July 25, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

Original Filed Oct. 29, 1946 14 Sheets-Sheet 1

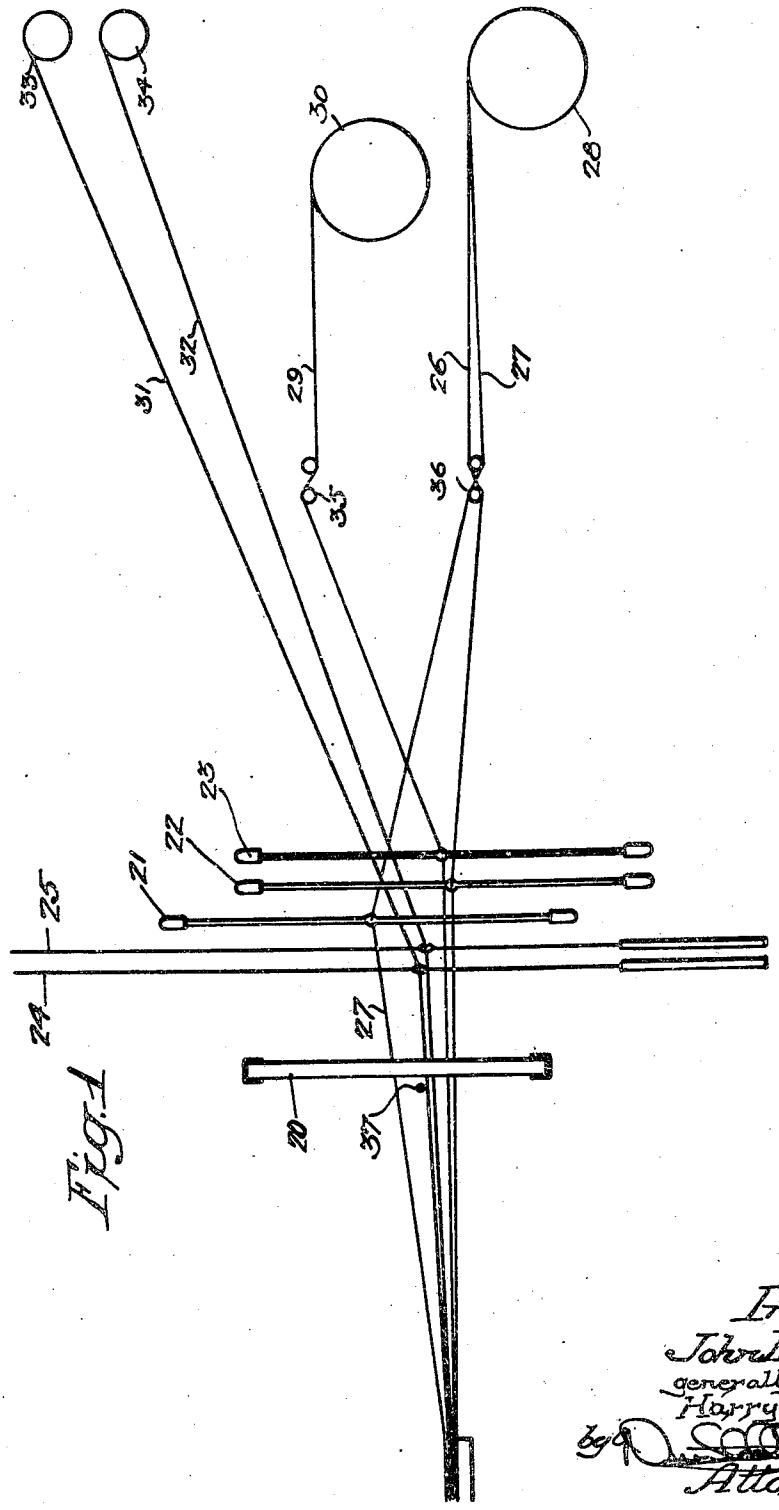


Fig. 1

Inventor
John Henry Harding
generally known as
Harry J. Harding.
by
Attorneys.

July 26, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

Original Filed Oct. 29, 1946 14 Sheets-Sheet 2

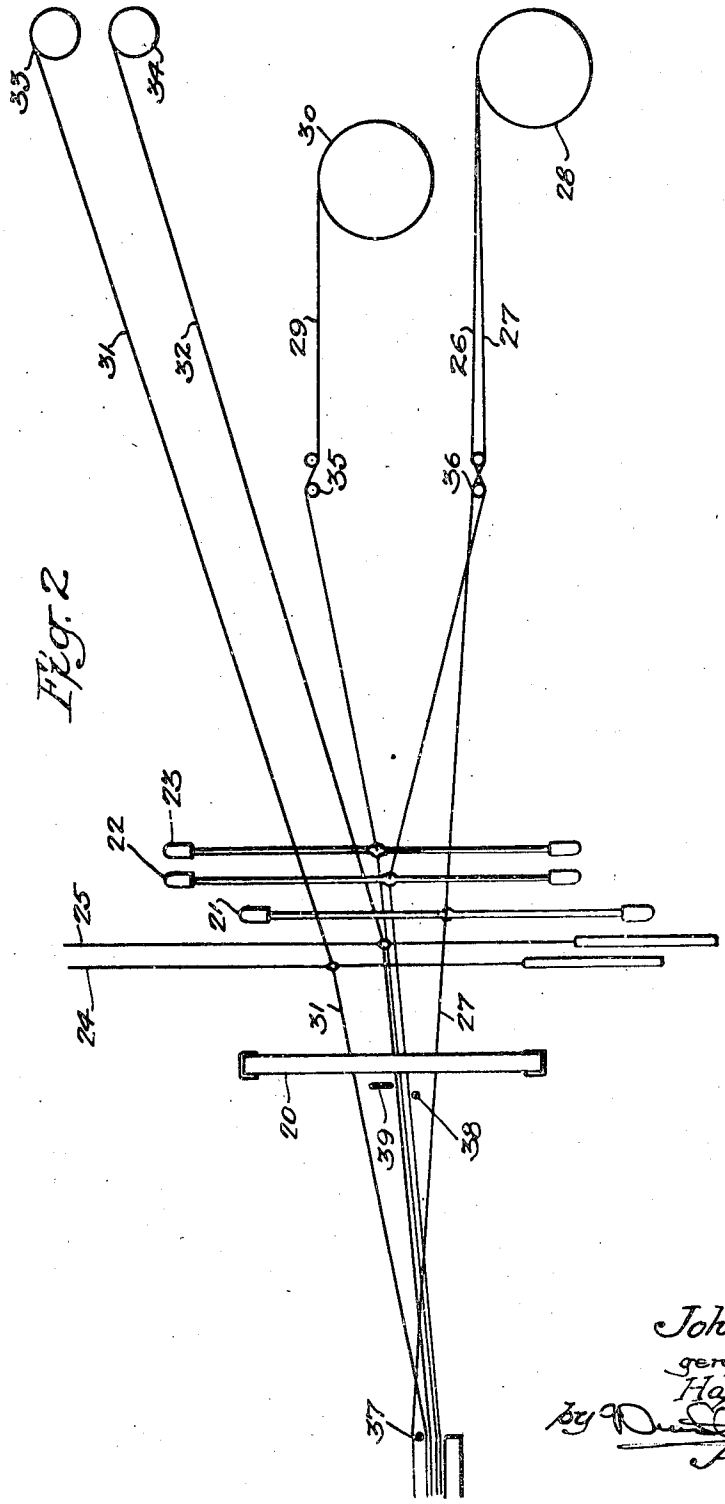


Fig. 2

Inventor
John Henry Harding
generally known as
Harry J. Harding
by Dueell & Dueell
Attorneys.

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PROCESS OF WEAVING PILE FABRIC

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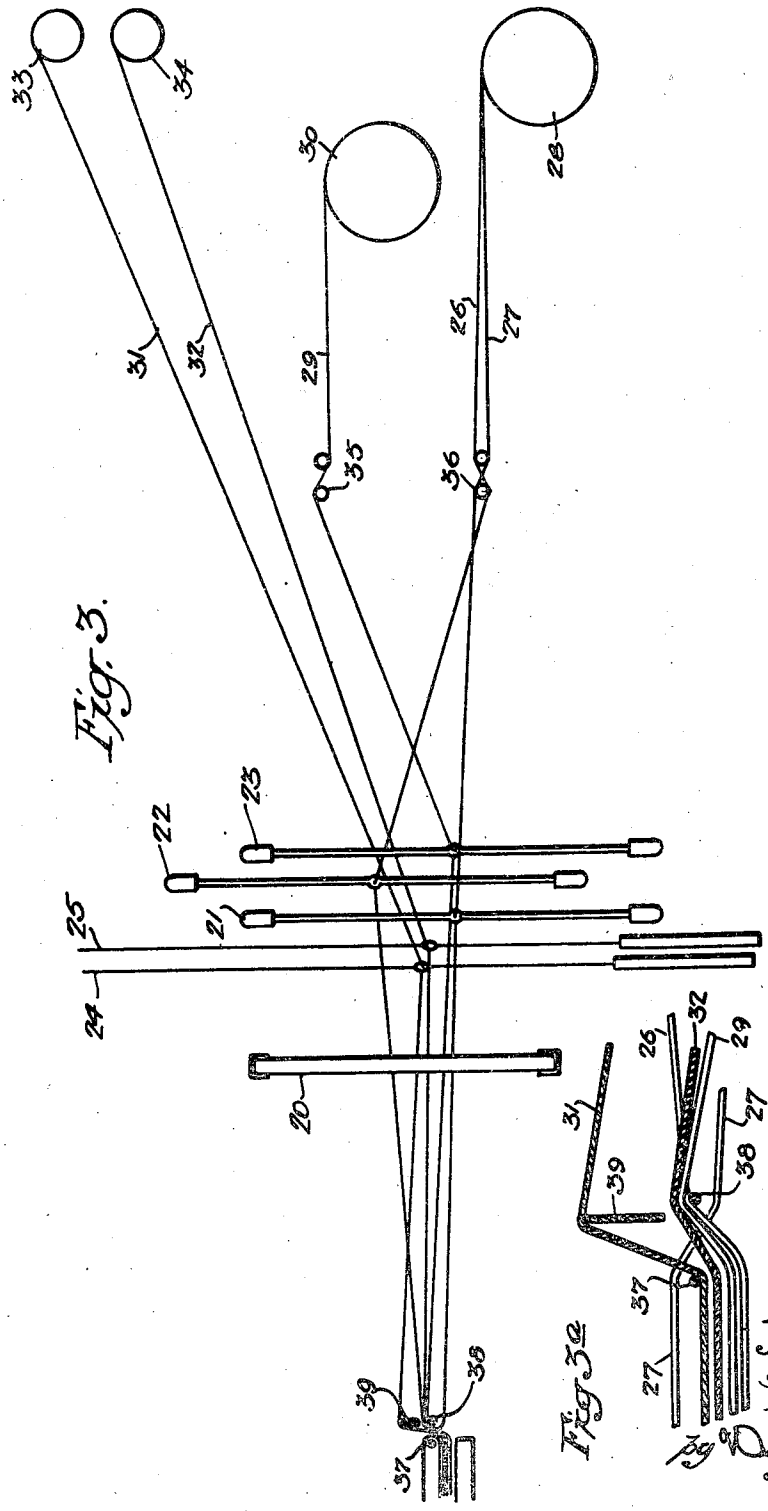


Fig. 3.

Fig. 3a.

