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(54) **Method for distributing wound yarn and device for carrying it out**

(57) The invention relates to a method and a device for distributing yarn wound on a cross-wound bobbin (2) at an operating unit of a textile machine, in which a yarn guide (3) actuated by a synchronous motor (43) reciprocates along the axis of the rotation of the wound bobbin (2), whereby on the synchronous motor (43) a time interval for the reciprocating travel of the yarn guide (3) from one dead centre (U1) to the other dead centre (U2) is set and the position of the yarn guide (3) is synchronized with the reference position which is between these dead centres (U1, U2). During each reciprocating travel, the time point of the actual passing of the yarn guide (3)

through the reference position is detected and the time difference between the time point of the actual passing of the yarn guide (3) through the reference position and the predetermined theoretical time point of the passing of the yarn guide (3) through the reference position is evaluated and, on the basis of the detected time difference, the duration of the rotation of the synchronous motor (43) changes until the respective reciprocating travel is finished, which also leads to the change of the length of the path of the yarn guide (3) from the reference position to the dead centre (U1, U2), to which the yarn guide (3) is currently approaching.

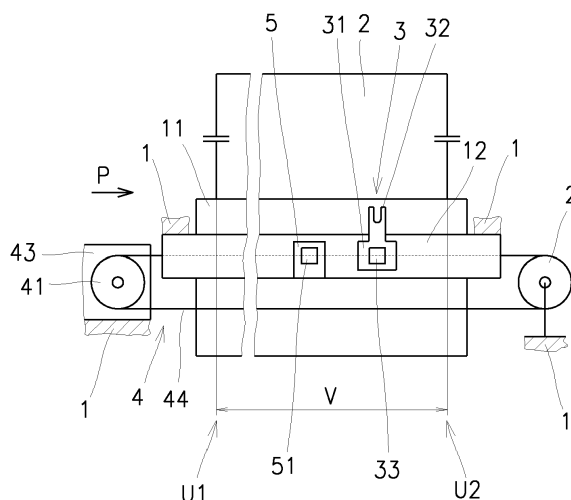


Fig. 1

Description

Technical field

[0001] The invention relates to a method for distributing yarn wound onto a cross-wound bobbin at an operating unit of a textile machine, in which a yarn guide actuated by a synchronous motor reciprocates along the axis of the rotation of the wound bobbin, whereby on the synchronous motor a time interval for a reciprocating travel of the yarn guide from one dead centre position to another is set, the position of the yarn guide being synchronized with the reference position which is found between these dead centres.

[0002] The invention also relates to a device for distributing wound yarn for a winding device of an operating unit of a textile machine, especially of a high-speed open-end spinning machine producing cross-wound bobbins, the device comprising a belt gear coupled with a drive synchronous motor which puts the belt into cyclic reciprocating motion, whereby on one branch of the belt of the drive gear is mounted a yarn guide, arranged movably in the guidance attached to a frame, whereby the distance between the dead centre positions of its motion corresponds to the width of the wound bobbin, whereby the synchronous motor is coupled with the control unit of the operating unit.

Background art

[0003] When distributing yarn which is wound to create a cross-wound bobbin, the bobbin rotates and the wound yarn is guided by the yarn guide, reciprocating along the axis of the bobbin rotation. The dead centre positions of this motion are defined by the ends of the yarn package in the area of the wound bobbin faces.

[0004] In the open-end spinning machines, the rotary drive of the bobbins, as well as the drive of the reciprocating yarn guides, are ensured communally for a row of operating units arranged next to each other. The reciprocating motion of a long distribution rod carrying a plurality of yarn guides results in large inertial forces, by which the frequency of this cyclic motion is limited.

[0005] With regard to large inertial masses, this solution, especially in the case of long guide rods, is scarcely applicable for highly efficient modern machines.

[0006] In air-jet spinning machines winding mechanisms with an individual drive of a yarn distribution device are preferred.

