July 23, 1968 R. L. BARNES 3,393,654

VARIABLE STITCH PLACEMENT ATTACHMENT FOR TUFTING MACHINES

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FIG. 1.

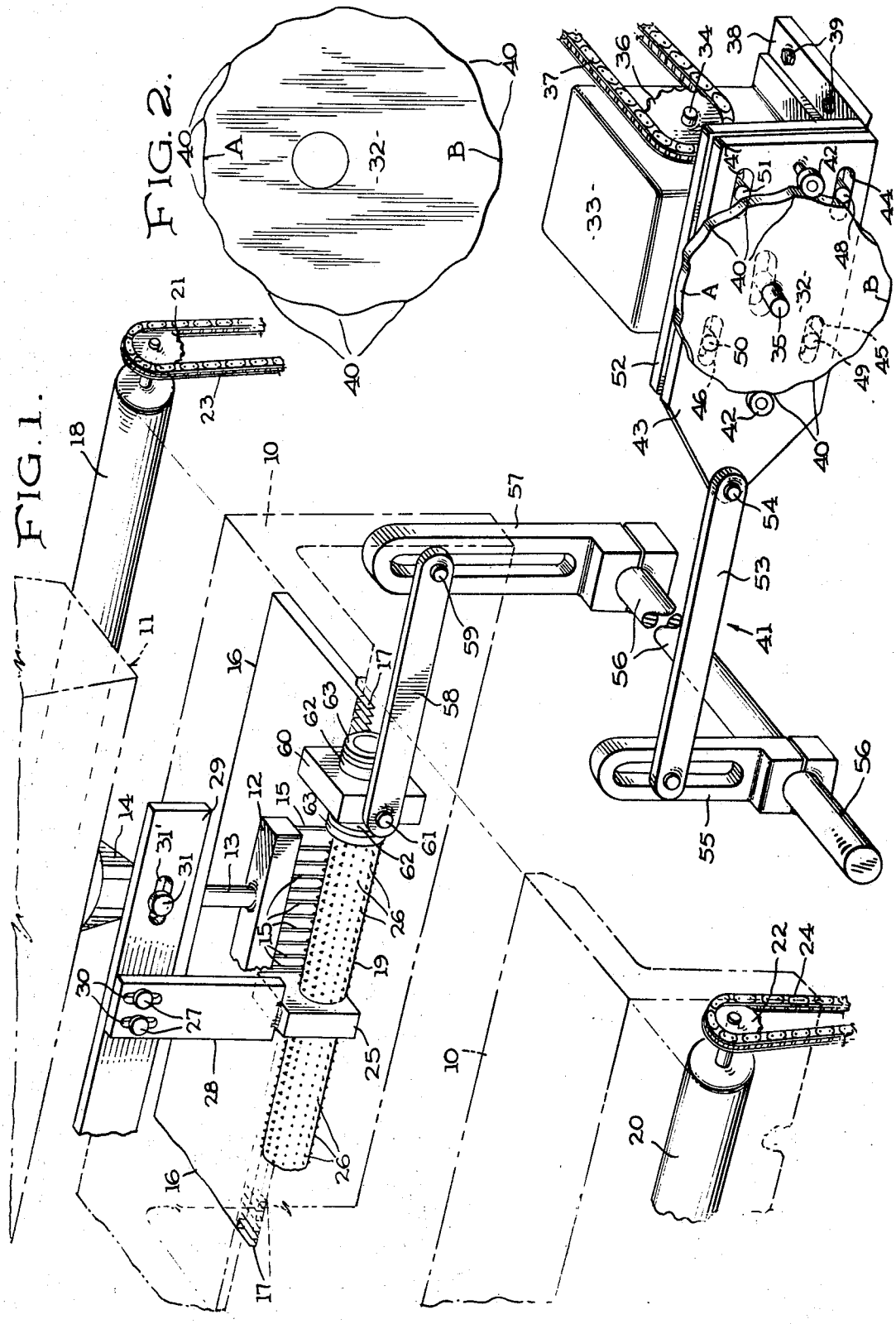
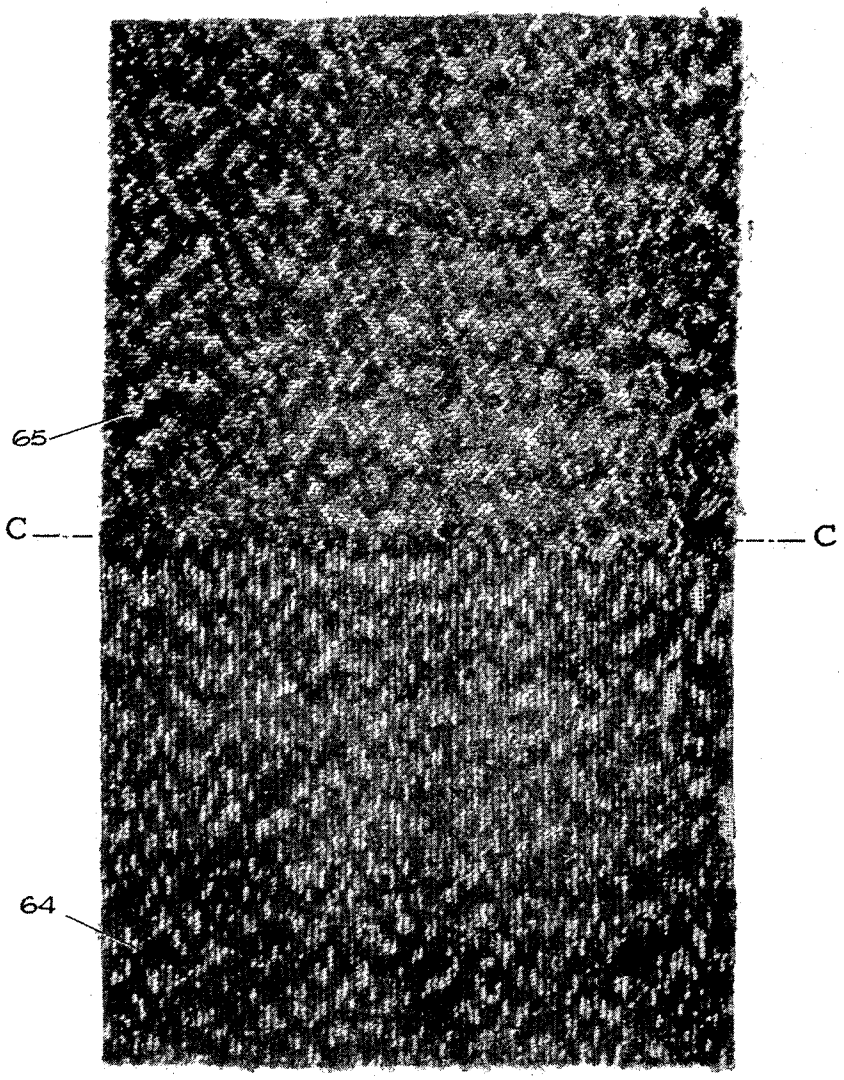


