July 3, 1962 J. T. MacISAAC, JR., ETAL 3,042,081

HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

Filed Aug. 27, 1959 6 Sheets-Sheet 1

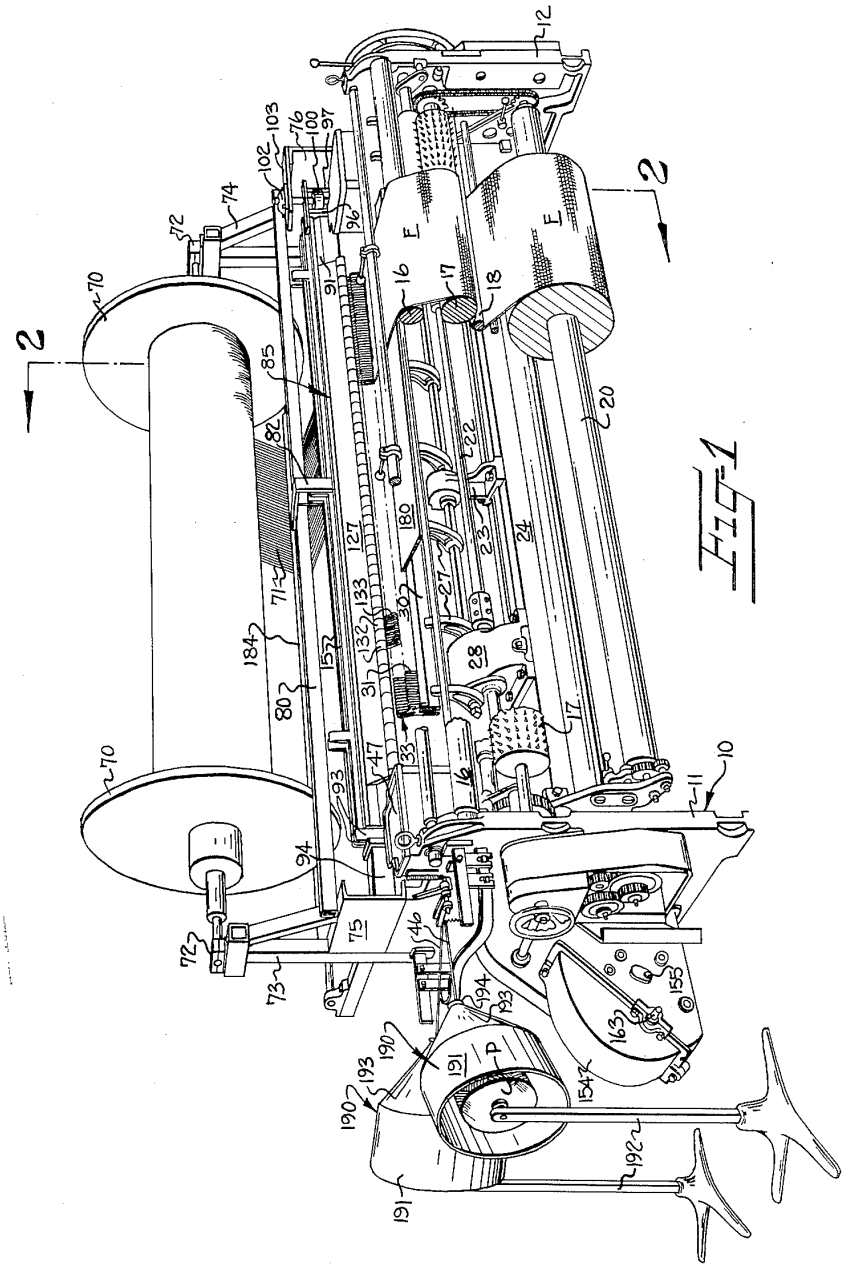

FIG. 1

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HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

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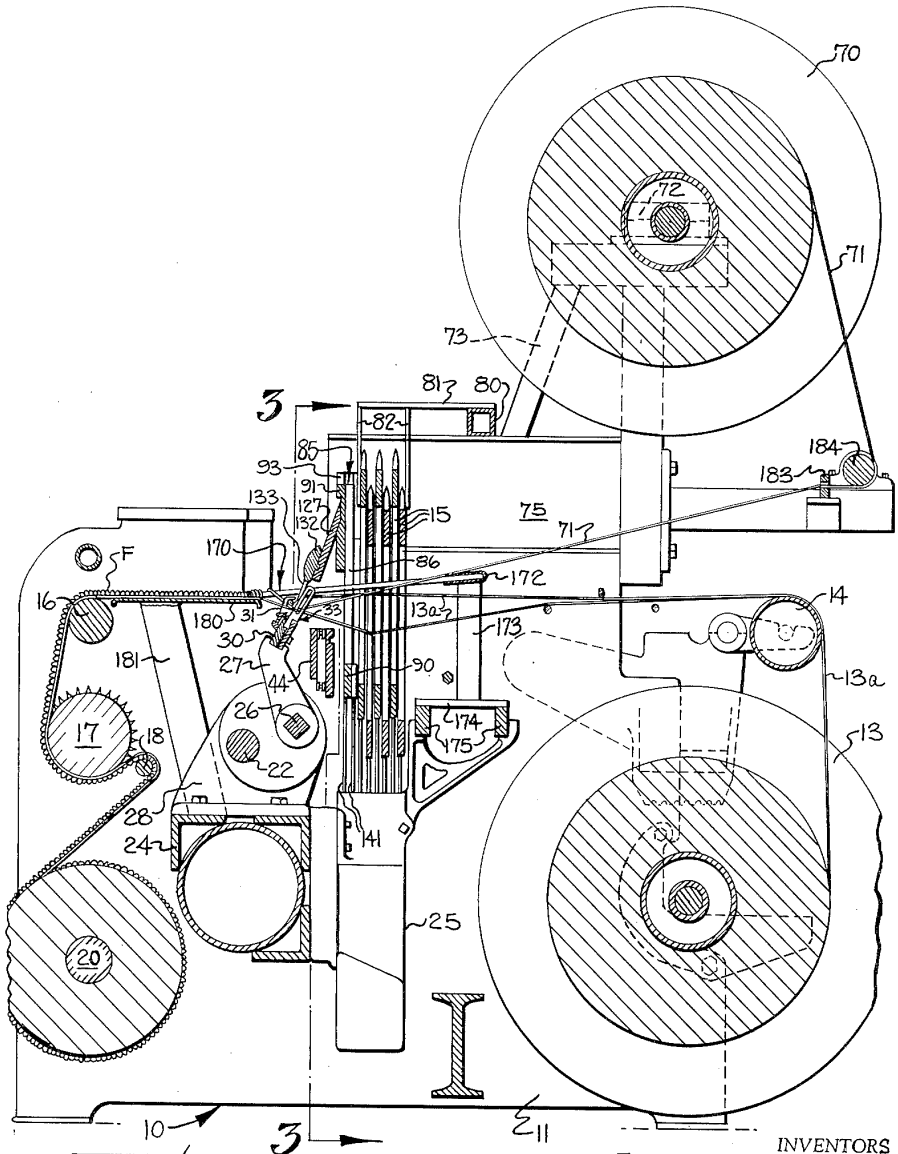

Fig-2

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HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

