

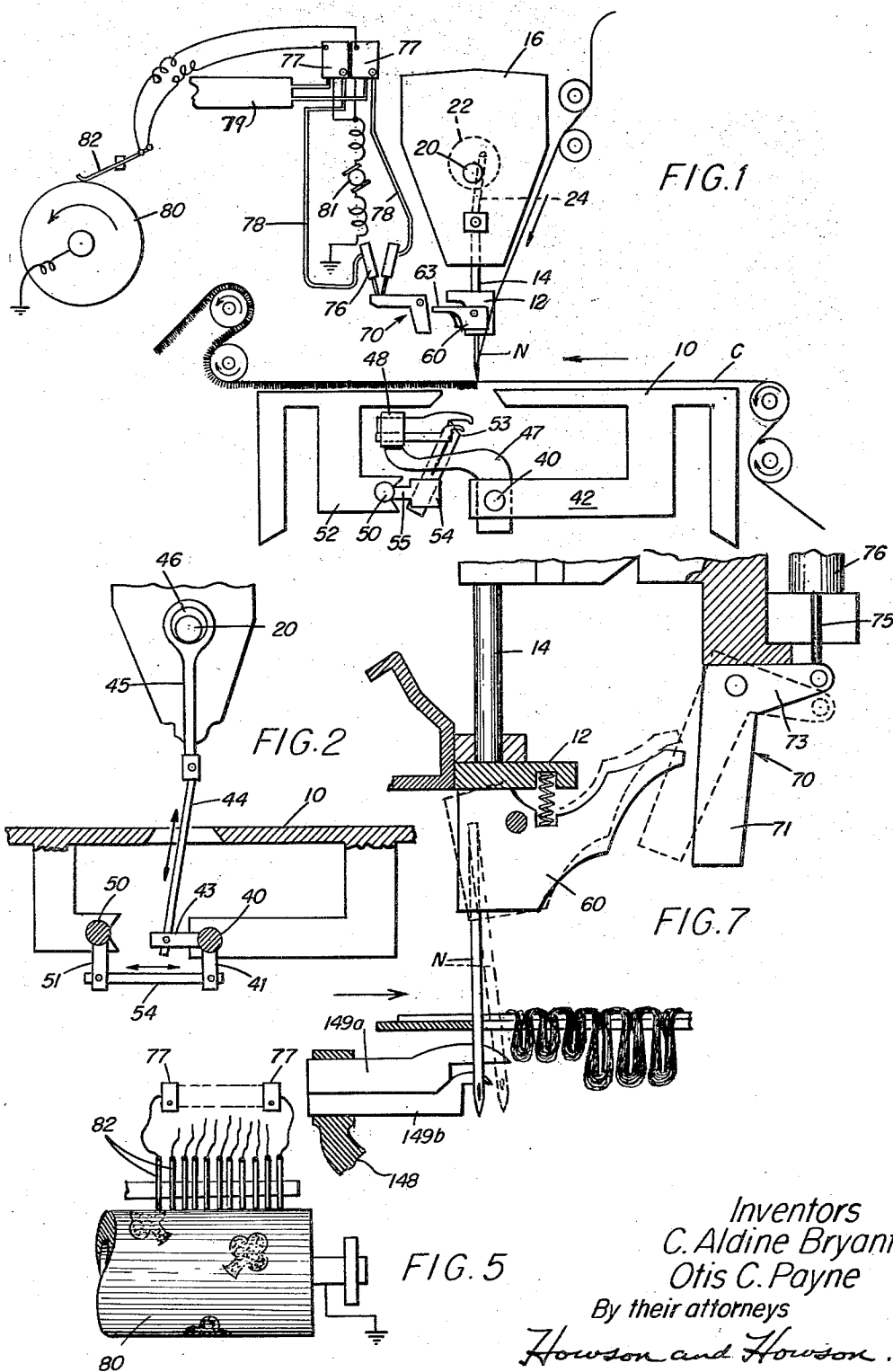
Oct. 29, 1963

O. C. PAYNE ETAL
MACHINE FOR PRODUCING PILE FABRICS HAVING
DIFFERENT PILE HEIGHTS

3,108,554

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2 Sheets-Sheet 1



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FIG. 4

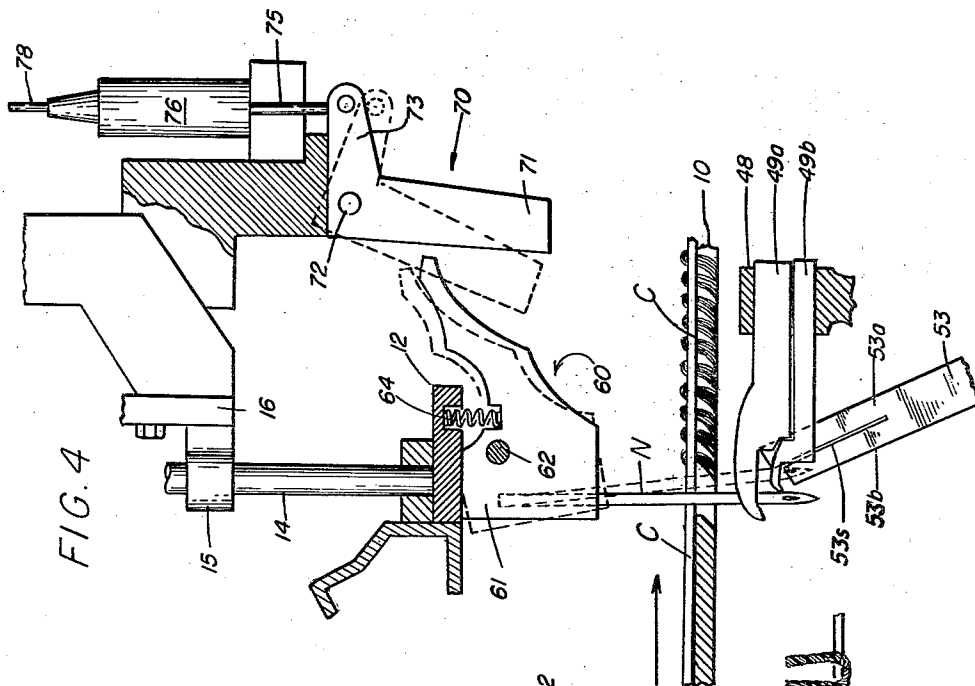


FIG. 3

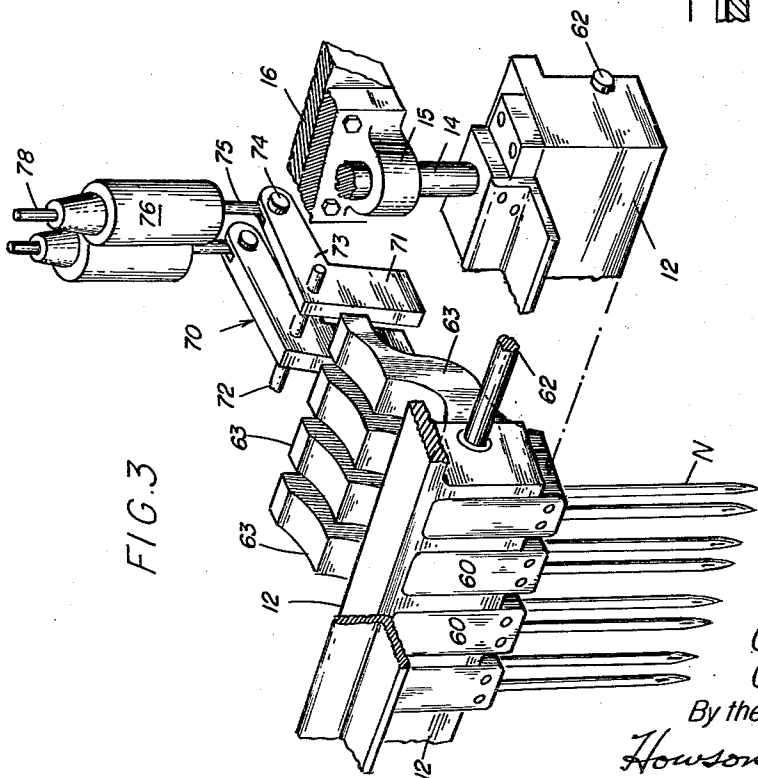


FIG. 6



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MACHINE FOR PRODUCING PILE FABRICS HAVING DIFFERENT PILE HEIGHTS

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13 Claims. (Cl. 112-79)

This invention relates to a machine for making pile fabrics by the formation of loops in a cloth or foundation sheet. More particularly, it relates to a machine for producing tufted fabrics in which the pile may be of different heights in selected areas over the whole surface of the fabric as may be desired in accordance with a chosen pattern. The pile may be all cut pile or all loop pile.

