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3,301,205 1/1967 Card..... 112/79

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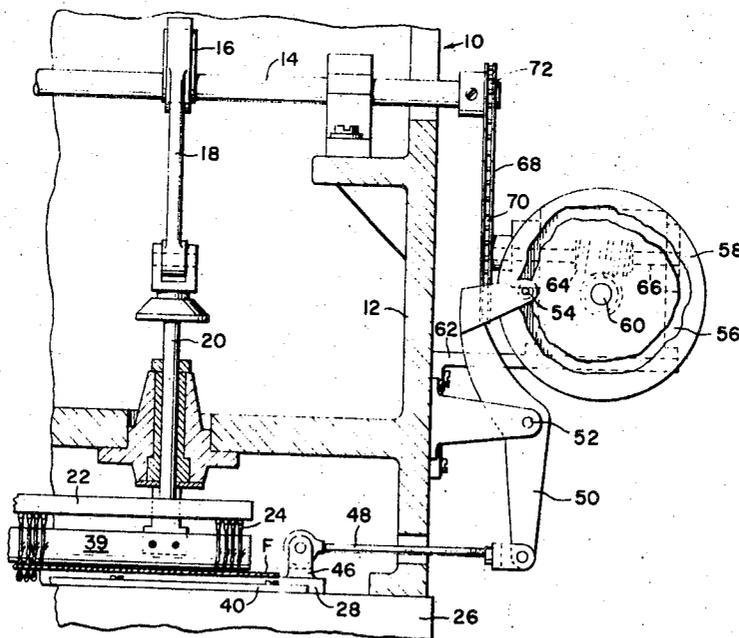
[54] **DENSE PILE TUFTING MACHINES**
16 Claims, 1 Drawing Fig.

[52] U.S. Cl..... **112/79,**
112/266
 [51] Int. Cl..... **D05c 15/28**
 [50] Field of Search..... **112/79,**
79.6, 266, 410

[56] **References Cited**
UNITED STATES PATENTS

2,679,218	5/1954	Jones.....	112/79
2,975,736	3/1961	Card.....	112/79
3,282,235	11/1966	Crawford	112/79

ABSTRACT: This disclosure relates to tufting machines for producing dense pile fabrics and more particularly those of the cut pile type. In general, the machine includes apparatus for shifting the backing fabric used in the tufting process relative to the needles, loopers, and cutting mechanism. Through the novel arrangement of the shifting mechanism and the tufting components, as set forth in this disclosure, a dense pile fabric is produced having rows of pile tufts which are spaced less than the distance of the spacing between adjacent needles as viewed in the direction of the backing fabric feed. As is known in the art, the gauge of the machine is measured by the transverse spacing between adjacent needles. The longitudinal rows of tufting produced through the apparatus of the present disclosure are spaced less than the gauge distance. The disclosure further presents a commercially desirable machine of the so-called sliding needle plate type which produces a cut pile fabric.



