ABSTRACT

A yarn tension control for use with a tufting machine or the like and which is adapted to selectively vary the tension on the yarns during each reciprocation of the needles such that the yarns are tensioned during movement of the needles from their lowered to their raised position to thereby tighten the tufting loops about the loopers, and the yarns are relaxed when the needles reach their raised position. The machine is designed to be stopped when the needles are in the raised position and the yarns are relaxed such that the machine may be stopped for threading or other purposes without causing stop marks on the pile fabric caused by a prolonged tensioning of the yarns.

6 Claims, 10 Drawing Figures
YARN TENSION CONTROL FOR A TUFTING MACHINE

The present invention relates to an apparatus for selectively varying the tension of the yarns in a tufting machine during each cycle of operation whereby the problem of stop marks on the pile fabric may be eliminated.

As is well known, nylon and other yarns presently being used in the production of tufted carpeting and other pile fabrics have a tendency to elongate when subjected to excessive or prolonged tension. This may result in defects, referred to as tufting streaks or stop marks, on the face or pile side of the carpet when the machine is stopped and the yarns remain taut. More specifically, when the tufting machine is stopped to rethread a broken strand or for some other purpose, the operator normally stops the machine with the needles in their fully raised position above the backing fabric. At this position, the tufting needles exerting maximum tension on the yarns, and this prolonged tension often causes an elongation of the yarns and a drawing of the loops previously formed, to thereby produce a line of tufting loops of reduced height. This results in a line or stop mark which is visible across the face of the fabric.

It is accordingly an object of the present invention to provide a yarn tension control for a tufting machine of the described type wherein the tension applied to the yarns is relaxed when the needles are in their fully raised position such that the machine may be stopped in this position without causing stop marks.

It is another object of the present invention to provide a yarn tension control for a tufting machine which is adapted to jerk or pull tight the yarns during movement of the needles upwardly toward their raised position to thereby tighten the tufting loops about the loopers and thereby insure a proper stitch, and then release the tension on the yarn when the needle is positioned substantially at its raised position.

It is a further object of the present invention to provide a yarn tension control for a tufting machine which relaxes the tension at the top of the needle stroke, and which includes means for stopping the machine with the needles fully raised and the tension relaxed.

It is still another object of this invention to provide a yarn tension control of the described type wherein adjustment to the yarn tension may be made, and wherein such adjustment may be made while the machine is running.

These and other objects and advantages of the present invention are achieved in the embodiment of the invention illustrated herein by the provision of tension control means positioned along the path of travel of the yarns for selectively varying the tension on each yarn during the reciprocation of the needles such that each yarn is tensioned during movement of the associated needle from its lowered to its raised position and the yarn is relaxed when the needle reaches its raised position. In the illustrated embodiment, the tension control means includes a pair of spaced guide members fixedly carried by the machine, a movable guide member positioned intermediate the spaced guide members, and a cam operated shaft for moving the movable guide member in timed relation to the operation of the machine such that the yarn path of travel is alternately lengthened and shortened during each cycle of operation to thereby alternately tension and relax the yarns. The machine may further include means for stopping the machine when the needles are up and the yarns are relaxed such that the operator may stop the machine with the needles fully raised to facilitate retreading.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds, when taken in connection with the accompanying drawings, in which —

FIG. 1 is a partially schematic, fragmentary perspective view of a tufting machine embodying the features of the present invention;

FIG. 2 is a fragmentary end view of the tufting machine shown in FIG. 1 and illustrating the position of maximum oscillation of the tension control means;

FIG. 3 is a fragmentary end view of a portion of the apparatus shown in FIG. 2 and illustrating a position of limited oscillation of the tension control means;

FIG. 4 is a sectional end view taken substantially along the line 4—4 in FIG. 1 and showing the apparatus with the needles in their lowered position;

FIG. 5 is a view similar to FIG. 4 but showing the apparatus with the needles in their raised position;

FIG. 6 is a fragmentary sectional end view showing the yarn tension control means and the needle bar after the apparatus has been rotated from the raised position approximately 90° through its cycle operation;

FIG. 7 is a view similar to FIG. 6 and showing the apparatus after having been rotated 180° through its cycle of operation and wherein the needles are at their lowered position and corresponding to FIG. 4;

FIG. 8 is a view similar to FIG. 6 and showing the apparatus after having been rotated 270° through its cycle of operation;

FIG. 9 is a view similar to FIG. 6 and showing the apparatus after having been rotated approximately 350° through its cycle of operation;

FIG. 10 is a view similar to FIG. 6 and showing the apparatus at its fully raised position and corresponding to FIG. 5.

