

April 9, 1963

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3,084,644

APPARATUS FOR TUFTING SKIP-STITCH PATTERNS

Filed March 23, 1960

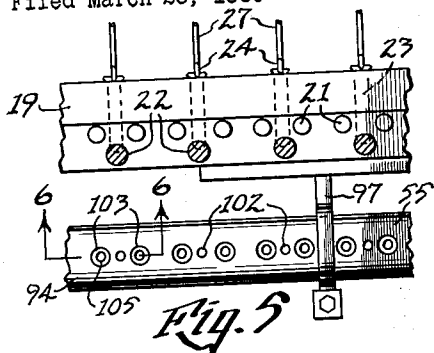
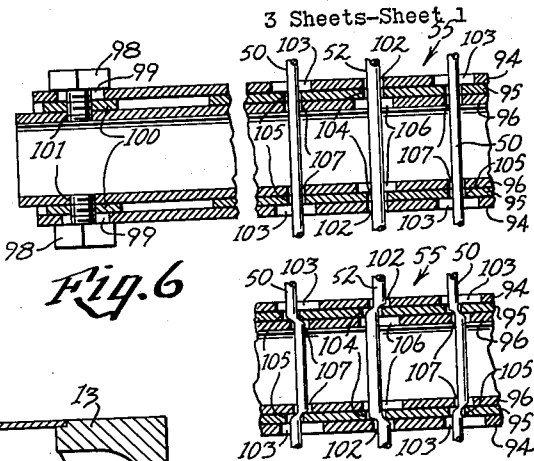
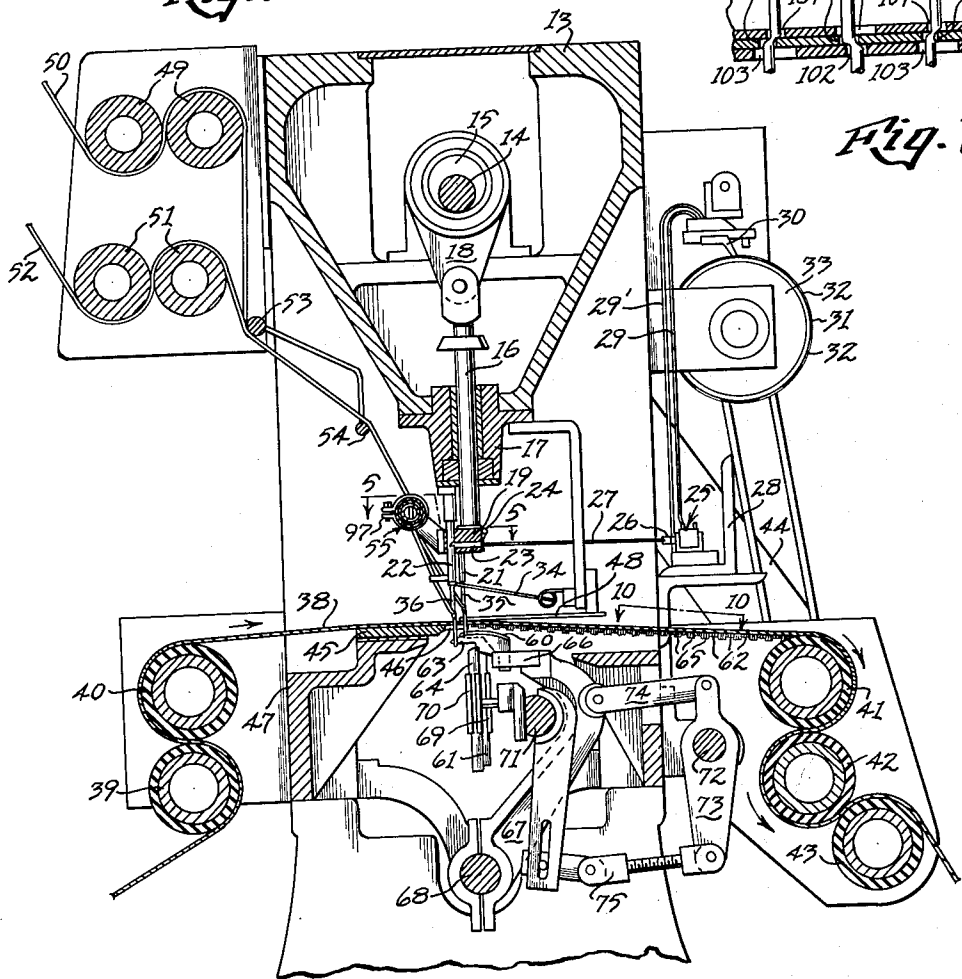


