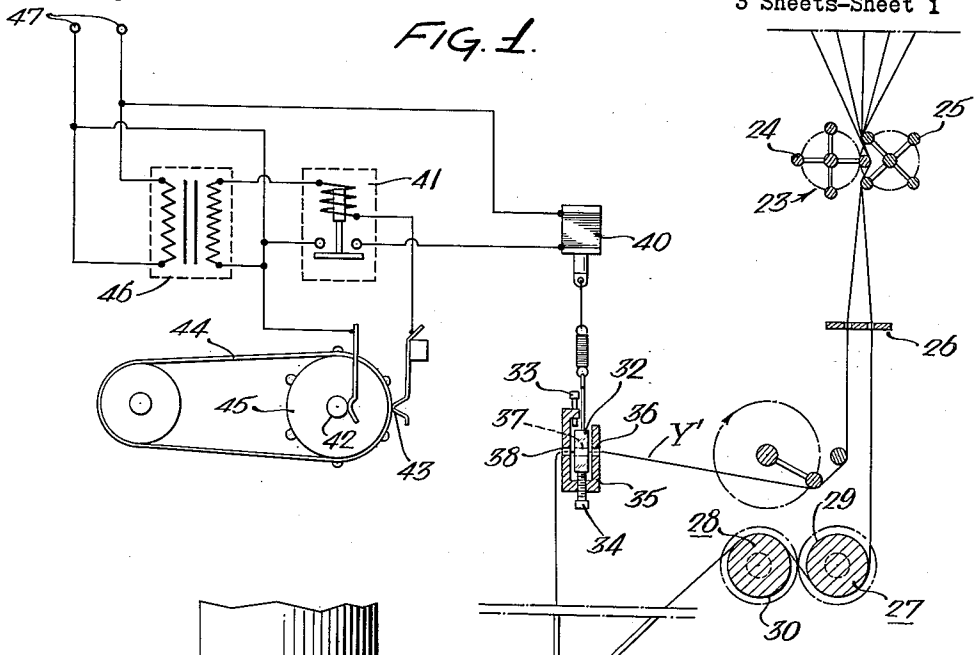
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METHOD FOR TUFTING PILE FABRICS

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FIG. 1.



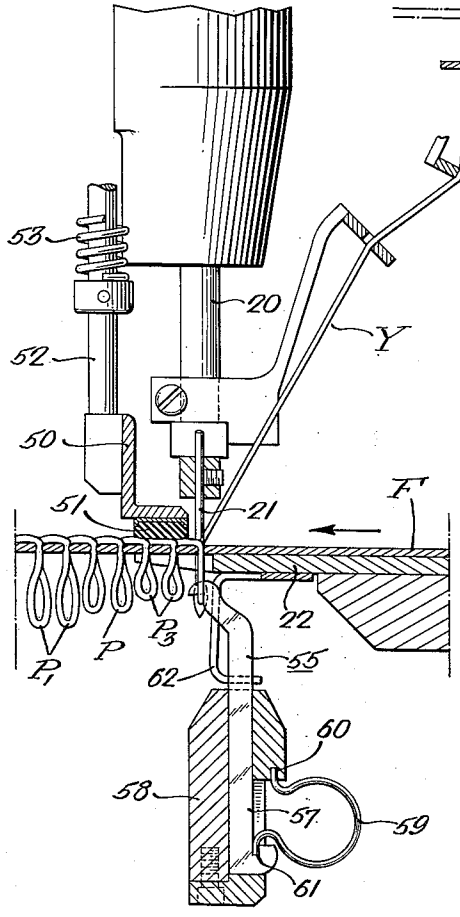
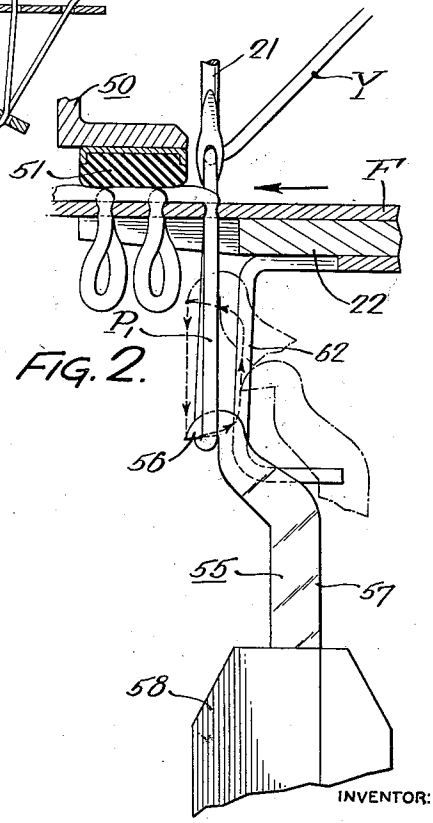


