Jan. 8, 1963

M. A. LAW

METHOD AND APPARATUS FOR WEAVING VARIANT-HEIGHT-LOOP TERRY FABRICS

3,072,153

Filed Feb. 6, 1959

6 Sheets-Sheet 1

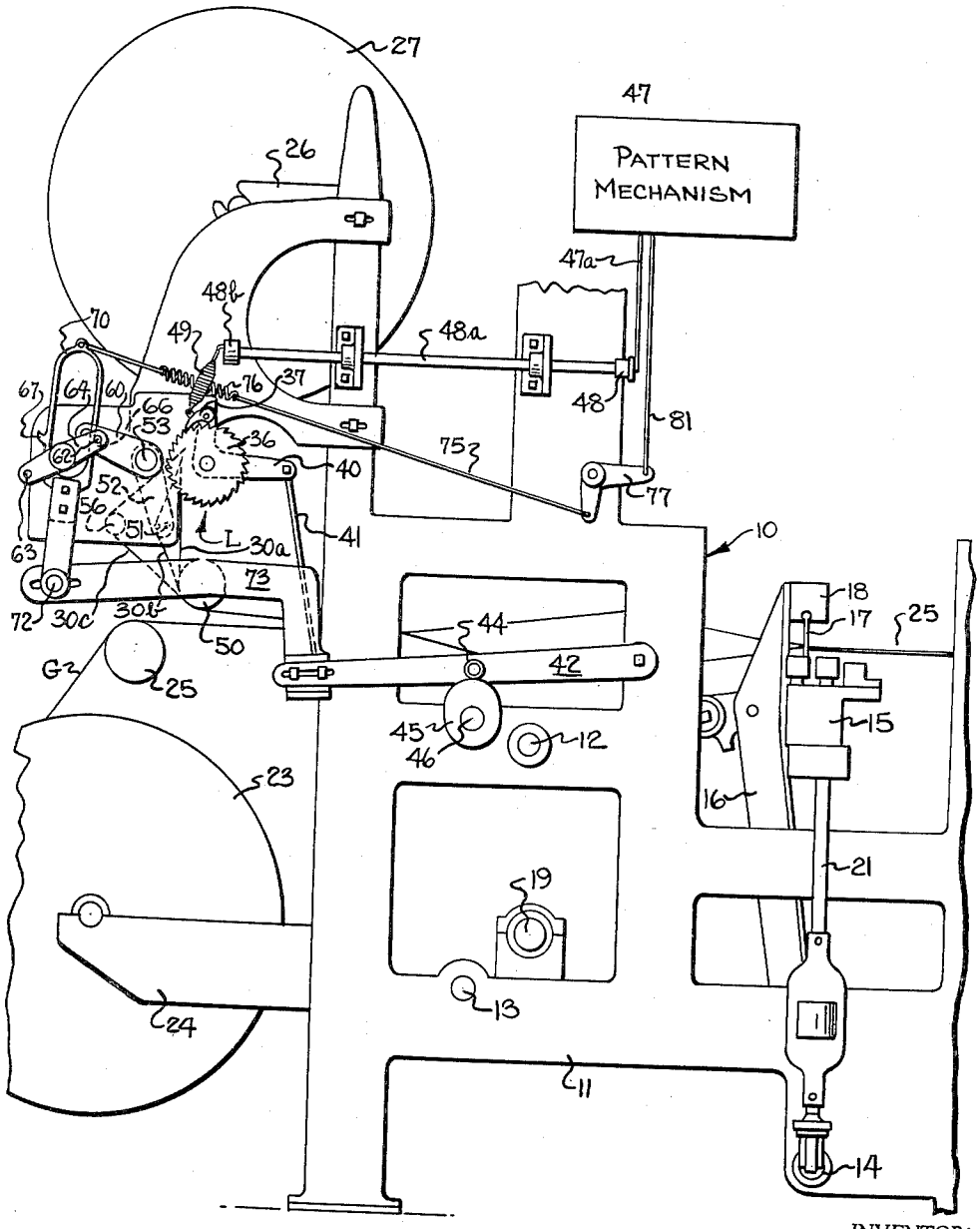


FIG-1

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6 Sheets-Sheet 2

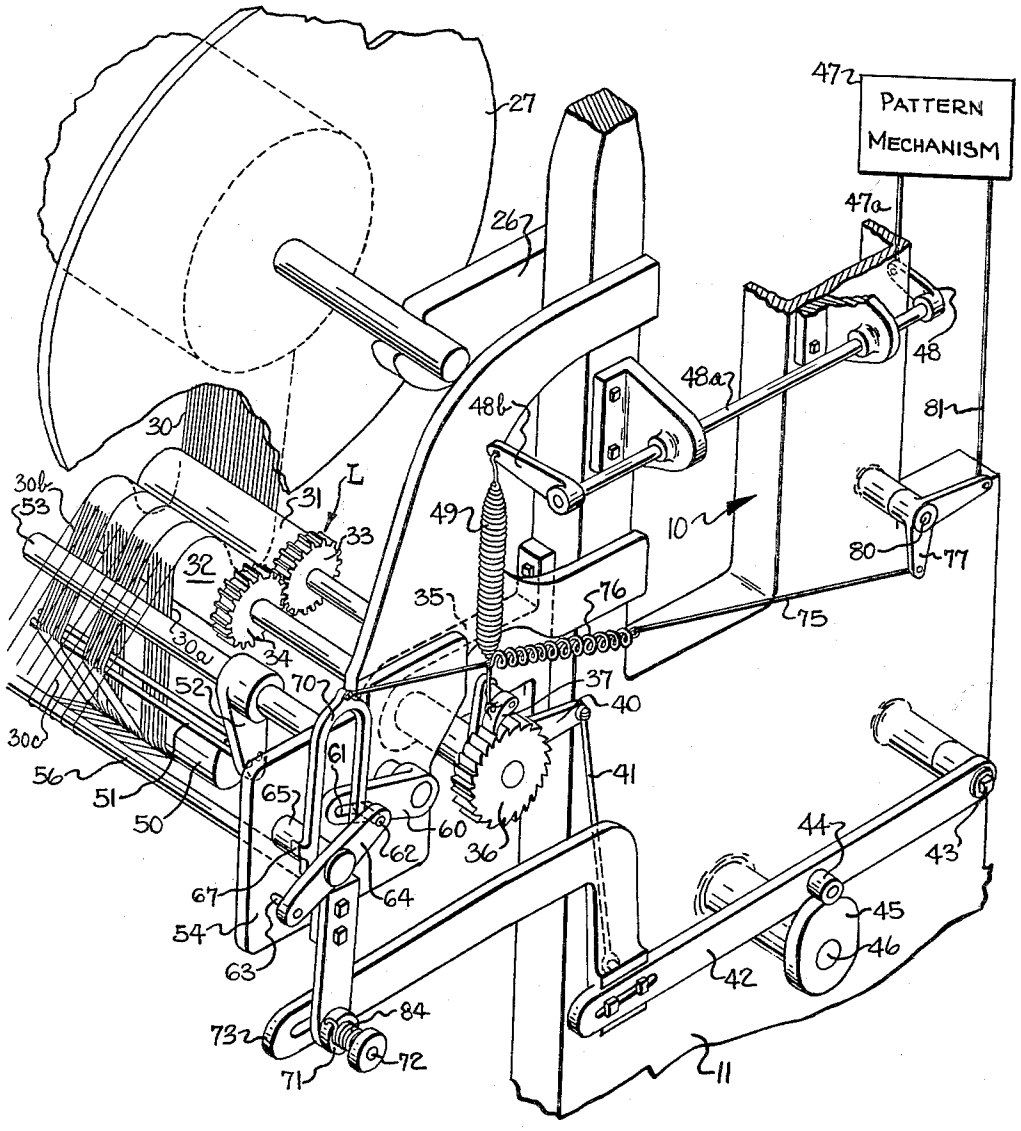


FIG-2

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Jan. 8, 1963

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6 Sheets-Sheet 3

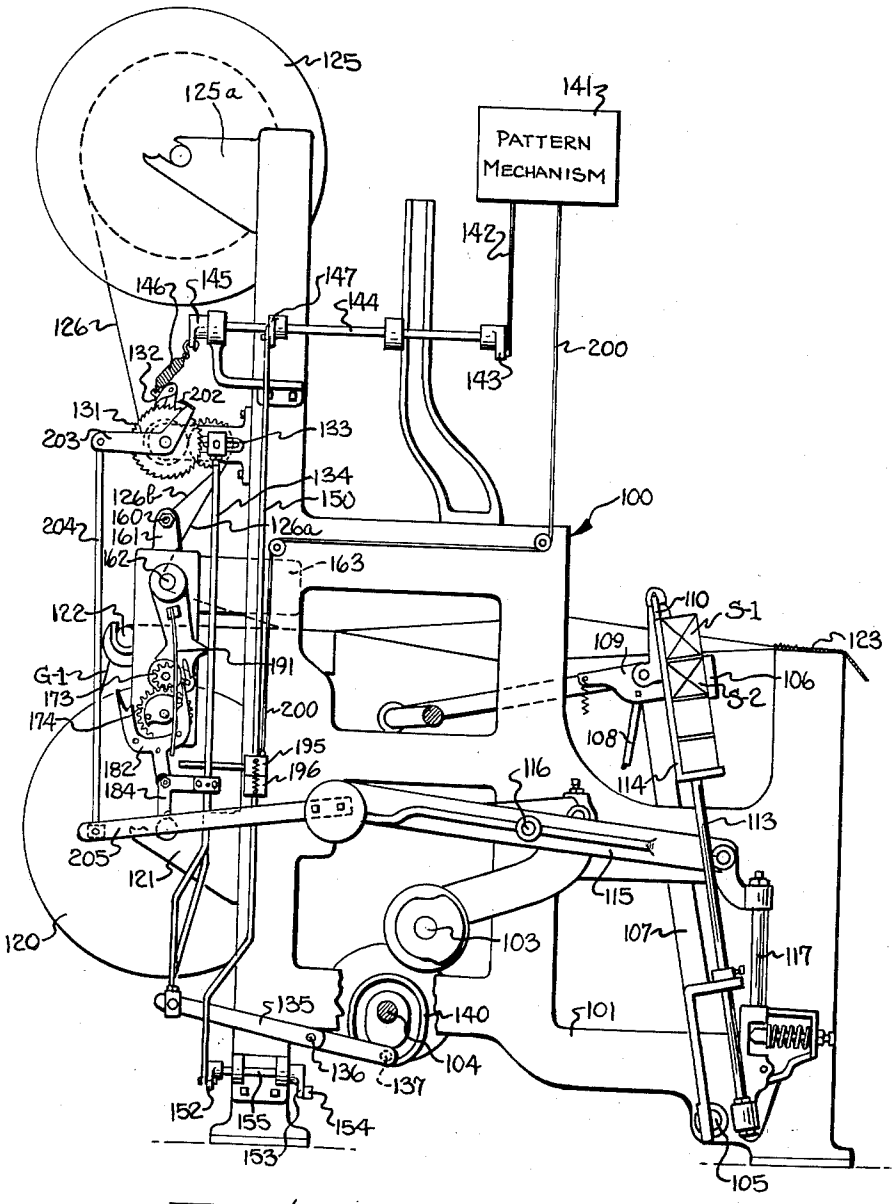


Fig-3

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METHOD AND APPARATUS FOR WEAVING VARIANT-HEIGHT-LOOP TERRY FABRICS

3,072,153

Filed Feb. 6, 1959

6 Sheets-Sheet 4

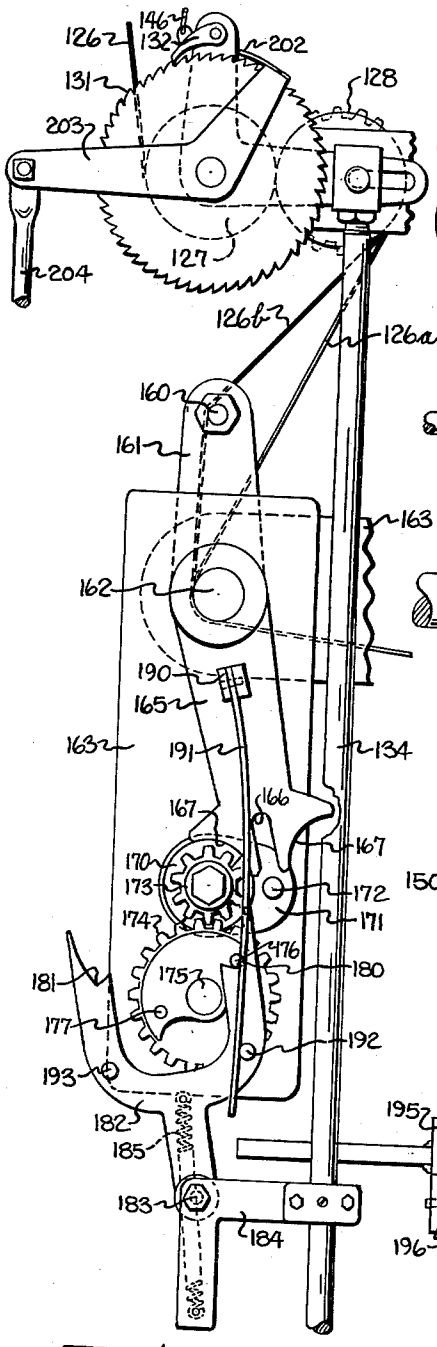
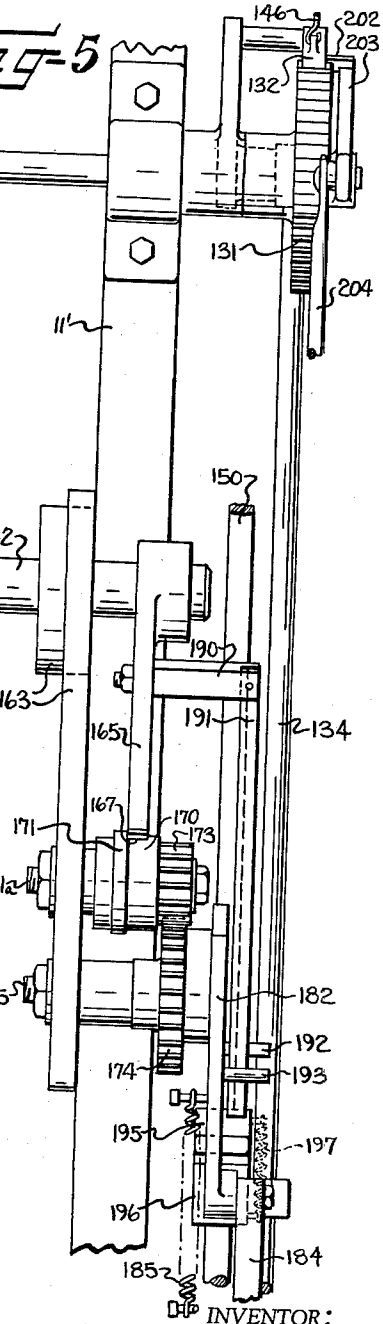


Fig-4

Fig-5



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3,072,153

Filed Feb. 6, 1959

6 Sheets-Sheet 5

Fig-6

