

**Sept. 23, 1958**

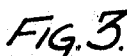
**H. F. ODENWELLER**

**2,853,032**

# APPARATUS FOR CONTROLLING PILE HEIGHT

Filed April 1, 1954

2 Sheets-Sheet 1



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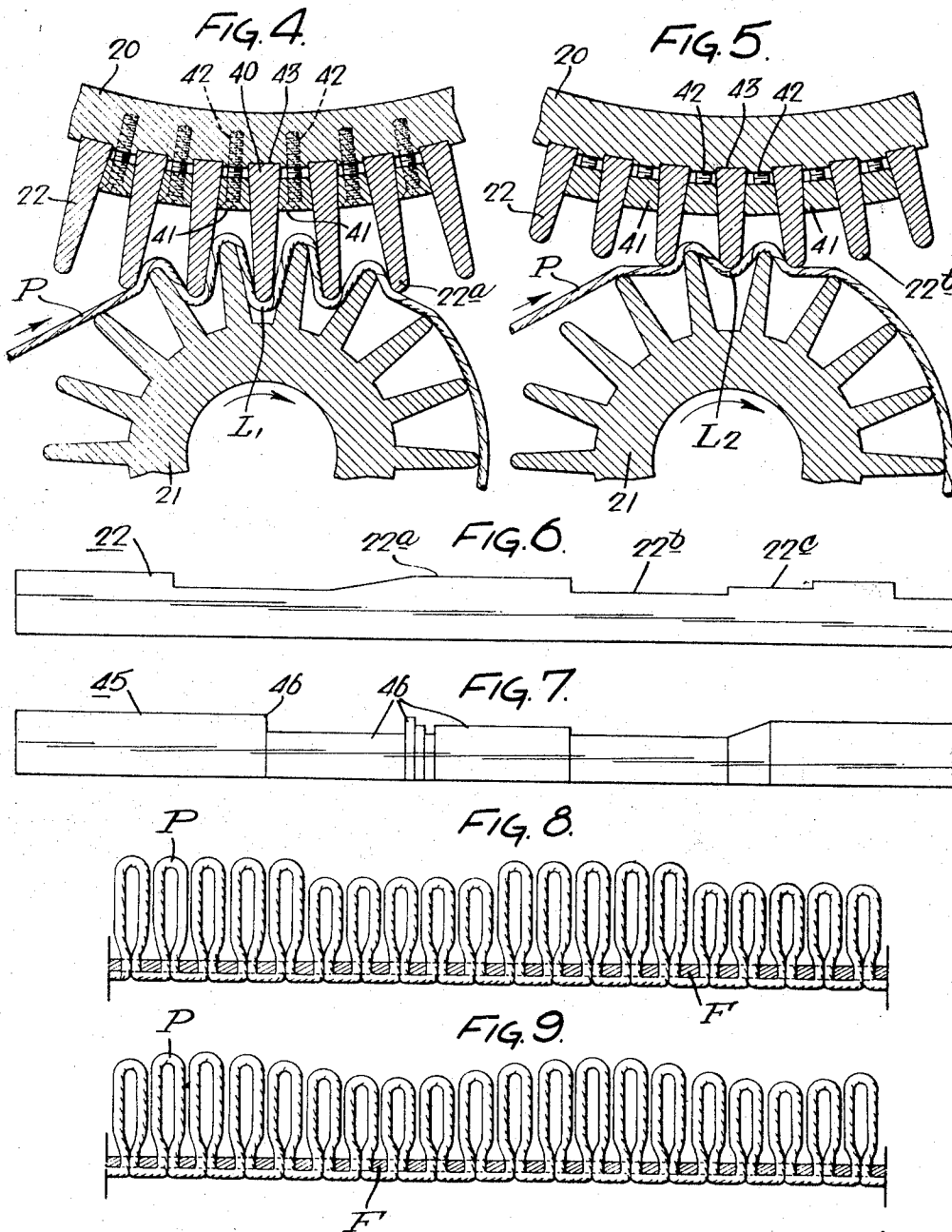
H. F. ODENWELLER

