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(54) A METHOD OF DETECTING THE PRESENCE OF A SLIVER AT THE ENTRANCE OF A WORKSTATION OF A TEXTILE MACHINE FOR THE PROCESSING OF THE SLIVER, IN PARTICULAR A MACHINE FOR PRODUCING YARN, A DEVICE FOR PERFORMING THE METHOD, A SLIVER FEEDING OR DRAFTING DEVICE AND A TEXTILE MACHINE

(57) The invention relates to a method for detecting the presence of sliver (18) at the entrance of a workstation of a textile machine for processing the sliver (18), in particular at the entrance of a textile machine for the production of yarn from the sliver, during which the monitored sliver (18) is conveyed at the entrance of the workstation of the machine by a sliver feeding device (3) or by a sliver drafting device (2) and the sliver feeding device (3) or drafting device (2) is driven by at least one individual electric drive (30, 50) connected to a control device (11) equipped with a regulation loop for controlling the drive (30,50), wherein at least one quantity corresponding to the current load of said drive (30,50) is monitored and the sensed quantity is evaluated. As the quantity sensed during the process of producing yarn (14) and/or during the process of resuming spinning is sensed the size of the supply current I and/or the value of the power input P and/or the speed S of rotation of the electric drive (30,50) of the feeding device or the drafting device, and during the process of producing yarn (14) and/or during the process of resuming spinning, a change in the size of the supply current I and/or a change in the value of the power input P and/or a change in the speed S of rotation of said individual electric drive (30, 50) is detected, whereupon, when a change in the sensed quantity is detected, the size of this change is evaluated and is compared to the set decision level R of the change in the size of the sensed quantity, and according to the result of this comparison, the occurrence of the transient phenomenon of said drive (30, 50) is determined and information about the change in the presence of the sliver (18) in the feeding device (3) or the drafting device (2) is generated, in particular information about the moment of introduction of the sliver is generated and information about the moment of interruption of the sliver feed is generated, or the occurrence of a transient phenomenon of said drive (30, 50) is not detected and information about ongoing feeding of the sliver (18) is generated or information about non-progressive feeding of the sliver (18) is generated.

The invention also relates to a device for detecting the presence of a sliver (18) in in a drafting device (2) or a feeding device (3) or at a workstation of a textile machine.

The invention also relates to the drafting device (2) or to the feeding device (3) of a textile machine for processing a sliver and a textile machine with these devices.

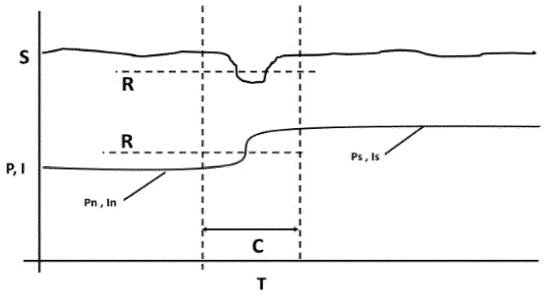

Fig. 3

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Description

Technical field

[0001] The invention relates to a method of detecting the presence of a sliver at the entrance of a workstation of a textile machine for the processing of the sliver, in particular at the entrance of a textile machine for producing yarn from the sliver, during which the monitored sliver is conveyed at an entrance of the workstation of the machine by a sliver feeding device or by a sliver drafting device and the sliver feeding device or the sliver drafting device is driven by at least one individual electric drive connected to a control device equipped with a regulation loop for controlling the drive, wherein at least one quantity corresponding to the current load of said drive is sensed and the sensed quantity is evaluated.

[0002] The invention also relates to a device for detecting the presence of a sliver in a sliver feeding device or in a sliver drafting device at a workstation of a textile machine, in particular a textile spinning machine for producing yarn, wherein the sliver feeding device or the sliver drafting device comprises at least one roller coupled to an individual electric drive which is connected to a control device and to a power source, wherein the roller is arranged to transport the sliver.

[0003] In addition, the invention relates to a sliver drafting device or a sliver feeding device of a workstation of a textile machine for processing the sliver, in particular a spinning machine for producing yarn, which comprises at least one roller coupled to an individual electric drive which is provided with connecting means for connection to a power source and to a control device, wherein the roller is arranged to transport the sliver.

[0004] Furthermore, the invention relates to a textile machine for processing a sliver, in particular a spinning machine for producing yarn, comprising at least one sliver feeding device or sliver drafting device which comprises at least one roller coupled to an individual electric drive which is coupled to a power source and to a control device, wherein the roller is arranged to transport the sliver.

Background art

[0005] The detection of the presence of a sliver supply is an important function of automated spinning machines which transform the sliver supply into yarn. In the event that the sliver supply is not inserted into a feeding or drafting device, this situation needs to be detected and an automatic service device needs to be prevented from performing spinning-in functions. This will result in an increase in the useful performance of the spinning machine, as the automatic device is not unnecessarily burdened by an activity that does not bring any effect, and moreover, possible damage to the machine will be prevented in the event that the absence of the sliver is caused by a technical defect at the spinning station of the spinning machine and the operation of the automatic device on such a spinning unit would be potentially dangerous for the spinning station as such, as well as for the automation device or possibly even for the human operator. Spinning machines with a traveling automatic service device use a sensor located on each automatic service device to detect the presence of the sliver in the feeding device or the drafting device, wherein the presence of the sliver is checked in the zone immediately upstream of the feeding or drafting device before starting the spinning process.

[0006] For machines with an individual automatic service device arranged at each spinning station, the detection of the presence of the sliver at the entrance of the spinning unit must also be ensured individually.

[0007] This problem is addressed, for example, in EP 3231902, which discloses a sensor of the presence of a sliver at each spinning unit, wherein the sensor of the presence of the sliver is located at a distance before the sliver enters the drafting device. The specific type of sensor used as a spring presence detector is not addressed in this document, only its separate existence is assumed.

[0008] Another document which uses sensors of the presence and even the quality of the fed sliver is WO 9920819. This document deals with the regulation of the speed of feeding the sliver into a spinning unit depending on variations in the weight of the sliver in order to achieve an improvement in the mass non-uniformity of the produced yarn. Here again, a specific embodiment of the sliver sensor is not dealt with in the document.

[0009] Another possible use of the information about the absence of the sliver in the feeding or the drafting device is the creation of a request for the exchange of a sliver can/sliver reservoir. The request is transmitted to the superior control system of the spinning mill, which ensures the exchange of the empty can for a full one by means of a human operator or an automatic conveying device. This problem is addressed, for example, by US4150534, without dealing with the principle and a specific embodiment of a sensor of the presence of the sliver.

[0010] Numerous specific technical solutions can be found In the patent literature that attempt to create information about the presence of a sliver supply at the entrance of the spinning unit, whether it is a ring, rotor or air-jet spinning machine. For example, document JP2009155781 solves this problem for a machine with a drafting device by means of a mechanically hinged sensor equipped with an encoder indicating the angular position of the sensor. Also, document CN106895776 solves the problem of detecting the presence of a sliver by means of a hinged arm touching the sliver and a sensor of the tilt angle of this arm. Document GB2154619 deals with a specific technical embodiment of a sliver sensor which consists in the fact that a sliver guide is tube-shaped and inside the tube there is a light source and a light sensitive sensing cell. The passing sliver shadows the light source and the signal detected by the light sensor corresponds to this. A similar principle of sliver detection using passing light is used in the solution described in

CN201276629.

[0011] Based on the principle of light reflection from the sliver is the solution according to Chinese utility model CN202047193.

[0012] Document CN204185605 solves the detection of the presence of a sliver by means of an air pressure sensor which is arranged in a cavity through which the sliver passes.

