June 8, 1965 H. J. SMILEY ETAL 3,187,779

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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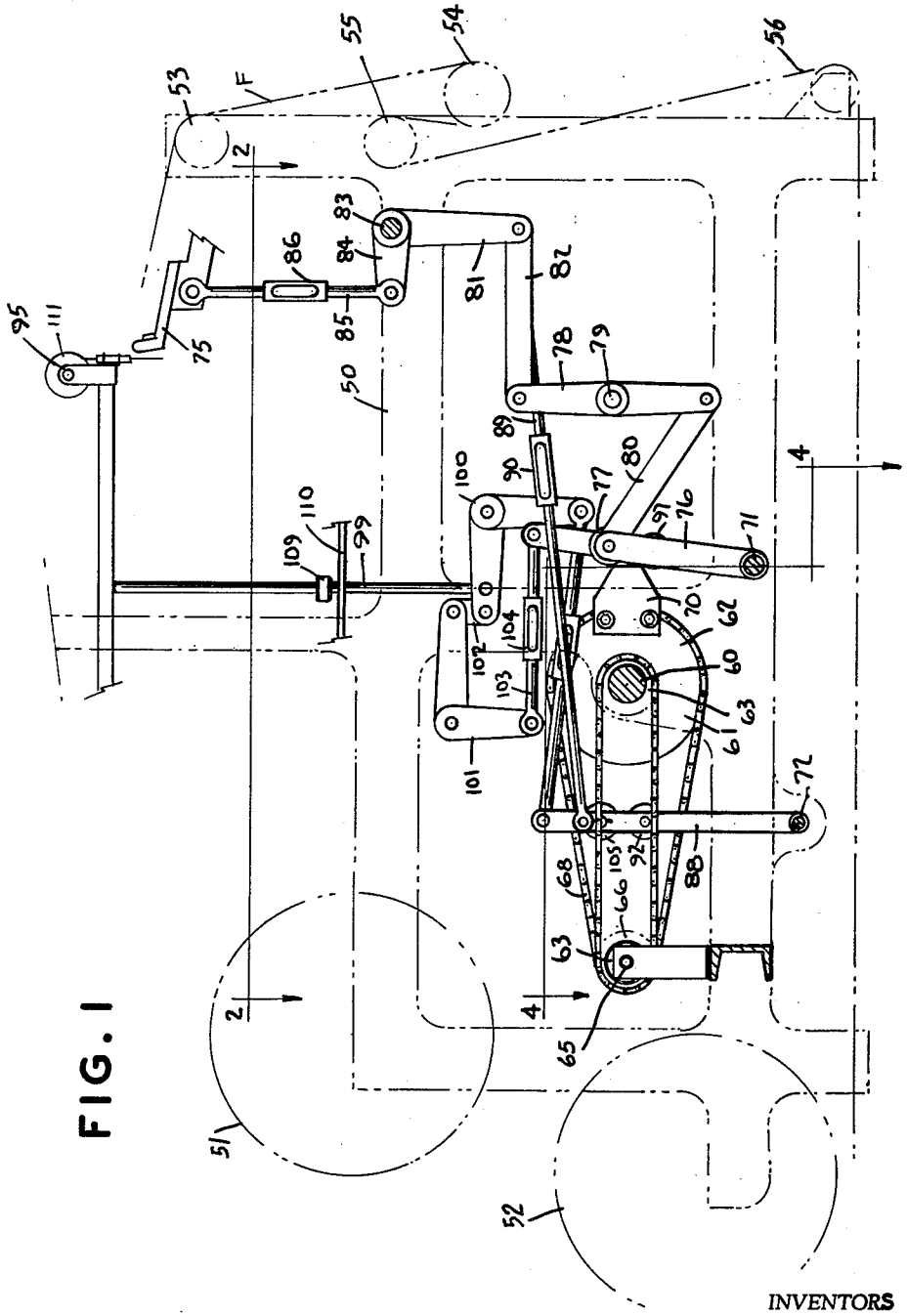


FIG. 1

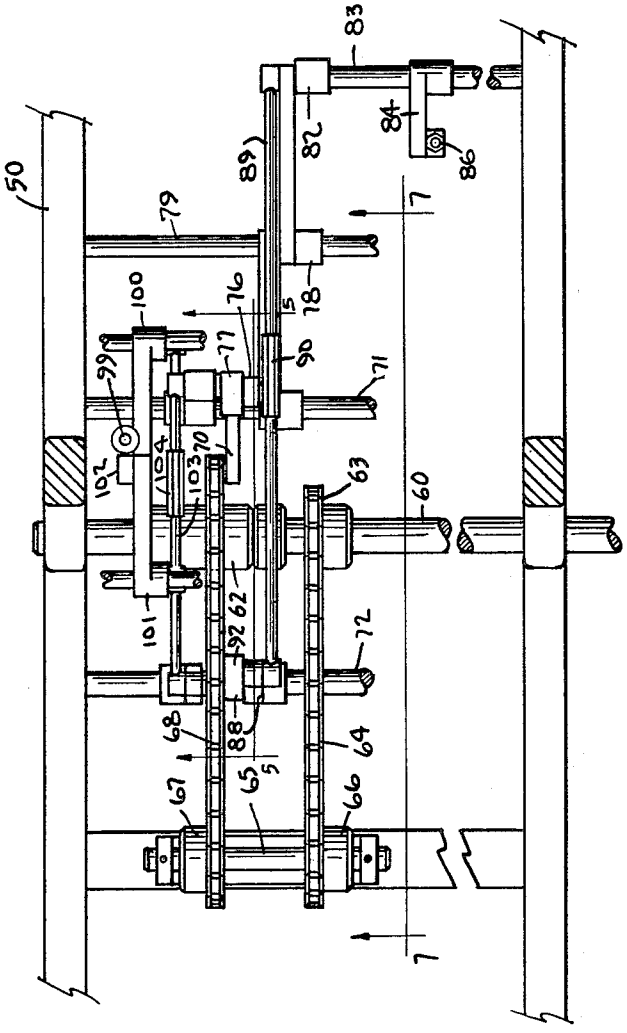
INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH
BY
Hyde W. Ballard

June 8, 1965 H. J. SMILEY ETAL 3,187,779

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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FIG. 2



INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde & Ballard

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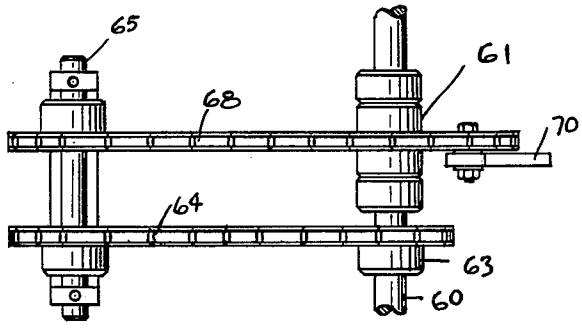


FIG. 3

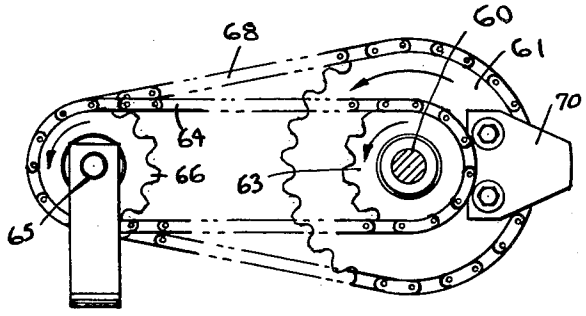


FIG. 4

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH
BY

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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FIG. 6

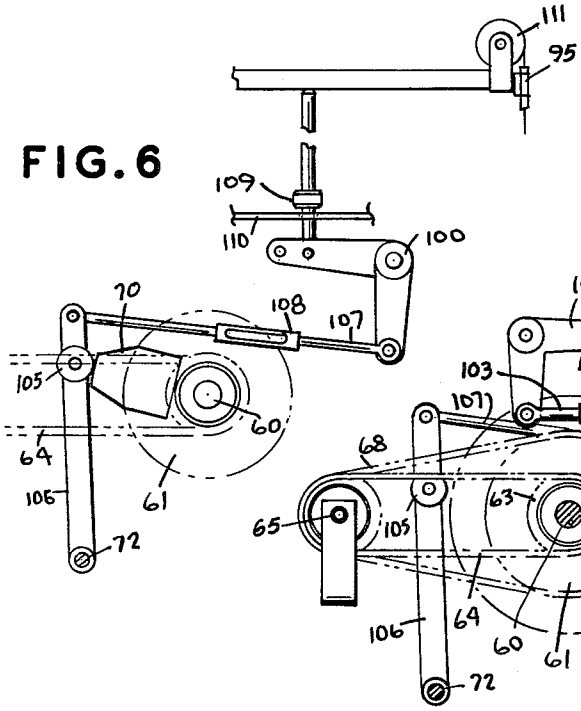


FIG. 5

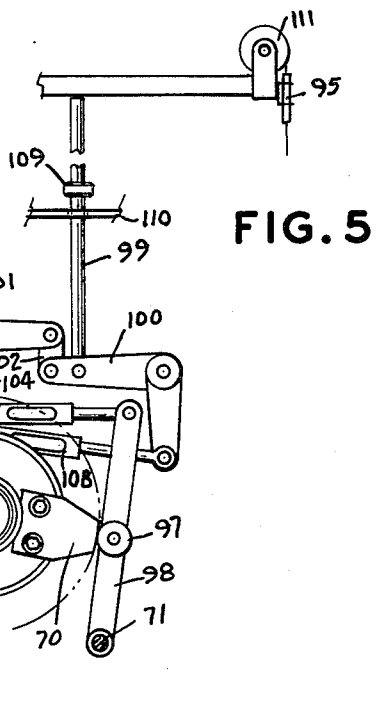


FIG. 8

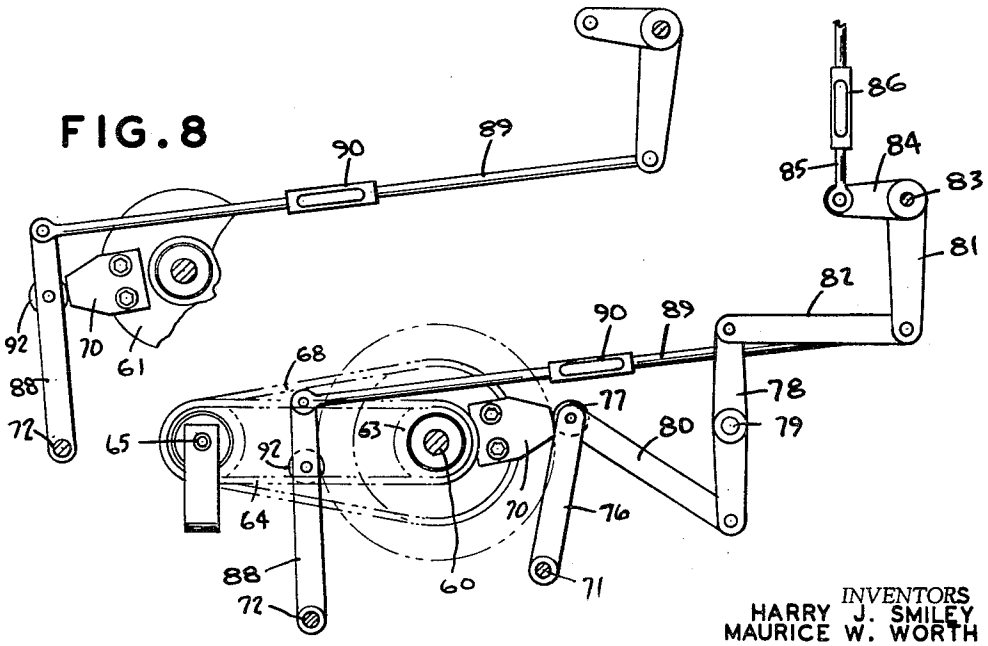


FIG. 7

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde & Ballard

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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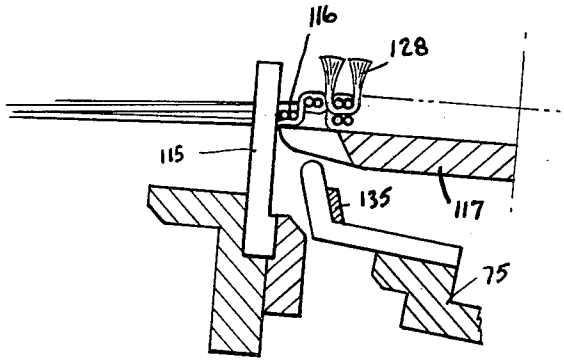