[0007] The device according to WO99/05055 solves a method for yarn laying and a corresponding distribution device, in which a traversing yarn guide at its travel is actuated by an electric motor, whereby the predetermined position of the guide is defined by the position of the electric motor, and the actual position of the guide is registered by a measuring device. The actual position is continuously registered during the process of winding, whereby the instant actual position is compared to the

predetermined desired position of the yarn guide and a corresponding differential signal is generated by the control device to control the operation of the electric motor. The differential signal is used to change the rotational speed of the electric motor. Some means of this device have large inertial masses and this fact, especially in combination with changes of the rotational speed of the electric motor, does not serve the purpose, for example in air-jet spinning machines. Moreover, continuous monitoring and assessment of the difference between the actual and predetermined positions of the yarn guide is complicated.

[0008] An apparatus for determining the zero position of a yarn guide of a winding device of a textile machine producing cross-wound bobbins is protected by the patent EP1684403B1. The guide of the yarn distribution device, or an element which is coupled with it, is connected to the drive by means of a belt drive means. The drive of the guide is created as a hybrid stepper motor comprising a rotor which has in its centre an axially magnetized two-pole permanent magnet. The rotor of the stepper motor is adjustable by means of switching off and resuming defined current supply of the stator windings. The apparatus does not solve high frequencies of the reciprocating motion and appears complicated in relation to setting the position of the yarn guide.

[0009] The aim of the invention is to eliminate or at least reduce the drawbacks of the background art and particularly to increase considerably the working speed of yarn distribution, as well as shorten extraneous unproductive periods which are caused by the elaborateness of device setting before its start-up.

Principle of the invention

[0010] The objective of the invention is achieved by a method for distributing yarn wound onto a cross-wound bobbin at an operating unit of a textile machine, whose principle is that during each reciprocating travel the time point of the actual passing of the yarn guide through the reference position is detected and a time difference between the actual passing of the yarn guide through the reference position and the predetermined theoretical time point of the passing of the yarn guide through the reference position is evaluated and, on the basis of the recorded time difference, the duration of the synchronous motor rotation till the moment of a corresponding reciprocating travel changes, and, consequently, it leads to the change of the length of the path of the yarn guide from the reference position to the dead centre to which the guide is currently approaching. Monitoring the time point of the passing of the yarn guide through one set reference position simplifies the operation of the device and makes it more precise, which favourably influences the quality of the yarn package, life service of the device and its reliability.

[0011] It is also advantageous if the rotational speed of the synchronous motor is constant during the process

of distribution.

[0012] The goal of the invention is also achieved by a device for distributing wound yarn for a winding device of an operating unit of a textile machine, whose principle consist in that on a yarn guide there is arranged a marking means, and between the dead centres of the motion of the yarn guide there is a sensor of passing of the marking means of the yarn guide, which is fixedly attached to the stationary frame in proximity of the guidance of the yarn guide, the sensor being coupled with the drive synchronous motor. That enables to evaluate easily and precisely a deviation of the operation of the device from the desired process of distribution and thereby creation of the yarn package.

[0013] Also, placing the sensor of passing of the marking means of the yarn guide in the middle between the dead centres of the motion of the yarn guide is a factor that contributes to it.

[0014] The sensing device comprises at least one contactless magnetic sensor, whereby the marking means of the yarn guide is composed of at least one magnet. This arrangement is simple, reliable and precise. It is especially advantageous to use a permanent magnet as a marking means.

[0015] The synchronous motor drive is realized by a two-phase disk synchronous motor with a feedback element. This type of motor has a very low moment of inertia, therefore it can work at a very high rotation speed.

[0016] The belt gear is realized by a flat belt, wherein its surface, which is in contact with the pulleys, comprises an electrically conductive layer. To achieve precise operation and long service life, the friction surface of the drive pulley is provided with an adhesive abrasion resistant material. Also, a tension means of the belt coupled with the driven pulley contributes to achieving that purpose.

[0017] The guidance of the yarn guide is composed of an on a stationary frame mounted guide rail, to which a sensing device is fixedly attached. It is advantageous if at least the surface of the guide rail, which is in contact with the yarn guide, is provided with a hard surface coating displaying a low friction coefficient.