Fig. 1

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3 Sheets-Sheet 2

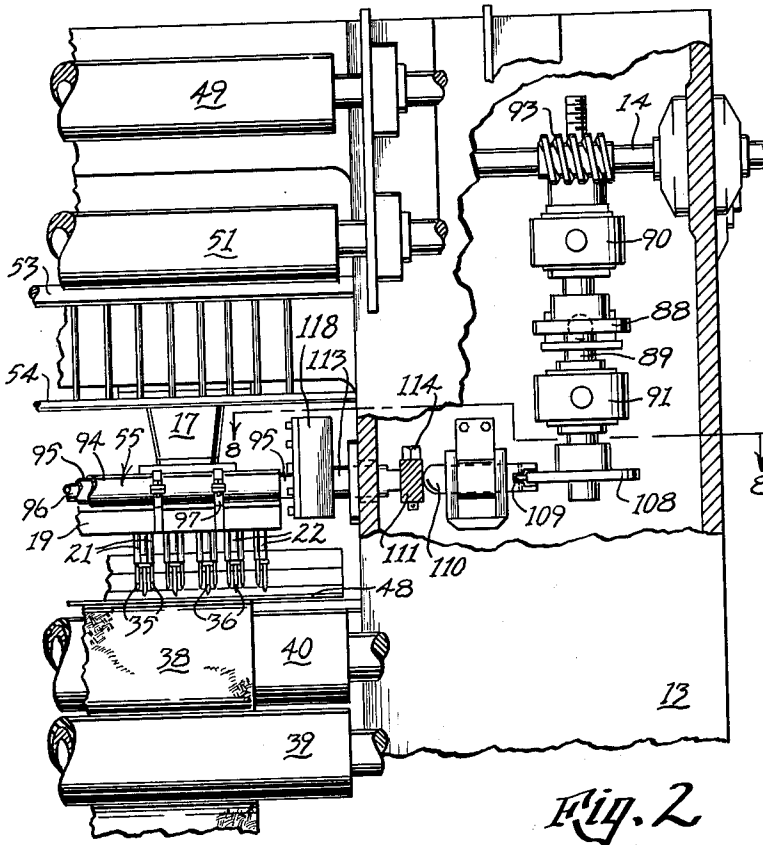


Fig. 2

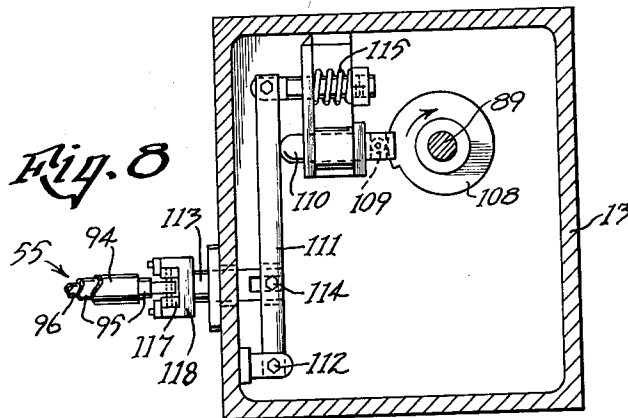


Fig. 8

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3 Sheets-Sheet 3

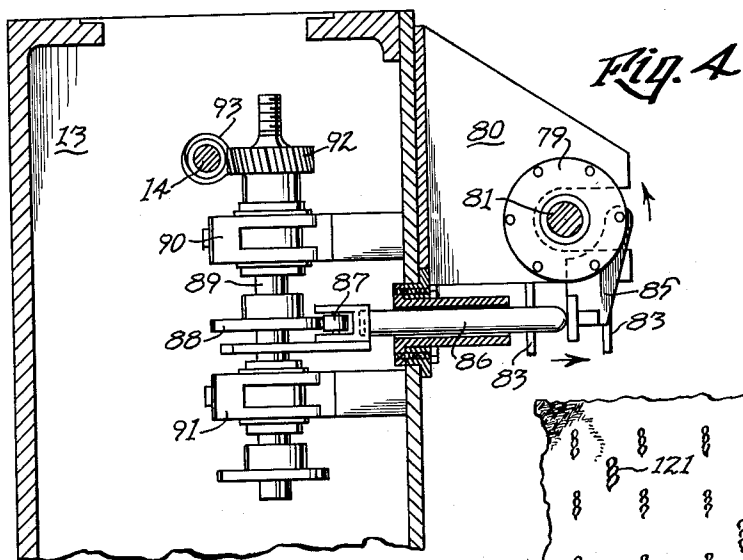


Fig. 10

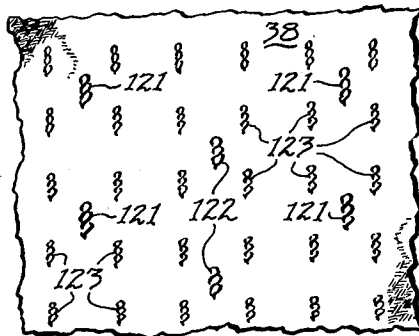
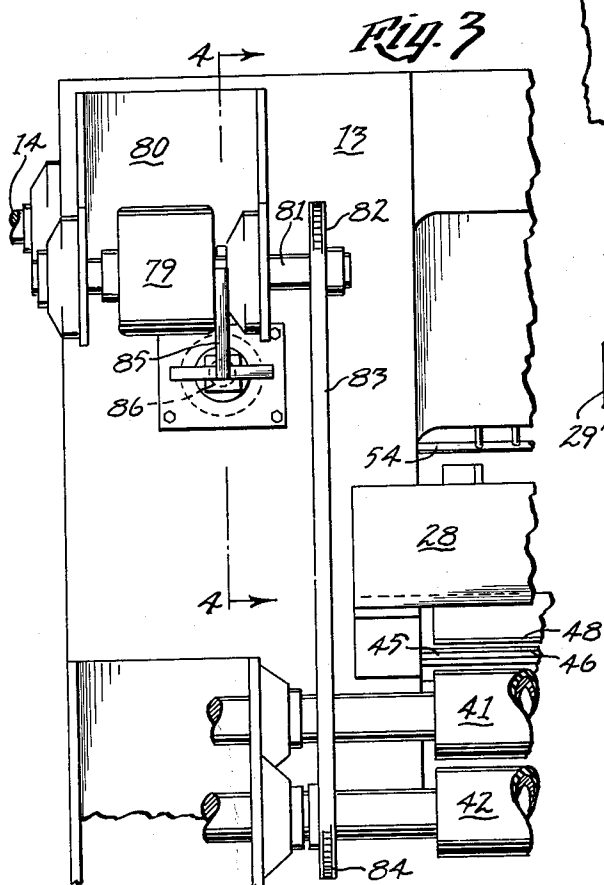
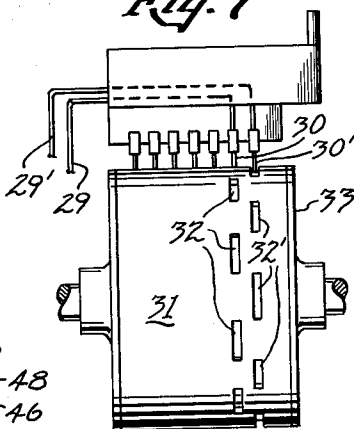


Fig. 9



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APPARATUS FOR TUFTING SKIP-STITCH PATTERNS

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7 Claims. (Cl. 112—79)

This invention relates to an apparatus for forming 10 patterned tufted pile fabric and more particularly for forming novel skip-stitch patterns in a tufted pile fabric.

Although it is old in the art of skip-stitching tufted pile fabrics generally to selectively lock and unlock a needle to a continuously reciprocating needle bar to selectively form skip-stitches in a base fabric, and it is 15 old to intermittently feed a base fabric at a faster rate than normal beneath a continuously reciprocating needle, this invention contemplates the combination of these two methods of skip-stitching in a novel manner to form a variety of unique skip-stitch patterns in a tufted pile fabric.

One object of this invention is to provide a multiple needle tufting machine having two rows of transverse needles, the needles in one row being fixed to the continuously reciprocating needle bar, while the needles in the other row are selectively locked to the needle bar, 25 as the base fabric is continuously fed beneath the reciprocating needle bar and intermittently overfed to form a variety of staggered skip-stitches of different lengths.

Another object of this invention is to provide an apparatus for forming novel skip-stitch designs in a base fabric in which a plurality of groups of needles are mounted on a continuously reciprocating needle bar, each group comprising a pair of transversely aligned needles fixed to the needle bar with a third needle equally spaced between but out of alignment with the pair of needles, and means are provided to selectively lock and unlock the third needle to the needle bar in accordance with a predetermined pattern.

