

May 5, 1959

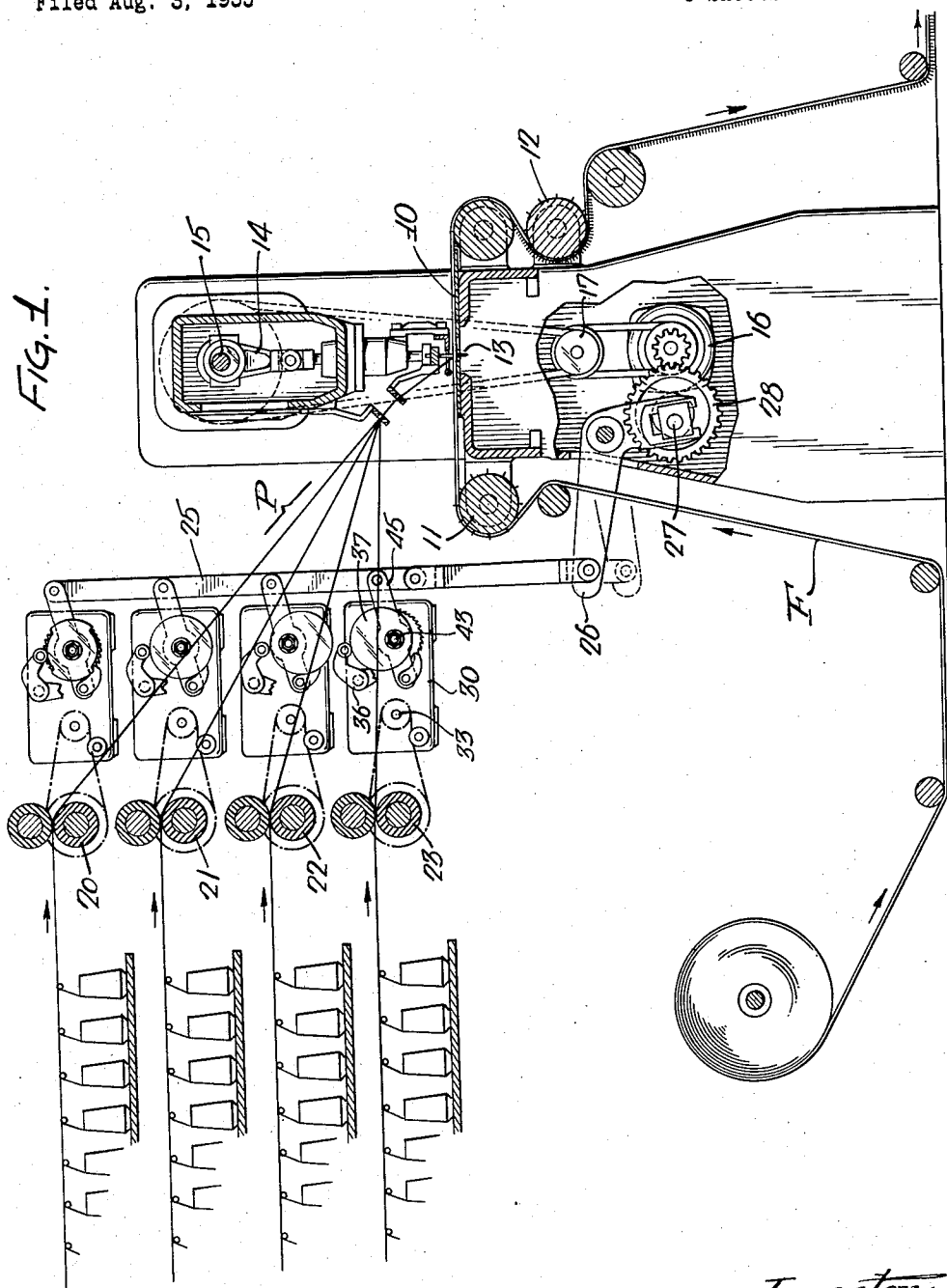
R. E. OBERHOLTZER

2,884,881

PILE HEIGHT CONTROL APPARATUS

Filed Aug. 3, 1953

3 Sheets-Sheet 1



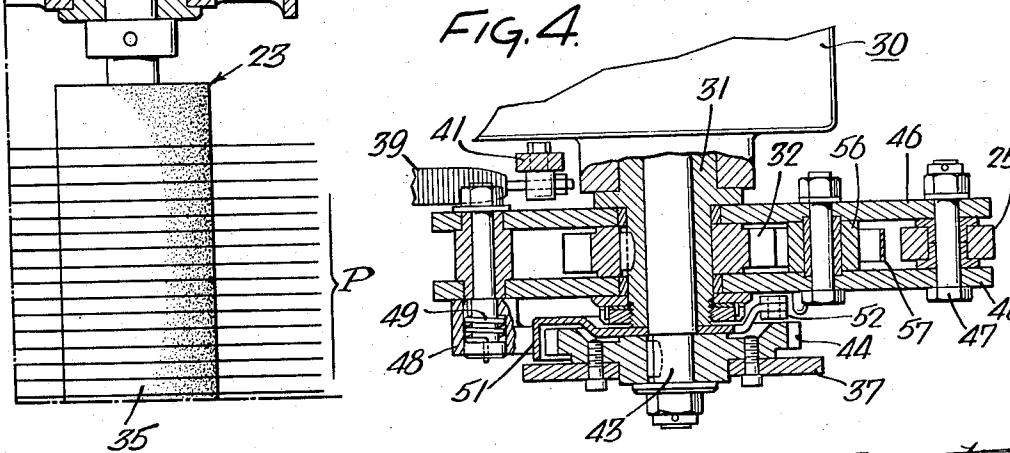
