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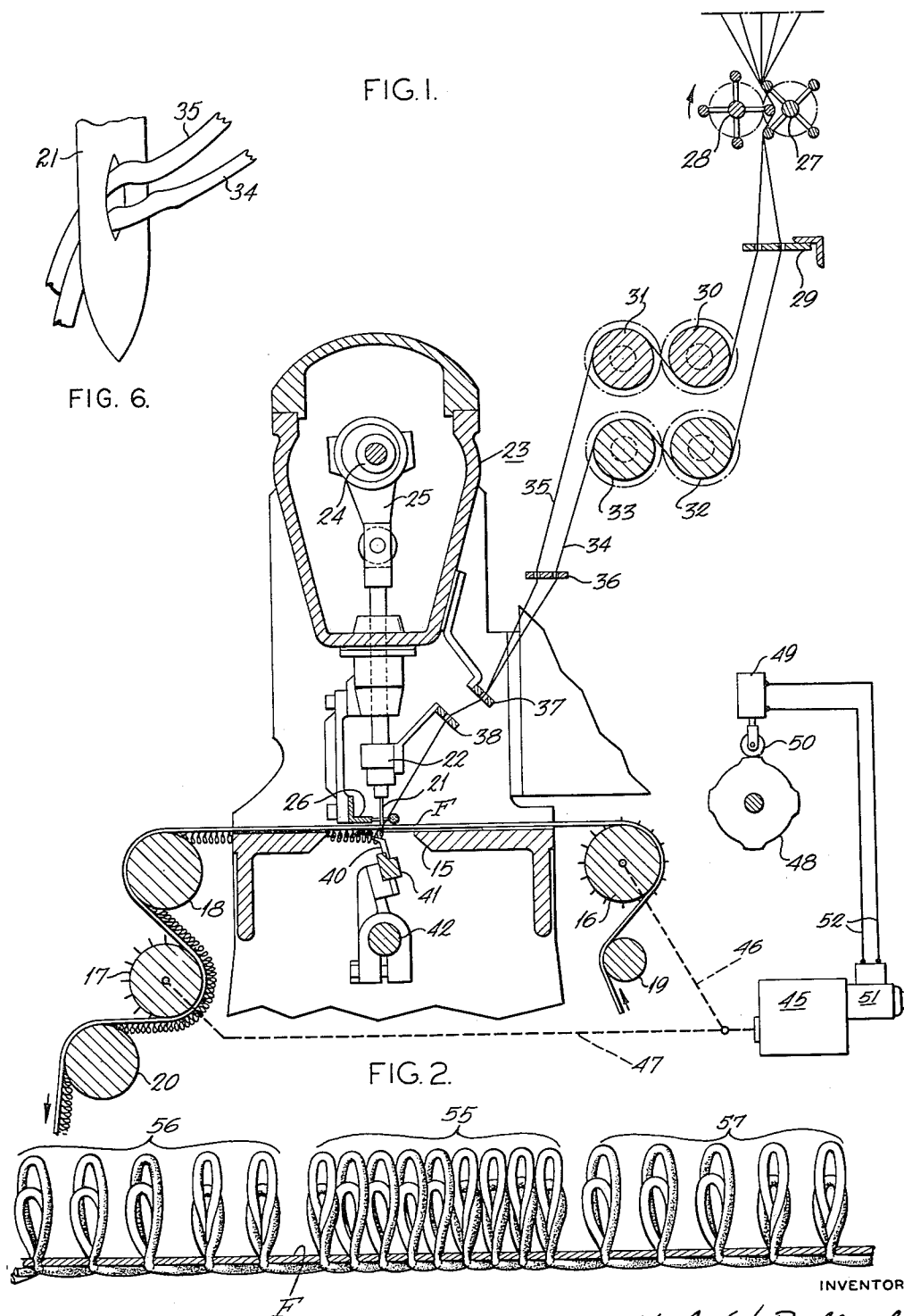
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METHOD AND APPARATUS OF TUFTING PILE FABRIC

