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(54) **WINDING UNIT PROVIDED WITH A THREAD TENSIONING DEVICE OF A YARN, AND THE RELATED CONTROL METHOD**

(57) A winding unit (4) of a yarn (8) comprising a spool (20) on which said yarn (8) is wound and a reel (32) on which to wind the yarn (8) unwound from the spool (20), winding means (36) for performing the unwinding of the yarn (8) from the spool (20) and the winding of the yarn (8) on the reel (32), a thread tensioning device (56) for controlling the winding tension of said yarn (8) during its unwinding from the spool (20) and its winding on the reel (32). Advantageously the thread tensioning device (56) comprises a rotor (60) mechanically connected to an electric motor (64) for rotating around a control axis (X-X), wherein the yarn (8) unwound from the spool (20) is wound with a predetermined number of turns around a winding portion (68) of said rotor (60), the rotor (60) being positioned between the spool (20) and the reel (32), and further comprises a processing and control unit (80) operatively connected to said electric motor (64) and programmed to control the rotation of the rotor (60) so that the tension of the yarn (8) follows a set tension value.

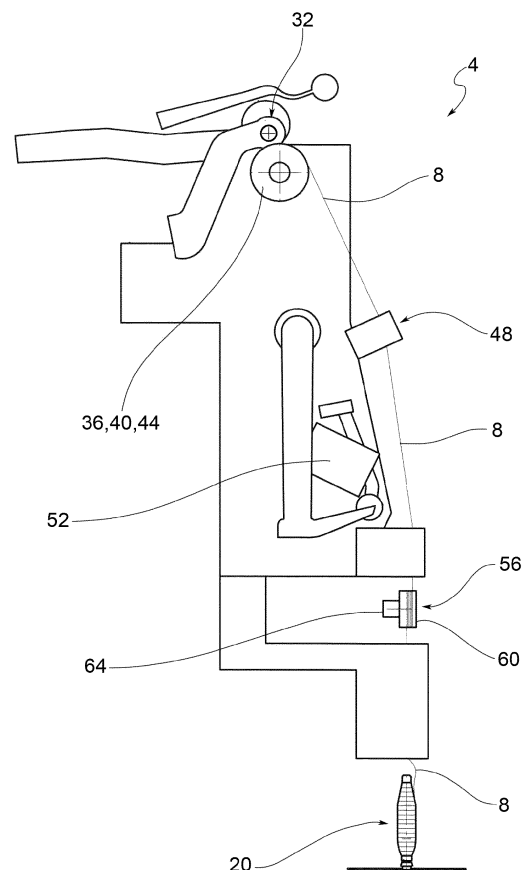


FIG.1

Description

FIELD OF APPLICATION

[0001] The present invention relates to a winding unit provided with a thread tensioning device of a yarn, and the related control method.

[0002] As is known, the regularity of the winding tension of a yarn represents a decisive aspect for ensuring the goodness of the reel being formed. For this reason, the winding units are typically provided with a special device, called a thread tensioner, which is responsible for controlling the tension of the yarn in motion. Moving along the thread path from the bottom upwards, the thread tensioner is interposed between the untangler, which controls the evolution of the unwinding balloon of the spool below, and the winding cylinder, which governs the collection of the yarn in the reel above by means of the thread guiding cylinder. Normally, the system also comprises a sensor, located before the collection unit, configured to monitor the thread tension and to feed the control loop in feedback which controls the thread tensioner itself, so as to follow a predefined tension target. In other words, the thread tensioner applies a certain overtension to the thread in motion as a function of the actual value read by the sensor and the stored setpoint. If the thread tensioner is no longer able to limit the tension, the system reduces the winding speed and thus also the hourly production of the head.

STATE OF THE ART

[0003] As can easily be seen, the process factors which hinder the regularity of the thread tension reside both on the spool side (in the thread untangling mode) and on the reel side (in the thread collection speed), in addition to generally depending on the type of yarn processed. Therefore, in order to pursue optimal tension control, they must be appropriately considered and counteracted.

[0004] On the spool side, an effective tension modulation strategy consists in the adoption of systems, such as those illustrated in patents US5377923A and EP3950551A1, which respectively axially follow or radially contain the extension of the untangling balloon. In fact, the thread unwinds from the spool at pulsating height as a function of the length of the free section from the pick-up point, on which the size of the balloon correspondingly depends and thus the tension which is generated in the thread due to the centrifugal force, also with pulsating and increasing trend as the untangling proceeds. With the use of these devices it is possible to reduce the difference in tension between the start and end of the spool and thus limit the tension variability in input to the normal tensioning devices.

[0005] On the reel side, on the other hand, the winding tension essentially depends on the collection speed of the yarn, which in turn depends on the peripheral winding

speed imposed by the winding cylinder and the transverse crossing speed imposed by the thread guide. In fact, even if the winding cylinder rotates at a substantially constant speed, the draw speed of the thread undergoes considerable oscillations due to the geometry of the collection system, in particular for two different reasons.

