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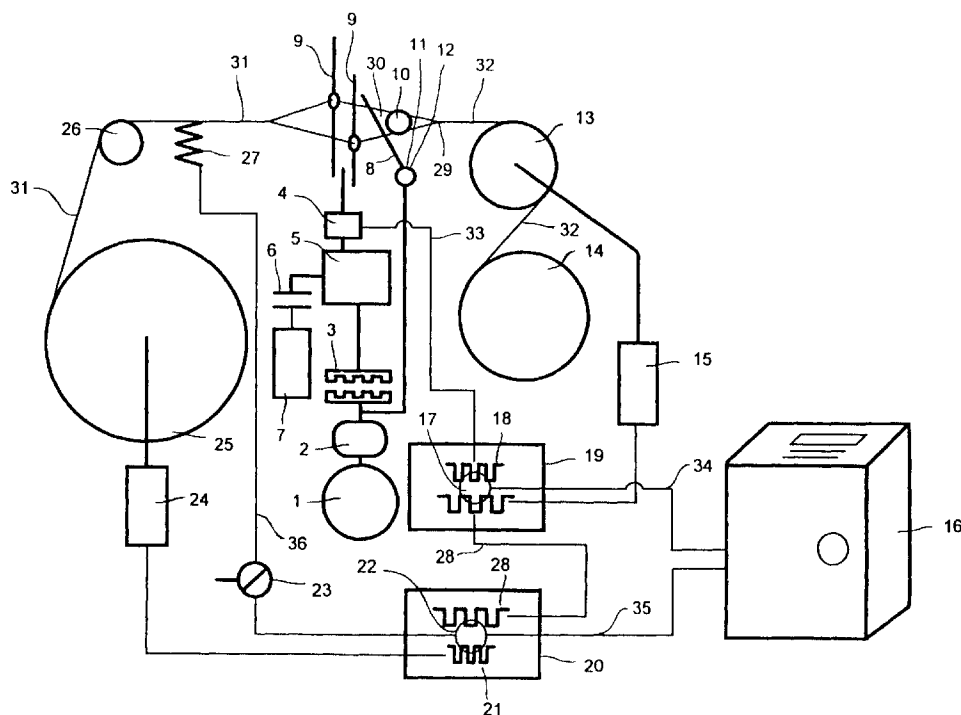
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(54) Control system for a shuttleless loom

(57) A control system for a shuttleless loom, in which the electric motor (24) driving the warp beam (25) is connected to the electric motor (15) driving the take-up roller (13) via a first control unit (20) for the electrical signal controlling the beam motor (24), and of which the transformation ratio is adjustable by the loom control unit (16); to the first control unit (20) there is also fed a signal representing the difference between the tension signal

of the tension sensor and a set signal, the two said motors (24,15) being synchronized with each other by the electrical signal of an angular velocity and/or position transducer (4) applied to the shed formation device, which signal is fed to the beam motor (24) and to the input of said first control unit (20) via an analogous second control unit (19), adjustable by said loom control unit (16).



Description

This invention relates to a shuttleless loom control system which, by synchronizing, with suitable transmission ratios, the warp beam speed with the electric motor speed on the basis of the speed of the shed formation device, for example the loom dobby, enables, in a simple and effective manner, not only weaving defects, such as so-called streaking, to be substantially avoided during transients consequent on the starting and stopping of the loom, and the weft density of the produced fabric to be easily varied, but also enables a broken weft yarn to be sought, in synchronization with said shed formation device, without any danger of alteration in the relative position of the last weft yarns inserted, which would produce a fabric defect.

In shuttleless looms, a warp beam provides the warp yarns which, guided by the heddles operated by the shed formation device, form the shed into which the weft yarns are inserted, these being beaten by a reed against the edge of the fabric under formation which, drawn by a take-up roller, is wound on a receiving roller.

A basic condition in such looms for achieving a fabric free of coarse defects is that the dragging tension of the warp yarns always remains constant. Again, as is well known, said tension depends on the unwinding diameter of the warp beam, this diameter evidently decreasing gradually as the warp yarns are unwound from said beam during operation. To compensate said tension variation, known looms are all provided with a tension sensor which measures the tension variation and conveniently controls the warp beam drive motor so as to return the tension to the desired value.

