United States Patent

[11] 3,590,880

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Winterthur, Switzerland
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[33] **Switzerland**
[31] **895/68**

[54] **APPARATUS AND METHOD FOR OPERATING A LOOM**
15 Claims, 15 Drawing Figs.

[52] **U.S. Cl.** **139/192,** 139/48, 139/93

[51] **Int. Cl.** **D03d 49/62,** D03c 9/02

[50] **Field of Search** 139/1, 11, 188, 189, 190, 191, 192, 48, 93, 96

[56] **References Cited**

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Primary Examiner—Henry S. Jaudon
Attorney—Kenyon, Kenyon, Reilly, Carr & Chapin

ABSTRACT: The ribbonlike warps in the bottom of the shed are inclined to the horizontal so as to permit clearance for the shuttle guide elements during return of the reed from the beat-up position. These warps are caused to twist out of the horizontal by the droppers in the reed, comb or healds.

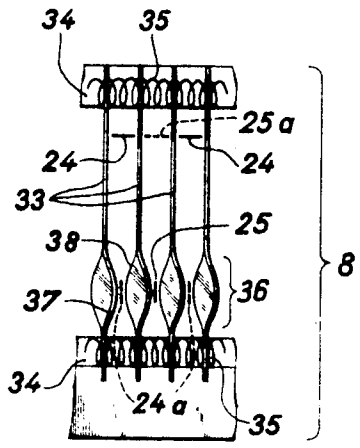

Fig. 1

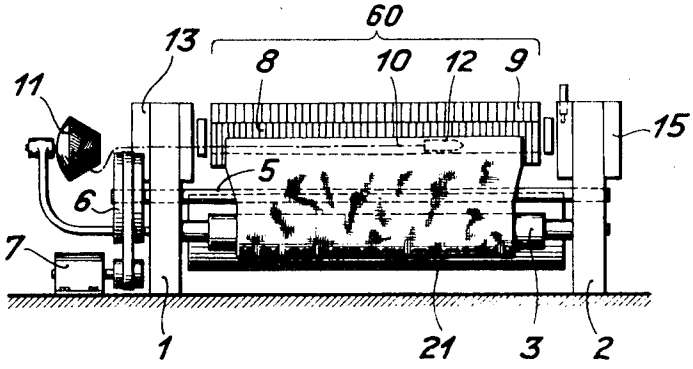

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Fig. 2

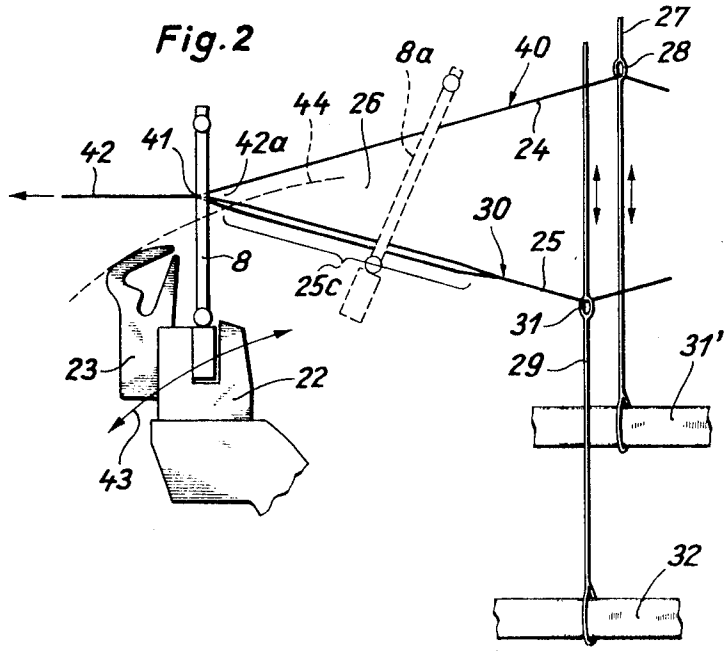

Fig. 12

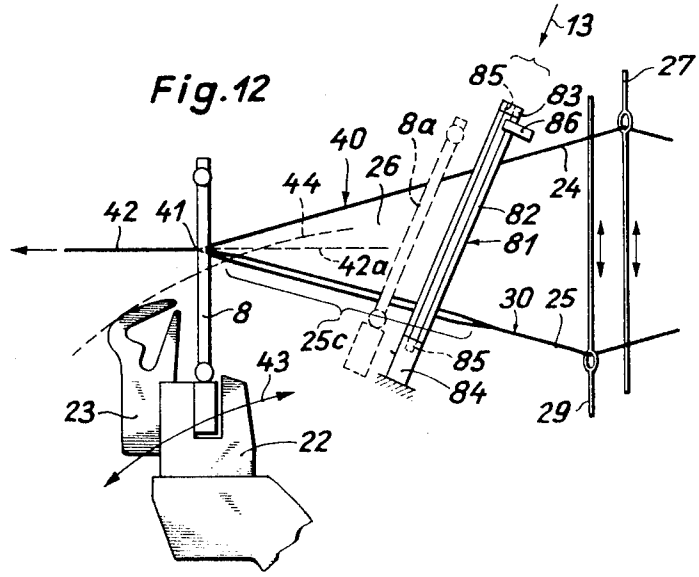

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Fig. 3

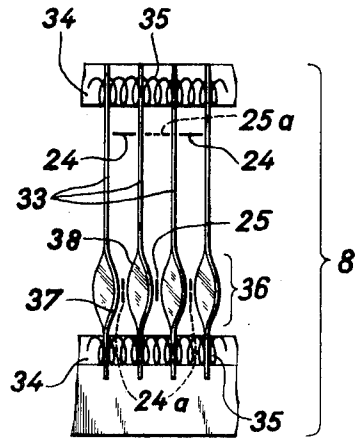

Fig. 4

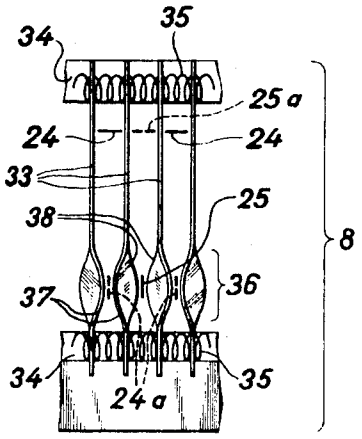

Fig. 5

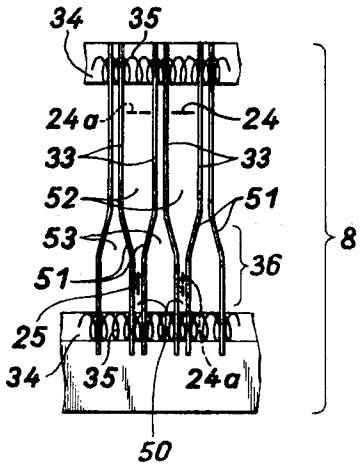

Fig. 6

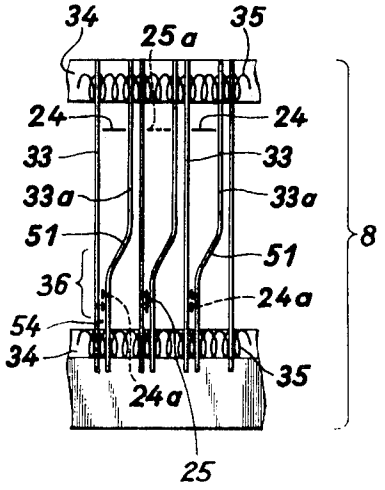

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Fig. 7

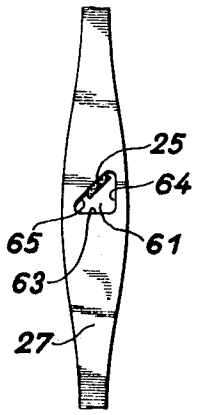


Fig. 7a

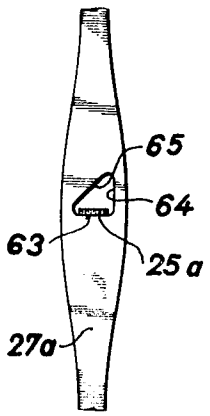


Fig. 13

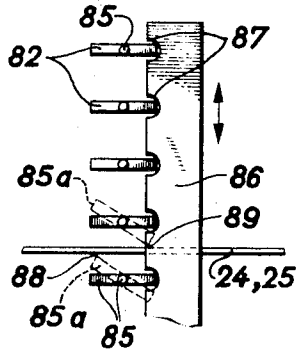


Fig. 8

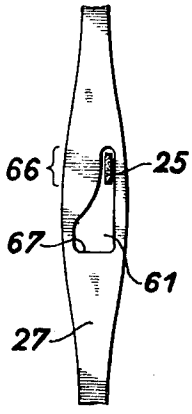


Fig. 8a

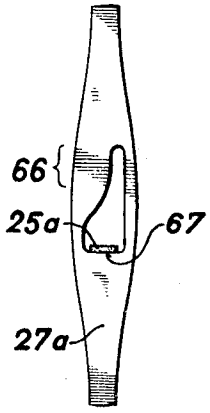


