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(54) THREAD TENSION ANOMALIES DETECTION

(57) Provided is a braiding machine with a bobbin carrier and a sensor for detecting thread tension anomalies. The bobbin carrier comprises a compensation device including a movable member, wherein a position and/or an orientation of the movable member depends on the thread tension. During operation of the braiding machine, the bobbin carrier travels, relative to the sensor, along a curved track and the sensor measures the position and/or the orientation of the movable member when the bobbin carrier passes by the sensor.

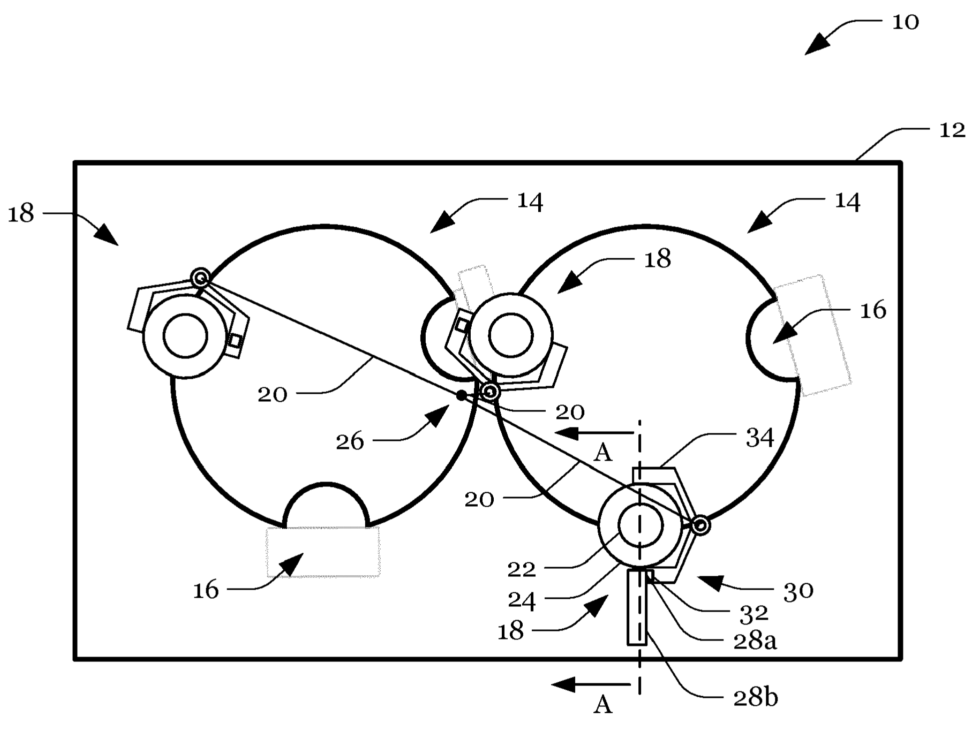

Fig. 1

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Description

FIELD

[0001] The present disclosure relates to devices, systems and methods for detecting thread tension anomalies. Particularly, the present invention relates to devices, systems and methods for detecting thread tension anomalies which may occur in a braiding machine during braiding.

BACKGROUND

[0002] The ability to precisely measure and control the thread tension during braiding is an important factor for both, machine uptime and braiding quality. For example, the measured thread tension may allow detecting a broken thread or reduce/increase thread tension to a desired value by operating a thread tensioning mechanism. Due to the various setups and braiding materials available, different approaches have been pursued to measure thread tension during braiding. For instance, DE 197 30 965 C1 teaches a stationary tactile sensor which measures the thread tension when a thread is moved past and deflected by the sensor. Moreover, DE 10 2014 016381 B4 teaches a bobbin carrier mounted sensor which measures the deflection of a thread guiding element of the bobbin carrier.

SUMMARY

[0003] The present invention provides for braiding machines, systems, and methods for detecting thread tension anomalies by use of a stationary (bobbin-independent) sensor. In this regard, the term "thread tension anomalies", as used throughout the description and the claims, particularly refers to changes in the thread tension (e.g., transient spikes) occurring during operation, which foreshadow (thread unwinding issues which may result in) a sudden rise in thread tension that may cause the thread to break.

[0004] A braiding machine in accordance with the present invention has a bobbin carrier and a sensor for detecting thread tension anomalies. The bobbin carrier comprises a compensation device which includes a movable member, wherein a position and/or an orientation of the movable member depends on the thread tension. During operation of the braiding machine, the bobbin carrier travels, relative to the sensor, along a curved track. When the bobbin carrier passes by the sensor, the sensor may measure the position and/or the orientation of the movable member. The measured position and/or the measured orientation may then be used to detect thread tension anomalies.

[0005] In this regard, the term "bobbin carrier", as used throughout the description and the claims, particularly refers to devices on which a bobbin is mounted. I.e., a bobbin carrier provides a frame that supports the bobbin while the bobbin rotates relatively thereto when unwinding the thread. As the bobbin carrier moves relatively to the machine body, the movement of the bobbin relative to the machine body may be determined by superimposing the movement of the frame of the bobbin carrier (along a closed track) relative to the machine body, and the rotation of the bobbin relative to the frame of the bobbin carrier during unwinding. As braiding involves interlacing three or more threads of flexible material such as textile yarns, wires, etc. the braiding machine may comprise a bobbin carrier for each of said threads.

[0006] Moreover, the term "compensation device", as used throughout the description and the claims, particularly refers to a device that allows compensating variations in the distance between the bobbin carrier and the braiding point as the bobbin carrier travels along the curved track. Furthermore, as used throughout the description and the claims, said term may also refer to devices which (partially) compensate variations in the speed at which the thread is unwound from the bobbin. In any case, the compensation device may ensure that the thread tension is maintained within a region that is suitable for both, the thread material and the desired braiding pattern.

