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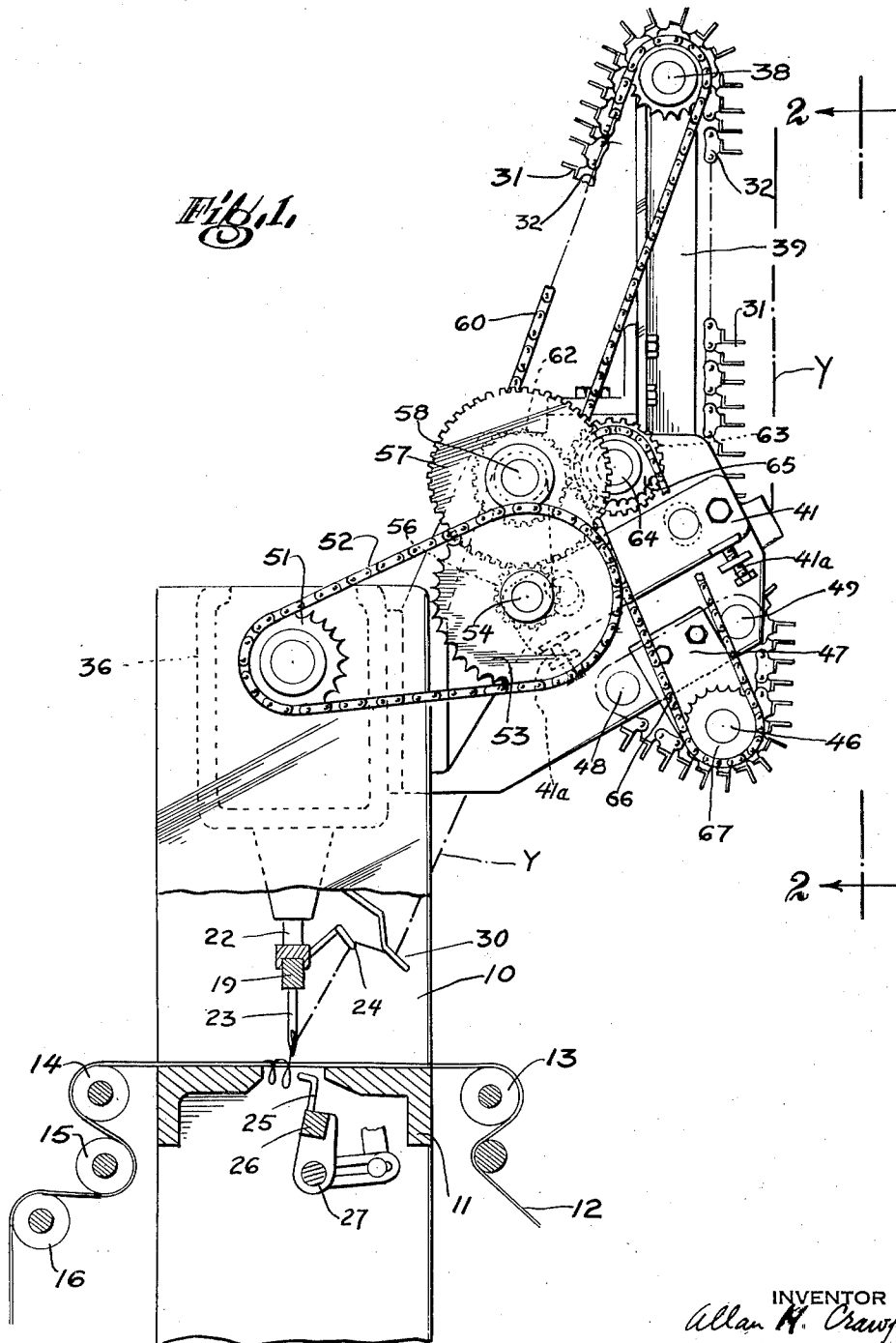
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METHOD AND APPARATUS FOR FEEDING YARNS

