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(54) **SPINNING CONTROLLER FOR A SPINNING MACHINE AND METHOD FOR CONTROLLING A SPINNING MACHINE**

(57) A spinning controller (c1) for a spinning machine (1) and a method for controlling a spinning machine (1) for producing a cop (C) with wound yarn from a roving (R) are configured to: access a quality curve (qu) which defines a quality of the yarn depending on a position (y) of the cop (C), the quality curve (cu) being determined based on a winding machine (2), determine based on the quality curve (qu) a spinning curve (sp) which defines a spindle speed of a spindle (10) of the spinning machine (1) for producing the cop (C) depending on a position (y) of the cop (C), control the spinning machine (1) for producing the cop (C) according to the spinning curve (sp).

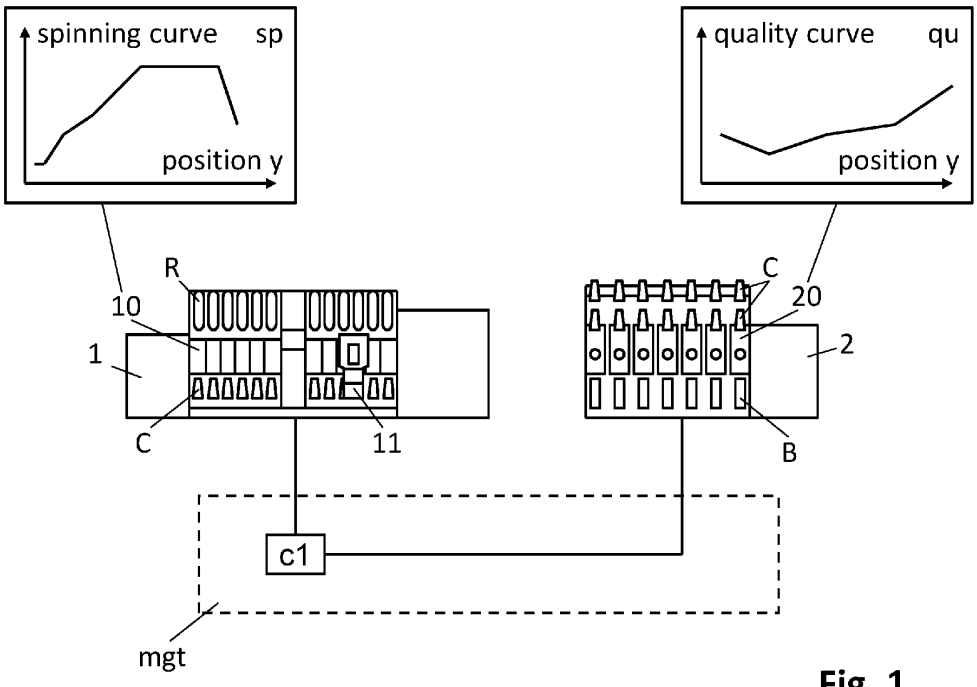

Fig. 1

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Description

Field of invention

[0001] This disclosure relates to a spinning controller for a spinning machine for producing one or more cops with wound yarn and a method for controlling a spinning machine for producing one or more cops with wound yarn.

Description of related art

[0002] Spinning controllers for spinning machines operate respective spinning machines for producing cops with wound yarn from roving. In ring spinning machines, roving passes downwards to drafting rollers to a thread guide that is adjusted centrally above a spindle assembly, where the roving is threaded through a traveller which moves along a ring. A cop is fixed on a spindle, which is driven at a specific speed, and receives the thread for producing a cop with wound yarn. Completed cops with wound yarn are doffed from the machine.

[0003] The cops are received in winding machines, where yarn is unwound from the cops and rewound on bobbins, for example for producing bobbins adapted to predefined applications.

[0004] Spinning controllers can monitor and/or control spinning machines for proper operation, for example regarding doffing upon completion of cops, etc. At winding machines, a quality of yarn can be determined.

Brief summary of the invention

[0005] There may be a need for an improved spinning controller for a spinning machine for producing cops with wound yarn from roving, and for an improved method for controlling a spinning machine for producing cops with wound yarn from roving.

[0006] Such a need may be met by the subject-matter of the independent claims. Advantageous embodiments are defined in the dependent claims.

[0007] An aspect of the invention relates to a spinning controller for a spinning machine for producing a cop with wound yarn from a roving. The spinning controller is configured to: access a quality curve which defines a quality of the yarn depending on a position of the cop, the quality curve being determined based on a winding machine, determine based on the quality curve a spinning curve which defines a spindle speed of a spindle of the spinning machine for producing the cop depending on a position of the cop, control the spinning machine for producing the cop according to the spinning curve. For example, performance at the spinning machine and/or the winding machine can be increased. For example, yarn breaks at the spinning machine and/or the winding machine can be decreased.

[0008] In some embodiments, the cop has assigned a plurality of zones and wherein the spinning curve and/or the quality curve depends on the plurality of zones. For example, determining the spinning curve can be simplified.

