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(54) **ELECTROMAGNETIC ACTIVE COMPENSATOR OF A YARN LOOP AT A WORKSTATION OF A TEXTILE MACHINE AND METHODS OF CONTROLLING IT**

(57) The invention relates to a method of controlling an electromagnetic active compensator, in which is controlled the motion of the compensating arm, whose one end acts on the yarn in the section between a draw-off mechanism of yarn and a yarn winding device and maintains stable tension in the yarn, whereby the position of the compensating arm (1) is sensed and a signal (P1) about the position of this compensating arm (1) is carried to a control device for the compensation of a yarn (21) loop, which according to it controls the operation of the compensator, the course of the motion of the compensating arm (1) and the size of the force (F) of the compensating arm (1).

An electromagnetic active yarn loop compensator at a workstation of a textile machine comprising a compensating arm mounted on a cylindrical magnet or a shaft with a magnet, which is mounted rotatably about its longitudinal axis between the pole extensions of the magnet, which is associated with an electric control coil connected to a source of electric current and to a control device, whereby the compensator comprises a position sensor (2) of the compensating arm (1). The position sensor (2) of the compensating arm (1) comprises at least two mutually spaced sensing elements, which are coupled to a control device (13).

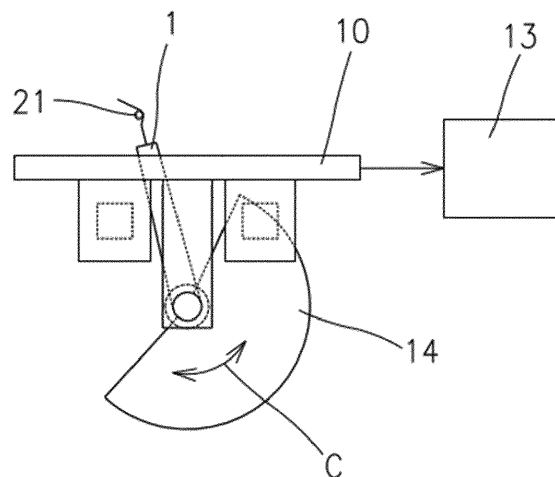


Fig. 3b

Description

Technical field

[0001] The invention relates to an electromagnetic active compensator of a yarn loop at a workstation of a textile machine comprising a compensating arm mounted on a cylindrical magnet or on a shaft with a magnet, which is mounted rotatably about its longitudinal axis between the magnet pole extensions, which is associated with an electric control coil connected to a power source and to a control device, the compensator comprising a position sensor of the compensating arm.

[0002] The invention also relates to a method of controlling the electromagnetic active compensator, in which the motion of the compensating arm is controlled, whereby the yarn is acted upon by one end of the compensating arm in the section between a draw-off mechanism of yarn and a winding device of yarn, while maintaining stable tension in the yarn.

Background art

[0003] During the winding of yarn on a cross-wound bobbin on a spinning machine at a constant speed of the yarn being produced, for example, on an open-end spinning machine or an air-jet spinning machine, the yarn is periodically slackened due to traversing the yarn across the bobbin width and a yarn loop is formed. Also, when yarn is wound on a cross-wound bobbin, yarn loop formation is caused by the different diameters of the two ends of the bobbin.

[0004] Due to the yarn loop formation or the slackening of the yarn, owing to the constant speed of the yarn production and the constant speed of drawing off the yarn from a spinning unit, it is necessary to compensate for this slackening by periodic lengthening and shortening the length of the yarn travel path between a draw-off mechanism and a winding device of yarn. For this purpose, various compensators are used, which comprise a compensating arm, which by one of its ends acts upon the yarn, lengthening or shortening the working path of the yarn at a workstation in the relevant section between the draw-off mechanism of yarn and the yarn winding device as required. Thus, the compensating arm also maintains a stable tension in the yarn, which is essential for the correct winding of yarn on a bobbin.

[0005] Known are solutions of spring compensators and magnetic compensators with a permanent magnet. However, these compensators have recently encountered limitations, particularly in terms of the dynamics of the compensating arm, depending on the ever-increasing yarn production speed, which makes it difficult to meet the technological requirements for the bobbin formation and at the same time maintain the simplicity in construction and the ease and speed of the setting of the individual parts as well as of the whole device.

[0006] CZ PV 2014-399 discloses a device for elimi-

nating a yarn loop when winding yarn on a cross-wound bobbin at a constant speed of the yarn being produced on a spinning machine, comprising a movable compensating arm with a yarn capturing and guiding means, whose path intersects the yarn travel path between a draw-off mechanism and a winding device of yarn. The compensating arm is rigidly mounted on an output element of a reversible bi-directionally controlled means which is connected to a control device for controlling the position and/or direction and/or speed and/or force action of the output element of the reversible bi-directionally controlled means. The reversible bi-directional means is formed either by a suitable electric motor, typically a BLDC motor, or by an electromagnetic device with a cylindrical magnet rotatably disposed about its longitudinal axis between the magnet pole extensions with which a control coil is associated. The control of the BLDC motor is based on the knowledge of the immediate position of the compensating arm, since BLDC motors already have a built-in encoder of rotation of its output shaft. The control of the electromagnetic device with a cylindrical magnet is based here on the data of at least one position sensor of the compensating arm.

[0007] The compensator thus created has several advantages, particularly in terms of reaction velocity and relatively large swing amplitude of the compensating arm. There is, however, a drawback which consists in limited manoeuvrability in certain situations, especially in connection with specific needs of the operations and manipulations performed during transient states that occur at the workstation, such as yarn spinning, a yarn break, bobbin replacement, etc.

