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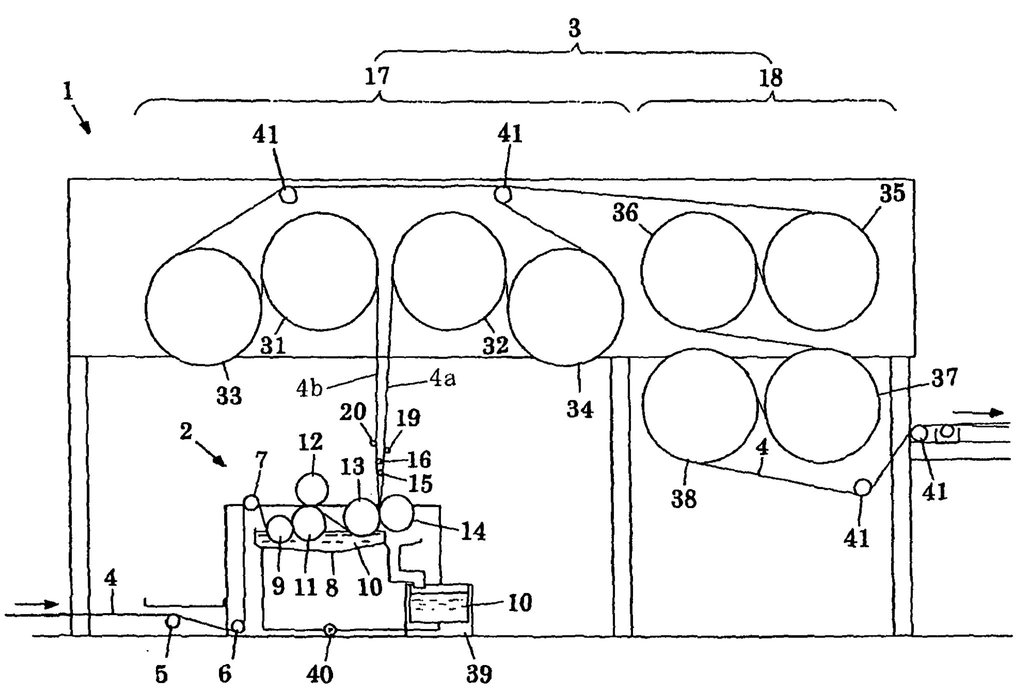
(54) **Warp sizing machine**

(57) A warp sizing machine (1) includes a sizing unit (2) for sizing a warp sheet (4) and a cylinder drying unit (3) placed above the sizing unit (2), the warp sheet (4) sized by the sizing unit (2) being divided into two separate warp sheets (4a and 4b) and the two warp sheets (4a and 4b) being guided to respective drying cylinders (31 and 32) included in the cylinder drying unit (3). Two rods (15 and 16) corresponding to the two warp sheets (4a and 4b) are provided in a space between the two warp sheets (4a and 4b) moving from the sizing unit (2) to the respective drying cylinders (31 and 32), the rods (15 and 16) rotating at peripheral speeds lower than the moving speed of the warp sheets (4a and 4b) and being in contact only with the respective warp sheets (4a and 4b).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a warp sizing machine, which is one of weaving preparation machines.

2. Description of the Related Art

[0002] Japanese Unexamined Utility Model Registration Application Publication No. 5-56988 discloses a warp sizing machine. In this warp sizing machine, a sheet of multiple warp yarns, that is, a warp sheet, is guided into a size box for sizing the warp sheet, squeezed by squeeze rollers so that excess size is removed, and then divided into two separate warp sheets. The two separate warp sheets are then dried on different drying cylinders.

[0003] The warp yarns with the size applied thereto are bonded to one another with fluff, and therefore the warp sheet cannot be smoothly divided into the two separate warp sheets immediately after it has been squeezed. In addition, the manner in which the warp yarns are bonded to one another with the fluff varies depending on the manner in which the size is applied thereto, and the position at which the warp sheet is divided varies accordingly. In addition, when the warp yarns are strongly bonded to one another, the warp sheet cannot be divided immediately and dries before it can be divided. When the warp sheet is divided after it has dried, it is divided irregularly and a large amount of fluff with uneven lengths is generated.

[0004] In addition, Japanese Unexamined Patent Application Publication No. 3-227449 discloses a sizing technique in which, after the warp sheet is guided into the size box for sizing the warp sheet and squeezed by the squeeze rollers so that the excess size is removed, it is divided into two separate warp sheets using a comb placed above a sizing unit. According to this technique, the warp sheet is divided more easily compared to the technique disclosed in Japanese Unexamined Utility Model Registration Application Publication No. 5-56988. However, the number of teeth on the comb is less than the number of warp yarns, and the warp yarns which are not separated from one another by the teeth are separated at a position higher than the position where the other warp yarns are separated by the teeth. As a result, fluff with uneven lengths is generated.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a warp sizing machine in which the fluff length is equalized and fluff binding is performed when the warp sheet moving upward from a sizing unit to a drying unit is divided into two separate warp sheets, thereby improving the weavability of the warp yarns.