FIG. 2.



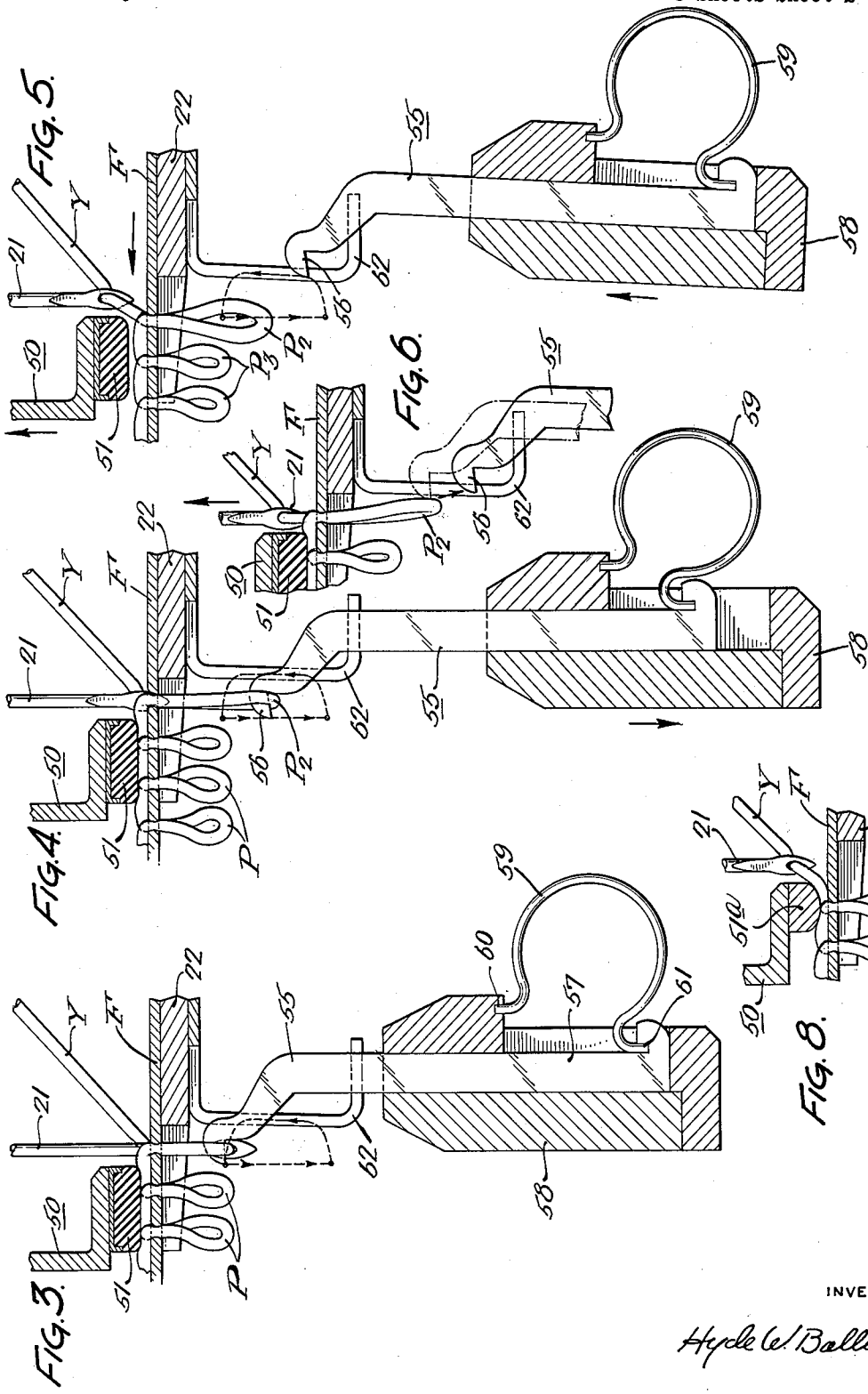
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FIG. 9.

