

Jan. 29, 1963

R. T. CARD

3,075,482

THREE-LEVEL TUFTED PILE APPARATUS

Filed June 15, 1961

4 Sheets-Sheet 1

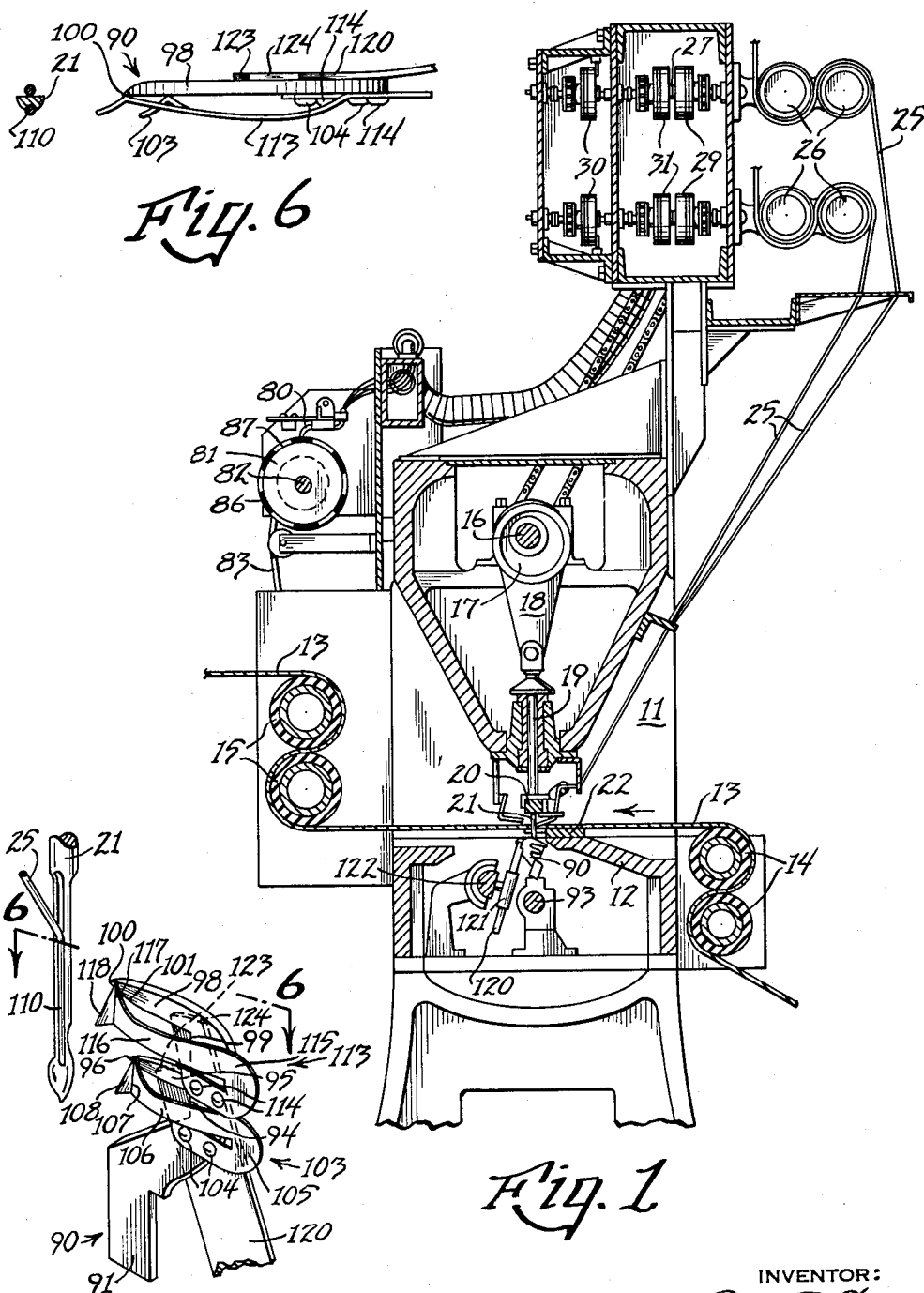


Fig. 5

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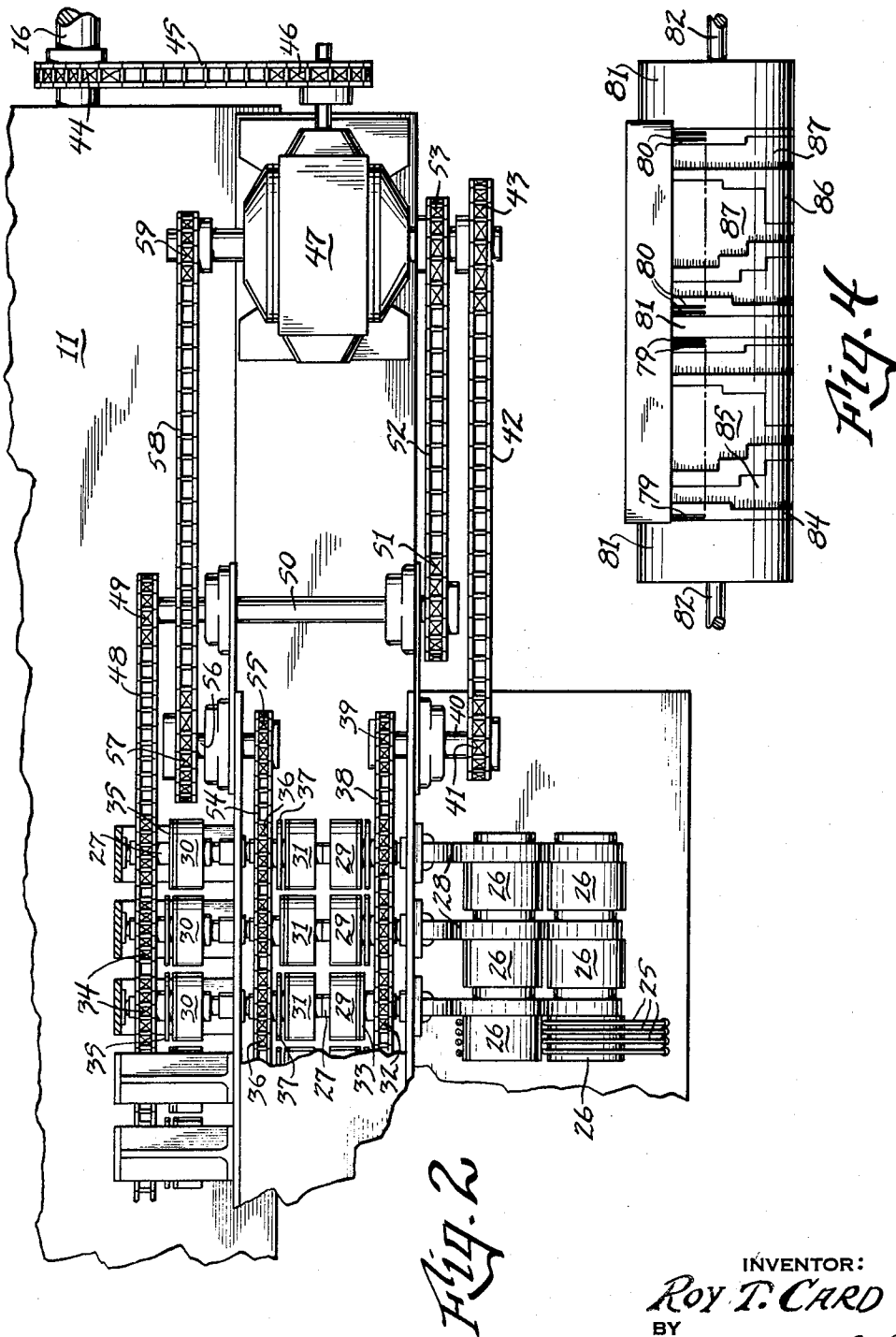