FIG. 9

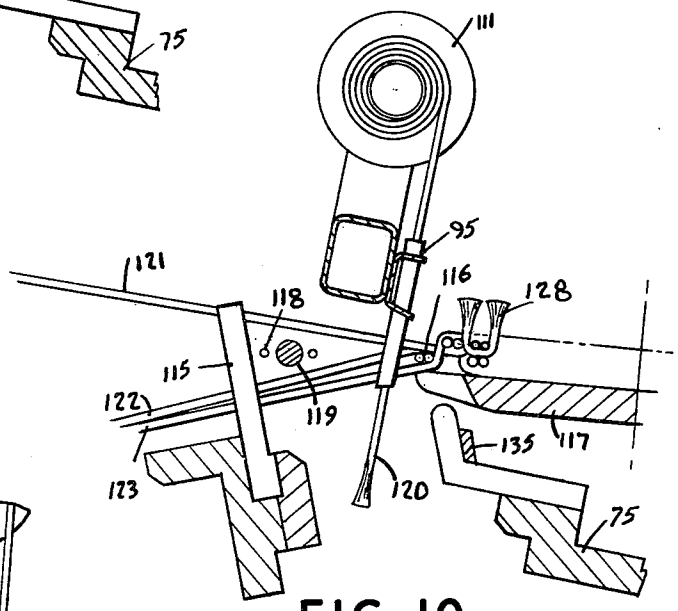


FIG. 10

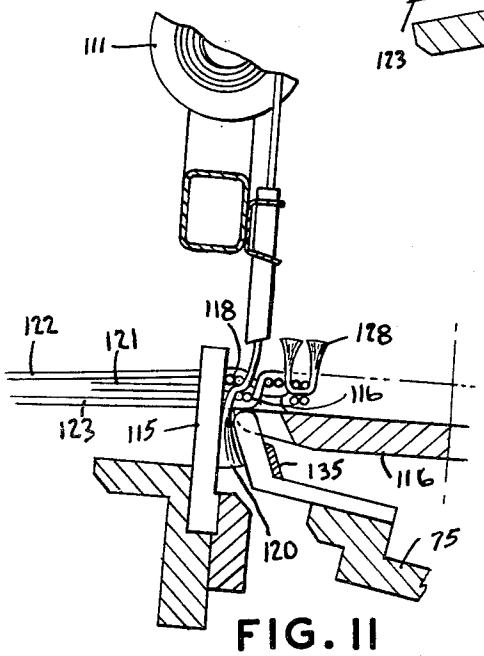


FIG. 11

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde W. Ballard

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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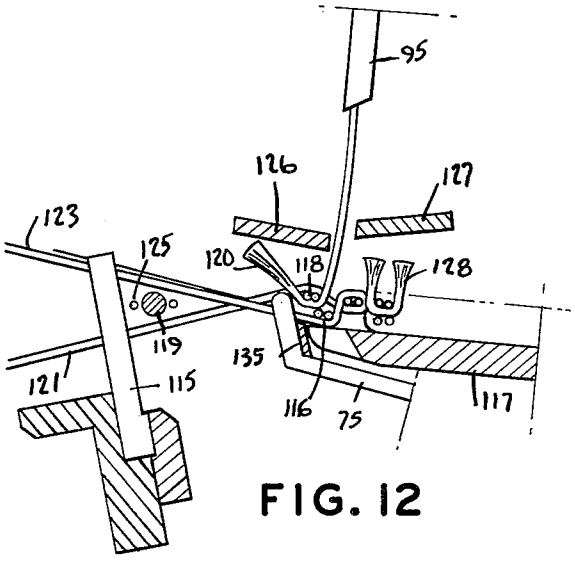


FIG. 12

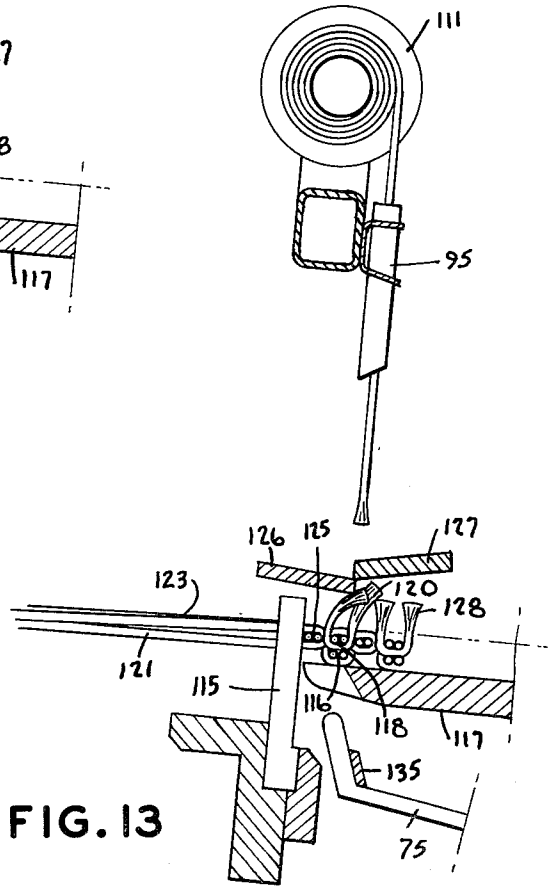


FIG. 13

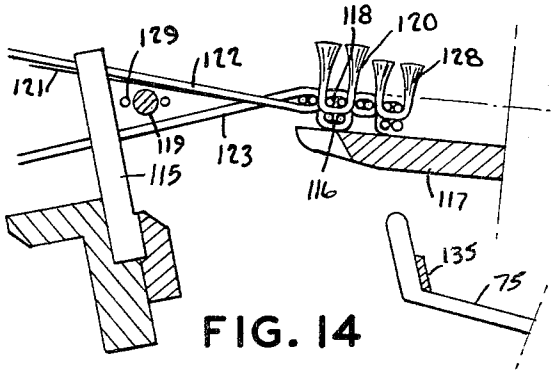


FIG. 14

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Lydia W. Ballard

June 8, 1965 H. J. SMILEY ETAL 3,187,779

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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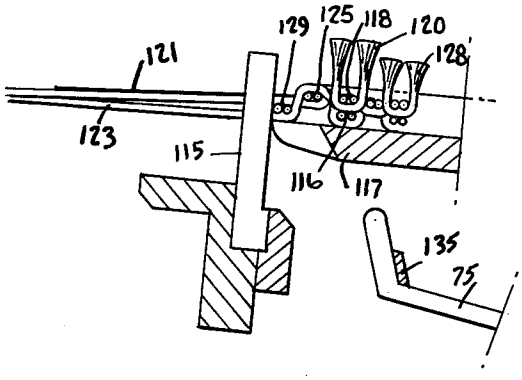


FIG. 15

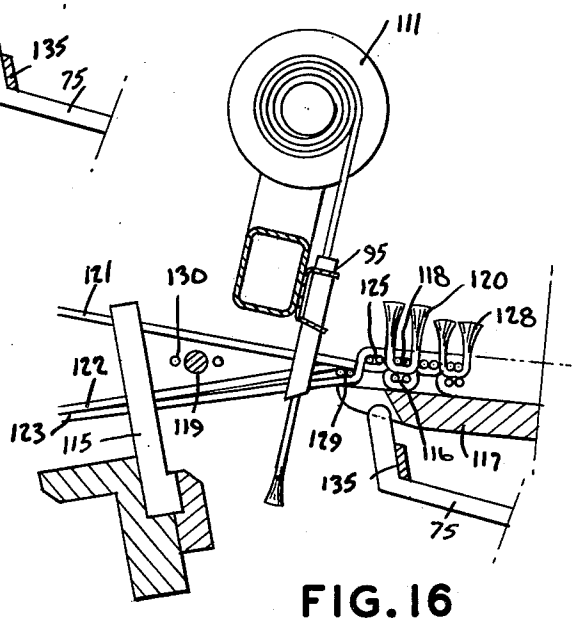


FIG. 16

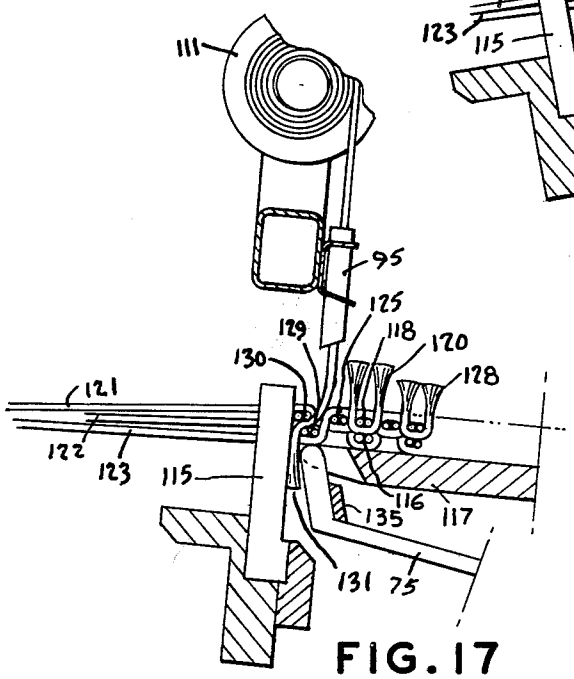


FIG. 17

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde & Ballard

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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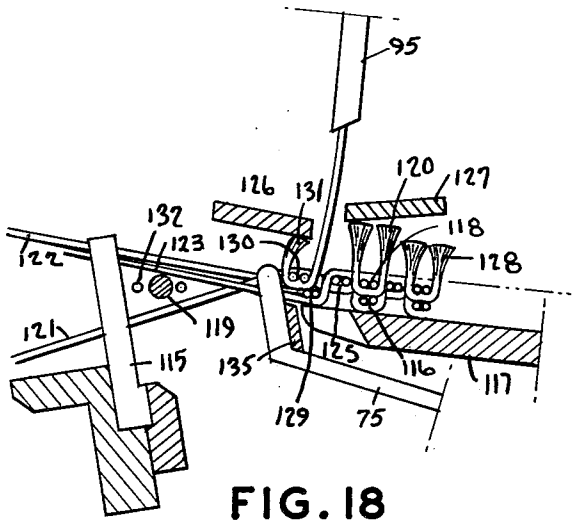
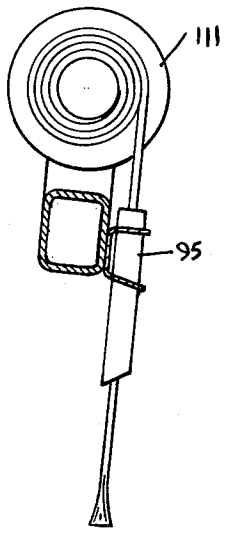


