Jan. 14, 1969 C. W. WATKINS 3,421,929

TUFTING MECHANISM, METHOD, STITCHES AND ARTICLE

Filed June 14, 1966 Sheet 1 of 4

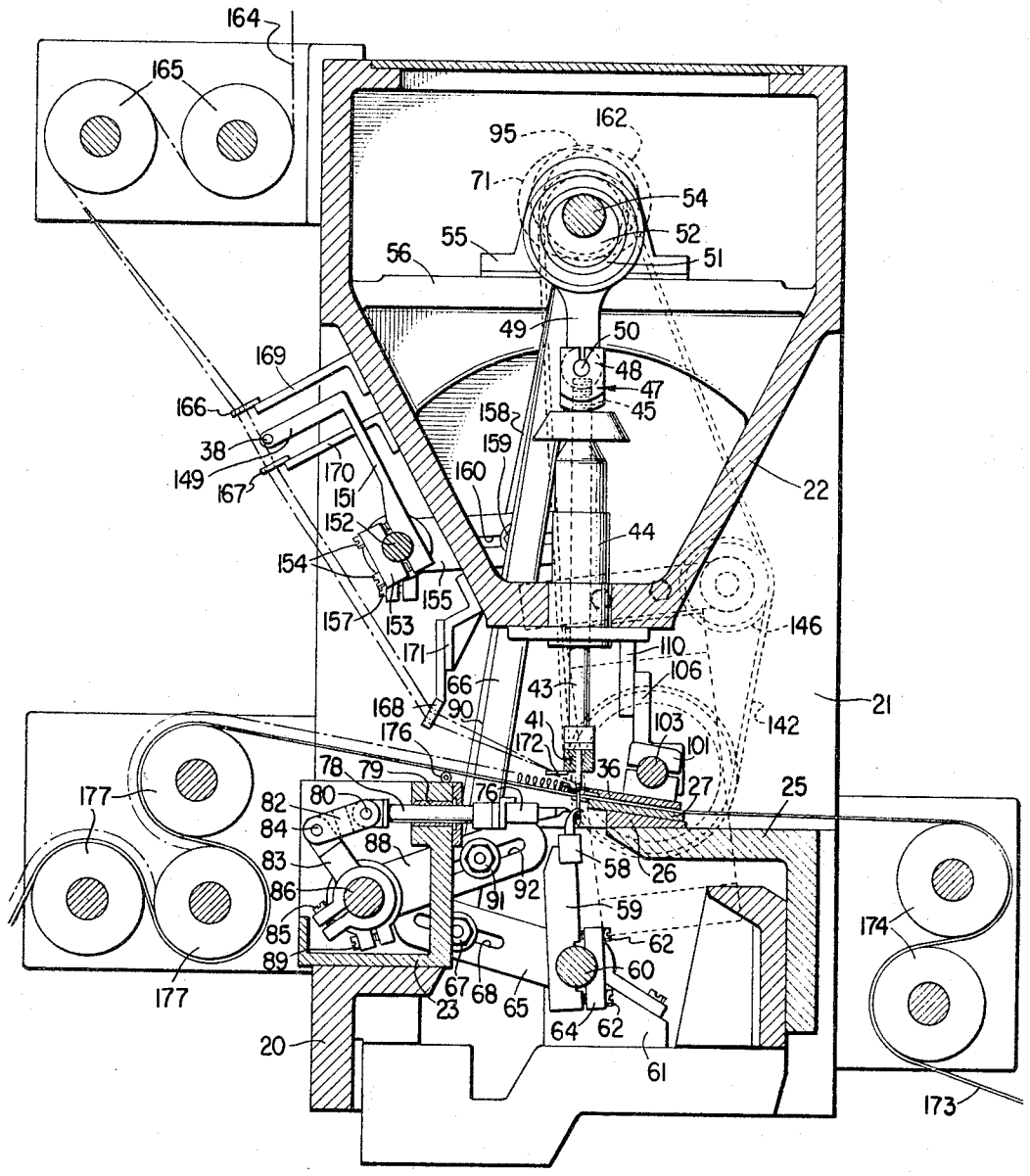

Fig. 1.