[0006] The first cause lies in the crossing, i.e., in the oscillatory distribution of the turns of thread on the winding reel. By virtue of its helical grooves, the yarn guide cylinder imposes a predefined transverse deposit law on the reel and, as a function of the shape of the grooves and the crossing frequency, periodically lengthens and shortens the length of the section of thread which oscillates between the last transverse reel constraint and the thread guide. Such a length is minimum when the thread guide delivers the thread to the centreline of the reel (and thus is at the middle of its stroke), while it is maximum when the thread guide deposits the thread at the two ends of the reel (and is thus at the ends of its stroke).

[0007] This pulsing variation in the length of the thread path translates into a first pulsation of the speed of the thread, which recalls from the spool precisely the stretch of thread which corresponds to the length wound in the reel, increased or decreased by the periodic excursion due to the crossing.

[0008] The second cause of pulsation of the draw speed of the thread lies, instead, in the conicity of the reel. When the thread is wound on the larger diameter portion (reel bottom), it is drawn with a higher peripheral speed and is thus subjected to a greater tension; conversely, when the thread is wound on the smaller diameter portion (reel tip), the thread is drawn at a lower speed and is less taut. In other words, the thread undergoes a lower or higher pull as a function of the winding position on the reel. Now, even if the conicity of the tubes is rather limited, at the usual winding speeds the thread is subjected to pulsations of draw speeds that are not at all negligible, with relative variations between tip and tail which can reach up to 20%.

[0009] For all these reasons, the thread tensioner is responsible for adjusting and compensating for such variations in the speed and tension of the thread, as well as damping any vibrations due to the untangling of the thread from the spool.

[0010] In general, the use of two different types of thread tensioner is known from the prior art: that with plates and that with combs.

[0011] The plate thread tensioner consists of a pair of discs with opposite friction which exert an adjustable braking pressure on the running thread, approaching or moving away, without however changing the path thereof. For example, patent EP734990B1 illustrates a magnetically driven plate thread tensioner, while patent EP1975105A2 describes one having a plurality of pairs of springloaded plates.

[0012] In the comb thread tensioner, on the other hand, the structure of the device consists of a plurality of fixed and movable diverters arranged in a comb according to

an opposite and offset configuration, which mutually interpenetrate to multiply the thread tension by means of an increase or decrease in the total winding angle of the thread, and thus the friction force induced therein. For example, patents US5499772A and US5738295A describe comb thread tensioners which control the adjustment with the excitation of a solenoid, while patent IT1276819B1 describes an apparatus with pneumatic control.

[0013] Unfortunately, the thread tensioners of the prior art are affected by a poor dynamic response and by a limited ability to modulate the tension, consequently they are not capable of following the speed and tension pulsations to which the thread is subjected with sufficient rapidity, nor to effectively dampen the relative peaks.

[0014] Normally, in fact, the thread tensioner is capable of following the evolution of the untangling of the spool by measuring the average tension of the thread which reaches the reel, for example with the tension sensor, and adjusting the additional tension induced by the thread tensioner to ensure a predetermined overall average tension. If the tension cannot be reduced as expected even after reducing the tension added by the thread tensioner to a minimum, the system is forced to reduce the winding speed of the cylinder to lower the tension, with consequent loss of productivity of the unit and thus of the machine.

[0015] Furthermore, if the tension control is not accurate, the clearer can give rise to false cuts, because for example the shape and size of the defects vary or because a loosening of the yarn is mistakenly read as a defect.

[0016] Finally, the unevenness of the tension gives rise to winding portions having different tensions, to the detriment of the quality of the reel formed, especially for particularly slippery yarns and for dyeing reels, whose dye absorption is strongly linked to the winding/spooling tension of the thread.

PRESENTATION OF THE INVENTION

[0017] The need is therefore felt to resolve the drawbacks and limitations mentioned with reference to the prior art.

[0018] Such a requirement is satisfied by a winding unit provided with a thread tensioning device of a yarn according to claim 1 and a method for controlling the winding tension of a yarn in accordance with claim 13.

DESCRIPTION OF THE DRAWINGS

[0019] Further features and advantages of the present invention will be more clearly comprehensible from the description given below of preferred and non-limiting embodiments thereof, in which:

figure 1 depicts a side view of a winding unit provided with a thread tensioning device, for controlling the

winding tension of a yarn in accordance with the present invention;

figure 2 depicts a schematic view of a thread tensioning device for controlling the winding tension of a yarn in accordance with an embodiment with open circuit control;

figure 3 depicts a schematic view of a thread tensioning device for controlling the winding tension of a yarn in accordance with an embodiment with closed circuit control;

figure 4 depicts a schematic view of a thread tensioning unit for controlling the winding tension of a yarn, provided with outer compensation means.

[0020] The elements or parts of elements common to the embodiments described below will be indicated using the same reference numerals.

DETAILED DESCRIPTION

[0021] With reference to the aforementioned figures, reference numeral 4 globally indicates a winding unit of a yarn 8.

[0022] It should be noted that the term thread or single thread or continuous thread refers to a single filament or continuous filament (for example in the case of silk, artificial or synthetic fibres), while the term yarn refers to a group of fibrils of varying lengths which are paralleled and joined together by twisting. Hereinafter, one or the other term will be used indifferently, it being understood that the applications of the present invention are not limited to one or the other type.

