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EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.09.2004 Bulletin 2004/40

(51) Int Cl.7: D03D 49/04

(21) Application number: 04006691.2

(22) Date of filing: 19.03.2004

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

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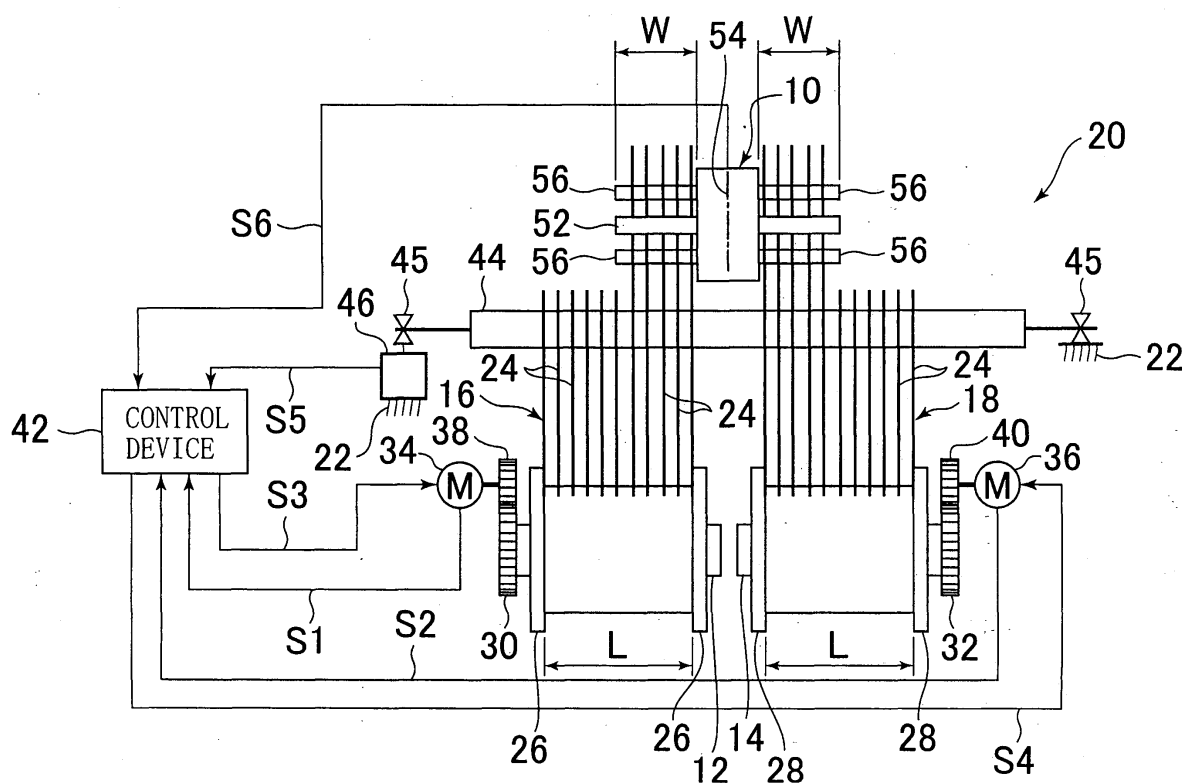
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(54) Device for detecting difference in warp tension of a loom

(57) A device (10) for detecting difference in warp tension of a plurality of warp sheets (16, 18) let off side by side from different warp beams (12, 14) in the weft inserting direction detects a tension receiver (52) having a plurality of contact faces (48, 50) which are individually

in contact with the boundary side end portions of adjoining warp sheets (16, 18) at intervals in the weft inserting direction, and detects an angular rotational displacement or angular rotational force of the tension receiver around the axis extending in the warp moving direction.

FIG. 1



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a device for detecting difference in tension of a plurality of warp sheets adjacent in the weft inserting direction, in a loom comprising a plurality of warp beams.

Description of Prior Art

[0002] As a device for detecting difference in warp tension between two warp sheets let off side by side in the weft inserting direction from two warp beams, there is known a device comprising a rocker bar having contact faces which are in contact with boundary-side end portions of two warp sheets at two positions spaced apart in the weft inserting direction; a support for supporting the rocker bar so as to rotate angularly about an axis extending in the warp moving direction; two reference planes assembled into the rocker bar at an interval in the weft inserting direction with the support therebetween; and two optical or capacity-type sensors for measuring a distance from a horizontal reference member to the reference planes at each warp sheet (see, for example, Patent Document 1). This conventional device measures by the optical sensors a displacement of the distance from the horizontal reference member of the rocker bar to the reference planes of the sensors at each warp sheet and calculates the difference in warp tension. Here, the angular rotation means a rotation by less than 180°.

[0003] As another device for detecting difference in warp tensions of two warp sheets, there is known a device in which a warp tension detector is disposed at each warp sheet on a warp path of the boundary-side end portions of the warp sheets adjacent in the weft inserting direction, for detecting the warp tensions of the boundary side end portions of both warp sheets at each warp sheet and processing a detection signal as detected (see, for example, Patent Documents 2 and 3).

[Patent Document 1]

Japanese Patent Appln. Public Disclosure No. 6-41847 (paragraph [0012], Figs. 1 and 2)

[Patent Document 2]

Japanese Patent No. 3070265 (Fig. 1)

[Patent Document 3]

Japanese Patent No. 3070266 (Fig. 1)

[0004] According to the former device, the distance from the horizontal reference member to the reference planes are optically measured by using optical or capacity-type detecting device, so that detection of the warp tension cannot be performed accurately.