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TUFTING MECHANISM, METHOD, STITCHES AND ARTICLE

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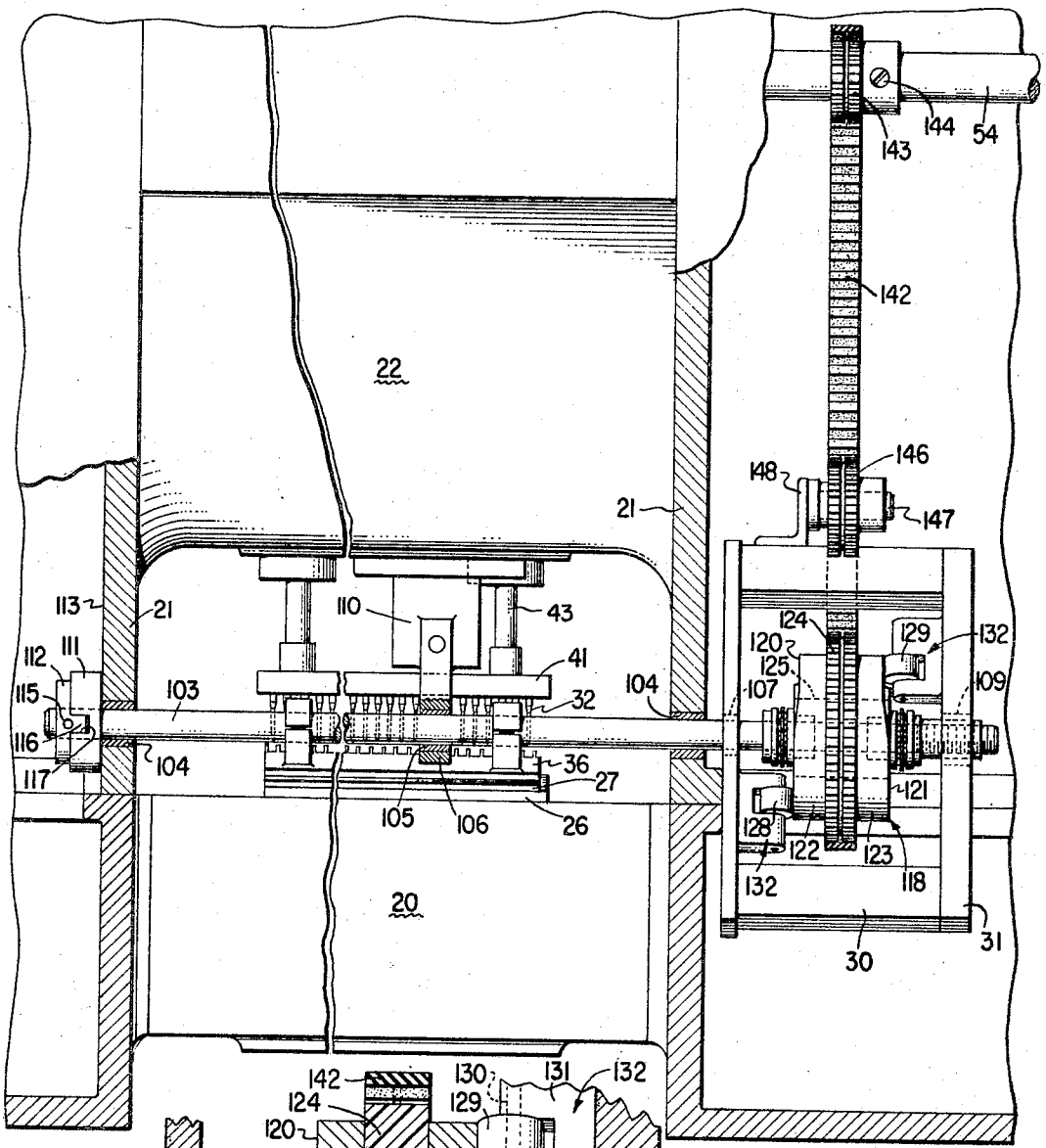

Fig. 2.

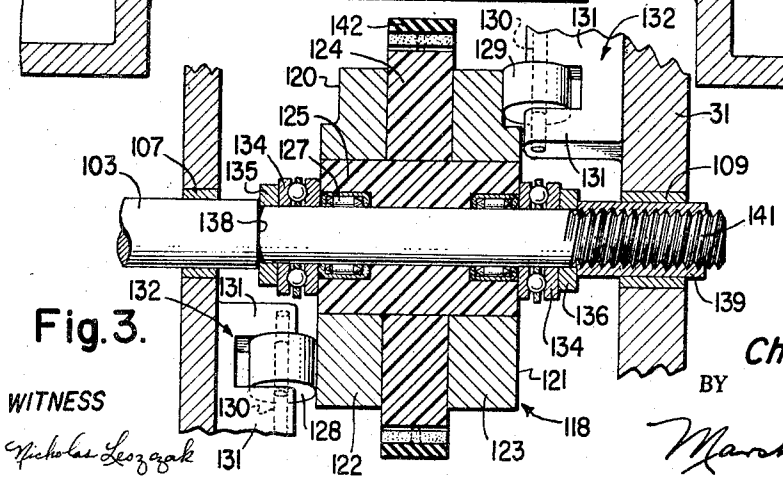

Fig. 3.

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TUFTING MECHANISM, METHOD, STITCHES AND ARTICLE

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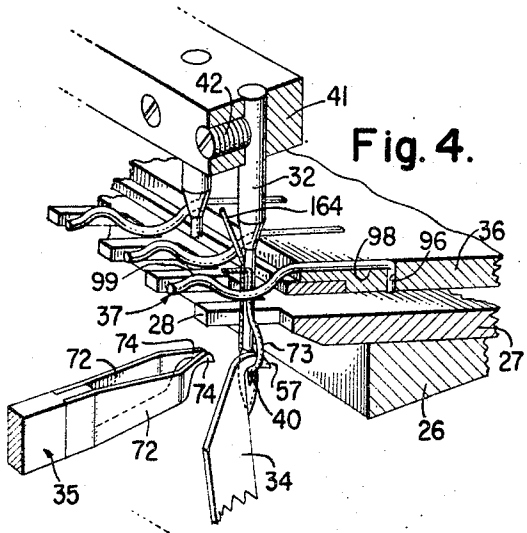

Fig. 4.