[0008] CZ PV 2016-102 describes a solution of the electromagnetic compensator with a cylindrical magnet disposed rotatably about its longitudinal axis between the magnet pole extensions, which is associated with a control coil, whose aim is to improve dynamic parameters and control. According to this solution, the compensating arm and/or the cylindrical two-pole magnet is associated with at least one position sensor which is connected to a control device. Nevertheless, CZ PV 2016-102 does not describe in more detail how the signal of the sensor is processed in the control device. Although the device according CZ PV 2016-102 has some advantages, it still does not allow the regulation of the trajectory and force of the compensating arm during the entire compensation cycle, i.e., the entire range of the compensating arm motion. Moreover, there is a certain drawback regarding the limited controllability in certain situations, e.g. in idle state outside the loop compensation and when handling the compensating arm in the extreme positions, etc.

[0009] The goal of the invention is therefore to further improve the functional properties of the electromagnetic compensator with a cylindrical magnet rotatably mounted about its longitudinal axis between the magnet pole extensions to which is associated a control coil, during the winding of yarn on a cross-wound bobbin at a constant yarn speed of the yarn being produced on a spinning

machine.

Principle of the invention

[0010] The aim of the invention is achieved by an electromagnetic active compensator of a yarn loop at a workstation of a textile machine, whose principle consists in that the position sensor of the compensating arm comprises at least two mutually spaced sensing elements, which are coupled to a control device. The advantage of this arrangement is the fact that it enables to determine the position of the compensating arm, direction of its motion and its speed.

[0011] In a preferred embodiment, the position sensor of the compensating arm comprises at least two mutually spaced transmitting elements, against which are arranged two mutually spaced receiving elements constituting the sensing elements, whereby between the transmitting elements and the receiving elements there is a gap for the reciprocating motion of the shader of the moving compensating arm. The advantage of this arrangement is the fact that the position of the compensating arm, direction of its motion and its speed can be determined by using simple means.

[0012] In another preferred embodiment, the position sensor of the compensating arm comprises one optical transmitting element, against which are arranged two mutually spaced optical receiving elements constituting the sensing elements, whereby between the optical transmitting element and the optical receiving elements there is a gap for the reciprocating motion of the shader of the moving compensating arm. The advantage of this arrangement is saving one transmitting element and lower production costs of the device.

[0013] In another preferred embodiment, the position sensor of the compensating arm comprises at least one light source against which, behind the gap for the passage of the shader, is arranged at least a single-line optical sensor with a row of light-sensitive elements arranged next to each other. The advantage of such an arrangement is that there is a greater number of input data for the control device about the position and motion along the entire path of the compensating arm and finer regulation of the compensation force.

[0014] In another preferred embodiment of the position sensor of the compensating arm, the shader is formed by a compensating arm and/or by a shading element which is coupled to the compensating arm. The advantage of this arrangement in which the compensating arm constitutes the shading element is a simpler construction of the device, lower manufacturing costs and less space requirements. The arrangement in which the shading element is not formed by a compensating arm, allows a variable arrangement with respect to the spatial possibilities of incorporating the yarn loop compensator into the machine.

[0015] In another preferred embodiment of the position sensor of the compensating arm, the sensor comprises

at least one magnetic field source, against which is arranged at least one magnetic field receiver in at least two different spaced apart positions of the compensating arm, whereby between the the magnetic field source and the magnetic field receiver there is a gap for the passage of the shader which is coupled to the compensating arm and which is made of a magnetically active material. The advantage of this arrangement is insensitivity to dusty environments.

[0016] In another preferred embodiment of the position sensor of the compensating arm, the sensor comprises at least one s one magnetic field source, against which is arranged at least one one magnetic field receiver in at least two different spaced apart positions of the compensating arm, whereby the magnetic field source or the magnetic field receiver is formed by a shader, which is coupled to the compensating arm and which is made of a magnetically active material. The advantage of this arrangement is insensitivity to dusty environments and lower manufacturing costs of the device.

[0017] In yet another preferred embodiment, the active compensator comprises control electronics, which is provided with means of connection to a control system via a communication line. The advantage of this arrangement is easier service when replacing a voltage compensator and the possibility of adjusting and calibrating it outside the machine.

[0018] The principle of the method of controlling the electromagnetic active yarn loop compensator consists in that the position of the compensating arm is sensed and the signal about the position of this compensating arm is carried to the control device for the yarn loop compensation, which according to it controls the operation of the compensator, the motion of the compensating arm and the magnitude of the force exerted by the compensating arm. The advantage of this method of control is the fact that it provides the control device with a signal about the position of the compensating arm at least at two different points of the path of the working swing amplitude of the compensating arm and in this manner allows more accurate control of the parameters of the compensating arm motion by means of controlling the electric current flowing through the electric control coil, by which it is not only the speed of the motion of the compensating arm that is controlled more accurately, but also the direction and force by which the compensating arm acts on the yarn when winding the yarn on a bobbin.

[0019] In another preferred method of controlling an electromagnetic active yarn loop compensator, the force of the compensating arm is controlled to maintain the yarn tension during winding and traversing the yarn at a constant level or within a specified tolerance band or according to a predetermined pattern, even during one compensation stroke. The advantage of this method of control is that it enables to achieve dynamic control of the force of the compensating arm acting on the yarn at high winding speeds and to maintain the necessary yarn tension, while eliminating the yarn loop. Moreover, this

method of control also allows to set the development of the yarn tension over time.

[0020] In yet another preferred method of controlling an electromagnetic active yarn loop compensator, the force of the compensating arm is regulated to achieve a defined yarn loop while maintaining a crossing angle (α). The advantage of this method of control is that the median position of the swing amplitude of the compensating arm is maintained relative to the set median position of the bobbin being wound and that the crossing angle α is maintained by varying the winding speed or the rate of yarn traversing, with a view to its further technological use.

[0021] In another preferred method of controlling an electromagnetic active yarn loop compensator, the position of the compensating arm for the active control of the force of the compensating arm during a compensation stroke is sensed in an optical, magnetic or inductive or capacitive manner. The advantage of this method of control is the fact that it enables to select different kinds of materials of the shading element (of the compensating arm or the shader).

