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(54) **METHOD FOR CONTROLLING THE WINDING TENSION**

(57) A method for controlling the winding tension of a yarn (12) in a winding unit (14) comprises a tension sensor (16), a thread tensioner (18), and an unravelling tension control device (20). The unravelling tension control device (20) comprises a first containment element (22) operable on command, and a second containment element (24) fixed and arranged downstream of the first containment element (22) along the winding direction of the yarn (12). The method comprises the following steps: (a) start of the winding step with winding speed equal to v_{max} ; (b) upon reaching a predetermined tension value measured by the tension sensor (16), the winding speed is brought to a predetermined percentage of v_{max} ; (c) upon reaching said predetermined percentage of v_{max} , from here on the unravelling tension is controlled by the thread tensioner (18); and (d) upon reaching a predetermined operating parameter of the winding, operating the first containment element (22) of the unravelling tension control device (20).

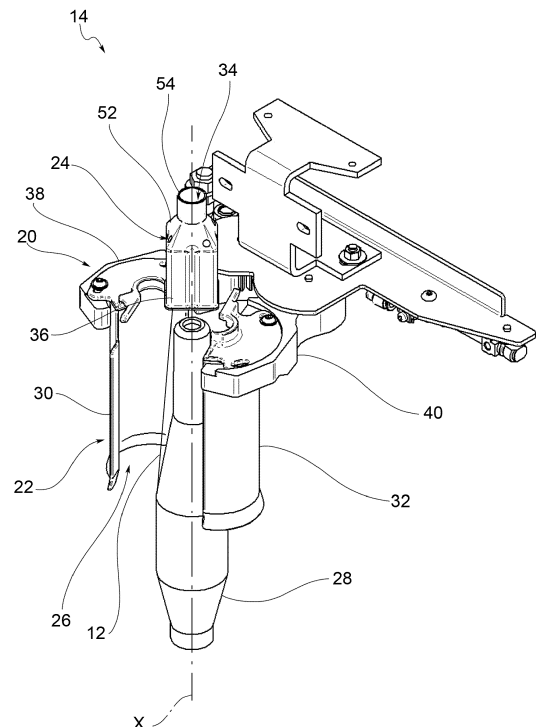


FIG.2

Description

FIELD OF APPLICATION

[0001] The present invention relates to a method for controlling winding tension. In particular, the present invention relates to a method for controlling the winding tension in high productivity winding machines.

BACKGROUND ART

[0002] As is known, the industrial type winding machines comprise a plurality of winding units where the yarn wound in a spool is unwound, subjected to a quality control, and subsequently rewound on a tube to form a reel. Typically, the yarn is collected by a thread guide cylinder, which drags the rotating reel by friction and governs the deposit of the thread so as to optimize the subsequent unravelling during the weaving step.

[0003] It is evident that at high collection speeds correspond to high unravelling speeds from the spool, and consequently high tension values in the yarn. In fact, the yarn, unwinding from the spool at pulsating height as a function of the length of the free section from the pick-up point, forms a so-called balloon. The increase in the diameter of the balloon causes a progressive increase in the tension of the yarn due to the centrifugal effect as the unravelling proceeds.

[0004] In addition, once a certain unravelling speed has been exceeded, the balloon collapses and slides against the spool tube, thus losing its characteristic shape: this causes a further increase in tension, which can lead to the deterioration and breakage of the yarn.

[0005] Typically, the winding units comprise the following constituent elements:

- a tension sensor, responsible for monitoring the tension of the yarn in real time;
- a thread tensioner (disc or comb), configured to increase or reduce the tension of the running yarn in order to keep it constant; and
- a balloon-breaker, shaped to equalize the unwinding tension of the yarn.

[0006] In the absence of any tension control, drawing the yarn at the nominal collection speed v_n and keeping the operating position of the thread tensioner constant at the nominal pressure p_n , there is initially a lowering of the tension T below the average level of the spool due to the balloon-breaker, while in the final section the undesired increase in tension due to the progress of the unravelling is observed.

[0007] In order to homogenize the tension, and thus actuate a first form of control, it is customary on the one hand to compensate for the initial under-tensioning of the yarn due to the balloon-breaker by activating the thread tensioner at the maximum pressure (and not at the nominal pressure p_n) and then progressively decrease it as

the spool turns, on the other hand by decreasing the winding speed in the final section, when the thread tensioner has now reached the minimum set pressure and is no longer capable of absorbing further tension peaks.

