

**July 30, 1968**

W. J. CRENSHAW ET AL

**3,394,739**

# APPARATUS FOR MAKING PLUSH FABRICS

Filed March 31, 1966

3 Sheets-Sheet 1

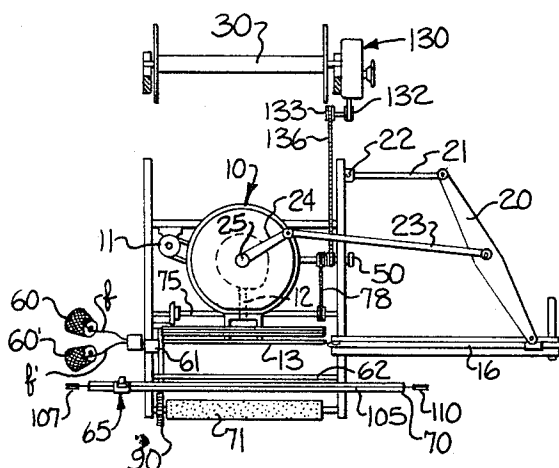


Fig-1

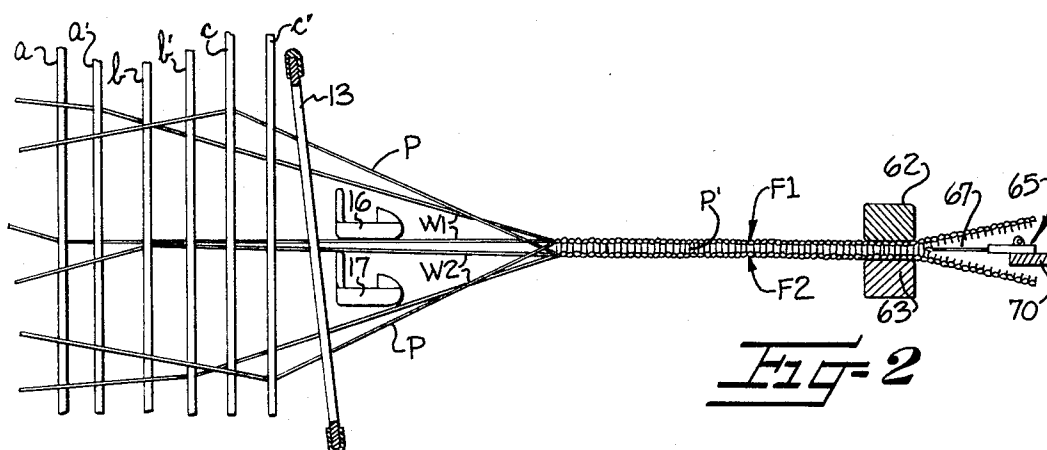
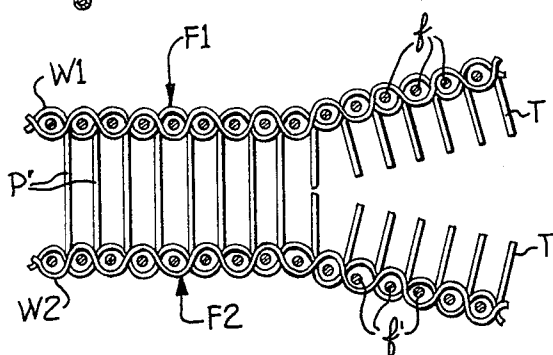