FIG. 18



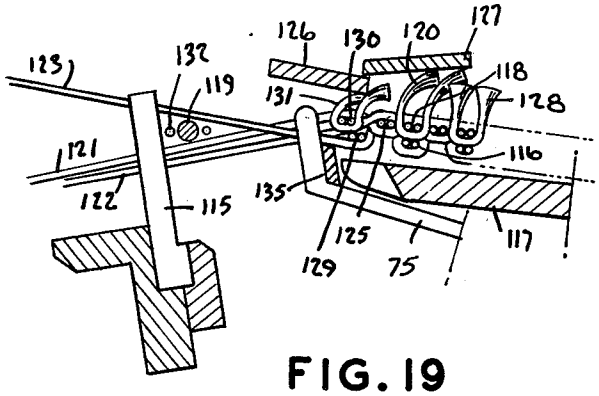


FIG. 19

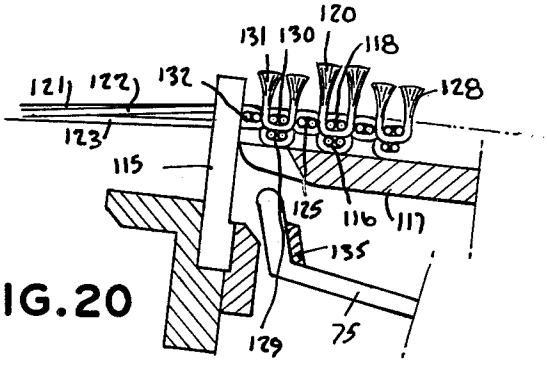


FIG. 20

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde W. Ballard

June 8, 1965 H. J. SMILEY ETAL 3,187,779

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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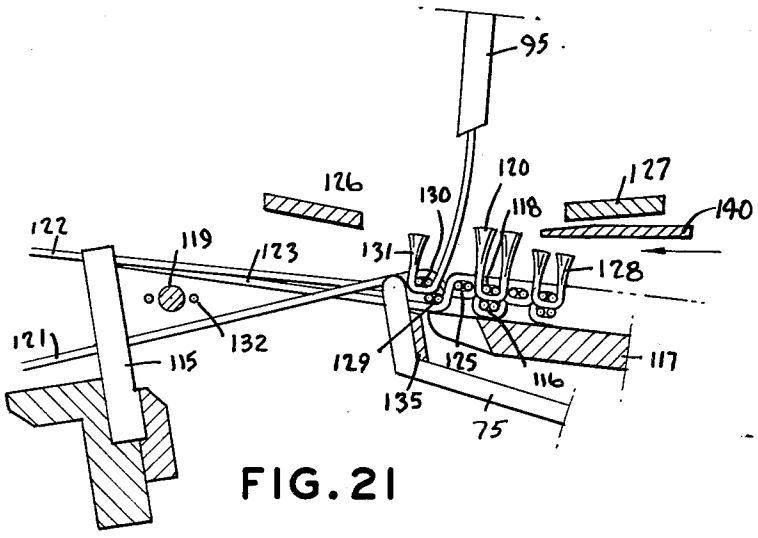


FIG. 21

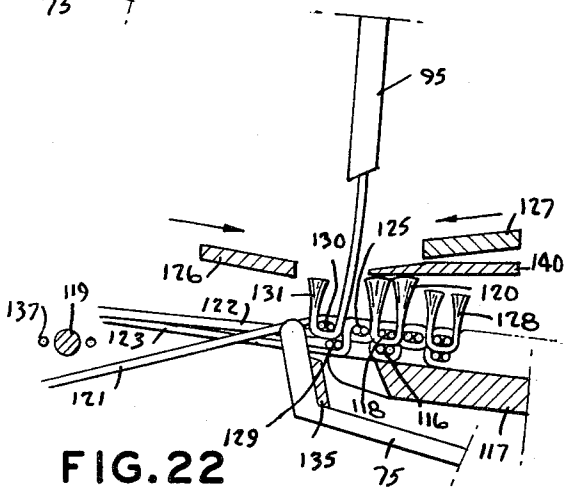


FIG. 22

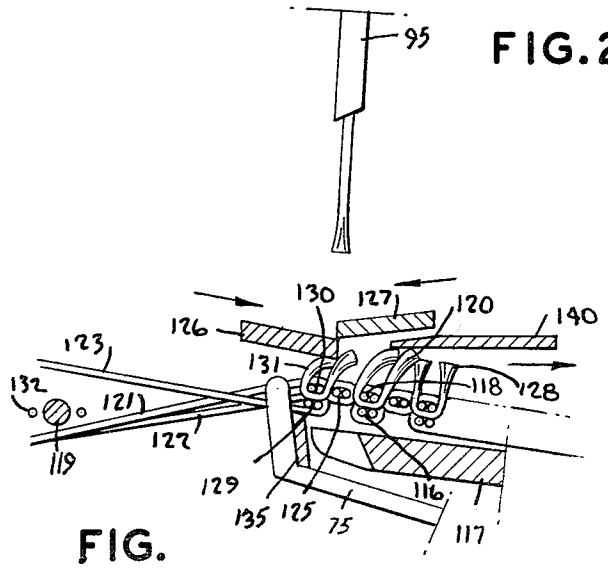


FIG. 23

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde & Baldwin

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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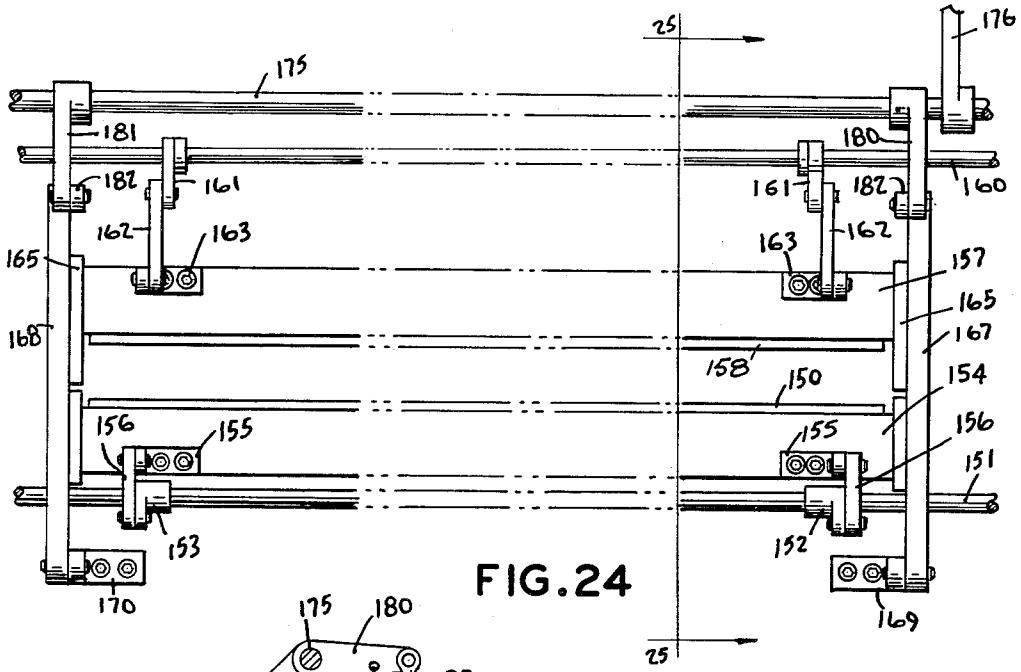


