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NEEDLE STITCHING PATTERN MECHANISM

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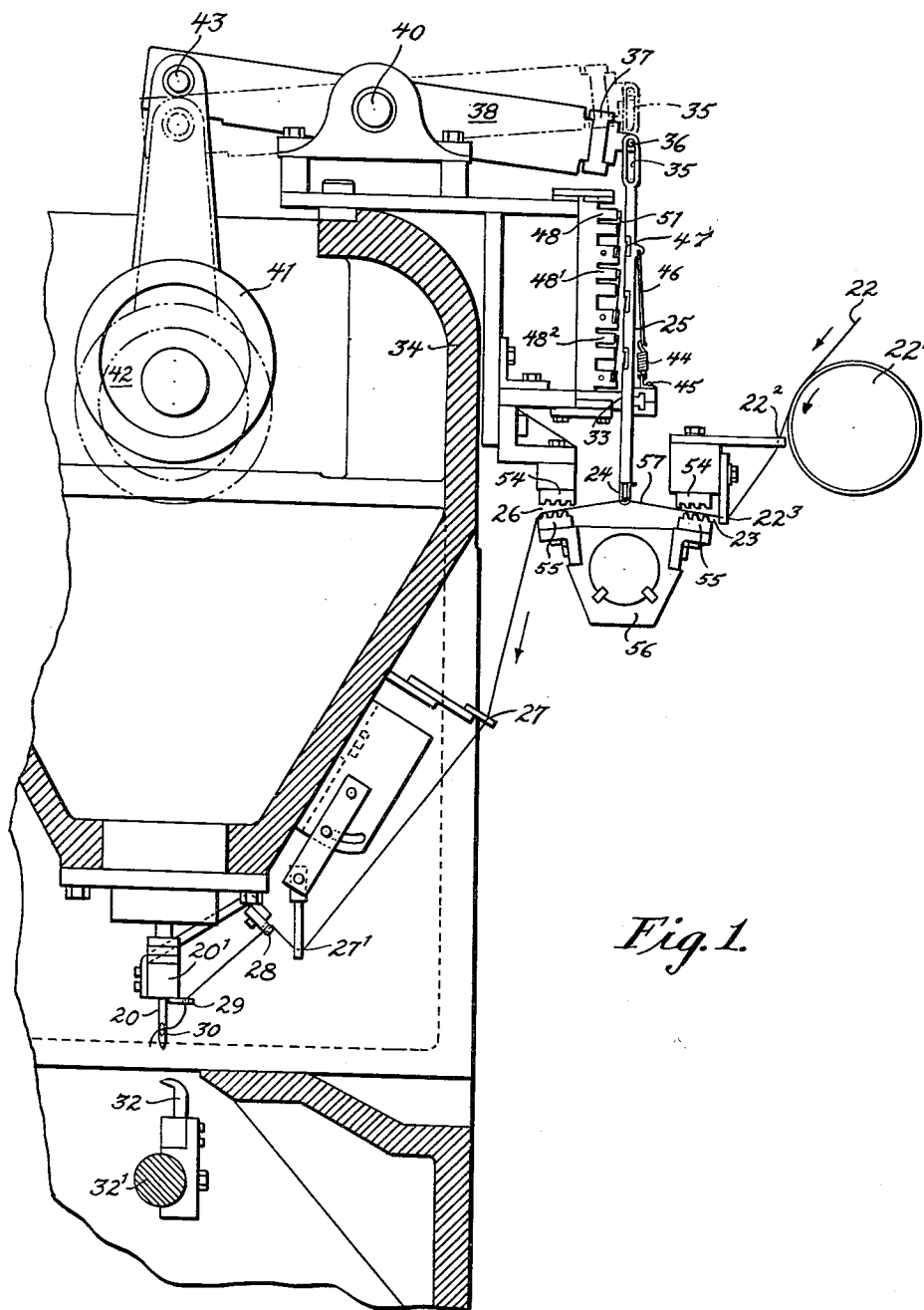


Fig. 1.