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4 Sheets-Sheet 1



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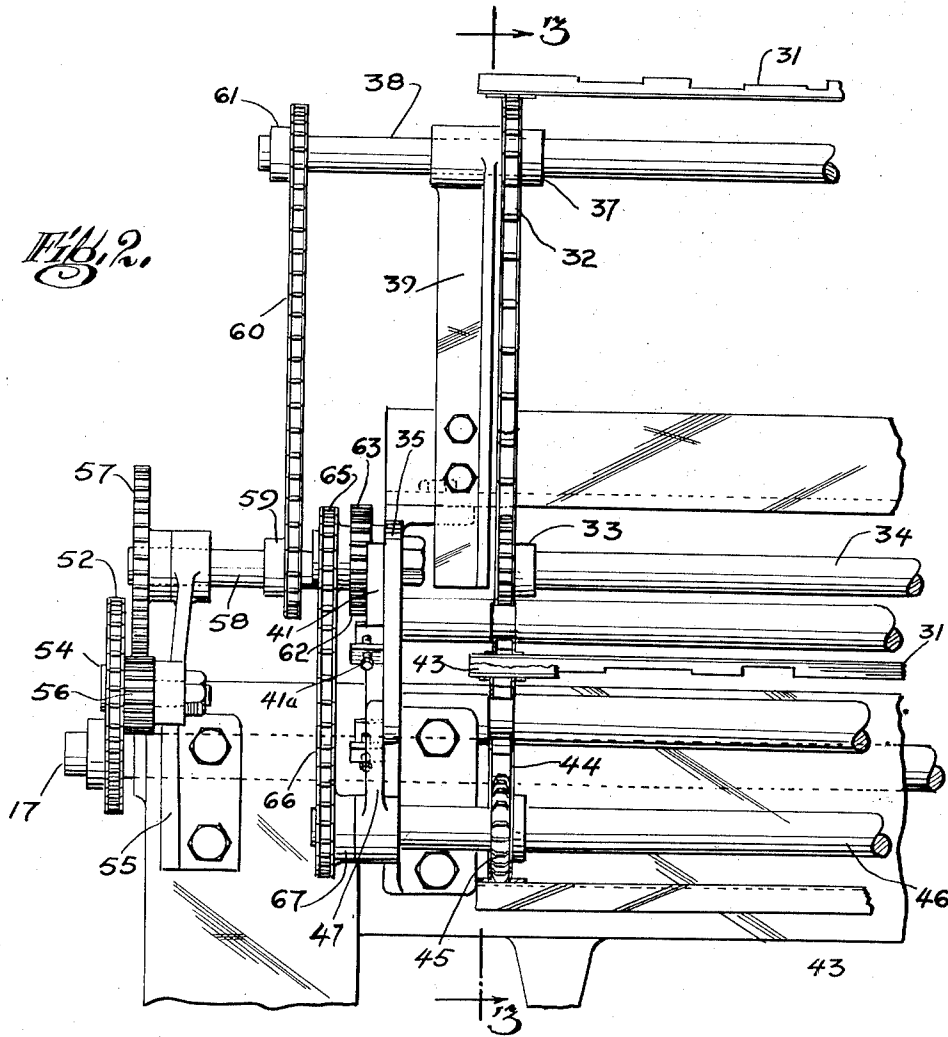
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