[0013] Document GB2163781 deals with the regulation of the speed of a sliver feeding device to a spinning unit, wherein solutions using an inductive sensor, a variable resistance sensor or a piezoelectric pressure sensor as a sensor of instantaneous sliver weight are envisaged.

[0014] It is evident from the above-mentioned documents that the issue of detecting the presence of the sliver in the feeding or drafting device of the spinning machines is important above all for fully or partially automated spinning mills. The disadvantages of all known concrete solutions of sliver presence detectors include complexity, sensitivity to pollution and fibre contamination, in many cases the necessity of mechanical adjustment of the starting position, and last but not least, high costs of production, assembly and maintenance.

[0015] On the other hand, document IN202027050132, also published as EP3802926, describes a method and a device for monitoring the parameters and characteristics of a sliver by measuring the load angle (α) and/or torque of one of the electric drives of the working organs of the spinning unit during the processing of the fibrous material into yarn. These are primarily drives of processing means, realizing the actual production of yarn from fibrous material, for example the drives of a combing roller, a spinning rotor, a traversing device, yarn draw-off rollers or the drive of a wound bobbin. However, the above-mentioned document does not deal with the detection of the presence of the sliver before entering the actual technological process of spinning the yarn.

[0016] EP 3 438 334 A1 describes the detection of the consumed length of a sliver from a sliver can at a workstation of an air-jet spinning machine in order to optimize the servicing operations at the workstation depending on the consumption of the sliver.

[0017] The object of the invention is to eliminate or at least reduce the disadvantages of the background art by means of a method and a device enabling detection of the presence of a sliver at the entrance of a spinning unit of a spinning machine before the sliver enters the yarn spinning process.

Summary of the invention

[0018] The object of the invention is achieved by the method, the device, the feeding or drafting device and the textile machine according to the present invention, the principle of which consists in monitoring and evaluating, prior to the beginning of the spinning-in process, i.e. during the preparation of the end of the sliver, or during the spinning-in process and/or during spinning, a change in the supply current and/or the power input and/or the speed of rotation of the individual drive of at least one electric motor in the area of the sliver input to a spinning unit of a respective workstation is sensed and evaluated, whereby transient phenomena arising in the regulation loop from changes in the mechanical load of the respective electric drive are analysed and a change in the size of the supply current and/or a change in the value of the power input and/or a change in the speed of rotation of this individual electric drive is detected. Afterwards, the size of the detected change is evaluated and compared to a set decision level R of the change in the size of the supply current and/or the value of the power input and/or the rotational speed, and according to the result of this comparison, information is generated about the presence or absence of the sliver in the feeding or drafting device. Alternatively, only a rapid relative change in the current or the power are evaluated if the control system knows the exact moment when the introduction of the sliver should occur.

[0019] Modern air-jet spinning machines are equipped with a multi-stage drafting device, with at least some stages being driven by individual electric drives with electronic control systems, usually equipped with a control regulation loop, the primary objective of which is to maintain the speed of the individual electric drive at a set constant value. Rotor spinning machines are also equipped with a feeding device for the input of the sliver into the technological process of yarn spinning, consisting of a feeding roller and an electric drive assigned to it, including an appropriate electronic control system with a regulation loop. When the mechanical load of the individual electric drive assigned to the feeding of the sliver into the spinning process changes, the regulation loop intervenes to maintain the set speed, wherein a so-called transient phenomenon can be observed, manifested by a short-term change in the speed or a change in the consumed current or power input.

[0020] For the purposes of mere detection of the sliver without spinning, other speed parameters of the feeding or drafting device can be selected for the short-time sliver detection function, so that the generated change in the current and/or the power input and/or the rotational speed is more significant and thus easier to detect.

[0021] Another possibility to increase the sensitivity of the detection of the presence of the sliver is to slow down or completely switch off the regulation loop of the individual electric drive which is intended for the sliver presence detection.

[0022] The value of the decision level of the supply current and/or power input and/or the speed of rotation of the respective individual drive of the individual spinning station can be determined centrally in control unit of the machine as an average of the measured values at the individual spinning units of the entire machine during spinning and idling and subsequently set at all control units of the workstations and/or a mere relative increase

in the current or the input is evaluated, which is advantageous, especially if a sliver with a higher fineness is processed. This ensures that the decision level is sufficiently reliably determined and is always up-to-date regardless of the type and weight of the sliver and/or yarn supplied.

[0023] Another possibility of implementing the method according to the invention is the analysis of short-term changes in the angular speed of the respective electric drive during changes in load, caused by a change in the presence of the sliver in the feeding or drafting device of the spinning machine.

[0024] To increase the sensitivity of this method, it is again advisable to slow down or completely disable the function of the speed regulation loop, which during normal operation of the spinning station keeps the speed of the individual electric drive at a constant level.

[0025] Both of the above-mentioned methods, i.e., monitoring changes in the current consumption and/or the motor input and analyzing short-term changes in the angular speed can be combined in a suitable way and thereby achieve an even further increase in reliability when detecting the presence of the sliver in the feeding or the drafting device of the spinning unit of the respective workstation.

[0026] Preferably, it is possible to use the fact that the control system knows with relatively considerable accuracy at which moment after the start of the feed of the sliver the introduction of the sliver should actually take place, and therefore it is possible to create a certain time window C for monitoring the change in the supply current and/or the power input and/or the speed of rotation of the individual drive, so as to eliminate possible disturbing influences, arising, for example, during the start-up and run-up of the respective electric drive.

[0027] Another possibility of implementing the method according to the invention is the analysis of "permanent" changes in the speed of the respective electric drive during load changes, caused by a change in the presence of the sliver in the feeding or drafting device of the spinning machine with a constant motor input and the speed control regulation loop switched off.

[0028] The solution according to the invention may be implemented, for example, with a BLDC electric motor or a stepper motor.

[0029] The BLDC electric motor is usually controlled by an electronic control system which has the task of maintaining a constant speed even when the load changes. Since the usual regulation loop used for its control always has a certain non-zero time delay, a certain transition phenomenon occurs when the mechanical load changes due to a change in the presence of the sliver, manifested either by a short-term increase in the speed (at the moment of absence of the sliver) or a short-term decrease in the speed (when the presence of the sliver is restored). These changes, together with changes in the supply current or the power input, can be detected by the control system equipped with appropriate software.

[0030] To increase the sensitivity of the solution according to the invention, it is advisable to slow down or completely disable the operation of the regulation loop of the electric drive within the time interval when the presence of the sliver is being detected in the feeding or drafting device of the spinning machine.

[0031] Also with a stepper motor, it is possible to detect the mechanical power drawn, depending on the presence of the sliver in the relevant section of the drafting device. To detect the mechanical power drawn - i.e., the load caused by the fed sliver - it is advantageous to use, for example, the TMC5160 electronic circuit manufactured by Trinamic (www.trinamic.com), see technical documentation TMC5160/TMC5160ADATASHEET (Rev. 1.13/ 2019-NOV-19), page 87 and others.

[0032] The invention represents a reliable solution that does not require complicated assembly and primary adjustment, wherein it is feasible at relatively low costs and with the use of material and software components that are often already present on the textile machines and especially on the yarn manufacturing spinning machines.

Brief description of drawings

[0033] The invention is represented schematically in drawings, wherein Fig. 1 shows a first exemplary embodiment of the invention at a spinning station of an air-jet spinning machine with a sliver drafting device, Fig. 1a shows a second exemplary embodiment of the invention at the spinning station of the air-jet spinning machine with a drafting device of sliver, Fig. 2 shows an exemplary embodiment at the spinning station of a rotor spinning machine, Fig. 3 shows a typical course of the transition event and the response to it according to the present invention at the moment of introducing the sliver into the drafting device and Fig. 4 shows a typical decrease in the speed S of one of the monitored drives during the implementation of the invention.