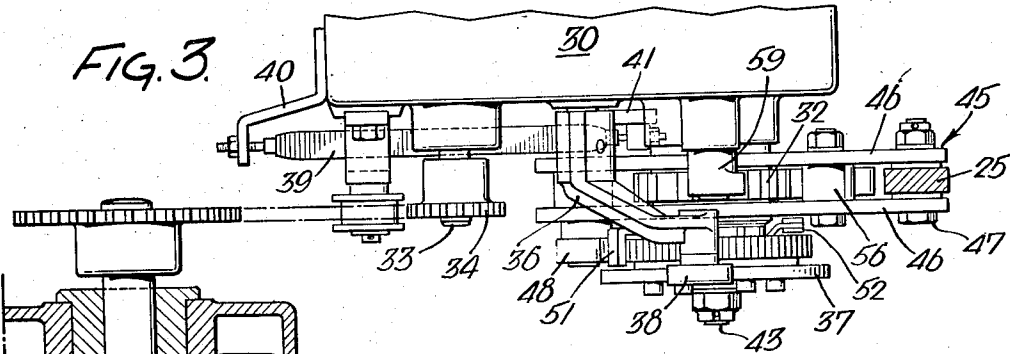
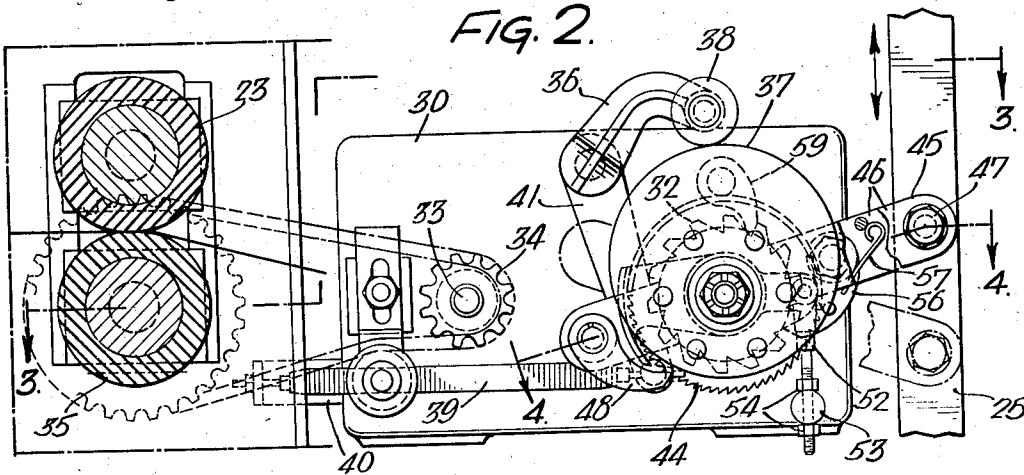
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3 Sheets-Sheet 2



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FIG. 5.

