

June 14, 1960

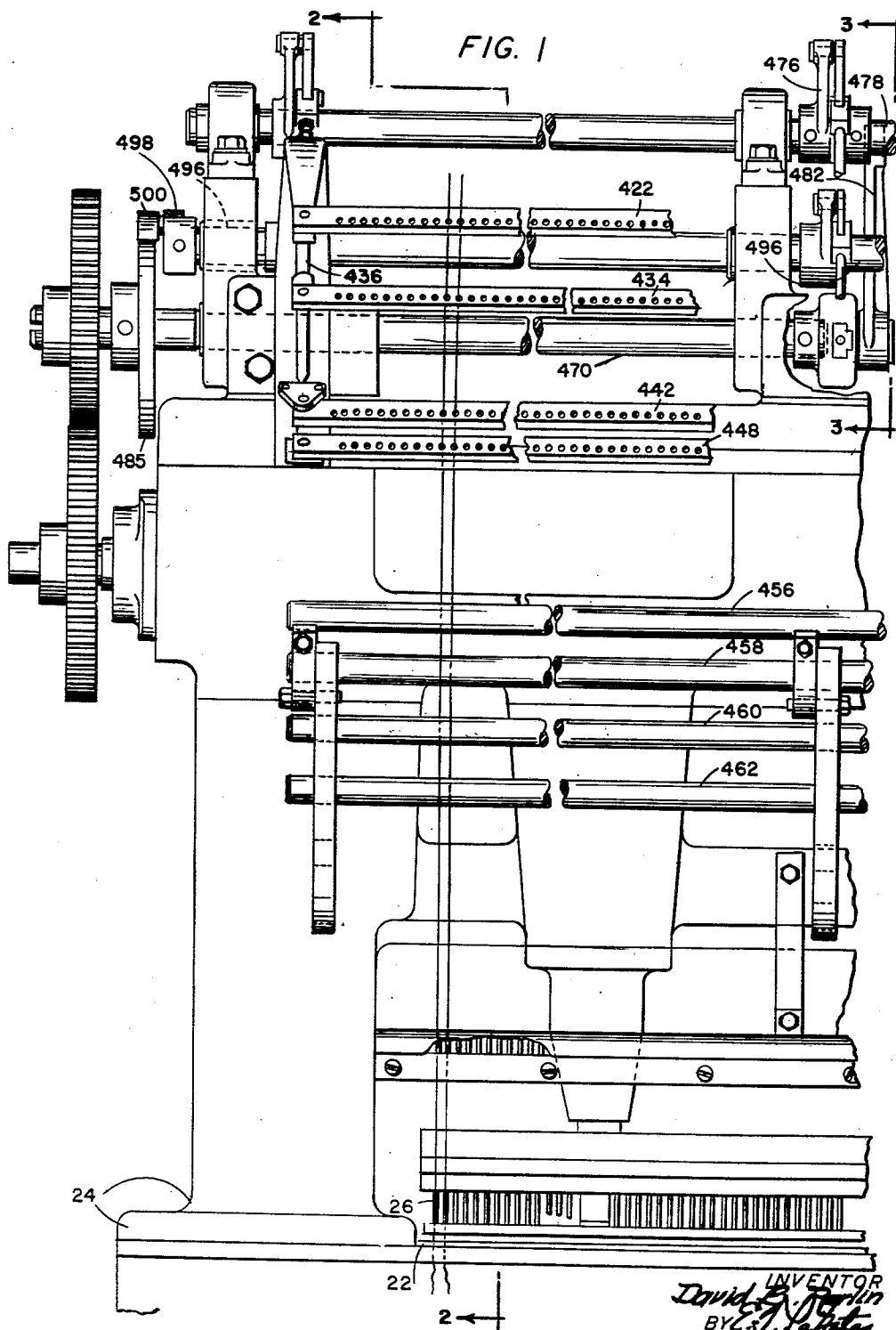
D. B. PARLIN

2,940,405

MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

Filed Oct. 28, 1954

7 Sheets-Sheet 1



June 14, 1960

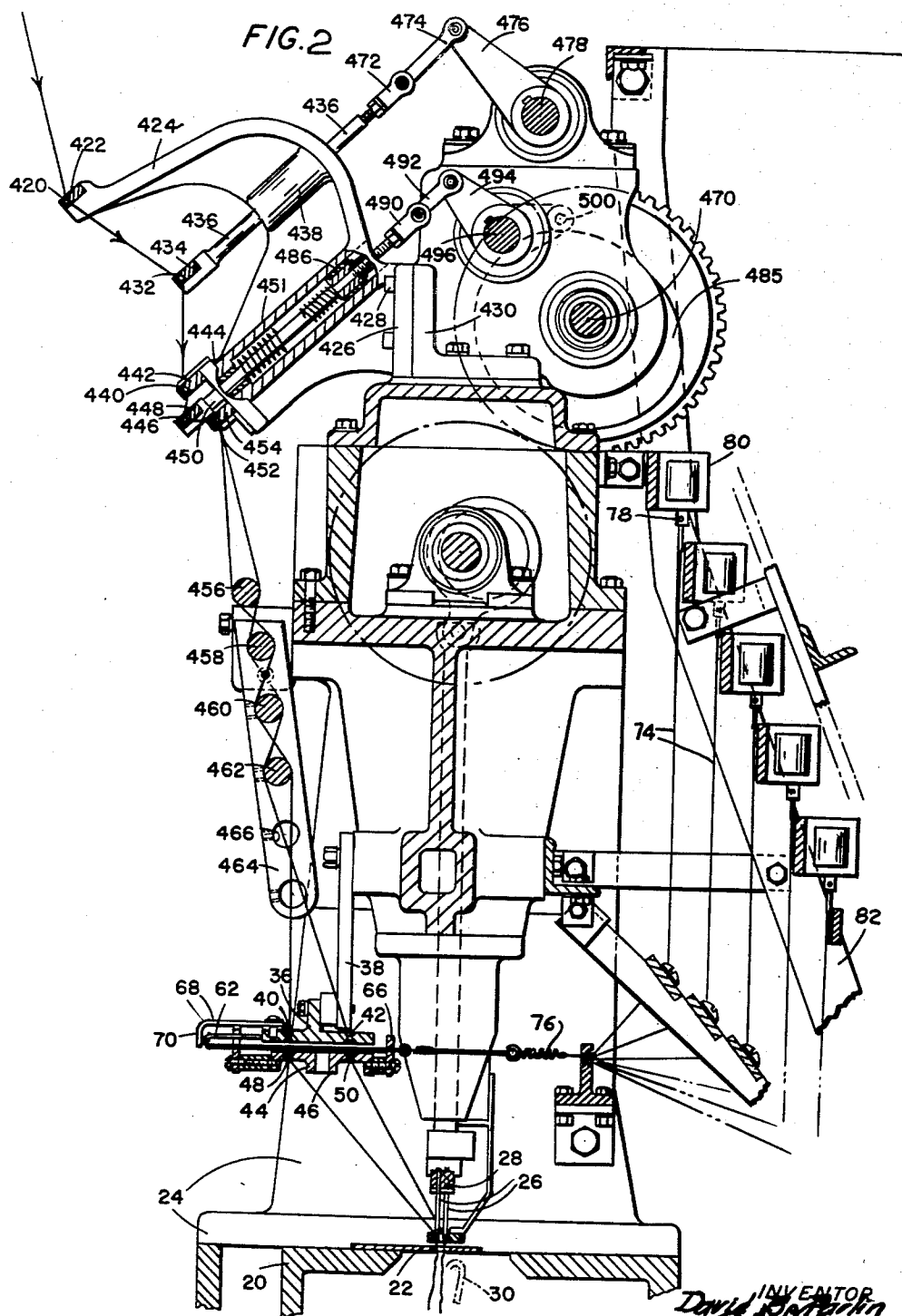
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MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