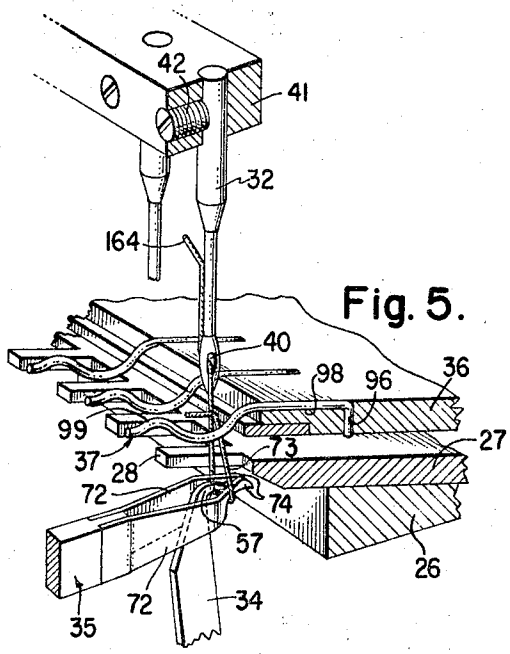

Fig. 5.

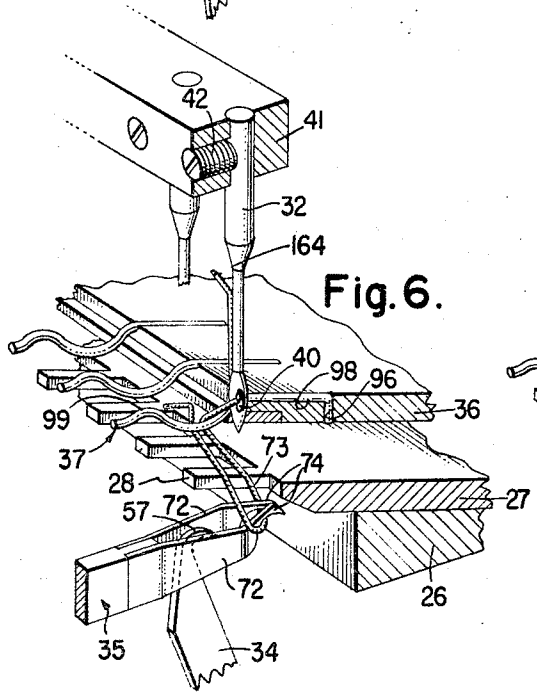

Fig. 6.

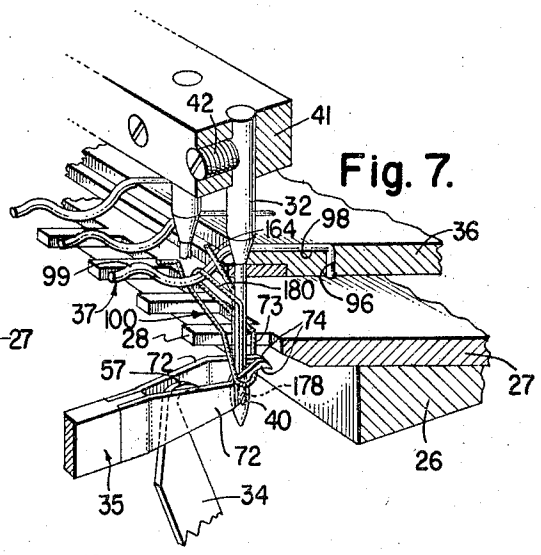

Fig. 7.

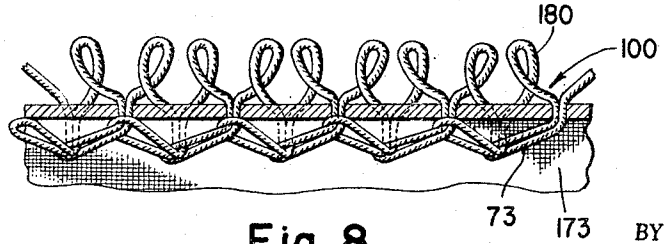

Fig. 8.

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TUFTING MECHANISM, METHOD, STITCHES AND ARTICLE

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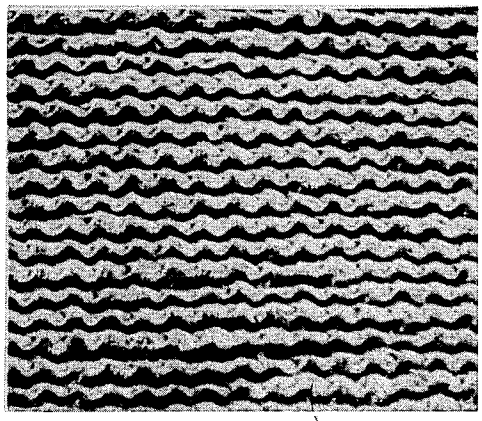

Fig. 9.