[0008] In the absence of effective devices for controlling the unravelling tension, the decrease in speed represents an extremely limiting technological constraint with regard to the productivity of the winding unit and thus of the entire machine. Furthermore, such a forced reduction in speed is particularly disadvantageous because it can already amount to around 50% of the spool's square footage.

[0009] These process restrictions are poorly combined with the increase in production capacity which the market currently requires of these machines so that they are increasingly economically attractive and performing.

[0010] It is well-known to adopt devices and processes, such as those illustrated in European patent application EP3950551A1, aimed at reducing the difference in tension between the start and end of the spool. In particular, the device in question comprises a square-section static balloon-breaker which overlies a pair of containment components which can be opened and closed in a radial direction with respect to the spool, in which these elements are configured to lower the tension of the yarn respectively in the initial and final unravelling steps. However, the document does not propose any methodology for using the device in order to achieve an increase in machine productivity.

PRESENTATION OF THE INVENTION

[0011] The need is therefore felt to resolve the drawbacks and limitations mentioned with reference to the prior art.

[0012] Therefore, there is a need to provide a method for controlling the winding tension of a yarn which is advantageous in terms of production times and thus is particularly advantageous in economic terms.

[0013] Furthermore, the need is felt for a method which can be easily implemented in existing machines, through an adequate programming of a programmable control unit of the winding machine.

[0014] Such requirements are satisfied by a method for controlling the winding tension of a yarn in a winding unit in accordance with claim 1.

DESCRIPTION OF THE DRAWINGS

[0015] 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 in schematic form a side view of a winding unit according to a possible embodiment of the present invention;
- figures 2 and 3 depict in schematic form a portion of

a winding unit according to a possible embodiment of the present invention, respectively in a perspective view and in a top plan view;

- figure 4 depicts in schematic form the trend of the winding speed, tension and pressure exerted by the thread tensioner in a possible embodiment of a process according to the present invention; and
- figure 5 shows the trend of the winding speed according to the prior art and according to a possible embodiment of the present.

[0016] The elements or parts of elements common to the embodiments described below will be indicated using the same reference numerals.

DETAILED DESCRIPTION

[0017] The method for controlling the winding tension of a yarn 12 according to the present invention will be described with reference to figure 1, in which a winding unit 14 is shown comprising: a tension sensor 16, a thread tensioner 18, and an unravelling tension control device 20 comprising a first containment element 22 operable on command, and a second containment element 24 fixed and arranged downstream of the first containment element 22 along the winding direction of the yarn 12.

[0018] The method comprises the following steps:

- (a) start of the winding step with winding speed equal to v_{max} ;
- (b) upon reaching a predetermined tension value measured by the tension sensor (16), the winding speed is brought to a predetermined percentage of v_{max} ;
- (c) upon reaching said predetermined percentage of v_{max} , from here on the unravelling tension is controlled by the thread tensioner (18); and
- (d) upon reaching a predetermined operating parameter of the winding, operating the first containment element (22) of the unravelling tension control device (20) .

[0019] In this discussion, 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.

[0020] In this discussion, v_{max} refers to the maximum winding speed which can be set based on a certain type of yarn and process conditions. In other words, it is a maximum winding speed which can be predetermined based on information regarding the yarn and/or the spool and/or specific process conditions.

[0021] In accordance with a possible embodiment, in

step (a) the pressure exerted by the thread tensioner (18) can be between p_{min} and p_{max} .

[0022] In step (b), upon reaching a predetermined tension value measured by the tension sensor 16, the winding speed can be brought to a percentage of v_{max} between 90% and 99%.

[0023] Advantageously, in step (b), upon reaching a predetermined tension value measured by the tension sensor 16, the winding speed can be brought to a predetermined percentage of v_{max} around 95%.

[0024] In accordance with a possible embodiment of the method of the present invention, if in step (d) the tension is greater than a predetermined value and the pressure is equal to p_{min} , then the winding speed is further lowered.

[0025] The predetermined operating parameter of the winding, the obtaining of the first containment element 22 is operated can be the square footage of the spool.

[0026] In accordance with a possible embodiment, the operation of the first containment element 22 of the unravelling tension control device 20 can occur at a square footage of the spool between 40% and 60%, preferably around 50%.

[0027] In accordance with a possible alternative embodiment, the predetermined operating parameter of the winding upon which the first containment element 22 is operated can be for example a winding time.

[0028] The first containment element 22 can substantially be tubular, having a longitudinal axis x and a first through opening 26 suitable for the passage of the yarn 12 exiting from a spool 28.