[0022] In another preferred method of controlling an electromagnetic active yarn loop compensator, by feeding defined time-limited current pulses into the drive, the compensating arm moves from its working position, in which the compensating arm acts on the yarn being wound, to the handling position, in which the compensating arm is situated outside the travel path of the yarn being wound and which is a stable position. The advantage of this method of control is the fact that while handling the yarn is performed in the space of the compensation stroke, it is not necessary to perform the moving of the compensating arm from the working position into the handling position by the machine operator or by another service robot, and, in addition, the handling position is stable.

[0023] The advantage of this arrangement is the fact that it enables to perform yarn loop compensation at high speeds, to set the position and force of the compensating arm throughout the compensation cycle at any point of its trajectory and control the functions for handling the yarn either by the machine operator or by an automatic service robot.

Description of the drawing

[0024] The invention is schematically represented in the drawing, where Fig. 1 shows an arrangement of an active yarn loop compensator, Fig. 2 shows a block diagram of controlling the active yarn loop compensator, Fig. 3a shows an arrangement of a position sensor of the compensating arm on an optical principle with two transmitting and two receiving optical elements, providing a signal about the position of the compensating arm, Fig. 3b is a top view of the arrangement of the position sensor of the compensating arm on an optical principle; Fig. 4a is an example the sensor of the compensating arm cre-

ated on a magnetic principle; Fig. 4b is a top view of an embodiment of the sensor of the compensating arm created on a magnetic principle.

Examples of embodiment

[0025] The invention will become apparent from the description of an exemplary embodiment of an active yarn loop compensator with a position sensor of the compensating arm and from the description of examples of controlling this compensator at a workstation of a spinning machine, where the compensator is arranged in the section between a draw-off mechanism of yarn from a spinning unit and a yarn winding device on a cross-wound bobbin.

[0026] The workstation of a spinning machine as such is well-known, and therefore, for the sake of completeness, it will be described herein only symbolically without a drawing. The spinning machine comprises at least one row of identical workstations arranged next to each other, each of which comprises a spinning unit in which yarns are formed. From the spinning unit, the yarn is withdrawn by a draw-off mechanism of yarn which comprises a known pair of draw-off rollers, between which the yarn passes and which are rotatably mounted in the machine frame. One of the draw-off rollers is coupled to an unillustrated drive and constitutes a driven draw-off roller, whereby the other draw-off roller is a pressure draw-off roller, which is rotatably mounted on a spring-loaded arm, by which it is pressed against the driven draw-off roller. In the yarn travel path downstream of the draw-off mechanism is arranged a winding device of yarn on a cross-wound bobbin comprising a transversing device of yarn by which the yarn being wound is traversed across the bobbin width.

[0027] The device for eliminating a yarn loop formed by an electromagnetic active compensator is arranged at the workstation in the yarn travel path between the draw-off mechanism and the winding device.

[0028] Fig. 1 shows an exemplary embodiment of an electromagnetic active compensator with a cylindrical magnet 5, which is arranged rotatably about its longitudinal axis between the magnet pole extensions 6. The magnet 6 is further associated with an electric control coil 3 connected to a source of electric current and to a control device 13, which controls the magnitude of the electric current flowing through the electric control coil 3, which creates a magnetic field 4 through which is controlled the magnitude and resulting direction of the action of the force F of the compensating arm 1 by which the compensating arm 1 acts on the yarn being produced during winding onto a conical bobbin. The magnitude and resulting direction of the action of the force F of the compensating arm 1 is determined by the synergistic effect of the magnetic coupling between the cylindrical magnet 5 and the magnet pole extensions 6 without the action of the electric control coil 3 and the magnetic coupling between the cylindrical magnet 5 and the magnet pole

extensions 6 with the addition of the magnetic forces generated by the electric control coil 3 acting on the magnet 6 on the basis of the control performed by the control device 13. In principle, the electromagnetic active compensator according to the invention can operate in such a manner that the compensating arm 1 on the cylindrical magnet 5 is held in one position by the magnetic forces between the individual magnetic parts. From this position, the arm 1 is moved in a controlled manner to a second position by the additional magnetic force generated by the electrical coil 3 due to the electric current controlled by the control device. Essentially, by controlling the electric current supplied to the coil 3 the bi-directional motion of the compensating arm 1 is controlled, including the magnitude of the force of the compensating arm 1 acting on the yarn (torque on the arm 1 x the length of the arm 1).

[0029] The electromagnetic active compensator according to the invention further comprises a position sensor 2 of the compensating arm 1, which provides the control device with a signal about the position of the compensating arm 1 at least at two different points of the path of the working swing amplitude of the compensating arm 1 and thus enables to achieve a more accurate control of the parameters of the motion of the compensating arm 1 by means of controlling the electric current flowing through the electric control coil 3, thereby controlling more accurately not only the speed of the motion of the compensating arm 1, but also the direction and force F, by which the compensating arm 1 acts on the yarn during the winding of the yarn on the bobbin. For safety reasons, the temperature of the windings of the electric control coil 3 is sensed by an unillustrated sensor of temperature to secure the protection of the windings of the electric control coil 3 from overheating and damage in the event of excessive electric current flowing through the electric control coil 3.

[0030] Fig. 3a and 3b show an example of embodiment of a position sensor 2 of the compensating arm 1 for determining the current position of the compensating arm 1 at two points of its path. In this embodiment, the sensor comprises a support plate of a printed circuit 10, on which two optical transmitting elements 11a and 11b, are located spaced from each other. From the optical transmitting elements 11a and 11b a light beam 15 is transmitted through a gap for the passage of a shader 14, which will be described hereinafter, the light beam being transmitted onto a pair of opposing optical receiving elements 12a and 12b, which change the received light signal into an electric signal, which is further processed by the control device 13 and is used to control the compensator. In one exemplary embodiment, the control device 13 is a part of the compensator body, in another exemplary embodiment the control device 13 is arranged outside the compensator body, e.g., it is formed by the control electronics of the workstation or of the spinning unit or even of the entire machine, etc.