Fig. 9

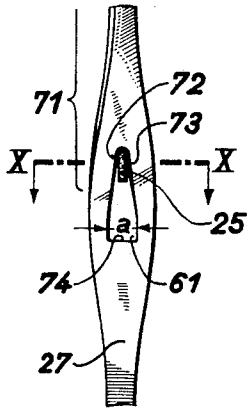


Fig. 10

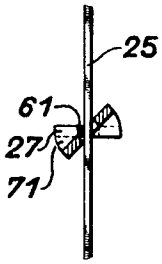
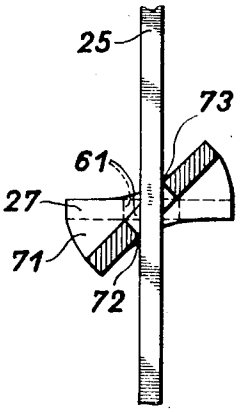


Fig. 11



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APPARATUS AND METHOD FOR OPERATING A LOOM

This invention relates to an apparatus and method for operating a loom. Still more particularly, this invention relates to an apparatus and method of aligning ribbonlike warps during the operation of a loom.

Heretofore, looms have been known for forming cloth of strips or ribbons or the like as the warp material. These looms have utilized reed containing-droppers and a picker guide having discrete guide elements which move between the warp strips, for instance, during the reed return movement. In some instances, the spacing between any two adjacent reed droppers has been at least as large as the width of a single warp strip of the kind used. Consequently, at least in the zone between the leaves for the healds forming the warps into a shed and the reed-beating-up station, the warp strips have had their major surfaces substantially parallel to the weaving plane or to the bottom-shed or top-shed plane. This has been satisfactory for reed beat-up as the strips picked in the picking direction are also tucked into the warp strips with their major surfaces substantially parallel to the cloth plane determined e.g. by the cloth and the shed center plane. However, since the warp strips which are in the bottom shed position are usually disposed horizontally, the picker guide elements may upon moving into the shed, occasionally knock into the surfaces presented by the various warp strips, with the result that some of the warp strips may be torn off or torn or holed.

Accordingly, it is an object of the invention to prevent interference between the warp strips and picker guide elements after beat-up.

It is another object of the invention to increase the spacing between the warp strips in the bottom shed position.

It is another object of the invention to twist the warp strips in the bottom-shed position out of the horizontal plane.

Briefly, the invention provides an apparatus and method for increasing the spacing between the warp strips in the bottom-shed position of a loom during rearward movement of the reed of the loom after beat up.

The apparatus is incorporated into the loom as deflecting or twisting elements for longitudinally twisting every warp strip in the bottom-shed position. These deflecting elements are disposed over the cloth width in that region of the warp strips which extends from the leaves for the healds to shortly before the reed-beating-up station so that the major surfaces of the warp strip are brought from a position parallel to the bottom-shed plane into a position in which the major surfaces form a preferably inclined or substantially or completely vertical angle to the bottom-shed plane. With the warp strips in this position, the guide elements for the shuttle cannot then damage or destroy the warp strips. As a result, the material in strip form can be used for warp and weft and can be converted, e.g., into packaging bags, woven underlays for carpets, etc. as were previously made, e.g. of jute. Also, the shuttle guide elements cannot accidentally move the warp strips in the bottom-shed position into or towards the top-shed position. Thus, the pattern program is not disturbed.