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4 Sheets-Sheet 2



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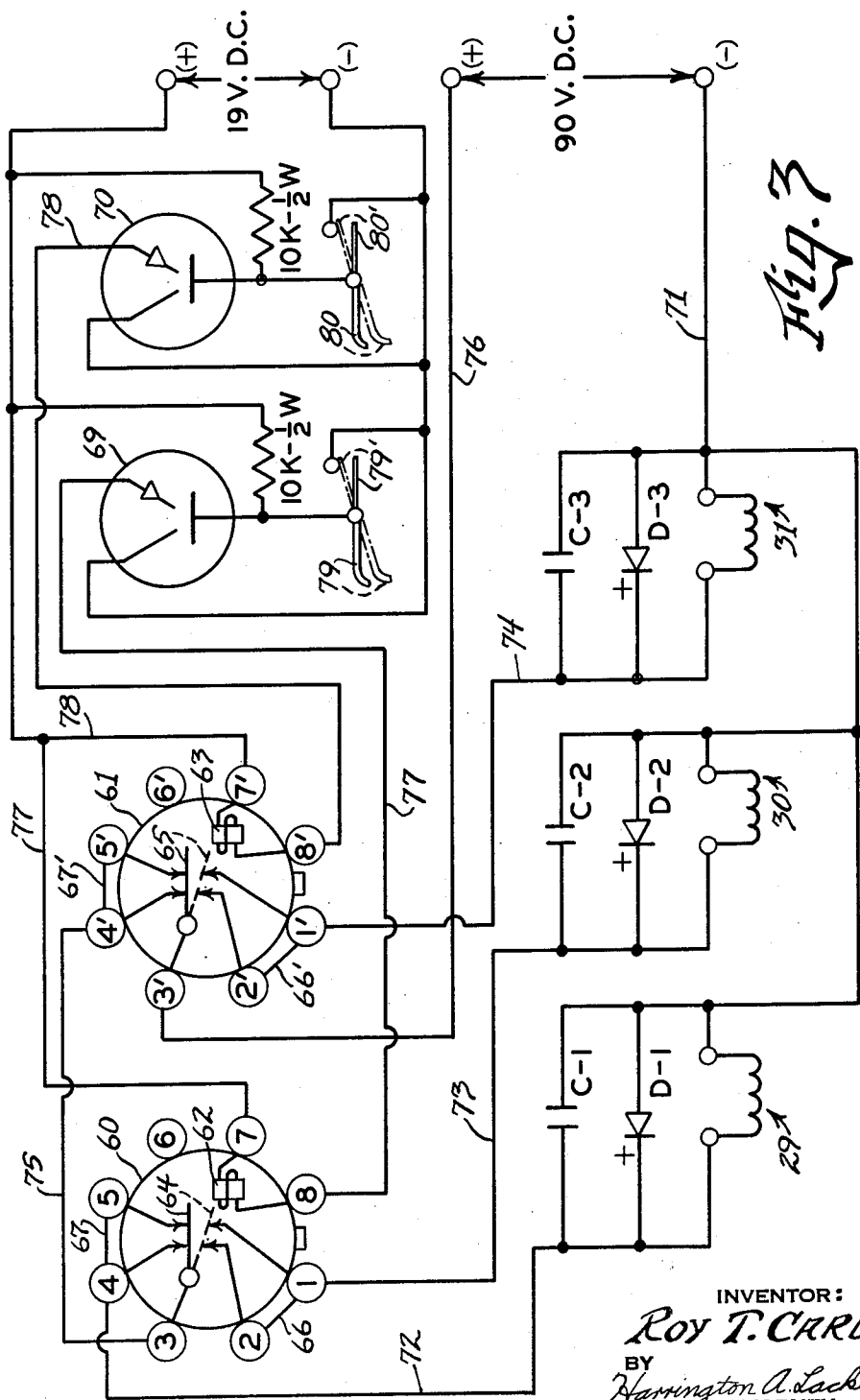
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4 Sheets-Sheet 3