A further object of this invention is to provide a multiple needle tufting machine for forming novel skip-stitch designs in a tufted pile fabric comprising a group of three needles, the first and second needles being in transverse alignment and adapted to continuously reciprocate through the base fabric while the third needle is spaced equally between and in front of the first two needles and adapted to be selectively reciprocated through the base fabric according to a predetermined pattern, the third needle being adapted to be adjusted at different heights from the first two needles and adapted to carry a yarn of a different characteristic from the yarns carried by the first two needles.

Another object of this invention is to provide a multiple needle tufting machine employing means for continuously feeding a base fabric at a uniform rate beneath a first set of continuously reciprocating needles and a second set of needles which are adapted to selectively reciprocate through the base fabric and means for intermittently feeding the base fabric faster than the uniform rate.

Another object of this invention is to provide a multiple needle tufting machine employing a first set of needles adapted to reciprocate continuously, a second set of needles adapted to selectively reciprocate and a yarn clamp of novel design for intermittently clamping yarns of one size fed to their corresponding needles in the first set and for simultaneously clamping yarns of any size fed to the needles of the second set.

Further objects and advantages of the invention will be apparent from the following description, taken in conjunction with the drawings, wherein:

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FIG. 1 is a sectional elevation taken through the machine made in accordance with this invention, looking toward the left end of the machine;

FIG. 2 is a fragmentary front elevation taken near the right end of the machine, with parts broken away;

FIG. 3 is a fragmentary rear elevation of substantially the same portion of the machine disclosed in FIG. 2;

FIG. 4 is a section taken along the line 4—4 of FIG. 3, disclosing the parts for operating the overrunning feed clutch in full view;

FIG. 5 is a section taken along the line 5—5 of FIG. 1, disclosing the controlled needles locked to the needle bar and the yarn clamp in releasing position;

FIG. 6 is a section taken along the line 6—6 of FIG. 5;

FIG. 7 is a view similar to FIG. 6 showing the yarn clamp in clamping position;

FIG. 8 is a section taken along the line 8—8 of FIG. 2;

FIG. 9 is a fragmentary rear elevational view of the pattern control mechanism; and

FIG. 10 is a view taken along the line 10—10 of FIG. 1;

Referring now more particularly to the drawings in detail, the tufting machine made in accordance with this invention comprises a frame or housing 13 supporting in a conventional manner a rotary transverse main drive shaft 14 upon which are fixed a plurality of spaced eccentrics 15, only one of which is disclosed in FIG. 1. Each eccentric 15 is adapted to vertically reciprocate a push rod 16 through a push rod housing 17 by means of a connecting rod 18. Supported at the lower ends of and adapted to reciprocate with the push rods 16, is a transverse needle bar 19. The main shaft 14 may be driven to rotate at a continuous speed by any convenient drive means, such as a motor, not shown.

The needle bar 19 supports a transverse row of uniformly spaced fixed needle holders 21. Spaced forward of the needle holders 21 is a parallel row of uniformly spaced controlled needle holders 22. For every pair of fixed needle holders 21 there is a controlled needle holder 22 spaced equally between the pair of needle holders 21, so that the spacing of the controlled needle holders 22 is twice the spacing of the fixed needle holders 21, and the needle holders 22 are staggered, both longitudinally and transversely, with respect to the needle holders 21. Each controlled needle holder 22 is slidably received within the needle bar 19 and is adapted to be selectively locked and unlocked to the needle bar 19 by means of a locking pin 23. Each locking pin 23 is biased into engagement with a notch in its respective needle holder 22 by means of a spring 24, so that the needle holder 22 will be locked to and vertically reciprocate with the needle bar 19.

Each locking pin 23 may be withdrawn from its notch in its respective needle holder 22 by means of a solenoid 25 having an armature 26 pivotally connected to a link 27, which in turn is permanently fixed at its other end to the locking pin 23. The solenoids 25 are supported in transverse alignment on a bracket 28 mounted on the rear of the housing 13, so that each solenoid 25 will be substantially directly behind its corresponding locking pin 23. Each solenoid 25 is grounded to the frame 13 and connected by an electrical lead 29 or 29¹ to a corresponding pattern finger 30 or 30¹ biased into engagement with the surface of the pattern sheet 31 or the corresponding notches 32 or 32¹ in the pattern sheet 31 mounted on the rotatable pattern drum 33, supported on the rear of the housing 13. In a conventional manner, each finger 30 or 30¹ is provided with an electrical contact so that a complete electrical circuit is made when a pattern finger 30 or 30¹ engages its corresponding notch 32 or 32¹ to actuate the corresponding solenoid 25 and draw the armature 26, link 27 and locking pin 23 toward the rear of

the machine to unlock the corresponding controlled needle holder 22. Thus, the unlocked needle holder 22 remains in raised position by inertia and the assistance of the upwardly biased spring 34, while the needle bar 19 reciprocates downward, carrying all the fixed needle holders 21 and the locked controlled needle holders 22.