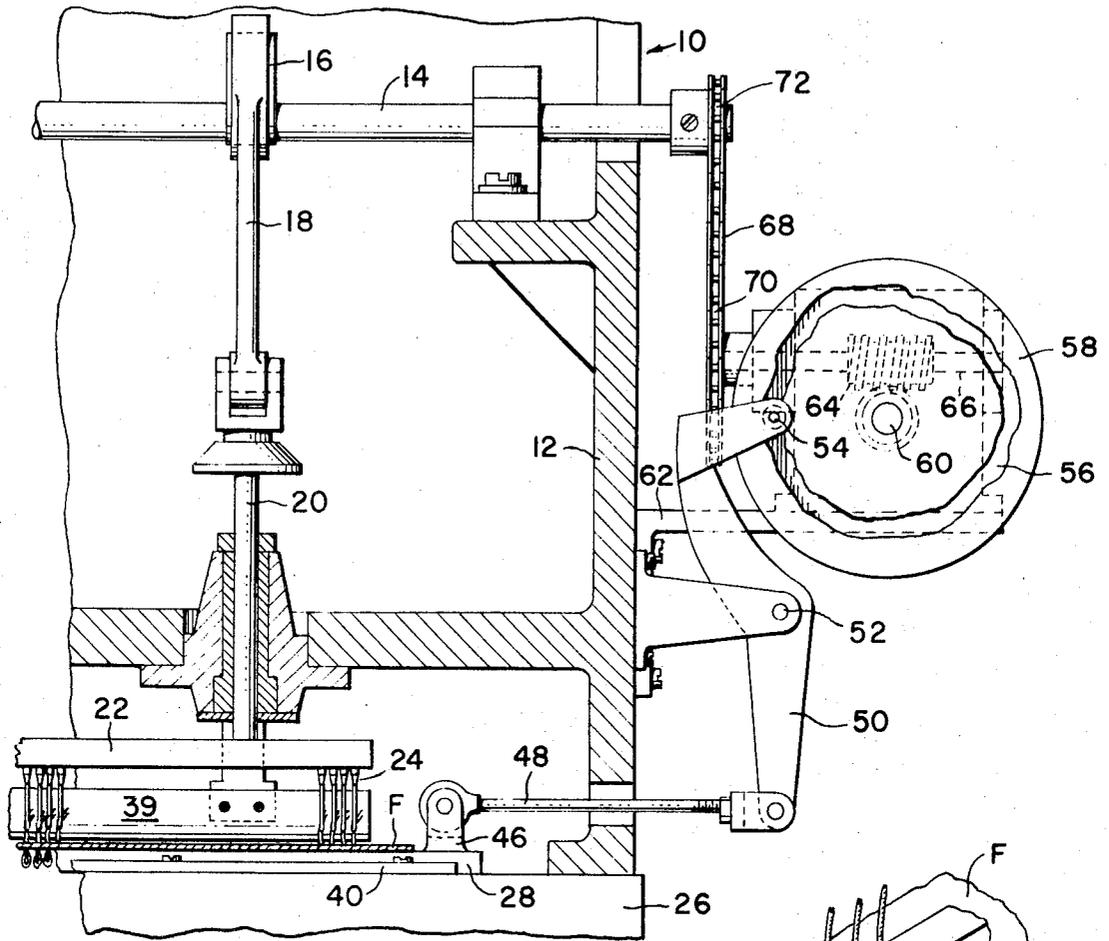


Fig. 1

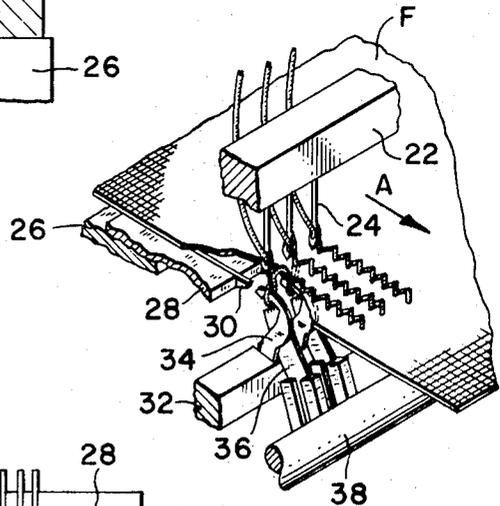


Fig. 2

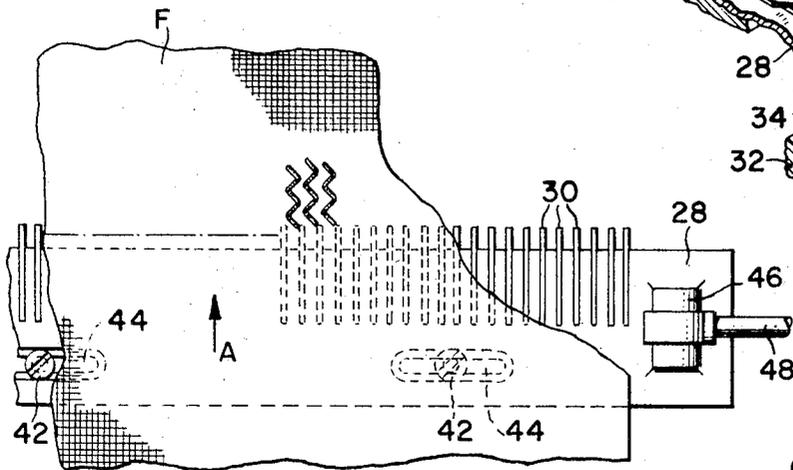


Fig. 3

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DENSE PILE TUFTING MACHINES

BRIEF DESCRIPTION OF THE INVENTION

Reference is made to U.S. Pat. No. 3,301,205 to R. T. Card, wherein there is described and illustrated a machine of the so-called sliding needle plate type. As disclosed in this patent, one of the main objects of this type machine was to eliminate the "corn-cob" effect produced by some types of tufting machines. The apparatus for accomplishing this purpose comprises in general a sliding needle plate mechanism which shifts the needle plate and the fabric relative to the needle bank and in the transverse direction so as to eliminate the straight-line appearance of the tufting on the pile side of the fabric. However, as noted in this patent, the machine illustrated therein is mainly directed to the production of fabric of the so-called loop pile variety. Until the advent of the present invention, the sliding needle plate-type machine was not commercially used for producing cut pile fabrics. In the loop pile type of machine of the aforementioned patent, the loops were required to be shed from the loopers prior to shifting of the fabric so as not to restrain the lateral shifting thereof. In the present invention, this requirement has been eliminated and a cut pile fabric is produced which is relatively dense and which can be produced through the use of guage parts which are substantially twice the guage of the guage of the fabric produced thereby.

In the present invention, a plurality of loopers are provided below the backing fabric and are disposed so that they face in a direction opposite to the direction of fabric feed. As loops are produced through penetration of the needles and are picked up by the looper mechanism, the loops are fed toward the rear portion of the looper by the advancement of the backing fabric. While the loops are on the loopers, they permit some lateral shifting of the backing fabric but restrain the backing fabric from shifting