[0023] The winding unit 4 of a yarn 8 comprises a spool 20 on which said yarn 8 is wound and a reel 32 on which to wind the yarn 8 unwound from the spool 20.

[0024] The winding unit further comprises winding means 36 for performing the unwinding of the yarn 8 of the spool 20 and the winding of the yarn 8 on the reel 32.

[0025] Said winding means 36 can comprise, for example, a thread guide cylinder 40 operatively connected to the reel 32 or a crossing device 44 associated with said thread guide cylinder 40.

[0026] The winding unit 4 can further comprise a clearer 48 and a yarn reattachment or splicer device 52 in the event of breakage of the yarn itself, in a known manner.

[0027] The winding unit 4 advantageously comprises a thread tensioning device 56 of said yarn 8, for controlling the tension of the yarn during its unwinding from the spool 20 and its winding on the reel 32.

[0028] Advantageously, said thread tensioning device 56 comprises a rotor 60 mechanically connected to an electric motor 64 for rotating around a control axis X-X.

[0029] The yarn 8 unwound from the spool 20 is wound with a predetermined number of turns around a winding portion 68 of said rotor 60.

[0030] The rotor 60 is positioned between the spool 20 and the reel 32 so as to intercept the yarn 8 which is unwound and subsequently wound.

[0031] In accordance with an embodiment, the rotor 60 has a moment of inertia less than 5000 g mm² with respect to the control axis X-X. Thereby the rotor 60 can quickly respond to any acceleration/deceleration condition and thus limit the transient dynamic effects.

[0032] In accordance with an embodiment, the rotor 60 has a turn winding diameter less than 75 mm. Thereby, the rotor 60 can quickly respond to any acceleration/deceleration condition and thus limit the transient dynamic effects.

[0033] In accordance with an embodiment, the rotor 60 is driven by a brushless electric motor 64: this type of electric motor is particularly advantageous, because this type of motor has low inertia as well as high dynamic performance, to the advantage of the overall response readiness of the thread tensioning device 56.

[0034] Furthermore, the brushless motor is characterized by high efficiency, which translates into a substantial energy saving, given the continuous operation.

[0035] In accordance with a possible embodiment, the winding unit 4 comprises at least one angular speed sensor 76 of the rotor 60; it is thereby possible to perform a speed control in a precise and timely manner, especially for the purposes of metering the yarn 8 and thus the reel 32 being formed.

[0036] For example, said angular velocity sensor 76 of the rotor 60 is an encoder or a resolver.

[0037] Preferably, said angular speed sensor 76 of the rotor 60 is integrated in the electric motor 64, to the advantage of the compactness of the thread tensioning device 56.

[0038] The winding unit 4 further comprises a processing and control unit 80 operatively connected to said electric motor 64 and programmed to control the rotation of the rotor 60 so that the tension of the yarn 8 follows the set tension value.

[0039] In accordance with a possible embodiment, the processing and control unit 80 is programmed so as to increase or decrease the rotation speed of the rotor 60 respectively to increase or reduce the peripheral speed of the yarn 8 (and thus its drawing depending on the reel 32 winding demand) if the tension of the yarn 8 deviates from said set value.

[0040] In accordance with a possible embodiment (figure 2), the processing and control unit 80 is programmed to operate a tension control of the yarn 8 in open loop, inferring the instantaneous tension of the yarn starting from operating parameters of the winding unit 4, such as the winding speed, the type of thread guide cylinder and the moment when the yarn has passed at least one known point of the crossing. This solution makes it possible to have a relatively simple thread tensioning device 56, without the need to make the electronic architecture of the winding unit 4 excessively complex and at the same time using already known process variables.

[0041] In accordance with a possible embodiment, the moment of passage of the thread 8 in the at least one known point of the crossing is detected by sensor means.

[0042] Advantageously, said sensor means can comprise a vision system.

[0043] Advantageously, said sensor means can be of the optical or piezoelectric type.

5 **[0044]** In accordance with a possible further embodiment (figure 3) the thread tensioning device 56 comprises at least one tension sensor 84 of the yarn 8, configured to continuously monitor the winding tension of the yarn 8 prior to its winding in the reel 32.

10 **[0045]** Said tension sensor 84 of the yarn 8 is operatively connected to the processing and control unit 80, so that a tension control of the yarn 8 can operate in closed loop. It is thereby possible to obtain a much more accurate piloting of the tension of the yarn 8.

15 **[0046]** In particular, in doing so, the angular speed of the rotor 60 is piloted to follow a set theoretical value of the tension of the yarn 8, which is measured by the tension sensor 84. In essence, if the tension of the yarn 8 grows, the angular speed of the rotor 60 is increased, thus returning (i.e., reducing) the measured tension to said set theoretical value.

20 **[0047]** For example, said at least one tension sensor 84 of the yarn 8 is installed near the rotor 60, so as to limit the dimensions of the thread tensioning device 56 and simplify the architecture of the winding unit 4.

