March 16, 1965 Y. JUILLARD 3,173,452

WEAVING PROCESS

Filed March 20, 1962 2 Sheets-Sheet 1

FIG. 6

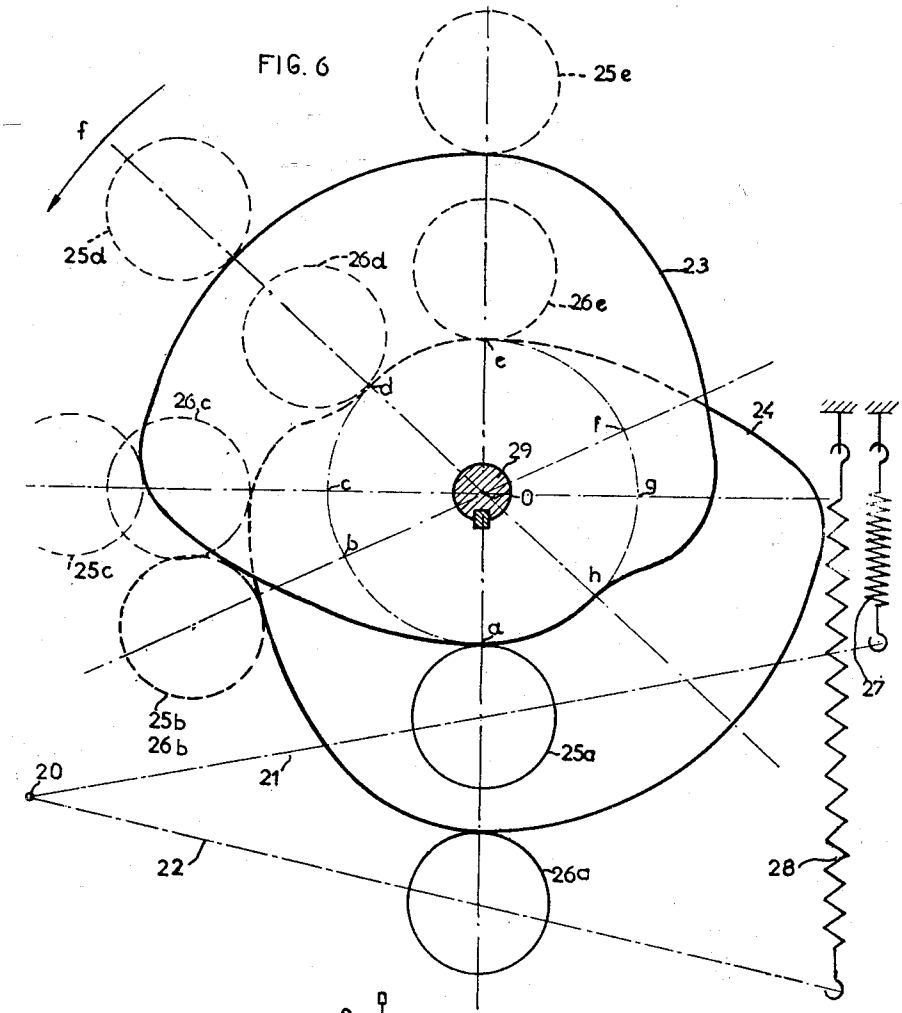
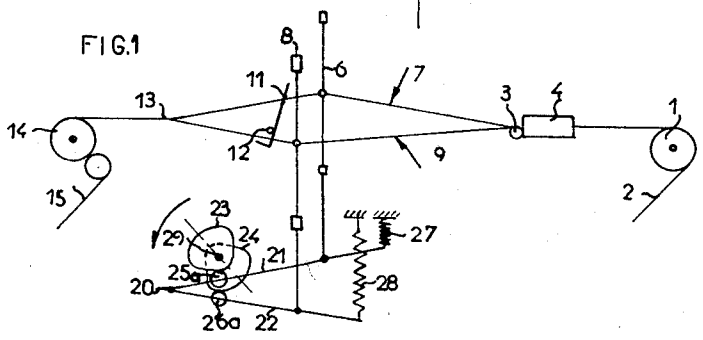