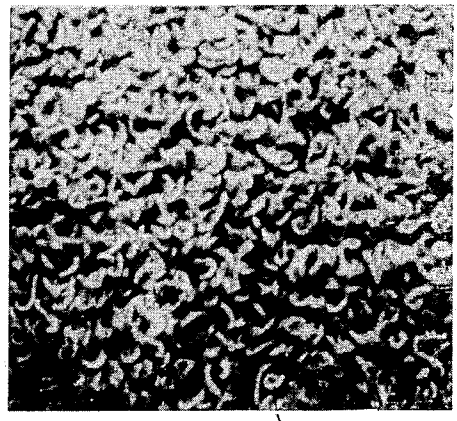

Fig. 10.

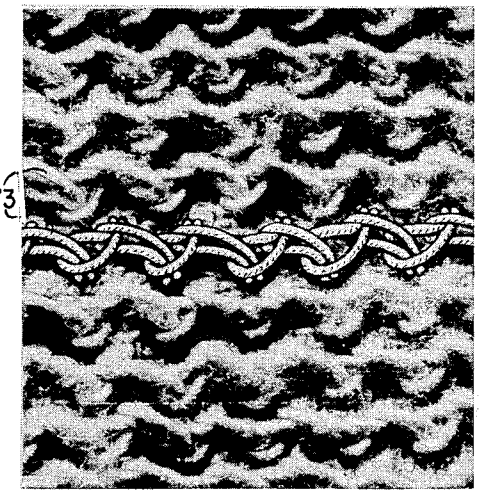

Fig. 11.

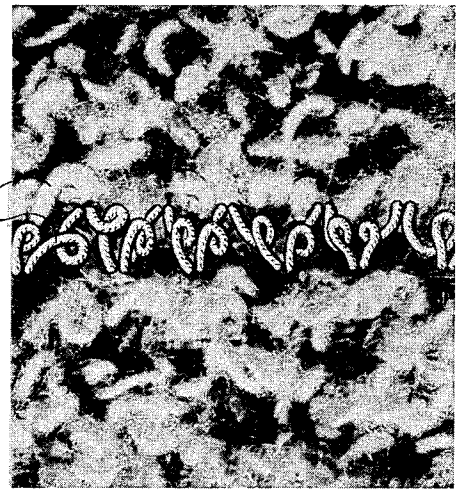

Fig. 12.

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TUFTING MECHANISM, METHOD, STITCHES AND ARTICLE

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U.S. Cl. 117—79 14 Claims

Int. Cl. D05c *15/08;* D05c *3/02;* D04b *23/00*

ABSTRACT OF THE DISCLOSURE

This disclosure relates to the tufting art and is more particularly directed to the production of a novel tufted fabric through a novel method and mechanism for producing said novel fabric. Heretofore, pile fabrics such as terry cloth and the like have usually been produced by methods and mechanisms other than those found in the tufting arts. The present disclosure relates to the accomplishment of production of these types of fabrics through tufting with its inherent advantages of speed of production and other advantages as will be apparent herein.

This invention relates to a tufting mechanism, method, stitches and article and more particularly to a tufting mechanism, method and stitches for forming one-sided terry cloth.

Conventional machines for forming terry cloth have the inherent disadvantage of being slow in operation. Tufting machines have the advantage of speed over the conventional terry cloth machines. However, many of the present tufting machines have proven to be erratic in the formation of terry cloth of uniform high quality. In addition, the pile loops formed by many of the present tufting machines can be pulled out of the backing fabric too easily for use in terry cloth.

It is, therefore, a primary object of this invention to provide an improved tufting mechanism which will form one-sided terry cloth of uniform high quality.

Another object of the invention is to provide a mechanism and method for forming one-sided terry cloth which is inherently faster than present mechanisms and methods for forming one-sided terry cloth.

Another object of the invention is to provide a tufting mechanism and method for forming one-sided terry cloth in which pile loops are positively held in the backing fabric.

Another object of the invention is to provide tufting stitches for forming one-sided terry cloth having pile loops positively held in the backing fabric and optimally covering the backing fabric.

Another object of the invention is to provide an improved one-sided terry cloth having pile loops positively held in the backing fabric and optimally covering the backing fabric.

Another object of the invention is to provide an improved mechanism for forming one-sided terry cloth which has only five major moving parts.

Another object of the invention is to provide a mechanism for forming one-sided terry cloth which will maintain positive control over yarn at all times without putting too much strain on the yarn.

Another object of the invention is to provide a looper which will hold a loop of yarn or other type of strand from a reciprocating needle in such a way as to ensure positive penetration of the loop of yarn or other type of strand by the needle during its next pass.

Another object of the invention is to provide an improved yarn-supporting finger which will form loop pile, tighten stitches, and maintain uniform pile height.

Another object of the invention is to provide an improved mechanism for shifting a yarn-supporting finger laterally so that a needle penetrates a backing fabric alternately on opposite sides of the yarn-supporting finger to form a loop of yarn over the finger.