Inventor:
John Henry Harding
generally known as
Harry J. Harding
by
Attorneys

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PROCESS OF WEAVING PILE FABRIC

Original Filed Oct. 29, 1946 14 Sheets-Sheet 4

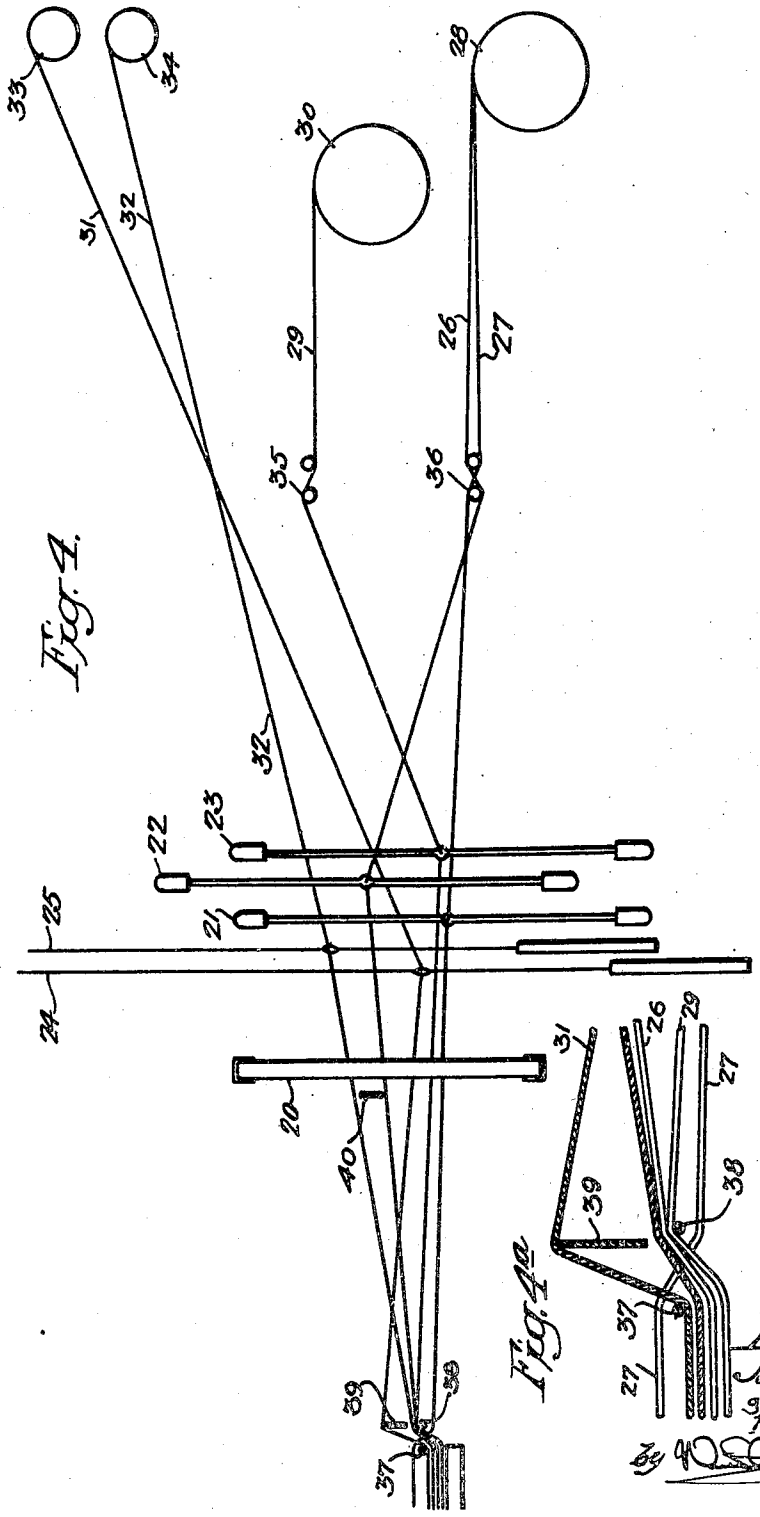


Fig. 4.

Fig. 4a

Inventor
John Henry Harding
generally known as
Harry J. Harding.
By
Attorneys.

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PROCESS OF WEAVING PILE FABRIC

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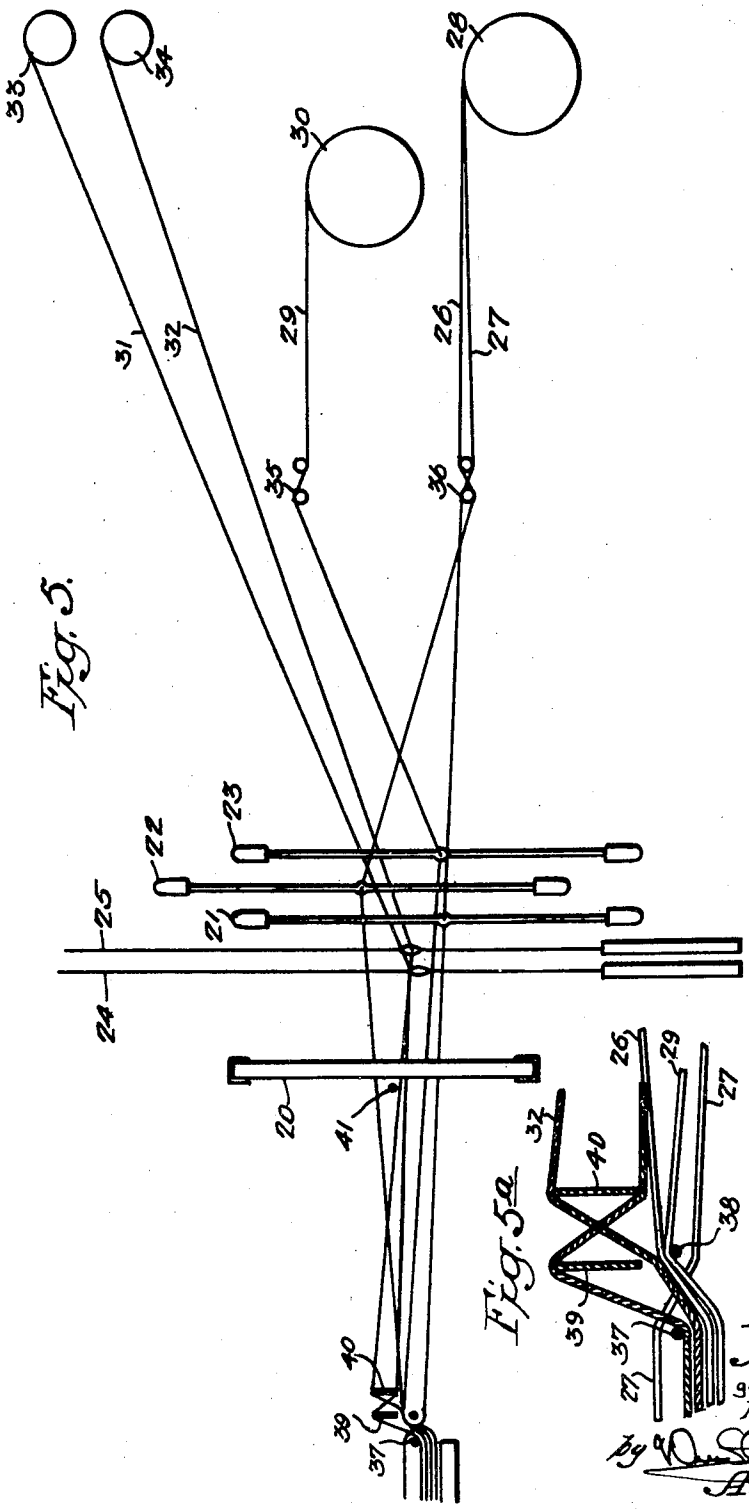


Fig. 5.

Fig. 5a

Inventor:
John Henry Harding
generally known as
Harry J. Harding
by
Attorneys.

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PROCESS OF WEAVING PILE FABRIC

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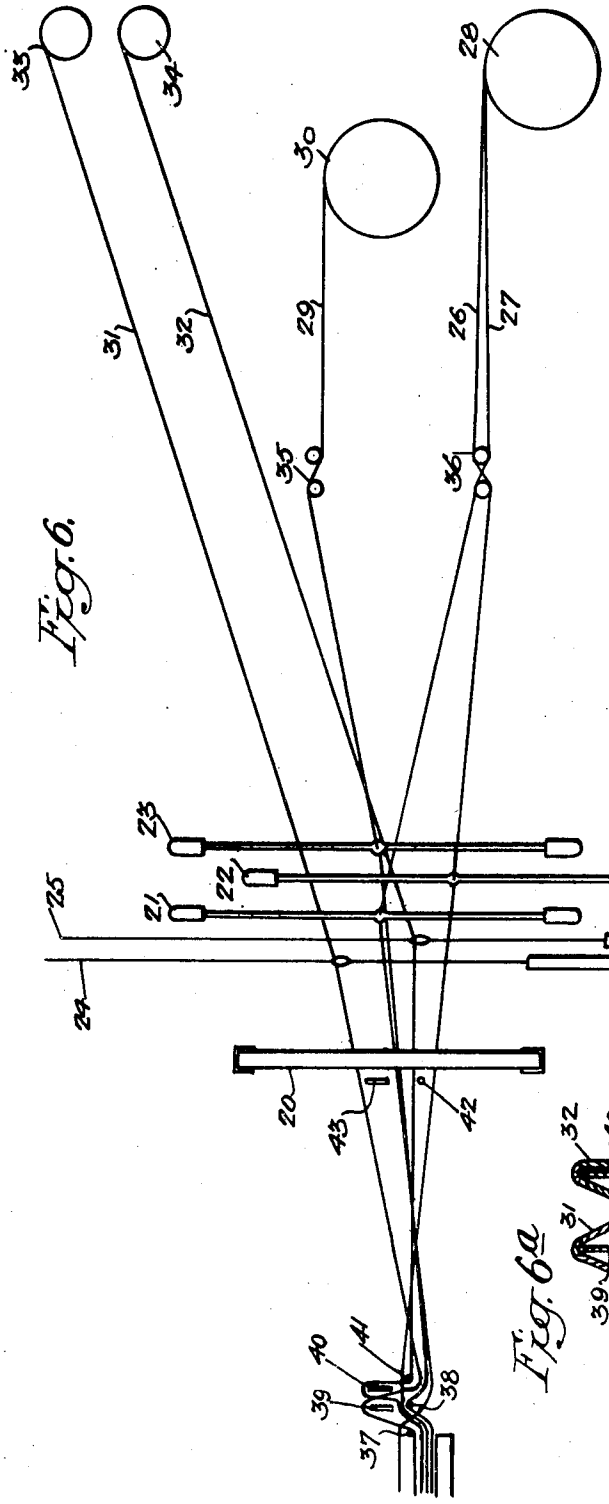


Fig. 6.