In one embodiment, the deflecting elements are reed droppers which are twisted in the zone corresponding to the bottom-shed position of the warp strips. The reed droppers, which are provided anyway, can then be used to impart a required and, as a rule, substantially vertical or inclined position to the warp strips at the right time and in the correct portion of warp strip length.

In another embodiment, the deflecting elements are healds for the warp strip which are suspended in the leaves. In this embodiment, the heald eyes for the warp strips are narrower in the region in which a warp strip is disposed when in the bottom shed position than in the other regions. Thus, the healds are advantageously used not only for their normal purpose of warp strip control but also to bring the warp strips into a substantially vertical or inclined position at the required time and in the required portion of warp strip length.

The method of the invention includes the step of initially forming a shed of a plurality of horizontal warp strips in an upper plane and a plurality of alternating warp strips in a lower plane. Next, the warp strips in the lower plane are twisted about each of their axes to lie at least at an angle to the horizontal from a point near the lowermost point of the shed to a point spaced from the fell of the cloth being formed. The twisted portions of these warp strips are held in these positions during passage of the reed from the beat-up point to a rest point so as to permit the shuttle guide elements to pass between the warp strips without interference. Upon moving in the opposite direction, the reed passes by the point where the warp strips transgress into a horizontal plane. This allows the warp strips to be available for beating up into a cloth having a thickness equal to about the thickness of a warp strip.

These and other objects and advantages of the invention will become more apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** illustrates a diagrammatic general view from the cloth side of a loom according to the invention;

FIG. **2** illustrates a vertical section through the part of the loom of FIG. **1** containing the shed;

FIG. **3** illustrates a view of a plurality of reed droppers according to the invention;

FIG. **4** illustrates a view of a modified structure of the invention similar to FIG. **3**;

FIG. **5** illustrates another modified structure of the invention as applied to reed droppers;

FIG. **6** illustrates another modified reed dropper structure;

FIG. **7** illustrates a modified heald according to the invention with a warp strip located in an uppermost position;

FIG. **7***a* illustrates the heald of FIG. **7** with the warp strip in the lowermost position;

FIGS. **8** and **8***a* are similar to FIGS. **7** and **7***a* and illustrate another modified heald of the invention;

FIG. **9** illustrates a view of another modified heald according to the invention;

FIG. **10** illustrates a view taken on line X–X of FIG. **9**;

FIG. **11** illustrates an enlarged FIG. **10**;

FIG. **12** illustrates a view similar to FIG. **2** wherein a stationary comb is mounted in the shed area; and

FIG. **13** illustrates a plan view of the comb of FIG. **12** in the direction of the arrows.

Referring to FIG. **1**, the loom, as is known, includes a pair of upright supports **1**, **2**, a tie bar **5** between the supports, a cloth beam **3** and a warp beam **21** each rotatably mounted in the uprights, a reed **8**, leaves **9**, a picking mechanism **13** for picking a shuttle **12** across the loom with a weft strip **10**, a catcher **15** for receiving the shuttle **12** and a drive including a transmission **6** and a motor **7**. The loom is operable to form a width of cloth **60** from warp strips and weft strips. The shuttle **12**, for example, a gripper shuttle, picks the weft material, e.g. a polypropylene strip, into the shed in known manner, while the warp material also, polypropylene strips, are delivered in known manner.

Referring to FIG. **2**, the reed **8** is mounted on a sley **22** which also carries a large number of shuttle guide teeth **23** (only one of which is shown). In the position shown, the warp strips **24**, **25** are separated exactly into a top-shed position and a bottom-shed position so that a shed **26** is formed. All the strips **25** together form a bottom shed plane **30** and all the strips **24** together form a top shed plane **40**. Between the planes **30** and **40** is a center plane **42***a* which is usually disposed in continuation of the plane formed by the formed cloth **42**. The cloth plane and the center plane **42***a* form the weaving plane. During the operation, the strips **24** are guided in eyes **26** on healds **27**, and the strips **25** are guided in eyes **31** on healds **29**. The healds **27**, **29** are threaded in known manner on to heald bars **31**, **32** secured to the leaves **9**. It is noted that only two warp strips **24**, **25** two healds **27**, **29** and some of the two bottom bars **31**, **32** are shown for clarity and simplicity.