Filed Aug. 27, 1959 6 Sheets-Sheet 3

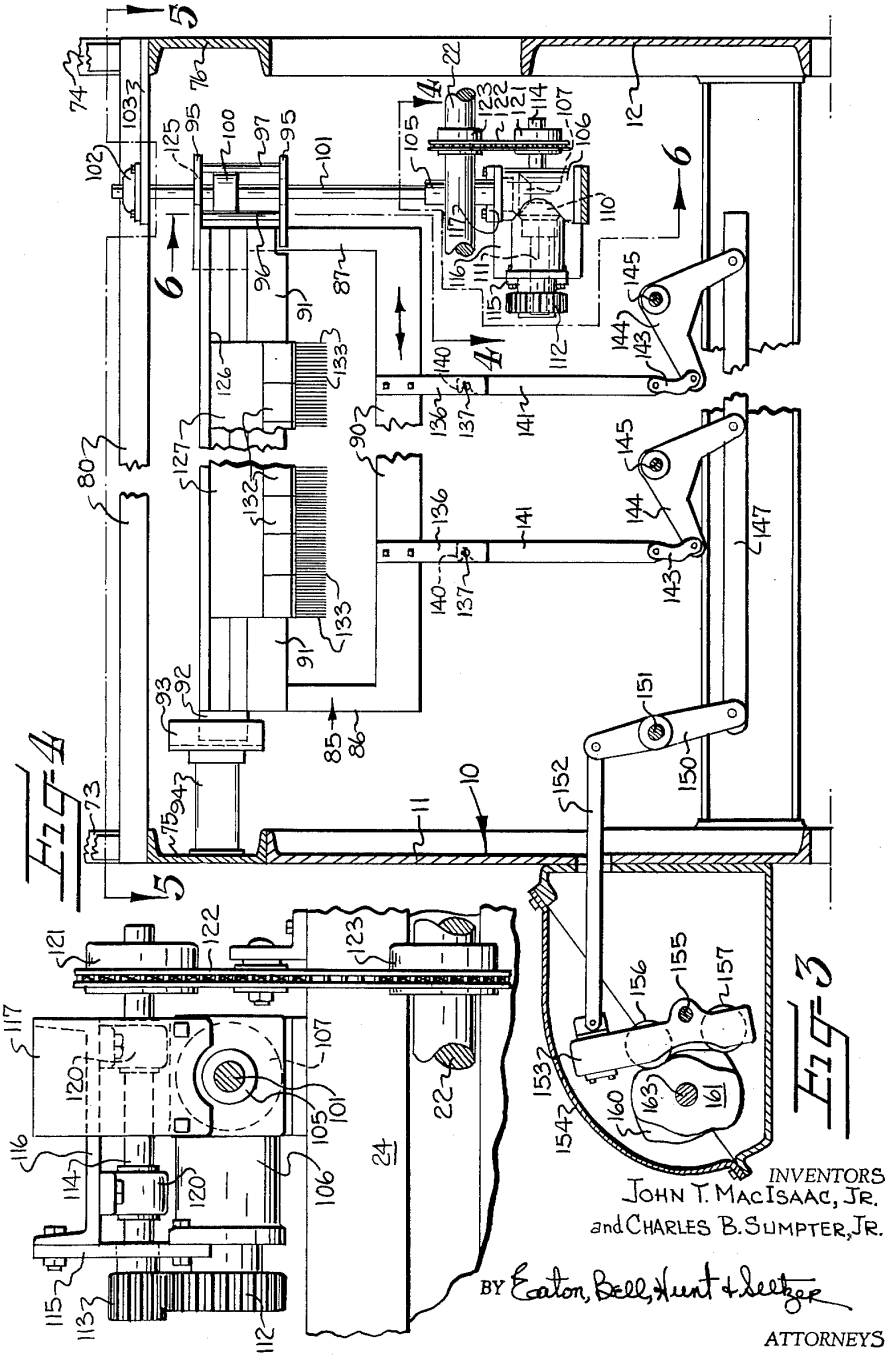

Fig. 4

Fig. 3

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HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

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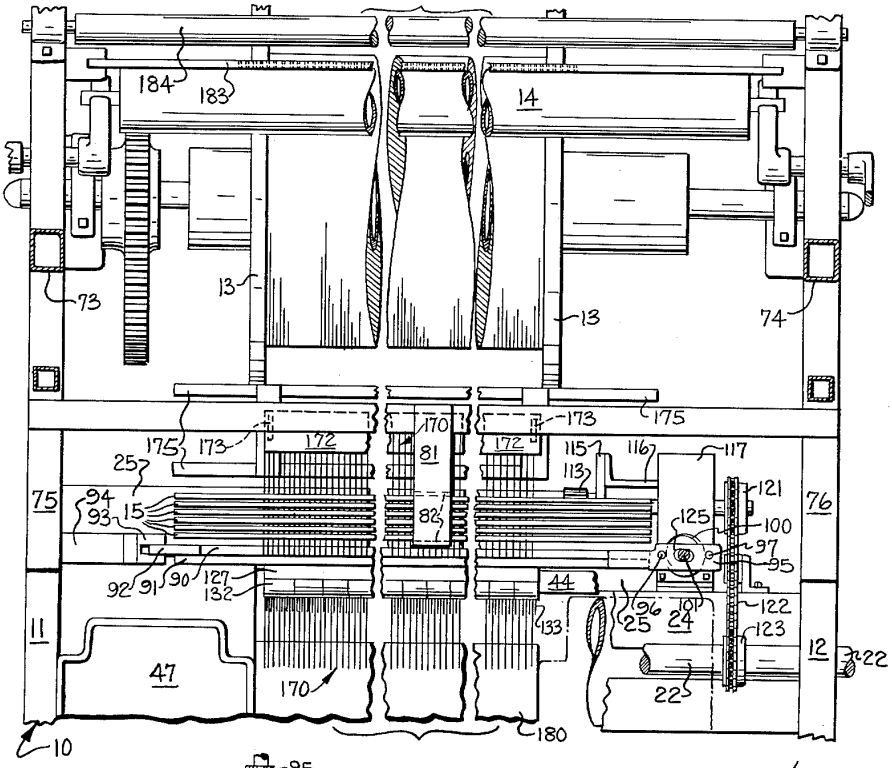

Fig-5

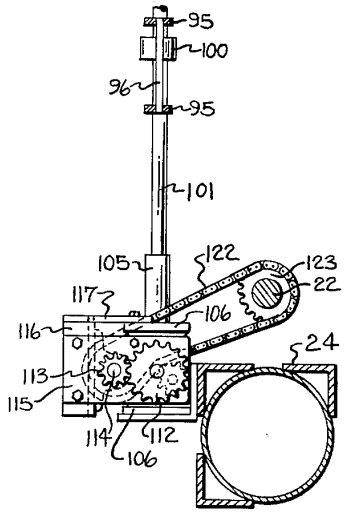

Fig-6

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HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