FIG. 24

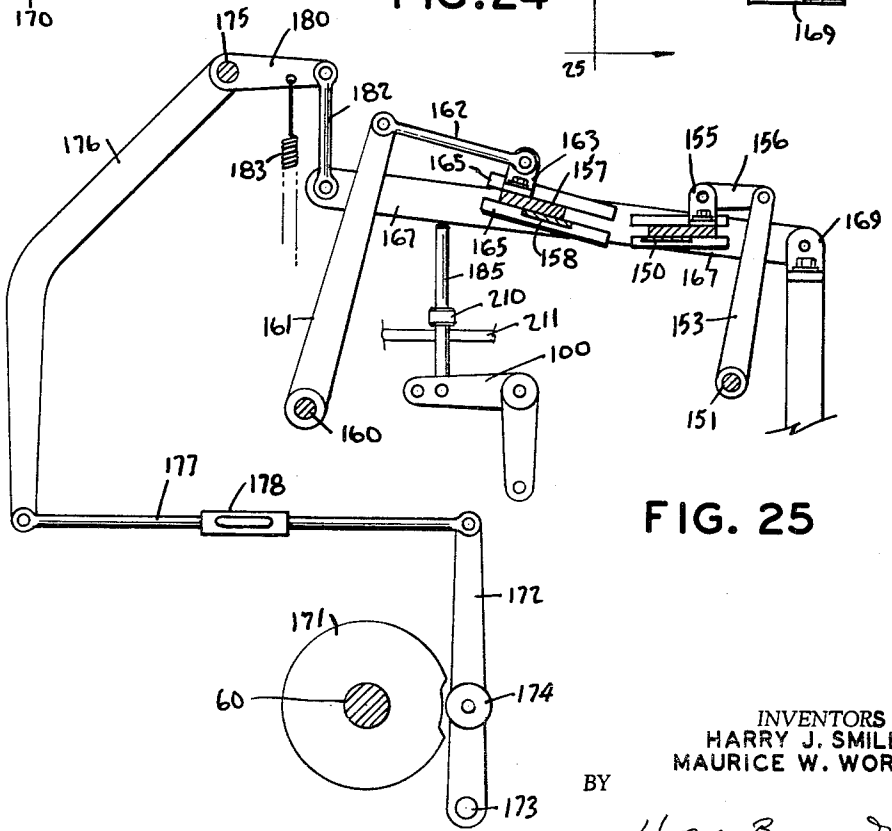


FIG. 25

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

Filed Dec. 20, 1962 18 Sheets-Sheet 11

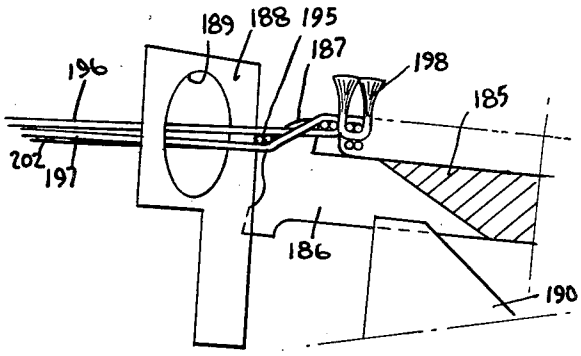


FIG. 26

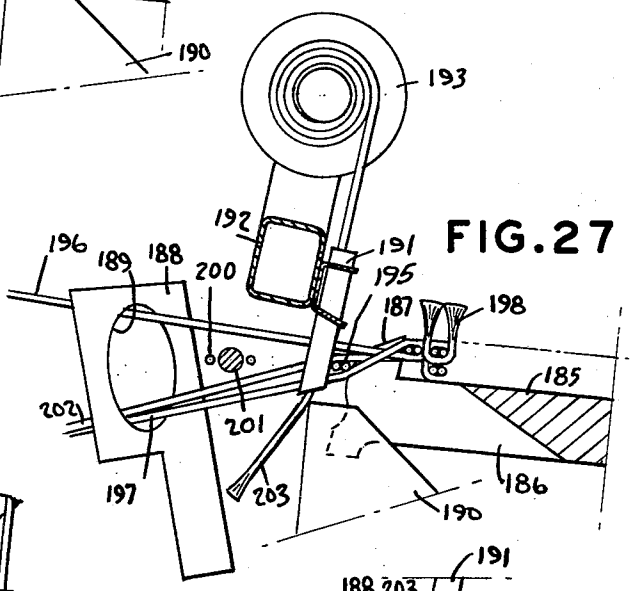


FIG. 27

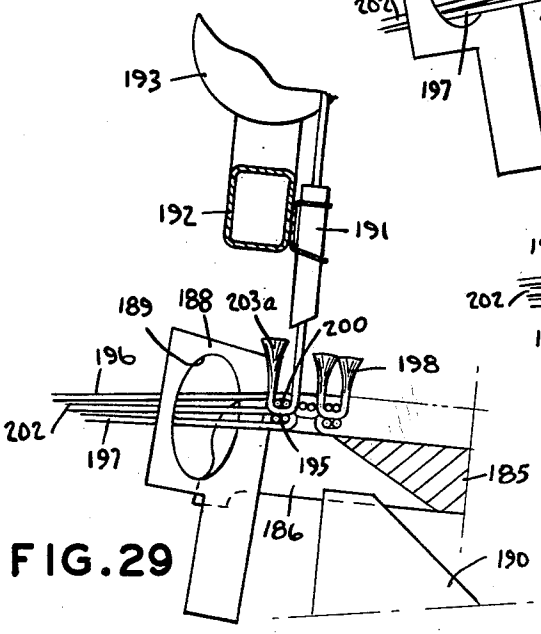


FIG. 29

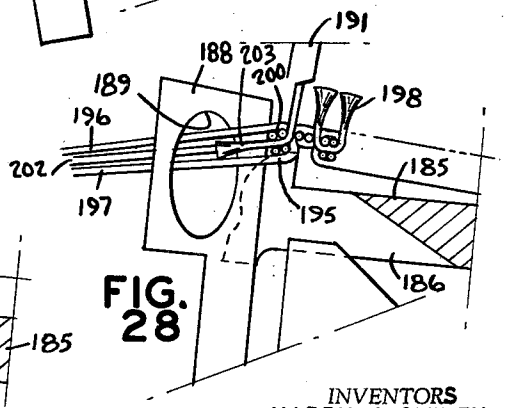


FIG. 28

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde W. Buckingham

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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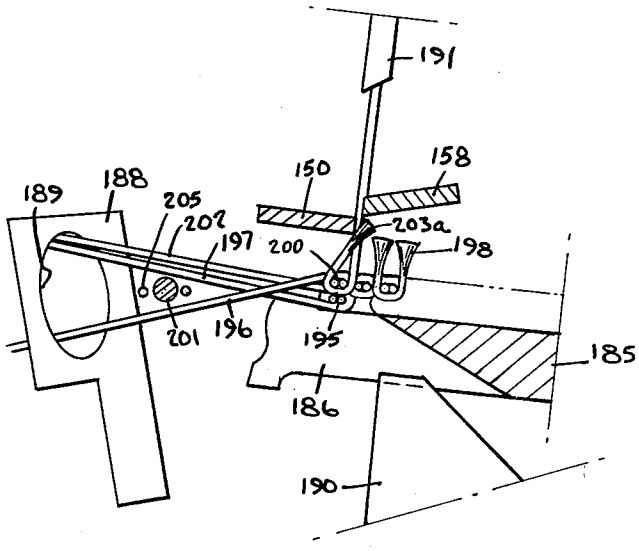


FIG. 30

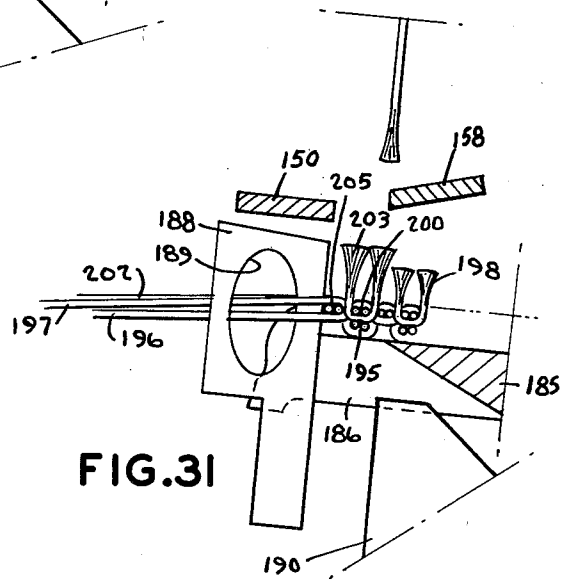


FIG. 31

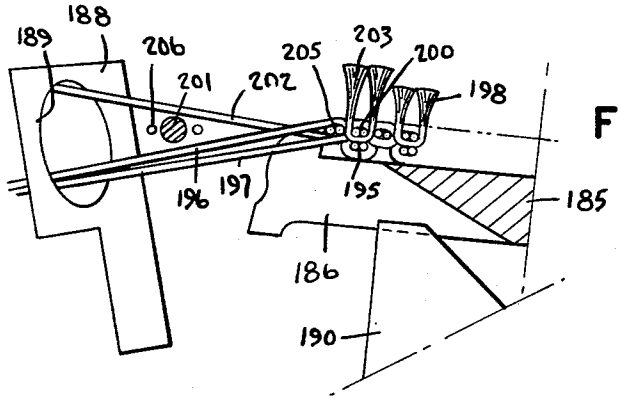


FIG. 32

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH
BY
Hyde & Baldwin

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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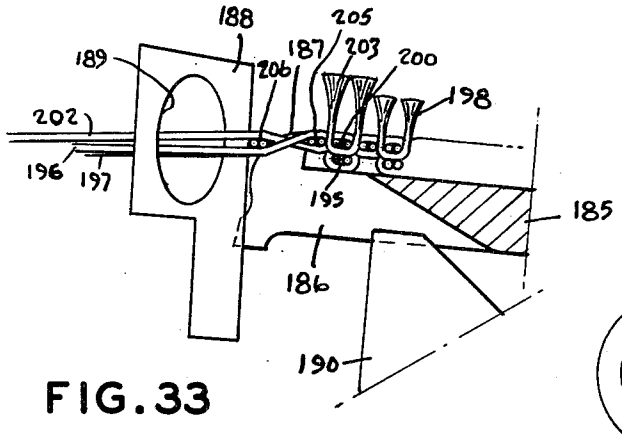


FIG. 33

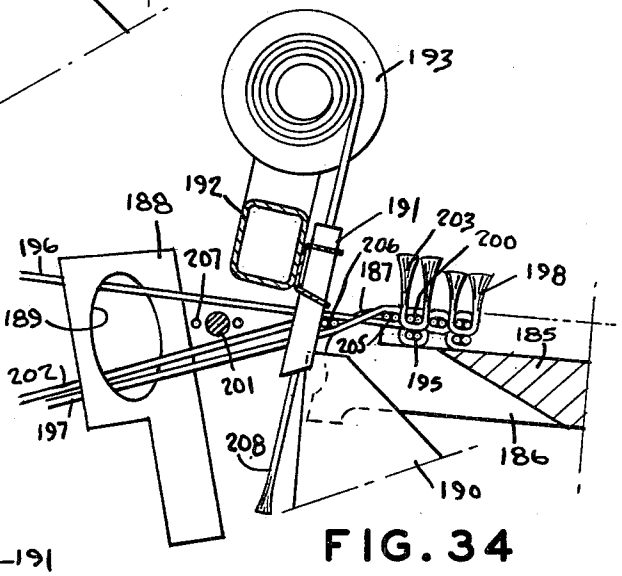


FIG. 34

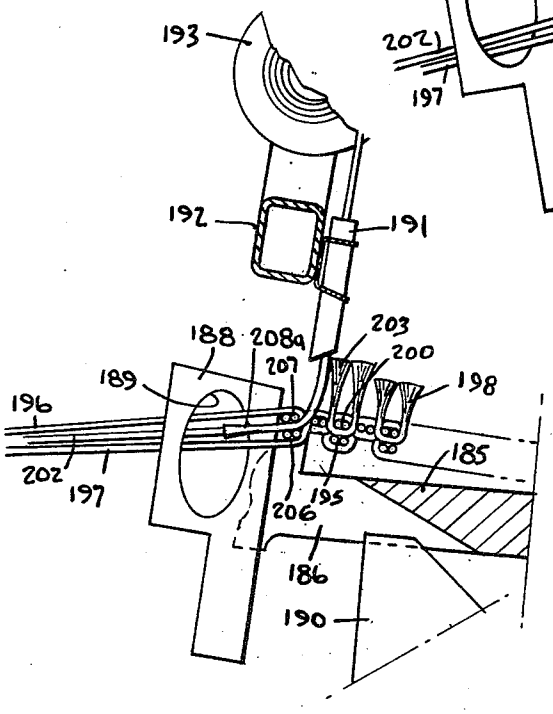


FIG. 35

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde W. Record

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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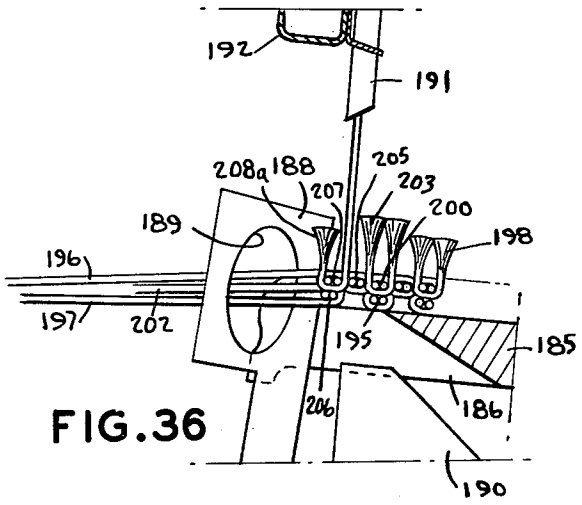