The main feature of the invention is the provision for a tufting machine which will form one-sided terry cloth of uniform high quality at high speeds on the order of 1,000 to 3,000 revolutions per minute. The tufting machine has only five major moving parts: (1) a needle; (2)–(3) two loopers; (4) a laterally shiftable needle plate carrying a yarn-supporting finger, and (5) a yarn take-up bar. The second looper is formed with a pair of prongs between which the needle penetrates to ensure positive penetration of a loop of yarn held on the looper, the laterally shiftable needle plate is driven by a cam mechanism, and the yarn-supporting finger is composed to a length of wire having a hump near the free end to tighten a stitch formed over the finger as the stitch is pulled off the finger. The tufting machine forms a one-sided terry cloth composed of a plurality of closely spaced parallel rows of essentially loose-stitch zigzag chain stitches with the chaining loops tight against the reverse side of the backing fabric and the other loops twisted naturally and forming uncut pile on the obverse side of the backing fabric. Thus, the pile loops are positively held in the backing fabric making tufted terry cloth for the first time suitable for such uses as in upholstery.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a cross sectional view of a tufting machine showing generally the tuft-forming mechanism;

FIG. 2 is a cross sectional view of the tufing machine of FIG. 1 as viewed from the rear of the machine showing the mechanism for shifting the needle plate laterally;

FIG. 3 is a slightly enlarged cross sectional view of the cam mechanism shown in FIG. 2;

FIGS. 4 through 7 are cross sectional views in perspective of sequential movements of the tuft-forming mechanism shown in FIG. 1 in forming a tufting stitch of the invention;

FIG. 8 is a cross sectional view in perspective of a backing fabric as viewed from the reverse side of the fabric showing tufting stitches of the invention;

FIG. 9 is a plan view of the reverse side of one-sided terry cloth formed by the invention showing the chaining loops tight against the backing fabric;

FIG. 10 is a plan view of the obverse side of the terry cloth of FIG. 9 showing the pile loops;

FIG. 11 is a close-up plan view of the reverse side of the terry cloth as shown in FIG. 9 with the chaining loops of a selected row of stiches highlighted for clarity; and

FIG. 12 is a close-up plan view of the obverse side of the terry cloth of FIG. 11 with the pile loops of the selected row of stitches in FIG. 11 highlighted for clarity.

With reference to the drawings, the invention is illustrated as embodied in a conventional tufting machine having a frame which include a bed **20**, a standard **21** rising from each end of the bed, and a head **22** overhanging the bed and spanning the distance between the standards. A looper housing **23** is mounted at the rear of the bed, and a bed plate **25** is mounted at the front of the bed. Mounted on the bed plate is a wedge-shaped plate **26** which supports a stationary needle plate **27** at a 9 degree angle. Fingers **28** project from the needle plate toward the rear of the machine. A cam housing **30** is mounted inside one of the standards. The cam housing is closed by a cover **31**.

The machine has only five major moving parts: (1) a

needle 32, (2)–(3) two loopers 34 and 35, (4) a laterally shiftable needle plate 36 carrying a yarn-supporting finger 37, and (5) a yarn take-up bar 38. The mechanisms for driving the foregoing five parts are presently to be described in succession. The needle, the loopers, the yarn-supporting finger, and associated mechanisms are described in singular form for convenience. It is understood that there are a plurality of each of the foregoing parts extending the width of the machine.

The needle has an eye 40 and is connected to a needle bar 41 by a setscrew 42. The needle bar is in turn connected to the bottom end of a push rod 43 which is mounted in a bushing 44 in the head. The top end portion of the push rod has screw threads 45 to mount a clevis 47 having upwardly projecting arms 48 of which only one is shown. A short pitman 49 is pivotally mounted between the arms of the clevis by a pivot pin 50. The pitman has a strap 51 which embraces an eccentric 52 on a main shaft 54. The main shaft is journaled in brackets 55, of which only one is shown, which are mounted on a shelf 56 in the head, and the main shaft is rotated by a motor, which is not shown, to impart reciprocation to the needle through the eccentric.

The vertical looper 34 has a loop-seizing beak 57 and is connected to a looper bar 58 which is mounted on the free end of a rock arm 59. The rock arm is clamped to a rock shaft 60 by a bracket 61 and clamping screws 62. The rock shaft is journaled in brackets 64 of which only one is shown. A second rock arm 65 is also clamped to the rock shaft. A long pitman 66 is pivotally connected to the second rock arm by a pivot bolt 67 in a longitudinal slot 68 in the rock arm. The pitman has a strap, which is not shown, at the top end. The strap embraces an eccentric 71 on the main shaft. Rotation of the main shaft imparts oscillating motion to the vertical looper through the eccentric 71. The amplitude of the oscillating motion imparted to the vertical looper can be adjusted by changing the location of the bolt 67 in the slot in the second rock arm.