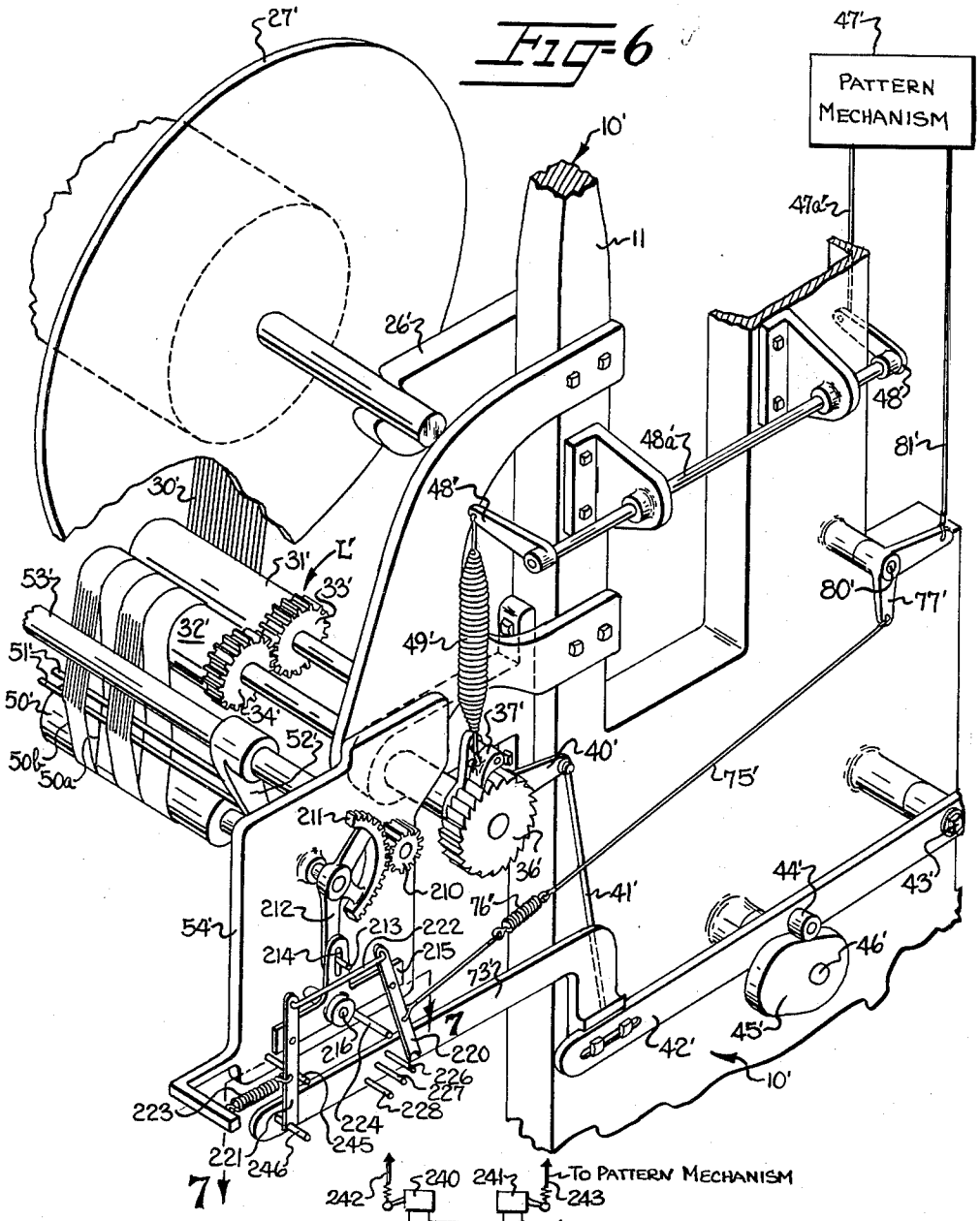
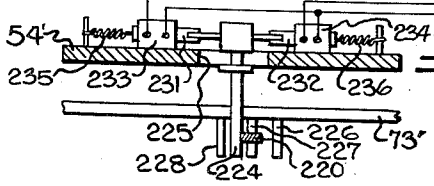


Fig-7



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6 Sheets-Sheet 6

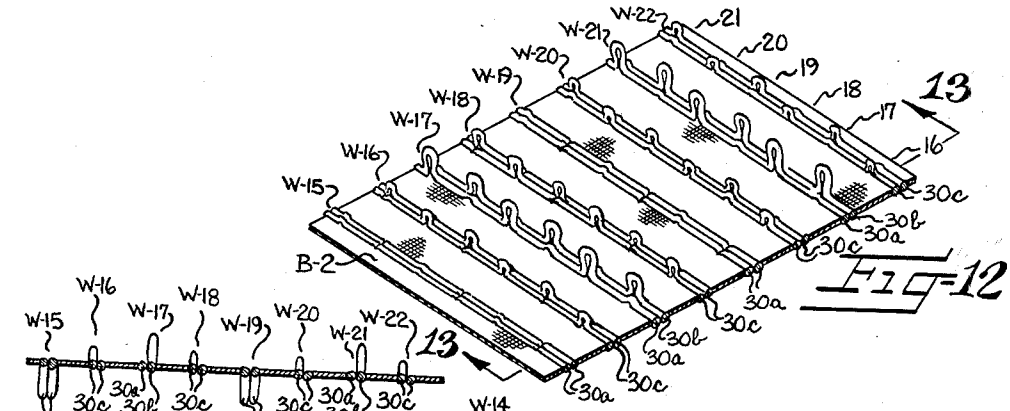


FIG-12

FIG-13

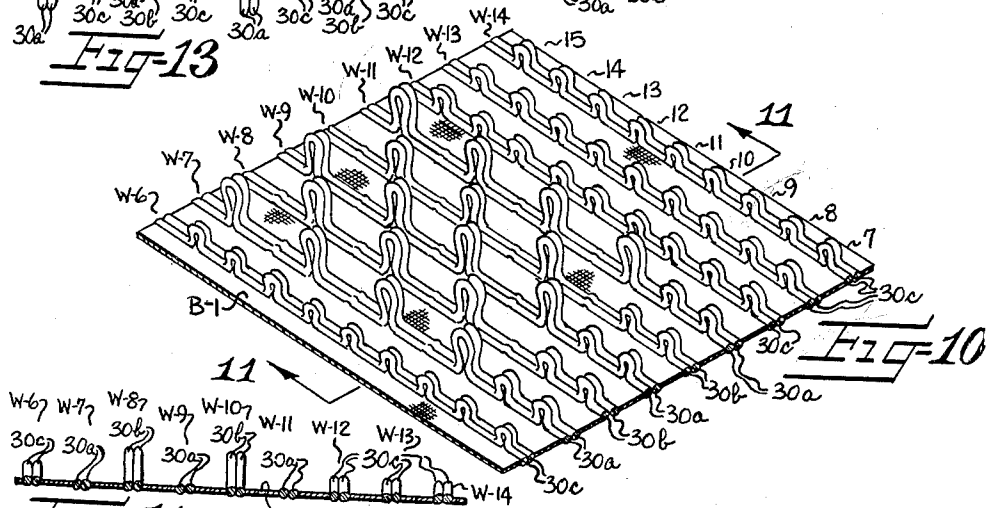


FIG-10

FIG-11

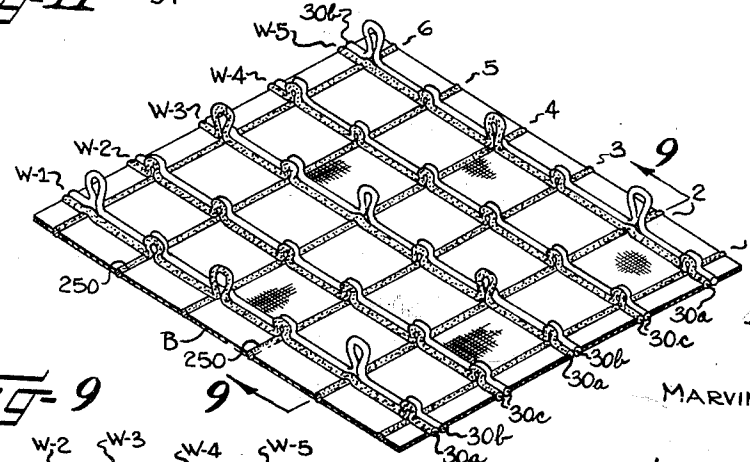
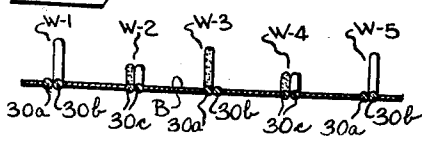


FIG-8

FIG-9



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United States Patent Office 3,072,153
Patented Jan. 8, 1963

3,072,153
METHOD AND APPARATUS FOR WEAVING VARIANT-HEIGHT-LOOP TERRY FABRICS

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Filed Feb. 6, 1959, Ser. No. 791,716
37 Claims. (Cl. 139—25)

This invention relates to improvements in terry pile fabric looms and, more especially, to a novel apparatus and method for weaving terry fabrics with terry loops and/or tufts of different heights.