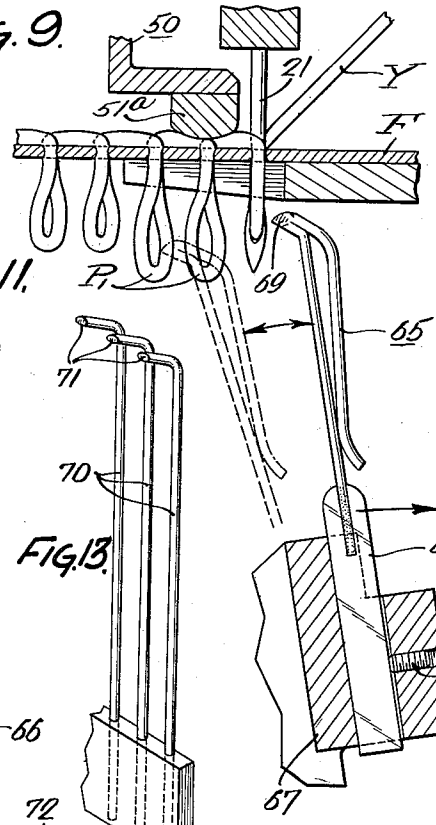


FIG. 10.

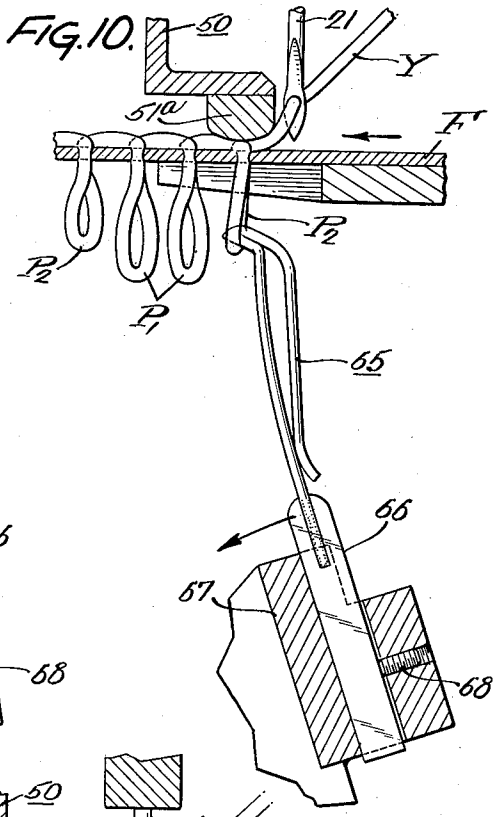


FIG. 11.

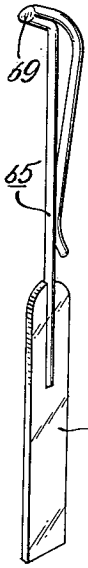
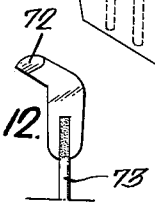


FIG. 13.

FIG. 12.



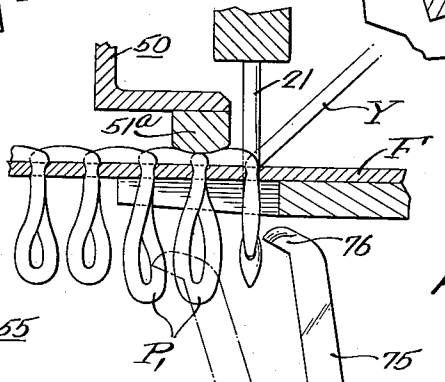


FIG. 14.