[0005] In other words, in the former device, since the

rocker bar is only supported by the support, the rocker bar is vibrated not only by the difference in warp tension of the warp sheets but by vibration of the loom. Therefore, if the rocker bar is vibrated independently of an angular rotation displacement following variation in warp tension and displaced, the distance or capacity between the horizontal reference member and reference planes are also varied. As a result, in the former, the displacement of the warp corresponding to a change in warp tension cannot be measured accurately.

[0006] Also, according to an optical detecting device, when cotton flies adhere on a light sending face or a light receiving face of a detector, the warp and the like which are to be detected, there are cases that a light from the detector is reflected by the cotton flies, and as a result, the distance from the horizontal reference member to the reference planes cannot be measured accurately.

[0007] Particularly, according to a device for measuring the distance between the reference plane provided in the rocker bar and the horizontal reference member of the detecting device, accuracy in measurement of about 0.1 mm to 0.01 mm is required, and the optical detecting device itself has such a high accuracy in measurement, but with such a structure of the rocker bar as in the former device, the distance between the reference plane and the horizontal reference member cannot be measured with high accuracy.

[0008] In the latter device, the warp tension of the warp sheets from a twin warp beam is detected individually by a warp tension detector at each warp sheet, so that two warp tension detectors are required, and besides, both detected tensions should be processed by operation.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to detect a difference in warp tension of a plurality of warp sheets by a simple technique and prevent generation of warp streaks.

[0010] The inventors, a result of various experiments and studies based on their idea that, in order to prevent generation of warp streaks in a cloth, it suffices to finely adjust the warp tension at each warp sheet according to the difference in warp tension of both warp sheets in a state that the warp tensions of adjoining warp sheets are controlled to be substantially constant, has come to a conclusion that it is preferable to directly detect the difference in warp tension of the adjoining warp sheets as stress (torque) such as angular rotational force or an angular rotational displacement amount such as a difference in distance. Hence the following invention.

[0011] A first device for detecting difference in warp tension according to the present invention is a device for detecting difference in warp tension of a plurality of warp sheets let off side by side in the weft inserting direction from different warp beams, comprises: a tension

receiver provided with a plurality of contact faces individually in contact with the boundary side end portions of the adjoining warp sheets; a shaft extending in the direction orthogonal to the adjoining direction of the warp sheets and supporting the tension receiver; a rotation blocking member for blocking an angular rotation of the tension receiver, and a rotational force detector for detecting the angular rotation of the tension receiver; and a rotational force detector for detecting the angular rotation acting about the axis of the shaft.

[0012] It is possible that the first device for detecting difference in warp tension further comprises an auxiliary member extending from the tension receiver, and that the rotational force detector is constituted as the rotation blocking member, located between the auxiliary member and the loom frame, and adapted to detect the angular rotational force acting on the rotation blocking member from the auxiliary member in the adjoining direction of the warp sheets. Thereby, the rotational force detector detects the force acting on a rotation blocking member (rotational force detector) in the weft inserting direction which is largely different from the direction of motion (vibration) such as reed beating, shedding motion and the like causing vibration to the loom, so that a result of detection of the angular rotational force is hardly influenced by such a large vibration. As such detection means, a load detector by a strain gauge such as a load cell can be given.

[0013] The rotation blocking member may block an angular rotation about the axis of the shaft, and the rotational force detector may be constituted as the rotational force blocking member and may include a torque converter for detecting the angular rotational force about the axis of the shaft.

[0014] The angular rotational force of the tension receiver depends on difference in tension of adjoining warp sheets, but is hardly influenced by the vibration of the loom. Also, even if cotton flies adhere to the contact faces, the warp and the like, such cotton flies are removed from the contact faces and the warp while the warp is moving in contact with the contact faces. Further, a device for detecting an angular rotational displacement or the angular rotational force of the tension receiver can obtain the difference in warp tension promptly and highly accurately in comparison with a device for detecting a distance or a capacity between a reference position and a position to be measured.

[0015] As a result of the above, according to the present invention, measurement of the difference in warp tension is hardly influenced by vibration of the loom and cotton flies in comparison with the above-mentioned conventional device, and besides, the difference in tension of the warp sheets can be detected directly and highly accurately.

[0016] Also, according to the present invention, differences in warp tension of a plurality of adjoining warp sheets are directly detected, only one sensor for measuring the differences in warp tension suffices, dispens-

ing with any sensor for measuring the tension itself, so that less parts of the device for detecting the differences in warp tension are required than those of the conventional device, thus simplifying the operation process of a detection signal.

[0017] A second device for detecting difference in warp tension according to the present invention, which is a device for detecting differences in warp tensions of a plurality of warp sheets to be let off side by side in the weft inserting direction from different warp beams, includes: a tension receiver having a plurality of contact faces individually in contact with the boundary side end portions of the adjoining warp sheets, the tension receiver being able to angularly rotate about an axis extending in the warp moving direction; a shaft supporting the tension receiver so as to rotate angularly and extending in the direction orthogonal to the adjoining direction of the warp sheets; and a potentiometer for detecting an angular rotational displacement of the tension receiver.

[0018] It suffices that in the first and second devices for detecting warp tension, the shaft is positioned such that the axis of the shaft extends inside of plane orthogonal to the weft inserting direction. Therefore, it is possible to dispose a rotational force detector, for example, such that the axis of the shaft extends inside the perpendicular plane to the warps sheets.

[0019] In the first and second devices for detecting difference in warp tensions, the contact faces may be made displaceable in the perpendicular direction to the warp sheets.

[0020] In the first and second devices for detecting difference in warp tension, the axis may be disposed at the position in the direction perpendicular to the warp sheets, the position being located between both the boundary the face end portions.