[0007] Furthermore, the term "movable member", as used throughout the description and the claims, particularly refers to an element which is rotatably and/or slidably mounted onto the bobbin carrier frame such as, for example, a lever or slider. In this regard, the formulation that "a position and/or an orientation of the movable member depends on the thread tension" is to be understood in the way that the movable member may be moved from a first position towards a second position (which is different from the first position) if the thread tension increases and vice versa. For example, the thread tension may act on the movable member against a restoring (or resetting) force such that the movable member remains stationary (relative to the frame of the bobbin carrier), if both forces are in equilibrium. Accordingly, the position of the movable member can be mapped to the thread tension.

[0008] In addition, the formulation that "the bobbin carrier travels, relative to the sensor, along a curved track", as used throughout the description and claims, in particular means that the bobbin carrier frame is guided by the braiding machine along a closed path. The track may be populated with one or more bobbin carriers and the path may comprise self-intersections. The closed path may also intersect with (other) closed paths along which one or more other bobbin carriers of the braiding machine are guided to interlace the threads unwound from the bobbins mounted on said bobbin carriers. When traveling along its track, the bobbin carrier may be driven by horn gears or another suitable driving mechanism.

[0009] Moreover, the formulation "when the bobbin carrier passes by the sensor", as used throughout the description and claims, in particular means that the sensor is arranged alongside the track and assigns measurements to a bobbin carrier that is within a measurement range of the sensor and/or closest to a center of the measurement range of the sensor. In each cycle, the bobbin carrier moves towards/into (a central portion of) the measurement range of the sensor (wherein the distance between the bobbin carrier and the sensor typically decreases), and then moves out of/away from the (central portion of) the measurement range of the sensor (wherein the distance between the bobbin carrier and the sensor typically increases).

[0010] Furthermore, the formulation "the sensor may measure the position and/or the orientation of the movable member", as used throughout the description and claims, in particular means that different positions and/or orientations of the movable member will result in different sensor signals when the bobbin carrier moves past the sensor. Moreover, multiple measurements may be used for detecting a change in the position and/or orientation, resulting in a time series of measurements that show the thread tension over time and allow to determine thread tension variations and/or patterns in the thread tension variations.

[0011] As the sensor is arranged (independently from the bobbin carrier) along the track along which the bobbin carrier(s) is/are travelling during operation of the braiding machine, a single sensor may serve to determine the tension of multiple different threads. If multiple sensors are arranged along the track, "blind spots" may be avoided/reduced and the overall accuracy may be increased, as each sensor may be used to determine the thread tension of each bobbin carrier that passes by. In this regard, it is to note that because the sensor is configured to measure the position and/or the orientation of a movable member of the compensation device, no (potentially damaging) strain is imposed on the threads.

[0012] In an embodiment, the braiding machine further comprises a computing device that is configured to raise an alarm and/or to generate a control signal if one or more measurements indicate that the thread tension and/or a variation of the thread tension is/are above an upper limit or shows/show a predefined pattern.

[0013] In this regard, the term "predefined pattern", as used throughout the description and claims, in particular refers to a gradual increase in a moving average of the thread tension.

[0014] Hence, if unwinding issues such as e.g. a fibrous ring, occur, the braiding machine may be stopped (e.g. by the control signal) to avoid that the thread breaks. Accordingly, instead of being limited to detecting that a thread has broken (as currently available braiding machines often are), a braiding machine according to the present disclosure may allow resolving an unwinding issue (as part of a maintenance operation) before the thread breaks, thereby increasing overall machine uptime and reducing maintenance effort.

[0015] In an embodiment, the computing device is configured to assign measurements to different bobbin carriers and to indicate which bobbin carrier is subject to a thread tension anomaly, when an alarm is raised and/or a control signal is generated.

[0016] For example, a track may be populated with multiple bobbin carriers that are subject to measurements taken by the sensor. If the computing device is provided with information that allows assigning one of the bobbin carriers to one measurement and if the overall number of movable members in relation to which the sensor will take measurements is made available to the computing device, the computing device may keep track of which measurement belongs to which bobbin carrier. To allow for an initial assignment, one movable member may be provided with a target that differs from the targets of other movable members. Regardless of whether an initial assignment has been performed, the braiding machine may be stopped after an alarm has been raised in such a way that the bobbin carrier is placed at a pre-determined position. Moreover, the position of the bobbin carrier, which shows an anomaly, may be indicated to maintenance personnel, e.g., by a visual indicator (, e.g., a lamp mounted onto the machine body close to the pre-determined position, a symbol on a screen of the computing device, etc.).

[0017] In an embodiment, the computing device is configured to determine an operation speed by counting bobbin carriers which pass by the sensor during a time interval.

[0018] For instance, the time that lapses between two or more instances, at which the bobbin carrier passes by the sensor, may be used as an indicator for the operation speed of the braiding machine, or a part of the braiding machine relating to the curved track along which the bobbin carrier travels. I. e., as it can be detected when a bobbin carrier passes by the sensor, a higher operation speed will (statistically) result in more detections within a same time interval or less time between detections (which means a higher detection frequency).

[0019] In an embodiment, the movable member is configured to generate a magnetic field and the sensor is configured to measure said magnetic field when the movable member passes by the sensor.

[0020] For example, the target may be a permanent magnet which produces a magnetic field that can be measured using a Hall effect sensor. During operation, the Hall effect sensor may continuously measure the magnetic field within a measurement range and determine the thread tension from the measured magnetic flux density. As each permanent magnet that passes by the sensor will produce a characteristic variation of the magnetic flux density (e.g., a spike), the sensor may allow collecting data that adds to a magnetic flux density pattern. The pattern may show at what time a bobbin carrier passed by the Hall effect sensor, as well as, through a mapping process, the corresponding thread tension.

[0021] In an embodiment, the movable member is a lever or slider which is connected to a guiding element and a resilient element, wherein the guiding element is to guide the thread upon unwinding and the resilient element is to apply a restoring force opposing the thread tension, to the movable member.