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7 Sheets-Sheet 2



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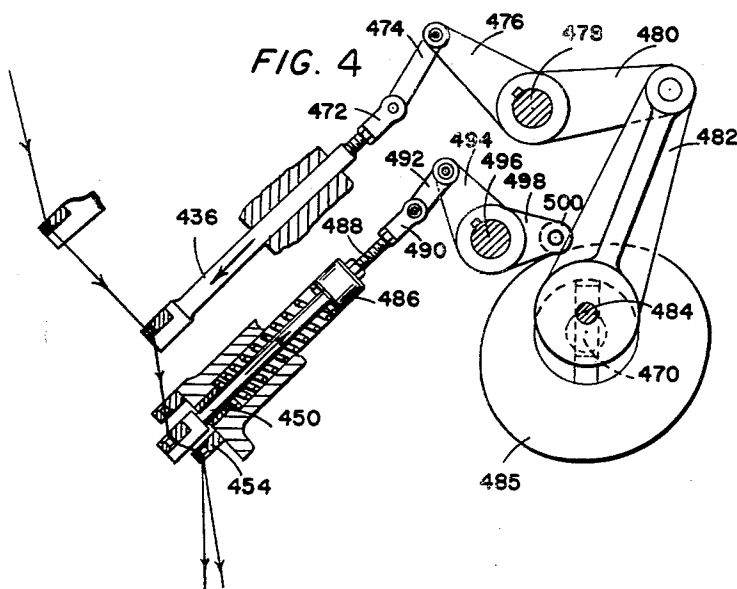
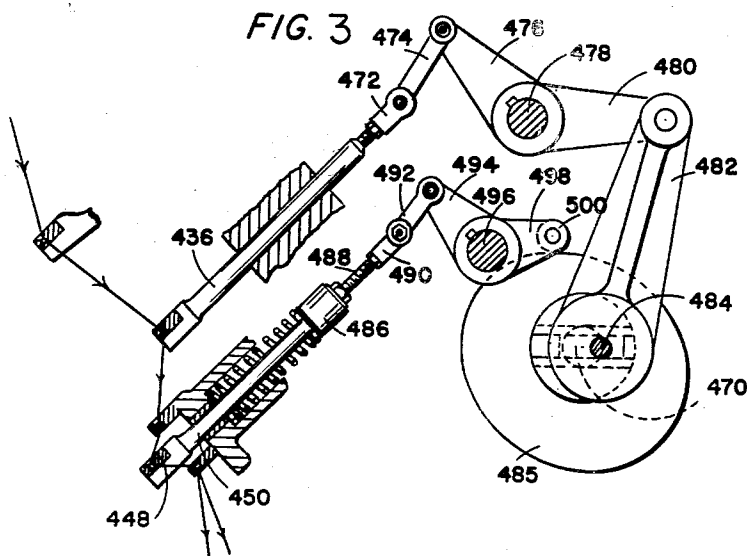
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MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

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7 Sheets-Sheet 3



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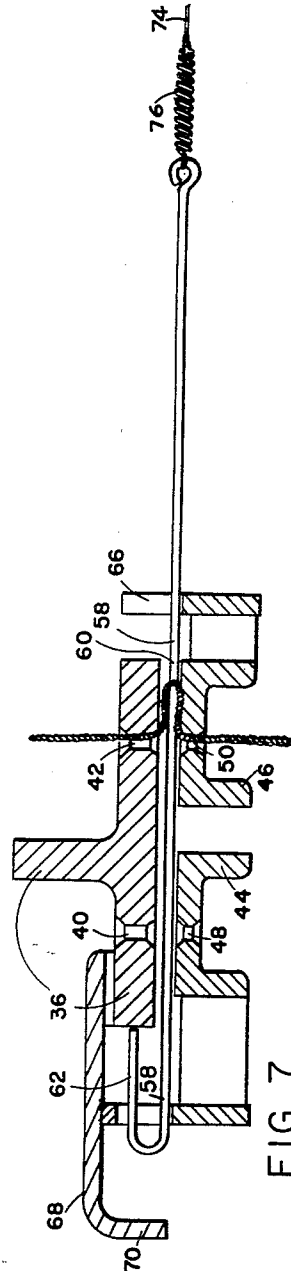
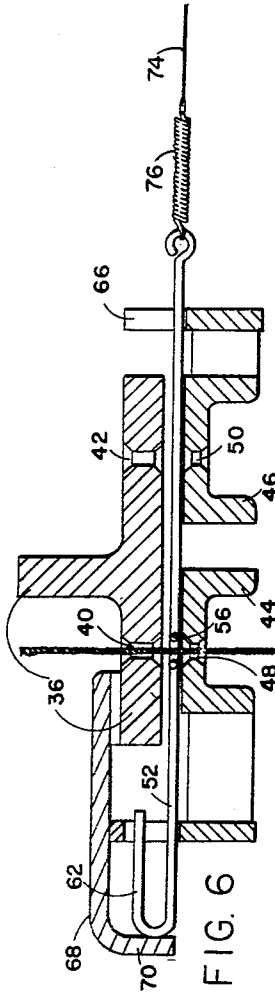
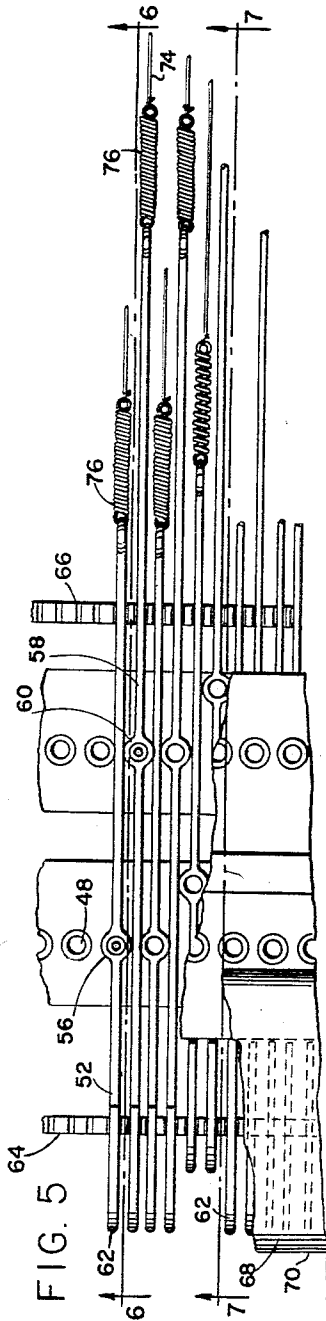
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MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