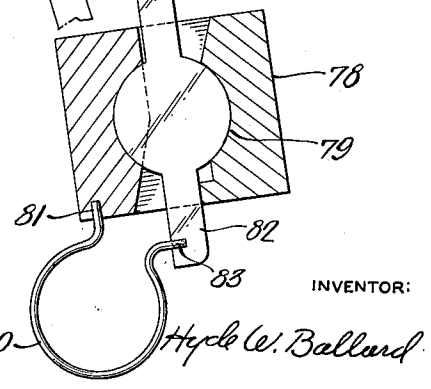


FIG. 15.

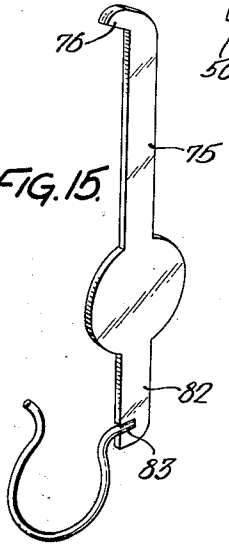
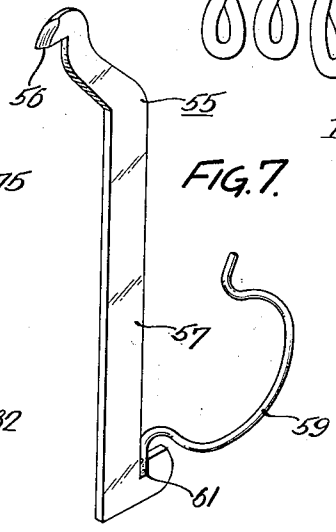


FIG. 7.



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METHOD FOR TUFTING PILE FABRICS

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Filed Sept. 5, 1957, Ser. No. 682,119
6 Claims. (Cl. 112—79)

This invention relates to the tufting of pile fabrics such as carpets and rugs and more particularly has to do with a novel method and apparatus for producing tufted pile fabrics with various pre-determined pile heights.

For some time there has been a popular demand for pile fabrics having a sculptured or patterned effect produced by a judicious selection of various pile heights. Methods and machines capable of producing such fabrics have been developed and placed on the market, but in all such machines the difference in height is obtained by robbing a certain amount of yarn from a previously formed loop. This robbing is usually accomplished by means of variable tension imparted to the individual ends or to selected groups of individual ends. The present invention accomplishes the same or an equivalent result without robbing any yarn whatsoever from previously formed pile projections. Furthermore, the present invention accomplishes variable pile height without changing the position of the needle bar or of the looper rockshaft. In a multi-needle tufting machine in which all the needles are controlled from one needle bar and all the loopers are controlled from one looper rockshaft, any change in the relative position of either would, of course, affect all the loopers or pile projections being formed in at least one transverse row. In accordance with the present invention, it is entirely feasible to control the height of a pile projection regardless of its position with respect to other projections.

A primary object of the invention, therefore, is to provide a novel method for tufting a pile fabric having pile projections of pre-determined height in accordance with a pattern.

A further object of the invention is to provide a method of fabricating a pattern tufted fabric in which a predetermined amount of yarn is always carried by the needle to the same depth below the base fabric whereupon the pile projection thus formed is contracted or elongated in accordance with a pre-determined pattern.

A still further object of the invention is to provide a resilient looper which engages pile projections inserted by a needle and subsequently releases the projection if a predetermined tension is applied to the yarn.

A further object of the invention is to provide a spring-loaded looper for a tufting machine in which pile loops are held at maximum projection under conditions of minimum tension in the yarn but in which the looper automatically releases pile yarns which are subjected to more than a pre-determined tension.

A further object is to provide a spring-loaded looper in a tufting machine having variable displacement in accordance with the tension in the yarn and means for disengaging the yarn from the looper.

A further object of the invention is to provide a resilient looper which is bendable to release a yarn loop subjected to a pre-determined tension.

A further object of the invention is to provide a resilient looper for a tufting machine which is yieldable to permit the formation of variable height pile projections.

A further object is to provide a resilient presser foot operable to clamp previously stitched yarn to prevent robbing of yarn from a previously formed pile projection.