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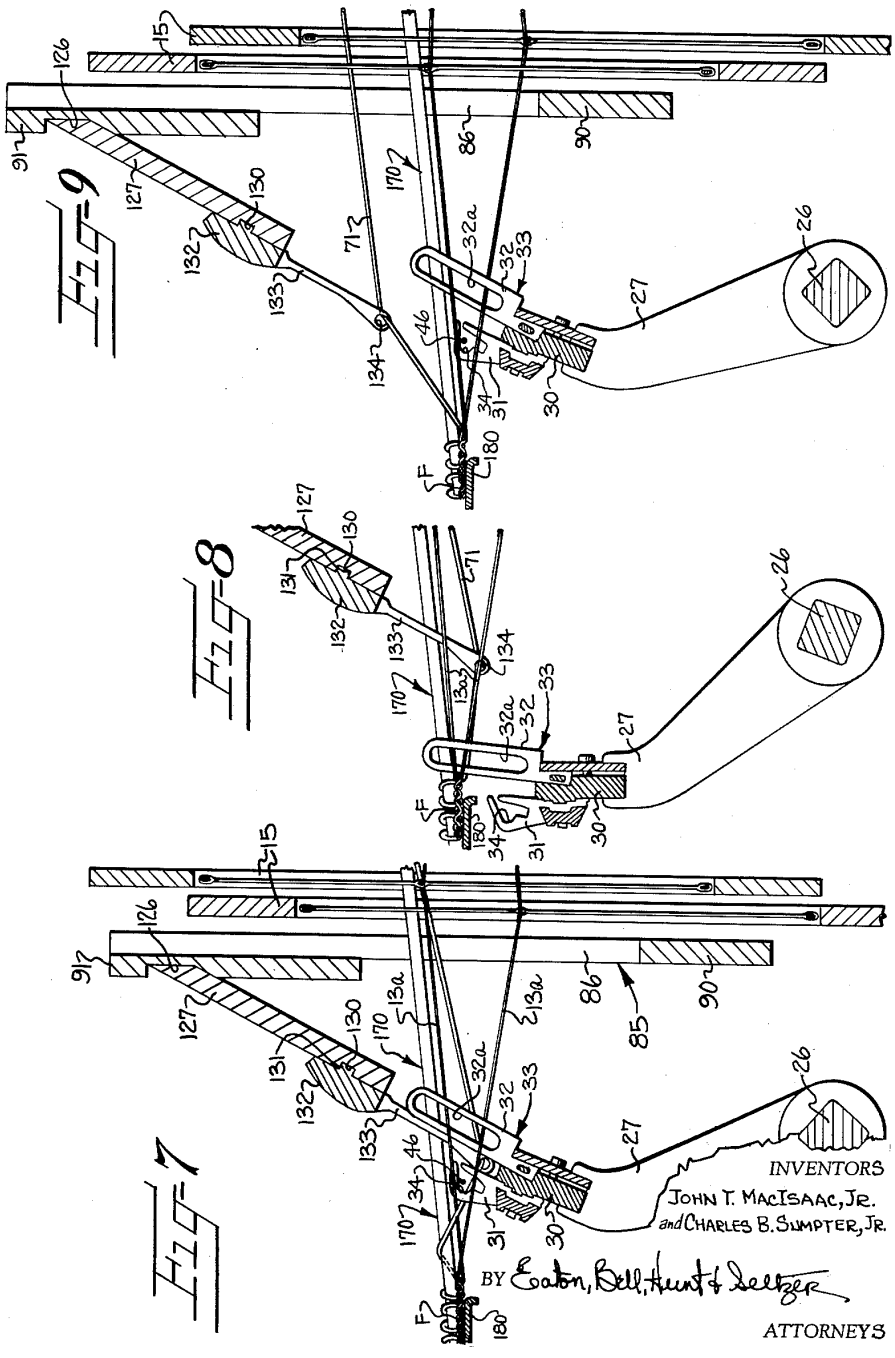

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HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

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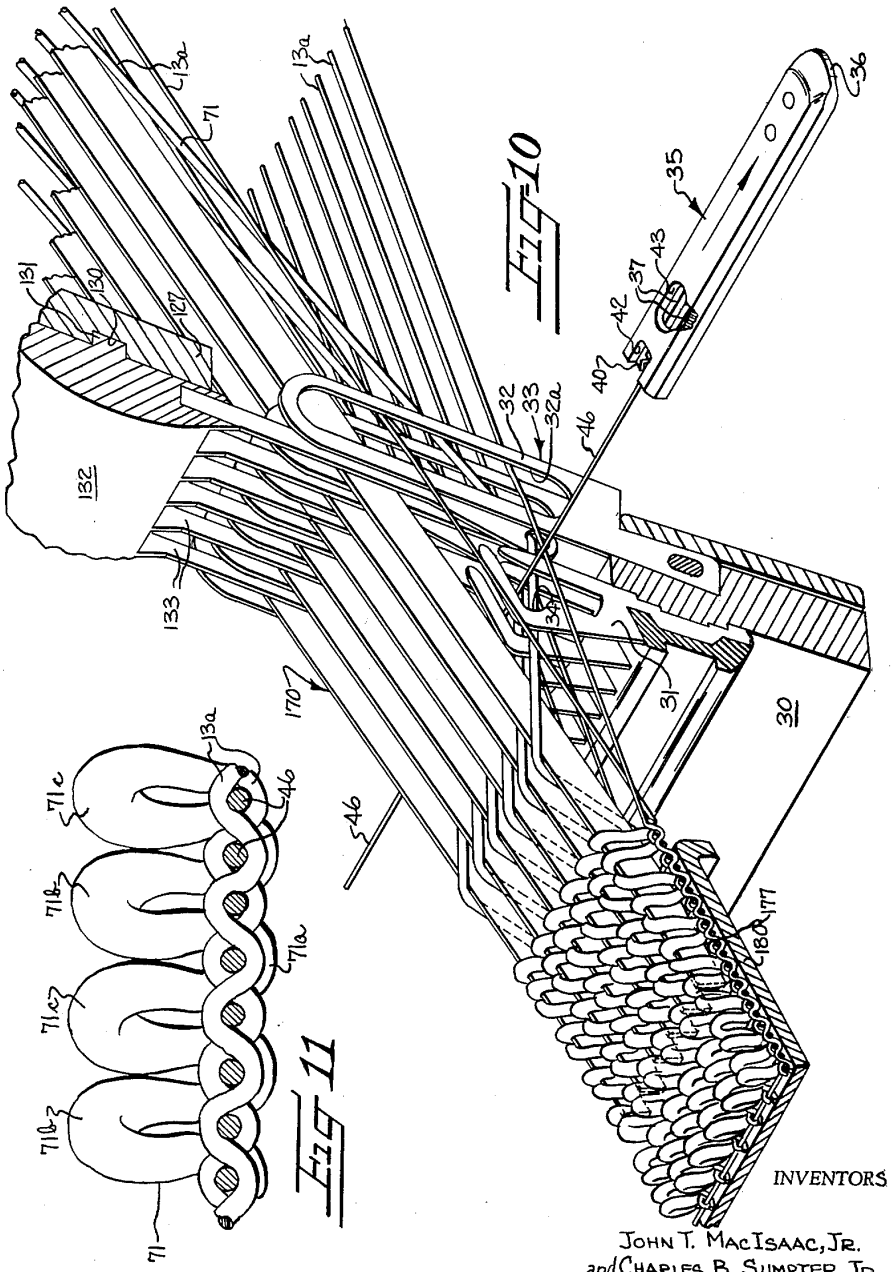

FIG 10

FIG 11

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United States Patent Office 3,042,081 Patented July 3, 1962

3,042,081

HIGH SPEED CARPET LOOM AND METHOD OF WEAVING

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Filed Aug. 27, 1959, Ser. No. 836,491
18 Claims. (Cl. 139—46)

This invention relates to fly shuttle looms of the type known as a Sulzer loom and more especially to a novel apparatus and method for weaving pile fabrics on looms of this character.

Various types of looms are currently in use for weaving cut and loop pile fabrics, such as rugs, carpets, and the like. Some looms, known as the Wilton type, utilize weftwise pile wires which are inserted in the shed formed of the ground warps and pile yarns for forming loops over the pile wires.

Other looms, known as the Clark type, utilize warpwise extending, stationary or movable pile wires which extend through an oscillating reed. Pile warps are interwoven with the ground fabric by means of vertically and laterally movable pile yarn guides which, subsequent to each double waft yarn being inserted by a reciprocating needle, wove upwardly out of the shed, over the tops of respective pile wires and ground warps and then downwardly into the shed on the other side of the pile wires so that another double weft yarn may be inserted over the looped lower portions of the pile yarns. Single-shot and multiple-shot carpet fabrics are woven in this manner.

Both types of looms mentioned above must operate relatively slow due to the fact that, among other things, the Wilton type loom has required the insertion and withdrawal of transverse pile wires at frequent intervals, and the Clark type loom has required that an elongated, cantilever-supported, reciprocating needle be used for inserting double weft yarns with each pick of the loom. The Clark loom has also required that the tension in the pile yarns be carefully controlled and maintained at all times during the weaving operation.

It is an object of this invention to provide an improved apparatus for and method of weaving loop pile fabrics which comprises inserting warpwise pile yarns and respective pile yarn guides between certain adjacent ground warps while passing a single strand of weft yarn through the shed and over the pile yarns, then raising and shogging the guides over and across respective pile wires and groups of warps while beating up the single strand of weft yarn, and then repeating the steps prescribed in weaving a length of fabric. This produces a pile fabric at a much faster speed than has been obtainable on prior looms.