One object of the invention is to provide novel means operative without interrupting the running of a tufting machine which will form the same type of pile (cut or loop) over the whole area of a carpet or other tufted fabric with the pile of different heights in selected areas.

Another object is to provide a machine of the foregoing type in which the selection of the height of the pile is done by action of the needle.

Another object of the invention is to provide a machine of the foregoing type in which the different heights of pile produced over the surface of the tufted article may be in accordance with a pattern without regard as to shape, and in which no limits will be imposed by the machine itself as to the nature of the pattern which can be produced in the manufactured article.

Another object of the invention is to provide a machine of the foregoing type which can make loop pile fabric or cut pile fabric over its whole area in which the pile is of different heights at different places, as determined by any desired pattern, and in which the action of the needle determines which of two loopers shall catch the yarn to form high or low pile, respectively.

Another object of the invention is to provide a machine of the foregoing type in which two loopers each having a separate point or bill and both located on the same side of the needle with respect to cloth travel cooperate with each needle and determine the height of the pile and in which the action of the needle determines by which of the two loopers yarn shall be caught.

Another object of the invention is to provide a machine of the foregoing type in which a tiltable needle has its action controlled according to a pattern for cooperation with one or another of two loopers which determine the height of the pile which is to be formed on any particular needle reciprocation. A related object is to provide cutting means associated with the looper to form cut pile.

Other objects and advantages of the invention will become apparent as it is described in connection with the accompanying drawings.

In the drawings:

FIG. 1 is an end elevation view diagrammatically illustrating a machine embodying the invention.

FIG. 2 is an elevational section view through the machine of FIG. 1 illustrating the rocking mechanisms.

FIG. 3 is a fragmentary perspective view showing the needle tilting mechanism.

FIG. 4 is a vertical section view showing the needle tilting mechanism of FIG. 3.

FIG. 5 is an elevational section view, partly broken away, illustrating the pattern drum and associated parts.

FIG. 6 is a detail view illustrating the high and low cut pile produced by the machine of FIGS. 1-5.

FIG. 7 is a vertical section view of another form of the invention showing the needle tilting mechanism and

its cooperation with the loopers for making high and low loop pile.

Referring to the drawings, the invention is applied to a tufting machine having a flat work-support 10 over which the work or cloth C is moved during the tufting operation. Above the work-support is a needle-supporting bar member 12 on which are tiltable mounted a plurality of needles N, as hereinafter more fully described. The needle bar is reciprocated vertically by two or more vertical thrust shafts 14 to which the bar is attached at each end and along the bar, depending upon its length and the number of needles it carries.

The thrust shafts 14 are suitably and conventionally guided in their reciprocation by guides 15 in a head or frame 16 fixedly mounted over the work support 10. A main drive shaft 20 rotatably mounted horizontally in the head or machine frame 16 has an eccentric 22 thereon to which is pivotally connected the upper end of a crank 24 causing reciprocation of the crank whose lower end is pivotally connected to the needle-bar-thrust shaft or shafts 14 whereby the needle bar is reciprocated vertically above the table 10. It will be understood that the means described for reciprocating the needle bar is exemplary and any of a number of means now in common use for reciprocating the needle bar of tufting machines can be used with equal satisfaction.

Beneath the work support are two horizontal parallel rock shafts 40 and 50 supported for rotation in bearings in pairs of arms 42 and 52 which are integral with and extend under the work support 10 at spaced points along the shafts 40 and 50, only one arm of each pair being visible.

Rock shafts 40 and 50 are rocked in unison by radial arms 41 and 51 (see FIG. 2) extending from shafts 40 and 50, respectively, and linked together by a link 54 pivotally connected at its ends to said arms 41 and 51. Rock shaft 40 is rocked by a lever arm 43 radially extending therefrom and pivotally connected with a connecting rod 44 which in turn is pivotally connected with the lower end of an eccentric rod 45. The upper end of the eccentric rod 45 has a loop in which rotates an eccentric 46 on the main drive shaft 20. Thus, eccentric 46 is responsible for the rocking of both shafts 40 and 50.

