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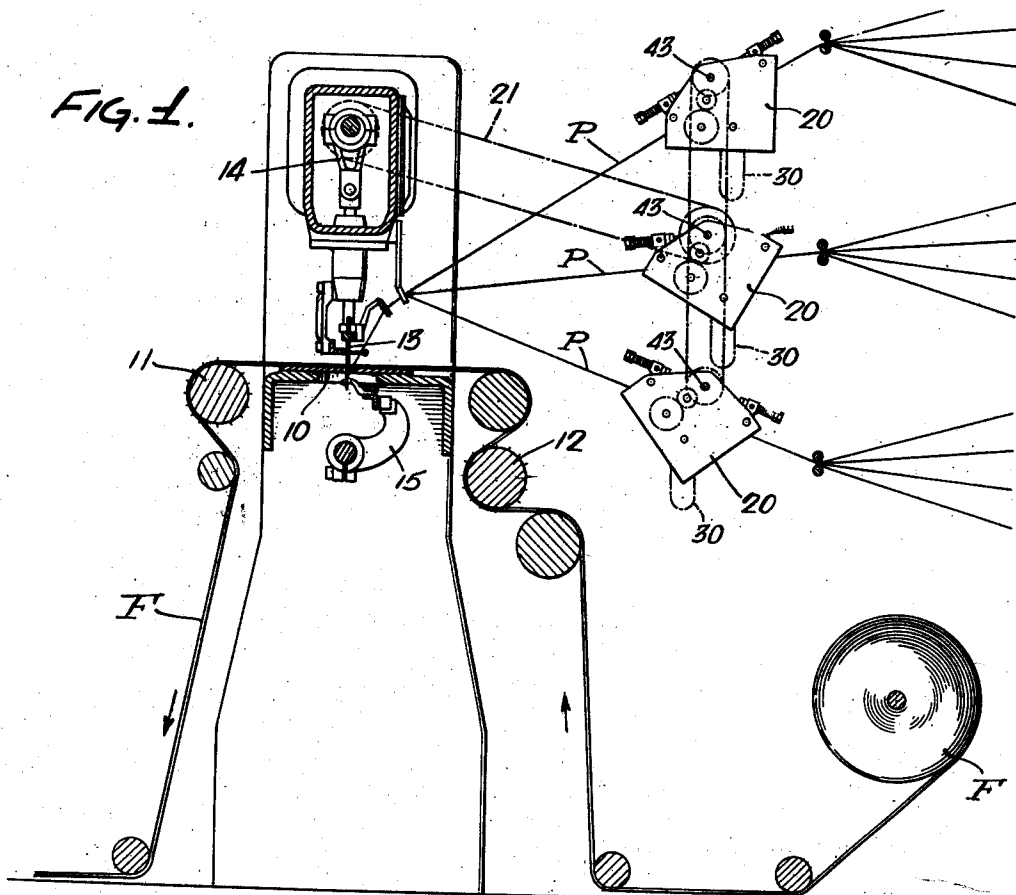
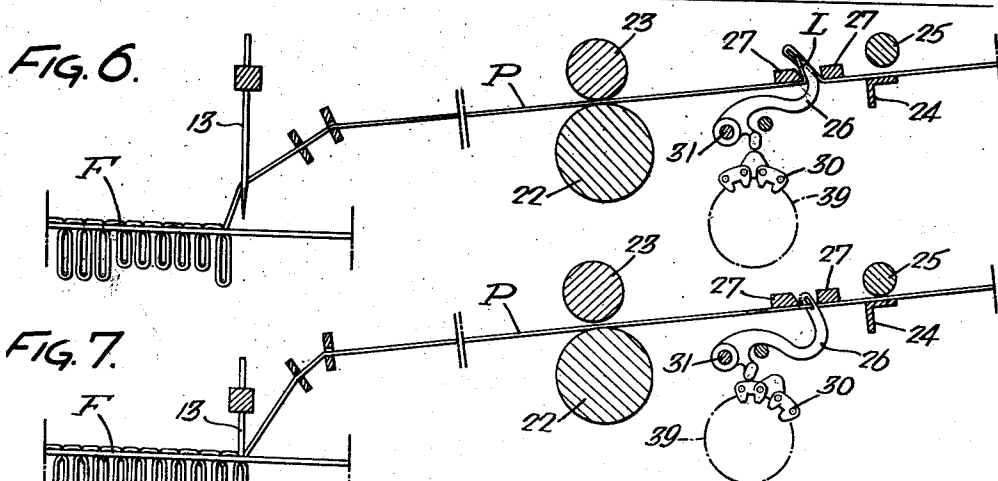
H. O. KAFFINE ETAL

