

- [54] METHOD OF FORMING A PLURALITY OF
SHEDS AND THEREBY A PLURALITY OF
PIECES OF FABRICS IN A SHUTTLELESS
LOOM**

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ABSTRACT

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139/291 R

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- [58] **Field of Search** 139/20-23,
139/82, 93, 114, 127 P, 291 R

- [56]
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[57]

In a shuttleless loom, a plurality of sheds are laid one over another in a direction of a shedding motion such that the adjacent yarn systems of the shed cross each other between a reed and a fell of cloth and each pick of weft is carried through the shed with fluid jet and a common reed. Fabrics having even qualities from fabric to fabric can be woven with a minimum required floor space according to the present invention and productivity and economy of a loom have been widely improved.

8 Claims, 12 Drawing Figures

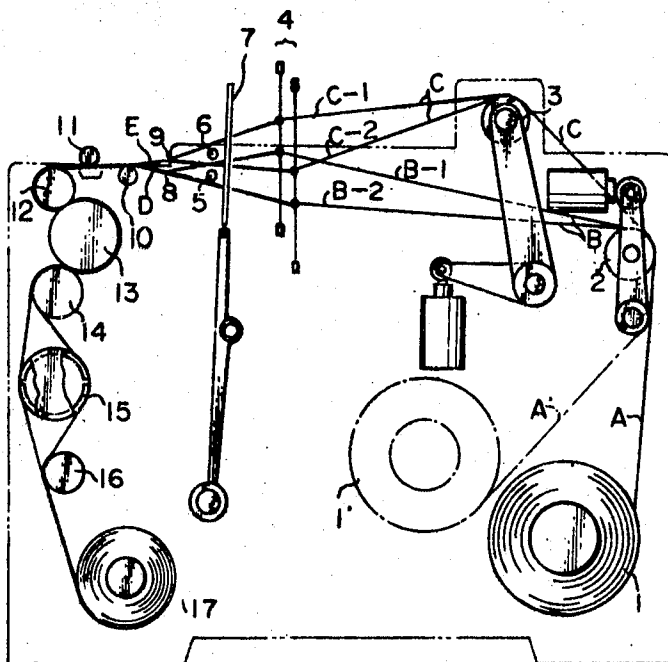


Fig. 4

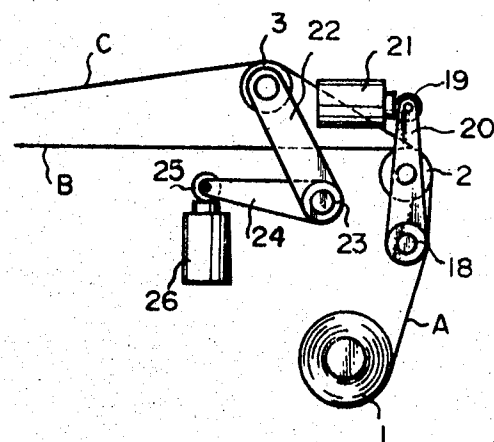


Fig. 5

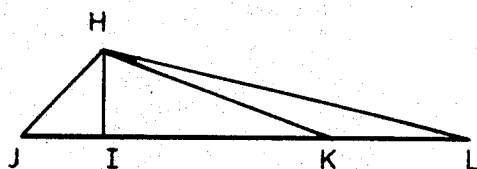


Fig. 6

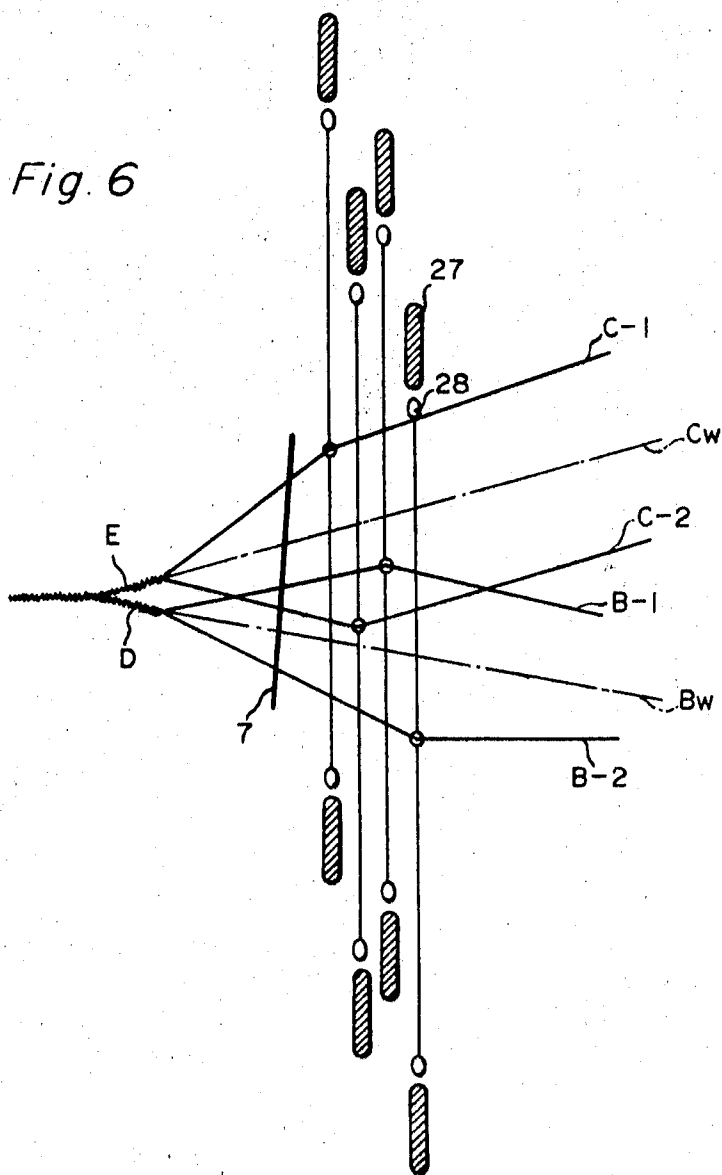


Fig. 7

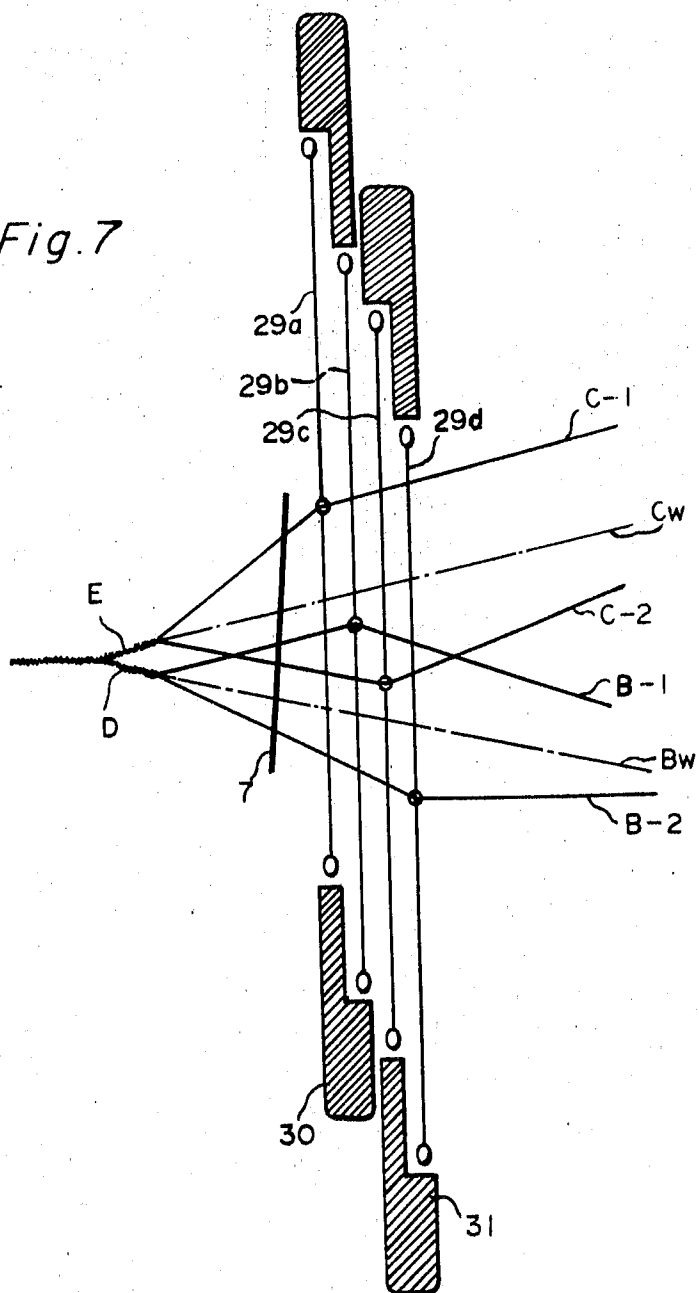


Fig. 8

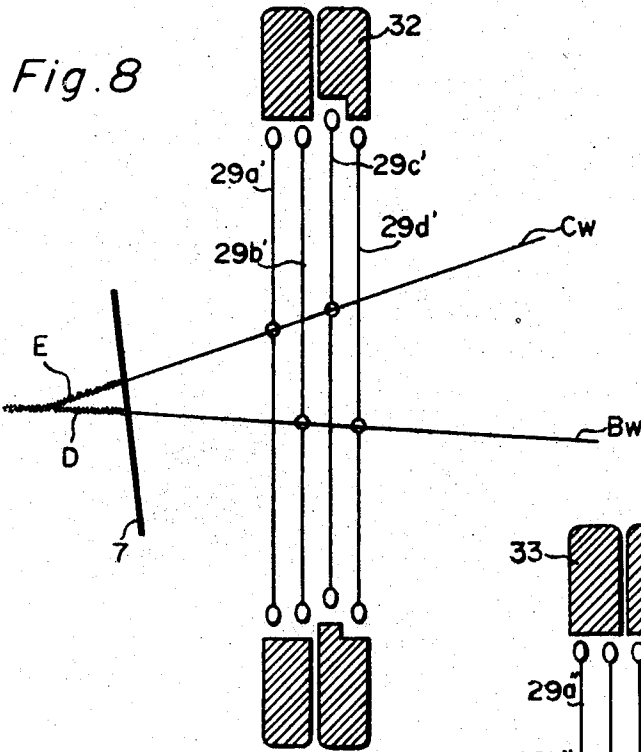
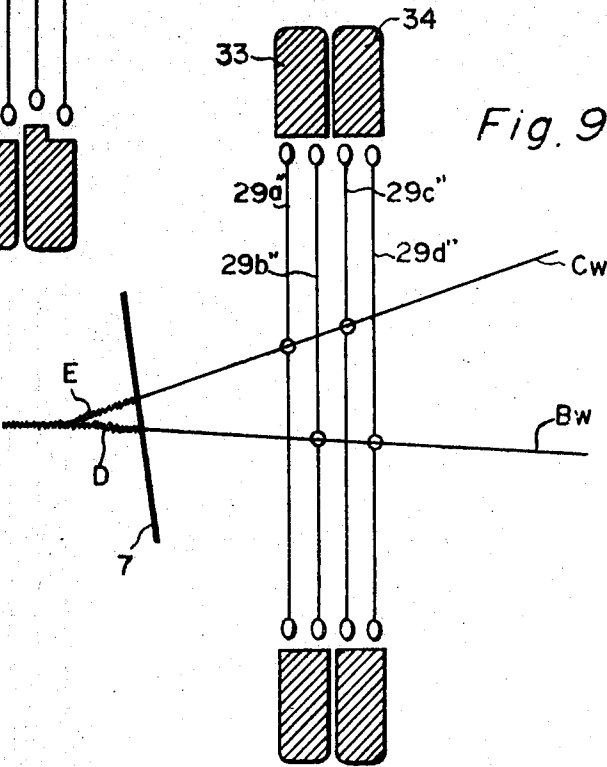