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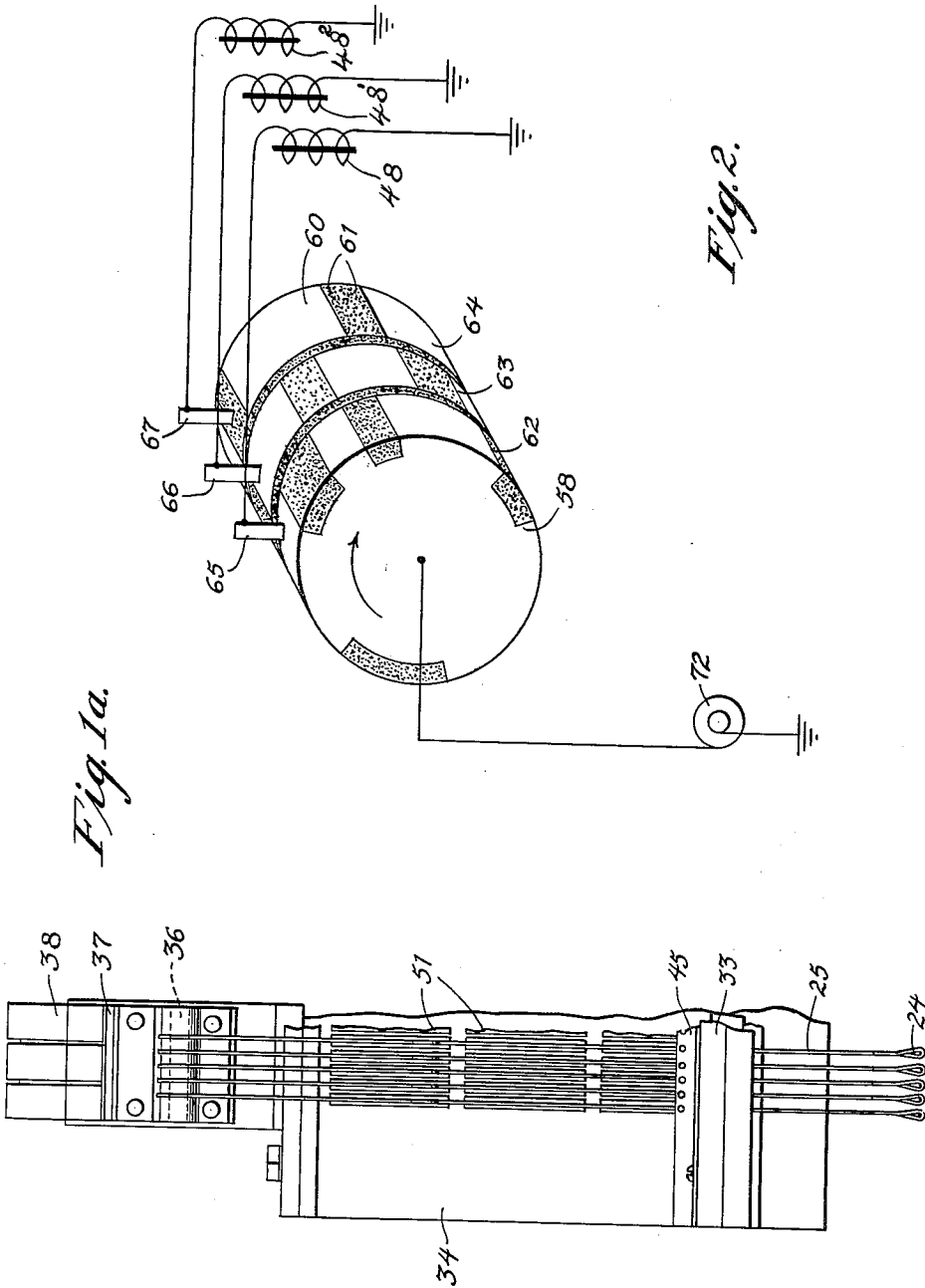
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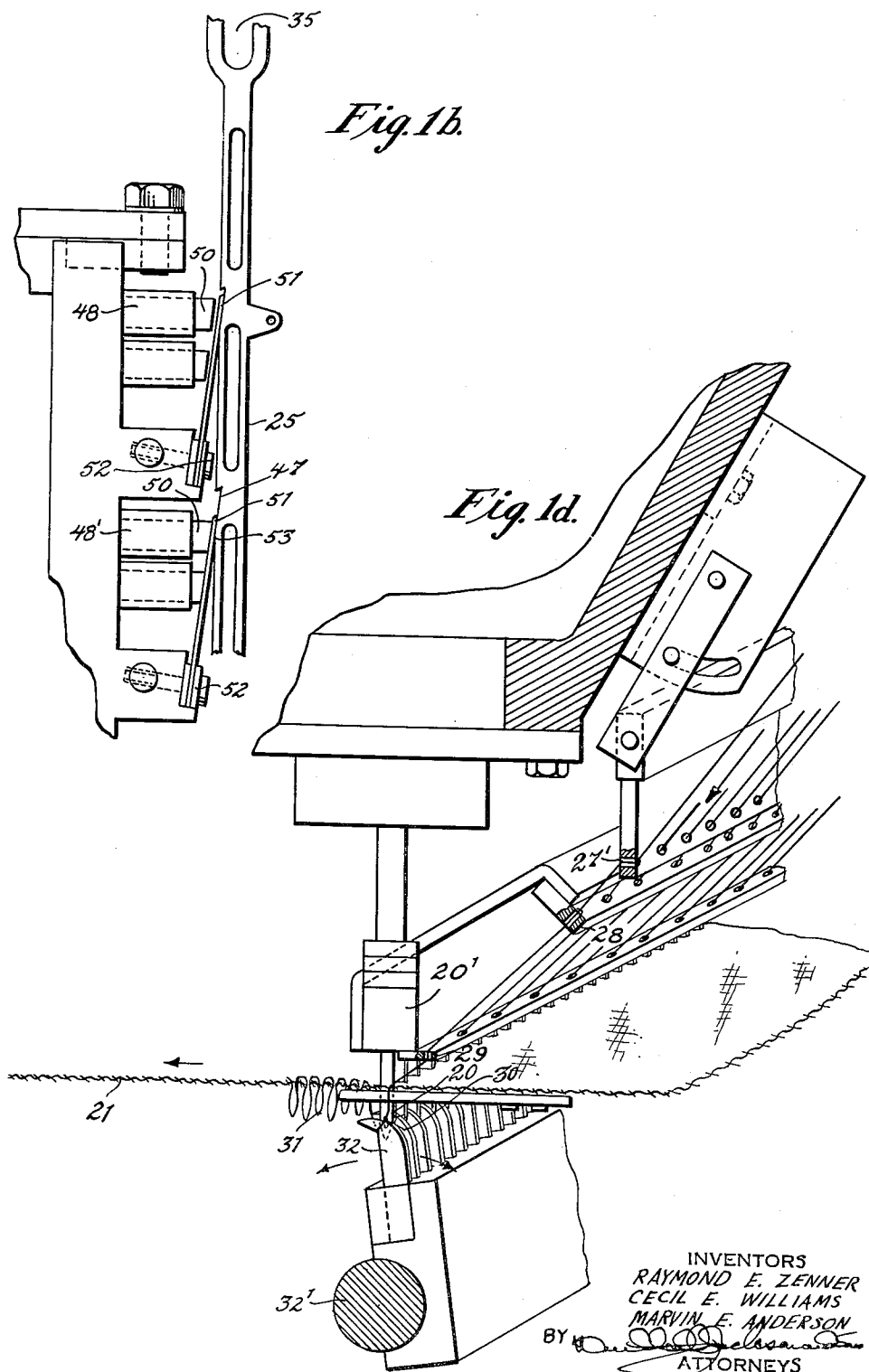