Description of drawings

[0018] An example of embodiment according to the invention is schematically shown in the drawings, where Fig. 1 represents a front view of the device for distributing wound yarn and Fig. 2 is a side view in a direction P from Fig. 1.

Specific description

[0019] The high performance of air-jet spinning machines practically does not allow to use a common drive system for a plurality of yarn guides by one long traversing rod. Winding devices that are driven individually according to the background art enable to increase the fre-

quency of the reciprocating motion of the yarn guides, but there are still problems to be solved, namely the dynamics of the reciprocating motion of the yarn guides at extreme frequencies of this motion and a complexity of the control process of this motion with respect to the desired shape of the yarn package.

[0020] In the example of embodiment of a yarn distribution device according to the invention illustrated in Fig. 1 and 2, in the frame 1 of the operating unit of the machine is mounted a driving roller 11 driven by an unillustrated drive electric motor.

[0021] In contact with the surface of the driving roller 11 is a winding bobbin 2 arranged in a well-known manner in an unillustrated winding device of the operating unit. A guide rail 12 of a yarn guide 3 is mounted in a frame 1 parallel with the axes of the rotation of the driving roller 11 and the wound bobbin 2. A belt gear 4 comprising a drive pulley 41 and a driven pulley 42 is arranged parallel with the guide rail 12. The drive pulley 41 and the driven pulley 42 are situated outside the front faces of the driving roller 11. The drive pulley 41 is mounted on an output shaft of a synchronous motor 43. The driven pulley 42 is coupled with an unillustrated tension means. The drive pulley 44 runs in a vertical plane. The driven pulley 42 is coupled with an unillustrated tension device, or, in another embodiment, the tension of the belt 44 is solved by an unillustrated tension pulley arranged in contact with the lower branch of the belt 44.

[0022] The belt gear 4 uses a flat belt 44, whose friction surface is formed by a coating having a sufficiently high friction coefficient, whereby it is also partially electrically conductive so as to eliminate an occurrence of an electrostatic charge. Mounted in an unillustrated manner on the upper branch of the belt 44 is a carrying body 31 of the yarn guide 3 created from a material with a low friction coefficient. Fastened to the carrying body 31 of the yarn guide 3 is an independent ceramic guide means 32, which is in contact with the running distributed yarn.

[0023] The carrying body 31 of the yarn guide 3 is movably arranged in a groove 13 of the guide rail 12, which has a hard surface finish on account of achieving minimum abrasion and which has a minimum coefficient of friction. In the middle of the width of the wound bobbin 2, that means in the middle of the distance V between the dead centres U1, U2 of the motion of the yarn guide 3, on the guide rail 12 is fastened a contactless position sensing device 5 provided with a magnetic sensor 51 turned towards the path of the guidance of the yarn guide 3. In the surface of the carrying body 31 of the yarn guide 3 turned towards the vertical wall of the groove 13 of the guide rail 12 and thereby to the contactless sensing device 5 is situated a permanent magnet 33, which acts as a marking means of the yarn guide 3. In an unillustrated embodiment an electromagnet is used instead of a permanent magnet 33.

[0024] Both the drive synchronous motor 43 and the position sensing device 5 fastened to the guide rail 12 are coupled with the unillustrated control unit of the op-

erating unit of the textile machine using feedback signals, by which the control unit is informed about the state of the drive.

[0025] The overall configuration of the system of yarn distribution according to the invention is solved as a mechanical electronic system with emphasis on a minimum moment of inertia of the moving parts. Thus it is possible to achieve especially maximum and minimum accelerations of the reciprocating parts.

[0026] The solution is aimed especially at the means of the belt pulley 4 and at the controlling of the movement of the yarn guide 3, or, more specifically, its position within an extent of the distance V between the dead centres U1, U2, mainly in the area of these dead centres U1, U2.