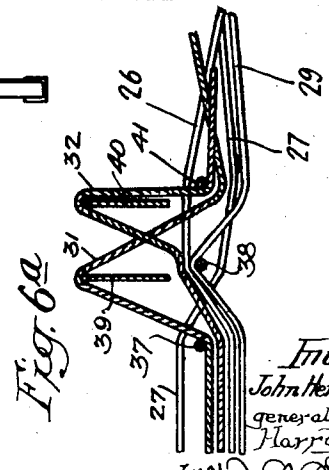


Fig. 6a

Inventor:
John Henry Harding
generally known as
Harry J. Harding
By
Attorneys

July 26, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

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Fig. 8a

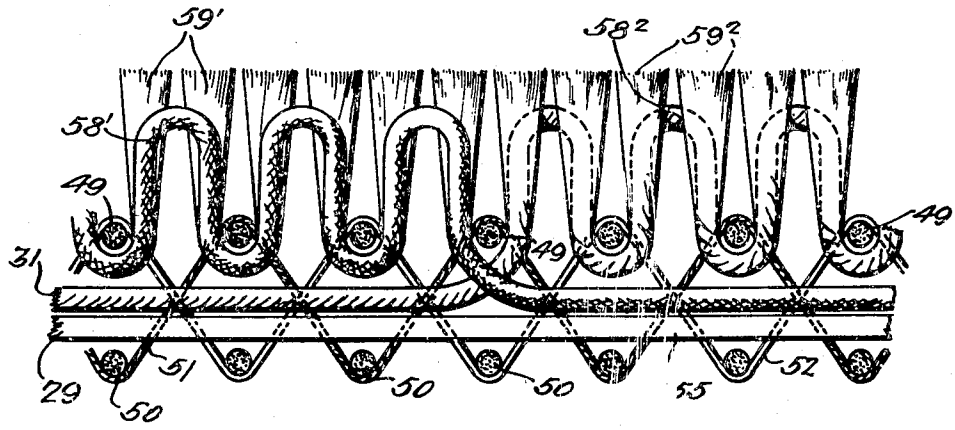
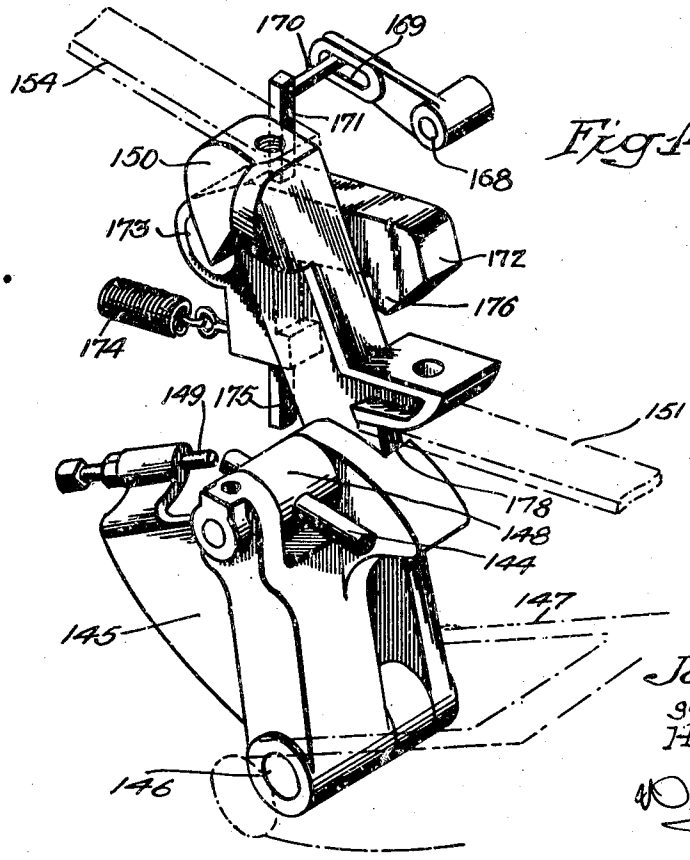


Fig. 14

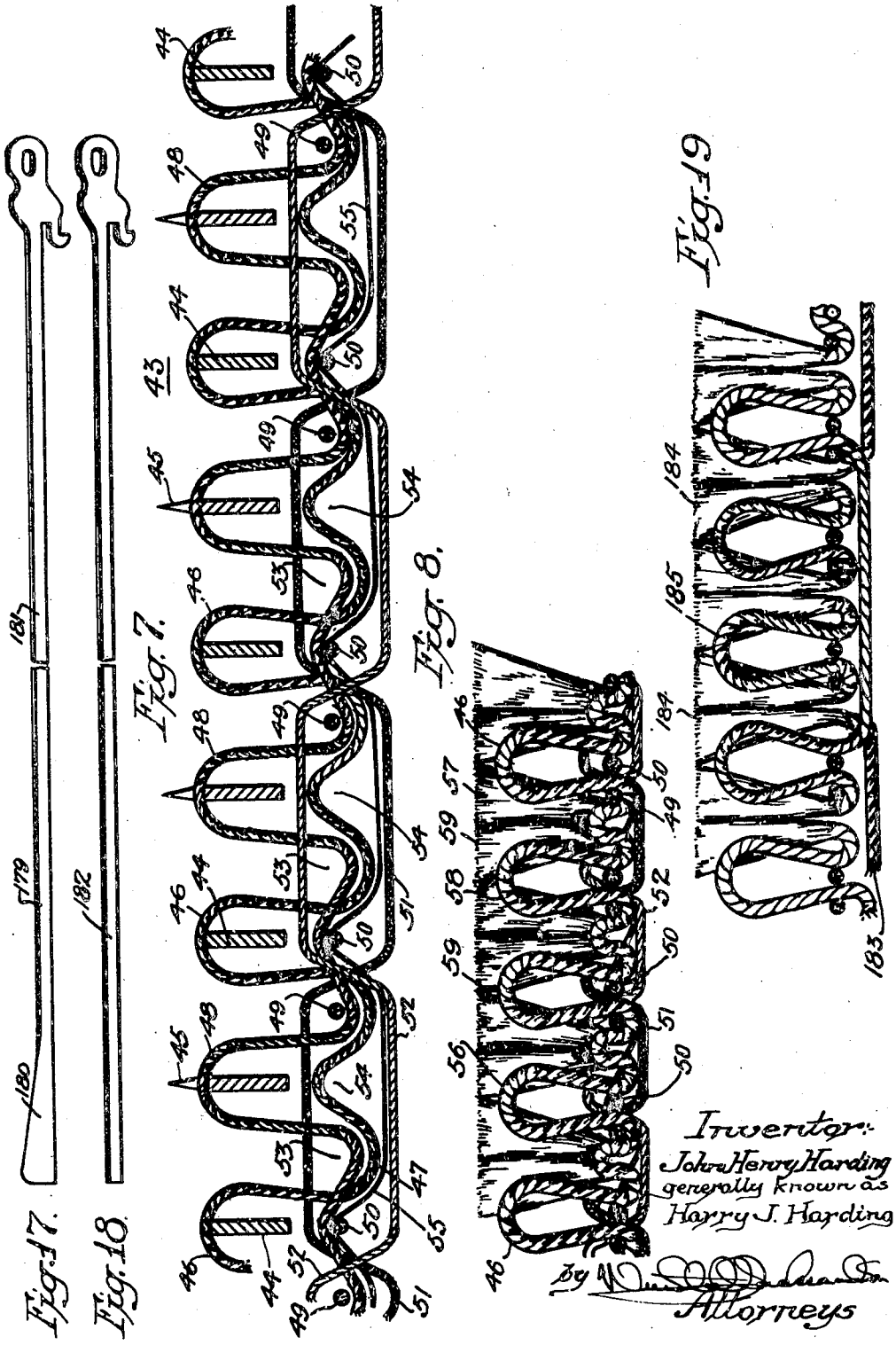


Inventor
John Henry Harding
generally known as
Harry J. Harding.
BY
ATTORNEYS

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PROCESS OF WEAVING PILE FABRIC

Original Filed Oct. 29, 1946 14 Sheets-Sheet 8

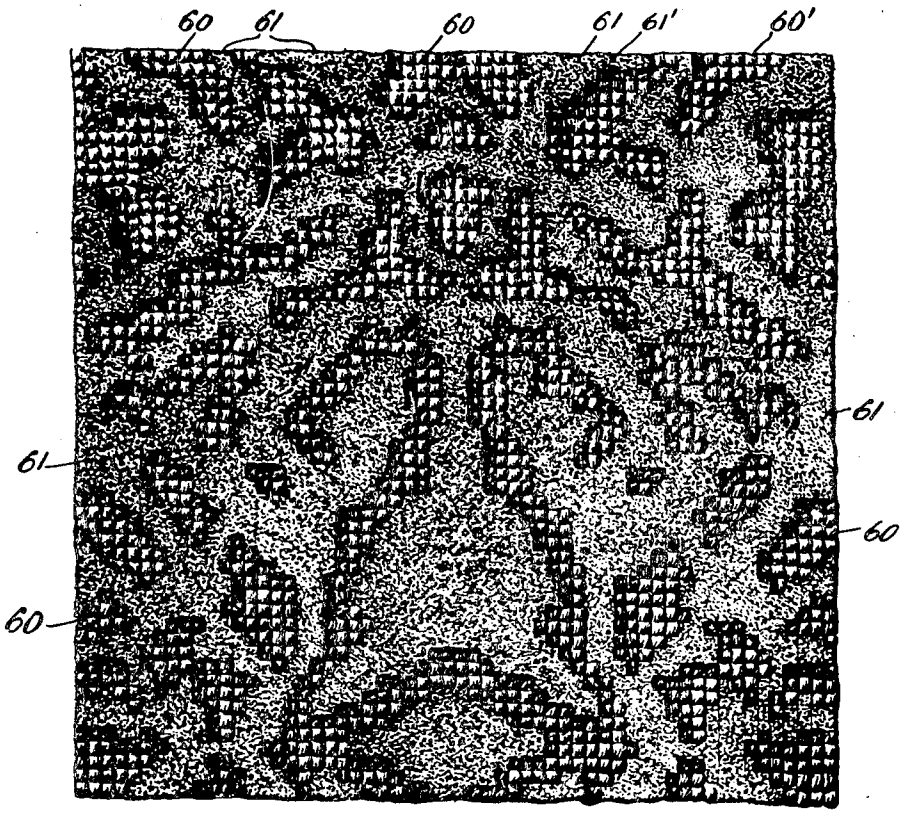


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Fig. 9.



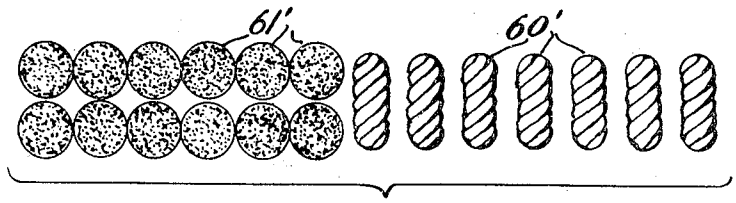


Fig. 9a

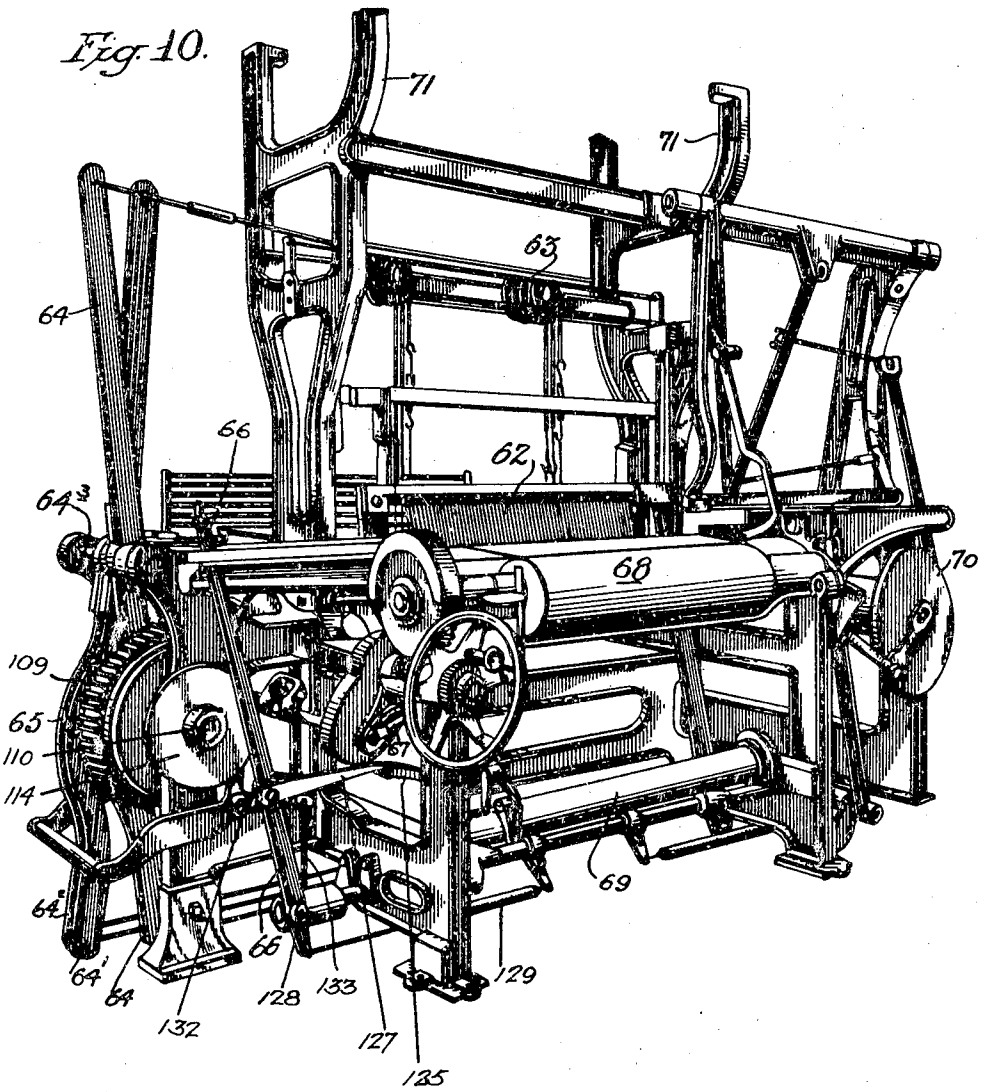
Inventor:
John Henry Harding
generally known as
Harry J. Harding
by
Attorneys.