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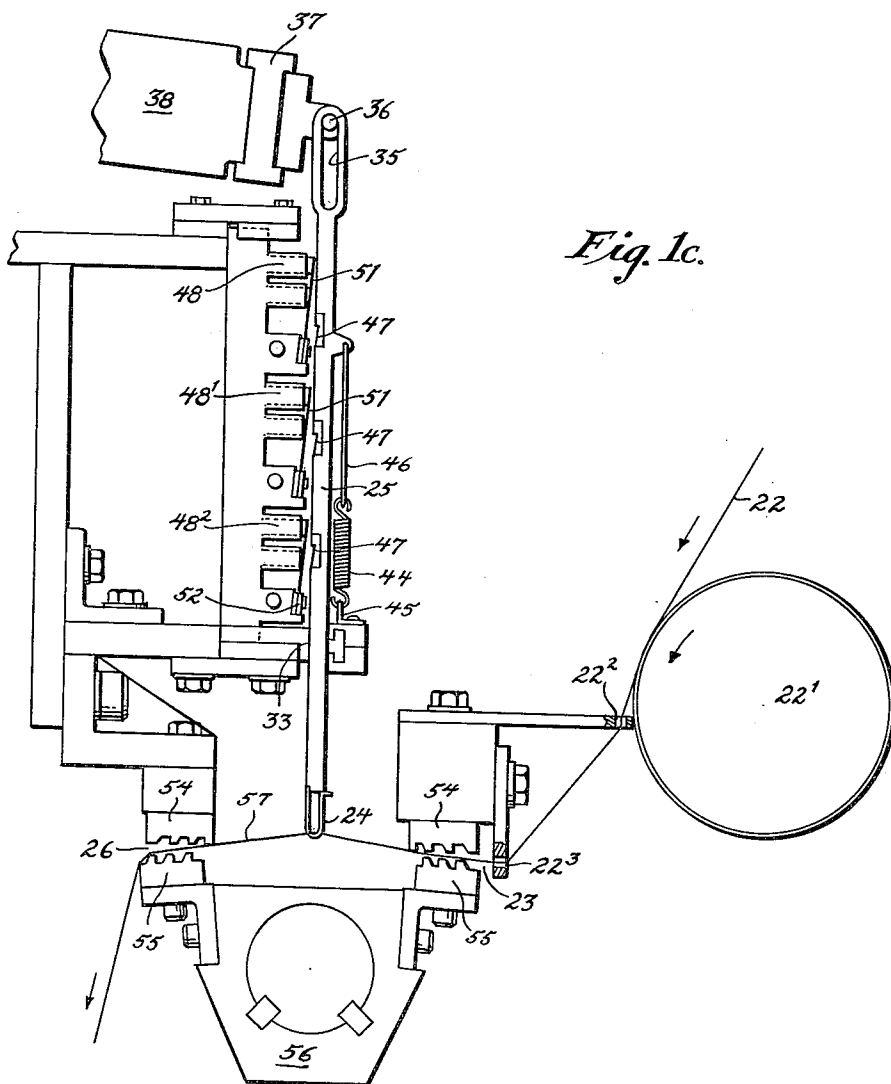
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