FIG. 1



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WEAVING PROCESS

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FIG. 2

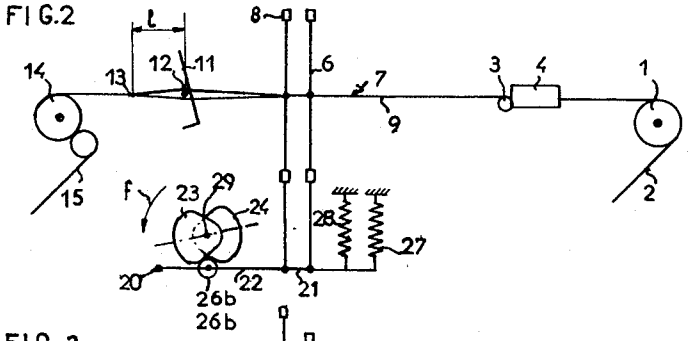


FIG. 3

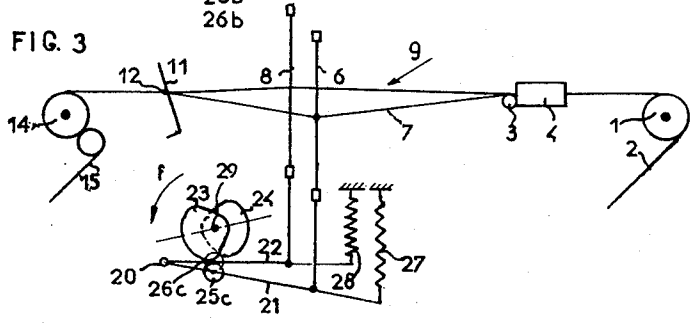


FIG. 4

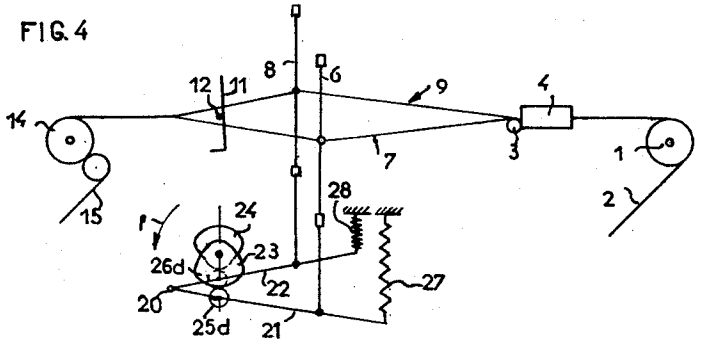
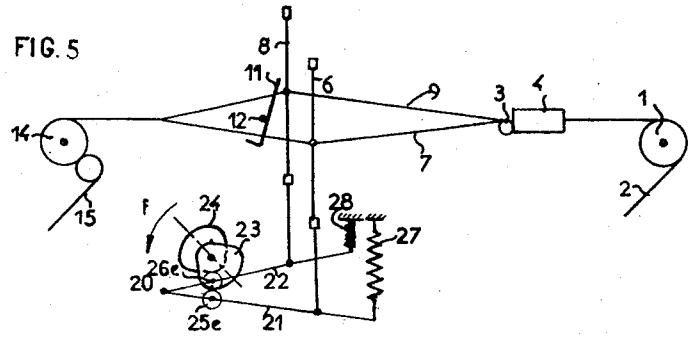


FIG. 5



United States Patent Office 3,173,452 Patented Mar. 16, 1965

3,173,452

WEAVING PROCESS

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Claims priority, application France, Mar. 22, 1961, 856,394
1 Claim. (Cl. 139—55)

This invention relates to weaving, and its main object is to provide an improved weaving process and loom whereby a more efficient and uniform packing of the weft threads will be produced in the woven fabric.