Terry fabrics, such as towels, bedspreads, draperies and the like, are woven on a loom provided with a relatively tight ground warp and a loose terry warp together with a variable beat-up mechanism for the lay of the loom which is operable at certain intervals to advance the terry warp relative to the ground warp to form a row of loops wherever the terry warp appears throughout the width of the fabric. For many years, terry looms have been capable of forming piles of one height, or the terry warp was not overfed, and thereby slackened, at certain intervals so it was merely woven into the base fabric. More recently, various attachments have been constructed for varying the height of successful weftwise rows of terry piles in which all the loops or piles in each weftwise row were of the same height. The latter type of fabric has been produced by letting off or overfeeding the terry warp varying amounts between successive fast picks. A typical apparatus for weaving this type of fabric is disclosed in U.S. Patent No. 1,739,192 granted to W. H. Wakefield on December 10, 1929. Another type of fabric made on looms equipped with apparatus, such as is disclosed in U.S. Patent No. 1,665,274, granted to C. E. Neisler, Jr. on April 10, 1928, includes weftwise and warpwise rows of loops which form alternating blocks of loops or tufts, all of which are of the same height. However, intervening areas have the pile or terry warp woven into the base fabric, and are devoid of loops. The latter type of fabric is woven by splitting the terry warp and alternately overfeeding a first group of terry warp ends while maintaining taut the other group, and then overfeeding the other group of terry warp ends while maintaining taut the first group.

It is an object of this invention to provide an improved method of and apparatus for weaving terry fabrics provided with terry loops which not only vary in height in certain selected longitudinal or warpwise rows, but which also vary in height in certain selected weftwise rows intersecting said warpwise rows.

In accordance with the present invention, terry warp ends are split into at least two groups or sheets, and apparatus, operating in conjunction with the terry warp let-off or feeding means, functions to increase the amount of slack effected in one group of terry warp ends and to decrease the amount of slack effected in the other group of terry warp ends and to reverse this procedure at predetermined intervals according to a desired pattern. At still other intervals, the apparatus is rendered inoperative so the amount of slack in both groups of terry warp ends, as effected by said feeding means, is the same. Thus, the two groups of terry warp ends alternate, at times, in forming high and low loops relative to each other and both groups are, at other times, simultaneously formed into loops of an intermediate height.

By splitting the terry warp into three or more sheets or groups of terry warp ends, two of the groups may be intermittently rendered slack and partially or entirely taken up in alternation, and an additional group of terry warp ends may remain independent of the slacking means so that it is slackened only by the feed from the terry warp beam to form certain warpwise rows of terry loops all of

a uniform height, but which are of intermediate height with respect to the high and low loops alternately formed by the other two groups of terry warp ends. Further aesthetic effects are produced by varying the extent at which the terry warp is let off or fed in conjunction with the mechanism for producing increased slack in one group of warp ends and decreasing the slack in the other of the groups of warp ends in alternation and vice versa.

The term "Terry Fabric" is used herein to define any type of pile fabric originally woven by periodically forming loose picks, then slackening pile yarns relative to ground yarns and drawing the slack out of the pile yarns with a fast pick to pile up the pile yarns in the form of loops between adjacent weft yarns. Such fabric may include toweling, bedspreads, draperies, rugs, carpets and the like. Certain types of apparel may also be made from fabric woven according to the present method.

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 side elevation of a loom with parts broken away and other parts omitted, showing one form of a preferred apparatus for weaving terry fabrics according to the present invention;

FIGURE 2 is an enlarged isometric view of the apparatus shown in the upper portion of FIGURE 1;

FIGURE 3 is a view similar to FIGURE 1 illustrating a second embodiment of apparatus for weaving terry fabrics according to this invention;

FIGURE 4 is an enlarged view of the apparatus shown in the left-hand central portion of FIGURE 3;

FIGURE 5 is a fragmentary elevation looking at the left-hand side or rear of the structure shown in FIGURE 4;

FIGURE 6 is a fragmentary isometric view similar to FIGURE 2, showing still another form of apparatus for letting off sheets of terry warp in accordance with the present invention;

FIGURE 7 is a fragmentary, partially schematic, sectional plan view showing means for shifting control pin 224 in FIGURE 6;

FIGURE 8 is a somewhat diagrammatic isometric view of one type of fabric made according to the present method and showing how the variant-height-loop construction may be employed with terry warps of different colors or textures;

FIGURE 9 is a fragmentary weftwise sectional view taken substantially along line 9—9 in FIGURE 8;

FIGURE 10 is a diagrammatic isometric view of another type of fabric formed by successively slacking pairs or groups of contiguous terry warp yarns varying amounts with respect to adjacent pairs or groups of contiguous terry warp yarns;

FIGURE 11 is a sectional view taken along line 11—11 in FIGURE 10;

FIGURE 12 is a diagrammatic isometric view of still another type of fabric in which loops of varying height appear on both sides of the base fabric;

FIGURE 13 is a sectional view taken substantially along line 13—13 in FIGURE 12.

Generally, the present method includes weaving a base or ground fabric and forming terry loops of different heights throughout the width of the fabric or in selected weftwise spaced portions of the fabric, and successively varying the height of loops formed from certain adjacent terry warp yarns. Various embodiments of apparatus for carrying out the present method are illustrated in the annexed drawings. In each embodiment, the terry warp is split to form two or more sheets of terry warp ends, one of which extends on one side and the other of which extends on the opposite side of a slacking de-

vice in the form of a bar which oscillates backward and forward in timed relation to the terry warp let-off or feed mechanism to, at times, increase the tension in one sheet of terry warp ends while increasing the slack in the other sheet of terry warp ends. At other times, the slacking bar increases the slack in the first sheet while increasing the tension in the other sheet. At still other times, the slacking bar remains inactive so that the amount that the two sheets of terry warp are fed, and thereby let off, remains uniform.

In weaving terry towels or certain types of bed-spread fabrics, such as that shown in FIGURE 8, individual terry yarns may be arranged on opposite sides of the slacking bar in alternation; that is, alternate yarns appear on one side of the slacking bar and intervening yarns appear on the other side of the slacking bar. In weaving another type of bedspread fabric, such as that shown in FIGURE 9, each sheet of terry warp may be divided into groups of two or more yarns in which alternate groups appear on one side of the slacking bar and intervening groups appear on the other side of the slacking bar.

Further, an additional sheet of warp may be drawn from a source independent of the beam from which the split warp is drawn, or may be another split formed in the same warp of which the first two sheets of warp ends are formed. This additional sheet may be fed simultaneously with the first two sheets, but may be independent of the slacking bar, so that terry loops formed from the yarn in third sheet will always appear of the same height throughout the length of the fabric, except for any variations made in the actual feed mechanism.

Means are also provided to vary the amount of yarn which is delivered to the slacking mechanism to cause further variations in the height of the terry loops as the fabric is woven.

The first embodiment of the improved apparatus is shown in FIGURES 1 and 2 in association with a terry loom capable of weaving towel and bedspread fabrics or similar fabrics. Since looms for weaving terry fabrics are generally well known in the art, only a general description will be given of the conventional parts of the loom shown in FIGURES 1 and 2, wherein the frame of the loom is broadly designated at 10 and includes opposed side frame members 11 in which opposite ends of a crank shaft 12, a reed motion shaft 13 and a rock shaft 14 are journaled. Crank shaft 12 drives a lay 15 carried by swords 16 fixed on rock shaft 14. A reed 17, carried by a reed cap 18, is shifted forwardly and rearwardly at predetermined intervals relative to the lay 15, thus varying the relative positions of the beat-up point of the reed and the fell of the cloth, to form so-called fast and loose picks. The means for oscillating reed 17 relative to lay 15 is commonly known as a variable beat-up mechanism and may be of a type such as is disclosed in said Wakefield Patent No. 1,739,192. Such reed oscillating means usually includes a control rod having suitable connections, not shown, with reed motion shaft 13.

Reference is made to FIGURE 3 wherein there will be observed a control rod 108 connected by linkage 109 to a corresponding reed 110, which is of the same type as reed 17. It is apparent that lowering and raising rod 108 swings reed 110 backward and forward relative to lay 106. Since there are many well-known types of pattern controlled variable beat-up mechanisms, a further illustration and description thereof is deemed unnecessary.

Reed motion shaft 13 is usually driven, by a main drive or pick shaft 19 (FIGURE 1), to rotate one revolution with every three revolutions of crank shaft 12 and, through suitable connections, not shown, shaft 19 imparts active strokes to a picker stick 21 for throwing a shuttle, not shown, across lay 15 to form a pick. A ground warp generally designated at G is drawn under tension from a warp beam 23 carried by brackets 24 extending rearwardly from side frame members 11. Ground warp G passes upwardly over a roll 25 and then

passes forwardly through reed 17 where it is formed into a base fabric 25.

Brackets 26 extend rearwardly from upper portions of side frame members 11 and support a terry or pile warp beam 27 from which terry warp ends or yarns 30 are drawn.

Terry warp yarns 30 are drawn from the terry warp beam 27, under tension, by a let-off or terry overfeed mechanism L including a pair of feed rolls 31, 32 having intermeshing gears 33, 34 on corresponding ends thereof. Rolls 31, 32 are suitably journaled in bearings 35 projecting rearwardly from upper portions of side frame members 11. It will be noted that terry warp 30 passes downwardly from beam 27, beneath roll 31, then upwardly between rolls 31, 32 and then over and downwardly from roll 32.

Roll 32 is usually driven to rotate at intervals of, say, every third pick in weaving towel fabrics. Such intervals may vary, as is well known. In this instance, the reduced end of roll 32 has a ratchet wheel 36 fixed thereon which is engaged by a pawl 37 pivotally mounted on one arm of a bell crank 40 journaled upon the corresponding reduced portion of roll 32. The other arm of bell crank 40 has the upper end of a link 41 pivotally connected thereto, whose lower end is pivotally connected to a rear portion of a lever 42 journaled, as at 43, on the corresponding loom side frame member 11.

Follower arm 42 has a follower 44 thereon which engages a cam 45 fixed on a shaft 46. Cam 45 may be of any desired shape and may be varied in accordance with the speed of shaft 46 relative to crank shaft 12. It may be assumed that shaft 46 is driven to rotate one revolution with every beat-up stroke of lay 15. This being the case, pawl 37 is controlled by a dobby head, jacquard or other pattern mechanism 47, which permits pawl 37 to engage ratchet wheel 36 only at intervals in which loops are to be formed. To this end pattern mechanism 47 has a link of cable 47*a* connected to a crank 48 fixed on a shaft 48*a* journaled on frame 10. A crank 48*b*, fixed on shaft 48*a*, is connected to pawl 37 by means of a tension spring 49. Spring 49 is relaxed while pawl 37 is in lowered or operative position.