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2 Sheets-Sheet 1



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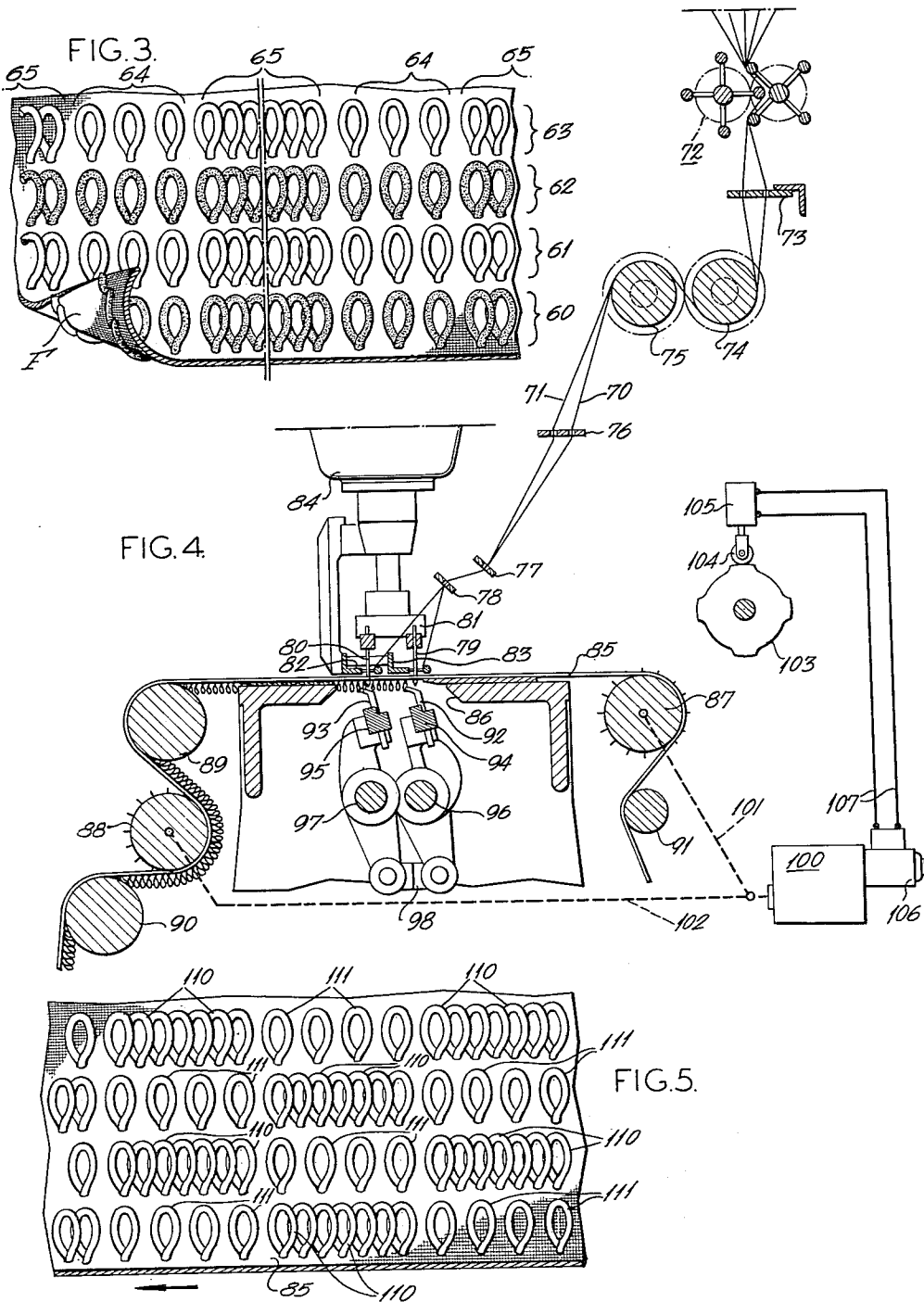
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METHOD AND APPARATUS OF TUFTING PILE FABRIC

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This invention relates to the manufacture of pile fabrics and more particularly to an improved apparatus for producing a tufted pile fabric having novel pattern effects.