[0022] As the thread is guided by the guiding element, an increase in thread tension will also increase a force that acts on the guiding element. As the force acting on the guiding element is countered by a restoring force of the resilient element, the guiding element will be displaced against the restoring force if the thread tension increases, and vice versa. Hence, the displacement can be mapped to the thread tension. The mapping may be achieved by way of calculation and/or experiments (e.g., test runs).

[0023] In an embodiment, the lever or slider is connected to a locking and/or braking member which locks and/or brakes the bobbin if the thread tension is below a desired value.

[0024] Accordingly, the movable member may serve multiple purposes at once. More particularly, the movable member may allow compensating variations in the distance between the bobbin and the braiding point when the bobbin carrier moves along the curved track. Moreover, the movable member may cause unwinding the thread when the thread tension reaches an upper limit. In addition, the displacement and/or orientation of the movable member may be monitored to detect thread tension anomalies that are caused by unwinding issues that may, if not resolved, result in breaking the thread. If a thread breaks, all threads have to be cut, and a part of the braid has to be removed. After that, the threads have to be reconnected such that considerable maintenance effort is caused.

[0025] In an embodiment, the locking member is a pin which is to engage with notches in the bobbin to lock the bobbin.

[0026] Hence, when the thread tension reaches an upper limit, the pin disengages with the bobbin notches and releases the bobbin. As the released bobbin rotates to unwind the thread, the thread tension is stabilized. When the thread tension falls below the upper limit, the pin reengages with the bobbin and locks the bobbin. During braiding, cycles of disengaging and reengaging may occur at a high frequency.

[0027] In an embodiment, the guiding element is a pulley.

[0028] The pulley changes the direction at which the thread tension acts on the bobbin. For example, the thread may extend between the bobbin and the pulley in a direction perpendicular to the axis of rotation of the bobbin. Between the pulley and the braiding point, the thread may extend in a direction which is substantially parallel to the axis of rotation of the bobbin. However, the present invention is not limited to radial braiding machines, but may also be applied to other types of braiding machines, such as, for example, axial braiding machines.

[0029] A system for measuring a tension of a thread in a braiding machine, in accordance with the present invention, comprises a target to be attached to a compensation device of a bobbin carrier of the braiding machine, a sensor to be attached to a body of the braiding machine, and a computing device which is configured to monitor a state of the compensation device when the target is moved past the sensor.

[0030] The system may be used to upgrade legacy braiding machines or equip current braiding machines with a thread tension monitoring/controlling mechanism.

[0031] In this regard, the formulation "to monitor a state of the compensation device", as used throughout the description and claims, in particular refers to extending the use of components required for compensating the variation in distance between the bobbin and the braiding point (while maintaining the thread tension within a desired range) to monitoring the thread tension. I. e., the compensation device which reacts to/is controlled by the thread tension is reused as a building block of the present thread tension monitoring mechanism.

[0032] In an embodiment, the target is a magnet and the sensor is a Hall effect sensor.

[0033] In an embodiment, the computing device is configured to monitor a position and/or an orientation of a movable member which is to control a braking force applied to the bobbin, based on the thread tension.

[0034] A method of measuring a tension of a thread in a braiding machine, in accordance with the present invention, comprises sensing, by a stationary sensor arranged along a path of a bobbin carrier, a position of a movable member when the bobbin carrier passes by the sensor, wherein the movable member is connected to a resilient element that resets the movable member against the thread tension, and determining tension anomalies based on one or more sensed positions and/or sensed orientations.

[0035] In an embodiment, a magnet is attached to the movable member and the stationary sensor is a Hall effect sensor.

[0036] In an embodiment, the stationary sensor is configured to sense positions and/or orientations of movable members of different bobbin carriers passing by the stationary sensor one after the other.

[0037] It will be appreciated that the features and attendant advantages of the disclosed machine/system may be realized by the disclosed method and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The foregoing aspects and many of the attendant advantages will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein like reference numerals refer to like parts throughout the various views, unless otherwise specified.

Fig. 1 shows a schematic top view of a braiding machine;

Fig. 2a and Fig. 2b show schematic cross-sectional views of the braiding machine of Fig. 1, that illustrate a movement of the movable member;

Fig. 3 shows an example of a bobbin carrier with a compensation device;

Fig. 4a and Fig. 4b show examples of movements the movable member may perform when the thread tension increases;

Fig. 5 illustrates a locking/braking mechanism coupled to the movable member;

Fig. 6 illustrates a thread tension anomaly that may be detected by a computing device which is fed with data from a sensor that measures the position and/or the orientation of the movable member;

Fig. 7a-7c illustrate further thread tension anomalies the computing device may be programmed to detect; and

Fig. 8 shows a flow-chart of a method for measuring a tension of a thread in a braiding machine.

Notably, the drawings are not drawn to scale and unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

DETAILED DESCRIPTION

[0039] Fig. 1 shows a schematic top view of a braiding machine 10. The braiding machine 10 comprises a machine body 12. The body 12 supports two disks 14 (horn gears). Each disk 14 has three notches 16. During operation of the braiding machine 10, the notched disks 14 rotate in opposite directions. The rotating notched disks 14 move the bobbin carriers 18 along a closed path that resembles a figure of eight. While a bobbin carrier 18 is moved along the closed path, a thread 20 is unwound from the bobbin 22 mounted to the foot 24 (or frame) of the bobbin carrier 18. The threads 20 unwound from the bobbins 22 interlace at the braiding point 26.

[0040] Notably, the particular braiding machine 10 shown in Fig. 1 is not to be construed as limiting the present disclosure. Rather the present disclosure may also be practiced in relation to other braiding machines 10 which, for example, comprise more than three bobbin carriers 18 and more than two notched disks 14 (or any other means of moving the bobbin carriers 18 on a curved track that defines a path that intersects with itself and/or paths of other bobbin carriers 18).