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INDIVIDUAL PILE YARN CONTROL APPARATUS

Filed Jan. 18, 1954

4 Sheets-Sheet 1



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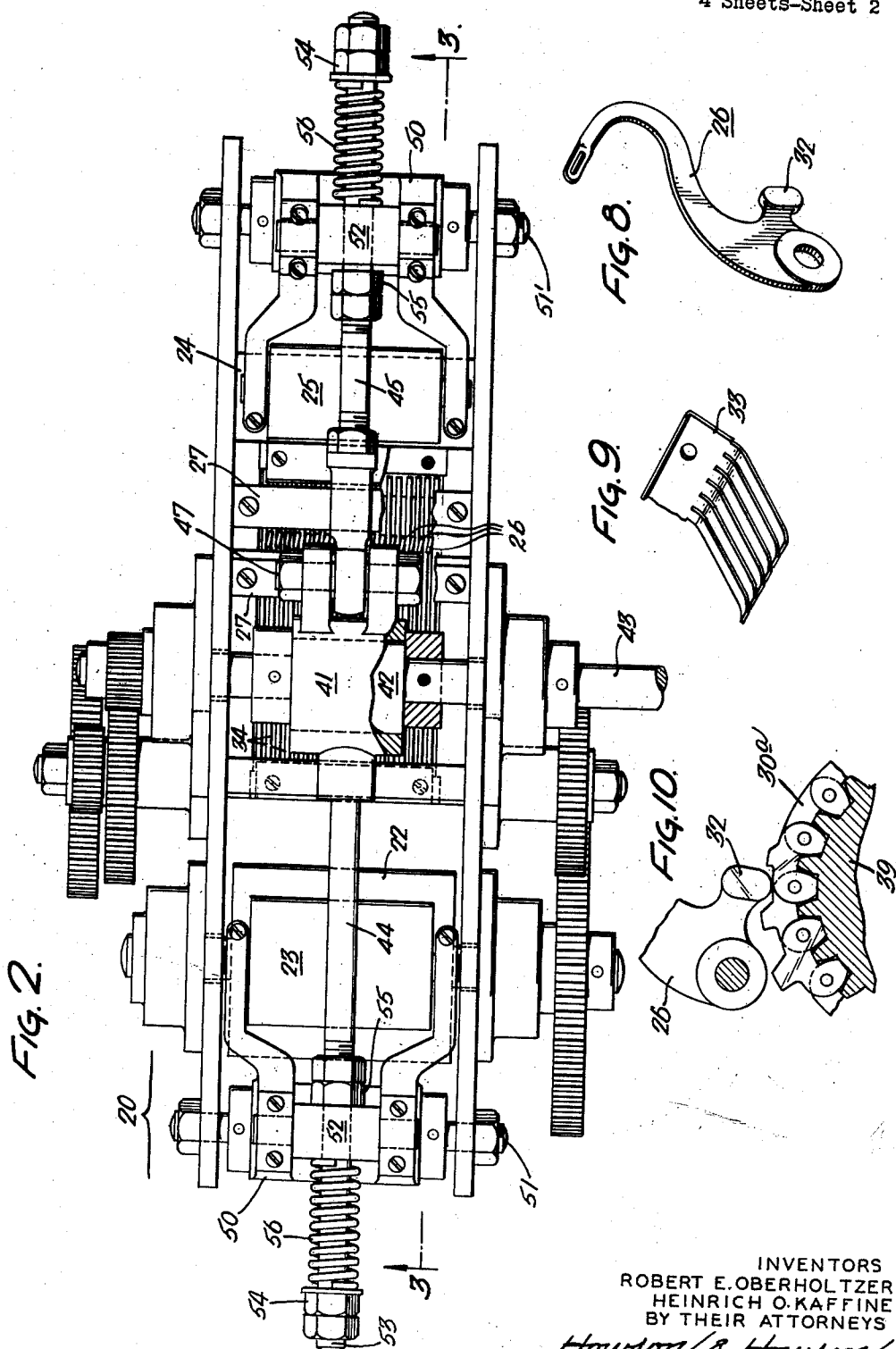
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4 Sheets-Sheet 2