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7 Sheets-Sheet 4



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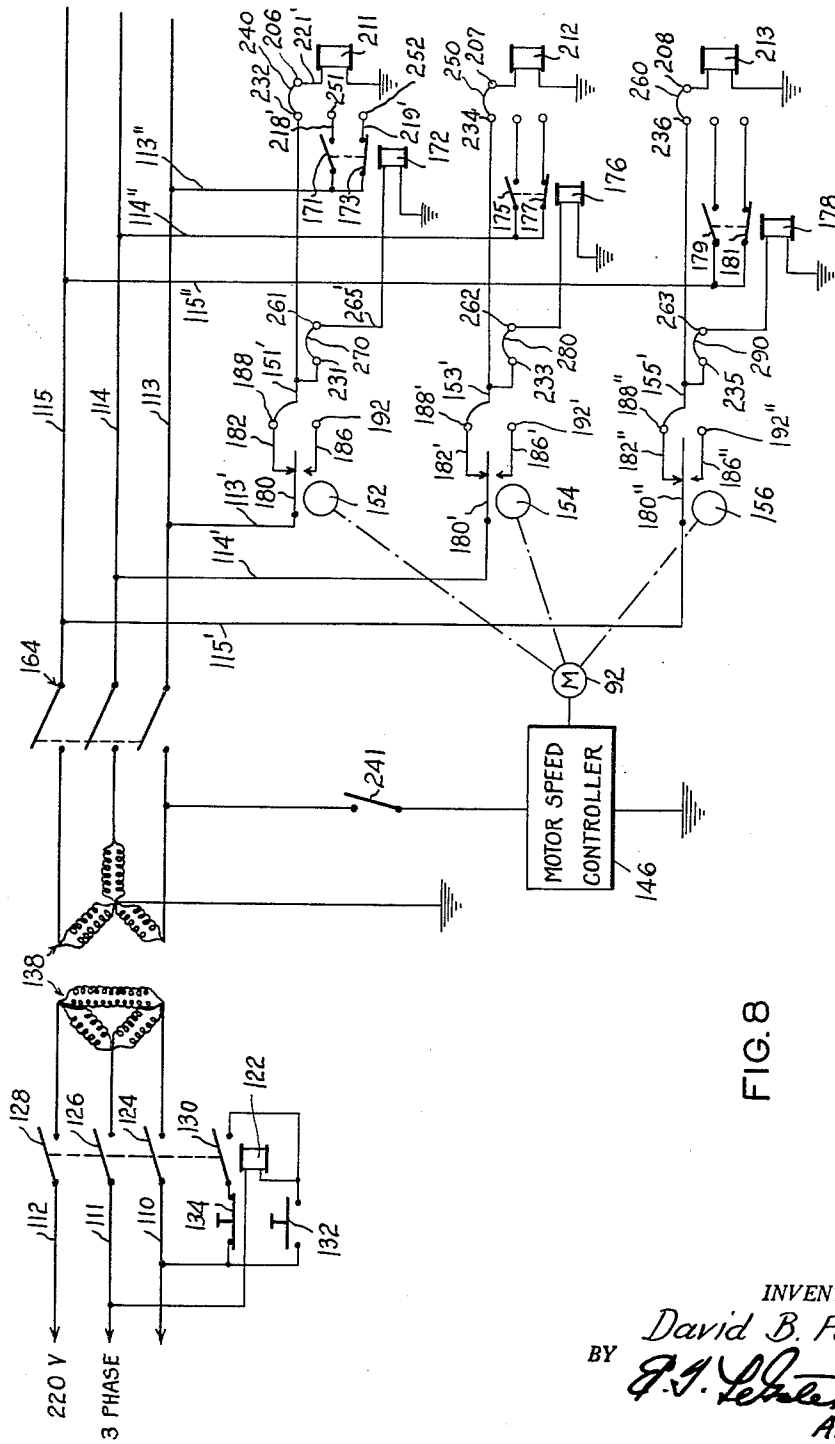
D. B. PARLIN

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MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

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7 Sheets-Sheet 5



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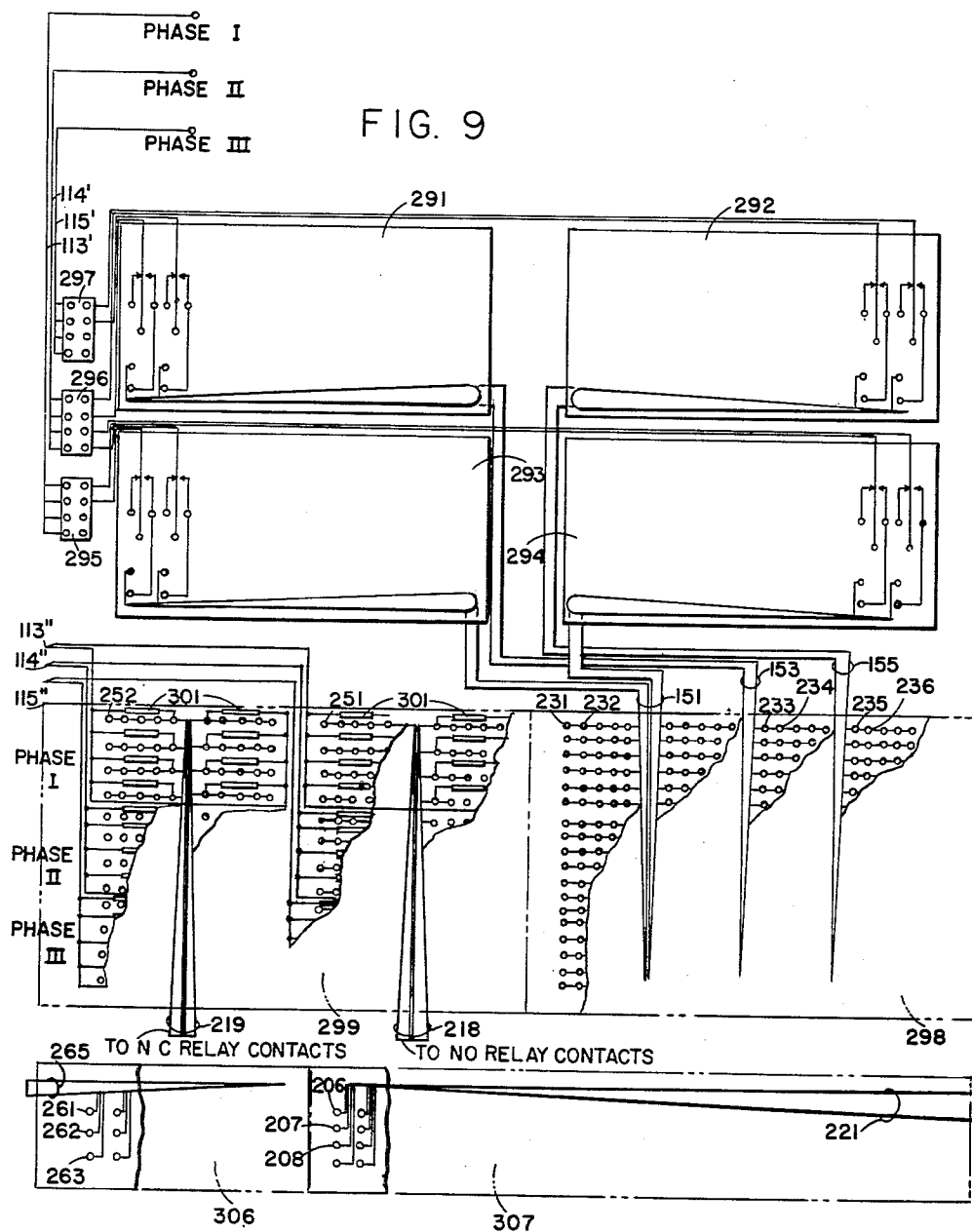
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MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