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Inventor:  
Hugo F. Odenweller  
by his Attorneys  
Howson & Howson

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## APPARATUS FOR CONTROLLING PILE HEIGHT

Hugo F. Odenweller, Bridgeport, Pa., assignor, by mesne assignments, to Mohasco Industries, Inc., Amsterdam, N. Y., a corporation of New York

Application April 1, 1954, Serial No. 420,378

9 Claims. (Cl. 112—79)

The present invention relates to apparatus for producing a variable height pile in pile fabrics and more particularly to control mechanism for varying the rate at which the pile yarn is supplied to the pile-forming station of tufting machines and similar apparatus.

In the manufacture of conventional tufted fabrics, the pile surface is formed with uniform pile heights at the pile-forming station by means of a bank of tufting needles which are adapted to insert a row of pile loops into a base fabric. A let off 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. Because of this, it has not been possible to produce a variable pile height in conventional tufted fabrics.

With the ever-increasing use of tufted fabrics for floor covering and the like, it is desirable to provide means for producing variations in the pile height of the finished fabric in order to provide an embossed or carved pile surface effect. An embossed pile surface produces a fabric having striking characteristics which are unobtainable with printed or plain pile patterns.

The prior methods for producing embossed surface effects on tufted pile fabrics involves the use of complicated mechanisms which are disposed along the feed roll to control the feed of the individual pile yarns. These mechanisms are space-consuming and it is therefore difficult to obtain the desired regulation of the height of the individual pile loops across the full width of the fabric.

In addition to the difficulty in obtaining the desired regulation of the individual pile loops, the prior mechanisms are difficult to regulate to obtain the desired pattern effect on the pile surface. To obtain the desired pattern, the designer must have an intimate knowledge of the function of the control apparatus in order to properly adjust the regulating devices of the mechanisms to produce the desired effect.

With the foregoing in mind, a primary object of the present invention is to produce novel apparatus for feeding the pile yarn to the pile-forming mechanism of a tufting machine at variable rates of speed to produce a pile surface of varying height in the finished pile fabric.

Another object is to provide control apparatus which is easily regulated and set up to provide the desired pattern without the necessity for intimate knowledge of the operating characteristics of the apparatus by the designer.

A further object is to provide control apparatus which can be readily changed to produce a different pattern effect.

Still another object is to provide improved pile yarn control apparatus of simple construction which is entirely effective 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 wherein:

Fig. 1 illustrates a tufting machine embodying control apparatus made in accordance with the present invention;

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Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1;

Figs. 4 and 5 are sectional views showing the operation of the novel control apparatus of the present invention;

Figs. 6 and 7 are elevational views of the teeth of the control apparatus showing different types of configuration of the teeth; and

Figs. 8 and 9 are typical warpwise sectional views of the fabric produced by the present invention showing pile effects which may be obtained by means of the present invention.

The invention may be applied to the formation of any pile fabric in which the pile yarn is fed to the base fabric at a pile-forming station substantially independently of the formation of the base fabric, but for the purposes of illustration, the present embodiment of the invention is shown and described in conjunction with a conventional tufting machine.

Referring more particularly to the drawings, in the tufting machine shown in Fig. 1, the ground fabric F is fed across the bed 10 of the machine by pin rollers 11 and 12. The pile surface is formed by loops which are inserted into the ground fabric by a bank of needles 13 mounted for vertical oscillation relative to the bed 10 at the pile-forming station of the tufting machine. The needles are oscillated by a crank mechanism indicated generally at 14 and driven by an eccentric shaft 15. The base fabric F is driven intermittently and the bank of needles 13 inserts full rows 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 latching mechanism for retaining the pile loops in the fabric upon withdrawal of the needles is conventional, for example, as shown at 16.