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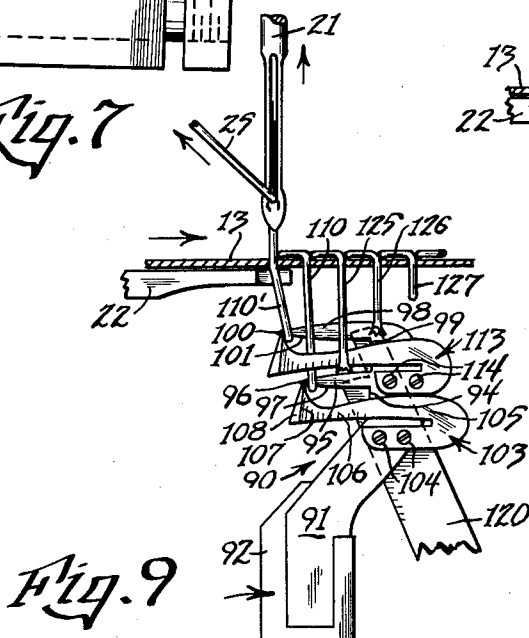
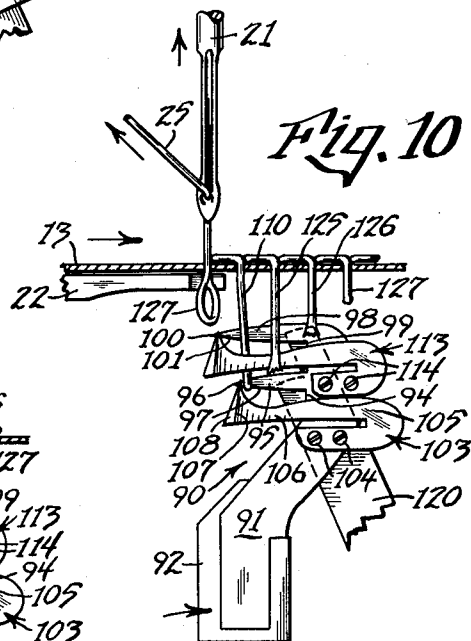
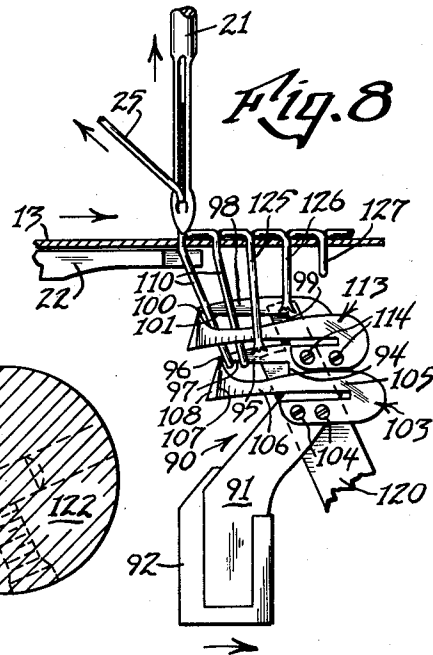
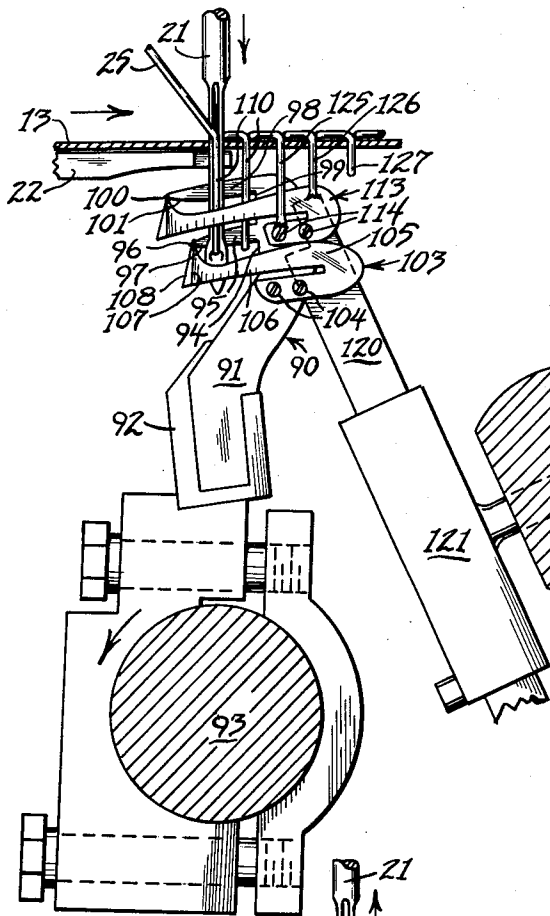
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4 Sheets-Sheet 4