Filed Oct. 28, 1954

7 Sheets-Sheet 6



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2,940,405

MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

Filed Oct. 28, 1954

7 Sheets-Sheet 7

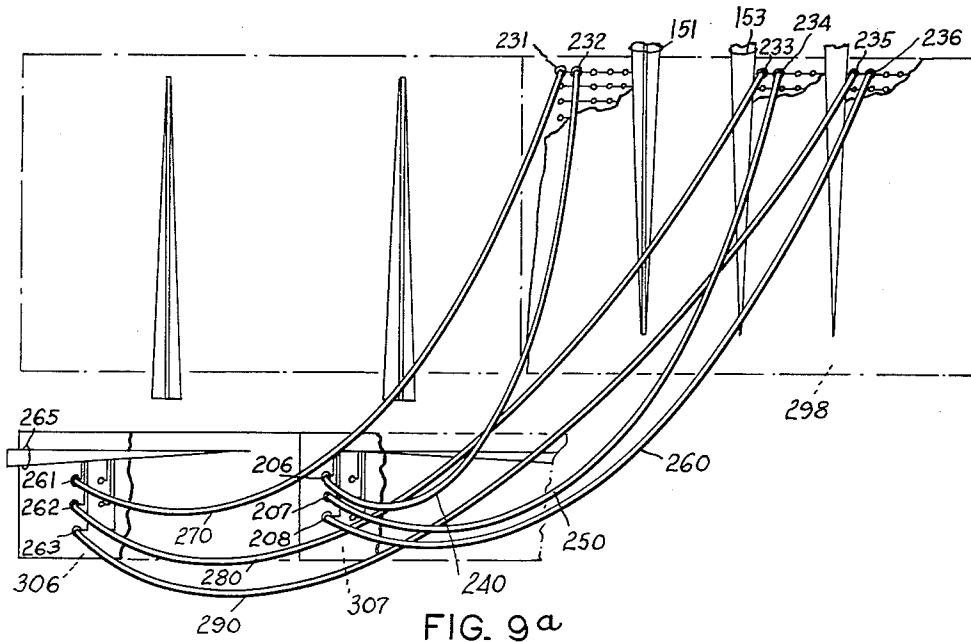


FIG. 9a

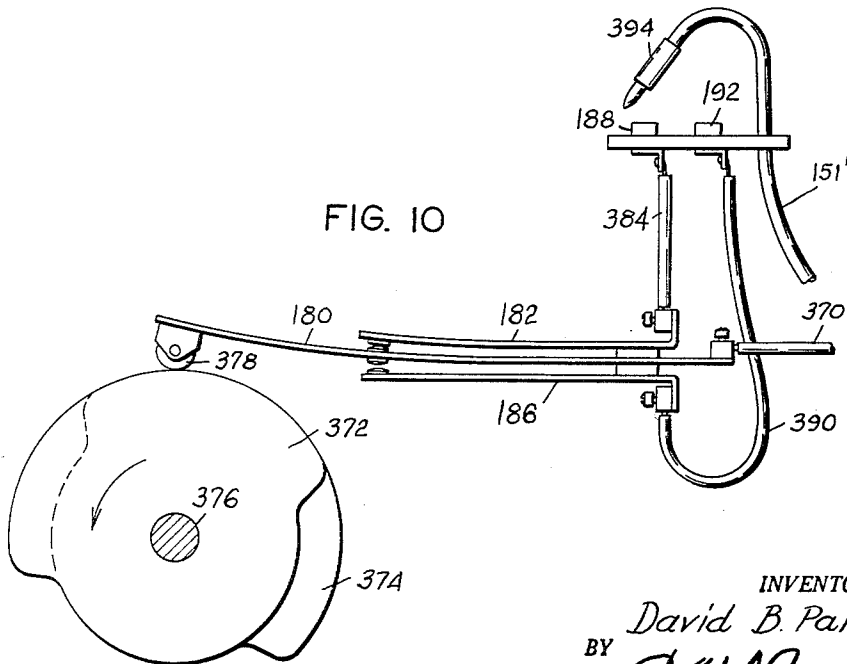


FIG. 10

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MACHINE FOR PRODUCING DRAWN LOOP PILE FABRIC

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Filed Oct. 28, 1954, Ser. No. 465,348

22 Claims. (Cl. 112—79)

The present invention relates to improvements in a machine for producing drawn loop pile fabric, and more particularly to improvements in a machine of this general description having a loop inserting mechanism including a substantial number of loop drawing needle and loop measuring looper units simultaneously operative to produce successive courses of drawn loops extending the width of the needle series and in which each needle and looper unit is adapted to draw loops of an individually fed yarn to form a separate line of stitching.

It is a principal object of the invention to provide a novel and improved means for effecting individual control of the loop lengths produced in each loop drawing and measuring cycle on each of the large number of simultaneously operating needle and looper units of the machine, including a pattern mechanism which is well adapted to control the lengths of the loops drawn in successive cycles of each of the several units for the production of an infinitely variegated pattern of loops of different lengths in a drawn pile surface fabric.

It is a further object of the invention to provide an improved means for effecting variations in the length of the loops drawn by the individual needle and looper unit assemblies associated together in a needle series of substantial length and fineness of gauge.

It is another object of the invention to provide in a machine of the general type described a yarn pull-off and tension control mechanism well adapted for drawing a supply of each feeding yarn from a creel and for supplying each of said yarns under exactly uniform conditions of controlled tension to form loops of predetermined height.

With these and other objects in view as may hereinafter appear, a feature of the invention consists in the organization of individually controlled loop length control devices for each of the feeding yarns of the general type in which a tension may be applied to the feeding yarn to cause the needle in its loop drawing stroke to rob yarn from the previously formed loop. The devices herein disclosed for controlling the length of each individual loop across the width of the fabric include solenoid actuated yarn tensioning means for the individual feeding yarns, pattern cams, and connections therefrom for actuating the individual solenoids in accordance with any desired pattern, a variable speed electric motor to drive the cams and an electrical circuit well adapted for supplying power to each of the solenoids and to the variable speed motor, referred to.

Another feature of the invention consists in the construction and arrangement of the yarn tensioning means whereby the individual alternating current actuated solenoids are permitted to function immediately when energized, while permitting a delayed action of the yarn tensioning means until a point is reached in the needle operating cycle when a slackening off of the tension on the feeding yarn just beyond top dead center of the needle permits the feeding yarn to be drawn laterally into its bent tensioned position.

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An important feature of the invention consists in the provision of an improved yarn pull-off means for supplying yarn to all the loop length control devices under exactly equalized conditions of tension so that loops of equal length will be drawn. The means referred to include a yarn pull-off device including a yarn pull-off bar which is movable to engage simultaneously with and to draw off exactly the amount of each yarn required from a creel. Cooperating with the pull-off bar, referred to, is a yarn braking device which includes a movable braking rod by means of which a braking bend is imposed upon a portion of each of the feeding yarns disposed between the pull-off bar and the loop length control devices of the machine.

Further in accordance with the invention a yarn tensioning device in the form of series of lease rods is provided which is located between the pull-off bar and braking device, above described, on the one hand, and the loop length control devices of the machine on the other hand, so that an exactly equalized tension is imposed at all times on all of the feeding yarns during the loop forming operation.

The several features of the invention consist also in the devices, combinations and arrangement of parts hereinafter described and claimed, which together with the advantages to be obtained thereby will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a view in front elevation of a portion of a machine for producing drawn loop pile fabric with a portion thereof broken away and with only so much of the machine shown as believed necessary to illustrate the connection of the invention therewith;

Fig. 2 is a view in left side elevation of the machine illustrated in Fig. 1 including particularly the mechanism for controlling loop length including the several banks of loop length control solenoids, and the yarn pull-off and associated yarn braking and yarn tensioning devices of the invention;

Fig. 3 is a detailed view partly in section of the cam operated mechanism for drawing off yarns from a creel, and of the yarn braking device associated therewith, the parts being shown with the brake applied and with the yarn pull-off bar half way to its retracted position;

Fig. 4 is a view similar to Fig. 3 but with the parts in the positions taken as the yarn braking device is rendered operative and the yarn pull-off bar is substantially extended;

Fig. 5 is a fragmentary plan view of the loop length control devices with portions broken away to show the movable eyeleted yarn guides;

Fig. 6 is a section in elevation taken on the line 6—6 of Fig. 5;

Fig. 7 is a section in elevation taken on the line 7—7 of Fig. 5;

Fig. 8 is a simplified schematic diagram of the electrical circuit associated with the pattern control system of this invention;

Fig. 9 is a view of the plug-in panels utilized with the circuit of Fig. 8 to provide a wide choice of patterns and to expedite setting up the pattern;

Fig. 9a is a view of certain ones of the panels of Fig. 9 showing jumper connections therebetween; and

Fig. 10 is a detailed view of one of the cam actuated switches used in the circuit of Fig. 8.

The machine for producing drawn loop pile fabric illustrated in the drawings as embodying in a preferred form the several features of the invention as shown in Fig. 2 comprises a base frame 20 having a table surface 22 across which backing material is fed, and an upper

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frame 24 secured to the base frame 20. The sewing mechanism of the machine comprises a series of needles 26 supported in a longitudinally extending needle supporting bar 28 for movement as a unit, and a cooperating series of loopers 30 which are similarly supported for movement as a unit in cooperation with the bank of needles 26. In operation the eye pointed needles are projected downwardly through the work to position loops of yarn in position for engagement with the cooperating loopers 30. Thereafter, the needles are retracted, the backing fabric is advanced, the loopers are moved to cast off the finished loops, and the machine is in position for the formation of the next succeeding stitch. Inasmuch as machines for producing drawn loop pile fabric having banks of needle and looper units operating in the general manner described to produce series of drawn loops of a length measured by the cooperating looper elements are well known in the art no particular illustration or description of this mechanism is believed necessary.

In accordance with the present invention, the illustrated machine is provided with an improved pattern mechanism for inhibiting the feed of the yarn to selected needles in following courses of stitching to cause the needles to rob yarn from the next previously formed loop and thereby to control the length of the individual drawn loops. In certain respects the illustrated mechanism is intended as an improvement upon the mechanism for controlling loop length particularly illustrated and described in applicant's co-pending application Serial No. 404,243, and now Patent No. 2,876,183, dated March 3, 1959, filed in the United States Patent Office January 15, 1954, as a division of applicant's copending application Serial No. 288,823 filed in the United States Patent Office on May 20, 1952, for Manufacture of Drawn Loop Pile Fabric, now abandoned.