Fig-2



*Fig-3*

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3 Sheets-Sheet 2

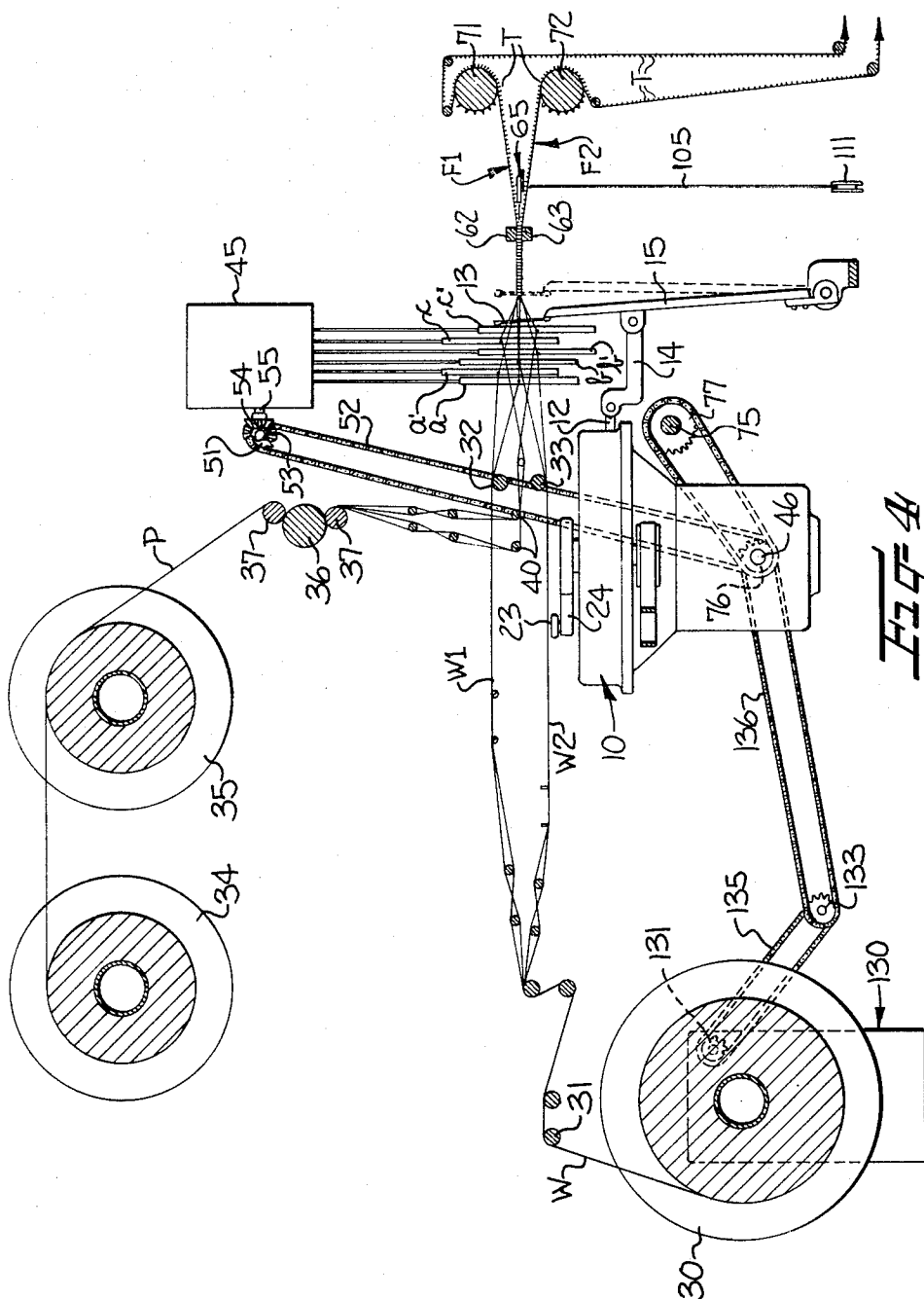


FIG. 4

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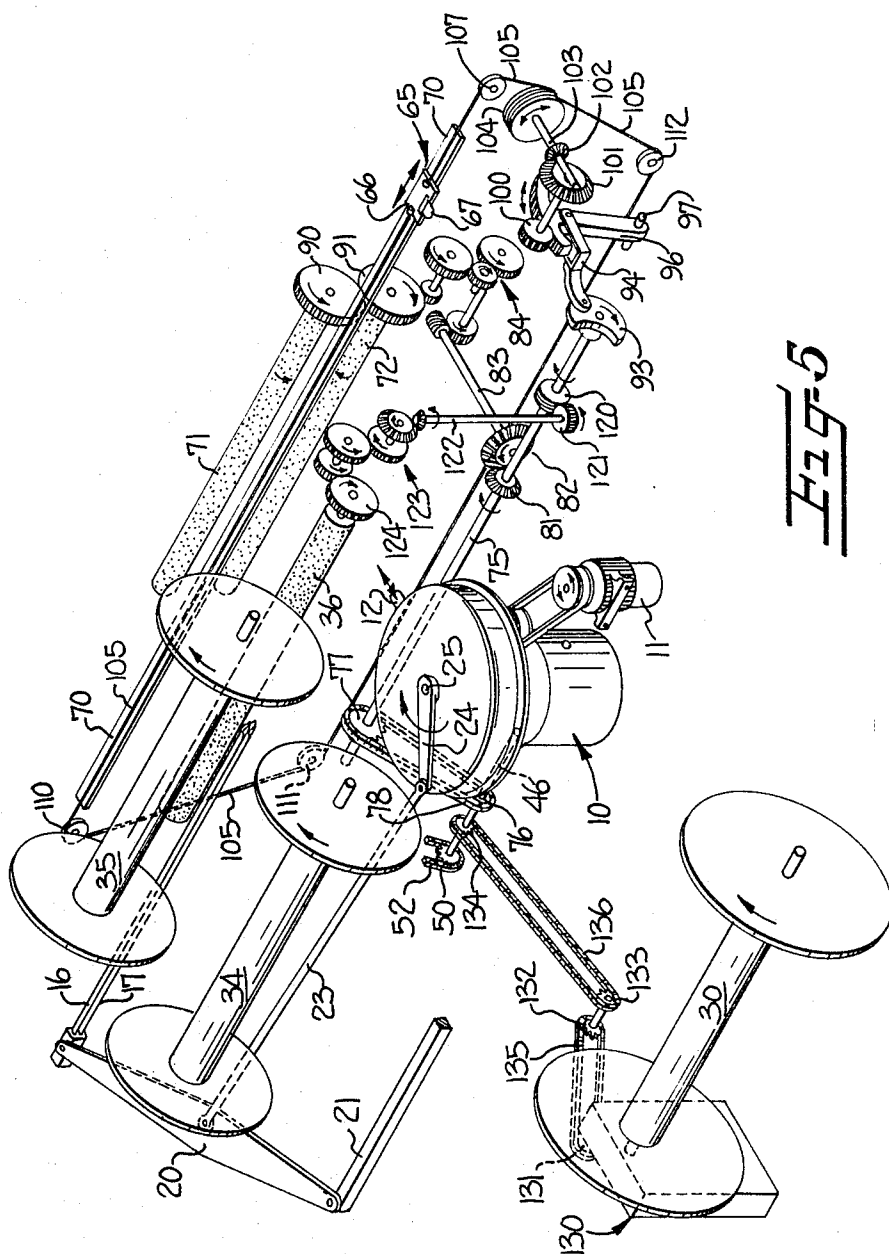
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# APPARATUS FOR MAKING PLUSH FABRICS

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3 Sheets-Sheet 3



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## APPARATUS FOR MAKING PLUSH FABRICS

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Filed Mar. 31, 1966, Ser. No. 538,995  
5 Claims. (Cl. 139—21)

### ABSTRACT OF THE DISCLOSURE

A conversion of a shuttleless loom of the type having a driven central mechanism driving a pair of superposed weft drawing rapiers and a reed for weaving plush fabrics, wherein special shed forming means cooperates with the rapiers and reed to weave two superposed webs with interconnecting pile warp portions therebetween. Take-up means are provided for the webs as a reciprocating blade severs the pile warp portions to disconnect the webs. The shed forming means, the take-up means and the reciprocating blade also are driven by the central mechanism.