July 26, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

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Fig. 10.



Inventor
John Henry Harding
generally known as
Harry J. Harding
by Dueltgen & Co.
Attorneys.

July 26, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

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Fig. 10a

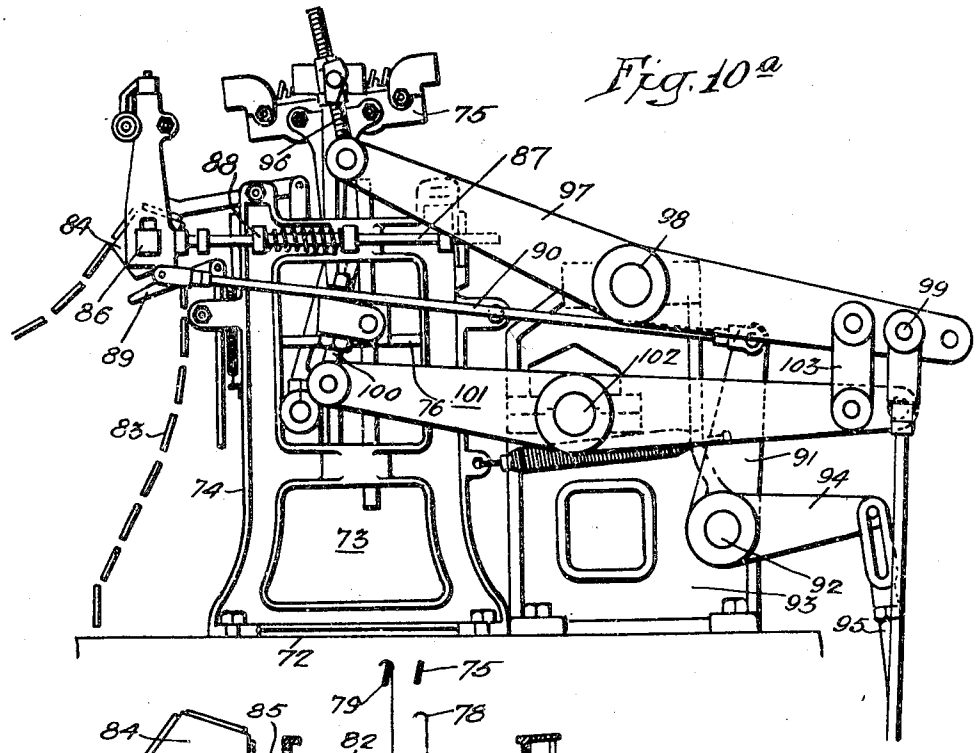
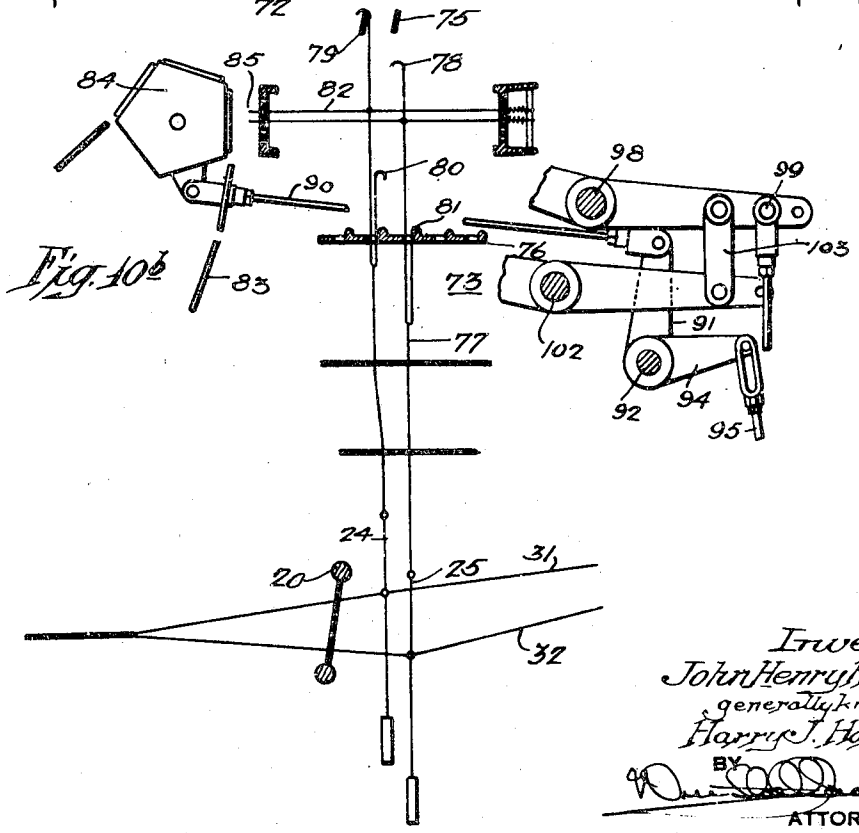


Fig. 10b



Inventor
John Henry Harding
generally known as
Harry J. Harding
BY
ATTORNEYS

July 26, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

Original Filed Oct. 29, 1946 14 Sheets-Sheet 12

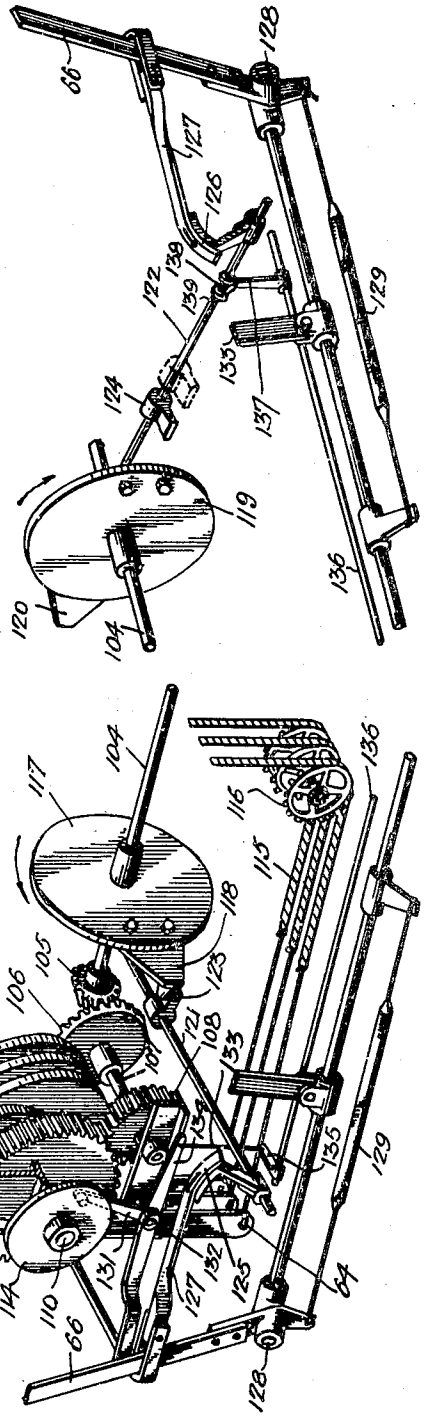


Fig 11.

Inventor:
John Henry Harding
generally known as
Harry J. Harding
BY
ATTORNEYS

July 26, 1949. J. H. HARDING GENERALLY KNOWN AS H. J. HARDING 2,477,248

PROCESS OF WEAVING PILE FABRIC

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Fig. 12.

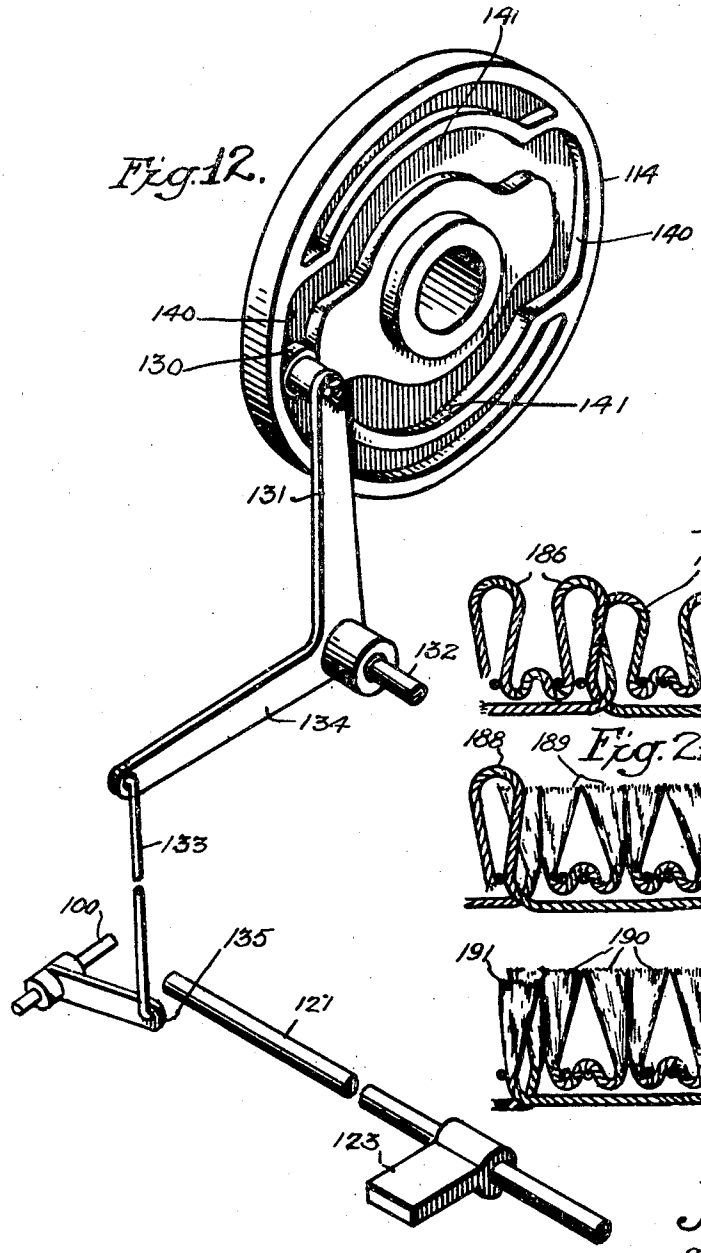


Fig. 20

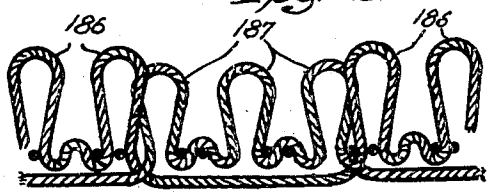


Fig. 21.