[0006] A warp sizing machine according to one aspect of the present invention includes a sizing unit for sizing a warp sheet and a cylinder drying unit placed above the sizing unit, the warp sheet sized by the sizing unit being divided into two separate warp sheets and the two separate warp sheets being guided to respective drying cylinders included in the cylinder drying unit. The warp sizing machine is characterized in that two rods corresponding to the two warp sheets are provided in a space between the two warp sheets moving from the sizing unit to the respective drying cylinders, the rods rotating at peripheral speeds lower than the moving speed of the warp sheets and being in contact only with the respective warp sheets. The two cylinders are at the most upstream positions in two series of drying cylinders included in the cylinder drying unit placed above the sizing unit, and are separated from each other in a direction substantially perpendicular to the two warp sheets (that is, the planes including the warp sheets) .

[0007] Preferably, the two rods are positioned such that the relationship $L \leq (D1 + D2)/2$ is satisfied, where D1 and D2 are the outer diameters of the rods and L is the distance between the axes of the rods in a direction substantially perpendicular to the moving directions of the warp sheets.

[0008] The two rods may rotate in opposite directions such that the peripheries of the rods move in the same directions as the moving directions of the respective warp sheets at the contact areas of the rods and the respective warp sheets. Alternatively, the two rods may rotate in opposite directions such that the peripheries of the rods move in the directions opposite to the moving directions of the respective warp sheets at the contact areas of the rods and the respective warp sheets. Alternatively, the two rods may rotate in opposite directions such that the peripheries of the rods selectively move in directions the same as or opposite to the moving directions of the respective warp sheets at the contact areas of the rods and the respective warp sheets.

[0009] A warp sizing machine according to another aspect of the present invention includes a sizing unit for sizing a warp sheet and a cylinder drying unit placed above the sizing unit, the warp sheet sized by the sizing unit being divided into two separate warp sheets and the two separate warp sheets being guided to respective drying cylinders included in the cylinder drying unit. The warp sizing machine is characterized in that two rods corresponding to the two warp sheets are provided in a space between the two warp sheets moving from the sizing unit to the respective drying cylinders, the rods rotating at peripheral speeds lower than the moving speed of the warp sheets and being in contact only with the respective warp sheets, and another two rods corresponding to the two warp sheets are provided outside the space between the two warp sheets, the rods rotating at peripheral speeds lower than the moving speed of the warp sheets and being in contact with the respective warp sheets.

[0010] In the warp sizing machine according to the present invention, two rods corresponding to the two warp sheets are provided in the space between the two warp sheets moving from the sizing unit to the respective drying cylinders of the cylinder drying unit, the rods rotating at peripheral speeds lower than the moving speed of the warp sheets and being in contact only with the respective warp sheets. Since the two rods are disposed in the space between the two warp sheets and are in contact only with the respective warp sheets, the two warp sheets are separated from each other at a constant position near the sizing unit. Accordingly, the fluff length is equalized and fluff binding is performed in which the rods slick down the fluff by coming into contact with the respective warp sheets. In addition, the size and the fluff on each of the two warp sheets are prevented from being transferred onto the rod corresponding to the other warp sheet and eventually onto the other warp sheet. Since the rods rotate, the fluff and the size transferred onto the rods from the respective warp sheets rotate together with the rods, come into contact with the warp sheets again, and are transferred back onto the warp sheets before they accumulate on the rods and form large lumps. Accordingly, the resulting warp sheet is free from large lumps of size and fluff, and therefore warp yarns in the warp sheet is prevented from being damaged when they are separated from one another. In addition, the warp yarns are prevented from sticking to one another to form two-ply or three-ply yarns, and failure in shedding motion can be prevented in a loom. In addition, since the peripheral speeds of the rods are lower than the moving speed of the warp sheets, the fluff and the size on the rods are prevented from being spattered due to the rotation.

[0011] When the two rods are positioned such that the relationship $L \leq (D1 + D2)/2$ is satisfied, where D1 and D2 are the outer diameters of the rods and L is the distance between the axes of the rods in a direction substantially perpendicular to the moving directions of the warp sheets, the rods are in contact only with the respective warp sheets with a small contact force at positions near the sizing unit. Accordingly, fluff binding is performed without causing the rods to rub the respective warp sheets hard, and therefore the fluff length is equalized.

[0012] When the two rods rotate in opposite directions such that the peripheries of the rods move in the same directions as the moving directions of the respective warp sheets at the contact areas of the rods and the respective warp sheets, the fluff and the size on the rods come into contact with the warp sheets at upstream points in the moving directions of the warp sheets as the rods rotate, and are transferred onto the warp sheets. Accordingly, the size and the fluff are prevented from accumulating on the rods.