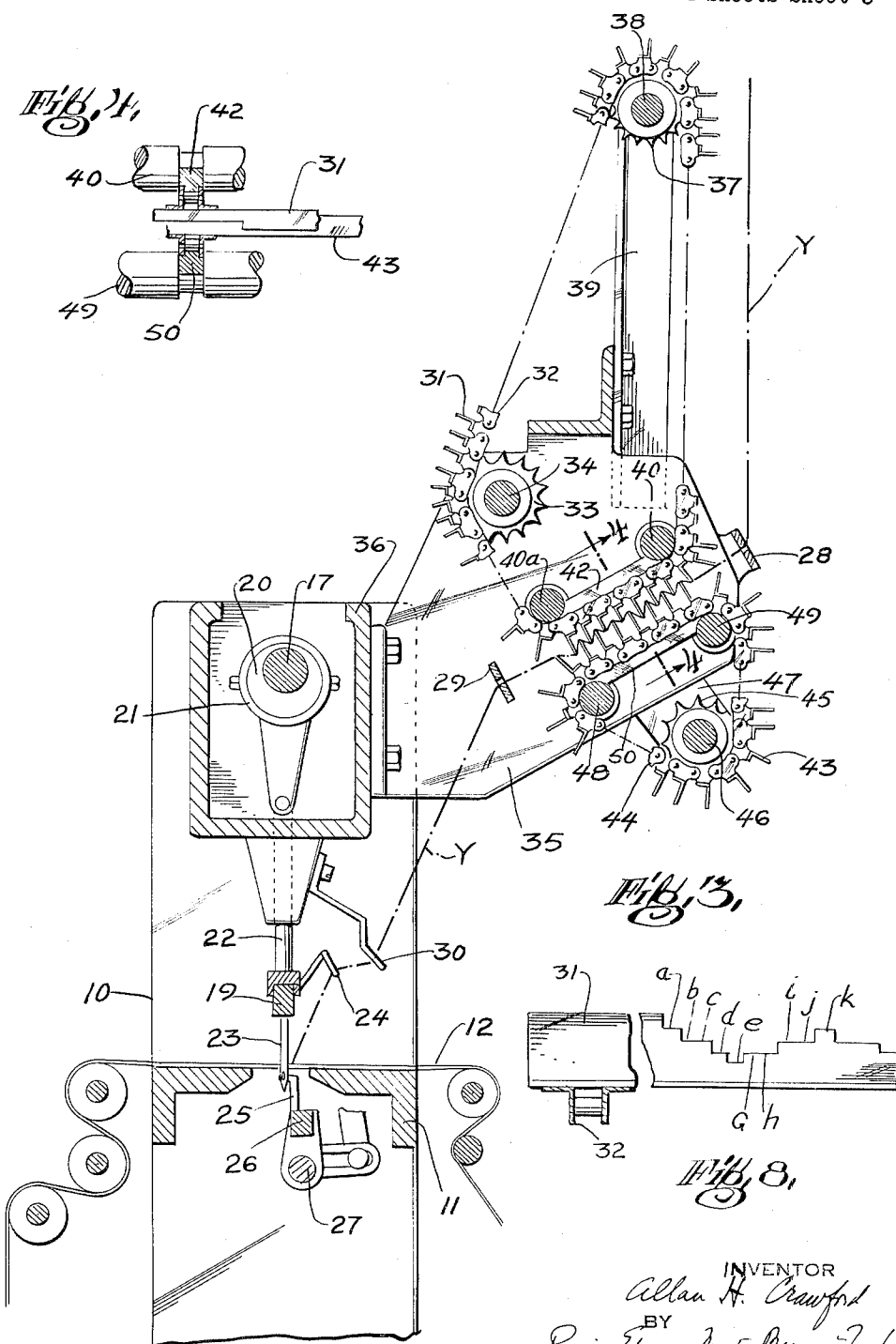
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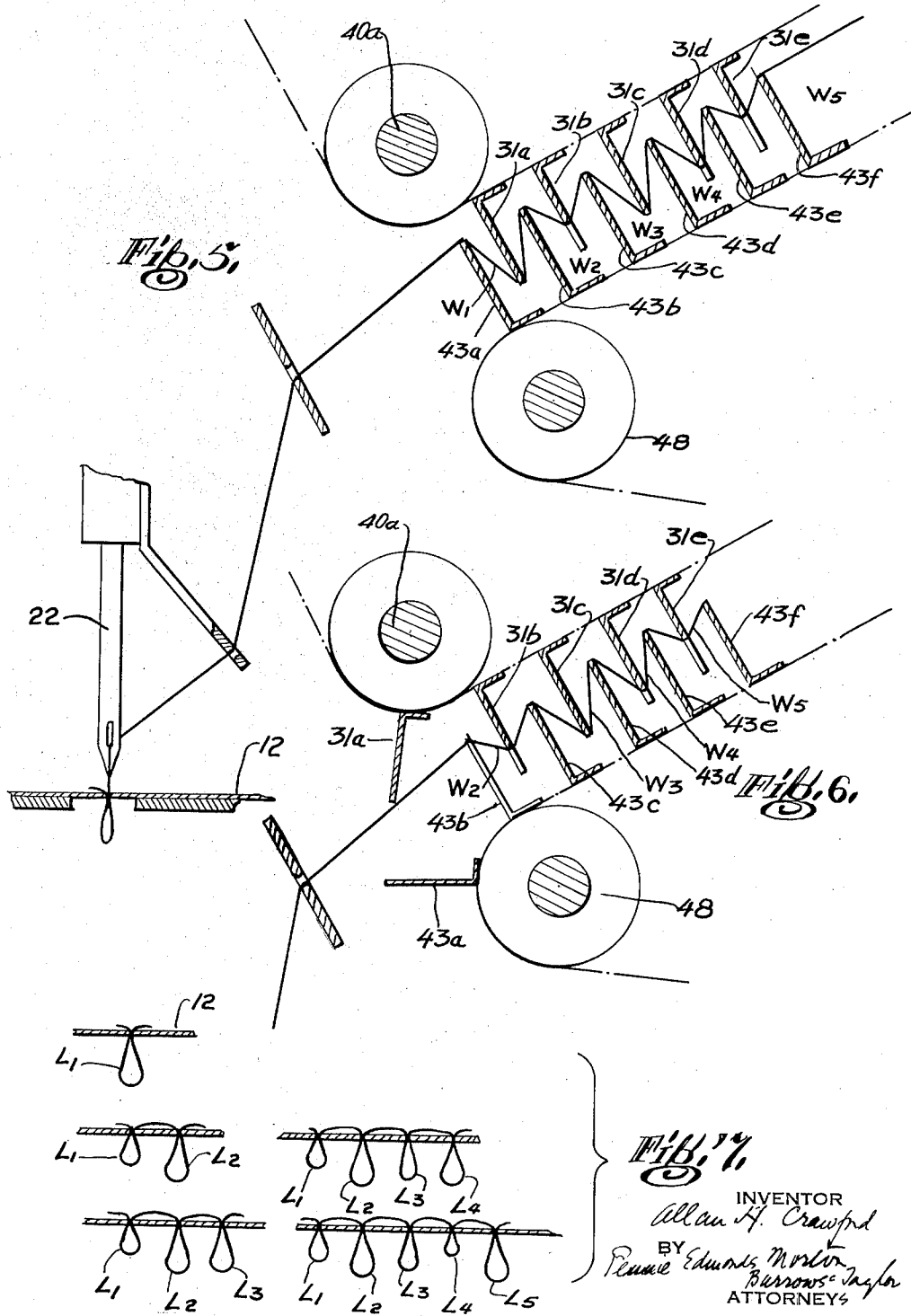
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METHOD AND APPARATUS FOR FEEDING YARNS