It is apparent that reed 17 is shifted rearwardly a few picks in advance of each active stroke of pawl 37 (with pawl 37 in lowered position), and reed 17 is shifted forwardly substantially simultaneously with each active stroke of pawl 37. In weaving bedspread fabrics, for example, it may be desirable to lower pawl 37 into action every tenth pick, and it may be desirable to lower pawl 37 into action every third or fourth pick in the weaving of terry toweling and the like.

It is apparent that each time follower 44 is engaged by the high point of cam 45, an active stroke is imparted to pawl 37. If pawl 37 is in lowered position, it then imparts a partial revolution to feed rolls 31, 32 for drawing off from beam 27 a predetermined amount of terry warp 30 to produce a corresponding amount of slack in the terry warp between said rolls 31, 32 and lay 15.

The parts heretofore described are conventional and it is with such or similar parts that the present apparatus is adapted to be associated. In the first form of apparatus shown in FIGURES 1 and 2, as terry warp 30 leaves feed roll 32, it is split into a plurality of sheets; i.e., three in this instance, indicated at 30*a*, 30*b* and 30*c* (FIGURE 1). Each sheet of terry warp may include individually spaced yarns or groups of yarns alternating with individual yarns or groups in the other sheets. The two sheets 30*a*, 30*b* are maintained separate between feed roll 32 and a lateral guide or idler roll 50 by a laterally extending slacking bar 51 shown in the form of a pair of relatively small parallel rods in this instance, but which may be in the form of a single rod or bar if desired.

Slacking bar 51 is supported in eccentric relation to a rock shaft 53 by means of a pair of rocker arms 52, only one of which is shown. Rocker arms 52 are fixed on

rock shaft 53. Shaft 53 is journaled in brackets 54 carried by the respective side frame members 11. Slacking bar 51 is oscillated backward and forward in timed relation to operation of the let-off or feed mechanism, including rolls 31, 32, by means to be later described. In order to maintain the third sheet of terry warp ends 30c out of engagement with the first and second sheets 30a, 30b, and to permit the same to be slackened or fed with the sheets 30a, 30b, an additional lateral guide or idler roll 56 may be journaled in brackets 54 rearwardly of slacking bar 51, and the sheet of terry warp yarn 30c passes downwardly and rearwardly, at an angle, from roll 32, partially around roll 56 and then forwardly beneath idler roll 50. The three sheets 30a, 30b, 30c are thus gathered into a single sheet at idler roll 50, where they advance to reed 17.

From the foregoing, it is apparent that feed roll 32 draws a given length of terry warp from beam 27 with each active stroke of pawl 37 and, if slacking bar 51 remains stationary between the time that feed rolls 31, 32 are operated and the next succeeding beat-up stroke of lay 15 in the forming of a fast pick, all three sheets of terry warp 30a, 30b, 30c will have been slackened equal amounts and all terry loops formed therefrom with the next fast pick will be of the same height throughout the width of fabric 25.

However, depending upon the length of stroke imparted to slacking bar 51, as slacking bar 51 moves away from either sheet 30a, 30b, the amount of slack in this sheet is increased. Also, with movement of slacking bar 51 away from the latter sheet and into engagement with the other sheet, some or all of the slack in the other sheet may be removed. It follows, therefore, that the immediately succeeding active or beat-up stroke of lay 17 will form loops of intermediate height from those yarns in the sheet 30c while relatively long loops will be formed from those yarns in the sheet which was additionally slackened by movement of the slacking bar 51 away from the same, while relatively short loops or no loops at all (ground-engaging loops) will be formed from the yarns in the sheet which was tightened by slacking bar 51 subsequent to being let off by feed rools 31, 32.

In order to control and impart movement to slacking bar 51, the first form of apparatus shown in FIGURES 1 and 2 comprises a crank 60 fixed on one end of rock shaft 53 and provided with a radial or longitudinally extending slot 61 therein. Slot 61 is loosely penetrated by a pin 62. Pin 62 also serves as as abutment, along with a pin 63, which pins 62, 63 are fixed in opposite ends of a rocker element 64 journaled on a stub shaft 65 carried by the corresponding bracket 54.

Rocker element 64 may be in the form of a wheel in which pins 62, 63 are positioned in substantially diametrically opposed relationship, or it may be in the form of a lever as shown in FIGURES 1 and 2. Pins or abutments 62, 63 are adapted to be alternately engaged by respective abutments or teeth 66, 67 provided on opposite sides of a vertically reciprocating actuator 70 in the form of a yoke in FIGURES 1 and 2. A hub 71 on the lower end of yoke 70 is pivotally mounted on a stub shaft 72 adjustably secured to the rear portion of a follower arm extension 73. Follower arm extension 73 is suitably adjustably secured to the rear portion of follower arm 42.

It is thus seen that, each time follower 44 is engaged by the high point of cam 45, an active stroke is imparted to both the pawl 37 and yoke 70. Pins 62, 63 are spaced a substantially greater distance apart than are abutments 66, 67 on yoke 70 so that yoke 70, under control of suitable pattern means, may be rocked back and forth. Accordingly, tooth 66 engages pin 62 with certain upward or active strokes of yoke 70 and tooth 65 engages pin 63 with certain other active or upward strokes of yoke 70.

In order to mave slacking bar 51 in the desired direction at selected intervals, the upper end of yoke 70 has one end of a link 75 connected thereto in which a tension spring 76 is preferably interposed. Link 75 extends forwardly and is connected to one arm of a bell crank 77 oscillatably mounted, as at 80, on the corresponding side frame member 11. The other arm of bell crank 77 has one end of a link or cable 81 connected thereto whose other end is connected to a suitable pattern mechanism such as 47. Pattern mechanism 47 may be of any desired or conventional construction, such as a dobby, a jacquard mechanism, a driven cam or other suitable pattern mechanism, and, therefore, a detailed description thereof is deemed unnecessary.

Upon actuation of link 81 by pattern mechanism 47, link 81 imparts counterclockwise movement to bell crank 77 to impart forward movement to yoke 70, which position it occuplies until link 81 is released by pattern mechanism 47. In order to then move yoke 77 in a rearward direction, a suitable spring means may be provided, which is shown in the form of a torsion spring 84 surrounding shaft 72 and having one of its ends connected to shaft 72 and its other end connected to hub 71 of yoke 70.

In operation, assuming that the various parts of the first form of the present apparatus occupy the positions shown in FIGURES 1 and 2, rotation of cam 45 moves the high point thereof out of engagement with follower 44 so that follower lever 42 moves downwardly. In so doing, an inactive stroke is imparted to ratchet pawl 37 and yoke 70. Although tooth 66 moves out of engagement with pin 62, the tension in the sheet 30a of terry warp ends is insufficient to overcome the friction in the various elements connected to rock shaft 53 so that slacking bar 51 remains stationary.

Assuming that pattern mechanism 47 causes yoke 70 to remain in forward position and permits pawl 37 to remain in lowered position, as the high point of cam 45 again engages follower 44 and raises follower lever 42 and extension 73, an active stroke is imparted to pawl 37, but slacking bar 51 remains in its previous position, because pin 62 will merely be contacted by tooth 66 when the same reaches the limit of its upward movement. Thus, this active stroke of pawl 37 causes equal amounts of yarn to be let off in all three of the sheets of terry warp ends 30a, 30b, 30c between feed roll 32 and lay 15.

This condition is maintained until such time as pattern mechanism 47 releases cable 81 or permits the same to move downwardly in FIGURE 1. In this event, spring 84 (FIGURE 2) causes yoke 70 to move rearwardly or to the left in FIGURES 1 and 2 so that, with the next succeeding active stroke of follower lever 42 and extension 73, tooth 67 engages pin 63 at substantially the same time as or immediately after a step in rotation is imparted to ratchet wheel 36 by pawl 37. In so doing, feed rolls 31, 32 let off a predetermined length of terry warp 30 and, at substantially the same time, upward movement of tooth 67 against pin 63 imparts a clockwise movement to lever 64 and a counterclockwise movement to crank 60, rock shaft 53 and slacking bar 51.

As slacking bar 51 moves away from sheet 30b, this produces additional slack in sheet 30b. With further movement of slacking bar 51 away from sheet 30b, it engages sheet 30a to increase the tension therein; i.e., to remove a substantial portion of or all of the slack originally effected in sheet 30a by feed rolls 31, 32. Of course, if the third sheet 30c is utilized as shown in FIGURE 1, this sheet is not affected by slacking bar 51.

Thus, with the corresponding fast pick beat-up stroke of lay 15 and reed 17, relatively short or ground-engaging loops are formed in the yarns in sheet 30a; relatively long loops are formed from the yarns in sheet 30b, and loops of intermediate length are formed from the yarns in sheet 30c. It is apparent that, if yoke 70 remains in rearward position during any subsequent active strokes of pawl 37 and during the forming of any immediately subsequent fast picks, terry loops formed from all three sheets 30a, 30b, 30c will be of length or height substantially equal to said intermediate length.

Now, the next time that pattern mechanism 47 causes yoke 70 to move forwardly, immediately subsequent active strokes of pawl 37 and yoke 70 will cause feed rolls 31, 32 to feed a given amount of terry warp yarn and slacking bar 51 will swing rearwardly to substantially the position shown in FIGURE 2, thus producing increased slack in sheet 30*a* and substantially removing the slack in sheet 30*b*. Thus, with the next fast pick beat-up stroke of lay 15 and reed 17, relatively long or high loops will be formed of the yarns in sheet 30*a*, relatively short or ground-engaging loops will be formed of the terry warp yarns in sheet 30*b*, and loops of intermediate height or length will be formed of the yarns in sheet 30*c*. Anytime that pattern mechanism 47 raises pawl 37 to inoperative level above ratchet wheel 36, yoke 70 remains in either forward or rearward position, as the case may be, and reed 17 remains forward relative to lay 15 for weaving a plain heading, for example.

It is thus seen that medium height loops are formed from terry warp yarns 30*c* and long and short or ground-engaging loops are formed, in alternation, from yarns 30*a*, 30*b*. Also, loops of intermediate height may be formed from yarns 30*a*, 30*b* at predetermined intervals. Where the sheets of terry yarn differ from each other or the yarns in any given group or sheet differ from each other with respect to the type of pile yarn, the height of the loops formed with each pick may also vary. The alternate formation of high and low loops from yarns 30*a*, 30*b* combined with loops formed from the third sheet 30*c*, results in loops of two or more different heights or lengths in certain selected weftwise rows of terry loops and also results in loops of two or more different heights being formed in succession so that warpwise rows of loops intersecting said weftwise rows of loops also include loops of two or more different heights or lengths.

Second Form of the Invention

The second form of the invention shown in FIGURES 3, 4 and 5 embodies a different construction and arrangement of elements than the first form of the invention shown in FIGURES 1 and 2, but generally produces the same end result as the structure of the first form of the invention. However, the first form of the invention is particularly adapted for use in association with relatively broad bedspread-weaving terry looms while the second form of the invention is particularly for use on relatively narrow ware terry looms of the type for weaving towels and the like. The second form of the invention includes means for varying the extent to which the terry feed rolls are racked to effect further relative variation in loop lengths.

The loom shown in FIGURE 3, broadly designated as 100, comprises opposed side frame members 101 in which opposite ends of a crank shaft 102, a cam shaft 103, a reed motion shaft 104 and a rocker shaft 105 are journaled. Crank shaft 102 drives a lay 106 carried by swords 107 fixed on rock shaft 105. Lay 106 also supports the oscillatable reed 110 which is shifted forwardly and rearwardly at predetermined intervals by rod 108 and linkage 109, as heretofore described, to vary the relative positions of the beat-up point of reed 110 and the fell of the cloth.