[0013] When the two rods rotate in opposite directions such that the peripheries of the rods move in the directions opposite to the moving directions of the respective warp sheets at the contact areas of the rods and the respective warp sheets, the relative speeds between the peripheries of the rods and the respective warp sheets are high, and the rods rub the respective warp sheets hard. Accordingly, a sufficient fluff binding effect is obtained.

[0014] When the two rods rotate in opposite directions such that the peripheries of the rods selectively move in directions the same as or opposite to the moving directions of the respective warp sheets at the contact areas of the rods and the respective warp sheets, the rotating directions of the rods can be selected depending on the kind of warp and the kind of size. Accordingly, optimum conditions can be set.

[0015] When another two rods corresponding to the two warp sheets are provided outside the space between the two warp sheets, the rods rotating at peripheral speeds lower than the moving speed of the warp sheets and being in contact with the respective warp sheets, fluff binding is performed not only by the rods disposed in the space between the warp sheets but also by the rods disposed outside the space between the warp sheets. Accordingly, weavability of the warp yarns in a loom increases.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a side view showing a warp sizing machine according to an embodiment of the present invention;

Fig. 2 is an enlarged view showing the positions at which a first inner rod, a second inner rod, a first outer rod, and a second outer rod are attached;

Fig. 3 is a partially sectioned front view showing the manner in which the first inner rod and the second inner rod are attached;

Fig. 4 is a side view showing a drive unit in which the first inner rod and the second inner rod rotate in the normal direction;

Fig. 5 is a side view showing the drive unit in which the first inner rod and the second inner rod rotate in the reverse direction; and

Fig. 6 is an enlarged side view showing the main part of a warp sizing machine according to another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Fig. 1 shows a warp sizing machine 1. The warp sizing machine 1 includes a sizing unit 2 and a cylinder drying unit 3 placed above the sizing unit 2. A sheet of multiple warp yarns, that is, a warp sheet 4, is supplied from a warp-sheet feeder (not shown), guided into a size box 8 included in the sizing unit 2 by guide rollers 5, 6, and 7, and immersed into size 10 by an immersion roller 9. Then, the warp sheet 4 passes between a first sizing roller 11 and a first squeeze roller 12, which face each other in the vertical direction, and between a second sizing roller 13 and a second squeeze roller 14, which face each other in the horizontal direction. Sizing and squeezing processes are thus performed, and an adequate amount of size is applied to the warp sheet 4. Then, the warp sheet 4 is divided into two separate warp sheets 4a and 4b, and the two warp sheets 4a and 4b are guided into the cylinder drying unit 3 placed above the sizing unit 2.

[0018] In the sizing unit 2, the immersion roller 9, the first sizing roller 11, and the second sizing roller 13 are partially immersed in the size 10, and are rotated at a peripheral speed equal to the moving speed of the warp sheet 4. The size 10 is contained in the size box 8, and the level of the size 10 is maintained at a predetermined depth by causing the size 10 to overflow. More specifically, a collection box 39 which also contains the size 10 is provided below the size box 8, and the size 10 in the collection box 39 is supplied to the size box 8 through a circulation path by a size circulation pump 40, and is caused to overflow into the collection box 39. Accordingly, the amount of size 10 in the size box 8 is always maintained constant and the level of the size 10 in the size box 8 is maintained at the predetermined depth. The collection box 39 is refilled when the level of the size 10 in the collection box 39 falls to or below a predetermined depth.

[0019] The cylinder drying unit 3 includes a first cylinder drying section 17 for primary drying at an upstream location in the moving direction of the warp sheets 4a and 4b and a second cylinder drying section 18 for secondary drying at a downstream location in the moving direction of the warp sheets 4a and 4b. The first cylinder drying section 17 includes a first series of drying cylinders 31 and 33 and a second series of drying cylinders 32 and 34 for separately drying the two warp sheets 4a and 4b. The two drying cylinders 31 and 32 at the most upstream positions in the two series of drying cylinders are separated from each other in a direction substantially perpendicular to the planes including the warp sheets 4a and 4b, thereby dividing the warp sheet 4 into the two separate warp sheets 4a and 4b.

[0020] When the warp sheet 4 comes out from between the second sizing roller 13 and the second squeeze roller 14 after the sizing process, it is divided into the two warp sheets 4a and 4b including alternate warp yarns. More specifically, one of the warp sheets 4a and 4b includes N^{th} warp yarns, where N is an odd number, and the other one of the warp sheets 4a and 4b includes M^{th} warp yarns, where M is an even number. The warp sheet 4b is wrapped around the drying cylinders 31 and 33 and guided into the second cylinder drying section 18 by a guide roller 41, and the warp sheet 4a is wrapped around the drying cylinders 32 and 34 and guided into the second cylinder drying section 18 by another guide roller 41. Since the two warp sheets 4a and 4b are separated from each other as described above, the warp interval (the pitch of the warp yarns) in the primary drying is larger than that in the sizing process.