This invention relates to an apparatus and method for making plush fabrics utilizing a shuttleless loom of the type having reciprocating weft-laying rods, commonly known as rapiers, for drawing wefts through the warp sheds during weaving. More particularly, this invention is concerned with the conversion of a loom of this type for weaving plush fabrics thereon.

Conventional plush weaving looms form two superposed ground warp sheds and a pile warp shed common to both ground warp sheds and through which wefts are inserted by superposed reciprocating shuttles each containing a cop or bobbin of weft thread therein. The picking motions of such conventional plush weaving looms are necessarily quite complicated, certain parts of them become worn beyond further use in a relatively short period of time and therefore must be replaced quite frequently, and frequent adjustment of the picking motion is required. More importantly, only a few such looms may be properly attended by a single operator because, among other reasons, every time the supply of weft yarn in a shuttle becomes exhausted, the loom stops and the exhausted cop or bobbin must be manually replaced by a filled cop or bobbin, thus reducing production. The weft drawing rapiers of the aforementioned shuttleless loom, on the other hand, are reciprocated by relatively simple mechanism including relatively few parts and practically no adjustment once the loom has been set up for operation. Also, the sources of weft yarn for the rapiers may operate continuously for very long periods of time without replacing the weft yarn supply.

It is therefore an object of this invention to provide a shuttleless loom adapted for making plush fabric comprising an oscillatable reed, and a pair of reciprocating weft drawing rapiers movable into respective warp sheds for drawing wefts from respective weft supplies through the sheds, means cooperating with said reed and rapiers for forming plush fabrics from ground warps, wefts and pile warps and comprising first and second shed forming means for repeatedly forming respective upper and lower independent ground warp sheds from respective groups of said ground warps for movement of the respective rapiers therethrough to weave respective upper and lower webs of fabric therefrom, a third shed forming means for repeatedly forming pile warp sheds of substantially greater height than and common to both said upper and lower ground warp sheds and through which both rapiers move with each reciprocation thereof whereby the pile warps extend between and are interwoven with both webs of

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fabric, means on the loom for severing the portions of pile warps extending between the webs and thereby disconnecting the webs, and means for taking up the disconnected webs.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings in which:

FIGURE 1 is a somewhat schematic plan view of a shuttleless loom converted for weaving plush fabrics, according to the present invention;

FIGURE 2 is an enlarged view of the shed forming means and reed, showing how the two woven webs of fabric are woven with the pile yarns extending therebetween and also showing the severing means for severing the pile yarns and disconnecting the two webs;

FIGURE 3 is an enlarged fragmentary longitudinal vertical sectional view through a portion of the fabric adjacent the cutting means of FIGURE 2;

FIGURE 4 is a schematic longitudinal vertical sectional view through the loom as it is converted for weaving plush fabrics; and

FIGURE 5 is a perspective schematic view of the operative drive connections between the common central driving unit and various operating mechanisms of the loom.

The shuttleless loom with which the present invention is associated may be of a type known as "American IWER Shuttleless Weaving Machine" and such as is disclosed in Ancet et al. U.S. Patents Nos. 2,837,124; 2,960,118; and 2,977,996, for example. Conventionally, looms of this type comprise a central circular motion mechanism 10 driven by a motor 11, which mechanism may be of the type disclosed in said Patent No. 2,837,124, to which reference is made for a detailed disclosure thereof. The central mechanism 10 reciprocates an arm 12 forwardly and rearwardly to oscillate a reed 13 through the medium of a pitman arm 14 and pivoted swords 15. Such looms are also provided with one or two elongate weft drawing members or rapiers, two of which are employed in this instance and indicated at 16, 17, and which are reciprocated into and out of respective warp sheds and in front of the reed 13 in timed relation to oscillation of the reed, by connections with the central mechanism 10.