Fig. 9



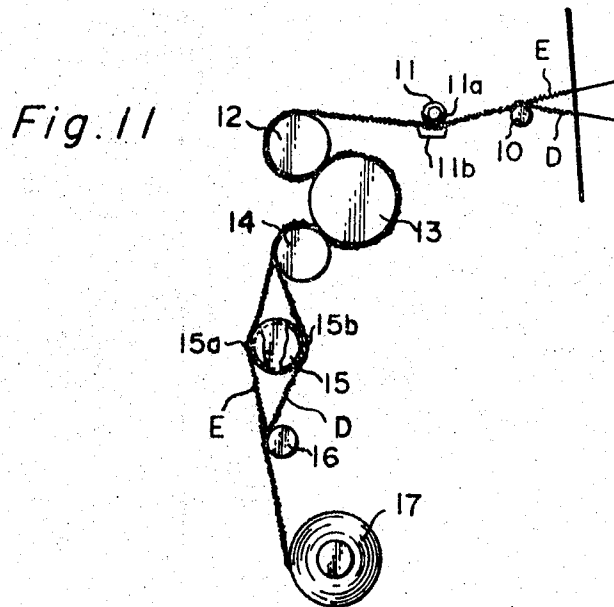
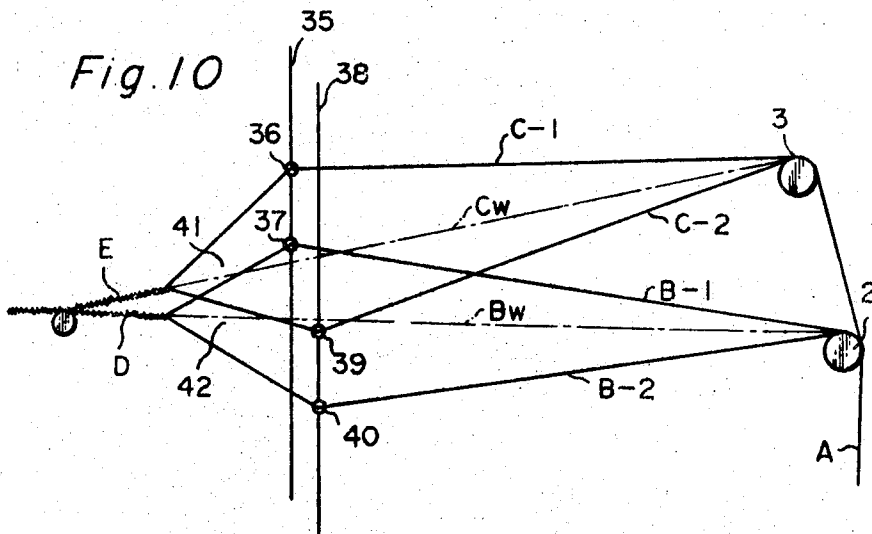
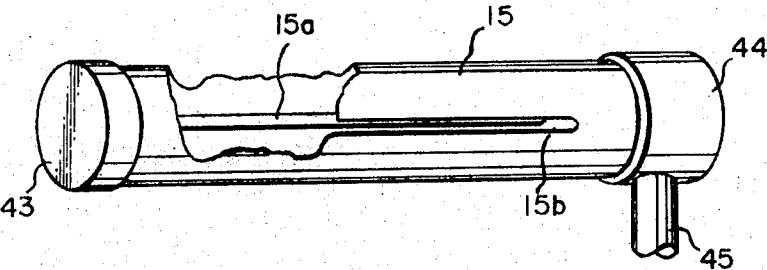


Fig. 12



METHOD OF FORMING A PLURALITY OF SHEDS AND THEREBY A PLURALITY OF PIECES OF FABRICS IN A SHUTTLELESS LOOM

The present invention relates to weaving with a shuttleless loom and particularly to weaving a plurality of fabrics with one reed by forming a plurality of sheds one over another in a direction of a shedding motion in a shuttleless loom which projects weft into the shed with liquid jet.

A loom requires a given floor space (the sum of the floor space occupied by the loom itself and the area occupied by aisles between looms required for operations, maintenance and repair for the loom), and the necessary floor space for producing a given amount of fabric affects very widely productivity and economy of the fabrics. Even if the number of looms is increased, the necessary floor space per loom is often increased instead of decreased since the size auxiliary equipment becomes larger.

Various attempts have hitherto been made for reducing the necessary floor space required for a given amount of fabric, but the desired result has not yet been effected on account of some other conditional factors.

For instance, increase in the number of revolutions of the loom is restricted by mechanism used or properties of the yarn. If a plurality of pieces of fabric by the woven laterally with a wider loom, floor space becomes spacious but the running distance of weft becomes longer and the number of revolutions are compelled to be reduced. Further, since in the case of a shuttleless loom, the form of running weft varies as its distance from a nozzle varies, there is a drawback that uneven qualities occur from piece of fabric to piece of fabric. Attempts have been made to lay sheds one over another in a direction of a shedding motion instead of horizontal arrangement of sheds and beat up the weft with a common reed. In this case, beating force of a reed to the cloth fell corresponds to the distance between a rocking shaft, which is a fulcrum of the beating motion and the point of beating. Therefore, if the distance between the adjacent cloth fells is great, uneven qualities from fabric to fabric are likely to occur. However, as it was essential that the shed be kept appropriately wide open, it was difficult to reduce the uneven qualities from fabric to fabric under a certain limit. It was very difficult to repair warp yarn breakage of the lower shed or find defects of the lower gray cloth.

SUMMARY OF INVENTION

In the present invention, a plurality of sheds are vertically laid one over another in a direction of a shedding motion in a shuttleless loom. Each shed is arranged such that it is kept open wide enough for picking; the distance between cloth fells is as small as possible; and the adjacent yarn systems cross each other between the reed and the cloth fell at a time when shedding is greatest in order that uneven qualities of fabrics from fabric to fabric may be prevented.

According to the present invention, a primary group of warp yarn drawn out of one or more than one warp beam is divided into subgroups of warp yarn by the aid of a plurality of back rests. Each warp yarn subgroup forms its own shed and the adjacent yarn systems are arranged such that they cross each other between a reed and a cloth fell. Each pick of weft is carried

through each shed by fluid jet and beaten up into the cloth with one common reed to produce pieces of fabric having no uneven qualities and minimize the necessary floor space of a loom per piece of fabric.