[0021] The two warp sheets 4a and 4b are recombined together after the primary drying, and accordingly the warp interval returns to the original warp interval. Then, the thus obtained warp sheet 4 is subjected to the secondary drying in the second cylinder drying section 18, where the warp sheet 4 is further dried by coming into contact with drying cylinders 35, 36, 37, and 38. After the primary and secondary drying, the warp sheet 4 is guided by guide rollers 41 and is wrapped around a warp beam (not shown).

[0022] The warp sizing machine 1 according to the present invention is characterized by including a plurality of rods, for example, a first inner rod 15 and a second inner rod 16 corresponding to the two warp sheets 4a and 4b, respectively, in a space between the two warp sheets 4a and 4b moving from the sizing unit 2 to the respective drying cylinders 32 and 31 of the cylinder drying unit 3 (the first cylinder drying section 17). The first and the second inner rods 15 and 16 rotate at peripheral speeds lower than the moving speed of the warp sheets 4a and 4b, and are in contact only with the respective warp sheets 4a and 4b. In addition, a first outer rod 19 and a second outer rod 20 corresponding to the two warp sheets 4a and 4b, respectively, are further provided as necessary. The first and the second outer rods 19 and 20 rotate at peripheral speeds lower than the moving speed of the warp sheets 4a and 4b, and are in contact with the respective warp sheets 4a and 4b.

[0023] Fig. 2 shows the positional relationship between the first and the second inner rods 15 and 16 and that between the first and the second outer rods 19 and 20. The first and the second inner rods 15 and 16 are disposed as near as possible to the second sizing roller 13 and the second squeeze roller 14 of the sizing unit 2. This is because the warp sheet 4 is preferably divided as quickly as possible after the size starts to dry in view of equalizing the fluff length and reducing the quality variation of the resulting warp sheet 4. More specifically, the first and the second inner rods 15 and 16 are positioned such that the relationship $L \leq (D1 + D2)/2$ is satisfied, where D1 is the outer diameter of the first inner rod 15, D2 is the outer diameter of the second inner rod 16, and L is the distance between the axes of the first and the second inner rods 15 and 16 in a direction substantially perpendicular to the moving directions of the warp sheets 4a and 4b, and are disposed as near as possible to the sizing unit 2.

[0024] According to the above configuration, the first and the second inner rods 15 and 16 are in contact with the respective warp sheets 4a and 4b with a small contact force at positions near the sizing unit 2. Accordingly, fluff binding is performed without causing the first and the second inner rods 15 and 16 to rub the respective warp sheets 4a and 4b hard, and therefore the fluff length is equalized. The positions of the first and the second outer rods 19 and 20 and their function will be described in detail below with reference to Fig. 6.

[0025] Fig. 3 shows the supporting structure of the first and the second inner rods 15 and 16 at one end thereof. The first and the second inner rods 15 and 16 are both cylindrical, and are connected to hollow shafts 22 with connectors 21 at both ends thereof so that they can rotate relative to oil-impregnated bearing portions included in bearing brackets 23. In addition, the bearing brackets 23 are attached to a frame 24, and accordingly the first and the second inner rods 15 and 16 are held in place by the frame 24. The shafts 22 are connected to rotary joints 26 at ends remote from the first and the second inner rods 15 and 16, and center holes of the shafts 22 and those of the rotary joints 26 function as water passages 25 for a coolant (cooling water). The first and the second inner rods 15 and 16 may be rotated by a motor (not shown), or by a driving force obtained from one of the rollers, for example, from the second sizing roller 13, via a chain 28 and sprockets 29. The supporting structure at the other end of the first and the second inner rods 15 and 16 is similar to that described above.

[0026] The coolant (cooling water) is supplied from a coolant source (cooling water source) into the water passages 25 in the shafts 22 and the rotary joints 26 at one end, enters cooling sections 27 provided in the first and the second inner rods 15 and 16 to cool the first and the second inner rods 15 and 16, and flows out at the other end. When the coolant (cooling water) circulates in the inner spaces of the first and the second inner rods 15 and 16 as described above, condensation occurs on the peripheral surfaces of the first and the second inner rods 15 and 16, and moisture is added to the size 10 on the peripheral surfaces of the first and the second inner rods 15 and 16. Therefore, the size 10 does not solidify on the peripheral surfaces of the first and the second inner rods 15 and 16, but is removed from the peripheral surfaces by being transferred onto the warp sheets 4a and 4b as the first and the second inner rods 15 and 16 rotate. Accordingly, the size 10 is prevented from accumulating and solidifying on the peripheral surfaces of the first and the second inner rods 15 and 16.

