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Cobble

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[54] **YARN TENSION CONTROL FOR A TUFTING MACHINE**

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[52] **U.S. Cl.** ..... **112/79 R,** 112/219 A, 112/255

[51] **Int. Cl.** **D05c 15/16**

[58] **Field of Search** ..... 112/79 R, 79 A, 80, 112/266, 410, 254, 255, 219 A

[56] **References Cited**

UNITED STATES PATENTS

3,529,560	9/1970	Jackson	112/79 R
3,548,766	12/1970	Colbert	112/79 R
3,095,841	7/1963	Ballard et al	112/79 R
3,352,396	11/1967	Moseley	112/219 A X
485,546	11/1892	Hunt	112/253
2,191,046	2/1940	Tiesler	112/255
3,216,387	11/1965	Short	112/79 R X

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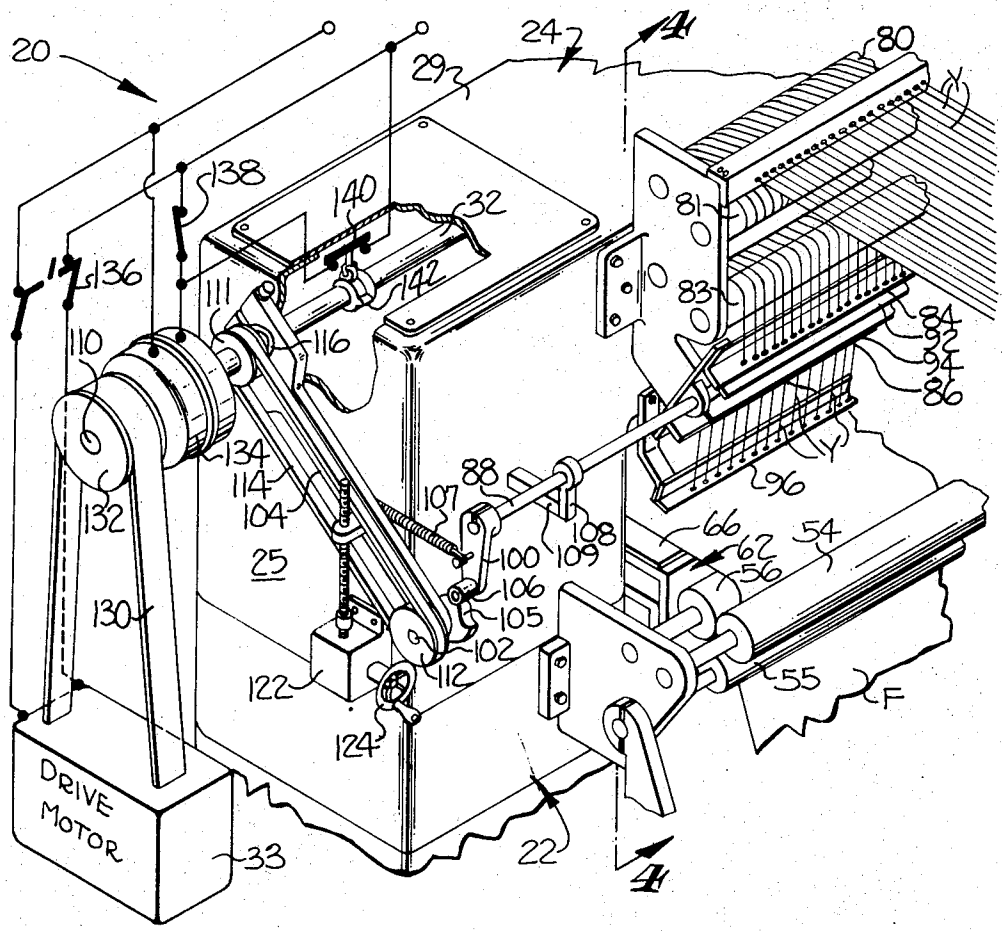
[57] **ABSTRACT**