[0031] Between the pair of optical transmitting elements 11a and 11b and the pair of optical receiving ele-

ments 12a and 12b, there is the above-mentioned gap for the reciprocating motion of the shader 14, which is formed either directly by any part of the compensating arm 1 and/or is formed by a special shading element, which is coupled to or is mounted on the compensating arm 1. As a result, the reciprocating motion of the compensating arm 1 is transmitted to this shading element, which moves reciprocatingly through the above-mentioned gap between the pair of optical transmitting elements 11a and 11b and the pair of optical receiving elements 12a and 12b. During this reciprocating motion, the shader 14 interrupts the luminous flux between the optical transmitting elements 11a and 11b and the optical receiving elements 12a and 12b, whereby from this data the control device 13 evaluates, for example, the current position of the compensating arm 1. In addition, from the time sequence of these signals it is possible to determine the direction of motion of the compensating arm 1, its speed and, if appropriate, even acceleration, etc. An output signal is then generated from these signals, serving as an input signal for the control system of the compensator. In this specific embodiment, the sensor elements 2 are located on a common plate of a printed circuit 10.

[0032] In the exemplary embodiment in Fig. 1, the sensor 2 of the position of the compensating arm 1 comprises an unillustrated light source, against which is arranged behind the gap for the passage of the shader 14 at least a single-line optical sensor 20, e.g., a CCD or CMOS image sensor, with a row of radiation-sensitive elements, whereby in the illustrated example of embodiment, the shader 14 is formed directly by a compensating arm 1 or by a shading element coupled to or mounted on the compensating arm 1. This sensor 2 is able to provide the control system of the compensator with very detailed information about the immediate position of the compensating arm 1 depending on time, including even information about the speed, acceleration and the direction of the motion of the compensating arm 1. Due to the circular travel path of the compensating arm there is a problem concerning the correct identification of the position of the compensating arm 1, which in several positions shades more than one light-sensitive element of the line optical sensor 20, but this problem can be solved by, for example, computing means.

[0033] In the embodiment shown in Figs. 4a and 4b, the sensor 2 is created on a magnetic principle, comprising at least one magnetic field source, against which is arranged at least one magnetic field receiver at least at two different spaced apart positions of the compensating arm 1, i.e. different positions within the working range of the reciprocating motion of the compensating arm 1. The magnetic field source here is either directly the compensating arm 1 made of a magnetically active material or the shader 14 mounted on it or connected to it and made of a magnetically active material.

[0034] The electromagnetic compensator according to the invention enables to realize a range of operating modes of the compensator, i.e. various functional activ-

ities, which will be described in greater detail with reference to Fig. 2.

[0035] The first example of the electromagnetic compensator control according to the invention is the dynamic control of the force **F** of the compensating arm **1**, which makes it possible to set (control) by the electric current supplied by the line **27** the force **F** exerted by the compensating arm **1** on the yarn **21** and which reaches different values during winding on a conical bobbin **22**, namely during each compensation stroke so as to eliminate changes in the yarn **21** tension caused by the conical nature of the bobbin **22** and by the deceleration of the guide **31** of yarn **21** of the traversing device in the path turns.

[0036] In another embodiment, controlling the electromagnetic active compensator according to the present invention is performed only by using the signal **P1** of the position sensor **2** of the compensating arm **1** at least at two points of the path of the compensating arm **1**, where the signal **P1** transmitted to the control device **13** by the line **25** gives information about the absolute position of the compensating arm **1**, and the control device **13** on the basis of the signal **P1** determines the direction of motion of the compensating arm **1**, and, subsequently, according to pre-defined requirements, controls the electric current into the electric control coil **3** of the electromagnetic compensator, by which is controlled the magnitude of the force **F** exerted by the compensating arm **1** on the yarn **21** being wound in the desired sections or within the entire range of the reciprocating motion (stroke) of the compensating arm **1**.

[0037] In another exemplary embodiment, dynamic control of the force **F** of the compensating arm **1** of the electromagnetic active compensator is performed with optimization according to the position of the traversing guide **31** of the yarn traversing device **21** before the winding device **32** of yarn **21**, see Fig. 2, which is an embodiment particularly suitable for the individual (unit) drive of the yarn traversing device **21**, in which is available signal **P2** carried by the line **26** from the sensor **29** of the position of the traversing guide **31** of yarn **21** or, in the case of the central drive of the traversing guides **31** of yarn **21** from the sensor **29** of the position of the traversing guides **31**. With this arrangement, for the control of the force **F** of the compensating arm **1** of the electromagnetic active compensator, the position of the compensating arm **1** is evaluated and, at the same time, also the position of the traversing guide **31** of yarn **21** is evaluated, which allows more accurate regulation of the yarn **21** tension in the desired sections of winding the yarn **21** on the bobbin **22**. Specifically, signal **P2** of the position of the traversing guide **31** of yarn **21** supplied by the line **26** and the signal **P1** of the position of the compensating arm **1** supplied by the line **25** are evaluated by the control device **13**, which according to predefined requirements controls the supply current of the electric control coil **3**, thereby controlling the force **F** by which the compensating arm **1** acts on the yarn **21** being wound at the desired points or sec-

tions or throughout the entire range of the stroke of the traversing guide **31** of yarn **21** as well as the electromagnetic active compensator according to the present invention.

[0038] In another exemplary embodiment, the two above-mentioned embodiments of the electromagnetic compensator control method have been modified in such a manner that the yarn **21** being wound is aligned with a sensor **35** of the yarn **21** tension, which is via the line **28** coupled to the control device **13**, whereby signal **Fp** of the sensor **35** of the yarn **21** tension is the feedback signal **Fp** for the control device **13** of the electromagnetic compensator.

