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(54) **Method of operating a slitter-winder for winding fiber webs**

(57) The invention relates to a method of operating a slitter-winder for winding fiber webs into partial fiber web rolls, in which time period (10) of slitting and winding of one set of partial web rolls comprises acceleration period (10A), normal running speed period (10N) and deceleration period (10D) in which during acceleration period (10a) the speed of the slitter-winder is accelerated to normal running speed of slitting and winding. In operating the slitter-winder the speed is accelerated to the normal running speed of slitting and winding in the beginning of winding the set of the partial fiber web rolls by using high acceleration rate from 1,3 m/s^2 to 3,0 m/s^2.

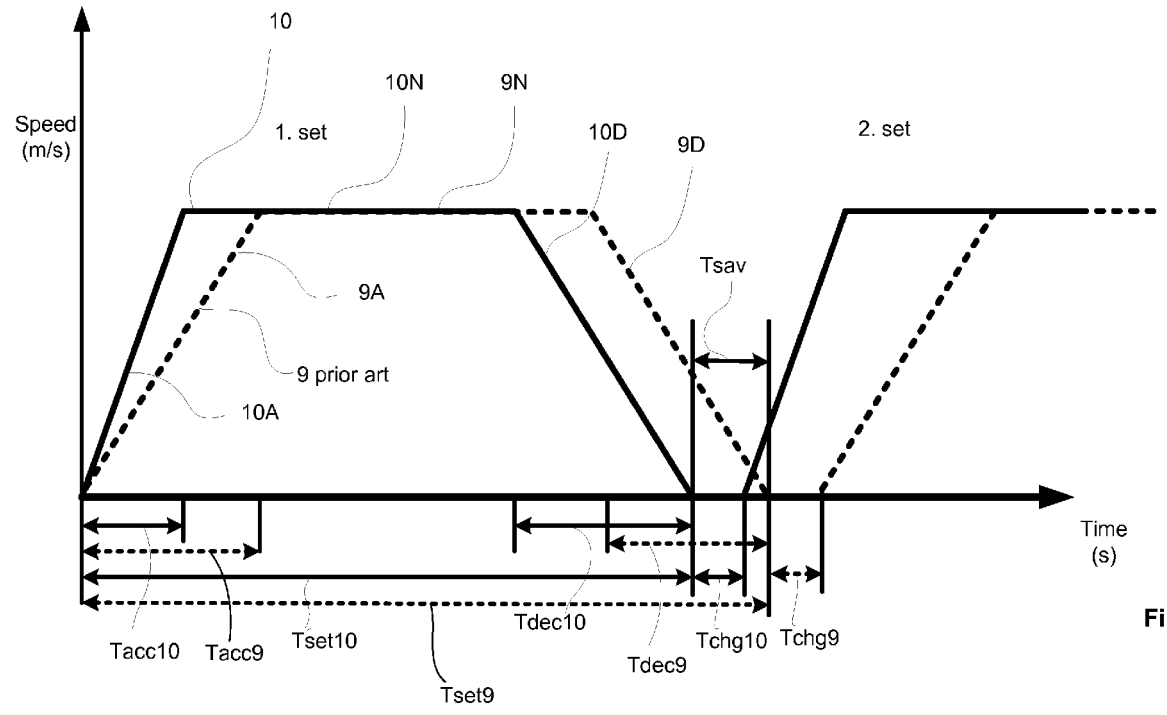

Fig. 1

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Description

[0001] The invention relates to a method of operating a slitter-winder for winding fiber webs into partial fiber web rolls in a period in which speed of the winder is accelerated to a normal running speed of winding. Especially the invention relates to a method according to the preamble of claim 1.

[0002] It is known that a fiber web, e.g. paper, is manufactured in machines which together constitute a paper-manufacturing line which can be hundreds of metres long. Modern paper machines can produce over 450,000 tons of paper per year. The speed of the paper machine can exceed 2,000 m/min and the width of the fiber web can be more than 11 metres.