[0009] In some embodiments, the spinning controller is configured to determine the spinning curve based on operating information which includes one or more of a yarn count, a roving quality, a twist level, a fiber strength, and a fiber elasticity. For example, operating information can relate to current or past operating information. For example, the spinning curve can be adapted to properties of the textile material.

[0010] In some embodiments, the spinning controller is configured to determine the spinning curve based on operating information which includes one or more of a yarn break rate, a temperature, a humidity and an energy consumption. For example, the spinning curve can be adapted to parameters which are widely recorded in spinning mills.

[0011] In some embodiments, the spinning controller is configured to determine the spinning curve based on operating information which includes one or more of a tension of the yarn in the spinning machine and/or a tension of the yarn in the winding machine. For example, the spinning curve can be adapted to tension problems during spinning and/or winding.

[0012] In some embodiments, the spinning controller is configured to determine the spinning curve based on operating information which includes a traveller life cycle. For example, after replacement of a traveller, the spinning curve can be adapted accordingly.

[0013] In some embodiments, the spinning controller is configured to determine the spindle curve based on a spindle size and/or design.

[0014] In some embodiments, the spinning controller is configured to determine the spinning curve based on a trend in operating information of the spinning machine and/or the winding machine. For example, trends relating to doffing times, group of machines, etc. can be used for determining the spinning curve.

[0015] In some embodiments, the spinning controller is configured to determine the spinning curve based on a wear based signature or pattern in the operating information of the spinning machine and/or the winding machine. For example, an increased energy consumption can indicate a wear and the spinning curve can be adapted accordingly.

[0016] In some embodiments, the spinning controller is configured to determine the spinning curve using an artificial intelligence machine.

[0017] The invention further relates to a spinning mill management system including a spinning controller as described.

[0018] The invention further relates to a method for controlling a spinning machine for producing a cop with wound yarn from a roving. The method comprises the steps executed at a spinning controller of: accessing a quality curve which defines a quality of the yarn depending on a position of the cop, the quality curve being de-

termined based on a winding machine, determining based on the quality curve a spinning curve which defines a spindle speed of a spindle of the spinning machine for producing the cop depending on a position of the cop, controlling the spinning machine for producing the cop according to the spinning curve.

[0019] In some embodiments, the cop has assigned a plurality of zones and wherein the spinning curve and/or the quality curve depends on the plurality of zones.

[0020] In some embodiments, the method further comprises: determining the spinning curve based on operating information which includes one or more of a yarn count, a roving quality, a twist level, a fiber strength, and a fiber elasticity.

[0021] In some embodiments, the method further comprises: determining the spinning curve based on operating information which includes one or more of a tension of the yarn in the spinning machine and/or a tension of the yarn in the winding machine.

[0022] In some embodiments, the method further comprises: determining the spinning curve based on operating information which includes a traveller life cycle.

Brief description of drawings

[0023] The invention will be better understood with the aid of the description of an embodiment given by way of example an illustrated by the figures, in which:

Fig. 1 illustrates schematically a spinning controller for controlling a spinning machine according to the present invention,

Fig. 2 illustrates schematically a cop,

Fig. 3 illustrates schematically an example of a spinning curve according to the present invention,

Fig. 4 illustrates schematically in vertical direction from bottom to top: a spinning curve, a cop and a plurality of quality curves,

Fig. 5 illustrates schematically possible method steps of a method for controlling a spinning machine according to the present invention.

Detailed Description of the invention

[0024] Fig. 1 illustrates schematically a spinning controller c1 for controlling a spinning machine 1 according to the present invention.

[0025] The spinning machine 1 has a plurality of spinning units 10. Each spinning unit 10 receives roving R for producing cops C with wound yarn. The spinning machine 1 can include a piecing robot 10 for repairing ends down that occur while the spinning machine 1 is running or during doffing.

[0026] The winding machine 2 has a plurality of winding units 20. Each winding unit 20 receives cops C produced by the spinning machine 1 for producing bobbins B.

[0027] Fig. 2 illustrates schematically a cop C. The cop C includes a cop tube T with wound yarn A. During production of the cop C, the empty cop tube T gets arranged in a spinning unit 10 of the spinning machine 1. While the cop tube T is rotated with a predetermined speed, yarn A is wound onto the cop tube T at positions y along the length of the cop tube T.

[0028] As illustrated in Fig. 1, the spinning controller c1 is configured to access a quality curve qu which defines a quality of the yarn depending on a position y of the cop C, the quality curve cu being determined based on a winding machine 2.

[0029] For example, the quality curve qu relates to cops C which were produced at a particular spinning unit 10 of the spinning machine 1, wherein at the winding machine 2 it is determined that this spinning unit 10 produces cops C having the quality curve cu. For example, the quality curve cu relates to cops C which were produced earlier at this spinning unit 10, wherein it is assumed that producing a cop at this spinning unit 10 results in a cop having this quality curve cu.

