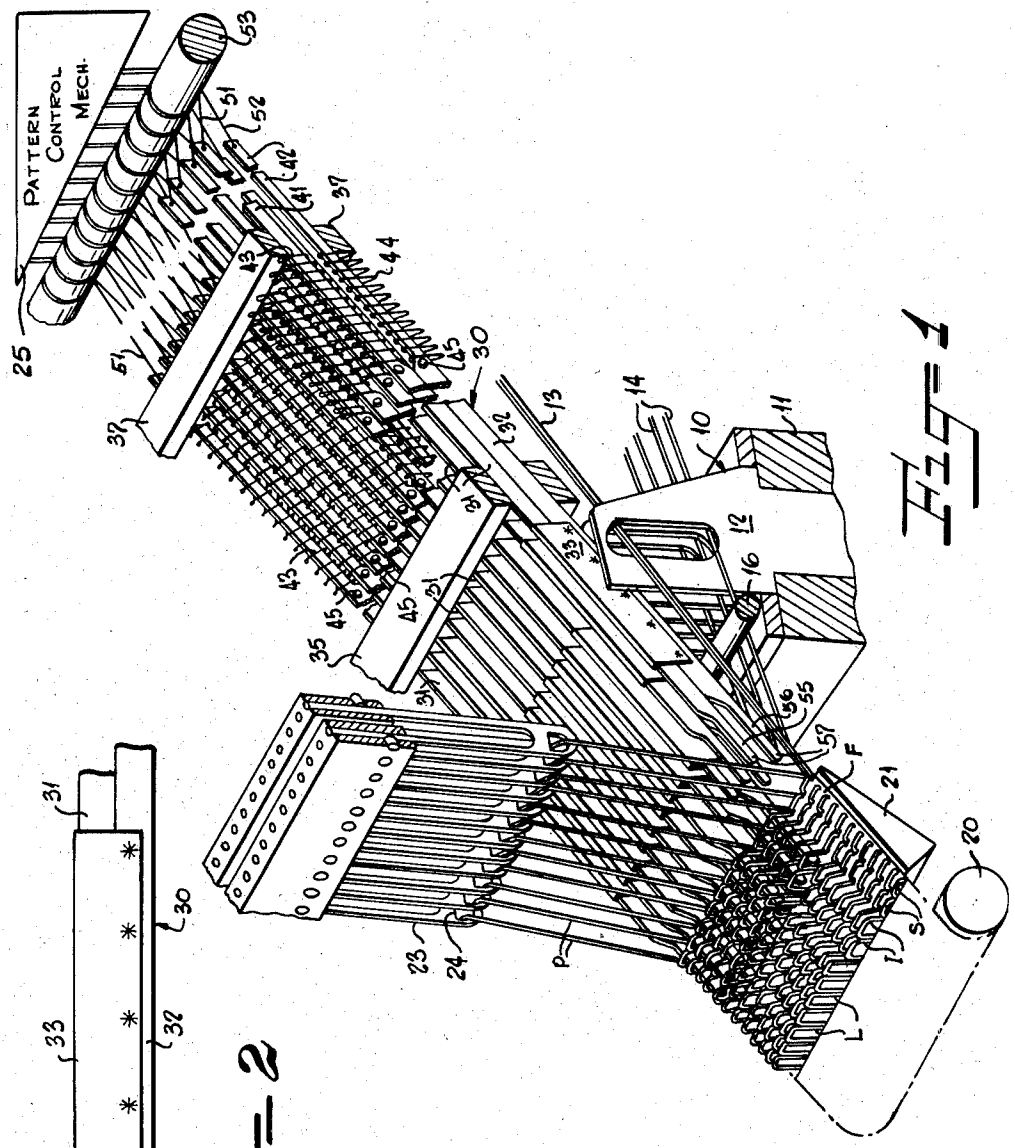


Fig. 1

Fig. 2

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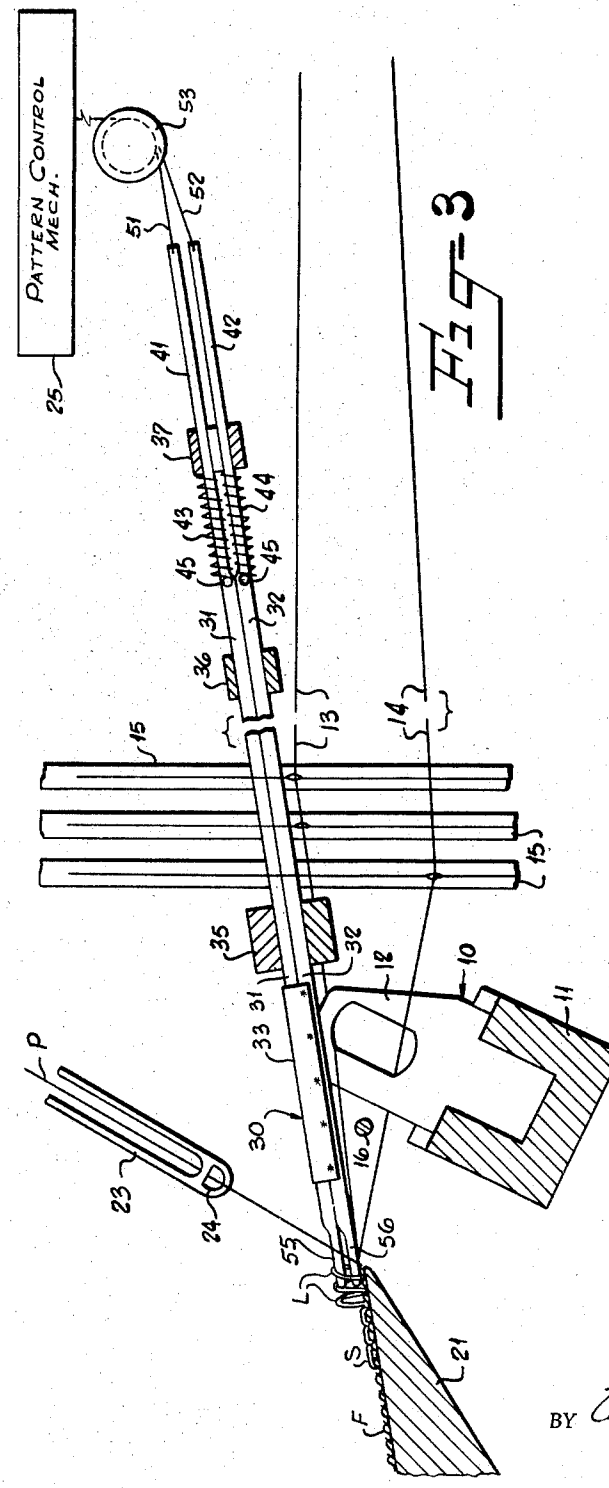