[0021] In the first and second devices for detecting difference in warp tension, the axis may be located at the position in the direction orthogonal to the adjoining direction of the warp sheets, the position being located at the center between the contact faces.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a view showing a loom provided with a first embodiment of the device for detecting difference in warp tension according to the present invention. Figs. 2 (A) and (B) are views for explaining the device for detecting difference in warp tension used in the loom in Fig. 1, in which (A) is a view as seen from the warp moving direction, and (B) a view as seen from the weft inserting direction.

Figs. 3 (A) and (B) are views showing a second embodiment of the device for detecting difference in warp tension according to the present invention, in which (A) is a view seeing (B) from the warp moving direction, and (B) a view seeing the device for de-

tecting difference in warp tension from above.

Fig. 4 is a view showing a third embodiment of the device for detecting difference in warp tension according to the present invention.

Figs. 5 (A) and (B) are views for explaining examples of transformation of the device for detecting difference in warp tension in Fig. 4, in which (A) is a view seeing the device for detecting difference in warp tension from above, and (B) a view seeing (A) from the axial direction.

PREFERRED EMBODIMENT OF THE INVENTION

[0023] Referring to Fig. 1, the device 10 for detecting difference in warp tension detects a difference in warp tension of two warp sheets 16 and 18 to be let off side by side in the weft inserting direction from two warp beams 12 and 14.

[0024] The warp beams 12 and 14 are disposed in a frame 22 of a loom 20 at an interval in the weft inserting direction so that their rotary axes coincide. The warp beams 12 and 14 have a plurality of warps 24 wound round and respectively let off those warps 24 side by side in the weft inserting direction in a form of the warp sheets 16 and 18 arranged in parallel like a sheet. The roll widths L of the warps 24 in the warp beams 12 and 14 are the same.

[0025] The warp beams 12 and 14 removably attach to their both end portions respectively beam flanges 26 and 28, and removably attach warp beam gears 30 and 32 to the outside surface of the beam flanges 26 and 28.

[0026] The warp beam gears 30 and 32 respectively mesh with gears 38 and 40 assembled into the output shafts of motors 34 and 36 so as not to rotate relatively, and transmit the rotational force of the motors 34 and 36 to the warp beams 12 and 14. As for the motors 34 and 36, AC servo motors are adopted, for example.

[0027] The motors 34 and 36 respectively output values detected by an encoder (not shown) for detecting the rotational speed of the output shafts of the motors 34 and 36 as rotational frequency signals S1 and S2 to a control device 42 of the loom 20, and rotate the output shafts of the motors 34 and 36 on the basis of rotation command signals S3 and S4 to be outputted from the control device 42.

[0028] The warp sheets 16 and 18 let off from the warp beams 12 and 14 are stretched over a tension roller 44 having a dimension longer than the width dimension L of the warp sheets 16 and 18. The warp sheets 16 and 18 whose directions to be let off by a tension roller 44 are changed are to be taken up by a cloth beam, through the device 10 for detecting difference in warp tension, by a friction roller (not shown) of a take-up device after reed beating.

[0029] The tension roller 44 is assembled into the frame 22 of the loom 20 so as to rotate at one end side by a support member 45 like a bearing so that its own rotation axis may extend in the weft inserting direction,

and supported at the other end side on the frame 22 through the load cell 46 by the other support member 45 like the other bearing.

[0030] The load cell 46, upon receipt of force (warp tension) in the moving direction of the warp sheets 16 and 18, detects total warp tension T of the warp sheets 16 and 18, and outputs the detected total warp tension T as a total warp tension signal S5 to the control device 42.

[0031] The device 10 for detecting difference in warp tension detects a difference in tension of the warp sheets 16 and 18 in a position on the more downstream side than the tension roller 44 and on the more upstream side than the reed beating position in the warp moving direction.

[0032] The device 10 for detecting difference in warp tension comprises a tension receiver 52 extending in the weft inserting direction across a space between adjoining warp sheets 16 and 18. The tension receiver 52 has two contact faces 48 and 50 (see Fig. 2) which are in contact with one side face in the range of a dimension w from the boundary side end portions of the warp sheets 16 and 18. The contact faces 48 and 50 are spaced apart in the weft inserting direction so as to respectively correspond to the warp sheets 16 and 18.

[0033] The tension receiver 52 is, as explained later, assembled into a rotary shaft 62 (see Fig. 2) which is angularly rotatable about an axis 54 extending in the warp moving direction. Consequently, the contact faces 48 and 50 are made displaceable perpendicularly to the warp sheets 16 and 18.

[0034] The device 10 for detecting difference in warp tension also comprises four yarn guides 56 in contact with the other side face in the range of the dimension w from the boundary side end portions of the warp sheets 16 and 18. Two each of the yarn guides 56 are provided in each of the warp sheets 16 and 18 as well as in the forward and backward of the tension receiver 52 in the warp moving direction. The yarn guides 56 have at least a substantially the same length w as the tension receiver 52 and extend in the weft inserting direction.

[0035] The boundary side end portions of the warp sheets 16 and 18 let off from the tension roller 44 are moved while being brought into contact with the upper side faces of the yarn guides 56, the underside of the tension receiver 52 and the upper side faces of the yarn guides 56 in this order. In the illustrated embodiment, the tension receiver 52 and the yarn guide 56 are in contact with substantially the same number of the warps 24 from the boundary side end portions of the warp sheets 16 and 18.

[0036] The device 10 for detecting difference in warp tension comprises an angular rotation detector for directly detecting an angular rotational displacement or angular rotational force of the tension receiver 52 around the axis 54. The angular rotational displacement or angular rotational force is caused by the difference in tension at the boundary side end portions of the warp

sheets 16 and 18. The device 10 outputs the value of the detected angular rotational displacement or angular rotational force as a warp tension difference signal S6 representing a warp tension difference Tc to the control device 42.