[0003] In paper-manufacturing lines, the manufacture of paper takes place as a continuous process. A fiber web completing in the paper machine is reeled by a reel-up around a reeling shaft i.e. a reel spool into a parent roll the diameter of which can be more than 5 metres and the weight more than 160 tons. The purpose of reeling is to modify the fiber web manufactured as planar to a more easily processable form. On the reel-up located in the main machine line, the continuous process of the paper machine breaks for the first time and shifts into periodic operation.

[0004] The web of parent roll produced in paper manufacture is full-width and even more than 100 km long so it must be slit into partial webs with suitable width and length for the customers of the paper mill and wound around cores into so-called customer rolls before delivering them from the paper mill. This slitting and winding up of the web takes place as known in an appropriate separate machine i.e. a slitter-winder.

[0005] On the slitter-winder, the parent roll is unwound, the wide web is slit on the slitting section into several narrower partial webs which are wound up on the winding section around winding cores, such as spools, into customer rolls. When the customer rolls are completed, the slitter-winder is stopped and the wound rolls i.e. the so-called set is removed from the machine. Then, the process is continued with the winding of a new set. These periods of so-called set change are repeated in sequences periodically until paper runs out of the parent roll, whereby a parent roll change is performed and the operation starts again as the unwinding of a new parent roll.

[0006] Slitter-winders employ winding devices of different types depending on, inter alia, on the type of the fiber web being wound. On slitter-winders of two drum winder type, the web is guided from the unwinding via guide rolls to the slitting section where the web is slit into partial webs which are further guided to the winding (support or carrier) drum of the two drum winder and slit component webs are wound around a winding core on support of the winding drums. On slitter-winders of the multistation winder type, the web is guided from the unwinding via guide rolls to the slitting section where the web is slit into partial webs which are further guided to the winding drum/drums on the winding stations into customer rolls to be wound up onto cores. Adjacent partial webs are wound up on different sides of the winding drum/drums. Multistation winders have one to three winding drums and in them each partial web is wound to a partial web roll in its own winding station.

[0007] The slitter-winders comprise as parts of its operating process the set-change and the slitting and winding process as successive periods. The slitting and winding process may also be considered to comprise an acceleration period after the set change, a normal slitting and winding period and a deceleration period preceding the set change. Of these the normal slitting and winding period takes the longest time and the web speed can be typically even 3000 m/min (50 m/s). Thus in winding applications for slitter-winders the partial web rolls should in the beginning of winding be accelerated to the speed needed and at the end decelerated to crawling speed and to be stopped.

[0008] During past years the efficiency of the slitter-winders has been improved considerably for example by increasing running speeds. The total efficiency is naturally influenced by efficiency of operation in all periods, but typically the normal slitting and winding process is the one which gives the results most easily.

[0009] Recently there has arisen a need to intensify the slitting and winding process more and thus the time needed for acceleration period has become an important factor. It is known that the acceleration rate used in slitter-winders is normally from 0,2 m/s^2 to 0,6 m/s^2 and in rare cases maximally 1,0 m/s^2. In particular in connection with slitting and winding of thick fiber web grades, for example pulp and thick board grades, acceleration period is very important, since typically the normal running period is very short or in practice deceleration period follows directly the acceleration period and thus normal running period does not exist.

[0010] It is known to limit the acceleration rate when the diameter of the parent roll in unwinding is at its largest due to the torque transfer capacity of the existing reeling shaft or of the mechanical drive or for optimizing the size of the electric drive. In these techniques the simple limit value approach has been employed and when the diameter of the parent roll has decreased below the predetermined fixed limit value, higher acceleration rate has been introduced.

[0011] In WO publication 2008/09603 is disclosed a method of utilizing a drive capacity reserve in winding of a fiber web. In the method the changing acceleration and/or deceleration capacity of the electric drive is utilized during the treatment of the parent roll to be unwound in an unwinder. In FI application 20085915 is disclosed an electric drive arrangement for a section and/or device of a fiber web machine comprising an electric drive and its control arrangement, where the electric drive is controlled based on the thermal capacity of the electric drive and/or its control arrangement.