Examples of embodiment

[0034] The invention will be described on two examples of embodiment of a workstation of an air-jet spinning machine for manufacturing yarn, see Figs. 1 and 1a, and on one example of embodiment of a workstation of a rotor spinning machine for manufacturing yarn, see Fig. 2. Both these types of machines are yarn manufacturing textile machines.

[0035] An air-jet spinning machine comprises a plurality of workstations arranged in a row next to one another, usually on either side of the machine. Each workstation, see Figs. 1 and 1a, comprises a spinning unit 1 which, in the direction of passage of the fibrous material during the production of the yarn 14, first comprises a drafting device 2 of sliver 18, which is adapted to refine the sliver 18 from its initial state to a state of fibrous ribbon suitable for subsequent transformation into the yarn 14 to be pro-

duced in a twisting device 6 which is arranged in the direction of passage of the fibrous material in the production of the yarn downstream of the drafting device 2. In the direction of passage of the fibrous material during the production of the yarn, an unillustrated yarn draw-off mechanism is arranged downstream of the twisting device and also an unillustrated winding device of yarn 14 onto an unillustrated bobbin, which is adapted to wind the produced yarn 14 onto the unillustrated bobbin.

[0036] The drafting device 2 of sliver 18 first comprises, in the direction of passage of the fibrous material during the production of the yarn, a pair of feeding rollers 31, 32, the so-called Feeding, downstream of which is arranged a drafting system 4, the so-called Apron, which comprises rollers 40 and 42 wrapped with a drafting apron 11. in the direction of passage of the fibrous material during the production of the yarn downstream of the drafting system 1 is arranged a pair of output rollers 5, the so-called Delivery, which are adapted to draw off the refined sliver 18, i.e., to draw off the fibre ribbon, from the drafting system 4 and to feed the refined sliver 18 to the twisting device 6.

[0037] The twisting device 6 comprises a working body for transforming the refined sliver 18 into yarn 14, e.g., it comprises a spinning nozzle in which the fibres are twisted into the resulting yarn in a known manner by means of an air vortex created by compressed air.

[0038] The pairs of rollers 31, 32 and 5 of the drafting device 2 are coupled to individual electric drives 30 and 50. The drafting system 4 is coupled to its own drive (not shown).

[0039] The drives 30, 50 of the pairs of rollers 31, 32 and 5 of the drafting device 2 are coupled to a control device 11, which either comprises a monitoring, evaluation and comparison device 10 or is coupled to this device 10, which is in an unillustrated example configured as external. The control device 11 is coupled to an unillustrated superior control system, e.g., the control system of the entire machine.

[0040] At least one of the drives 30, 50 of the pairs of rollers 31, 32 and 5 of the drafting device 2 is coupled to at least one sensor 390 and 590 of the speed of rotation of the respective drive 30, 50, e.g., to a sensor of the angular speed of the respective drive 30, 50. In the exemplary embodiment of Fig. 1, each of the drives 30, 50 of the pairs of rollers 31, 32 and 5 of the drafting device 2 is coupled to the sensor 390 and 590 of the speed of the respective drive 30, 50. In the exemplary embodiment of Fig. 1a, only the drive 30 of the feeding rollers 31, 32 of the drafting device 2 is coupled to the sensor 390 of the speed of the drive 30 of the feeding rollers 31, 32.

[0041] To at least one of the drives 30, 50 of the pairs of rollers 31, 32 and 5 of the drafting device 2 is assigned at least one sensor 391, 591 of the supply current I and/or the power input P of the respective drive 30, 50. In the embodiment shown in Fig. 1 to each of the drives 30, 50 of the pairs of rollers 31, 32 and 5 of the drafting device 2 is assigned one sensor 391, 591 of the supply current I and/or power input P of the respective drive 30, 50. In an unillustrated example of embodiment, the sensor 391 of the supply current I and/or power input P of the respective drive 30, 50 is assigned to the drive 30 of the feeding rollers 31, 32 of the drafting device 2.

[0042] The sensors 391, 591 of the current I and/or the power input P are coupled to the monitoring, evaluation and comparison device 10 and the sensors 390, 590 of the speed are coupled to the control device 11 or to the monitoring, evaluation and comparison device 10.

[0043] The control device 11comprises unillustrated means, e.g., software means, for controlling the drives 30, 50, and further comprises an unillustrated regulation loop adapted to control the drives 30, 50. The control device 11 further comprises unillustrated means, e.g., software means, for controlling the regulation loop for controlling the drives 30, 50, especially means to slow down the regulation loop or temporarily remove the regulation loop from the process of controlling the drives 30, 50. Disabling or slowing down the operation of the regulation loop for controlling the drives 30, 50 is advantageous for accentuating the manifestations of the transition event.

[0044] The control device 11 is further coupled to unillustrated drives of the draw-off mechanism of yarn 14 and the winding device of yarn 14.

[0045] The rotor spinning machine comprises a plurality of workstations arranged in a row next to one another, usually on either side of the machine. Each workstation, see Fig. 2, comprises a spinning unit 1, which in the direction of the passage of the fibrous material during the production of the yarn 14 first comprises a feeding device 3 of sliver 18, which includes a feeding roller 33 and a pressure table 17 assigned to the circumference of the feeding roller 33, wherein the feeding device 3 is adapted to feed the sliver 18 to an opening device 15 of fibres which is arranged further in the direction of the passage of the fibrous material. The opening device 15 of fibres has a driven opening roller 150, a trash waste channel 151 and a transport channel 19 of opened fibres 180 to the twisting device 6 which is arranged in the direction of the passage of the fibrous material during the production of yarn 14 downstream of the opening device 15 of fibres. The opening device 15 of fibres is provided with a spinning rotor 16 which is adapted to transform the opened fibres into yarn 14. In the direction of passage of the fibrous material during the production of the yarn 14, an unillustrated yarn drafting device 14 and also an unillustrated yarn winding device 14 onto a bobbin are arranged downstream of the twisting device 6. The yarn winding device 14 is adapted to wind the produced yarn 14 onto an unillustrated bobbin.

[0046] The feeding roller 33 of the feeding device 3 of the sliver 18 is coupled to an individual electric drive 30, which is coupled to a control device 11, which either comprises a monitoring, evaluation and comparison device 10 or it is coupled to this device 10, which is in an unillustrated example configured as external. The control de-

vice 11 is coupled to an unillustrated control system, e.g., the control system of the entire machine. The drive 30 of the feeding roller 33 is coupled to a sensor 390 of the speed of rotation of the drive 30 of the feeding roller 33, e.g., to a sensor of the angular speed of the drive 30 of the feeding roller 33. The drive 30 of the feeding roller 33 is associated with a sensor 391 of the supply current I and/or the power input P of the drive 30 of the feeding roller 33.

[0047] The sensor 391 of the current I and/or the power input P is coupled to the monitoring, evaluation and comparison device 10 and the sensor 390 of the speed is coupled to the control device 11 or to the monitoring, evaluation and comparison device 10.

[0048] The control device 11 comprises unillustrated means, such as software, for controlling the drive 30 of the feeding roller 33 and further comprises an unillustrated regulation loop adapted to control the drive 30 of the feeding roller 33.The control device 11 further comprises unillustrated means, such as software, for controlling the functions of the regulation loop for controlling the drive 30 of the feeding roller 33, in particular means for slowing down the operation of the regulation loop or temporarily removing the control loop from the process of controlling the drive 30 of the feeding roller 33.

[0049] The control device 11 is further coupled to unillustrated drives of the draw-off mechanism of yarn 14 and the winding device of yarn 14.