[0041] To detect thread tension anomalies, the braiding machine 10 is equipped with a sensor 28a that monitors a state of the compensation device 30 of the bobbin carrier 18. The compensation device 30 is provided with a target 32, and the sensor 28a is configured to measure the target position and/or orientation when the target 32 passes by the sensor 28a. The sensor 28a is mounted on a positioning device 28b that allows quickly changing/adapting the position and/or orientation of the sensor 28a. In an example, the target 32 may be a magnet and the sensor 28a may be a single Hall effect sensor 28a or (an array of) multiple Hall effect sensors 28a which measure the density of the magnetic flux produced by the magnet, as the magnet passes by the sensor 28a.

[0042] In another example, the sensor 28a may be an optical sensor 28a that detects electromagnetic radiation emitted from, or reflected by, the surface of the target 32. In yet another example, the sensor 28a may be an acoustic sensor 28a (e.g., a transducer) that detects sound waves emitted from, or reflected by, the surface of the target 32. In yet another example, the sensor 28a may be an inductive (distance) sensor 28a. In yet another example, the sensor 28a may be a tactile sensor 28a that detects a collision with the surface of the target 32. For instance, if a collision occurs, a sensor element may be moved out of the way of the target 32, thereby signaling that the target position and/or orientation interfered with the position and/or orientation of the sensor element.

[0043] As can be seen from Fig. 2a and Fig. 2b, the target 32 is attached to a movable member 34 of the compensation device 30. The position and/or orientation of the movable member 34 depends on the thread tension as illustrated in Fig. 3. Notably, Fig. 3 illustrates just one specific example of a compensation device 30, as the present disclosure may also be practiced with other compensation devices 30 that have a movable member 34, wherein the position and/or orientation of the movable member 34 depends on the thread tension.

[0044] The compensation device 30 of Fig. 3 comprises a a first guiding element 36a, a second guiding element 36b and a resilient element 38. The first guiding element 36a guides the thread 20, such that when the thread 20 is under tension, a force is applied to the first guiding element 36a. As the first guiding element 36a is connected to the movable member 34, the movable member 34 is displaced relatively to the foot 24 of the bobbin carrier 18 against the restoring force of the resilient element 38.

[0045] As shown in Fig. 4a and Fig. 4b, the displacement of the movable member 34 may be a rotational movement, if the movable member 34 is a lever, or a linear movement, if the movable member 34 is a slider. In addition, the displacement may also be a combination of both, i.e. a combination of a linear movement and a rotational movement. In any case, the displacement of the movable member 34 may be determined by measuring the position and/or the orientation of the target 32 attached to the movable member 34. Notably, the target 32 may also be integrated into the movable member 34 such that the movable member 34 and the target 32 cannot be divided (without destroying them).

[0046] As shown in Fig. 5, the movable member 34 of the compensation device 30 may also be connected to a locking and/or braking member 40 which locks and/or brakes the bobbin 22, if the thread tension is below a desired value. For example, the locking member 40 may be a pin which engages with notches in the bobbin 22 to lock the bobbin 22, if the thread tension is below an upper limit. In another example, the breaking member 40 may be a friction brake that is pressed with a constant force against the bobbin 22. By replacing the resilient element 38 with another resilient element 38 (having a higher or lower stiffness), the range of the thread tension can be adapted to different operating scenarios.

[0047] As shown in Fig. 6, the tension of all threads 20 may be monitored by a computing device 42 that is connected to the sensor 28a. If a thread tension anomaly occurs, the computing device 42 may raise an alarm and/or generate a control signal, stop the braiding machine 10 and indicate the bobbin carrier 18 that caused the alarm and/or the control signal. In this regard, Fig. 6 shows an exemplary embodiment in which the computing device 42 (or rather a program carried-out by the computing device 42) assesses a peak tension of a thread 20 that is above an upper limit 44b as a thread tension anomaly. However, the present invention is not limited to this specific example.

[0048] For instance, Fig. 7a-7c show further examples of thread tension anomalies, the computing device 42 may be programmed to detect. As shown in Fig. 7a-7c, the tension 44a of a thread 20 may oscillate around a desired value 44c during normal operation. I.e., the bobbin 22 may be locked until the tension 44a causes a release of the bobbin 22 which decreases the tension again. As the locking/unlocking may occur at a high frequency, the tension 44a may repeatedly rise and fall, but remain within a pre-determined operation range. Hence, the oscillations occurring during normal operation may have a specific amplitude that remains substantially constant over time. As shown in Fig. 7a, a thread tension anomaly may be detected if the thread tension exceeds an upper limit 44b.

[0049] However, to safeguard the computing device 42 from false alarms, a tension curve 44a may not be assessed as being caused by a thread tension anomaly if, after exceeding the upper limit 44b, the thread tension 44a (almost) immediately falls below the upper limit 44b and remains below the upper limit 44b for a substantial amount of time. Otherwise, if the thread tension 44a remains above the upper limit 44b for a considerable amount of time or number of cycles, or if the thread tension 44a surpasses the upper limit 44b multiple times within a specific time interval or number of cycles, the computing device 42 may be programmed to decide on the occurrence of a thread tension anomaly.

[0050] Moreover, the computing device 42 may decide that a thread tension anomaly is occurring, if the amplitude of the thread tension oscillations (suddenly) increase over time, as illustrated in Fig. 7b. Notably, the thread tension 44a may remain below the upper limit 44b, but the computing device 42 may be programmed to assess the variation in thread tension 44a as abnormal and likely caused by a malfunction of the braiding machine 10. Furthermore, as shown in Fig. 7c, the computing device 42 may be programmed to assess a gradual increase of a moving average of the thread tension 44a as a thread tension anomaly. Notably, the present invention is not limited to detecting the illustrated thread tension anomalies as (depending on the type of machine 10 and operation) other patterns may foreshadow circumstances that (if not resolved) might cause a thread 20 to break. Moreover, the computing device 42 may be programmed to detect any combination of or even all thread tension anomalies. For example, the likelihood of false alarms may be assessed and patterns that often result in false alarms may be excluded.