Fig-3

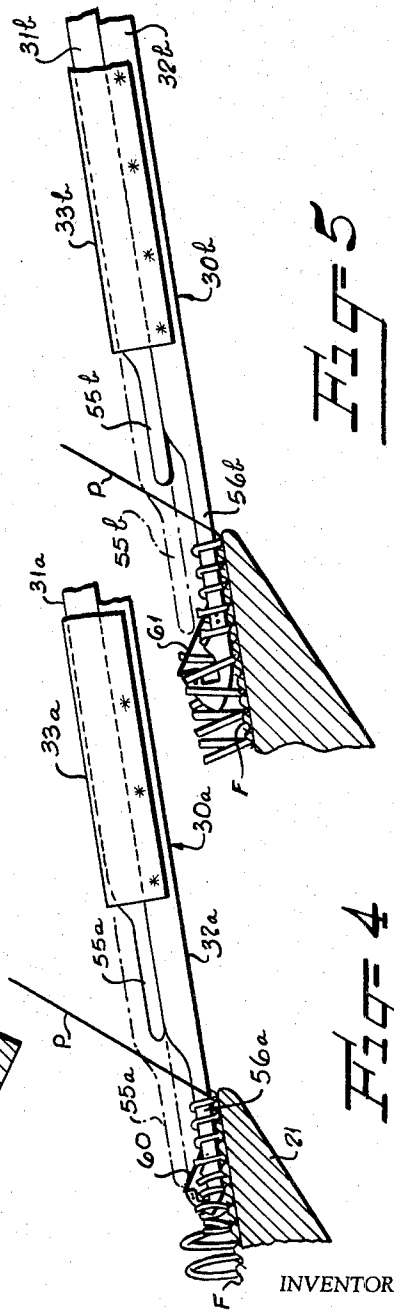


Fig-5

Fig-4

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METHOD OF WEAVING AND COMPOSITE PILE WIRE FOR LOOMS

Filed Dec. 19, 1956 3 Sheets-Sheet 3

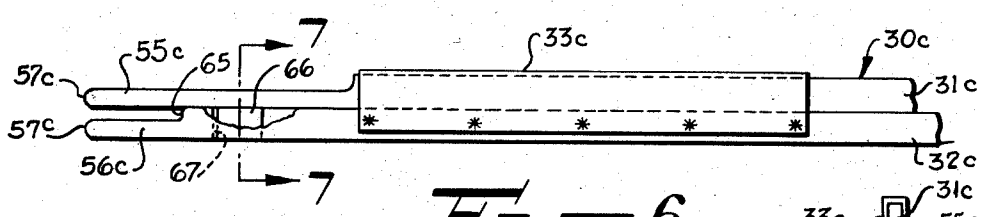


Fig-6

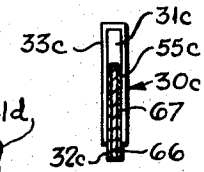


Fig-7

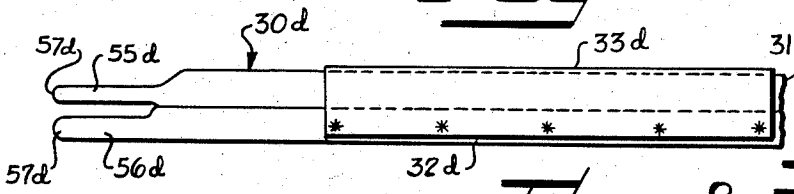


Fig-8

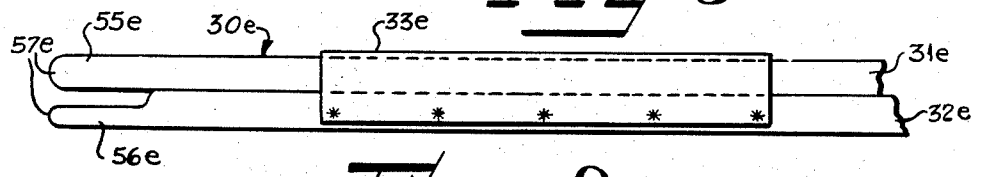


Fig-9

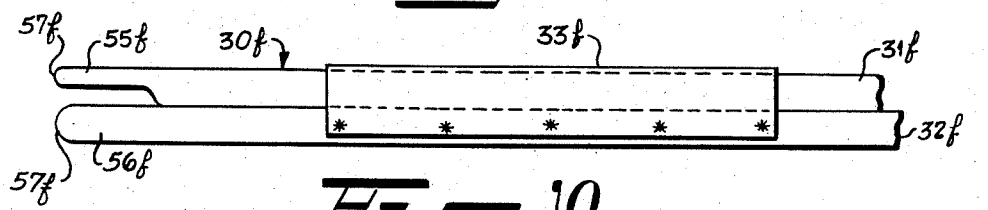


Fig-10

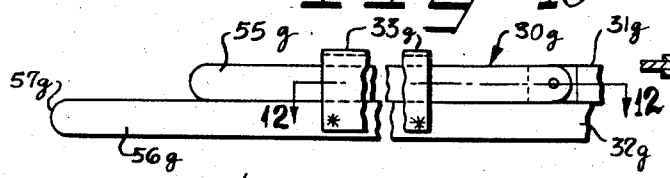


Fig-11

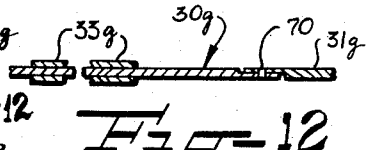


Fig-12

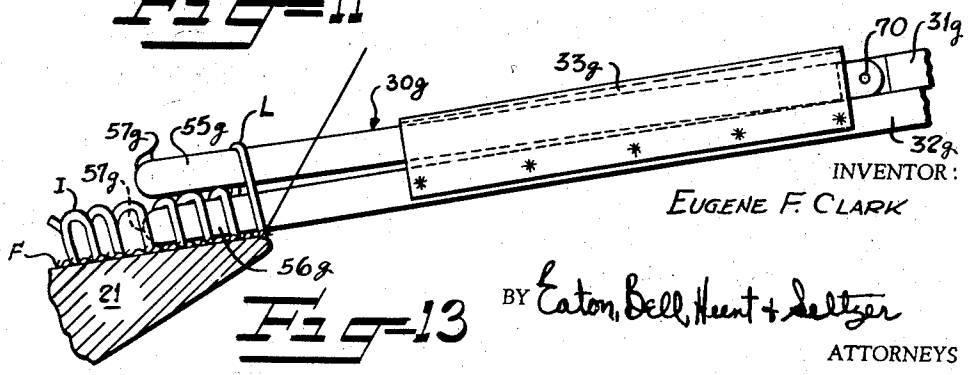


Fig-13

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Patented Nov. 18, 1958

2,860,666

METHOD OF WEAVING AND COMPOSITE PILE WIRE FOR LOOMS

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Application December 19, 1956, Serial No. 629,345

29 Claims. (Cl. 139—46)

This invention relates to pile wires or loop-forming fingers of the type used with looms having means for shogging warpwise extending pile yarns weftwise over certain warp yarns and/or loop-forming fingers or pile wires. A loom of this type is disclosed in my United States Patent No. 2,437,378, dated March 9, 1948, and is referred to hereinafter as a Clark loom.