[0027] From this point of view, in an example of embodiment according to the invention a high-speed disk two-phase motor 43 with an extremely low moment of inertia is used as a driving synchronous motor 43. Its maximum speed is, for example, 5000 min^{-1} and the moment of inertia is $7 \text{ kgm}^2 \cdot 10^{-7}$.

[0028] The actual position of the yarn guide 3 is registered by a sensing device 5, which identifies the time point in which the marking means of the yarn guide 3, that is the permanent magnet 33, is positioned against the magnetic sensor 51 of the sensing device 5. The actual position of the yarn guide 3 is recorded only in the middle of the distance V, that means exactly in the middle between the dead centres U1, U2 of the motion of the yarn guide 3.

[0029] Before the start of yarn winding, synchronization of the yarn guides is carried out by a magnetic sensor 51 of the sensing device 5. The reference position of the yarn guide 3 is defined only by the sensing device 5 situated immovably in the middle of the path of the yarn guide 3. The actual position of the yarn guide 3 is registered by the sensing device 5 during the passing of the yarn guide 3 in one and the other direction of its motion. The time points of the passing are recorded, whereby a time deviation from the predetermined time point of the passing is monitored. This deviation is recorded, the differential value occurs as a result of the belt 44 slip on the surface of the drive pulley 41. The time points of the passing of the permanent magnet 33 around the magnetic sensor 51 of the sensing device 5 are passed to the control unit of the operating unit of the textile machine as input signals. On the basis of the time deviation of the time point of the actual passing from the predetermined time point of the passing, a slip correction factor is generated as a time data, which is subtracted from or added to the predetermined (theoretical) duration of the path of the yarn guide 3. The resulting time indication is used for the subsequent reciprocating travel of the yarn guide controlled by a synchronous motor 43.

[0030] By changing the duration of motion (rotation) of the synchronous motor 43 with a feedback, the position of the yarn guide in dead centres U1, U2 of its motion is adjusted. Corrections of the position are then performed by changing the length of the path of the yarn guide 3,

by which means practically upon each reciprocating travel of the yarn guide the dead centre positions U1, U2 are adjusted to achieve the predetermined (theoretical) position. Thus the speed of the motion of the synchronous motor 43 remains constant.

[0031] The device according to the invention and the method for carrying it out is made simpler by a system of controlling the motion of the yarn guide 3, which added to employing a disk two-phase synchronous motor 43 and its constant rotational speed substantially reduces the negative impact of the inertial forces both in terms of the package quality and in terms of service life and reliability of the device.

15 List of references

[0032]

1	frame (of operating unit of textile machine)
11	driving roller
12	guide rail (of yarn guide)
13	guide groove (of yarn guide)
2	bobbin (wound)
3	yarn guide
31	carrying body (of yarn guide)
32	guide means (of yarn guide)
33	permanent magnet (marking means of yarn guide)
4	belt gear
41	drive belt pulley
42	driven belt pulley
43	stepper motor
44	belt (of belt gear)
5	sensing device (attached to guide rail)
51	magnetic sensor
U1	dead centre of motion (of yarn guide)
U2	dead centre of motion (of yarn guide)
V	distance between dead centre positions