[0037] The control device 42 operates the following formulas (6) and (7) on the basis of the total warp tension T and difference Tc in warp tension obtained from the total warp tension signal S5 and warp tension difference signal S6 to obtain warp tensions T1 and T2 of the warp sheets 16 and 18.

[0038] The control device 42 generates the rotation command signals S3 and S4 for rotating the motors 34 and 36 at a predetermined speed on the basis of rotation frequency signals S1 and S2 representing the rotation frequencies of the motors 34 and 36 as well as the calculated total warp tension T and warp tensions T1, T2, and drives the motors 34 and 36 at rotational speeds corresponding to the rotation command signals S3 and S4. Consequently, the control device 42 feedback-controls the motors 34 and 36.

[0039] The warp tensions T1 and T2 are obtained in the following manner.

[0040] Suppose the tensions of the warp sheets 16 and 18 acting on contact faces 48 and 50 of the tension receiver 52 are respectively t1 and t2, the tensions t1, t2 and the difference Tc in warp tension are respectively represented by Formulas (1) and (2) and Formula (3).

$$t1 = (w \cdot T1)/L \quad (1)$$

$$t2 = (w \cdot T2)/L \quad (2)$$

$$Tc = t1 - t2 \quad (3)$$

[0041] From Formulas (1) through (3), the difference Tc in warp tension can be shown by Formula (4).

$$Tc = \{w(T1 - T2)\}/L \quad (4)$$

[0042] Also, since the total warp tension T is represented by Formula (5), the warp tensions T1 and T2 can be shown by Formulas (6) and (7).

$$T = T1 + T2 \quad (5)$$

$$T1 = \{(T + (L \cdot Tc)/w)\}/2 \quad (6)$$

$$T2 = \{(T - (L \cdot Tc)/w)\}/2 \quad (7)$$

[0043] The device 10 for detecting difference in warp

tension is explained in detail with reference to Fig. 2.

[0044] As shown in Fig. 2(A), the tension receiver 52 has the contact faces 48 and 50 on the undersides of its both end portions. The tension receiver 52 has an auxiliary member 58 extending from its longitudinal central portion downward integrally connected and acts as a T-shaped member together with the auxiliary member 58 as viewed in the warp moving direction.

[0045] As shown in Fig. 2 (B), the tension receiver 52 and both yarn guides 56 have the same diameter. The tension receiver 52 is placed at the same height position as both yarn guides 56, and extends in the weft inserting direction between both yarn guides 56 in the warp moving direction. Consequently, the warp sheets 16 and 18 are moved while being brought into contact with the upper side face of one yarn guide 56, then with the underside face of the tension receiver 52, and thereafter with the upper side face of the other yarn guide 56.

[0046] Also, should the above-mentioned state be maintained, the tension receiver 52 and both yarn guides 56 may have different diameters and may be provided at height positions different from each other.

[0047] The contact faces 48 and 50 of the tension receiver 52 are located in Fig. 2 (B) on the underside of an imaginary plane connecting the contact portions of the two yarn guides 56 and 56 where the warp sheets 16 and 18 are brought into contact. Therefore, the warp tensions t1 and t2 of the warp sheets 16 and 18 act on the tension receiver 52 substantially in the perpendicular direction (the upper side in Fig. 2 (B)) to the faces of the warp sheets 16 and 18.

[0048] The device 10 for detecting difference in warp tension detects the angular rotation of the tension receiver 52 as rotational force by the angular rotation detector 60.

[0049] The angular rotation detector 60 includes: the rotary shaft 62 for supporting the tension receiver 52; the auxiliary member 58 extending from the tension receiver 52 in the direction to intersect the rotary shaft 62; and a rotational force detector 64 disposed between the front end portion of the auxiliary member 58 and the frame 22.

[0050] The rotary shaft 62 extends in the warp moving direction, and assembles the tension receiver 52 into the frame 22 so as to angularly rotate about the axis 54. In the following explanation, it is assumed that the tension receiver 52 is assembled into the rotary shaft 62 so as not to angularly rotate relatively, and that the rotary shaft 62 is assembled into the frame 22 so as to angularly rotate relatively.

[0051] It is, however, possible, should the tension receiver 52 be supported by the frame 22 so as to angularly rotate, to assemble the rotary shaft 62 and tension receiver 52 so as to or not to angularly rotate relatively and to assemble the rotary shaft 62 and frame 22 so as to or not to angularly rotate relatively.

[0052] When the tension of either one of the warp sheets 16 and 18 becomes greater than that of the other,

the tension receiver 52 is lifted on the side of the contact face 48 or 50 which is brought into contact with the warp sheet 16 or 18 with large tension to be rotated about the axis 54 by an angle corresponding to the difference in tension. By this, the auxiliary member 58 is angularly rotated, and its rotation amount, in turn, rotational force is detected by the rotational force detector 64.

[0053] The rotational force detector 64 is connected to the lower end portion of the auxiliary member 58 so as to receive the rotational force of the auxiliary member 58 in the weft inserting direction, and is supported by the frame 22. As such rotational force detector 64, a load cell can be used.

[0054] The rotational force detector 64 acts as a rotation blocking member 66 for blocking the angular rotation of the tension receiver 52 about the axis 54, detects the angular rotational force of the tension receiver 52 acting on a loading axis of the rotational force detector 64 as the warp tension, difference Tc by the auxiliary member 58, and outputs the detected difference Tc in warp tension as the warp tension difference signal S6 to the control device 42.