The improved pattern mechanism herein described for controlling the length of the drawn loops comprises a yarn guide bar 36 supported by means of depending straps 38 from the upper frame 24 of the machine. As best shown in Figs. 5, 6, and 7, the yarn guide bar 36 is formed with two sets of yarn guiding apertures or eyes 40 and 42 which are staggered with relation to one another to provide a continuous series of yarn eyes equal in number to the number of needles on the machine. Two cooperating yarn guide bars 44 and 46 are fixedly supported beneath the yarn guide bar 36 and spaced therefrom. The bar 44 is provided with yarn guiding apertures or eyes 48 located directly beneath the apertures 40, and the guide bar 46 is formed with apertures 50 located directly beneath the apertures 42. Located between the upper and lower yarn guide bars are a series of movable yarn guides consisting of guides 52 provided with eyes 56 arranged to cooperate with the stationary yarn eyes 40 and 48, and, alternating therewith, movable yarn guides 58 having yarn eyes 60 arranged to cooperate with the stationary yarn eyes 42 and 50. As will be evident from an inspection of Figs. 5, 6, and 7, each of the yarn guides 52 and 58 is provided at its outer end with a hook portion 62 which is arranged for sliding movement between the dents of a comb 64 secured to the under yarn guide bar 44. Each yarn guide adjacent its rear end is similarly guided between the dents of a comb 66 secured to the lower yarn guide bar 46. A cover member 68 secured to the upper yarn guide bar 36 is arranged to overlie the hooked ends of the yarn guides and is provided along its outer edge with a downwardly extending lip 70 forming a stop which limits the movement of the yarn guides in one direction to a position in which their respective yarn eyes 56 and 60 are in alignment with the associated stationary yarn eyes. Movement of each yarn guide rearwardly or to the right is limited by engagement of the hooked end of the guide with the edge of the yarn guide bar 36. The arrangement of the stationary and movable yarn guides, above described, is such that when any of the individual guides 52 and 58 are moved to the right

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their respective yarn eyes 56 and 60 are moved out of alignment with their stationary yarn eyes, sharply bending the engaged yarn and thus introducing a tensioning strain which tends to inhibit the yarn feed, and thus causes the associated needle on its downward loop drawing movement to rob yarn from the previously formed loop.

The loop drawing stroke of the eye needles employed is the downward thrust or fabric penetrating stroke. The needles are preferably grooved along the yarn feed side. In accordance with the normal procedure, as the needle on its downward stroke pierces the foundation fabric there is a slight amount of pressure applied to the yarn by that fabric, so that just at that point it is easier to draw yarn from the previously formed loop than from the yarn supply. Consequently, there is at that point a slight reduction in the previous loop. But, after the needle eye penetrates the foundation fabric it draws freely on the yarn supply rather than on the previous loops, thus forming the normal long length loops.

It has been found that the balance of the tensioning strains which determine the extent to which yarn is drawn from supply and from the previously formed loops is a relatively delicate one and that even slight changes in this tension will result in variations of loop length.

In the formation of low loops where a bend, as above described, has been introduced into the feeding yarn, conditions are altered so that the tension on the feeding yarn is greater in that portion extending between the needle and yarn guides 52-58 than it is in that portion between the needle and the previously formed loop. Under this condition, as the needle penetrates the foundation fabric and forms another loop, a greater portion of the yarn required therefor is obtained by robbing the previous loop. It will be understood, however, that the bend introduced into the yarn acts only to increase the tension on the yarn, but does not act as a positive brake. The tension remains greater on the feeding yarn than on the portion leading to the preceding loop, however, during a portion only of the downward travel of the needle. There is a point during the downward movement of the needle where the tension in that portion of the yarn extending to the previous loop again exceeds the tension imposed upon the yarn extending from the side of the needle so that no further yarn is robbed from the previous loop, and whatever additional yarn may still be needed is drawn from the feed. With the mode of operation above described it will be understood that an accurate control of the tension applied against the feeding yarn is required, and that any change in that tension will immediately result in variations in the amount of yarn robbed from the previously formed loop.

The yarn guides 52 and 58 are controlled by means of electrically operated devices which are well adapted to provide for the individual pattern control of loop length produced by any needle and looper unit of a series which may be of any desired length and may contain any desired number of such needle and looper units. The yarn guides are connected by means of pull cords 74 and coiled tension springs 76 with the armatures 78 of alternating current solenoids 80, see Fig. 2, which are arranged in banks on supports 82 mounted on the upper frame 24 of the machine. The springs 76, referred to, perform two very important functions in the machine in that a tensioning strain of predetermined uniform value is exerted upon the movable yarn guides to insure production of drawn loops of uniform length. The second function of the springs 76 is to permit the instant shifting of any particular solenoid armature when the solenoid is energized even though the movement of the associated guide is delayed during movement of the needles through portions of the stitch forming cycle when a relatively heavy tension is exerted on the feeding yarn.

In accordance with the invention, an electrical pattern control circuit is provided which is well adapted for

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simultaneous control of the yarn feed to a very large number of needle and looper units for the construction of fabric of any desired complexity of pattern formed by high and low loops. As previously noted, control of the individual feeding yarns is effected by means of individual alternating current solenoids, generally designated at 80 in Fig. 2, one being provided for each feeding yarn and all of the solenoids being mounted in banks on a frame at the back of the machines. With reference to Fig. 8, where only three such solenoids having their windings specifically designated as 211, 212, and 213, have been illustrated for clarity in the drawing, it will be observed that the pattern control circuit is supplied with power by means of lines 110, 111, and 112. These power lines are connected to the source of power for the loom which is conventionally 220 volt, 3 phase or 550 volt, 3 phase. To reduce this voltage to a value of 110 volts, as is better adapted for energizing solenoid windings 211-213 as well as the other circuit elements, there is provided a bank of six transformers generally designated by numeral 138, having parallel delta connected primary windings, and parallel Y connected secondary windings. The primary windings of transformers 138 are coupled to lines 110, 111, and 112 through normally open contacts 124, 126, and 128, respectively, of a contactor having a coil 122 and a pair of holding contacts 130. Coil 122 is coupled across lines 110 and 111 through a normally open bush button type switch 132 on the one hand and also through the series combination of a normally closed push button switch 134 and holding contacts 130. The latter maintain coil 122 energized after switch 132 has been momentarily closed and until switch 134 is momentarily opened. The secondary windings of transformers 138 are connected to lines 113, 114 and 115 which in turn supply power to the remainder of the circuit at 110 volts line to neutral, the neutral or center of the Y being connected to a common point or ground. A motor 92 and motor speed controller 146 are coupled between line 113 and ground through a pair of normally open relay contacts 241. These contacts are adapted to close whenever the loom motor is started, and to this end the relay coil associated with contacts 241 is connected across one of the loom motor windings, not shown. In this way, motor 92 may be energized concurrently with the loom motor.

Motor 92 drives a plurality of cam actuated switches three of which have been shown and designated as 152, 154, and 156. Each of the switches 152, 154, and 156 has a movable contact arm and two stationary arms designated at 180, 182 and 186, respectively, 180', 182' and 186' respectively, and 180'', 182'' and 186'' respectively, so as to form in effect a single pole double throw switching circuit as will be described in detail along with Fig. 10. For the purpose of understanding the herein described Figure 8, however, it is sufficient to note that the respective movable arms 180, 180' and 180'' are connected with lines 113', 114', and 115' after the latter have passed through a manually operated switch 164. Stationary arms 182 and 186 are coupled to plug-in terminals or jacks 188 and 192, respectively, either of which may be selected for connection with a line 151'. That is to say, line 151' may be connected to either of terminals 188 or 192 of switch 152 the connection illustrated being from terminal 188 to line 151'. Likewise, terminals 188' and 188'' associated with switches 154 and 156 are connected to lines 153' and 155', respectively, although the latter may be connected to terminals 192' and 192'' respectively. Lines 151', 153', and 155' terminate at plug-in terminals 232, 234 and 236, respectively, which serve to furnish power to the solenoid windings 211, 212, and 213. To this end, the respective solenoid windings are connected from terminals 206, 207, 208 to ground, the latter terminals being readily adapted for connection with terminals 232, 234 and 236 by means of jumpers 240, 250 260 as shown.