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THREE-LEVEL TUFTED PILE APPARATUS

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Filed June 15, 1961, Ser. No. 117,423

10 Claims. (Cl. 112—79)

This invention relates to an apparatus for selectively tufting pile of three different heights in the same row of stitching in a base fabric, and more particularly to an apparatus for selectively forming high cut pile, medium cut pile and low loops in the same row of stitching.

In a previous application S.N. 14,034, filed March 10, 1960, applicant disclosed an apparatus for forming high cut pile and low loop pile in the same row of stitching by holding the loops upon the looper until they were cut by the reciprocating knife when a regular full length of yarn was fed to the needle. However, when the yarn was selectively backdrawn from the needle, means were provided for releasing the yarn from the free end of the looper before the loop was cut. Thus, high cut pile was formed for normal length stitches, and low loops were formed in the backdrawn stitches.

In a subsequent application S.N. 102,842, filed April 13, 1961, applicant disclosed an apparatus for forming high cut pile and low cut pile in the same row of stitching by adding a second bill above the first bill in the looper disclosed in application S.N. 14,034 for catching and cutting a loop released from the first bill. In this invention the reciprocating knife was given an extra long stroke in order to cut loops formed adjacent the closed ends of both bills of the looper. Thus, high cut pile was formed for normal length stitches, and low cut pile was formed in the backdrawn stitches.

It is therefore one object of this invention to provide a novel hook structure for forming pile tufts of three different heights in the same row of stitching.

Another object of this invention is to provide in a tufting machine a hook or a looper of novel construction incorporating a pair of loop-forming bills and a yieldable means for selectively holding or releasing loops on the corresponding bills.

A further object of this invention is to provide a looper having two different bills for holding loops at a medium and high level, respectively, and means for selectively feeding a yarn at a fast, medium or slow speed, the medium or slow speeds being adapted to backdraw yarns respectively from the high level bill to the medium level bill and from the medium level bill to a low level.

Another object of this invention is to provide an apparatus for tufting an infinite variety of patterns comprising high cut pile, medium cut pile, and low loop pile in a tufted fabric.

A further object of this invention is to provide a novel mechanism for selectively feeding yarn at any one of three different speeds to any needle in a multiple needle tufting machine.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawings, wherein:

FIG. 1 is a sectional elevation of a multiple needle tufting machine made in accordance with this invention;

FIG. 2 is a fragmentary top plan view, partially in section, disclosing the three-speed yarn feed mechanism;

FIG. 3 is a schematic electrical diagram of the pattern control means;

FIG. 4 is a top plan view of the double pattern drum;

FIG. 5 is a perspective fragmentary view of a preferred form of the hook and a needle in operative position preparatory to forming a loop;

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FIG. 6 is a section taken along the line 6—6 of FIG. 5;

FIG. 7 is an enlarged sectional elevation looking in the opposite direction from FIG. 1, disclosing a second operative position of the hook engaging the needle;

FIG. 8 is a fragmentary view similar to FIG. 7, disclosing a third operative position of the hook releasing the loop from the lower bill;

FIG. 9 is a fragmentary view similar to FIG. 8, disclosing a fourth operative position of the hook preparatory to releasing the loop from the upper bill; and

FIG. 10 is a view similar to FIG. 9 disclosing a fifth operative position of the hook where the loop has been completely released from both bills.

Referring now to the drawings in more detail, FIG. 1 discloses a cross section of a multiple needle tufting machine comprising a frame or housing 11 having a bed plate 12 adapted to support the movement of the base fabric 13 fed through the machine from the front to the rear by means of fabric feed rolls 14 and 15. The needle drive means comprises a transverse shaft 16, which may be driven by any suitable power means, not shown. The shaft 16 intermediate its ends is provided with a plurality of eccentrics 17, operatively associated with the connecting rods 18 to vertically reciprocate the push rods 19 and needle bar 20, supporting a plurality of aligned needles 21 adapted to alternately penetrate the moving fabric 13. The slotted needle plate 22 is mounted on top of the bed plate 12 to support the base fabric 13, while the needles 21 reciprocate therethrough.