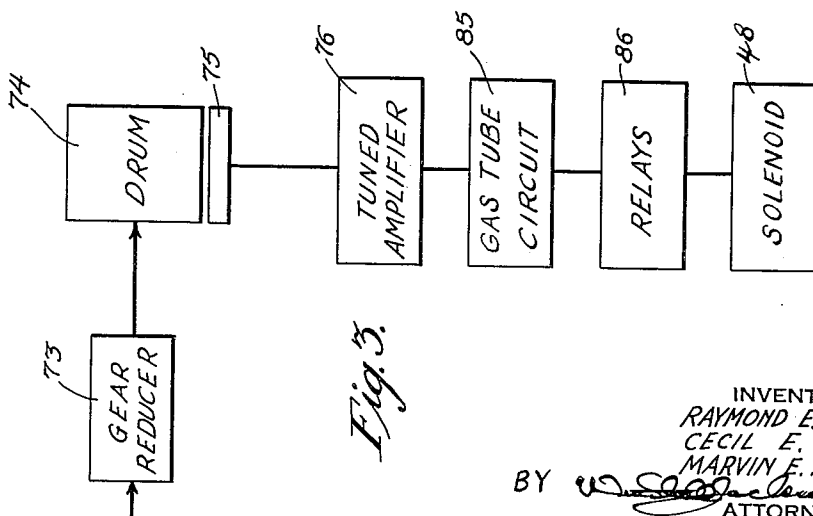
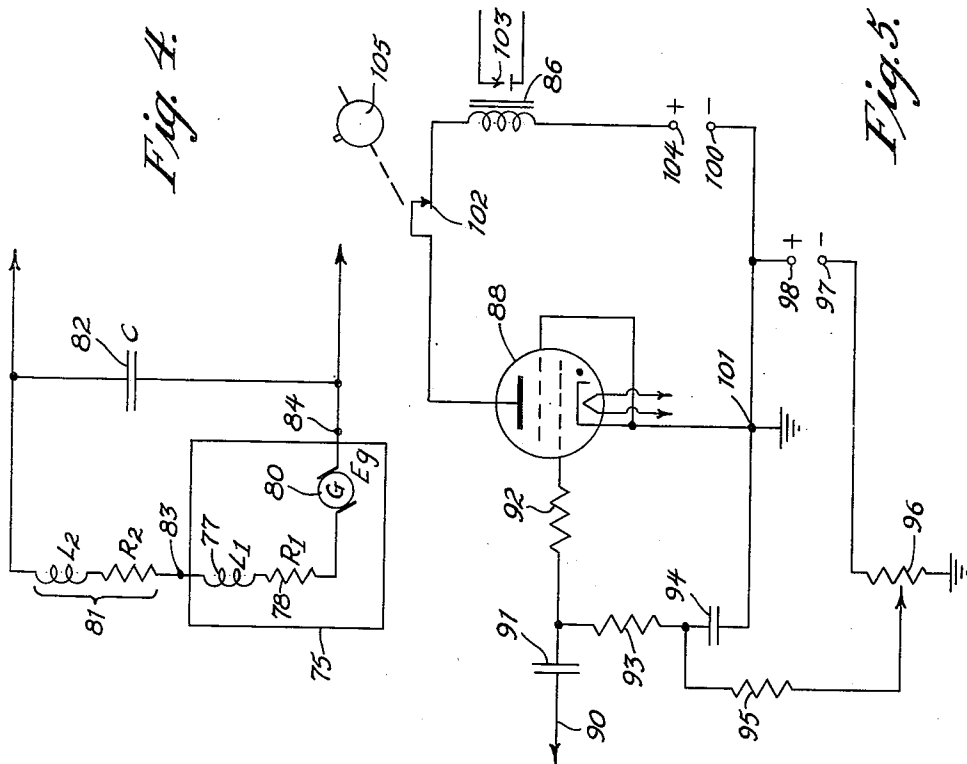
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## NEEDLE STITCHING PATTERN MECHANISM