[0030] For example, the quality curve can relate to a surface index, which can have a spread of for example +- 10%.

[0031] As illustrated in Fig. 1, the spinning controller c1 is configured to determine a spinning curve sp which defines a spindle speed of the spinning unit 10 of the spinning machine 1 for producing the cop C depending on the position y of the cop C.

[0032] For example, the spinning curve sp relates to a spindle speed curve. For example, the spinning curve sp relates to a traveller speed curve.

[0033] The spinning controller c1 is configured to control the spinning machine 1 for producing the cop C according to the spinning curve sp.

[0034] As illustrated in Fig. 2, the cop C can have assigned a plurality of zones z1, z2, ..., zn. For example, the spinning curve sp can depend on the zones z1, z2, ..., zn. For example, the quality curve cu can depend on the zones z1, z2, ..., zn. For example, the zones z1, z2, ..., zn can relate to five zones z1, z2, ... z5, to seven zones z1, z2, ..., z7, etc. Assigning zones z1, z2, ..., zn to the cop C can simplify determining the spinning curve sp.

[0035] Fig. 3 illustrates schematically an example of a spinning curve sp according to the present invention. At position y1, spinning starts up. At position y2, first layers are wound on the cop tube T, wherein the spindle speed can be kept constant, which is in particular beneficial with nep issues at the base of the cop tube T, wherein the duration can be selected via the meters delivered. At position y3, which relates to a base buildup, yarn tension compensation is applied, with a higher yarn tension as a result of a higher spindle speed, wherein reduced production from the previous point is compensated. At position y4, which relates to a base finish, an approximately

lower spindle speed as of ring rail position applies. At position y5, a maximal spindle speed as of ring position applies, which is applied until position y6. At position y7, the cop is full and spinning-out applies.

[0036] The spinning curve sp can be determined based on operating information oi, for example by accessing knowledge base stored in a knowledge base database and/or with an artificial intelligence machine, as follows.

[0037] The spinning curve sp can be determined depending on a yarn count. Higher yarn counts can require slower speeds to maintain proper tension.

[0038] The spinning curve sp can be determined depending on a yarn quality, such as a strength, thickness, etc. Lower quality yarns can require slower spindle speeds to prevent breaks.

[0039] The spinning curve sp can be determined depending on a twist level. Higher twist levels can require slower speeds to prevent yarn breakage.

[0040] The spinning curve sp can be determined depending on a temperature and/or humidity, or depending on other climatic conditions. High temperatures and humidity can cause the yarn to expand, which can increase tension and cause breaks. Low temperatures and humidity can cause the yarn to contract and become dry, which can increase tension on the yarn and cause breaks. Slower spindle speeds can be required to maintain proper tension. High temperatures can degrade lubricants, which can increase friction and cause yarn breaks. Slower spindle speeds can be required to avoid an increase in friction causing yarn breaks.

[0041] The spinning curve sp can be determined depending on a spindle size and/or design, for example depending on the geometry of a cop tube T. Larger spindles can require slower spindle speeds to prevent yarn breakage.

[0042] The spinning curve sp can be determined depending on a fiber quality, such as a strength, elasticity, etc. Lower quality fibers can require slower spindle speeds to prevent breaks.

[0043] The spinning curve sp can be determined depending on an operator skill and/or depending on machine settings.

[0044] The spinning curve sp can be determined depending on an energy consumption. For example, overall energy consumption can be minimized while avoiding yarn breaks.

[0045] The spinning curve sp can be determined depending on a yarn tension indication. For example, a yarn tension indication can be determined according to CN107190377B, CN107201577A or CN218088345U. Yarn tension indication can be determined using other facilities. Yarn tension indication can be determined indirectly, for example by analyzing a spinning speed and a rate of yarn breaks.

[0046] The spinning curve sp can be determined depending on a traveller life cycle. Travellers are small, circular rings that transfer the yarn from the spinning ring to the cop. As the traveller wears out, its diameter decreases, and it becomes less effective at transferring the yarn. This can cause an increase in tension on the yarn. A decrease in the spindle speed can be required. A worn traveller can cause the yarn to slip and the yarn to break more frequently, which can lead to a decrease in yarn quality and efficiency. To minimize the impact of traveller life on ring frame spindle speed, it is important to regularly inspect and replace the travellers as needed. The replacement of traveller should be done in time before they become too worn, which can help to maintain proper tension and prevent yarn breaks. The spindle speed can be adjusted when replacing the traveller. For example, the speed can be decreased to compensate for the change in tension caused by the new traveller.

[0047] The spinning curve sp is determined depending on a position y along a length of a cop tube T (cf. Fig. 2). Yarn breaks can occur on the nose and bottom of the cop C. Yarn breaks on the nose of the cop are typically caused by tension issues, while yarn breaks on the bottom of the cop are typically caused by issues with the winding process. The spindle speed can be adjusted to ensure that the proper tension and/or winding is maintained while winding yarn onto the cop C at positions y along the length of the cop tube T.