a full guage width or the distance between one needle to the next. Further, the apparatus is designed so that the needles penetrate the backing fabric during a portion of the lateral shifting thereof so as to restrain the lateral shifting of the backing fabric after a predetermined amount of shifting has occurred while the shifting mechanism continues to shift relative to the backing fabric. By this means, the backing fabric is shifted substantially only one-half the distance between adjacent needles to produce parallel rows of tufting which are relatively closely spaced and are substantially one-half the guage of the guage parts of the machine. This latter operation is in contrast to the operation of the previously described patent where the shifting of the backing fabric took place while the needles were in the up position so as to permit full shifting of the backing fabric along with the sliding needle plate so that the fabric stepped at least a full guage width during each shifting thereof. Also, in the prior described patent, a plurality of relatively long needle plate fingers was required for supporting a backing fabric during penetration of the needles and which needle plate fingers aided in securing the backing fabric to the needle plate for lateral movement thereof. In the present invention, since the loops are held by the looper mechanism and the backing fabric is not shifted a full guage width, the use of these relatively long needle plate fingers is not required.

Accordingly, it is one object of the invention to provide a novel and improved tufting machine for producing relatively dense pile fabrics.

It is another object of the invention to provide a sliding needle plate tufting machine for producing dense cut pile fabrics.

It is a further object of the invention to provide a novel and improved tufting machine wherein fabrics are produced thereby having parallel rows of tufts which are spaced less than the distance between adjacent needles.

It is an additional object of the invention to provide a novel and improved method of operating a tufting machine for producing relatively dense pile fabrics.