[0055] In more detail, the tension receiver 52 receives the warp tensions t1 and t2 of the warp sheets 16 and 18 respectively on the contact faces 48 and 50. The tension receiver 52, when there is a relation of the warp tension t1 > the warp tension t2, receives clockwise rotational force in Fig. 2 (A), and when there is a relation of the warp tension t1 < the warp tension t2, receives counterclockwise rotational force. In either case, however, the tension receiver 52 is blocked its rotation by the rotational force detector 64 and hardly rotates relative to the frame 22 of the loom 20.

[0056] The difference Tc in warp tension obtained by Formula (3) represents the rotational force of the tension receiver 52 about the axis 54 and is directly detected in the rotational force detector 64 through the lower end portion of the auxiliary member 58.

[0057] The angular rotational (difference in warp tension) force directly detected by the rotational force detector 64 as mentioned above depends on difference in tension between the adjoining warp sheets 16 and 18 but is hardly influenced by vibration of the loom 20, cotton flies, etc., and can be obtained by the single detector 64 promptly and highly accurately.

[0058] Referring to Fig. 3, a device 70 for detecting difference in warp tension detects the angular rotation of the tension receiver 52 about an axis extending in the warp moving direction as a torque by an angular rotation detector 72.

[0059] The angular rotation detector 72 is constituted as a torque converter which includes a rotary shaft 74 angularly rotatable about the axis extending in the warp moving direction, and a torque converter 76 for detecting the angular rotational force acting on the tension receiver 52 through the rotary shaft 74.

[0060] The rotary shaft 74 extends in the warp moving direction between both warp sheets 16 and 18, and sup-

ports the tension receiver 52 at the center in the weft inserting direction. The rotation axis of the rotary shaft 74 is between the height positions of the boundary side face end portions of the warp sheets 16 and 18 in the perpendicular direction to the warp sheets 16 and 18. The torque converter 76 is a rotating type, and detects angular rotational force of the rotary shaft 74 about an axis extending in the warp moving direction as a torque.

[0061] The rotary shaft 74 may be shared with a load acting portion of the torque converter 76. Also, the rotary shaft 74 may be integrated with or assembled into the tension receiver 52 with a connecting member such as a screw or the like so as not to move relatively.

[0062] The torque converter 76 is assembled into the frame 22 so as not to move relatively, and by supporting the rotation shaft 74, supports the tension receiver 52 at a position having a physical relation with the yarn guide 56 as shown in Fig. 2 (B). The warp tensions t1 and t2 of the warp sheets 16 and 18 act on the surfaces of the warp sheets 16 and 18 in a substantially perpendicular direction (upward).

[0063] When there is a relation of the warp tension t1 > the warp tension t2, the tension receiver 52 receives rotational force clockwise in Fig. 3 (A), and when there is a relation of the warp tension t1 < the warp tension t2, receives rotational force counterclockwise in Fig. 3 (A). Consequently, the difference Tc in warp tension acts on the torque converter 76 as the angular rotational force.

[0064] The torque converter 76, of which a housing portion receiving the rotary shaft 74 does not rotate relatively to the torque converter 76, acts as a rotation blocking member 78 for blocking the angular rotation of the tension receiver 52 as well as a rotational force detector for detecting the angular rotational force of the tension receiver 52.

[0065] The torque converter 76 detects the angular rotational force (torque) of the tension receiver 52 as the detected difference Tc in warp tension, and outputs the detected difference Tc in warp tension as the warp tension difference signal S6 to the control device 42.

[0066] The torque (difference in warp tension) to be directly detected as the angular rotational force by the torque converter 76 as mentioned above depends on the difference in tension of adjoining warp sheets 16 and 18, but is hardly influenced by vibration of the loom 20, cotton flies, etc., and can be obtained by the single detector 76 promptly and highly accurately.

[0067] Referring to Fig. 4, a device 82 for detecting difference in warp tension detects an angular rotation of the tension receiver 52 about the axis extending in the warp moving direction as a voltage value (or, a current value) by an angular rotation detector 84. The angular rotation detector 84 is provided with a potentiometer 86 for detecting a displacement amount in angular rotation in place of the torque converter 76 shown in Fig. 3. The potentiometer 86 includes a movable contact (not shown) provided in its shaft and a fixed resistor provided around its axis.

[0068] A rotary shaft 88 extends in the warp moving direction so as to rotate about the axis in the warp moving direction and supports the tension receiver 52. The rotary shaft of the potentiometer 86 is combined with the rotary shaft 88 coaxially so that axis of the rotary shaft of the potentiometer 86 coincides with the axis of the rotary shaft 88 and so as not to displace relatively. Consequently, the rotary shaft of the potentiometer 86 is angularly rotated relative to the frame 22 of the loom 20 by the angular rotation of the tension receiver 52.

[0069] The rotary shaft 88 may be integrated with the tension receiver 52, or as shown in Fig. 5, may be assembled with a key 92 by forming key way in a fitting shaft which is one end portion of the rotary shaft 88 and within a fitting hole of the tension receiver 52 so as not to rotate relatively. In the former case, the potentiometer 86 may be directly attached to the shaft portion acting as the rotary shaft of the tension receiver. 52.

[0070] When the warp tensions acting on the warp sheets 16 and 18 are the same, the tension receiver 52 is maintained in a horizontal state.

[0071] When there is a relation of the warp tension $t_1 > \text{the warp tension } t_2$, the tension receiver 52 tends to rotate clockwise in Fig. 4, and when there is a relation of the warp tension $t_1 < \text{the warp tension } t_2$, tends to rotate counterclockwise in Fig. 4.