The limitations of the multiple needle tufting machine for the production of pile floor coverings are generally well known in the art. Heretofore it has been impossible to duplicate on a tufting machine all of the pattern effects which have currently received popular acceptance in woven fabrics. The popularity of texture, which may be defined as an overall uneven pile surface, and also carved and sculptured effects are of considerable importance in the manufacture and sale of such fabrics. The present invention is directed to a modification of the conventional tufting machine which enables controlled variations in the pile density to be accomplished.

A primary object of the invention, therefore, is to provide apparatus for regulating the feed of the backing fabric in a broad tufting machine to provide pile density variations in accordance with a pre-determined pattern.

A further object of the invention is to provide a pattern control drive connection for the feed and take-up pin rolls for the backing fabric in a tufting machine.

A further object of the invention is to provide in combination with a variable control drive for the backing fabric, a pile feeding apparatus which enhances the pattern effect.

A further object of the invention is to provide in a multiple needle tufting machine a variable drive for the backing fabric and two separate needle bars which insert pile at different spaced positions.

A further object of the invention is to provide a method for tufting a pile fabric which includes the combination of controlling the backing fabric and also the pile height in certain areas in accordance with the pattern.

Further objects will be apparent from the specification and drawings in which:

FIG. 1 is a schematic transverse section through a multiple needle tufting machine constructed in accordance with one form of the present invention,

FIG. 2 is an enlarged schematic longitudinal section of the fabric produced with the tufting machine of FIG. 1,

FIG. 3 is a schematic view showing a fabric similar to FIG. 2 but with only one pile yarn end per needle,

FIG. 4 is a schematic sectional view of a "staggered needle" tufting machine using the apparatus of the present invention,

FIG. 5 is a schematic top view of the fabric produced on the tufting machine of FIG. 4, and

FIG. 6 is an enlarged fragmentary elevation of a needle to be employed in the present invention illustrating the insertion of two yarn ends through the eye of a single needle.

The invention comprises essentially the provision of a pattern controlled variable drive and take-up for the backing fabric of a tufting machine. The result of the relatively higher feed provided with such a device is to reduce the longitudinal density of the pile projections. Where the backing feed is slower, then, of course, the longitudinal density of the projections is increased. Where this density is varied in accordance with a pre-determined pattern, the evenness of the face appearance of the fabric can be broken up, thus creating desirable texture effects. When the device is utilized in conjunction with a tufting

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machine carrying two ends per needle and a pattern attachment which controls the height of the various ends, additional novel effects are provided and the further breaking up or texturing of the pile projections may be enhanced by providing a staggered needle machine which comprises two rows of tufting needles which are longitudinally out of line with each other.