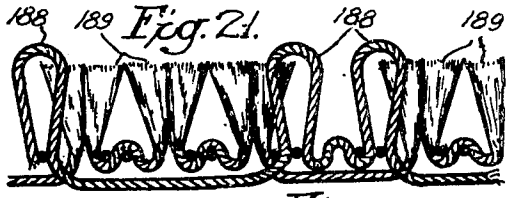


Fig. 22

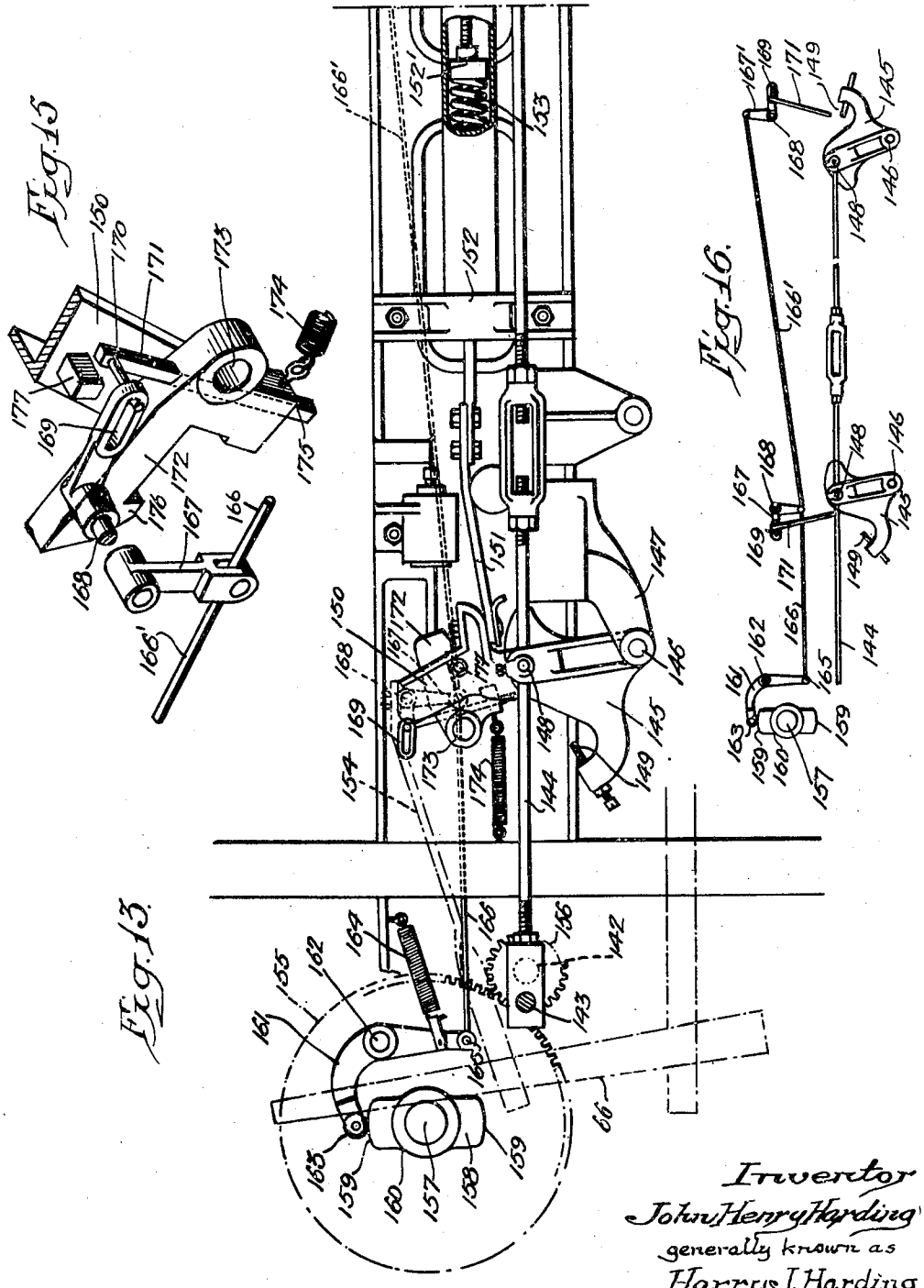


Inventor
John Henry Harding
generally known as
Harry J. Harding.
by
Attorneys.

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PROCESS OF WEAVING PILE FABRIC

Original Filed Oct. 29, 1946 14 Sheets-Sheet 14



Inventor
John Henry Harding
generally known as
Harry J. Harding
BY
ATTORNEYS

Patented July 26, 1949

2,477,248

UNITED STATES PATENT OFFICE

2,477,248

PROCESS OF WEAVING PILE FABRIC

John Henry Harding, generally known as Harry J. Harding, Philadelphia, Pa., assignor to C. H. Masland & Sons, Carlisle, Pa., a corporation of Pennsylvania

Original application October 29, 1946, Serial No. 706,354. Divided and this application September 4, 1947, Serial No. 772,080

19 Claims. (Cl. 139—39)

1

My invention relates to a process of weaving in which there are two different types of pile, high and low, cut and uncut, either or both, produced on one cycle.

The present application is a continuation in part of my application Serial No. 631,202, filed November 27, 1945, for Fabric, process and loom, now abandoned. The loom subject matter relating to the present application is described and claimed in my copending application Serial No. 706,353, for Loom, filed October 29, 1946, and the fabric subject matter is described and claimed in my copending application Serial No. 706,354, for Fabric and process, filed October 29, 1946, of which the present application is a division.

A purpose of my invention is to weave both a cut and uncut pile tuft, either or both as the pattern requires, on a given cycle of loom operation, and which in the finished fabric will lie in the same transverse line of tufts.

A further purpose is to employ two heights of pile in the same transverse row of tufts in the finished fabric, either or both of which may be cut or uncut.

A further purpose is to weave a pile fabric with one tuft raised on the second of a pair of weft shots and another tuft raised on a weft miss, preferably on the second of a pair of weft misses, either or both as the pattern requires, in a given weaving cycle.

A further purpose in the weave of a floor covering is to insert only two shots of weft for two wires which are used selectively on one weaving cycle as the pattern may require.

A further purpose is to form a pile fabric over a cut wire and an uncut wire both inserted on a given cycle, while inserting only two weft shots during the cycle.

A further purpose is to provide a pile fabric having alternate cut and uncut pile and in which there are two solid picks and then two blank picks.

A further purpose is to produce a pile fabric in which there are 16 wires for each 16 solid picks but for 32 beats of the lay.

A further purpose is in special weaving to start the cycle with one chain warp heddle up, the other chain warp heddle down and the stuffer warp heddle down, the lash or pile down, and pick; reverse all of the heddles while carrying the lash or pile up, insert a wire and pick; reverse the stuffer warp heddle, carrying the lash or pile down and miss a pick; maintain the positions of the chain warp heddles and stuffer warp heddle, while carrying the lash or pile up, insert a wire and again miss a pick; and then

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repeat the cycle, beginning with the heddle positions unchanged, the lash or pile down and pick, etc.

A further purpose is to provide eight revolutions of the crank shaft to one revolution of the treadle box, and alternate two solid picks and two blank picks, to allow for change in the character of wire as the pattern requires.

A further purpose is to reverse the fine chain warps between adjacent solid picks, to correspondingly reverse the stuffer warp between adjacent solid picks and to keep it below the pick positions at blank picks and to provide uncut pile coincident with one of the solid picks and cut pile between one pair of solid picks and the next, as required by the pattern.

The fine chain warps are reversed between each adjacent pair of solid picks and then remain one up and the other down during the next two blank picks, being reversed between the following adjacent pair of solid picks to then remain in the same raised or lowered position until the next two adjacent solid picks. The result is that the fine chain warp heddles are one lifted and the other lowered between two solid picks and remain in their lifted and lowered position until the next pair of solid picks, between which they are lowered and lifted respectively, this action keeping on progressively. Meantime the stuffer warp heddle is lifted between each pair of solid picks, lowered immediately after, and held down during the intermediate blank picks and the first succeeding solid picks then lifted and lowered again over the second of the adjacent solid picks.

This invention relates to the formation of a relief pattern in weaving pile fabrics through control of the position and relation of cut and uncut pile tufts and to a process of manufacture of the fabric.

A further purpose is to use the difference in appearance between the surfaces secured by cut as compared with uncut pile tufts as a means of weaving a design or figure within transverse rows of tufts in a pile fabric.

A further purpose is to use a standard type of loom with suitable control of the picking cam so as to intersperse solid picks and at least one blank pick and suitable to control the heddles lifting and lowering the chain warps, stuffer warp and pile warps and alternate or intersperse cutting and non-cutting pile wires in accordance with the extent and position of cut pile tufts and uncut pile tufts by which the design is to be effected.

A further purpose in my special pile fabric is to take a number of solid picks at intervals be-

tween at least one blank pick position, each of which shall have a suitable relation, preferably each to be equal to the number of pile wires used, cutting the tufts formed by some of the pile wires and not cutting the tufts formed by intervening pile wires, in a number and relation of cut and uncut tufts corresponding with the field and design of the pile fabric woven.

A further purpose is to intervene blank picks preferably in pairs between solid picks in pairs with cut and uncut pile respectively alternating, one opposite the solid picks and the other opposite the blank picks.

A further purpose is to obtain an embossed effect in pile fabric weaving without unnecessary utilization of weft yarn by raising the pile over the second of a pair of weft shots in the cycle and/or as the pattern requires raising the same or another pile yarn to a different height over one of two misses in the shuttle operation in the same cycle.

A further purpose is to bring pile tufts of different kinds into the same transverse row of pile tufts in the finished fabric while employing mispicks between the respective different tufts in weaving, without crossing the chain warps in the interval between the tufts.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate two embodiments, of numerous forms in which the invention might be employed, choosing the form shown from the standpoint of convenience of illustration, satisfactory operation and clear exemplification of the principles involved.

Figures 1 to 6 inclusive are diagrammatic, longitudinal illustrations of the steps in weaving the fabric according to the invention.

Figures 3^a, 4^a, 5^a and 6^a are enlarged diagrammatic illustrations of fragments of the respective Figures 3 to 6 inclusive.

Figure 7 is a diagrammatic, longitudinal section of the preferred form of the weave of the present invention prior to cutting of the pile.

Figure 8 is a diagrammatic, longitudinal section similar to Figure 7, but showing the cut pile in cut form.

Figure 8^a is a longitudinal section of the completed fabric.

Figure 9 is a diagrammatic plan view of the fabric of the invention.

Figure 9^a is an enlarged fragment of Figure 9.

Figure 10 is a perspective view of one loom to which the invention has been applied.

Figure 10^a is a fragmentary diagrammatic elevation of a Jacquard mechanism.

Figure 10^b is an enlarged central vertical section of the Jacquard mechanism of Figure 10^a.

Figure 11 is a partially diagrammatic fragmentary perspective of the two sides of the loom, showing one form of picking mechanism.

Figure 12 is a perspective of a picking cam assembly for a four shot weave using the picking motion of Figure 11.

Figure 13 is a front elevation of a variant picking mechanism.

Figure 14 is an enlarged fragmentary perspective of the picking latch mechanism of Figure 13.

Figure 15 is a fragmentary perspective of the reverse side of the mechanism shown in Figure 14 detached or pulled apart to show the interrelations of the parts.

Figure 16 is a diagrammatic view showing the means of connecting the picking mechanism on the two sides of the loom.

Figures 17 and 18 are fragmentary side elevations of wires.

Figures 19 to 22 inclusive are diagrammatic longitudinal sections of variant weaves embodying the invention.

In the drawings, like numerals refer to like parts throughout.

In the present invention, a two shot fabric is produced since there are two wefts per cycle, but the treadle box motion, the take-up and the pick are in the preferred embodiment on a four shot basis since there are preferably two miss shots per cycle.