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

FIG. 1 is a schematic view partly sectioned, showing a tufting machine having a pattern attachment and a resilient looper constructed in accordance with the present invention,

FIG. 2 is an enlarged view of the looper of FIG. 1 showing the manner in which it oscillates,

FIGS. 3–6 show various positions in the operation of the looper of FIGS. 1 and 2,

FIG. 7 is a perspective of the looper of FIGS. 1–6,

FIG. 8 is a sectional detail showing a modified form of presser foot,

FIG. 9 is a sectional detail showing a modified form of looper which is resiliently bendable to release pile projections,

FIG. 10 shows the structure of FIG. 9 in a moved position,

FIG. 11 is a perspective of the looper of FIGS. 9 and 10,

FIGS. 12 and 13 are details of modified forms of bendable loopers,

FIG. 14 shows another form of resiliently mounted oscillating looper, and

FIG. 15 is a perspective of the looper of FIG. 14.

The invention comprises essentially the provision of a resiliently displaceable looper for a tufting machine which engages a pile projection and either holds the projection or extends it to a maximum position under conditions of minimum tension in the pile yarn but which is resiliently yieldable to permit the formation of a shorter pile projection under conditions of selective elevated tension in the particular pile yarn engaged by the looper. With a resilient looper of the type disclosed, it is possible to employ one of the conventional forms of pattern attachments for tufting machines to provide variable height loops in accordance with a pre-determined pattern without withdrawing yarn from a previously formed pile projection. The present invention is shown in conjunction with both a presser foot and a stripping comb for the loopers, but it will be understood that either or both of these may be eliminated under certain conditions, and for many types of fabrics. In the following description it will be understood that a pile fabric produced on a multi-needle tufting machine is stitched in an upside-down condition and in a horizontal plane. Therefore, high pile in the fabric when placed on the floor is actually produced by pile projections which appear lower or deeper when the fabric is in an inverted condition in the tufting machine.

Referring now more particularly to the drawings, a conventional tufting machine has a needle bar 20 which carries a plurality of tufting needles 21 that are oscillated to insert pile projections P through a base fabric F being fed across the throat plate 22 of a tufting machine. The needle bar 20 is oscillated from a crankshaft, not shown, in the usual manner. The yarn Y is fed to the needles 21 from a yarn supply, such as a creel (not shown), through a feeding mechanism 23 which may take the form of beaters having interdigitating elements 24 and 25. The yarn then passes through a guide 26 and over feed rollers 27 and 28 having friction or sand surfaces 29 and 30. The rollers 27 and 28 may operate at constant peripheral speed to feed selected yarn ends to the tufting mechine, thereby providing some yarns under constant tension to produce constant height pile projections. Alternatively, the speed of rollers 27 and 28 can be varied in accordance with a speed control mechanism, thus varying the tension in the yarn ends threaded around rollers 27 and 28 to provide pile projections of different heights. Another form of tension control which operates on individual ends rather than selected groups of ends, as in the case of a roller attachment, is shown in FIGURE 1 in which a sinker 32 is selectively raised and lowered between limit stops 33 and 34 to snub an in-

dividual yarn end W_1 between the sinker 32 and a housing 35. When the sinker is lowered, the yarn Y_1 travels freely through a series of aligned holes 36, 37 and 38 in the housing and the sinker to remove substantially all tension from the yarn. The energization of a solenoid 40 through relay 41 and contacts 42 and 43 elevates the sinker 32 to impart elevated tension to yarn Y_1. A non-conductive belt or tape 44 having perforations permits selective closing of the circut to relay 41 through contact 43 and conductive drum 45. The electrical circuit is completed through a transformer 46 and power supply 47. It will be understood that pattern attachments of the individual sinker type or of the roller type are not a part per se of the present invention but are utilized to selectively increase the tension on various yarn ends whereby the desired pattern is produced.

A presser foot 50 is provided with a rubber or elastomeric face 51 and is resiliently mounted on the needle bar or some other oscillating structure of the tufting machine by means of a shaft 52 and spring 53.

In the form of FIGS. 1–6 the individual loopers 55 are provided with a bill 56 and a shank 57 which is slidably mounted in a housing 58. The housing 58 is apertured and slotted to carry a fly spring 59 which engages the housing at one end 60 and a notch 61 at the base of each looper 55. The loopers extend through slots in a stripper or comb 62 to insure that the yarn is detached from the bills 56 of the loopers. The looper rockshaft for oscillating the loopers is well known in the tufting machine art, and this construction has been used for many years to produce cut or uncut pile. Examples of such rockshafts which mount oscillating loopers may be found in the following patents: No. 362,368; No. 438,427; No. 1,485,213; No. 1,800,522; No. 2,423,608; No. 2,482,682; No. 2,804,835.