In order to carry out this invention, yarn 25 is selectively fed at any one of three different speeds, high speed, medium speed and low speed, to each needle 21. In order to feed the yarn 25 at three different speeds, a plurality of pairs of yarn feed rolls 26 are mounted on the frame 11 as disclosed in FIGS. 1 and 2. Each pair of rolls 26 is driven in opposite directions by means of a single shaft 27 through reduction gearing, not shown, in housing 28. A high speed magnetic clutch 29, an intermediate speed magnetic clutch 30 and a low speed magnetic clutch 31 are fixedly supported on each shaft 27 for rotation therewith. A sprocket 32, supporting an armature 33 for operative engagement with each high speed magnetic clutch 29, is loosely mounted for independent rotation on the shaft 27. In a similar manner, the sprocket 34, supporting another armature 35 for operative engagement with each medium speed magnetic clutch 30, is loosely mounted on the shaft 27. Also, a sprocket 36, supporting an armature 37 for operative engagement with each low speed magnetic clutch 31, is loosely mounted on the shaft 27. Each sprocket 32 is driven at a high rate of speed by a chain 38, which in turn is driven through sprocket 39, shaft 40, sprocket 41, and chain 42 from a large drive sprocket 43, which in turn receives its power from the main drive shaft 16 through sprocket 44, chain 45, sprocket 46 and reduction gear box 47. In a like manner, the sprockets 34 are driven at a medium speed by the chain 48, sprocket 49, shaft 50, sprocket 51, chain 52 and a medium size drive sprocket 53, which in turn is driven through the reduction gear box 47. The sprockets 36 are driven at a low speed by the chain 54, sprocket 55, shaft 56, sprocket 57, chain 58 and the small low speed drive sprocket 59, which is also driven through the reduction gear box 47.

From the description thus far, it will be obvious that only one of the three magnetic clutches, 29, 30, 31, on any single shaft 27 may be energized at any one time to engage its respective armature in order to drive the yarn feed rolls 26 at that particular corresponding speed. The means for selectively energizing only one magnetic clutch at a time for each pair of yarn feed rolls 26 is best disclosed in the electrical circuit diagram of FIG. 3. The

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circuit disclosed in FIG. 3 includes the coils of the three magnetic clutches 29, 30 and 31, each of which is connected in parallel with their respective arc suppressor diodes D-1, D-2 and D-3, and the three respective capacitors C-1, C-2 and C-3. Also included in the circuit are a pair of relays 60 and 61, each of which are provided with eight peripherally spaced contacts, numbered 1-8 and 1'-8', respectively. The relays 60 and 61 also include their respective coils 62 and 63 and their respective armature switches 64 and 65. The relay contacts 1 and 2, and 1' and 2', are bridged respectively by the conductors 66 and 66'. In a like manner contacts 4-5 and 4'-5' are bridged by the conductors 67 and 67'. Also included in the circuit are a pair of transistors 69 and 70.

A power input lead 71 is connected in parallel to the same side of each of the magnetic clutches 29, 30 and 31. The other side of the clutch 29 is connected through a lead 72 to the contacts 4 and 5 of the relay 60. The other side of the magnetic clutch 30 is connected through lead 73 with the contacts 1 and 2 of the relay 60. The other side of the magnetic clutch 31 is connected through the lead 74 to the contacts 1' and 2' of the relay 61. Contact 3 of relay 60 is connected by lead 75 to the contact 4'-5' of relay 61. The contact 3' of the relay 61 is connected to the output line 76. The coil 62 bridges the contacts 7 and 8 of the relay 60, which are connected in that part of the control circuit 77 controlled by the transistor 69. In a like manner, the coil 63 of the relay 61 bridges the contacts 7' and 8' and forms a part of the control circuit 78 which is controlled by the transistor 70. The transistor 69 is energized by means of the pattern finger switch 79', while the transistor 70 is energized by means of the pattern finger switch 80'.

Each pattern switch 79' forms the rear end of a pattern finger 79 pivotally mounted upon a pattern drum 81 having a shaft 82 adapted to be rotated in synchronism with the drive shaft 16 by any convenient means, such as the belt 83. Fitted upon the pattern drum 81 beneath the pattern fingers 79 is a pattern sheet or sleeve 84 having slots 85 formed therein in a definite pattern, as best disclosed in FIGS. 1 and 4. Also mounted on the same pattern drum 81 coaxially with the pattern sheet 84 is a second pattern sheet 86 having slots 87 formed therein in a definite pattern. The pattern fingers 79 are adapted to ride over the pattern sheet 84, while the pattern fingers 80, pivotally carrying the switches 80', are adapted to ride over and be actuated by the pattern sheet 86. As the pattern drum 81 is rotated, the pattern finger 79 will engage the surface of the pattern sheet 84 to open the switch 79' as disclosed in the solid line position of FIG. 3. When a pattern finger 79 engages a slot 85, the pattern finger switch 79' automatically closes to the dashed line position of FIG. 3 to energize the transistor 69, which in turn energizes the coil 62 and the relay 60 to move the switch finger 64 from its solid line to its dashed line position, closing the contacts 1 and 2. In a like manner, when a pattern finger 80 engages the surface of the pattern sheet 86, the switch 80' will be open, as disclosed in the solid line position of FIG. 3. However, when a pattern finger 80 engages its corresponding slot 87, the switch 80' will close to its dashed line position disclosed in FIG. 3, actuating the transistor 70 and the coil 63 in the relay 61 to move the switch finger 65 from its solid line position to its dashed line position closing the contacts 1' and 2'.