The horizontal looper 35 has a pair of prongs 72 between which the needle penetrates to ensure positive penetration of a loop 73 of yarn held on the looper. Formed on the ends of the prongs are loop-taking beaks 74 which are biased together by the prongs so that the beaks can perform their loop-taking function. The looper is connected to a looper bar 76 which is mounted on the end of a push rod 78. The push rod is mounted in a bushing 79 in the looper housing 23. Pivotally connected to the other end of the push rod by a pivot pin 80 is a link 82. The link in turn is pivotally connected to the free end of a rock arm 83 by a pivot pin 84. The rock arm is clamped by a clamping screw 85 to a rock shaft 86 which is journaled in the looper housing. A second rock arm 88 is also clamped to the rock shaft by a clamping screw 89. As in the case of the drive mechanism for the vertical looper 34, a long pitman 90 is pivotally connected to the second rock arm by a pivot bolt 91 in a longitudinal slot 92 in the rock arm. The pitman has a strap, which is not shown, at the top end. The strap embraces an eccentric 95 on the main shaft. Rotation of the main shaft imparts reciprocating motion to the horizontal looper through the eccentric 95. The amplitude of the reciprocating motion imparted to the horizontal looper can be adjusted by changing the location of the bolt 91 in the slot in the second rock arm.

The yarn-supporting finger 37 is composed of wire and mounted in a hole 96 and a groove 98 in the laterally shiftable needle plate 36. A hump 99 is formed on the finger near the free end to tighten a stitch 100 formed over the finger as the stitch is pulled off the finger. The shiftable needle plate is connected to brackets 101 which are clamped on a lateral shaft 103 in such a way that the fabric-contacting surface of the shiftable needle plate is oriented at a 9 degree angle to oppose the fabric-contacting surface of the stationary needle plate 27 which, as stated previously, is also oriented at a 9 degree angle. The lateral shaft is mounted in bushings 104 in the standards, bushings 105 in brackets 106 of which only one is shown, a bushing 107 in the cam housing 30, and a bushing 109 in the cover 31 for the cam housing. Each one of the brackets 106 depends from a second bracket 110 which is connected to the overhanging head of the machine.

The lateral shaft 103 is restrained against rotation by a pair of collars 111 and 112 mounted on one end of the shaft. One of the collars 111 is connected to a wall 113 of one of the standards in such a way that the collar cannot rotate while the other collar 112 is clamped to the shaft by a setscrew 115. A tongue 116 on the second collar 112 seats in a groove 117 in the first collar 111 to prevent the lateral shaft from rotating while at the same time permitting limited lateral movement.

The mechanism for shifting the shaft 103 laterally includes a split rotary cam 118 which is mounted on the other end of the shaft. Cam surfaces 120 and 121 are formed on the ends of the split cam so that the two halves 122 and 123 of the cam 118 are mirror images of each other. A sprocket wheel 124 is sandwiched between the two halves 122 and 123 of the split cam. Both halves of the split cam and the sprocket wheel are mounted on a hub 125 which rotates around the shaft on needle bearings 127. The cam surfaces 120 and 121 of the split rotary cam are tracked by cam follower rollers 128 and 129 which are journaled on pins 130 held between ears 131 of brackets 132 mounted on inside walls of the cam housing 30 and the cover 31 for the cam housing, respectively. The hub 125 for the two halves of the split cam and the sprocket wheel is sandwiched between thrust bearings 134 on the shaft, and the thrust bearings in turn are sandwiched between washers 135 and 136 on the shaft. The innermost washer 135 bears against a shoulder 138 on the shaft and the outermost washer 136 bears against the end of a sleeve 139 which is threaded on screw threads 141 on the end portion of the shaft. A lug belt 142 is looped around the sprocket wheel 124, which is sandwiched between the two halves of the split cam, and a sprocket wheel 143 which is mounted on the main shaft by a setscrew 144. Tension is maintained in the lug belt by an intermediate sprocket wheel 146 which is journaled on a pin 147 mounted on a bracket 148 on top of the cam housing 30. Rotation of the main shaft reciprocally shifts the shaft 103 laterally through the lug belt 142 and the split rotary cam 118. Lateral movement of the shaft carries with it the shiftable needle plate 36 and the yarn-supporting finger 37.

The yarn take-up bar 38 is held between arms 149, of which only one is shown, each of which is at right angles to the free end of a rock arm 151 clamped to a rock shaft 152 by a bracket 153 and clamping screws 154. The rock shaft is journaled in the standards at the rear of the head of the machine. A second rock arm 155 is also connected to the rock shaft by a clamping screw 157. As in the case of the drive mechanisms for the loopers 34 and 35, a pitman 158 is pivotally connected to the second rock arm by a pivot bolt 159 in a longitudinal slot 160 in the rock arm. The pitman has a strap, which is not shown, at the top end. The strap embraces an eccentric 162 on the main shaft. Yarn 164 from a source of supply which is not shown is threaded around rolls 165, through yarn guides 166, 167, and 168 which are connected to brackets 169, 170, and 171, respectively, a yarn guide 172 which is connected to the needle bar 41, and through the eye of the needle. Rotation of the main shaft imparts oscillating motion through the eccentric 162 to the take-up bar 38 which takes up slack yarn by bearing against the portion of the yarn which is threaded between the first two yarn guides 166 and 167. The amplitude of the oscillating motion imparted to the take-up bar can be adjusted by changing the location of the bolt 159 in the slot in the second rock arm.