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In order to simplify the process of setting up certain patterns and to make the pattern control circuit more flexible, as will become readily apparent from the description of Figs. 9 and 10, there are also provided a plurality of relays to be energized by the cam actuated switches including cam switches 152, 154, and 156. In particular, additional plug-in terminals 231, 233 and 235 coupled to lines 151', 153', and 155', respectively, and plug-in terminals 261, 262, and 263 coupled to the respective relay coils 172, 176, and 178 through connecting lines including line 265' serve as connecting points which may be readily interconnected as required by means of jumpers 270, 280 and 290. Associated with relay coils 172, 176, and 178 are pairs of normally open contacts 171, 175 and 179, respectively, and pairs of normally closed contacts 173, 177, and 181, respectively. One of the contacts 171 is coupled to power line 113 through a connecting line 113'', and the other contact 171 is coupled to a plug-in terminal 251 through line 218'. Similarly, one of the contacts 173 is coupled to power line 113 through connecting line 113'' and the other contact 173 is coupled to a plug-in terminal 252 through line 219'. As is apparent, the normally open and normally closed contacts 175, 177, 179, and 181 associated with relay coils 176 and 178 connect the remaining power lines 114 and 115 through lines 114'' and 115'' to additional plug-in terminals which have not been numbered for the sake of clarity in the drawing. These latter terminals as well as numbered terminals 251 and 252 provide a ready means for connection to any one of the solenoid terminals, such as terminal 206, for example.

Referring now to Fig. 9, there is shown in detail, the plug-in terminal panels of the pattern control circuit along with a schematic representation of the cam actuated switches. The switches including those designated at 152, 154, and 156 in Fig. 8 are contained in four boxes 291, 292, 293, and 294, and total seventy-two in number, so that the number of switches in each box is eighteen. In order that a substantially balanced load be presented to transformer 138 (Fig. 8) each of the phases carried by lines 113', 114', and 115' are brought into the individual boxes 291-294 through terminal blocks 295, 296, and 297 at the upper left of Fig. 9. The movable arms of a first group of six cam switches in each box are then coupled to a single one of the lines such as line 113', the movable arms of a second group of six are coupled to line 114', and the movable arms of the remaining six switches are connected to line 115'. The lines including 151', 153', and 155' (Fig. 8), which are coupled to one of the stationary arms of the cam switches, are arranged in three bundles 151, 153, and 155 for interconnection with a cam switch terminal panel 298. Upon panel 298 are mounted pairs of plug-in terminals corresponding to the respective stationary arms of the cam switches and including terminals 231 through 236 of Fig. 8. As shown, three additional terminals, horizontally aligned and interconnected with each terminal pair, such as terminals 231 and 232, make it possible to readily connect as many as five plug-in leads or jumpers to a stationary arm of a single cam switch.

Adjacent panel 298 is a relay contact plug-in panel 299 for mounting the terminals including terminals 251 and 252 coupled to one each of the normally open and normally closed relay contacts such as contacts 171 and 173 of Fig. 8. Since twenty-four relays having twenty-four normally open and normally closed sets of contacts are utilized, there are provided forty-eight plug-in terminals which are separately connected to the relay contacts. By way of illustration, lines 218' and 219' of Fig. 8 are two of the lines in cable groups 218 and 219, respectively, leading from the contacts to the terminals. As in the case of cam switch panel 298, additional plug-in terminals are provided which interconnect

with terminals 251, 252 and so forth, such that the total number of relay contact terminals utilized is two hundred and forty, the total consisting of forty-eight groups of five terminals which are common to one another as shown. Connected between the individual groups of five terminals and its corresponding phase lines 113", 114", and 115" are capacitors 301. Since lines 113", 114", and 115" respectively, connect both normally open and normally closed sets of relay contacts (see Fig. 8), capacitors 301 are effectively across the individual relay contacts. In this way, burning of the contacts through arcing is minimized. It has also been found desirable to utilize capacitors across the cam operated switch contacts for like reason although these latter capacitors have been omitted from the drawing for clarity.

Referring now to the lower portion of Fig. 9, and to Fig. 9a which illustrates this portion in detail, there are illustrated a relay coil plug in terminal panel 306 and a solenoid plug-in terminal panel 307. The former is provided with twenty-four terminals, including terminals 261, 262, and 263, individually connected to the relay coils including coils 172, 176, and 178 of Fig. 8. The lines leading from the terminals to the individual coils are arranged in a cable group or bundle 265 which includes line 265' (Fig. 8) for example. Solenoid panel 307 has a total of one hundred and twenty terminals mounted thereon including terminals 206, 207, and 208. These are individually connected to the solenoids which also number one hundred and twenty, so as to accommodate the same number of needle and looper units. The lines leading from the terminals to the solenoids such as line 221' (Fig. 8) are bundled as shown at 221.

Each cam switch, as best shown in detail in Fig. 10, consists of two identical cams 372 and 374 on a driven shaft 376. The two cams 372 and 374 have a 180° lobe and each may be rotated on the shaft to produce a lobe length from 180° to 360°. Conversely, the dip may be adjusted from 0° to 180°. As the cams rotate they actuate a follower 378 which in turn actuates a single pole, double throw switch. A line 370 coupled to one of the lines 113', 114' and 115' brings current to the common arm 180 of the switch. When the follower 378 is riding on the cam lobe, contact is made with the upper switch arm 182 which is connected by a wire 384 to female plug-in terminal 188. Likewise, when the follower 378 is riding in the dip in the cam, contact is made with the lower switch arm 186 which is connected by wire 390 to female plug-in terminal 192. Male plug-in 394 may be inserted into either terminal 188 or terminal 192 according to the requirement of the pattern thus connecting either aforementioned terminal 188 or 192 to the panel board 298 via wire 151'.

In setting up a particular pattern, the speed of motor 92 is adjusted by means of speed controller 146 so as to cause a full 360° rotation of cams 372, 374 for the length of the pattern repeat. The lengths of the portions of the pattern repeat wherein pull-down or low pile occur may then be related to angular movement of the cams in degrees. For each of the pull-down portions having lengths corresponding to less than 180°, one of the connectors 394 is plugged into one of the terminals 192 on a cam actuated switch and the cams associated with that switch are adjusted to cause movable arm 180 to be lowered into contact with stationary arm 186 during the required number of degrees. For each of the pull-down portions having lengths corresponding to 180° or more, one of the connectors 394 is plugged into one of the terminals 188 on a cam switch and the cams associated with that switch are adjusted to cause movable arm 180 to be raised into contact with stationary arm 182 during the required number of degrees. By connecting jumpers such as 240, 250, 260 between the cam switch plug-in terminals on panel 298 corresponding to the particular cam switches utilized and the solenoid plug-in terminals on panel 307 (Fig. 9a) as required by

the pattern, the solenoids such as solenoids 211, 212, and 213 will be energized, causing pull-down portions of desired length. It will also be necessary of course to properly relate the angular position of the cams to one another so that the pull-down portions are properly related spatially on the pattern.

If the pattern requires a relatively large number of pull-downs simultaneously such that the five terminals provided for each cam switch on panel 298 are insufficient, jumpers such as 270, 280, 290 may also be connected between one or more cam switch terminals on panel 298 and one or more of the relay coil terminals on panel 306 as shown in Fig. 9a. Hence, the relay contacts associated with the relay coils energized through the cam switches in this way will operate in synchronism therewith so as to provide corresponding groups of five energized terminals on panel 299. These in turn may be connected to solenoid terminals on the solenoid panel 307 by means of additional jumpers (not shown) as necessary.