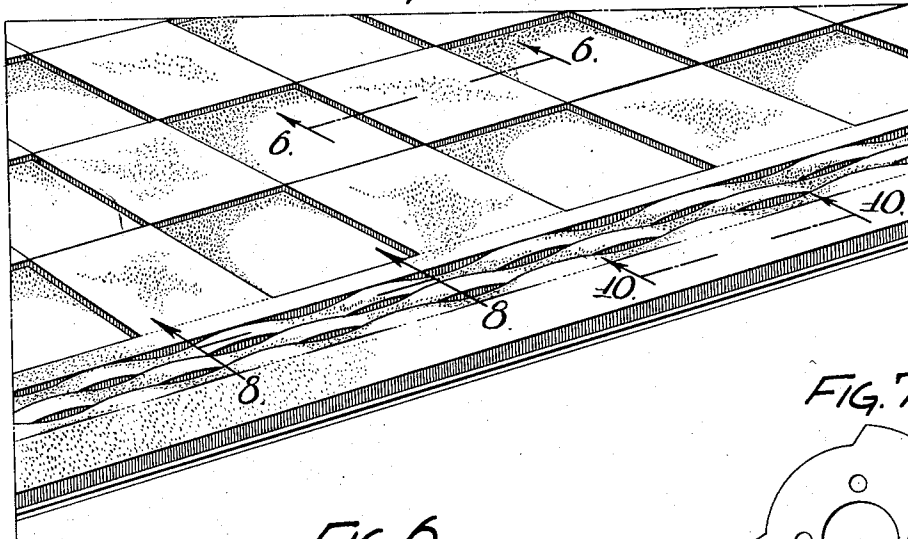


FIG. 6.

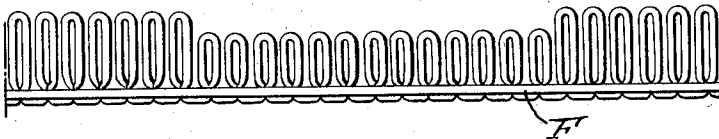


FIG. 8.

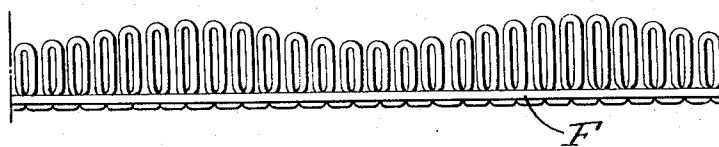


FIG. 12.



FIG. 10.

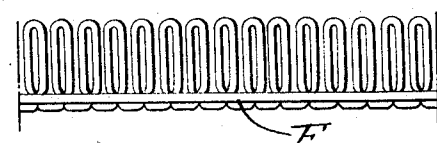


FIG. 7.

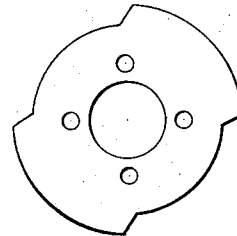


FIG. 9.

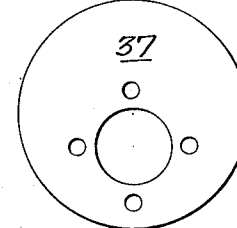


FIG. 13.

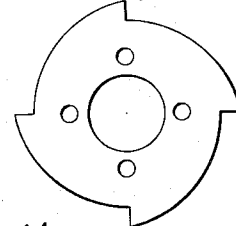
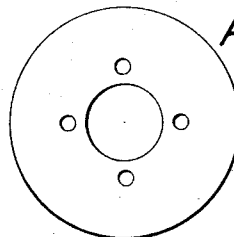


FIG. 11.