FIG. 2.

VARIABLE STITCH PLACEMENT ATTACHMENT FOR TUFTING MACHINES

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FIG. 3.



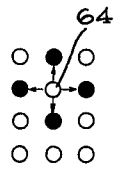


FIG. 4.

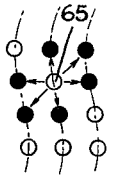


FIG. 5.

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VARIABLE STITCH PLACEMENT ATTACHMENT FOR TUFTING MACHINES

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ABSTRACT OF THE DISCLOSURE

A free wheeling spike roller is disposed transversely of the direction of travel of a tufted material advancing through a tufting machine. The roller is supported in position to engage the upper surface of the backing fabric adjacent the needle assembly of the machine on the exit side of the needle assembly as the tufted material moves away from the tufting position. The spike roller is laterally shiftable with respect to the direction of movement of the backing fabric in a series of successive steps or shifts, the length of each step, as well as the total distance of the successive steps, being less than one-half needle gauge.

The present invention relates to tufting machines, and more particularly to an attachment for tufting machines for creating a non-directional effect in the face of a tufted carpet.

Although the present invention is shown and described herein as an attachment intended for application to existing machines, it will be readily apparent that the invention may be adapted to and incorporated in a new machine.

One present shortcoming of tufted carpets is the fact that tufting is done in straight rows, referred to as "corn rows." In addition to providing minimum pile support, the "corn rows" pattern gives an undersirable appearance to the finished product. Because of this shortcoming, various arrangements have been used in an attempt to eliminate "corn rows." These arrangements generally include either the use of laterally movable feed rollers which oscillate the backing material as it is advanced through the machine or a laterally movable needle assembly which is shifted relative to its normal line of stitching to continue the stitching in a line parallel to, but offset from the normal line of stitching.

An exemplary form of the former arrangement is illustrated in U.S. Patent No. 3,100,466, wherein a pattern chain control is utilized to effect oscillation of the feed rollers in accordance with a predetermined pattern. Because the feed rollers are disposed at a considerable distance from the needles as they penetrate the backing material and the fact that the feed rollers are continually oscillated, the result is a spaced wavy or sinuous pattern, not much better in appearance than "corn rows". In an attempt to avoid the wavy pattern effect, resort is made to the use of a complicated, expensive pattern clutch drive arrangement to effect a variable speed lateral displacement of the backing fabric.

An exemplary form of a laterally movable needle assembly is illustrated in U.S. Patent No. 3,213,813, wherein the needle bar is shifted to offset stitch placement. Such an arrangement has been found undesirable, because the needle is generally shifted in steps equal to a full gauge i.e., the distance between the longitudinal axis of two adjacent needles, and such large shifts result in uneven pile lay, streaking and a considerable waste of yarn due to the varying length of stitches on the back of the carpet. In addition such an arrangement has limited application and cannot be used for creating, for example, cut pile carpeting.

These and other disadvantages of known arrangements

are overcome by the present invention which is simple and inexpensive to manufacture and easily adapted to multiple needle tufting machines, and which has as its primary object to provide an attachment for tufting machines for creating a non-directional effect in the face or nap of a tufted carpet.

Another object of the present invention is to provide an attachment for tufting machines which results in a tufted carpet having increased pile support and less pile lay then heretofore obtainable in carpets tufted by conventional tufting techniques with the same type and weight yarn.

Another object of the present invention is to provide an attachment for tufting machines for creating a carpet having greater pile recovery than heretofore obtainable with carpets tufted with the same type and weight yarn by conventional tufting techniques.

A further object of the present invention is to provide an attachment for multiple needle tufting machines adapted to secure a variable stitch placement for any fraction of needle gauge.

Still another object of the present invention is to provide an attachment for multiple needle tufting machines which is simple, rugged and reliable in operation, requiring little or no attention once set up for a particular job.

Yet another object of the present invention is to provide an attachment for multiple needle tufting machines which results in a reduction of objectionable defects in a tufted carpet such as pinholing, rough nap and "corn rows".

Still a further object of the present invention is to provide an attachment for multiple needle tufting machines which minimizes damage to the backing material during tufting, thus increasing the strength of the carpet.

These and other objects and many of the attendant advantages of the present invention will become readily apparent from the following description of one specific embodiment of the inventive concept.

In accordance with the present invention, by placing the successive tufts between the normal gauge of adjacent rows, the overall effect is to provide a more closely tufted carpet having a non-directional effect and giving the appearance and characteristics of a carpet tufted with a smaller gauge. The length of stitches on the back of the backing fabric are substantially uniform which minimizes streaking or uneven pile on the face of the tufted carpet. Also, instead of the pile being supported only by the yarn on both sides of a given loop and adjoining rows, the pile is given a six or eight-way pile support by having rows placed all around it, as in a circle. This reduces pile lay or matting and results in an increase of approximately 25% in pile recovery as compared to a finished carpet when tufted by conventional techniques with the same type and weight yarn.

To this end, contrary to the long established and long believed necessary practice of using a stationary pressure foot adjacent the needle bar assembly of a tufting machine, in the present invention the conventional stationary pressure foot is replaced with a free wheeling spike roller mounted directly behind the needle bar of the machine. The free wheeling roller is arranged to be laterally shifted with respect to the advancing backing material in a series of successive, short steps, the total shift in one direction being not greater than a full needle gauge, to correspondingly move the backing material. Because the movement of the backing material is minute and made adjacent to the needle bar assembly at the point where the needles enter the backing, the tufts are closely spaced and there is created a total non-directional effect in the tufted carpet by the varied stitch placement which gives the appearance of a woven material. The soft interblending in directional stitch continuity avoids sharp directional

changes that cause pile variations and maintains the length of the stitching on the back substantially uniform.