As the sheds are laid very close to each other one over the other, one can easily repair broken warp yarn forming the lower shed by just inserting one's fingers into the lower shed-forming yarn. If the upper and lower sheds are spaced apart from each other, insertions of one's fingers will not be sufficient for repairing broken yarn of the lower shed and an awkward and difficult operation is required.

Further, with the use of liquid jet in the shuttleless loom and owing to the small distance between the sheds, the wet gray cloths stick tightly to each other within 0 to 30 mm of the cloth fells and the defects of the lower piece of fabric can easily be found owing to the wetness of the fabrics.

Further according to the present invention, in order that troubles of warp yarn due to needles may be eliminated, a plurality of sheds are formed in one loom with the use of a heddle assembly where a plurality of rows of heddles are disposed side by side in one and the same harness frame and the eyelets of each heddle are arranged so as to agree with the warp line or with that of a heddle assembly where a plurality of eyelets are provided in one heddle.

Then, a plurality of woven gray cloths are freed of liquid before they are taken up, respectively and gray cloths are always taken up in the dry state.

Accordingly, it is the object of the present invention to provide a method of weaving a plurality of pieces of fabrics having no uneven qualities from fabric to fabric with a plurality of sheds in a shuttleless loom with minimum floor space of the loom.

It is another object of the present invention to provide a method of forming a plurality of sheds and weaving with a shuttleless loom, where defects of fabric are easy to find.

It is still another object of the present invention to provide a method of forming a plurality of sheds and weaving in a shuttleless loom with the use of a heddle assembly causing no troubles to warp yarn.

It is further the object of the present invention to provide a method of forming a plurality of sheds and weaving fabrics in which the woven fabrics are taken up always in the dry state in a shuttleless loom.

Further objects and advantages of the present invention will become readily apparent from the following detailed description of the invention when taken in conjunction with the accompanying drawings in which.

FIG. 1 is a schematic elevation of a shuttleless loom producing fabrics according to the present invention.

FIGS. 2 and 3 are elevations showing the shedding state of the present invention.

FIG. 4 is an elevation of a warp yarn tension control device.

FIG. 5 is a diagram disclosing variations of length of warp yarn due to shedding.

FIG. 6 is an elevation showing a heddle assembly in which each heddle having one eye is attached to one harness frame.

FIGS. 7 to 9 are elevations of a heddle assembly in which two heddles are attached to each harness frame.

FIG. 10 is an elevation of a heddle assembly in which two eyes are provided in each heddle.

FIG. 11 is an elevation showing a section for the removal of a liquid and the winding-up of fabrics.

FIG. 12 is a perspective view, partly cut away, of a liquid-removing tube.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1, warp yarn group A drawn out from a warp beam 1 or from warp beams 1 and 1' is divided into warp yarn subgroups B and C by the aid of two back rests 2 and 3, which are caused to form a shed, respectively with a heddle assembly 4 and divided into warp yarn systems B-1, B-2, C-1, and C-2. Through each shed, a pick of weft is inserted with nozzles 5 and 6 and beaten up with a common reed 7 to produce gray cloths D and E at cloth fells 8 and 9. The gray cloths D and E are caused to tightly adhere to each other on a supporting member 10 and taken up onto a cloth roller 17 via a first liquid-removing tube 11, a press roller 12, a friction roller 13, a press roller 14, a liquid-removing tube 15 and a guide roller 16.

Referring to FIGS. 2 and 3, shedding motions of warp yarn will be described below. The warp yarn group A is divided into two warp yarn subgroups B and C with the aid of the two back rests 2 and 3. The warp line of the warp yarn subgroup B connecting the back rest 2 with the supporting member 10 approaches gradually to the warp line of the warp yarn subgroup C connecting the back rest 3 with the supporting member 10 towards the direction of the respective cloth fells 8 and 9 from the respective back rests 2 and 3, until at least the two warp lines converge with each other at the supporting member 10. The subgroups B and C are respectively caused to form an opening with a heddle assembly.

In this case, the lower yarn system C-2 of the upper shed and the raised yarn system B-1 of the lower shed cross each other at an intersection point P. The intersection point P is arranged so as to stay between cloth fells 8 and 9 and a reed 7. When these adjacent yarn systems are caused to cross each other at the front of the reed, the distance between the cloth fells can be minimized and an opening space sufficient enough for picking can be maintained. It is very advantageous for picking to have an appropriate opening near the intersection point P. It is clearly seen that consistent and level weaving is possible with the formation of sheds as shown in the figures.