In operaion, backing fabric 173 from a source of supply, which is not shown, is continuously fed by conventional

means, which are not shown, around rolls **174**, between the stationary and shiftable needle plates **27** and **36**, over a guide roll **176**, around rolls **177**, and to a take-up roll which is not shown. With particular reference to FIGS. 4 through 7, to form one-sided terry cloth, the needle moves downwardly past one side of the yarn-supporting finger **37** to project a first bight of yarn held in the eye of the needle through the backing fabric. As the needle begins its upstroke, the bight of yarn held in the eye of the needle becomes a loop **73** due to friction between the yarn and the backing fabric which causes the yarn to retract more slowly than the needle thus forming slack yarn. The vertical looper **34** seizes the loop of yarn by means of its loop-seizing beak as the needle continues its upstroke. Then, the horizontal looper **35** moves over the vertical looper to project its loop-taking beaks into the loop of yarn held by the vertical looper. As the vertical looper withdraws toward the rear of the machine, the loop **73** of yarn is left on the loop-taking beaks of the horizontal looper.

Before the second penetration of the backing fabric by the needle, the shiftable needle plate **36** and, along with it, the backing fabric are shifted laterally by the split rotary cam **118** so that the needle lays the yarn over the yarn-supporting fingers **37** and moves downwardly past the other side of the finger from the first downstroke. Feeding movement of the backing fabric and lateral shifting of the backing fabric cause the needle to penetrate the backing fabric at a location downstream and offset from its first penetration of the backing fabric. The needle then easily penetrates the loop **73** of yarn held by the horizontal looper **35** because the horizontal looper spreads the limbs of the loop of yarn far enough apart to ensure positive penetration. The horizontal looper then withdraws to release the first loop **73**, and the yarn take-up bar **38** pulls the first loop **73** of yarn up around the shank of the needle to form a first chain stitch **100**. During withdrawal of the looper, the shank of the needle momentarily spreads the prongs **72** at the loop-taking beaks **74** to permit escape of the needle from between the prongs. As in the case of the first penetration of the needle, the vertical looper then seizes a second loop **178** of yarn held by the needle and the horizontal looper takes the second loop from the vertical looper. After the needle has withdrawn from the first loop of yarn, feeding movement of the backing fabric pulls the yarn over the hump **99** in the yarn-supporting finger **37** to tighten the chaining loop **73** of the first chain stitch **100** on the reverse side of the backing fabric and leave a pile loop **180** on the obverse side of the backing fabric after the loop is pulled off the yarn-supporting finger.

Before the third penetration of the backing fabric by the needle, the shiftable needle plate **36** and, along with it, the backing fabric are shifted laterally to the lateral position they occupied during the first penetration of the needle so that the needle lays the yarn over the yarn-supporting finger **37**, and moves downwardly on the same side of the yarn supporting fingers as in the first downstroke. Continued feeding movement of the backing fabric and the foregoing lateral shifting of the backing fabric cause the needle to penetrate the backing fabric at a location downstream from the second penetration of the backing fabric and in line with the first penetration. The looper movements are repeated as in the case of the second penetration of the backing fabric by the needle to form essentially loose-stitch zigzag chain stitches having the chaining loops **73** tight against the reverse side of the backing fabric and the other loops **180** twisted naturally and forming pile loops on the obverse side of the backing fabric. It is understood that the foregoing operations are repeated over and over again and that there are numerous needles, loopers **34** and **35**, yarn-supporting fingers **37**, and associated mechanisms extending the width of the machine between the standards so that high quality one-sided terry cloth is formed quickly and efficiently with pile loops **180** positively held in the backing fabric and optionally covering the backing fabric.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention.

Having thus set forth the nature of this invention, what is claimed herein is:

1. A tuft-forming mechanism for a tufting machine having a frame, a supply of backing fabric associated with the frame, means for feeding the backing fabric across the frame, a needle bar mounted on the frame on one side of the backing fabric, a needle having an eye and mounted on the needle bar, means for imparting reciprocation to the needle bar to cause the needle to cyclically penetrate through the backing fabric, and a supply of yarn associated with the frame and leading to the eye of the needle, said tuft-forming mechanism comprising a first looper mounted in the frame on the opposite side of the backing fabric from the needle, means for imparting oscillating motion to the first looper for seizing a loop of yarn from the needle, a second looper mounted in the frame also on the opposite side of the backing fabric from the needle, means for imparting oscillating motion to the second looper for taking the loop of yarn from the first looper and holding the loop of yarn for penetration by the needle on the next succeeding downstroke of the needle to form a chain stitch, means mounted on the frame for taking up slack yarn, a yarn-supporting finger mounted on the frame on the needle side of the backing fabric, and means for shifting the yarn-supporting finger so that the needle penetrates the backing fabric alternately on opposite sides of the finger to form a loop of yarn over the finger on the needle side of the backing fabric.