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2,884,881

PILE HEIGHT CONTROL APPARATUS

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Application August 3, 1953, Serial No. 372,007

9 Claims. (Cl. 112—79)

The present invention relates to an apparatus for producing a variable pile height in pile fabrics and more particularly to control mechanism for varying the rate at which the pile yarn is 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 uniform pile height by means of a bank of tufting needles which are adapted to insert pile yarns and form 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 a conventional tufted fabric.

With the ever-increasing use of tufted fabrics for floor coverings and the like, it is desirable to provide means for producing a variation 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.

Embossed or "carved" pile patterns are produced on velvet and Wilton pile fabrics by the use of wavy or serrated wires over which the pile yarn is formed into loops. However, tufting apparatus and machines for producing similar pile fabrics do not employ wires to form the pile loops and consequently, this method of producing an embossed or carved effect is not possible in the manufacture of tufted and similar fabrics.

With the foregoing in mind, a primary object of the present invention is to produce a novel pile fabric having an embossed pile surface without the use of wires or like mechanism.

More specifically, the invention contemplates a method and apparatus for feeding the pile yarn to the loop forming mechanism at variable rates of speed to produce a pile surface of varying height in the finished pile fabric.

The invention provides pile forming apparatus which is of simple construction and is entirely efficient and effective 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 is a side elevational view partly in section showing a feed control mechanism made in accordance with the present invention applied to a conventional tufting machine;

Fig. 2 is an enlarged fragmentary side elevational view of the control mechanism illustrated in Fig. 1;

Fig. 3 is a fragmentary plan view taken on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is a perspective view showing a pile fabric embodying a pile surface made in accordance with the present invention;

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Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a detached view of the cam element of the control mechanism employed to form the pattern illustrated in Fig. 6;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 5;

Fig. 9 is a detached view of the cam element employed to form the pile surface illustrated in Fig. 8;

Fig. 10 is a sectional view taken on the line 10—10 of Fig. 5;

Fig. 11 is a detached view of the cam element employed to form the pile surface illustrated in Fig. 10;

Fig. 12 is a view similar to Fig. 10 of a modified pile pattern which may be produced by the feed control mechanism of the present invention; and,

Fig. 13 is a detached view of the cam element employed to form the pattern disclosed in Fig. 12.

The invention may be applied to the formation of any pile fabric wherein the pile yarn is fed to a 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 which are mounted for vertical oscillation relative to the bed 10. The needles are oscillated by a crank mechanism indicated generally at 14 driven by an eccentric shaft 15 from a motor 16 through a pulley arrangement indicated generally at 17. The base fabric F is driven intermittently and the needles 13 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 latching mechanism for retaining the pile loops in the fabric upon withdrawal of the needles is conventional and not shown herein.

In accordance with the present invention, the pile yarn P is fed to the needles from a plurality of pairs of let-off rolls, in the present instance four, indicated at 20, 21, 22, and 23. The present invention affords a variation in the height of the pile loops by varying the rate at which the yarn is fed to the needles by the let-off rolls. When a pair of let-off rolls is driven at maximum speed, the needles fed by that pair form loops of maximum height as determined by the depth of penetration of the needles below the bed 10 of the machine. When the roll is driven at a slower speed, insufficient pile yarn will be fed to the needles from the roll to permit the formation of loops of maximum height. However, since the needles penetrate to the same depth, the yarn necessary to form a loop of the maximum height, will be robbed or drawn back from the immediately preceding row of loops, forming loops of lesser height in the latter row. By varying the speed at which the yarn P is fed by the let-off rolls, it is therefore 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 each left-off roll is taken from the tufting machine through a conventional variable speed transmission which, in turn, is intermittently actuated by an oscillating lever 25 controlled by a crank 26 which is driven by an eccentric crank pin 27 geared to the motor 16 as indicated at 28. The lever 25, on its upstroke, is operable to actuate

the control for the ratio between the input and output of each variable speed transmission, and on its downstroke, drives the input shaft of each transmission a predetermined angular distance.