It is an object of this invention to provide a method of weaving pile fabrics utilizing improved composite pile wires with looms of the character described which pile wires are each provided with a plurality of loop-forming stages or weaving stages which are relatively movable into and out of the loop-forming zone.

It is another object of this invention to provide a composite pile wire comprising at least two superposed relatively thin and rigid finger elements, which elements are relatively movable longitudinally of each other and which may be connected with pattern control means for selectively moving either of the elements into and out of loop-forming position and for moving them into and out of loop-forming position in unison for producing pile fabrics having intricately figured areas of loop pile or open pile, or both, of varying heights and colors.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

Figure 1 is a somewhat schematic isometric view showing some of the improved composite pile wires or loop-forming fingers in association with means for controlling the forward and rearward movement of the relatively movable elongated elements thereof on a loom;

Figure 2 is an enlarged fragmentary side elevation of the operating end of one form of one of said composite pile wires removed from the loom;

Figure 3 is another somewhat schematic view of the weaving instrumentalities of a loom showing said one form of one of the improved loop-forming fingers in elevation;

Figure 4 is a fragmentary view of the operating or loop-forming end of a two-part loop-forming finger or wire of the type shown in Figures 1 and 2 wherein the lower part is provided with a blade or knife on its free end of sufficient height to sever only those loops formed over the loop-forming stage thereof;

Figure 5 is a view similar to Figure 4 wherein the lower part or element of the composite loop-forming finger is provided with a blade or knife on its free end which is of sufficient height to sever both the relatively short loops formed over the loop-forming stage of the lower element and the relatively long loops formed over the loop-forming stage of the upper element, the upper elements in both Figures 4 and 5 being shown in withdrawn position in solid lines and in extended or operative position in broken lines;

Figure 6 is a fragmentary side elevation similar to Figure 2 showing another form of composite pile wire

with additional guiding means between the upper and lower strip elements;

Figure 7 is a transverse vertical sectional view taken along line 7—7 in Figure 6;

Figures 8, 9, 10 and 11 are fragmentary side elevations similar to Figure 2, but wherein each view shows the operating end of the composite wire formed differently from the others;

Figure 12 is a fragmentary longitudinal sectional plan view taken substantially along line 12—12 in Figure 11;

Figure 13 is a fragmentary view of the form of composite pile wire shown in Figures 11 and 12, showing how the upper element passes above short loops formed on the lower element for forming long loops thereover.

Referring more specifically to the drawings, portions of a Clark loom are shown in Figures 1 and 3, which Clark loom may be of a type disclosed in my United States Patents Nos. 2,437,378 and 2,437,379 and, generally, includes means for weaving a base or ground fabric from warp yarns and weft yarns in the usual manner and is provided with pile yarn guides, through which respective continuous pile yarns pass, and which move downwardly from a position spaced above the fabric, whereupon double-weft yarns are inserted through the open shed formed of the warp yarns and over the strands of pile yarn. Upon weft yarns being inserted, the pile yarn guides move upwardly from a position within the shed and are then shifted laterally substantially simultaneously with the beat-up stroke of the reed and then again moved downwardly preparatory to another double-weft yarn being inserted over strands of pile yarn. In so doing, the pile yarns are looped over corresponding groups of warp yarns and respective loop-forming fingers, pile wires or gauges.

More recently, means have been developed for shifting pile wires longitudinally of the warp to present loop-forming stages, or free end portions thereof of varying heights, to the loop-forming zone or to completely withdraw selected loop-forming fingers from the loop-forming zone as disclosed in the pending application of Ivar O. Moberg, Serial No. 398,287, filed December 15, 1953, and entitled Method of and Apparatus for Weaving High and Low Pile Fabric, and in the copending application of George Thomas Stovall, Serial No. 483,067, filed January 20, 1955, now Patent No. 2,808,072, and entitled Loop-Pile-Forming Wires for Looms and Method, for example, according to a desired pattern.

In the present application, the improved pile wires are shown in association with a loom of the type disclosed in said patent and said pending applications, which loom is equipped with a suitable pattern control mechanism, preferably a jacquard. It is to be understood that the improved loop-forming fingers, wires and gauges may be used in association with other types of looms and other types of pattern mechanism may be provided therefor, without departing from the spirit of the invention.

Referring particularly to Figures 1 and 3, the portion of a loom illustrated includes a reed or beating-up means broadly designated at **10** and comprising a reed box or lay **11** having a plurality of closely spaced reed splits **12** mounted thereon with openings therebetween, which are commonly known as reed dents and through which ground warps **13, 14** are threaded. The ground warps **13, 14** pass through conventional heddles or harnesses **15** which are controlled in the usual manner by any suitable means, not shown, for forming a shed therewith. A suitable weft-inserting means necessarily cooperates with the shed forming means in forming the fabric. The weft inserting means is shown in the form of a weftwise reciprocable weft-carrying needle **16** in this instance.

As the fabric is woven, it is taken up by a suitable take-up means shown schematically in the form of a roll

20 in Figure 1, which take-up means draws the fabric over a breast beam 21. The loom is also provided with loop-forming pile yarn guides 23, there being a plurality of such guides 23 disposed in closely spaced relationship to form a row extending transversely of the loom and each of which is provided with an eye 24 in its free lower end for guiding a corresponding pile yarn P from a point substantially above the reed 10, under predetermined tension, to the base fabric indicated at F. The pile yarn guides 23 may be of substantially the same construction as, and operated by the same means as disclosed in my said Patent No. 2,437,378. As disclosed in said patent, the pile yarn guides 23 are moved into and out of the warp shed and laterally over corresponding warp yarns or loop-forming fingers, such as will presently be described, to thereby shog the pile yarn P over the warps or loop-forming fingers, as the case may be, by conventional controlled means which operate in relation to the operation of the needle 16 as it places the filler or weft yarn into the warp. Thus, a further detailed description of the beating-up means 10, the shed forming means 15, the weft or filler inserting means 16 and the pile yarn guides 23 is deemed unnecessary. The loom is also equipped with a suitable pattern control mechanism 25, preferably a jacquard mechanism, which is shown in the form of a block or box suitably legended, in Figures 1 and 3.