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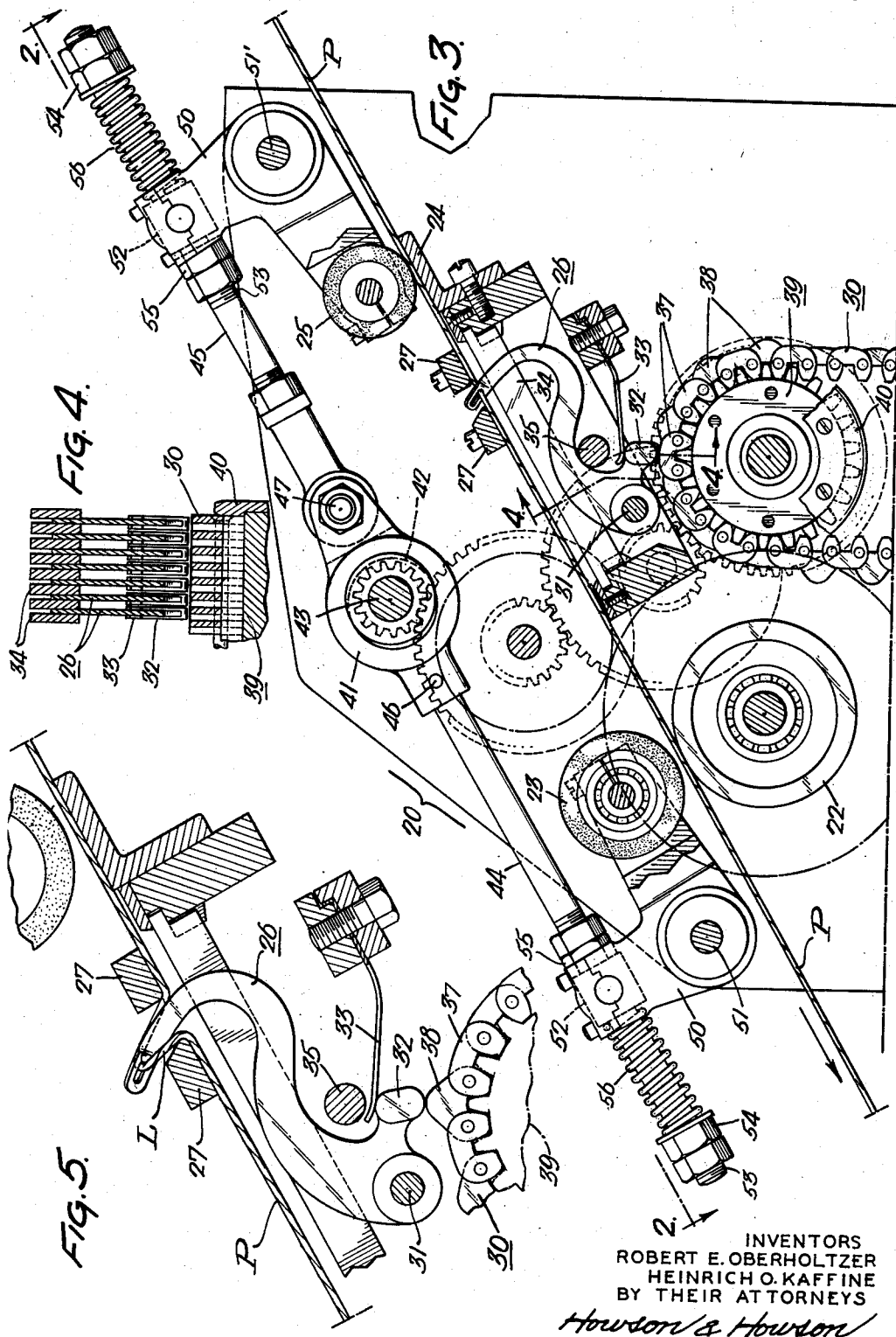
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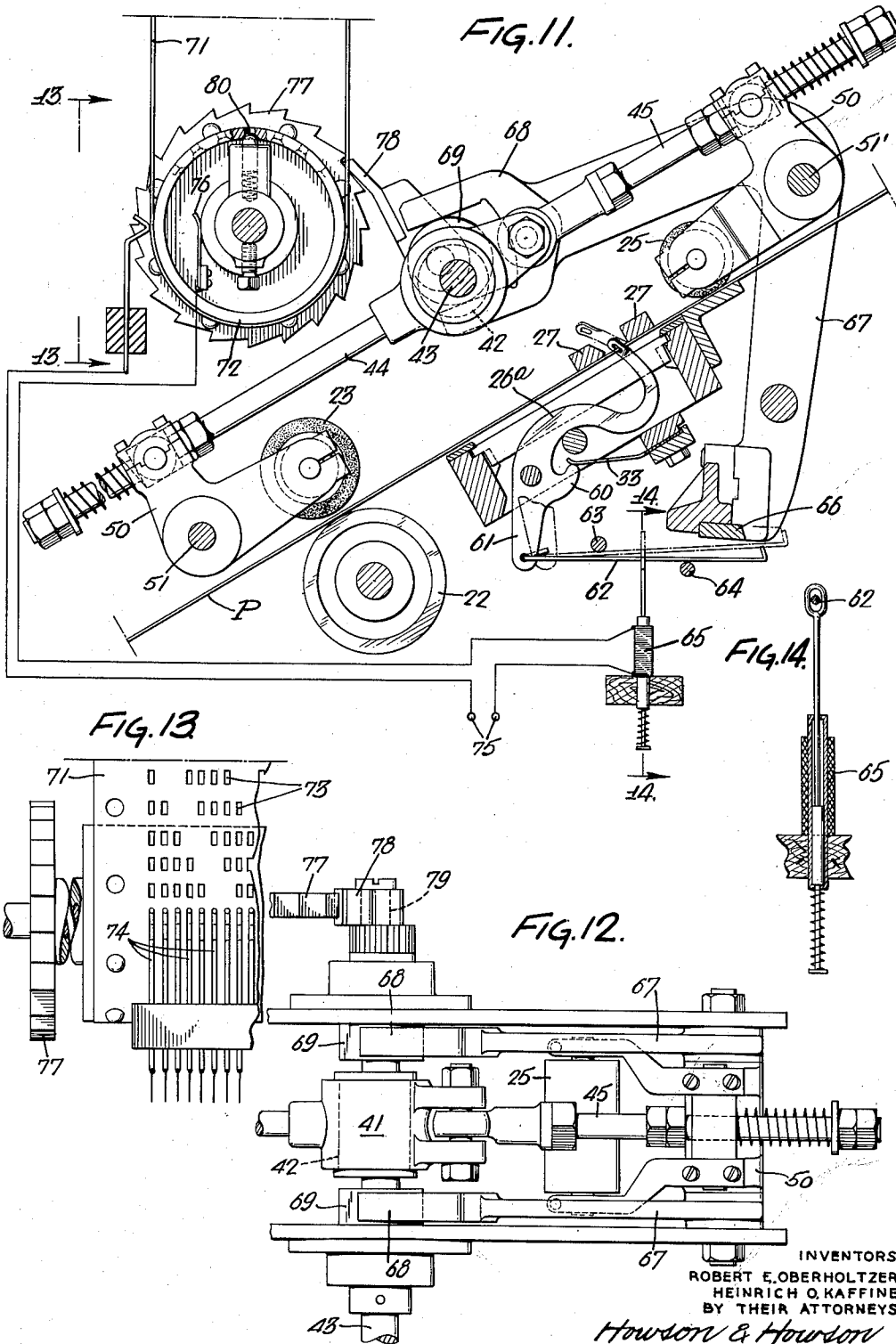
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4 Sheets-Sheet 4