Referring more specifically to the drawings, a tufting machine embodying the features of the present invention is indicated generally at 20. The tufting machine 20 includes a bedplate 22 which is supportable by a suitable frame (not shown) on a horizontal surface such as the floor of a building or the like. The frame also supports the head casting 24 positioned above the bedplate 22. The casting 24 comprises end walls 25 and 26, side walls 27 and 28, a top wall 29 and a bottom wall 30.

A main drive shaft 32 extends horizontally through the casting 24 and is journaled in the end walls 25, 26. In addition, the shaft 32 may be supported throughout its length by other suitably spaced bearings (not shown), and it is adapted to be continuously driven by the drive motor 33 in a manner hereininafter further described. An additional rotatable shaft 34 is disposed parallel to the main drive shaft 32 on one side thereof and is mounted within the casting 24 by suitable bearings (not shown).

The main drive shaft 32 has mounted thereon a plurality of spaced needle drive came 36 which include an eccentric disc 38 mounted on the main drive shaft 32 for rotation therewith and a cam follower 40 surrounding the eccentric disc 38. The follower 40 is connected at its remote end to a rocker arm 42, the rocker arm being adapted to pivot about the shaft 34 so that rotation of the main drive shaft 32 oscillates the rocker arm 42 and imparts a reciprocating motion to the connect-
A needle bar 50 having a plurality of conventional tufting needles 52 carried thereby is mounted at the lower end of the push rod 46 whereby the needles 52 reciprocate upon rotation of the main drive shaft 32. Preferably, the needles 52 are uniformly and equally spaced to form a horizontal row with the yarns Y being continuously fed thereto along a path of travel hereinafter further described.

A backing fabric F is fed beneath the reciprocating tufting needles 52 from right to left as seen in FIGS. 4 and 5 by means of the feed roll pairs 54, 55 and 56. As shown, the roll 56 is spiked to firmly grip and advance the fabric into the machine at a speed coordinated to the reciprocation of the tufting needles 52 so that the needles 52 penetrate and carry the yarns Y through the fabric F to successively form tufting loops 58.

As best seen in FIGS. 4 and 5, the backing fabric F is fed over guide means for supporting the fabric in operative relation to the tufting needles 52. The guide means is in the form of a needle plate support 62 fixedly mounted to the bedplate 22, the needle plate support having a generally inverted L-shaped cross-section and including a vertical leg member 62a and a horizontal leg 62b, the latter of which extends inwardly toward the tufting needles 52. Superimposed on the horizontal leg 62b is a needle plate 66 which extends inwardly from the needle plate support 62 and has a plurality of projecting fingers 68 (not FIGS. 6–10) which are positioned between the tufting needles 52 to support the backing fabric F adjacent the point of tufting.

With reference to FIGS. 4 and 5, looper means generally indicated at 70 is positioned below the fabric F and operatively associated with the needles 52 for forming successive tufting loops 58 from the yarns Y. As illustrated, the looper means 70 comprises a looper head 72 and a plurality of loopers 74 which extend from the head rearwardly toward the path of the tufting needles 52. The head 72 is mounted to an oscillating looper shaft (not shown) to cause the loopers to similarly oscillate into cooperating relation with the needles to produce the pile loops 58 on the fabric F as the fabric is fed through the machine. The formation of the pile loops in this manner is well known in the art and will therefore not be described in more detail herein.

The yarns Y are fed to the tufting needles 52 along a path of travel, the first portion of which is defined by four emory-covered feed rolls 80, 81, 82 and 83 as seen in FIGS. 4 and 5. From the roll 83, the yarns are fed through a first guide member 84 comprises a horizontally directed bar having a plurality of apertures along its length, with each aperture being adapted to receive an individual yarn end. A second yarn guide member 86 is fixedly carried by the machine below the guide member 84 and in spaced relation thereto. The guide member 86 is of similar construction to the member 84 and comprises a horizontal bar having a like number of apertures along its length for receiving the individual yarn ends.