[0072] When a difference is caused between the warp tensions acting on the warp sheets 16 and 18, a difference is caused in tensions acting upward in Fig. 4 on the contact faces 48 and 50 of the tension receiver 52, and the tension receiver 52, receiving an angular rotational force about the axis of the rotary shaft 88, is angularly rotated.

[0073] As the tension receiver 52 is angularly rotated clockwise or counterclockwise, the warp 24 in contact with the contact face 48 or 50 moved to the upside in Fig. 4 slackens, and the warp 24 in contact with the contact face 50 or 48 moved to the underside in Fig. 4 extends.

[0074] By this, the clockwise or counterclockwise angular rotational force of the tension receiver 52 becomes smaller, and soon the tension receiver 52 stops at a rotational angle position where the tensions received from the contact faces 48 and 50 are balanced. The rotational angle position of the tension receiver 52 with balanced tension is approximately proportional to the difference T_c in warp tension.

[0075] With the displacement of the tension receiver 52 such as above due to the angular rotation, a resistance value of the potentiometer 86 varies. A potentiometer converter 87 detects a voltage value or a current value A inputted to the potentiometer 86 and outputs the voltage value or the current value A as the warp tension difference signal S6 representing the angular rotational displacement of the tension receiver 52 to the control device 42. The angular rotation detector 84, therefore, does not detect the angular rotational force of the tension receiver 52 but detects the angular rotation dis-

placement amount.

[0076] The voltage value or the current value (difference in warp tension) directly detected as the angular rotational displacement amount by the potentiometer 86 as mentioned above depends on the difference in the tensions of adjoining warp sheets 16 and 18, but is hardly influenced by cotton flies and the like and can be obtained by the single detector 86 promptly and highly accurately.

[0077] The present invention is not limited to the foregoing embodiments but can be variously modified without departing from its spirit.

15 Claims

1. A device (10) for detecting difference in warp tension of a loom (20), said device (10) for detecting a difference in warp tension of a plurality of warp sheets (16, 18) let off side by side in the weft inserting direction from different warp beams (12, 14), **characterized by** comprising:

a tension receiver (52) having a plurality of contact faces (48, 50) which are individually in contact with boundary side end portions of the adjoining warp sheets (16, 18);

a shaft (62, 74, 88) extending in the direction orthogonal to the adjoining direction of said warp sheets (16, 18) and supporting said tension receiver (52);

a rotation blocking member (66, 78) for blocking angular rotation of said tension receiver (52); and

a rotational force detector (64) for detecting angular rotational force acting around the axis (54) of said shaft (62, 74, 88).

2. A device (10) for detecting difference in warp tension according to claim 1, **characterized by** further comprising an auxiliary member (58) extending from said tension receiver (52),

wherein said rotational force detector (64) is constituted as said rotation blocking member (66, 78) is disposed between said auxiliary member (58) and a frame (22) of the loom (20), and detects said angular rotational force acting in the adjoining direction of said warp sheets (16, 18) from said auxiliary member (58) to said rotation blocking members (66, 78).

3. A device (10) for detecting difference in warp tension according to claim 1, **characterized in that** said rotation blocking member (66, 78) blocks the angular rotation about the axis (54) of said shaft (62, 74, 88);

wherein said rotational force detector (64) is constituted as said rotation blocking member (66,

78), and includes a torque converter (76) for detecting angular rotational force about the axis (54) of said shaft (62, 74, 88).

4. A device (10) for detecting difference in warp tension of a loom, said device (10) detecting a difference in warp tensions of a plurality of warp sheets (16, 18) let off side by side in the weft inserting direction from different warp beams (12, 14), **characterized by** comprising:

a tension receiver (52) having a plurality of contact faces (48, 50) individually in contact with boundary end portions of the adjoining warp sheets (16, 18) and angularly rotatable about an axis (54) extending in the warp moving direction;

a shaft (88) supporting said tension receiver (52) so as to rotate angularly and extending in the direction orthogonal to the adjoining direction of said warp sheets (16, 18); and

a potentiometer (86) for detecting an angular rotational displacement of said tension receiver (52).

5. A device (10) for detecting difference in warp tension according to any one of claims 1 through 4, **characterized in that** said contact faces (48, 50) are displaceable in the perpendicular direction to said warp sheets (16, 18).
6. A device (10) for detecting difference in warp tension according to any one of claims 1 through 5, **characterized in that** said axis (54) is disposed at the position in the direction perpendicular to said warp sheets (16, 18), said position being located between both said boundary side face end portions.
7. A device (10) for detecting difference in warp tension according to any one of claims 1 through 6, **characterized in that** said axis (54) is located at the position in the direction orthogonal to the adjoining direction of said warp sheets (16, 18), said position being located at the center between said contact faces (48, 50).