[0039] In yet another exemplary embodiment, the control of the electromagnetic active compensator according to the present invention is the control of the size of the yarn **21** loop, in which the swing amplitude (extreme position) of the compensating arm **1** is controlled by means of the signal **P1** from the sensor **2** of the position of the compensating arm **1** at least at two points of the path of the compensating arm **1**. During winding on a cross-wound bobbin **22**, the well-known yarn **21** loop is formed due to the conical nature of the bobbin **22**, i.e. due to the different diameters of the bobbin **22** on the two edges of the bobbin **22**, (periodic slackening of yarn **21** - lengthening the travel path of yarn **21**). The aim of this method of control of the electromagnetic compensator is controlling the maximum size (length) of the yarn **21** loop so that the maximum size (length) of this yarn **21** loop is constant and so that also the swing amplitude of the motion of the compensating arm **1** depending on the diameter of the conical bobbin **22** is constant, while maintaining the constant tension in the yarn **21** being wound as well. The position sensor **2** of the compensating arm **1** determines the swing amplitude of the compensating arm **1**, namely not only the absolute value of the compensating arm **1** at least at two points of the path of the compensating arm **1**, but also the symmetry of the swing amplitude of the compensating arm **1** with respect to the set median position relative to the position of the traversing guide **31** of yarn **21**. The corresponding signal **P1** is carried from the sensor **2** to the control device **13**, and if the size of the swing amplitude of the compensating arm **1** exceeds the set limits **X0** or **X1** from either side or if the swing amplitude of the motion of the compensating arm **1** is not symmetrical with respect to the set median position, then the control device **13**, which is connected to the drive **33** of the winding device **32** of yarn **21** via the line **23**, adjusts the winding speed **Vn** of yarn **21** and/or the traversing speed **Vr** of yarn **21**, so that the median position of the swing amplitude of the compensating arm **1** will be maintained with respect to the set median position and so that the size of the swing amplitude will not exceed the set limits **X0** and **X1**, thus maintaining the crossing angle α (indicated by arrow **B**) of yarn **21** on the bobbin **22**.

[0040] Another example the electromagnetic compensator control according to the present invention is the targeted automated displacement of the compensating

arm 1 from the working position to the handling position and back. In the working position, the compensating arm 1 intersects the travel path of yarn 21 between the unillustrated draw-off mechanism of yarn 21 and the traversing device of yarn 21 before winding the yarn 21 on the bobbin 22 and performs the compensation of the yarn loop 21 being formed, whereas in the handling position, the compensating arm 1 is moved away outside the travel path of yarn 21 and the yarn 21 loop being compensated for between the unillustrated draw-off mechanism of yarn 21 and the traversing device of yarn 21 before winding the yarn 21 on the bobbin 22. Consequently, the compensating arm 1 in this position does not obstruct any mechanism in the service activity or does not stand in the way of the machine operator performing service activities at a specific workstation. In this method of controlling the electromagnetic compensator, at the time when the yarn 21 is not produced and yarn 21 is not wound at the workstation and when it is necessary to manipulate the yarn 21 or other elements or means at the workstation in the space of the compensation stroke of the compensating arm 1, the compensating arm 1 automatically moves from said working position to said handling (displaced, tilted) position, because the compensating arm 1 left in this workspace would make it difficult or impossible to perform the necessary handling operations. This displacement of the compensating arm 1 into the handling position according to the invention is carried out by applying an electric pulse targetedly to the electric control coil 3 of the electromagnetic active compensator with a higher value than the value used to control the compensator during the yarn 21 production, and due to this increased pulse the compensating arm 1 moves in a single movement from the working position to the handling position which, due to the force ratios (magnetic force from the individual magnets) in the compensator, is stable even after the control higher electric pulse has dropped, therefore no additional energy is required to maintain the compensating arm 1 in this stable handling position. The handling position of the compensating arm 1 lies outside the working swing amplitude (range of the working motion) of the compensating arm 1 in compensating the yarn loop during the production and winding of the yarn on the bobbin. To return the compensating arm 1 from the stable handling position back to the working/operating position, or, more specifically, to the space of the working motion range of the compensating arm 1 in compensating the yarn loop during the production and winding of the yarn on the bobbin, an electric pulse of higher value but with polarity opposite to the electric pulse used to move the compensating arm 1 from the working to the handling position is targetedly introduced into the electric control coil 3 of the compensator, thereby overcoming the internal magnetic forces of the electromagnetic active compensator which hold the compensating arm 1 in the handling position without energy being exerted, and the compensating arm 1 automatically moves to its working position, or to the space within the range

of the working motion of the compensating arm 1 during the yarn loop compensation during the production and winding of the yarn on the bobbin.

Claims

1. An electromagnetic active compensator of a yarn loop at a workstation of a textile machine comprising a compensating arm which is mounted on a cylindrical magnet or on a shaft with a magnet, which is rotatably mounted around its longitudinal axis between the pole extensions of the magnet to which is assigned an electric control coil, which is connected to a power source and to a control device (13), whereby the compensator further comprises a position sensor (2) of the compensating arm (1), **characterized in that** the position sensor (2) of the compensating arm (1) comprises at least two sensing elements, which are spaced apart from each other and coupled to the control device (13).
2. The electromagnetic active compensator of a yarn loop according to claim 1, **characterized in that** the position sensor (2) of the compensating arm (1) comprises at least two optical transmitting elements (11a, 11b), which are spaced apart from each other, against which are arranged optical receiving elements (12a, 12b) constituting the sensing elements, whereby between the optical transmitting elements (11a, 11b) and the optical receiving elements (11a, 11b) there is a gap for the reciprocating motion of a shader (14) of the moving compensating arm (1).
3. The electromagnetic active compensator of a yarn loop according to claim 1, **characterized in that** the position sensor (2) of the compensating arm (1) comprises one optical transmitting element, against which are arranged two optical receiving elements (12a, 12b), which are spaced apart from each other, the two optical receiving elements (12a, 12b) constituting the sensing elements, whereby between the optical transmitting element and the optical receiving elements (11a, 11b) there is a gap for the reciprocating motion of the shader (14) of the moving compensating arm (1).
4. The electromagnetic active compensator of a yarn loop according to claim 1, **characterized in that** the position sensor (2) of the compensating arm (1) comprises at least one light source, against which, behind the gap for the movement of the shader (14), is arranged at least a single-line optical sensor with a row of light-sensitive elements arranged next to each other.
5. The electromagnetic active compensator of a yarn loop according to any of claims 2 to 4, **characterized**

in that the shader (14) is formed by the compensating arm (1) itself and/or by a shading element which is coupled to the compensating arm (1).