In Figures 1, 2 and 3, one form of the improved composite loop-forming finger or pile wire is shown, there being a plurality of such fingers, each of which is designated broadly at 30. Each of the loop-forming fingers 30 comprises a pair of elongated, flat and incompressible strips or strip elements which may be termed as upper and lower elements respectively designated at 31 and 32. The shanks of the elements 31, 32 are sufficiently thin to pass between adjacent reed splits 12 and are preferably maintained in superposed relationship by means of an inverted substantially U-shaped guide 33 preferably made from relative thin sheet metal and whose side portions are attached to or formed integral with the lower element 32 and through which guide the upper element 31 may have free sliding longitudinal movement. The inverted U-shaped guide 33 is also sufficiently thin to extend between adjacent reed splits 12.

It is preferable, but not necessary, that one of the composite loop-forming fingers 30 is provided for each of the pile yarn guides 23. It is apparent, by referring to Figure 3, that the shanks of the elements 31, 32 of each composite loop-forming finger 30 extend through the harnesses 15 and suitable transversely extending guide bars 35, 36 and 37 may also be provided for guiding the composite loop-forming fingers 30 longitudinally of the warp. In this instance, the guide bars 35 and 36 are disposed adjacent opposite sides or forwardly and rearwardly of the harnesses or heddles 15, respectively, and the shanks of the elements 31, 32 are slidably mounted in the guide bars 35, 36, 37.

The upper and lower finger elements 31, 32 are provided with respective rearwardly projecting relatively narrow extensions or portions 41, 42 thereon (Figure 3) which loosely penetrate the guide bar 37 and are provided to accommodate respective compression springs 43, 44. The compression springs 43, 44 are preferably substantially oval-shaped so that adjacent composite loop-forming fingers 30 may be disposed in relatively closely spaced relationship. The shank of each of the elements 31, 32 may be provided with a suitable stop means or abutment, which is shown in the form of a pin 45 in Figures 1 and 3 and the forward ends of the compression springs 43, 44 engage the corresponding abutments 45. The rear ends of the springs 43, 44 may engage the rearmost transverse guide bar 37. It is thus seen that each of the elements 31, 32 of each composite loop-forming finger 30 is normally urged forwardly to fully operative position.

The rearmost ends of the extensions 41, 42 of the respective strip elements 31, 32 have respective cords, pliable elements or cables 51, 52 connected thereto and extending rearwardly, beneath and partially around a suitable guide means 53 and, thence, to the pattern control mechanism 25. The pattern control mechanism operates in a well known manner and, in this instance, serves to pull the cords 51, 52 rearwardly predetermined distances and to release them at predetermined intervals, depending upon the desired pile pattern to be formed. The guide means 53 may be in the form of a plurality of individual rollers, sheaves or a guide rod, as desired.

It will be observed in Figures 1, 2 and 3 that the forward or operating ends of the strip elements 31, 32 of each composite loop-forming finger 30 have their upper portions cut away to form respective reduced nose portions 55, 56 whose forward ends are rounded, as at 57. The upper edges of the nose portions 55, 56 form loop-forming or weaving stages of varying heights. Although only two strip elements 31, 32 are provided for each composite loop-forming finger 30, it is to be distinctly understood that additional strip elements, like strip element 31, may be positioned above the element 31 and controlled independently of the elements 31, 32.

Referring again to Figure 1, it will be observed that both the upper and lower strip elements 31, 32 of the first two loop-forming fingers 30 in the right-hand portion of Figure 1 are in withdrawn position with respect to the loop-forming zone so the first two warpwise rows of loops are being formed from the corresponding pile yarns P against the base fabric F; that is, the bights of the first two warpwise rows of loops, indicated at S, engage the base fabric F. The bights of the next two rows of loops are formed at an intermediate height indicated at I above the base fabric F, since the lower elements 32 of the corersponding composite loop-forming fingers 30 are in loop-forming or operative position while the two corresponding upper elements 31 are in withdrawn position.

The remaining loop-forming fingers to the left of the first four fingers in the right-hand portion of Figure 1 are shown with both the upper and lower elements 31, 32 in operative or loop-forming position so that relatively high loops, indicated at L, are formed over the nose portions 55 of the strip elements 31 as corresponding pile yarns P are shogged thereover in the manner heretofore described. Although the nose portion 55 of the upper element 31 of each composite loop-forming finger 30 is shown as being of lesser height than the shank of the strip elements 31, this strip element is merely made this way for convenience to provide the shank of each upper strip element 31 of sufficient width or vertical dimension for mounting the same to accommodate the corresponding spring 43. Also, such strips are usually stocked in one standard width and are machined to the desired shape. Of course, depending upon the desired height of the highest loops to be formed, the nose portion 55 may be of the same height or vertical dimension as the shank of the upper parts or elements 31 of each composite loop-forming finger (see Figures 9 through 13).

It is thus seen that each of the strip elements 31, 32 of each composite loop-forming finger 30 is movable relative to the other under control of the pattern control mechanism 25, the springs 43, 44 urging the corresponding elements 31, 32 toward operative position upon the tension in the corresponding cords 51, 52 extending from the pattern control mechanism 25 being relaxed and, of course, as each cord is drawn into the pattern control mechanism 25, it moves a corresponding element of one of the loop-forming fingers 30 rearwardly a predetermined distance.

Since the upper element 31 of each loop-forming finger 30 must move over the loop-forming stage or nose portion 56 of the lower element 32 following the formation of loops over the nose portion 56 of the corresponding lower element 32, depending upon the sequence of the

patterning, it is apparent that the nose portion **56** of each lower element **32** is of lesser height than the shank of the corresponding lower element **32** in order that the nose portion **55** of the corresponding upper element **31** may move over the bights of loops previously formed over and then positioned over the nose portion **56** of the corresponding lower element **32**.

As illustrated in Figures 8 and 10, however, it is apparent that the proximal edges of the nose portions may be cut away or the lower edge of the nose portion of the upper element may be cut away to provide space to accommodate the loops previously formed over the nose portion of the lower element when the upper element is moved into operative position. Also, by referring to Figures 11, 12 and 13, it is to be noted that neither element need necessarily be cut away, provided that the nose portion of the upper element may be pivoted upwardly to ride over loops previously formed over the nose portion of the lower element as shown in Figure 13, all of which will be later described in detail.