A horizontally directed shaft 88 is positioned intermediate the first and second yarn guide members 84 and 86, and defines a first axis. The shaft 88 is mounted for limited rotation about the first axis as hereinafter further described, and carries a tangentially disposed plate 90, the plate 90 in turn mounted upper and lower movable yarn guide members 92 and 94, respectively. The upper and lower yarn guide members 92 and 94 are disposed on opposite sides of the shaft 88 as best seen in FIGS. 4 and 5, and each comprises a horizontally directed bar having a plurality of apertures along its length which conform in number and alignment with the apertures in the fixed guide members 94 and 86.

From the second fixed yarn guide member 86, the yarns Y pass through a conventional thread jerk assembly which comprises a fixed yarn guide 96 carried by the front side wall 28 of the casting 24, and a reciprocating yarn guide 98 carried by the needle bar 50. In operation, the upward movement of the guide 98 during movement of the needles 52 from their lowered to their raised position acts to tighten the tufting loops about the loopers 74 to make a proper stitch.

As best seen in FIGS. 6–10, the movable guide members 92 and 94 are oscillated about the axis of shaft 88 in timed relation with the operation of the machine such that the yarn path of travel is alternately lengthened and shortened by the movement of these guide members. By design, the movement of the guide members 92 and 94 is timed such that the yarn is tensioned during movement of the needles 52 from their lowered to their raised positions to tighten the tufting loops about the loopers 74, and then relaxed when the needles are positioned substantially at their raised position. This controlled movement of the movable guide members 92 and 94 is obtained by means of a drive mechanism which includes a follower 100 fixedly carried by the shaft 88 at one end thereof. A second shaft 102 defines a second axis which extends generally parallel to the first axis defined by the shaft 88 and is mounted for rotation at one end of the lever arm 104. The second shaft 102 carries a cam 105 at one end for rotation therewith, the cam having a predetermined peripheral outline as best seen in FIGS. 6–10. The follower 100 in turn carries a spindle 106 which is adapted to operatively engage the cam peripheral outline whereby the rotation of the second shaft causes the follower 100 to selectively oscillate the shaft 88 and the movable guide members 92 and 94. To insure continuous contact between the cam 105 and follower 100, there is provided a spring 107 interconnected between the follower and the end wall 25 of the machine to resiliently bias the follower toward the cam. Also, a stop member 108 may be fixedly connected to the shaft 88 for engagement with a fixed pin 109 as seen in FIG. 1. To limit counterclockwise rotation of the shaft 32.

The second shaft 102 is adapted to be continuously rotated in timed relation to the operation of the machine by a mechanism which includes a third shaft 110 mounted for rotation about a third axis which extends generally parallel to the axes of the shafts 88 and 102. In the illustrated embodiment, the third shaft 110 is co-axial with and operatively connected to the main drive shaft 32 such that the shaft 110 is in the nature of an external extension of the shaft 32.

The shaft 110 mounts a pulley or sprocket 111 which is aligned with a similar pulley or sprocket 112 carried by the shaft 102. A non-slip drive belt 114 is interposed between the two pulleys such that rotation of the shaft 110 causes a corresponding rotation of the
The lever arm 104 is mounted for free or independent movement about the axis of the shaft 110 by means of a conventional bearing assembly 116 for the purposes hereinafter described.

The apparatus of the present invention further includes means for manually adjusting the relative spacing of the shafts 88 and 102 such that the extent of the oscillation of the follower 100, and thus the shaft 88 and movable guide members, may be varied. The structure for accomplishing this function includes a female threaded member 118 carried by the lever arm 104 and a male threaded member 120 carried by the machine and threadedly engaging the female member 118 as best seen in FIGS. 1 through 3. The lower end of the male member 120 is supported by a conventional crank assembly including a gear box 122 and rotatable crank 124 whereby the male member 120 may be rotated by manually turning the crank 124. As will be apparent, the female member 118 should preferably be mounted for limited lateral and pivotal movement on the arm 104 so as to permit a non-binding engagement with the male member during rotation thereof.