Referring now to FIGS. 3–6, when the needle 21 has penetrated to its maximum depth to carry the yarn Y through the backing fabric F, looper 55 oscillates in a forward direction to engage the bill 56 of the looper between the pile projection on needle 21 and the needle. The looper then moves downwardly as shown by the arrows in FIG. 3 to carry the yarn to a somewhat lower position in accordance with the tension in yarn Y and the reaction of spring 59. If there is a condition of minimum tension in yarn Y the pile projection on the needle will be pulled down a maximum amount such as shown by the high loop P_1 in FIGS. 1 and 2, so that there will be no relative displacement of looper 55 with respect to the housing 58. The looper then oscillates slightly and withdraws in back of the stripper to disengage the yarn from the bill of the looper, whereupon the looper moves upwardly following the path shown in FIG. 2 to engage the next pile projection. If, however, there has been applied more than a pre-determined minimum tension in yarn Y either by means of pattern roller attachments or the solenoid-actuated attachment described above, then the looper 55 will be pulled upwardly against the pressure of spring 59, as shown in FIG. 4, so that a full length of loop is not formed. Upon pivoting of the looper housing 58 this shortened loop P_2, shown in FIG. 5, is removed from the looper by means of stripper 62, whereupon the looper is elevated and pivoted to repeat the cycle. The dotted position of the looper 55 in FIG. 6 illustrates the point at which the pile projection P_2 becomes disengaged from the looper through action of the stripper. As soon as this disengagement occurs, the looper immediately returns to its normal at rest position in housing 58 under action of spring 59. This position is shown in full lines in FIG. 6. Further increase of tension provided by any suitable tension control device will additionally displace the looper 55 upwardly to provide the lowest or minimum height pile projections P_3 all in accordance with the selection of the pattern mechanism.

The presser foot 50, when it is desirable to use this element, clamps the yarn by the pile projections, as shown in FIGS. 3 and 4, to positively prevent the withdrawal of any yarn from the previously formed projections. When the needle 21 is elevated to become disengaged with fabric F, as shown in FIG. 5, the presser foot 50 also momentarily releases the fabric so that it can be advanced for the next needle insertion. The resilient face 51 on the presser foot may be rounded, as shown in FIG. 8 at 51*a*, and made of any desirable width so that accurate timing of the presser foot may be avoided. In this way the fabric F can be advanced even through the presser foot is partly or wholly engaging the fabric simply by bending the resilient face 51*a*.

A modified form of spring looper is shown in FIGS. 9 and 10 in which a bendable wire looper 65 is mounted in a bracket 66 clamped to bar 67 by means of a set-screw 68. The bendable wire 65 is provided with a bill 69 suitably beveled to enage the yarn carried by needles 21. The wire forming the looper may be carried backwardly and anchored in element 66 or the other end and be left free, as shown in FIG. 9. This looper has no dual motion as does the looper 55, shown in FIG. 2. Simple pivoting oscillation of the housing 67 on the conventional looper shaft serves to engage the bill 69 of the looper wth the pile projection carried by needle 21. Under conditions of minimum tension in yarn Y there is no flexing of the looper 65, so that the loop or pile projection P_1 is retained at its full depth caused by the penetration of needle 21. Where tension is applied to the particular yarn, the resilient looper 65 flexes to permit the loop to be drawn back with the needle, so that a lower projection P_2 is formed. Depending upon the relative tensions in the looper and the yarn, limited flexing may take place or the loop may spring off completely and become disengaged from the bill of the looper. Naturally the height of the loop can be controlled by simple flexing of the looper, flexing of the looper with substantially simultaneous disengagement, or flexing of the looper with subsequent complete disengagement. The desired height of the pile projection as dictated by the pattern and the size and tension of the pile yarns will determine the precise manner in which the action of the looper takes place. Another consideration relating to the action of the looper will be the angle that the bill of the looper makes with regard to the shank of the looper as well as its length. Where my flexible looper is used on the conventionally-located looper rockshaft, it is preferable that the angle between the underside of the looper bill and the center line of the looper be obtuse, as is indicated in FIGURES 9–14. In the construction of FIGURES 1–5, this angle may be equal to or less than 90°, because the loops are mechanically released by means of the stripper.