[0050] The detection of the presence of the sliver 18 in the feeding device 3 or the drafting device 2 of the textile machine for producing yarn 14 according to the present invention is based on the knowledge that the transport of the fibrous material, here the sliver 18, to the twisting device 6 requires a certain mechanical power, which must overcome the friction between the individual fibres in the sliver 18 and which must be supplied by the respective drive 30, 50 in the feeding device 3 or in the drafting device 2 at the workstation of the textile machine for manufacturing yarn 14. Therefore, the electric power input Pn and the supply current In, which is consumed by the respective drive 30, 50 during its idle running, i.e., without the sliver 18, differs from the power input Ps and the current Is, which is consumed by the respective drive 30, 50 during the drafting of the sliver 18 in the drafting device 2 or during the feeding of the sliver 18 in the feeding device 3. Significantly, this difference is detectable during the introduction of the sliver 18 into the feeding device 3 or into the drafting device 2, when this difference manifests itself as a so-called transition process.

[0051] During the introduction of the sliver 18 into the feeding device 3 or into the drafting device 2, i.e., during the so-called transition process, there is also a short-term decrease in the speed S of rotation of the respective drive 30, 50 in the feeding device 3 or in the drafting device 2, as shown in Fig. 3. During the above described transient phenomenon occurring during the introduction of the sliver 18 into the feeding device 3 or into the drafting device 2, the typical course of which is shown in Fig. 3, there is a short-term decrease in the speed S, e.g., in the angular speed of at least one of the drives 30, 50 of the feeding device 3 or the drafting device 2, and at the same time there is a sudden increase in the power input P of at least one of the drives 30, 50 from the value Pn during idling, i.e., without the sliver 18, to the value Ps during spinning, i.e. with the sliver 18, and there is also a sudden increase in the value of the supply current I of at least one of the drives 30, 50 from the value In during idling, i.e., without the sliver 18, to the value Is during spinning, i.e., with the sliver 18. The occurrence of this step change on at least one of the drives 30, 50 of the feeding device 3 or the drafting device 2 during the introduction of the sliver 18 between the feeding rollers 31, 32 and/or between the output rollers 5 of the drafting device 2 or between the feeding roller 33 and the pressure table 17 of the feeding device 3 - i.e., the occurrence of an increase in power input P and/or current I and/or a change in the speed S of one of the drives 30, 50 thus identifies the moment when the sliver 18 was introduced into the respective place of the drafting device 2 or the feeding device 3. If the power input P and/or the current I does not change and/or a change in the speed S of one of the drives 30, 50 does not occur during the introduction of the sliver 18 into the feeding device 3 or into the drafting device 2, it means that the sliver 18 has not been introduced and a signal is generated by the control device 11 about the failure to introduce the sliver 18, i.e., about missing sliver 18. Subsequently, corresponding service operations are carried out at the relevant workstation.

[0052] On the contrary, if during the ongoing production of the yarn 14, i.e., if, during spinning, there is a sudden decrease in the power input P and/or the electric current I and, if appropriate, a short-term increase in the speed S of any of the drives 30, 50 of the feeding unit 3 or the drawing unit 2, and consequently the production of the yarn 14 is interrupted, this is identified as the moment when the supply of the sliver 18 has been interrupted, either because of a break of the sliver 18 or because of the emptying of the unillustrated reservoir of the sliver 18, for example of the respective sliver can assigned to the respective workstation. In this case, a signal 18 about the absence is generated and the workstation stops. Subsequently, the corresponding service operations are performed at the relevant workstation.

[0053] The method according to the invention is such that during the yarn production process 14, i.e., during spinning, as well as during the spinning resumption process, i.e. during spinning-in, the size of the supply current I and/or the value of the power input P and/or the speed S of the at least one individual electric drive 30, 50 of the drafting device 2 or feeding device 3 is monitored at the workstation 1, and a change in the size of the supply current I and/or a change in the value of the power input P and/or a change in the speed S of this individual electric driver 30, 50 of the drafting device 2 or the feeding device 3 is detected. The size of the detected change in the supply current I and/or in the value of the power input P

and/or the speed S of this individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 is evaluated and compared to the set decision level R of the change in the size of the supply current I and/or the values of the power input P and/or the speed S of this individual electric drive 30, 50 of the drafting device 2 or the feeding device 3. According to the result of this comparison, information about the presence or absence of the sliver 18 in the drafting device 2 or the feeding device 3. is generated, e.g., by the control device 11.

[0054] According to one embodiment, the change in the speed S of the respective individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 is preferably monitored during the intervention of the regulation loop of the control of this electric drive 30, 50 of the drafting device 2 or the feeding device 3, for example, by setting a constant speed S of the individual electric drive S of the drafting device 2 or of the feeding device 3 before introducing the sliver 18 into the drafting device 2 or the feeding device 3 and during introducing the sliver 18 into the drafting device 2 or the feeding device 3, the control device 11 deactivates the operation of the control regulation loop of the respective drive 30, 50 of the drafting device 2 or the feeding device 3, wherein the moment of introduction of the sliver 18 into the drafting device 2 or the feeding device 3 is detected as a permanent decrease in the speed S of the individual electric drive 30, 50 of the drafting device 2 or the feeding device 3, see Fig. 4.

[0055] According to another exemplary embodiment, the change in the speed S of the respective individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 is preferably monitored in such a manner that before introducing the sliver 18 into the drafting device 2 or the feeding device 3 the operation of the control regulation loop of the respective drive 30, 50 of the drafting device 2 or the feeding device 3 is slowed down by the intervention of the control device 11, thereby achieving an accentuation of the detectable transient phenomenon caused by the introduction of the sliver 18 into the drafting device 2 or the feeding device 3.

[0056] The decision level R of the size of the supply current I and/or the power input P and/or the speed S of the individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 is, according to one exemplary embodiment, determined as an average size of the supply current I and/or the power input P and/or the speed S of the individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 measured at least at one workstation of the textile machine during spinning, i.e., with the sliver 18 in the drafting device 2 or in the feeding device 3, and during idling, i.e., without the sliver 18 in the drafting device 2 or in the feeding device 3. These average values of the supply current I and/or the power input P and/or the speed S of the individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 are preferably generated by the central control system of the machine and are distributed (sent out) to the individual workstations and their spinning units 1.

[0057] Preferably, the detection of the presence of the sliver 18 in the drafting device 2 or the feeding device 3 is performed by means of a program, i.e., software, in the control device 11 in such a manner that first the feeding device 3 or the drafting device 2 is started, then a time window C is determined for the monitoring (measurement) of the supply current I and/or the power input P and/or the speed S of the respective individual electric drive 30, 50 of the drafting device 2 or the feeding device 3. From the values of the supply current I and/or the power input P and/or the speed S of the respective individual electric drive 30, 50 of the drafting device 2 or the feeding device 3 measured within the time window C, a change in the supply current I and/or the power input P and/or the speed S of the respective drive 30, 50 of the drafting device 2 or the feeding device 3C is evaluated (detected), thereby eliminating possible disturbing influences, given, for example, by the start-up of the feeding device 3 or the drafting device 2, etc. Since the control system 11 of the workstation knows with a relatively high degree of accuracy at which point after the initiation of rotation of the respective drive 30, 50 of the drafting device 2 or the feeding device 3 the sliver 18 should actually be introduced between the monitored elements of the drafting device 2 or the feeding device 3, it is possible to determine a time window C for the evaluation (measurement) of the relevant parameters in order to monitor the change in the supply current I and/or the electrical input P and/or the speed S of at least one monitored drive 30, 50 by means of the control software of the control system 11 so as to eliminate possible disturbing influences arising, for example, during the start-up and run-up of the respective electric drive.