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12 Claims. (Cl. 112—79)

This invention relates to the feeding of yarns to apparatus, in which they are to be used, and is concerned more particularly with a novel method and mechanism for feeding yarns at rates varying in accordance with a pattern. The new mechanism makes possible control of the lengths of successive small feed increments of a large number of yarns being fed and is especially suitable for use in the production of pile fabrics having pile elements of different heights, the mechanism being employed in that application for supplying the yarns to the pile-forming devices of the fabric producing apparatus. A typical apparatus for the purpose is a sewing machine constructed for carrying out tufting operations, in which loops of pile yarn are inserted through a backing sheet to provide the pile of the fabric. As all the advantages of the new feed mechanism are realized in its use in conjunction with such a sewing machine, a form of the mechanism suitable for that purpose will be illustrated and described in detail.

Pile fabrics can be produced rapidly and at low cost on sewing machines of the multiple needle type constructed for tufting purposes and attachments have been developed for feeding the pile yarns to the needles at varying rates, so that the height of the pile loops in the fabric can be varied. However, the attachments now available are complex and expensive to install and operate.

The present invention is directed to the provision of a method of feeding a plurality of yarns as, for example, to pile-forming devices for incorporation into a fabric as pile elements varying in height as determined by a pattern, and the invention also includes a mechanism, by which the method can be advantageously practiced. The new mechanism feeds the yarns under close control and, although it is simple in construction, the mechanism can be used to determine the height of every pile element in an area of the fabric carrying a repeat of the pattern.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which

Fig. 1 is a view in side elevation, with parts omitted, of a sewing machine for tufting purposes, which is equipped with the new yarn feeding mechanism of the invention;

Fig. 2 is a fragmentary elevational view on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary sectional view on the line 4—4 of Fig. 3;

Figs. 5 and 6 are diagrammatic views illustrating the operation of the new yarn feeding means;

Fig. 7 is a diagram showing the mode of operation of the machine; and

Fig. 8 is a partial side elevational view of one of the pattern elements.