Now, when only intermediate and high loops I, L are to be formed in any particular warpwise row of loops or in all rows of loops throughout the width of the fabric F, the lower element **32** of each loop-forming finger **30** may be fixed in operative position and the corresponding springs **44** and cords **52** could then be omitted, since it would only be necessary that the upper element **31** of each corresponding loop-forming finger **30** be movable longitudinally of the fabric under control of the pattern control mechanism **25**. This is particularly true wherein all the intermediate loops I or all the relatively high loops L in any particular row are to be severed following the formation of such loops while the fabric is on the loom.

Referring to Figures 4 and 5, two modified forms of composite loop-forming fingers are shown respectively broadly designated at **30***a* and **30***b*. Only the forward portions of the composite loop-forming fingers **30***a*, **30***b* are shown in Figures 4 and 5 since, with the exception of the forward ends of the nose portions of the lower strip elements being provided with knives or blades in Figures 4 and 5, the composite loop-forming fingers **30***a*, **30***b* may be constructed in the same manner as the loop-forming fingers **30**. Accordingly, the portions of the loop-forming fingers **30***a*, **30***b* shown in Figures 4 and 5 which are identical to corresponding portions of the loop-forming fingers **30** will bear like reference characters with the letter *a* affixed to the numerals appearing in Figure 4 and with the letter *b* affixed to the numerals shown in Figure 5.

Referring to Figures 4 and 5, the nose portions **56***a* and **56***b* of the respective composite fingers **30***a*, **30***b* are preferably relatively longer than the respective nose portions **55***a*, **55***b* to accommodate respective blades or knives **60**, **61** on the free ends thereof. The blades **60**, **61** may be suitably secured to the nose portions **56***a*, **56***b*, the blade **60** being relatively short as compared to the blade **61**. The cutting edges of the blades **60**, **61** extend upwardly and forwardly at an angle from the upper edges of the respective nose portions **56***a*, **56***b* and it should be noted that the uppermost edge of the blade **60** is disposed below the plane of the upper edge of the nose portion **55***a* of the corresponding loop-forming finger **30***a* while the uppermost edge of the blade **61** is disposed above the plane of the upper edge of the nose portion **55***b* of the composite loop-forming finger **30***b*. Thus, only the intermediate loops formed across the nose portion **56***a* of any loop-forming fingers **30***a* will be severed by the blade **60** as the fabric F is taken up while relatively long loops formed over the corresponding nose portion **55***a* will remain unsevered. On the other hand, loops formed over either of the nose portions **55***b*, **56***b* will be severed by the blade **61** as the fabric F is taken up. The nose portions **55***a*, **55***b* of the respective loop-forming fingers **30***a*, **30***b* will occupy substantially the broken line positions shown in the respective Figures 4 and 5 while in operative position. It is apparent that all forms of composite loop-forming fingers disclosed herein may be used in combination or separably or with other types of movable or fixed loop-forming fingers in forming various types of pile fabric.

While not shown, the nose portion of the upper strip element of any of the forms of loop forming fingers disclosed herein could also be provided with a blade for cutting only the loops formed thereon. However, in this event, the weave, such as a two shot or three shot weave, or the nature of the apparatus maintaining tension in the yarn would have to be such that the shifting of the upper element from loop-forming position and the consequent cutting of any loops previously formed thereon, would not cause the pile yarn to pull out of the fabric.

In Figures 6 through 13, five additional forms of composite loop-forming fingers are shown respectively broadly designated at **30***c*, **30***d*, **30***e*, **30***f* and **30***g*, the form **30***c* being shown in Figures 6 and 7, the forms **30***d*, **30***e* and **30***f* being shown in the respective Figures 8, 9 and 10, and the form **30***g* being shown in Figures 11, 12 and 13.

Only the forward portions of the composite loop-forming fingers **30***c* through **30***g* are shown, since, with the exception of variations in the configuration of the forward or loop-forming ends thereof, the composite loop-forming fingers **30***c* through **30***g* may be constructed in the same manner as the loop-forming fingers **30**. Accordingly, the portions of the loop-forming fingers **30***c* through **30***g*, and the associated elements which are identical to corresponding portions of the loop-forming fingers **30** will bear like reference characters with the letter *c* affixed to the numerals appearing in Figures 6 and 7, the letter *d* affixed to the numerals shown in Figure 8, the letter *e* affixed to the numerals shown in Figure 9, the letter *f* affixed to the numerals shown in Figure 10, and the letter *g* affixed to the numberals shown in Figures 11, 12 and 13.

Referring to Figure 6, the nose portions **55***c*, **56***c* are to be considered as exemplary of any of the various forms of nose portions illustrated herein insofar as the guiding means peculiar to Figure 6 is concerned. However, the nose portions **55***c*, **56***c* differ from those of the other forms of the invention in that the nose portion **55***c* is relatively long as compared to the nose portion **56***c* and, while the upper edge of the nose portion **56** in Figure 2 extends upwardly and rearwardly at an angle to the upper edge of the shank of the lower strip element **32**, it will be noted that the strip element **32***c* in Figure 6 is cut off at substantially right angles at the rear end of the portion **56***c*, as at **65**.

In order to assist in guiding the upper strip element **31***c* relative to the lower strip element **32***c* of the composite pile wire **30***c*, and to lend rigidity to the free end of the nose portion **55***c* when it occupies operative position as shown in Figure 6, the upper and lower strip elements **31***c*, **32***c* are provided with a relatively thin key or fin **66** and a mating slot **67**, respectively. As best shown in Figure 7, the fin **66** is relatively thin as compared to the thickness of the upper strip element **31***c* and the slot **67** is of sufficient width to permit freedom of relative movement between the fin **66** and the lower strip element **32***c*. Of course, the key **66** should be positioned as close as possible to the free end of the nose portion **55***c*, just so long as it will not move into the vertical plane of the nose portion **56***c* to where it will engage loops previously formed over the nose portion **56***c*. The slot **67** should also be of sufficient length to permit the upper strip element **31***c* to be moved between fully withdrawn and extended positions.

The fin **66** is shown in Figure 7 with its upper portion fixed in the nose portion **55***c* of the upper strip element **31***c*. However, it is to be understood that the key or fin **66** may be attached to the upper strip element **31***c* by other means or it may be formed integral with the upper

strip element **31***c*. Also, the fin may be connected to the lower strip element and the mating slot formed in the upper strip element, without departing from the spirit of the invention. The key and slot arrangement shown in Figure 6 may be used with the other forms of composite pile wire disclosed herein.