Each of the fixed needle holders 21 supports a needle 35, while each controlled needle holder 22 supports a needle 36, preferably of slightly larger diameter than the needle 35, to reciprocate through a base fabric 38.

The base fabric 38 is continuously fed through the machine beneath the needles 35 and 36 from front to rear by means of the front fabric feed rolls 39 and 40 and the rear fabric feed rolls 41, 42, and 43. In a conventional manner, the top rear fabric feed roll 41 is continuously driven, as opposed to being intermittently driven, by any conventional means, such as a chain or belt within the housing 44 for connecting the main drive shaft 14 and the feed roll 41 by means of sprockets or pulleys, not shown. The fabric feed rolls 41, 42 and 43 are positively driven at the same speed by intermeshing gears, not shown. By continuously feeding the base fabric 38, as opposed to intermittently feeding the fabric, the reciprocating needles 35 and 36 will remain in the fabric 38 too brief a period to tear the fabric, but long enough to produce a desirable tension in the fabric. Supporting the base fabric 38 beneath the needles 35 and 36 is a conventional needle plate 45 having slots 46 to permit passage of the needles 35 and 36, the needle plate 45 in turn being supported on the bed plate 47. A presser foot 48 is also supported on the frame 13 to hold the base fabric 38 down against the needle plate 45.

Mounted on the front of the housing 13 are an upper pair of yarn feed rolls 49 adapted to be continuously rotated by any convenient means, not shown, but preferably synchronized with the main shaft 14, to continuously feed yarns 50 to the fixed needles 35. Mounted below the upper yarn rolls 49 are a similar pair of yarn feed rolls 51, also adapted to be continuously rotated in a similar manner, to feed yarns 52 to the forward controlled needles 36. The yarns 50 and 52 may be fed over appropriate yarn guides 53 and 54 of any conventional construction and subsequently through a yarn clamp 55 of novel construction, which will later be described.

Adapted to cooperate with each fixed needle 35 in a conventional manner to hold loops in the yarn 50 formed by the penetration of the needle 35 through the base fabric 38, is a cut pile hook 60. Cooperating with the hook 60 is a knife 61 adapted to shear the loops to form cut pile tufts 62. In a like manner, a cut pile hook 63 and a knife 64 are provided to cooperate with each of the locked controlled needles 36 to form cut pile tufts 65 in the yarn 52. As previously stated, the controlled needles 36 are staggered forward of the fixed needles 35, and preferably are of larger diameter than the fixed needles 35. Moreover, the needles 36 are preferably mounted slightly lower than the fixed needles 35 in order that the cut pile tufts 65 formed by the needles 36 will be of greater depth than the cut pile tufts 62 formed by the needles 35. Accordingly, the hooks 60 and 63 are arranged substantially vertically beneath their respective needles 35 and 36 and have the same relative staggered spacing and depth as their respective needles, as disclosed in FIG. 1. The hooks 63 are slightly longer than the hooks 60 and are mounted in their proper spaced relation in a common hook bar 66 supported on a rocker arm 67 adapted to be reciprocated by means of the hook shaft 68. The knives 61 and 64 are likewise spaced and staggered from each other and set at the proper depth to cooperate with their respective hooks 60 and 63 in order to shear the yarn loops to form respectively the low cut pile tufts 62 and the high cut pile tufts 65. The knives 61 and 64 are respectively supported in knife holders 69 and 70 which are mounted on a common knife shaft 71 for limited reciprocation. The hook shaft 68 is driven by any con-

venient means, not shown, synchronously with the main shaft 14. The knife shaft 71 is reciprocated from the hook shaft 68 through the rock shaft 72 and links 73, 74 and 75.