In accordance with one feature of the present invention, the free wheeling spike roller is shifted laterally in successive steps by a drive mechanism adapted for connection in driving relationship to the main drive of the tufting machine so that each shift of the backing material occurs as the needle assembly is in the uppermost position with the needles withdrawn from the fabric being advanced through the machine.

In accordance with another feature of the present invention the drive mechanism for effecting lateral shift of the free wheeling spike roller includes an eccentric cam comprising a plurality of spaced stepped portions of the periphery thereof. A cam follower is disposed to ride on the periphery of the eccentric cam and is mounted to a shifting plate adapted to be operatively connected to the free wheeling spike roller to impart to the roller a successive series of steps or strokes in one direction and a successive series of steps or strokes in an opposite direction as the cam wheel is rotated.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter of the present invention it is believed the invention will be more clearly understood from the following detailed description thereof taken in connection with accompanying drawings; however, it is to be expressly understood that these drawings are for the purpose of illustration only and are not intended to represent the full scope of the invention which is defined by the appended claims.

In the drawings:

FIG. 1 is a fragmentary, perspective view illustrating the attachment of the present invention as it is adapted to be used with a conventional tufting machine which is shown partially in outline form by dashed lines.

FIG. 2 is a plan view of one form of eccentric cam wheel adapted to impart to the free wheeling presser foot successive lateral shifting movements.

FIG. 3 is a photograph of a sample of carpeting material, one half of which was made by a conventional tufting machine and the other half of which was made by the same machine using the same yarn and equipped with the novel attachment of the present invention.

FIG. 4 is a diagrammatic representation of "corn rows" achieved by conventional machines, and

FIG. 5 is a diagrammatic representation of the variable stitch placement and increased pile support achieved by the present invention.

Referring now to the drawings, and in particular to FIG. 1, a tufting machine constructed in accordance with the present invention comprises a conventional bed plate **10** over which is mounted a crank shaft housing or head **11** which encloses a crank shaft (not shown) adapted to be driven to reciprocate a plurality of needles **15**. Needles **15** are carried by a needle carrier **12** mounted to needle bar **13** which is in turn supported by the needle bar housing **14** beneath head **11**.

As should be apparent, needles **15** are reciprocated up and down to penetrate a backing fabric (not shown) which is fed over a throat plate **16** and pass between the needle wires **17** extending therefrom. The backing fabric is fed in a conventional manner from a roll **18**, over the throat plate **16**, under free wheeling roller or presser foot **19** and over the bedplate **10** to the take-up roll **20**. Feed roll **18** and take-up roll **20** may be driven in any suitable manner from the main drive of the tufting machine to advance the backing fabric in a horizontal, longitudinal direction while the needles **15** are reciprocated and to this end may be provided with sprockets **21** and **22** adapted to be driven from the main drive through chains **23** and **24**, respectively.

In the interest of clarity, the conventional jerker bars for the pile yarn fed to the needles and loopers and cutters for retaining and cutting the pile projections have been omitted in the illustration of the present invention, as has been the details of the tufting machine which are well known.

Advantageously, the free wheeling presser foot **19** is mounted adjacent the area where the needles **15** penetrate the backing material as it is advanced through the machine beyond the tufting position and replaces the conventional stationary presser foot normally utilized with conventional tufting machines. The free wheeling presser foot or roller **19** is supported for rotation upon advancement of the material through the machine by bearings **25**, only one of which is shown, and may be fabricated from a solid cylindrical roll provided with a plurality of projections, pins or spikes **26** disposed about its surface.

It should be apparent that the free wheeling presser foot **19** extends across the bedplate **10** and may be several feet long. Accordingly, several supporting bearings may be provided to prevent bowing. Each bearing **25** is in turn supported by a bracket **28** adjustably secured to cross plate **29**. Due to the free wheeling action of the rotating presser foot **19**, the critical adjustment of the conventional stationary presser foot is avoided. To effect initial placement of the free wheeling presser foot, bracket **28** is provided with one or more vertically disposed elongated slots **30** through which are passed the mounting bolts **27**.

Cross plate **29** is adapted to be laterally shifted together with the free wheeling presser foot. To this end, cross plate **29** is mounted to the needle bar housing **14** by a plurality of cross plate bearings **31**, only one of which is illustrated. Each of the bearings **31** rides in a horizontally disposed, elongated slot **31'** provided in cross plate **29**.