As is well known, looms of the Clark type have a cantilever-supported, reciprocating needle and are devoid of a lay, due to the fact that the pile yarns must be inserted downwardly; by pile yarn guides, through the warp shed a sufficient distance so that the weft yarns may be inserted above the pile yarns. The presence of a lay would obstruct the downward movement of the pile yarn guides through the shed. It follows, therefore, that conventional cop-carrying or bobbin-carrying shuttles could not be used with pile yarn guides of the character described, since the stroke of the pile yarn guides would not be sufficient to move the pile yarns below the path of travel of the shuttle because of the obstruction of the lay.

With the foregoing in mind, it is another object of this invention to provide a pile loom having a free-flight shuttle guided by a shuttle race which will permit pile yarns to be inserted downwardly through the shed and sufficiently so the yarn carried by the shuttle may be inserted above the pile yarn.

It is a more specific object of this invention to provide apparatus for weaving pile fabric in which a ground fabric is woven from ground warps with weft threads inserted in the shed from one side only of the loom by means of projectile-like gripping shuttles which pass through a race formed of a weftwise row of closely spaced hook shaped shuttle guides. Concurrently with the weaving of the fabric, pile yarn is inserted downwardly through the shed, between the shuttle guides and below the path of the weft, which is then inserted over the pile yarns.

To our knowledge, carpet and rug fabrics could not be woven on Sulzer looms heretofore, not only because no way had been conceived for inserting and shogging pile yarns on this type of loom, but because the prior art projectile-like shuttles were incapable of efficiently grasping and pulling jute and similar weft yarns through the shed, since such weft yarns would slip out of the grippers provided on such prior art gripper shuttles. However, we have overcome this defect by providing the shuttles with grippers having serrated or irregular mating surfaces which will tightly grip the jute, as disclosed in our co-pending United States application, Serial No. 826,830, filed July 13, 1959, now abandoned, and entitled Gripper Shuttle.

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 perspective view of a Warner & Swasey-Sulzer loom, with parts broken away and showing the improved pile weaving apparatus in association therewith;

FIGURE 2 is a transverse vertical sectional view taken substantially along line **2—2** in FIGURE 1 and showing the pile yarn guides in lowered or pile-inserting position;

FIGURE 3 is a schematic elevation, partially in section and with parts broken away, looking rearwardly substantially along line **3—3** in FIGURE 2 and illustrating, in particular, preferred means for vertically reciprocating the pile yarn guides and for shogging the same;

FIGURE 4 is an elongated fragmentary plan view taken substantially along line **4—4** in FIGURE 3, and showing parts of the mechanism for shogging the pile yarn guides;

FIGURE 5 is a top plan view of the loom, partially in section, and being taken substantially along line **5—5** in FIGURE 3, with parts being broken away for purposes of clarity;

FIGURE 6 is a fragmentary vertical sectional view taken substantially along line **6—6** in FIGURE 3 and showing the parts of the mechanism for shogging the pile yarn guides;

FIGURE 7 is an enlarged, schematic, vertical sectional view similar to the central portion of FIGURE 2, showing the pile yarn guides in lowered or pile-inserting position;

FIGURE 8 is a view similar to FIGURE 7 showing the reed in beat-up position and the pile yarn guides starting to move upwardly;

FIGURE 9 is a view similar to FIGURE 7 showing the reed in a backward stroke, the pile yarn guides in raised position and a single strand of weft yarn inserted in the shed formed of the ground warps;

FIGURE 10 is a fragmentary isometric view, partially in section, showing the reed, shuttle guides and pile yarn guides in the position occupied thereby as a shuttle inserts a single weft yarn in the shed; and

FIGURE 11 is a fragmentary sectional view taken warpwise of one example of the fabric and looking weft-

wise thereof, wherein the fabric is shown in the form of a two-shot fabric.

The present method is carried out on a loom of the type known as a Warner & Swasey-Sulzer weaving machine, many elements of which are constructed and operated substantially in the manner disclosed in U.S. Patent No. 2,099,627 granted to Rudolph Rossmann, November 16, 1937, and in other patents mentioned therein. Also, since many of the elements shown in the accompanying drawings are usual parts of a Warner & Swasey-Sulzer weaving machine or loom, only so much of such usual parts will be described as is necessary to a clear understanding of the present invention.

As best shown in FIGURES 1, 2, 3 and 5, the loom comprises a frame broadly designed at **10** and including left-hand and right-hand side frame members **11**, **12** between which are mounted a ground warp beam **13**, a rear guide roll or vibrator roll **14**, a plurality of vertically movable harnesses or heddles **15**, a front carrier roll **16** for the fabric F, a driven take-up roll or sand roll **17**, a press roll **18**, and a cloth beam **20**, all of which are usual parts of a loom of this character.

The loom is equipped with a main drive shaft **22** journaled in a lay drive housing **28** and in frame members **11**, **12**. Housing **28** is mounted on a composite main girt **24** (FIGURES 1 and 2). Girt **24** supports a housing **25** within which a suitable mechanism is provided for imparting vertical reciprocatory movement to the heddles or harnesses **15**.

Housing **28** has suitable gearing therein for transmitting rocking or oscillating motion to a rocker shaft **26** from the main drive shaft **22**. Rocker shaft **26** is also journaled in frame members **11**, **12** and bearings **23**, only one of which is shown mounted on girt **24** in FIGURE 1. Shaft **26** has a plurality of rocker arms or swords **27** fixed thereon which support a transverse reed bar or lay **30** on which a row of closely spaced shuttle guides or shuttle guide hooks **31** and a row of corresponding reed splits **32** are fixedly mounted. Reed splits **32** collectively form a reed **33** which is peculiar to the present invention, as will be later described.

As best shown in FIGURES 7, 8, 9 and 10, each shuttle guide **31** is in the form of a hook having a hole or opening **34** therethrough. The holes **34** in shuttle guides **31** collectively form a shuttle race for guiding successive shuttles, such as shuttle **35** of FIGURE 10, through the shed formed of the warps **13***a* by the harnesses or heddles **15**.

As shown in FIGURE 10, each shuttle **35** is in the form of a small metal projectile having a rounded, tapered or pointed nose **36**. Shuttle **35** is of hollow construction and contains a pair of yieldable gripper arms **37** which are biased toward each other and whose rear ends have a pair of irregular mating jaws or grippers **40** thereon which are exposed in an opening or notch **42** provided in the rear end of the projectile or shuttle **35**. Shuttle **35** is also provided with an intermediate opening **43** therethrough through which a usual spreading device (not shown) passes and spreads apart the gripper arms **37** for momentarily opening grippers **40** as each shuttle **35** is moved from an endless return conveyor mechanism **44** (FIGURE 2) and positioned in alinement with either or both of a pair of weft or filling yarns **46** (FIGURE 1) and within a shuttle feeding or picking box **47**.

By means substantially as disclosed in FIGURES 5, 6 and 7 of said Rossmann Patent No. 2,099,627, the end of a filling or weft yarn **46** is positioned between the open jaws or grippers **40**, which are then released to clamp the corresponding end of the weft yarn **46** therebetween (FIGURE 10). Thereupon, the loom is equipped with a suitable means for propelling the corresponding gripping shuttle through the shuttle guides **31** and the shed formed of the ground warps **13***a*. Such looms are usually provided with a picking lever which propels each successive shuttle **35** through the shed in timed relation to the operation of the harnesses or heddles **15**.

As is peculiar with this particular type of loom, but which is a usual mechanism of such loom, energy is built up in the picking lever by twisting a torsion rod through a cam action in the picking box and then locking it in its loaded position approximately four times a second. A shuttle is placed in firing position and the driving force is then released. The shuttle is then flipped or shot across the machine at high speed, carrying the filling with it. Such looms are normally equipped with a hydraulic dashpot which cushions the picking lever as it nears the end of each stroke. Since the picking lever and associated elements, including the means for returning the shuttles to picking position are usual parts of a Warner & Swasey-Sulzer weaving machine, a detailed illustration and description thereof is deemed unnecessary.