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FIG. 1

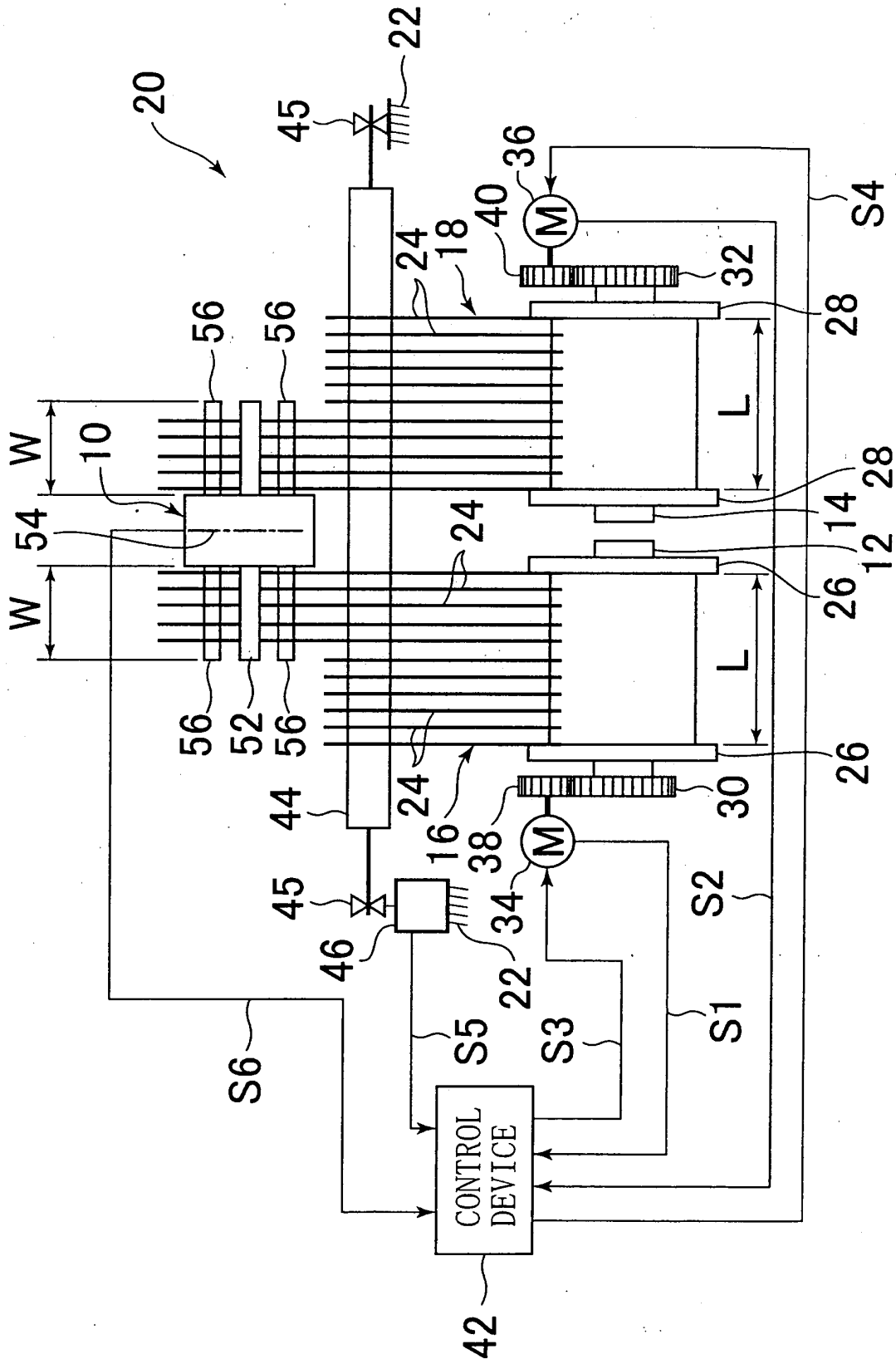


FIG. 3(A)

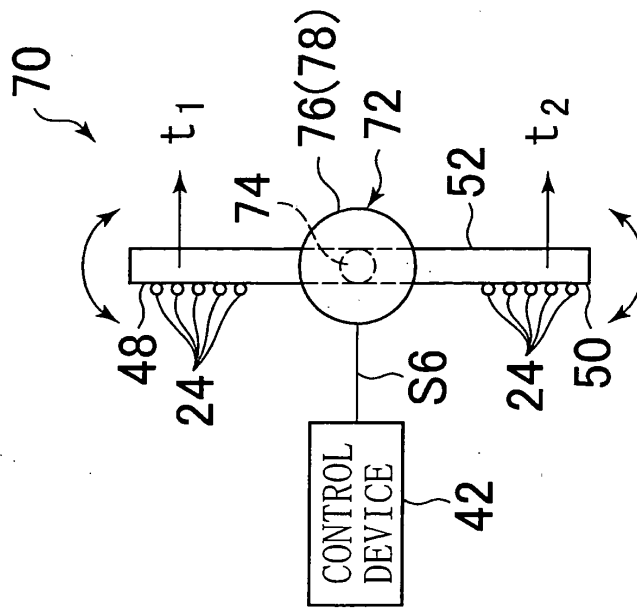


FIG. 3(B)