Other objects and advantages will be best understood from reading the following detailed description with the accompanying drawings wherein:

FIG. 1 is a fragmentary sectional view of a tufting machine embodying the present invention;

FIG. 2 is a fragmentary perspective view of the pile forming elements of the machine illustrated in FIG. 1, portions of the machine having been eliminated for purposes of illustration; and

FIG. 3 is a fragmentary top plane view of the needle plate of the machine of FIG. 1 with broken-away portions of a tufted fabric in position thereon and portions of the machine again having been eliminated for purposes of illustration.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawings, there is illustrated a portion of the frame 10 of a generally conventional cut pile tufting machine such as disclosed, for example, in U.S. Pat. No. 3,084,645, issued to R. T. Card. The frame 10 includes a head 12 in which is journaled a driven main shaft 14. A plurality of eccentrics 16, only one of which is shown, are supported on the main shaft 14, each of which eccentrics is connected by a link or connecting rod 18 to a pushrod 20 mounted substantially vertically for endwise sliding in the lower portion of the head 12. The lower ends of the pushrod 20 are connected to a needle bar 22 which carries a plurality of transversely spaced, yarn-carrying needles 24 that are substantially aligned laterally of the machine, as viewed in the drawing. Upon rotation of the main shaft 14 through a suitable power source, not shown, an endwise reciprocation is imparted to the bank of needles 24 for penetrating a backing fabric F and to project loops of yarn therethrough. A machine bed 26 is provided on the lower portion of the machine frame 10 and supports a needle plate 28 thereon. The needle plate 28 includes a plurality of spaced grooves in the top surface thereof and in each of which there is supported a needle plate finger 30, which needle plate finger 30 need only be of sufficient length to support the backing fabric F as the needles penetrate said backing fabric to project loops therethrough.

Suitably supported in the machine frame 10 and beneath the needle plate 28, there is provided an oscillatory looper or hook shaft 32 which carries a plurality of spaced loopers 34, each of which is adapted to cooperate individually with one of the needles 24 to seize a loop of yarn presented by the needle and to hold the same as the needle is withdrawn from the backing fabric. With particular reference to FIG. 2, it will be seen that the loopers 34 are supported in the looper shaft 32 so that they are facing a direction opposite to the direction of fabric feed as indicated by the letter A. It will be apparent that as the backing fabric is fed and loops are formed, they will be seized by the loopers 34 and fed toward the rear portion thereof. As will be more fully explained hereinafter, the holding of the loops on the loopers 34 during relative movement of the backing fabric aids in accomplishing one of the main objects of the invention, that is, producing the dense pile fabric. Associated with each looper 34, there is provided a knife 36 which is supported in a knife shaft 38 for cutting the loops as they are fed toward the most rearward portion of the looper. Preferably, the knives are stationary but may be rocked relative to the loopers. A presser foot 39 is also provided over and in spaced relation to the fabric F and is carried by the head in the usual manner (by means not shown). The presser foot 39 is adjusted just to clear the backing and acts to prevent the backing from following the needles as the needles are withdrawn.

The backing fabric F is fed longitudinally across the needle plate 28 in the direction of arrow A by conventional feed means such as that disclosed in U.S. Pat. No. 2,840,019 to M. M. Beasley. This means comprises in general a fabric feed element and a guide means, both of which are in the form of driven fabric feed rolls and include a feed roll on the fore end and a feel roll on the aft end of the machine arranged, respectively, in back and in front of the line along which the needles 24 penetrate the backing fabric. The feed rolls are preferably spiked to prevent slippage of the fabric relative thereto, both

laterally and tangentially. It is also preferable to operate the aft feed roll at a slightly greater speed than the fore feed roll so that the fabric is held taut, for reasons as best explained in the aforementioned patent.