6. The electromagnetic active compensator of a yarn loop according to claim 1, **characterized in that** the sensor (2) comprises at least one magnetic field source, opposite which is arranged at least one receiver of the magnetic field in at least two different positions of the compensating arm (1) which are spaced apart from each other, whereby between the source and the receiver of the magnetic field there is a gap for the passage of the shader (14) which is coupled to the compensating arm (1) and which is made of a magnetically active material. 5
7. The electromagnetic active compensator of a yarn loop according to claim 1, **characterized in that** the sensor (2) comprises at least one magnetic field source, opposite which is arranged at least one magnetic field receiver in at least two different positions of the compensating arm (1), the two positions being spaced apart from each other, whereby the magnetic field source or the magnetic field receiver is formed by a shader (14) which is coupled to the compensating arm (1) and which is made of a magnetically active material. 10
8. The electromagnetic active compensator of a yarn loop according to any of claims 1 to 7, **characterized in that** the control device (13) of the active compensator, which is part of the compensator assembly, is provided with means of connection to its superior control system via a communication line. 15
9. The method of controlling the electromagnetic active compensator according to any of the preceding claims, in which the motion of the compensating arm is controlled, one end of the compensating arm acting on the yarn in the section between a draw-off mechanism of yarn and a yarn winding device, maintaining stable yarn tension, **characterized in that** the position of the compensating arm (1) is sensed and the signal (P1) about the position of the compensating arm (1) is carried to the control device for the yarn (21) loop compensation, which according to the signal (P1) controls the operation of the compensator, the course of the motion of the compensating arm (1) and the size of the force (F) of the compensating arm (1). 20
10. The method of controlling the active compensator of a yarn loop according to claim 9, **characterized in that** the force (F) of the compensating arm (1) is regulated to maintain the yarn (21) tension during winding and traversing the yarn (21) at a constant level or within a specified tolerance band or according to a predetermined course, even during one com- 25

pensation stroke.

11. The method of controlling of the active compensator of a yarn loop according to claims 9 and 10, **characterized in that** the force (F) of the compensating arm (1) is regulated to achieve a defined yarn (21) loop while maintaining the crossing angle (α). 30
12. The method of controlling of the active yarn loop compensator according to claim 9, **characterized in that** the position of the compensating arm (1) for the active control of the force (F) of the compensating arm (1) is sensed during the compensation stroke in an optical, magnetic or inductive or capacitive manner. 35
13. The method of controlling the active yarn loop compensator according to any of claims 9 to 12, **characterized in that** by bringing defined time-limited current pulses to the drive (3) the compensating arm (1) moves from the working position, in which the compensating arm (1) acts on the yarn (21) being wound, to the handling position, in which the compensating arm (1) is situated outside the path of the yarn (21) being wound and which is a stable position. 40