The particular loom illustrated also has vertically reciprocating shuttle boxes, only two of which are normally used in the weaving of terry fabrics. These two shuttle boxes are indicated at S–1 and S–2 in FIGURE 3. Multiple shuttle boxes are mounted upon a vertically movable shaft 113 guided in a frame 114 carried by lay 106. Shaft 113 has a conventional shuttle box operating mechanism connected thereto which is operated under control of a pattern mechanism in a manner well known in the art. Accordingly, a detailed description thereof is deemed unnecessary. It might be stated, however, that the operating mechanism for the shuttle boxes S–1, S–2 includes a lever 115 oscillatably mounted on frame member 101 as at 116, and whose forward end is connected by conventional linkage 117 to the lower end of shaft 113, upon which said shuttle boxes are mounted.

Ground warp G–1 is drawn under tension from a warp beam 120 carried by brackets 121 extending rearwardly from side frame members 101. Ground warp G–1 passes upwardly over a roll 122 and then passes forwardly through reed 110 where it is formed into a base fabric 123.

As in the first form of the invention, a terry or pile warp beam 125 is supported by brackets 125*a* extending rearwardly from side frame members 101. Pile or terry warp ends or yarns 126 are drawn from beam 125, under tension, by a let-off or terry feed mechanism comprising feed rolls 127, 128 which may be mounted in the same manner as feed rolls 31, 32. Roll 127 has a ratchet wheel 131 fixed thereon which is engaged, at times, by a pawl 132 pivotally mounted on one arm of a pawl carrier or bell crank 133. Bell crank 133 has the upper end of a link or connecting rod 134 pivotally connected thereto whose lower end is connected to a lever 135 oscillatably mounted, as at 136, upon the respective side frame member 101. The forward end of lever 135 has a follower 137 thereon which engages a cam 140 fixed on shaft 104. Shaft 104 and cam 140 generally rotate one revolution to three revolutions of crank shaft 102.

Pawl 132 is also controlled by a pattern mechanism 141 which permits pawl 132 to engage ratchet wheel 131 only at intervals in which loops are to be formed. As is the case in the first form of the invention, pattern mechanism 141 has a link or cable 142 extending downwardly therefrom which is connected to a crank 143 fixed on a shaft 144 suitably journaled on the respective side frame member 101. Shaft 144 also has a crank 145 fixed thereon which is connected to pawl 132 by means of a tension spring 146.

Shaft 144 also has another crank 147 fixed thereon which is connected, by a link 150, to a crank 152 fixed on a shaft 155 adjacent the lower portion of FIGURE 3. Shaft 155 is suitably journaled on the respective side frame member 101 and has a crank 153 on the other end thereof to which one end of a link 154 is connected, this link operating in a well-known manner to control the operation of reed 110 relative to the lay 106. It is thus seen, that whenever pawl 132 is raised out of action with respect to ratchet wheel 131, link 150 also moves upwardly to cause reed 110 to remain in forward position relative to lay 106, as is conventional. The parts heretofore described are usual parts of a terry loom and it is with such or similar parts that the second form of the present invention is particularly adapted to be associated.

In the second form of the invention shown in FIGURES 3, 4 and 5, as the terry warp 126 leaves feed roll 128, it is split into a plurality of sheets; there being two such sheets 126*a*, 126*b* shown in this instance, although it is apparent that an additional sheet may be formed as is the case in the first form of the invention.

As best shown in FIGURE 4, sheets 126*a*, 126*b* extend downwardly astraddle a slacking bar 160 shown in the form of a shaft fixed in a pair of rocker arms 161, only one of which is shown. Rocker arms 161 are fixed on a rock shaft 162 journaled in brackets 163 carried by respective side frame members 101.

Slacking bar 160 is operating backward and forward in time relation to operation of the feed mechanism including rolls 127, 128. In this instance, rock shaft 162 also serves as a guide roll or shaft for the two sheets of terry warp 126*a*, 126*b*, since they are gathered together at rock shaft 162 and then extend downwardly and forwardly, at an angle, to and through reed 110.

Bracket 163 shown in FIGURES 3, 4 and 5 is of inverted L-shaped built-up construction. The upper end of an arm 165 is fixed on the corresponding outer end of shaft 162. Arm 165 is a part of a Geneva motion to the extent that it is provided with a radially extending

slot 166 in its free end which is disposed between a pair of arcuate concave surfaces 167 which alternately engage a segmental block 170 journaled on a stub shaft 171a carried by bracket 163. Segmental block 170 has a Geneva arm 171 integral therewith or suitably secured thereto which has an abutment or pin 172 projecting outwardly therefrom adapted to engage radial slot 166 in lever 165, as will be later described. Also integral with block 170 is a pinion or gear 173 which is engaged by a pinion or gear 174 journaled on a stub shaft 175 also carried by bracket 163.

The hub of gear 174 has a pair of circularly spaced abutments or pins 176, 177 projecting outwardly therefrom which are adapted to be alternately engaged by shallow teeth 180, 181 on a substantially Y-shaped rocker element or yoke 182. Yoke 182 is pivotally mounted, as at 183, on a bracket 184 fixed on a medial portion of rod or link 134. Bracket 184 is preferably of the configuration shown in FIGURE 4 wherein it will be observed that its lower portion has the lower end of a tension spring 185 connected thereto, whose upper end is connected to a medial portion of yoke 182. Thus, spring 185 tends to move yoke 182 to either side of dead center, as will be later described.

A medial portion of lever 165 has a spring anchor bracket 190 projecting outwardly therefrom to which the upper end of a leaf or torsion spring 191 is suitably secured. It will be noted that leaf spring 191 extends downwardly between a pair of laterally spaced abutments or pins 192, 193 projecting outwardly from yoke 182. Thus, whenever yoke 182 moves upwardly in an active stroke, during which an active stroke is imparted to pawl carrier 133, that tooth 180 or 181 which happens to be in alinement with the respective pin 176 or 177 engages said respective pin and imparts a partial revolution to gear 174. In so doing, a half revolution is imparted to gear 173, arm 171 and pin 172. Referring to FIGURE 4, it is apparent that counterclockwise movement of pin 172, with arm 171 and gear 173, causes pin 172 to engage slot 166 and move lever 165 in a clockwise direction, the segmental block 170 being of such dimensions as to permit lever 165 to move upon pin 172 engaging slot 166. As lever 165 moves in a clockwise direction in FIGURE 4, this also moves torsion spring 191 therewith. Since clockwise movement of lever 165 is effected by engagement of tooth 181 with pin 177, it follows that movement of leaf spring 191 from right to left in FIGURE 4 causes the same to engage pin 193 to subsequently swing the yoke 182 in a counterclockwise direction with the succeeding downward movement of link 134 and yoke 182. It follows, therefore, that pin 176 on gear 174 would then occupy a lower position relative to pin 177 so that, with the next succeeding upward stroke of link 134, tooth 180 on yoke 182 will engage pin 176 to impart a counterclockwise movement to gear 174, a clockwise movement to gear 173, arm 171 and pin 172, and a counterclockwise movement to lever 165.

Counterclockwise movement of lever 165 returns the parts to the position of FIGURE 4. With the next downward stroke of link 134, tooth 180 moves out of engagement with pin 176 so that spring 191, which then bears against pin 192 on yoke 182, will swing yoke 182 in a clockwise direction to complete a cycle in the operation of the slacking bar shifting means.

During the weaving of plain fabric, such as headers between adjacent towels,, pattern mechanism 141 raises pawl 132 away from ratchet wheel 131 and raises connecting rod or link 150 to render the reed shifting means inoperative in the manner heretofore described. Since it is then necessary that slacking bar 160 remains stationary, a cam block 195, which is normally positioned below the level of the leaf spring 191, moves upwardly, with link 160, into the path of leaf spring 191 so that leaf spring 191 remains biased as shown in FIGURE 4 during subsequent downward movement of connecting rod or link 134. In other words, leaf spring 191 does not apply sufficient pressure against pin 192 to impart movement to yoke 182 about its pivot 183. Since yoke 182 then remains in its same attitude during subsequent vertical reciprocation thereof, it does not transmit movement to gear 174.

If the pattern being woven does not call for intermediate length loops interspersed with the high and low or ground-engaging loops effected by oscillation of slacking bar 160, cam block 195 may be fixed to link 150. However, in this instance, cam block 195 is loose on link 150 and is normally urged downwardly against a stop block 196 fixed on link 150 by any suitable means, such as a tension spring 197. A suitable connection, such as a cable 200, is provided between cam block 195 and pattern mechanism 141 so that cam block 195 can be raised to operative position relative to leaf spring 191 while pawl 132 remains in lowered or active position. Thus, slacking bar 160 remains stationary while the terry warp feeding apparatus 127, 128, and the reed operating mechanism remain operative for weaving loops of intermediate length at predetermined intervals.

In order to form loops of low, intermediate and long lengths which are respectively relatively shorter than the low, intermediate and long length loops produced by the apparatus thus far described, a relatively thin shield 202 is provided adjacent the periphery of ratchet wheel 131 and is normally spaced rearwardly of pawl 132. Shield 202 is controlled by a suitable pattern mechanism so as to move between pawl 132 and ratchet wheel 131 at predetermined intervals so that pawl 132 will engage a lesser number of teeth during each inactive stroke thereof, and will, consequently, impart lesser movement to ratchet wheel 131 and feed rolls 127, 128 with each active stroke thereof than is the case when shield 202 occupies inoperative position as shown in FIGURE 4.

To this end, it will be observed in FIGURES 3, 4 and 5 that shield 202 is mounted on one arm of a shield carrier or bell crank 203 to the other arm of which the upper end of a link or connecting rod 204 is pivotally connected. Connecting rod 204 extends downwardly in FIGURE 3 and is connected to the outer end of a lever 205 which is shown as being an extension to lever 115 heretofore described. Lever 115 is a part of the usual box motion and such box motions are usually controlled by a dobby head or other pattern mechanism and, accordingly, the use of the box motion in this instance is to be construed as exemplifying any suitable form of pattern mechanism for imparting movement to shield 202.

From the foregoing, it is apparent that, each time shuttle box S–2 is raised to operating level with respect to lay 106, shield 202 is moved into operative position in the manner heretofore described. Conversely, each time shuttle box S–1 is lowered to operative position, shield 202 is moved to inoperative position relative to pawl 132. Since pawl 132 does not advance feed rolls 127, 128 to the normal extent when shield 202 occupies operative position, it follows that lesser terry warp yarn 126 is fed by feed rolls 127, 128, to slacking bar 160 and reed 110, with the result that relatively shorter loops are formed in each instance than is the case when shield 202 occupies inoperative position.

Third Form of the Invention

The apparatus in the third form of the invention (FIGURE 6) includes many elements which are identical to those described with respect to the first form of the invention shown in FIGURES 1 and 2. Accordingly, those parts in FIGURE 6 which are identical to or substantially the same as like parts in FIGURES 1 and 2, bear the same reference characters with the prime notation added. The third form of the invention differs from the first and second forms of the invention as to the particular parts for transmitting motion to the slacking bar, and is also provided with means for varying the strokes of the slack-

ing bar. In so doing, the extent to which the two sheets of terry warp straddling the same are taken up and slackened, as they are fed by feed rolls 31', 32', is varied to produce further variation in loop pile height.