FIG.36

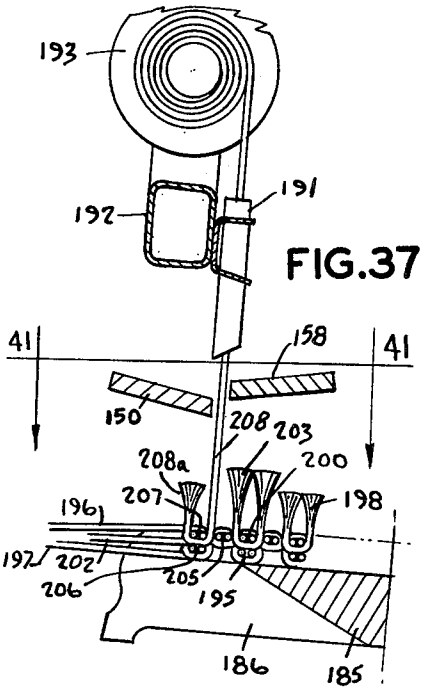


FIG.37

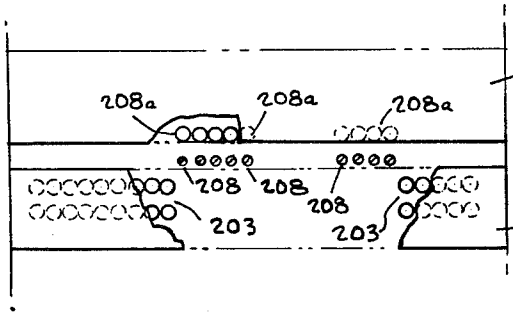


FIG.41

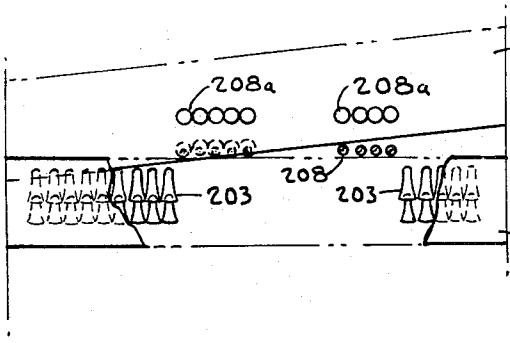


FIG.42

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde & Ballard

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

Filed Dec. 20, 1962 18 Sheets-Sheet 15

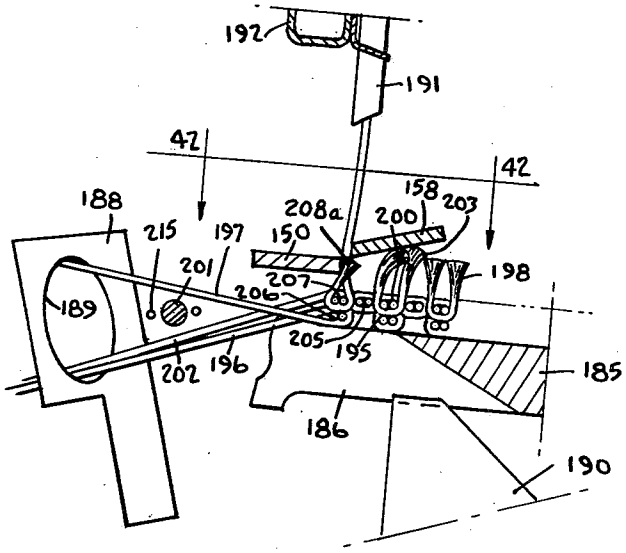


FIG. 38

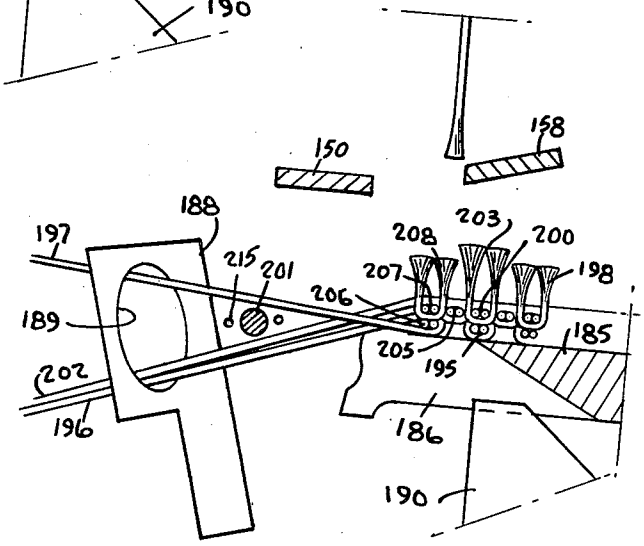


FIG. 39

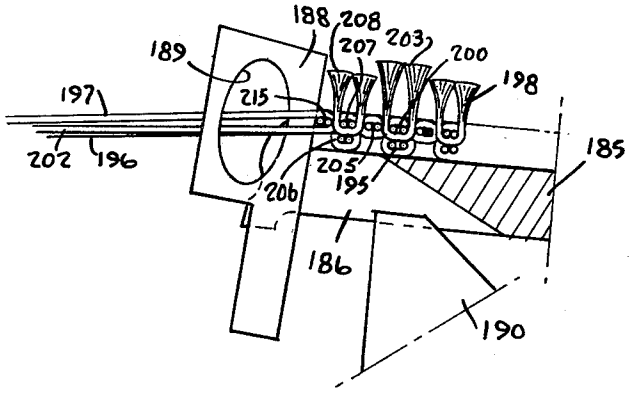


FIG. 40

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH
BY

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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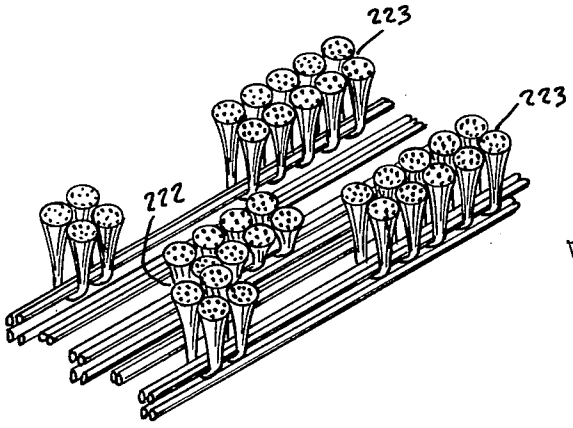


FIG. 43

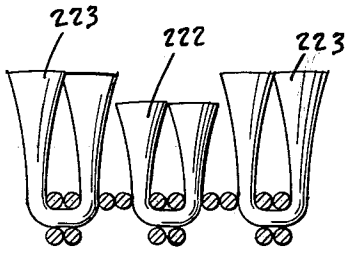


FIG. 44

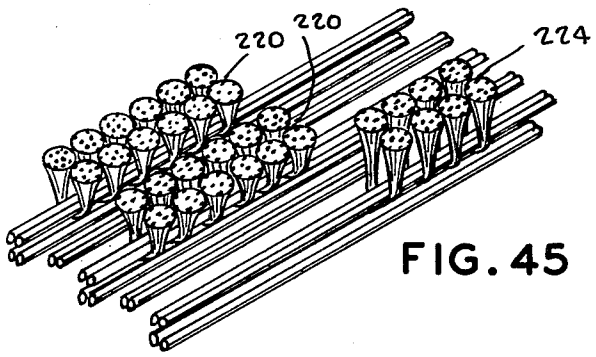


FIG. 45

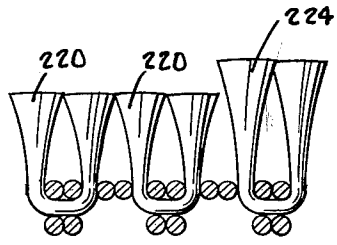


FIG. 46

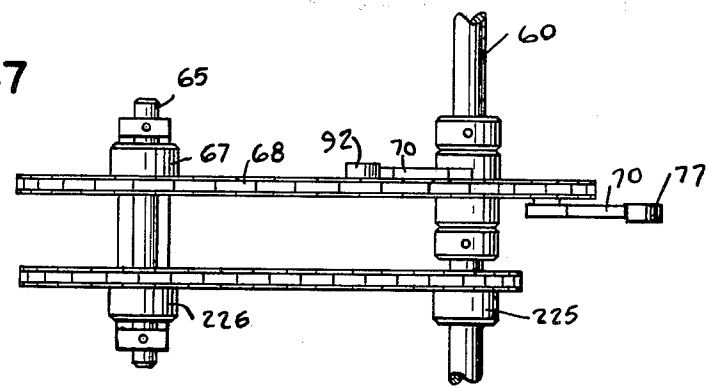
INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH
BY
Howard W. Ballard

June 8, 1965 H. J. SMILEY ETAL 3,187,779

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

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FIG. 47



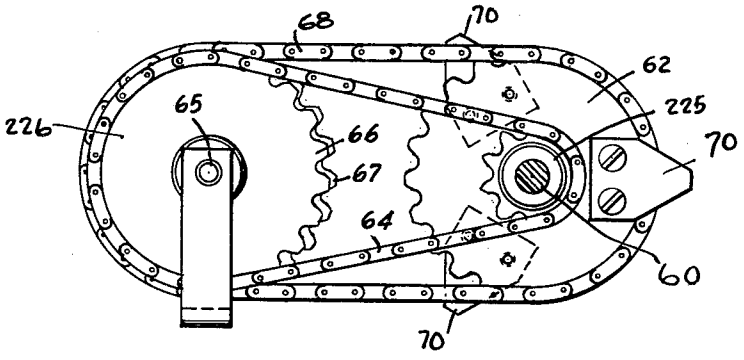


FIG. 48

INVENTORS
HARRY J. SMILEY
MAURICE. W. WORTH

BY

Hyde W. Ballard

June 8, 1965 H. J. SMILEY ETAL 3,187,779

VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINISTER LOOMS

Filed Dec. 20, 1962 18 Sheets-Sheet 18

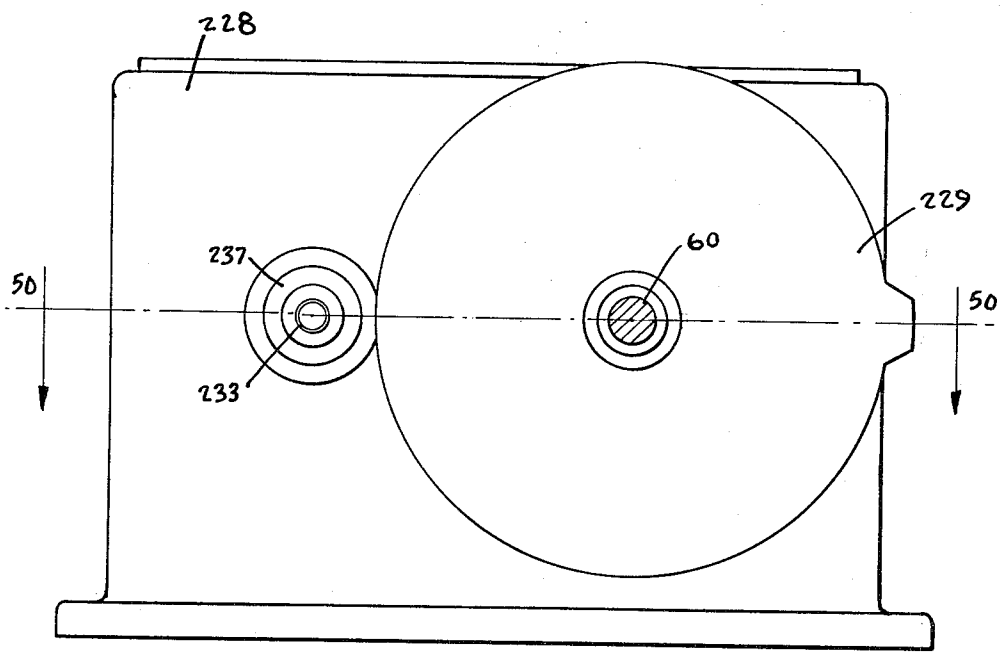


FIG. 49

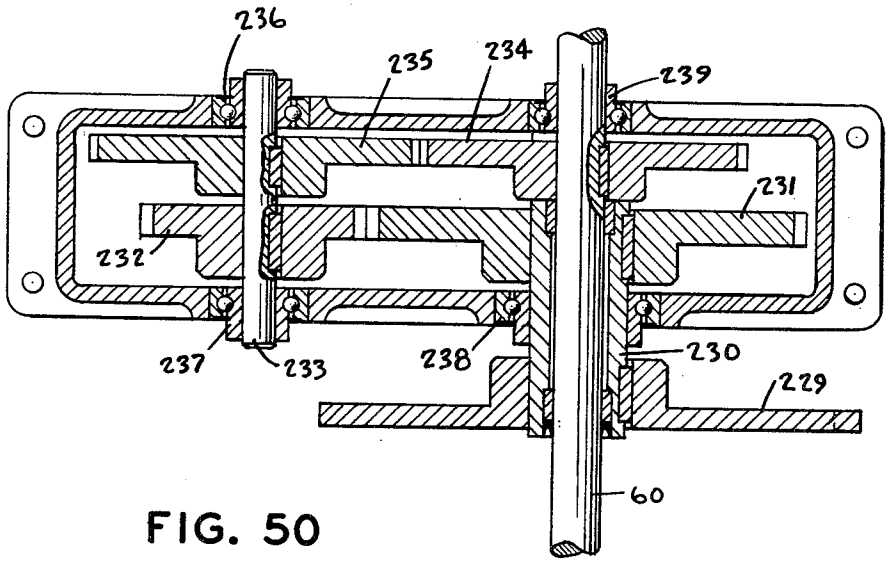


FIG. 50

INVENTORS
HARRY J. SMILEY
MAURICE W. WORTH

BY

Hyde & Ballard

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VARIABLE HEIGHT PILE CUTTING APPARATUS IN AXMINSTER LOOMS

Harry J. Smiley and Maurice W. Worth, Glasgow, Va., assignors to James Lees and Sons Company, Bridgeport, Pa., a corporation of Delaware

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This invention relates to an improved multi-height Axminster fabric and an Axminster carpet loom for producing pile tufts of two or more different heights.