At regular predetermined intervals, the base fabric 38 is overfed, or fed more rapidly than normal, by means of a mechanism for rotating the intermediate rear fabric feed roll 42 at a faster rate than the fabric feed roll 41 is normally driven, in order to create regularly spaced skip-stitches 123 formed by the fixed needles 35, such as disclosed in FIG. 10. Such a mechanism for periodical speeding up the rotation of the fabric feed roll 42 comprises an overrunning clutch 79 of any conventional construction, such as a cam clutch of the PB series disclosed on page 139 of Catalog SP-62 of the Morse Division of Borg-Warner Corporation, supported in a bracket 80 mounted on the rear of the housing 13 with its shaft 81 disposed transversely of the machine, as best disclosed in FIGS. 3 and 4. The shaft 81 is drivingly connected to the fabric feed roll 42 by means of a sprocket 82, mounted on the shaft 81, a chain 83, and a sprocket 84 fixed on one end of the fabric feed roll 42. In order to periodicaly actuate the overrunning clutch 79, a lever 85 fixed to and depending from the housing of the clutch 79 is adapted to be pivoted about the axis of the shaft 81 by means of a slidable push rod 86 carrying a cam follower 87 which rides on a cam 88 fixed to a vertical cam shaft 89 rotatably supported in bearings 90 and 91. Near the top of the cam shaft 89 is a gear 92 which meshes with a worm 93 on the end of the main drive shaft 14. Thus, as long as the main shaft 14 is driven, the cam shaft 89 and cam 88 will be continuously rotated to intermittently actuate the cam follower 87, push rod 86 and lever 85 to cause the overrunning clutch 79 to periodically grip and rotate the shaft 81 in the direction of the arrow (FIG. 4), faster than it is normally rotated by the roll 42, through the sprockets 82 and 84 and chain 83. The housing of the clutch 79 may be provided with inner cam surfaces or pawls for gripping the shaft 81 through balls or ratchet teeth when the housing 79 is rotating in the direction of the arrow disclosed in FIG. 4. Reverse rotation of the clutch 79 will release the grip of the housing on the shaft 81, so that the shaft 81 may rotate independently of the clutch housing. The overrunning clutch 79 operates in a conventional manner, permitting the shaft 81 to continuously rotate at a normal speed until the lever 85 is actuated to cause the clutch 79 to grip and accelerate the shaft 81.

The yarn clamp 55 comprises three concentric cylinders 94, 95, and 96. The largest or outer cylinder 94 is rigidly held by the brackets 97 supported on the needle bar 19, in order that the clamp 55 will reciprocate as a unit with the needle bar 19. The inner or smallest cylinder 96 is adjustably fixed at its left end to the outer cylinder 94 by means of a bolt 98 extending through an elongated slot 99 in the end of the cylinder 94, through a spacer 100 and threadedly secured in the hole 101 tapped in the end of the cylinder 96. The intermediate cylinder 95 is adapted to be slidably reciprocated within the space between the outer and inner cylinders 94 and 96, respectively. In its normal unclamped position, disclosed in FIGS. 5 and 6, all three cylinders have vertically aligned apertures to permit the free passage of yarns 50 and 52 therethrough, there being a set of vertically aligned apertures for each needle, with approximately the same spacing as the needle holders 21 and 22. In the outer cylinder 94 there are small apertures 102 to permit the passage therethrough of the yarns 52 to the controlled needles 36, with the same gauge as the controlled needle holders 22. Also formed in the outer cylinder 94 are clearance apertures 103, which are substantially twice as large as the apertures 102, for receiving the passage of yarns 50 to the fixed needles 35. In the intermediate cylinder 95, the apertures 104 for receiving the yarns 52 and the apertures 105 for receiving the yarns 50 are of slightly greater

diameter than their respective yarns. The inner cylinder 96 is provided with clearance apertures 106 for the yarns 52 and smaller apertures 107 for the yarns 50, each aperture 107 being just large enough to permit the free passage of the yarn 50 and each aperture 106 having about twice the diameter of the aperture 107. As best disclosed in the unclamped or yarn releasing position of FIG. 6, the apertures 103, 105 and 107 are in vertical alignment to permit the free passage therethrough of a yarn 50, and the apertures 102, 104 and 106 are in vertical alignment to permit the free passage of a yarn 52. It will be noted that the clearance aperture 103 for the yarn 50 is in the outer cylinder 94, while the clearance aperture 106 for the yarn 52 is in the inner cylinder 96. Thus, when the intermediate cylinder 95 is moved to the left, as disclosed in FIG. 7, the yarn 50 will be clamped or pinched only between the intermediate cylinder 95 and the inner cylinder 96, and the yarn 52 will be clamped only between the intermediate cylinder 95 and the outer cylinder 94. The adjustability of the outer cylinder 94 with respect to the inner cylinder 96, by means of the bolt 98 and elongated slot 99, permits variation in yarn sizes for either or both sets of yarns 50 and 52, passing through the yarn clamp 55 with even clamping of both yarns 50 and 52.