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3,080,837

INDIVIDUAL PILE YARN CONTROL APPARATUS
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7 Claims. (Cl. 112—79)

The present invention relates to apparatus for producing variable height in pile fabrics, and more particularly to control mechanism for varying the rate at which the individual pile yarns are supplied to the pile-forming means of tufting machines and similar apparatus.

In the manufacture of conventional tufted fabrics, the pile surface is formed with a uniform pile height by means of a bank of tufting needles which are adapted to insert and form a row of pile loops into base fabrics. A letoff roll extends the full width of the tufting machine to feed pile yarn to the tufting needles which penetrate the base fabric to a uniform depth when inserting the loops therein. Embossed patterns have been produced on this type of machine by feed mechanisms controlling selected groups of pile yarns, but the prior mechanisms are capable of producing only a limited number of geometric designs. It has not been possible to produce designs of the floral type which are beyond the capability of any known yarn feed control device.

With the foregoing in mind, a primary object of the present invention is to provide a mechanism for producing tufted fabrics which is capable of producing an embossed or relief design in any preselected pattern.

More specifically, the invention contemplates a feed control mechanism for the pile yarn which controls the individual yarns in accordance with a preselected pattern.

Another object of the invention is to provide a yarn feed control device having operational and structural features and characteristics set forth which is comparatively economical and efficient in operation and use.

These and other objects of the invention and the various features and details of the construction and operation thereof are more fully set forth hereinafter with reference to the accompanying drawings in which:

FIG. 1 is a diagrammatic view of control devices made in accordance with the present invention applied to a tufting machine;

FIG. 2 is a plan view of one of the control mechanisms illustrated in FIG. 1 and in a plane indicated by the line 2—2 in FIG. 3 with portions broken away to show its structural features;

FIG. 3 is a vertical sectional view taken on the line 3—3 of FIG. 2 showing an operation wherein the chain is advanced two links during each cycle of the mechanism;

FIG. 4 is an enlarged fragmentary sectional view taken on the line 4—4 of FIG. 3;