Conventionally an Axminster loom of the type used to produce soft floor coverings has been capable of producing only one pile height. The pile tufts are wiped into the warp shed in the loom, whereupon they are anchored, the tube frame raised, and all of the pile yarns are severed by means of a knife extending entirely across the breast beam of the loom. With the current style trend requiring the production of sculptured or multiheight pile to achieve acceptable design effects, many attempts have been made to produce multi-level pile on the Axminster loom. Some of these have met with moderate success. However, the limitations in the pattern effects that can be achieved are substantial and, for the most part, it has been only possible to produce geometric designs of high and low uncut pile on an Axminster type loom.

The present invention permits the production of high and low cut pile on an Axminster loom in which it is possible to achieve much wider pattern effects since the present invention provides a more or less random control of the areas in which the low pile tufts are present and similarly the areas in which the high pile tufts are present. This is accomplished by threading only selected tubes in each tube frame with pile yarns. The Axminster loom is modified so that the pile yarns in any given tube frame may be cut high or low as desired. It will be understood that, by repeating a selected group of yarns in a series of successive tube frames, a continued area less than the entire width of the fabric may have either high or low pile as desired.

Conventional Axminster looms for producing pile carpets are of two types. The older, or comb-type, uses a comb to wipe up the pile tufts before the reed beats up against the fell. The "noseboard" Axminster loom employs a reed which beats up with alternately short and full strokes. On the full stroke the reed carries the last shot and the pile tufts up and over the hook of the noseboard which has the effect of wiping up the trailing ends of the inserted row of pile. We have modified both of the above conventional looms to produce selected high and low cut pile tufts. The modification takes slightly different forms depending upon which loom is employed. In the comb loom we provide a separate drive with alternate high and low movements of the comb to which an elevator bar is attached whereby in one part of the cycle the fabric is raised from the breast beam of the loom higher than at another portion of the cycle so that the height of the pile depends upon the elevation of the fabric at the time the knives cut.

In the case of the noseboard loom, we mount the knives on a vertically oscillating subframe which is timed to raise and lower the knives to provide the cutting for the high and low pile. Suitable mechanism for displacing previous pile tufts from the knives is likewise provided in both cases. This insures that in the transition from a high series of tufts to a low series of tufts none of the high tufts improperly extends between the knives.

A primary object of the invention, therefore, is to provide an attachment for an Axminster loom to cyclically vary the distance from the tube frames at which a series of pile tufts are severed.

A further object of the invention is to provide in an Axminster loom means for displacing the cutting point vertically for selected series of pile tufts.

A further object of the invention is to provide in a comb-type Axminster loom a stepped comb for elevating the fabric at predetermined positions in the weaving cycle.

A further object of the invention is to provide in a noseboard Axminster loom, means for cyclically raising and lowering the knives with respect to the nose of the loom.

A further object of the invention is to provide a loom for producing successive rows of either high or low tufts in an Axminster high and low cut pile fabric.

A further object of the invention is to provide in an Axminster loom for producing high and low pile, means for displacing pile tufts from the cutting means.

A still further object of the invention is to provide a multi-level Axminster pile fabric having predetermined random areas of high and low cut pile.

Further objects will be apparent from the specification and drawings in which

FIG. 1 is a side view of a comb-type Axminster loom constructed in accordance with the present invention,

FIG. 2 is a top view of a part of the structure of FIG. 1 as seen at 2—2 of FIG. 1,

FIG. 3 is a top view of the chain drive portion of the structure of FIG. 2,

FIG. 4 is an end view of the structure of FIG. 3,

FIG. 5 is a fragmentary section as seen at 5—5 of FIG. 2,

FIG. 6 is a view similar to FIG. 5 with the cam turned 180°,

FIG. 7 is a fragmentary section as seen at 7—7 of FIG. 2,

FIG. 8 shows the structure of FIG. 6 with the cam moved approximately 180°,

FIGS. 9–20 are schematic diagrams showing the successive steps in weaving a series of rows of high and low tufts on a comb-type Axminster loom as modified by the present invention,

FIGS. 21–23 show a modification for avoiding cutting of high tufts,

FIG. 24 is a top view showing the vertically oscillating knife supporting structure as applied to a noseboard Axminster loom,

FIG. 25 is a section of the structure of FIG. 23 as seen at 25—25,

FIGS. 26–40 are views similar to FIGS. 8–19 but showing the successive steps of weave series of high and low pile tufts on a noseboard Axminster loom,

FIG. 41 is a view as seen at 41—41 of FIG. 37 showing the knives just before cutting takes place,

FIG. 42 shows the knives of FIG. 41 in a moved position as cutting progresses and as seen at 42—42 of FIG. 38,

FIG. 43 is an exploded perspective showing an Axminster three shot fabric having alternating rows of high and low pile tufts,

FIG. 44 is an end view of the fabric of FIG. 43,

FIG. 45 shows a three shot exploded Axminster fabric having two adjacent rows of low tufts and a succeeding row of high tufts,

FIG. 46 is an end view of the fabric of FIG. 45,

FIG. 47 is a view similar to FIG. 3 showing the loom modification for producing the fabric of FIG. 45,

FIG. 48 is an end view of the structure of FIG. 47,

FIG. 49 is a modified drive for the camshaft of the Axminster loom utilizing a gear box instead of chains and sprockets, and

FIG. 50 is a section as seen at 50—50 of FIG. 49.

The invention comprises essentially the provision of a cam controlled actuating linkage for the comb in a comb-type Axminster loom. With a special cam plate and

sprocket driven from the loom camshaft, it is possible to selectively control the height to which the comb is elevated on alternate portions of the cycle or, if desired, more frequently during the cycle. In either case, one actuation of the comb in a cycle takes place in which the relative height of comb elevation is less than the height in other portions of the cycle. Raising the comb produces low pile and permitting the comb to remain at a relatively minimum raised position produces high pile. The depth of tube frame penetration into the shed also varies inversely with the comb elevation.

Alternatively in a noseboard loom, it is possible to cyclically raise and lower the knives when it is desired to cut high or low pile. The motion for raising the knives is likewise controlled through suitable linkage from the loom camshaft.

Referring now more particularly to the drawings a comb-type Axminster loom partially shown in FIGURES 1 and 2 has a frame **50**, chain warp and stuffer warp beams **51** and **52** journaled on the loom frame, and fabric take-up rollers **53**, **54** and **55**, which may direct the finished fabric onto a take-up beam in front of the loom (not shown) or to other take-up means in the back of the loom in which case the fabric F passes around roller **56**. The main camshaft **60** is journaled in the loom frame as may be seen in FIGURE 2 and a combination sprocket-cam plate **61** is freely journaled on the camshaft **60**. Depending upon the number of successive rows of high and/or low tufts desired, the speed reduction between the camshaft **60** and the crankshaft of the loom may be determined in accordance with the ratio of the diameters of sprockets **62** and **63**. The interconnecting drive between sprockets **62** and **63** is provided by a chain **64** which turns a jackshaft **65** through sprocket **66**. A sprocket **67** is also keyed to jackshaft **65** and drives the large sprocket **62** through chain **68**. The ratio of sprockets **63**, **66**, and **67** is 1:1 whereas the ratio of sprocket **62** to sprocket **63** is 2:1. It will thus be seen that shaft **60** turns twice as fast as sprocket **62**.

Sprocket **62** is provided with a cam or lobe **70** which pivots the front or high tuft actuating linkage journaled on shaft **71** and also the back or low tuft actuating linkage journaled on shaft **72**. One actuation of each linkage occurs for each revolution of sprocket **62**. This, of course, equals a single actuation for each revolution of shaft **60**. The front linkage for elevating the comb **75** comprises a rocker arm **76** pivoted on shaft **71**, a cam follower or roller **77** secured to rocker arm **76**, a reversing rocker **78** journaled on shaft **79**, one end of the reversing rocker **78** being connected to arm **76** by a link **80** and the other being connected to a lever **81** through a link **82**. Lever **81** is keyed to rockshaft **83** which is provided with a shorter lever **84** connected to the comb elevating rod **85**. This rod is provided with a turnbuckle **86** which permits proper adjustment of the comb **75** with regard to the timing of cam **70**. Lever **81** is also connected to the rear rocker arm **88** by means of a rod **89** having an adjusting turnbuckle **90**. Sprocket **62** turns in a counterclockwise direction as seen in FIGURES 1, 4, and 6 so that displacement of roller **77** to the right elevates comb **75** and this actuation of comb **75** through roller **77** occurs once per revolution of the sprocket **62** which corresponds to two revolutions of shaft **60**.

Referring now to FIGURE 6, it will be seen that roller **92** on rocker **88**, when out of contact with cam **70**, is normally positioned nearer the center of sprocket **62** than is the case with roller **77**. When the cam **70** displaces roller **77** to elevate comb **75**, the height to which the comb is raised will therefore be less than the height to which the comb is raised when it is actuated by roller **92** and rod **89**. With a single cam on sprocket **62**, the alternate high and low raising of the comb **75** produces a fabric in which alternate weftwise rows of pile tufts are cut high and low and the relative height of the tufts depends upon the difference in relative elevations of the comb **75**. The actuation of rod **89** at the opposite part of the cycle through roller **92** is shown in FIGURE 8.

We control the limit for tuft insertion by the tube frame **95** in timed relation to the comb action by means of the same cam **70**. Referring now to FIGURE 5, cam **70** strikes a roller **97** on rocker **98** also journaled on shaft **71**. Pivoting of rocker **98** raises the spool motion stop rod **99** through bell cranks **100** and **101**, connecting link **102**, and adjustable rod **103** provided with turnbuckle **104**. This action limits the depth that tube frame **95** dips into the shed in timed relation to the actuation of the comb and needle (FIG. 10) as will be explained more fully hereinafter. Dipping of the tube frame **95** at the 180° position of the cycle (FIG. 16) occurs when cam **70** strikes roller **105** on rocker arm **106** which is also pivoted on shaft **72**. Displacement of roller **105** limits the dip of tube frame **95** through movement of rod **107** which is connected to bell crank **100**. Adjustment of rod **107** is accomplished through turnbuckle **108** and it will be noted that the amplitude of movement of the dipping rod **99** is adjustable. It will be understood that the depth to which the tube frame **95** dips in the shed varies depending upon whether or not a high or low tuft is to be produced. The reason for this resides in the fact that the extent to which the pile yarn extends through the shed controls the height of the back tuft leg since the knives shear only the front leg.