The nose portions **55***d*, **56***d* of the pile wire **30***d* shown in Figure 8 differ from those heretofore described in that the nose portion **56***d* may be of relatively greater height, relative to the body of the strip element **32***d*, than the nose portions on the lower strip elements heretofore described or the pile yarn may be larger in diameter than the pile yarn used with the fingers **30**. Accordingly, in order to provide sufficient space for the loops formed over the nose portion **56***d* of strip element **32***d* when the nose portion **55***d* is moved into operative position above the nose portion **56***d*, the nose portion **55***d* extends forwardly from a medial portion of the forward end of the body of the upper strip element **31***d*; that is, the forward end of the shank is cut away at both its upper and lower edges to form the nose portion **55***d*. Of course, it is contemplated that the upper surface of the nose portion **55***d* may be on the same level as the upper edge of the shank of the upper strip element **31***d*.

The form of composite pile wire **30***e* shown in Figure 9 comprises a nose portion **56***e* which may be substantially the same as the upper nose portion **56** or **56***c*; to the extent that its lower surface is alined with the lower surface of the body or shank of the lower strip element **32***e* and the nose portion **56***e* is of lesser height than the height of the shank of the lower strip element **32***e*. On the other hand, the upper strip element **31***e* is of the same height throughout its length so that loops formed over the nose portion **55***e* thereof would be of relatively greater height than loops formed over any of the nose portions previously described, assuming that the shanks of the strip elements **31***e*, **32***e* are of substantially the same height as the shanks of the other strip elements heretofore described.

The composite pile wire **30***f* shown in Figure 10 is similar to the form **30***e* shown in Figure 8 with the exception that the nose portion **56***f* of the lower strip element **32***f* is of the same height as the shank of the lower strip element **32***f* while the lower portion of the forward end of the upper strip element **31***f* is cut away to form the nose portion **55***f*. It is apparent that the lower portion of the nose potrion **56***f* of the lower strip element **32***f* may also be cut away and loops could still be formed of the same height over the upper surface of nose portion **56***f*. However, it would ordinarily be unnecessary to cut away the lower surface of the nose portion **56***f* of the strip elements **32***f* in Figure 10, unless it is desired that the upper and lower strip elements **31***f*, **32***f* be interchangeable, as might be the case in the event that a large number of the upper strip elements **31***f* are stocked.

The form of composite pile wire **30***g* in Figures 11, 12 and 13 illustrates how loops may be formed over both upper and lower relatively shiftable strip elements without recessing the proximal surfaces of either of the nose portions thereof. In this instance, the nose portion **56***g* of the lower strip element **32***g* is formed of the same height as the shank thereof and the same as the nose portion **56***f* of the lower strip element **32***f* in Figure 10.

However, the upper strip element **31***g* differs from those previously described herein in that the nose portion **55***g* is formed separately from the shank of the strip element **31***g* and is pivotally connected to the shank, as at **70**. Since it is desirable that the thickness of the nose portion **55***g* is substantially the same as the thickness of the lower strip element **32***g* and substantially the same as the thickness of the shank of the strip element **31***g*, the proximal ends of the shank strip element **31***g* and the nose portion **55***g* are overlapped, as shown in Figure 12, to facilitate the pivotal interconnection **70** therebetween. As shown in Figure 13, when the upper strip element **31***g* is moved into operative position following the formation of loops I over the nose portion **56***g* of the lower element **32***g*, it is apparent that the rounded forward end **57***g* of the nose portion **55***g* will engage the last formed loop I and cause the nose portion **55***g* to pivot upwardly about its pivot point **70** so that the subsequent loops L may be formed over the high nose portion **55***g*.

It is apparent that the lower nose portion of each of the forms of pile wires shown in Figures 6 through 13 may be extended relative to the nose portions of the upper strip elements and provided with blades or knives for severing loops during the weaving of the fabric in substantially the same manner in which the knives **60** and **61** are provided on the lower strip elements **32***a*, **32***b* of the respective composite pile wires **30***a*, **30***b* in Figures 4 and 5. Accordingly, an illustration of each of the forms of pile wires shown in Figures 6 through 13 with the lower nose portions thereof provided with such blades is deemed unnecessary.

It is thus seen that I have provided improved loop-forming fingers adapted to be associated with a loom for weaving pile fabrics such as rugs, carpets and the like, wherein the loom is provided with means for selectively shifting loop-forming fingers longitudinally of the warp and wherein each loop-forming finger comprises a plurality of superposed warp-wise extending sections provided with respective nose portions thereon and wherein each section of each loop-forming finger or pile wire may be shifted into and out of operative position relative to the others and relative to loops previously formed over corresponding nose portions and wherein the lower prong or nose portion of each of certain of the loop-forming fingers or pile wires may be provided with means for cutting either loops of intermediate height or relatively high loops and intermediate loops.

It is apparent that this provides means whereby the major portion of a fabric, for example, may be formed with relatively long pile loops with variantly-shaped design areas formed from loops of an intermediate height and wherein each of the areas formed by any one of the heights of loops will stand out sharply and thereby providing a definite and distinct line of demarcation between such areas. A further distinction between adjacent areas formed from different height loops may also be made by shifting both upper and lower strip elements to inoperative position to form loops whose bights lie against or engage the base fabric. Of course, areas of any desired configuration may be formed from any desired height of loops and, also, by providing fingers such as are indicated at **30***a* and **30***b* in Figures 4 and 5, high and low cut pile areas and high and low loop pile areas of predetermined configuration may be formed.

When using a loom of the type disclosed in the present drawings or when using a doup heddle loom or a Warner-Swasey projectile loom, pile loops may be formed with their bights against the base fabric or over nose portions on the corresponding lower elements or sections or over nose portions on the corresponding upper sections of corresponding pile wires. However, in a double-shuttle loom, for example, wherein two fabrics are woven simultaneously, the different loop-forming stages or nose portions may support weft shots which, in turn, support the pile loops as they are formed between adjacent pile wires and whereby the loop-supporting weft shots may subsequently be removed for separating the fabrics.

The loop-forming stages, in each instance, should preferably be of sufficient length so that approximately four loops are present on the free front end portion of each of those loop-forming stages which is in active or loop-height-determining position so the last formed or rearmost of these four loops is pulled taut with the next beat-up stroke of the reed **10** while the immediately preceding free loops, which were previously pulled taut,

serve to guide and steady the free front ends of the corresponding loop-forming fingers.

In the drawings and specification there has been set forth preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

I claim:

1. In a loom having a reed and other means for making cloth, longitudinal pile gauge wires having free end portions extending through the reed dents, individual wires of said pile wires having a plurality of loop-forming stages of different height including a lower stage and at least one upper stage and means for importing relative longitudinal movement to the lower and upper stages of each of said individual wires relative to the cloth during weaving to position different loop-forming stages of different heights to the fell of the cloth at predetermined intervals.