A conventional multiple needle tufting machine comprises a bed or throat 15 over which the backing cloth or fabric F is fed from the pin feed roll 16 to the pin take-up roll 17. Intermediate idler roll 18 guides the fabric from throat 15 over the periphery of take-up roll 17. Sufficient peripheral contact between the fabric F and rolls 16 and 17 is provided by idler rolls or bars 19 and 20. A series of needles 21 are mounted in a vertically oscillating needle bar 22, journaled in housing 23, and controlled by a crankshaft 24 having connecting rods 25. The usual presser foot 26 retains the backing fabric on the throat 15. The pile yarn is fed from a supply such as a creel or beam, not shown, through feeding devices such as rotating beaters 27 and 28. The yarns are thence fed through guides 29 and over pairs of feed rollers 30, 31, and 32, 33. The speed of the yarn feeding mechanism can be, if desired, so constructed and arranged that the amount of feed and/or the tension of the various yarn ends is varied so that different height pile projections are produced in the fabric. In the present showing, I have illustrated two separate series of pile yarn ends 34 and 35 which may be independently controlled by rollers 32, 33, and 36, 31 respectively. The yarns 34 and 35 feed through stationary guide bars 36 and 37 and oscillating thread jerker 38. One end of the pile yarn from each set 34 and 35 is threaded through the eye of each needle, as shown in FIG. 6, so that there will be two pile projections in each row of stitches and projecting through the same perforations in the backing F. A conventional series of loopers 40 are mounted on looper bar 41 and are oscillated by the looper rock shaft 42 in accordance with conventional practice. Ordinarily the backing feed F is fed at a constant rate across the throat or bed 15. This constant rate, however, may comprise intermittent starting and stopping in timed relation to each vertical stroke of the needle, or the feed may be generally uniform relying upon the stretch of the fabric to take care of fabric fed while the needles 21 are penetrating the fabric. In either case, however, the resultant pile projections are of uniform density along the entire fabric. By connecting driving motor 45 to the feed and take-up rolls 16 and 17 and controlling the speed of motor 45, I have found that it is possible to vary the density of the pile projections longitudinally on the fabric F. The motor 45 may be drivingly connected to the rolls 16 and 17 in any convenient manner as shown schematically at 46 and 47 in FIGURE 1. The pattern cam 48 intermittently operates a switch 49 through cam follower 50 to vary the speed control element 51 on the motor 45 through electrical connectors 52, 52. As will be noted from the foregoing, the pattern control means which effects the variable speed of the rolls 16 and 17 includes a pattern cam 48 which, by means of cam follower 50, actuates a switch 49 to achieve either a normal constant speed of the motor 45 or an increase or decrease of such normal constant speed. Thus the pattern control means includes a first control speed section, determined by the position of the pattern cam 48, which will permit the driving of the motor 45 at its normal constant speed, and a second speed control section, likewise determined by the position of the pattern cam 48, which will drive the motor 45 at a different or greater constant speed. Alternatively, the motor 45 may be replaced with one or more of the conventional variable speed drive devices ordinarily employed in a drive system.

Such a device will take the form of a variable diameter sheave or pulley.

The fabric produced with the apparatus of FIG. 1 is shown as having a relatively dense area of pile loops 55 which, in FIG. 2, are double loops projecting from the same interstices in the backing fabric F. These areas appear at controlled distances from relatively less dense areas 56 and 57 so that a textured appearance is provided. The dense area 55 is produced by relatively slow backing fabric feed with consequent shorter stitches for the pile projections in the dense area. The less dense areas 56 and 57 illustrate the lengthening of the stitches and the greater spacing of the pile projections when the rate of the backing fabric feed is increased. Where the relative tension in the ends 34 and 35 in any particular needle is varied, it is possible to alternate the height of the pile projections in each interstice in the fabric F so that different colors or different characteristics of the yarn may predominate in selected areas. Where alternate needles are threaded with differently colored yarns, the effect shown in FIG. 3 may be provided in which the denser and less dense areas run generally across the fabric. In FIG. 3 there are shown four rows 60, 61, 62, and 63 of pile loop projections which are progressively formed into the less dense areas 64 and the denser areas 65. If the color or other characteristics of the pile yarn in rows 60 and 62 contrasts with the pile yarns in rows 61 and 63, for example, an interesting new type of design may be achieved.