The variable speed transmission may be a typical Reeves drive which employs a stiff belt running over two coned spools. The inside cone bearings of the spools are simultaneously changed to meet requirements for equal belt tension by a lever controlled by a jack screw, for example as shown in the publication "Design Work Sheets—New Fifth Series" compiled by Products Engineering Editors Contributors, published about 1940 in New York, N.Y., at page 141 (Fig. 26). See also "Mechanical Movements, Devices and Appliances," by Gardner, De Hiscox, published by Norman W. Henley and Company, New York, N.Y., in 1899, page 323, section 1321.

Referring now to Fig. 2, which shows the drive for the let-off rolls 23, the variable transmission is indicated at 30. The transmission has a hollow input shaft 31 which has rigidly secured thereto a drive ratchet wheel 32, and an output shaft 33 having keyed thereto a pinion 34 for driving the lower roll 35 of the let-off rolls 23. The ratio between the input 31 and the output 33 is variable and is controlled by a ratio change lever 36. In accordance with the invention, the ratio change lever is actuated by a pile height control cam 37. To this end, the ratio change lever 36 is provided at its outer extremity with a follower roller 38 which rides on the cam 37, being held thereagainst by a spring 39 tensioned between the frame 40 of the transmission and a downwardly extending leg 41 of the ratio change lever 36. The cam 37 is keyed to a shaft 43 which is rotatably mounted interiorly of the hollow input shaft 31. A friction brake or other control means may be provided at the opposite end of the shaft 43 to prevent inadvertent rotation thereof.

The pile height control cam is driven by a ratchet wheel 44 which in turn is intermittently driven by the oscillating lever 25. The connection between the lever 25 and the ratchet wheel 44 comprises a cross arm 45, consisting of a pair of spaced-apart plates 46, 46, pivoted to the lever 25 as indicated at 47 and mounted for rotation on the input shaft 31. The opposite end of the cross arm 45 mounts a pawl 48 which engages the ratchet wheel 44 and effects counterclockwise movement thereof upon upward movement of the lever 25. The pawl is resiliently urged into engagement with the ratchet wheel 44 by a torsion spring 49 so that when the cross arm is rocked counterclockwise on the shaft 31, the pawl 48 engages the teeth of the ratchet wheel and effects counterclockwise rotation thereof.

The effective speed of rotation of the ratchet wheel is adjustable to change the rate at which the cam 37 rotates and thereby change the timing of the repeats of the variation in the pile height. For example, the cam 37 is an eccentric cam which causes a sinusoidal variation in the ratio of the transmission 30. This, in turn, effects a sinusoidal variation in the height of the pile as indicated at the section 8—8 in Fig. 5. By varying the speed of rotation of the cam 37, the distance between the crests of the high portions of the loops in Fig. 8, is similarly varied. Slowing the speed of the cam 37 elongates the distance between the crests, whereas increasing the speed of the cam shortens the distance between the crests.

To effect the variation in the speed of rotation of the cam, a guard plate 51 partially covers the teeth of the ratchet wheel 44 and regulates the number of teeth engaged by the pawl upon each oscillation of the lever 25. The guard plate 51 is adjustable angularly on the shaft 43 to expose the desired number of teeth of the ratchet wheel 44. To this end, the opposite end of the guard plate 51 is provided with a threaded yoke 52 which is vertically positioned on the frame of the transmission 30 by a stud 53 and cooperating lock nuts 54. Thus, by adjusting the yoke vertically, the guard plate 51 is ad-

justed angularly about the shaft 43 to expose a greater or lesser number of teeth of the ratchet wheel 44 to the pawl 48. The number of teeth exposed determines the angular movement of the ratchet wheel upon each oscillation of the oscillating lever 25, and therefore the effective speed of the cam 37.