As said variation is generally slow, this type of device fully satisfies fabric quality requirements during continuous loom operation. However problems arise when the loom stops, for example because of a yarn breakage, and weaving is required to be restarted without discontinuity signs or striping appearing on the fabric.

In this respect, during a loom stoppage, for example while awaiting repair of the broken yarn, the elasticity of the yarns and fabric, which are kept under tension during operation, give rise during this static phase to a different tension balance in said yarns and fabric than when in the dynamic condition, so that there is a progressive translational movement of the fabric formation edge which, if not compensated, could on restart lead to a thickening or thinning of the inserted weft yarns and hence to a weaving defect.

Again, on loom restart, said tension sensor instantaneously measures a high tension difference value which is gradually compensated down to the normal value during a transient phase, during which the beam is hence alternately accelerated and braked with the result of giving rise to an alternation of weft yarns inserted alternately thinned and thickened. Moreover, because of the inevitable inertia of the moving members of the loom,

these reach working speed only after a certain transient period, during which for example the reed does not reach its normal weft beating position. The weft yarns inserted during this transient phase are hence spaced differently apart, giving rise to a fabric which is non-uniform and hence defective.

At this point it will be apparent that all the described transient phenomena determine a discontinuity in the fabric and hence a defective fabric, substantially in that they create a relative positioning error between the reed and the fabric formation edge.

It would hence be sufficient during the transient phase to suitably shift said fabric formation edge, so as to annul said error to overcome said drawbacks.

A system is already known in the state of the art for as far as possible reducing or preventing said transient phenomena during the starting and stopping of a shuttleless loom, so as to minimize weaving defects and fabric wastage. For this purpose, said known system provides for connecting both the warp beam motor and the motor of the weaving device to a control system for their direct synchronization, either stable or controlled, according to requirements. In other words, an angular velocity and/or position transducer is applied to the main loom motor, to be connected to the control system of the warp beam motor. In this manner, said control system receives information regarding the start and operating speed of the weaving device and hence adequately controls the operation of the warp beam.

A further development of the known system comprises the provision of a separate motor for the take-up roller, which is also connected to said control system, to be able to vary the transmission ratio between the main motor and the take-up roller in order to weave fabrics of different thickness and density, and to be able to suitably translate said fabric formation edge.

Such a known system, although being effective overall, presents drawbacks due to a certain operational complexity, in that the beam motor and the take-up roller motor are not synchronized with each other, so that the operator has to program two movements, namely those of the beam and of the take-up roller, in addition evidently to the transmission ratio necessary to obtain a determined weft density in the fabric. In addition, said known system is totally unable to synchronously search for the broken weft yarn, ie to synchronously rotate the beam and take-up roller backwards, because the angular velocity and/or position transducer, ie the element which allows the synchronization, is applied to the main loom shaft which, as known, is at rest during the search for the broken weft yarn.

The present invention seeks to obviate said drawbacks by providing a control system which, besides simplifying the task of the operator, allows unweaving synchronously with the search for the broken weft yarn.

According to the invention, there is provided a control system for a shuttleless loom comprising a warp beam driven by a first electric motor to feed the warp yarns,

with a certain tension measured by a tension sensor positioned downstream of said beam, to heddles which are operated to form the shed, into which the weft yarns are fed, by a shed formation device driven either by the main loom motor via a main coupling/decoupling device, or by an auxiliary motor via a secondary coupling/decoupling device; a take-up roller driven by a second electric motor to drag the fabric formed in correspondence with the vertex of said fabric formation shed; a reed, driven by said main motor to beat the weft inserted into the shed against said fabric formation edge or reed beating position; an angular velocity and/or position transducer; and a loom control unit, characterised in that said first electric motor driving the warp beam is directly connected to said second electric motor driving the take-up roller via a first control unit for the electrical signal controlling said first motor, which first control unit has a transformation ratio adjustable at will by said loom control unit and to which there is fed the output difference signal of a comparator which compares the signal of said warp tension sensor with a set value, the two said motors being synchronized with each other by the output signal of said angular velocity and/or position transducer, which is applied to said shed formation device, via a second control unit for the electrical signal controlling the take-up roller and of which the transformation ratio can be adjusted at will by said loom control unit, the output of which is connected to said electric motor of said take-up roller and to said first control unit for the electrical signal controlling the electric motor of said warp beam.