Mounted on the rock shaft 40 are one or more horizontally spaced identical looper-supporting arms 47 carrying a horizontally extending block 48. Fixedly mounted in the block are a series of upper and lower looper elements 49a and 49b, there being a pair of such looper elements to cooperate with each needle. The loopers extend toward the needles. As shown in FIGS. 1 and 4, the loopers are for making cut pile of different heights and they are pointed opposite the direction of cloth travel.

The block 48 has a series of parallel vertical slots along its length which receive the shanks of loopers 49a, 49b in the same plane, one above the other. Preferably the loopers are separate and individual elements in order that one or the other, or both, may be replaced with longer or shorter elements or with elements having higher or lower points, or both. Also separate elements allow separate positioning horizontally or vertically as, for example, by use of flat or tapered shims. However, the invention may also be practiced successfully when the upper and lower loopers are integrally formed as one piece.

The upper and lower loopers 49a, 49b, as shown best in FIG. 4, are similar in form, but are not identical. Both have shanks mounted in the block or holder 48 and extending horizontally therefrom opposite the direction of cloth movement, the latter being indicated by an arrow in FIG. 4.

The upper looper has a longer point or bill than the

lower. As the loopers are rocked back and forth in the course of the machine operations, the upper looper point or bill will move across the path in which the needle bank moves when the needles are vertical; and each upper looper will move alongside its needle and will catch and hold the yarn loop as the needle moves up and withdraws from the cloth C. But the lower looper, being shorter, does not rock far enough toward the vertical path of the needle and, hence, cannot catch the yarn.

In order for the lower looper to catch and hold a loop as the needle reciprocates and penetrates the cloth, the lower end of the needle must be moved closed to the lower looper and to carry the yarn loop into the path of the lower looper point or bill. This is accomplished by tilting the needle as shown in dotted lines in FIG. 4.

The tiltable mounting of the needle and the means to cause or not to cause tilting of each needle or group of needles selectively at predetermined times in accordance with a pattern may be as described in copending application Serial No. 690,995, filed October 18, 1957, owned by the assignee hereof. In said application are claims, dominating the present invention, for formation of pile of different characteristics according to a pattern by varying the operation of the needle so that yarn will be caught on one or another of two loopers. As therein disclosed, the needles may be mounted singly, or in pairs as shown, or in larger groups, in tiltable holders 60 (see FIGS. 3 and 4 herein) which are carried pivotally on a horizontal shaft 62 supported in the vertically-reciprocating needle-supporting bar 12. The needles N extend downwardly from the bottom faces of the holders 60 which extend horizontally. In the head portion 61, the needles are mounted side by side, and an arm portion 63 extends laterally.

The tiltable needle holders 60 are inserted in a series of slots provided in the needle supporting bar 12. Compression springs 64 between each holder and the top of its slot urge the holder to maintain the needles vertically normally with the top face of the holder flush against the needle bar 12.

To tilt the needle holders and needles, a series of needle tilt levers 70 (there being one lever for each holder) are mounted in a row on a fixed horizontal shaft 72 mounted in a fixed part of the machine adjacent to, but out of the path of reciprocation of the needle bar. A series of slots are provided in said part for the reception individually of the levers 70 with one leg 71 of each lever extending vertically and being tiltable into engagement with the needle tilt arms 60.

Tilting of the levers 70 is accomplished by individual pneumatic cylinders 76 which are selectively actuated by opening and closing air valves operated by electric solenoids which are, in turn, selectively energized by a pattern drum, as will hereinafter more fully appear.

The horizontal leg 73 of each bell-crank lever 70 extends away from the needle bar 12 and has loosely connected to it on its end as by a pin-and-slot connection 74, the lower end of a piston rod 75. Each piston rod extends downwardly from a vertically mounted pneumatic cylinder 76 in which the piston is normally pressed upwardly by a coiled compression spring (not visible) within the cylinder, in usual fashion.