[0048] In accordance with a possible embodiment, said at least one tension sensor 84 of the yarn 8 is installed near the thread guide cylinder 40 operatively connected to the reel 32.

30 **[0049]** It is thus possible to precisely control any tension fluctuations of the yarn 8 just before its winding in the reel 32. In general, the number and the installation position of the tension sensor 84 must not be understood in the limiting sense for the purposes of the present invention.

35 **[0050]** In accordance with a possible embodiment of the present invention (figure 4), the rotor 60 can operate in coupling with outer compensation means 90 configured to dynamically increase or decrease the amount of thread 8 wound on the winding portion 68 of the rotor 60.

40 **[0051]** Advantageously, the compensation means are driven by a brushless electric motor. This type of electric motor is particularly advantageous, because this type of motor has low inertia as well as high dynamic performance, benefiting the overall response readiness of the compensation means 90.

45 **[0052]** Advantageously, said outer compensation means 90 comprise a slider 92 which moves with respect to the rotor 60, in which said slider 92 comprises an eyelet 94 forming an insertion point of the thread 8 on the rotor 60.

50 **[0053]** The displacement of the slider 92 and the related insertion point of the thread 8 can be controlled in relation to the type of thread guide cylinder 40, and/or in relation to the rotation speed of the thread guide cylinder 40 and/or in relation to the position of the thread 8 on the thread guide cylinder 40.

[0054] In particular, the slider is operatively connected

to motor means (not shown) in turn connected to the processing and control unit 80.

[0055] According to a preferred embodiment, the slider 92 moves along a circular trajectory with respect to the control axis X-X, near the outer periphery of the rotor 60.

[0056] As can be appreciated from what has been described, the present invention has considerable advantages with respect to the current solutions of the prior art and allows to overcome the drawbacks thereof.

[0057] A first advantage of this solution lies in the fact that the tension is made ideally constant between the start and end of the spool, and between spool and spool, which greatly improves the formation of the reel.

[0058] Secondly, it becomes easy to make reels with variable density, simply by varying the tension generated by the device, without changing the type of cylinder, the position of the arm and the extent of counterweighting. It is thereby possible to conveniently configure the formation of "hard" or "soft" reels from a PC depending on the needs.

[0059] Furthermore, there is the fact that, since a predetermined number of turns is wound on the surface of the rotor, the peripheral speed of the thread, and therefore the length that is wound in a reel, is automatically also known, as a function respectively of the diameter and the rotation speed of the rotor and the number of turns wound. Consequently, the device acts as an integrated metering system, as well as a speedometer.

[0060] Furthermore, it is also possible to solve the drawbacks of the known art due to fluctuations in the drawing speed of the thread caused by the crossing and conicity of the reel. In particular, as seen, the rotor can operate in coupling with outer compensation means configured to dynamically increase or decrease the total number of turns wound, moving the insertion point of the thread on the rotor forward or backward and therefore also instantly varying the winding of the thread. This particular configuration allows the system to anticipate the thread demands from the reel to the spool based on the measured or calculated tension, a magnitude which implicitly provides the instantaneous deposit position of the thread and thus also the information in terms of the recall or release of the thread in the subsequent moments, depending on whether it is in the reel tail or tip.

[0061] The system is also capable of compensating for the variations in speed between the reel tail and tip, typical of conical reels, which are normally absorbed by the untangling of the spool, which is a highly dynamic process, working at speeds of tens of metres per second, as well as unstable. The system described above, in the step between tail and tip, actively increases the winding on the rotor, varying the position of the entry point, while in the step between tip and tail, it reduces it, cancelling or greatly reducing the fluctuation of the draw speed to which the thread being untangled from the spool is subjected.

[0062] Therefore, the tensioning system will be capable of predicting the demand for thread to the spool, main-

taining the draw speed substantially constant and at the same time eliminating the problems of rising turns and/or tension peaks capable of generating breakage, losses and/or false cuts of the clearer.

[0063] Finally, with regard to the layout of the winding unit, the use of the apparatus in object does not change the current spool side setup and does not involve substantial construction changes, therefore it can be easily implemented even on existing machines, without entailing considerable increases in footprint.

[0064] In fact, it can even replace the traditional tension control devices of the winding units, the pre-tensioner and/or the thread tensioner itself.

[0065] A person skilled in the art may make numerous modifications and variations to the solutions described above so as to satisfy contingent and specific requirements.

[0066] The scope of protection of the present invention is defined by the following claims.

Claims

1. A winding unit (4) of a yarn (8) comprising:

- a spool (20) on which said yarn (8) is wound and a reel (32) on which to wind the yarn (8) unwound from the spool (20),
- winding means (36) for performing the unwinding of the yarn (8) from the spool (20) and the winding of the yarn (8) on the reel (32),
- a thread tensioning device (56) for controlling the winding tension of said yarn (8) during its unwinding from the spool (20) and its winding on the reel (32),

characterized in that

thread tensioning device (56) comprises a rotor (60) mechanically connected to an electric motor (64) for rotating around a control axis (X-X),

- wherein the yarn (8) unwound from the spool (20) is wound with a predetermined number of turns around a winding portion (68) of said rotor (60), the rotor (60) being positioned between the spool (20) and the reel (32),

and further comprises a processing and control unit (80) operatively connected to said electric motor (64) and programmed to control the rotation of the rotor (60) so that the tension of the yarn (8) follows a set tension value.