The tufting machine shown somewhat diagrammatically in the drawings comprises a frame 10 provided with a table 11, over which the backing sheet 12 is advanced from a supply by means of rolls 13, 14, 15, and 16, some

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or all of which are driven. A shaft 17 mounted above the table and driven by suitable means reciprocates a needle bar 19 through suitable connections including a plurality of eccentric discs 20, straps 21 encircling the discs, and push rods 22 connected to the straps and attached to the needle bar. The needle bar carries a plurality of needles 23 and a yarn guide 24 movable with the bar and having an eye for the yarn Y supplied to each needle. Beneath the table are a plurality of looper hooks 25, one for each needle, which are mounted on a bar 26 carried on arms on a rock shaft 27. As the needles pass loops of pile yarn through the backing sheet in the usual way, the loopers are swung to cause their hooks to enter the loops and hold them, when the needles are retracted and rise out of the fabric. The features of the machine so far described are of conventional construction and may take various forms.

The yarns Y to be fed to the respective needles are drawn from packages in a creel and pass through a stationary guide 28 having an eye for each yarn. A second guide 29 with an eye for each yarn is mounted in alignment with guide 28 at a distance therefrom and the yarns issuing from the eyes in guide 29 travel to a stationary guide 30, which has an eye for each yarn and is mounted on a fixed part of the machine adjacent the movable guide 24, when the needle bar is in its upper position. The yarns passing from guide 29 to guide 30 from a sheet.

The yarns are drawn from the supplies by the new feeding mechanism, which comprises an upper endless series of pattern members 31, which extend the full width of the sheet of the yarns traveling from guide 28 to guide 29. The pattern members are mounted on two or more flexible carriers, such as chains 32, which are trained about sprocket wheels 33 mounted on shafts 34 journaled in bearings in brackets 35 attached to the housing 36 for the main drive shaft 17 of the sewing machine. The chains also pass about sprocket wheels 37 on a shaft 38 journaled in bearings in extensions 39 from the brackets and about idler pulleys on shafts 40 and 40a journaled in bearings on plates 41 mounted on brackets 35. Plates 41 can be adjusted relative to brackets 35 by screws 41a to keep chains 32 taut. Plates 41 carry rails 42, which back up the stretches of the chains lying between shafts 40 and 40a and extend substantially parallel to a line drawn between the eyes of guides 28 and 29.

A second set of pattern members 43 are mounted on flexible carriers in the form of chains 44 passing about sprocket wheels 45 on shaft 46 journaled in extensions 47 from brackets 35. The chains 44 are also trained about idler pulleys on shafts 48 and 49 journaled in bearings in brackets 35. Rails 50 between the idlers on shafts 48 and 49 back up the lengths of chains 44, which extend parallel to a plane containing the eyes in guides 28 and 29.

The main drive shaft 17 carries a sprocket wheel 51 connected by a chain 52 to a sprocket wheel 53 on a stud 54 mounted on a bracket 55 attached to the frame 10 of the sewing machine. The stud carries a pinion 56 meshing with a gear 57 on a shaft 58 journaled in bearings in brackets 55 and 35. Shaft 58 carries a sprocket wheel 59 connected by a chain 60 to a sprocket wheel 61 on shaft 38 and shaft 58 also carries a gear 62 meshing with a gear 63 on a stud 64 attached to one of the brackets 35. Stud 64 also carries a sprocket wheel 65 connected by a chain 66 to a sprocket wheel 67 on shaft 46.

The pattern members 31 and 43 are wires of L-section, of which the bases are connected to the outer faces of links of chains 32 and 44, respectively. The wires on the stretches of the chains backed up by rails 42 and

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50 are staggered and their free ends are partially intermeshed, so that they subject the yarns in the sheet between guides 28 and 29 to lateral deviation and cause the yarns to assume the form of waves. The length of a yarn extending from a wire of the 43 series past a wire of the 31 series to the next wire of the 43 series constitutes one feed increment or wave of the yarn and the yarns in the sheet between guides 28 and 29 are formed into such a number of waves that the wires of the two series grip the yarns sufficiently to draw them from their packages and feed them to the needles as chains 32 and 44 are driven. The chains advance by the distance between adjacent wires thereon for each reciprocation of the needles, so that a feed increment of each yarn equal to the length of a wave of the yarn is fed to the needles for each reciprocation of the needles. A feed increment of each yarn is thus fed to its needle for the formation of a single pile loop.