With the exception of a novel reed construction **33** being substituted for the usual reed construction, the parts heretofore described are usual parts of a Warner & Swasey-Sulzer weaving machine or loom and it is with such parts that the present method and appaartus are particularly adapted to be associated.

The present invention resides in a novel method and apparatus for interweaving pile yarns with a base fabric in which a single strand of weft yarn is inserted with each pick of the loom and all strands are inserted in one direction by means of successive gripper or gripping shuttles of the character heretofore described, and wherein the pile yarns extend through a row of "dipping" pile yarn guides which move the pile yarns downwardly over the tops of pile wires and into the shed formed of the ground warps. This causes the pile yarns to extend from the pile wires downwardly and rearwardly at an angle and below the path of the weft yarn as it is being inserted through the openings **34** in the shuttle guides **31** (FIGURE 7). After, or at substantially the same time as, the corresponding weft yarn is beat-up against the fell of the cloth by the reed **33**, the pile yarn guides move upwardly and then cross above the pile wires and again move downwardly preparatory to a succeeding weft yarn or pick being inserted through the shuttle guides **31**.

In carrying out the present method, there is provided a pile yarn beam **70** from which pile yarns **71** are withdrawn. Pile yarn beam **70** is journaled in blocks **72** at opposite ends thereof. Blocks **72** are carried by respective A-frames **73**, **74** which are suitably attached to the respective side frame members **11**, **12** by respective substantially horizontal frame members **75**, **76** (FIGURES 1, 2 and 3). Opposed ends of a heddle guide beam **80** are suitably secured to the upper portions of frame members **75**, **76**. The central portion of beam **80** has a forwardly extending bar **81** thereon (FIGURE 2) from which a pair of guide plates **82** depends. Guide plates **82** straddle the upper portions of harness **15** to assist in the guiding the same during vertical reciprocation thereof.

Mounted for vertical and lateral shogging motion forwardly of harnesses **15** is a substantially rectangular pile guide frame **85** which is similar to a conventional harness frame, but is devoid of any heddles. The pile guide frame **85** is best shown in FIGURES 2, 3, 5, 7 and 9 and comprises a pair of substantially upright side frame members **86**, **87**, a lower substantially horizontal frame member **90** and an upper transverse frame member or plate **91**. Frame members **86**, **87**, **90**, **91** of pile guide frame **85** are suitably interconnected.

The left-hand side frame member **86** of pile guide frame **85** has a laterally projecting portion **92** integral therewith or suitatbly secured thereto which is guided for vertical and horizontal sliding movement in a substantially vertically extending channel member **93**. Channel member **93** is fixed on the inner end of a support **94** projecting inwardly from the horizontal portion **75** of A-frame **73**.

The other or right-hand end of pile guide frame 85 has a pair of substantially horizontal bars 95 projecting outwardly therefrom which support upper and lower ends of spaced cam follower elements or rods 96, 97. Rods 96, 97 engage substantially diammetrically opposed surfaces of an eccentric shogging cam 100 fixed on a substantially vertical shaft 101. The upper end of shaft 101 is journaled in a bearing block 102 fixed on a bar 103 projecting inwardly from and being suitably secured to the substantially horizontal frame member 76 of the right-hand A-frame 74.

The lower portion of shaft 101 is journaled in a bearing block or sleeve 105 (FIGURES 3, 4 and 6) whose flanged lower end is fixed to a gear housing 106 suitably supported by the main girt 24 (see FIGURE 6).

The lower end of shaft 101, within gear housing 106, has a bevel gear 107 fixed thereon which meshes with a bevel gear 110 fixed on a shaft 111. Shaft 111 extends outwardly of housing 106. A gear 112 fixed on the free end of shaft 111 engages a smaller gear or pinion 113 (FIGURES 4 and 6) which is fixed on one end of a jack shaft 114. Gear housing 106 has a rearwardly projecting arm or bar 115 fixed thereto which supports a parallel frame member 116.

Frame member 116 is also supported by a substantially horizontal bar 117 projecting rearwardly from and being suitably secured to the top portion of housing 106. Jack shaft 114 is journaled in a pair of bearing blocks 120 suitably secured to the parallel frame member 116.

The end of shaft 114, remote from that end to which gear 113 is secured, has a sprocket wheel 121 fixed thereon. Sprocket wheel 121 is engaged by an endless sprocket chain 122 which is also mounted on a sprocket wheel 123 fixed on the main drive shaft 22.

It is thus seen that main drive shaft 22 transmits rotation to vertical cam shaft 101 to rotate cam 100. Cam 100 thus engages and imparts shogging movements or horizontal reciprocation to pile guide frame 85. Since pile guide frame 85 must reciprocate relative to shaft 101, the two brackets or arms 95 are each provided with a longitudinally extending slot 125 (FIGURE 5) through which shaft 101 loosely extends.

The front face of the upper plate or bar 91 of pile guide frame 85 is substantially vertical and, therefore, plate 91 is provided with a recess 126 in which the upper rear portion of a downwardly and forwardly inclined pile guide supporting plate 127 is suitably secured. Pile guide supporting plate 127 has a longitudinally extending groove 130 in its front surface adjacent the lower edge thereof, which receives a keyed portion 131 on a pile guide holder 132. Pile guide holder 132 has a plurality of downwardly and forwardly projecting pile yarn guides or dipping needles 133 thereon. The lower end of each guide 133 is provided an eye or opening 134 through which pass one or more corresponding pile yarns 71.

In order to impart vertical reciprocatory movement to the pile yarn guides 133 in timed relation to the shogging motion imparted thereto by eccentric cam 100, it will be observed in FIGURE 4 that the lower horizontal bar 90 of pile guide frame 85 has a plurality of downwardly projecting frame members or links 136 suitably secured thereto, each of which is provided with a pin 137 for receiving a hooked upper portion 140 of a link 141.

The lower ends of links 141 are connected, by means of a link coupling 143, to one arm of a bell crank 144. Each bell crank 144 is pivoted, as at 145, on the housing 25 within which they are disposed. The other arms of bell cranks 144 are fixed to a common horizontally movable tappet rod or arm 147. One end of tappet rod 147 is pivotally connected to one end of a crank 150 fixed on a shaft 151 which is also suitably journaled in housing 25.

The other end of crank 150 has a link 152 extending therefrom to a crank or follower arm 153 disposed within a conventional tappet drive housing 154. Tappet drive housing 154 has a shaft 155 journaled therein on which a medial portion of follower arm 153 is journaled. Follower arm 153 has a pair of followers 156, 157 journaled thereon which are maintained in engagement with respective cams 160, 161.

Cam 160 maintains follower 156 in engagement with the periphery of cam 161 while cam 161 maintains the follower 157 in engagement with the periphery of cam 160. Cams 160, 161 are mounted on a common tappet cam drive shaft 163 which is driven by a conventional means, not shown, in timed relation to the main drive shaft.

In fact, the elements heretofore described for imparting vertical reciprocatory movement to pile guide frame 85 and pile yarn guides 133 may be of the same construction as the harness motion usually employed in this type of loam for imparting vertical reciprocatory movement to the harnesses 15, and may be substantially as disclosed in United States Patents Nos. 2,069,330 and 2,099,627 granted to Rudolph Rossmann.

A series of pile wires, loop-forming fingers or gauges 170 extends through the heddles or harnesses 15 and reed 33 from a transverse support 172 which is shown as being of substantially C-shape in FIGURE 2. The pile wire support 172 is fixed on the upper ends of posts 173, only one of which is shown in FIGURE 2. The lower ends of posts 173 are fixed to bars 174 whose forward and rearward portions are suitably secured to transverse frame members 175 carried by the heddle drive housing 25.