[0029] The first containment element 22 can comprise a first containment component 30 and a second containment component 32; in which the containment components 30, 32, can be movable between: a first position in which they are spaced apart from each other, and a second position in which they are close to each other with respect to the first position.

[0030] In other words, according to an aspect of the present invention, the operation of the first containment element 22 provides for the first containment element 30 and the second containment element 32 to move from the first position to the second position.

[0031] In accordance with a possible embodiment, in the second position the containment components 32, 34 can be in contact with each other.

[0032] The containment components 30, 32 can have an enlargement, and thus an increase in the diameter of the through opening 26 at the yarn inlet portion 12.

[0033] In accordance with a possible embodiment, the containment components 32, 34 can be arranged on respective first arm 38 and second arm 40, which rotate with opposite directions, about respective rotation axes y, z spaced from each other, and substantially parallel to said axis x.

[0034] The first arm 38 and said second arm 40 can be provided with a cogwheel 42, 44 integral with the respective arms, which mesh with each other and are

adapted to rotate around the respective axes y, z, so that the rotation of the first arm 38 and of the second arm 40 is synchronous.

[0035] In accordance with a possible embodiment, the first containment element 22 can comprise movement means 46 arranged with a linear actuator 48 connected to one of the arms 38, 40. In particular, the linear actuator 48 can be connected to a lever 50, arranged on one of the arms 38, 40, such that a linear movement of an operating end of the linear actuator 48 causes a rotation of the arm 40, 42. Advantageously, the linear actuator 48 can be of the electrical type.

[0036] Advantageously, the second static type containment element 24 is arranged with a second through opening 34 comprising a base portion 36 facing the first containment element 22 in use, and can have a substantially rectangular transverse section with respect to the longitudinal axis x.

[0037] Preferably, the second through opening 34 can have a substantially square transverse section with respect to the longitudinal axis x. In particular, the side of the substantially square transverse section of the second through opening 34 can have a dimension between 20 mm and 30 mm, preferably between 24 mm and 28 mm, and even more preferably around 26 mm.

[0038] The base portion 36 of the second through opening 34 can have a height, according to a longitudinal direction perpendicular to the transverse section of the through opening 34, between 30 mm and 45 mm, preferably between 35 mm and 40 mm.

[0039] The second through opening 34 can comprise a substantially truncated-pyramid central portion 52 having a greater base at the base portion 36, in an opposite position with respect to the yarn inlet section in the second containment element 24. The central truncated-pyramid portion 52 can comprise a minor base having a substantially circular shape, opposite the major base.

[0040] The second through opening 34 can comprise a substantially cylindrical end portion 54.

[0041] In accordance with a possible embodiment, the winding unit 14 can comprise a programmable control unit 56 operatively connected to the tension sensor 16, the thread tensioner 18, the tension control device 20, and adapted to compare a value of an operating parameter measured with a reference value, and based on such a comparison, operating the first containment element 22 accordingly so that the first containment component 30 and the second containment component 32 pass from the first position to the second position, or to an intermediate position if present.

[0042] Thus, the advantages that can be achieved with the method of the present invention are now apparent.

[0043] Initially, by drawing the yarn at a collection speed greater than the nominal value, it is possible to exploit the initial undertension induced by the tension control device 22 to obtain a first benefit in terms of production capacity.

[0044] In this regard, in figure 4, three graphs are sche-

matically depicted showing possible trends in the winding speed, tension and pressure applied.

[0045] As can be seen, the initial speed is greater than the nominal speed which would normally be used in the initial winding step.

[0046] Subsequently, when the tension begins to increase, it is sufficient first to decrease the winding speed at the nominal speed (speed which would still be used) to actuate a first tension control, without changing the position of the thread tensioner.

[0047] Finally, in addition to a certain percentage of the square footage of the spool, the traditional adjustment of the tension by means of the thread tensioner 18 is assisted by the tension control device 20, which absorbs those tension peaks which would otherwise cause the pressure of the thread tensioner 18 to decrease too quickly to the minimum value.

[0048] It is thereby possible to effectively distribute the pressure regulation interval over a wider time interval, delaying the achievement of the minimum pressure and thus the forced decrease of speed, remaining at the nominal speed practically until the end of the spool, further benefiting productivity.

[0049] Furthermore, it is possible to manage the tension control until the spool is exhausted in a simple and effective manner with the sole use of the thread tensioner, also reducing the operating field thereof in terms of stroke and encumbrance.

