June 7, 1955 J. T. WHITE 2,710,028

LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

Filed May 11, 1953 8 Sheets-Sheet 1

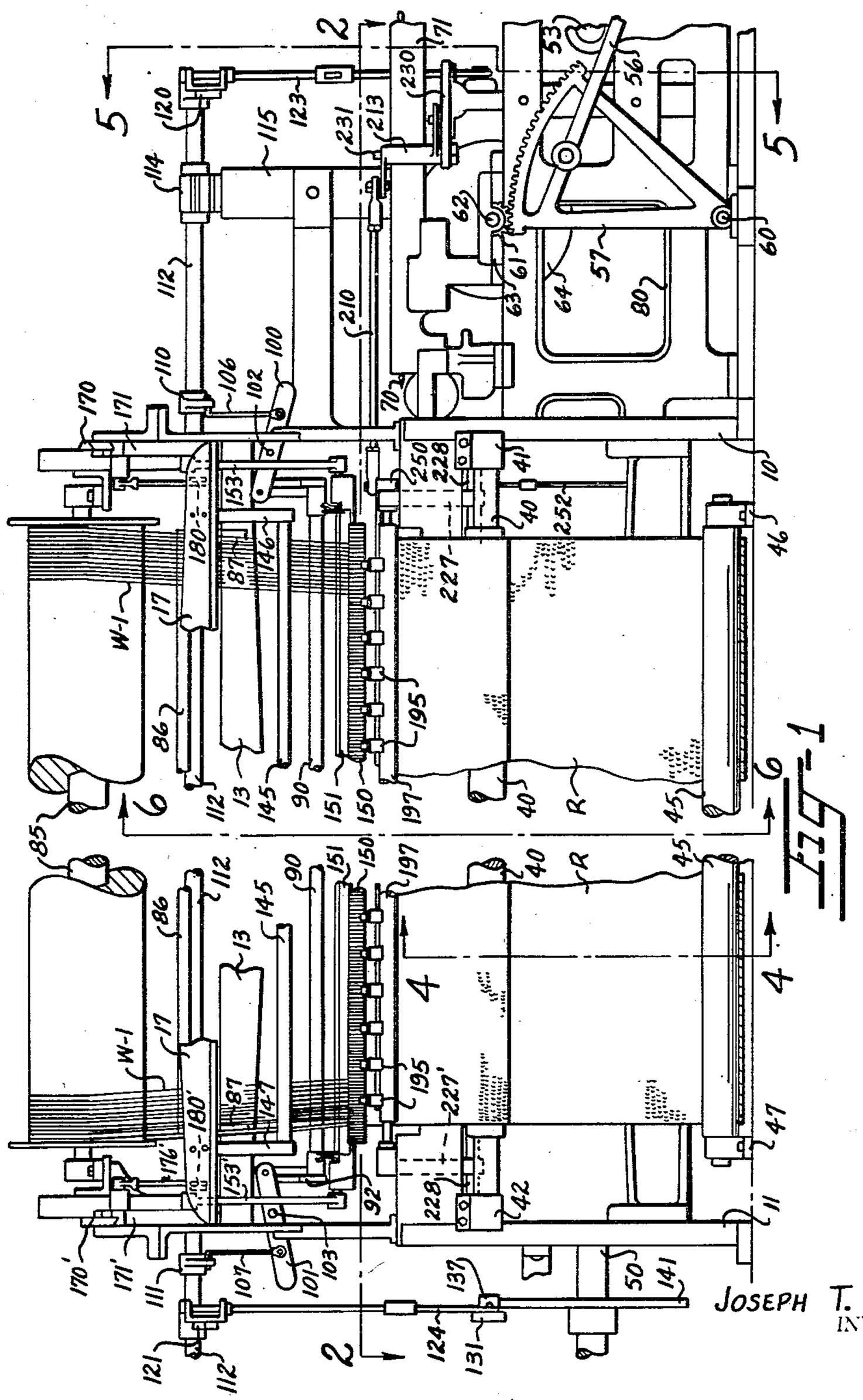

FIG. 1

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LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

Filed May 11, 1953 8 Sheets-Sheet 2

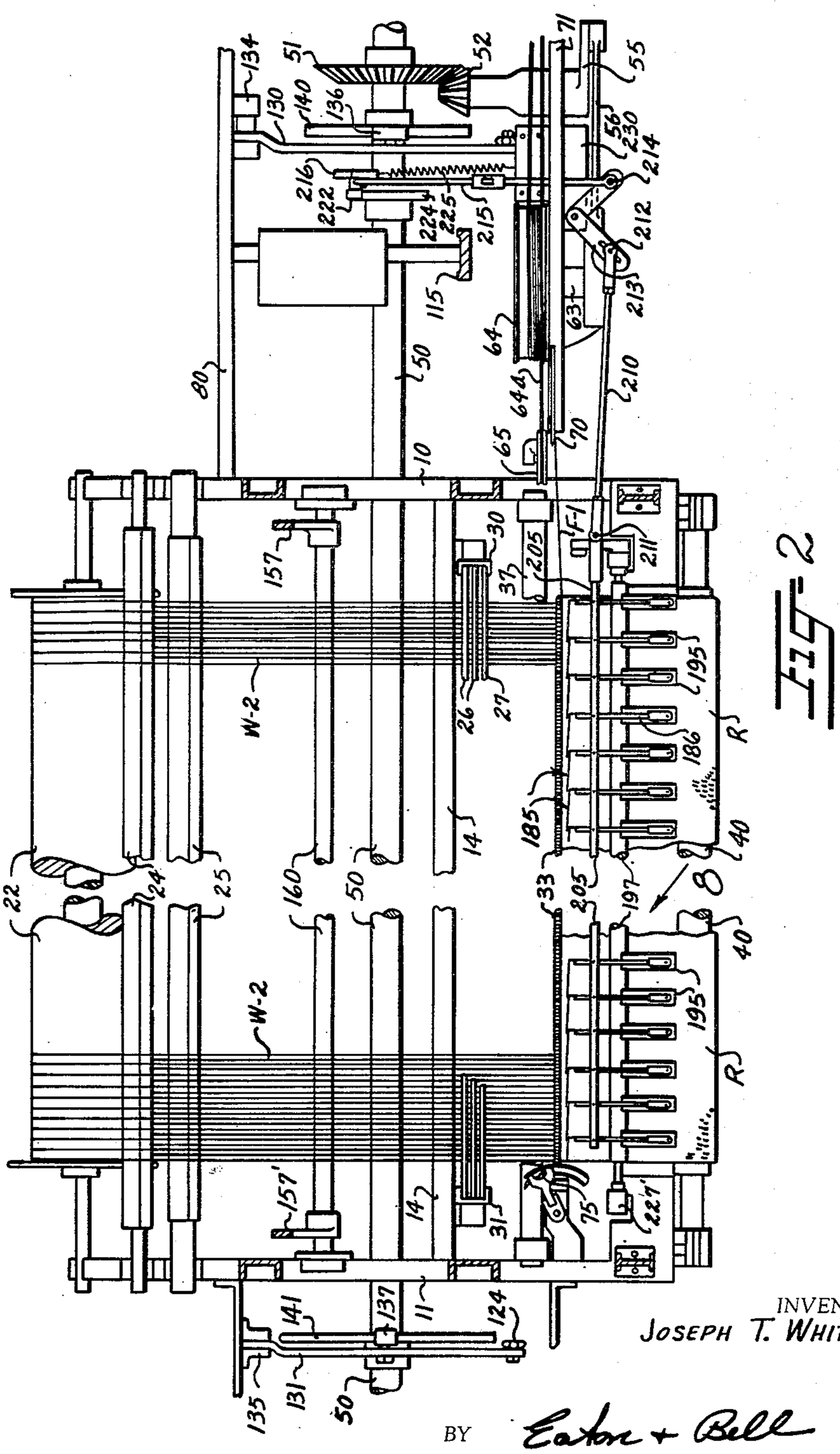

FIG. 2

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LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

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Fig. 3

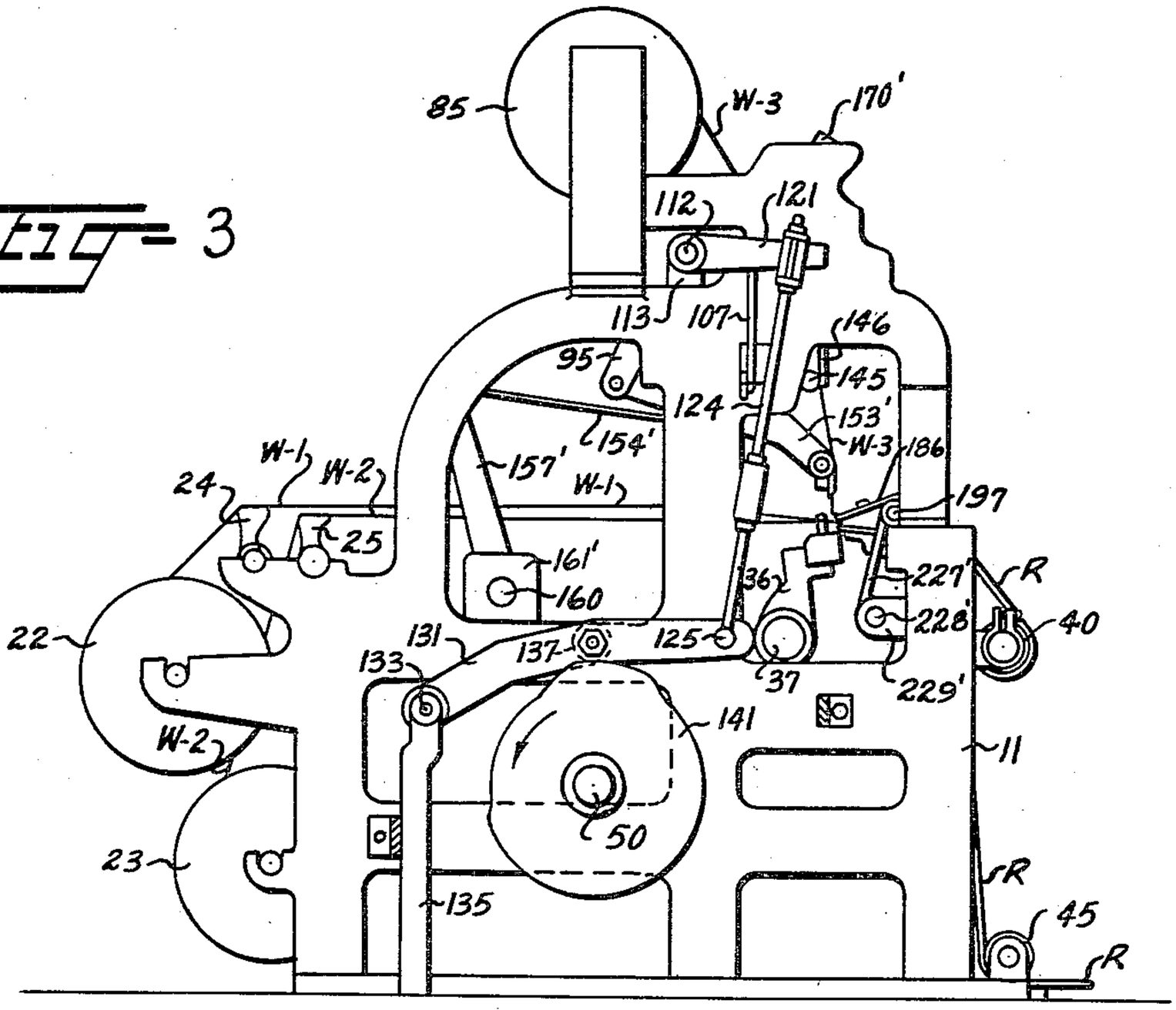
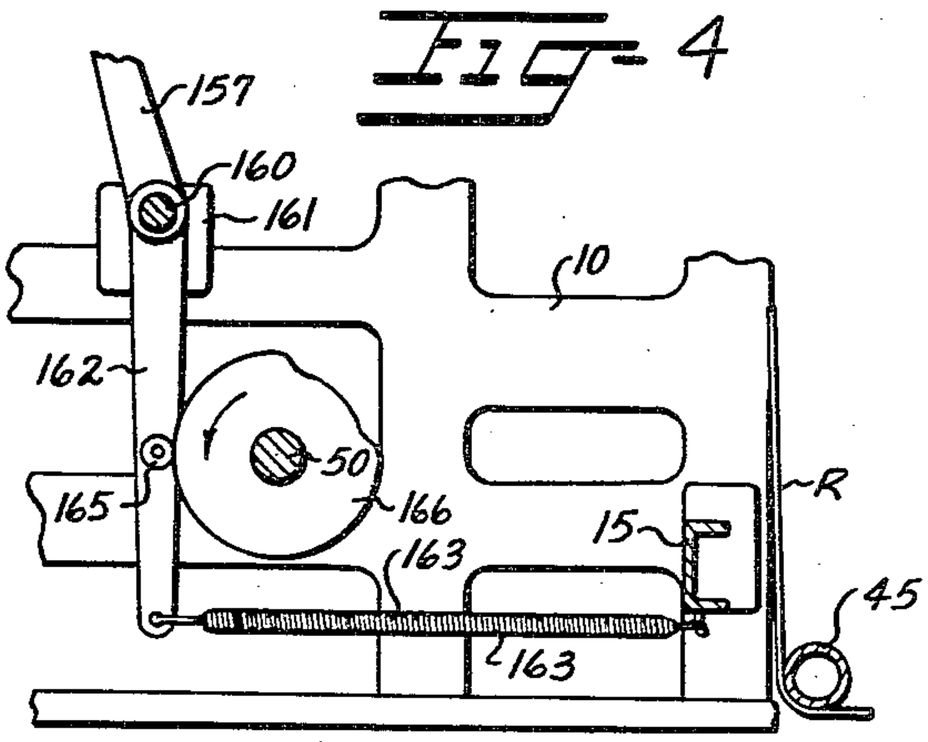