[0048] The spinning curve sp can be determined depending on a drafting roller gap. A larger gap can result in a lower spindle speed, while a smaller gap can result in a higher spindle speed.

[0049] The spinning curve sp can be determined depending on a spindle belt slippage. When the belt slips, the spindle can slow down or stop, which can lead to a yarn break. A worn belt can cause an increase in breaks, which can require slower spindle speeds to prevent breaks.

[0050] The spinning curve sp can be determined depending on a grinding of a top roller. Improper grinding can result in uneven wear and cause variations in the tension. Dust generated from the grinding process can cause increased yarn breaks. Grinding debris can cause contamination of lubricants. A slower spindle speed can be required.

[0051] The spinning curve sp can be determined depending on a lifecycle of a top apron. Worn or damaged aprons can cause irregular yarn tensions. Torn or frayed aprons can cause increased fiber entanglement and yarn breaks. Worn or damaged aprons can cause increased fiber abrasion, leading to increased fiber damage. A slower spindle speed can be required.

[0052] The spinning controller c1 can be configured to record operating information oi from the spinning machine 1 and or winding machine 2 via one or more sensors attached to the spinning machine c1 and/or winding machine 2. For example, the spinning controller c1 includes a communication interface for communicating via a computer network with the sensors attached to the spinning machine 1 and/or the winding machine 2.

[0053] Fig. 4 illustrates schematically in vertical direction from bottom to top: a spinning curve sp, a cop C and

a yarn breakage rate for different yarn qualities q1, q2, ... , qn. As illustrated in Fig. 4, during cop building, the spinning speed according to the spinning curve sp assumes different speeds from start to stop of building the cop. As illustrated in Fig. 4, a first quality q1 of yarn has a yarn breakage rate which is different to a yarn breakage rate of a second quality q2 of yarn. For example, at the end of cop building, the second quality q2 has a higher yarn breakage rate than the first quality q1, while before, the second quality q2 has a lower breakage rate than the first quality q1. For example, by determining a spinning curve sp having a slower spinning speed at the end of cop building, the yarn breakage rate of the second quality q2 can be reduced.

[0054] The winding machine 2 includes sensors for determining the quality of the yarn of the cops C. For example, the quality can relate to a surface index, etc.

[0055] The winding controller c2 can be configured to determine a yarn quality q1, q2, ..., qn. For example, the winding controller c2 can be configured to determine a yarn quality q1, q2, ..., qn depending on a plurality of zones z1, z2, ..., zn. Thus, the winding controller c2 can be configured to determine a quality signature of the cop C.

[0056] The spinning controller c1 and/or the winding controller c2 can be configured to determine a deviation from a nominal quality signature of the determined quality signature of the cop C. In case of a deviation from a nominal quality, the spinning controller c1 and/or the winding controller c2 can be configured to adapt operation of the spinning machine 1 and/or the winding machine 2 accordingly.

[0057] The spinning controller c1 and the winding controller c2 can relate to one or more computers which include one or more applications for executing the functions of the spinning controller c1 and the winding controller c2 as described above.

[0058] An artificial intelligence machine can be arranged for determining the spinning curve sp based on a long term analysis of an operation of the spinning machine 1 and/or the winding machine 2.

[0059] As illustrated in Fig. 1, the spinning controller c1 can be arranged within a spinning mill management system mgt for a spinning mill.

[0060] Fig. 5 illustrates schematically possible method steps of a method for controlling a spinning machine 1. The steps include executed at a spinning controller c1 of: determining S51 a spinning curve sp which defines a spindle speed of a spindle 10 of the spinning machine 1 for producing the cop C depending on a position y of the cop C, controlling S52 the spinning machine 1 for producing the cop C according to the spinning curve sp, recording and storing S53 operating information oi relating to the production of the cop C in a database db.

[0061] Finally, it should be noted that the term "comprising" does not exclude other elements or steps and the "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

Reference numerals/signs

[0062]

1	spinning machine
10	spinning unit
11	piecing robot
2	winding machine
20	winding unit
c1	spinning controller
db	database
R	roving
C	cop
B	bobbin
mgt	spinning mill management system

Claims

1. A spinning controller (c1) for a spinning machine (1) for producing a cop (C) with wound yarn from a roving (R), the spinning controller (c1) being configured to:

   access a quality curve (qu) which defines a quality of the yarn depending on a position (y) of the cop (C), the quality curve (cu) being determined based on a winding machine (2),
   determine based on the quality curve (qu) a spinning curve (sp) which defines a spindle speed of a spindle (10) of the spinning machine (1) for producing the cop (C) depending on a position (y) of the cop (C),
   control the spinning machine (1) for producing the cop (C) according to the spinning curve (sp).