In the usual weaving process, two sheets of warp yarn are formed, the sheets comprising the alternate yarns of the warp, and the two sheets are cyclically reciprocated relative to one another by means of the so-called harness, to opposite sides from a horizontal midplane, so as to form between the sheets a V-shaped recess, called the shed, which reverses at each weaving cycle. That is, first one sheet of warp lies above the midplane and the other below, and at the next cycle the one sheet drops below the midplane while the other sheet is raised above said plane. Means are provided for shooting a length or "pick" of weft yarn across the warp through the shed at each cycle, first in one transverse direction and then in the other. The weft shooting or picking means may comprise the traditional shuttle, or as is more often the case at the present time, a pair of needles which are projected into the shed from both sides, and then out, at each cycle, with the weft thread being transferred from one to the other of these needles first in one direction then in the other, as both needles meet at the center of the shed. Every time a pick of weft has thus been shot through the shed, it is struck by means, such as a reed carried by a batten, which pushes it home into the apex of the V-shaped shed so as to beat-up and pack it tightly against the preceding pick of weft in the woven fabric.

Difficulty is experienced in this last mentioned weft-beating-up operation in order to achieve the desired tight and uniform packing of the successive picks of weft yarn, especially when it is desired to produce a tightly woven fabric having a high count of weft threads per centimeter. It is found that when the warp yarn in both sheets is equally taut it is practically impossible to press the weft yarn tightly into place against the preceding pick, since it tends to spring back and away due to the resiliency of the tightly stretched warp yarn of both sheets meeting at the apex of the shed.

To obviate this difficulty, it has heretofore been usual practice to impart a somewhat dissymmetrical shape to the shed, by lifting the whip roll, over which the warp yarn is passed and from which the warp yarn diverges to produce the two sheets between which the shed is defined, above the horizontal midplane of the shed. In this manner, at the instant in the cycle the reed beats-up the pick of web into the apex of the shed, the shed is dissymmetrical, with one sheet being closer to the midplane than the other, and hence being slacker than it. With the warp yarn in one sheet thus slackened, a more satisfactory packing of the weft yarn is possible.

However, this well-known expedient is far from being wholly satisfactory. In the first place, it is difficult or impossible to adjust the vertical position of the whip roll

to a position where it will give ideal results. If the adjusted position is too greatly spaced from the midplane, the shed opening angle becomes too small at the instant the weft is shot therethrough, and the yarn is apt to catch and tangle, causing frequent yarn breakage. If on the other hand the whip roll is adjusted close enough to the midplane to provide the desired wide shed angle, then of course the first mentioned difficulty turns up again, that is, both sheets of warp are so tight that the weft packing is poor. In addition, the vertical adjustability of the whip roll considerably complicates the construction of the loom, especially since it generally brings with it the further requirement that the stopper mechanism, i.e. the device responsive to warp yarn breakage to stop loom operation, must also be provided vertically adjustable.

The present invention solves the problem thus posed in a complete and rather perfect manner, and achieves the desired tight and uniform packing of the weft threads without any of the difficulties in adjustment mentioned above and without in any way complicating the construction of the loom. The basic idea underlying the invention is to modify the timing of the harness operation during each weaving cycle in such a manner that at the instant in each cycle when the batten is acting to press the newly shot pick of weft home into the apex of the shed, one of the two sheets of warp is lying nearly flat on the midplane while the other sheet is displaced close on to the maximum distance away from the midplane; thus there is a differential in the tension between the warp threads in the two sheets and efficient packing of the weft is readily obtained.

According to a preferred embodiment, this modified timing of harness operation may be simply and effectively obtained by using a pair of suitably contoured cams interposed in the connections from each harness actuating means, such as one of two reversely reciprocating treadle arms, to the related harness means or heddle, the cam contours being so predetermined as to achieve the desired non-uniform movement of the heddles in each weaving cycle.

An exemplary embodiment of the invention will now be described for purposes of illustration but not of limitation with reference to the accompanying diagrammatic drawings wherein:

FIGS. 1 to 5 are diagrammatic views illustrating the main components of a loom constructed and operated in accordance with the invention, in various operating stages; and

FIG. 6 is a larger-scale view showing an illustrative cam usable in controlling the loom harness.