Raymond E. Zenner, Park Ridge, Ill., Cecil E. Williams, Hawthorne, Calif., and Marvin E. Anderson, Chicago, Ill., assignors, by mesne assignments, to C. H. Masland and Sons, Carlisle, Pa., a corporation of Pennsylvania  
Filed Aug. 11, 1958, Ser. No. 754,327  
7 Claims. (Cl. 112—79)

The present invention relates to pattern control mechanism for regulating the length of pile loops in production of a needled pile carpet.

The present application is a continuation-in-part of our copending application Serial No. 490,061, filed February 23, 1955, for Needle Stitching Pattern Mechanism, now abandoned.

The present application is being divided, and the subject matter relating to the electrical control device is being embodied in a divisional application Serial No. 856,571, filed December 1, 1959, for Electrical Control Device.

A purpose of the invention is to permit precise control of the lengths of pile loops formed by needling a pile carpet at a high operating speed, suitably six stitches per second per needle.

A further purpose is to achieve pattern control of each end passing from a creel to a needle of a set of ganged needles by pulling a pattern feed loop which will be the same for each yarn end between a set of opposed clamps, and then reducing the feed loop length in accordance with the regulation of one of a plurality of latches which are subject to pattern control.

A further purpose is to pull the feed loop while clamping the yarn between the feed loop puller and the needle and freeing the yarn between the feed loop puller and the creel, and at the same time preferably advancing the needle (or permissibly retracting), and then reduce the feed loop height to the predetermined extent in accordance with a pattern control while clamping the yarn between the feed loop puller and the creel and freeing the yarn between the feed loop puller and the needle as the needle preferably retracts (or permissibly advances).

A further purpose is to pull the feed loop by a lifting bar individual to each yarn end, to resiliently retract the lifting bar while allowing effective lost motion between the lifting bar and its lifting means, and to determine the extent of retraction at that stage by engagement of one of a plurality of latches located along the lifting bar in one of the latching recesses on the lifting bar.

A further purpose is to latch the feed loop-forming mechanism by deenergizing solenoids acting on armatures which are effectively weak springs urged into engagement with the lifting bar latching recesses.

A further purpose is to deflect the leaf spring armatures to a position adjacent the solenoids as the lifting bar is raised, so as to reduce the reluctance of the magnetic path.

A further purpose is to make the upstroke of the lifting bar invariable and to vary the return stroke of the lifting bar by the leaf springs with a selected armature-latch.

A further purpose is to energize the solenoids by switches which respond to a program control.

A further purpose is to energize the solenoids by a magnetic memory record which conforms to the pattern. Further purposes appear in the specification and in the claims.

In the drawings we have chosen to illustrate a few only of the numerous embodiments in which our invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

2

FIGURE 1 is a diagrammatic view largely in vertical section showing the needle tufting machine, the clamping mechanism, the lifting bar mechanism and the latches according to the invention.

FIGURE 1a is a fragmentary end elevation of the mechanism of FIGURE 1.

FIGURE 1b is an enlarged fragment of FIGURE 1.

FIGURE 1c is an enlarged fragment of FIGURE 1 showing the lifting bars and clamps.

FIGURE 1d is an enlarged fragment of FIGURE 1 showing the needle and the tufting operation.

FIGURE 2 is a diagrammatic perspective of one form of switching mechanism which may be used.

FIGURE 3 is a block diagram of a further form of electrical energizing and switching mechanism which may be used in the invention.

FIGURE 4 is a circuit diagram showing the magnetic memory playback head and frequency selecting circuit which may be employed in FIGURE 3.

FIGURE 5 is a circuit diagram of the gas tube circuit and relay mechanism which may be employed in the mechanism of FIGURE 3.

Describing in illustration but not in limitation and referring to the drawings:

Widespread use has been made in the production of floor coverings such as carpets and rugs of multiple needle tufting machines which reciprocate a gang of needles in unison, each needle carrying a single yarn end through its forward eye, and advancing and retracting the yarn ends through a backing and in cooperation with loopers, as well known in the art to form cut or uncut pile projections in the fabric.

In the prior art, mechanical mechanism has been developed to control the height of loops formed on individual stitches so that the completed fabrics will contain areas of high pile and areas of low pile, or areas of piles of several different heights to produce texturing effects which are highly desired in the carpet industry.

Since the needling machine operates at high speed, usually of the order of six or more cycles per second, it is difficult to complete selection of a feed yarn on each yarn end to produce a new loop and pull back on the last previous loop to regulate its height by mechanical means during the limited time available. There is also the possibility that unless the yarn feed selection is accomplished with great positiveness in a minimum of time, the selection of the feed for one stitch may carry over to the next stitch and prevent sharply defined texturing.

It is also difficult with purely mechanical control of yarn feed to obtain a simple mechanism which can be changed readily with change in pattern, without necessitating major modifications in the machine.

In accordance with the present invention an extremely simple control of yarn feed has been accomplished and one which is extremely compact so that it can fit in the spacing available in width above a particular needle position. Furthermore the control is readily changed to produce any one of a wide variety of different patterns.

The invention lends itself particularly to electrical operation of the control either under actuation from direct positive switching, or magnetic memory control of switching.

In accordance with the invention the feed of the yarn is regulated by a pattern feed loop. On each cycle a pattern feed loop is pulled and before the loop is released to feed to the needle, the loop is regulated by retraction under pattern control. This is best accomplished by retraction according to a selecting latch action, the various latches desirably engaging in latching recesses of the lifting bar which in the best form of the invention moves a predetermined distance and then is retracted in lost

motion connection with the lifting mechanism, until the selecting latch is encountered.