Referring more specifically to FIGURE 6 of the drawings, a pinion or gear 210 fixed on one end of shaft 53' meshes with a gear 211 shown in the form of a segmental gear journaled on one reduced end of guide roll 50'. Gear 211 has an arm 212 extending radially therefrom which has a pin 213 projecting outwardly therefrom. Pin 213 operates in a slot 214 provided in one arm of a substantially T-shaped rocker arm or element 215 suitably journaled, as at 216, on bracket 54'. A pair of substantially diametrically opposed shifting levers 220, 221 are oscillatably mounted on rocker element 215, their upper ends being pivotally connected to a bridging link 222.

A spring 223 normally urges said levers 220, 221 in a clockwise direction in FIGURE 6, such movement being limited by an adjustable stop element or pin 224 spaced beneath rocker element 215 and loosely extending through a slot 225 (FIGURE 7) provided in bracket 54'. Stop 224 may be fixed to bracket 54' when the range of movement of slacking bar 160 is to remain constant.

Control pin 224 is adjustable to different positions for alining the lower end of lever 220 with respective abutments carried by extension 73' of lever 42'. In this instance, there are three of the latter abutments provided on extension 73' which are indicated at 226, 227, 228. It will be noted that abutments 226, 227, 228 are shown in the form of pins spaced both horizontally and vertically relative to each other so that, as these different pins engage the lower end of lever 220, they impart varying degrees of movement thereto, due to the fact that the range of vertical movement of lever extension 73' is constant in this instance.

Accordingly, control pin 224 is movable to three different positions under control of a pattern mechanism such as that indicated at 47'. To this end, it will be observed in FIGURE 7 that control pin 224 extends through slot 225 and has adjacent ends of solenoid plungers 231, 232 connected thereto. Plungers 231, 232 extend outwardly in opposite relationship and through solenoid coils 233, 234. Coils 233, 234 are normally de-energized and the distal ends of solenoid plungers 231, 232 have respective tension springs 235, 236 connected thereto so that pin 224 normally occupies a middle or intermediate position.

When coils 233, 234 are alternately energized, pin 224 is moved toward the respective coils. Coils 233, 234 are connected to respective normally open switches 240, 241 arranged in a parallel circuit with the respective coils. The control arms of switches 240, 241 have respective cords, cables or other connecting elements 242, 243 connected thereto and extending to pattern mechanism 47'. It follows that, upon upward movement of cable 242, switch 240 is closed to energize solenoid coil 233 and move control pin 224 from right to left in FIGURE 7, so that spring 223 (FIGURE 6) urges control lever 220 into alinement with pin 228 on lever extension 73'.

On the other hand, upon lowering cord 242 and raising cord 243, switch 240 is opened, switch 241 is closed, solenoid coil 233 is de-energized and solenoid coil 234 is energized. This causes pin 224 to move from left to right in FIGURE 7 to where spring 223 may then urge the lower end of control lever 220 into a position above the control pin 226. When neither coil 233, 234 is energized, pin 224 occupies intermediate position so as to aline lever 220 with the centrally located abutment 227 on lever extension 73'.

Referring again to FIGURE 6, it will be observed that cable 75' is connected to a lower portion of lever 220 so that, when pattern mechanism 47' calls for movement of cable 75' from left to right in FIGURE 6, this moves forwardly the lower end of control lever 220; clear of the vertical path of movement of all three abutments or pins 226, 227, 228 on lever extension 73'. On the other hand, such forward movement of cable 75' also moves control lever 221 in a counterclockwise direction in FIGURE 6 to where it engages an abutment or pin 245 projecting outwardly from bracket 54'. Pin 245 is so positioned that the lower end of control lever 221 is then in vertical alinement with an abutment or pin 246 projecting from a rear portion of lever extension 73'.

In operation, assume that lever 42' and extension 73' are in the course of an upward stroke in FIGURE 6 and that parts occupy substantially the position shown. It is apparent that further upward movement of lever extension 73' causes pin 245 to engage and impart upward movement to control lever 221 while imparting clockwise movement to rocker element 215 and counterclockwise movement to gear 211, with consequent clockwise movement being imparted to pinion 210, shaft 53', crank 52' and slacking bar 51'.

As heretofore stated, such movement of the slacking bar 51' produces additional slack in terry warp sheet 30*a*' while reducing the slack in terry warp sheet 30*b*'. With subsequent downward movement of lever extension 73', the parts remain in the last position occupied thereby, and then pattern mechanism 47' releases cable 75' so that spring 223 moves levers 220, 221 in a clockwise direction in FIGURE 6. In so doing, lever 221 moves out of the path of pin 246 on lever extension 73' and lever 220 moves against control pin 224 and is thus alined with a corresponding pin 226, 227 or 228, as the case may be.

It has already been stated that the position of control pin 224 is pattern controlled and governs the particular pins 226, 227, 228 which will subsequently engage the lower end of control lever 220. Assuming that control pin 224 occupies neutral or intermediate position, pin 227 on lever extension 73' engages the lower end of control lever 220 with the next upward movement of lever extension 73' to thus impart counterclockwise movement to rocker element 215 and to thus impart corresponding movement to slacking bar 51'.

A most important feature of this invention resides in the means for accurately timing the operation of each form of slacking bar with respect to the overfeeding of the terry warp. The slacking bar, when in operation, must commence moving away from one terry sheet substantially as the production of slack in the terry warp commences, and it must complete its movement against the other terry sheet as the production of slack in the terry warp ceases, as well as prior to the full development of the next active fast pick stroke of the reed. To this end, the slacking bar drive mechanism is coupled with the terry warp feed mecahnism, in each instance. The ideal condition is to maintain the stocking bar against one terry sheet until a final loose pick is formed. Then, the slacking bar moves (as the terry warp is overfed) against and with the other terry sheet to maintain constant tension therein until the slacking bar stops, so that slack is produced in said one sheet equivalent to the amount of overfeed plus the slack resulting by movement of the slacking bar away from said one sheet.

A pawl shield, such as that indicated at 202 in FIGURE 4, and additional sheets of warp such as that indicated at 30*c* in FIGURE 1 may also be used with the form of apparatus shown in FIGURE 6 without departing from the spirit of the invention.

It is thus seen that I have provided various forms of apparatus for weaving terry fabrics having terry loops of infinitely varying heights, which loops may vary both warpwise and weftwise, and may all be of the same height in any given weftwise or warpwise row. Of course, the usual heddles or harnesses usually associated with looms of this character may also be manipulated to provide such variations in the height of pile on either or both sides of the fabric being woven.

The Fabric

In FIGURES 8 through 13, various types of fabrics are shown which may be woven according to the principles of this invention. However, since the different types of loop formations which may be formed by the present apparatus are practically unlimited, the illustrations of FIGURES 8 through 13 are merely exemplary, although novel. Also, although each of the forms of fabric shown in FIGURES 8, 10 and 12 is illustrated in the form of a bedspread fabric, the same character of loop formation may be embodied in terry fabrics such as towels and the like wherein relatively few yarns (usually three to six) are provided between adjacent loops both weftwise and warpwise of the fabric.

The fabric of FIGURE 8 includes a base B which may be woven from relatively fine or small yarn as compared to the yarn employed in forming terry loops. The base may be in the form of a plain or fancy weave, as desired, and, in this instance, the base B is provided with spaced weftwise extending relatively heavy yarns 250 preferably inserted immediately prior to each fast pick. The fabric of FIGURE 8 may be woven with the apparatus in one of the three forms of the invention.

By way of example, it should be assumed that the fabric of FIGURE 8 is woven on the loom shown in FIGURES 1 and 2 relatively heavy terry strands of different colors or textures are arranged in alternation in warp 30. The strands of the sheets 30*a*, 30*b*, 30*c* are also indicated by the same reference characters in FIGURE 8. The weftwise rows of terry loops are generally designated at 1 through 6 in FIGURE 8. Warpwise rows are generally designated at W–1 through W–5. It will be observed that, in weaving the loops in weftwise row 1, slacking bar 51 remains stationary so that all loops are of a given intermediate height or length.

In forming loops in weftwise row 2 (FIGURES 8 and 9), as terry warp 30 is fed by feed rolls 31, 32, slacking bar 51 moves forwardly in FIGURES 1 and 2 against warp 30*a* to draw the slack out of these strands while moving away from sheet 30*b* so that the subsequent fast pick beat-up stroke of reed 17 forms relatively short or ground-engaging loops from all the strands in sheet 30*a* (warpwise rows W–1, W–3, W–5) while forming relatively high or long loops from all the strands and sheet 30*b*, and while forming loops of intermediate height of all the strands in sheet 30*c* (warpwise rows W–2, W–4).

It is thus seen that relatively short or ground-engaging loops of one color of terry yarn in weftwise row 2 and warpwise rows W–1, W–3, W–5 are covered or hidden by the relatively high loops of the immediately adjacent strand. The intermediate height loops formed of yarns 30*c* in row 2 present loops of both colors with equal intensity.

It will be observed that, in the weaving of the next succeeding weftwise row of loops indicated at 3, slacking bar 51 again remains stationary so that all loops are again of intermediate height. On the other hand, in weaving weftwise row 4, slacking bar 51 moves rearwardly as terry warp 30 is fed by feed rolls 31, 32, so that additional slack is formed in sheet 30*a* while substantial slack is removed from sheet 30*b* with the result that the loops formed; with the next fast pick beat-up stroke of reed 17, from strands 30*a* in FIGURE 8 are relatively high, the loops formed from strands 30*b* are relatively low or ground-engaging loops, and the loops formed from strands 30*c* are all of intermediate height. This completes a cycle in the forming of the fabric shown in FIGURE 8, it being noted that weftwise rows 5 and 6 are identical to respective rows 1 and 2.

The fabric of FIGURE 10 illustrates another arrangement of loops in which all the terry warp yarns may be of the same color and/or texture. Weftwise rows of loops 7 through 15 and warpwise rows of loops W–6 through W–14 are included, in FIGURE 10, with a base fabric B–1. All the loops in warpwise rows W–6, W–12, W–13, W–14 are of the same, intermediate, height or length and are accordingly, formed from strands in sheet 30*c* of FIGURE 1. The loops in rows W–7, W–9, W–11 might be formed from strands in sheet 30*a*, while the loops in intervening warpwise rows W–8 and W–10 might be formed from strands in sheet 30*b*. It will be noted that, in the weaving of the first two weftwise rows, indicated at 7 and 8 in FIGURE 10, slacking bar 51 remains stationary. In weaving the remaining weftwise rows 9–15, slacking bar 51 moves to and fro, in the manner heretofore described, to form high and ground-engaging loops in alternation but in opposed relationship from respective terry strands 30*a*, 30*b*. The relative size of the loops in row 10 is further illustrated in FIGURE 11.

The fabric of FIGURE 12 is also constructed in much the same manner as the fabric of FIGURES 8 and 10 with the exception that the shedding of the ground warp is such that loops are formed on both faces of a base fabric B–2. The base B–2 carries weftwise rows of loops 16–21 and warpwise rows of loops W–15 through W–22. In FIGURE 12, each warpwise row of loops W–15 through W–22 is formed from two strands of terry warp yarn. The strands in each of the latter rows are designated by numerals corresponding to sheets 30*a*, 30*b*, 30*c* of FIGURE 1.

All the loops in warpwise rows W–16, W–18, W–20 are of intermediate height, although they appear on opposed faces of the base B–2 in alternation. Accordingly, these particular loops are formed from strands in the sheet 30*c* in FIGURE 1. The loops in rows W–15, W–19, W–22 all appear on the back or lower face of the base fabric B–2, but these loops may alternate in size as will be presently described with respect to the loops in rows W–17, W–21. In the latter rows W–17, W–21, it will be noted that alternate loops made from one of the strands are, in each instance, relatively high loops while corresponding intervening loops made from the other of the strands are relatively low loops. Further, each of the strands alternates in the forming of high and low loops. Very pleasing effects are also produced by forming alternate high and low loops from selected terry warp strands or yarn and wherein portions of the fabric would have the high loops formed on only one side thereof while the low loops would be formed on the other side thereof. This produces shallow design areas on one side of the base fabric and relatively high design areas corresponding thereto on the other side of the fabric. As heretofore stated, all the loops may vary as to length, although some adjacent loops may be alternating high and low relative to each other, by using the pawl shield 202 of FIGURE 4 and the variable stroke control mechanism for the slacking bar shown in FIGURES 6 and 7. The present apparatus enables the formation of pile fabrics having variegated or single-color patterns in sharp relief or of a shadow-like appearance on either or both sides of the fabric.