Referring to FIG. 1, a generally conventional loom is shown as comprising a back roll **1** over which warp yarn **2** is passed, a whip roll **3** and an associated warp stop motion **4**, a harness fixing or heddle **6** controlling the upper sheet of warp yarn **7**, a harness fixing or heddle **8** controlling the lower sheet of warp yarn **9**, a reed **11** for beating-up each pick such as **12** of weft yarn against the woven fabric at **13**, and a breast beam **14** over which the woven fabric is passed before it is taken up around a winding drum provided with regulator means of any suitable type, not shown.

The heddle control mechanism is schematically illustrated as comprising a pair of treadle levers **21, 22** pivoted on a fixed shaft **20** and connected to the heddles **6** and **8**. The levers **21** and **22** are actuated by a pair of cams **23**,

24 secured on a shaft 29 by way of follower rollers 25*a*, 26*a* carried by the treadle levers and applied against the cam periphery by springs 27, 28 respectively.

FIG. 6 illustrates on an enlarged scale an illustrative contour for the cams 23, 24 constructed in accordance with the invention. The two cams are identical and are displaced in setting 180° around their common shaft 29, so that the cam contours are symmetrical on opposite sides of the geometric axis O of shaft 29.

In the interests of clarity, in FIG. 6 the two cams are regarded as being stationary and the follower rollers 25 and 26 have been shown in a series of positions along their contours as assumed by said rollers for a number of corresponding angular positions of the shaft. It will be understood of course that the cams are actually rotated in the machine and the direction of cam rotation is indicated by arrow *f* in FIG. 6.

As shown, the follower roller 25*a* successively assumes the series of relative positions indicated at 25*b*, 25*c*, 25*d* and 25*e* relative to the cam 23, said positions being respectively situated on the theroretical radii O*a*, O*b*, O*c*, O*d* and O*e* and respectively corresponding to the five operating positions of the loom shown in FIGS. 1 to 5. For identical positions of the camshaft 29, the other follower roller 26*a* controlling the motion of heddle 8 assumes the positions 26*b*, 26*c*, 26*d* and 26*e* relative to cam 24.

It will be seen that in cam 23 the cam vector radius increases rapidly in length from radius O*a* to radius O*c* then remains constant from O*c* to O*e*, and then decreases in length, rapidly at first then more and more slowly from radius O*e* to radius O*g*; then the radius diminishes very fast from radius O*g* to O*h*, and finally remains constant from O*h* to O*a*.

As indicated earlier, the cam 24 has exactly the same configuration as that of cam 23.

The harness operating system of the invention operates as follows: It is assumed for descriptive purposes that the loom is of the type comprising needles for the insertion of the picks of weft through the shed, and that at the initial point in the cycle the needles are just meeting at the midpoint of the shed which is then wide open. In other words the drawing needle is taking over the pick of weft presented to it by the inserting needle, in accordance with the conventional procedure. The batten with the reed 11 carried by it are positioned at rear neutral position and the remaining components, including the harness operating means, are in the positions shown at FIGS. 1 and 6. The follower roller 25*a* is on the minimum-radius portion of cam 23, while roller 26*a* is on the maximum-radius portion of cam 24, so that the heddle 6 is in an uppermost position and heddle 8 in a lowermost position.

The next significant position encountered during the weaving cycle is that shown in FIG. 2, wherein the reed has struck the pick 12 and pushed it to a distance *l* from the shed apex 13. This distance *l* may, for example, be about one centimeter. During the same time the camshaft 29 has rotated in the direction of arrow *f* by the angle shown between radii O*b* and O*a*. Roller 25*a* is hence now at the position 25*b* with respect to cam 23, and roller 26*a* is in the position 26*b* relative to cam 24. As will be apparent from FIGS. 2 and 6, the two rollers are in coincident positions as seen in side view, indicating that both heddles are positioned at a common elevation and the shed is substantially closed or flat; the needles are just disengaging the shed from each side.