[0050] Furthermore, the method can also be implemented on existing machines by means of appropriate process parameter management.

[0051] The graph shown in figure 5 illustrates the advantages associated with the increase in productivity (expressed in terms of winding speed) which can be achieved with the use of the method of the present invention with respect to the prior art. In particular, it is seen that in the initial step and in the final step the winding speed (depicted with a continuous line) which can be used is substantially higher than the winding speed according to the prior art (depicted with a dotted line).

[0052] To the embodiments described above, the person skilled in the art may, in order to meet specific needs, make changes and/or replacements of elements described with equivalent elements, without departing from the scope of the attached claims.

Claims

1. Method for controlling the winding tension of a yarn (12) in a winding unit (14) comprising: a tension sensor (16), a thread tensioner (18), and an unravelling tension control device (20) comprising a first containment element (22) operable on command, and a second containment element (24) fixed and arranged downstream of the first containment element (22) along the winding direction of the yarn (12); said method comprises the following steps:

- (a) start of the winding step with winding speed equal to v_{\max} ;
 (b) upon reaching a predetermined tension value measured by the tension sensor (16), the winding speed is brought to a predetermined percentage of v_{\max} ;
 (c) upon reaching said predetermined percentage of v_{\max} , from here on the unravelling tension is controlled by the thread tensioner (18); and
 (d) upon reaching a predetermined operating parameter of the winding, operating the first containment element (22) of the unravelling tension control device (20).
2. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to the preceding claim, **characterised in that** in step (a) the pressure exerted by the thread tensioner (18) is between p_{\min} and p_{\max} .
 3. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any of the preceding claims, **characterized in that** in step (b) upon reaching a predetermined tension value measured by the tension sensor (16), the winding speed is brought to a percentage of v_{\max} between 90% and 99%.
 4. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of the preceding claims, **characterized in that** in step (b) upon reaching a predetermined tension value measured by the tension sensor (16), the winding speed is brought to a percentage of v_{\max} around 95%.
 5. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of the preceding claims, **characterised in that** if in step (c) the tension is greater than a predetermined value and the pressure is equal to p_{\min} , then the winding speed is further lowered.
 6. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of the preceding claims, **characterised in that** the predetermined operating parameter of the winding upon which the first containment element (22) is operated is a predetermined square footage of the spool.
 7. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of the preceding claims, **characterised in that** the operation of the first containment element (22) of the unravelling tension control device (20) occurs at a square footage of the spool (28) between 40% and 60%, preferably around 50%.
 8. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of claims 1-6, **characterized in that** the predetermined operating parameter of the winding at which the first containment element (22) is operated is a predetermined winding time.
 9. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of the preceding claims, **characterised in that** said first containment element (22) is substantially tubular, having a longitudinal axis (x) and a first through opening (26) suitable for the passage of the yarn (12) exiting from a spool (28); said first containment element (22) comprising a first containment component (30) and a second containment component (32); wherein said containment components (30, 32) are movable between: a first position in which said containment components (30, 32) are spaced apart from each other, and a second position in which said containment components (30, 32) are close to each other with respect to the first position.
 10. Method for controlling the winding tension of a yarn (12) in a winding unit (14) according to any one of the preceding claims, **characterised in that** the second static containment element (24), arranged downstream with respect to said first containment element (22), said second containment element (24) being arranged with a second through opening (34) comprising a base portion (36) facing said first containment element (22) in use, having a substantially rectangular transverse section with respect to said longitudinal axis (x).