2. The spinning controller (c1) according to claim 1, wherein the cop (C) has assigned a plurality of zones (z1, z2, ..., zn) and wherein the spinning curve (sp) and/or the quality curve (qu) depends on the plurality of zones (z1, z2, ..., zn).

3. The spinning controller (c1) according to claim 1 or 2, further configured to determine the spinning curve (sp) based on operating information (oi) which includes one or more of a yarn count, a roving quality, a twist level, a fiber strength, and a fiber elasticity.

4. The spinning controller (c1) according to one of claims 1 to 3, further configured to determine the spinning curve (sp) based on operating information (oi) which includes one or more of a yarn break rate, a temperature, a humidity and an energy consumption.

5. The spinning controller (c1) according to one of claims 1 to 4, further configured to determine the spinning curve (sp) based on operating information (oi) which includes one or more of a tension of the yarn in the spinning machine and/or a tension of the yarn in the winding machine (2).

6. The spinning controller (c1) according to one of claims 1 to 5, further configured to determine the spinning curve (sp) based on operating information (oi) which includes a traveller life cycle.

7. The spinning controller (c1) according to one of claims 1 to 6, further configured to determine the spinning curve (sp) based on a spindle size and/or design.

8. The spinning controller (c1) according to one of claims 1 to 7, further configured to determine the spinning curve (sp) based on a trend in operating information (oi) of the spinning machine (1) and/or the winding machine (2).

9. The spinning controller (c1) according to one of claims 1 to 7, further configured to determine the spinning curve (sp) based on a wear based signature or pattern in the operating information (oi) of the spinning machine (1) and/or the winding machine (2).

10. A spinning mill management system (mgt) including a spinning controller (c1) according to one of claims 1 to 9.

11. A method for controlling a spinning machine (1) for producing a cop (C) with wound yarn from a roving (R), the method comprising the steps executed at a spinning controller (c1) of:

    accessing a quality curve (qu) which defines a quality of the yarn depending on a position (y) of the cop (C), the quality curve (cu) being determined based on a winding machine (2),
    determining based on the quality curve (qu) a spinning curve (sp) which defines a spindle speed of a spindle (10) of the spinning machine (1) for producing the cop (C) depending on a position (y) of the cop (C),
    controlling the spinning machine (1) for producing the cop (C) according to the spinning curve (sp).

12. The method according to claim 11, wherein the cop (C) has assigned a plurality of zones (z1, z2, ..., zn) and wherein the spinning curve (sp) and/or the quality curve (qu) depends on the plurality of zones (z1, z2, ..., zn).

13. The method according to claim 11 or 12, further comprising determining the spinning curve (sp) based on operating information (oi) which includes one or more of a yarn count, a roving quality, a twist level, a fiber strength, and a fiber elasticity.

14. The method according to one of claims 11 to 13, further comprising determining the spinning curve (sp) based on operating information (oi) which includes one or more of a tension of the yarn in the spinning machine and/or a tension of the yarn in the winding machine (2).

15. The method according to one of claims 11 to 14, further comprising determining the spinning curve (sp) based on operating information (oi) which includes a traveller life cycle.