The connections between rapiers 16, 17 and central mechanism 10 may be as shown in said last-named patent and include a lever 20 having its front end pivotally connected to the outer ends of rapiers 16, 17, and having its rear end pivotally connected to a swing lever 21 which extends inwardly and is pivotally connected to the loom frame as at 22 (FIGURE 1). A connecting rod 23 extends from a medial portion of lever 20 to one end of a crank 24 fixed on a continuously rotating upright shaft 25 of the central mechanism 10.

A sheet of ground warp yarns W is drawn from a suitable ground warp beam 30 over rolls 31 and is separated into two groups or sheets of upper and lower ground warps W1, W2. In order to accommodate the passage of pile warps P in a plane between the upper and lower ground warps W1, W2, the latter warps are held in substantially vertically spaced relationship by suitable guide bars 32, 33 extending transversely of and attached to the frame of the loom. Pile yarns P are drawn from suitable pile warp beams 34, 35 suitably supported above the sheets of upper and lower ground warps W1, W2. Pile warps P are advanced toward reed 13 by a driven pile warp let-off or feed roll 36 and are held in engagement with roll 36 by suitable idler rolls 37. From the lower idler roll 37, pile warps P extend downwardly through the upper sheet of ground warps W1 and then pass beneath

and partially around guide rods 40 so located that the pile warps P pass forwardly between the ground warp guide rods 32, 33 and thus pass between the upper and lower sheets of ground warps W1, W2.

From guide rods 32, 33, warps W1, W2, P extend through respective shed forming means shown, in this instance, in the form of two harnesses for each sheet of warps W1, W2, P. As best shown in FIGURE 2, alternately spaced upper ground warps W1 may extend through the heddles of a harness *a* while intervening upper warps W1 extend through heddles of a harness *a'*. Alternately spaced lower or bottom ground warps W2 may extend through the heddles of a harness *b* and intervening lower warps W2 extend through the heddles of a harness *b'*. Alternately spaced pile warps P may extend through the heddles of a harness *c* and intervening pile warps P extend through a harness *c'*. Harnesses *a*, *b*, *c* may be raised and lowered in opposition to the respective harnesses *a'*, *b'*, *c'* by any suitable harness or heddle operating means driven by central mechanism 10. It is important, however, according to the present invention, that the extent of vertical movement imparted to the pile warp harnesses *c*, *c'* is substantially greater than that imparted to harnesses *a*, *a'*, *b*, *b'* and that the range of vertical movement imparted to harnesses *a*, *a'* is substantially the same as, but on a higher level than, the range of vertical movement imparted to harnesses *b*, *b'*, so that independent ground warp sheds are formed from the sheets of upper and lower ground warps W1, W2 and so that a relatively large pile warp shed is formed of the pile warps P which is common to both of the ground warp sheds.

As shown in FIGURE 4, harnesses *a-c*, *a'-c'* are connected to and operated by a harness operating mechanism, dobby or any desired form of pattern device 45, which may be of any well known type, and is spaced above the harnesses. Dobby 45 is also driven by central mechanism 10. To this end, central mechanism 10 has a substantially horizontal output shaft 46 in the lower portion thereof which is continuously driven during normal operation of the loom and which is connected, by means of sprocket wheels 50, 51, an endless chain 52 and gears 53, 54 to the input shaft 55 of dobby 45. Since the manner in which dobbies are adjusted in order to effect various ranges and/or extents of vertical movement to harnesses is well known in the art, a detailed illustration and description of the dobby 45 is deemed unnecessary.