By tracing the circuits in FIG. 3, it will be seen that, when both pattern fingers 79 and 80 for a corresponding pair of feed rolls 26 engage the surface of their respective pattern sheets 84 and 86, the corresponding switches 79' and 80' will remain open in their solid line positions disclosed in FIG. 3. In these positions, current will flow through the line 71, the high speed magnetic clutch 29, the line 72, contacts 4 and 5, the switch finger 64, contact 3, lead 75, contacts 4' and 5', switch finger 65, contact 3'

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and power line 76. It will also be noted that the circuits including the medium speed magnetic clutch 30 and the low speed magnetic clutch 31 are open.

With the pattern finger 80 still engaging the surface of its respective pattern sheet 86, so that the switch 80' remains open, assume that the pattern finger 79 engages a slot 85 to close the switch 79' to its dashed line position disclosed in FIG. 3. In this condition, the transistor 69 is activated to energize the coil 62 and draw the switch finger 64 into its dashed line position opening the contacts 4 and 5 and closing the contacts 1 and 2. In this position, current will flow through the lines 71, the medium speed clutch 30, lead 73, contacts 1 and 2, switch finger 64 in its dashed line position, contact 3, lead 75, contacts 4' and 5', switch finger 65, contact 3' and power line 76. The circuits through the high speed clutch 29 and the low speed clutch 31 are open.

When the pattern finger 79 engages either the pattern sheet 84 or a slot 85, and the pattern finger 80 engages a slot 87, thereby closing the switch 80' to its dashed line position disclosed in FIG. 3, the transistor 70 will be activated to energize the coil 63, and move the switch finger 65 from its solid line to its dashed line position, thereby opening the contacts 4' and 5' and closing the contacts 1'-2'. In this condition, current will flow through the line 71, the low speed clutch 31, lead 74, contacts 1'-2', the dashed line finger 65, contact 3' and power line 76. Since the contacts 4' and 5' are open when the switch finger 65 engages the contacts 1' and 2', it makes no difference whether the pattern finger switch 79' is open or closed because the circuits through the high speed clutch 29 and the medium speed clutch 30 will remain open.

It will therefore become apparent that regardless of the various combinations of the pattern fingers 79 and 80 with their respective pattern sheets 84, 86 and slots 85-87, the condition of the circuit disclosed in FIG. 3 will always be such that one clutch 29, 30 or 31 will always be energized, but no more than one clutch will be energized at the same time. Consequently, as long as power is supplied to the circuit, and as long as the machine is operating, yarn fed by any pair of feed rollers 26 to any needle 21 will be fed at a fast speed, a medium speed or a low speed.

In order to cooperate with the needle 21 and the yarn 25 fed at three different speeds, a looper or hook 90 of novel construction is provided. The hook 90 comprises a shank 91 which is inserted into a reciprocable hook bar 92 mounted transversely of the machine on a shaft 93 adapted to be reciprocated by mechanism, not shown, in a conventional manner. The shank 91 extends upwardly to form a first throat 94 from which a first or lower bill 95 extends in the opposite direction of fabric feed and substantially normal to the axis of the shank 91. However, the undersurface of the first bill 95 adjacent its free end 96 forms an upwardly sloping surface 97.

Spaced above and substantially parallel to the lower bill 95, a second or upper bill 98 extends from throat 99 in the same direction as the lower bill 95 and in the same plane as the shank 91. The free end 100 of the upper bill 98 also has an upwardly sloping undersurface 101.

Secured to one side of the hook 90 is a resilient spring clip 103 having one end fixed to the shank 91 by any convenient means, such as bolts or pins 104. The clip 103 extends substantially parallel to and spaced below the lower bill 95 in a substantially straight portion 105. The clip 103 then bends outwardly away from the hook 90 into a gradual arcuate portion 106 and then curves back in to form an elongated creased portion 107, which extends upwardly to engage the free end 96 of the lower bill 95. A flared portion 108 of the clip 103 diverges from the creased portion 107 away from the hook 90 at such an angle as to engage and guide a needle 21 between the bill 95 on one side and the spring clip 103 on

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the other side as the hook 90 moves toward engagement with a loop 110 carried by the needle 21.

A second spring clip 113 of similar construction to the clip 103 is mounted above the spring clip 103 on the same side of the hook 90 by means such as bolts or pins 114. Spring clip 113 has a straight portion 115, an arcuate portion 116, creased portion 117, and flared portion 118, similar to the corresponding parts of the first spring clip 103. The creased portion 117 extends upwardly to engage the free end 100 of the upper bill 98 in the same manner as the creased portion 107 engages the free end 96 of the lower bill 95.