The needle plate 28 is mounted on the bed 26 for sliding movement laterally of the machine, that is, in a direction parallel to the line of needles. The needle plate 28 is guided by a guide bar 40 secured to the bed 26 and butted against the edge of the needle plate opposite to the edge from which the fingers 30 extend. Shoulder screws 42 extend downwardly into the bed 26 through stepped slots 44 in the needle plate 28 to permit relative sliding movement of the needle plate 28 with respect to the bed 26.

At one end of the needle plate 28, there is provided an upstanding lug 46 to which there is pivotally connected a link or rod 48 at one end thereof, and the opposite end of the rod 48 is pivotally connected to the lower end of a cam follower lever 50 which in turn is pivotally supported intermediate its ends at pivot point 52. A cam follower 54 is provided on the upper end of the lever 50 which cam follower rides in a cam track 56 provided in a cam 58. The cam 58 is mounted on a shaft 60 journaled in bracket 63 on the machine head 12 which shaft is rotated by a worm gear 64 mounted on a countershaft 66 which in turn is driven by a chain 68 entrained about a sprocket 70 carried by countershaft 66 and a sprocket 72 carried by main shaft 14.

It will be seen, therefore, that the cam is driven in synchronous movement with the main shaft of the machine which in turn also drives the tufting components. The cam is designed to initiate pivotal movement of the lever 50 during the downstroke of the needles 24, so that sliding movement of the needle plate is initiated while the needles are traveling toward the backing fabric F for penetrating said backing fabric with a loop of yarn. The cam track 56 is also designed to initiate sliding movement of the needle plate 28 at least a full guage distance or at least the distance from one needle to the next adjacent needle. Thus, if the guage or distance between the needles is five thirty-seconds of an inch, one full sliding step of the needle plate 28 would be five thirty-seconds of an inch.

The operation of the apparatus of the invention is generally as follows. During the downstroke of the needle bank, sliding movement of the needle plate 28 is initiated a full guage distance by the cam mechanism. As the needles descend, they will intercept the backing fabric F as it is moving laterally with the needle plate 28 and will penetrate the same with each needle passing between a pair of needle plate fingers 30. However, because of the design of the cam, and its timing, the full step sliding movement of the needle plate 28 will not be completed at this time but will continue the remainder of its sliding action. Due to the fact that the needles have intercepted the backing fabric prior to the full stepping movement of the needle plate, the backing fabric will be restrained from moving the full guage distance along with said needle plate.

Because the loopers are facing in a direction opposite to the fabric feed, loops will be fed onto the loopers and will be held thereby until they are fed to the rearward portion of the looper for cutting by the knives 36. Normally, in a cut pile tufting machine, several loops are held by the loopers 34 until the loop farthest back on the looper reaches the knife wherein it will be cut and the next loop will not be cut until it is fed back on the looper by movement of the backing fabric F. The holding of the loops on the loopers 34 also serves to restrain the backing fabric from moving a full guage distance with the needle plate 28. This is so because of the fact that the yarn around the looper is held at one side by the previously formed stitches and is tensioned at its other side by the yarn passing through the needle while it is forming a new loop. Thus, the loops on the loopers tend to restrain full guage shifting of the backing fabric F, which restraining movement is also aided by the penetration of the needles through the backing during shifting thereof.

As illustrated in FIGS. 2 and 3, it can be seen that longitudinally extending parallel rows of tufts will be produced, which parallel rows are spaced substantially one-half the distance between adjacent needles. As further viewed in FIG. 3, it will be seen that two parallel rows of tufts are produced at the needle penetration points between adjacent needle plate fingers 30 with the two parallel rows having a common zigzag backstitch. The fabric produced through the novel apparatus and method, described above, will have spaced rows of tufts which are spaced at a distance substantially one-half the distance of the guage parts. In other words, if the guage of the needles and other tufting components is five thirty-seconds of an inch, the fabric produced thereby will have a guage of five thirty-seconds of an inch. Likewise, a one-fifth of an inch guage machine will produce one-tenth of an inch guage fabric. It will be apparent that this is very desirable since very fine or dense guage products can be produced using relatively wide guage parts, so that it is possible to use approximately one-half the guage parts that would normally be required for production of the guage fabric produced by the apparatus of the present invention. This also eliminates the need for using relatively fine guage parts with the inherent disadvantages thereof, such as difficulty in threading, maintenance, repair, replacement, etc. In addition to the elimination of the so-called "corn-cob" effect, which is an advantage in all machines of this type, various pattern effects can be produced by using a different color or textured yarns in different needles. It is also contemplated that the machine of the present invention can be used with needle banks having needles in a staggered relationship in comparison to the inline needle bank illustrated in the drawings.