Referring to FIG. 3, the reed 8 comprises a number of droppers 33 which are secured at top and bottom in a baulk 34 of cast nonferrous metal in which a spring 35 is cast. The spring 35 serves to maintain the droppers 33 at a required constant spacing from one another. The droppers 33 are twisted in a lower region 36 out of the usual plane of the remainder of the droppers 35 so that the edge 37 nearer the viewer of a first dropper and the edge 38 remote from the viewer of an adjacent dropper are displaced to near the center plane extending between the two droppers. Consequently, the warp strips 25 in the bottom shed position which lie between the twisted droppers in the lower region 36 are positioned vertically during operation. FIG. 3 shows a bottom warp strip 25 in such a vertical position, whereas the adjacent two warp strips 24 in the top-shed position are shown in a horizontal position. The spacings between the droppers 33 are such that the warp strips in the top part of the spaces between the droppers 33 can readily take up a horizontal position.

After shed changing, the warp strips 24 in FIG. 3 move into the bottom-shed position 24*a* shown in chain lines, and the strip 25 moves into the top-shed position 25*a*.Now, because of the twisted dropper parts 36 the strips 24 are positioned vertically while the strip 25 is positioned horizontally. There is then another shed change, and so on.

Referring to FIG. 2, the reed 8 and the guide teeth 23 are exactly in the beating-up position. In this position, the most recently picked weft strip is beated up at the fell 41 on the finished cloth 42. Thereafter the reed 8 and teeth 25 move, in the direction indicated by arrow 43 and along an arc 44 (shown in chain lines), into a rear position 8*a* shown only for the reed 8. During this return movement the twisted bottom region 36 of the reed droppers 33 acts to vertically position whichever of the warp strips are in the bottom shed position (cf. the portion 25*c* shown in FIG. 2). The teeth 23, however, cannot, as their top portions move along the arcuate path 44, damage the bottom-shed warp strips 25. Indeed, because the strips 25 are positioned vertically, the teeth 23 cannot effectively strike them, but are bound to find a way between the strips 25.

During operation, when the parts are in the position 8*a*, a gripper shuttle 12 picks the next weft strip 10 into the shed 26. Thereafter the reed 8 and teeth 23 return to the beating-up position (on the left in FIG. 2) and so on. As the reed 8 and teeth 23 advance into the beating-up position, the bottom-shed warp strips 25 eventually move, because of the advance of the reed 8 and because of the ascent during shed changing, into a region above the twisted portions 36. Consequently, the warp strips 25 must, shortly after beating-up, change over to the horizontal position which is required for association with the weft strips which are also positioned horizontally. The cloth is therefore dense and flat while being substantially as thick as a single warp or weft strip.

When the warp strips 25 in the bottom shed position are brought into a vertical or substantially vertical position at least during the time when, and in the region 25*c* where, the teeth 23 penetrate upwards into the shed 26,—their major surfaces—visible at the place 25*c* in FIG. 2—form a right angle or substantially a right angle with the bottom-shed plane 30. However, during the beating-up movement of the reed 8, the warp strips 25 take up the horizontal position required for beating-up in a continuously easier manner and reach the horizontal position shortly before beating-up.

Referring to FIG. 4, the bottom parts 36 of any two adjacent droppers 33 are twisted relative to one another so that the viewer-side edges 37 of two first adjacent droppers are displaced towards the central plane between the two droppers, whereas the viewer-remote edges 38 are displaced towards the center plane of the next aperture between the droppers. That is, adjacent droppers are twisted in reversed manner alternately so that adjacent edges of adjacent droppers substantially face each other. Thus, two edges 37 and 38 always act to position the bottom-shed warp strips 25 vertically.

Referring to FIG. 5, the adjacent droppers 33 of the reed 8 can alternatively be bent relative to one another to have inclined intermediate portions 51 so as to bound narrow passages 50 at one end and wider passages 52, 53 at the opposite end. This enables the bottom-shed warp strips 25 to be positioned vertically while the top-shed warp strips 24 can take up a horizontal position. Unlike the examples shown in FIGS. 3 and 4, the warp entry into the reed in FIG. 5 is such that the warp strips are drawn into alternate wide upper passages 52 without any warp strips being drawn into the passages 53 in-between.