In accordance with the invention, the pile yarn P is fed to the needles from a pair of cooperating toothed let off rolls 20 and 21 respectively. The present invention affords a variation in the height of pile loops by varying the rate at which the yarn is fed to the needles by the let off rolls. The rate of feed, in turn, is controlled by the height of the teeth on the roll 20, the teeth on the roll 21 being of uniform height. The high teeth on the roll 20 effect a fast rate of feed since the teeth form a high loop in the pile yarn P as it passes between the rolls 20 and 21. When the rolls 20 and 21 are advanced, the high loop of yarn is fed to the machine, thereby creating a fast feed. A low tooth, on the other hand, as seen in Fig. 5, effects a slow feed of the yarn because of the low loop produced in the pile yarn P as it passes between the rolls 20 and 21.

Thus when a high tooth advances the yarn to the tufting machines, the needles fed by that tooth form loops of maximum height as determined by the depth of penetration of needles below the bed 10 of the machine. When a tooth of low height advances the pile yarn, insufficient yarn is fed to the needles from the roll 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 is robbed or drawn back from the immediately preceding row of loops, thereby forming loops of lesser height in the latter row. By varying the height of the teeth on the roll 20, it is possible to vary the height of the loops in the row formed immediately preceding the row being formed by the needles.

The high teeth on the roll 20 form high loops, whereas low teeth form low loops.

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In the present embodiment of the invention, the drive for the feed roll 20 is taken from the tufting machine through a chain drive, for example as indicated at 25, and gear train 26 which drives the shaft 27 mounting the feed roll 20. The gear train 26 also actuates the feed roll 21 through a chain and sprocket connection indicated generally at 28 driving the shaft 29 which mounts the feed roll 21.

As shown in Fig. 1, the yarn is fed from a supply (not shown) over guide rollers 31 and 32, around the feed roll 21, the yarn being engaged by the feed roll 20 at the point of mesh thereof with the feed roll 21, and to the tufting machine through a reed or similar guide means indicated at 33. From the reed 33 the yarn is fed to the needles 13 through the conventional guides 34 and 35 respectively.

As stated above height of the teeth 22 on the roll 20 controls the height of the pile loops in the fabric F. To this end the teeth 22 are separable from the roll 20 so that they may be mounted thereon in any selected sequence to give the desired pattern effect. Thus by choosing the desired sequence of teeth, it is possible to predetermine the pattern formed in the pile of the fabric. As shown in Fig. 4, the teeth are of tapered cross section so that the broad bases 40 thereof may be releasably secured to the feed roll 20, for example by spacer elements 41. In the present instance the spacer elements 41 are secured to the roll by bolts, for example as indicated at 42. To insure proper spacing of the teeth, the roll 20 may be grooved as indicated at 43 to receive the bases 40 of the teeth 22.

The teeth 22 may have any suitable conformation, and a typical tooth is shown in Fig. 6, having high portions 22a, low portions 22b, and intermediate portions 22c. As shown in Fig. 4, the high portions 22a form a loop L1 in the pile yarn F threaded around the roll 21. When the roll is advanced to feed the loop L1 to the tufting machine, the needles form a loop of maximum height in the fabric F. The low portion 22b, as shown in Fig. 5, forms a loop L2 of minimum height which when fed to the tufting machine provides insufficient yarn to produce a loop of maximum height. Thus, yarn to form such a loop is robbed or drawn back from the immediately preceding row of loops so as to form a loop of low height in the latter row.

The tooth 22 shown in Fig. 6 is integral along the full length of the feed roll 21, but it is within the scope of the invention to form the tooth 45 in sections 46, each section being of a given height. This construction is shown in Fig. 7. Since the spacers 41 for securing the teeth to the roll extend the full length of the roll it is not necessary to provide separate fastening means for the several sections of the tooth 45, the sections 46 being held in place by the spacer elements 41 and the grooves 43.