[0058] According to another exemplary embodiment, the size of the supply current I and/or the value of the power input P and/or the speed S of the electric drive 50 of the output rollers 5 of the drafting device 2 of the sliver 18 is monitored at the moment without the presence of the sliver 18 between the output rollers 5, also monitored is the time course of the electric current I and/or the value of the power input P and/or speed S of this electric drive 50 of the output rollers 5 of the drafting device 2 of the sliver 18 during the start of introduction of the sliver 18, and then the size of the electric current I and/or the value of the power input P and/or the speed S of this electric drive 50 of the output rollers 5 of the drafting device 2 of the sliver 18 with the sliver 18 between these output rollers 5 is monitored, wherein the detected values are evaluated and compared to the set decision level R for the subsequent generating of a signal about the presence or absence of the sliver 18 in the drafting device 2.

[0059] Alternatively, the size of the supply current I and/or the value of the power input P and/or the speed S of the electric drive 30 of the feeding rollers 31, 32 of the drafting device 2 or of the drive of the feeding roller 33 of the feeding device 3 in the state without the presence of the sliver 18 is monitored, also monitored is the time course of the electric current I and/or the value of

the power input P and/or the speed S of the electric drive 30 of the feeding rollers 31, 32 of the drafting device 2 or the drive 30 of the feeding roller 33 of the feeding device 3 during the transient phenomenon after starting introduction of the sliver 18 by the drafting device 2 or the feeding device 3, also monitored is the size of the electric current I and/or the value of the power input P and/or the speed S of the electric drive 30 of the feeding rollers 31, 32 of the drafting device 2 or the drive of the feeding roller 33 of the feeding device 3 when the sliver 18 is present between the feeding rollers 31, 32 of the drafting device 2 or between the feeding roller 33 and the feeding table 17 of the feeding device 3, wherein the detected values of the electric current I and/or the value of the power input P and/or speed S are evaluated and compared to the set decision level R for generating a signal of the presence or absence of the sliver 18 in the drafting device 2 or the feeding device 3.

[0060] According to another exemplary embodiment, a change in the supply electric current I or a change in the power input P is detected from the monitored values, and at the same time a short-term change in the speed S of the drive 50 of the output rollers 5 of the drafting device 2 of the spinning unit 1 is detected at the workstation of the air-jet spinning machine.

[0061] According to another exemplary embodiment, a change in the supply current I or a change in the power input P is detected from the monitored values and at the same time a short-term change in the speed S of the drive 30 of the feeding rollers 31, 32 of the drafting device 2 of the spinning unit 1 is detected at the workstation of the air-jet spinning machine.

[0062] According to yet another exemplary embodiment, from the monitored values, a change in the supply current I or a change in the power input P is detected and at the same time is detected a short-term change in the speed S of the drive 30 of the feeding roller 33 of the feeding device 3 of the spinning unit 1 at the workstation of the rotor spinning machine.

[0063] According to a further exemplary embodiment, from the monitored values is detected a change in the supply current I and a change in the power input P and/or a change in the speed S of the drive 30 of the feeding rollers 31, 32 of the drafting device 2 of the spinning unit 1 at the workstation of the air-jet spinning machine and/or of the drive 50 of the output rollers 5 of the drafting device 2 of the spinning unit 1 at the workstation of the air-jet spinning machine or these changes are detected on the drive 30 of the feeding roller 33 of the feeding device 3 of the spinning unit 1 at the workstation of the rotor spinning machine.

[0064] The speed S of at least one electric drive 30, 50 of the feeding device 3 or the drafting device 2 of the sliver 18 to be monitored is, e.g., the instantaneous angular speed of the respective electric drive 30, 50 of the drafting device 2 or the feeding device 3.

[0065] In order to exclude the influence of random step changes in the size of the supply current I and/or the power input P or the speed S of one of the drives 30, 50 of the feeding device 3 or the drafting device 2, caused, for example, by voltage peaks in the electrical network etc., the measured data on the size of the supply current I and/or power input P and/or speed S from all the spinning units 1 of the entire spinning machine is transmitted to the central control system of the spinning machine in which evaluated and determined are the average values of the current I and/or the power input P and/or the speed S of one of the drives 30, 50 of the feeding device 3 or of the drafting device 2 of both the spinning units 1, which are currently producing yarn 14, i.e., which are currently spinning, and the spinning units 1, which are not currently producing yarn 14, i.e., which are currently not spinning. From the values thus centrally evaluated and determined, a decision level R is then determined, which is subsequently set in all the control devices 11 of the workstations of the entire machine to be subsequently used by the monitoring, evaluation and comparison device 10 at each respective workstation for performing the method according to the present invention.

[0066] In another exemplary embodiment, the measured parameters of the short-term decrease or short-term increase in the instantaneous speed S of the respective drive 30, 50 of the drafting device 2 or the feeding device 3 due to the presence or absence of the sliver 18 in the drafting device 2 or the feeding device 3 are also sent to the central machine control system, in which they are statistically evaluated and subsequently, the determined or set values of the decision level R are sent back to the individual control devices 11 of the workstations of the machine.

[0067] To increase the reliability of the detection of the presence of the sliver 18 in the drafting device 2 of the workstation of the air-jet spinning machine, according to another exemplary embodiment, changes in the supply current I, the power input P and the speed S of all the drives 30, 50 of the drafting device 2 are evaluated simultaneously or in a temporal succession determined by the speed of movement of the sliver 18 in the drafting device 2 or in the feeding device 3, changes in the electric current I, the power input P and the speed S of all the drives 30, 50 of the drafting device 2.

[0068] In the exemplary embodiments, the electric drive 30, 50 is formed by a BLDC or a stepper electric motor. In unillustrated exemplary embodiments, the drives 30, 50 are formed by another suitable type of electric drives.

Industrial applicability

[0069] The invention can be used to detect the presence of a sliver at the entrance of a workstation of a textile machine for processing the sliver, ideally at the entrance of a textile spinning machine for producing yarn from the sliver.

List of references

[0070]

1	spinning unit
2	drafting device
3	the power input
30	drive of the feeding roller
31	first pair of feeding rollers
32	second pair of feeding rollers
33	feeding roller
390	sensor of the speed of the feeding roller drive
391	sensor of the current and/or power input of the feeding roller drive
4	drafting system
40	roller
41	drafting apron
42	roller
5	output rollers
50	drive of the output rollers
6	twisting device
590	sensor of the speed of the output rollers drive
591	sensor of the current and/or power input of the output rollers drive
10	monitoring, evaluation and comparison device
11	control device
14	yarn
15	opening device
150	combing roller
151	trash waste channel
16	spinning rotor
17	pressure table
18	sliver
180	opened fibre
19	transport channel of opened fibres

Claims

1. A method for detecting the presence of sliver (18) at the entrance of a workstation of a textile machine for processing the sliver (18), in particular at the entrance of a textile machine for the production of yarn from the sliver, during which the monitored sliver (18) is conveyed at the entrance of the workstation of the machine by a sliver feeding device (3) or by a sliver drafting device (2) and the sliver feeding device (3) or drafting device (2) is driven by at least one individual electric drive (30, 50) connected to a control device (11) equipped with a regulation loop for controlling the drive (30,50), wherein at least one quantity corresponding to the current load of said drive (30,50) is monitored and the sensed quantity is evaluated, **characterized in that** as the quantity sensed during the process of producing yarn (14) and/or during the process of resuming spinning is sensed size of the supply current I and/or value of the power input P and/or speed S of rotation of the electric drive (30,50) of the feeding device or the drafting device, and during the process of producing yarn (14) and/or during the process of resuming spinning, a change in the size of the supply current I and/or a change in the value of the power input P and/or a change in the speed S of rotation of said individual electric drive (30, 50) is detected, whereupon, when a change in the sensed quantity is detected, the size of this change is evaluated and is compared to the set decision level R of the change in the size of the sensed quantity, and according to the result of this comparison, the occurrence of the transient phenomenon of said drive (30, 50) is determined and information about the change in the presence of the sliver (18) in the feeding device (3) or the drafting device (2) is generated, in particular information about the moment of introduction of the sliver is generated and information about the moment of interruption of the sliver feed is generated, or the occurrence of a transient phenomenon of said drive (30, 50) is not detected and information about ongoing feeding of the sliver (18) is generated or information about non-progressive feeding of the sliver (18) is generated.