The pile yarn guides 133 may be constructed and operated in the manner substantially as disclosed in United States Patent No. 2,808,072 granted to G. T. Stovall on October 1, 1957 and United States Patent No. 2,860,664 granted to I. O. Moberg on November 18, 1958, without departing from the spirit of the invention. In this instance, the warpwise pile wires 170 are each in the form of a thin rigid strip which is inclined downwardly and forwardly and extends substantially beyond the beat-up point or fell of the fabric F. The front ends of the pile wires 170 may overlie respective groups of warps 13*a*, so that guides 133 may shog pile yarns 71 over respective pile wires as well as the respective groups of warps 13*a*. As indicated in FIGURES 7, 8, 9 and 11, a group of said warps 13*a* may be provided between each adjacent pair of warp groups over which pile wires 170 are positioned and over which raised loops are formed. Since the pile wires 170 extend at an angle with respect to the fabric F as it is woven, the lower surface of the front portion of each pile wire 170 is formed at a slight angle with respect to the longitudinal axis of the respective pile wire 170.

In order to support the fabric F so that it is taken up at an angle relative to the attitude of the pile wires 170, we have also provided a novel substantially horizontal breast plate 180 which is suitably supported on standards 181 whose lowered ends are carried by the composite girt 24 (FIGURES 1 and 2). As best shown in FIGURES 2, 7, 8, 9 and 10, the breast beam or plate 180 extends from a point closely adjacent to, but forwardly of, the fell of the fabric F, to a point closely adjacent the front carrier roll 16.

In order that the pile yarns passing through guides 133 may be properly tensioned by frictional engagement with the guides themselves rather than by maintaining critical tensions in the pile yarns 71, it will be observed in FIGURE 2 that the pile yarns extend rearwardly from the pile yarn guides at only a very slight angle relative to the substantially horizontal plane of the ground warps 13*a*. In order to guide the pile yarns 71 at this angle, it will be noted that they extend rearwardly through an eye-board 183 and, thence, around a guide roll 184 and then upwardly to the beam 70 heretofore described.

As shown in FIGURE 7, whenever pile yarn guides 133 are lowered to pile yarn inserting position, they must move downwardly the portions of the respective pile yarns which extend over the pile wires, so that pile yarns extend at the angle below the path of at least the pointed portion 36 of each of the corresponding gripper shuttles

35 as it inserts a single weft yarn 46 through the shed formed of the ground warps 13*a*. Thus, the pile yarn guides 133 must enter the shed as the reed 33 and shuttle guides 31 move in a backward stroke. The pile yarn guides 133 must reach a fully lowered position closely adjacent to and rearwardly of the shuttle guides 31.

Accordingly, each reed split 32 is free at its upper end; that is, there is no connection between the upper portions of adjacent reed splits 32 so that the pile yarn guides 133 may move downwardly through the dents defined between adjacent reed splits 32 and may remain in lowered position or may be in the course of upward movement as the reed 33 moves forwardly relative to the pile yarn guides 133 in a beat-up stroke. Each of the reed splits 32 is preferably in the form of a relatively flat thin metal body having a longitudinally extending slot 32*a* therein through which ground warps 13*a* pass in their course from the heddles or harnesses 15 to the fabric F.

As heretofore indicated, all the shuttles 35 of this type of loom insert the weft thread in the shed always in the same direction and each time one of the gripper shuttles 35 is shot through the shuttle guides 31 and the shed formed of the ground warps 13*a*, another succeeding shuttle 35 is positioned in the picking box 47 and receives, between the jaws or grippers 40 thereof, a weft yarn 46 extending from either of a pair of yarn packages P, only one of which is shown in FIGURE 1.

Since the weft yarns of carpet fabrics usually include jute, and jute is a loosely wound yarn including small relatively stiff fibers, it is necessary that excessive agitation and excessive radial forces be avoided when using jute in the weaving of cloth. Excessive agitation and radial forces acting upon jute will cause the jute to literally fly apart in some instances, or it will cause the fibers to become separated to such extent, as to be insufficiently compacted to be grasped by the gripping shuttles.

Therefore, in order to minimize agitation and the radial forces acting upon yarn which are normally caused by the violent whipping of the yarn as it is unwound from the package, we have provided an enclosure 190 for each yarn package P. Each enclosure 190 comprises a substantially circular shield 191 which is open at its outer end and may be supported on the usual post 192 which supports the respective yarn package P. Connected to and extending inwardly from each circular shield 191 is a hollow cone 193 which, like the annular shield or circular shield 191, is preferably made from a relatively thin sheet metal. The apex of the cone 193 is provided with a guide eye 194 which may be made from a suitable ceramic or plastic material and through which the filler yarn 46 passes to the picking box 47 as it is withdrawn from the corresponding package P.

From the foregoing, it follows that the circular wall 191 and cone 193 limit ballooning and consequent whipping of the filler yarn 46 as it is withdrawn from each package P.

In operation, assume that the pile yarn guides 133 are in fully lowered position as shown in FIGURES 2 and 7 and a portion of the fabric F has been previously woven and extends across and above the breast plate 180. It will be noted that as each successive weft yarn 46 is inserted by a gripper shuttle 35, the weft yarn 46 extends above the pile yarns and through the shed formed of the ground warps 13*a*. The reed 33 then moves forwardly in a beat-up stroke substantially as the pile yarn guides 133 commence to move upwardly, so that the single strand of weft yarn 46 is positioned above the looped lower portions 71*a* (FIGURE 11) of the pile yarns 71.

As heretofore stated, the pile yarn guides 133 are moved upwardly by the mechanism shown in FIGURE 3 and, since shaft 101 rotates continuously during operation of the loom, the cam 100 then causes pile guide frame 85 and pile yarn guides 133 to move laterally, say, from right to left in FIGURE 3. In so doing, the pile yarns are pulled upwardly beneath the single weft yarn last beat-up by the reed 33 and are shogged over the respective pile

wires 170 and corresponding groups of ground warps to draw the pile yarns 71 over the pile wires 170 and form raised loops 71*b* (FIGURE 11).

The mechanism in the lower portion of FIGURE 3 then causes the pile yarn guide 133 to move downwardly adjacent the other sides of the respective pile wires to again occupy substantially the position shown in FIGURES 2 and 7. However, the pile yarns will then extend from the upper edges of the respective pile wires 170 and downwardly past the opposite sides thereof from that shown in FIGURE 7. Thereupon another single weft varn 46 is inserted through the open shed and above the pile yarns. The process is then repeated in the course of which cam 100 causes the pile yarn guides to shog from left to right in FIGURE 3 or in the opposite direction from that in which they had last been shogged to form loops 71*c* and to complete a cycle in the operation of the apparatus. In this instance, warpwise rows of loops 71*b*, 71*c* may be formed over alternate groups of warps 13*a*, so that a group of warps devoid of loops may appear between each adjacent pair warpwise rows of loops 17*b*, 71*c* to facilitate cutting the fabric warpwise between adjacent rows of loops during installation thereof.

In weaving the two-shot fabric shown in FIGURE 11, the pile yarn guides 133 are lowered with alternate picks and remain raised with intervening picks. It follows, therefore, that shaft 101 and the operation of the pile guide frame lifting means of FIGURE 3 must then operate at half the speed of main drive shaft 22. However, it is well within the scope of the present invention to change the speeds of the shafts 101, 163 to produce one-shot or three-shot fabrics, if desired, without departing from the spirit of the invention.

Now, one important reason why it is not necessary that a certain predetermined tension be maintained in the pile yarns 71 between beam 70 and the pilot yarn guides 133 is due to the fact that the substantially vertical reciprocatory movement of the pile yarn guides 133 is substantially perpendicular to the normal path or plane of the pile yarns 71 passing through the eyes 134 of the pilot yarn guides 133. Also, since the lower surfaces of the pile wires 170 extend at an angle relative to the immediate fell of the cloth, the pile yarns actually raise the base fabric immediately adjacent the fell thereof as the pile yarn guides 133 dip into the shed formed of the ground warps 13*a*. Thus, the pile yarn is tightened against the lower surfaces of the individual weft yarns 46 immediately after each weft yarn is beat-up by reed 33 so the pile yarns are tightly secured in the fabric immediately upon each succeeding pick being inserted and beat-up at the fell of the cloth.