In the drawings and specification there have 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 method of weaving on a loom having means for weaving cloth including a beating means and means for varying the relative positions of the beat-up point of the beating means and the fell of the cloth in alternation so as to produce fast and loose picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which strands of pile yarn are interwoven with said base fabric; the steps of relatively varying the amount at which selected strands of pile yarn are fed to said beating means during the weaving of each of any selected fast picks while forming loops from all of said selected strands, and varying the amount

at which each selected strand is fed to said beating means during weaving of a plurality of said selected fast picks.

2. In a method of weaving on a loom having means for weaving cloth including a variable beating means capable of producing loose picks and fast picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which strands of pile yarn are interwoven with said base fabric; the step of alternating in the feeding to said beating means of relatively large and small amounts of certain of said strands sufficient to form respective large and small loops with the weaving of selected fast picks and concurrently alternating in the feeding to said beating means of relatively small and large amounts of certain others of said strands sufficient to form respective small and large loops with the weaving of said selected fast picks and wherein said amounts of the first-mentioned certain strands vary relative to the amounts at which said other certain strands are fed to said beating means with the weaving of each of said selected fast picks.

3. A method of weaving on a terry loom having a variable beating means capable of producing loose picks and fast picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which strands of terry yarn are interwoven with said base fabric; the steps of feeding given amounts of selected terry strands and other amounts of other selected terry strands to said beating means in the forming of at least one fast pick to form loops of a given height from said first selected terry strands and to form loops of another height from said other selected terry strands, then feeding to said beating means said other selected terry strands said given amounts while feeding said first selected terry strands said other amounts in the forming of at least one succeeding fast pick to form loops of said given height from other selected terry strands while forming loops of said other height from said first selected strands, and repeating the steps as prescribed.

4. A method of weaving on a terry loom having a variable beating means capable of producing loose picks and fast picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which strands of terry yarn are interwoven with said base fabric; the steps of feeding given amounts of selected terry strands and other amounts of other selected terry strands to said beating means while forming at least one first fast pick to form loops of a given height from said first selected terry strands and to form loops of another height from said other selected terry strands, then, while forming at least one second fast pick, feeding all of said selected terry strands to the beating means the same, but an intermediate amount, to form loops of intermediate height from all of said selected terry strands, then feeding to said beating means said other selected terry strands said given amounts while feeding said first selected terry strands said other amounts while forming at least one third fast pick to form loops of said given height from other selected terry strands while forming loops of said other height from said first selected strands, and repeating the steps as prescribed.

5. A method of weaving on a terry loom having a variable beating means capable of producing loose picks and fast picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which strands of terry yarn are interwoven with said base fabric; the steps of feeding given amounts of selected terry strands and other amounts of other selected terry strands to said beating means while forming at least one first fast pick to form loops of a given height from said first selected terry strands and to form loops of another height from said other selected terry strands, then feeding all of said selected terry strands to the beating means the same but an intermediate amount while forming at least one second fast pick, to form loops of an intermediate height from all of said selected terry strands, then feeding to said beating means said other selected terry strands said given amounts while feeding said first selected terry strands said other amounts while forming at least one third fast pick to form loops of said given height from other selected terry strands while forming loops of said other height from said first selected strands, then again feeding all of said selected terry strands to the beating means the same but said intermediaate amount while forming at least one fourth fast pick, to form loops of said intermediate height from all of said selected terry strands, and repeating the steps prescribed.

6. In a method of weaving on a terry loom having a variable beating means capable of forming fast and loose picks in alternation, and wherein ground warp and weft yarns are woven into a base fabric concurrently with which strands of terry yarn are interwoven with said base fabric; the steps of feeding tensioned terry strands with certain active strokes of said beating means, overfeeding said terry strands with certain other fast pick forming active strokes of said beating means whereby pile loops are formed, overfeeding a first group of said terry strands relative to a second group of said terry strands with still other fast pick forming active strokes of said beating means, aand overfeeding said second group of terry strands relative to said first group of the terry strands with certain other fast pick forming active strokes of said beating means, and repeating the steps prescribed in a predetermined sequence to form terry loops of varying height in selected warpwise and selected weftwise rows.

7. A method of feeding terry warp strands to a variable beating means of a terry loom wherein said beating means is capable of forming fast and loose picks in alternation, said method comprising producing a given amount of slack in said terry strands during selected fast pick forming active strokes of said beating means, removing some of the slack from some of said terry strands while increasing slack in others of said terry strands during certain of said selected active strokes of said beating means so as to form short and long loops from said some and said other terry strands, respectively and increasing the slack in said some of the terry strands while removing at least some of the slack from said others of the terry strands during certain others of said selected active strokes of said beating means so as to form long and short loops from said some and said other terry strands, respectively, the removal of at least some of the slack from said some of the terry strands occurring in alternation with the removal of said some of the slack from said others of the terry strands thereby to form loops of varying length throughout the length and width of predetermined portions of the fabric being woven.

8. A method of feeding terry warp strands to a beating means of a terry loom and wherein the loom is provided with means for varying the relative positions of the beat-up point of the beating means and the fell of the cloth being formed so as to produce fast and loose picks in alternation, said method comprising producing a given amount of slack in said terry strands during selected active fast pick forming strokes of said beating means, and alternately removing at least some of the slack from and increasing the slack in some of said terry strands while alternately increasing slack in and removing at least some of the slack from others of the terry strands in the order prescribed during certain successive selected active strokes of said beating means.

9. The method of weaving on a loom having means for weaving cloth including a variable beating means capable of producing loose picks and fast picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which pile yarn is interwoven with said base fabric; the step of dividing said pile yarns into at least two first and second groups and overfeeding said first group while overfeeding said second group to a greater extent than said first group in the forming of at least one fast pick and while forming loops

from the pile yarns of both groups, then, prior to another subsequent fast pick, overfeeding said first group to a greater extent than the extent to which it was fed in forming said first-mentioned fast pick while overfeeding said second group to a lesser extent than the extent to which said first group is overfed, then forming loops from the pile yarns of both groups in the forming of said subsequent pick, and repeating the steps prescribed.

10. The method of weaving on a loom having means for weaving cloth, including a variable beating means capable of producing loose picks and fast picks in alternation, and wherein ground warp and filler yarns are woven into a base fabric concurrently with which pile yarn is interwoven with said base fabric; the steps of dividing said pile yarns into at least two sheets and overfeeding one of said sheets to the beating means, relative to, and to a greater extent than, the other of said sheets while forming loops from all the pile yarns in the forming of at least one fast pick and, thereafter, prior to another subsequent fast pick in which relative overfeeding of the two sheets occurs, overfeeding said one of said sheets to the beating means, relative to, and to a lesser extent than said other sheet and, also, to a lesser extent than the extent to which it was fed prior to said first-mentioned fast pick, and then forming loops from all the pile yarns with said subsequent fast pick.

11. The method of controlling slack in strands of pile yarn on a loom equipped with a variable beating means to thereby vary the length of loops formed on either side of a base fabric as it is woven; which method includes overfeeding pile strands from a source to said beating means to produce predetermined amounts of slack therein at predetermined intervals during weaving, splitting the pile strands into a pair of sheets, applying pressure against one only of said sheets as said pile strands are overfed and then removing the pressure from said one of said sheets and applying pressure against the other of said sheets to increase the slack in said one of the sheets between the source and said beating means and to at least partially remove the slack from the other of said sheets between the source and said beating means all between successive active strokes of said beating means and, between a subsequent pair of successive active strokes of said beating means, applying pressure to said other of the sheets while overfeeding said pile strands and then relieving the pressure on said other of the sheets and applying pressure to said one of the sheets, and then repeating the steps as prescribed.

12. In a terry loom having overfeeding means for producing slack in a terry warp including a ratchet wheel and a cooperating pawl; the combination of a slacking bar extending transversely of and through said terry warp and thereby separating the same into two sheets, mechanical connections between said ratchet pawl and said slacking bar, said mechanical connections including means for shifting said slacking bar in one direction with certain spaced active strokes of said pawl and said last-named means including means for also shifting said slacking bar in the opposite direction with certain intervening active strokes of said pawl to increase and decrease the amount of slack produced in said sheets by said overfeeding means in alternation.

13. A structure according to claim 12 including means forming and guiding at least one additional sheet of terry warp independently of said slacking bar.

14. In a terry loom having means for producing slack in a terry warp including a ratchet wheel and a cooperating pawl; the combination of a slacking bar extending transversely of and through said terry warp and thereby separating the same into two sheets, mechanical connections between said ratchet pawl and said slacking bar, said mechanical connections including pattern controlled means for shifting said slacking bar in one direction with certain spaced active strokes of said pawl and for also shifting said slacking bar in the opposite direction with certain intervening active strokes of said pawl to alternately and relatively increase and decrease the amount of slack produced in said sheets.

15. A structure according to claim 14 including pattern controlled means for varying the extent of movement of said slacking bar in either of said directions to thereby vary the relative increases and decreases in the slack effected in said sheets.

16. In a terry loom having means for weaving cloth, including a variable beat-up reed and wherein ground warp and filling yarns are woven into a base fabric concurrently with which terry warp is interwoven with said base fabric, a lateral guide for said terry warp disposed between a source of said terry warp and said reed, a terry warp overfeeding means, and pattern controlled means for actuating said overfeeding means for advancing said terry warp relative to the ground warp and being disposed between said source and said lateral guide; the combination of a laterally extending slacking bar spaced between said overfeeding means and said lateral guide, said terry warp being divided into at least two sheets separated by said slacking bar at a point between the overfeeding means and the lateral guide, means operatively connecting said overfeeding means with said slacking bar for moving the latter toward one sheet and away from the other sheet and alternately moving said slacking bar away from said one sheet and toward said other sheet in response to selected actuations of said overfeeding means.

17. A structure according to claim 16 including additional guide means forming at least one additional sheet from said terry warp at a point between said source and the lateral guide, said additional guide means being independent of said slacking bar.

18. In a terry loom having means for weaving cloth, including a variable beat-up reed and wherein ground warp and filling yarns are woven into a base fabric concurrently with which terry warp is interwoven with said base fabric, a lateral guide for said terry warp disposed between a source of said terry warp and said reed and pattern controlled means for overfeeding said terry warp relative to the ground warp and being disposed between said source and said lateral guide; the combination of a laterally extending slacking bar spaced between said overfeeding means and said lateral guide whereby said terry warp may be divided into at least two first and second sheets separated by said slacking bar, means operatively connecting said overfeeding means and said slacking bar for moving said slacking bar away from said first sheet and toward said second sheet, with alternate operations of said overfeeding means and for moving said slacking bar away from said second sheet and toward said first sheet with intervening operations of said overfeeding means.