2. An improved pile loop-forming finger for use with a loom for weaving loop pile fabric and wherein said loom is equipped with means for looping pile yarns over certain warp yarns and means for shifting loop-forming fingers longitudinally of the warp, said improved loop-forming finger comprising a lower elongated relatively thin strip of incompressible material having a nose portion on its free forward end, at least one upper elongated thin strip of incompressible material vertically alined with said lower strip and being guided for movement parallel to the lower strip and means to connect at least one of said strips to said shifting means for shifting the last-named strip into and out of loop-forming position longitudinally of the warp.

3. In a loom having a reed and other means for making cloth, longitudinal pile gauge wires having free end portions extending through the reed dents, individual wires of said pile wires comprising superposed elongated elements having respective loop-forming stages of different heights than the others including a lower stage and at least one upper stage, and means for imparting relative longitudinal movement to the lower and upper stages of each of said individual wires relative to the cloth during weaving to position different loop-forming stages of different heights to the fell of the cloth at predetermined intervals.

4. A structure according to claim 3 wherein the forward end of said lower stage has integral loop severing means thereon.

5. An improved pile loop-forming finger for use with a loom for weaving loop pile fabric and wherein said loom is equipped with means for looping pile yarns over certain warp yarns and means for shifting loop-forming fingers longitudinally of the warp, said improved loop-forming finger comprising a lower elongated relatively thin strip of incompressible material having a nose portion on its free forward end of lesser height than the height of the lower strip proper, at least one upper elongated thin strip of incompressible material vertically alined with said lower strip and being guided for movement parallel to the lower strip and means to connect at least one of said strips to said shifting means for shifting the last-named strip into and out of loop-forming position longitudinally of the warp.

6. An improved pile loop-forming finger for use with a loom for weaving loop pile fabric and wherein said loom is equipped with means for looping pile yarns over certain warp yarns and means for shifting loop-forming fingers longitudinally of the warp, said improved loop-forming finger comprising a lower elongated relatively thin strip of incompressible material having a nose portion on its free forward end, at least one upper elongated thin strip of incompressible material vertically alined with said lower strip and being guided for movement parallel to the lower strip, said upper strip having a nose portion on its free forward end of lesser height than the height of the upper strip proper, and means to connect at least the upper strip to said shifting means for shifting the last-named strip into and out of loop-forming position longitudinally of the warp.

7. A structure according to claim 6 wherein the nose portion of said lower strip has loop severing means thereon of less height than the height of the nose portion of said upper strip.

8. A structure according to claim 6 wherein the nose portion of said lower strip has loop severing means thereon of greater height than the height of the nose portion of said upper strip.

9. An improved pile loop-forming finger for use with a loom for weaving loop pile fabric and wherein said loom is equipped with means for looping pile yarns over certain warp yarns and means for shifting loop-forming fingers longitudinally of the warp, said improved loop-forming finger comprising a lower elongated relatively thin strip of incompressible material having a nose portion on its free forward end of lesser height than the height of the lower strip proper, at least one upper elongated thin strip of incompressible material vertically alined with said lower strip said upper strip having a nose portion on its free forward end of lesser height than the height of the upper strip proper and being guided for movement parallel to the lower strip, and means to connect said lower and said upper strips to said shifting means for shifting the strips into and out of loop-forming position longitudinally of the warp and independently of each other.

10. In a loom having a reed and other means for making cloth and including a pattern control mechanism; the combination of longitudinal pile gauge wires extending through the reed dents, individual wires of said pile wires comprising a lower section including an elongated relatively thin incompressible strip, an upper section including an elongated relatively thin incompressible strip having its lower edge resting upon the upper edge of the lower strip, said lower strip having a nose portion thereon adapted to be positioned above the cloth during weaving, and means under control of said pattern control mechanism for moving said upper section into and out of loop-forming position.

11. A structure according to claim 10 wherein the end of at least one of said strips adjacent the cloth is formed to provide a space between the proximal edges of the upper and lower strips when the upper section occupies loop-forming position whereby the end of the upper section adjacent the cloth may pass over loops previously formed over the lower section.

12. In a loom having a reed, means for shogging pile yarn and other means for making cloth and including a pattern control mechanism; the combination of longitudinal pile gauge wires extending through the reed dents, individual wires of said pile wires comprising a lower section including an elongated relatively thin incompressible strip, an upper section including an elongated relatively thin incompressible strip having its lower edge at least in part resting upon and slidable along the upper edge of the lower strip, said sections having nose portions at their forward ends adapted to be positioned at the fell and above the cloth during weaving, and means under control of said pattern control mechanism for moving said upper section forwardly and rearwardly relative to the cloth and relative to the lower section to position the nose portion of the upper section over the nose portion of the lower section and the fell and at predetermined intervals.

13. In a loom having a reed and other means for making cloth and including a pattern control mechanism; the combination of longitudinal pile gauge wires extending through the reed dents, individual wires of said pile wires comprising a lower section including an elongated relatively thin incompressible strip, an upper section in-

cluding an elongated relatively thin incompressible strip having its lower edge resting upon and slidable along the upper edge of the lower strip, the free forward end of said upper strip being cut away at its upper edge to form an elongated nose portion thereon, said lower strip having its upper portion cut away at its forward end to form an elongated nose portion thereon adapted to be positioned above the cloth during weaving, and means under control of said pattern control mechanism for moving said upper strip and said lower strip forwardly and rearwardly relative to each other and to the cloth to position the free forward end of the upper strip over the nose portion of the lower strip at predetermined intervals.

14. A structure according to claim 13 wherein spring means are provided to normally urge the upper strip forwardly into operative position and wherein said pattern control mechanism is provided with pliable elements extending therefrom to the corresponding upper strip whereby, upon any of the pliable elements being tensioned and pulled by the pattern control mechanism, the corresponding upper strip is withdrawn to inoperative position and, upon the corresponding cord or pliable element being released by the pattern control mechanism, the spring returns the upper section to operative position.

15. A structure according to claim 14 including spring means also urging the lower strip into operative position, and a second pliable element connecting said lower strip with the pattern control mechanism.

16. In a loom having a reed and other means for making fabric and also having means for looping pile yarn over warp yarns and over longitudinal pile gauge wires; the combination therewith of longitudinal pile gauge wires extending through the reed dents, individual wires of said pile gauge wires comprising a plurality of relatively movable vertically arranged and vertically spaced loop-forming stages which may be predeterminedly positioned at that position where pile loops are formed in the fabric during weaving, means for moving individual loop-forming stages longitudinally of the fabric to position them at that position where pile loops are formed in the fabric at predetermined times, and at least one of said stages positioned below the uppermost of said stages being spaced from the lower surface of the stage thereabove whereby individual sections of individual gauge wires may be moved forwardly, upon pile loops being formed over any of said stages of different heights, at a rate exceeding the rate at which the fabric is woven and the bights of any loops formed over any of the stages of different heights other than the uppermost of said stages may extend through the space between the upper surfaces of the latter stages and the lower surfaces of the stages thereabove as corresponding individual sections are moved forwardly.