The weft drawing members or rapiers 16, 17 may each be constructed and operated substantially in the manner of the weft drawing member disclosed in said U.S. Patent No. 2,960,118. In this instance, weft drawing members 16, 17 are arranged in superposed spaced relationship so that, during each reciprocation thereof, they pass through the sheds formed of the respective ground warps W1, W2, while passing through the common pile warp shed. At the end of each inward stroke of the weft drawing members 16, 17 through the sheds, the free ends of the weft drawing members 16, 17 grasp respective weft yarns or filling yarns *f*, *f'* (FIGURE 1) from respective yarn packages or other suitable stationary sources of supply 60, 60' located outwardly of and adjacent one side of the sheds being formed so that, upon the succeeding return or outward stroke of weft drawing members 16, 17, weft yarns *f*, *f'* are drawn through the common pile warp shed and the respective upper and lower ground warp sheds, after which the reed 13 beats the thus inserted weft yarns against the fell of the fabrics being woven. As is well known, the weft yarns may be severed at the selvages of the fabric being woven following the insertion of the weft yarns through the warp sheds or following successive beat-up strokes of reed 13. A suitable weft yarn severing device 61 (FIGURE 1) is provided for severing the ends of each weft yarn inserted through the corresponding sheds at a point between the corresponding source of supply and the adjacent side of the sheds or fabric webs being formed. Such weft sever-

ing device may constitute a part of each rapier 16, 17 as disclosed in said Patent No. 2,837,124. Accordingly, a detailed illustration and description of the weft severing device 61 is deemed unnecessary.

Owing to the fact that the sheds formed of the upper and lower ground warps W1, W2 are independent of each other and that independent picks of weft are inserted in these respective sheds, respective upper and lower superposed fabric webs F1, F2 are formed from upper and lower ground warps W1, W2. However, since each shed formed of pile warp P is common to both the sheds formed of the ground warps W1, W2 and both the upper and lower shots of the filling or weft yarn *f*, *f'* are inserted in the common pile warp shed, this results in the pile yarns extending between and interconnecting the upper and lower fabric webs, F1, F2 being woven. Such interconnecting portions of the pile yarn extending between the fabric webs F1, F2 are indicated at P' in FIGURES 2 and 3.

Since any raised ground warp harnesses exert an upward pull on the upper fabric web F1 while any lowered ground warp harnesses exert a downward pull on the lower fabric web F2 adjacent the fell of the fabric webs, it follows that the fabric webs F1, F2 are, in effect, pulled apart from each other adjacent the fell thereof. Thus, in order to hold the fabrics in proper position for subsequent severing of the pile warp portions P' extending between the fabric webs F1, F2, the two fabric webs are straddled by a pair of relatively vertically adjustable transverse fabric holding bars 62, 63 which are located a substantial distance forwardly of the fell of the fabric webs being woven, and the respective fabric webs F1, F2 are urged against the respective bars 62, 63 by the action of the ground warp harnesses *a*, *a'*, *b*, *b'*, heretofore described. It follows, therefore, that the distance between the bars 62, 63 is determined by the length of the portions P' of the pile warp extending between the base fabric webs F1, F2 which length is, in turn, determined by the rate of feed effected by pile warp feed roll 36.

Spaced a substantial distance forwardly of the fell of the fabric webs F1, F2, and movable between the fabric webs, is a reciprocating pile severing device 65 including a blade carrier 66 having a rearwardly extending cutting blade 67 mounted thereon. Blade carrier 66 is guided for transverse movement between the woven fabric webs F1, F2 on a transverse guideway 70, and means are provided for reciprocating cutting device 65 in timed relationship to the reciprocation of weft drawing members 16, 17 for severing the successive pile yarn portions P' extending between fabric webs F1, F2 to form cut pile tufts T on the proximal faces of the thus disconnected upper and lower fabric webs F1, F2 as they move forwardly in diverging relationship to be taken up or advanced by respective upper and lower fabric advancing rolls or sand rolls 71, 72 (FIGURES 4 and 5).

In addition to driving the reed 13, the rapiers 16, 17 and the harness motion or dobby 45; the central mechanism 10 also drives the ground warp beam 30, the pile warp feed roll 36, the take-up rolls 71, 72 and the pile severing device 65 in timed relationship during operation of the loom. The drive for rotating the take-up rolls 71, 72 and for reciprocating the severing device 65 will now be described.