FIG. 5 is an enlarged fragmentary sectional view showing a succeeding operation of the mechanism disclosed in FIG. 3;

FIGS. 6 and 7 are schematic views showing the operation of the control mechanism as applied to a tufting machine;

FIGS. 8 and 9 are perspective views of elements of the control mechanism;

FIG. 10 shows a pattern chain wherein the chain is advanced one link during each cycle of the mechanism;

FIG. 11 is a fragmentary view similar to FIG. 3 showing a modified form of the invention;

FIG. 12 is a fragmentary plan view of the embodiment illustrated in FIG. 11;

FIG. 13 is a fragmentary sectional view taken on the line 13—13 of FIG. 11; and,

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FIG. 14 is an enlarged sectional view taken on the line 14—14 of FIG. 11.

The invention may be applied to the formation of any pile fabric wherein the pile yarn is fed to the base fabric substantially independently of the mechanism for forming the latter, but for the purposes of illustration, it is shown and described as applied to a conventional type tufting machine.

Referring now to the drawings, FIG. 1 illustrates an embodiment of the invention applied to a conventional tufting machine. In the tufting machine the ground fabric F is fed across the bed 10 of the machine by pin rollers 11 and 12. The pile surface is formed of loops which are inserted into the ground fabric by a bank of needles 13 mounted for vertical oscillation relative to the bed 10. The needles are oscillated by mechanism indicated generally at 14 and the base fabric is driven intermittently so that the needles insert a full row of loops at successive intervals along the length of the fabric. The needles 13 move in unison and penetrate the fabric F to a given distance below the bed 10 of the tufting machine, so that upon each oscillation of the needles, a row of loops of uniform height is formed in the base fabric. The looper mechanism for retaining the pile loops in the fabric upon withdrawal of the needles is indicated generally at 15.

In accordance with the present invention, the pile yarns P are fed to the needles from a plurality of pile height control assemblies indicated at 20. The present invention affords a variation in the height of the pile loops by varying the length of yarn which is fed to the needles by the control mechanism 20. When the length of yarn is at a maximum, the needle forms a loop of maximum height as determined by the depth of penetration of the needles below the bed 10 of the machine. When the length is diminished, insufficient yarn will be fed to the needle to permit the formation of a loop of maximum height. However, since the needles penetrate to the same depth, the yarn necessary to form a loop of maximum height will be robbed or drawn back from the immediately preceding loop in the same warpwise row, forming a loop of lesser height in the latter row. By varying the length of yarn fed to the needles by the control mechanism 20, it is possible to vary the height of the loops in the row formed immediately preceding the row being formed by the needles.

In the present embodiment of the invention, the drive for the control mechanism is taken from the tufting machine through a belt and pulley arrangement, indicated generally at 21. The control mechanism is operable to withdraw a predeterminable length of yarn from the yarn source, and supply that length to the needles of the tufting machine. In the present instance, the control mechanism withdraws yarn from the source during the upstroke of the needles and affords feeding of the yarn to the machine during the downstroke. Thus, each cycle of the control device corresponds to one cycle of the tufting machine.

In accordance with the invention, the control mechanism 20 comprises a continuously driven feed roll 22 and a cooperating presser roll 23 which is operable to engage against the feed roll during one portion of the cycle of the control mechanism. The feed roll is positioned at the forward end of the control mechanism and a clamping device which operates during another portion of the cycle, is positioned at the trailing end of the mechanism between the feed roll 22 and the yarn supply. The periods of engagement of the presser roll and the clamping device are each independently adjustable, as set forth more fully hereinafter. In the present instance, the clamping device comprises a fixed plate 24 and a cooperating clamping roller 25. Mechanism is provided as described more fully hereinafter to engage the clamping

roller 25 against the clamping plate 24 during the portion of the cycle when the presser roller 23 is disengaged from the feed roll 22. A ratchet mechanism (not shown) may be provided to rotate the clamping roller 25 so as to present a new contact area to the plate 24 upon each cycle of the control mechanism.

Mechanism is provided between the feed roll and the clamping device to control the length of yarn drawn from the supply and fed to the tufting machine during each cycle of the control mechanism. The length is controlled by an operator 26 which is movable between the positions illustrated in FIGS. 3 and 5 respectively. The operator 26 cooperates with a pair of spaced guide members 27 to control the length of yarn. When the operator 26 is in the limit position shown in FIG. 5, it forms a loop L in the pile yarn between the feed roll 22 and the clamping device 24. The operator is in the other limit position for a portion of each cycle, in the present instance, when the clamping roller 25 is engaged against the clamping plate 24. During the alternate portion of the cycle, the operator is in the elevated position of FIG. 5, in the lower position of FIG. 3, or in an intermediate position in accordance with the length of yarn desired to be withdrawn from the supply and fed to the tufting machine.