[0027] Fig. 4 shows an example in which the first and the second inner rods 15 and 16 rotate in opposite directions such that the peripheries of the first and the second inner rods 15 and 16 move in the same directions as the moving directions of the respective warp sheets 4a and 4b (in the normal direction) at the contact areas of the first and the second inner rods 15 and 16 and the respective warp sheets 4a and 4b. In this example, the rotation of the second sizing roller 13 is transmitted to the first and the second inner rods 15 and 16 by two gears 42, a sprocket 43, the chain 28, a switching sprocket 30, and the two sprockets 29, such that the first and the second inner rods 15 and 16 rotate in opposite directions. Since the first and the second inner rods 15 and 16 are in contact only with the respective warp sheets 4a and 4b, the fluff and the size 10 carried by the warp sheets 4a and 4b and transferred onto the first and the second inner rods 15 and 16, respectively, come into contact with the same warp sheets 4a and 4b at upstream points in the moving directions of the warp sheets 4a and 4b as the first and the second inner rods 15 and 16 rotate, and are transferred back onto the warp sheets 4a and 4b to remain on the warp sheets 4a and 4b. Accordingly, the fluff and the size 10 are prevented from accumulating on the peripheral surfaces of the first and the second inner rods 15 and 16. This effect becomes more significant as the relative speeds between the peripheries of the first and the second inner rod 15 and 16 and the respective warp sheets 4a and 4b reduce. The chain 28 and other components are contained in a chain cover 44.

[0028] Fig. 5 shows an example in which the first and the second inner rods 15 and 16 rotate in opposite directions such that the peripheries of the first and the second inner rods 15 and 16 move in the directions opposite to the moving directions of the respective warp sheets 4a and 4b (in the reverse direction) at the contact areas of the first and the second inner rods 15 and 16 and the respective warp sheets 4a and 4b. In this example, the relative speeds between the peripheries of the first and the second inner rods 15 and 16 and the respective warp sheets 4a and 4b are high, and the first and the second inner rods 15 and 16 rub the respective warp sheets 4a and 4b hard. Accordingly, a sufficient fluff binding effect is obtained.

[0029] With reference to Figs. 4 and 5, the rotating directions of the first and the second inner rods 15 and 16 are switched by moving the switching sprocket 30 between the upper and lower positions and changing the manner in which the chain 28 is wrapped around the two sprockets 29. The optimum rotating direction is selected depending on the kind of warp, the kind of size, and the operational conditions, such as the moving speed, of the warp sizing machine. When the first and the second inner rods 15 and 16 are driven by an exclusive motor as described above, the rotating directions of the first and the second inner rods 15 and 16 can of course be selected with a selection switch.

[0030] Fig. 6 shows an example in which the first outer rod 19 and the second outer rod 20 corresponding to the two warp sheets 4a and 4b, respectively, are provided outside the space between the two warp sheets 4a and 4b. The first and the second outer rods 19 and 20 rotate at peripheral speeds lower than the moving speed of the warp sheets 4a and 4b, and are in contact with the respective warp sheets 4a and 4b. In this case, fluff binding is performed not only by the first and the second inner rods 15 and 16 disposed in the space between the warp sheets 4a and 4b but also by the first and the second outer rods 19 and 20 disposed outside the space between the warp sheets 4a and 4b. Accordingly, the weavability of the warp yarns in a loom increases. In Fig. 6, the first and the second outer rods 19 and 20 are placed above the first and the second inner rods 15 and 16 disposed in the space between the warp sheets 4a and 4b. However, one or both of the first and the second outer rods 19 and 20 may also be placed below the first and the second inner rods 15 and 16. The first and the second outer rods 19 and 20 also serve to bend the warp sheets 4a and 4b and reduce the space therebetween. When the first and the second outer rods 19 and 20 are provided, the rods 15, 16, 19, and 20 are arranged such that the first and the second inner rods 15 and 16 are in contact only with the respective warp sheets 4a and 4b.

[0031] When the warp sheet 4 is divided into the two separate warp sheets 4a and 4b, vibration of the warp sheets 4a and 4b may occur depending on the kind of warp. In such a case, the warp sheets 4a and 4b vibrate while moving, and there is a risk that the first and the second inner rods 15 and 16 will accidentally come into contact with the warp sheets 4b and 4a, respectively. In this case, however, the first and the second inner rods 15 and 16 are not continuously in contact with the warp sheets 4b and 4a, respectively, but come into contact with them irregularly. Accordingly, the operations and effects of the present invention are maintained.

[0032] The present invention is incorporated in the structure for dividing the warp sheet 4 into the two separate warp sheets 4a and 4b at a position between the sizing unit and the two series of drying cylinders, and the sizing method and the drying method are not limited to those described above.