Alternatively, referring to FIG. 6, only alternating flat droppers 33*a* are bent to have inclined intermediate portions 51 with the in-between droppers 33 remaining straight. The bent portions 51 are such that between any two droppers 33 and 33*a* a bottom region 36 is produced in which the droppers bound a passage 54 corresponding to the thickness of the warp strips. The bottom-shed warp strips 25 are positioned vertically in the passage 54, whereas in the region above, the top-shed warp strips 24 can take up a horizontal position.

Referring to FIGS. 7 and 7*a*, the warp strip healds 27, 29 can be formed with triangular eyes 61 for passage of the warp strips 25. Each eye 61 has a bottom horizontal edge 63, a vertical edge 64 and an inclined edge 65 of about 45°. When the healds 27 are in the bottom-shed position (FIG. 7), the warp strip 25 in the eye 61 engages with the inclined edge 65 thereof. The warp strip 25 therefore forms an angle of about 45° with the bottom-shed plane 30, so that the teeth 23 cannot knock, damage, or tear off the horizontal warp strips upon moving between the strips 25 on return movement. Even if a tooth 23 does strike an inclined strip 25, the strip moves aside because of its inclined position and is not damaged.

When the heald 27 is in the top-shed position shown in FIG. 7*a*, the warp strip 25 takes up the horizontal position 25*a*, engaging with the bottom horizontal edge 63.

Referring to FIGS. 8 and 8*a*, the healds, e.g. heald 27, can be formed with eyes 61 which so converge in the top portion 66 as to position a warp strip 25 completely or substantially vertically in the bottom shed position (FIG. 8). In the top shed position 27*a* of the heald (FIG. 8*a*) the bottom horizontal edge 67 of the eye 61 makes the warp strip take up the horizontal position 25*a*.

Referring to FIGS. 9—11, the healds 27 can alternatively have an eye 61 which is of the same width *a* over the whole of its bottom part while but the top part 71 of the heald 27, and therefore the top part of the eye 61, are twisted as shown in FIGS. 10 and 11. Consequently, the edges 72, 73 (visible more particularly in FIG. 11) of the center plane passing through the eye 61 converge, so that a bottom-shed warp strip 25 in the eye 61 is positioned vertically. When the heald 27 and therefore the warp strip 25 move into the top-shed position, the warp strip engages with the bottom horizontal edge 74 of the eye 61 i.e., when in the top-shed position the warp strip is positioned horizontally in the required manner.

Referring to FIGS. 12 and 13, a stationary comb 81 is disposed in the region between the rear position 8*a* of the reed and the leaves 9 or healds 27, 29. The comb 81 has droppers 82 identical to those in a reed which are pivotally mounted by means of pins 85 in horizontal bars 83, 84 of the comb 81. A slider or pusher 86 (FIG. 13) engages with the droppers 82 at places 87 and is reciprocally moved to shift the droppers from the position shown in solid line in FIG. 13—and extending parallel to the plane of the drawing in FIG. 12—into the chain-like inclined position 85*a* shown in FIG. 13. In this position, the edges 88, 89 of the center plane between any two droppers 82 converge, so that the warp strips 24, 25 extending between the droppers 82 are contacted and positioned vertically. Reciprocation of the member 86 is so controlled during the loom cycle that the dropper 85 is in the inclined position 85*a* during entry of the teeth 23 into the shed 26, whereas when the reed 8 is in the beating-up position, the droppers 85 are either in the solid-line parallel position in FIG. 13 or in a position in which the droppers 82 are substantially parallel to one

another. In this embodiment the reed **8** can have unbent (ordinary) droppers.

In all the embodiments of the operating method and of the loom whichever warp strips are in the bottom shed position [and possibly whichever are in the top-shed position (FIGS. **12** and **13**)], at least during that period of the cycle in which the teeth **23** move towards and through the bottom-shed warp strips **25**, and at least in that part of their length where the teeth **23** pass through,—are brought temporarily by the appropriate deflecting elements—such as the deformed droppers **33**——(FIGS. **3** to **6**) or the heald eyes **61** (FIGS. **7** to **11**) or the controlled droppers **82** of a stationary comb (FIGS. **12** and **13**)—into a vertical position or an inclined position or in any case into a position other than horizontal, so that the teeth **23** do not damage the warp strips upon entering the shed.