As the air pressure is admitted to each cylinder through their individual compressed air pipes 78 connecting with the cylinder at its top, the piston and piston rod are pressed down causing pivoting of the needle tilt lever 70 clockwise (referring to FIG. 4) and pressing its vertical leg 71 into the path of its tiltable needle holder 60. Hence, as the needle bar 12 descends, the needle holders 60 are tilted into the dotted position of FIG. 4 by the levers 70 so that when the needle has penetrated the cloth, it is positioned at a small angle from the vertical, approximately 15° more or less, and puts the loop of yarn in the path of the lower looper 49b by which it is caught and held.

Either high and low cut pile or high and low loop pile may be formed by this invention.

In FIGS. 1-4, the arrangement is shown for making cut pile. A cutter, designated generally by the numeral 53, is mounted in a slot in a supporting bar or block 54 extending longitudinally of the machine. There is a cutter for each pair of upper and lower loopers. The cutter support 54 is connected to the rock shaft 50 by a radial arm or arms 55. The rocking of the cutter causes loops on the looper to be cut. Ordinarily several loops will accumulate on the looper before the first-formed of those several loops is cut.

The cutter, as may be seen best in FIG. 4, is a thin metal blade directed obliquely upward from its mounting and having its upper end sharpened and at an angle to the looper bills. The cutters slide against the side surfaces of the upper and lower loopers and in usual scissor-like fashion the loops are cut.

Since there are two loopers with which the cutter cooperates, the cutter is slit centrally along its length, as at 53s, partway from its cutting edge toward its mounting. Two separate blades 53a, 53b are thus provided which cooperate separately with the upper and lower loopers respectively; and they are separately flexible to compensate for any possible small variations of the sides of the loopers with respect to one another which could otherwise reduce the effectiveness of the cutting action of one blade or the other.

The blade 53a for the upper looper is longer than the blade 53b so that the top edge of the blade 53a is above the edge of blade 53b, the respective lengths being such that simultaneous cutting action occurs at the upper and lower loopers.

Conventional gearing drives the rock shafts 40 and 50 for the loopers 49 and knives 53 so that the knives operate once for each looper oscillation. These motions are coordinated through the gearing with the needle reciprocations to cut the loops after the needles rise.

It is necessary that the tilting of the needles for formation of cut pile be in the direction of movement of the cloth over the table of the machine. Also, the loopers 49a, 49b and their knives 53a, 53b should be on the side of the needle from which the cloth is receding.

In FIG. 7, the arrangement is shown for making loop pile. In this arrangement, the loopers 149a, 149b generally speaking are as previously described. However, variations in the precise shaping of the looper bills from the shapes illustrated, or as used for cut pile, will occur to those skilled in the art, bearing in mind that the loops must be able to slide off the loop-pile loopers easily as the cloth moves on and the loopers rock back.

As has been previously indicated, the loopers are mounted in an oscillating looper block 148; but in this instance, the loopers point in the same direction as the cloth travels, as indicated by the arrow in FIG. 7; and the needle tilts in the direction of the cloth feed. FIGS. 1 and 7 may be compared. In them one views the two forms of the machine from opposite sides. (In FIG. 4, one views the machine of FIG. 1 as in FIG. 7.)

In FIG. 7, the tilting of the needle will cause formation of low pile in contrast to FIG. 4 wherein the tilting will cause formation of high pile. This is because in FIG. 7 on normal vertical reciprocation as shown in full lines, the lower shorter looper 149b will enter the yarn loop formed by the needle descent and will hold it; but on tilting, the low short looper will be cleared, but the upper longer looper will not. Hence, the upper looper will catch the yarn loop and will cause a loop of less height (a low loop) to be formed.

In order that a loop which is to be cut to form high pile shall be spaced exactly the same distance from the previous tuft of low pile and so that the tufts throughout the length of the carpet shall be equally spaced, it is desirable for the needle to start tilting just after it starts to enter the cloth. Bearing in mind that the cloth is

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moving continuously and that as the needle descends it tilts more and more, it will be understood that the tilt follows the cloth movement after having penetrated at a point exactly spaced from the previous penetration when the previous loop was formed. If the needle was fully or partially tilted before starting to penetrate the cloth, the penetration would be too close to the previous loop and would give an uneven appearance to the fabric. The foregoing observations and provisions as to equal spacing apply also to the formation of high and low loop pile.