The latches are most desirably solenoids which actuate armatures preferably of the leaf spring type, which are resiliently urged into latching position, and pulled out of latching position by the solenoids.

The lifting bar desirably moves the leaf spring armatures into proximity with the solenoids when the lifting bar is raised, thus reducing the current requirements on the solenoids and reducing the heating effect in the mechanism.

Considering now the drawings in detail and referring particularly to FIGURES 1, 1a, 1b, 1c and 1d, the needling machine comprises a gang of needles extending transversely of the machine of which needle 20 and needle bar 20' only are shown, and reciprocating in unison to advance and retract through a backing fabric 21, progressing in the direction of the arrow and suitably consisting of burlap, osnaburg, felt, or the like. A yarn end 22 passes to each needle from a source, suitably a creel not shown, over a guiding roller 22' and through guiding eyes 22<sup>2</sup> and 22<sup>3</sup>, through a first clamp 23, then through lifting eye 24, at the bottom of lifting bar 25 individual to the particular yarn end, then through a second clamp 26, to guides 27 and 27', and a guiding eye 28, of a jerker bar moving with the needle, then through guide 29 on the needle bar, to the eye 30 in the needle 20, and thus forms needled loops 31 of variant height according to the pattern control as later explained. In forming the loops the yarn is suitably engaged by a looper 32, of any well known character, moving in the direction of the arrows and suitably turning on shaft 32', and holding the yarn loop as the needle preferably retracts, and then releasing to allow the needle in accordance with its feed in advancing on the next stitch to determine the loop height.

It will be understood that the clamps 23 and 26 suitably extend the full width of the machine and alternately engage all of the yarn ends in one clamp or the other, but a lifting eye 24 and a lifting bar 25 are individual to each yarn end and one of a large series extending along the width of the machine.

The lifting bars are suitably narrow in the direction transverse to the paper in FIGURE 1, so that each lifting bar can occupy only the width of a single needle.

The lifting bars at an intermediate point below the latches are guided to permit vertical motion by a guide 33 supported on the frame 34 of the machine, and at the top the individual lifting bars have elongated slots 35 which engage lifting pins 36 distributed along a lifting head 37 which is mounted at one end of lifting levers 38 (only one is shown) pivoted intermediate their ends at 40 on the frame and spaced side by side across the machine.

The lifting levers are moved in synchronism with the needles by any suitable means, here shown as eccentric straps 41 (only one is shown) riding on eccentrics 42 and pivotally connected at 43 to the ends of the lifting levers remote from the lifting head. In the preferred embodiment, the lifting bars are all raised as the needles advance and start downward as the needles retract, but the reverse relationship may be used.

The lifting bars are individually spring urged downwardly by helical tension springs 44 secured to spring abutments 45 on the guide 33 at one end and to pull wires 46 connected to the upper portion of the lifting bar from the other end of the spring.

Along the length of the lifting bar, suitably on the side remote from the retracting springs, the lifting bar has a plurality of latching recesses 47, shown on the drawing as three and directed to latch in downward or retracting motion.

There are latching solenoids 48, 48' and 48<sup>2</sup>, one for each latching recess, distributed at different positions along the path of each lifting bar, and having cores 50 which

are in magnetic attracting relationship to magnetically susceptible armatures 51. The armatures are desirably leaf springs which may be individual or formed in sets laterally, and are secured as by mounting screws 52 at the lower end and are resiliently urged by their own spring action outwardly to engage in the latching recesses 47. The leaf spring armatures, since they extend almost parallel to the lifting bar, are quite strong in compression to latch the lifting bars. When, however, the lifting bar moves upward, the cam action of the latching recesses pushes the armature into close engagement with the cores of the adjoining solenoids, as indicated at 53, so that the reluctance of the magnetic path of the solenoids is reduced, the pick-up current is cut down and the heating effect in the solenoids is reduced.

The clamps 23 and 26 suitably each consist of opposed cooperating jaws 54 and 55, the jaws 54 being mounted on the frame and the jaws 55 being secured on rocker 56, which rocks back and forth in synchronism with the needle reciprocation and the lifting bar reciprocation to close one clamp, while opening the other, and then close the other clamp while opening the one.

In operation of the mechanism as shown in FIGURE 1, the clamp 26 toward the needle with respect to the lifting bar eye is closed, and the clamp 23 toward the creel is open as the lifting bars move up in unison to pull a predetermined pattern control loop 57. At the same time the needles preferably advance in unison (in the alternate form they retract at this time).

When the needles in the preferred form are fully advanced and are ready to begin retracting in unison, the clamp 26 towards the needles opens, and the clamp 23 towards the creel closes and at the same time all the lifting bars begin to move down, the pins 36 moving more rapidly than the lifting bars to permit lost motion as the springs 44 pull the lifting bars down. Previously a suitable electrical switching mechanism has energized all but one of the solenoids, if the lifting bar is to be latched in raised position, and all of the solenoids, if the lifting bar is permitted to move fully down.