The present invention also lends itself to the manufacture of novel fabrics in conjunction with a skip-stitch, multiple needle tufting machine. Such a machine is illustrated generally in FIG. 4 and comprises yarn ends 70 and 71 which are supplied from a source such as a creel, not shown. The yarns 70 and 71 are tension controlled through a beater system 72 and thence they run through a guide 73 and around feed rolls 74 and 75. In accordance with conventional practice, the yarns 70 and 71 are then carried through a series of guides 76, 77, and thread jerker 78 and are fed to separate rows of needles 79 and 80 respectively mounted on needle bar 81. Otherwise the tufting machine is substantially the same as that shown in FIG. 1 having a pair of presser feet 82 and 83 and the usual housing assembly 84. The fabric which comprises the burlap or cloth 85 is fed across the throat 86 of the tufting machine from a pin feed roll 87 to a pin take-up roll 88. Guide rolls 89 and 90 control the travel of fabric around the periphery of take-up roll 88 whereas guide roll 91 controls the cloth fed around pin roll 87. Two sets of simultaneously acting loopers 92 and 93 are mounted in their individual looper bars 94 and 95 and oscillate from the looper rockshafts 96 and 97. These rockshafts may be connected by means of suitable cranks and linkage shown generally at 98.

The variable speed control for the skip-stitch machine comprises a variable drive element or motor 100 which is drivingly connected to pin feed roll 87 by means of shaft or connections 101. Likewise the element 100 is drivingly connected to pin take-up roll 88 by means of suitable driving connections 102. The speed of the driving element 100 is controlled by a cam 103 which in turn actuates a cam follower 104 to open and close an electrical circuit through relay or switch 105. Switch 105 is electrically connected to the control member 106 by means of electrical connectors 107, 107 in the same way that has been described in conjunction with FIG. 1. The control element 100 may be accelerated or decelerated in accordance with the pattern of cam 103 to regulate the relative feed of the cloth 85 with respect to the vertical oscillation of needle bar 81. In a staggered needle machine, the fabric so produced will have alternating transverse areas of dense pile indicated at 110, 110 in FIGURE 5 and intermediate areas of less dense pile projections 111,

111. Since the groups of needles 79 and 80 are longitudinally offset along the fabric, the dense and less dense areas appear to alternate back and forth from one row of stitches to another. The effect can also be substantially enhanced by the use of different types or colors of yarn in each of the rows of stitches.

The present invention provides a novel fabric and means for producing this fabric which have not heretofore been achieved, partly due to the thinking that only constant feed of the backing cloth was feasible because of its penetration by the needles. However, since this penetration is so rapid, it appears that there is ample opportunity for the cloth to advance at any desired speed when the needles are raised, and the advancing increment during the time that the needles penetrate the cloth is insufficient to cause any undesired results. Presumably there is sufficient resilience or stretchability to prevent any tearing or rupture of the backing cloth.

Having thus described my invention, I claim:

1. In a tufting apparatus for tufting stitches through a moving backing fabric including at least two rows of longitudinally spaced needles in longitudinally offset relationship along the fabric, a feed roll on one side of the needles for moving the fabric through the tufting zone, and a take-up roll on the other side of the needles for moving the tufted fabric, the improvement for producing alternating areas of dense pile projections and intermediate areas of less dense pile projections in transversely staggered relationship across the fabric which comprises variable speed driving means operatively connected to said feed roll and said take-up roll for varying the speed of such rolls and pattern control means operatively connected to said driving means, said pattern control means including a first speed control section and a second speed control section having relatively greater speed control than said first section, each of said speed control sections providing uniform speed for the fabric when either of said sections is in operation during any tufting cycle.

2. The method of tufting a pile fabric which comprises the steps of feeding a backing fabric into and through a pile forming zone, simultaneously inserting two pile yarns through the same interstice in the backing fabric to form a single row of double pile projections, moving the fabric through the pile forming zone at a first uniform speed to produce a first series of dense pile projections and moving the fabric through the pile forming zone at a second uniform speed greater than said first speed to produce a second series of pile projections less dense than said first series.

3. The method according to claim 2 including the steps of differentially controlling the tension in the pile yarns in each row to provide high and low pile projections in the same interstices of said single row.

4. The method of tufting a pile fabric in accordance with claim 3 in which the height of the yarns in the first series alternates from high to low.

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