Selection of needles to be tilted may be by the same pattern control for the tilting means as disclosed and claimed in the aforementioned copending application Serial No. 1,037 wherein a pattern drum 80 controls energizing or deenergizing of electrical devices selectively to operate selected pneumatic cylinders 76 and to tilt selected needles.

Admission of air to each cylinder 76 is controlled by conventional, individual electric solenoid operated air valves 77 in each air line 78 from the compressed air source 79 to each cylinder 76.

The solenoid valves 77 are connected electrically, as usual, to a suitable common source 81 of electric current; and each valve is also electrically connected individually to one finger in a row of contact fingers 82 which are insulated from one another and rub over a rotating drum 80 which is likewise connected to the common or ground side of the circuit. A pattern having conductive portions corresponding to the areas where high pile is to appear in the rug and non-conducting portions where low pile is to appear is laid on or affixed to the surface of the drum so that as the drum rotates certain fingers contact with the conductive portion causing energization of the solenoids connected to those fingers and opening of air valves, thereby to tilt individual needles.

Rotation of the drum is regulated and determined in accordance with the speed of production of a given length of the rug or tufted article which the pattern is to cover, one revolution taking place during the production of said given length.

Many modifications within the scope of the invention will occur to those skilled in the art. Therefore, the invention is not limited to the specific form and arrangement described and illustrated.

What is claimed is:

1. In a tufting machine, a work support across which a foundation sheet is adapted to be fed in a predetermined direction, a yarn-carrying needle, means to reciprocate said needle to penetrate said sheet to form yarn tufts, upper and lower looping means on the same side of said needle but on the opposite side of said support from said needle, means to oscillate said looping means the same distance on each oscillation to catch yarn loops formed by said needle in said foundation sheet, and means to tilt said needle to move said needle point and yarn to and fro in line with the direction of movement of the foundation sheet to cause either said upper or said lower looping means to hold the yarn loop in accordance with the to or fro position of the needle and yarn to form tufts of different heights.

2. A tufting machine as claimed in claim 1 having pattern-controlled means to operate said needle-moving means to create different heights of tufts in the foundation sheet according to a pattern.

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3. A tufting machine as claimed in claim 2 having cutting means to sever the loops on said looping means.

4. A tufting machine as claimed in claim 1 having cutting means to sever the loops on said looping means.

5. A tufting machine as claimed in claim 1 having separately flexible cutting means separately cooperating with said upper and lower looping means respectively to sever the loops on said looping means.

6. A tufting machine comprising a work support, a bank of yarn-carrying needles above the support, means to reciprocate the needle bank for penetrating a foundation sheet moving in a predetermined direction over said support, a first looper below the support for each needle adapted to catch yarn carried by its needle and to hold a loop, means including a second looper bentath said first looper adapted to catch yarn carried by said needle and to form pile of a greater height than that formed by the first looper, means to oscillate said loopers the same distance on each oscillation, tiltable needle-holding means on which at least one needle is mounted, and means to separately tilt said needle-holding means to move said needle points and yarns to and fro in line with the direction of movement of the foundation sheet to cause either said first or said second looper to hold the yarn loop formed by its needle in accordance with the to or fro position of the needle.

7. A tufting machine as claimed in claim 6 having pattern-controlled means to operate said needle-moving means individually to create the different heights of tufts in the foundation sheet as determined by a pattern.

8. A tufting machine as claimed in claim 7 wherein the loopers point in the same direction as the feed of the foundation sheet and form high and low loop pile.

9. A tufting machine as claimed in claim 6 wherein the loopers point in the same direction as the feed of the foundation sheet and form high and low loop pile.

10. A tufting machine as claimed in claim 6 having cutting means acting with the loopers to sever the loops to create high or low cut pile.

11. A tufting machine as claimed in claim 10 having pattern-controlled means to operate said needle-holding means individually to create high or low cut-pile as determined by a pattern.

12. A tufting machine as claimed in claim 6 having separately flexible cutting means separately cooperating with said upper and lower loopers individually to sever the loops on the respective looping means.

13. A tufting machine as claimed in claim 12 wherein the cutting means for a pair of said first and second loopers is unitary with separate blades for said first and for said second loopers.

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