Thus the velocity of the warp beam and of the take-up roller are mutually synchronized on the basis of the velocity of the shed formation device, for example the dobby, by suitable transmission ratios adjustable by the loom control unit.

In other words, the electric motor driving the warp beam is directly connected to the electric motor driving the take-up roller, via a control unit for the first motor, the two motors being synchronized by the signal of an angular velocity and/or position transducer applied to the shed formation device, for example the loom dobby.

In this manner, it becomes necessary merely to program the corrections to the take-up roller movement, as the beam automatically follows the take-up roller, being synchronized therewith, even when this latter carries out particular manoeuvres, such as during transients, to maintain the fabric formation-edge in the correct position, so that no variations in the tension of the fabric and of the warp yarns arise. Again, as during the search for the broken weft yarn it is precisely the shed formation device which is moved slowly backwards by the auxiliary motor, the unweaving manoeuvre is carried out while always maintaining the beam motor and take-up roller motor in phase with the shed formation device, thus ensuring correct positioning of the fabric formation edge and hence excellent quality of the fabric produced.

Moreover, the transformation ratio of said control unit for the electrical signal controlling the warp beam

motor can be adjusted by the loom control unit, so that it becomes simple and rapid to vary the transmission ratio between the beam and take-up roller at will, even with the loom operating, on the basis of the different types of fabric to be produced. This central unit also receives the electrical signal representing the difference between the warp tension signal produced by the tension sensor and the set value, to correct the electrical control signal for the beam motor, in order to compensate the variation in the diameter of the beam as the warp yarns are gradually unwound.

Finally, said electrical signal from the angular velocity and/or position transducer applied to the shed formation device is fed in order to synchronize the take-up roller electric motor with the beam electric motor via a second control unit, the transformation ratio of which is adjustable by said loom control unit, the output of which is connected to said take-up roller electric motor and to said control unit for the warp beam electric motor. In this manner any appropriate velocities can be applied to the beam and take-up roller, thus making it possible to vary the fabric formation position as required.

The invention will now be described in greater detail, by way of example, with reference to the drawing, the single figure of which is a schematic representation of a shuttleless loom using the control system of the invention. In the figure, the reference numeral 1 indicates the main loom motor which, via a transmission device 2 of variable transmission ratio in order to be able to adjust the loom operating speed, controls the movement of the reed 8 from the retracted position, indicated in the figure by full lines, to the reed beating position, indicated in the figure by dashed lines 12, and vice versa, to beat the weft yarn, inserted by the insertion members 10 into the shed 30, against the fabric formation edge 29. Via said transmission device 2 and said coupling/decoupling device 3, the main motor 1 also operates the shed formation device 5 which itself operates the heddles 9 to form said shed 30 with the warp yarns 31 provided by the warp beam 25 via the deviation roller 26.

Alternatively, to seek a broken weft yarn, the shed formation device 5 can be operated by the auxiliary motor 7, by engaging the coupling/decoupling device 5 and disengaging the coupling/decoupling device 3. The fabric 32 produced is dragged by the take-up roller 13 and wound onto the winding roller 14. The warp beam 25 is driven by the electric motor 24, and the take-up roller is driven by the electric motor 15. An angular velocity and/or position transducer 4 is applied to the shed formation device 5 and feeds along the cable 33 an electrical signal 18, proportional to the velocity of the device 5, to a second control unit 19 for the electrical signal 28 controlling the motor 15 of the take-up roller 13, with a transformation ratio 17 adjustable at will by the loom control unit 16, via the cable 34. Said electrical signal 28 for controlling the motor 15 is also fed to a first control unit 20 for the electrical signal 21 controlling the electric motor 24 of the warp beam 25, with a transformation ratio

22 adjustable at will by said loom control unit 16 via the cable 35. Finally, a tension signal for the warp yarns 31, obtained by the tension sensor 27, is fed, via the cable 36, to be compared at 23 with a set value, the difference being fed to said first control unit 20.

The system operates in the following manner.