The configuration of each transverse or weftwise row of pile loops need not be limited to low, intermediate, and high loops, but there may be a gradual variation. To effect gradual variation of the pile in each weftwise row, the teeth for forming the rows are formed with a curved conformation so as to provide a similar conformation of loops in the fabric. This is illustrated in the warpwise section shown in Fig. 9.

As seen in Fig. 3, the teeth of the lower feed roll 21 are uniform across its full width. Since these teeth are not varied to produce variable pile and are also uniform around the full circumference, the teeth may be formed integrally with the roll 21, as seen in Figs. 4 and 5.

Thus it is seen that the present invention affords pile height control apparatus wherein opposed toothed rolls are provided which mesh with one another to control the rate of feed of the pile yarn to the tufting machine. The rate of feed is controlled by the height of the teeth on the feed roll 20, which in turn controls the degree of mesh between the rolls 20 and 21 and therefore height

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of loop formed at the point of mesh. The height of loop at the point of mesh similarly determines the length of yarn fed to the needle 13 so as to control the pile height of the immediately preceding row of loops in the tufted fabric.

Means is provided to adjust the degree of mesh of the let-off rolls 20 and 21 to control the height of all the loops formed by the rolls. To this end, the shaft 29 of the roll 21 is mounted in a journal 50 which is adjustable relative to the roll 20 by adjusting bolts 51, 51. Thus, to increase the overall height of the pile loops in the fabric F, the journal 50 is adjusted upwardly toward the roll 20, and to decrease the overall pile height, the journal 50 is adjusted downwardly.

When setting up the machine for producing the desired pattern, the designer simply selects a series of teeth, each of which has a configuration similar to that of a weftwise row of pile loops. The teeth are mounted in proper sequence on the feed roll, and the latter is installed in the feed apparatus of the tufting machine. To increase the number of rows of pile in a warpwise repeat in the fabric, a roll having a greater number of teeth may be employed. Thus, the present invention provides pile height control apparatus of simple design which is easily installed in a minimum of space, and is readily regulated to provide the desired pile pattern effect.

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

I claim:

1. In a machine for manufacturing pile fabrics having a pile yarn supply and a pile-forming station, mechanism for feeding the pile yarn comprising a pair of members each having a plurality of teeth, means for supporting the members between the pile yarn supply and the pile-forming station with at least part of the teeth on the members intermeshing, means for guiding the pile yarn from the supply to and between the members and from the members to the pile-forming station, and means for moving the members in such manner that successive teeth on the members engage the pile yarn from opposite sides to form successive undulations therein and advance the yarn toward the pile-forming station and release the undulations successively, the teeth on at least one member varying in height in accordance with a pattern and producing corresponding variations in the lengths of yarn in the undulations.

2. In a machine for manufacturing pile fabrics having a pile yarn supply and a pile-forming station, feed mechanism as defined in claim 1, in which the teeth of varying height are removably mounted on their member.

3. In a machine for manufacturing pile fabrics having a pile yarn supply and a pile-forming station, mechanism for feeding pile yarns comprising a toothed member having teeth extending across the width of said pile-forming station to engage a full complement of pile yarns for said station, means to advance said toothed member in the direction of feed of the pile yarns, means to guide each of the pile yarns from the supply into engagement with said toothed member and to the pile-forming station, a second member operable to engage the pile yarns with said toothed member during advancement of the latter and to form a full complement of loops in the pile yarns along the length of each of the teeth of said member and simultaneously feed said pile yarns, at least one of the teeth of the toothed member varying in height along the length of said toothed member, and cooperating with the second member to form said loops of different heights in the pile yarns and thereby effect feed of different lengths of the pile yarns to the pile-forming station.