During the portion of the cycle, when the presser roller 23 is engaged against the feed roll 22, the desired length of yarn is withdrawn from the supply. The feed roll passes the same length of yarn during its operative portion of the cycle, but the length withdrawn from the supply is varied in accordance with the length of yarn contained in the loop L. Thus, when the operator is in the lower limit position during the feed of the feed roll 22, a minimum amount of yarn is withdrawn from the supply, and when the operator is in the upper limit position shown in FIG. 5, a maximum amount of yarn is withdrawn from the supply. During the next portion of the cycle, the presser roller 23 is disengaged from the feed roll 22, the clamping roller 25 is engaged against the clamping plate 24, and the operator 26 is positioned in its lower limit position, so that the full length of yarn withdrawn from the supply is free to be inserted into the fabric by the needles 13 of the tufting machine.

In the embodiments of FIGS. 1 to 9 inclusive, the position of the operator is controlled by a pattern chain 30. To this end, the operator is pivotally mounted on the frame of the control mechanism as indicated at 31. As shown in FIG. 8, the operator is formed with a foot portion 32 which engages and rises upon the links of the chain 30. A spring member 33 is provided to bias the foot 32 into engagement with the links. As seen in FIGS. 2 and 4, there is an operator 26 for each pile yarn. Since each operator is adapted to be controlled independently of the remaining operators, the spring member 33 is formed as indicated in FIG. 9 to provide individual bias for each of the foot portions 32.

To maintain proper spacing of the individual operators 26, a grid 34 is positioned on the framework of the mechanism in underlying relation to the pile yarns P. The grid 34 maintains the operators in properly spaced relation and prevents inadvertent interference therebetween. A stop bar 35 underlies the series of operators 26 upon which the operators rest when in their lower limit position, illustrated in FIG. 3.

The position of the operator and the size of the loop L formed thereby, is determined by the height of the chain links of the chain 30. In the present instance, the chain is advanced one link during each half cycle of the control mechanism, so that alternate links 37 control the position of the operator 26 when the clamping roller 25 is engaged against the clamping plate 24. The intermediate links 38 control the position of the operator 26 when the presser roller 23 is engaged against the feed roll 22. In accordance with the above-described operation, the alternate links 37 are all low, whereas the inter-

mediate links 38 vary between high and low positions. The links are supported in upright position on a chain sprocket 39. As shown in FIG. 4, the sprocket is provided with end plates 40 which receive the chain and support it against lateral displacement. The links for controlling the various operations are ganged together as shown in FIG. 4 and are advanced by the teeth of the sprocket 39.

If desired, the mechanism may be modified to provide a single link control during each full cycle of the control mechanism. A chain 30a for accomplishing this end is illustrated in FIG. 10 wherein the center portion of each link controls the operator during the feed portion of the cycle and the end portions control the operator during the clamping portion of the cycle. In this manner, the rotary speed of the chain may be reduced, and the number of links of chain employed to produce a given pattern effect is correspondingly halved.

As pointed out above, during each cycle of the control mechanism, the roller 23, is engaged against the feed roll 22 for one part of the cycle and the roller 25 is engaged against the clamping plate 24 for another part of the cycle. The mechanism for accomplishing this is clearly illustrated in FIG. 3 wherein a strap 41 is rotatably mounted on an eccentric 42 of a continuously driven shaft 43. The strap 41 has oppositely extending arms 44 and 45 mounted thereon, so that as the shaft 43 rotates, the arms 44 and 45 are oscillated back and forth. As shown, the arm 44 is rigidly secured to the strap 41 as indicated at 46, and the arm 45 is pivoted to the strap as indicated at 47.

Adjacent the free end of each arm, a bell-crank lever 50 is pivotally mounted on the framework as indicated at 51 and 51'. One leg of each lever 50 pivotally mounts a bearing block 52 which is resiliently carried by the free end of the outwardly projecting arm. To this end, the arm is threaded as indicated at 53 and is provided with a stop nut 54. A spring 56 is compressed between the nut 54 and the bearing block 52 to bias the latter inwardly on the arm. At the inner end of the threaded portion 53, a nut 55 is adapted to engage against the bearing block 52 during the outward movement of the arm. As the shaft 43 rotates, the arms reciprocate substantially longitudinally toward and away from the shaft 43. During the movement toward the shaft, the spring 56 bears against the bearing block 52 to rock the lever 50 inwardly. During the movement away from the shaft 43, the nut 55 engages the bearing block 52 and effects outward rocking of the lever 50. Adjusting the nuts 54 and 55 controls the rocking movements of the levers 50, 50 on their pivots, as will be described more fully below.