Further, it is desirable that the intersection point P falls on the line connecting the centers of the nozzles 5 and 6 or is located slightly nearer the reed than the line. It is clear that positioning the intersection point at the front of the reed is possible only in a shuttleless loom but impossible in a shuttle loom which requires provision of a race, etc. at the front of a reed.

It is desirable that the distance between cloth fells be as small as possible, say, 0 to 15 mm. Within the range, to a broken warp end of the raised yarn system B-1 of the lower shed is tied a repair end and the tied repair end is pulled to the cloth fell 8 through the heddle and the reed without interfering with picking from the nozzle 6.

It is also desirable to allow the gray cloths formed at the cloth fells 8 and 9 to stick tightly to each other within 0 to 30 mm from the cloth fells by the aid of the

small distance between the two cloth fells. With the use of liquid jet for projecting weft, wet fabrics sticking to each other aid considerably in finding broken warp yarn of the lower fabric.

Referring to FIGS. 4 and 5, warp yarn tension control will be described below. When as described above, the warp yarn group A is divided into two warp yarn subgroups B and C by the aid of the two back rests to form two sheds in a direction of a shedding motion, warp yarn tension should be controlled somehow or other because without control of tension, tension to warp yarn forming each shed differs from each other, resulting in fabric quality being different from fabric to fabric and loose warp yarn causes poor picking. It is desirable that the back rests 2 and 3 be not laid one over the other vertically but be staggered away from or towards the cloth fell in view of each access of yarn and the height of a loom. However, with this arrangement yarn tension becomes uneven all the more. Referring to FIG. 5, K and L denote positions of the back rest, J a cloth fell and H an apex at the time of maximum shedding. Hence $\overline{JK}$ and $\overline{JL}$ show warp lines. The two warp lines do not really overlap, but are laid one over the other for simplicity of explanation. I is the foot of a common perpendicular from H and shows that the size of the sheds is equal to each other. Assume that $\overline{HK} = l_1$, $\overline{IK} = l_2$, $\overline{HL} = l_3$, and $\overline{KL} = l_4$; then $l_1 + l_4 > l_3$; therefore, $l_1 > l_3 - l_4$, $l_1 - l_2 > (l_3 - l_4) - l_2$ and $l_1 - l_2 > l_3 - (l_2 + l_4)$; consequently $\overline{HK} - \overline{IK} > \overline{HL} - \overline{IL}$.

Hence, the difference in the length of warp yarn $\overline{JH} + \overline{HK}$ at opening of a shed and the length of $\overline{JK}$ at closing is greater when the distance is smaller between the cloth fell and the back rest. It is understood from this fact that when a plurality of back rests are in use, one single tension control device is not sufficient enough for warp yarn tension control.

According to the present invention, the tension of a primary warp yarn group drawn out of a warp beam is adjusted with a main back rest, and the tension of a warp yarn subgroup further divided therefrom is additionally adjusted with a second back rest. In this case an individual back rest may be provided for each warp yarn subgroup for adjusting each yarn tension or one of the warp yarn subgroups may be adjusted with a main back rest and the other subgroup may be adjusted with a second back rest. The embodiment in FIG. 4 shows the latter case. In FIG. 4, the warp yarn group A unwound from a warp beam 1 is divided into the warp yarn subgroups B and C after it passes through a guide roller 18 and the primary back rest 2. The subgroup C is pulled toward the backrest via the second back rest 3. The primary back rest 2 is rotatably mounted on a lever 20, the lever being connected to a tension control device 21 through a roller 19 with the pivot at the guide roller 18. The second back rest 3 is rotatably mounted on a lever secured to a shaft 23. One end of a lever 24 is secured to the shaft 23 and the other end is connected to a tension control device 26 through a roller 25. Accordingly, the back rest 2 is adjusted with the tension control device 21 and the back rest 3 by the tension control device 26; thus the tension of the warp yarn subgroup B is adjusted by the tension control device 21 and that of the warp yarn subgroup C by the tension control device 21 and further sensitively by the tension control device 26. Clearly, adjustment by the tension control device 21, that is, adjustment by means of the back rest 2 lies within the range suitable for the

warp yarn group B. It is possible to provide an individual back rest for each of the warp yarn subgroups B and C after adjustment of tension has been made to a certain extent with a primary back rest.