Embodiments are possible wherein the reed has bent droppers, for instance, as shown in any of FIGS. **3** to **6**, and the healds **27** have specially controlled eyes **61**, for instance, as shown in FIGS. **7** to **11**.

In an alternative loom construction, the shuttle guide formed by the teeth **23** is not secured to the sley **22**, in which event the shuttle guide teeth are controlled separately and do not move into the shed **26** at exactly the same time as the reed **8** returns to its rear position **8***a*. Indeed, the movement of the shuttle guide into the shed **26** can occur later in the loom cycle than the return movement of the reed **8**. The shuttle guide is then to some extent dragged. The invention can be carried into effect in this case too. That is, the bottom shed warp strips **25** must, at entry of the teeth **23** into the shed **26**, be in a position other than parallel to the bottom shed plane **30** and must be inclined or disposed vertically to the plane.

The invention is, of course, also of use in cases where filaments instead of strips are used as weft material and are possibly picked into the shed **26** by other picking mechanisms, such as needles or bands or the like.

In this specification the terms "warp material in strip form" and "warp strips" are used to refer to any material suitable for use on the warp in weaving and having one dimension perpendicular to its length greater than the other and the term "dropper" is used instead of the term "dent" to refer to the physical elements of a reed or like structure which separate adjacent warp strips and not to the spaces between such elements which is sometimes the sense in which the term "dent" is used.

If the spacing between any two adjacent droppers or dents on the reed is at least as large as the width of a single warp strip of the kind being used, the warp strips at least in the zone between the healds and the fell of the cloth, have their major surfaces substantially parallel to the weaving plane or to the bottom-shed or top-shed plane. This is satisfactory for reed beat-up, for the weft strips introduced in the picking direction are also interwoven into the warp strips with their major surfaces substantially parallel to the cloth plane determined by the cloth and the shed center plane.

What I claim is:

1. In combination with a loom and a plurality of warp strips, said loom including means for forming a shed of said warp strips, said warp strips forming a top-shed plane and a bottom-shed plane, a reed for beating up a weft into a beating-up position at the end of said shed, and a shuttle guide having a plurality of discrete guide elements movable into and out of said shed through said bottom-shed plane for picking of a weft into said shed; a plurality of twisting elements disposed in said shed each having a portion thereof spaced from a corresponding portion of an adjacent element a distance less than the width of one said warp strip for twisting a longitudinal portion of each of said warp strips in said bottom-shed plane into an angle with respect to said bottom-shed plane, said inclined longitudinal portions of said warp strips being located out of the path movement of said discrete guide elements whereby said discrete guide elements are movable between said inclined warp strip portions.

2. In combination with a loom including means for forming a shed of warp strips, said warp strips forming a top-shed plane and a bottom-shed plane, a reed for beating up a weft into a beating-up position at the end of said shed, and a shuttle guide having a plurality of discrete guide elements movable into and out of said shed through said bottom-shed plane for picking of a weft into said shed; a plurality of reed droppers mounted in said reed, each said reed dropper having a twisted portion in a lower region thereof inclined relative to the remainder of each said reed dropper to form a narrow passage with an adjacent reed dropper for twisting a longitudinal portion of a warp strip therebetween in said bottom-shed plane into an angle relative to said bottom-shed plane, said twisted portions being located in the path of movement of said discrete guide elements whereby said discrete guide elements are movable between said angled warp strip portions.

3. The combination as set forth in claim **2** wherein each said reed dropper twisted portion is inclined in the same direction.

4. The combination as set forth in claim **2** wherein alternating reed dropper twisted portions are inclined in opposite directions.

5. The combination as set forth in claim **1** wherein said twisting elements are reed droppers mounted in said reed, each said reed dropper having a bent intermediate portion inclined toward an adjacent reed dropper whereby a passage of narrow width is formed below said intermediate portions to guide a warp strip into said inclined angle and a passage of wider width is formed above said intermediate portions to guide said warp strips in said top-shed plane.

6. The combination as set forth in claim **5** wherein said reed droppers are bent in alternating manner whereby a narrow passage and a wider passage are alternately formed between said reed droppers.