As seen in FIG. 2, the opposite legs of the levers are bifurcated and journal between them the rollers 23 and 25 respectively. Thus, the rocking movement of the levers alternately engages the rollers 23 and 25 respectively against the feed roll 22 and the clamping plate 24. As pointed out above, the timing of the mechanism is such that when the presser roller 23 is engaged against the feed roll 22, the foot portion 32 of the operator is engaged and actuated by one of the control links 38, and when the clamping roller 25 is engaged against the plate 24, the foot portion 32 is in registry with an alternate link 37.

The above-described sequence of operations may be reversed so as to engage the presser roller 23 against the feed roll 22 when the alternate links 37 are in registry with the foot 32. In this event, the feed rolls withdraw a given amount of yarn from the supply during one part of the cycle of the mechanism. In the other part of the cycle, the operator 26 is actuated and withdraws yarn away from the tufting machine in order to form the loop L when the clamping roller 25 is engaged against the plate 24. When employing this sequence of operation, the feed roll normally advances enough pile yarn to the tuft-

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ing machine to form the maximum height loop, and when the operator is actuated upwardly, this maximum length of yarn will be shortened to the extent of the length of the loop L. Thus, when the operator is up, short loops will be formed, and when the operator is down, long loops will be formed in the pile fabric.

The present invention affords a wide range of control of the pile height of the carpet. The height of all the loops may be controlled not only by adjusting the rotary speed of the feed rolls, but also by adjusting the length of time the yarn is engaged by the feed roll. This latter control is effected by adjusting the nut 55 on the arm 44 to control the portion of the cycle when the presser roll is engaged against the feed roll. Likewise, by adjusting the nut 55 on the arm 45, control of the clamping portion of the cycle is obtained.

With slight modification of the present device, the pile height may be controlled electrically. A suitable modification is illustrated in FIGS. 11 to 14 inclusive. In this modification of the invention, the control of the pressing roll 23 and the clamping roller 25 is identical to that described above in connection with FIGS. 1 to 9. The operator 26a, however, is modified as illustrated in FIG. 11. The operator is provided with a projecting finger 60 which bears against the spring member 33 to provide the downward bias on the operator. A depending leg portion 61 of the operator 26a is connected to a horizontal elongated hook member 62 which is vertically displaceable against upper and lower limit bars 63 and 64 respectively.

The position of the hook 62 is controlled by a solenoid 65 as clearly illustrated in FIGS. 11 and 14. When the solenoid is de-energized, the hook 62 rests against the lower limit bar 64. When the solenoid is energized, the hook is elevated to abut the upper limit bar 63. When the hook is in the upper limit position, the free end thereof is adapted to engage behind a hook bar 66 which is carried between the lower extremities of oppositely disposed fork levers 67, 67'. The levers are pivotally mounted on the pivot 51', and are each formed with a fork 68 which embraces an eccentric 69 mounted on the shaft 43. Thus, as the shaft makes a complete revolution, the hook bar 66 will oscillate between the forward and back positions indicated respectively in full and broken lines in FIG. 11. When it is desired to form a loop in the pile yarn P between the members 27, 27', the hook 62 is raised by the solenoid 65 and during the rearward movement of the hook bar 66, the latter engages the hook and causes the operator 26a to pivot to the position shown in broken lines in FIG. 11.

The selective energization of the solenoids 65 is controlled by a pattern tape 71. The tape 71 is carried by a metallic drum 72 and is provided with a plurality of holes 73 which control the energization of the solenoids 65. To this end, a contact finger 74 is provided for each solenoid 65. The finger 74 is connected to one side of an electric voltage source 75 and is operable to contact the metallic drum 72 when in registry with a hole 73 in the tape 71. The drum is electrically connected by a brush 76 through the solenoid 65 to the other side of the source 75, all of which connections are shown schematically in FIG. 11.

To bring the proper holes 73 into registry with the fingers 74, the drum is rotated stepwise upon each cycle of the mechanism. To this end, the drum is provided with a ratchet wheel 77 which cooperates with a pawl 78 carried by an eccentric 79 on the shaft 43. Thus, as the shaft rotates, the pawl 78 will be displaced downwardly and upwardly to advance the ratchet 77. A detent 80 is provided to insure proper positioning of the drum. Although we have disclosed a tape and a solid drum for controlling the solenoid 65, it is within the scope of the invention to provide a pinned wheel to actuate micro switches or other contact members to control the solenoid.