Thus if one of the solenoids is permitted to latch, the pattern loop is to that extent prevented from paying out to the needle as the needle and jerker bar preferably retract. Because the yarn is of insufficient length, the jerker bar pulls yarn through the needle, to that extent reducing the height of the pile loop which is being controlled. If, however, the lifting bar is permitted to move all the way down because no latching occurs, the controlled pile loop is allowed to remain at maximum height. The downward travel of the lifting bar may be arrested at one of the three latching positions shown and fewer or more latching positions may be used as required.

The particular control for the circuits which energize the solenoids will vary in individual systems.

FIGURE 2 shows a suitable control which may be of the character of a sign flasher 58, suitably rotating and having on its circumference electrically energized segments 60 and insulating segments 61 in a plurality of separate channels 62, 63, and 64, each of which is connected to one of the brushes 65, 66 and 67, which in turn are connected to one of the coils of solenoids 48, 48' and 48<sup>2</sup>. The solenoid coils are grounded and the current carrying segments are connected to a source of electric current 72, which is also suitably grounded.

In the preferred embodiment of the invention it will be preferable to utilize a control which is easier from the standpoint of pattern change and more rapid and reliable. In FIGURE 3 we illustrate such a mechanism by a block diagram. Gear reducer 73, driven in synchronism with the needles and lifter bars, turns a magnetic memory record drum 74 of well known type having numerous axially spaced magnetic control paths, one for each of the solenoids for each needle. The circumferential paths at different positions have "go" or "no-go" magnetic energized or deenergized areas, which de-

termine whether the playback heads 75, one for each channel, will pick up or not. The playback heads may be of any suitable type but are preferably of the character described by Schurch & Schleif, "A Magnetic Tape Oscillograph for Power System Analysis," 70 Electrical Engineering 993 (November 1951).

Each playback head in its respective channel connects to the proper channel of a frequency selective circuit and tuned amplifier 76. The tuned amplifier itself for each channel is of any suitable type, conveniently of the form shown by Terman, Radio Engineers Handbook (First Edition 1943) 435, FIG. 67(a). The frequency selective circuit for each channel may be of any well-known character, desirably of the type shown in FIGURE 4, which illustrates the electrical aspects of the playback head and the corresponding frequency selective circuit components for a given channel, connecting at the output side to the tuned amplifier for that channel at terminal 90 and ground. These show in the playback head 75 an inductive reactance 77 having a value  $L_1$  in series with a resistance 78, having a value  $R_1$  in series with an alternating current generator 80 of zero impedance having a voltage  $E_g$ . These elements of the playback head are all in series with an inductor 81 having an inductance  $L_2$  and a resistance  $R_2$ . The leads to the tuned amplifier supplied by the output from these circuit elements in series are shunted by tuning capacitor 82 having a capacity  $C$ .

The voltage between points 83 and 84 in this system corresponds to the voltage across the playback head of the Schurch & Schleif article above mentioned.

For resonance this system complies with the following equation:

$$E_{out} = \frac{W(L_1 + L_2)}{R_1 + R_2} E_g$$

where  $W$  is  $2\pi f_0$ , and

$$f_0 = \frac{1}{2\pi(L_1 + L_2)C}$$

This frequency selective and tuned amplifier circuit in its respective channels connects with a switch tube or gas tube circuit 85 which may be of any suitable type but is conveniently of the character of FIGURE 5, which includes an output relay 86, which opens and closes the circuit energizing the solenoid 48.

In FIGURE 5, the gas filled tube 88, suitably a tetrode, has its control grid signal supplied through D.C. blocking capacitor 91 from the output of the tuned amplifier at terminal 90 and ground. The grid of tube 88 has an A.C. path to ground through resistors 92 and 93 and capacitor 94. The D.C. return of the grid to ground is through resistors 92, 93, 95 and 96. Resistor 96 is also a potentiometer allowing adjustment of the D.C. grid voltage from a D.C. bias supply connected to terminals 97 and 98. The minus B voltage terminal is at 100. A suitable bias supply voltage is 75 volts.

The cathode is grounded at 101. The anode is connected through circuit opening relay 102 to relay 86, which opens and closes the circuit of one of the latching solenoids 48, 48' or 48<sup>2</sup> by switch 103 in circuit with a suitable electrical source. The opposite side of the relay 86 is connected to the plus B voltage terminal at 104.

Circuit breaking relay 102 is part of a commutator actuated by motor 105 which is turning in synchronism with the needles and breaking the circuit by relay 102 at the end of each stitching cycle to prevent the gas tube 88 from remaining energized.

The gas tube can be of any suitable type, Thyatron type 5696 being a desirable form.