2. Winding unit (4) according to claim 1, wherein the rotor (60) has a moment of inertia less than 5000 g mm² with respect to the control axis (X-X).

3. Winding unit (4) according to any one of claims 1 to 2, comprising at least one angular speed sensor (76) of the rotor (60), like an encoder or a resolver.
4. Winding unit (4) according to any one of claims 1 to 3, wherein the processing and control unit (80) is programmed so as to increase or decrease the rotation speed of the rotor (60) respectively to increase or reduce the peripheral speed of the yarn (8) when the tension of the yarn (8) deviates from said set value.
5. Winding unit (4) according to any one of claims 1 to 4, wherein the processing and control unit (80) is programmed to operate a tension control of the yarn (8) in an open loop, inferring the instantaneous tension of the yarn starting from operating parameters of the winding unit (4), such as the winding speed, the type of thread guide cylinder and the moment when the yarn (8) has passed at least one known point of the crossing and wherein the winding unit (4) comprises sensor means configured to detect the moment of passage of the thread (8) in the at least one known point of the crossing.
6. Winding unit (4) according to claim 5, said sensor means comprise a vision system.
7. Winding unit (4) according to claim 5 or 6, wherein said sensor means are of the optical or piezoelectric type.
8. Winding unit (4) according to any one of claims 1 to 7, wherein the thread tensioning device (56) comprises at least one tension sensor (84) of the yarn (8), configured to continuously monitor the winding tension of the yarn (8) before its winding in the reel (32), said tension sensor (84) being operatively connected to the processing and control unit (80).
9. Winding unit (4) according to claim 8, wherein said processing and control unit (80) is programmed to pilot the angular speed of the rotor (60) to follow a set theoretical value of the tension of the yarn (8), which is measured by said tension sensor (84), so that if the tension of the yarn (8) increases or decreases, said processing and control unit (80) respectively increases or decreases the angular speed of the rotor (60), returning the measured tension to said set theoretical value.
10. Winding unit (4) according to any one of claims 1 to 9, wherein the rotor (60) operates in coupling with outer compensation means (90) configured to dynamically increase or decrease the amount of thread (8) wound on the winding portion (68) of the rotor (60), wherein said outer compensation means (90) comprise a slider (92) which moves with respect to the rotor (60), wherein said slider (92) comprises an eyelet (94) forming an insertion point of the thread (8) on the rotor (60).
11. Winding unit (4) according to claim 10, wherein the displacement of the slider (92) and the related insertion point of the thread (8) is controlled in relation to the type of thread guide cylinder (40), and/or in relation to the rotation speed of the thread guide cylinder (40) and/or in relation to the position of the thread (8) on the thread guide cylinder (40).
12. Winding unit (4) according to any one of claims 10 to 11, wherein the slider is operatively connected to motor means in turn connected to the processing and control unit (80).
13. Method for controlling the winding tension of a thread (8) comprising the steps of:
 - providing a winding unit (4) provided with a spool (20) on which said yarn (8) is wound and a reel (32) on which to wind the yarn (8) unwound from the spool (20), winding means (36) for performing the unwinding of the yarn (8) from the spool (20) and the winding of the yarn (8) on the reel (32),
 - providing a control device (76) of the winding tension of said yarn (8) during its unwinding of the spool (20) and its winding on the reel (32),
 - said control device (76) comprises a rotor (60) mechanically connected to an electric motor (64) for rotating around a control axis (X-X.),
 - wherein the yarn (8) unwound from the spool (20) is wound with a predetermined number of turns around a winding portion (68) of said rotor (60), the rotor (60) being positioned between the spool (20) and the reel (32),
 - the method comprising the step of controlling the rotation of the rotor (60) so that the tension of the yarn (8) follows a set tension value.
14. Method for controlling the winding tension of a yarn (8) according to claim 13, comprising the steps of increasing or decreasing the rotation speed of the rotor (60) respectively to increase or reduce the peripheral speed of the thread (8) when the tension of the thread (8) deviates from said set value.
15. Method for controlling the winding tension of a yarn (8) according to claim 13 or 14, comprising the step of providing at least one tension sensor (84) of the yarn (8), configured to continuously monitor the winding tension of the yarn (8) before its winding in the reel (20), and operating a tension control of the yarn (8) in closed loop, commanding the rotation of the rotor (60) so that the tension of the yarn (8) follows said set value and comprising the step of piloting the

angular speed of the rotor (60) to follow said set tension value of the yarn (8), which is measured by said tension sensor (84), so that if the tension of the yarn (8) grows, said processing and control unit (80) increases the angular speed of the rotor (60), bringing the measured tension back to said set theoretical value.