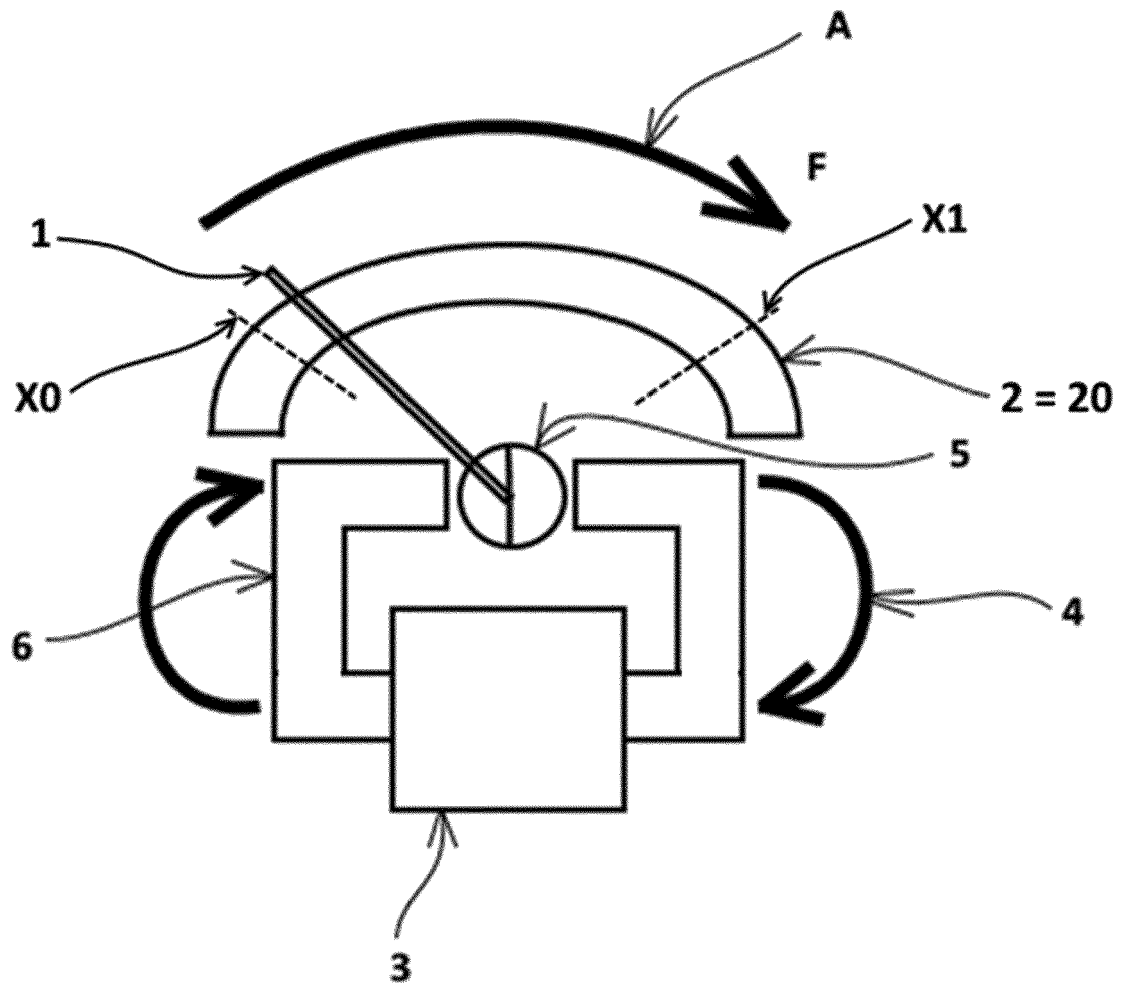


Fig. 1

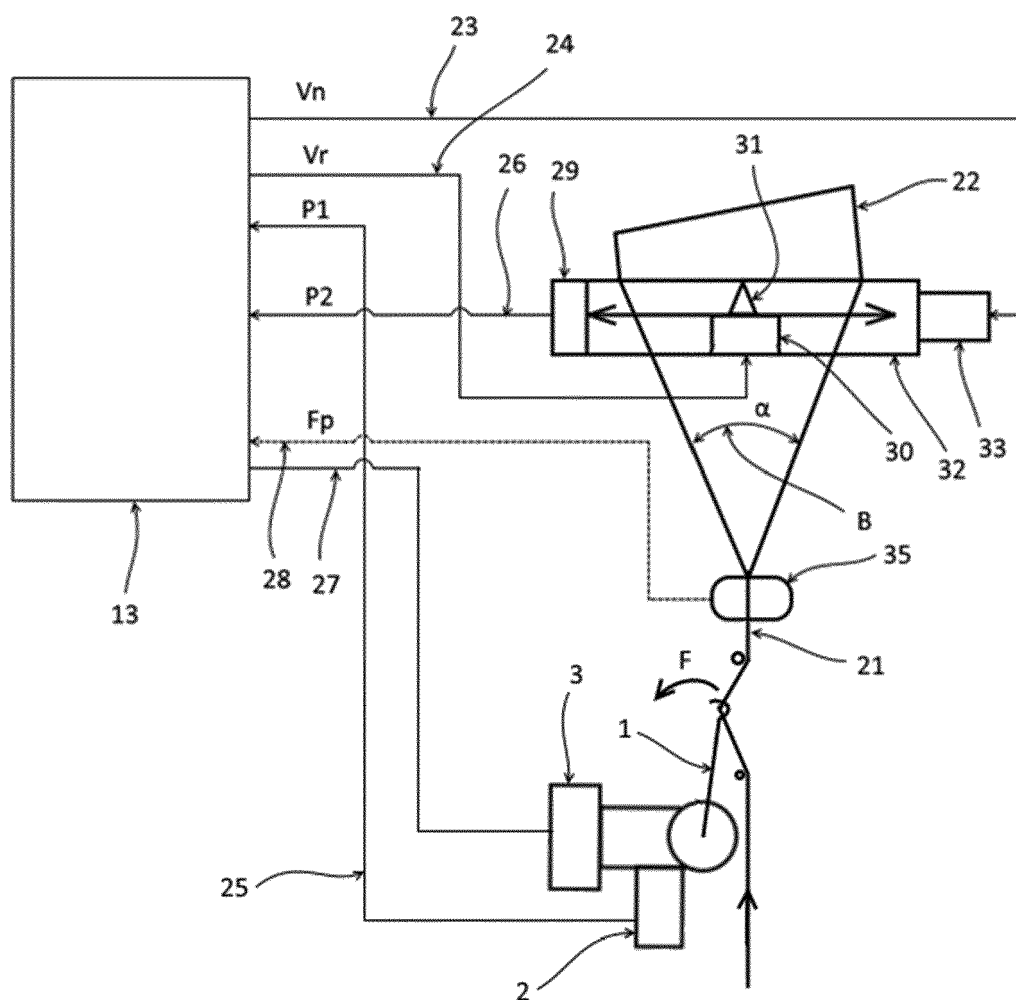


Fig. 2

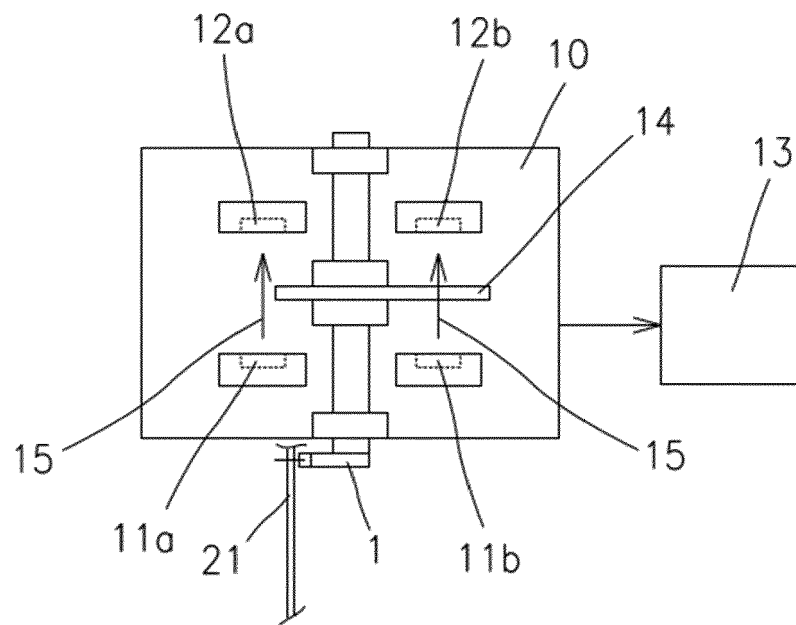


Fig. 3a

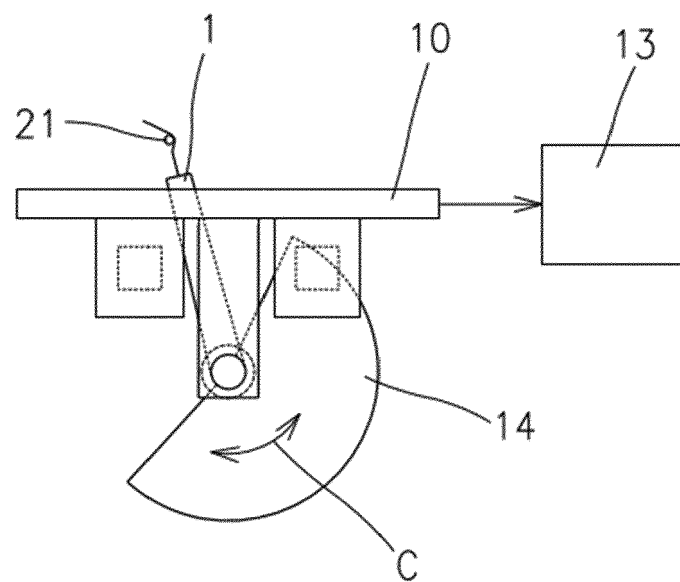


Fig. 3b

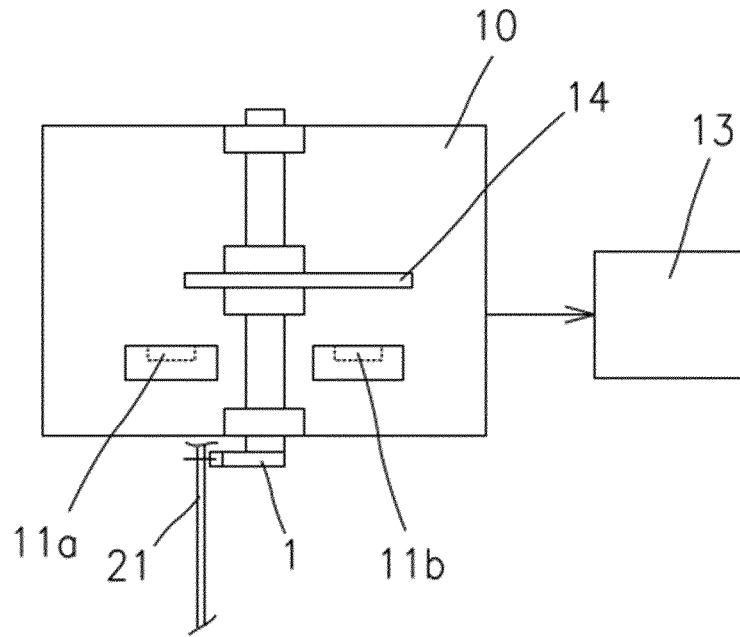


Fig. 4a

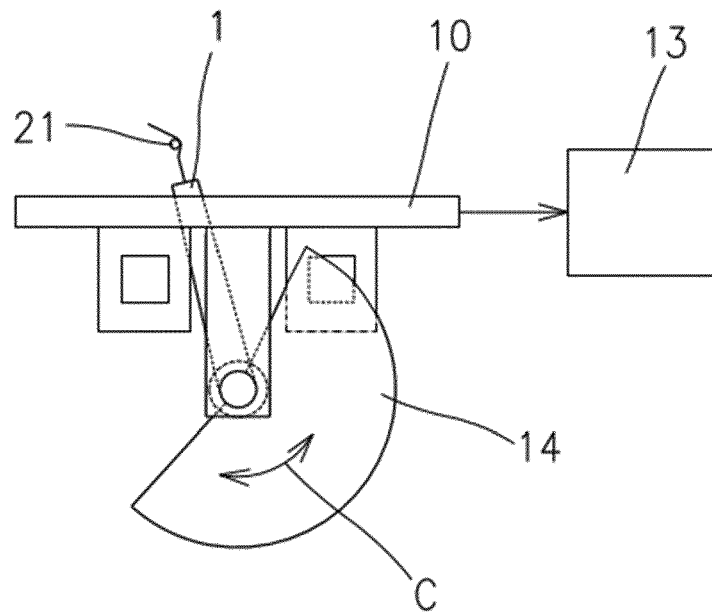


Fig. 4b



EUROPEAN SEARCH REPORT

Application Number
EP 18 17 3789

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 955 142 A1 (RIETER CZ S R O [CZ]) 16 December 2015 (2015-12-16)	1,8-11, 13	INV. B65H54/10
Y	* paragraphs [0003], [0006], [0008], [0009], [0010], [0023], [0026], [0028], [0031]; figures * -----	2-7,12	B65H59/00
Y	EP 0 285 204 A1 (SAVIO SPA [IT]) 5 October 1988 (1988-10-05) * column 5, line 48 - column 6, line 27 * * column 8, lines 35-42 * -----	2-7,12	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 October 2018	Examiner Lemmen, René
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 17 3789

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-10-2018

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Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 2955142	A1	16-12-2015	CN	105151894 A		16-12-2015
			CZ	305860 B6		13-04-2016
			EP	2955142 A1		16-12-2015

EP 0285204	A1	05-10-1988	CS	8801797 A3		12-08-1992
			DE	3872557 D1		13-08-1992
			DE	3872557 T2		10-12-1992
			EP	0285204 A1		05-10-1988
			IT	1203385 B		15-02-1989
			US	4854511 A		08-08-1989

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CZ PV2014399 [0006]
- CZ PV2016102 [0008]