Fig. 4



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LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

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8 Sheets-Sheet 4

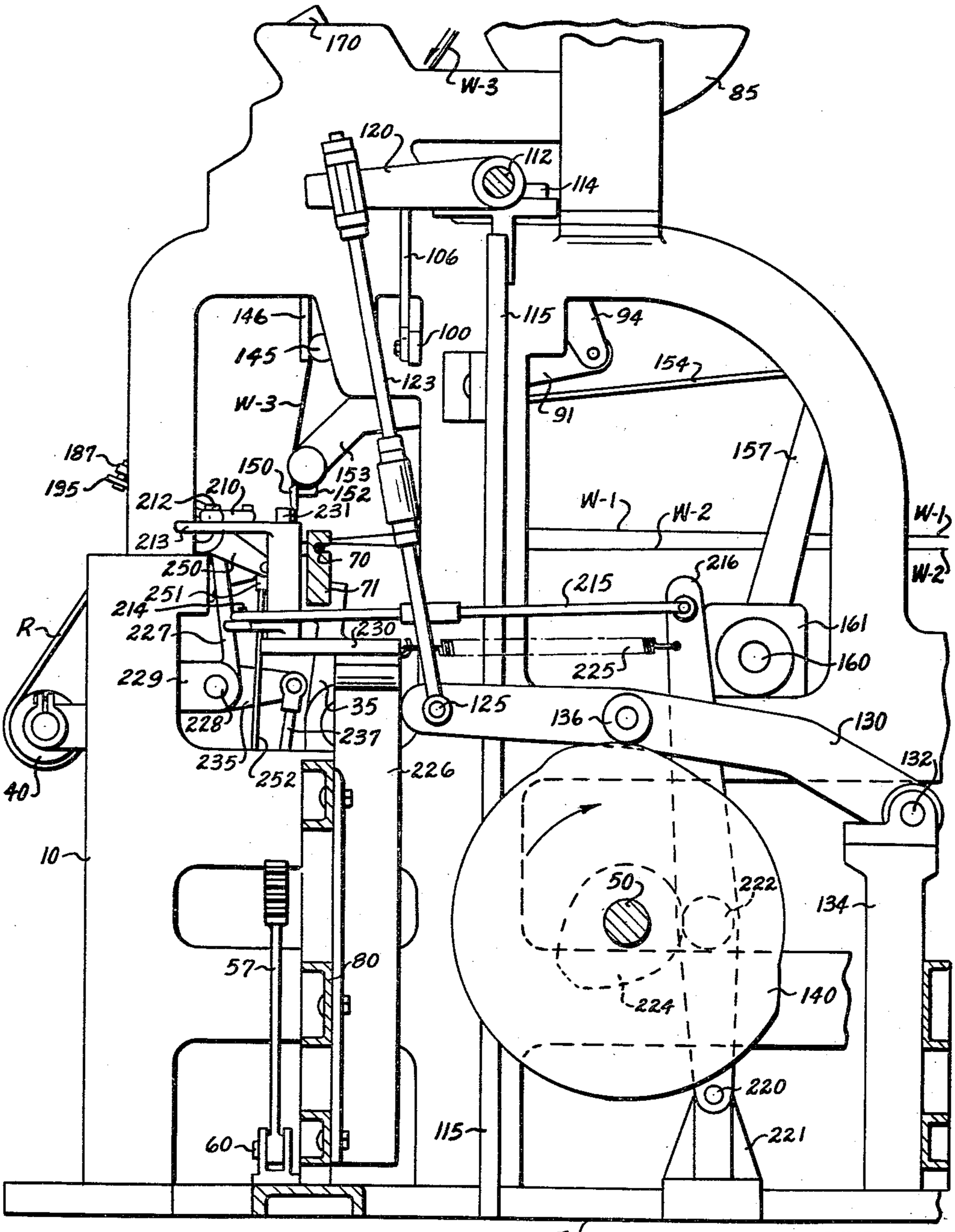

Fig-5

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LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

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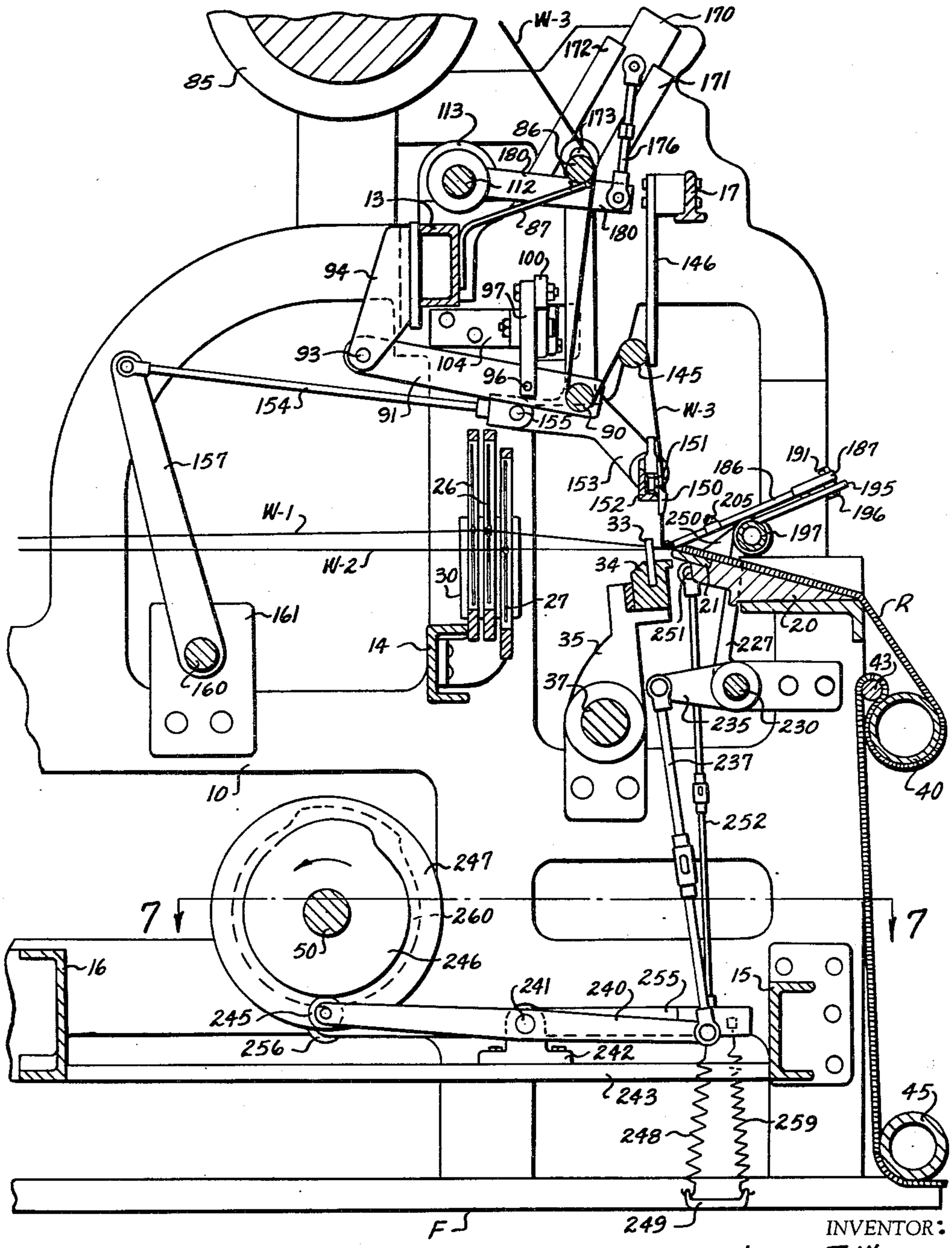

Fig.-6

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LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

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Fig-8

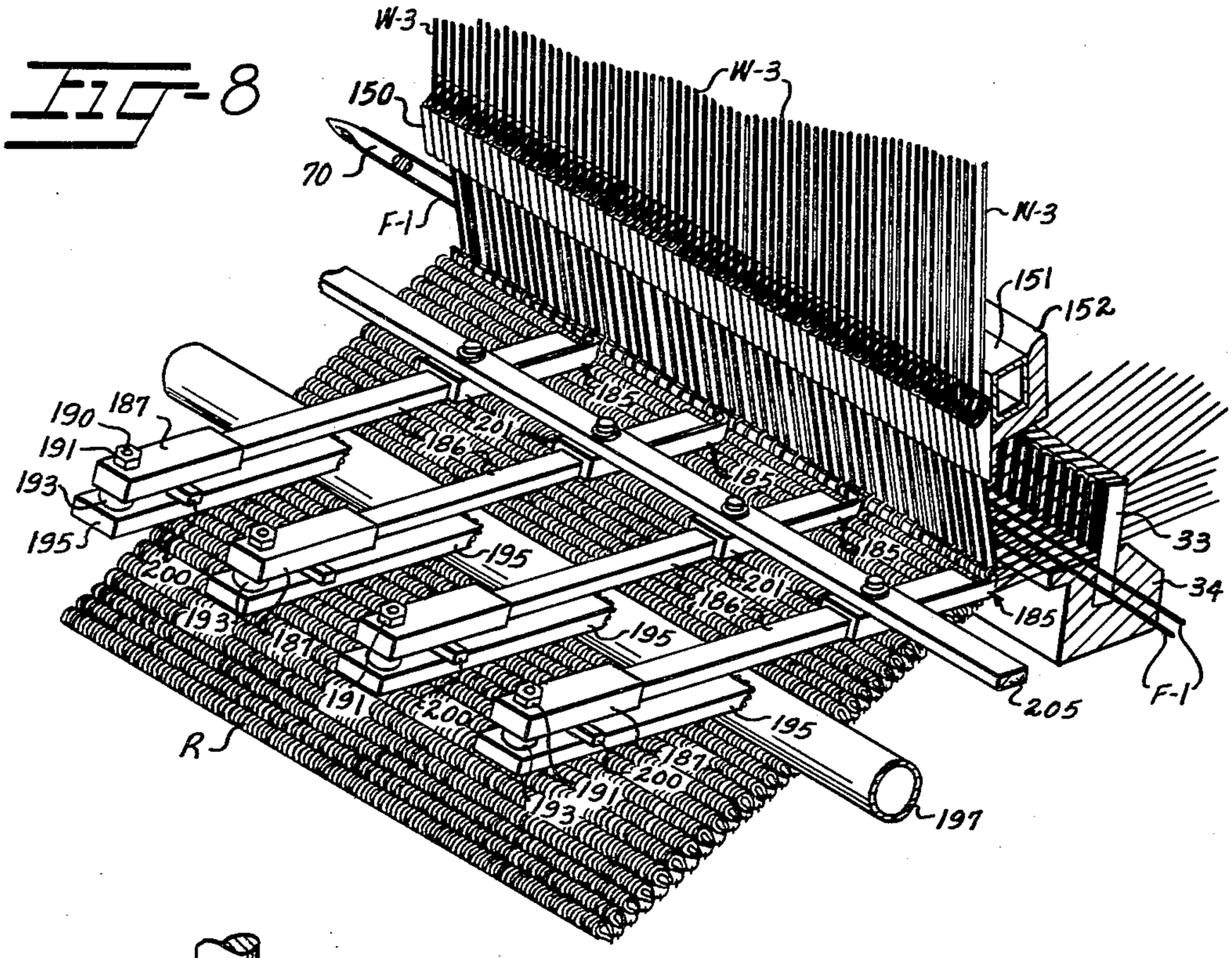
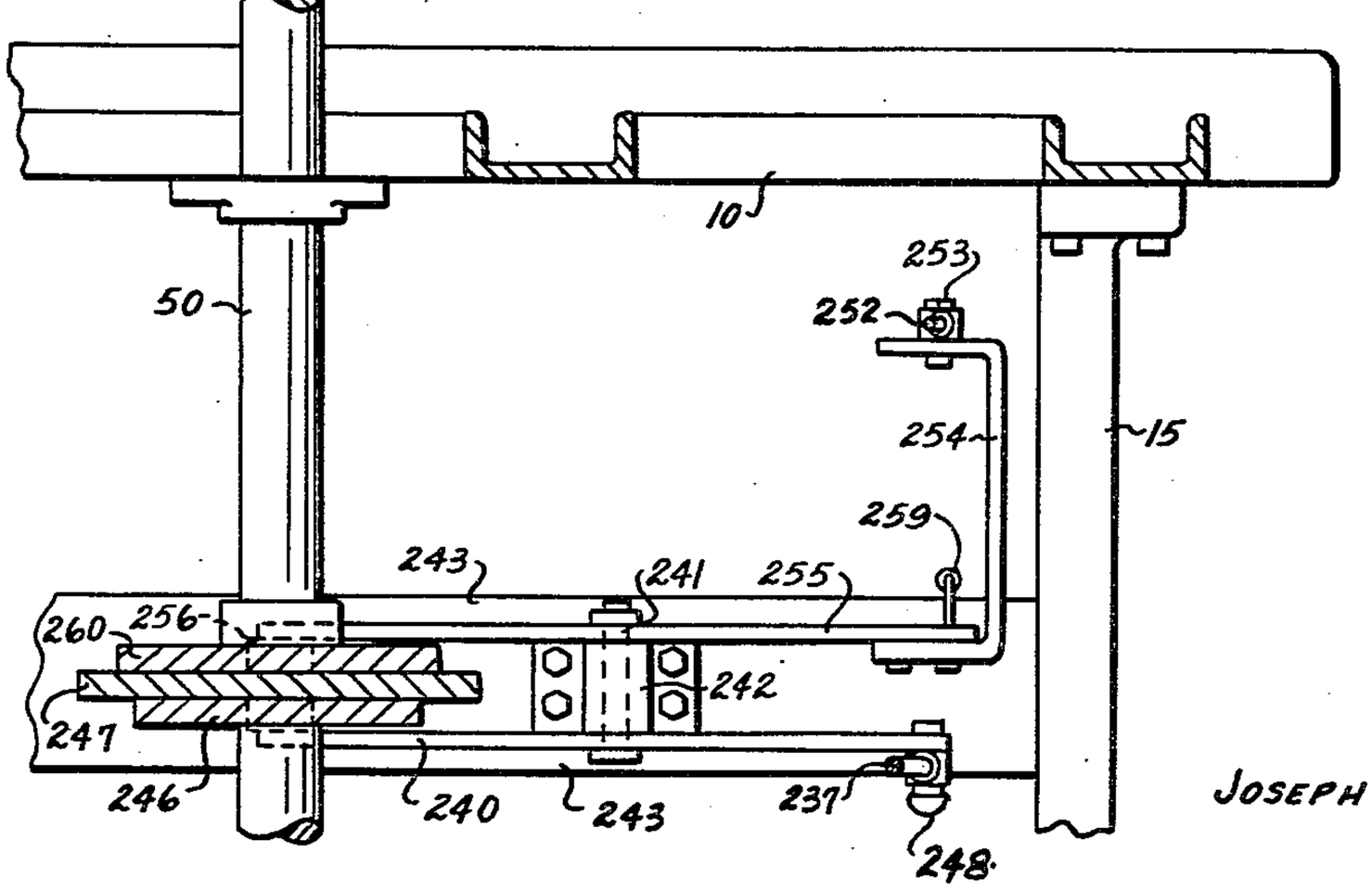