To effect lateral shift of the backing material 90° from the normal horizontal direction of travel across the bed plate **10**, the free wheeling spike presser foot or roller **19** is adapted to be laterally shifted in successive steps. The total number of successive steps or shifts may be varied; however, each step advantageously corresponds to one stitch of the needles and the total amount of lateral displacement in one direction is less than the needle gauge of the tufting machine, i.e., the distance between the longitudinal axis of two adjacent needles of the needle assembly. This stitch placement creates a total nondirectional effect in the finished product and gives the appearance of a woven fabric.

Lateral stepping of the free wheeling presser foot **19** is effected through an eccentric cam **32** adapted to be driven from the main drive of the tufting machine. To this end, there is provided a speed reducer **33** having the usual input shaft **34** and output shaft **35**. Mounted on input shaft **34** is a driven sprocket **36** which carries chain **37** connected in driving relationship to the main drive. Speed reducer **33** drives the eccentric cam **32** which is affixed to the output shaft **35** in any suitable manner.

Referring to FIG. 1, the speed reducer **33**, eccentric cam **32** and associated linkage **41** connected to the free wheeling presser foot **19** is illustrated, for clarity, as being disposed to one side of the tufting machine, as viewed in the drawing. However, it should be apparent that these elements may be disposed in any convenient location. For example, the speed reducer **33** may be securely fastened above the free wheeling presser foot **19** to the head **11** by means of mounting plate **38** and mounting bolts **39**.

Referring now to FIG. 2 the eccentric cam **32** is advantageously constructed with at least two symmetrical sections and is provided with a plurality of stepped portions **40** about its periphery. In the illustrated embodiment, 14 steps are provided, however, the number of steps may be varied depending on the stitch placement desired. Starting from a reference point A and traveling counterclockwise around the periphery of the eccentric cam **32**, the distance from the axis of rotation of the cam to each step portion **40** gradually increases until the reference point designated B is reached, after which the distance

from the axis of rotation of the cam to each step portion gradually decreases. As the distance from the axis of rotation of the cam to adjacent step portion increases or decreases the length of the step portion on the periphery correspondingly varies. The increase or decrease in length of the steps serves to compensate for the change in surface speed of the cam wheel at various portions due to its eccentricity as it is rotated.

Referring again to FIG. 1, successive stepping of the free wheeling presser foot **19** and corresponding shifting movements of the backing is imparted thereto through a linkage connection **41** and cam follower **42** mounted to shifter plate **43**. The shifter plate **43** includes a central horizontally disposed, elongated slot (not shown) through which shaft **35** passes and four spaced elongated slots **44–47**. As should be apparent, shifter plate **43** rides on 4 pins **48–51** which are mounted to a stationary bracket **52** so that one pin is positioned in each of the elongated slots **44–47**.

Cam follower **42** is disposed to track on the periphery of the eccentric cam wheel **32** so that, as the cam wheel is rotated, there is imparted to the shifter plate **43** a series of positive successive strokes comprising several strokes in one direction and then several strokes in the opposite direction. Advantageously, cam follower **42** may comprise two or more diametrically opposite positioned cam wheels which are disposed, together with the peripheral contour of the eccentric cam, to remain in constant engagement with the periphery of the cam wheel **32**. In the illustrated embodiment, the cam wheel **32** is provided with 14 steps whereby the shifter plate has imparted thereto 7 successive strokes in each direction, the total displacement of the 7 successive strokes being preferably approximately equal to one half of the gauge of the needle assembly of the tufting machine. This is effected by maintaining the variations in the configuration of the eccentric cam **32** very small so that it is possible to secure lateral stitch displacements in the order of $\frac{1}{128}$ inch. Thus, for a 14 step cam configuration, the total lateral shift imparted to the spike roller in each direction is $\frac{7}{128}$ inch, which is less than ½ of the needle gauge of a standard needle assembly of $\frac{5}{32}$ gauge.

