May 4, 1943. W. R. KEEN 2,318,499

LOOP PILE FABRIC

Original Filed April 17, 1941

FIG. I

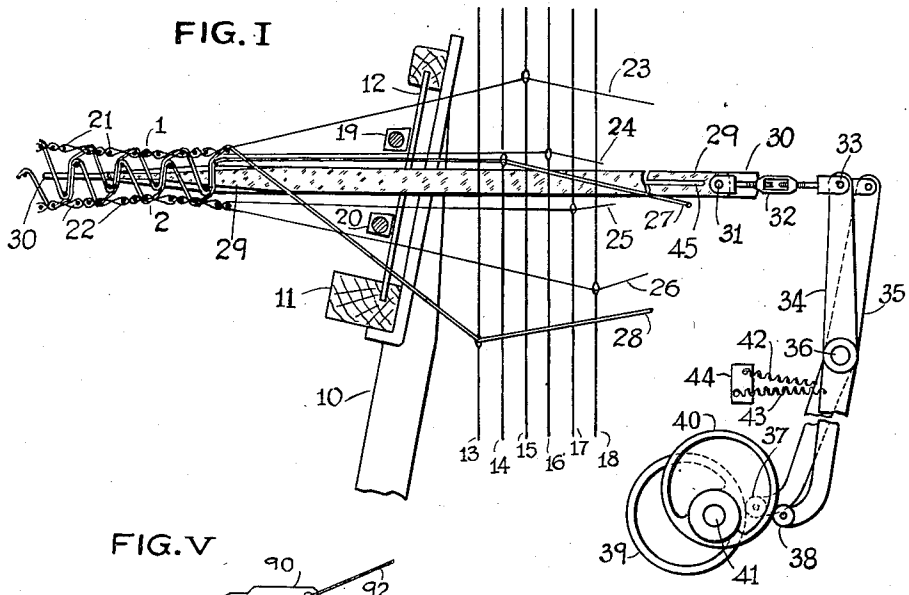


FIG. V

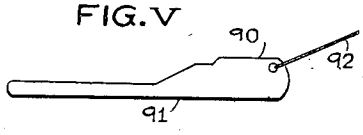


FIG. II

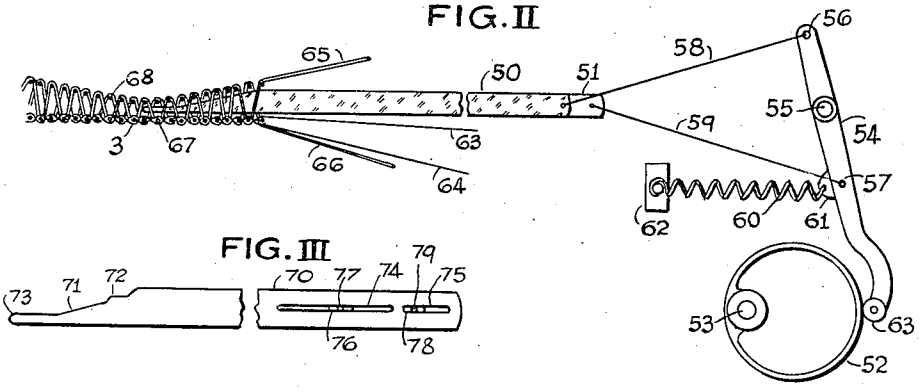


FIG. III

FIG. VI

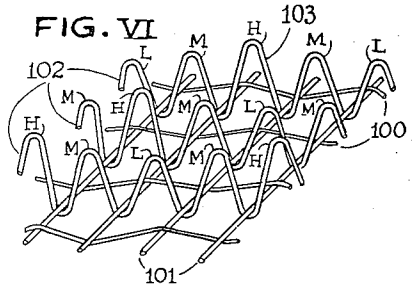
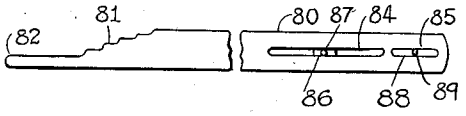


FIG. IV



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LOOP PILE FABRIC

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Original application April 17, 1941, Serial No. 388,969. Divided and this application October 9, 1942, Serial No. 461,373

5 Claims. (Cl. 139—402)

This invention relates to an apparatus for and method of weaving loop pile fabrics with longitudinal gauge wires extending through the dents of the loom reed.