The let-off motion of the rolls 23 is effected by oscillation of the oscillating lever 25 and the cross arm 45. With reference to Fig. 3, it is seen that the side plates 46 of the cross arm 45 are disposed on opposite sides of the drive ratchet wheel 32 and mount between them a let-off motion pawl 56. The pawl 56 is resiliently urged into engagement with the drive ratchet wheel 32 by means of a leaf spring 57 so that when the lever 25 is displaced downwardly and the cross arm 45 is rocked clockwise, the input shaft 31 of the transmission is displaced angularly a given distance. A stop pawl is provided at 59 to prevent reverse rotation of the ratchet wheel 32. The angular displacement of the input shaft 31 effects a corresponding angular displacement of the output pinion 34 which in turn drives the lower roll 35 of the let-off rolls 21 to advance the pile yarn P to the needles 13. The angular displacement of the output sprocket 34 is determined by the setting of the ratio change lever 36 which, as set forth above, is controlled by the pile height control cam 37. Thus, the cam 37 determines the amount of feed or let-off effected by the rolls 23.

In the operation of the tufting machine, the fabric is advanced across the bed 10 by the pin rollers 11 and 12. At the same time, the oscillating lever 25 is actuated upwardly to advance the pile height control cam a given angular distance as determined by the setting of the guard plate 51. The lever 25 is then actuated downwardly to feed a given length of pile yarn P to the needles which are simultaneously inserted through the fabric F. The amount of let-off afforded by the let-off rolls 21 determines the height of the loops in the row formed immediately prior to the advance of the fabrics. The needles are then withdrawn and the fabric is again advanced across the bed of the machine to position the same for receiving the next row of pile loops.

As seen in Fig. 5, the present invention provides an embossed or "carved" pile surface on the tufted fabric in accordance with the shape of the cams employed in the feed control mechanism. For example, at the section shown in Fig. 6, the feed alternates between fast and slow speeds so as to produce alternative high and low portions on the pile surface. The cam for controlling the ratio change lever of the let-off rolls feeding the warpwise bands of fabric, is shown in Fig. 7. By employing an eccentric cam as shown in Fig. 9, the sinusoidal variation in pile height shown in Fig. 8, is obtained. By employing a straight cam (Fig. 11), the let-off rolls feed a constant length of material of pile yarn to the needles to provide a level pile surface as indicated in Fig. 10.

The present invention affords a wide variety of pile surfaces by simple selection of the proper shape of cam. For example, it is possible to obtain a saw tooth pile configuration as shown in Fig. 12 by employing a saw tooth cam such as shown in Fig. 13.

The invention has been illustrated and described as applied to a tufting machine but it is within the scope of the invention to apply it to other machines wherein the pile yarn is fed to a base or ground fabric independently of the mechanism for forming the latter, for example as in modified Axminster looms of the type disclosed in Patent No. 2,715,918 to Eisler and Moxley.

While the invention has been illustrated and described as embodying four pairs of let-off rolls, it is to be understood that any number of such rolls may be employed to produce the desired pattern effect. It is not intended to limit the invention to the above disclosure, and changes and modifications may be made therein and thereto within the scope of the following claims.

I claim:

1. In a machine for manufacturing a pile fabric, feed mechanism for the pile yarns comprising a pair of let-off rolls, variable drive means for the let-off rolls including a variable transmission having an output shaft operatively 5 connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output shafts, power means to drive said input shaft intermittently, a follower roller rotatably mounted on said lever, and a cam rotatably driven by the power means during 10 the lulls in the intermittent drive of said input shaft, said cam engaging said follower roller to actuate said lever to vary the speed ratio and control the rate of feed of the pile yarns to the machine.

2. In a machine for manufacturing a pile fabric, feed 15 mechanism for the pile yarns comprising a pair of let-off rolls for each of selected groups of the pile yarns, variable drive means for each pair of let-off rolls including a variable transmission having an output shaft operatively connected to said pair of rolls, an input shaft, and a 20 lever to determine the speed ratio between said input and output shafts, power means to drive said input shaft intermittently, a follower roller rotatably mounted on said lever, and a cam rotatably driven by the power means during the lulls in the intermittent drive of said input 25 shaft and engaging said follower roller to actuate said lever to vary the speed ratio and control the rate of feed of the selected group of pile yarns to the machine.