As best shown in FIGURE 5, the substantially horizontally disposed output shaft 46 of central mechanism 10 is connected to a jack shaft 75 by means of sprocket wheels 76, 77 and an endless sprocket chain 78. A bevel gear 81 fixed on jack shaft 75 meshes with a larger bevel gear 82 fixed on a forwardly extending cloth take-up drive shaft 83 which is connected by a train of gears 84 to gears 90, 91 fixed on the take-up rolls 71, 72. A crank or balance wheel 93 is also fixed on a jack shaft 75 and has one end of a bifurcated link 94 extending therefrom and connected to an arcuate or seg-

mental gear 96 pivotally mounted on the loom frame, as at 97. The teeth of segmental gear 96 mesh with a pinion 100 having a bevel gear 101 in fixed axial relation thereto which meshes with another relatively small bevel gear 102 fixed on a shaft 103. Shaft 103 carries a drum 104 about which several convolutions of opposite end portions of a cable or elongate pliable element 105 are positioned. Opposed ends of cable 105 are suitably attached to drum 104. Cable 105 extends upwardly from drum 104 and over a pulley 107, from whence it extends inwardly and is connected to the blade carrier 66 of severing device 65. Cable 105, or a separate cable, then extends from blade carrier 66 over guideway 70 to the opposite side of the loom where it passes over and downwardly from a pulley 110 and beneath and between a pair of pulleys 111, 112 adjacent the lower portion of the loom. From the pulley 112, cable 105 extends upwardly to drum 104. From the foregoing description, it is apparent that rotation of jack shaft 75, as effected by central mechanism 10, imparts reciprocatory motion to gear segment 96 to, in turn, impart oscillatory motion to drum 104 thus imparting reciprocatory transverse movement to severing device 65 in timed relation to the reciprocation of the rapiers 16, 17 for severing the pile yarn portions P' (FIGURE 3) extending between the upper and lower fabric webs F1, F2 as the webs are being taken up by cloth advancing rolls 71, 72.

In order to drive the pile warp feed roll 36 to feed the pile warps P in accordance with the speed at which the fabric webs F1, F2 are being woven, it will be observed in FIGURE 5 that jack shaft 75 also has a worm 120 fixed thereon which meshes with a worm gear 121 fixed on the lower end of an upright shaft 122. The upper end of shaft 122 is connected by a suitable train of gears 123 to gear 124 fixed on one end of pile warp feed roll 36.

In order to drive the ground warp beam 30 at the proper speed with respect to the rate at which the fabric webs F1, F2 are woven and then taken up by rolls 71, 72, one end of ground warp 30 is operatively connected to a conventional ground warp let-off mechanism 130 which is preferably of the positive feed type such as is shown in Hunt's United States Patent No. 2,786,491, to which reference is made for a detailed description thereof, by way of example. The input portion of let-off mechanism 130 is connected, as by sprocket wheels 131-134 and sprocket chains 135, 136, to the output shaft 46 of central circular motion mechanism 10.

It is thus seen that we have provided a method and apparatus for making plush fabric utilizing a shuttleless loom having weft drawing members or rapiers 16, 17 which reciprocate into and out of the warp sheds for drawing wefts or filling yarns *f*, *f'* from the weft supplies 60, 60' through the sheds, with means cooperating with the oscillatable reed 13 and the rapiers 16, 17 for forming plush fabrics from the ground warps W1, W2, the weft or filling yarns *f*, *f'* and the pile warps P. More specifically, it can be seen that the means cooperating with the reed and rapiers for forming the plush fabrics includes means embodied in the ground warp harnesses *a*, *a'*, *b*, *b'* for repeatedly forming respective upper and lower independent ground warp sheds from the respective groups W1, W2 of the ground warps for movement of the respective rapiers 16, 17 therethrough to weave the respective upper and lower webs of fabric F1, F2 therefrom. Further, it is to be noted that a third shed forming means is embodied in the harnesses *c*, *c'* for repeatedly forming pile warp sheds of substantially greater height than and common to both the upper and lower ground warp sheds, and through which both of the rapiers 16, 17 move with each reciprocation thereof, whereby the pile warps extend between and are interwoven with both fabric webs F1, F2 and wherein means embodied in the severing device 65 is provided on the loom for severing the portions P' of pile warps extending between the webs and thereby disconnecting the webs, after which the