Referring particularly to Figures 1 to 6 inclusive, which illustrate the weaving of a two frame Wilton carpet (floor covering), a loom is diagrammatically illustrated of any suitable design, having reed **20**, front chain warp heddle **21**, rear chain warp heddle **22** and stuffer warp heddle **23**, as well as lingoe heddles **24** and **25** which carry the pile warps in raised or lowered position. The double chain warp sets **26** and **27** are supplied from beam **28**. The stuffer warp **29** is mounted on stuffer beam **30**. It will be evident, of course, that any suitable number of stuffers desired may be employed.

Any suitable number of pile yarns may be used, of which two are illustrated at **31** and **32**, supplied from creel frames **33** and **34**. The invention has been applied successfully using up to six pile warps, and the choice of two pile warps herein is for the sake of simplicity in illustration. As well known in the art, the stuffers and chains are supplied over jumbos **35** and **36**.

Each of Figures 1 to 6 corresponds to a different rotation of the crankshaft in a normal loom.

Figure 1 shows the assumed condition at the beginning of a cycle, based upon the production of a two shot fabric using a four shot motion. At the beginning of the cycle shown in Figure 1, the front chain heddle **21** is up, the rear chain heddle **22** is down and the stuffer warp heddle **23** is down, while the lingoe heddles **24** and **25** are also down. In this position, the first shot of weft **37** is taken, passing under chain warp **27** and over all other warps. At the end of the step shown in Figure 1, the reed moves forward beating up the weft or filling shot in the conventional manner.

As shown in Figure 2, the heddles are reversed in this position, the front chain heddle **21** moving down and the rear chain heddle **22** and stuffer warp heddle **23** moving up. Some lingoe heddles **24** rise fully, lifting the pile warp **31**, while other lingoe heddles **25** go up half way, as the pattern requires. In this position, a shot of weft **38** is inserted under the stuffer **29**, the pile warps **31** and **32** and the chain warp **26**, and above the chain warp **27**. A wire **39** is inserted above everything except the pile warp **31**, and the reed moves forward beating up the weft.

In the position of Figure 3, the chain warp heddles remain unchanged while stuffer warp heddle **23** moves down, and lingoe heddles **24** and **25** carrying the pile likewise move down. In this position the loom misses a pick, although the reed comes forward and again beats up the previous shot. As shown in Figure 3^a, the forming pile at this position includes the two wefts **37** and **38** and the wire **39**, with no additional weft. The last operation inserted either a cut wire or an uncut wire, but in the preferred embodiment as later explained it will be an uncut wire. This step is convenient to conform to a four step cycle commonly used and may if desired be the occasion for removal of wires.

As shown in Figure 4, during the next step the front and back chain heddles and the stuffer heddle remain the same while some lingoe heddles **24** come up half way and other lingoe heddles **25** come up fully as the pattern requires. A wire **40** is inserted below the pile warp **32** and above all other warps, while the weft shot is missed. As shown in Figure 4ª, the position of the forming fabric is substantially the same as illustrated in Figure 3ª since the previous shot was a miss. The reed comes forward and beats up the weft **38** in the usual manner.

The four steps described represent a complete cycle. To illustrate the relation with the succeeding cycle, a portion of the next cycle is illustrated in Figures 5 and 6.

In Figure 5, the front and rear chain warp heddles and the stuffer warp heddles remain the same, the lingoe heddles both remain down and the weft shot **41** is taken passing under the chain warp **26** and above all other warps. The condition of the fabric resulting from the previous cycle is represented in Figure 5ª, with two wefts in position and two wires also in position, one of the wires corresponding to the second miss shot.

As illustrated in Figure 6, the next step results in a reversal of the chain warp heddles and stuffer warp heddle, while some lingoe heddles **24** are up and other lingoe heddles **25** are half way up, as the pattern requires. A shot of weft **42** is inserted below all warps except chain warp **26**, and a wire is inserted above all other warps except pile warp **31**. The condition of the fabric resulting from the previous step is illustrated in Figure 6ª.

The beating up of the lay at the mispick position and on the next pick performs an important function, which will be understood by reference to Figure 6ª. It will be noted that once the wires are withdrawn, there is nothing in the structure of the fabric separating the different tufts formed over the respective wires **39** and **40**. The beat of the lay on the mispicks and the next pick applies tension on the chain warps and the pile, and as soon as the wires are removed this tension pulls the different tufts formed over the wires **39** and **40** into the same transverse line of tufts, so that then they will appear from the face of the fabric to be in the same transverse line of tufts, as in fact they previously have been from the standpoint of the structure of the fabric.

The successive wires inserted will normally be alternately low wires and high wires. Due to the fact that if the low wire is inserted last in the cycle, it will not be protected against being pushed up by the reed, it is very desirable to insert the low wire first and the high wire second in the sequence. Thus wire **39** is preferably a low wire and wire **40** is a high wire. By this procedure the wefts of the next cycle tend to bind the high wire in position and it protects the low wire ahead of it from being improperly forced up by the reed.

It is also very desirable to use a combination of uncut and cut wires, the low wire being normally a non-cutting wire to produce an uncut pile loop, and the high wire being a cutting wire to produce a cut pile tuft. This results in the mosaic effect later described.

It will be evident, of course, that any suitable number of wires may be employed, and the wire insertion mechanism may be that used in conventional practice. The wires, of course, will remain in place until long after completion of the weaving cycle and will then be withdrawn at a suitable point.

The steps which take place in one cycle produce either or both of two tufts (depending upon the pattern requirement) which are transversely in the same line of tufts as all other tufts produced on that cycle, once the wires are removed.

In the preferred embodiment of the weave of the present invention, each second cycle (after four picks and four mispicks) is a true repetition and each next cycle (after two picks and two mispicks) is a repetition except that the chain warps are reversed.

It will be noted that while the drawings show two pile tufts of different characters forming selectively at a given lateral point on a given cycle, one opposite the second of a pair of picks and the other opposite the second of a pair of mispicks, the action of the subsequent beat of the lay applied to the mispicks and to the next pick creates the tension in the chain warp and pile which, on removal of the wires well after the end of the cycle, brings all pile tufts formed on a given cycle into the same transverse line of tufts. Thus though Figure 7 and other similar figures show high pile and low pile tufts which appear to be in a different transverse line, when the fabric has been beaten up and the wires removed, the various tufts transversely across the fabric formed on a given cycle, whether they be high tufts or low tufts or cut tufts or uncut tufts, are brought into the same transverse line of tufts. This is important from the standpoint of appearance, economy in material used in production of the fabric and wearing qualtiy of the fabric.

The nature of the fabric **43** will be better understood by reference to Figure 7 which shows diagrammatically a sequence of non-cutting wires **44**, desirably relatively lower, and cutting wires **45** desirably relatively higher. The pile formed by the loops **46** extending over the non-cutting wires is carried to the back of the fabric at **47**, coming up again as the pattern may require. In Figure 7 the loops **46** are brought up over each of the uncut wires, whereas in actual practice they would normally only be brought up at points where the pattern required loops rather than cut pile. Likewise the loops **48** subsequently to be cut are shown in Figure 7 as carried over each of the cutting wires, whereas in actual practice they woould normally not be carried up where uncut loops were being used on the particular cycle and lateral position.

It will thus be evident that for each cycle there are two wires of different dimensions or types inserted, but the pile will normally be carried over only one of them in accordance with the demands of the pattern. Both of these wires form tufts which, after the wires are removed, lie in the same transverse row. The weft shots **49** and **50** are in pairs between which the chain warps **51** and **52** cross, the intermediate spaces **53** and **54** being indicated as miss shots. Actually in the finished fabric the wefts will, of course, be positioned with weft **49** of each pair to the front of the fabric and weft **50** of each pair to the back of the fabric, and the spaces corresponding to the miss shots will be lost, bringing all solid shots into uniform and normal spacing sequence (Figure 8ª). But the effect of the miss shots will be there, since the different tufts formed with the weft shot and the following miss shot will lie in the same transverse line of tufts. The stuffer warp **55** is carried up over each second shot **50** of the pair, but otherwise remains in the back of the fabric.

The result achieved is better indicated in Figure 8 in which the tufts for convenience in illustra-

tion retain the conventional positions which they had when held by the wires. The relatively low uncut tufts or loops 46 appear in a group at 56 corresponding to a portion of the pattern calling for uncut loops, while the cut tufts 57 resulting from cutting of the loops 48 correspondingly conform to a portion of the pattern calling for cut pile.

One of the important features of the invention is that the uncut tufts or loops 58 formed in a given cycle are, after the fabric is beaten up and the wires are removed (the wires will normally not be removed until considerably later, as in normal practice, and this may be accomplished on the third step of the cycle), in the same transverse line of tufts as the cut tufts 59, formed on that cycle, although actually in the drawing the tufts 59 appear slightly to one side, in accordance with the convention of illustrating the fabric before the beat.

Figure 8[a] shows more clearly the actual form of the completed fabric, with wefts 50 at the back and wefts 49 at the front, and low uncut pile tufts 58′ standing in the same transverse line of tufts and in front of higher cut pile tufts 59′, while higher cut pile tufts 59[2] stand in the same transverse line of tufts with and in front of low uncut tufts 58[2]. Thus it will be seen that in the finished fabric the cut and uncut loops are in the same transverse row.

Figures 9 and 9[a] illustrate the face of pile fabric according to the invention. The uncut pile areas 60 in base relief are interspersed with cut pile areas 61 which are higher and more prominent, causing an embossed or mosaic effect.

Certain tufts 60′ of the areas 60 are on the same transverse row of tufts as other tufts 61′ in the areas 61. One of the important advantages of the invention is that it is possible to place the cut and uncut or high and low pile tufts in the same transverse row of tufts.

The loom of the present invention may correspond to any standard design with structural modifications to accomplish the special weave. The invention will normally be applied by modifying a standard Wilton loom.

Figure 10 shows a typical Dobcross Wilton loom omitting the jacquard, which has been modified as later explained to produce my special weave. The loom is of well known type having a reed 62, heddle harness 63, treadle box levers 64, treadle box 65, picking sticks 66, take-up 67, spike roll 68, take-up roll 69, wire motion mechanism 70, and jacquard standards 71.

Figures 10[a] and 10[b] illustrate a conventional jacquard mechanism consisting of an upper frame 72 mounting the usual jacquard mechanism 73 having end frames 74 in which are vertically slidably mounted an upper grid 75 and a lower grid 76.

The jacquard mechanism 73 also comprises the usual series of wires 77, of which only two are shown, but of which one will be used for each of the pattern threads of each pile warp. Lingoe heddles 24 and 25 are suitably operated by the wires 77.

Each jacquard wire has the usual upper hook 78 which is adapted to be engaged by a bar 79 of the upper grid 75 under some operating conditions as well known in the art. Each jacquard wire 77 also comprises a lower hook 80 adapted under normal conditions to rest on a bar or rib 81 of the lower grid 76.

The jacquard wires 77 are controlled by needles 82 and these needles are controlled by a string of jacquard cards 83 which pass around a card cylinder 84, which is reciprocated bodily back and forth with respect to ends 85 of the needles 82, as well known in the art of weaving, to present the suitably punched cards of the string 83 successively to the operating ends 85 of the needles 82.

The card cylinder 84 is mounted for intermittent rotation, in the usual manner, in bearings 86 carried on the ends of axially movable rods 87 slidably mounted in bearings 88 on the frame 74 of the jacquard mechanism 73, and the usual hooks 89 are provided for turning the cylinder one step at a time for each reciprocation of the cylinder toward and away from the needles 82.

The cylinder is reciprocated by operating rods 90 connected at one end to the bearing heads 86 on the cylinder supporting rods 87, the opposite ends of the operating rods 90 being connected to the outer ends of levers 91. The levers 91 are fixed on rock shafts 92 rotatably mounted in frames 93 supported by the super-structure 72.

On the cylinder rock shaft 92 is a lever 94 the other end of which is operatively connected to a suitable link 95 driven by the loom as well known in the art.