The yarns in successive feed increments are laterally deviated by amounts corresponding to the heights of successive pile elements in a longitudinal row in the fabric to be produced and the yarns in transversely aligned feed increments across the yarn sheet are deviated by different amounts determined by the pattern. The varying lateral deviation of the yarns as described with resultant variation in the individual feed increments or waves or undulations is produced by forming the wires of the series 31 or 43, or both, of varying height throughout their length, although, ordinarily, the wires of the longer series 31 only are so formed. A typical pattern wire 31 is shown in Fig. 8 and the wire has sections marked *a*, *b*, *c*, *d*, etc., which are of uniform width and are engageable with individual pile yarns. Each section of a wire may be considered to be a pattern element and each wire is thus an assembly of individual pattern elements lying in a row transverse to the direction of feeding movement of the yarns. The sections are of different heights determined by the pattern to be produced in the fabric and the length of yarn in each wave extending between a pair of wires in the 43 series depends on the height of that section of the wire 31, which engages the yarn between the wires 43. Accordingly, if the section of the wire 31 in contact with the yarn is relatively high like section *a*, Fig. 8, the length of the yarn in the wave will be long, whereas, if the effective section is low like section *e*, the length of the wave will be short. The length of yarn required for formation of a normal loop by a needle is that in a wave of maximum length.

In the operation of the machine, the yarns are drawn from the supply, threaded through the eyes in guide 28 and between those wires of the two series 31 and 43, which are in effective position in contact with the supporting rails 42 and 50. The yarns are then led through the eyes in guides 29, 30, and 24 and threaded through their respective needles 23. On each downward stroke, each needle passes a loop of pile yarn through the fabric and the loop is retained by the looper, as the needle is retracted. Whatever the length of the first wave W_1 (Fig. 5) of a yarn supplied to its needle, the loop L_1 (Fig. 7) of that yarn left in the fabric will be of maximum length. If the next wave of yarn W_2 between wires 43*b* and 43*c* is of less than maximum length, because the effective section of wire 31*b* is of less than maximum height, the needle will form the yarn in wave W_2 into a loop L_2 of maximum length, but the insertion of the yarn in the short wave W_2 to form the loop L_2 will cause the withdrawal of a sufficient amount of yarn from the preceding loop L_1 to make up the deficiency in wave W_2 . As a result, loop L_1 , which was originally a normal loop, that is, one of maximum length, will be left as a loop equal in length to the length of yarn in the short second wave W_2 . If the third wave W_3 of yarn between wires 43*c* and 43*d* is of maximum length, the insertion of wave W_3 will produce a loop L_3 of maximum length

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and, since an adequate amount of yarn for this loop was supplied to the needle, the formation of loop L_3 will not alter the length of the preceding loop L_2 and loop L_2 will remain as a loop of maximum length, as shown.

As illustrated, the fourth wave W_4 of yarn between wire 43*d* and 43*e* is of less than maximum length, so that the insertion into the fabric of the yarn in wave W_4 will produce a loop L_4 of maximum length, but yarn will be withdrawn from the preceding loop L_3 to shorten loop L_3 by the difference between the length of yarn in wave W_4 and a wave of maximum length. With the wires shown, the fifth wave W_5 between wires 43*e* and 43*f* is short by reason of the effective part of wire 31*e* being low and, when the yarn in wave W_5 is inserted by the needle to form the loop L_5 , the loop L_4 will be reduced in length as shown.

From the foregoing, it will be apparent that, in the operation of the machine, the height of each loop in the pile in the finished fabric is determined by the amount of the lateral deviation of the feed increment of the pile yarn supplied for formation of the succeeding loop and thus depends upon the height of the sections of the pattern wires, which determine the deviation of the feed increment of the yarn for the succeeding loop. If, in two successive feeding operations, the amounts of yarn fed to a needle are sufficient for the formation of loops of the maximum height that the needle can form, the first loop inserted will remain as a loop of maximum height. The second loop will remain as a loop of maximum height until the third loop of the same yarn is inserted and the final height of the second loop will depend on the amount of yarn supplied for the formation of the third loop. It is thus possible by equipping the machine with sets of pattern elements of proper formation to produce a fabric, in which elaborate surface effects are obtained by reason of differences in height of the pile loops.