Fig-7



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June 7, 1955 J. T. WHITE 2,710,028

LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

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Fig-9

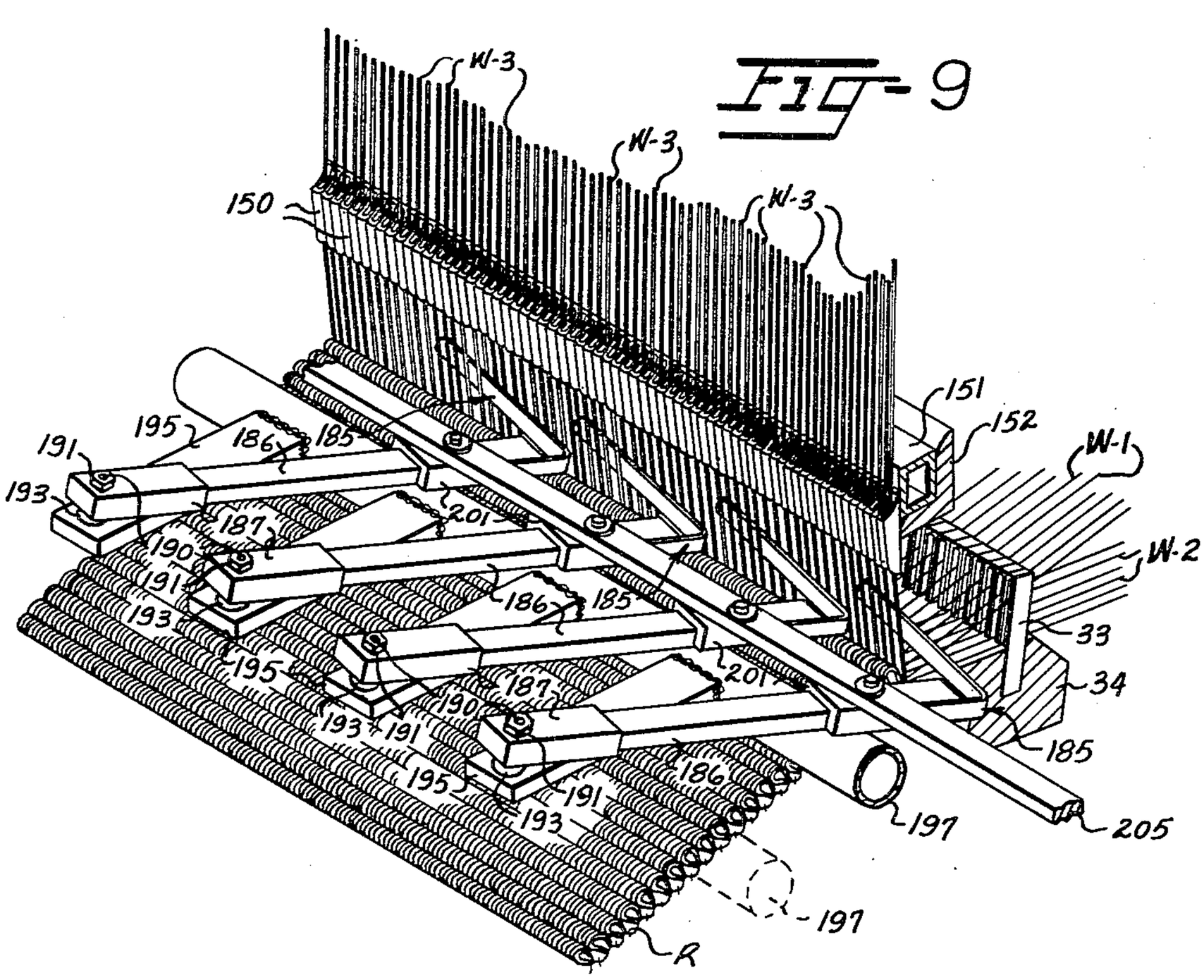
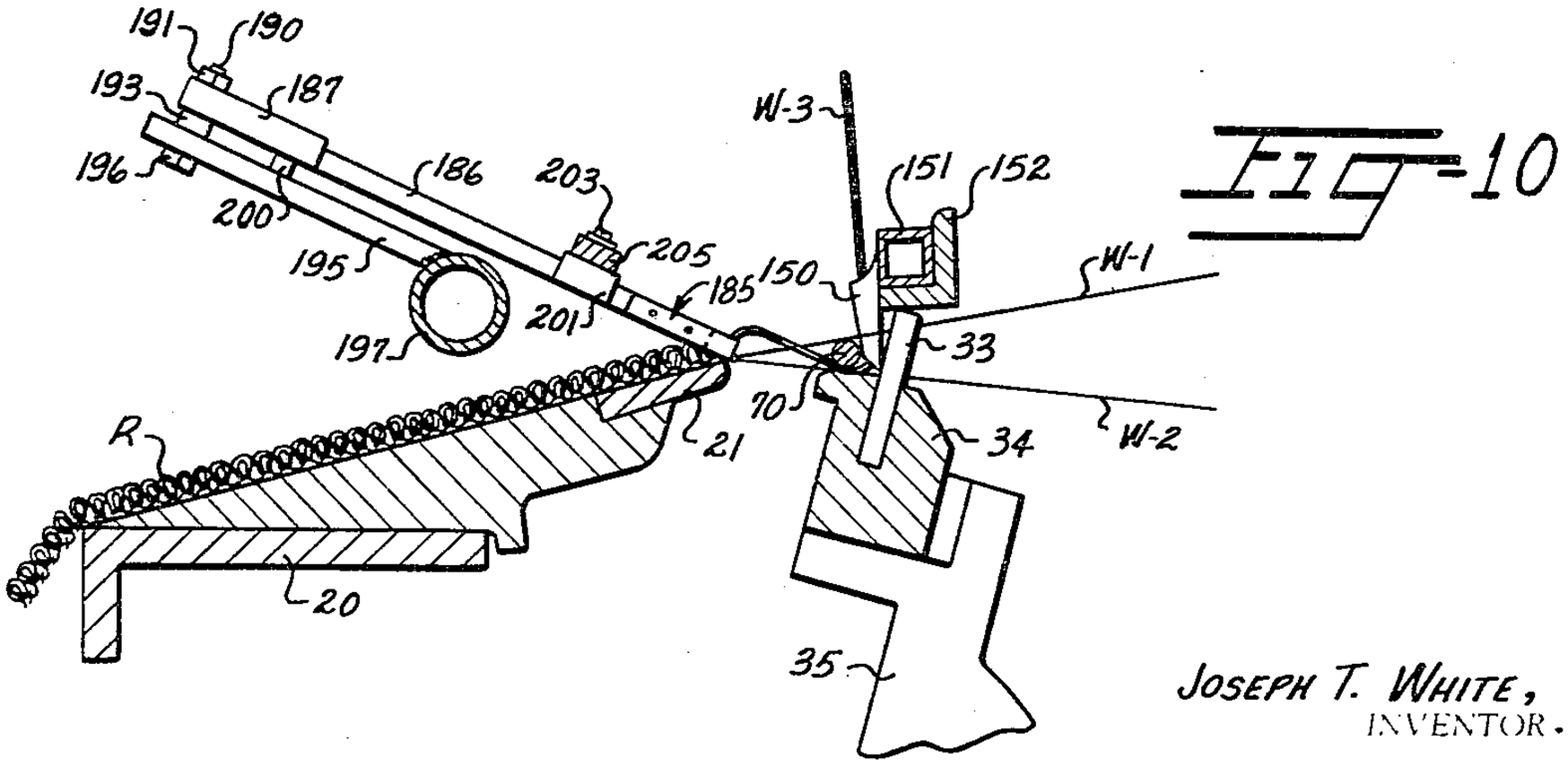