The grids 75 and 76 are coupled together and operate in unison with differential rise and fall between the two grids, as well known. The upper grid 75 is connected at each of its opposite ends by links 96 to one end of levers 97 pivotally mounted on a rock shaft 98 having bearing support on the frame 93, the opposite lever end being connected to a link 99 for operation of the frame from the loom in the well known manner.

The lower grid 76 is operatively connected at each of its ends by a link 100 to one end of a lever 101, of which there are two, only one being shown. The levers 101 are rigidly secured to a rock shaft 102 which is rotatably mounted in the frame 93. One of the levers 101 is provided at its opposite end with an operating link 103 which connects to the outer end of lever 97.

As well known in the art, the card cylinder moves toward the ends of the needles 82 of the jacquard mechanism once in any single step of the weaving operation and each card in the string is adapted to select certain pattern threads to be raised in a manner to form the pile face of the fabric and produce the desired design.

In order to modify the loom of Figure 10 to produce my special weave, it is of first importance to change the picking mechanism so that the cycle will begin with two picks and follow with two mispicks. As shown in the modified treadle box of Figure 11, power to drive the picking mechanism is transmitted through bottom shaft 104 running from side to side of the loom on suitable bearings, not shown, turning in the direction of the arrow, and carrying bevel gear 105 which drives cooperating bevel gear 106 on countershaft 107 carried by suitable bearings, not shown. The countershaft 107 also carries pinion 108 meshing with treadle box pinion gear 109 on treadle box shaft 110 supported in suitable bearings, not illustrated. Treadle box gear 109 drives stuffer heddle cam 111 and chain heddle cams 112 and 113, of well known character. Also turning on the same shaft is picking change cam 114, shown more in detail in Figure 12.

The stuffer and chain warp heddle cams may be identical with those normally used, preferably modified at approach and release portions to give quick pick-up and release with change

of driving speed. In the normal prior art construction a one-to-one ratio has been used on the gears 105 and 106, whereas in the present invention it has been found desirable to employ a one-to-two ratio, thus cutting the heddle cam speed in half. The ratio between the pinions 108 and 109 is one-to-two, so that the ratio between the bevel gear 105 and the treadle box shaft 110 is one-to-four, giving one rotation of the picking change cam 114 for every two cycles, or one-half rotation per cycle. The heddle cam speeds are cut in half with respect to the prior art practice.

The mechanism for transmitting heddle motion from the cams consists of the treadle box levers 64, 64' and 64^2, which are pivoted at 64^3 and provided with followers, not shown, which ride the cams as well known in the art. As the treadle box levers are moved, they transmit the motion to the heddle harnesses through rigging such as chains 115, passing over suitable sprockets 116 as in prior practice.

At the two sides of the loom, or at opposite ends of the bottom shaft 104, I provide a left hand picking disc 117 having a picking hammer 118 and a right hand picking disc 119 having a picking hammer 120, the respective picking hammers being 180° out of phase as shown in Figure 11, so that when the hammer at one side is in picking position the hammer at the other side is 180° removed therefrom. At each side of the loom is a picking shaft 121 on the left, and 122 on the right, carrying a picking tongue 123 on the left and 124 on the right, which are located toward the outside of the loom with respect to the picking disc and at the proper time are engaged and depressed by the appropriate picking hammer. The picking shafts are supported in suitable bearings not shown. Picking shaft 121 merely rotates, but picking shaft 122 both rotates and moves longitudinally as later explained. On each picking shaft is a picking wing 125 on the left and 126 on the right, the two picking wings being oppositely directed as well known. Each picking wing through its leather strap 127 applies an impulse to the appropriate picking stick 66 suitably pivoted at 128 and spring urged to return at 129 toward a suitable abutment. The action of the picking stick in throwing the shuttle is of course well known in loom design.

The picking change cam 114 operates on a follower 130 (Figure 12) at the end of a bell crank lever 131 pivoted at 132 to vertically urge the pull rod 133, on the opposite end 134 of the bell crank, pulling or pushing on the lever 135 on picking change shaft 136 running from left to right of the loom and mounted in suitable bearings, not shown. On the right hand side of the loom, shaft 136 carries picking shaft lever 137 whose forked end 138 engages between two abutments 139 on longitudinally movable picking shaft 122. Thus when the follower 130 is on a "high" of the cam, the picking tongue 124 is in picking position and adapted to be engaged by the picking hammer 120, while when the follower 130 is on a "low" of the cam, the picking tongue 124 is moved to the position shown in dot and dash lines in Figure 11 so that it is missed by the picking hammer 120 and picking does not occur.

The picking change cam as shown in Figure 12 has a comparatively short "high" or outer cam portion 140 corresponding in length to one step in the cycle, and a substantially longer "low" or inner radial cam portion 141 corresponding in

length to three steps of the cycle, and 140 and 141 totalling one-half revolution, to be accomplished in one cycle.

Thus at the beginning of a cycle, as shown in Figure 1, the shuttle is in the right hand position, and the picking change cam 114 is in "high" or picking position, with the follower 130 at a "high" or radially outer portion 140 of the picking change cam. This places picking tongue 124 in the position shown in full lines in Figure 11. The picking hammer 120 at the right is 180° out of the position shown in Figure 11, or in picking position, and the shuttle is thrown from right to left. Nothing happens regarding the shuttle on the left because the picking hammer is 180° out of phase and the shuttle is not over in the left hand box at the beginning of this step.

In the next step, as shown in Figure 2, the picking change cam moves on until the follower 130 is in the "low" or radially inner portion 141 of the cam path, moving the right hand picking tongue 124 out of picking position. This is immaterial in any case because the right hand picking hammer 120 is 180° removed from picking position and the shuttle is over on the left so that no pick could occur from the right. Over on the left, however, the picking hammer 118 is in picking position and encounters the picking tongue 123, throwing the shuttle from left to right.

In the next step, shown in Figure 3, no picking action can occur from the left because the picking hammer 118 is 180° out of picking position, and the shuttle is on the right. The follower 130 is still in a radially inner or "low" position 141 of the picking change cam, so that the right hand picking tongue 124 is in the dot-and-dash or inoperative position of Figure 11, and no picking can occur, notwithstanding that the shuttle is in the right hand box. This is the first of the misses on the cycle.

In the next step, corresponding to Figure 4, the follower 130 is still in a "low" or radially inner portion 141 of the picking change cam, and the picking tongue 124 on the right is in inoperative or miss position, so that there is a miss from the right. Over on the left the picking hammer 118 is in picking position and actually strikes the picking tongue 123 and operates the picking stick 66 at the left, but there is a miss because the shuttle is not in the left hand box and cannot be thrown.

Thus by this procedure the required sequence in the preferred embodiment of two picks and two misses is obtained with very little departure from the standard Dobcross picking mechanism.

Figures 13 to 16 inclusive illustrate the changes required in the picking motion in order to carry out the process of the present invention on a Landsdowne loom.

The driving shaft 142, though positioned transversely to the bottom shaft 104 above referred to, moves at the same speed as the bottom shaft 104 and may be considered to be the equivalent thereof. The shaft 142 carries a crank 143, which operates on a connecting rod 144 which extends horizontally across from one side to the other of the loom, and on each side of the loom operates an identical but opposite counterpart picking rocker 145 pivoted at 146 to rigid frame structure 147, and pivotally connected to the connecting rod 144 at 148. Each picking rocker 145 carries an adjustable picking abutment 149. The picking abutments 149 are continuously carried by the crank through an arc from one limiting position at the left of their stroke as shown in

Figure 13 to the opposite limiting position somewhat less than 90° toward the right, as well known.

Loosely pivoted on the same shaft 146, behind the picking rocker in Figure 13, is an opposite counterpart picking arm 150 at each side of the mechanism, connected by a strap 151 extending through an opening in a spring support 152 to a spring abutment 152', which when pulled to the left in Figure 13 compresses a compression spring 153. The structure at the right, not shown, is an opposite counterpart.

The picking arm 150 carries a picker strap 154, suitably of conventional type, which connects to a pivoted picker stick 66 of well known character.

The picking motion is determined by a gear 155 driven from a gear 156 on shaft 142, at one fourth the speed of shaft 142. Gear 155 is on shaft 157 carrying picking change cam 158. Bearings for the shaft are of any suitable character, not shown. The picking change cam 158 turns one-half revolution per cycle and has two high portions 159 each extending slightly over 45° and two low portions 160 each extending slightly over 45°, with suitable transition portions between. A follower lever 161 on fixed pivot 162 carries a follower 163 which engages the picking change cam, and is spring urged toward the cam by a spring 164 suitably of tension type connected to a spring abutment. The opposite end of the follower lever 161 is pivotally connected at 165 to a follower rod 166 illustrated more in detail in Figures 15 and 16, which connects to and operates a bell crank lever 167 pivoting at 168 on bearings not shown, and having at its opposite end a slot 169 engaging a pin 170 for moving in and out a sliding latch control bar 171 moving longitudinally in a latch 172 on a fixed pivot 173 in the frame structure, and spring urged toward latching position by a tension spring 174 from a suitable anchorage. The end 175 of the latch control bar 171 when in its lower position with respect to Figure 15 is engaged by the picking abutment 149 on the picking rocker 145 near the upper end of its stroke.

The latch 172 by its latching dog 176 engages a latching abutment 177 (Figure 15), on the picking arm 150, when the latch is in latching position, holding the picking arm against release of the pull of spring 153 and preventing throwing of the picker stick.

When the cam moves to a low, the latch control bar moves to lower position (Figures 13 to 16 inclusive) where it can be engaged by the picking abutment 149, the latch is opened, releasing the picking arm 150 and permitting spring 153 to throw the picker stick. In case cam 158 prevents the latch control bar from engagement by the picking abutment 149, the latch cannot be released and the picker stick cannot be thrown, so that there is a miss.

A projection at 178 from the back of the picking rocker 145 engages the picking arm 150 on the return stroke and returns the arm to the position shown in Figure 13, compressing the spring 153 and permitting the latch spring 174 to restore the latch to latching position, and holding the picking arm in this position until the latch is next released.

It will be evident of course that the picker stick and the picking mechanism on the right hand side of the loom will be opposite counter parts of those here shown at the left hand side of the loom, as indicated in Figure 16, where it is seen that the bell crank 167' is connected with its arm engaging follower rod extension 166' extending up rather than down, and the arm engaging the latch control bar 171 oppositely directed from that on the left. Likewise the picking rockers, arms and latches are opposite, so that the forward stroke on the left which creates a pick or a miss pick corresponds to the return stroke on the right, and vice versa.

To summarize the operation of the form of Figures 13 to 16 inclusive, in the first step corresponding to Figure 1, with the shuttle in the right hand box, the cam follower 163 has just begun to arrive at a radial inner or "low" portion 160 of the picking change cam 158, moving the picking latch control bars 171 at both sides of the loom into the picking position where they can be intercepted by the picking abutment 149. However, the picking rocker 145 on the right is then moving toward the position for engagement between the abutment 149 and the end 175 of the latch control bar, while on the left the picking rocker 145 is on its return or inoperative stroke. Therefore on the right the picking abutment 149 engages the latch control bar, releasing the latch and permitting the spring 153 to throw over the picking arm 150, which in turn pulls the picker strap 154 and the picker stick 66 and throws the shuttle from right to left.

In the next step as shown in Figure 2, the follower 163 is still on a radial inner or low portion 160 of the picking change cam 158, the shuttle is in the left hand box and the picking rocker at the left is in its operative stroke. Therefore at the left the picking abutment 149 strikes the end 175 of the latch control bar, releases the latch, and permits the spring 153 to throw over the picking arm 150, the picker strap 154 and the picker stick 66, throwing the shuttle from left to right. No operation occurs on the right because the shuttle is not in the right hand box and the picking rocker 145 on the right is on its return stroke.