4. In a machine for manufacturing pile fabric having a plural yarn supply and a pile-forming station, feed

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mechanism for feeding the pile yarns comprising a pair of meshed toothed let-off rolls having teeth extending across the width of said pile-forming station to engage a full complement of pile yarns for said station, means to detachably mount the teeth on one of said rolls, drive means for said rolls to advance the same in the direction of feed of the pile yarns, and means to guide each of the pile yarns from the supply between said toothed rolls at the line of mesh thereof and to the pile-forming station, each tooth of the one said toothed roll upon advancement thereof being operable to form at the line of mesh of said rolls a full complement of loops in the pile yarns along the length of said let-off rolls and simultaneously feed said pile yarns, the teeth of the one said roll varying in height along the length of said roll to form said loops of different height and thereby effect feed of different lengths of the pile yarns to the pile-forming station.

5. In a multiple needle tufting machine, apparatus for feeding a plurality of yarns to the needles of the tufting machine, said apparatus comprising a pair of movable members having inter-meshing elements projecting therefrom for gripping and causing undulation of yarns passing in generally side by side relationship therebetween, means for driving said members in a direction to advance the yarns toward the needles of the tufting machine, the driving of such members being at a rate to cause one of said elements on each of said members to leave the zone of intermeshing of said elements during each excursion of the needles of the tufting machine, certain of said intermeshing elements having indentations of greater and lesser depth in the projecting edges thereof, means for guiding certain yarns into said indentations of greater depth, and means for guiding other of said yarns into said indentations of lesser depth whereby the extent of undulation and the consequent rates of feed of said certain yarns will be less than the rates of feed of said other yarns to thereby cause the tufting machine to form pile of different heights.

6. In a machine for producing pile fabrics having a plurality of substantially-aligned pile-forming devices operating cyclically at a station and a supply of pile yarns for the individual pile-forming devices, mechanism for feeding the pile yarns comprising a movable member carrying spaced projections in an endless series, a second movable member carrying spaced projections in an endless series, said movable members extending lengthwise of the group of said pile-forming devices, means for supporting the members between the pile yarn supply and the pile-forming station with part of the projections on the members intermeshing, means for guiding the pile yarns from the supply to and between the members and from the members to the pile-forming station, and means for moving the members in such manner that successive projections of the series on the members engage the pile yarns from opposite sides to form successive undulations therein and advance the yarns towards the pile-forming

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station and release the undulations successively, the projections of at least one series varying in height along their length in accordance with a pattern and producing undulations correspondingly varying in the lengths of yarn therein.

7. In a machine for producing pile fabrics having a plurality of substantially-aligned pile-forming devices operating cyclically at a station and a supply of pile yarns for the individual pile-forming devices, mechanism for feeding the pile yarns defined in claim 6 in which the members are rolls, the projections are mounted on the rolls to extend radially therefrom, and the means for moving the rolls rotates them at a uniform speed and in such direction that their projections on engagement with the yarns advance the yarns towards the pile-forming station.

8. In a machine for producing pile fabrics having a plurality of pile-forming devices operating cyclically at a station and a supply of pile yarns for the individual devices, a mechanism for feeding pile yarns from the supply to the devices, which comprises a pair of movable members each having spaced projections arranged thereon in an endless series, means for supporting the members between the supply and the station with part of the projections on the members intermeshing, means for guiding the pile yarns from the supply to and between the projections on the members, the projections causing undulations in the yarns passing between them, and means for moving the members in such direction that successive projections engage the yarns and advance them toward the devices, the projections on at least one member varying in height along their length in accordance with a pattern and producing undulations in the yarns correspondingly varying in the lengths of the yarns therein, the moving means moving the members at a constant rate in timed relation to the operation of the pile-forming devices, whereby the individual yarns are supplied to the devices in increments of lengths corresponding to the length of the yarns in the undulations.

9. In a machine for producing pile fabrics having a plurality of pile-forming devices operating cyclically at a station and a supply of pile yarns for the individual devices, the mechanism for feeding pile yarns defined in claim 8, which includes means for moving at least one supporting means for a member to vary the extent of intermeshing of the projections on the members.

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