Where less resiliency may be indicated, the resilient loopers 70 may be of a single length of flexible material having bills 71, 71 that are displaceable when the yarn is subjected to more than a predetermined tension. A modified version of the spring looper of FIG. 13 is shown in FIG. 12 in which the bill 72 is mounted upon a resilient element 73 in the looper so that there is no resiliency in the bill itself but flexing is provided by means of dependable element 73.

A still further modification is shown in FIGS. 14 and 15 in which a non-resilient looper 75 having a somewhat biased bill 76 and a bearing element is mounted in a housing 78 having a bore 79. A fly spring 80 is anchored in housing 78 at 81 and in the tail section 82 of looper 78 at 83. Here again under conditions of minimum tension in yarn Y there will be no relative pivoting of looper 75 in housing 78, so that high pile projections P_1 are consequently formed. Under conditions of elevated yarn tension, spring 80 flexes to permit looper 76 to pivot in housing 78, thus prematurely releasing the yarn and permitting it to spring back or draw up if the needle 21 is retracted from the fabric F.

To summarize and to clearly define the scope of the

present invention in its broadest aspects, the yarns supplied to a broad tufting machine having several hundred needles are tensioned either individually or in groups to such a degree (up to or beyond their elastic limit) that pile projections actually being formed by the simultaneous and substantially equal penetration of all the needles through a backing fabric are controlled as to height or depth without the necessity for supplying any yarn for the projections being formed from projections previously formed.

It will thus be understood that I have provided a method and apparatus for tufting a pile fabric in which the height of the individual pile projections can be selectively controlled in accordance with a predetermined pattern without withdrawing the yarn from previously formed projections. There is no individual activation to relatively displace the needles or the loopers other than the tension in the individual yarn ends. The apparatus is relatively inexpensive, free from maintenance problems, and easy to install. Depending upon the type of yarn used and the pattern being produced, it is not at all times necessary to employ the presser foot or the stripper comb, and in some circumstances it has been found that a judicious selection of the angle or bill on the looper permits the yarn to slip off the looper at the desired time with little or no flexing of the looper and with little or no pressure of the presser foot.

Having thus described my invention,

I claim:

1. The method of producing a pattern tufted pile fabric which comprises the steps of inserting a transverse series of pile yarn projections through a backing fabric, varying the tension in the pile yarns forming said projections in accordance with a predetermined pattern, holding the projections on the opposite side of the backing fabric, and releasing certain of said held pile projections solely in accordance with said varying tension in the yarns without removing yarn from previously formed projections.

2. The method of producing a pattern tufted pile fabric which comprises the steps of inserting a transverse series of pile yarn projections through a backing fabric, to a uniform depth under conditions of minimum controlled tension, positively engaging all of said pile projections when inserted through the backing fabric to a uniform depth, applying relatively greater tension to certain of said inserted pile projections substantially at the time of maximum insertion, selectively disengaging said pile projections by means of said relatively greater tension, and shortening the first selectively disengaged projections to an ultimate height lower than later disengaged pile projections in accordance with a predetermined pattern.

3. The method of producing a pattern tufted pile fabric which comprises the steps of inserting a transverse series of pile yarn projetcions through a backing fabric to a uniform depth under conditions of minimum controlled tension, positively engaging all of said pile projections when inserted through the backing fabric to a uniform depth, maintaining the height of previously inserted pile projections fixed during said inserting step, applying relatively greater tension to certain of said inserted pile projections substantially at the time of maximum insertion, selectively disengaging said pile projections by means of said relatively greater tension, and shortening the first selectively disengaged projections to an ultimate height lower than later disengaged pile projections in accordance with a predetermined pattern.

4. The method of claim 1 in which the projections are yieldably held on the opposite side of the backing fabric.

5. The method of claim 2 in which the pile projections are yieldably held after insertion through said backing fabric.

6. The method of claim 3 in which the pile projections are yieldably held after insertion through said backing fabric.

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