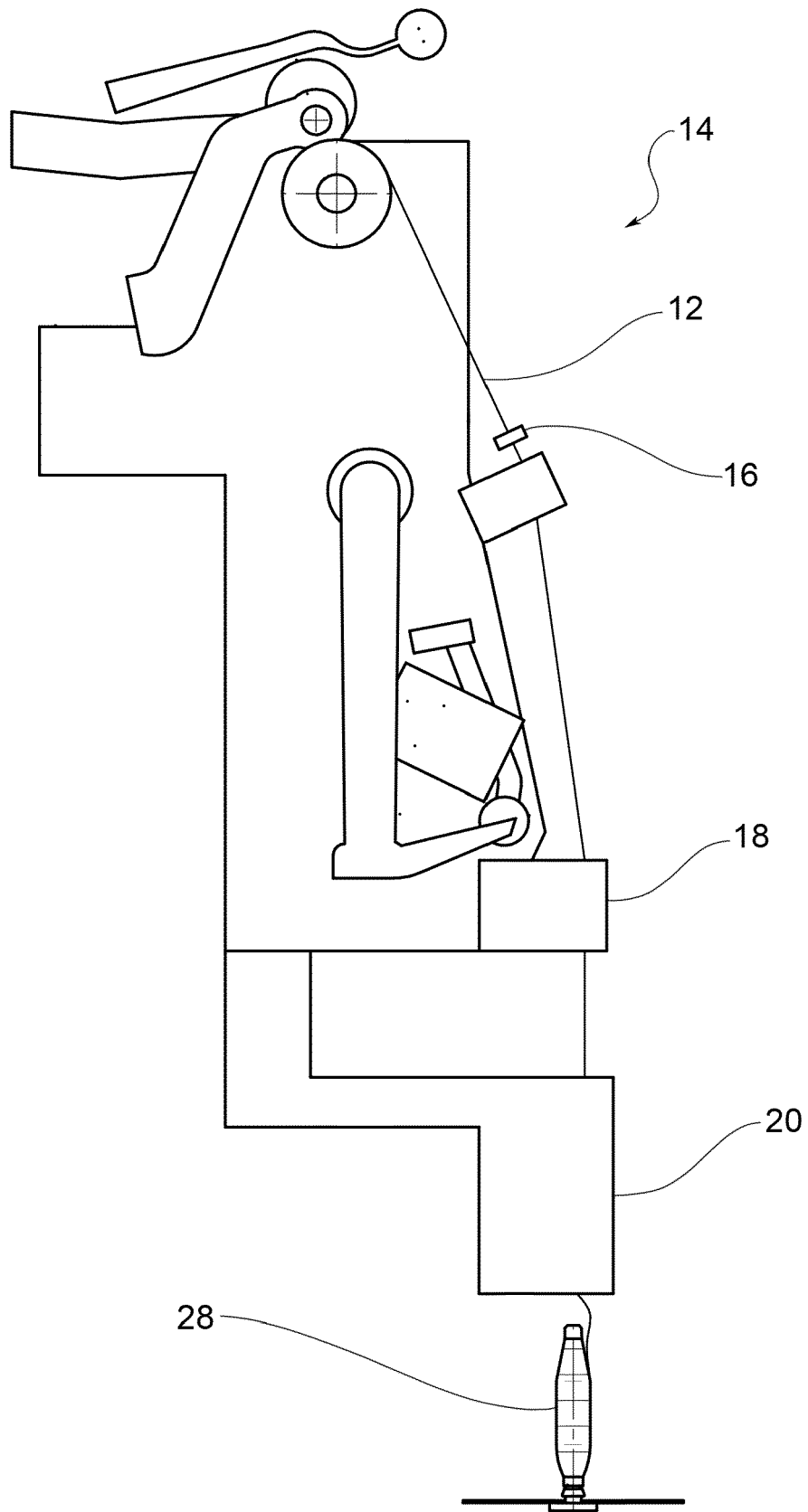


FIG.1

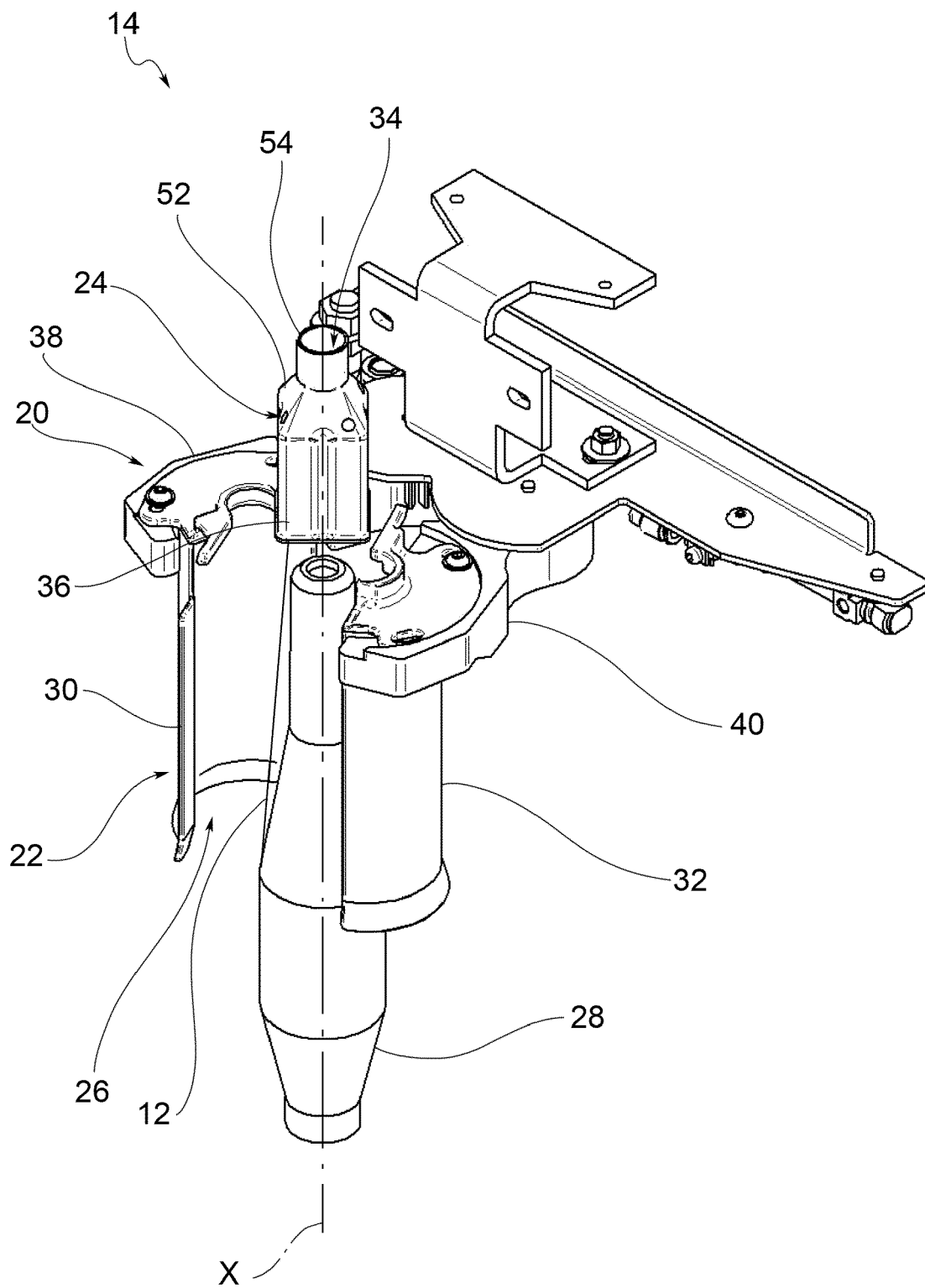


FIG.2

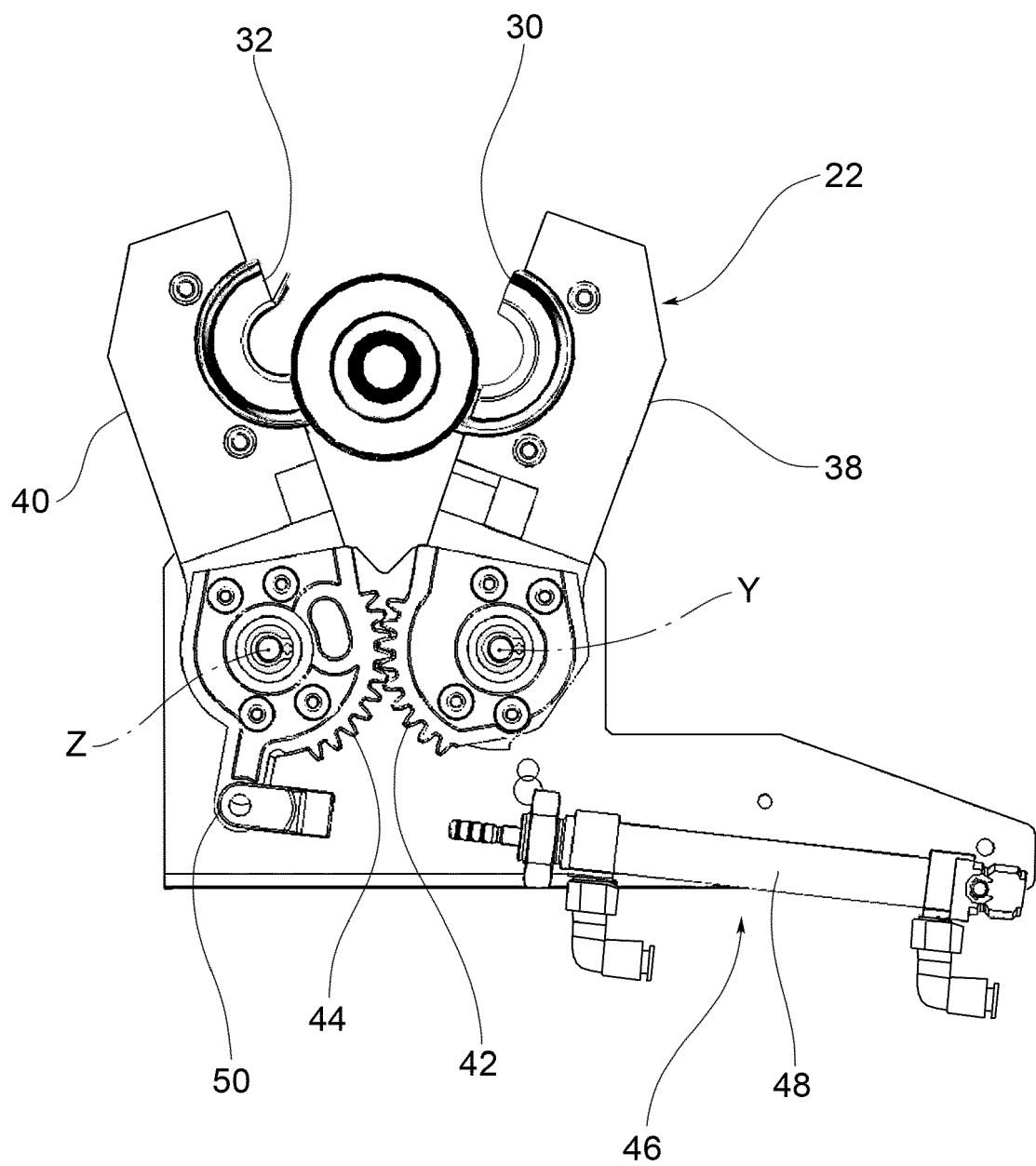


FIG.3