2. The method according to claim 1, **characterized in that** the change in the speed S of rotation of the individual electric drive is detected during the intervention of the regulation loop of this electric drive (30, 50) in the control of this individual electric drive (30,50), and the time course of the transient phenomenon is evaluated from the detected data.

3. The method according to claim 1, **characterized in that** before starting the introduction of the sliver (18) into the feeding device (3) or into the drafting device (2), a constant speed S of the rotation of the individual electric drive (30, 50) is set, whereupon during the introduction of the sliver (18) into the feeding device (3) or into the drafting device (2) the regulation loop of said drive (30, 50) is deactivated, wherein the moment of introducing the sliver (18) into the feeding device (3) or the drafting device (2) is detected from a permanent decrease in the speed S of rotation of said drive (30, 50).

4. The method according to claim 2, **characterized in that** before starting the introduction of the sliver (18) into the feeding device (3) or into the drafting device (2), the operation of the regulation loop of said drive (30, 50) is slowed down, whereupon the introduction of the sliver (18) is started, thereby accentuating the manifestation of the transient phenomenon to facilitate detection of the moment of introduction of the sliver (18).

5. The method according to any of the preceding claims, **characterized in that** after starting the feeding device (3) or the drafting device (2), and before

starting the feed of the sliver (18), a time window C for detecting the sizes of the supply current I and/or the power input P and/or the speed S of rotation of said drive (30, 50) is determined, whereupon the feeding of the sliver (18) is started and changes in at least one sensed quantity (I, P, S) are detected.

6. The method according to claim 1, **characterized in that** the decision level R of the supply current I and/or the power input P and/or the speed S of rotation of the individual electric drive (30, 50) is determined in the central control system of the machine as an average value from the values of the supply current I and/or the power input P and/or the rotational speed S previously measured at the workstations of the textile machine during spinning and during idle running of the workstations.

7. The method according to any of claims 1 to 6, **characterized in that** the size of the supply current I and/or the value of the power input P and/or the speed of rotation of the individual electric drive (50) of the output rollers (5) of the drafting device (2) of the sliver (18) in the state without the presence of the sliver (18) between the output rollers (5) is monitored, and also the time course of the size of the electric current I and/or the value of the power input P and/or the speed S of rotation of the electric drive (50) of the output rollers (5) of the drafting device (2) of the sliver (18) during the introduction of the sliver (18) is monitored, and also the size of the electric current I and/or the value of the power input P and/or the speed of rotation of the electric drive (50) of the output rollers (5) of the drafting device (2) of the sliver (18) with the sliver between the output rollers (5) is monitored, wherein these values are evaluated and compared to the set decision level R for generating a signal about a change in the presence of the sliver (18) in the drafting device (2), in particular information about the moment of introduction of the sliver and information about the moment of interruption of the feeding of the sliver, or for generating a signal about the feeding of the sliver in progress or for generating information about the feeding of the sliver not in progress.

8. The method according to any of claims 1 to 6, **characterized in that** the size of the supply current I and/or the value of the power input P and/or the speed of rotation of the individual electric drive (30) of the feeding rollers (31, 32) of the drafting device (2) of the sliver (18) in the state without the presence of the sliver (18) between the feeding rollers (31, 32) is monitored, furthermore, the time course of the size of the electric current I and/or the value of the power input P and/or the speed of rotation of the electric drive (30) of the output rollers (3) during the introduction of the sliver (18) is monitored, as well as the size of the electric current I and/or the value of the power input P and/or the speed of rotation of the electric drive (30) of the feeding rollers (31, 32) with the sliver (18) between the feeding rollers (31, 32), wherein these values are evaluated and compared to the set decision level R for generating a signal a change in the presence of the sliver (18) in the drafting device (2), in particular information about the moment of introduction of the sliver and information about the moment of interruption of the feeding of the sliver, or for generating a signal about the feeding of the sliver in progress or for generating information about the feeding of the sliver not in progress.

9. The method according to any of claims 1 to 8, **characterized in that** as a speed S of rotation of at least one individual electric drive (30, 50) of the drafting device (2) of the sliver (18), instantaneous angular speed of this electric drive (30, 50) is monitored.

10. The method according to any of claims 1 to 6, **characterized in that** a change in the supply current I or a change in the power input P is detected from the monitored quantities and at the same time a short-term change in the speed S of rotation of the individual electric drive (50) of the output rollers (5) of the drafting device and/or individual electric drive (30) of the feeding rollers (31, 32) of the feeding device is detected.

11. A device for detecting the presence of sliver in a sliver feeding device or in a sliver drafting device at a workstation of a textile machine, in particular a textile spinning machine for the production of yarn, wherein the feeding device or the drafting device comprises at least one roller (31, 32, 33, 5) which is coupled to an individual electric drive (30, 50), which is connected to a control device (11) and to an electric power source, wherein the roller (31, 32, 33, 5) is arranged for transporting the sliver, **characterized in that** the electric drive (30, 50) is coupled to at least one sensor (391, 591) of electric current I and/or the power input P and/or is coupled to at least one sensor (390, 590) of the speed S of rotation of the drive (30, 50), wherein the sensors (390, 590, 391, 591) of the drive (30, 50) are coupled to a monitoring, evaluation and comparison device (10) which is coupled to the control device (11), wherein the monitoring, evaluation and comparison device (10) is adapted to monitor the size of the supply current I and/or the value of the power input P and/or the speed S of rotation of at least one individual electric drive (30, 50) and is further adapted to detect changes in the size of the supply current I and/or the value of the power input P and/or the speed S of rotation of at least one individual electric drive (30, 50).

12. The device according to claim 11, **characterized in**

that the monitoring, evaluation and comparison device (10) is integrated into the control device (11).

13. The device according to claim 11 or 12, **characterized in that** the control device (11) is provided with means for slowing down the reactions or for completely disabling the operation of the control regulation loop of the individual electric drive (30, 50) during the detection of the presence of the sliver (18) in the feeding device or the drafting device of the sliver (18).

14. A drafting device or a feeding device of a sliver of a workstation of a textile machine for processing the sliver, in particular of a spinning machine for the production of yarn, which comprises at least one roller (31, 32, 33, 5) which is coupled to an individual electric drive (30, 50) which is provided with connecting means for connection to a power source and to a control device (11), wherein the roller (31, 32, 33, 5) is arranged for transporting the sliver, **characterized in that** at least one electric drive (30, 50) is coupled to at least one sensor (391, 591) of the supply current I and/or the power input P and/or is coupled to at least one sensor (390, 590) of the speed S of rotation of the drive (30, 50), wherein the sensors (390, 590, 391, 591) are provided with means for coupling to the monitoring, evaluation and comparison device (10) for monitoring the size of the supply current I and/or the value of the power input P and/or the speed S of rotation of at least one individual electric drive (30, 50) and for detecting changes in the size of the supply current I and/or the value of the power input P and/or the speed S of rotation of at least one individual electric drive (30, 50).

15. A textile machine for processing fibre sliver, in particular a spinning machine for the production of yarn, comprising at least one feeding device or drafting device of the sliver, which comprises at least one roller (31, 32, 33, 5) coupled to an individual electric drive (30, 50), which is coupled to a power source and to a control device (11) wherein the roller (31, 32, 33, 5) is arranged for transporting the sliver, **characterized in that** the feeding device or the drafting device of the sliver (18) is configured according to any of claims 11 to 14.