Claims

1. A warp sizing machine (1) including a sizing unit (2) for sizing a warp sheet (4) and a cylinder drying unit (3) placed above the sizing unit (2), the warp sheet (4) sized by the sizing unit (2) being divided into two separate warp sheets (4a and 4b) and the two warp sheets (4a and 4b) being guided to respective drying cylinders (31 and 32) included in the cylinder drying unit (3), the warp sizing machine (1) **characterized in that**:

    two rods (15 and 16) corresponding to the two warp sheets (4a and 4b) are provided in a space between the two warp sheets (4a and 4b) moving from the sizing unit (2) to the respective drying cylinders (31 and 32), the rods (15 and 16) rotating at peripheral speeds lower than the moving speed of the warp sheets (4a and 4b) and being in contact only with the respective warp sheets (4a and 4b).

2. A warp sizing machine (1) according to Claim 1, wherein the rods (15 and 16) are positioned such that the relationship $L \leq (D1 + D2)/2$ is satisfied, where D1 and D2 are the outer diameters of the rods (15 and 16) and L is the distance between the axes of the rods (15 and 16) in a direction substantially perpendicular to the moving directions of the warp sheets (4a and 4b).

3. A warp sizing machine (1) according to one of Claims 1 and 2, wherein the rods (15 and 16) rotate in opposite directions such that the peripheries of the rods (15 and 16) move in the same directions as the moving directions of the respective warp sheets (4a and 4b) at the contact areas of the rods (15 and 16) and the respective warp sheets (4a and 4b).

4. A warp sizing machine (1) according to one of Claims 1 and 2, wherein the rods (15 and 16) rotate in opposite directions such that the peripheries of the rods (15 and 16) move in the directions opposite to the moving directions of the respective warp sheets (4a and 4b) at the contact areas of the rods (15 and 16) and the respective warp sheets (4a and 4b).

5. A warp sizing machine (1) according to one of Claims 1 to 4, wherein the rods (15 and 16) rotate in opposite directions such that the peripheries of the rods (15 and 16) selectively move in directions the same as or opposite to the moving directions of the respective warp sheets (4a and 4b) at the contact areas of the rods (15 and 16) and the respective warp sheets (4a and 4b).

6. A warp sizing machine (1) including a sizing unit (2) for sizing a warp sheet (4) and a cylinder drying unit (3) placed above the sizing unit (2), the warp sheet (4) sized by the sizing unit (2) being divided into two separate warp sheets (4a and 4b) and the two warp sheets (4a and 4b) being guided to respective drying cylinders (31 and 32) included in the cylinder drying unit (3), the warp sizing machine (1) **characterized in that**:

    two rods (15 and 16) corresponding to the two warp sheets (4a and 4b) are provided in a space between the two warp sheets (4a and 4b) moving from the sizing unit (2) to the respective drying cylinders (31 and 32), the rods (15 and 16) rotating at peripheral speeds lower than the moving speed of the warp sheets (4a and 4b) and being in contact only with the respective warp sheets (4a and 4b); and

    two rods (19 and 20) corresponding to the two warp sheets (4a and 4b) are provided outside the space between the two warp sheets (4a and 4b), the rods (19 and 20) rotating at peripheral speeds lower than the moving speed of the warp sheets (4a and 4b) and being in contact with the respective warp sheets (4a and 4b).