It will be noted that, since the loom operates at relatively high speeds of 240 picks per minute or even more, the use of the gripping shuttles, due to their small size, is particularly compatible with the reciprocating pile yarn guides 133, since the pile yarn guides 133 need only reciprocate with relatively short strokes in opposite directions in order to insure that the pile yarns are inserted below the plane of the weft yarns 46 as they are cast. Also, pile yarn guides 133 need only rise a relatively short distance in order to position the same above the pile wires to shog the pile yarns over the pile wires. Thus, the present dipping and shogging apparatus, embodied in the pile yarn guides 133 and the operating means therefor, are used with the particular type of weft inserting means, embodied in the shuttles 35, without any sacrifice in the speed of the loom and corresponding rate of production of the loom.

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 method for interweaving ground warps and pile yarns into a pile fabric on a fly shuttle type loom having

pile wires extending in the same general direction as the ground warps and pile yarns, means for picking shuttles from one side only of the loom and also having spaced-apart shuttle guide hooks forming a shuttle guide; said method comprising forming a shed of ground warps, positioning pile yarns above the pile wires with portions of the yarns extending downwardly between the pile wires and between the shuttle guide hooks, then passing a shuttle through the shuttle guide to carry and insert a weft yarn therethrough, through the shed and over the pile yarns, beating up the inserted weft yarn, raising the pile yarns above the shuttle guide, and repeating the steps as prescribed.

2. A method of weaving pile fabrics on a fly shuttle type loom having means for picking shuttles from one side only of the loom, an oscillating reed and spaced shuttle guide hooks forwardly of the reed; which comprises weaving a base fabric by forming a shed of ground warps, inserting a single weft yarn through the shuttle guide hooks and the shed and over pile yarns extending upwardly from the woven fabric over warpwise pile wires and downwardly between the pile wires, beating up said single weft yarn, raising the pile yarns above the shuttle guide hooks and shogging the pile yarns in one direction over and across respective warpwise pile wires and respective ground warps, then inserting the pile yarns downwardly between the pile wires, the ground warps and the shuttle guide hooks, inserting another single weft yarn, in the same direction as the first-mentioned weft yarn, through the shed and the hooks and above the pile yarns, then again beating up the weft yarn, drawing the pile yarns upwardly between the pile wires, shogging the pile yarns over and across the pile wires in the opposite direction from said one direction, and then again inserting said pile yarns downwardly between the pile wires, the ground warps and the hooks.

3. A method of interweaving ground warps and pile yarns into a pile fabric on a fly shuttle type loom having pile wires extending in substantially the same direction as the ground warps and pile yarns, means for picking shuttles from one side only of the loom, and utilizing a shuttle race provided with transverse slots complementing the pile yarns; said method comprising forming a shed of ground warps, positioning pile yarns above the pile wires with portions of the pile yarns extending to the fell of the fabric being woven, moving the pile yarns downwardly through the shed with portions of the pile yarns extending over the upper edges of the pile wires, between the pile wires and into said slots, passing a shuttle along said shuttle race to carry and insert a weft yarn through the shed and over the portions of pile yarns in said slots, beating up the inserted weft yarn and raising the pile yarns above the pile wires, shogging the pile yarns across and above said pile wires, and repeating the steps prescribed.

4. In a fly shuttle type loom for weaving pile fabrics from ground warps, pile yarns and weft yarns, and having a plurality of shuttles, means for picking the shuttles from one side only of the loom, spaced-apart shuttle guide hooks forming a shuttle guide for controlling the flight of the shuttles, and an oscillatable reed positioned immediately rearwardly of the shuttle guide; the combination therewith of a series of pile wires extending through the reed and beyond the shuttle guide and terminating forwardly of the fell of the fabric being woven, and means for raising and lowering the pile yarns in alternation above the pile wires and between the shuttle guide hooks forming the shuttle guide and below the weft yarns carried by the shuttles to form pile loops.

5. A loom in accordance with claim 4 wherein said means for raising and lowering the pile yarns comprises means for shogging the pile yarns across adjacent pile wires when in raised position to position the pile yarns over adjacent pile wires.

6. In a fly shutter type loom for weaving pile fabrics from pile yarns, ground warps and weft yarns, means to form said warps into a succession of sheds transversely of said ground warps and said loom, a row of hook-shaped shuttle guides extending transversely of the loom, at least one projectile-like shuttle adapted to be picked through said shuttle guides, means for picking the shuttle from one side only of the loom, said shuttle guides being so positioned as to be disposed within the shed formed of said ground warps, a plurality of warpwise pile wires above said row of shuttle guides, means operable automatically preceding the insertion of a weft yarn through said shuttle guides and said shed for moving said pile yarns downwardly in the shed between the shuttle guides and below the path of travel of the weft yarn so inserted, and said last-named means being operable to raise the pile yarns and shog the same over the pile wires and again insert the same prior to a certain succeeding weft yarn being inserted.

7. The combination with a fly shuttle type loom having weft gripping shuttles, means for picking the shuttles from one side only of the loom, closely spaced shuttle guides for the shuttles and a reed oscillatable immediately rearwardly of and in synchronism with said shuttle guides, of a series of substantially vertically reciprocable pile yarn guides having pile yarn extending therethrough, pile wires extending through the reed and terminating forwardly of the fell of the fabric being woven, means for raising and lowering said pile yarn guides in timed relation to the operation of said reed and said shuttles, means for shogging said pile yarn guides when in raised position first in one direction and then in the other direction in alternation with beat-up strokes of said reed whereby said pile yarn guides insert pile yarn between said shuttle guides and below the path of successive shuttles, then raise the pile yarns beneath the weft yarn thus inserted and shog the same over the corresponding pile wires and wraps and again insert the pile yarns below the path of a succeeding shuttle and then raise the pile yarns upwardly and shog them back over the same pile wires and warps to complete a cycle.

8. In a fly shuttle type loom for weaving pile fabrics from ground warps, weft yarns and pile yarns, said loom having a plurality of shed-forming heddles through which the ground warps pass to the fabric being woven, at least one shuttle for inserting weft yarns in the shed, means for picking the shuttle from one side only of the loom, and a shuttle race for guiding said shuttle in its flight through the shed; the combination therewith of a transverse row of pile yarn guides through which said pile yarns pass to the fell of the fabric being woven, said shuttle race having a plurality of slots therein complementing said pile yarn guides, a plurality of warpwise extending pile wires adapted to extend forwardly and rearwardly of the fell of the fabric, means for lowering said pile yarn guides from a position above the level of the pile wires to a position such that portions of the pile yarns extend through said slots in the shuttle race and below the path of travel of the shuttle whereby the shuttle inserts a weft yarn over the pile yarns with movement of the shuttle through the shed, said means being operable to raise said pile yarn guides upwardly above the level of the pile wires, means to shog the pile yarn guides across and above respective pile wires while in raised position, and an oscillatable reed for beating up successive weft yarns as they are inserted in the manner described.

9. A structure according to claim 8 in which said shuttle race comprises a plurality of hook-shaped shuttle guides which are spaced from each other to define said slots therebetween.

10. A structure according to claim 8 including means for feeding said pile yarns to the pile yarn guides from a position rearwardly of said heddles and in substantially parallel relation to the path of the ground warps to said heddles, and said feeding means maintaining said pile

yarns under a minimum of tension in their course to the pile yarn guides.