3. In a machine for manufacturing a pile fabric, feed 30 mechanism for the pile yarns comprising a pair of let-off rolls, variable drive means for the let-off rolls including a variable transmission having an output shaft operatively connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output 35 shafts, a follower roller rotatably mounted on said lever, a cam engaging said follower roller to control said lever to determine the speed ratio and the rate of feed of the pile yarns to the machine, a ratchet wheel keyed to said input shaft, a second ratchet wheel keyed to said cam, a 40 drive lever operatively connected to the machine for oscillation thereby, and pawl means mounted on said drive lever operable to selectively engage said ratchet wheels and drive the same alternately to intermittently drive the let-off rolls and vary said speed ratio.

4. In a machine for manufacturing a pile fabric, feed 45 mechanism for the pile yarns comprising a pair of let-off rolls, variable drive means for the let-off rolls including a variable transmission having an output shaft operatively connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output 50 shafts, a follower roller rotatably mounted on said lever, a cam engaging said follower roller to control said lever to determine the speed ratio and the rate of feed of the pile yarns to the machine, a ratchet wheel keyed to said input shaft, a second ratchet wheel keyed to said cam, a 55 drive lever operatively connected to the machine for oscillation thereby, pawl means mounted on said drive lever operable to selectively engage said ratchet wheels and drive the same alternately to intermittently drive the let-off rolls and vary said speed ratio, and means to control the angular advance of the cam upon each oscillation of the drive lever.

5. Mechanism according to claim 4 wherein said control means for the cam comprises a guard plate adjustably 60 mounted on the cam ratchet wheel to control the engagement of the pawl means therewith.

6. In a tufting machine having a constant speed drive means, feed mechanism for the pile yarns comprising a 65 pair of let-off rolls, variable drive means for the let-off rolls including a variable transmission having an output shaft operatively connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output shafts, a follower roller rotatably

mounted on said lever, a cam engaging said follower roller to control said lever to determine the speed ratio and the rate of feed of the pile yarns to the tufting machine, a ratchet wheel keyed to said input shaft, a second ratchet wheel keyed to said cam, a drive lever operatively connected to said constant speed drive means for oscillation thereby, and pawl means mounted on said drive lever operable to selectively engage said ratchet wheels and drive the same alternately to intermittently drive the let-off rolls and vary said speed ratio.

7. In a tufting machine having a constant speed drive means, feed mechanism for the pile yarns comprising a pair of let-off rolls for each of selected groups of the pile yarns, variable drive means for each pair of let-off rolls including a variable transmission having an output shaft operatively connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output shafts, a follower roller rotatably mounted on said lever, a cam engaging said follower roller to control said lever to determine the speed ratio and the rate of feed of the selected group of pile yarns to the tufting machine, a ratchet wheel keyed to said input shaft, a second ratchet wheel keyed to said cam, a common drive lever operatively connected to the tufting machine for oscillation thereby, and pawl means for each transmission mounted on said common lever and operable to selectively engage said ratchet wheels and drive the same alternately to intermittently drive the let-off rolls and vary said speed ratio.

8. In a tufting machine, feed mechanism for the pile yarns comprising a pair of let-off rolls for each of selected groups of the pile yarns, variable drive means for each pair of let-off rolls including a variable transmission having an output shaft operatively connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output shafts, a follower roller rotatably mounted on said lever, a cam engaging said follower roller to control said lever to determine the speed ratio and the rate of feed of the selected group of pile yarns to the tufting machine, a ratchet wheel keyed to said input shaft, a second ratchet wheel keyed to said cam, a common drive lever operatively connected to the tufting machine for oscillation thereby, pawl means for each transmission mounted on said common lever and operable to selectively engage said ratchet wheels and drive the same alternately to intermittently drive the let-off rolls and vary said speed ratio, and means associated with each cam ratchet wheel to control the angular advance thereof upon each oscillation of the common drive lever.

9. In a machine for manufacturing a pile fabric, feed mechanism for the pile yarns comprising a pair of let-off rolls, variable drive means for said let-off rolls including a variable transmission having an output shaft operatively connected to said rolls, an input shaft, and a lever to determine the speed ratio between said input and output shafts, power means to drive said input shaft intermittently, a follower roller rotatably mounted on said lever, and a cam rotatably driven by the power means and engaging said follower roller to actuate said lever to vary the speed ratio and control the rate of feed of the pile yarns to said machine.

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