7. In combination with a loom including means for forming a shed of warp strips, said warp strips forming a top-shed plane and a bottom-shed plane, a reed for beating up a weft into a beating-up position at the end of said shed, and a shuttle guide having a plurality of discrete guide elements movable into and out of said shed through said bottom-shed plane for picking of a weft into said shed; a plurality of reed droppers mounted in said reed, each alternating reed dropper having a bent intermediate portion inclined toward an adjacent straight reed dropper to form a narrow passage below said intermediate portion to guide a longitudinal portion of a warp strip in said bottom-shed plane into an angle relative to said bottom shed plane and a passage of wider width above said intermediate portion to guide said warp strips in said top-shed plane, said bent intermediate portion being located in the path of movement of said discrete guide elements whereby said discrete guide elements are movable between said angled warp strip portions.

8. The combination as set forth in claim **7** wherein said narrow passage is equal to the thickness of a warp strip and said wider passage is equal to the width of said warp strip.

9. In combination with a loom including means for forming a shed of warp strips, said warp strips forming a top-shed plane and a bottom-shed plane, a reed for beating up a weft into a beating-up position at the end of said shed, and a shuttle guide having a plurality of discrete guide elements movable into and out of said shed through said bottom-shed plane for picking of a weft into said shed; a plurality of healds suspended in said means for forming a shed from leaves of the loom, each said heald having an eye for passage of a warp strip, each said eye having a narrow upper portion and a wider lower portion for inclining a longitudinal portion of each said warp strip in said bottom-shed plane into an angle with respect to said bottom shed plane, said angled portions of said warp strips being located out of the path of movement of said discrete guide elements whereby said discrete guide elements are movable between said inclined warp strip portions.

10. The combination as set forth in claim **9** wherein said eye has a lower horizontal surface for receiving a warp strip of said top-shed plane in horizontal disposition thereon and an inclined surface above said horizontal surface for receiving a warp strip of said bottom-shed plane to guide said warp strip into an inclined plane.

11. The combination as set forth in claim 9 wherein said narrow upper portion of each eye is equal to the thickness of a warp strip.

12. In combination with a loom including means for forming a shed of warp strips, said warp strips forming a top-shed plane and a bottom-shed plane, a reed for beating up a weft into a beating-up position at the end of said shed, and a shuttle guide having a plurality of discrete guide elements movable into and out of said shed through said bottom-shed plane for picking of a weft into said shed; a plurality of healds suspended in said means for forming a shed from leaves of the loom, each said heald having an eye of uniform dimension for passage of a warp strip and being twisted in the region of said eye to incline the upper portion of said eye at an angle relative to the lower portion of said eye whereby said upper portion guides a longitudinal portion of a warp strip in said bottom-shed plane into an angle relative to said bottom-shed plane, said angled portions of said warp strips being located out of the path of movement of said discrete guide elements whereby said discrete guide elements are movable between said angled warp strip portions.

13. In combination with a loom including means for forming a shed of warp strips, said warp strips forming a top-shed plane and a bottom-shed plane, a reed for beating up a weft into a beating-up position at the end of said shed, and a shuttle guide having a plurality of discrete guide elements movable into and out of said shed through said bottom-shed plane for picking of a weft into said shed; a plurality of droppers pivotally mounted in a stationary comb within said shed, said droppers being disposed in alternation with said warp strips, and a reciprocally mounted slider engaging said droppers for pivoting said droppers relative to said warp strips to guide longitudinal portions of said warp strips therebetween in said bottom-shed plane into an angle relative to said bottom-shed plane, said angled portions of said warp strips being located out of the path of movement of said discrete guide elements whereby said discrete guide elements are movable between said angled warp strip portions.

14. A method of operating a loom for weaving warp strips into cloth comprising the steps of

forming a shed of the warp strips with a top-shed plane and a bottom-shed plane,

moving a guide containing discrete guide elements for a weft-picking shuttle into and out of said shed through said bottom-shed plane, and

twisting the warp strips in said bottom-shed plane into an angle with respect to said bottom-shed plane in the path of said discrete guide elements whereby passage of said guide elements into said shed is afforded substantially without interference with the warp strips in said bottom-shed plane.

15. A method as set forth in claim 14 wherein the warp strips are twisted 90°.