11. In a fly shuttle type loom for weaving pile fabrics from ground warps, weft yarns and pile yarns, said loom having a plurality of shed-forming heddles through which the ground warps pass, a plurality of gripper shuttles for inserting independent weft yarns in the shed, means for picking the shuttles from one side only of the loom, and a shuttle race for guiding each successive shuttle in its flight through the shed; the combination therewith of a row of pile yarn guides through which said pile yarns pass to the fell of the fabric being woven, said shuttle race comprising a row of spaced hook-shaped guides defining a plurality of slots therebetween complementing said pile yarn guides, a plurality of warpwise extending pile wires extending forwardly above said guides and to the fell of the fabric, means for lowering said pile yarn guides from a position above the level of the pile wires to a position such that portions of the pile yarns extend over said pile wires, downwardly through said slots in the shuttle race, and below the path of travel of each shuttle whereby each shuttle inserts a weft yarn over the pile yarns with movement of each shuttle through the shed, said means being operable to raise said pile yarn guides upwardly above the level of the pile wires, means to shog the pile yarn guides across and above respective pile wires while in raised position, and an oscillatable reed for beating up successive weft yarns as they are inserted in the manner described.

12. A structure according to claim 11 in which said means to shog said pile yarn guides and said means for lowering and raising said pile yarn guides comprises a frame rigidly supporting said pile yarn guides, means for shogging said frame in opposite directions laterally of the ground warps, and means for imparting downward and then upward movement to said frame following each lateral movement of said frame.

13. In a fly shuttle type loom for weaving pile fabrics from pile yarns, ground warp yarns and weft yarns, means to form said ground warps into a succession of sheds open transversely of said ground warps and said loom, a plurality of closely spaced transversely arranged shuttle guides having openings therein, a plurality of gripper shuttles, means for successively picking the shuttles in one direction only through the openings in said shuttle guides, said shuttle guides being so arranged that the ground warps, in part, extend between adjacent shuttle guides in forming said sheds whereby each successive shuttle inserts a weft yarn through said shed, a plurality of pile wires extending above said shuttle guides and having their forward ends terminating upon the base of the fabric being woven, a plurality of pile yarn guides, means for moving said pile yarn guides from a raised to a lowered position such as to cause pile yarns to extend from above the pile wires rearwardly and downwardly at an angle between said shuttle guides and below the path of the weft yarn being inserted, said last-named means being operable to raise said pile yarns as the corresponding weft yarn is beat against the fell of the fabric, said last-named means also being operable to shog said pile yarn guides in one direction with alternate upward movements thereof and being operable to shog the pile yarn guides in the opposite direction with intervening upward movements thereof whereby the pile yarn guides draw the pile yarn upwardly beneath the weft yarns, across and above the pile wires and alternately insert the pile yarns into the shed adjacent opposite sides of respective pile wires.

14. In a loom for weaving pile fabrics from ground warps, weft yarns and pile yarns, said loom having a plurality of shed-forming heddles through which the ground warps pass to the fabric being woven, said heddles comprising a plurality of relatively vertically movable harnesses, a harness motion for imparting vertical movement to said harnesses, and at least one shuttle race for guiding said shuttle in its flight through the shed; the combination therewith of a transverse row of pile yarn guides through which said pile yarns pass to the fell of the fabric being woven, said shuttle race having a plurality of slots therein complementing said pile yarn guides, a plurality of warpwise extending pile wires adapted to extend forwardly and rearwardly of the fell of the fabric, means for lowering said pile yarn guides from a position above the level of the pile wires to a position such that portions of the pile yarns extend through said slots in the shuttle race and below the path of travel of the shuttle whereby the shuttle inserts a weft yarn over the pile yarns with movement of the shuttle through the shed, said means being operable to raise said pile yarn guides upwardly above the level of the pile wires, means to shog the pile yarn guides across and above respective pile wires while in raised position, an oscillatable reed for beating up successive weft yarns as they are inserted in the manner described, said means for lowering and raising said pile yarn guides comprising a frame mounted for substantially vertical movement in substantially parallel relation to said harnesses and disposed between said harnesses and the reed, means on said frame for supporting said row of pile yarn guides, mechanical connections between said frame and said harness motion to thereby effect said lowering and raising of said pile yarn guides, said means to shog said pile yarn guides including means supporting said frame for lateral movement on said loom, a cam adjacent at least one side of said frame, means driving said cam in timed relation to said harness motion, and follower means on said frame engageable with said cam whereby rotation of the cam imparts lateral movement to said frame to, in turn, shog said pile yarn guides.

15. In a loom for weaving pile fabrics from ground warps, weft yarns and pile yarns, said loom having a plurality of shed-forming heddles through which the ground warps pass, a plurality of gripper shuttles for inserting independent weft yarns in the shed, each in the same direction, and a shuttle race for guiding each successive shuttle in its flight through the shed; the combination therewith of a row of pile yarn guides through which said pile yarns pass to the fell of the fabric being woven, said shuttle race comprising a row of spaced hook-shaped guides defining a plurality of slots therebetween complementing said pile yarn guides, a plurality of warpwise extending pile wires extending forwardly above said guides and to the fell of the fabric, means for lowering said pile yarn guides from a position above the level of the pile wires to a position such that portions of the pile yarns extend over said pile wires, downwardly through said slots in the shuttle race and below the path of travel of each shuttle whereby each shuttle inserts a weft yarn over the pile yarns with movement of each shuttle through the shed, said means being operable to raise said pile yarn guides upwardly above the level of the pile wires, means to shog the pile yarn guides across and above respective pile wires while in raised position, an oscillatable reed for beating up successive weft yarns as they are inserted in the manner described, said means to shog said pile yarn guides and said means for lowering and raising said pile yarn guides comprising a frame rigidly supporting said pile yarn guides, at least one cam follower extending in a substantially vertical plane, a driven substantially vertical shaft adjacent said frame, an eccentric cam fixed on said shaft and engaging said follower for imparting lateral shogging movement to said frame in opposite directions relative to the ground warps, and means for imparting downward and then upward movement to said frame following each lateral movement of said frame.

16. A structure according to claim 15 wherein said loom is equipped with a harness motion, and said means for imparting vertical movement to said frame includes

mechanical connections between said frame and said harness motion.

17. In a loom for weaving pile fabrics from pile yarn, ground warps and ground weft yarns, said loom having means for forming the warps into a succession of sheds, means to insert wefts into the sheds, and a plurality of warpwise extending pile wires carried by the loom and having their forward ends terminating adjacent the fell of the fabric being woven; the combination therewith of a plurality of pile yarn guides, means to shog said guides across and above said pile wires and for lowering and raising said guides comprising a frame rigidly supporting said guides, means supporting said frame for lateral movement on said loom, a cam adjacent at least one side of said frame, means driving said cam in timed relation to said means for forming the sheds, follower means on said frame engageable with said cam, whereby rotation of the cam imparts lateral movement to said frame to, in turn, shog said pile yarn guides, and means for imparting downward and then upward movement to said frame following each lateral movement thereof.

18. In a loom for weaving pile fabrics from pile yarns, ground warps and weft yarns, means for forming the ground warps into a succession of sheds comprising a plurality of relatively vertically movable harnesses and a harness motion for imparting vertical movement to said harnesses, a plurality of warpwise extending pile wires adapted to extend forwardly and rearwardly of the fell of the fabric, and means to insert weft yarns into the sheds; the combination of a transverse row of pile yarn guides through which said pile yarns pass to the fell of the fabric being woven, means for lowering and raising said guides between a position above the level

of the pile wires and a position below the weft yarn inserting means comprising a frame mounted for lateral and substantially vertical movement in substantially parallel relation to said harnesses, means on said frame for supporting said row of pile yarn guides, means operatively connecting said harness motion to said frame to thereby effect said lowering and raising of said pile yarn guides, means to shog said guides including cam means adjacent at least one side of said frame, means driving said cam means in timed relation to said harness motion, and follower means carried by said frame engageable with said cam means, whereby rotation of the cam means imparts lateral movement to said frame to shog said pile yarn guides, said cam means being so arranged as to shog the pile yarn guides across and above respective pile wires while said guides occupy raised position.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,042,081 July 3, 1962

John T. MacIsaac, Jr., et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 25, for "waft" read -- weft --; line 26, for "wove" read -- move --; column 8, line 74, for "method for" read -- method of --; column 9, line 75, for "shutter" read -- shuttle --.

Signed and sealed this 30th day of October 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

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Commissioner of Patents