Summarizing the general operation, the clamping means 26 engages all yarn ends between the lifting bars and the needles 20, while freeing the yarn ends between the lifting bars and the creel at jaws 23. At this posi-

tion the lifting bars move up in unison to pull predetermined uniform length yarn feed loops. The needles are simultaneously advancing in the preferred embodiment and sufficient yarn is being fed from the jerker mechanism to form the next loop (retracting in the alternate form). As the lifting bars move up, the latching notches exert a cam action which tends to push the latching armatures into a position adjacent the solenoids. At the same time, considering only one yarn end for description clarity, a suitable program switch having a channel for each solenoid as shown in FIGURE 2 or a magnetic memory and switching device as described in reference to FIGURES 3, 4 and 5 causes all of the latches controlling undesired pile loop heights of the yarn end to be energized so that their latching armatures cannot operate to hold the individual lifting bar up at a later stage when the lifting bars are to move down. It will be understood, however, that if one particular selected latch is not energized it will resiliently engage the lifting bar and spring into the appropriate latching notch as the lifting bar later moves down, thus feeding insufficient yarn to the jerker bar to form a maximum height pile loop. Of course, if it is desired that the previous pile loop be of maximum height it is not necessary to rob from it and in that case no latching of the particular lifting bar need occur at all and said lifting bar can be permitted to move to lowermost position on that stitch. It is understood that this description applies to the plurality of individual yarn ends.

After the needles have been fully advanced in the preferred embodiment (retracted in the alternate form) and are about to move up, clamp 26 towards the needles opens and clamp 23 toward the creel closes and the lifting bars move down. At this position the switching mechanism of FIGURE 2 or the magnetic memory and switching mechanism of FIGURES 3 to 5 is still operating to remove all nonselected latches from operative position. The extent to which the lifting bar is held up by latching at a particular yarn end determines the restraint applied to the yarn feed, and this correspondingly determines the amount of yarn which will be robbed from the previous loop formed on the preceding stitch. Lost motion occurs at 35 when any one of the bars is engaged by a latching armature.

In view of our invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of our invention without copying the apparatus shown, and we, therefore, claim all such insofar as they fall within the reasonable spirit and scope of our claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. A pattern needling machine for carpet and the like, including a gang of needles having eyes through which yarn from a source is carried and including means for advancing and retracting said needles as a group through a backing, in combination with opposed clamping means located along the path of the yarn toward the needles and positioned in spaced relation along the yarn path through which a plurality of yarn ends are fed to the needles, a yarn engaging eye located on each yarn end between said clamping means and engaging said yarn end, means for deflecting said yarn engaging eye a predetermined distance away from the path of each yarn end between the clamping means and then retracting said eye toward the path between the yarn clamping means to first form a large loop and then diminish said loop, latching means operating selectively at different loop heights to intercept said retracting means during the diminishing of the loop and thus selectively regulate the size of the loop ultimately formed, and pattern control means for operating the latch means along the path of particular deflecting means.

2. A pattern needling machine of claim 1, in which

7

the deflecting means comprises a lifting bar individual to each yarn end, means for raising all of the bars in unison to a predetermined position, lost motion mechanism between each bar and the means for raising the bars, and means for retracting the bars to a position permitted by the latch means.

3. A pattern needling machine of claim 2, in which the bar has a plurality of latching notches and the latch means includes latching projections selectively engaging in the latching notches.

4. A pattern needling machine of claim 3, in which the latch means comprises a solenoid for each latch and comprises a latching solenoid armature cooperating with each solenoid and in one position engaging in a latching notch in the lifting bar.

5. A pattern needling machine of claim 3, in which the latch means comprises a solenoid and comprises a leaf spring armature spring-biased to latch against the lifting bar and pulled out of latching position when the solenoid is energized.

6. A pattern needling machine of claim 2, in which the clamping means engages between the lifting bars and the source of yarn when the needles move in one direction

8

while freeing between the lifting bars and the needles, and then engages between the lifting bars and the needles while freeing between the lifting bars and the source of yarn when the needles move in the opposite direction and when the lifting bars retract to the selecting position established by the latch means.

7. A pattern needling machine of claim 1, in which the latch means comprises a plurality of latching positions for each yarn end.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |          |                |
|-----------|----------|----------------|
| 1,688,057 | Reed     | Oct. 16, 1928  |
| 1,786,621 | Lawson   | Dec. 30, 1930  |
| 2,481,993 | Fuss     | Sept. 13, 1949 |
| 2,773,222 | Chauvin  | Dec. 4, 1956   |
| 2,782,741 | Smith    | Feb. 26, 1957  |
| 2,853,034 | Crawford | Sept. 23, 1958 |
| 2,860,588 | Penman   | Nov. 18, 1958  |
| 2,876,183 | Parlin   | Mar. 3, 1959   |
| 2,878,763 | Jackson  | Mar. 24, 1959  |
| 2,898,876 | Penman   | Aug. 11, 1959  |
| 2,965,054 | Masland  | Dec. 20, 1960  |