The camshaft proceeds to rotate while the reed settles the pick of weft against the fabric and the roller 25*a* reaches position 25*c* on the maximum radius of cam 23 and roller 26*a* reaches position 26*c* on a smaller radius of cam 24. The upper sheet of warp yarn 7 is now at a position substantially below the bisector plane of the shed, whereas the lower sheet 9 has now risen very slightly above the bisector plane (FIG. 3) though it still is substantially horizontal whereas sheet 7 is markedly bent downwards at the heddle. As a result of this relationship, at the instant the pick is beaten-up against the fabric, the warp yarn in sheet 9 is tensioned considerably less than is the yarn in sheet 7, a condition ensuring excellent beating-up of the pick. At this time, the downward stress exerted by the warp yarn towards the rear of the loom is taken up by the whip roll 3, thereby relieving the warp stop motion 4.

The next significant position in the cycle is that shown in FIG. 4, where the needles are entering the wide-open shed; the shed is wide open since roller 25*a* is at position 25*d* in the maximum-radius position of cam 23, as in the preceding position, while roller 26*a* is now passing over the minimum-radius section of cam 24, commencing at radius O*d*, and is now therefore positioned at 26*d*. The sheet 7 therefore retains its lowermost position while sheet 9 is rising to its uppermost position. Both sheets of warp yarn are now equally tensioned.

The last stage of the settling cycle (FIG. 5) is that wherein both rollers are passing from positions 25*d* and 26*d* to positions 25*e* and 26*e*. The rollers and heddles therefore have not moved nor have the sheets of warp yarn. All of the loom components in FIG. 5 are in the same positions as in FIG. 1 except that the two sheets of warp yarn 7 and 9 have reversed.

During the next cycle, the sheet 7 will perform the motions described above with reference to the sheet 9 and vice versa, since the follower rollers 25*a* and 26*a* will be engaging with the diametrically opposed portions of cams 23 and 24 from the portions engaged by them in the cycle described above, and since said cams are identical and displaced 180° from one another.

Thus it will be seen that in each successive weaving cycle of the loom, the beating-up of the newly-shot weft pick against the end of the woven fabric occurs at a point in the cycle at which one of the two sheets of warp yarn is substantially flat and relatively slack while the other sheet is bent a maximum amount and is hence under maximum tension. Since moreover the slack sheet and the tensioned sheet are interchanged as from each weaving cycle to the next at the instant of beating-up of the pick, it will be apparent that a high degree of uniformity will be achieved in the compacity of the weft yarn throughout the fabric with optimum results in the finished article.

It will further be noted that the whip roll and the warp stop motion are stationarily mounted in the system of the invention, an advantageous simplification over certain conventional arrangements including means for adjustably raising the whip roll is achieved as earlier described.

Thus it will be evident that the invention has provided new and improved means for beating-up the picks of weft during the weaving of fabric thereby considerably improving the quality of the woven fabric, and that such improvement is accomplished in an extremely simple and practical manner, in that it does not require any modification of existent weaving frames beyond simply changing the contour of the harness actuating cams. It should be understood that the exemplary embodiment shown and described is illustrative only and that various changes may be made therein within the scope of the invention. Thus, the invention is applicable to various types of weaving frames other than the particular type schematically shown herein. The precise contour of the cams may differ from that shown, and in fact the desired non-uniform motion of the harness or heddles, as required to achieve the benefits of the invention, may be obtained by operating the heddles through kinematic means other than the treadle and cam system here shown as a typical example.

What is claimed is:

In a method of operating a shed defined by two groups of warp threads passing through a loom by moving the two groups of warp threads in opposite directions between an upper open shed position above the position whereat

the two groups are crossing and a lower open shed position below said position of crossing, said method including the steps of opening the shed by moving one of the two groups of warp threads from said position of crossing towards said upper open shed position faster than the other group of warp threads is moved from said position of crossing towards said lower open shed position, accelerating the movement of said other group of warp threads as said one group of warp threads reaches said upper open shed position, maintaining said one group of warp threads in said upper open shed position at least until said other group of warp threads reaches said lower open shed position, and closing the shed by moving both groups of warp threads from the respective open shed positions thereof substantially simultaneously and at the same speed towards said position of crossing.

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