Claims

1. A method for distributing yarn when being wound on a cross-wound bobbin (2) at an operating unit of a textile machine, in which a yarn guide (3) actuated by a synchronous motor (43) reciprocates along the axis of the rotation of the wound bobbin (2), whereby on the synchronous motor (43) a time interval for the reciprocating travel of the yarn guide (3) from one dead centre (U1) to the other dead centre (U2) is set and the position of the yarn guide (3) is synchronized with the reference position, which is found between these dead centres (U1, U2), **characterized in that** during each reciprocating travel the time point of the actual passing of the yarn guide (3) through the reference position is detected, the time difference between the time point of the actual passing of the yarn guide (3) through the reference position and the predetermined theoretical time point of the passing of the yarn guide (3) through the reference position is evaluated, and, on the basis of the recorded time difference, the duration of the synchronous motor rotation (43) changes till the moment of finishing the respective reciprocating travel, which also leads to the change of the length of the path of the yarn guide (3) from the reference position to a dead centre (U1, U2), to which the yarn guide (3) is currently approaching.
2. A method of yarn distribution according to Claim 1, **characterized in that** the rotation speed of the synchronous motor (43) is constant during the distribution.
3. A device for distributing wound yarn for a winding device of an operating unit of a textile machine, especially of a high-speed open-end spinning machine producing cross-wound bobbins (2), the device comprising a belt gear (4) coupled with a drive synchronous motor (43), which imparts a cyclic reciprocating motion to the belt (44), whereby on one branch of the belt (44) of the belt gear (4) is mounted a yarn guide (3), arranged movably in the guidance connected to a frame (1), whereby the distance between the dead centre (U1, U2) of its motion corresponds to the width of the wound bobbin (2), whereby the synchronous motor (43) being coupled with the control unit, **characterized in that** on a yarn guide (3) there is arranged a marking means of the yarn guide and between the dead centres (U1, U2) of the motion of the yarn guide (3) there is a sensing device (5) of passing of the marking means of the yarn guide (3), which is fixedly attached to the stationary frame (1) in proximity of the guidance of the yarn guide (3), whereby the sensing device (5) is coupled with the drive synchronous motor (43).
4. A device according to Claim 3, **characterized in that** the sensing device (5) of the passing of the marking means of the yarn guide (3) is placed in the middle between the dead centres (U1, U2) of the motion of the yarn guide (3).
5. A device according to Claim 3 or 4 **characterized in that** the sensing device (5) comprises at least one contactless magnetic sensor (51), whereby the marking means of the yarn guide (3) is composed of at least one magnet.
6. A device according to any of Claims 3 to 5, **characterized in that** the magnet of the marking means of the yarn guide (3) is a permanent magnet (33).
7. A device according to any of Claims 3 to 6, **characterized in that** the drive synchronous motor (43) is a two-phase disk synchronous motor with a feedback element.
8. A device according to any of Claims 3 to 7, **characterized in that** the belt (44) of the belt gear (4) is a flat belt, whereby its surface, which is in contact with the pulleys (41, 42), comprises an electrically conductive coating.
9. A device according to any of Claims 3 to 8, **characterized in that** the friction surface of the drive belt pulley (41) is provided with an adhesive abrasion resistant material.
10. A device according to any of Claims 3 to 9, **characterized in that** the belt gear (4) comprises a tension means of the belt (44) coupled with the driven belt pulley (42).
11. A device according to any of Claims 3 to 10, **characterized in that** the guidance of the yarn guide (3) is composed of an on the stationary frame (1) mounted guide rail (12), to which a sensing device (5) is fixedly attached.
12. A device according to any of Claims 3 to 11, **characterized in that** at least the surface of the guide rail (12), which is in contact with the yarn guide (3), has a hard surface layer, whereby it has a low coefficient of friction.