17. In a loom having a reed and other means for making cloth and also having means for looping pile yarn over longitudinal pile gauge wires; the combination therewith of composite longitudinal pile gauge wires extending through the reed dents, individual wires of said composite wires having a plurality of vertically spaced prongs on the free forward ends thereof, and means for moving individual prongs of each of said individual wires longitudinally of the cloth in either direction independently of the other prongs on the corresponding wires and independently of the rate at which the cloth is woven whereby, upon loops being formed over any prongs other than the uppermost prongs, any prongs disposed above other prongs over which loops have previously been formed may be advanced over the bights of the loops so said bights may extend through the space between adjacent prongs as loops are subsequently formed over another prong to permit the formation of loop pile areas having a distinct line of demarcation between loops of different heights.

18. In a pile fabric loom with a reed having dents and means for shedding and shogging pile warp yarns, the combination therewith of rigid longitudinal pile gauges extending through the reed dents to the fell of the fabric, each gauge comprising upper and lower sections, means to guide said gauges in a warpwise path of travel, and means for relatively inserting and withdrawing warpwise said sections to change the effective loop-forming height of gauges at the fell.

19. In a pile fabric loom with a reed having dents and means for shedding and shogging pile warp yarns, the combination therewith of rigid longitudinal pile gauges extending through the reed dents to the fell of the fabric, each gauge comprising upper and lower sections, the lower section of each gauge being fixed in loop-forming position, and the upper section being provided with means for being inserted at and withdrawn from the fell of the fabric.

20. In a pile fabric loom, a reed having dents, pile forming warp yarn, means for shogging pile yarn over longitudinal pile wires, the combination therewith of composite longitudinal pile gauge wires having free end portions extending through the reed dents, means to guide said composite pile wires in a warpwise path of travel, individual wires of said composite pile wires comprising rigid superposed lower and upper elements providing a plurality of loop-forming stages of different heights on said free end portions including a lower stage and at least one upper stage, and means for imparting at predetermined intervals relative longitudinal movement to the elements to present different loop-forming stages of different heights to the shogging means.

21. An improved pile-loop-forming finger for use with a loom, said improved loop-forming finger comprising a lower elongated relatively thin strip of incompressible material, at least one upper elongated thin strip of incompressible material vertically alined with and supported by said lower strip, said strips having complementary nose portions thereon, said upper strip being longitudinally movable on and parallel to the lower strip between a first position where the nose portion of the upper section is slightly spaced vertically from the nose portion of the lower section and a second position where the nose portion of the upper section is rearwardly of the nose portion of the lower section.

22. A structure according to claim 21 wherein the forward portion of the lower strip has a longitudinal slot therein and the upper strip has affixed to the forward lower edge thereof a fin adapted to move back and forth in the slot provided in the lower strip.

23. A structure according to claim 21 wherein the nose portion of said lower strip has loop severing means thereon of less height than the height of the nose portion of said upper strip.

24. A structure according to claim 21 wherein the nose portion of said lower strip has loop severing means thereon of greater height than the height of the nose portion of said upper strip.

25. In a loom having a reed, means for shogging pile yarn and other means for making cloth and including a pattern control mechanism; the combination of composite longitudinal pile gauges extending through the reed dents, means to guide said gauges in a warpwise path of travel, certain of said pile gauges each comprising a lower section including an elongated relatively thin incompressible strip, an upper section including an elongated relatively thin incompressible strip having its lower edge resting upon and slidable along all but the most forward portion of the upper edge of the lower strip, said sections having nose portions at their forward ends adapted to be positioned at the fell and above the cloth during weaving, and means under control of said pattern control mechanism for moving at predetermined intervals said upper section forwardly and rearwardly relative to the cloth and relative to the lower section to position the nose portion of the upper section over the nose portion of the lower section at the fell.

26. In a loom having a reed, means for making cloth and means for looping pile yarn over longitudinal pile wires; the combination therewith of composite longitudinal pile wires extending through the reed dents, means to guide said wires in a warpwise path of travel, certain of said composite wires each having a plurality of separate vertically spaced prongs on the free forward ends thereof, and means for moving individual prongs of each of said wires longitudinally of the cloth in either direction independently of other prongs on the corresponding wire and independently of the rate at which the cloth is woven whereby, upon loops being formed over any prongs other than the uppermost prongs, any prongs disposed above other prongs over which loops have previously been formed may be advanced over the bights of such loops as loops are subsequently formed thereover to permit the formation of loop pile areas having distinct lines of demarcation between loops of different heights.

27. In a method of weaving pile fabrics on a loom having weft insertion means, warp pile yarn shogging means and sets of upper and lower longitudinal pile gauge elements extending through reed dents to the fell of the fabric, the steps which comprise weaving a ground fabric, during said weaving forming loops by shogging pile yarn over upper gauge elements and interlacing it with selected weft shots, then withdrawing from the fell of the fabric selected upper elements, then shogging warp pile yarn over the remaining upper elements and such lower elements as are then exposed, then withdrawing and advancing other selected upper elements, and repeating said shogging step to produce, during the weaving of the ground fabric, individual high and low loops.

28. In a method of weaving pile fabrics, the steps which include weaving a base while positioning a bottom set of pile wire elements warpwise of and on the base,

then positioning a top set of warpwise pile wire elements above said bottom elements, interlacing pile-forming yarns with the base, then establishing a pile gauge pattern by withdrawing selected top elements from the fell of the fabric and leaving at the fell the remaining top elements and such bottom elements as have been exposed, then shogging all of said pile forming yarns over such top and bottom elements to form low and high loops at the fell of the base corresponding to the height of the respective exposed bottom elements and those top elements that were not withdrawn, and repeating said steps to obtain an overall textured pattern.

29. In a loom having means for weaving a base fabric; means for forming pile from pile yarn on the base comprising warpwise composite pile wires, at least some of the pile wires comprising a lower elongated element and an upper elongated element, means to advance and withdraw the forward end of at least the upper element into and out of loop-forming position, respectively, relative to the base, the upper element comprising a shank longitudinally movable upon the lower element, and an elongated nose pivotally connected at its rear end to the forward end of the shank whereby the nose may pivot upwardly to ride over yarn extending over the forward portion of the lower element when said upper element is advanced.

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