When operating under normal conditions, the transducer 4 feeds to the control unit 19 a signal proportional to the velocity of the shaft of the shed formation device 5, which is driven by the main motor via the coupling 3. The control unit 19 feeds an operating command to the motor 15 and to the control unit 20 proportional to the transformation ratio 17 set by the operator via the loom control unit 16. Said operating command 28, originating from the control unit 19, is corrected by the control unit 20 in accordance with the memorized ratio 22, this being continuously corrected by the comparison between the warp tension signal from 27 and the set value in 23, this latter correction compensating the variation in the diameter of the beam 25 as the warp yarns gradually unwind. During the starting of the loom, the reed 8 because of its inertia does not reach the reed beating position 12, but an intermediate position 11 as stated. The approach of the reed 8 to the position 12 is progressive as the loom speed increases, until it reaches normal speed. Hence to prevent a distance error between the last weft yarn inserted and the preceding, before starting the loom the motor 15 is made to undergo a movement independent of the loom and programmed by the operator via the control unit 16. The motor 24 moves in accordance with the memorized ratio 22, maintaining the warp tension unvaried. In this manner the fabric formation edge 29 can be moved into the correct position relative to the device 8, without altering the yarn tension and such that, after starting, the initial weft insertion takes place the correct distance from the preceding. After the approach of the first weft, the motors 15 and 24 have to make up the previously imposed movement, until the loom reaches normal working speed. This is achieved by progressively varying only the ratio 17. The

described operations are computed automatically at each loom restart, after suitable programming of the loom control unit 16 by the operator.

When the loom is at rest for repairing a broken yarn, during which the yarn and fabric tensions are in different equilibrium than in the dynamic condition and which can cause progressive translational movement of the fabric formation edge 29, at each loom stoppage the motors 15 and 24 are made to undergo non-synchronized movements arranged to impose the re-attainment of the correct tension equilibrium during loom stoppage, so as to prevent translation of the edge 29. If necessary, before starting the loom the movements carried out after stoppage can be compensated by returning to the previous running condition. These movements are also effected automatically, after the operator has programmed the loom control unit 16.

Finally, when seeking a broken weft yarn, as the

loom because of its inertia cannot stop instantaneously when the appropriate sensor detects a broken weft yarn, the broken weft yarn becomes trapped within the fabric. To prevent fabric defects it is therefore necessary to extract the broken weft yarn by an unweaving operation which releases the weft from the warp yarns and causes the loom to restart exactly at the same weft, with the same selection of the shed formation device 5 and with the same relative position of the motors 15 and 24. Moreover, the reed 8 must not enter into contact with the already formed fabric, as this would result in an alteration of the relative position of the last weft yarns inserted.

All this is achieved by the system of the invention, in that the reed 8 is maintained at rest and the slow-running unweaving operation is achieved by a synchronous movement of the electrically associated devices 5, 15 and 24 by engaging the device 6 and disengaging the device 3 under the control of the auxiliary motor 7.

Claims

1. A control system for a shuttleless loom comprising a warp beam driven by a first electric motor to feed the warp yarns, with a certain tension measured by a tension sensor positioned downstream of said beam, to heddles which are operated to form the shed, into which the weft yarns are fed, by a shed formation device driven either by the main loom motor via a main coupling/decoupling device, or by an auxiliary motor via a secondary coupling/decoupling device; a take-up roller driven by a second electric motor to drag the fabric formed in correspondence with the vertex of said fabric formation shed; a reed, driven by said main motor to beat the weft inserted into the shed against said fabric formation edge or reed beating position; an angular velocity and/or position transducer; and a loom control unit, characterised in that said first electric motor driving the warp beam is directly connected to said second electric motor driving the take-up roller via a first control unit for the electrical signal controlling said first motor, which first control unit has a transformation ratio adjustable at will by said loom control unit and to which there is fed the output difference signal of a comparator which compares the signal of said warp tension sensor with a set value, the two said motors being synchronized with each other by the output signal of said angular velocity and/or position transducer, which is applied to said shed formation device, via a second control unit for the electrical signal controlling the take-up roller and of which the transformation ratio can be adjusted at will by said loom control unit, the output of which is connected to said electric motor of said take-up roller and to said first control unit for the electrical signal controlling the electric motor of said

warp beam.

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