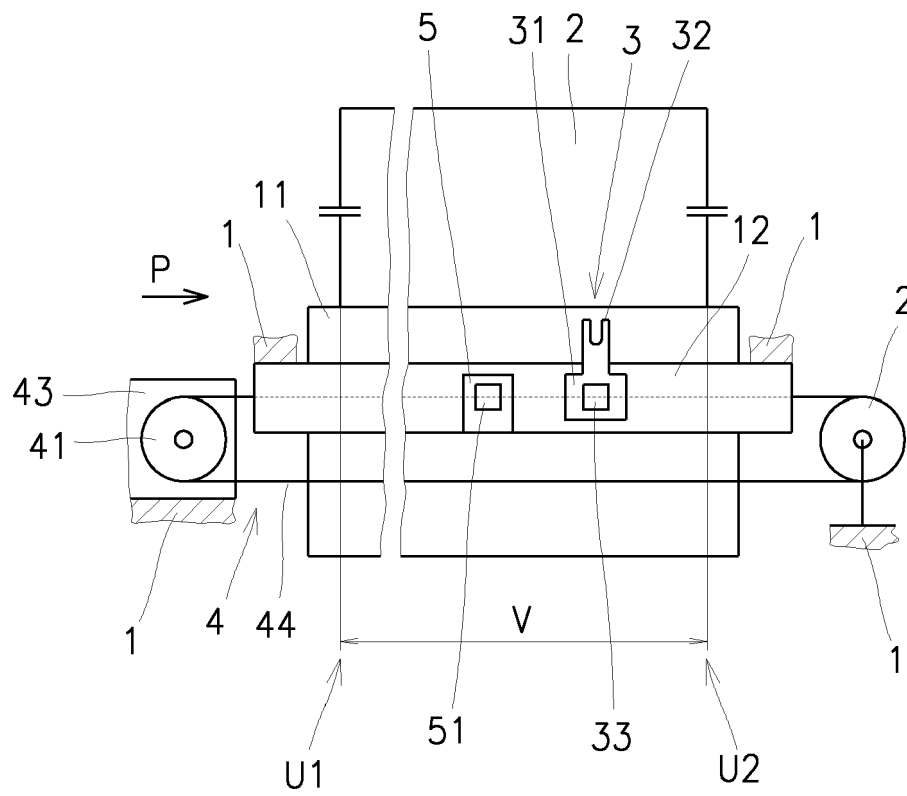


Fig. 1

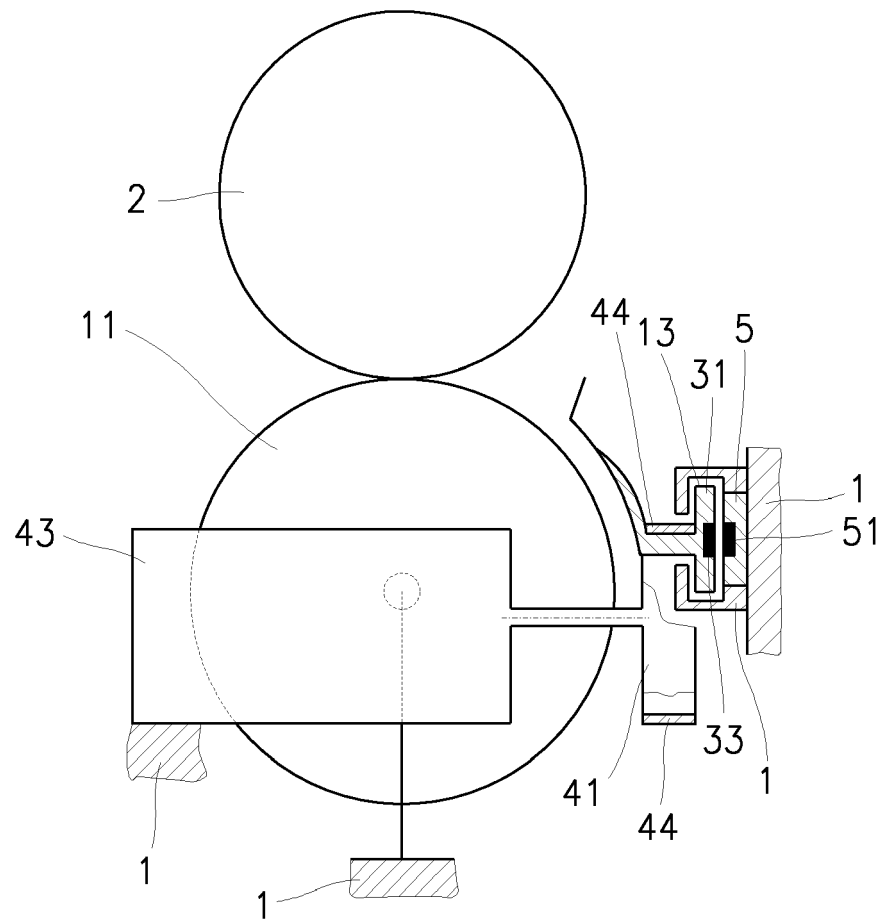


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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