Since the individual yarns extending side by side in the sheet between guides 28 and 29 have their successive feed increments laterally deviated by amounts corresponding to the heights of successive elements in longitudinal rows in the fabric to be produced, the yarns in the sheet are so distorted that the sheet has a shape corresponding to the surface of the pile of the finished fabric. Each yarn feed increment of maximum deviation corresponds to a pile element, such as a loop, of maximum height in the fabric and the yarn feed increments of less deviation correspond to pile elements of less than maximum height. As the feed increments of yarn are advanced with the wires 31 and 43 and reach the end of the series of wires, the leading feed increments of all the yarns are simultaneously released. The yarns then return to undeviated condition from guides 29 through guides 30 and 24 to the needles.

Since the new feeding mechanism affords separate control of the height of every pile element in the fabric being produced, the use of pattern wires of proper shape makes it possible to produce fabrics, in which the arrangement of pile elements of different height in transverse rows across the fabric differs from row to row and no two rows in a repeat of the pattern are alike. The mechanism thus makes possible the production of fabrics with a variety of surface effects obtainable in weaving pile fabrics by the use of a Jacquard mechanism.

The feed mechanism described permits individual control of the height of every loop in the fabric and, although the yarns are fed simultaneously, the control of each yarn is exercised independently of the control exercised over all the others. The two sets of pattern wires feed the yarns to the needles in waves varying in amplitude both with the yarns and also along the yarns. As a result, the amounts of the yarns fed to the needles for simultaneous formation of loops will vary from yarn to yarn across the sheet of yarns depending on the pattern and the amounts of a given yarn fed for successive loops

will also vary according to the pattern. As the amount of yarn in each wave is supplied to a needle for insertion through the backing sheet to form a single loop, the waves of yarn being fed are of the same frequency as that of the reciprocation of the needles.

The desired variation in height in the pile loops of the fabric can be usually obtained by the use of one set of wires varying in height along their length, while the wires of the other set are plain wires. However, both sets of wires may vary in height lengthwise, if desired. When the wires of only one set are of variable height, it is preferable that such wires form the 31 series, since there are more wires in this series and this makes possible the formation of a pattern with a longer repeat than could be made, if the wires 43 of the smaller set were of variable height and wires 31 were plain. Whenever a change in pattern is to be made, chains 32 are removed and replaced by others carrying wires of the appropriate form and arrangement. If the pattern requires more wires than are in set 31, extensions 39 are replaced by longer ones, which will space shaft 38 and its sprocket wheels 37 at the desired location for the longer chains 32.

I claim:

1. A method of feeding a yarn to a pile-forming device for incorporation into a fabric as pile elements varying in height as determined by a pattern which comprises holding a length of yarn with a plurality of successive feed increments thereof laterally deviated by varying amounts corresponding to the heights of successive pile elements in a longitudinal row in the fabric to be produced, advancing said held length of yarn, with the said increments held deviated by said varying amounts, towards the pile-forming device, successively releasing the leading feed increment of said held length of yarn for passage to the pile-forming device, and, simultaneously with the releasing of the leading feed increment, introducing another feed increment at the trailing end of said held portion of yarn.

2. A method of feeding a plurality of yarns to pile-forming devices for incorporation into a fabric as pile elements varying in height as determined by a pattern, which comprises holding lengths of yarns lying side-by-side with a plurality of successive feed increments of each yarn laterally deviated by varying amounts corresponding to the heights of successive pile elements in a longitudinal row in the fabric to be produced and with transversely-aligned feed increments of the yarns deviated by varying amounts determined by the pattern, simultaneously advancing said held lengths of yarn, with the feed increments of the yarns held deviated, towards the pile-forming devices, successively releasing the leading increment of said held lengths of yarn for passage to the pile-forming devices, and, simultaneously with the releasing of the leading feed increment, introducing another feed increment at the trailing end of said held portions of each yarn.

3. A method of feeding a plurality of yarns to pile-forming devices for incorporation into a fabric as pile elements varying in height as determined by a pattern, which comprises supplying the yarns lying side-by-side in a sheet, engaging lengths of the yarns in said sheet from opposite sides along spaced lines extending transversely of the yarns and bending the engaged lengths of yarn to the form of a plurality of waves varying in amplitude both with and along the respective yarns, moving the bent yarns simultaneously toward the pile-forming devices, successively releasing the leading waves of all of the yarns simultaneously, and, simultaneously with the releasing of the leading waves of each yarn, engaging a new section of each yarn and bending it to wave form.