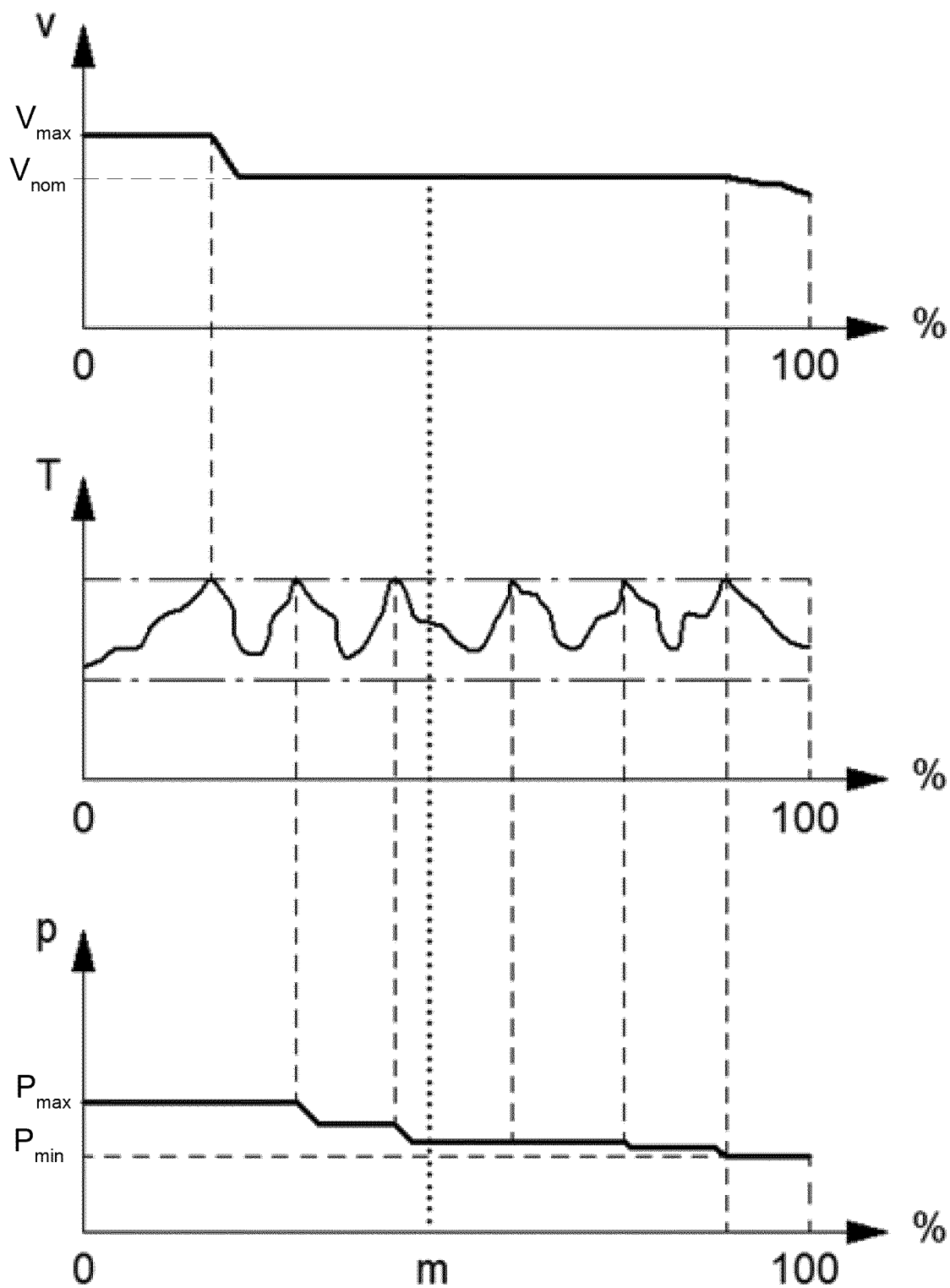


FIG.4

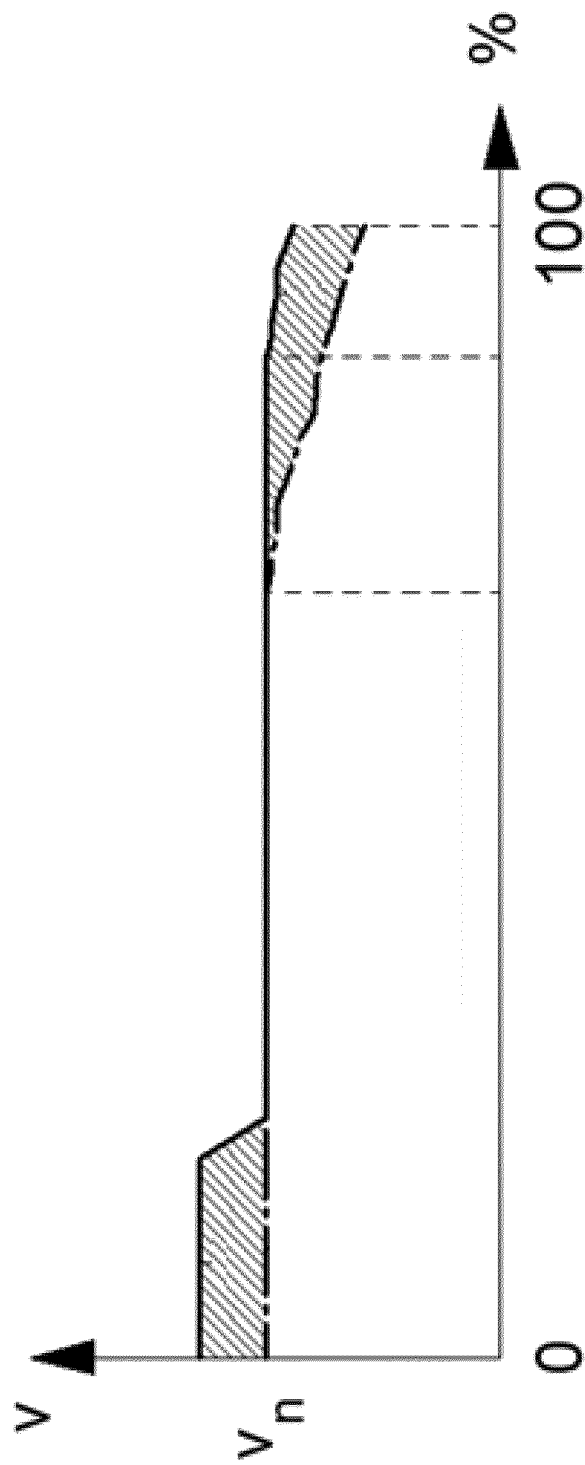


FIG. 5



EUROPEAN SEARCH REPORT

Application Number

EP 23 18 2007

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The present search report has been drawn up for all claims			

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EPO FORM 1503 03:82 (P04C01)

Place of search The Hague	Date of completion of the search 28 November 2023	Examiner Guisan, Thierry
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