16. Method for controlling the winding tension of a yarn (8) according to any one of claims 13 to 15, comprising the step of providing outer compensation means (90) coupled to the rotor (60) and configured to dynamically increase or decrease the amount of thread (8) wound on the winding portion (68) of the rotor (60), wherein said outer compensation means (90) comprise a slider (92) which moves with respect to the rotor (60), wherein said slider (92) comprises an eyelet (94) forming an insertion point of the thread (8) on the rotor (60).
17. Method for controlling the winding tension of a thread (8) according to claim 16, comprising the step of controlling the movement of the slider (92) and the relative insertion point of the thread (8) in relation to the type of thread guide cylinder (40), and/or in relation to the rotation speed of the thread guide cylinder (40) and/or in relation to the position of the thread (8) on the thread guide cylinder (40).

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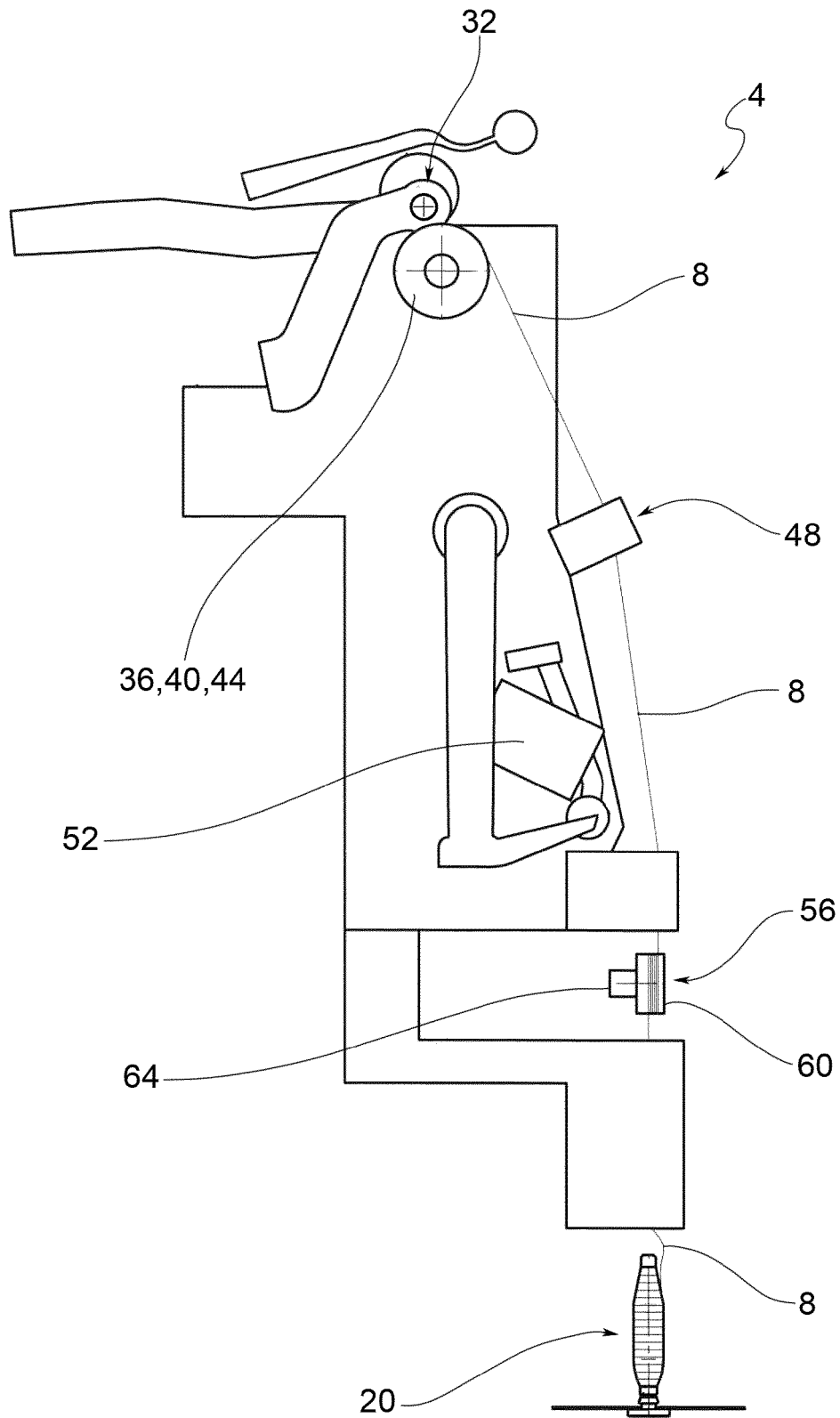