Movements of the shifter plate **43** are translated to the free wheeling presser foot **19** to cause laterally shifts of the backing material by virtue of the pins **26** which engage the backing and connecting linkage **41**. Linkage **41** includes a drive link **53** mounted at one end to a drive link pin **54** and at its other end to a drive link lever **55**. Lever **55** is affixed to a rock shaft **56**. Rock shaft **56** also has mounted thereto a second drive link lever **57** which is operatively connected with one end of drive link **58** by pin **59**. The other end of drive link **58** is connected to the drive block **60** of the free wheeling presser foot **19** by drive link bolt **61**. Thrust bearings **62** are mounted next to each side of the drive block **60** and are held in place by two collars **63** disposed on opposite sides of the drive block.

In operation, the shifter plate **43** is shifted in successive steps upon rotation of the eccentric cam wheel **32** and a corresponding movement is imparted to drive link **53** which causes drive lever **55** to pivot about the rock shaft axis. The torque thus applied to rock shaft **56** is transmitted to drive lever **57**, and causes the drive lever to actuate drive link **58**, which in turn moves the free wheeling presser foot **19** and cross plate **29** laterally with respect to the direction of travel of the backing material across the bed plate **10**. By virtue of the spikes **26** extending into the backing material, the backing is also correspondingly shifted.

Advantageously, cam wheel **32** is adapted to be driven in timed relation with the main drive of the tufting machine so that a shift or stroke is imparted to the free wheeling presser foot and backing only when the needles are withdrawn from the backing. In this manner, the backing material is shifted slightly from its present stitch line to another stitch line. The very short shifts serve to avoid sharp directional changes and provide a soft interblending in directional stitch continuity.

It should be readily apparent that by variations in the configuration of the eccentric cam **32**, it is possible to secure any amount of lateral stitch placement from $\frac{1}{128}$ inch, i.e., almost no movement, up to a full gauge of the needle assembly, the normal gauge of the needle assembly being $\frac{5}{32}$ inch or $\frac{3}{16}$ inch. In this manner, the tufts of yarn are placed between the normal stitch rows so that an effect very similar to reducing the gauge is obtained.

Referring to FIG. 3 there is shown a photographic representation of the stitching pattern produced by the present invention as compared to the stitch pattern obtained by the same machine without the attachment. The area of the carpet below lines C—C as viewed in the drawing, illustrates the normal "corn row" effect of conventional tufting machines, while the area of the carpet above lines C—C, as viewed in the drawing, illustrates the totally non-directional effect created in the tufted carpet by the present invention which gives the appearance that the carpet has been woven.

As hereinbefore stated, the present invention results in an increase pile support over conventional methods which makes for better fabric. FIG. 4 diagrammatically illustrates a conventionally tufted carpet having "corn rows." Each individual pile **64** is supported by adjacent yarn on both sides in adjacent rows and on both sides of the same row which, for clarity, have been illustrated as solid circles. Thus, there is provided a 4-way pile support as indicated by the arrows. As shown in FIG. 5, by the present invention each individual yarn **65** is completely encircled to provide at least a 6-way pile support which results from adjacent stitch lines being shifted slightly to one side. The improved pile support was demonstrated by tests conducted at the U.S. Testing Laboratory where a fabric tufted in a conventional manner was compared to a fabric tufted by the same machine with the attachment of the present invention incorporated and using the same yarn. The carpet where the "corn rows" were eliminated in accordance with the present invention were found to have a 25% improvement in pile recovery.

Referring to FIG. 5, it can be shown that the overall strength of the carpet is improved. To this end, the carpet is sewn over the entire surface of the backing, rather than being limited to straight rows, as would be the case with "corn rows." This is important, since any backing material such as, for example, jute is limited to the number of stitches it can accept and still maintain its strength. Normally, when installing carpet wall to wall, the carpet is subjected to a stress of around 100 lbs. per sq. in., the normal breaking point of jute being about 135 lbs. per sq. inch. Where the carpet is created by the present invention, the number of holes made in any one row or straight line along of the backing is decreased. Therefore, if desired, the number of stitches per given amount of backing can be increased.

There is thus provided by the present invention a novel attachment for a tufting machine which, as hereinbefore described, is readily adapted to be used with new or existing tufting machines to create a non-directional effect which not only affects the appearance of a carpet, but also improves its characteristics. Advantageously, the number of step portions on the eccentric cam can be varied to increase or decrease the number of lateral shifts provided to the free wheeling presser foot and by using different peripheral contours or changing the speed ratio of the cam wheel to the main drive, different effects can be achieved. Also, if desired the shifter plate **43** may be connected to drive the cross plate **29** rather than the drive block **60**.