FIG. 1

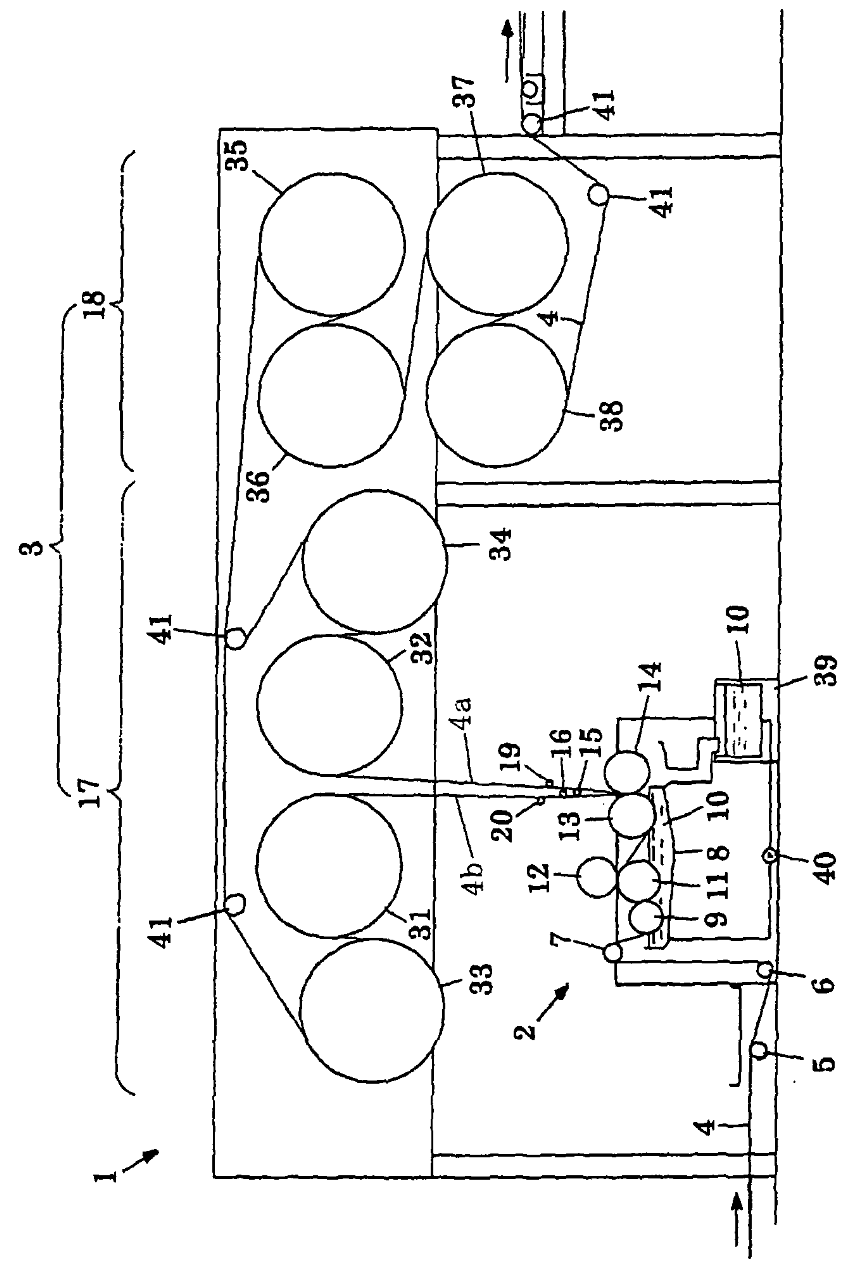
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FIG. 2