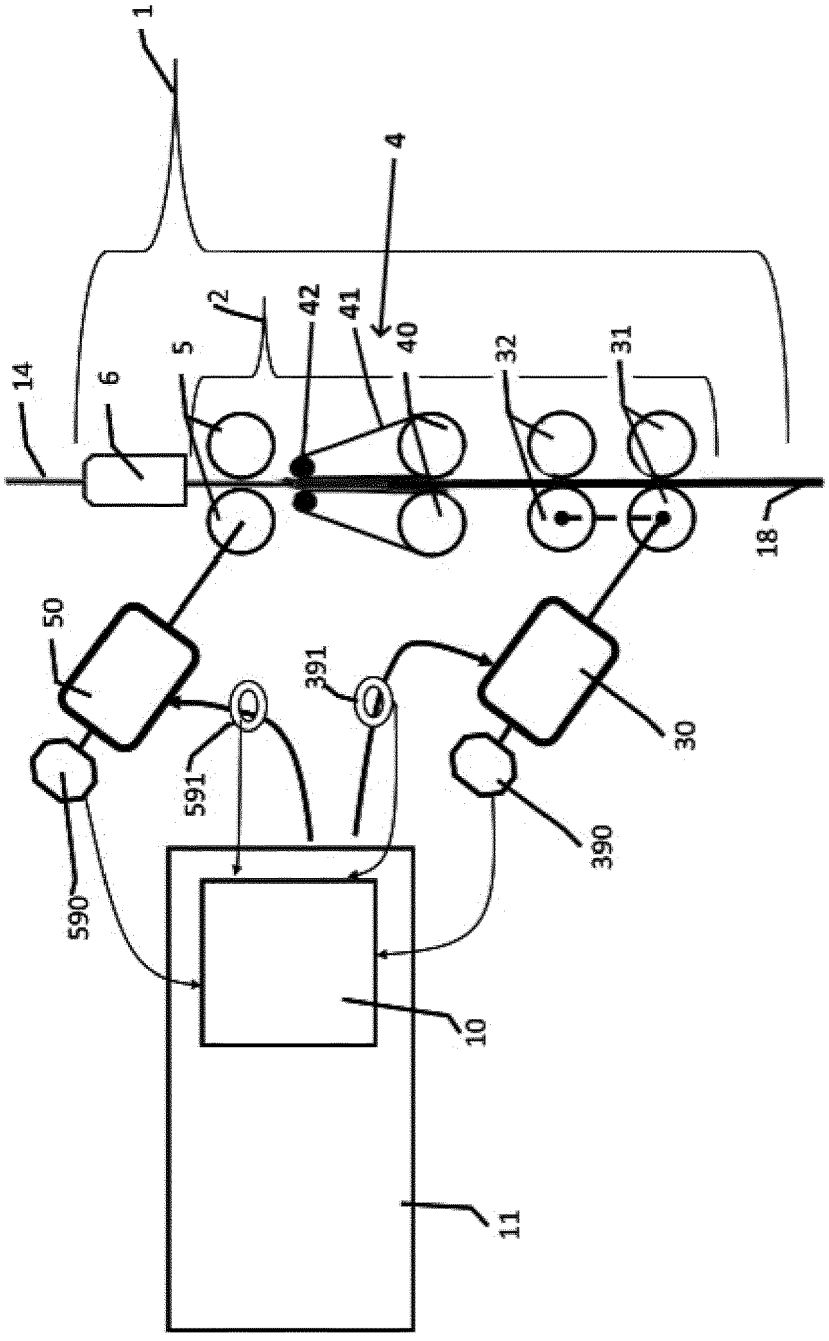

Fig. 1

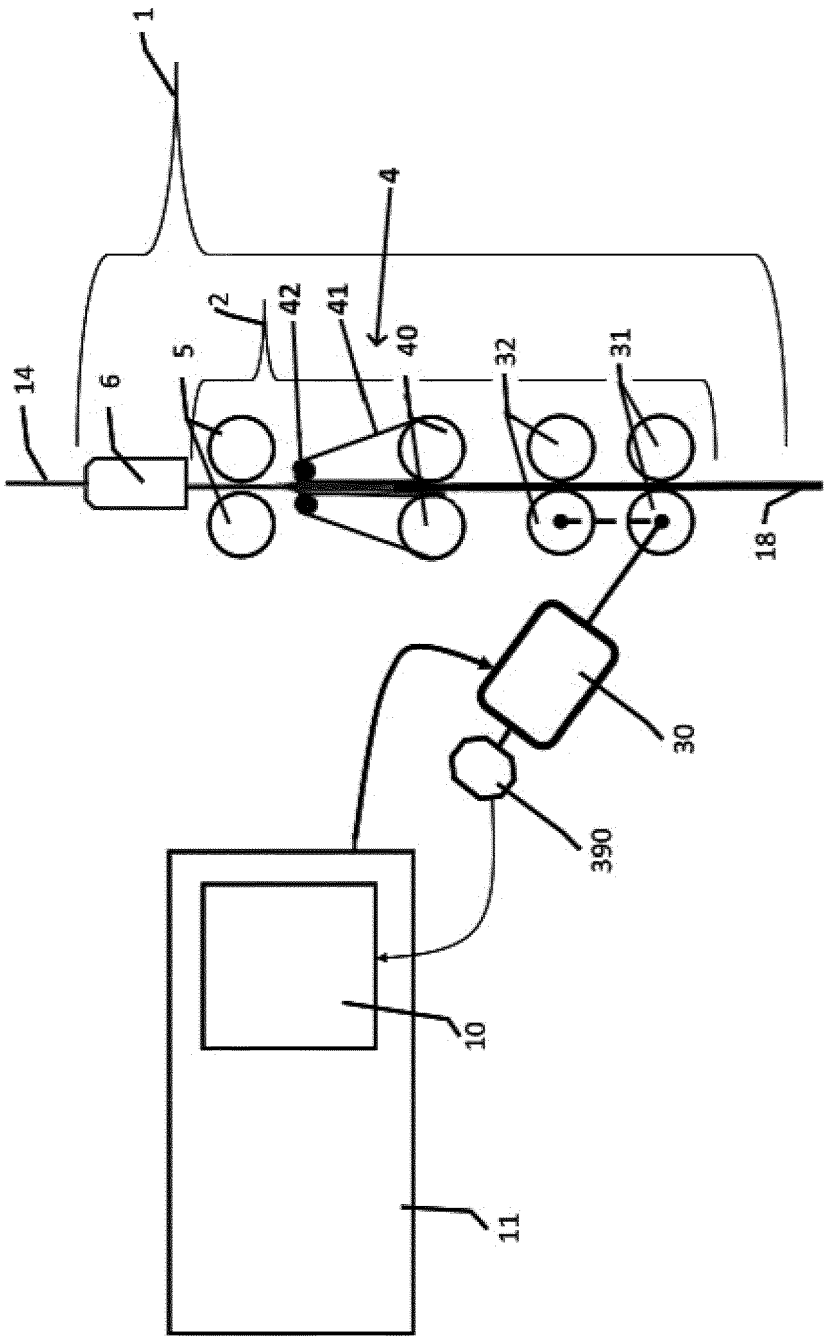

Fig. 1a

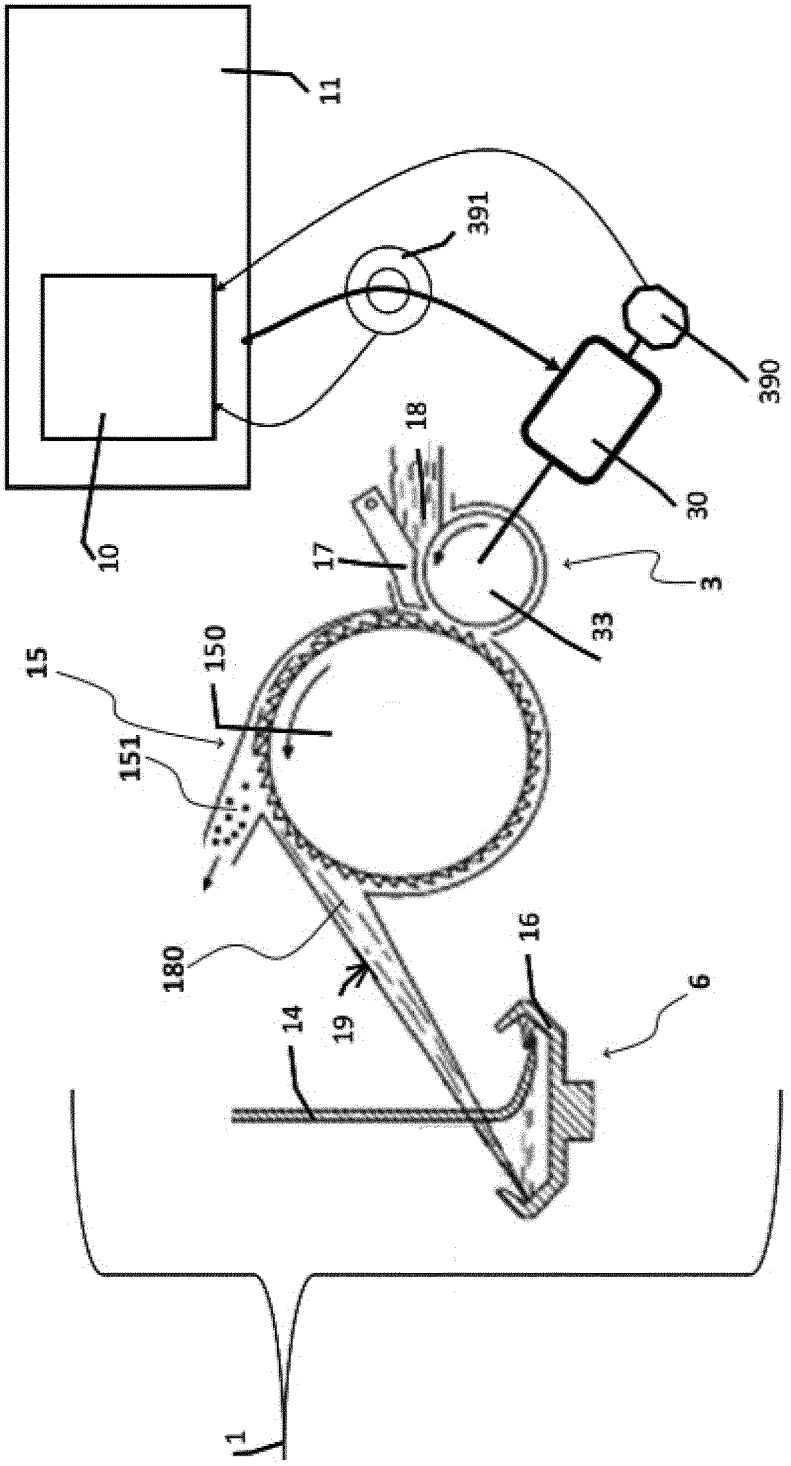

Fig. 2

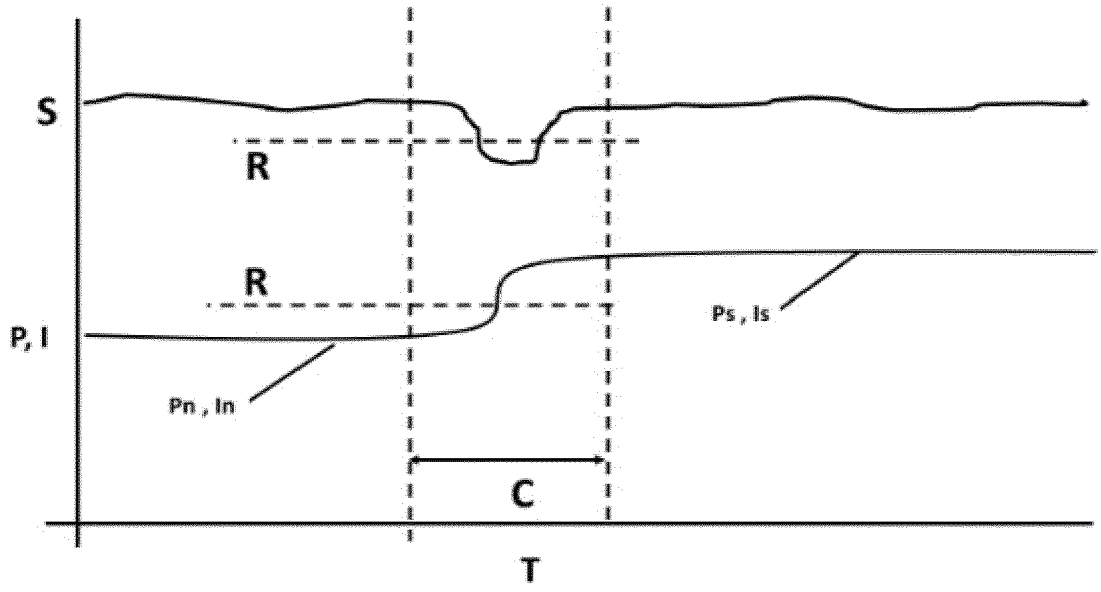

Fig. 3

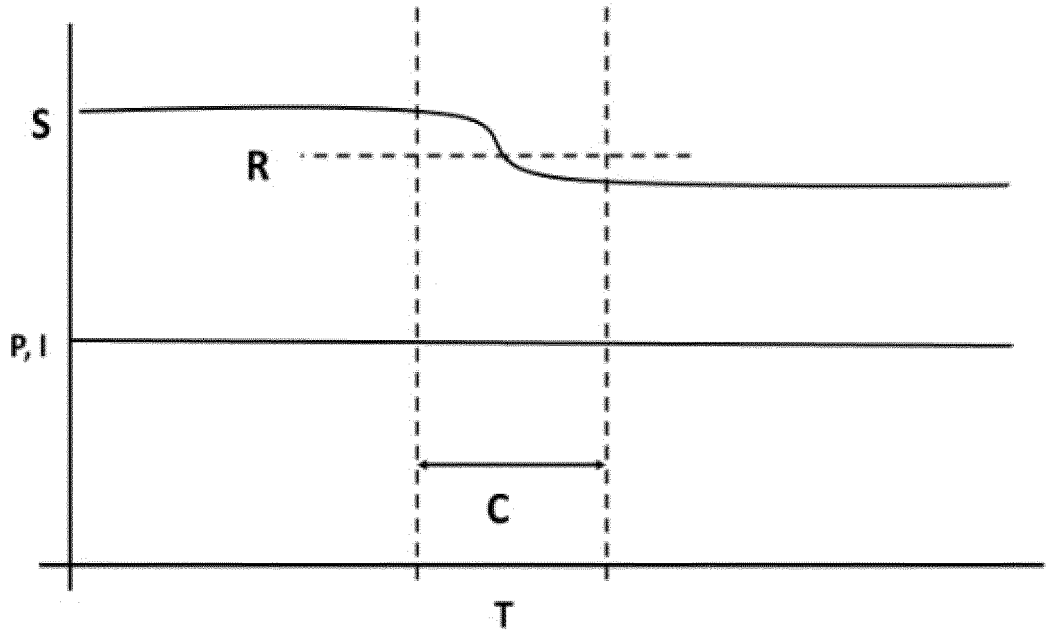

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 0047

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Place of search	Date of completion of the search	Examiner
Munich	9 April 2024	Todarello, Giovanni

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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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