Mounted on the opposite side of the hook 90 from the spring clips 103 and 113 is a knife 120 supported in a conventional manner by a knife holder 121 mounted on a reciprocable knife shaft 122. The knife shaft 122 may be reciprocally rotated by any conventional drive means in a tufting machine, not shown. The knife 120 is provided with a lower cutting edge 123 and an upper cutting edge 124. The knife 120 is adapted to reciprocate in such a manner that the lower cutting edge 123 will cooperate with the lower bill 95 in the vicinity of the throat 94 and the upper cutting edge 124 will cooperate with the upper bill 98 in the vicinity of the throat 99 to cut loops formed on the respective bills.

The operation of the invention is as follows:

With the motor, not shown, in operation, the fabric feed rolls 14 and 15, the main drive shaft 16, the yarn feed rolls 26 and the pattern drum 81 are simultaneously rotated, and the hook shaft 93 and knife shaft 122 are simultaneously reciprocated to cooperate with each other in synchronous relationship.

As each needle 21 is pushed down through the base fabric 13, each hook 90 and knife 120 are reciprocated to their extreme rearward positions, substantially shown in FIG. 10. When the needle 21 descends to its lowermost position carrying the yarn 25 through the base fabric 13, the hook 90 begins its movement toward the front of the machine in the direction opposite the fabric feed, as best disclosed in FIGS. 5 and 6. Continued forward movement of the hook 90 will cause the flared portions 108 and 118 to engage and be moved outwardly by the needle 21, so that the bills 95 and 98 may pass between the needle 21 and one leg of the loop 110. As the bills 95 and 98 continue their forward passage through the loop 110, the needle 21 enters the curved portions 106 and 116 of both spring clips 103 and 113, which return to their original position with the creased portions 107 and 117 resting against their respective free ends 96 and 100, as disclosed in FIG. 7. While the hook 90 is momentarily in its lowermost position, the needle 21 will move upward, leaving the loop 110 on the bill 95, while the creased portion 107 normally prevents the loop 110 from slipping over the free end 96 when the hook 90 reciprocates toward the rear. During this operation the yarn 25 is normally being fed to the needle 21 by the yarn feed rolls 26 when they are driven by the corresponding high speed magnetic clutch 29 in order to form long loops. Continued feeding of the fabric 13 will cause the long loops 110 to move along the lower bill 95 toward the throat 94 where the loops will be cut by the lower edge 123 of the reciprocating knife 120 to form high cut pile tufts 125. As previously discussed, these high cut pile tufts 125 will be formed when the pattern fingers 79 and 80 engage the surfaces of their respective pattern sheets 84 and 86.

When it is desired to form medium height cut pile tufts 126 in a particular row of stitching, the pattern finger 79 will engage a slot 85 while the corresponding pattern finger 80 will continue to ride on its pattern sheet 86. Such a condition will cause the medium speed magnetic clutch 30 to engage its corresponding armature 35 to drive the yarn feed rolls 26 at a medium speed. Such action will backdraw the yarn 25 from the previously formed long loop 110, which is still being held on the lower finger

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95 by means of the spring clip 103. However, the back-drawing of the yarn 25 provides sufficient tension to draw the loop 110 toward the free end 96 and force the creased portion 107 to separate from the bill 95, as disclosed in FIG. 8, and thereby permit the loop 110 to pass between the free end 96 and the flexed spring clip 103 and off the bill 95. The resulting medium height loop 110' is immediately caught upon the upper bill 98 and held there by the upper spring clip 113, as long as the yarn 25 is fed at a medium or fast speed, as best disclosed in FIG. 9. Continued rearward movement of the hook 90 will also provide additional tension in the yarn 25 to assist in removing the loop 110 from the lower bill 95, although this invention contemplates back-drawing yarn from a stationary hook, if desired. Movement of the fabric 13 carries the intermediate height loops 110' held on the upper bill 98 toward the throat 99 where these loops are cut by the upper edge 124 of the reciprocating knife 120 to form intermediate or medium height cut pile tufts 126.

When it is desired to form low loops 127, the corresponding pattern finger 80 engages a slot 87 thereby energizing the low speed magnetic clutch 31 and simultaneously de-energizing the other magnetic clutches 29 and 30 to drive the yarn speed rolls 26 at a low speed. If the immediately formed loop 110' is caught on the upper bill 98, as disclosed in FIG. 9, the low speed of the yarn 25 will cause further backdrawing to provide sufficient tension in the loop 110' to force the creased portion 117 of the upper spring clip 113 away from the free end 100, as disclosed in FIG. 9, thereby permitting the loop 110' to pass between the bill 98 and the flexed spring clip 113 to form the low loop 127, as disclosed in FIG. 10.

If the yarn feed is changed from a high speed directly to a low speed, the resulting tension in the yarn 25 will cause the loop 110, held on the lower bill 95 to force both creased portions 107 and 117 successively away from their respective bills 95 and 98 so that the loop will be removed from the free ends of both bills in one operation.