In order to reciprocate the intermediate cylinder 95 axially of the other cylinders 94 and 96, a cam 108 is fixed to the lower end of the cam shaft 89, and is adapted to actuate a cam follower 109 and push rod 110 to pivot a lever 111 about a pin 112 mounted on the frame 13 (FIGS. 2 and 8). The right end of the intermediate cylinder 95 is connected to a slide member 117 vertically slidable in a guide block 118 fixed to link 113, which is pivotally connected to lever 111 by the pin 114. Continuous rotation of the cam shaft 89 will cause the raised portion of the cam 108 to periodically actuate the cam follower 109 and move the intermediate cylinder 95 toward the left to clamp the yarns 50 and 52 until the raised surface of the cam 108 disengages the cam follower 109 and the spring 115 biases the lever 111, link 113, and intermediate cylinder 95 back toward the right and the normal unclamped position of the yarn clamp 55, disclosed in FIGS. 5 and 6.

The operation of the machine is as follows:

With a pattern sheet 31, having any desired configuration of notches 32 and 32¹, such as that disclosed in FIG. 9, fitted on the pattern drum 33, the motor, not shown, is started to drive the main shaft 14, the rock shaft 72, the yarn feed rolls 49 and 51, the rear fabric feed roll 41 and the pattern drum 33. Continuous rotation of the main shaft 14 will not only cause the needle bar 19 to reciprocate vertically above the continuously fed base fabric 38, but will also drive the cam shaft 89 to actuate the overrunning feed clutch 79 and the yarn clamp 55 simultaneously and periodically. FIG. 10 discloses a tufted fabric 38 which has been periodically overfed every fourth stitch. In order to produce this effect, drive shaft 14 is geared to the cam shaft 89 through the gears 92 and 93, and the cam 88 is of such configuration that for every four revolutions of the drive shaft 14, the cam 88 will thrust the cam follower 87, push rod 86 and lever 85 to the right, as disclosed in FIG. 4, to actuate the overrunning clutch 79, which in turn will momentarily accelerate the rotation of the fabric feed roller 42. This action produces the spaces between each group of four stitches disclosed in FIG. 10. The gears 92 and 93 could be designed so that the shaft 14 makes four revolutions for one revolution of the cam shaft 89. Thus, for a four to one gear ratio, the cam 88 would be provided with a single raised surface similar to the raised surface of the cam 108 disclosed in FIG. 8. It is, of course, also within the scope of this invention for the gear ratio between 92 and 93 to be eight to one, in which event the cam 88 would have a pair of raised surfaces formed on the edge of the cam 88 at 180° from each other. Thus, for every eight revolutions of the shaft 14,

the cam shaft 89 would rotate once and actuate the overrunning clutch 79 on each half revolution.

But assuming that the gear ratio of 93 and 92 is four to one, then the cam 88 will actuate the overrunning clutch 79 for each revolution of the cam shaft 89, and simultaneously the cam 108 will actuate the intermediate cylinder 95 to clamp the yarns in the position as disclosed in FIG. 7, by means of the mechanism disclosed in FIGS. 2 and 8. It is thus seen that the yarn clamping mechanism 55 operates periodically and synchronously with the overrunning fabric feed mechanism so that all the yarns 50 and 52 are clamped while the fabric 38 is being accelerated, regardless of whether the needle bars 22 are locked or unlocked by the pattern control mechanism 26—33. Thus, as the fabric 38 is over-fed and the yarns 50 and 52 are clamped every fourth stitch, the last leg of the third stitch of the cut tuft is removed. Without this synchronizing operation, a long stitch of yarn or "tail" would remain on the fabric 38 and would have to be removed by hand or other mechanisms known as "tail pickers."

In the particular pattern sheet 31, disclosed in FIG. 9, there are only two rows of slots 32 and 32¹. The slots in each row are equally spaced and the slots 32¹ are staggered with respect to the slots 32. Actually, only the two pattern fingers 30 and 30¹ are in operation, so that the pattern finger 30 is connected through the electrical wire 29 to each odd alternate solenoid 25, while the even alternating solenoids 25 are electrically connected to the pattern finger 30¹ through lead 29¹. Thus, when the machine is in operation, the pattern fingers 30 and 30¹ will alternate in engaging their respective slots 32 and 32¹, so that each odd needle holder 22 will be locked to the needle bar 19, while the alternating even needle holders 22 will be unlocked in raised position to form skip-stitches. The pattern of the controlled needle stitches is disclosed in FIG. 10, where 121 represents three consecutive stitches made by an odd controlled needle 36, while the stitches 122 are formed by the alternating even controlled needles 36, in accordance with the arrangement of the notches 32 and 32¹ in the pattern sheet 31. While the controlled needles 36 are alternately being locked and unlocked to the continuously reciprocating needle bar 19, all the fixed needles 35 are being continuously reciprocated through the base fabric 38 to form the stitches 123.