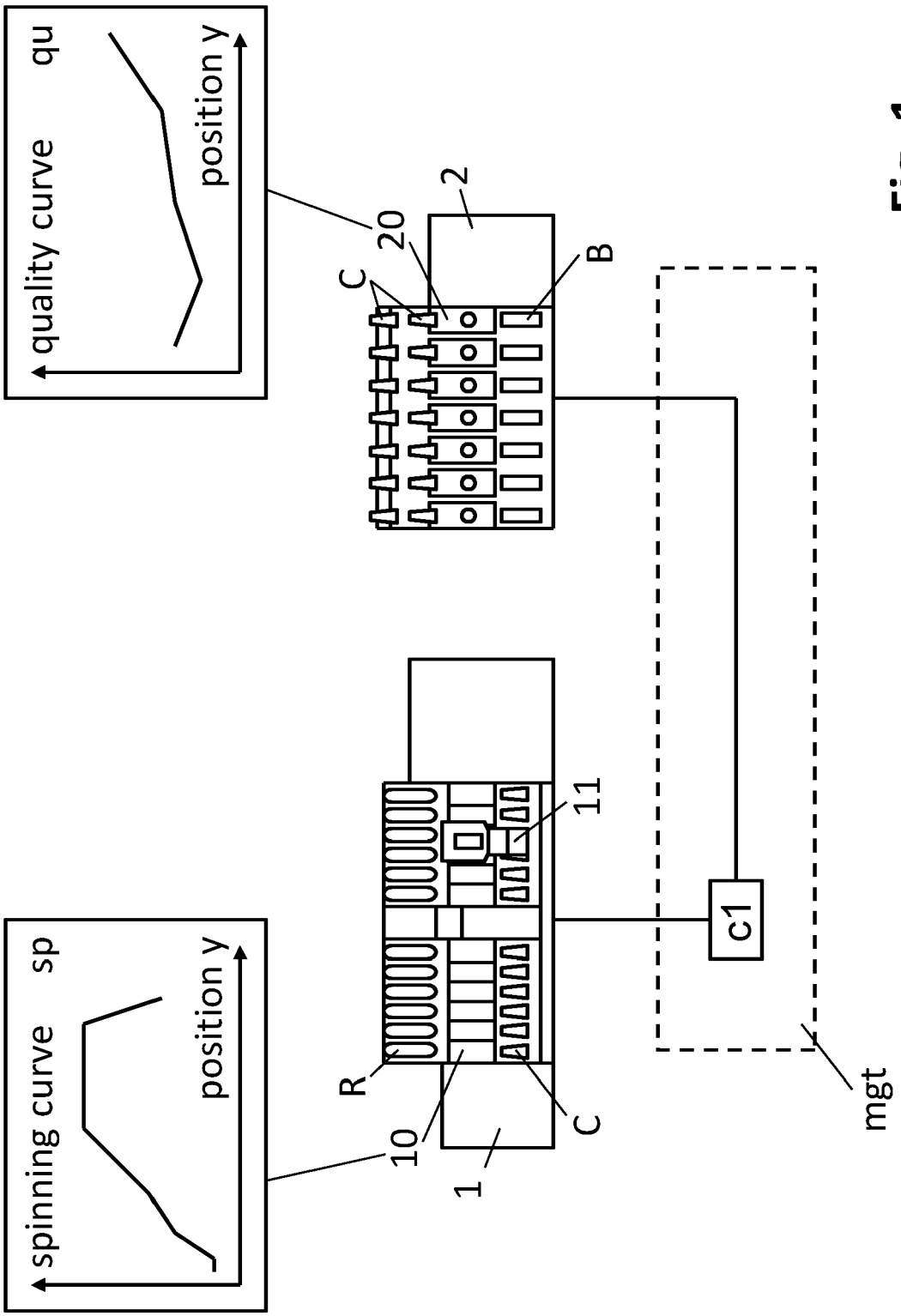
quality curve qu
position y
spinning curve sp
position y
20
2
C
B
11
R
10
1
C
c1
mgt