In the present invention, a plurality of sheds are to be formed and if one harness frame with one heddle having one eye makes a shedding motion, two times as many heddles and harness frames as the number of sheds are required. For instance, when two sheds are formed, four heddles and four harness frames are required. Now consideration should be given to relations between the number of harness frames and the size of a shed. As the number of harness frames increases and the distance between the cloth fell and the harness frame on the side of the back rests becomes greater, the desired shed cannot be obtained unless the size of a shed is made greater. However, if the size becomes greater, warp yarn comes into contact with harness frames and soiled, broken, bruised or chafed warp yarn will occur. And if the number of heddles, that is, the density of heddles increases, abrasion between warp yarn and the heddles causes chafed and broken warp yarn and poor warp yarn arrangements.

In forming a plurality of sheds in a direction of a shedding motion, therefore, it is desirable to mount a plurality of rows of heddles on one and the same harness frame and cause an eye of each heddle to agree with the warp line or to make a plurality of eyes in one heddle.

FIG. 6 shows conventional methods in which one heddle having one eye is mounted on one harness frame. As seen in FIG. 6, in obtaining the desired sheds, the raised yarn C-1 of the upper shed comes into contact with a rod 28 of a harness frame 27 moving the lower yarn B-2 of the lower shed.

FIGS. 7 to 9 show two heddles per harness frame. In FIG. 7, warp yarn, B-1, B-2, C-1 and C-2 are drawn through eyes of heddles 29b, 29d, 29a and 29c are laid together in the direction of the cloth fell. The heddles 29a and 29b are mounted on a stepped harness frame 30 such that the eyes thereof agree with the warp lines Cw and Bw. In like manner, the heddles 29c and 29d are mounted on a stepped harness frame 31 such that the eyes agree with the warp lines, Cw and Bw. Accordingly, two rows of heddles will become a pair, are mounted on a harness frame and move simultaneously. In this way, the number of the harness frames can clearly be reduced to make great the size of a shed without contact of yarn with a harness frame.

In FIG. 8, eyes are not located in the center of heddles. Heddles 29a' and 29c' are arranged upside down relative to heddles 29b' and 29d'. The position of each eye agrees with the warp lines Bw and Cw, respectively. The heddles 29c' and 29d' are attached to a stepped harness frame 32.

FIG. 9 shows that the eyes of heddles 29a'' to 29d'' are positioned in warp lines and the rods of the harness frame correspond to each other. Owing to the corresponding positions of rods of heddle frames 33 and 34, drawing-in and reeding-in of warp yarn are very simple and processing of harness frames is also simple.

FIG. 10 shows that each heddle has two eyes. A heddle 35 has two eyes 36 and 37, and a heddle 38 two eyes 39 and 40. Warp yarn, B-1, B-2, C-1 and C-2 are drawn through eyes 37, 40, 36 and 39 and sheds 41 and 42 are formed by shedding motions of heddles 35 and 38. With one heddle with two eyes attached, the num-

ber of harness frames can be reduced and the desired size of a shed can be obtained. Further the number of heddles per shed can be reduced to half as compared with a time when a heddle has one eye to inhibit excessive abrasion of warp yarn with heddles. In this case, it is desirable that the positions of eyes of the heddles be caused to be on the warp lines and there be no need to stagger up and down the harness frames.

Referring to FIGS. 11 and 12, the removal of a liquid will be described below.

When a liquid is in use in picking nozzles 5 and 6, it is desirable to remove completely the liquid from fabrics such that they are wound onto a cloth roller 17 in the dry state. For this purpose, as embodied in FIGS. 11 and 12 a tube 11 and a tube 15 are provided for removing the liquid. Fabrics D and E formed simultaneously are caused to adhere to each other on a cloth fell support 10 and guided through the take-up rolls which comprise a press roller 12, a friction roller 13 and then a press roller 14, and the tube 11 for removing the liquid is arranged between the cloth fell support 10 and the press roller 12. In a conventional shuttleless loom in which a piece of fabric is formed at a time, a tube for removing a liquid is disposed under the fabric supported by the cloth fell and a press roller and a liquid suction slit is turned upward to suck the liquid sticking to the fabric.

However, in case two pieces of fabrics are formed at a time in the present invention, a tube for removing a liquid cannot be disposed as taught in the prior art in the light of the distance between the cloth fell and the press roller, a diameter of the tube and the warp lines. Thus the tube 11 is disposed on the upper side of the fabrics D and E. The tube 11 has a downward slit 11a for sucking the liquid sticking to the fabrics. The numeral 11b denotes a trough-like receptacle disposed below the tube 11. Since the tube 11 for removing a liquid is located on the upper side of the fabrics D and E, the liquid is removed while the loom is working, but at the downtime, the liquid sucked into the tube drips through the slit 11a to dampen the fabrics. Against it, another tube 15 for removing a liquid is arranged between the press roller 14 and a guide roller 16. The fabric D fed through the press roller 14 comes into contact with the face of one side of the tube 15 and the fabric E comes into contact with the face of the opposite side of the same tube 15. Afterwards the fabrics D and E are wound up on a cloth roller 17 through the guide roller.