While the invention has been described above in its preferred embodiment, it will be obvious to those skilled in the art that various changes and modifications can be made without departing from the spirit and scope thereof as defined in the appended claims.

I claim:

1. A method of forming a dense pile fabric by means including a plurality of transversely spaced needles, a looper for each needle, and a laterally shiftable needle plate having a plurality of finger elements for supporting a backing fabric, said method comprising; feeding a backing fabric longitudinally across the needle plate, penetrating the backing fabric with the needles for forming yarn loops in said backing, holding the yarn loops with said loopers during the return stroke of said needles, initiating lateral shifting movement of said needle plate and said backing fabric during the downstroke of said needles with the relative timing of said needle plate and said needles being such as to permit interference-free relative movement therebetween such that said backing fabric is intercepted and restrained by said needles from further lateral shifting movement with said needle plate, whereby said backing fabric shifts only a portion of the distance with said needle plate with each lateral shift thereof.
2. A method of forming a dense pile fabric as recited in claim 1, wherein said needle plate is shifted at least the distance between adjacent transversely spaced needles and said backing fabric is shifted substantially one-half the distance of said needle plate.
3. A method of forming a dense pile fabric as recited in claim 1 further comprising, advancing the loop of yarn toward the rear portion of said loopers, and cutting each loop of yarn when it is adjacent the rear portion.
4. A method of forming a dense pile fabric as recited in claim 1 further comprising, initiating lateral shifting movement of said needle plate and said backing fabric while loops are being held on said loopers such that the loops on the loopers restrain said backing fabric from shifting the full shifting distance with said needle plate.
5. A method of forming a dense pile fabric by means including a plurality of transversely spaced yarn-carrying needles, a looper for each needle, and a laterally shiftable needle plate for supporting a backing fabric for lateral shifting movement

therewith, said method comprising; initiating lateral shifting movement of said needle plate at least the distance between adjacent transversely spaced needles, penetrating the backing fabric with said yarn-carrying needles before said backing fabric has shifted the full distance with said needle plate whereby said needles restrain further lateral movement of said backing fabric with said needle plate, the relative timing of said needle plate and said needles being such as to permit interference-free relative movement therebetween, removing said needles, advancing the backing fabric longitudinally of said needle plate and repeating the above steps.

6. A method of forming a dense pile fabric as recited in claim 5 further comprising, receiving the loops of yarn carried by said yarn-carrying needles through said backing fabric with said loopers to form loops and holding the loops of yarn during shifting of said needle plate and the backing fabric such that said backing fabric is further restrained by said loops on said loopers from shifting the full shifting distance with said needle plate.

7. A method of forming a dense pile fabric as recited in claim 5 further comprising, cutting the loops of yarn on said loopers after shifting of said needle plate.

8. A method of forming a dense pile fabric by means including a plurality of transversely spaced yarn-carrying needles, a looper for each needle, and a laterally shiftable needle plate for supporting a backing fabric, said method comprising; penetrating the backing fabric with said yarn-carrying needles to form loops therein, receiving and holding the loops of yarn on said loopers during the return stroke of said needles, initiating lateral shifting movement of said needle plate at least the distance between adjacent needles and in relative interference-free cooperation therewith and while the loops of yarn are held by said loopers whereby said backing fabric is restrained by the loops held by said loopers and shifts only a portion of the distance with said needle plate.