The strength of the respective spring clips 103 and 113 are pre-selected to flex only when forced by a backdrawn loop 110, 110' or the needle 21. Thus, selective feeding of the yarn 25 at one of the three different speeds will cause the formation of high cut pile tufts 125, medium cut pile tufts 126 and low loops 127 in the same row of stitching. Selective speed control of a plurality of yarns 25 in a multiple needle tufting machine will create a new design pattern of contrasting high cut pile, medium cut pile and low loop pile as determined by the patterns formed in the pattern sheets 84 and 86.

It will be apparent to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof, and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. In a tufting machine, means for supporting a base fabric, means for stitching a yarn continuously through said base fabric to form loops therein, a looper comprising a first bill and a second bill, both said bills having free ends adapted to enter substantially simultaneously each loop in succession, means for relatively moving loops along said bills away from their free ends, first means for releasably engaging the free end of said first bill, second means for releasably engaging the free end of said second bill, first means for backdrawing yarn from a loop on said first bill with sufficient tension to cause said yarn to separate said first engaging means from said first free end whereby said loop is released from said first bill and caught upon said second bill, second means for backdrawing yarn from a loop on said first or second bill with sufficient tension to cause said yarn to separate said corresponding engaging means from said corresponding free end whereby the loop is com-

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pletely released from said first and second bills, and means for cutting loops moved along said bills away from their free ends.

2. In a tufting machine, means for feeding a base fabric in one direction, a needle carrying yarn to penetrate the base fabric and form loops therein, means for reciprocating said needle, a reciprocatory looper comprising a first and second bill spaced from each other in the reciprocatory direction of said needle, each bill having a free end and a closed end, the free end of each bill pointing in the direction opposite the fabric feed and being adapted to enter substantially simultaneously each loop, means for reciprocating said looper to direct both said bills across said needle and through the loop formed by said needle, said loop being caught on said first bill, first means for releasably engaging the free end of said first bill, second means for releasably engaging the free end of said second bill, first means for backdrawing yarn from a loop on said first bill with sufficient tension to cause said yarn to a separate said first engaging means from said first free end whereby said loop is released from said first bill and caught upon said second bill, second means for backdrawing yarn from a loop on said first or second bill with sufficient tension to cause said yarn to separate said corresponding engaging means from said corresponding free end whereby the loop is completely released from said first and second bills, and means for cutting loops formed adjacent the closed ends of said first and second bills.

3. The invention according to claim 2 in which the free end of said second bill extends beyond the free end of said first bill in the direction opposite the fabric feed.

4. The invention according to claim 3 in which said second bill is above said first bill and the undersurfaces of said free ends slope upward in the direction opposite the fabric feed.

5. The invention according to claim 2 in which each of said first and second engaging means comprises a spring clip having a free end biased toward engagement with the free end of each bill, the strength of each spring clip being sufficient to yield to the tension of the yarn in the corresponding backdrawn loop.

6. The invention according to claim 2 in which said cutting means comprises a single knife having first and second cutting edges, and means for reciprocating said knife so that said first cutting edge will cooperate with the closed end of said first bill and said second edge will cooperate with the closed end of said second bill to cut corresponding loops thereon.

7. A tufting machine, means for feeding a base fabric in one direction, a needle carrying yarn to penetrate the base fabric and form loops therein, means to reciprocate

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the needle, a reciprocatory looper comprising a first bill and a second bill spaced from each other in the reciprocatory direction of said needle, each bill comprising a free end and a closed end, said free ends pointing in the direction opposite the fabric feed, means for reciprocating said looper to direct both said bills across said needle and through the loop formed by said needle, said loop being caught on said first bill, first means for releasably engaging the free end of said first bill, second means for releasably engaging the free end of said second bill, means for selectively feeding yarn at a fast speed, a medium speed and a slow speed to said needle, whereby a loop caught on said first bill will be permitted to move toward its closed end to be cut to form high cut pile when said yarn is fed at a fast speed, whereby yarn fed at a medium speed will be backdrawn from a loop caught on said first bill with sufficient tension to cause the loop to separate said first engaging means from said first free end and to slip from said first bill upon said second bill, said loop being held and moved along said second bill toward its closed end for cutting to form a medium height cut pile, and whereby yarn fed at a slow speed will be backdrawn from a loop caught on said first or second bill with sufficient tension to cause said loop to separate said corresponding engaging means from its corresponding free end and to slip from both said first and second bills to form a low uncut loop, and means for cutting loops adjacent the closed ends of said first and second bills.

8. The invention according to claim 7 in which said yarn feed means comprise yarn feed rolls, and pattern control means for selectively driving said rolls at three different speeds.

9. The invention according to claim 8 in which said feed roll driving means comprises a high speed magnetic clutch, a medium speed magnetic clutch, and a low speed magnetic clutch operatively associated with said yarn feed rolls, and said pattern control means comprises electrical means for energizing only one magnetic clutch at a time.

10. The invention according to claim 9 in which said pattern control means comprises a pair of pattern drums, each drum being adapted to control no more than two of said clutches.

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