Fig-10



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June 7, 1955

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2,710,028

LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

Filed May 11, 1953

8 Sheets-Sheet 8

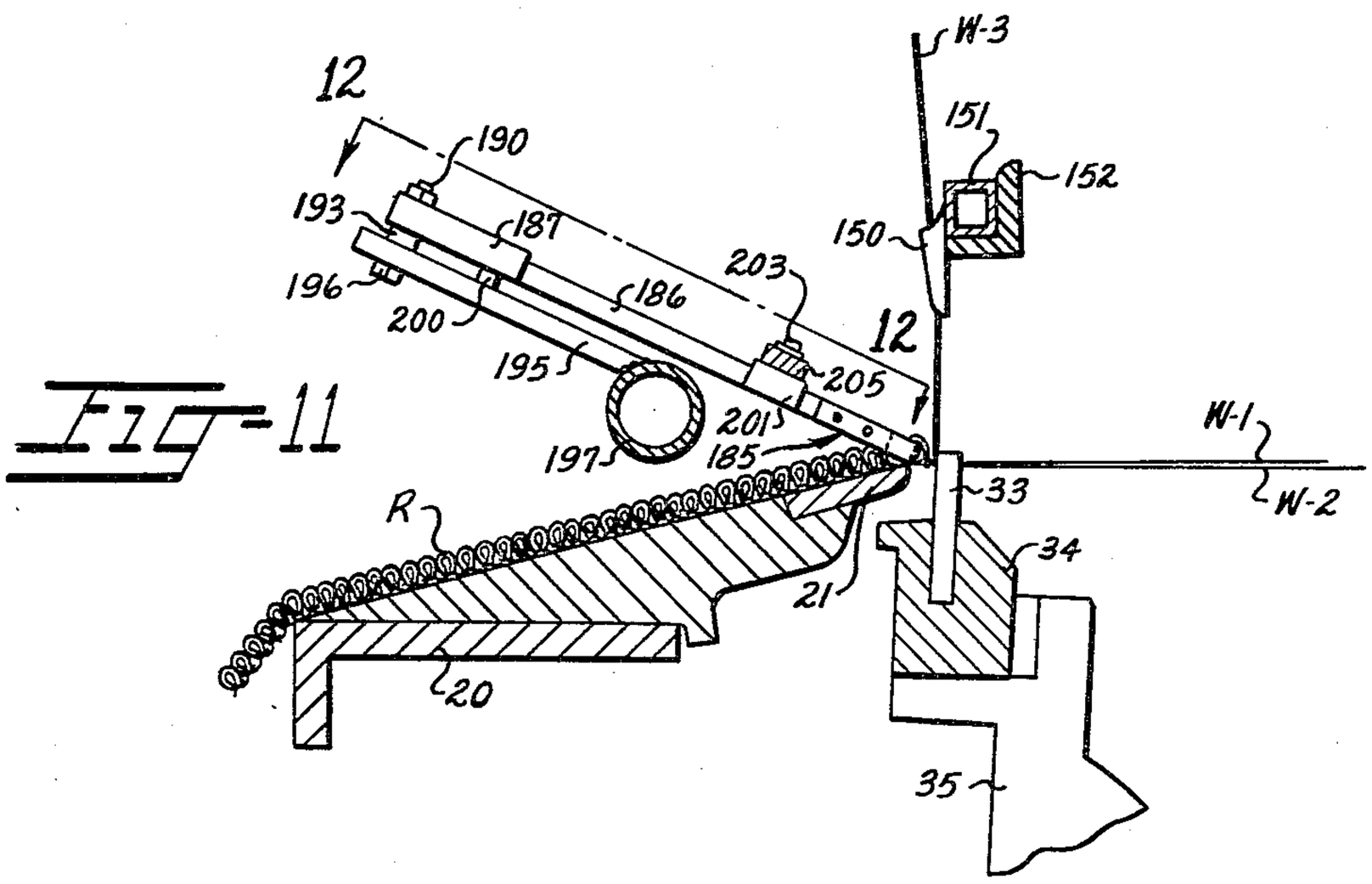

FIG-11

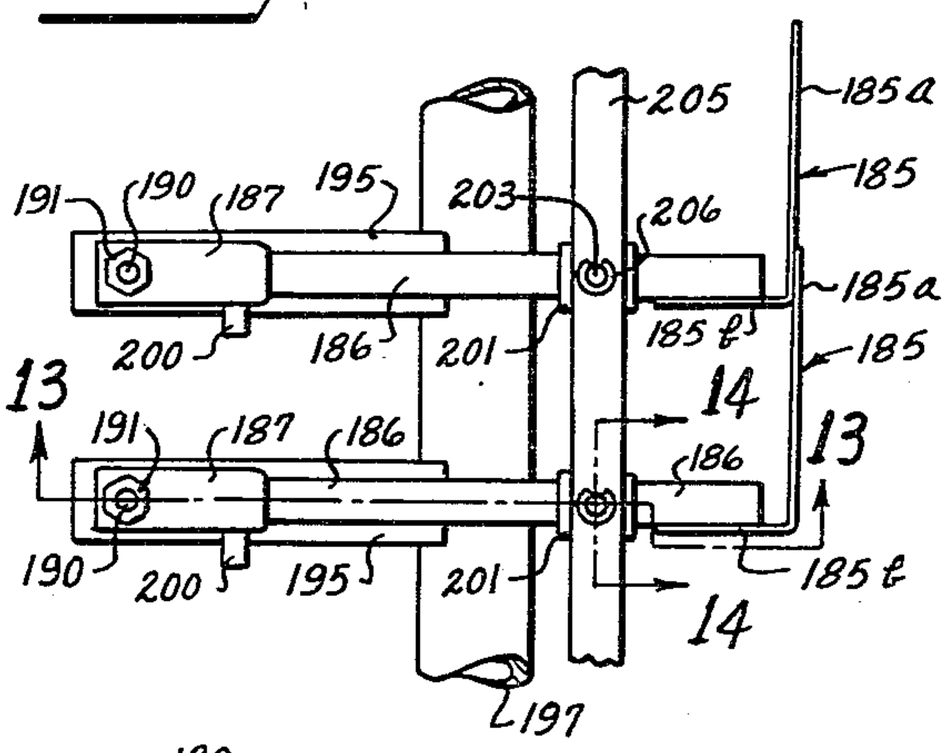

FIG-12

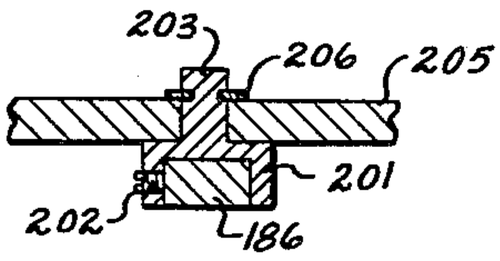

FIG-14

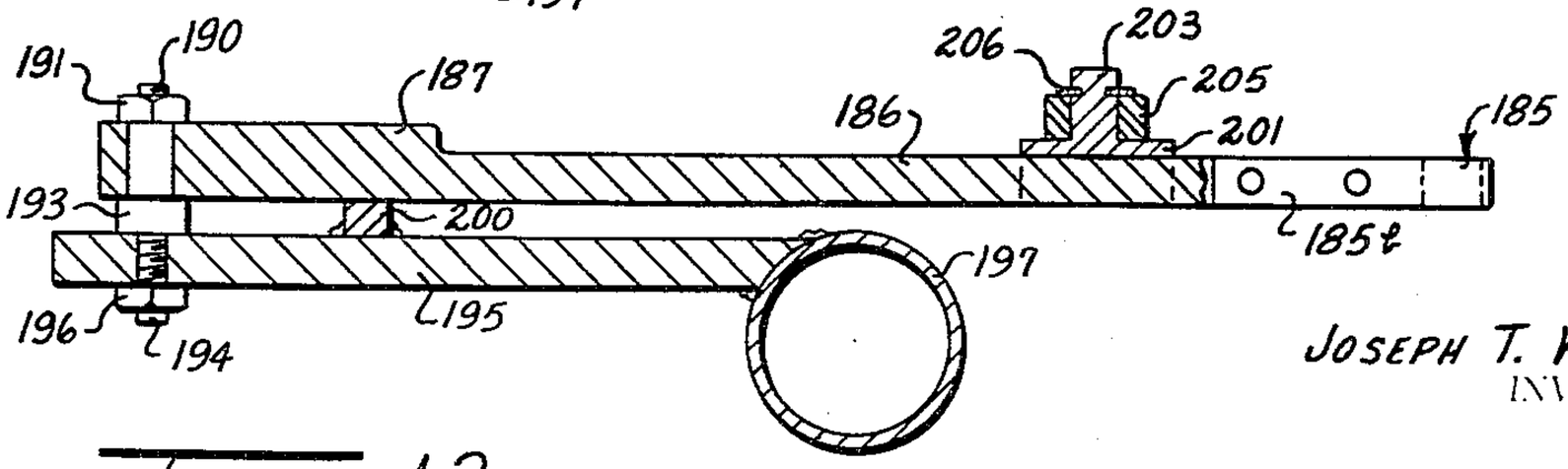

FIG-13

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ATTORNEYS.

United States Patent Office

2,710,028

Patented June 7, 1955

2,710,028

LOOP PILE ATTACHMENT FOR AXMINSTER LOOMS AND METHOD OF WEAVING

Joseph T. White, Charlotte, N. C., assignor, by mesne assignments, to Fieldcrest Mills, Inc., a corporation of Delaware

Application May 11, 1953, Serial No. 354,330

22 Claims. (Cl. 139—38)

This invention relates to looms of the type known as Axminster looms used in the manufacture of rugs and other cut pile fabrics. More especially, this invention relates to an attachment for conventional Axminster looms which facilitates the weaving of loop pile fabrics thereon without materially changing the conventional weaving instrumentalities of the loom.

Heretofore, it has been customary to make loop pile rugs on looms especially built for this purpose. Most of these especially built looms for weaving a loop pile fabric have devices for shifting continuous tufted yarns across a plurality of pile wires which are withdrawn from the full width of fabric and makes the loops in said fabric have a flat conventional appearance in the finished product.

The primary object of this invention is to provide an attachment for an Axminster loom for weaving pile fabrics such as that shown and described in my co-pending application entitled Loop Pile Fabric, Serial No. 350,710, filed April 23, 1953.

Another object of this invention is to provide a mechanism incorporated in a loom for weaving a loop pile fabric into an independently woven fabric in a continuous process, with the ground warp yarns taken from warp beams in the usual manner and with filling yarns woven with the warp yarns to form the backing or ground fabric, while the loop pile is formed from continuous strands of yarn taken from a beam and interwoven with the ground fabric in loop formation. The forming of loops in carried out by means of loop forming fingers which are moved behind a plurality of the pile yarns, which extend from a plurality of pile yarn tube guides, and which then move downwardly into an open shed formed by the ground warp yarns as a single or double filler yarn is inserted through the shed and over the pile yarns, after which the filler yarn is beat up to form loops of the pile yarns.

It is another object of this invention to provide an improved loop forming attachment for looms, particularly of the Axminster type, wherein pile yarns are continuously directed, by means of pile yarn tube guides, to the ground fabric being woven, said attachment comprising a plurality of rigid loop forming fingers arranged in a row extending from adjacent one selvage of the fabric to the other immediately above the fell of the fabric. The proximal lateral portions of adjacent fingers overlap each other and automatic control means are provided for reciprocating said fingers laterally, longitudinally and vertically in timed relation to the movement of the pile yarn guide tubes and the loom reed in a loop forming operation.

Another object of this invention is to provide an attachment which may be readily attached to the present types of Axminster looms without the expense of rebuilding the entire loom, but creating a new loom in its capability of performing functions and weaving fabrics for which such looms were never previously suited.

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 front elevation of an Axminster loom with the improved loop forming attachment mounted thereon and with parts broken away;

Figure 2 is a plan view of the loom, partially in section, taken substantially along the line 2—2 in Figure 1;

Figure 3 is a side elevation of the loom looking at the left-hand side of Figure 1;

Figure 4 is a fragmentary, somewhat schematic, vertical sectional view taken substantially along the line 4—4 in Figure 1;

Figure 5 is an enlarged elevation, with parts in section, looking at the right-hand side of Figure 1 and being taken substantially along the line 5—5 in Figure 1;

Figure 6 is an enlarged vertical sectional view taken substantially along the line 6—6 in Figure 1;

Figure 7 is a fragmentary sectional plan view taken substantially along the line 7—7 in Figure 6;

Figure 8 is an isometric view showing the loop fingers forming loops of the pile yarn and taken looking at Figure 2 in the general direction of the arrow 8;

Figure 9 is a view similar to Figure 8, but showing the loop forming fingers in a different position from that shown in Figure 8;

Figure 10 is a sectional elevation looking at the right-hand side of Figure 8, but showing the tubular loop pile yarn guides in lowered, rearward position;

Figure 11 is a view similar to Figure 10, but showing the loop pile yarn guides in raised, forward position and the reed in beat-up position;

Figure 12 is a fragmentary plan view of two of the loop forming fingers taken substantially along the line 12—12 in Figure 11;

Figure 13 is an enlarged vertical sectional view taken substantially along the line 13—13 in Figure 12;

Figure 14 is a vertical sectional view taken substantially along the line 14—14 in Figure 12.

Referring more specifically to the drawings, the numerals 10 and 11 indicate opposite side frames of an Axminster loom of a type known as a model A loom manufactured by Crompton and Knowles Company, Worcester, Massachusetts. The side frames 10 and 11 are spaced from each other and held in an upright position by an upper girt 13, an intermediate girt 14 and front and rear lower girts 15 and 16, respectively (Figure 6). The side frames 10 and 11 are also spanned by an upper horizontal frame member 17 and a conventional breast beam 20 which supports a breast plate 21 and opposite ends of which are suitably secured to the side frames 10 and 11.

Referring to Figures 2, 3, 5 and 6, it will be observed that the loom is also provided with conventional upper and lower ground warp beams 22 and 23 from whence warp yarns W–1 and W–2 pass over conventional whip rolls 24 and 25, respectively. The ground warp yarns W–1 and W–2 then pass through respective heddles 26 and 27 which are adapted to have vertical movement in end brackets 30 and 31 (Figure 2) fixed to the intermediate girt 14. In this instance, there are two sets of heddles 26 and one set of heddles 27. These heddles 26 and 27 are conventional and are vertically reciprocated to form a shed of the ground warp yarns W–1 and W–2 in a conventional manner. It is evident that a greater number of sets of ground warp yarns may be used and that any desired number of separate heddles, one for each ground warp yarn, may be used, as desired, without departing from the spirit of the invention.

The warp yarns W–1 and W–2 pass from the heddles 26 and 27, through a conventional reed 33 carried by a conventional lay 34 supported by a pair of relatively short swords 35 and 36. The swords 35 and 36 are fixed on a

conventional reed rocker shaft 37 which rocks from rearward position to forward position each time a pick is made by the loom. The ground warp yarns W–1 and W–2 are woven into a ground fabric R at the tip of the breast plate 21, this also being known as the fell of the fabric.

The fabric R then extends over the breast plate 21 and substantially around a sand or take-up roll 40 rotatably mounted in a pair of bearings 41 and 42 fixedly secured to the frame members 10 and 11. The fabric R then passes partially around a fabric releasing roll 43 and extends downwardly to a roll 45 rotatably mounted in a pair of bearing blocks 46 and 47 fixed to the floor F on which the loom rests. From this roll 45, the fabric R extends to a conventional take-up roll, not shown, as the fabric is woven. The rolls 40, 43 and 45 are conventional on this type loom and are connected with the let-off and take-up mechanisms of the loom so that the warp yarns and the fabric R are maintained under a constant predetermined tension.

Referring to Figures 2, 3, 4, 5 and 6, there is shown a conventional main cam shaft 50, journaled in suitable bearings adjacent each side frame 10 and 11 and which extends beyond the side frame 10 and has a bevel gear 51 fixed thereon which meshes with a smaller bevel gear 52 fixed on a shaft 53 (Figure 1). It is to be understood that the main cam shaft 50 extends further to the right in Figure 2 than shown and has a conventional driving means, not shown, for continuously driving the main cam shaft 50 in the direction indicated by the arrows in Figures 5 and 6 while the loom is operating.

Fixedly mounted on the shaft 53, at the front end thereof in Figure 2, is a crank arm 55 to which one end of a link 56 is pivotally connected and the other end of which is pivotally connected to a segmental gear 57. The lower end of gear 57 is oscillatably mounted, as at 60, on the loom frame and the upper edge of said segmental gear 57 engages a pinion 61 fixed on a shaft 62 rotatably mounted in a bearing 63. The end of shaft 62 opposite gear 57 has a drum 64 fixed thereon.

It is thus seen that, as rotation is imparted to the main cam shaft 50, the bevel gear 51 rotates the bevel gear 52, along with the shaft 53 and the crank arm 55, to impart oscillatory movement to the segmental gear 57 through the connecting link 56 to, thus, impart oscillation to the drum 64. The drum 64 has a cable 64*a* wrapped thereabout which passes over a pulley 65 and is connected, by conventional means, not shown, to a filling yarn carrying needle 70 (Figures 1, 2 and 5) slidably mounted in a needle guiding bar 71 which extends laterally from the right-hand side of the loom in Figures 1 and 2. Thus, the drum 64 causes the needle 70 to move, in timed relation with the loom, into the shed formed by the ground warp yarns W–1 and W–2. Upon each movement of the filling yarn carrying needle 70 from adjacent the side frame 10 to the opposite selvage of the fabric R, adjacent the side frame 11, yarn carried by a bobbin 75, mounted adjacent the side frame 11, catches a filling yarn F–1 (Figures 2 and 8), fed to the needle 70 in a conventional manner to prevent the same from being pulled back through the open shed formed by the ground warp yarns W–1 and W–2 as the filling yarn carrying needle 70 is again moved across the fabric from left to right in Figure 2 by the reverse movement of the drum 64. The needle guide bar 71 and the bearing 63 are supported by an upright framework 80, the lower end of which rests upon the floor F and the left-hand end of which, in Figure 1, is suitably secured to the side frame 10.

The ground fabric R is formed by the warp yarns W–1 and W–2 and double shots of the filling yarn F–1 in a conventional manner and, therefore, only a brief description of this operation will be given. The warp yarns W–1 and W–2 are caused to separate by relative vertical reciprocation of the heddles 26 and 27, at which time the reed 33 is at its rearward position to form an open shed,

as shown in Figures 8, 9 and 10, through which the filling yarn needle 70, along with the filling yarn F–1, passes.

As the filling yarn needle 70 moves from left to right in Figure 2 or to the position shown in Figures 1 and 2, the double shot of filling yarn F–1 or double weft is left in the open shed formed by the warp yarns W–1 and W–2, after which the reed 33 is caused to move forwardly and beat-up the filling yarn to thereby form the ground or base fabric R with which the independent loop pile yarns are interwoven in a manner to be presently described.

Rotatably mounted in the side frames 10 and 11 is a pile or loop warp beam 85 from which loop or pile warp yarns W–3 are withdrawn, downwardly and forwardly, against a guide rod 86 fixed at opposite ends thereof on a pair of supporting arms 87 fixed on the upper girt 13 (Figures 1 and 6). The pile warp yarns W–3 then pass downwardly beneath a whip roll 90, opposite ends of which are fixed on the forward ends of a pair of arms 91 and 92 pivotally mounted at their rear ends, as at 93, on a pair of brackets 94 and 95. The whip roll 90 serves as a restraining and let-off means for the pile warp yarns W–3. The brackets 94 and 95 are fixed on the rear surface of the upper girt 13 adjacent the side frames 10 and 11, respectively. Of course, the pile yarn beam 85 has the usual tension or brake means, not shown, associated therewith for maintaining the yarns W–3 under tension.

The arms 91 and 92 each has pivotally connected intermediate their ends, as at 96, a connecting link 97 (Figure 6). The upper ends of the links 97 are pivotally connected to rocker arms 100 and 101 pivotally mounted intermediate their ends, as at 102 and 103, on brackets 104 fixedly secured to the side frames 10 and 11, but only one of which is shown. The rocker arms 100 and 101 have, pivotally mounted adjacent their outer ends, respective connecting links 106 and 107 which extend upwardly in Figure 1 and are pivotally connected to crank arms 110 and 111 fixed on an upper rocker shaft 112. The shaft 112 is oscillatably mounted in bearings 113 (Figures 3 and 6) fixed on the upper girt 13, and in a bearing 114 fixed on the upper end of a standard 115 resting on the floor F (Figures 1 and 5).

The upper rocker shaft 112 is caused to oscillate by means of a pair of crank arms 120 and 121 fixed on opposite ends thereof (Figures 1, 3 and 5). The outer ends of said arms 120 and 121 are pivotally connected to respective downwardly extending, extensibly adjustable links 123 and 124, which are pivotally connected, as at 125, to respective lever arms 130 and 131. The lever arms 130 and 131 extend rearwardly and are pivotally connected, as at 132 and 133, to upstanding bearing members 134 and 135. The lever arms 130 and 131 have rollers or followers 136 and 137 rotatably mounted intermediate their ends which are adapted to engage and ride upon respective cam wheels 140 and 141 fixed on the main cam shaft 50.

It is thus seen that, as rotation is imparted to the cam shaft 50, in the manner previously described, the cam wheels 140 and 141 rotate continuously, in the direction indicated by the arrows in Figures 3 and 5, to cause the lever arms 130 and 131 to move upwardly as the high spots on the cam wheels 140 and 141 move into engagement with the rollers 136 and 137 on the arms 130 and 131. As the arms 130 and 131 are caused to move upwardly, the crank arms 120 and 121 move upwardly to, thus, rock the upper rocker shaft 112 in one direction. Of course, as the rollers 136 and 137 on the arms 130 and 131 move into engagement with the low or intermediate surfaces of the cam wheels 140 and 141 on the main cam shaft 50, the upper rocker shaft 112, through intervening connections, is caused to move in the opposite direction, thus causing the rocker shaft to oscillate continuously a predetermined amount in each direction during operation of the loom.

As the upper rocker shaft 112 is caused to oscillate, in

the manner described, it is thus seen that the crank arms **110** and **111**, which are fixed on the rocker shaft **112**, are oscillated and, thus, through the intervening connections, cause the whip roll **90** to reciprocate up and down in Figure 6. This insures that the warp yarns W–3 will be under greater tension while the whip roll **90** is in its lowermost position and will be under very little or no tension while the whip roll **90** is in its uppermost position (Figure 6).

After the pile warp yarns W–3 have passed beneath the whip roll **90**, they then move upwardly and over a second guide rod **145** (Figures 1 and 6), opposite ends of which are fixedly secured to upwardly extending supports **146** and **147** whose upper ends are fixedly secured to the upper bracing member **17**. The pile warp yarns W–3 then pass downwardly from the guide rod **145** and through a plurality of yarn guide tubes **150** which are conventional parts of an Axminster loom. In this instance, only one pile warp yarn W–3 is shown passing through each tube **150**, but, of course, several yarns may pass through each tube, if desired. The tubes **150** are fixed to the front surface of a common tube carrier or support **151** which rests in a tube cradle **152**. The lower ends of the tubes **150** are of smaller diameter than their upper ends so adjacent tubes can straddle the ground warp yarns when positioned as shown in Figure 10. The tube cradle **152** is secured at opposite ends thereof in a pair of substantially inverted T-shaped brackets **153** and **153'** adjacent each of the side frames **10** and **11** (Figures 1, 3, 5 and 6).

Since the inverted T-shaped brackets **153** and **153'** at opposite sides of the loom are identical and the linkage therefor is the same at opposite sides of the loom, the reference characters indicating the parts associated with the inverted T-shaped bracket **153'** at the left-hand side of the loom will bear the prime notation and only the parts associated with the inverted T-shaped bracket **153** at the right-hand side of the loom will be described.

The inverted T-shaped bracket **153** is shown in its uppermost position in Figure 6 and is caused to move downwardly from the position shown in Figure 6 and then upwardly by a link **154** pivotally connected, as at **155**, to the rear end of the inverted T-shaped bracket **153**. The rear end of the link **154** is pivotally connected to the upper end of a crank arm **157** whose lower end is fixed on a rear rocker shaft **160** extending from one side frame of the loom to the other and being journaled in bearing blocks **161** and **161'** (Figures 6 and 3, respectively). Fixedly mounted intermediate the ends of the rocker shaft **160** (Figures 2 and 4) is a crank arm **162** which extends downwardly in Figure 4 and has a tension spring **163** fixed to the lower end thereof. The other end of the tension spring **163** is connected to the lower girt **15** to normally urge the rocker shaft **160** in a counterclockwise direction in Figure 4.

The crank arm **162** has a cam follower or roller **165** thereon which is urged into engagement with the outer periphery of an irregularly-shaped cam wheel **166** by spring **163**. The cam wheel **166** is fixed on the main cam saft **50**. It is thus seen that, as the main camshaft **50** rotates in the direction indicated by the arrow in Figure 4, by the means previously described, the crank arm **162** is moved slightly in a counterclockwise direction, as the low spot of the irregularly-shaped cam wheel **166** moves into engagement with the roller **165** on the crank arm **162**, to thus impart rearward movement to the upper ends of the crank arms **157** and **157'**. Of course, the intervening connections cause the loop warp yarn guides **150** to move rearwardly in Figure 6.

The yarn guide tubes **150** are moved downwardly and upwardly with the inverted T-shaped brackets **153** and **153'** by means of angularly disposed guide bars **170** and **170'** (Figures 1, 3, 5 and 6). Each of the guide bars **170** and **170'** is slidably mounted between a pair of guide ways **171** and **172**. The upper ends of the inverted T-shaped brackets **153** and **153'** are pivotally

connected to the respective guide bars **170** and **170'**, as at **173** (Figures 1 and 6). The upper ends of the guide bars **170** and **170'** have the upper ends of respective links **176** and **176'** pivotally connected thereto whose lower ends are pivotally connected to respective crank arms **180** and **180'** fixed on the upper rocker shaft **112**.

As oscillation is imparted to the upper rocker shaft **112** in the manner previously described, the crank arms **180** and **180'** are oscillated up and down and, through intervening connections, cause the loop yarn guide tubes **150** to move up and down in timed relation with the forward and rearward movement of the guide tubes **150** as effected by the cam **166** on the main cam shaft **50**. This causes the loop warp guide tubes **150** to move in an arcuate path from substantially the position shown in Figures 6, 8, 9 and 11 to the position shown in Figure 10 and vice versa.

In this instance, the movement of the loop warp guides **150**, downwardly and rearwardly in an arcuate path, from the position shown in Figures 6, 8 and 11 to that shown in Figure 10 is timed with reciprocation of the filling yarn needle **70** so that the yarn tube guides **150** will only be in the position shown in Figure 10 every third time the filling yarn needle **70** passes from one side of the open shed to the other and back to its original position and while it is inserting a double filling yarn F–1. It is evident that a fabric could be woven with the apparatus described which would not have a loop pile, but would weave the loop pile yarn W–3 into the base of the fabric, if the pile forming fingers, to be presently described, were not used.

However, the primary object of this invention is to provide means facilitating weaving a loop pile fabric on Axminster looms and, to this end, there is provided a transverse row of loop forming fingers **185**, each of which is substantially L-shaped in plan thereby forming a lateral portion **185***a* and a longitudinal portion **185***b*. The portion **185***b* of each finger **185** is fixed on the rear end of a forwardly and upwardly inclined loop finger carrier bar **186** having an enlarged front end portion **187** pivotally mounted on a stub shaft **190** and held thereon by a nut **191**.

Said stub shaft **190** has a spacing shoulder **193** intermediate its ends (Figure 13) and a threaded lower portion **194** which penetrates, and is held in engagement with, a corresponding rearwardly extending finger carrier support bar **195**, as by a nut **196**. The rear ends of the support bars **195** are suitably secured, as by welding, to a loop finger control rod or primary finger rocker shaft **197** which has been used heretofore as a tuft rod control bar on conventional Axminster looms. A spacing bar **200** is suitably secured to the upper surface of each support bar **195**, rearwardly of stub shaft **190**, and on which the loop forming finger carrier bars **186** have sliding movement and which are used to support the rear or free ends of the loop forming finger carrier bars **186**.

Each loop forming finger carrier bar **186** is straddled by an inverted U-shaped cuff member **201** adjustable along the corresponding loop forming finger carrier bar **186** as by a set screw **202**. Each cuff member **201** has integral therewith a stub shaft **203**, which extends upwardly in Figure 14 through a common tie rod or bar **205** held thereon by a snap ring **206**. It is thus seen that, by imparting movement to the tie rod **205**, transversely of the loom, the loop forming fingers **185**, along with the carrier bars **186** are caused to swing about the stub shafts **190** to thus move the loop forming fingers **186** in an arcuate path between the position shown in Figure 8 and substantially that shown in Figure 9.

Referring to Figures 1 and 2, it will be observed that the tie rod **205** has one end of a link **210** pivotally connected to its right-hand end, as at **211**. The outer end of the link **210** is pivotally connected, as at **212**, to one arm of a bell crank **213**, the other arm of which has one end of a link **215** pivotally connected thereto, as at **214**

(Figures 1, 2 and 5). The link **215** extends rearwardly and is connected to the upper end of a crank arm **216**.

The lower end of the crank arm **216** is pivotally connected, as at **220** (Figure 5), to a bearing stand **221** extending from the floor F and a roller or follower **222** is mounted intermediate the ends of the crank arm **216** and is urged into engagement with the outer periphery of an elliptical cam **224** fixed on the main cam shaft **50**. The roller **222** on the crank arm **216** is urged into engagement with the elliptical cam **224** by a tension spring **225**, one end of which is connected to the upper end of the arm **216** and the other end of which is connected to a standard **226** fixed to the framework **80**.

The standard **226** has a platform **230** (Figures 1, 2 and 5) fixed on its upper end in which a pivot shaft **231** is fixedly mounted and on which the previously described bell crank **213** is pivotally mounted. It is thus seen that, as the cam shaft **50** rotates, in Figure 5, the elliptical cam **224** causes the crank arm **216** to oscillate and, through intervening connections, causes the bell crank **213** to oscillate, to thereby impart oscillation to the tie rod **205** and the loop forming fingers **185**.

Now, in order to move portions **185***a* of the loop forming fingers **185** in back of the pile warp yarns W–3 extending from the loop yarn guide tubes **150** to the fell of the fabric to form loops over the loop forming fingers **185**, the tie rod **205** is moved to the right in Figures 1 and 2 each time the high part of the elliptical cam **224** (Figure 5) moves into engagement with the follower **222**. Also, as the loop forming fingers **185** move outwardly or to the right, they are moved rearwardly and then forwardly relative to the warp yarns W–3, extending downwardly from the loop yarn guide tubes **150** to the fell of the fabric, by like movement of the loop forming finger control rod **197** which is effected by means which will now be described.

It will be observed in Figures 1, 2, 3, 5 and 6 that opposite ends of the loop forming finger control rod **197** are oscillatably mounted in the upper ends of brackets **227** and **227'** which extend downwardly and are fixed on a secondary finger rocker shaft **228**, opposite ends of which are oscillatably mounted in bearings **229** and **229'** fixed on the side frames **10** and **11** of the loom. The rocker shaft **228** also has a crank arm **235** fixed thereon (Figures 5 and 6), the outer or rear end of which has the upper end of a link **237** pivotally connected thereto whose lower end is pivotally connected to a rocker arm or lever **240** (Figure 6).

The lever **240** is oscillatably mounted intermediate its ends, as at **241**, on a standard **242** fixed on a support plate **243** which extends between and is fixed to the front and rear girts **15** and **16**. The rear end of the rocker arm **240** has a cam follower or roller **245** mounted thereon which is urged into engagement with an irregularly-shaped cam **246** by a tension spring **248**, one end of which is secured to the arm **240** and the lower end of which is secured to a spring anchor **249** on the floor F (Figure 6). The cam **246** is fixed to one side of a cam divider plate **247** fixed on the main cam shaft **50**. It is thus seen that, as rotation is imparted to the main cam shaft **50**, in the manner described, the irregularly-shaped cam wheel **246** causes the rear end of the rocker arm **240** to move downwardly once during each revolution of cam shaft **50**, and, through intervening connections, moves the loop forming finger control rod **197** forwardly of the position shown in Figures 8 and 10 and then rearwardly to substantially the position shown in Figures 8, 9 and 10.

As the loop forming fingers **185** initially move forwardly away from the fell of the fabric, in each cycle, they are moved upwardly by slight rotation of the loop finger control rod **197** which is imparted thereto by means of a crank arm **250** fixed on the right-hand end of the loop finger control rod **197**. The outer or rear end of the crank arm **250** has the upper end of a connecting link **252** pivotally connected thereto, as at **251** (Figures 5 and 6), the lower end being pivotally connected, as at **253** (Figure 7), to a lateral arm **254** fixed to a rocker arm or lever **255** also pivotally connected intermediate its ends at **241** on the standard **242**. The lever **255** has a cam follower or roller **256** mounted thereon which is urged into engagement with an irregularly-shaped cam wheel **260** by a spring **259** (Figure 6) attached to lever **255** and spring anchor **249**. The cam wheel **260** is fixed to the side of the cam divider plate **247**, opposite the cam wheel **246**.

It is thus seen that, rotation of the main cam shaft **50** (Figure 6) and the irregularly-shaped cam **260**, in the direction indicated by the arrow, causes the high part of the cam **260** to engage the roller **256** on the rocker arm **255** with each revolution thereof and, thus, the forward end of the rocker arm **255** moves upwardly, along with the connecting link **252**, to move the bracket **250** and the loop finger control rod or primary finger rocker shaft **197** in a clockwise direction in Figure 6 to thereby move the loop forming fingers **185** forwardly relative to the position shown in Figure 8.

Method of operation

Briefly, each cycle in the operation of the improved loop forming apparatus may be carried out in seven steps and, for purposes of description, it is to be assumed that at the beginning of each cycle, the loop forming fingers **185**, the loop pile yarn guide tubes **150** and the reed **33** occupy substantially the position shown in Figures 8 and 11. The series of seven steps in each cycle of the operation of the improved loop pile forming apparatus is as follows:

Step No. 1.—Loop forming fingers **185** swing outwardly relative to previously formed loops, to the right in Figure 8 or toward the observer in Figure 11, and start to move forwardly or away from the reed **33** as the portions **185***a* of the fingers **185** are withdrawn from the previously formed loops. In so doing, the fingers **185** also move upwardly in an arcuate path in the course of their forward movement to their foremost position.

Step No. 2.—In this instance, two double filler yarns F–1 are cast by needle **70** and beat up by the reed **33**. These two double filler yarns will appear beneath the subsequently formed loops as shown in my said co-pending application, Serial No. 350,710.

Step No. 3.—The fingers **185**, which have remained in a forward raised position during the weaving of the last-mentioned two double filler yarns, then move rearwardly while raised and start to swing inwardly as the free ends of the portions **185***a* of the fingers **185** reach the vertical plane of the fell of the fabric so the leading or free ends of the fingers **185** start to pass in back of the corresponding pile warp yarns W–3 extending from the pile yarn guide tubes **150** to the fell of the fabric as shown in Figure 9.

Step No. 4.—After the fingers **185** have swung all the way inwardly or away from the observer in Figure 9, they are lowered to a position against or immediately above the fell of the cloth as shown in Figure 10. In so doing, it is to be noted that the free ends of the lateral portions **185***a* of the fingers **185** overlap the heel portions of the next adjacent fingers immediately adjacent the juncture of the lateral and the longitudinal portions **185***a* and **185***b*, as shown in Figure 8, to thereby insure that all of the pile warp yarns W–3 are ensnared by the loop forming fingers **185**.

Step No. 5.—The pile yarn guide tubes **150** then move from the forward raised position shown in Figures 6, 8 and 11, downwardly and rearwardly, in an arcuate path, so they momentarily occupy the lowered rearward position shown in Figure 10 and wherein the lower ends of the pile yarn guide tubes **150** are disposed between adjacent ground warp yarns forming the upper portion of

the shed, which are the ground warp yarns W–1 in Figure 10 in this instance.

It will be noted that the reed 33 is then its rearmost position and the pile warp yarns are drawn over the upper edges of the loop forming fingers 185 and downwardly between adjacent ground warp yarns which form the upper portion of the shed. As the tubes 150 move from the position shown in Figures 8, 9, and 11 to that shown in Figure 10, the pile yarn whip roll 90 moves upwardly to momentarily slacken the pile warp yarns W–3 in order that the pile warp yarns W–3 may be withdrawn through the loop pile yarn guide tubes 150 as the tubes 150 move from the forward raised position to the rearward lowered position (Figures 8 and 10, respectively).

Step No. 6.—The pile yarn needle 70 then passes through the shed formed of the ground warp yarns W–1 and W–2 in a reciprocal manner to cast at least one double filler yarn or double weft above the portions of the pile warp yarns W–3 which are then held in the shed formed by the ground warp yarns W–1 and W–2 by the loop pile yarn guide tubes 150.

Step No. 7.—The guide tubes 150 then move upwardly and forwardly in an arcuate path from the position shown in Figure 10 to that shown in Figures 8, 9, and 11, simultaneously with downward movement of the whip roll 90 in Figure 6 and simultaneously with a beat-up stroke of the reed 33, whereby the whip roll takes up the slack in the pile warp yarns W–3 and the third double weft or filler yarn is beat against the fell of the cloth to complete the formation of a transverse row of loops and, in which instance, the parts will again occupy the position shown in Figure 8 preparatory to a repeat cycle.

A more specific description of the manner in which the series of steps of each cycle are carried out will now be given. The loop forming fingers 150 are swung outwardly relative to the loop pile warp yarns W–3 in Step No. 1 by means of the high point of cam 224 moving into engagement with follower 222 (Figure 5) to thereby move the lever or crank arm 216 and link 215 to the right or rearwardly to cause the bell crank 213 to move in a counterclockwise direction in Figure 2. Of course, the bell crank 213 is connected to bar 205 by means of link 210 and thus swings the fingers 185 outwardly.

As the fingers start to move outwardly, they are also caused to move forwardly so the free ends thereof, in the course of their arcuate movement, do not move rearwardly relative to the pile warp yarns W–3. Also, the fingers start to move upwardly at the time that they are moved outwardly and forwardly and the forward movement of the fingers is caused by the high point of the cam 246 (Figure 6) moving into engagement with follower 245 on lever 240. This causes the secondary rocker shaft 228 to move in a clockwise direction in Figure 6, thereby moving the brackets 227 and 227′, the primary finger rocker shaft 197 and the fingers 185 in a like direction, or, in other words, the fingers 185 are caused to move forwardly to their foremost position.

It is evident from the relative shape of the cams 246 and 260 in Figure 6, that, at substantially the same time that the fingers 185 start to move forwardly, they are caused to move upwardly, due to the high point of cam 260 engaging the follower 256 on lever 255 which, through intervening connections, causes the crank 250 to move in a clockwise direction in Figure 6 to thereby cause the primary rocker shaft 197 to move slightly in a clockwise direction in Figure 6, to, in turn, swing the fingers 185 upwardly to substantially the position shown in Figure 9 relative to the fell of the fabric.

During the latter outward, upward and forward movement of the loop forming fingers 185, the reed 33 is moving rearwardly and then occupies a rearward position as shown in Figures 8 and 9. In the course of the forward movement of the fingers 185, Step No. 2 is carried out; that is, two double filler yarns are cast across the lay and beat-up by the reed 33 as the positions of the ground warp yarns W–1 and W–2 reverse in the usual manner. As the reed 33 starts its rearward movement following the beat-up of the second of the two double filler yarns F–1, the Step No. 3 is carried out, in the course of which the fingers 185 are again caused to move rearwardly while in raised position, due to the relative positions of the high points of the cam wheels 246 and 260 in Figure 6, it being understood that the cam follower 245 engages the low surface of the cam wheel 246 while the cam follower 256 is still in engagement with the high surface or spot of cam wheel 260.

Also, as the free ends of the lateral portions 185*a* of the fingers 185 approach the vertical plane of the fell of the fabric, during the course of rearward movement thereof, they are swung inwardly or away from the observer in Figures 9 and 11 as the high surface of cam 224 moves out of engagement with cam follower 222 in Figure 5. The relative positions of the high surfaces of the cams 224 and 246 is such that the loop forming fingers 185 will be swung all the way inwardly to substantially the position shown in Figure 8 at substantially the time that the fingers 185 reach the limit of the forward movement of the reed 33.

Also, as set forth in Step No. 4, immediately after the fingers 185 complete their inward movement, they are then lowered from their raised position shown in Figure 9 to the lowered position shown in Figures 8, 10, and 11, since the high surface of cam 260 then moves out of engagement with the cam follower 245.

As heretofore stated, in Step No. 5, the pile yarn guide tubes 150 move downwardly and rearwardly in an arcuate path to occupy the position shown in Figure 10 as the whip roll 90 (Figure 6) moves upwardly to relax the tension in the pile warp yarns W–3. It might be stated here that, as the fingers 185 move rearwardly in raised position to the position shown in Figure 9, as set forth in Step No 3, the pile yarn guide tubes 150 are in the highest of three different positions, since the cam wheels 140 and 141 (Figures 5 and 3, respectively) are in engagement with the respective followers 136 and 137 and, after the fingers 185 have moved downwardly as described in Step No. 4, the pile yarn guide tubes 150 are lowered slightly to an intermediate position as the intermediate surfaces of the cam wheels 140 and 141 move into engagement with the respective followers 136 and 137.

The yarn guide tubes 150 remain in the same vertical plane while in the uppermost and intermediate positions and are merely caused to occupy the uppermost or highest position in order to insure that they are disposed above the level of the fingers 185 as they are moved rearwardly. On the other hand, the tubes 150 are moved downwardly into intermediate position in order that they may be properly positioned for their subsequent rearward and downward arcuate movement for properly directing the loop pile warp yarns W–3 over the loop forming fingers 185.

Now, following Step No. 4 and in carrying out Step No. 5, the lower surfaces of the cam wheels 140 and 141 move into engagement with the respective cam followers 136 and 137, thereby permitting the levers, rocker arms or follower arms 130 and 131 to move downwardly at the front ends thereof to their lowermost positions. In so doing, the links 123 and 124 impart downward movement to the front ends of crank arms 120 and 121 to thereby impart counterclockwise movement to shaft 112 in Figure 5 or clockwise movement thereto in Figures 3 and 6.

Referring to Figure 6, it will be observed that this causes crank arms 180 and 180′ to move downwardly with links 176 and 176′ and the corresponding guide bars 170 and 170′, to which upper ends of the vertical portions of the inverted T-shaped brackets 153 and 153′ are pivotally connected, to thereby move the pile yarn tube guides 150 downwardly. As the pile yarn tube guides 150 move downwardly, they are caused to move rearwardly in an

arcuate path to occupy substantially the position shown in Figure 10, due to the low surface of cam wheel **166** (Figure 4) moving into engagement with the cam follower **165** and, in which instance, the two crank arms **157** and **157'** will move rearwardly at the upper ends thereof to thereby move the inverted T-shaped brackets **153** rearwardly by means of the respective links **154** and **154'**, as they are permitted to move downwardly in the manner heretofore described. As heretofore stated, this positions the lower end portions of the guide tubes **150** within the shed formed by the ground warp yarns W–**1** and W–**2**.

As the pile warp yarn guide tubes **150** move downwardly and rearwardly in an arcuate path in the manner just described, the pile warp yarns W–**3** must be relaxed or slackened in order to permit the warp yarns W–**3** to be payed out from the tubes **150**. To this end, since the cam wheels **140** and **141** cause the shaft **112** to move in a clockwise direction in Figure 6, it will be observed in Figure 1 that the end of the crank arm **110** nearest the observer will cause the front ends of the crank arms **110** and **111**, or the ends thereof nearest the observer in Figure 1, to move downwardly to thereby rock the respective levers **100** and **101** about the respective pivot points **102** and **103** so the proximal ends thereof are caused to move upwardly to, in turn, move the whip roll **90** upwardly in Figures 1 and 6.

With upward movement of the proximal ends of the arms or levers **100** and **101**, the corresponding connecting links **97** move upwardly to raise arms **91** and **92** along with the whip roll **90** carried thereby (Figures 1 and 6). Of course, the downward and rearward arcuate movement of the yarn guide tubes **150** and the upward movement of the roll **90** is relatively fast and occurs during rearward movement of the reed **33** so the guide tubes **150** reach the lowered position shown in Figure 10 at substantially the same time that the reed **33** has reached its backward position. Thus, immediately thereafter, the needle **70** moves across the lay **34** and back again to cast a double filler yarn F–**1** above the portions of the loop pile warp yarns W–**3** which are disposed within the shed formed by the ground warp yarns W–**1** and W–**2**.

Step No. 7 is then carried out wherein the guide tubes **150** move upwardly and forwardly in an arcuate path to their original position (Figures 5, 6, 8, 9 and 11) as the high surface of the cam **166** moves into engagement with cam follower **165** and swings the inverted T-shaped brackets **153** and **153'** forwardly, and as the highest surfaces of the cam wheels **140** and **141** move into engagement with the respective followers **136** and **137**, to again cause the inverted T-shaped brackets **153** and **153'** to move upwardly to occupy the position shown in Figures 5 and 6.

It is evident that the whip roll **90** moves downwardly to again occupy the position shown in Figure 6 in unison with the upward and forward arcuate movement of the guide tubes **150** as the high surfaces of the cam wheels **140** and **141** move into engagement with the respective cam followsr **136** and **137**. Also, as the guide tubes **150** move upwardly and forwardly, the reed **33** moves forwardly in a beat-up stroke to beat the third set of double filler yarns into the fell of the fabric to thereby form another row of loops across the fabric as the loop warp yarns are tied into the ground fabric by the last-mentioned filler yarns.

Of course, immediately following the last-mentioned beat-up stroke of the reed **33**, the loop forming fingers **185** again start to move outwardly from the position shown in Figure 8 to start another cycle in the operation of the improved loop pile forming apparatus.

It is thus seen that I have provided an improved loop forming apparatus particularly adapted to be used in association with looms of the Axminster type and including a transverse row of loop forming fingers with means for moving the fingers longitudinally of the fabric, vertically and laterally in accurate timed relation to the operation of the pile yarn guide tubes **150** and the let-off mechanism, as exemplified by the whip roll **90**, and the beat-up strokes of the reed **33** whereby the loop pile warp yarns W–**3** are fed to the ground fabric continuously throughout the weaving of a given length of fabric.

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.

I claim:

1. In a loom having means for weaving a ground fabric from ground warp yarns including means for beating up filling yarns with the ground warp yarns and a support for a continuous pile yarn supply; the combination of means operable in timed relation to the means for weaving the ground fabric for intermittently introducing the pile yarns from a position above the last-mentioned means to a position within the shed formed by the ground warp yarns, a transverse row of loop forming fingers normally positioned forwardly of the weaving zone, means for imparting vertical, lateral and longitudinal movement to the loop forming fingers in timed relation to the operation of the means for weaving the ground fabric and in timed relation to the movement of the loop forming fingers to a position within the shed formed by the ground warp yarns in a loop forming operation, and said lateral movement being in an arcuate path to cause the fingers to pass between adjacent pile yarns as they move into position in back of the pile yarns.

2. In a loom having means for weaving a ground fabric including an oscillatable reed, said loom also having shed-forming means for forming ground warp yarns into sheds as they pass through the reed and a series of closely spaced pile yarn feeding guides, through which strands of pile yarn are threaded, movably mounted forwardly of and above the reed whereby the strands of pile yarn normally extend substantially perpendicular to the ground fabric; the combination of a transversely extending row of spaced loop forming fingers disposed forwardly of the reed and each having a lateral portion on the rear end thereof, means for shifting said fingers laterally inwardly to cause their lateral portions to move through and in back of the strands of pile yarn extending from the feeding guides to the fell of the fabric, means to lower said fingers adjacent the fell and then raise said fingers, means whereby said feeding guides are moved downwardly and rearwardly parallel to the ground warp yarns in timed relation to the movement of the fingers adjacent the fell whereby the pile yarn is looped over the lateral portions of said fingers, said means for weaving the ground fabric being operable in timed relation to the movement of the fingers and the pile yarn feeding guides for beating up the loops thus formed from the pile yarn as the fabric is woven, and means for shifting said fingers laterally outwardly while they are in lowered position and forwardly as they are raised.

3. An attachment in combination with a loom having means for weaving fabrics from ground warp yarns; said attachment comprising a series of spaced loop forming fingers each having a lateral portion thereon disposed forwardly of the reed, said loop forming fingers extending in a row transversely of the ground warp yarns, means for imparting vertical and lateral movement to the loop forming fingers, a series of spaced loop yarn guide tubes movably mounted above the fell of the fabric and through which strands of pile yarn are threaded, means for imparting vertical, forward and rearward movement to the yarn guide tubes in timed relation to the vertical and lateral movement of said loop forming fingers whereby said loop yarn guide tubes are shifted from directly above the fell of the fabric to predetermined positions in the shed formed by the ground warp yarns and vice versa and

whereby the pile yarn is looped over the loop forming fingers and under the filling yarns for attaching the loops thus formed to the fabric as it is woven from the ground warp yarns.

4. A loop forming attachment for looms of the type having means for feeding ground warp yarns and for beating up filler yarns into the fell of the fabric being woven; said attachment comprising movable pile yarn guides through which strands of pile yarn are threaded and normally being disposed above the fell of the fabric, loop forming fingers disposed in a horizontal plane between the fell of the fabric and the lower ends of the pile yarn guides, means for reciprocating said fingers longitudinally of the ground warp yarns and vertically and laterally in predetermined sequence, means for reciprocating said pile yarn guides between the normal position spaced above the fell of the fabric being woven and a position rearwardly of, and in substantially the same horizontal plane as, the fell of the fabric and whereby said pile yarn guides are repeatedly positioned in the shed formed of the ground warp yarns, and said longitudinal, vertical and lateral movement of the fingers and reciprocation of the pile yarn guides being operable in timed relation to each other and in timed relation to the means for weaving the ground fabric in a loop forming operation.

5. In a loom having means for weaving a ground fabric from ground warp yarns including means for beating up filling yarns with the ground warp yarns and a support for a continuous pile yarn supply; the combination of means operable in timed relation to the means for weaving the ground fabric for intermittently introducing the pile yarns from a position above the last-mentioned means to a position within the shed formed by the ground warp yarns, a transverse row of loop forming fingers normally positioned forwardly of the weaving zone, means for imparting vertical, lateral and rearward and forward movement to the loop forming fingers in timed relation to the operation of the means for weaving the ground fabric and in timed relation to the movement of the loop forming fingers to a position within the shed formed by the ground warp yarns in a loop forming operation, means normally restraining movement of the pile yarns from the yarn supply to the means for introducing the pile yarns, and means for momentarily slackening the pile yarns in timed relation to movement of the means for introducing the pile yarns to a position within the shed formed by the ground warp yarns.

6. A loop forming attachment for looms of the type having means for feeding ground warp yarns and for beating up filler yarns into the fell of the fabric being woven; said attachment comprising movable pile yarn guides through which strands of pile yarn are threaded and being normally disposed above the fell of the fabric, means normally restraining movement of said strands of pile yarn through said guides, loop forming fingers disposed in a horizontal plane between the fell of the fabric and the lower ends of the pile yarn guides, means for reciprocating said fingers longitudinally of the ground warp yarns and vertically and laterally in predetermined sequence, means for reciprocating said pile yarn guides between said normal position spaced above the fell of the fabric being woven and a lower position rearwardly of the fell of the fabric whereby said pile yarn guides are repeatedly positioned in the shed formed of the ground warp yarns, said longitudinal, vertical and lateral movement of the fingers and reciprocation of the pile yarn guides being operable in timed relation to each other and in timed relation to the means for weaving the ground fabric in a pile loop forming operation, and means operable in timed relation to the downward and rearward movement of the pile yarn guides for momentarily releasing the strands of pile yarn to permit the latter to be withdrawn from the guides at the fell of the fabric being woven.

7. In a loom having means for weaving a ground fabric from ground warp yarns and including an oscillatable reed, said loom also having means for supporting a continuous supply of pile yarns; the combination of a transverse row of spaced loop forming fingers disposed forwardly of the reed, each loop forming finger having a lateral portion at its end adjacent said reed, means for imparting vertical, longitudinal and lateral movement to said fingers relative to the ground warp yarns in predetermined sequence and in timed relation to predetermined strokes of said reed, a row of pile yarn guides normally spaced above, and in the vertical plane of, the fell of the ground fabric, means operable in timed relation to the vertical, longitudinal and lateral movement of said fingers and in timed relation to predetermined strokes of said reed away from the fell of the fabric for moving said pile yarn guides downwardly and rearwardly through the shed formed of the ground warp yarns, and said last-named means being operable to return the pile yarn guides to their normal positions in the course of the next succeeding beat-up stroke of said reed whereby said pile yarn guides draw the pile yarn over said loop forming fingers with downward movement of said guides and the subsequent beat-up stroke of the reed will bind the pile yarns into the ground fabric to form loops therefrom.

8. In a loom having means for weaving a ground fabric from ground warp yarns and including an oscillatable reed, said loom also having means for supporting a continuous supply of pile yarns; the combination of a transverse row of spaced loop forming fingers disposed forwardly of the reed, each loop forming finger having a lateral portion at its end adjacent said reed, means for imparting vertical, longitudinal and lateral movement to said fingers relative to the ground warp yarns in predetermined sequence and in timed relation to predetermined strokes of said reed, a row of pile yarn guides normally spaced above, and in substantially the vertical plane of, the fell of the ground fabric, means operable in timed relation to the vertical, longitudinal and lateral movement of said fingers and in timed relation to predetermined strokes of said reed away from the fell of the fabric for moving said pile yarn guides downwardly and rearwardly through the shed formed of the ground warp yarns, said last-named means being operable to return the pile yarn guides to their normal positions in the course of the next succeeding beat-up stroke of said reed whereby said pile yarn guides draw the pile yarns over said loop forming fingers with downward movement of said guides and the subsequent beat-up stroke of the reed will bind the pile yarns into the ground fabric to form loops therefrom, means supporting said loop forming fingers comprising a forwardly projecting support bar for each finger, a primary rocker shaft common to all of said fingers and extending transversely of the warp yarns, means carried by the primary rocker shaft for pivotally supporting the front ends of said finger support bars at their ends remote from said reed, a common finger-swinging bar pivotally connected to said finger support bars at points intermediate the front and rear ends thereof, and cam controlled means for imparting reciprocatory movement to said finger swinging bar in a direction transverse to the ground warp yarns and in timed relation to predetermined strokes of the reed.

9. In a loom having means for weaving a ground fabric from ground warp yarns and including an oscillatable reed, said loom also having means for supporting a continuous supply of pile yarns; the combination of a transverse row of spaced loop forming fingers disposed forwardly of the reed, each loop forming finger having a lateral portion at its end adjacent said reed, means for imparting vertical, longitudinal and lateral movement to said fingers relative to the ground warp yarns in predetermined sequence and in timed relation to predetermined strokes of said reed, a row of pile yarn guides normally spaced above, and in substantially the vertical plane of,

the fell of the ground fabric, means operable in timed relation to the vertical, longitudinal and lateral movement of said fingers and in timed relation to predetermined strokes of said reed away from the fell of the fabric for moving said pile yarn guides downwardly and rearwardly through the shed formed of the ground warp yarns, said last-named means being operable to return the pile yarn guides to their normal positions in the course of the next succeeding beat-up stroke of said reed whereby said pile yarn guides draw the pile yarns over said loop forming fingers with downward movement of said guides and the subsequent beat-up stroke of the reed will bind the pile yarns into the ground fabric to form loops therefrom, said means for imparting downward and rearward movement to the pile yarn guides and vice versa comprising a common support extending transversely of the loom above the reed and supporting said pile yarn guides, a pair of brackets disposed adjacent opposite sides of the loom and on the lower portions of which opposite ends of said common support for the pile yarn guides are mounted, a substantially vertically movable block supported on each of the side frames of the loom and to which the upper portions of said brackets are pivotally connected, cam controlled means for imparting vertical reciprocatory movement to said blocks for imparting like movement to said common support, and cam controlled means for swinging the lower portions of said brackets about the points at which they are pivotally connected to said blocks and being operable in timed relation to the substantially vertical reciprocatory movement of the blocks to thereby cause said pile yarn guides to be moved downwardly and rearwardly in an arcuate path on the one hand and to be moved forwardly and upwardly on the other hand.

10. In a loom having means for weaving a ground fabric from ground warp yarns including an oscillatable reed and means for feeding filler yarns through the shed formed by the ground warp yarns, said loom also having means for continuously feeding pile yarns to the fell of the ground fabric as it is being woven and including a transverse row of closely spaced pile yarn feeding guides normally spaced substantially above the fell of the fabric being woven; the combination of a transverse row of loop forming fingers disposed forwardly of the reed, each of said fingers having a lateral portion thereon normally disposed at a level between the lower ends of said pile yarn feeding guides and the fell of the ground fabric, means for moving said fingers successively toward and away from the reed, means for swinging said lateral portions of the fingers inwardly and outwardly in a substantially lateral direction in timed relation to the rearward and forward movement of said fingers, means for raising and lowering said fingers in timed relation to the lateral swinging movement thereof between a position closely adjacent the fell of the ground fabric being woven and a position spaced substantially above the fabric, means operable in timed relation to the movement of the fingers for moving said pile yarn feeding guides downwardly and rearwardly and then forwardly and upwardly to said normal position whereby the lower ends of said pile yarn feeding guides are momentarily positioned in the shed formed by the ground warp yarns and whereby the pile yarn is looped over the fingers and a filler yarn is threaded over the loops of pile yarn, and the movement of said fingers and the pile yarn feeding guides being operable in timed relation to oscillation of the reed whereby said reed beats up the loops thus formed as the fabric is woven.

11. In a loom for weaving pile fabrics including a ground fabric formed from ground warp yarns, said loom having means for forming a shed of the ground warp yarns, means for projecting filling yarns through the shed and a reed for beating the filling yarns in a weaving operation; the combination of a primary loop finger rocker shaft extending transversely of the loom and

spaced forwardly of the reed, a plurality of spaced fingers pivotally supported by said primary rocker shaft and extending rearwardly beyond the rocker shaft toward said reed, a lateral portion on the rear end of each of said fingers adjacent the reed, said lateral portions being free at their inner ends relative to one side of the loom and the free end of each lateral portion extending beyond the fixed end of the next adjacent finger disposed inwardly therefrom, movable pile yarn guides normally spaced above the horizontal plane of the reed and in a vertical plane substantially the same as that of the beat-up position of said reed and through which pile yarns pass to the fell of the fabric being woven, means operable in timed relation to predetermined beat-up strokes of the reed for reciprocating said primary rocker shaft parallel to the ground warp yarns whereby said fingers are caused to reciprocate parallel to the ground warp yarns, means operable in timed relation to said predetermined beat-up strokes of the reed for oscillating said primary rocker shaft to vertically vary the position of the lateral portions of said fingers relative to the reed, means for reciprocating said fingers inwardly and outwardly transversely of the ground warp yarns in timed relation to the reciprocation and oscillation of the primary rocker shaft whereby said lateral portions of the fingers are caused to move inwardly in back of the pile yarns extending from said pile yarn guides to the fell of the fabric and vice versa, means also operable in timed relation to said predetermined beat-up strokes of the reed whereby the guides are moved downwardly and rearwardly from said normal position while the reed is in a rearward position to move the same into position between the ground warp yarns and into the shed formed thereby whereby filling yarn is fed through the shed formed of the ground warp yarns above said pile yarns and whereby the pile yarns are pulled over the lateral portions of the fingers, and said last-named means also being operable to return the pile yarn guides to said normal position in the course of the subsequent beat-up stroke of the reed whereby said reed beats up the loops thus formed as the fabric is woven.

12. In a loom having means for weaving a ground fabric including an oscillatable reed, said loom also having a series of closely spaced pile yarn feeding guides through which strands of pile yarn are threaded movably mounted forwardly of and above the reed; the combination of a transversely extending row of spaced loop forming fingers disposed forwardly of the reed and each having a lateral portion on the rear end thereof, means for reciprocally shifting said fingers laterally and in an arcuate path to cause their lateral portions to move into and out of the strands of pile yarn extending from said feeding guides to the fell of the fabric, means to move said fingers downwardly and upwardly successively to cause them to engage the ground fabric while loops are formed and to be positioned above the previously formed loops as their lateral portions are swung into position in back of the pile yarns, means for moving said feeding guides downwardly and rearwardly in an arcuate path substantially parallel to the ground warp yarns in timed relation to the downward movement of the fingers whereby the pile yarn is looped over the lateral portions of said fingers, and said means for weaving the ground fabric being operable in timed relation to the movement of the fingers and the pile yarn feeding guides for beating up the loops thus formed from the pile yarn as the fabric is woven.

13. An attachment in combination with a loom having means for weaving fabrics from ground warp yarns, said attachment comprising a series of spaced loop forming fingers each having a lateral portion thereon disposed forwardly of the reed, said loop forming fingers extending in a row transversely of the ground warp yarns, cam controlled means for imparting vertical and lateral movement to the loop forming fingers, a series of spaced loop yarn guide tubes movably mounted above the fell of the fabric and through which strands of pile

yarn are threaded, cam controlled means for imparting vertical, forward and rearward movement to the yarn guide tubes in timed relation to the vertical and lateral movement of said loop forming fingers whereby said loop yarn guide tubes are shifted from directly above the fell of the fabric to predetermined positions in the shed formed of the warp yarns and vice versa and whereby the pile yarn is looped over the loop forming fingers and under the filling yarns for attaching the loops thus formed to the fabric as woven from the ground warp yarns.

14. In a loom having means for weaving a ground fabric from ground warp yarns including means for beating up filling yarns with the ground warp yarns and a support for a continuous pile yarn supply; the combination of means operable in timed relation to the means for weaving the ground fabric for intermittently introducing the pile yarns from a position above the last-mentioned means to a position within the shed formed by the ground warp yarns, a transverse row of loop forming fingers normally positioned forwardly of and above the weaving zone, means for repeatedly imparting rearward, downward, laterally inward, laterally outward, upward and forward movement to the loop forming fingers substantially successively and in timed relation to predetermined picks in the operation of the means for weaving the ground fabric and also in timed relation to the movement of the loop forming fingers to a position within the shed formed by the ground warp yarns in a loop forming operation.

15. In a structure according to claim 14, said means repeatedly imparting movement to the fingers including a first cam means for controlling inward and outward movement of said fingers, a second cam means for controlling upward and downward movement of said fingers, a third cam means for controlling rearward and forward movement of said fingers, said first, second and third cam means being so arranged as to cause said fingers to move rearwardly, then inwardly and downwardly simultaneously, then outwardly and then forwardly while moving upwardly in timed relation to each of said predetermined picks.

16. In a loom having means for weaving a ground fabric from ground warp yarns and including an oscillatable reed, said loom also having means for supporting a continuous supply of pile yarn; the combination of a transverse row of spaced loop forming fingers disposed forwardly of the reed, each loop forming finger having a lateral portion at its end adjacent said reed, means for imparting vertical, longitudinal and lateral movement to said fingers relative to the ground warp yarns in predetermined sequence and in timed relation to predetermined strokes of said reed, a row of pile yarn guides normally spaced above, and in substantially the vertical plane of, the fell of the ground fabric, means operable in timed relation to the vertical, longitudinal and lateral movement of said fingers and in timed relation to predetermined strokes of said reed away from the fell of the fabric for moving said pile yarn guides downwardly and rearwardly through the shed formed of the ground warp yarns and to return the pile yarn guides to their normal positions whereby said pile yarn guides draw the pile yarn over said loop forming fingers and the subsequent beat-up stroke of the reed will bind the pile yarn into the ground fabric to form loops therefrom, means supporting said loop forming fingers comprising a forwardly projecting support bar for each finger, a primary rocker shaft common to all of said fingers and extending transversely of the warp yarns, means carried by the primary rocker shaft for pivotally supporting the front ends of said finger support bars, a common finger swinging bar pivotally connected to said finger support bars at points intermediate the front and rear ends thereof, and means for imparting reciprocatory movement to said finger swinging bar in a direction transverse to

the ground warp yarns and in timed relation to predetermined strokes of the reed.

17. In a loom having means for weaving a ground fabric from ground warp yarns and including an oscillatable reed, said loom also having means for supporting a continuous supply of pile yarn; the combination of a transverse row of spaced loop forming fingers disposed forwardly of the reed, each loop forming finger having a lateral portion at its end adjacent said reed, means for imparting vertical, longitudinal and lateral movement to said fingers relative to the ground warp yarns in predetermined sequence and in timed relation to predetermined strokes of said reed, a row of pile yarn guides normally spaced above, and in substantially the vertical plane of, the fell of the ground fabric, means operable in timed relation to the vertical, longitudinal and lateral movement of said fingers and in timed relation to predetermined strokes of said reed away from the fell of the fabric for moving said pile yarn guides downwardly and rearwardly through the shed formed of the ground warp yarns and to return the pile yarn guides to their normal positions whereby said pile yarn guides draw the pile yarn over said loop forming fingers and the subsequent beat-up stroke of the reed will bind the pile yarn into the ground fabric to form loops therefrom, means supporting said loop forming fingers comprising a forwardly projecting support bar for each finger, a primary rocker shaft common to all of said fingers and extending transversely of the warp yarns, means carried by the primary rocker shaft for pivotally supporting the front ends of said finger support bars at their ends remote from said reed, means to oscillate said rocker shaft to impart vertical reciprocatory movement to said fingers, a common finger swinging bar pivotally connected to said finger support bars, and means for imparting reciprocatory movement to said finger swinging bar in a direction transverse to the ground warp yarns in timed relation to oscillation of said rocker shaft and in timed relation to predetermined strokes of the reed.

18. In a loom having means for weaving a ground fabric from ground warp yarns and including an oscillatable reed, said loom also having means for supporting a continuous supply of pile yarns; the combination of a transverse row of spaced loop forming fingers disposed forwardly of the reed, each loop forming finger having a lateral portion at its end adjacent said reed, means for imparting vertical, longitudinal and lateral movement to said fingers relative to the ground warp yarns in predetermined sequence and in timed relation to predetermined strokes of said reed, a row of pile yarn guides normally spaced above, and in substantially the vertical plane of, the fell of the ground fabric, means operable in timed relation to movement of said fingers for moving said pile yarn guides downwardly and rearwardly through the shed formed of the ground warp yarns and to return the pile yarn guides to their normal positions whereby said pile yarn guides draw the pile yarn over said loop forming fingers with downward movement of said guides and the subsequent beat-up stroke of the reed will bind the pile yarn into the ground fabric to form loops therefrom, said means for imparting downward and rearward movement to the pile yarn guides and vice versa comprising a common support extending transversely of the loom above the reed and supporting said pile yarn guides, a pair of brackets disposed adjacent opposite sides of the loom and on which opposite ends of said common support for the pile yarn guides are mounted, a substantially vertically movable block supported on each of the side frames of the loom and to which said brackets are pivotally connected, means for imparting vertical reciprocatory movement to said blocks for imparting like movement to said common support, and means for swinging the said brackets about the points at which they are pivotally connected to said blocks and being operable in timed relation to the substantially vertical reciprocatory

movement of the blocks to thereby cause said pile yarn guides to be moved downwardly and rearwardly in an arcuate path on the one hand and to be moved forwardly and upwardly on the other hand.

19. A method of weaving pile fabrics on a loom having movable beating means which comprises weaving warp and filler yarn into a base fabric and concurrently with the weaving of the base fabric extending strands of pile yarn upwardly from and substantially perpendicularly to the fell of the fabric, laterally inserting a plurality of laterally spaced weftwise extending fingers in back of the pile yarn forwardly of the beating means and above the level of previously formed loops, then lowering said fingers to a point closely adjacent the fell of the base fabric, drawing the pile yarn downwardly and rearwardly over the fingers, but forwardly of the beating means, into the shed of the loom below the path of the filler inserting means, inserting filler strands over the pile yarn and through the open shedded warp, then moving the pile yarn upwardly thereby looping the pile yarn around the filler whereby loops are formed over the fingers with the filler, beating up the filler and pile loops against the previously formed fabric, then moving the fingers laterally out of the loops formed thereover, then raising the fingers above the level of the loops and withdrawing the fingers forwardly away from the vertical plane of the fell of the fabric.

20. A method of weaving pile fabrics on a loom having movable beating means which comprises weaving warp and filler yarn into a base fabric and concurrently with the weaving of the base fabric extending strands of pile yarn upwardly from and substantially perpendicularly to the fell of the fabric, laterally swinging a plurality of free-ended laterally spaced weftwise extending fingers in an arcuate path between and in back of the pile yarn forwardly of the beating means, moving the fingers downwardly to a point adjacent the fell of the fabric, drawing the pile yarn downwardly and rearwardly over the fingers and forwardly of the beating means into the shed of the loom below the path of the filler inserting means, inserting at least one filler strand over the pile yarn and through the open shedded warp, then moving the pile yarn upwardly thereby looping the pile yarn around the filler whereby loops are formed over the fingers with the filler, beating up the filler and pile loops against the previously formed fabric, then swinging the fingers laterally in an arcuate path out of the loops formed thereover, then raising the fingers above the level of the latter loops and withdrawing the fingers forwardly away from the vertical plane of the fell of the fabric preparatory to a repeat operation.

21. A method of weaving pile fabrics on a loom having movable beating means which comprises weaving warp and filler yarn into a base fabric and, concurrently with the weaving of the base fabric, arranging pile yarn under tension to extend upwardly from the fell of the base fabric substantially perpendicular to the base fabric, laterally

swinging a plurality of relatively short fingers in an arcuate path through and in back of the pile yarn forwardly of the beating means and substantially above the level of the fell of the base fabric, then moving the fingers downwardly so they rest against the fell of the base fabric, threading the pile yarn over the fingers and into the open shedded warp forwardly of the beating means, placing filler yarn through the shed and over the portions of the pile yarn threaded into the open shedded warp, drawing the pile yarn upwardly while beating up the filler and pile loops against the previously formed fabric and immediately adjacent said fingers to thereby form loops over said fingers, then swinging said fingers outwardly in an arcuate path to withdraw the same from the immediately previously formed loops, then raising the fingers as they are moved forwardly away from the fell of the fabric so the fingers clear previously formed loops as they are moved forwardly preparatory to a repeat operation.

22. A method of weaving pile fabrics on a loom having a movable beating means, means for weaving warp and filler yarn into a base fabric and means for guiding pile yarns normally spaced above the level of the beating means and substantially in the vertical plane of the fell of the base fabric so the pile yarns normally extend upwardly from the fell of the fabric substantially perpendicular to the fell of the base fabric; said method including the steps of, concurrently with the weaving of base fabric, threading the strands of pile yarn over weftwise extending fingers disposed immediately above the fell of the base fabric by swinging the pile yarn guide means from its normal position downwardly and rearwardly into the shed of the loom below the path of the filler inserting means, but forwardly of the beating means, inserting filler strands over the pile yarn and through the open shedded warp, swinging the pile yarn guide means upwardly and forwardly to its original position to draw the pile yarn upwardly out of the shed and against the filler strands last inserted, beating up the filler and pile loops against the previously formed fabric and against the fingers to form loops over said fingers, then swinging said fingers laterally outwardly relative to the warp to withdraw the fingers from the last formed loops, raising the fingers as they are moved forwardly away from the fell of the fabric whereby the fingers move forwardly above the level of the previously formed loops, then moving the fingers rearwardly and swinging the fingers laterally inwardly in back of the strands of pile yarn and then lowering the fingers against the fell of the base fabric preparatory to a repeat operation.

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