19. In a terry loom having means for weaving cloth, including a variable beat-up reed and wherein ground warp and filling yarns are woven into a base fabric concurrently with which terry warp is interwoven with said base fabric, a lateral guide for said terry warp disposed between a source of said terry warp and said reed, and pattern controlled means for overfeeding said terry warp relative to the ground warp and being disposed between said source and said lateral guide; the combination of a laterally extending slacking bar spaced between said overfeeding means and said lateral guide whereby said terry warp may be divided into at least two first and second sheets separated by said slacking bar, means operatively connecting said overfeeding means and said slacking bar for moving said slacking bar away from said first sheet and into engagement with said second sheet with alternate operations of said overfeeding means and for moving said slacking bar away from said second sheet and into engagement with said first sheet with intervening operations of said overfeeding means.

20. In a terry loom having means for weaving cloth, including a variable beat-up reed and wherein ground

warp and filling yarns are woven into a base fabric concurrently with which terry warp is interwoven with said base fabric, a lateral guide for said terry warp disposed between a source of said terry warp and said feed, and pattern controlled means for overfeeding said terry warp relative to the ground warp and being disposed between said source and said lateral guide; the combination of a laterally extending slacking bar spaced between said overfeeding means and said lateral guide whereby said terry warp may be divided into at least two first and second sheets separated by said slacking bar at a point between the overfeeding means and the lateral guide, means automatically operable with certain spaced operations of said overfeeding means for moving said slacking bar away from said first sheet and against said second sheet, and means automatically operable with certain intervening operations of said overfeeding means for moving said slacking bar away from said second sheet and against said first sheet.

21. In a loom having means for weaving cloth, including a variable beating means and means for intermittently overfeeding terry warp strands from a source to said beating means; the combination of a slacking bar located between the beating means and the overfeeding means and extending transversely of and between certain of said strands to form at least two sheets therefrom, and means operating in timed relation to the means for overfeeding said terry warp for moving said slacking bar away from one of said sheets and toward and in engagement with the other of said sheets to increase the slack produced in said one of the sheets by said overfeeding means while decreasing the slack in the other of said sheets produced by said overfeeding means, said means for moving said slacking bar being operable to move first in one direction and then in the other direction at predetermined intervals according to a predetermined pattern.

22. A structure according to claim 21 including lateral guide means forming at least one additional sheet from said terry warp independent of said slacking bar.

23. In a loom having means for weaving cloth, including a variable beating means and pattern controlled means for intermittently overfeeding terry warp from a source to said beating means; the combination of a slacking bar positioned between said beating and overfeeding means and extending transversely of and between certain of the strands of terry warp to form at least two sheets therefrom, and pattern controlled means operating in timed relation to the means for overfeeding said terry warp for moving said slacking bar away from one of said sheets and toward and in engagement with the other of said sheets to increase the slack produced in said one of the sheets by said overfeeding means while decreasing the slack produced in the other of said sheets by said overfeeding means, said means for moving said slacking bar being operable to move first in one direction and then in the other direction at predetermined intervals according to a predetermined pattern.

24. A structure according to claim 23 including additional pattern controlled means for varying the extent of movement of said slacking bar from either sheet toward the other.

25. In a terry loom having means for weaving cloth including a variable beat-up reed and wherein ground warp and filling yarns are woven into a base fabric concurrently with which terry warp is interwoven with said base fabric, a lateral guide for said terry warp disposed between a source of said terry warp and said reed, overfeeding means for the terry warp located between said source and said guide, drive means for the overfeeding means including a ratchet wheel and a pawl, and means for imparting active and inactive strokes to said pawl; in combination, a laterally extending slacking bar spaced between said overfeeding means and said lateral guide, said slacking bar extending through said terry warp to form at least two sheets of terry warp, pattern controlled means for moving said slacking bar toward one of said sheets relative to the other sheet with certain spaced active strokes of said pawl and for moving said slacking bar toward the other of said sheets relative to said one sheet with certain intervening active strokes of said pawl.

26. A structure according to claim 25 including means varying the number of teeth the ratchet wheel is racked with certain active strokes of said pawl.

27. A structure according to claim 25 including pattern controlled means for varying the extent of movement of said slacking bar toward and away from either of said sheets of terry warp.

28. A structure according to claim 25 wherein said loom is equipped with a reciprocating arm which reciprocates in timed relation to active and inactive strokes of said pawl, shaft means supporting said slacking bar in eccentric relation thereto, said means for moving the slacking bar comprising a crank movable in fixed relation with said shaft means and having a radial slot therein, a rocker element carried by the loom, a pair of circularly spaced pins on said rocker element, the first of said pins extending through said slot, a yoke pivotally supported by said reciprocating arm and having a pair of opposed spaced teeth projecting therefrom and being spaced a lesser distance apart than the distance between said pair of pins, means for moving said yoke in one direction to cause one of said teeth to engage said first pin with certain strokes of said arm in one direction, and said pattern controlled means being operable for moving said yoke in the opposite direction to cause the other of its teeth to engage the other of said pins with certain intervening active strokes of said reciprocating arm whereby said first pin is moved first in one direction and then in the other direction, in alternation, to impart corresponding movement to said slacking bar.

29. A structure according to claim 28 in which said means for moving said yoke toward said first pin is pattern controlled.

30. In a terry loom having means for weaving cloth including a variable beat-up reed and wherein ground warp and filling yarns are woven into a base fabric concurrently with which terry warp is interwoven with said base fabric, a lateral guide for said terry warp disposed between a source of said terry warp and said reed, terry warp overfeeding means located between said source and said guide, drive means for said overfeeding means comprising a ratchet wheel and a pawl, and means for imparting active and inactive strokes to said pawl; in combination, a laterally extending slacking bar spaced between said overfeeding means and said lateral guide, said slacking bar extending through said terry warp to form at least two sheets of terry warp, a crank movable in fixed relation with said slacking bar, means for moving said crank in one direction to move said slacking bar toward one of said sheets relative to the other sheet with certain spaced active strokes of said pawl and for moving said crank in an opposite direction to move said slacking bar toward the other of said sheets relative to said one sheet with cetrain intervening active strokes of said pawl.

31. A structure according to claim 30 in which said means for moving said crank includes a member movable with said pawl, a yoke pivotally carried by, and movable with, said member, laterally spaced teeth on said yoke, a pair of yoke shifting pins on said yoke and disposed between said teeth and the point at which the yoke is pivotally carried, a first gear, a second gear meshing with the first gear, a pair of circularly spaced operating pins carried by the first gear and adapted to be alternately engaged by respective teeth on said yoke, said operating pins being relatively closely spaced with respect to said teeth, the free end of said crank having a pair of spaced arcuate surfaces thereon and a radial slot between said arcuate surfaces, a segmental portion concentric with said second gear, a radial arm integral with said second gear, a laterally extending pin on said arm for engaging

the slot in said crank whereby said arcuate surfaces alternately engage said segmental member upon rotation of said second gear in one direction and then in the other direction, a torsion spring carried by said crank and extending between said shifting pins on said yoke whereby upon said crank occupying one position, said torsion spring urges the yoke in one direction to move one of its teeth away from a corresponding operating pin on said first gear and to move its other tooth in alinement with the other of said operating pins on said first gear whereby, upon the next succeeding active stroke of said pawl, said other tooth engages and imparts movement to the corresponding operating pin on the first gear to impart movement to the crank through intervening connections and to thereby impart corresponding movement to said slacking bar, the torsion spring then engaging the other of the shifting pins on said yoke to swing the yoke in the opposite direction to effect another cycle in its operation.

32. A structure according to claim 30 in which said means for moving said crank comprises a rocker element, a pair of substantially diametrically opposed members carried by said rocker element, first engaging means responsive to said spaced active strokes of said pawl for engaging and imparting movement to one of said members and the rocker element in one direction, second engaging means engageable with the other of said members upon said other intervening active strokes of said pawl for imparting movement to said rocker element in the opposite direction, and mechanical connections between said rocker element and said crank for imparting movement to said crank in opposite directions corresponding to the movements of said rocker element.

33. A structure according to claim 32 in which the members carried by said rocker element are in the form of a pair of first and second actuating pins, an arm movable in unison with said pawl and disposed adjacent said rocker element, a yoke pivotally mounted on said arm on an axis substantially parallel with the axis of said rocker element, said first and said second engaging means comprising respective first and second spaced teeth on said yoke and which are spaced closer together than said actuating pins, said arm being substantially radially movable toward and away from the axis of said rocker element, means for rocking said yoke in one direction to aline said first tooth with said first pin whereby said arm causes the first tooth to engage and impart movement to said rocker element in said one direction, and means operable upon certain strokes of said arm for moving said yoke in the opposite direction to position the second tooth in alinement with the second pin.

34. A structure according to claim 32 in which the members carried by said rocker element are in the form of a pair of pivoted shifting levers, a link interconnecting corresponding ends of said pivoted levers, an arm movable with said pawl adjacent said levers, said first and second engaging means comprising respective first and second spaced pins on said arm, said arm being substantially radially movable toward and away from the axis of said rocker element, pattern controlled means for rocking said shifting levers in one direction with certain strokes of said arm to aline one of said levers with said first pin whereby said arm causes said first pin to engage said one of said levers and moves said rocker element in said one direction, and means operable upon certain strokes of said arm for moving said levers in the opposite direction to position the other of the levers in alinement with the second pin.

35. A structure according to claim 32 in which the

members carried by said rocker element are in the form of a pair of first and second pivoted shifting levers, a link interconnecting corresponding ends of said pivoted levers, an arm movable with said pawl adjacent said levers, said first engaging means comprising a first set of staggered pins on said arm spaced various distances from said rocker element, said second engaging means comprising a second pin on said arm and being spaced substantially from said first pins, said arm being substantially radially movable toward and away from the axis of said rocker element, pattern controlled means for rocking said shifting levers in one direction to aline an end of said second lever with said second pin to thereby move said rocker element in one direction, means yieldably urging said levers in the opposite direction, said pattern controlled means also being operable upon certain strokes of said arm for releasing said levers so they are moved in the opposite direction to position said first lever in alinement with a corresponding first pin, a movable control bar engageable by at least one of said shifting levers for limiting movement of said levers in said opposite direction, and pattern controlled means for shifting said control bar to various positions for alining said first shifting lever with a predetermined first pin on said arm whereby a succeeding active stroke of said arm imparts movement to the levers and the rocker element to an extent corresponding to the displacement of that particular first pin which engages the first shifting lever.

36. A structure according to claim 32 in which the members carried by said rocker element are in the form of a pair of first and second actuating pins, an arm movable in unison with said pawl and disposed adjacent said rocker element, said arm being substantially radially movable toward and away from the axis of said rocker element, a yoke pivotally mounted on said arm on an axis substantially parallel with the axis of said rocker element, said first and second engaging means comprising respective first and second spaced teeth on said yoke and which are spaced closer together than said actuating pins, pattern controlled means for rocking said yoke in one direction to aline said first tooth with said first pin whereby said arm causes the first tooth to engage and impart movement to said rocker element in said one direction, and means operable upon certain strokes of said arm for moving said yoke in the opposite direction to position the second tooth in alinement with the second pin.

37. A structure according to claim 36 in which said means for moving said yoke in the opposite direction comprises a resilient member, and said pattern controlled means includes a pattern mechanism for selectively moving said yoke in said one direction and for, at times, releasing said yoke whereby said resilient member moves the yoke in the opposite direction.

References Cited in the file of this patent

UNITED STATES PATENTS

465,411	Liberty	Dec. 15, 1891
577,981	Gilfillan	Mar. 2, 1897
1,665,274	Neisler	Apr. 10, 1928
1,739,192	Wakefield	Dec. 10, 1929
1,739,205	Blanchard	Dec. 10, 1929
2,103,836	Wakefield	Dec. 28, 1937
2,460,512	Lanz	Feb. 1, 1949
2,741,270	Mills	Apr. 10, 1956
2,814,314	Harding	Nov. 26, 1957

FOREIGN PATENTS

547,864	Great Britain	Sept. 15, 1942