2. The tuft-forming mechanism of claim **1** which includes a needle plate mounted on the frame on the needle side of the backing fabric, the yarn-supporting finger projecting from the needle plate downstream relative to the normal feeding movement of the backing fabric, and means for shifting the needle plate laterally so that the needle penetrates the backing fabric alternately on opposite sides of the yarn-supporting finger to form the loop of yarn over the finger on the needle side of the backing fabric.

3. The tuft-forming mechanism of claim **2** in which the fabric-contacting surface of the needle plate and the opposed fabric-contacting surface of the frame form an acute dihedral angle relative to a horizontal plane with the arms of the angle projecting downstream relative to the normal feeding movement of the backing fabric.

4. The tuft-forming mechanism of claim **3** in which the acute dihedral angle is between 5 and 15 degrees.

5. The tuft-forming mechanism of claim **1** in which the second looper includes a pair of prongs between which the needle penetrates and loop-taking beaks on the ends of the prongs biased together by the prongs so that the beaks can perform their loop-taking function from the first looper and in addition the second looper can be retracted during its loop-shedding stroke while the needle is still between the prongs because of the action of the shank of the needle in momentarily spreading the prongs at the beaks to permit escape of the needle from between the prongs.

6. The tuft-forming mechanism of claim **1** in which the yarn-supporting finger is a length of wire having a hump near the free end to tighten the stitch as the stitch is pulled off the finger and to establish the desired height of the pile.

7. The tuft-forming mechanism of claim **2** in which the means for shifting the needle plate laterally includes a lateral shaft having its axis substantially parallel to the

fabric-contacting surface of the needle plate, means for connecting the needle plate to the shaft, a cam rotatably mounted on the shaft, means on the shaft for fixing the cam against any substantial lateral movement along the axis of the shaft, means for rotating the cam, cam surfaces on the ends of the cam, and cam followers for the cam surfaces to shift the shaft laterally and along with it the needle plate so that the needle penetrates the backing fabric alternately on opposite sides of the yarn-supporting finger to form a loop of yarn over the finger on the needle side of the backing fabric.

8. The tuft-forming mechanism of claim **7** in which the cam followers are rollers and means are included for rotatably mounting the rollers on the frame.

9. A method for forming one-sided terry cloth comprising projecting a first loop of yarn through a backing fabric to its reverse side, holding the first loop of yarn in the reverse side, laying the yarn over a yarn-supporting finger at the observe side, projecting a second loop of the yarn through the backing fabric and through the first loop at a location laterally and longitudinally offset from the penetration of the first loop, releasing the first loop to form a first chain stitch, holding the second loop at the reverse side, tightening the first loop, laying the yarn over the yarn-supporting finger at the obverse side, projecting a third loop of the yarn through the backing fabric and through the second loop at a location in line with the penetration of the first loop, releasing the second loop to form a second chain stitch, holding the third loop at the reverse side, tightening the second loop, and wherein the steps of laying the yarn over the yarn-supporting finger are each preceded by moving the yarn-supporting finger and the backing fabric laterally so that the second loop can be projected through the first loop at a location offset from the penetration of the first loop and the third loop can be projected through the backing fabric and through the second loop at a location in line with the penetration of the first loop.

10. The method for forming one-sided terry cloth of claim **9** in which the steps of holding the loops of yarn at the reverse side of the backing fabric each includes initially seizing the loop of yarn by first means, holding the loop of yarn by the first means, then taking the loop of yarn from the first means by second means, and holding the loop of yarn by the second means thereby freeing the first means.

11. The method for forming one-sided terry cloth of claim **10** in which the steps of laying the yarn over the yarn-supporting finger are each preceded by moving the yarn-supporting finger and the backing fabric laterally so that the second loop can be projected through the first loop at a location offset from the penetration of the first loop and the third loop can be projected through the backing fabric and through the second loop at a location in line with the penetration of the first loop.

12. In a tufting machine including a needle for projecting a yarn through a backing fabric, means for advancing the backing fabric relative to said needle, looper means disposed for engaging a first loop of yarn projected through the backing fabric by said needle on the first stroke thereof, said looper means including means for projecting the first loop of yarn for receiving the needle and a second loop of yarn therethrough presented by said needle upon a second stroke of said needle through the backing fabric, a yarn-supporting finger disposed on the needle side relative to the backing fabric, and means for initiating relative lateral movement between said needle and said yarn-supporting finger such that during alternate strokes of said needle a loop of yarn will be placed over said yarn-supporting finger for forming a pile surface on the needle side relative to the backing fabric.

13. In a tufting machine as recited in claim **12** wherein said means for initiating lateral movement between said needle and said yarn supporting finger includes means for shifting the backing fabric relative to said needle such that said needle penetrates the backing fabric at offset points upon alternate strokes thereof to form a zigzag chain stitch on one side of the backing fabric and a pile loop on the other side thereof with the loop having its legs offset from one another.

14. In a tufting machine as recited in claim **12** wherein said looper means includes first and second loopers with said second looper being a split looper including a pair of prongs spaced from one another at one region thereof and biased together at one end thereof and said second looper being operative to hold and spread the first loop and to permit said needle to pass between said prongs during penetration of said needle with the second loop through the first loop.

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