The liquid-removing tube 15 is provided with slits 15a and 15b for sucking a liquid, the slits being extended toward the axis at each phase of contact with the fabrics D and E. Both ends of the liquid removing tube 15 are tightly closed with caps 43 and 44. To the cap 44 is connected a suction tube 45, which is connected to an appropriate vacuum source (not shown).

Hence, when a loom is restarted from a standstill, the fabrics D and E slightly moistened with the liquid which has dripped from the slit 11a of the liquid-removing tube 11, are rendered free of liquid through slits 15a and 15b of the tube 15. Hence, the fabrics D and E are wound up on the cloth roller 17 in the continuously dry state.

Referring to the accompanying drawings, one embodiment has been described in detail as above, but it will be understood that the details may be modified in

various respects without departure from the broad aspect of the invention.

We claim:

1. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually and continuously approaching each other warp yarn sub-group and converging ahead of a cloth fell but behind the take-up rolls; forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of maximum shedding; inserting a pick of weft into each shed by fluid jet; and beating up the pick into the cloth with a common reed.

2. The method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom as set forth in claim 1 wherein an intersection point of the adjacent warp yarn systems of sheds is positioned between a line connecting the centers of picking nozzles and a location slightly away from the line toward the reed.

3. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually approaching each other warp yarn sub-group and converging ahead of a cloth fell; placing the primary warp yarn group unwound from at least one warp beam on one primary back rest and dividing said unwound primary warp yarn group into said warp yarn sub-groups with secondary back rests less than the sheds by one in number, adjusting the tension of the primary warp yarn group and of the warp yarn sub-groups with the primary back rest and further adjusting the tension of the warp yarn sub-group with the secondary back rests; forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of maximum shedding; inserting a pick of weft into each shed by fluid jet; and beating up the pick into the cloth with a common reed.

4. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually approaching each other warp yarn sub-group and converging ahead of a cloth fell; placing the primary warp yarn group unwound from said at least one warp beam on one primary back rest and dividing said unwound primary warp yarn group into said warp yarn sub-groups with secondary back rests the same as the sheds in number, and adjusting the tension of the primary warp yarn group with the primary back rest, and adjusting the tension of the warp yarn sub-groups with both the primary and secondary back rests; forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of maximum shedding; inserting a pick of weft into each shed by fluid jet;

and beating up the pick into the cloth with a common reed.

5. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually approaching each other warp yarn sub-group and converging ahead of a cloth fell, the distance between cloth fells being in the range of 0 to 15 mm forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of maximum shedding; inserting a pick of weft into each shed by fluid jet; and beating up the pick into the cloth with a common reed.

6. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually approaching each other warp yarn sub-group and converging ahead of a cloth fell; forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of maximum shedding; inserting a pick of weft into each shed by fluid jet; and beating up the pick into the cloth with a common reed wherein said weft-inserting jet is a liquid and formed gray cloths are stuck together within 0 to 30 mm of the cloth fell by means of a cloth fell support and a liquid-removing tube.

7. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually approaching each other warp yarn sub-group and converging ahead of a cloth fell; forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of maximum shedding; inserting a pick of weft into each shed by fluid jet; and beating up the pick into the cloth with a common reed wherein formed gray cloths are stuck together with a cloth fell support; sucking a liquid sticking to the stuck gray cloths with a liquid-removing suction tube; leading the gray cloths to a press roller, a friction roller and a second press roller; and before the gray cloths are taken up, causing each gray cloth to come in contact with each slit of a fluid-removing tube having a plurality of slits to thereby remove the liquid sticking to each gray cloth.

8. A method of forming a plurality of sheds and thereby weaving a plurality of fabrics in a shuttleless loom comprising dividing a primary warp yarn group unwound from at least one warp beam into warp yarn sub-groups arranged in a direction of shedding motion, the warp line of each warp yarn sub-group gradually and continuously approaching each other warp yarn sub-group and converging ahead of a cloth fell but behind the take-up roll means wherein a plurality of eye-lets of each heddle for forming a plurality of sheds is positioned such that each warp line passes through the

corresponding eyelets of heddles when said sheds are closed and overlap with each corresponding warp line; forming a shed for each warp yarn sub-group such that the adjacent warp yarn systems of sheds cross each other between a reed and a cloth fell at the time of 5

maximum shedding; inserting a pick of weft into each shed by fluid jet; and beating up the pick into the cloth with a common reed.

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