From the above description, it will be apparent that rotation of the crank 124 will cause the lever arm 104 to be raised or lowered to thereby adjust the relative spacing of the shafts 88 and 102. FIG. 2 shows the shaft 102 in a raised position to achieve a maximum oscillation of the follower 100 illustrated by the angle A. In FIG. 3, the shaft 102 is in a somewhat lowered position, and it will be apparent that the angle of oscillation B is somewhat less than the angle A. Thus, the degree of yarn tension may be adjusted by merely turning the crank 124, and this may be accomplished even while the machine is running. Also, it will be apparent that the timing of the yarn jerk as well as the subsequent relaxation of the tension may be easily controlled by the design of the outline of the cam 105 and its angular positioning on the shaft 102.

The operation of the yarn tension control of the present invention is best described with reference to FIGS. 6-10. In FIG. 6, the yarn tension control and needles are indicated at a position approximately 90° through a cycle of operation from the fully raised position, and it will be observed that the needles 52 have begun to penetrate the fabric F, while the Y is generally relaxed. At the position shown in FIG. 7, wherein the needles have reached their lowered position, the yarn Y has been lightly tensioned by the interengagement of the follower 100 and cam 105. At the position shown in FIG. 8, the loopers 74 have engaged the loop formed by the associated needles 52, and the yarn tension control is exerting a somewhat higher degree of tension.

At the position shown in FIG. 9, the loopers are retaining the tufting loops which have been formed in the yarn beneath the fabric F, and the yarn tension control assembly is exerting maximum tension. In addition, the conventional thread jerk assembly comprising the guides 96 and 98 adds to the tension being exerted at this point. It will be apparent that the conventional thread jerk assembly is somewhat duplicative of the function of the yarn tension control at this point, but the conventional thread jerk is sometimes desirable as it will enable the machine to run in a regular fashion with the yarn tension control being non-operative.

FIG. 10 represents the fully raised position of the needles 52. At this point, the follower 100 has fallen from the raised portion of the cam outline, and the spring 107 acts to oscillate the movable guide members 92 and 94 clockwise to a position wherein they are aligned with the fixed guide members 84 and 86 and the yarn tension is relaxed. Thus, during each cycle of operation, the yarn path of travel is alternately lengthened by the rotation of the shaft 88 in a counterclockwise direction as represented in FIGS. 6-9, and then shortened as shown in FIG. 10 to relax the yarn tension.

The power means for the tufting machine includes the drive motor 33 which is operatively connected to the shaft 110 by a non-slip drive belt or chain 130 and sprocket 132. Preferably, the power means further includes means for stopping the operation of the machine in a predetermined position at which the needles are in their raised position and the yarn is relaxed as shown in FIG. 10. In this regard, an electromagnetic clutch-brake 134 of conventional design is interposed along the shaft 110, the clutch-brake being controlled by the circuity shown schematically in FIG. 1. More specifically, the circuity includes a master start-stop switch 136 to the motor 33 for controlling the operation of the whole machine. Also, a second switch 138 is connected to the brake-clutch, and a switch 140 is positioned in parallel to the switch 138 which is operatively controlled by a cam 142 carried by the shaft 32. Thus in normal operation, the switches 136 and 138 are closed such that the clutch is engaged and the brake is disengaged.

When it is desired to stop the reciprocation of the needles, the switch 138 is manually opened. The shafts 110 and 32 will continue to rotate however, until the cam 142 opens the switch 140 which causes the clutch to be disengaged and the brake engaged. As will be apparent, the drive motor 33 will continue to operate but the rotation of the shafts 110 and 32 will quickly terminate. By proper positioning of the cam 142 on the shaft 32, the needles may be brought to rest in any preselected position, and as noted above, this position normally will correspond to their fully raised position as shown in FIG. 10.

As an alternate to the above described stopping means, the machine may be stopped in the desired position by means of a conventional bumping or jogging switch (not shown) operatively connected to the drive motor 33. In this embodiment, the needles may be reciprocated by a series of small incremental movements until the desired position is reached, and the electromagnetic brake-clutch may be eliminated.