[0051] A flow-chart of the process is shown in Fig. 8. At step 46, the position of the movable member 34 is measured as an indicator for the thread tension which allows to determine thread tension anomalies at step 48. The process may then be continued by raising an alarm and/or generating a control signal, stopping the braiding machine 10 and indicating the bobbin carrier 18 that caused the alarm.

LIST OF REFERENCE NUMERALS

[0052]

10	braiding machine
12	body
14	disk
16	notch
18	bobbin carrier
20	thread
22	bobbin
24	foot
26	braiding point
28a	sensor
28b	positioning device
30	compensation device
32	target
34	movable member
36a	guiding element
36b	guiding element
38	resilient element
40	locking and/or braking member
42	computing device
44a	thread tension
44b	upper limit of the thread tension
46	process step
48	process step

Claims

1. A braiding machine (10) having a bobbin carrier (18) and a sensor (28a) for detecting thread tension anomalies, wherein:

the bobbin carrier (18) comprises a compensation device (30), the compensation device (30) including a movable member (34), wherein a position and/or an orientation of the movable member (34) depends on the thread tension (44a);
during operation of the braiding machine (10), the bobbin carrier (18) travels, relative to the sensor (28a), along a curved track;
the sensor (28a) is configured to measure the position and/or the orientation of the movable member (34) when the bobbin carrier (18) passes by the sensor (28a).

2. The braiding machine (10) of claim 1, wherein the braiding machine (10) further comprises a computing device (42) that is configured to raise an alarm and/or to generate a control signal if one or more measurements indicate that:

the thread tension (44a); and/or
a variation of the thread tension (44a);
is/are above an upper limit (44b) or shows/show a predefined pattern.

3. The braiding machine (10) of claim 2, wherein the computing device (42) is configured to assign measurements to different bobbin carriers (18) and to indicate which bobbin carrier (18) is subject to a thread tension anomaly, when an alarm is raised and/or a control signal is generated.

4. The braiding machine (10) of claim 2 or 3, wherein the computing device (42) is configured to determine an operation speed by counting bobbin carriers (18) which pass by the sensor (28a) during a time interval.

5. The braiding machine (10) of any one of claims 1 to 4, wherein the movable member (34) is configured to generate a magnetic field and the sensor (28a) is configured to measure said magnetic field when the movable member (34) passes by the sensor (28a).

6. The braiding machine (10) of any one of claims 1 to 5, wherein the movable member (34) is a lever or slider which is connected to a guiding element (36a) and a resilient element (38), wherein the guiding element (36a) is to guide the thread (20) upon unwinding and the resilient element (38) is to apply a restoring force opposing the thread tension (44a), to the movable member (34).

7. The braiding machine (10) of claim 6, wherein the lever or slider is connected to a locking and/or braking member (40) which locks and/or brakes the bobbin (22) if the thread tension (44a) is below a desired value.

8. The braiding machine (10) of claim 7, wherein the locking member (40) is a pin which is to engage with notches in the bobbin (22) to lock the bobbin (22).

9. The braiding machine (10) of any one of claims 6 to 8, wherein the guiding element (36a) is a pulley.

10. A system for measuring a tension (44a) of a thread in a braiding machine (10), the system comprising:

a target (32) to be attached to a compensation device (30) of a bobbin carrier (18) of the braiding machine (10);
a sensor (28a) to be attached to a body (12) of the braiding machine (10); and
a computing device (42) which is configured to monitor a state of the compensation device (30) when the target (32) is moved past the sensor (28a).

11. The system of claim 10, wherein the target (32) is a magnet and the sensor (28a) is a Hall effect sensor.

12. The system of claim 10 or 11, wherein the computing device (42) is configured to monitor a position and/or an orientation of a movable member (34) which is to control a braking force applied to the bobbin (22), based on the thread tension (44a).

13. A method of measuring a tension (44a) of a thread in a braiding machine (10), the method comprising:

sensing (46), by a stationary sensor (28a) arranged along a path of a bobbin carrier (18), a position of a movable member (34) when the bobbin carrier (18) passes by the sensor (28a), wherein the movable member (34) is connected to a resilient element (38) that resets the movable member (34) against the thread tension (44a); and
determining (48) tension anomalies based on one or more sensed positions and/or sensed orientations.

14. The method of claim 13, wherein a magnet is attached to the movable member (34) and the stationary sensor (28a) is a Hall effect sensor (28a).

15. The method of claim 13 or 14, wherein the stationary sensor (28a) is configured to sense positions and/or orientations of movable members (34) of different bobbin carriers (18) passing by the stationary sensor (28a) one after the other.