Fig. 1

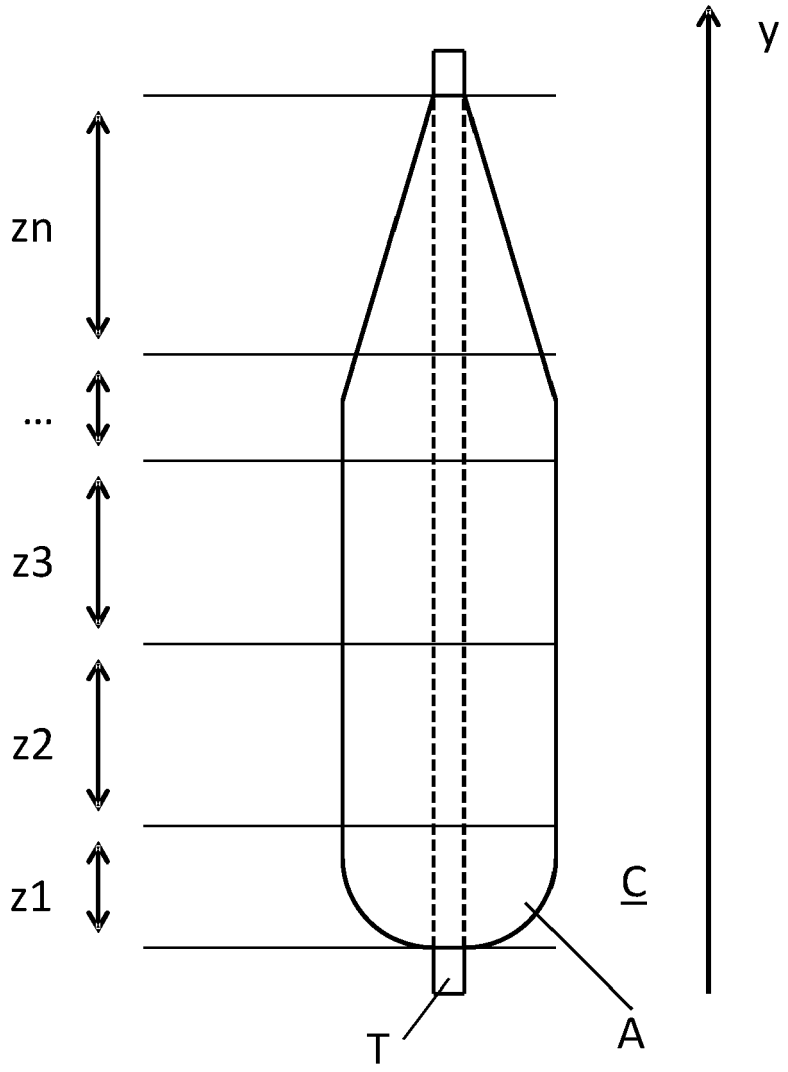

Fig. 2

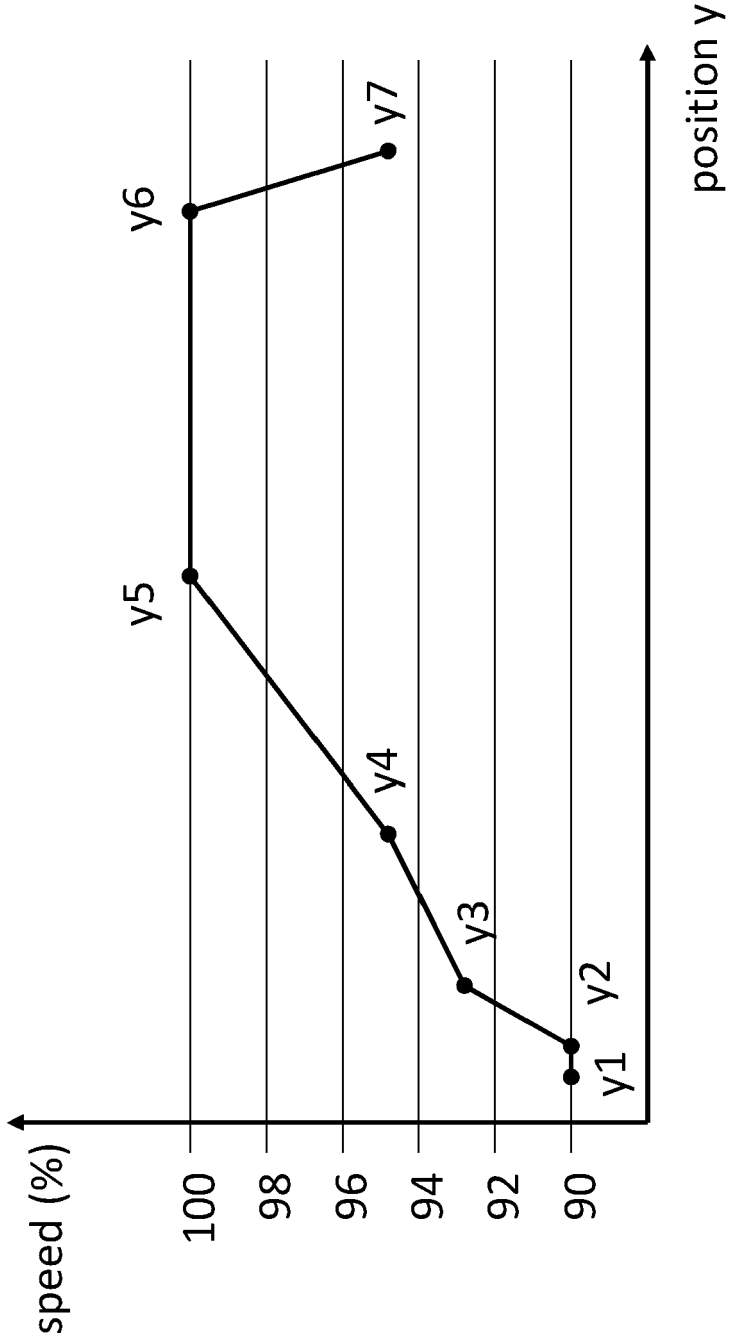

Fig. 3

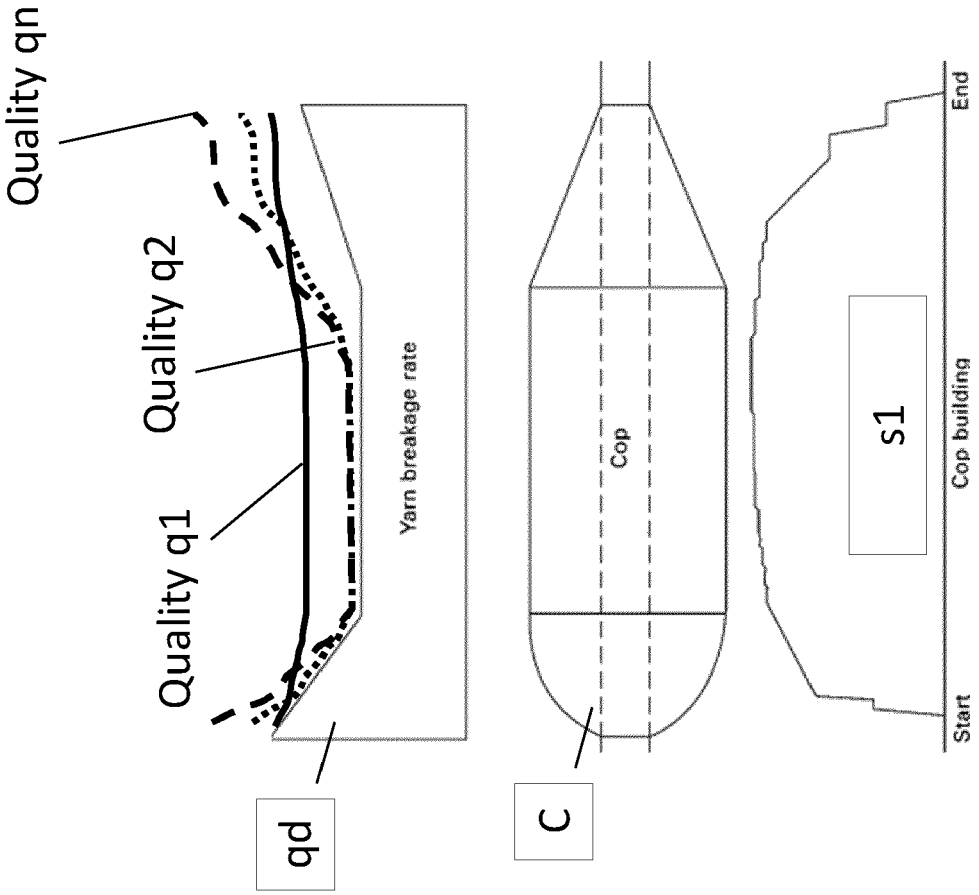
Quality qn
Quality q2
Quality q1
Yarn breakage rate
qd
Cop
C
s1
Start
Cop building
End

Fig. 4

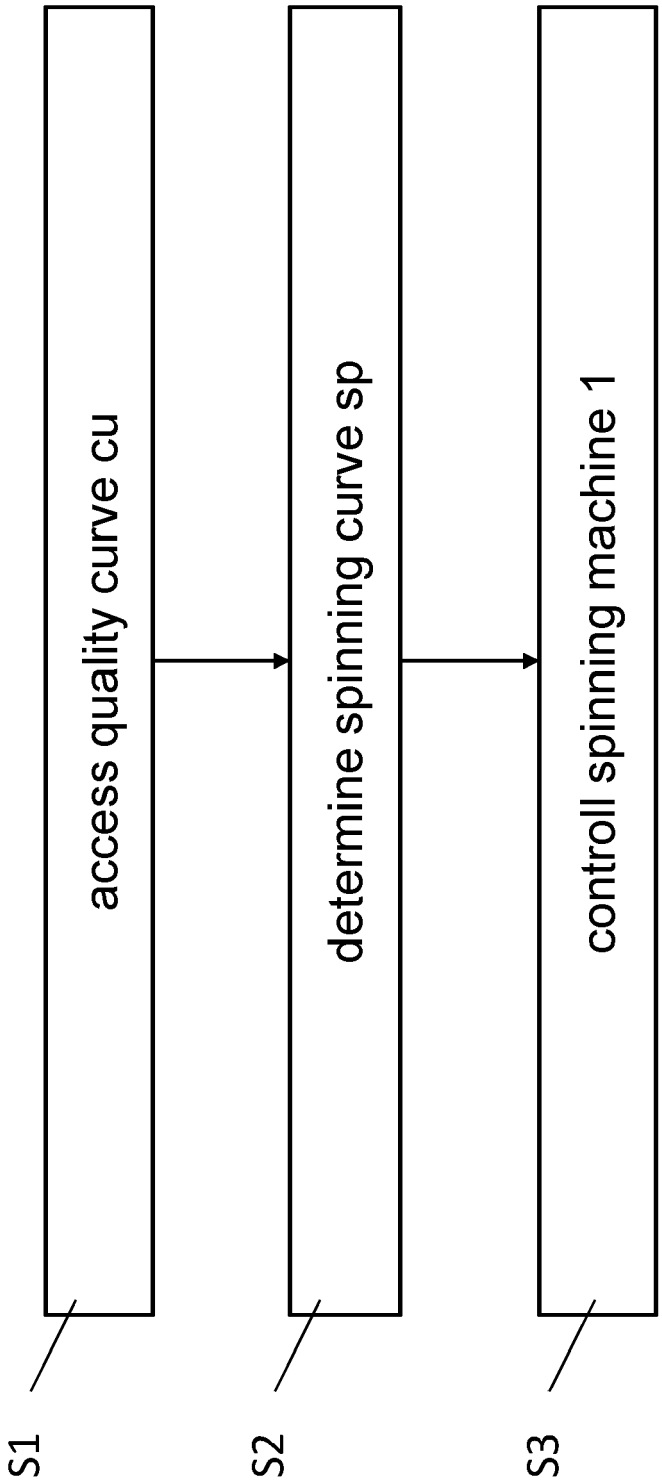
access quality curve cu
determine spinning curve sp
controll spinning machine 1
S1
S2
S3

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 8119

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 November 2023	Humbert, Thomas

CATEGORY OF CITED DOCUMENTS

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

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