In the development of a wide tufting machine having a substantial number of needle and looper units and in which a large number of individual yarns are required for supplying these units, considerable difficulty has been experienced in providing means for supplying the said yarns to the needles at a constant and even tension which will cause the individual needles in their loop drawing stroke to draw off exactly equal amounts of yarn from supply. It will be understood that yarns are supplied from individual spools which may be mounted on a conventional creel which extends a considerable distance rearwardly from the machine so that the distance through which the yarns are drawn from the individual spools will vary very substantially.

An important feature of the invention consists in the provision of a yarn pull-off and tension control mechanism which will operate equally to supply the necessary amount of yarn for the operation of each individual needle and looper unit and which will eliminate any drag on the yarns, uneven tension, and associated operational difficulties.

A further feature of the invention consists in the provision of a yarn pull-off means which automatically compensates for the varying amounts of yarn which is taken by different needles in accordance with the operation of the loop length control devices.

In accordance with the invention, individual yarns are drawn from a creel, not specifically illustrated, through individual apertures 420 formed in a guide bar 422 (Figs. 2, 3, and 4) which extends along the length of the machine and is supported at intervals on fixed arms 424 formed on brackets 426 secured by bolts 428 to an angle iron support 430 forming part of the fixed superstructure of the machine generally indicated as the upper frame 24. From apertures 420, individual yarns are threaded through apertures 432 formed in a yarn pull-off bar 434 which extends along the length of the machine and is supported by means of a plurality of pistons 436 which are slidably mounted in sleeve bearings 438 formed integrally with individual arms 424. The individual yarns passing through the apertures 432 in the pull-off bar 434 are threaded through apertures 440 formed in a fixed guide bar 442 carried on a lower forwardly projecting portion 444 of each individual arm 424. The stationary bars 420 and 442 form in combination with the shiftable pull-off bar 434 a yarn pull-off unit for the machine. The yarns are then threaded through apertures 446 formed in a shiftable yarn braking rod 448 carried on plungers 450 longitudinally shiftable in a cylindrical housing 451 which is formed integrally with the forward extension 444 of fixed arms 424. From the shiftable braking rod 448 the yarns passing through the apertures 446 are then guided through apertures 452 formed in a second stationary bar 454 rigidly secured to the fixed extension 444. The two stationary bars 442

1. In a multiple needle tufting machine, a loop inserting mechanism including a plurality of needles reciprocable as a unit in loop inserting and retracting strokes, cooperating looper mechanism arranged in parallel relation, and an intermittently applied needle yarn pull-off and tension control mechanism, said loop inserting mechanism being adapted to insert loops in parallel lines of stitching through a backing material, a loop length con-

4. In a tufting machine having a loop inserting mechanism including a plurality of needles, cooperating looper mechanism arranged in parallel relation, cooperating to insert loops in parallel lines of stitching through a backing material to form a pile surface, separate loop length control devices comprising yarn tensioning elements adapted to act on a portion of each individual yarn feeding to the needles from a yarn supply and shiftable between an inoperative position and an operative position to produce an increased tension drag on said feeding yarn and thereby to rob the previously formed loop.

means controlling the shift of said tensioning elements in accordance with a pattern in successive loop inserting cycles, and a yarn pull-off and tension control mechanism adapted to act upon a portion of the yarn disposed between said loop length control devices and supply including a yarn pull-off device operative to engage with and simultaneously draw off lengths of each yarn feeding from supply, and a yarn braking device disposed between said pull-off device and said loop length control devices for equalizing the tension upon the yarns acted upon by said tensioning elements.

5. In a tufting machine having a loop inserting mechanism including a plurality of needles and cooperating looper mechanisms arranged in parallel relation for inserting loops of measured length successively through a backing material to form a pile surface, separate loop length control devices comprising yarn tensioning means adapted to act on a portion of each individual yarn feeding to the needles from a supply, said means being shiftable between an inoperative position and an operative position to produce an increased tension drag on said feeding yarn and thereby to rob the previously formed loop, means controlling the shift of said tensioning means in accordance with a pattern in successive loop forming cycles, and a yarn pull-off and tension control mechanism adapted to act upon a portion of the yarn disposed between said loop length control devices and supply including a yarn pull-off bar movable to engage with and simultaneously draw off lengths of each yarn feeding from supply, a yarn braking device shiftable to brake each of said yarns between the pull-off bar and the loop length control device during the operation of said pull-off bar, and a set of lease rods engaging said yarns between the yarn braking devices and said loop length control devices for equalizing the tension upon the yarn passing through said loop length control devices.

6. In a tufting machine having a loop inserting mechanism including a plurality of needles and cooperating looper mechanism arranged in parallel relation for inserting loops of measured length in a plurality of yarns successively through a backing material to form a pile surface, a separate loop length control device for each yarn comprising a yarn tensioning means adapted to act on a portion of each individual yarn feeding from a supply to the needles, said tensioning means being shiftable between an inoperative position and an operative position to produce an increased tension drag on said feeding yarn and thereby to rob the previously formed loop, means controlling the shift of said tensioning means in accordance with a pattern in successive loop inserting cycles, and a yarn pull-off and tension control mechanism adapted to act upon a portion of the yarn disposed between said loop length control devices and supply including a yarn pull-off bar supported for movement to engage with and simultaneously draw off lengths of each yarn feeding from supply, a yarn braking device comprising a movable braking rod shiftable to bend and thereby to brake each of said yarns between the pull-off bar and the needles during the operation of said pull-off bar, and a set of lease rods adapted to engage said yarns between the braking device and said loop length control devices.

7. In a multiple needle tufting machine, a plurality of needle and looper units arranged in spaced relation to one another for inserting loops in parallel lines of stitching through a backing material, a yarn pull-off device comprising a pull-off bar adapted to engage each of the yarns feeding to the several needles, and means for imparting to said bar draw off and return movements, and a yarn tensioning device comprising a plurality of lease rods disposed between the yarn pull-off device and the needle and looper units and around which the yarns are passed.

8. In a multiple needle tufting machine, a plurality

of needle and looper units arranged in parallel relation for inserting loops in parallel lines of stitching through a backing material, a yarn pull-off device comprising a yarn pull-off bar adapted to engage each of the yarns feeding to the several needles, supporting means on which said bar has imparted thereto draw-off and return movements, a yarn braking device comprising a yarn braking rod adapted to engage portions of said yarns between said bars and needles, supporting means on which said rod is movable to introduce a braking bend in said yarns, and devices actuated by the machine for actuating said rod and said bar in sequence to exert a braking stress on all of said yarns and simultaneously to draw off additional yarns from the supply, and means for selectively tensioning the yarns between said rod and the needles.

9. In a multiple needle tufting machine, a plurality of needle and looper units arranged in parallel relation for inserting loops in parallel lines of stitching through a backing material, a yarn pull-off device having yarn engaging portions movable through the same distance for drawing off amounts of slack yarn from supply to each of said needle and looper units, a yarn braking device cooperating with said yarn pull-off device to brake portions of said yarn extending between the pull-off device and the needle and looper units, and a yarn tensioning device disposed between the yarn braking device and the needle and looper units to maintain a tensioning strain on the several yarns.

10. In a multiple needle tufting machine, a plurality of needle and looper units arranged in parallel relation for inserting loops from each of several yarns feeding from a supply in parallel lines of stitching through a backing material, a yarn pull-off device having yarn engaging portions movable through the same distance for drawing off amounts of slack yarn from said supply to each of said needle and looper units, a yarn braking device cooperating with said yarn pull-off device to brake portions of said yarns extending between the yarn pull-off device and the needle and looper units, and a plurality of lease rods around which the individual yarns pass disposed between said yarn braking device and the needle and looper units for tensioning each of the several feeding yarns.

11. In a multiple needle tufting machine, a plurality of needle and looper units arranged for inserting loops from each of several yarns feeding from a supply in a plurality of lines of stitching through a backing material, a yarn pull-off device comprising a yarn pull-off bar adapted to engage each of the yarns feeding to the several needles, supporting means on which said bar has imparted thereto draw-off and return movements, a yarn braking device comprising a yarn braking rod adapted to engage portions of said yarns between said bar and needles, supporting means on which said rod is movable to introduce a braking bend in said yarns, and devices actuated by the machine for actuating said rod and said bar in sequence to exert a braking stress on all of said yarns and thereupon to draw off additional yarn from the supply, and a set of lease rods around which the yarns are passed disposed between the braking device and the needle and looper units to maintain a uniform tensioning strain on the several yarns.