In the third step corresponding to Figure 3, the cam follower 163 has arrived at a high or radially outer portion 159 of the picking change cam 158, moving the latch control bars 171 to the upper or miss position, so that, while the picking rocker 145 on the right makes a stroke in the operative direction, the picking abutment 149 does not encounter the picking control bar, the latch is not released and the shuttle is not thrown. Over at the left the picking rocker 145 is making its return stroke.

In the fourth step of the cycle as shown in Figure 4, the follower 163 is near the end of a radially outer portion 159 of the picking change cam 158, so that the latch control bars 171 are still set for a miss. The picking rocker 145 on the right is on its return stroke, but the picking rocker at the left is on its operative or forward stroke, but accomplishes nothing due to the fact that the picking abutment 149 does not encounter the picking control bar 171. In any case there could be no picking from the left, as the shuttle is in the right hand box, but the shifting of the picking control bar at the left in this case prevents throwing the picker stick in the absence of the shuttle, which in the case of the heavier mechanism of Figures 13 to 16 might cause some damage to the equipment.

The only other change which normally would be encountered in a loom to produce the special weave under discussion would be the change in the take-up speed to make it accommodate the

rate of production of the fabric which is half the normal take-up speed, due to the two mispicks. This feature is obviously merely a matter of choosing suitable gear ratios.

In Figures 17 and 18, I illustrate suitable conventional wires, of which Figure 17 shows a cutting wire 179 having a cutting portion 180 and a wire portion 181 which is desirably a high wire capable of producing a high loop. The wire 182 of Figure 18 is normally a low wire and a non-cutting wire. The result of using the wire of Figure 17 for producing the high loops and the wire of Figure 18 for producing the low loops is that in the fabric of Figure 9 the areas 61 will not only be different in appearance because they contain cut pile but also because they are higher than the uncut pile in area 60. The net result is that a mosaic effect is produced entirely independent of any differences in pattern color, and this effect may be accentuated and rendered more artistic by choosing pattern colors which will function in harmony with the weave. Thus the textile designer is given a new tool in design to combine with the previously used feature of color contrast, without paying the penalty previously exacted of relatively greater material consumption and disadvantageous location of the respective contrasting tufts in different transverse rows of tufts. Accordingly the present invention makes possible production of an improved fabric on which infinite variation is possible due to the ability to employ variantly the features of cut and uncut loops and high and low loops, as well as the normal color contrast in the pattern.

Thus it is possible to get an additional color combination without adding additional pile yarn, for example by using a given pile warp at one point in the design as an uncut loop and at another point in the design as a cut loop. This is illustrated diagrammatically in Figure 19, in which it will be evident that the same pile yarn 183 is employed as a cut tuft at 184 due to the fact that it has been raised over a cutting wire, whereas at other points in the same fabric this is used as an uncut loop 185 due to the fact that it has been raised over a non-cutting wire.

This effect is both novel and unusual due to the fact that the cut ends of the pile have a distinctly different color effect from that given by a mass of loops of the same pile.

In Figure 8 I show a fabric having cut high pile and uncut low pile in the same transverse row of tults. The features of cut and uncut piles and high and low piles in the same transverse row of tufts may be combined in many variations. Thus in Figure 20 I show uncut high pile 186 and uncut low pile 187, which, as the pattern may provide, will come in the same transverse row of tufts. Figure 21 shows uncut high pile 188 and cut low pile 189, which in this fabric will come in the same transverse row of tufts. In Figure 22 cut high pile 190 and cut low pile 191 are provided, and these can come in the same transverse row of tufts in the fabric. In all of these figures, the high and low pile, or cut and uncut pile of different transverse rows, while permissibly made from the same pile warp, are preferably made from different pile warps, as shown.

Where reference is made herein to pile projections, it is intended to includes cut tufts and uncut loops.

Where reference is made herein to a cycle, it is intended to include the two picks and two mispicks, disregarding the feature of the reversal of the chain warps.

In view of my invention and disclosure variations and modification to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the process shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The process of weaving a pile fabric, which comprises inserting a plurality of solid picks and then a plurality of mispicks accompanied by beats in successive positions per cycle, raising a pile of one character with respect to height or cut and uncut condition over a wire at one of the solid picks, raising a pile of another such character over a wire at a successive position at one of the mispicks, and moving the pile projection formed over the latter wire into the same transverse row as the pile projection formed over the former wire.

2. The process of weaving a pile fabric, which comprises inserting a plurality of wires of different characters longitudinally displaced side by side in each cycle, selectively raising piles to form pile projections over any wire as the pattern may require, making only two shots per cycle, and moving all pile projections of different character formed on one cycle into the same transverse row of pile projections.

3. The process of weaving a floor covering pile fabric, which consists in interweaving chain warps, stuffer warps and wefts, inserting two wires of different character longitudinally displaced side by side on each cycle, selectively raising pile warps over one or the other wire as the pattern requires, making only two shots per cycle, and beating up the pile projections of different characters formed on one cycle into the same transverse row of pile projections.

4. The process of weaving a pile fabric, which comprises weaving a cycle consisting of a plurality of picks and two mispicks accompanied by beats in successive positions, inserting longitudinally displaced wires of different characters over one pick and over one mispick per cycle, selectively raising piles over one or the other of the wires as the pattern requires and beating up all pile projections of different characters formed on the one cycle into the same transverse row of pile projections.

5. The process of weaving a pile fabric, which comprises inserting a pair of solid shots of weft and a pair of misshots of weft accompanied by beats in successive positions per cycle, crossing chain warps between the solid shots of each pair, selectively raising pile warps into longitudinally displaced pile projections of different characters over one of the solid shots or one of the misshots as the pattern requires, and beating up all pile projections of different characters formed on one cycle into the same transverse row of pile projections.

6. The process of weaving a floor covering pile fabric, which comprises forming a pair of solid picks and a pair of mispicks accompanied by beats in successive positions, reversing chain warps between each pair of solid picks, raising a stuffer warp over only one solid pick, selectively raising a pile of one character over a solid pick and a pile of another character at a longitudi-

nally displaced position over a mispick as the pattern requires, and bringing the pile projections of different character formed on one cycle into the same transverse row of pile projections.

7. The process of forming a pile fabric having pile projections of different characters with respect to pile height or cut and uncut condition, which comprises forming on a given fabric cycle at a given transverse point either a pile projection of one character opposite a pick or a pile projection of another character opposite the second of a pair of adjoining mispicks longitudinally displaced at successive positions, and moving all pile projections formed opposite the mispicks into the same transverse line of pile projections as the pile projections formed opposite the picks on a given cycle under the action of the beat of the lay applied to a subsequent pick.

8. In a weaving cycle in which there are alternately two solid picks and two longitudinally displaced blank picks accompanied by beats, the process which comprises carrying chain warps over the blank picks between spaced solid picks, reversing the chain warps between adjacent solid picks and likewise reversing a stuffer warp over one of the adjacent solid picks.

9. In a weaving cycle in which there are alternately two solid picks and two longitudinally displaced blank picks accompanied by beats, the process which comprises carrying chain warps over the blank picks between spaced solid picks, reversing the chain warps between adjacent solid picks and likewise reversing a stuffer warp over one of the adjacent solid picks, and raising the pile over wires, the wires alternately being cutting wires and non-cutting wires.

10. In the method of weaving special warp fabric, the invention which comprises alternating solid picks and blank picks accompanied by beats in pairs at successive longitudinally displaced positions, and raising warp pile yarn over cutting and non-cutting pile wires positioned side by side corresponding in position to one of the pairs of picks or blank picks, as the pattern requires.

11. The process of weaving a pile fabric, which comprises starting with one chain warp raised, the other chain warp lowered, the stuffer warp lowered and the pile warps lowered and picking; next reversing the chain warps, raising the stuffer warp, raising some pile warps half-way, raising other pile warps fully as the pattern requires, inserting a wire and picking; next retaining the chain warp positions, lowering the stuffer warp, lowering the pile warps and mispicking; next retaining the chain warp positions and the stuffer warp position, raising some pile warps half-way, raising other pile warps fully, inserting a wire and mispicking; and repeating on subsequent cycles identical except that each cycle starts with the chain warps reversed with respect to the previous cycle.

12. The method of weaving, using chain warps, stuffer warps and pile warps with alternating pairs of solid picks and blank picks, which comprises starting with one of the chain warp heddles up, the other chain warp heddle down, the stuffer heddle down and the lash or pile down, and picking; next reversing the chain warp heddles and the stuffer warp heddle while lifting some pile warps fully, as the pattern requires, lifting the other pile warps half-way, inserting a wire and picking; next retaining the positions of the chain warp heddles and the stuffer warp heddle, lowering the pile warps and missing a pick; next retaining the positions of the chain warp heddles and the stuffer warp heddle while lifting some pile warps fully, as the pattern requires, lifting the other pile warps half-way, inserting a wire and missing a pick.

13. The method of weaving a special pile fabric of chain warps, stuffer warps and two sets of pile warps, which comprises reversing the chain warps at every fourth pick, inserting solid picks immediately before and immediately after the reversal, lifting the stuffer warp to the front of the fabric for each second solid pick, the stuffer warp being held in the back of the fabric at all other times, passing one set of pile warps about a pile wire opposite each second solid pick as the pattern requires and raising the other set of pile warps about a second pile wire opposite one of the blank picks, as the pattern requires, the pile warps being in the back of the fabric at intermediate pick positions, and cutting alternate sets of pile warps.

14. The process of weaving a pile fabric, using chain warp, stuffer warp and lingoe heddles, which comprises starting with one chain warp heddle raised and one chain warp heddle lowered, with the stuffer warp heddle lowered and the lingoe heddles lowered and picking; next reversing the chain warp heddles and the stuffer warp heddle, raising some lingoe heddles fully where the pattern requires and raising others half-way, inserting a wire and picking; next retaining the positions of the chain warp haddles, lowering the stuffer warp heddle, lowering the lingoe heddles and mispicking; next retaining the position of the chain warp heddles and stuffer warp heddles while raising some lingoe heddles fully, as required by the pattern, raising other lingoe heddles half-way, inserting a wire and mispicking; then repeating as the next cycle identical except that the chain warps are reversed.

15. The process of weaving a floor covering pile fabric, which comprises inserting successively both non-cutting and cutting wires longitudinally displaced side by side on each cycle, the non-cutting wire going in first and the cutting wire following with a view to facilitating positioning, selectively raising the pile over one or the other wire as the pattern may require, taking only two weft shots on each cycle, and moving both uncut and cut pile projections formed on one cycle into the same transverse row of pile projections.

16. In a weaving cycle in which there are alternately two solid picks and two blank picks accompanied by beats, the process which comprises carrying chain warps over the blank picks between spaced solid picks introduced at successive longitudinally displaced positions, reversing the chain warps between adjacent solid picks and likewise reversing the stuffer warp over one of the adjacent solid picks, and raising the pile over wires, the wires alternately being non-cutting wires and cutting wires, the first wire non-cutting and the second wire cutting.

17. In the process of making a fabric having chain and stuffer warps and pile yarn appearing in cut and uncut pile, the novelty which consists in forming solid picks in pairs one of which picks corresponds to the longitudinal position of one of the types of pile and omitting pairs of picks in longitudinal positions one of which corresponds to the other type of pile.

18. The process of forming a pile fabric, which comprises interweaving chain warps with only two shots of weft per cycle, bringing one of the shots to the front and one to the back of the fabric, and raising two distinctly different charac-

ters of pile between two adjoining wefts initially longitudinally displaced side by side and bringing them to the front of the fabric into the same transverse row of pile projections.

19. The process of forming a pile fabric, which comprises interweaving chain warps, a stuffer warp and only two shots of weft per cycle into a fabric having one warp at the front and one at the back in each cycle and raising between each pair of adjoining wefts at the front of the fabric two distinctly different characters of pile projections initially longitudinally displaced side by side and bringing them into the same transverse line of pile projections.

JOHN HENRY HARDING,
Generally Known as Harry J. Harding.

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