According to my improvements I may produce novel loop pile fabrics the loops of which are of graduated heights formed from a single pile warp yarn, and the all-over design of which includes loops of graduated heights both warpwise and weftwise of the fabric. This is a division of application Serial No. 388,969, filed April 17, 1941, and relates to the novel fabrics produced.

I accomplish all these results in a preferred practice of the present invention by providing a set or sets of longitudinal gauge wires which are movable warpwise of the fabric and which have a plurality of weaving stages near one end of the wires. The wires may be positively advanced at or less than the weaving rate or may be drawn forwardly by the cloth itself as the cloth is drawn forwardly in weaving. All or some of the wires may be held stationary during predetermined periods of the weaving cycle or may be positively moved rearwardly of the loom to present a selected weaving stage to the weaving point or fell of the cloth. The weaving stages of the wires may be formed by an inclined portion of the pile gauge wires or may be graduated in steps of different increasing heights toward the rear of the loom. If the gauge wire is inclined, an almost infinite number of pile heights can be produced from a single pile warp.

I prefer to practice my improvements on a double shuttle loom in which two shuttles are thrown simultaneously to insert a loop-supporting weft and a ground weft. In this way two self-separating fabrics may be woven simultaneously or a single fabric may be woven, as will be more fully set forth. It is to be understood that a single fabric may be woven if it is desired to produce results comparable to those obtained in the simultaneous self-separating weaving above referred to. Single fabric weaving also permits the pile loops to be formed over each pile supporting weft without the necessity of pulling out wefts to separate simultaneously woven fabrics.

While the use of a double weft carrier loom such as a double shuttle loom is preferred, my improvements are not limited thereto and can be carried out for example on a single shuttle loom or a single needle loom. I may do this by providing a short relatively rigid end portion for my pile gauges, which portion is connected to a sheddable portion over and under which a shuttle, dummy shuttle, or needle may pass during weaving, retraction of the wire within the fabric being performed in a convenient manner.

According to my improvements a pattern mechanism or mechanisms which may take the form of a cam or cams is mounted rearwardly of the shedding harnesses on one or both sides of the loom. These pattern cams are connected as by linkages or fulcrum lever arms to cross members to which my novel pile gauges are directly or indirectly connected by means of flexible or rigid connections. When the connections are rigid, the cams may operate the gauges positively in both their forward and rearward movement. Variations in the connections are contemplated and the illustrated embodiments are deemed to be the equivalets of those involving minor mechanical changes such as offsetting the ends of the wires to provide a clearance for the movement of the cross members. A lost motion may be provided between the cross members and the gauges by a flexible connection or by use of a cross bar which does not completely fill the slot in the gauges, as will be more fully described.

An object of my invention is to provide a loop pile fabric having loops of different graduated heights both warpwise and weftwise of the fabric.

Another object is to provide a method of weaving wherein pile gauges having a plurality of progressive weaving stages are moved within the fabric to vary the height of pile loops as the weaving progresses.

Another object is to provide a loom having a set or sets of progressively graduated warpwise extending pile gauges which are movable horizontally within the fabric.

Another object is to provide mechanism for moving progressively graduated pile gauges within the fabric during weaving.

Another object is to provide a novel longitudinal pile wire having a plurality of progressive weaving stages near their free ends.

Another object is to provide a method of weaving and a loom employing two weft carriers to simultaneously insert wefts above and below nonsheddable longitudinal gauges having a plurality of progressive weaving stages which are selectively presented to the weaving point to determine the height of pile loops being formed.

These and other objects of invention will be manifest from the following description of pre-

ferred embodiments illustrated in the drawing, wherein:

Figure I is a diagrammatic view of sufficient loom parts to illustrate my invention.

Figure II is a diagrammatic view illustrating a modification of my invention.

Figures III and IV are illustrations of novel longitudinal pile wires and their cross bars.

Figure V shows a novel sheddable gauge wire.

Figure VI is a diagrammatic showing of a portion of my novel fabric.

Referring to the drawing, in Figure I there is illustrated a portion of a loom having lay sword 10 carrying lay 11 and reed 12 and having heddles 13, 14, 15, 16, 17 and 18, the lay and heddles being driven and controlled by conventional means not shown.

Weft carrying shuttles 19 and 20 are shown in superposed position and may be picked simultaneously from the same side or from opposite sides of the loom to lay a weft 21 and a weft 22 simultaneously in the upper and lower sheds respectively. Ground warps 23 and 24, and 25 and 26 and the pile yarns form the sheds, as will be readily seen. Pile yarns 27 and 28 may be fed from a supply such as creels. Both the ground warps and pile yarns pass through the heddles and the reed dents in a known manner to form fabrics 1 and 2.

According to my improvements (Figure I), I provide in a loom of the general conventional type above indicated, sets of non-sheddable longitudinal incompressible pile gauges or wires 29 and 30 formed of flat strips sufficiently thin to pass through the reed dents. The forward or free ends of these wires engage the loop supporting wefts of the fabric being woven and may project variable distances into the fabric beyond the fell line or point of weaving.

The wires weftwise across the fabric may be of different shapes and the wires of each set may vary in height, length or design from each other and/or from the wires of the other sets. For the individual wires the weaving stages are higher than the width of the wires.

As will be seen from the different figures in the drawing, my novel wires have a longitudinal portion of weaving stages for supporting pile-supporting wefts and in the different wires this portion is characterized by being inclined or stepped regularly or irregularly or otherwise shaped to provide a plurality of heights progressively lesser toward the free end of the wire as used in weaving. I prefer that the extreme free end of the wires or gauges be substantially straight, as this facilitates the formation of the first few loops in the weaving process and tends to support the wires or gauges in an upright position, especially when the lowest loops are being formed in the inclined or stepped portions.

The rearward ends of my novel gauge wires (Figure I) are slotted to be looped about a cross bar traversing the loom. The end 31 of the cross bar is pivotally mounted in turnbuckles such as 32 and 33. Each cross bar has a turnbuckle on both sides of the loom which is pivotally connected to fulcrum levers such as 34 and 35. The levers 34 and 35 are fulcrumed as at 36 and have cam followers such as 37 and 38 in contact with the surface of cams 39 and 40 mounted on shaft 41, which may revolve once in a predetermined number of picks such as 14, 20 or 28. Springs 42 and 43, one end of each of which is fixed to a stationary part 44, keep the cam followers 37 and 38 in contact with the cam faces.

The pile wires 29 and 30 are slotted as at 45 so that any wire may be used in either set. The slot permits the cross bar of the other set to move within the outline of the wires. A second slot (as in Figure III) may provide a lost motion so that the wires of the set may be advanced by the cloth independently of the cams. The pattern cams retract the wires. If no lost motion is provided for, the cams (Figure I) will of course positively control the wire movement both forwardly and rearwardly as in Figure IV.

In structures similar to Figures I and II, I prefer that the portion of the fulcrum levers connected to the cross members be closer to the fulcrum than is the pattern follower. In this way a relatively large cam movement will produce a small change in the wire movement to effect greater control.

The two fabrics 1 and 2 are drawn to a side of the wires at the weaving point and the height of the loop is determined by the height of that portion of the gauge presented to the fell as the loops are formed.

Figure II illustrates single fabric double shuttle weaving in which a fabric 3 has adjacent loops over alternate loop supporting wefts. The spacing of the pile wires 50 and 51 of different sets may be varied so that wires such as 50 determine the height of the loops of two or more next adjacent pile threads. It is to be understood that as in Figure I the lay always beats up to the same position.

In Figure II the wire 50 has moved from its extreme forward position to its extreme rearward position and back, the forward motion being caused by the cloth and rearward motion by the spring 60 together with the pattern cams 52 one on each side of the loom. The wire 51 has had an opposite movement. The cams 52 are fixed to turn with shaft 53 for a pattern repeat. Fulcrum lever 54 is fulcrumed at 55 and carries transverse rods 56 and 57, to which a series of flexible wires 58 and 59 are connected. The flexible wires 58 and 59 are connected to the individual wires 50 and 51. A spring 60 fixed as at 61 to the lever 57 and fixed portion 62 keeps cam follower 63 on the cam face. The cam may provide slack in wires 58 or 59 as the wires connected thereto are advancing with the cloth if desired. The fabric comprises ground warps 63 and 64, pile warps 65 and 66 and ground wefts 67. Pile supporting wefts 68 may be removed.

Figure III illustrates two types of weaving stages in a pile wire 70. The inclined portion 71 and step 72 are near the straight end portion 73. A slot 74 permits movement of a bar connected to another set of wires and the slot 75 is for providing positive motion in both or one direction depending on the size of cross bar actuator used.

A flat cross bar 76 is shown within slot 74. Bar 76 has extension 77 for connection to a turnbuckle. The bar 76 supports other gauge wires (not shown) in a manner that cross bar 78 having extension 79 supports and manipulates gauge wire 70. The slot 74 in wire 70 is relatively long, as shown, and permits free movement therein of the cross bar 76 for its set of wires without producing a clash between the bar 76 and either end of the slot 74. It will also be noted that the cross bar 78 which withdraws a set of wires comprising wire 70 contacts the rearward end of slot 75 in doing so. In such cases as the fabric draws the wire 70 forwardly the cross bar 78 must of course permit such

movement without substantial interference. This is merely a matter of timing the movement of the actuator for the cross bar to position the cross bar **78** within the slot **75** so that forward movement of the wire by the fabric is permitted.

Figure IV is similar except as to the weaving stages. The wire **80** has step stages **81**, straight end portion **82**, and slots **84** and **85** similar to **74** and **75**. Flat cross bars **86** and **88** having extensions **87** and **89** respectively manipulate and support the sets of gauges similarly. The bar **88** completely fills the slot **85** so that the wire **80** is positively moved in both directions without any lost motion.

Figure V is a modified wire **90**, the rigid part **91** of which is short so that flexible portion **92** may be shedded for proper insertion of the shuttle.

In Figure VI there is shown a diagrammatic view of my novel fabric in which warps **100** and wefts **101** are interlaced to form a typical ground or base fabric, it being understood that the ground weave is merely illustrative. The pile loops **103** from a single pile warp **102** are progressively higher or lower and the loops of different pile warps form loops of graduated heights in a weftwise line. The loops are identified as L for low, M for medium and H for high. The height of the loops can be varied by control of my pile gauges which may be moved within or with the fabric to produce a great number of patterns. The ground warps and wefts are preferably cellulosic such as cotton, and the loops animal fibers or including animal fibers such as wool or mohair.

An adhesive may be applied to the backs of the fabrics of Figures I, II or VI. This will prevent the loops from pulling and in the case of Figure VI will secure the loops to the base fabric.

I prefer to use two pattern cams (Figure II), one on each side of the loom, and two fulcrum levers rather than a single cam and cam lever on one side and a lever joined by cross bars to the cam lever on the other side of the loom. It is further to be noted that the pattern cams can be conveniently driven continuously by a simple driving gear or change gear arrangement or intermittently. It is apparent that the rate at which the cams rotate and their design may be widely varied and that such variations together with my novel pile loop gauges can form a multitude of novel patterns. The ground weaves can be varied and the wires may be conveniently spaced as desired.

In Figure II, which is a view from the inside of the loom between the pattern cams, the wires such as **50** as hereinbefore stated support a portion of a loop supporting weft at the same level across a portion of the width of the fabric. In regard to Figure VI, it is of course to be understood that the spacing of the warps and wefts is greatly exaggerated.

Having described my invention in preferred embodiments, I claim:

1. In a loop pile fabric a warpwise row of pile loops of at least three different heights, said loops being formed from a single warpwise pile yarn, and a weftwise row of pile loops of different heights, one of said loops being common to the warpwise row and also to the weftwise row.

2. In a loop pile woven fabric having a base portion, a warpwise row of pile loops containing loops of at least three different heights, all of said loops in the warpwise row being formed from a single continuous pile yarn, a weftwise row of pile loops also containing loops of different heights and one loop being common to both the warpwise and the weftwise row.

3. In a loop pile woven fabric, a base portion, a warpwise row of pile loops containing loops of at least three different heights, all of said loops in the warpwise row being formed from a single continuous pile yarn, loops of different heights transversely of the fabric and one loop being common to both the said transverse loops and the warpwise row of loops.

4. In a single weft plane fabric, having a base portion, a warpwise row of pile loops containing loops of at least three different heights, all of said loops in the warpwise row being formed from a single continuous pile yarn, a weftwise row of pile loops also containing loops of different heights and one loop being common to both the warpwise and the weftwise row.

5. In a single weft plane, having a base portion, a warpwise row of pile loops containing loops of at least three different heights, all of said loops in the warpwise row being formed from a single continuous pile yarn, loops of different heights transversely of the fabric and one loop being common to both the said transverse loops and the warpwise row of loops.

WILLIAM ROLLIN KEEN.