In the drawings and specification, there has been set forth a preferred embodiment of this invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

That which is claimed is:

1. In a tufting machine for forming a pile fabric including a plurality of tufting needles mounted for reciprocation between a raised position and a lowered position, power means for reciprocating said needles in unison between said raised and lowered positions, means for guiding a yarn along a path of travel to each needle, and looper means operatively associated with each needle for forming successive tufting loops from the yarns, the combination therewith of means for stopping the reciprocation of said needles with said needles in a predetermined position substantially corresponding to said raised position of said needles, and
means positioned along said path of travel for tensioning said yarns during movement of the associated needles from their lowered to their raised position and while the tufting loops are held by said looper means to thereby tighten the tufting loops about said looper means, and for relaxing said yarns when said needles occupy said predetermined position whereby the machine may be stopped in said predetermined position for threading or other purposes without causing stop marks on the pile fabric caused by the yarns being tensioned during stoppage of the needles.

2. The tufting machine as defined in claim 1 wherein said stopping means comprises electrically controlled clutch means for disabling said power means, electrically controlled brake means for stopping reciprocation of said needles when said power means is disabled, and switch means for automatically actuating said clutch means and brake means when said needles are in a preselected position such that the reciprocation of said needles will stop when said needles reach said predetermined position.

3. In a tufting machine for forming a pile fabric including a plurality of tufting needles mounted for reciprocation between a raised position and a lowered position, power means for reciprocating said needles in unison between said raised and lowered positions, means for guiding a yarn along a path of travel to each needle, and looper means operatively associated with each needle for forming successive tufting loops from the yarns, the combination therewith of means positioned along said path of travel for selectively varying the tension on each yarn during each reciprocation of the associated needle such that the yarn is tensioned during movement of the associated needle from its lowered to its raised position to thereby tighten the tufting loops about said looper means, and the yarn is relaxed when the needle is positioned substantially at its raised position, said means for selectively varying the tension on each yarn comprising a pair of spaced guide members fixedly carried by said machine, at least one movable guide member positioned intermediately said spaced guide members, and means operatively associated with said power means for moving said movable guide member in timed relation to the operation of said machine such that the yarn path of travel is alternately lengthened and shortened by the movement of said movable guide member, said means for moving said movable guide member including a first shaft mounted for rotation about a first axis and mounting said movable guide mem-

ber, a second shaft mounted for rotation about a second axis extending generally parallel to said first axis, means for continuously rotating said second shaft in timed relation to the operation of said machine, a cam having a predetermined peripheral outline fixedly carried by said second shaft for rotation therewith, and a follower fixedly carried by said first shaft and operatively engaging said cam peripheral outline whereby the rotation of said second shaft causes said follower to selectively oscillate said first shaft and said movable guide member, and means for stopping the reciprocation of said needles in a predetermined position wherein said needles are positioned substantially at their raised position and the yarns are relaxed, whereby the machine may be stopped for threading or other purposes without causing stop marks on the pile fabric caused by the yarns being tensioned during stoppage of the needles.

4. A tufting machine as defined in claim 3 wherein said means for rotating said second shaft includes a third shaft mounted for rotation about a third axis extending generally parallel to said first axis, means operatively associated with said power means for continuously rotating said third shaft, means operatively connected between said second and third shafts for rotating said second shaft in accordance with the rotation of said third shaft, and means for manually adjusting the relative spacing of said first and second shafts whereby the extent of the oscillation of said follower and thus the first shaft and movable guide member may be varied.

5. The tufting machine as defined in claim 4 wherein said means for manually adjusting the relative spacing of said first and second shafts comprises a lever arm mounted for independent movement about said third axis and extending radially therefrom, said lever arm mounting said second shaft in spaced relation to said third axis, and means for manually adjusting the position of said lever arm about said third axis whereby said second shaft may be moved toward or away from said first shaft.

6. The tufting machine as defined in claim 5 wherein said means for manually adjusting the position of said lever arm includes a female threaded member carried by one of said lever arm and machine, a male threaded member rotatably carried by the other of said lever arm and machine and threadedly engaging said female member, and crank means for rotating said male threaded member.

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