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



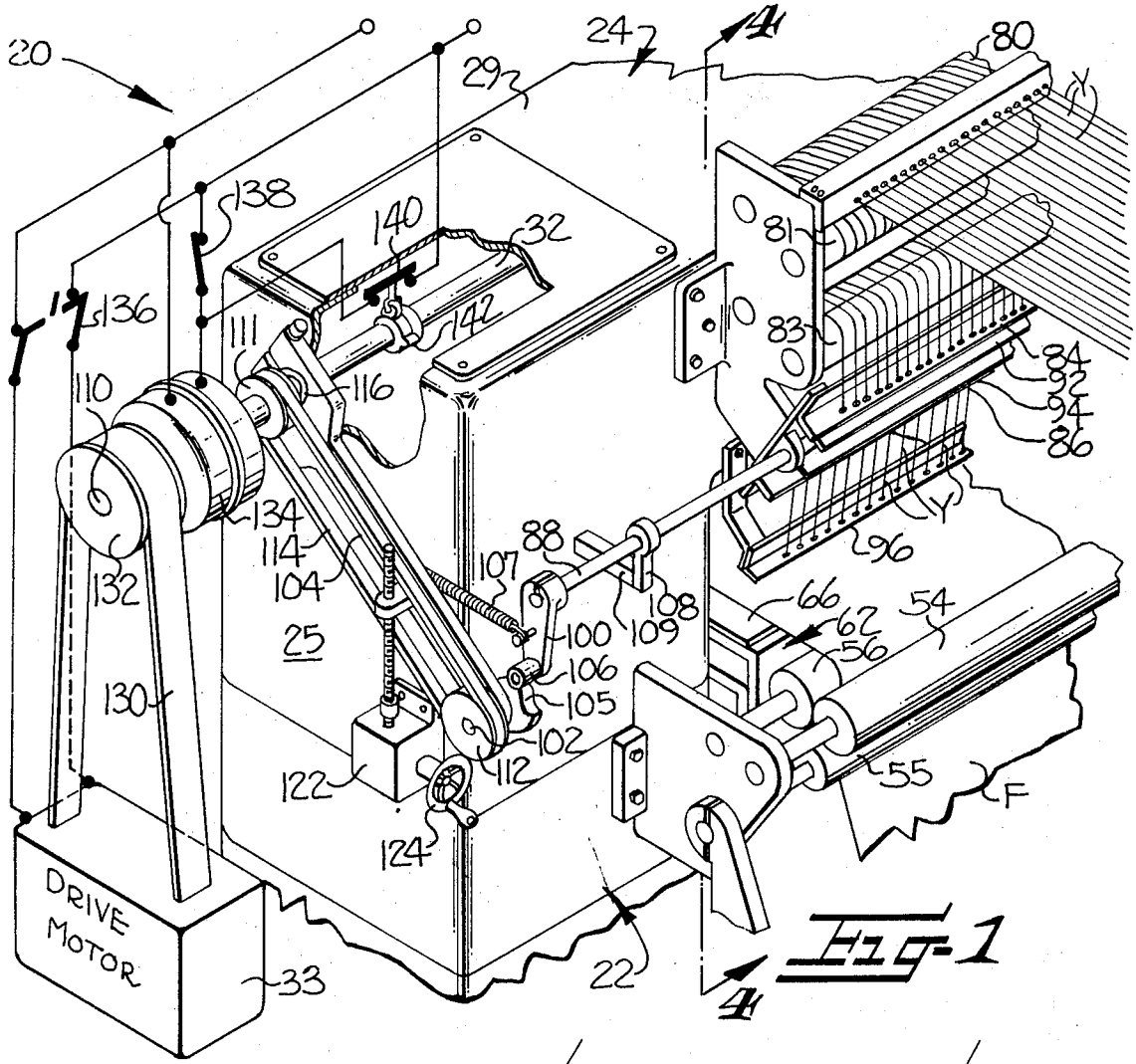


Fig-1

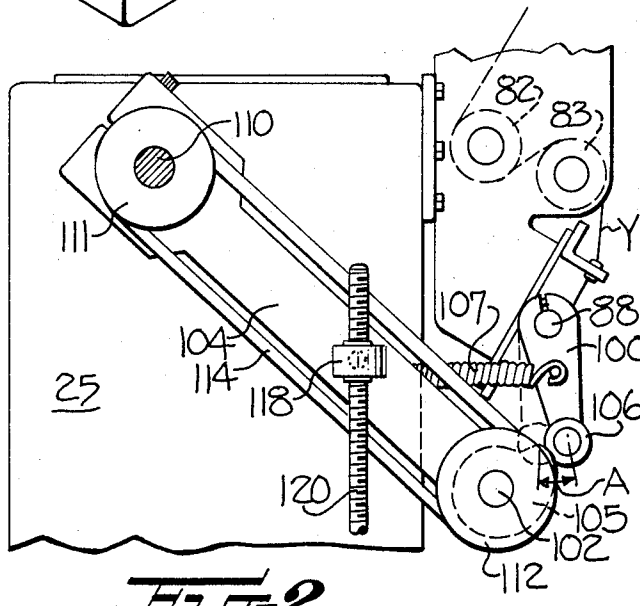


Fig-2

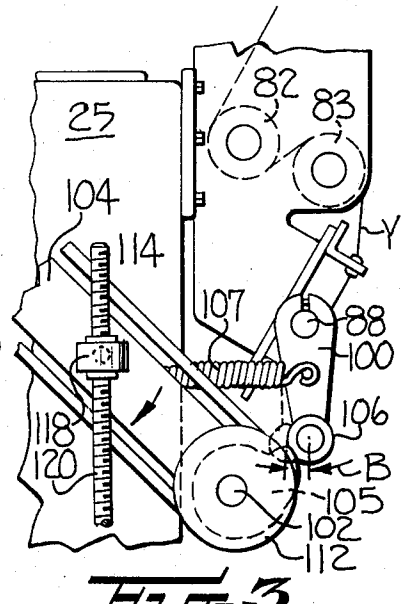


Fig-3

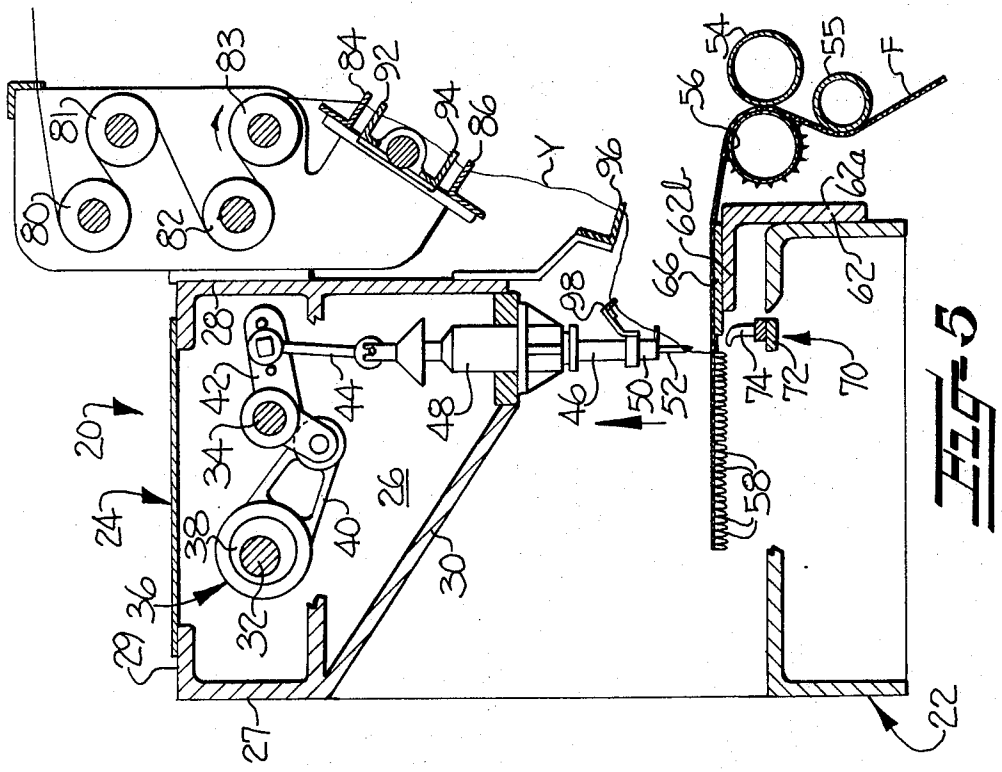


FIG. 5

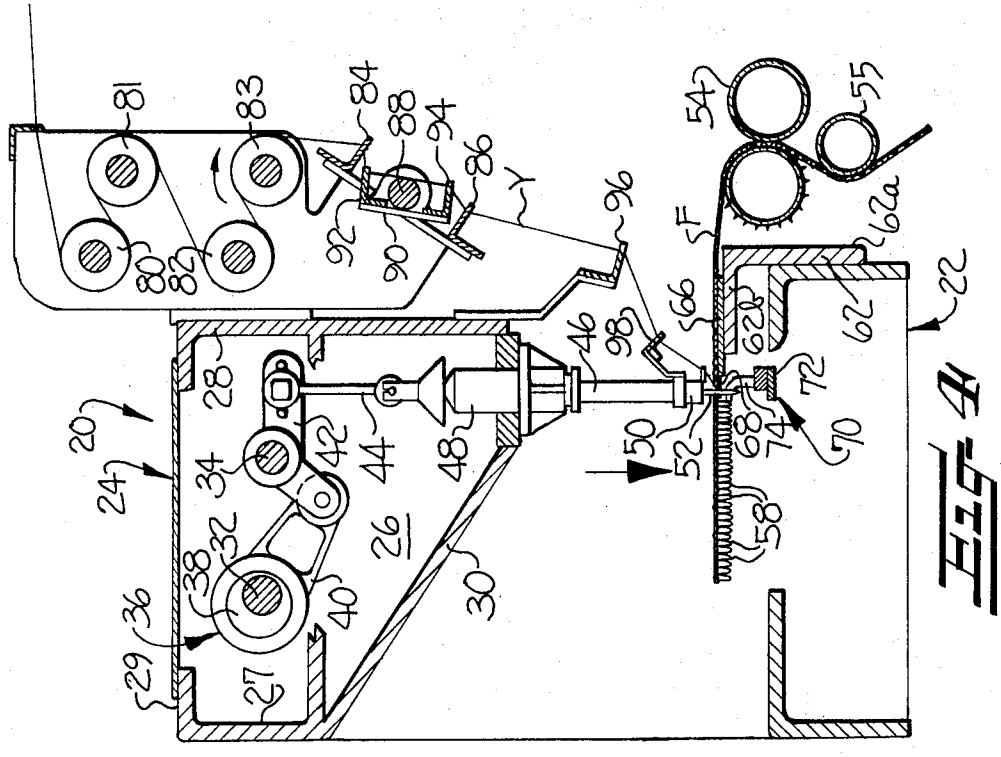


FIG. 4

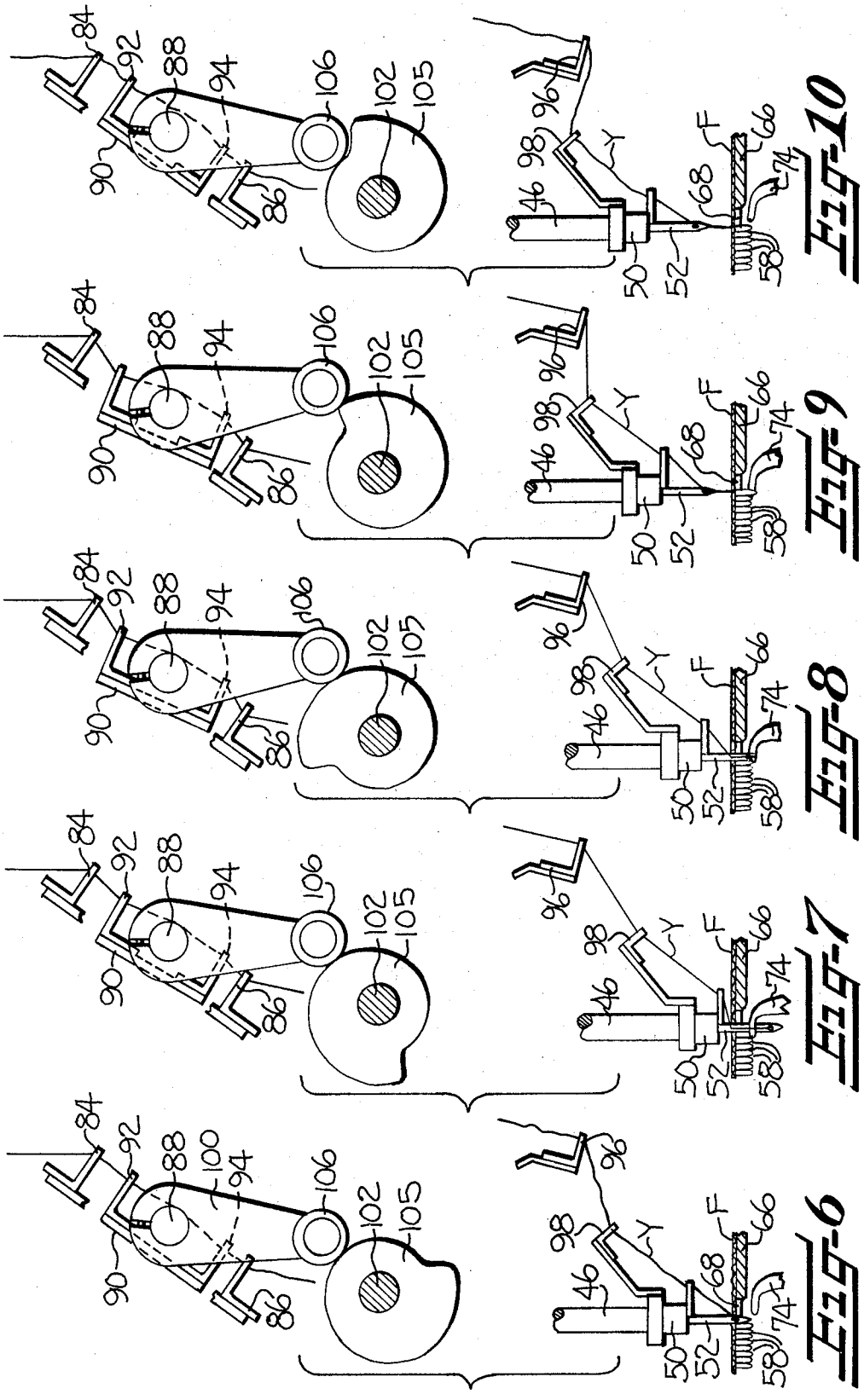


FIG-6

FIG-7

FIG-8

FIG-9

FIG-10

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 thread jerk is 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 an 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 rethreading.

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 hereinafter 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-

ing rod **44**. The connecting rod **44** is in turn connected to the push rod **46**, the push rod being translatably mounted in housing **48** which extends through the lower wall **30** of the casting **24**.

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 equal 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 fabric feed rolls **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 **62*a*** and a horizontal leg **62*b***, the latter of which extends inwardly toward the tufting needles **52**. Superimposed on the horizontal leg **62*b*** 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 alignement with the apertures in the fixed guide members **84** 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.

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 coaxial 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 or chain **114** is interposed between the two pulleys such that rotation of the shaft **110** causes a corresponding rotation of the

shaft **102.** 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 jerker 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 circuitry shown schematically in FIG. **1.** More specifically, the circuitry 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 intermediate 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 member, 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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