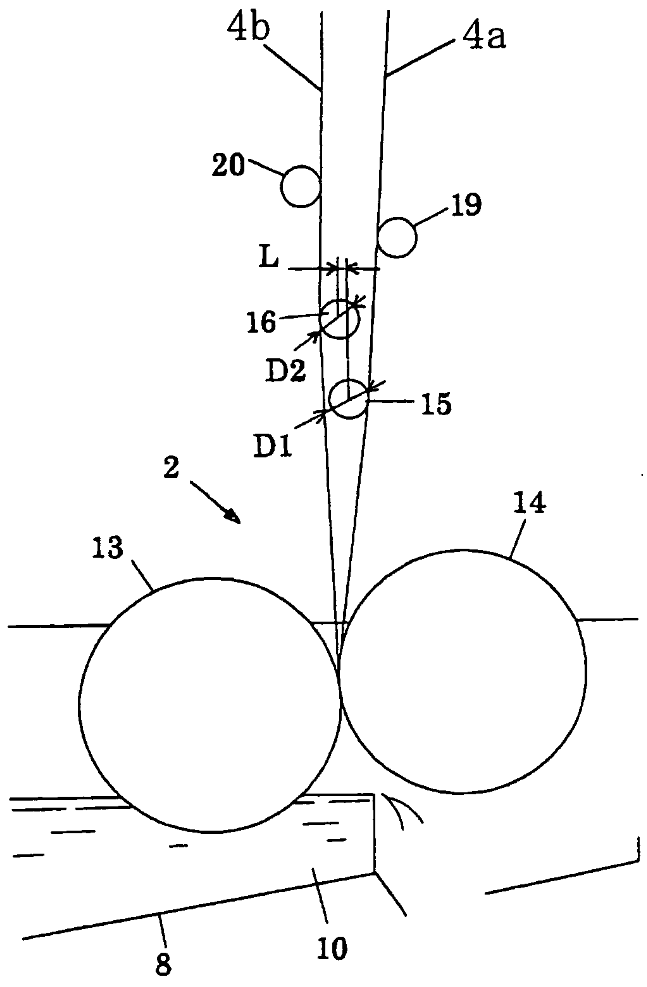

FIG. 3

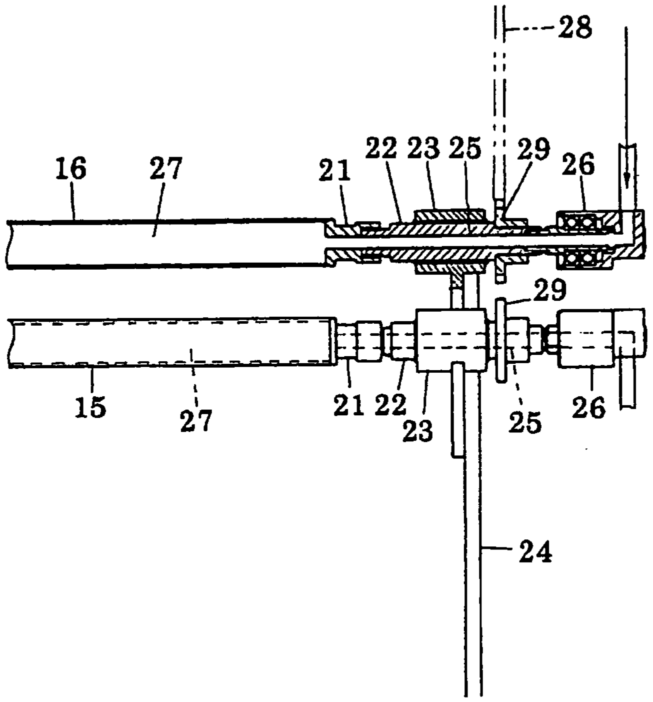

FIG. 4

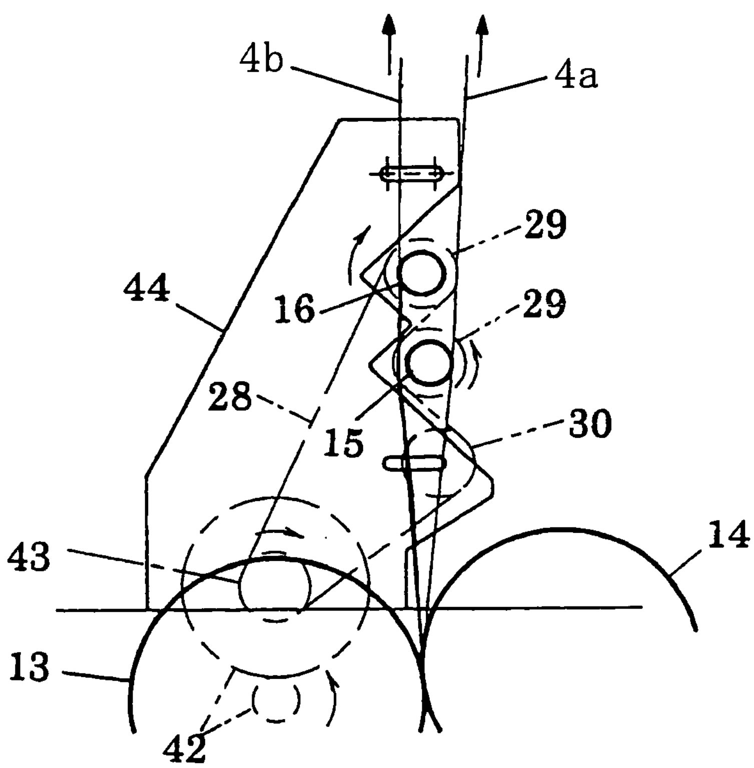

FIG. 5

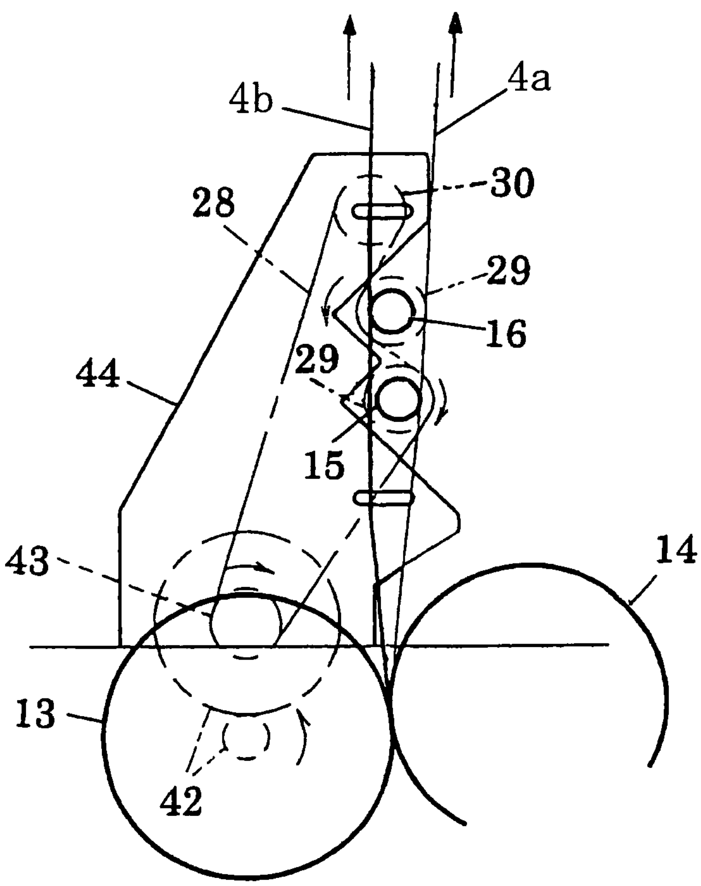

FIG. 6