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Other actuating mechanisms than the pattern chain 30 or the tape 71 may be employed to control the pattern of the pile fabric. For example, a modified jacquard mechanism controlled by the conventional cards may be employed to raise the pile yarn to form loops intermediate the guide members 27. This may be done by attaching the lingoes of the conventional jacquard mechanisms to the operators, or the lingoes may directly control the pile yarn intermediate the guide members 27. Other methods may also be used to provide the desired control of the individual pile ends to produce a preselected pattern in the fabric.

While particular embodiments of the invention have been herein illustrated and described, it is not intended to limit the invention to such disclosure, and changes and modifications may be made therein and thereto within the scope of the following claims.

We claim:

1. In a machine for manufacturing a pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly for the pile yarn comprising a pattern control device, feed roll means adapted to supply yarn to said needles and cyclically withdraw the pile yarn from a supply at a given rate, a fixed member positioned intermediate said feed roll means and said supply, roller means cyclically cooperable with said fixed member to clamp and immobilize the pile yarn, spaced guide members for said pile yarn positioned between said feed roll means and said fixed member, and operator means positioned intermediate said guide members and selectively actuated by said pattern control device to displace the yarn between said guide members and thereby withdraw at least some of the yarn supplied to said machine.

2. In a machine for manufacturing a pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly for the pile yarn comprising a pattern control chain having link portions of different heights, advancing means for said chain, feed means adapted to supply yarn to said needles and cyclically operable to withdraw the pile yarn from a supply at a given rate, clamping means positioned intermediate said feed means and said supply to cyclically engage and locally immobilize the pile yarn, spaced guide members for said pile yarn positioned between said feed means and said clamping means, and operator means positioned intermediate said guide members and selectively actuated by the links of said pattern control chain to displace the yarn between said guide members and thereby withdraw at least some of the yarn supplied to said machine.

3. In a machine for manufacturing a pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly for the pile yarn comprising an electrical pattern control device, feed roll means adapted to supply yarn to said needles and cyclically operable to withdraw the pile yarn from a supply at a given rate, a fixed member positioned intermediate said feed roll means and said supply, roller means cyclically cooperable with said fixed member to clamp and immobilize the pile yarn, spaced guide members for said pile yarn positioned between said feed roll means and said fixed member, looping means positioned intermediate said guide members to displace the yarn between said guide members and thereby control the length of yarn supplied to said machine, and a solenoid responsive to the electrical pattern control device to actuate said looping means.

4. In a machine for manufacturing a pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly for the pile yarn comprising feed means adapted to supply yarn to said needles, clamping means positioned intermediate said supply and said feed means to cyclically engage and locally immobilize the pile yarn, looping means to en-

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gage said pile yarn intermediate said feed means and said immobilizing means to form a loop in the yarn of preselected height, and actuating mechanism for said pile yarn looping means to control the height of said loop and thereby control in accordance with a predetermined pattern the length of yarn supplied to the machine.

5. In a machine for manufacturing a tufted pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly comprising feed means adapted to supply yarn to said needles at a given rate for a first portion of a cycle of said assembly, clamping means positioned intermediate said supply and said feed means to engage and locally immobilize the pile yarn during another portion of said cycle, looping means to engage said pile yarn intermediate said feed means and said clamping means to form a loop in the yarn of preselected height, actuating mechanism for said pile yarn looping means to control the height of said loop and thereby control in accordance with a predetermined pattern the length of yarn supplied to the machine, and an interlocking connection between the feed means and the clamping means.

6. In a machine for manufacturing a tufted pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly comprising feed means adapted to supply yarn to said needles at a given rate for a first portion of a cycle of said assembly, clamping means positioned intermediate said supply and said feed means to engage and locally immobilize the pile yarn during another portion of said cycle, looping means to engage said pile yarn intermediate said feed means and said clamping means to form a loop in the yarn of preselected height, actuating mechanism for said

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pile yarn looping means to control the height of said loop and thereby control in accordance with a predetermined pattern the length of yarn supplied to the machine, and an adjustable interlocking connection between the feed means and the clamping means.

7. In a machine for manufacturing a tufted pile fabric having a plurality of needles adapted to insert pile yarn through said fabric, a pile height control assembly comprising feed means adapted to supply yarn to said needles at a given rate for a first portion of a cycle of said assembly, clamping means positioned intermediate said supply and said feed means to engage and locally immobilize the pile yarn during another portion of said cycle, looping means to engage said pile yarn intermediate said feed means and said clamping means to form a loop in the yarn of preselected height, actuating mechanism for said pile yarn looping means to control the height of said loop and thereby control in accordance with a predetermined pattern the length of yarn supplied to the machine, and an adjustable interlocking connection between the feed means and the clamping means whereby either means is selectively and mutually exclusively actuated to engage the pile yarn.

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