4. An apparatus for feeding a plurality of yarns at rates varying in accordance with a predetermined pattern to be produced by means of said yarns, which comprise flexible endless carriers, a set of pattern members for producing said pattern secured to each endless carrier

and extending therefrom in spaced relation, means for supporting the carriers for longitudinal movement and with lengthwise stretches thereof lying parallel and so close that the pattern members on the stretches intermesh, means for guiding the yarns in side-by-side relation to and between the parallel stretches of the carriers, the yarns being bent to wave form and gripped by the intermeshing pattern members in the parallel stretches, and means for advancing the carriers in such direction that the intermeshing pattern members in the parallel stretches feed the yarns while holding them bent to wave form, the members successively releasing waves of the yarns at the forward ends of the parallel stretches and simultaneously engaging new portions of the yarns and bending them successively to wave form at the rear ends of the stretches, the pattern members on at least one carrier varying in height along their length in accordance with a pattern and producing yarn waves correspondingly varying in amplitude.

5. The apparatus of claim 4, in which means are provided for backing up the carriers in the stretches.

6. The apparatus of claim 4, in which the pattern members are flat wires secured to the carriers to project outwardly therefrom.

7. The apparatus of claim 4, in which the wires have a base extending at an angle to the remainder of the wire and the bases are secured to the carriers.

8. In a multiple needle tufting machine, apparatus for feeding a plurality of yarns at various rates of feed to the needles of the machine, said apparatus comprising a pair of sprocket and chain assemblies, each of said chain assemblies having bars projecting therefrom which intermesh with bars on the other of said chain assemblies, means for driving said sprocket and chain assemblies to cause said bars to move in closed paths, means positioning said chain assemblies in substantially parallel relationship at the zone of intermeshing of said bars, and yarn guide means for guiding the plurality of yarns in generally side-by-side relation between said intermeshing bars where said yarns are crimped and gripped by said intermeshing bars and advanced toward the needles of the machine by the movement of said intermeshing bars, at least some of said bars having spaced indentations in the projecting edges thereof, said yarn guide means being arranged to guide certain of said yarns into said spaced indentations and to guide other of said yarns between said indentations whereby said certain yarns are crimped to lesser amplitudes than said other yarns and the rate of feed of said certain yarns is less than the rate of feed of said other yarns.

9. Apparatus for feeding a plurality of yarns at varying rates to the cyclically operating pile-forming devices of a machine producing pile fabric, which comprises a pair of flexible movable carriers having pattern members thereon, means for supporting the carriers for endwise movement and with longitudinal stretches thereof traveling along substantially parallel paths with the pattern members on the carriers in said stretches intermeshing, the pattern members on at least one carrier varying in height along their length in accordance with a pattern, means for guiding the yarns in generally side-by-side relation between the intermeshing members on the carriers, where the yarns are crimped by the intermeshing members to form a plurality of undulations in each yarn of varying amplitude corresponding to the height of the portions of the members engaging the yarn, and means for driving the members to advance the yarns and at such a rate as to cause one member on each carrier to leave a parallel stretch of its carrier during each cycle of operation of the pile-forming devices, whereby an undulation of each yarn is released during each such cycle and the rate of feed of each yarn to its device in each cycle depends on the amplitude on the undulation of the yarn released during that cycle.

10. The apparatus for feeding yarns as defined in

claim 4 in which the carriers are a pair of sprocket and chain assemblies and the pattern members are bars mounted on and extending transversely to the chains of each assembly.

11. A method of feeding a yarn from a yarn supply at different rates of feed to a cyclically operating pile-forming device, which comprises gripping a linear portion of the yarn between the supply and the pile-forming device and forming the gripped portion into a plurality of undulations of different amplitudes, advancing the gripped and undulated portion of the yarn toward the pile-forming device while retaining the difference of the amplitudes of the undulations, and progressively releasing successive undulations in the yarn at one end of said linear portion and simultaneously forming undulations in succeeding linear portions of the yarn, whereby the rate of feed yarn to the pile-forming device at any instant depends

upon the amplitude of the undulation being released at that time.

12. The method of feeding yarns defined in claim 11, in which the advancing movement of the undulated portion of the yarn is controlled to release one undulation thereof during each cycle of operation of the pile-forming device.

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