12. In a multiple needle tufting machine, the combination with a plurality of needle and looper units arranged for inserting loops from each of several yarns feeding from a supply in a plurality of lines of stitching through a backing material of a yarn pull-off device comprising relatively stationary guides and a yarn pull-off bar movable with relation thereto to draw a bight of feeding yarn to each of the several needles, supporting and actuating means for imparting draw-off and return movements to said bar, a yarn braking device located between said pull-off device and the needles comprising relatively stationary guides and a braking rod movable with relation thereto to engage and to impart a braking

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bend to each of said yarns, means for actuating said braking rod in timed relation with said pull-off bar to exert a braking stress on all of said yarns and thereupon to draw off additional yarn from the supply, and a set of lease rods disposed between the braking device and the needles for further guiding and tensioning said yarns.

13. In a multiple needle tufting machine the combination with a plurality of needle and looper units arranged for inserting loops from each of several yarns feeding from a supply in a plurality of lines of stitching through a backing material of a loop length control device for each yarn for controlling the length of the drawn loops, each device including a yarn guide comprising a wire element having a yarn eye therein, adapted to engage a portion of an individual yarn leading to the needles, a support comprising a comb in which said guides are slidable between inoperative and yarn tension producing bend positions, yarn guide actuating devices having alternative operative and inoperative positions to shift and to permit the return of said yarn guides from said yarn tension producing bend positions, yieldable connections between said wire elements and said yarn guide actuating devices for shifting said wire elements to the yarn tension producing position, and pattern means for rendering said guide shifting devices selectively operative and inoperative.

14. In a tufting machine having elements of a loop inserting mechanism including a needle having a loop inserting and retracting stroke, a looper mechanism, and a needle yarn pull-off and tension control mechanism, said elements cooperating to insert drawn loops of measured lengths from needle yarns successively through a backing material to form a pile surface, the combination therewith of a loop length control device for controlling the length of each next preceding drawn loop including a yarn guide disposed between the needle and said pull-off and tension control mechanism, movable to produce a tension producing bend in a portion of said yarn between the said pull-off and tension control mechanism and needle and thereby to cause the needle during its loop inserting stroke to draw yarn from the previously formed loop, yieldably acting means for shifting said movable guide adapted when rendered operative to stress said guide at a pressure sufficient to produce said bend only when the tension on the yarn is released, and means acting when rendered operative to cause said yieldably acting means to stress said movable yarn guide to produce said tension producing bend when the tension is relieved during the loop inserting stroke of the needle.

15. A loop length control device for use in a tufting machine according to claim 14 in which the loop length control device comprises an alternating current actuated solenoid having a movable element, a yieldable connection between said movable guide and the movable element of the solenoid, said yieldable connection being of sufficient strength to produce said bend upon movement of the movable element of the solenoid only during portions of the needle stroke when the tension on the yarn is relieved, and means for energizing and deenergizing the solenoid.

16. In a tufting machine having elements of a loop inserting mechanism including a needle having a loop inserting and retracting stroke, a looper mechanism, and a needle yarn pull-off and tension control mechanism, said elements cooperating to insert drawn loops of measured lengths from needle yarns successively through a backing material to form a pile surface, the combination therewith of a loop length control device for controlling the length of each next preceding drawn loop, said device including a yarn guide disposed between the needle and said last-mentioned mechanism movable to produce a tension producing bend in a portion of said yarn between said last-mentioned mechanism and needle and thereby to cause the needle during its loop inserting stroke to draw yarn from the previously formed loop, yieldably

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acting means for shifting said movable guide adapted when rendered operative to stress said guide at a pressure sufficient to produce said bend only when the tension on the yarn is released, and means acting when rendered operative prior to the start of the loop inserting stroke of the needle to stress said yieldable connection.

17. In a tufting machine having elements of a loop inserting mechanism including a needle having a loop inserting and retracting stroke, a looper mechanism, and a needle yarn pull-off and tension control mechanism, said elements cooperating to insert drawn loops of measured lengths from needle yarns successively through a backing material to form a pile surface, the combination therewith of a loop length control device for controlling the length of each next preceding loop, said device including a yarn guide disposed between the needle and said last-mentioned mechanism movable to produce a tension producing bend in a portion of said yarn between the said last-mentioned mechanism and needle and thereby to cause the needle during its loop inserting stroke to draw yarn from the previously formed loop, actuating means for shifting said movable guide to bend and thereby to tension the feeding yarn comprising a solenoid having a shiftable element, a yieldable linkage connection between said movable guide and the movable element of the solenoid, and means for actuating the solenoid and yieldable connection therewith to bias the movable guide to yarn tensioning position.

18. In a multiple needle tufting machine, loop inserting mechanism including a plurality of needles reciprocal as a unit in loop inserting and retracting strokes, cooperating looper mechanisms arranged in parallel relation, and a needle yarn pull-off and tension control mechanism, said loop inserting mechanism being adapted to insert drawn loops of measured lengths of needle yarns successively through a backing material to form a pile surface, and loop length control devices for controlling the length of each next preceding drawn loop including a yarn guide disposed between each individual needle and said pull-off and tension control mechanism movable between an inoperative and a yarn bending position to produce a tension producing bend in a portion of said yarn between said pull-off and tension control mechanism and needle and thereby to cause the needle during its loop inserting stroke to draw yarn from the previously formed loop, a plurality of solenoids each having a shiftable element, yieldable linkage connections between said shiftable elements of the solenoids and said yarn guides adapted when rendered operative to stress said guides at a pressure sufficient to produce said bend only when the tension on the respective yarns is released thereby permitting a delayed response of the yarn guide to movement of the shiftable element, and control means for rendering selected solenoids operative and inoperative for controlling loop length in accordance with a pattern.

19. A loop length control device for use in a multiple needle tufting machine according to claim 18 in which the control means for rendering selected solenoids operative and inoperative comprises a group of cams, cam operated switches connected with individual solenoids to operate said solenoids selectively, and power means for driving said cams.

20. A loop length control device for use in a multiple needle tufting machine having a loop inserting mechanism in accordance with claim 18 in which each loop length control device comprises an individual cord and a yieldable linkage connection between the shiftable element of each solenoid and an associated yarn guide, and pattern means operative during successive reciprocations of the needles for actuating said solenoids selectively in accordance with a pattern.

21. In a multiple needle tufting machine, a plurality of needle and looper units arranged in spaced relation to one another for inserting loops of yarns in parallel lines of

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stitching through a backing material, a yarn supply, a yarn pull-off bar extending laterally of the yarn path between said supply and the needles, means for reciprocating said bar transversely of its length and transversely of the yarn path in a yarn pull-off movement for deviating the yarns from their normal paths, a yarn-braking device including a yarn braking rod extending laterally of the yarns between said pull-off bar and the needles, means for reciprocating said braking rod transversely of its length and transversely of the yarn path in timed relationship with the said pull-off movement of said pull-off bar for braking portions of the said yarns extending between the pull-off bar and the needles during said pull-off movement, whereby said deviation of the yarns causes yarn to be drawn from the supply, and means for selectively tensioning the yarns between said braking device and needles.

22. In a multiple needle tufting machine, a plurality of needle and looper units arranged in spaced relation to one another for inserting loops in parallel lines of stitching through a backing material, a yarn pull-off device having yarn engaging portions each movable through the same distance for drawing off amounts of slack yarn from supply to each of said needle and looper units, and a yarn

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braking device cooperating with said pull-off device during the draw-off movement of the pull-off device to brake portions of said yarns extending between the pull-off device and the needle and looper units during said draw-off movement, and means for selectively tensioning the yarns between said braking device and needles.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,940,405

June 14, 1960

David B. Parlin

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 2 and 12, and in the heading to the printed specification, lines 4 and 5, name of assignee, for "Bigelow-Sanford Carpet Company, Inc." read -- Bigelow-Sanford, Inc. --.

Signed and sealed this 15th day of November 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

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Commissioner of Patents