disconnected webs are taken up or advanced by the rolls 71, 72. Also, it can be seen that the pile severing means or device 65 is driven to reciprocate in unison with, or in precise timed relationship with, the reciprocation of the rapiers 16, 17 as they insert the weft yarns in the fabrics F1, F2 being woven.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A shuttleless loom adapted for making plush fabric comprising an oscillatable reed and a pair of reciprocating weft drawing rapiers movable into respective warp sheds for drawing wefts from respective weft supplies through the sheds, means cooperating with said reed and rapiers for forming plush fabrics from ground warps, wefts and pile warps and comprising first and second shed forming means for repeatedly forming respective upper and lower independent ground warp sheds from respective groups of said ground warps for movement of the respective rapiers therethrough to weave respective upper and lower webs of fabric therefrom, a third shed forming means for repeatedly forming pile warp sheds of substantially greater height than and common to both said upper and lower ground warp sheds and through which both rapiers move with each reciprocation thereof whereby the pile warps extend between and are interwoven with both webs of fabric, means on the loom for severing the portions of pile warps extending between the webs and thereby disconnecting the webs, means for taking up the disconnected webs, a driven central mechanism having a main shaft arranged vertically in a median plane of the loom and operatively connected to said reed and said rapiers for oscillating said reed and reciprocating said rapiers, and said central mechanism also having a second shaft operatively connected to said shed forming means, said taking up means and said severing means for operating the same in the manner prescribed and in timed relation to the operation of said reed and said rapiers.

2. A shuttleless loom according to claim 1, in which each of said shed forming means comprises a plurality of heddles through which corresponding warps extend, a pattern device spaced above and operatively connected to said heddles and including an input shaft, said second shaft being connected to said shed forming means by means including a first sprocket wheel on said second shaft, a second sprocket wheel adjacent said input shaft, an endless sprocket chain engaging said sprocket wheels, and gear means connecting said second sprocket wheel to said input shaft for driving the same.

3. A shuttleless loom according to claim 1, in which said severing means comprises a blade guided for reciprocating movement between and transversely of the webs being woven, said second shaft being connected to said severing means by means including a pliable element fixedly connected to said blade, pulley means supporting said pliable element for reciprocating movement between the webs, a drum engaged by said pliable element, and gear means positively operatively connecting said second shaft to said drum for imparting oscillatory motion to said drum to thereby reciprocate said pliable element and said blade.

4. A shuttleless loom according to claim 3, in which said gear means operatively connecting said second shaft to said drum comprises a gear segment pivotally mounted on said loom, a pinion meshing with said gear segment, a pair of intermeshing bevel gears drivingly connecting said pinion to said drum, and means connecting said gear segment to said second shaft for oscillating said gear segment.

5. A shuttleless loom according to claim 4, in which said means connecting said gear segment to said second

shaft includes a rotary jack shaft driven by said second shaft, a crank fixed on said jack shaft, and a link interconnecting said crank and said gear segment.

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HENRY S. JAUDON, *Primary Examiner.*

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,394,739

July 30, 1968

Walter J. Crenshaw et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 50, after "rapiers may" insert -- be in the form of large yarn packages so that the loom may --. Column 3, line 72, "ends" should read -- end --. Column 8, line 2, "2,837,134" should read -- 2,837,124 --.

Signed and sealed this 16th day of December 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents