Oct. 19, 1954 P. H. STORTZ 2,691,993

METHOD AND APPARATUS FOR PRODUCING WOVEN FABRICS

Filed Feb. 20, 1951

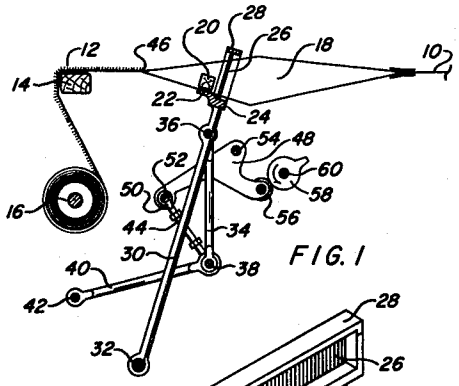


FIG. 1

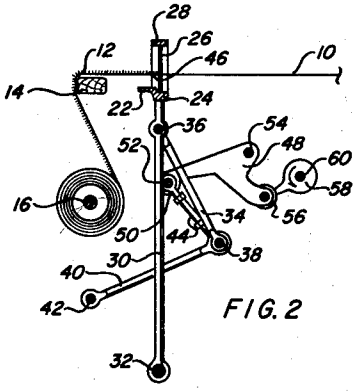


FIG. 2

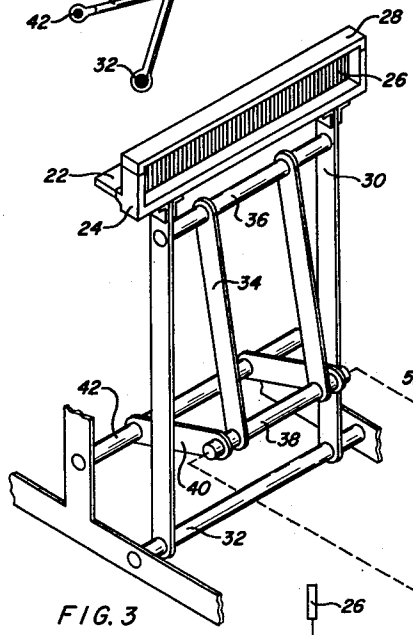


FIG. 3

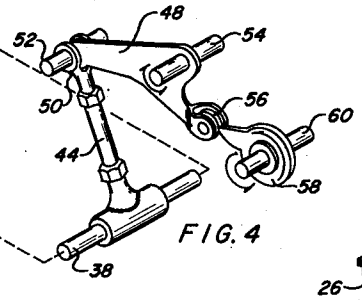


FIG. 4

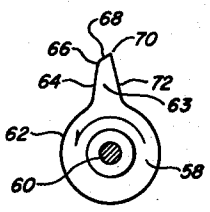


FIG. 6

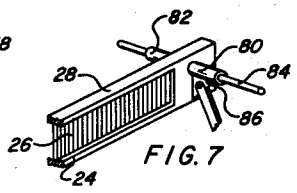


FIG. 7

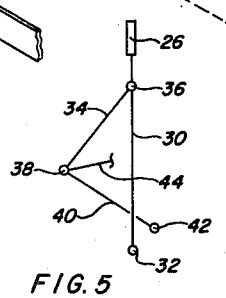


FIG. 5

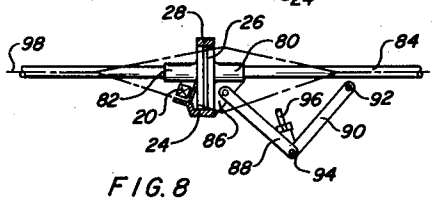


FIG. 8

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Patented Oct. 19, 1954

2,691,993

UNITED STATES PATENT OFFICE

2,691,993

METHOD AND APPARATUS FOR PRODUCING WOVEN FABRICS

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Application February 20, 1951, Serial No. 211,915

5 Claims. (Cl. 139—190)

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This invention relates to an improved method and apparatus for weaving and in particular relates to a specific improvement in the "beating-up" step of power driven loom operation for producing tufted or untufted fabrics. Specifically this invention involves an improved process and apparatus for actuating the oscillating lay employed in power driven looms.

In weaving fabrics there are two principal systems of yarns, those extending the length of the fabric and termed the "warp" and those traversing or crossing the warp at substantially right angles which are termed the "weft," "woof," and sometimes the "filling." The warp consists of a number of parallel yarns termed warp ends or merely ends stretched between the ends of the loom forming a sheet. The filling is interwoven into the sheet, passing under then over successive ends. On one traverse, the filling yarn passes over a given warp end and on the subsequent traverse, in a plain weave, it passes under the same end forming a mesh of woven fabric having a width determined by the number of ends in the sheet and the spacing between them. The length of the fabric is unrestricted in power-driven looms and may be made of considerable length by providing a source of long warp ends substantially the length of the fabric desired.

In producing the woven fabric in a power-driven loom, there are three principal motions which are involved, including shedding the warp, picking, and beating-up. These motions are repeated for each traverse of the filling in the fabric and take place rapidly in succession as fast as 150 to 200 times per minute.

The shedding operation involves separating certain ends from others by pulling them out of the plane of the sheet. In a plain weave, every other end is moved in one direction out of the plane of the warp while the remaining ends are either allowed to remain in place or are deflected in the other direction. Viewing the warp or sheet from the side under these conditions, a diamond- or triangular-shaped opening through the sheet is formed which is called a shed.

The picking operation involves the throwing of the shuttle through the opening or shed thus formed. The shuttle carries a bobbin of filling which unwinds during transit through the shed, leaving a strand of the filling yarn behind. Following transit of the shuttle the shed closes.

The beating-up operation pushes the last strand of filling yarn up against the edge or fell of the finished fabric so that it is parallel to and tight against the previous strand of filling. In

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a plain weave, the three operations are repeated in succession with the shed being formed by deflecting the even numbered ends in alternation with the odd numbered ends and passing the filling back and forth through the shed formed each time.

In conventional power-driven looms, the beating-up operation is performed by means of an oscillating lay which extends transverse to the warp ends and is provided with a reed consisting of a plurality of spaced parallel steel wires or bars which extend through the warp, usually with one wire or bar between each pair of ends. After each picking step the lay moves from its backward throw to its forward throw against the fell of the finished fabric to force the last strand of filling against the fell. This movement of the lay must necessarily be quite fast and considering the mass of the lay and the speed of the movement, a quick, sharp and heavy blow is administered to the fell of the cloth. Considerable strain is placed upon the parts of the loom involved in this motion and upon the filling yarn as well as the warp ends and heavy vibration results which is transmitted from the loom often throughout the building housing them.

The present invention therefore is directed to improved automatic looms in which the heavy impact of the fast moving lay and the strain on associated equipment is eliminated by means of an improved lay actuating mechanism hereinafter described which eliminates the heavy impact of the lay and reed against the finished fabric without sacrificing speed, precision or efficiency of operation.

It is a primary object of this invention to provide an improved weaving process in which the quick sharp impact of the oscillating lay and its attendant strain of equipment is eliminated.

It is another object of this invention to provide a weaving process of improved efficiency which involves a novel beating-up step characterized by a fast lay motion which is substantially slowed prior to impact with the fell and which involves a subsequent application of pressure to the fell.

A further object is to provide in power-driven looms an improved high speed lay actuating method which eliminates the heavy impacts formerly required and employs the steps of a fast movement of the lay from its backward throw to a point just short of its forward throw and adjacent the fell of the cloth, a relatively slow movement under substantial pressure of the lay and reed against the fell, and a relatively fast return from the forward to the backward throw.

It is a further object of the present invention to provide an apparatus adapted to accomplishment of the foregoing objects.

Other objects and advantages of the present invention will become apparent to those skilled in the art as the description and illustration thereof proceeds.

Briefly the present invention comprises an improved sequence of operations for beating-up the filling against the fell of the finished fabric which includes, in succession, a relatively fast movement of the lay and reed from its backward throw to a position just short of its forward throw thereby moving the last strand of filling to the fell, a relatively slow movement under which high pressure is applied to the last strand of filling and the fell of the cloth at the forward throw and a relatively quick return of the lay and reed to its backward throw.

This sequence of steps can be effected in a variety of manners including the use of cams of special shape as hereinafter more clearly described, with hydraulic systems, or other well known motive means employed in the weaving art. However, a preferred combination of elements is here described which permits the above indicated movements of the lay and reed to be accomplished through a combination of a cam of special design, a cam follower provided with an adjustable connecting arm which is attached to the lay swords through at least one pair of pivoted levers. One of these levers, termed a rocker arm, is pivotably attached to a rockshaft running transverse to the loom at one end and pivotably attached at the other end to the adjustable arm referred to above as well as to one end of a force arm, the other of the levers referred to above. This force arm is pivotably connected at its other end to a lay sword a short distance from the lay or to the lay itself. Thus, as the cam turns one revolution the cam follower is moved causing a force to be applied to the common pivot point of the rocker and force arm and a motive force is thus applied to the lay. A restoring force is applied or maintained on the lay to return it from its forward to its backward throw.

The present invention will be more clearly understood by reference to the accompanying drawings in which:

Figure 1 shows an elevation view of the improved loom of the present invention showing the lay and reed at the backward throw position,

Figure 2 shows the same view of the apparatus with the lay in the forward throw position,

Figure 3 is an isometric view of the preferred modification of the lay actuating mechanism of this invention showing the lay, reed, lay swords, and the pairs of pivoted rocker and force arms employed to oscillate the lay,

Figure 4 is an isometric view of the adjustable connecting arm, cam follower lever and actuating cam employed to oscillate the apparatus shown in Figure 3,

Figure 5 shows a schematic elevation view of another modification of the lay actuating mechanism,

Figure 6 shows the preferred form of cam-course employed to secure the sequence of steps required according to this invention,

Figures 7 and 8 are of an improved reciprocating reed and shuttle race actuated by the mechanism of Figure 4.

Referring now to Figures 1 through 4, and particularly to Figures 1 and 2, an elevation view of the improved weaving apparatus according to this

invention is shown. The warp 10 moves from the right to the left of the drawing as it is normally viewed. Finished cloth 12 moves over breast beam 14 and is accumulated upon cloth roll 16. By means of apparatus known as heddles, not shown, to those skilled in the art of weaving, the warp is parted forming shed 18 through which shuttle 20 is thrown, leaving a strand of filling yarn, weft or woof, through the shed. The shuttle is passed along shuttle race 22 attached to lay 24 and immediately adjacent to reed 26. Reed 26 consists of a plurality of parallel bars or wires held between lay 24 and reed cap 28, one each of these bars passing between adjacent pairs of warp ends.

Lay 24 is supported by means of at least two lay swords 30 pivotably mounted on lay sword rockshaft 32 so that the oscillating lay and reed may oscillate between the two positions shown in Figures 1 and 2. At least one force arm 34 is pivotably attached either to lay 24 or one such force arm is pivotably attached to each lay sword 30 by means of pivot 36. Force arm 34 is attached at its other end by means of pivot shaft 38 to rocker arm 40, which in turn is connected to a stationary rockshaft 42, and to adjustable connecting arm 44. By means of connection 44 adjustments may be made in the exact position of the forward throw of the lay and reed. By lengthening it, the forward throw is moved closer to fell 46 of cloth 12 and the beating-up pressure is increased. By shortening it the reverse effects are obtained.

Adjustable connecting arm 44 is provided with a pivotable connection to cam follower lever 48, clevis 50 and pin 52 being suitable. The follower lever 48 is pivoted about stationary rocker shaft 54 and further provided with cam follower 56 riding in contact with the cam-course of cam 58. This cam revolves about cam shaft 60 which is diretly driven from the source of motive power.

Upon rotation of cam 58 cam follower 56 is forced from its position shown in Figure 1 on the dwell or circular part of the cam-course to the position shown in Figure 2, on the extremity of a radial projection of the cam-course thereby rotating lever 48 about rocker shaft 54. A force toward the forward throw is thereby imparted through connection 44 and the hinged or pivoted combination of rocker arm 40 and force arm 34 to the lay. The lay moves from its backward throw into its forward throw against fell 46 of the cloth. Upon the return of cam follower 56 to the dwell or circular part of the cam-course a restoring means, not shown, returns the lay to its backward throw. This motion is, of course, repeated for every rotation of cam shaft 60.

Preferably rocker shaft 42 is positioned adjacent to but not coaxial with rocker shaft 32 and pivot shaft 36 is positioned as close to lay 24 as is convenient. The mechanical advantage is lost if pivot 36 is placed too far from lay 24. The position of rocker arm rockshaft 42 with respect to lay sword rockshaft 32 is preferably on the finished cloth side of the plane defined by the lay swords and the lay, however it may be positioned on the opposite side of this plane if desired and may be nearer to or farther away from the warp than is lay rockshaft 32.

Preferably rocker arm 40 extends from its stationary pivot on rockshaft 42 through the plane defined by the lay and lay swords to pivot shaft 38 since a great motion advantage is obtained with this configuration. For best results the angle between rocker arm 40 and force arm 34 ap-

proximates 90°, although during operation of this angle changes. Preferably the change includes a right angle.

The direction of adjustable connection arm **44** with respect to rocker arm **40** and force arm **34** is such that the force applied by arm **44** during movement of the lay toward its forward throw is directed toward the forward throw and either is within the angle defined by the positions of rocker and force arms **40** and **34** or is directed substantially along the direction defined by the position of force arm **34**. Preferably this force is directed at right angles to rocker arm **40** and toward the forward throw. In the modification shown this force places connecting arm **44** in tension.

In another modification shown schematically in Figure 5, the positions of rocker and force arms **40** and **34** are reversed from those shown in Figures 1 through 3. In this type of lay actuating mechanism, the forward motion of lay swords **30** is obtained by applying a compressive force via connection arm **44** to pivot shaft **38** between rocker arm **40** and force arm **34**. In this case, connection arm **44** is provided with a cam follower, not shown but similar to **56**, which rides directly upon the cam-course of cam **58** shown in Figures 4 and 6. Otherwise the two variations are the same, but that shown in Figures 1 through 3 is preferred since the lay swords and connecting arm are placed in tension rather than compression as in Figure 5.

Referring now to Figure 6, the cam-course of driving cam **58** is shown in detail. By employing this specific shape of cam, the process of beating-up according to this invention and its advantages may be obtained. The rotation of the cam is counterclockwise as the drawing is normally viewed and a cam follower rides upon the outer bearing surface or cam-course which includes dwell or circular portion **62** and a radial projection **63** which has, in the order which the cam follower contacts them, a rapidly rising (radially) surface **64**, a slowly rising (radially) surface **68** and a rapidly falling surface (radially) in succession. The projection is bounded by a first surface of rapidly increasing radius, a second surface of slowly increasing radius and a third surface of rapidly decreasing radius. Upon encountering first surface **64** of the projection on the cam-course, a rapid radial deflection away from the cam axis is imparted to the cam follower. This brings the lay immediately adjacent the fell of the fabric as indicated in Figure 2, i. e., just short of its forward throw. After the cam has rotated so that the cam follower has passed point **66**, it rides along second surface **68** which imparts a slow radial deflection of the follower away from the cam axis. During this slow radial deflection the high pressure at low speed referred to above is applied by the reed to the fell thereby forcing the last strand of filling tightly against the finished fabric. Further rotation of the cam causes the cam follower to pass point **70** and to ride along third surface **72**, imparting a rapid return of the cam follower toward the axis of the cam from the extreme throw to the dwell **62** of the cam. This rapid return causes the rapid movement of the lay and reed from the forward to the backward throw. Thus, by rotation of cam **58** at a constant rotary velocity, rapidly rising and falling surfaces **64** and **72** respectively impart to the lay its oscillating movement at high speed between its extreme positions while slowly rising surface **68** of the cam-course imparts the relatively slow motion to the lay and applies a high pressure to the fell of the cloth during the beating-up step.

Referring to Figures 7 and 8, the improved reed is shown which is provided with guide bearings **80** and **82** through which pass guide rods **84** thus permitting reciprocation of the lay and reed thereon during the beating-up operation. Reed top **28**, reed **26**, shuttle **20** and lay **24** are the same as shown in Figures 1 through 3 described above. Gusset **86** is provided to which force arm **88** is pivoted. Rocker arm **90** is pivoted at stationary pivot point **92** at one end and to force arm **88** at pivot point **94**. Also attached at this point is connecting arm **96** which corresponds to element **44** in Figures 1, 2 and 4. The apparatus shown in Figure 4 is employed to apply the improved beating-up motion to the lay. If desired the force and rocker arms **88** and **90** may be placed on the other side of the warp **98** from shuttle race and lay **24**. There are at least two sets of force and rocker arms, one set at each end of the lay, however additional sets may be employed if necessary. It should be understood that other types of guide bearings may be employed, such as a slotted guide in the loom side frame or the like. Also a set of rocker and force arms may be employed on both sides of the warp at each end of the lay and both actuated together if desired.

The utilization in repeated succession of the rapid movement of the lay, a slow application of pressure to the fell, and a rapid return of the lay in the improved beating-up method of the present invention is a material improvement over the conventional lay movements which involve a quick blow of the lay against the fell. There is considerably less wear of the filling and the warp ends as well as a decreased erosion of the reed bars. Further, the strain upon the parts involved in the beating-up operation is considerably reduced in the procedure and the apparatus of the present invention.

As an example of the use of the lay actuating mechanism of the present invention, the apparatus was applied in the construction of a model loom for the weaving of carpet having a plain weave backing in which a strip of tufted carpet about 1.25'' wide is produced. The lay swords are 2.5'' apart and are about 22'' long. The two force arms are pivoted about 2'' below the reed on the lay swords, they are about 9'' long from pivot shaft (**38**) to the pivot point (**36**) on the lay swords and are spaced 1.5'' apart. The rocker arms are about 11'' long from rockshaft to pivot shaft and are spaced 1.0'' apart. The position of rocker arm rockshaft is about 2'' toward the forward throw on a line parallel to the warp and about 2'' nearer the warp than the lay sword rockshaft. The operation of this lay actuation mechanism is exceedingly smooth, free from sharp impact and vibration and the reed has shown no sign of wear after long continued operation. The fabric produced is tightly woven and in every way satisfactory.

Although the apparatus has been described having a horizontal warp sheet it is to be understood that the warp may be horizontal or vertical or disposed at any other angle and that a particularly desirable modification involves a near vertical warp in a loom having a reed which is in a substantially horizontal plane when in its backward throw.

A particular embodiment of the present invention has been hereinabove described in consider-

able detail by way of illustration. It should be understood that various other modifications and adaptations thereof may be made by those skilled in this particular art without departing from the spirit and scope of this invention as set forth in the appended claims.

I claim:

1. An improved method for beating-up in fabric weaving looms in which a reed is oscillated between a backward throw and a forward throw against the fell of the fabric which comprises moving the reed from its backward throw at a relatively high rate of speed, substantially stopping it by an abrupt reduction in its forward velocity just short of its forward throw and prior to contact with the fell, then pressing the reed against the fell at a relatively low rate of speed and under substantial pressure but in the absence of a sharp impact because of the prior abrupt reduction in forward velocity, and subsequently returning the reed to its backward throw at a relatively high rate of speed.

2. In a weaving process which comprises shedding the warp, picking the filling through the shed, closing the shed, and beating up the filling by moving the reed from the backward throw to the forward throw against the filling and fell and then returning it to its starting position, the improvement which comprises eliminating the heavy impact of the lay and reed against the fell of the finished fabric by first applying a relatively fast motion to the reed between its backward throw to a point just short of its forward throw and adjacent the fell of the fabric, abruptly reducing the forward velocity of said reed at that point thereby avoiding an impact with the fell, subsequently applying a relatively slow movement under substantial pressure to the reed against the fell, and then returning the lay and reed to the backward throw by a relatively fast motion.

3. An improved beating mechanism for weaving machines which comprises in combination with an oscillating lay and reed, a cam shaft, a cam thereon having a circular cam-course with a radial projection, said projection bounded by a first substantially straight line surface of the cam-course of rapidly increasing radius and a third substantially straight line surface of the cam-course of rapidly decreasing radius with a second substantially straight line surface of the cam-course of slowly increasing radius therebetween, a cam follower riding on the cam-course, and a direct mechanical connection between said cam follower and said oscillating lay whereby during rotation of said cam said cam follower imparts through said connection to said lay and reed a relatively rapid forward motion followed by an abrupt reduction in forward velocity as said follower passes from said first cam-course surface to said second surface so as to avoid impact between said reed against the fabric fell.

4. An improved beating mechanism for weaving machines which comprises in combination with an oscillating lay and reed, a cam shaft, a cam thereon having a circular cam-course with a radial projection, a cam follower riding on said cam-course, said projection being such as to first rapidly displace said follower radially from the axis of said cam, followed abruptly by a relatively slow substantially straight line displacement in the same direction followed immediately by a relatively rapid return to the dwell of said cam, upon constant rotation of said cam, and a direct connecting link between said cam follower and said lay.

5. An improved beating mechanism for weaving machines which comprises an oscillating lay and reed, a cam having a predominantly circular cam-course with a radial projection thereon bounded by three substantially straight line surfaces, said projection having in the region of its greatest radius a substantially straight line bearing surface of relatively low increase in radius with angular position on said surface relative to the adjacent substantially straight bearing surfaces of said projection on said cam-course, a cam follower in contact with said cam-course, means for rotating said cam, and a direct linkage between said cam follower and said oscillating lay.

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