FIG.1

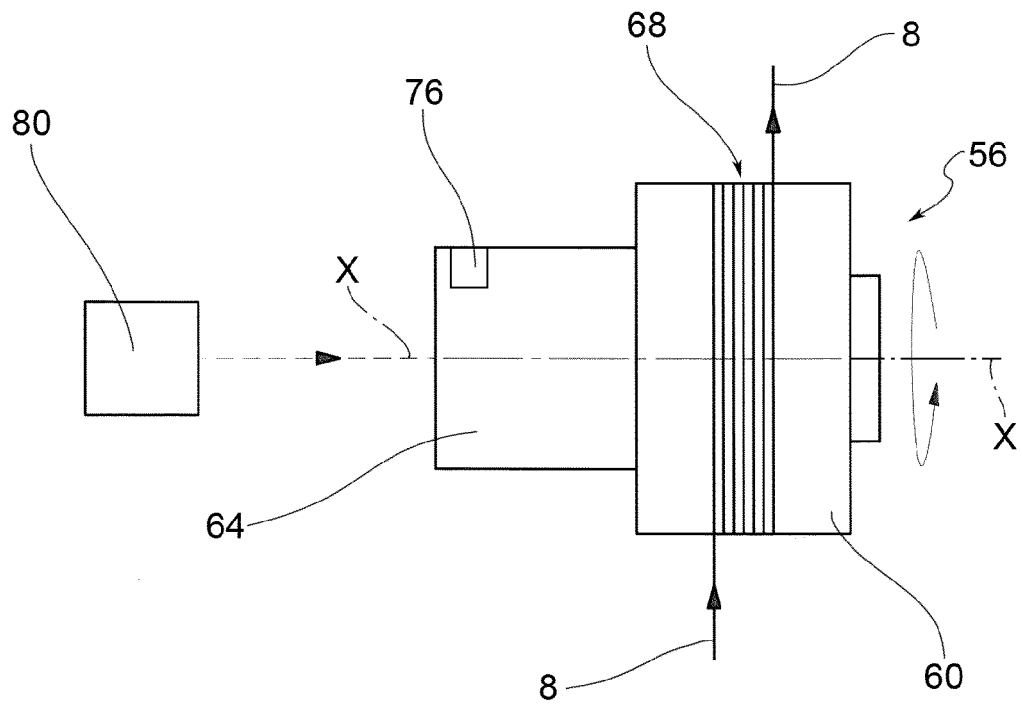


FIG. 2

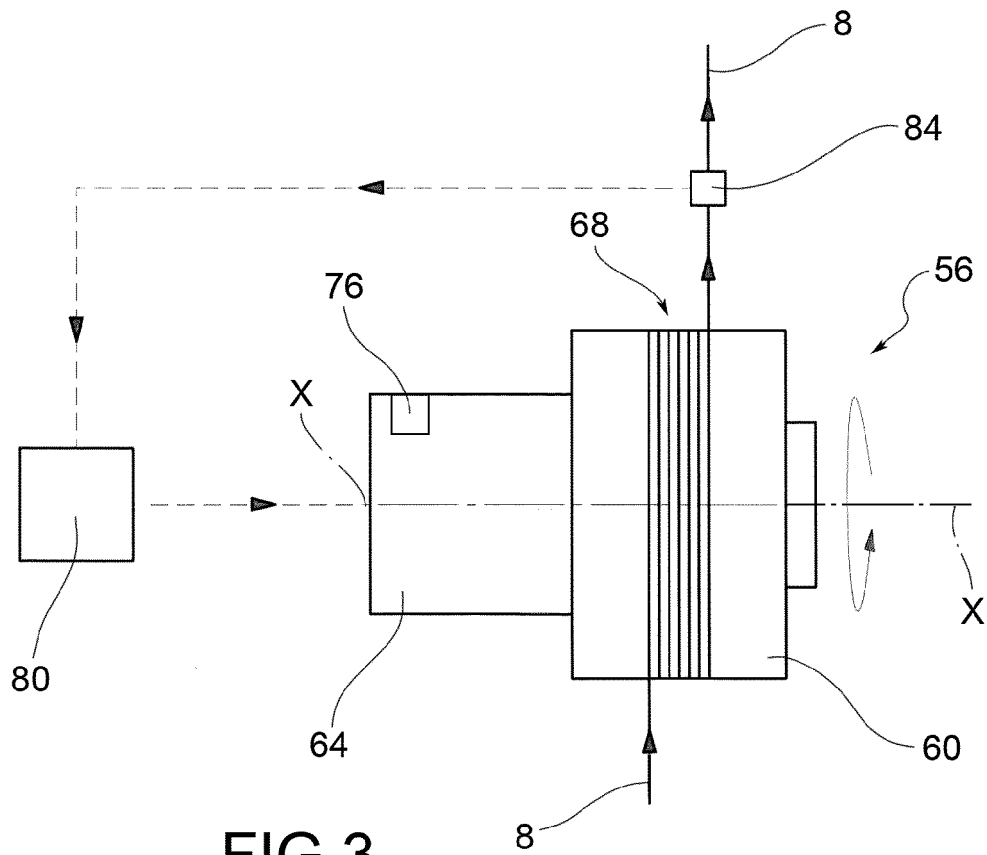


FIG. 3

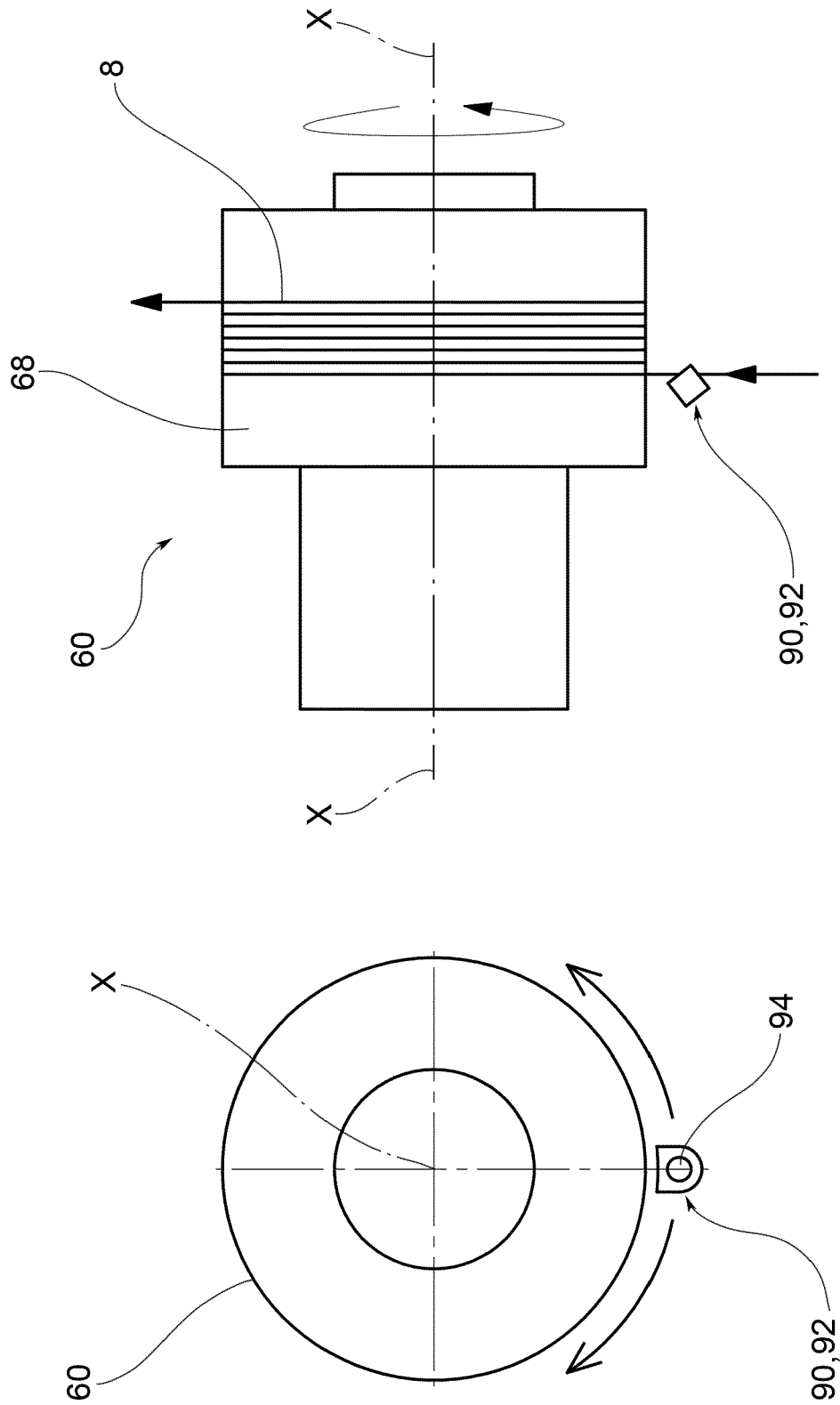


FIG.4



EUROPEAN SEARCH REPORT

Application Number

EP 23 17 9621

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EPO FORM 1503 03.82 (P04C01)

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 3 865 441 A1 (TMT MACHINERY INC [JP]) 18 August 2021 (2021-08-18)	1, 2, 4, 8, 13-15	INV. B65H59/18
Y	* paragraphs [0007], [0008], [0027],	3, 9	
A	[0028], [0035] - [0037], [0055], [0056], [0061], [0064] - [0082]; claims 1, 6-11; figure 1 *	5-7, 10-12, 16, 17	

X	WO 2020/075444 A1 (MURATA MACHINERY LTD [JP]) 16 April 2020 (2020-04-16)	1, 2, 4, 8, 9, 13-15	
Y	* paragraphs [0052] - [0057]; figures 1, 3, 4 *	3	TECHNICAL FIELDS SEARCHED (IPC) B65H

X	EP 0 499 380 A1 (JONES STROUD & CO LTD [GB]) 19 August 1992 (1992-08-19)	1, 2, 4, 8, 13, 14	
* column 5, line 13 - column 6, line 4; claims 1, 5-8; figures 3, 4 *			

Y	EP 2 684 827 A2 (RIETER CZ SRO [CZ]) 15 January 2014 (2014-01-15)	3, 9	
* paragraphs [0009] - [0014], [0017], [0022] - [0037]; claims 1-14; figures 1, 2 *			

Y	EP 3 371 082 B1 (VANDEWIELE NV [BE]) 17 February 2021 (2021-02-17)	3, 9	
* paragraphs [0023] - [0038]; figure 1 *			

The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 November 2023	Examiner Pussemier, Bart
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			

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

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