On the formation of low pile as shown in FIG. 5, the limit control rod **99** for the tube frame **95** has been raised to an elevated position indicated by the clearance between the stop **109** on the control rod and stationary frame member **110**. Thus the extent at which the pile yarns are inserted in the shed and particularly at the time the reed beats up to lock the pile yarns in the fell of the fabric is determined by the vertical position of rod **99**. The tube frame and spool **111** are actuated in accordance with the conventional motion of the Axminster loom. The modification for purposes of the present invention being to cyclically vary the length of pile yarn extending through the shed on selective dips of the tube frame in accordance with the formation of high or low pile tufts. In FIG. 6 the movement of the control rod **99** is less than the movement in FIG. 5 since the greater dip will be required to provide a longer back tuft leg. If desired, the linkage shown in FIG. 6 may be dispensed with entirely if stop **109** is made adjustable and comes to rest on frame **110** at the proper position for forming the maximum dip which in turn provides the desired length for the high tuft leg.

Referring now to FIGURES 9–23, the weaving cycle for producing a three shot Axminster high and low pile fabric on a comb loom will be described. FIGURE 9 shows the reed **115** beating up the last double weft shot **116** over the breastplate **117**. The comb **75** is retracted during the beat-up. FIGURE 10 shows the reed **115** retracted, the insertion of the next subsequent double weft shot **118** by needle **119**, and tube frame **95** dipping into the shed to insert the next row of pile tufts **120**. The warp sheds have opened with the chain warp **121** raised, and stuffer warp **122** as well as chain warp **123** lowered. The comb **75** is beginning its upward movement. In FIGURE 11 the reed **115** has beaten up the weft **118** into the fell of the fabric and the pile tuft **120** is now in between the last weft **118** and the previous weft **116**. Comb **75** continues to elevate towards the fell of the fabric. In FIGURE 12 the reed has again retracted to permit the insertion of the next double weft **125**, the chain warps **121** and **123** having completed a reversal. The comb **75** has now wiped up the tuft **120** to a position just below the back knife **126** which is advancing in cooperation with the front knife **127** to the cutting position. Tube frame **95** has now been retracted to a point above the path of knives **126** and **127**. In the next portion of the cycle as seen in FIGURE 13, the reed has beaten up weft **125**, comb **75** has retracted, and the knives

126 and 127 have cut the tuft 120 to provide two pile legs which in this case are longer than the previously inserted pile tuft 128. The reed 115 again retracts for the insertion of the next succeeding double weft 129 (FIG. 14). The comb 75 is now fully retracted and a high tuft 120 having two legs has been inserted into the fabric.

FIGURE 15 shows the beat-up of the last weft 129 with comb 75 remaining fully retracted. On the next insertion, a low pile tuft will be produced. FIGURE 16 shows the reed retracted, weft 130 being inserted into the shed with the stuffer warps now in the bottom shed position, tube frame 95 dipping into the shed a shorter distance in the formation of the high tuft of FIG. 10, and the comb 75 starting to wipe up. As the reed 115 beats up the filling weft 130, the next pile yarn 131 is laced under the last weft 130 and over the previous weft 129. Comb 75 is elevating and in position to carry up the depending leg of the pile yarn 131. In FIGURE 18 the reed is again retracted for the insertion of the next double weft 132. The knives 126 and 127 are beginning to close, the tube frame has lifted from the shed, and the comb has wiped up the trailing end of the last inserted pile yarn 131.

In this portion of the cycle, however, low pile will be produced and to accomplish this result, we provide a bar 135 across the comb. When the comb advances to its highest point of elevation, bar 135 engages the bottom of the warps and raises the fabric from the breastplate 117 (FIG. 19). This raising of the fabric at the fell occurs just prior to severing of the pile tuft by knives 126 and 127. The raising of the fabric and the cutting are shown in FIGURE 19. The reed 115 continues its forward travel thus beating up the last inserted weft shot 132. FIGURE 20 shows this beat-up of weft 132, the formation of low pile, high pile, then low pile. This completes the cycle for producing alternate rows of high and low pile tufts.

FIGURES 21–23 show a modification in which the loom is provided with a guard or shield 140 under the front knife 127. The shield is advanced to the position shown in FIGURE 22 to prevent the previously formed high pile from becoming improperly cut or engaged between the knives 126 and 127. FIGURE 21 shows the relative position of the loom parts corresponding to FIGURE 18. FIGURE 22 shows the guard 140 advanced in front of the knives 126 and 127 to protect the rows of high tufts 120. As the knives continue to advance as shown in FIGURE 23, the guard 140 is withdrawn to the right which tends to wipe away the legs of tufts 120. FIGURES 22 and 23 correspond to the showing of FIGURES 18 and 19 in which a low tuft is formed following a row of high tufts. In this circumstance it is important to prevent the previous row of high tufts from being sheared in any way by the knives.

Referring now to FIGURES 24 and 25, the invention as applied to a "noseboard" Axminster loom, takes a somewhat different form than as applied to the comb-type Axminster loom previously described. A noseboard loom as noted above is provided with a breastplate having a back or nose with a forwardly facing vertical edge. Instead of employing a comb, alternate beat-ups of the reed force the fabric and particularly the last filling weft over the nose and down in back of the vertical edge. This has the effect of wiping up the pile tufts. However, a device which operates in a manner not unlike the comb, but which is called a "cleaner" assists in making sure that all of the trailing tuft edges are carried up and around the nose. In the case of a noseboard loom, the warp yarns, namely the binder chains and stuffers, are carried through the reed. A generally oval shape hole is provided for this purpose. The above contruction of a noseboard Axminster loom is entirely conventional and has been in regular use for many, many years. Heretofore, however, the fabric produced on a noseboard loom has all been of the same pile height. The present invention provides a means for producing multi-height pile tufts on the noseboard loom.

The knives for cutting the pile tufts on the noseboard loom operate in an area directly over the nose and have a scissors-like cutting action in that one knife or blade is fixed whereas the other blade moves in at one end to initially shear the pile yarns whereupon it is advanced or pivoted forwardly to cut each tuft successively rather than cutting all of the tufts at once. These knives are actuated in a well-known manner from the loom camshaft. In the present invention, however, we provide auxiliary pattern control mechanism for raising and lowering the knife assembly in accordance with the height of pile which is to be cut. The front knife 150 is controlled by a rockshaft 151 having two levers 152 and 153 keyed to the shaft. The levers are bolted to the front knife holder 154 by means of angle brackets 155, 155 and connecting links 156, 156. The back knife holder 157 carries the back knife 158 and is similarly actuated by a rockshaft 160 having a pair of levers 161, 161 which are connected to the back knife holder 157 through angle brackets 163, 163 and links 164, 164. Movement of the front and back knives is achieved through the rockshafts 151 and 160 in accordance with the conventional and well-known operation of the knives on an Axminster loom. In the present instance, however, each knife holder is carried in a pair of ways. The reference numbers 165, 165 designate the ways for the back knife holder. These ways are secured to side arms 167 and 168 pivoted at one end on angle brackets 169 and 170. The side arms 167 and 168 can be selectively elevated with respect to the loom frame and the fabric by means of a cam 171 which actuates the rocker 172 pivoted at 173 through a cam follower 174. Rocker 172 is connected to a rockshaft 175 through a lever 176 keyed to shaft 175 and a rod 177 having an adjustable turnbuckle 178. Pivoting of rockshaft 175 under control of cam 171 causes the side arms 167 and 168 to raise and lower the knives through short levers 180 and 181 keyed to the rockshaft 175 and connected to the free end of the side arms by links 182, 182. The rockshaft 175 is conveniently spring loaded in the lower position by means of an extension spring 183 which may be anchored to the loom frame at any desired point.

Referring now to FIGURES 26–42, the cycle of operation for producing both high and low tufts on a noseboard loom will be described in detail. The breastplate 185 of the noseboard loom is slotted at 186 and is provided with a nose or abutment 187 over which the various wefts are beaten up by the reed 188. As is customary with noseboard looms, the reed blades have apertures 189 through which the various warp yarns are threaded. A cleaner 190 is cyclically actuated to wipe up the pile tufts as they are dipped into the shed from the tubes 191 carried on the tube frame 192. The pile yarns are fed through the tubes from the spools 193 which are sequentially presented to the shed in the Axminster loom.

FIGURE 26 shows the partial beat-up of reed 188 in which a double filling weft 195 has been inserted into the shed and the chain warps 196 and 197 are in substantially a mid-position. Also shown in FIGURE 26 is a previously inserted pair of pile tufts formed by a pile yarn 198. These are shown as low tufts. In FIGURE 27 the reed 188 is retracted to permit insertion of the next double filling weft 200 by needle 201. Also the tubes 191 are shown dipping into the shed which is formed by the raising of chain warps 196 and the lowering of chain warps 197 and stuffer warp 202. The cleaner 190 has advanced to contact the new pile yarn 203 which has been positioned below the shed by the tube frame 192. In FIGURE 28 the reed 188 is beating up both the filling wefts 195 and 200 over the top of the nose 187. Pile yarn 203 is being bent around the top filling weft 200 and the cleaner 190 is retracted. FIGURE 29 shows the completion of the full beat up of the reed 188 in which both of the filling wefts 195 and 200 have been pushed

over the nose **187** and are retained in position on the top of the breastplate **185**. Also, the last inserted pile yarn **203** is beaten up and held erect to form a high pile tuft leg **203***a* as shown in FIGURE 29. With the reed in this position, the tube frame **192** and spool are elevated to withdraw more yarn from the spool **193**. The extent to which the tube frame dips into the shed and thus the height of the tuft leg **203***a* is controlled by the same linkage shown in FIGURES 1 and 5 which determines the back tuft leg height as described previously in conjunction with the comb loom.

In the next portion of the cycle the reed **188** retracts (FIG. 30) for insertion of the next filling weft **205**, the chains **196** and **197** now being reversed and the stuffer warp **202** raised to the top shed position. In order to cut the high tuft shown in FIGURE 30, cam **70** raises stop rod **85** so that side arms **167** and **168** are in a relatively higher position so that when the knives **150** and **158** are actuated, the pile yarn **203** is sheared at substantially the same height as the high tuft leg **203***a*. In FIGURE 31 the reed **188** has beaten up the weft **205** up over the nose **187**. The tube frame is being returned to the warp chain and the knives **158** and **150** are returned to their normal noncutting position. Next the reed retracts as shown in FIGURE 32 for the insertion of the subsequent filling weft **206** with both chain warps down and the stuffer **202** at the top shed position. The reed then beats up filling weft **206** to the partial position in front of nose **187** as shown in FIGURE 33.

At this point the cycle repeats except that the next series of tufts may be low instead of high. In this event the tube frame dips into the shed again ahead of the next filling weft **207** (FIG. 34). The cleaner **190** is advanced but the point at which filling weft **207** engages the pile yarn **208** is lower than when a high tuft is produced. This means that the tuft leg **208***a* is formed shorter than was the tuft leg **203***a* due to the control of the spool motion by stop cam **70**. FIGURE 35 shows the reed beating up the filling wefts **206** and **207** over the nose **187** of the breastplate. FIGURE 36 continues the full beat-up and shows the wefts **206** and **207** positioned in back of the nose **187** and the tuft leg **208***a* erect and of a shorter height than the pile tufts **203**. In the position of FIGURE 36 the tube frame elevates to withdraw more yarn from the spool **193**. To cut the short tuft, however, the side arms **167** and **168** remain in the low position in accordance with the timing of cam **70** so that when the knives **150** and **158** are advanced, they will cut the pile **208** at the same height as the short tuft leg **208***a*.