Although, the invention has been described with reference to only one embodiment thereof, it will be readily

apparent to those skilled in the art that various modifications may be made without departing from the inventive concept. It is therefore intended by the appended claims to cover all such modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. In a multiple needle tufting machine having a frame, a vertically reciprocable needle bar assembly mounted to said frame and including a plurality of equally spaced needles, means for driving said needle bar assembly to cause a plurality of spaced pile yarns, carried by said needles to be inserted through a backing fabric and form pile loops on one side of said backing fabric, a throat supported to said frame and defining a tufting zone over which the backing fabric is advanced, drive means for advancing the backing fabric through the tufting machine in the direction of its length, the improvement comprising a free wheeling spike roller supported to said frame, said spike roller being positioned adjacent to and beyond said tufting position in the direction the backing fabric is advanced and being disposed for engagement with the other side of the backing fabric as it leaves the tufting zone and means for laterally shifting said spike roller a distance less than one-half the spacing between adjacent pile yarns to effect a corresponding lateral displacement of the backing fabric so as to break up the regularity of the pile loops on said one side of the backing fabric and thereby create a non-directional effect in the face of the tufted carpet.

2. A multiple needle tufting machine as set forth in clam 1 wherein said spike roller is laterally shiftable a successive series of steps, the total lateral displacement of said spike roller being less than one-half the needle gauge of the tufting machine.

3. A multiple needle tufting machine for creating a non-directional effect in the face of a tufted carpet comprising in combination a frame, a vertically reciprocable needle bar assembly mounted to said frame for inserting a plurality of equally spaced pile yarn carrying needles through a backing fabric to create the tufted fabric, a throat supported to said frame and defining a tufting zone over which the backing fabric is advanced, means disposed beneath said throat for forming pile loops on one side of said backing fabric, drive means having a feed roll and a take-up roll for advancing the backing fabric in the direction of its length, a free wheeling, laterally shiftable spike roller, said free wheeling spike roller being positioned between said take-up rolls and needles and adjacent to the tufting zone for engagement with the other side of the backing fabric as it leaves the tufting zone and is advanced from the area of the needle assembly to the take-up roll, means for laterally shifting said spike roller a distance less than one-half the spacing between adjacent pile yarns to effect lateral displacement of the backing fabric with respect in its direction of advancement, a drive mechanism, said drive mechanism including speed reducing unit having an input shaft and an output shaft, said input shaft being connected in driving relationship to the drive means of the tufting machine, an eccentric cam wheel connected to said output shaft comprising a plurality of spaced step portions on the periphery thereof, a cam follower disposed to ride on the periphery of said cam wheel, said cam follower being operatively connected to said means for laterally shifting said spike roller to effect lateral shifts thereof upon advancement of the backing fabric so as to break up the regularity of pile loops on said one side of the backing fabric and thereby create the non-directional effect in the face of the tufted carpet.

4. A multiple needle tufting machine as set forth in claim 3 wherein said spike roller is laterally shiftable a successive series of steps in one direction and a successive series of steps in the opposite direction, the total lateral displacement of said spike roller in each of said directions being less than one-half the needle gauge of the needle assembly.

5. A multiple needle tufting machine as set forth in claim 3 wherein said eccentric cam wheel includes at least two symmetrical sections, each section having seven step portions about the periphery thereof, the length of each step portion varying in correspondence to the distance of the step portion from the axis of rotation of the cam wheel such that one section causes said spike roller to be laterally shifted a series of seven successive strokes in one direction and the other section causes said spike roller to be shifted a series of seven successive strokes in the opposite direction, the total lateral displacement of said free wheeling spike roller in each of said directions being less than one-half the needle gauge of the tufting machine.

6. A multiple needle tufting machine for creating a non-directional effect in the face of a tufted carpet as set forth in claim 3 wherein said eccentric cam wheel includes at least two symmetrical sections, each section having a plurality of spaced step portions on the periphery thereof for imparting to said spike roller a series of successive strokes in one direction and a series of successive strokes in the opposite direction, the total lateral displacement of said free wheeling spike roller in each of said directions being less than one-half of the needle gauge of the tufting machine.

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