9. A method of forming a dense pile fabric as recited in claim 8, wherein said backing fabric shifts substantially one-half the distance said needle plate is shifted.

10. A method of forming a dense pile fabric by means including a plurality of transversely spaced yarn-carrying needles, a looper for each needle, and a laterally shiftable needle plate for supporting a backing fabric for relative longitudinal movement of said backing fabric and lateral shifting movement therewith, said method comprising; penetrating said backing fabric with said yarn-carrying needles to form loops therein, receiving and holding said loops with said loopers, initiating lateral shifting movement of said needle plate at least the distance between adjacent needles, and in relative interference-free cooperation therewith such that the backing fabric is shifted substantially one-half the distance said needle plate is shifted whereby rows of closely spaced longitudinal rows of loops are produced having a spacing substantially one-half the distance of the spacing between adjacent needles.

11. A method of forming a dense pile fabric as recited in claim 10 further comprising; removing the needles from said backing fabric, advancing said backing fabric longitudinally of said needle plate, and cutting said loops on said loopers to form cut pile.

12. In a tufting machine, a plurality of transversely spaced needles, means for reciprocating said needles so that during

reciprocation thereof said needles penetrate a backing fabric for inserting loops of yarn through said backing, a laterally shiftable needle plate for supporting the backing fabric, with said needle plate being shiftable so as to be disposed in interference-free relationship with said needles during penetration thereof, means for feeding the backing fabric longitudinally across said needle plate, a looper associated with each needle, each said looper having a hook portion for receiving and holding a loop of yarn from its associated needle, said looper being disposed with its hook portion facing in a direction opposite to the direction of backing fabric feed such that the loops of yarn will feed toward the rear of said looper as the backing fabric is fed relative thereto, cutting means for cutting the loops of yarn after they are fed toward the rear of said looper, and means for initiating lateral shifting movement of said needle plate and said backing fabric while loops are being held by said loopers such that said loops on said looper restrain the lateral shifting movement of said backing fabric whereby said backing fabric will shift a distance less than the distance between adjacent spaced needles.

13. In a tufting machine as recited in claim 12 wherein said means for initiating lateral shifting movement of said needle plate and said backing fabric is operative for initiating shifting movement thereof during the downstroke of said needles.

14. In a tufting machine as recited in claim 13 wherein said means for initiating lateral shifting movement of said needle plate and said backing fabric is operative to shift said needle plate at least the distance between adjacent needles.

15. In a tufting machine as recited in claim 12 further comprising, a plurality of transversely spaced needle plate fingers for supporting the backing fabric during penetration thereof by said needles, said needle plate fingers being supported by said needle plate and extending from said needle plate in the direction of fabric feed to a distance substantially equal to the spacing of said needles from said needle plate.

16. In a tufting machine, a plurality of transversely spaced needles, means for reciprocating said needles so that during reciprocation thereof said needles penetrate a backing fabric for carrying loops of yarn through said backing fabric, a laterally shiftable needle plate for supporting the backing fabric, means for feeding the backing fabric longitudinally across said needle plate, a looper associated with each needle for receiving and holding a loop of yarn from its associated needle, each said looper having a hook portion disposed in a direction facing opposite to the direction of fabric feed such that the loops of yarn from said needles will feed toward the rear portion of said looper during feeding of said backing fabric, cutting means for cutting the loops of yarn after they are fed toward the rear portion of said looper, means for initiating lateral shifting movement of said needle plate and said backing fabric during the downward stroke of said needles and while loops are disposed on said loopers, said means being operative to shift the needle plate at least the distance between adjacent needles and in relative interference-free relationship therewith, and the holding of the loops by said loopers and the penetration of the backing fabric by said needles during shifting of said needle plate being operative to restrain the shifting of said backing fabric so that the backing fabric will shift a distance less than the distance between adjacent needles.