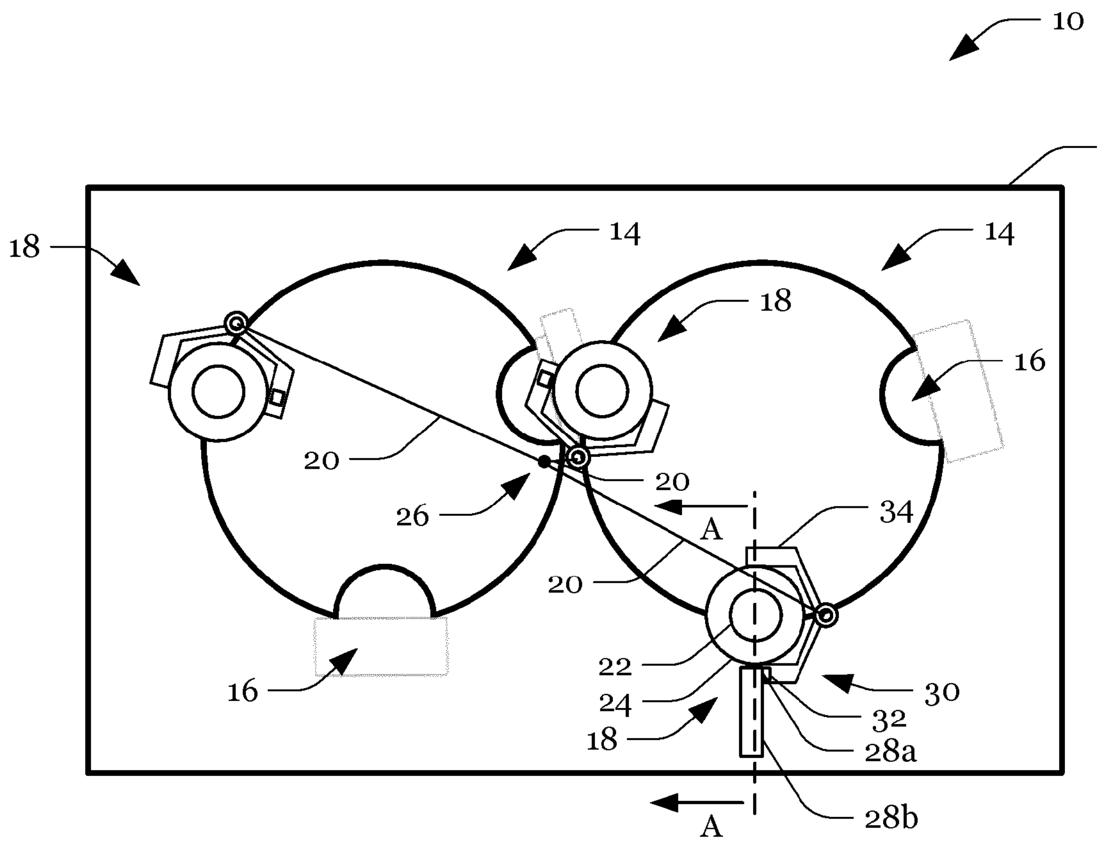

Fig. 1

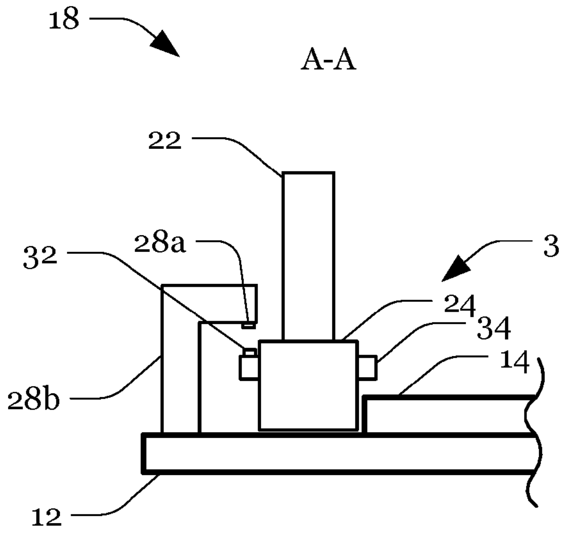

Fig. 2a

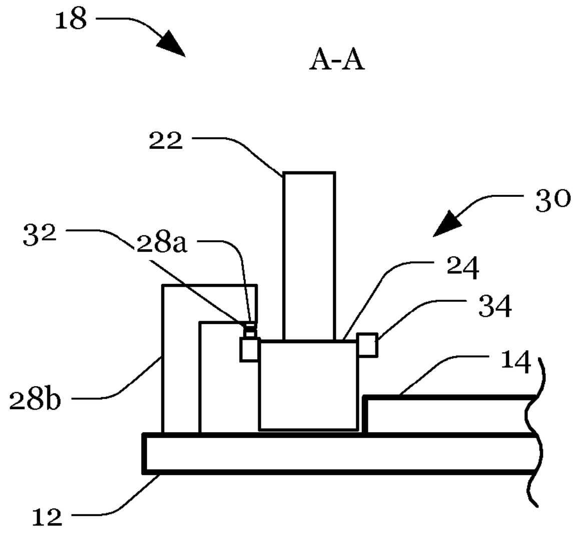

Fig. 2b

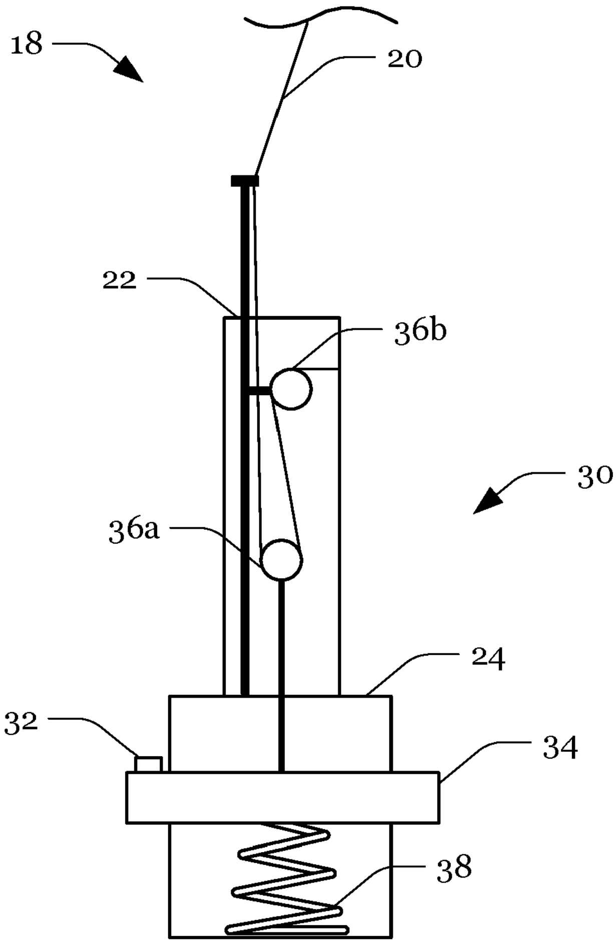

Fig. 3

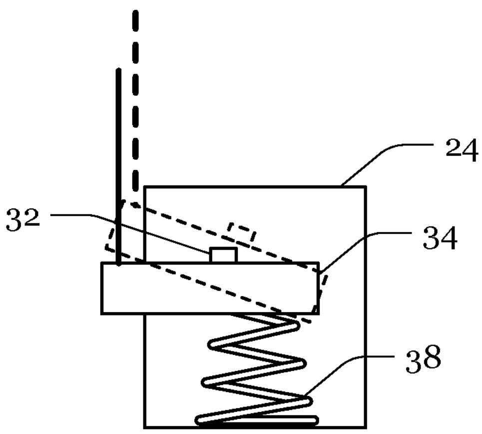

Fig. 4a

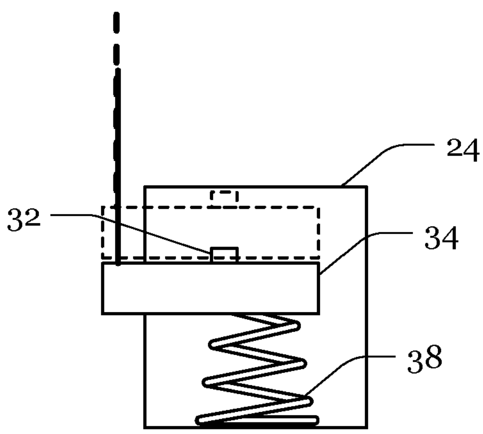

Fig. 4b

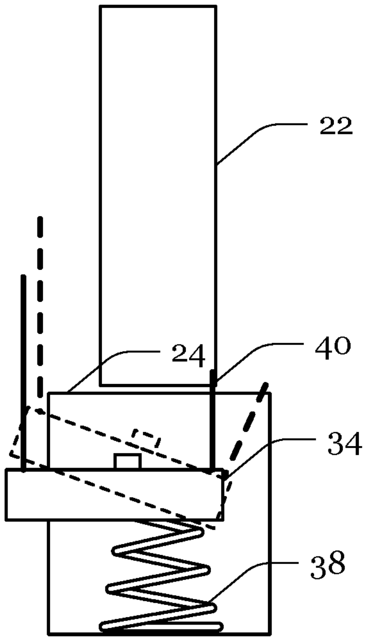

Fig. 5

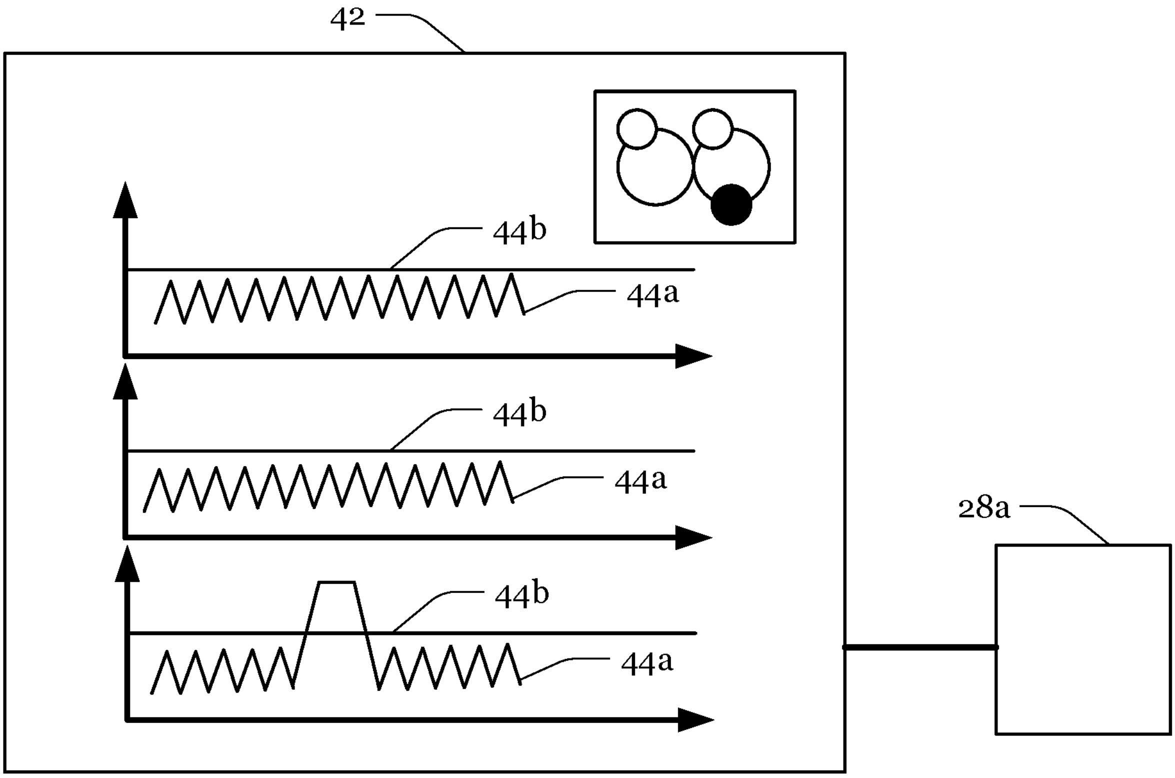

Fig. 6

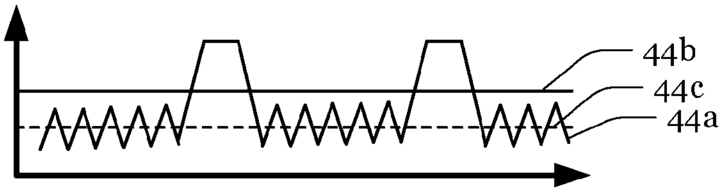

Fig. 7a

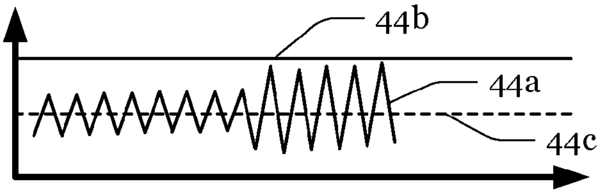

Fig. 7b

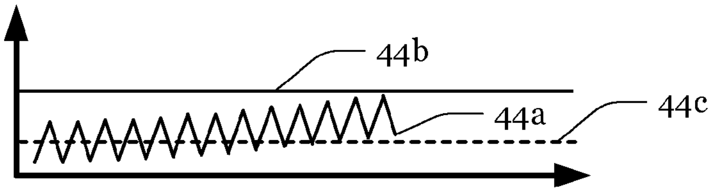

Fig. 7c

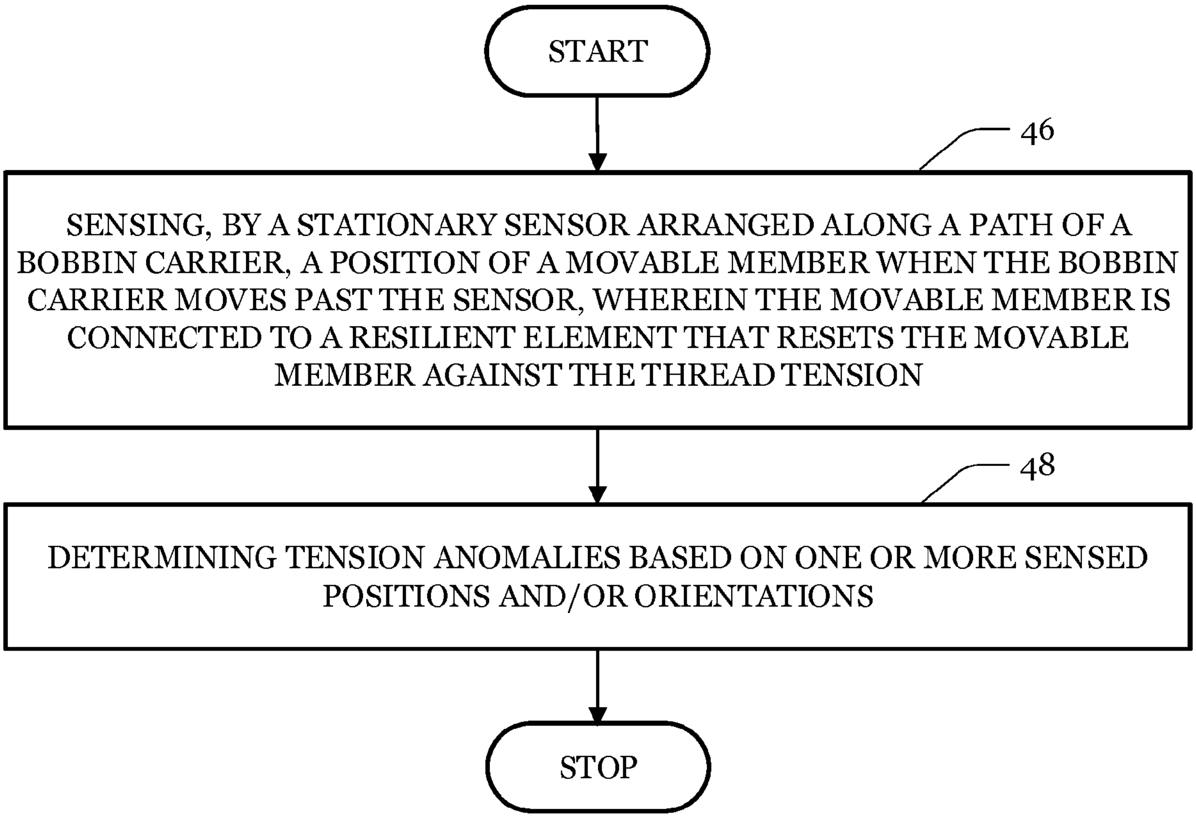

Fig. 8

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EUROPEAN SEARCH REPORT

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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)