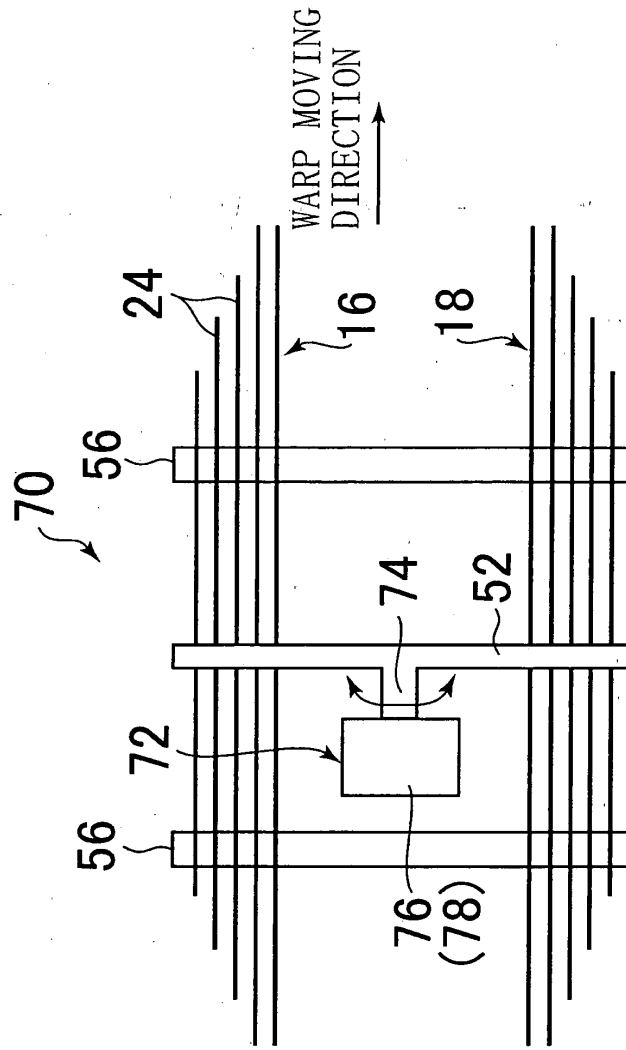


FIG. 4

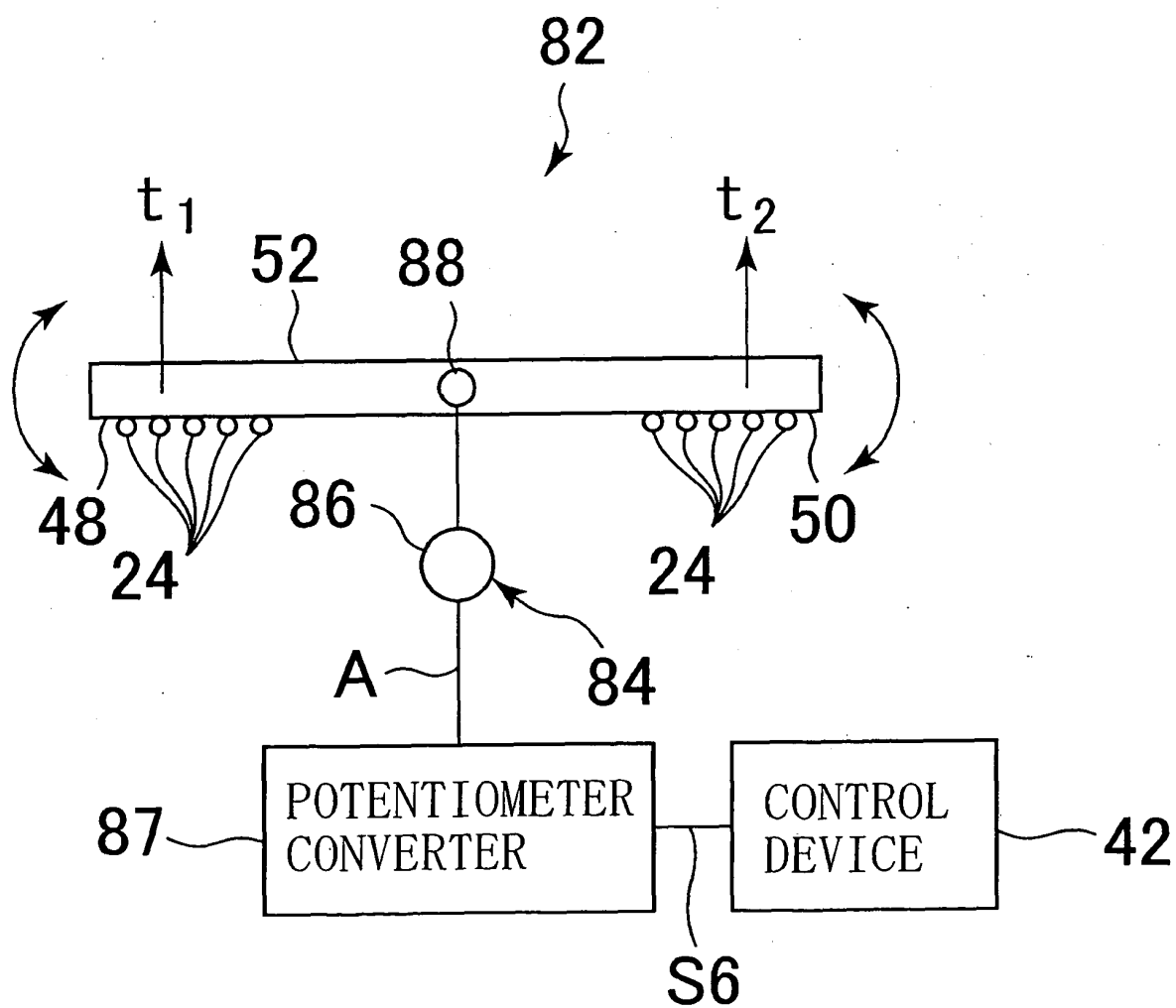


FIG. 5(A)

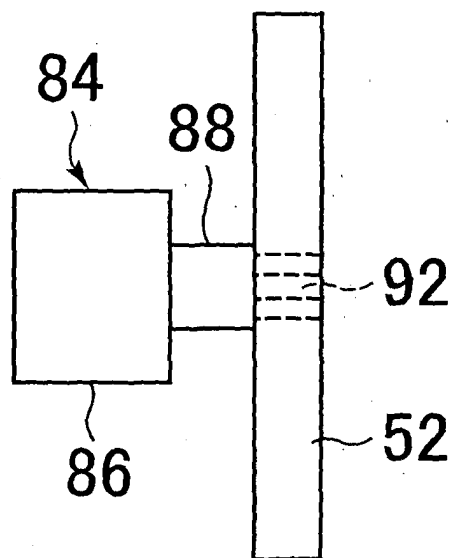


FIG. 5(B)