It will be understood that the control of the spool motion including the tube frame **192** is effected in the same manner and with the same apparatus as shown in FIGS. 1, 5, and 6. The linkage shown in these figures for controlling the comb is utilized in modified form to provide a limit for the movement of the slide arms **167** and **168** and for this purpose the rod **85** is modified as shown in FIG. 25 and is provided with an adjustable stop **210** which in lowered position rests against a stationary frame element **211**. Cam **171** is keyed to the shaft **60** and is provided with a dwell **212** which permits the side arms to pivot downwardly and rest against the stop rods **85, 85** which, in the low position for cutting low pile, will be controlled by the stops **210**, but in the position for cutting high pile will be elevated as shown in FIG. 25 by means of cam **70** and its associated control linkage through bell crank **100**.

The vertical movement of the knives **150** and **158** performs a second function in addition to controlling the height at which the pile tufts are cut. Referring to FIGS. 37, 38, 41, and 42, it will be seen that the knives are in an elevated position as they are beginning to close in preparation for cutting the yarn. They are retained in this partially closed position as shown in FIGS. 37 and 41, during the time that the knives are lowered by cam **171** so that they descend in a substantially vertical direction just prior to making the cut. The purpose for this action is to displace the previous tufts by the front knife **150** which is canted as shown in FIG. 38. This motion in a vertical plane instead of a horizontal plane pushes aside the previous tufts and prevents them from being cut. Obviously this function is of critical importance when the tufts in the previous row are high and the next row to be cut is low. This condition is shown in FIG. 38.

Continuing with the weaving cycle, FIG. 37 shows the pile yarn **208** positioned ready for cutting by the knives with the tube frame and spool in an elevated position. In FIG. 38 the reed **188** has retracted for the insertion of the next weft **215** with the stuffer warp **202** in the bottom shed position. After the pile tuft **208** is cut, as shown in FIG. 39, the knives again raise and open and the next spool is returned to the crib chain. The reed **188** then beats up as shown in FIG. 40 whereupon the cycle repeats.

The foregoing description shows the weaving of a three shot Axminster fabric having high and low pile tufts in alternate rows. Since the pile yarns are omitted from certain tubes in each frame, there will be gaps in each transverse row. These gaps are filled by aligned rows of pile of a different height in the preceeding and succeeding rows. This feature is shown in FIG. 43 in which the fabric has been expanded to illustrate the successive gaps in each weftwise row of pile tufts.

Where the pattern requires a plurality of succeeding rows having the same height of pile, a modification is utilized to produce the fabric, for example, such as shown in FIGS. 45 and 46. In this case we show two succeeding rows **220** and **221** of low tufts, there being shown six pile yarns having double tuft legs in each row. This is contrasted to the alternate rows **222** and **223** of FIG. 43 in which the low pile yarns are aligned with a gap in the high pile yarns in row **223**. This modification is described in FIGS. 47 and 48 in which the sprocket ratios are changed to call for a 3:1 reduction between shaft **60** and sprocket **62**. This simply means that the ratio between sprocket **225** and sprocket **226** on jackshaft **65** is 1:3 whereas the ratio between sprocket **67** and **62** remains 1:1. By placing one or more cams **70** on sprocket **62**, the actuations per revolution of shaft **60** may be controlled so that there are two successive actuations of the low pile mechanism for two successive revolutions of shaft **60** which may be followed by one or more actuations of the high pile linkage. In other words, pile is formed for each revolution of camshaft **60**. Whether high or low pile will be formed in any particular revolution of the shaft **60** depends upon whether the high or low linkage is actuated by cam **70**. If the repeat for high and low pile is selected to be three rows per revolution of shaft **60**, then the ratio between shaft **60** and sprocket **62** should be 3:1. Likewise the sequence of the actuation is determined by the location and number of cams **70** on sprocket **62**.

A wider variation of the ratios is possible by employing suitable gearing such as shown in FIGS. 49 and 50 which may be in the form of spur gears driven from camshaft **60** to sprocket **62** or a variable speed driving connection may be employed. Such a gearbox is shown at **228** in FIG. 49 in which the sprocket **62** is replaced by a cam **229** for actuating the linkages in accordance with any desired pattern. Cam **229** is keyed to a sleeve **230** journaled on shaft **60** which is in turn driven by a gear **231** also keyed to the sleeve which meshed with gear **232** on jackshaft **233**. The jackshaft is driven from shaft **60** by a pair of meshing gears **234** and **235** keyed to shaft **60** and **233** respectively. Shaft **233** is journaled in the housing **228** with bearings **236, 237** whereas sleeve **230** is journaled in the housing with bearings **238** and bearing **239** journals the far end of shaft **60** in the housing.

The present invention for the first time provides a satisfactory method and apparatus for producing sculptured

cut pile on an Axminster loom. The variations possible with differently colored yarns selectively supplied through less than all of the tubes in various tube frames of a set enable the carpet designer to provide high pile areas of one color and low pile areas of a contrasting color and the color of the yarn in any particular area can be chosen as the designer wishes. Not only can the color in any particular area be selected, but the color of any particular tuft in the repeat may be chosen. The invention as described herein has been applied to both of the conventional types of Axminster loom, namely the comb loom and the noseboard loom. Such looms have been used for over half a century and examples of relatively late descriptions may be found in U.S. Patents 2,057,394 to Robertson and 2,804,096 to Hughes for a comb type loom. Relatively recent showings of noseboard looms may be found in Dacey, 1,973,335 and Robertson, 2,021,431.

Having thus described our invention, we claim:

1. In an Axminster pile fabric loom having a dipping spool motion and a pair of knives for shearing pile tuft legs, the subcombination which comprises cyclically controlled mechanism for varying the extent of spool motion dip in accordance with a pattern, means including a cam for controlling said mechanism, and means for cyclically presenting short and long tuft legs to said knives in accordance with and in timed relation to the means for varying the dip of the spool motion.

2. Apparatus in accordance with claim 1 in which the means for presenting the tuft legs to the knives comprises a comb, a fabric lifting element on said comb, and pattern means for selectively presenting the comb to the underside of the fabric to lift the fabric from a breastplate on the loom and thereby to present a shorter length of pile yarn to the knives.

3. Apparatus in accordance with claim 1 in which the means for presenting the tuft legs to the knives comprises a cradle on which said knives are mounted, means for cyclically raising and lowering the cradle in timed relation to the spool motion to cut pile yarns at varying distances from a breastplate on the loom.

4. In a comb type Axminster pile fabric loom, the subcombination which comprises a spool motion including a tube frame, means for controlling the dip of said tube frame into and through a warp yarn shed on the loom, a pair of pile cutting knives for severing pile yarn from the tube frame, a comb oscillatable from underneath the fabric being woven to wipe up free ends of pile yarns, a stop on said comb, and pattern means for selectively elevating the comb and stop to lift the fabric being woven closer to the pile cutting knives in selected portions of a cycle.

5. Apparatus in accordance with claim 4 in which the comb elevating mechanism is driven at half loom speed thus producing alternate rows of high and low pile tufts.

6. Apparatus in accordance with claim 4 in which the comb elevating mechanism is driven at one third loom speed.

7. Apparatus in accordance with claim 4 having a guard positioned to hold down the tuft legs in a previously cut row.

8. Apparatus in accordance with claim 4 having a guard movable between one of the knives and the fabric for wiping previously cut tuft legs away from the cutting point of the knives.

9. In a noseboard Axminster pile loom having a spool motion, a breastplate, a pair of knives for cutting pile tufts, the subcombination which comprises a cradle on which said knives are mounted, means for raising and lowering said cradle to cyclically control the height of the knives from the breastplate, and pattern means including a cam for actuating the cradle in timed relation to the spool motion.

10. The method of producing high and low Axminster cut pile fabric which comprises the steps of wiping a series of pile yarns into a warp yarn shed, inserting a filling weft into said shed, beating up the pile yarns and the filling weft into the fell of the fabric, sequentially and variably controlling the length of the pile yarns at the point of beat up to provide a first series of relatively high tuft legs, concurrently controlling the distance between a pair of knives and the fell of the fabric, and cutting pile yarns at said controlled distance to provide a plurality of U tufts in said series for equal legs.

11. The method of producing high and low Axminster cut pile fabric which comprises the steps of wiping a series of pile yarns into a warp yarn shed, inserting a filling weft into said shed, beating up the pile yarns and the filling weft into the fell of the fabric, sequentially and variably controlling the length of the pile yarns at the point of beat up to provide a first series of relatively low tuft legs, concurrently controlling the distance between a pair of knives and the fell of the fabric, and cutting pile yarns at said controlled distance to provide a plurality of U tufts in said series for equal legs.

12. The method of producing high and low Axminster cut pile fabric which comprises the steps of wiping a series of pile yarns into a warp yarn shed, inserting a filling weft into said shed, beating up the pile yarns and the filling weft into the fell of the fabric, sequentially and variably controlling the length of the pile yarns at the point of beat up to provide a first series of relatively high tuft legs, concurrently controlling the distance between a pair of knives and the fell of the fabric, cutting the pile yarns at said controlled distance, wiping in a second series of relatively low tuft legs, concurrently controlling the distance between the knives and the fell of the fabric, and cutting the pile yarns to provide a plurality of U shaped pile tufts in the second series of equal length but shorter than the pile tufts in the first series.

13. The method of producing high and low Axminster cut pile fabric which comprises the steps of wiping a first series of pile yarns into a warp yarn shed, inserting a filling weft into said shed, bending the ends of said pile yarns around said filling weft to form a plurality of single pile tuft legs, beating up the pile yarns and the filling weft into the fell of the fabric, cutting the pile yarns at a point above the fell of the fabric to provide a first row of U shaped pile yarns, wiping a second series of pile yarns into a warp shed, inserting a filling weft into said shed, bending the ends of said pile yarns around said filling weft to form a plurality of single pile tuft legs in the second series but of a different height from the tuft legs in the first series, beating up the pile yarn and the filling weft into the fell of the fabric, and cutting the pile yarns of the second series at a point above the fell of the fabric to provide a second row of U shaped pile yarns of different height from the pile yarns in the first series.

14. The method of producing high and low Axminster cut pile fabric which comprises the steps of wiping a first series of pile yarns into a wrap yarn shed, inserting a filling weft into said shed, bending the ends of said pile yarns around said filling weft to form a plurality of single pile tuft legs, beating up the pile yarns and the filling weft into the fell of the fabric, cutting the pile yarns at a point above the fell of the fabric equal to the height of said single pile tuft legs to provide a first row of U shaped pile yarns, wiping a second series of pile yarns into a warp shed, inserting a filling weft into said shed, bending the ends of said pile yarns around said filling weft to form a plurality of single pile tuft legs in the second series but of a different height from the tuft legs in the first series, beating up the pile yarn and the filling weft into the fell of the fabric, and cutting the pile yarns of the second series at a point above the fell of the fabric equal to the height of the pile tuft legs in the second series to provide a second row of U shaped pile yarns of different height from the pile yarns in the first series.

15. The method of claim 13 including the step of

elevating the fell of the fabric to vary the height of the cutting.

16. The method of claim **13** including the step of maintaining the fell of the fabric constant, and varying the shear point at which the pile yarns are cut.

17. The method of claim **13** including the step of wiping back previously cut pile tuft legs.

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MERVIN STEIN, *Primary Examiner.*

RUSSELL C. MADER, DONALD W. PARKER, *Examiners.*