It will be noted that the skipped space between each group of stitches 123 in the same row is caused by overfeeding the fabric 38 by accelerating the rotation of fabric feed roll 42, while the additional spacing between the groups of stitches 121 and 122 in any one row is caused by the pattern control mechanism. By varying the length and arrangement of the notches 32, 32¹, or by including additional rows of notches in the pattern sheet 31 and rearranging the electrical circuits, varied spacing may be obtained between the groups of stitches 121 and 122. However, the basic pattern of stitching 121 or 122 in substantially the center of an imaginary square having a group of stitches 123 at each corner, remains constant.

It will be apparent to those skilled in the art that various changes may be made in the invention, without departing from the spirit and scope thereof, and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. In a tufting machine including needles for stitching a plurality of yarns through a base fabric to form tufts therein, means for reciprocating said needles, fabric feed rolls, means for continuously driving said rolls to feed said fabric beneath said needles at a predetermined rate, an overrunning clutch operatively connected to one of said fabric feed rolls for moving said fabric faster than said predetermined rate, first cam means operatively connected to said reciprocating means for periodically overrunning said clutch, a yarn clamp comprising clamp-

ing elements movable between an unclamping position to permit the passage therethrough of said yarns to their respective needles and a yarn clamping position, second cam means operatively connected to said first cam means for periodically moving said elements to clamping position to clamp said yarns when said clutch is being overrun.

2. In a tufting machine including needles for stitching a plurality of yarns through a base fabric to form tufts therein, means for reciprocating said needles, fabric feed rolls, means for continuously driving said rolls to feed said fabric beneath said needles at a predetermined rate, an overrunning clutch operatively connected to one of said rolls for moving said fabric faster than said predetermined rate, a cam shaft, means for operatively connecting said cam shaft to said needle reciprocating means for rotating said cam shaft, a first cam on said cam shaft, a first cam follower engaging said first cam and operatively connected to said overrunning clutch, a second cam on said cam shaft, a yarn clamp comprising concentric telescoping cylinders having in unclamped position aligned apertures therethrough to permit the passage of said yarn to their respective needles, a second cam follower engaging said second cam and being operatively connected to one of said cylinders for axial reciprocation, means for driving said cam shaft whereby said first cam follower actuates said clutch to accelerate said fabric feed and said second cam follower simultaneously reciprocates said one cylinder to clamping position for disaligning said apertures to clamp said yarns.

3. The invention according to claim 2 in which said means for reciprocating said needles comprises a drive shaft, gears operatively connecting said drive shaft to said cam shaft, the ratio of said gears providing a multiple number of drive shaft revolutions for each cam shaft revolution.

4. The invention according to claim 2 in which a lever is fixed to said clutch and said first cam follower comprises a push rod for engaging said lever to overrun said clutch.

5. The invention according to claim 2 in which a lever is pivotally mounted upon said machine, said one reciprocating cylinder is pivotally connected to said lever and said second cam follower engages said lever, whereby said lever is pivotally reciprocated upon rotation of said second cam for reciprocating said one cylinder.

6. In a tufting machine including needles for stitching a plurality of yarns of different sizes through a base fabric to form tufts therein, means for reciprocating said needles, means for continuously feeding said base fabric beneath said needles at a predetermined rate, means for periodically overfeeding said fabric faster than said predetermined rate, a yarn clamp comprising an outer cylinder, an intermediate cylinder and an inner cylinder concentrically arranged, said intermediate cylinder being adapted to telescopically reciprocate between said outer and inner cylinders, a first set of aligned apertures in all said cylinders to permit the passage of a first yarn of one size therethrough, a second set of aligned apertures extending through all said cylinders to permit the passage of a yarn of another size therethrough, the aperture in said outer cylinder in said first set being substantially larger than the apertures in said intermediate and inner cylinders of said first set, the aperture in said inner cylinder in said second set being substantially larger than the apertures in said intermediate and outer cylinders in said second set, means for adjustably securing said outer and inner cylinders in axial relationship, and means for periodically reciprocating said intermediate cylinder to clamp said first and second sets of yarns simultaneously with the overfeeding of said fabric.

7. The invention according to claim 6 in which the means for reciprocating said needles comprises a needle bar extending transversely of said machine for supporting said needles, said outer cylinder being mounted on and parallel to said needle bar.

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