A,D	DE 10 2014 016381 B4 (ADMEDES SCHUESSLER GMBH [DE]) 14 July 2016 (2016-07-14) * paragraph [0038] - paragraph [0057]; figures 1-3 *	1-15	INV. D04C3/06 D04C3/18 D04C3/48
A	DE 10 2014 014149 A1 (NIEHOFF KG MASCHF [DE]) 24 March 2016 (2016-03-24) * paragraphs [0016], [0049] - paragraph [0058]; figure 1 *	1-15	
A,D	DE 197 30 965 C1 (TENSOMETRIC MESTECHNIK STROEHM [DE]) 10 June 1999 (1999-06-10) * column 3, line 24 - column 4, line 51; figures 1-3 *	1-15	
A	DE 10 2012 223127 A1 (SGL KÜMPERS GMBH & CO KG [DE]) 18 June 2014 (2014-06-18) * paragraphs [0006], [0019] - paragraph [0021]; figures 1, 1a, 2 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			D04C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	25 October 2018	Braun, Stefanie

CATEGORY OF CITED DOCUMENTS

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EP 18 16 9383

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25-10-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102014016381 B4	14-07-2016	DE 102014016381 A1	12-05-2016
		EP 3018245 A1	11-05-2016
DE 102014014149 A1	24-03-2016	BR 112017003811 A2	05-12-2017
		CN 106470926 A	01-03-2017
		DE 102014014149 A1	24-03-2016
		EP 3198068 A1	02-08-2017
		JP 2017537039 A	14-12-2017
		RU 2664205 C1	15-08-2018
		US 2017298546 A1	19-10-2017
		WO 2016045987 A1	31-03-2016
DE 19730965 C1	10-06-1999	NONE	
DE 102012223127 A1	18-06-2014	NONE	

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Patent documents cited in the description

- DE 19730965 C1 **[0002]**
- DE 102014016381 B4 **[0002]**