[0012] It is also known to use with certain fiber web

grades acceleration rates, which are depending on strength properties of web grades mostly. Also depending on the fiber web grade accelerating of freely rotating rolls (for example guide roll used for guiding the fiber web in slitter-winders) may set limit to usable acceleration rate, particularly if wrap angle over the freely rotating roll is large, more than 20°.

[0013] It is know from the prior art that in winding, for example when a paper web is wound in a slitter-winder, with certain paper grades, for example fine paper or liner papers, intensive vibration peaks occur at the same ranges of frequency or rotation of the roll irrespective of the running speed of the slitter-winder. These ranges of vibration i.e. ranges of frequency of rotation of the roll, in which intensive vibration occurs in the slitter-winder, is typically 1 to 3 depending on the final diameter of the roll. This intensive vibration produces web broke, mechanical wear of the equipment and even bouncing-off of the rolls from the winder and decrease in winding capacity, because the running speed must be lowered during winding. In EP patent publication 0839743 is disclosed a method in winding of a paper web, in which the running speed of the winder is controlled based on the frequency of rotation of the paper roll that is being wound such that the intensive vibration causing ranges of frequency of rotation is avoided by lowering the running speed of the winder. In practice the most common known method for avoiding vibrations is to decrease the running speed manually so that when vibration occurs the running speed is decreased by an operator and the vibration dampens.

[0014] The vibration of the slitter-winder has also been a problem during acceleration period of the slitter-winder and it has been even more problematic as the different techniques used for damping and/or eliminating vibration during normal slitting and winding process are not as such utilizable for eliminating and/or damping vibration during acceleration period. Known methods for controlling vibration are for example using stepwise acceleration and/or using an extremely low acceleration rates. Drawback of these methods is the significant decrease of capacity.

[0015] In WO publication 2010/018305 is disclosed a method in which problems incurred by vibration during acceleration period are avoided or minimized by as the slitting starts the speed is accelerated to the normal slitting speed using more than one acceleration rate.

[0016] One problem in the known methods for controlling vibrations is that by avoiding vibrations by changing running speed the capacity of the winder is decreased and also the quality of the partial fiber web rolls is decreased due to speed changes, because the speed changes also cause changes in web tension which may cause stick-off layers in the partial fiber web roll.

[0017] Many of the above problems and disadvantages occur in winding irrelevant of the type of the slitter-winder used even though they have been in some cases described in reference of one example only.

[0018] One object of the invention is to eliminate or at least minimize the above problems and disadvantages of prior art winders if slitter-winders in particular relating to capacity losses and vibrations.

[0019] Another object of the invention is to create a method of operating a slitter-winder in which the problems and disadvantages relating to the accelerating the speed to the running speed are eliminated or at least minimized.

[0020] Another object of the invention is to provide a method of operating a slitter-winder in which the problems caused by vibration during acceleration period are avoided or at least minimized.

[0021] Another object of the invention is to create a method of operating a slitter-winder by which capacity of the slitter-winder is increased.

[0022] To achieve the above objects and those which will come out later, the method of operating a slitter-winder according to the invention is mainly characterized by what is presented in the characterizing part of claim 1.

[0023] Further advantageous features of the method according to the invention are presented in the dependent claims.

[0024] The applicant has observed in pilot and test trials that acceleration rate has an extraordinary effect to vibrations occurring in slitter-winders. It was surprisingly found out that high acceleration rate results as good roundness of the partial fiber web rolls to be wound and thus vibrations are eliminated or at least minimized during winding. Thus contrary to the teachings of prior art and known methods in the method according to the invention in operating a winder a novel and inventive approach has been taken. According to the invention in operating the winder the speed of the winder is accelerated to the normal running speed of winding in the beginning of winding fiber webs roll by using high acceleration rate from 1,3 m/s^2 to 3,0 m/s^2, advantageously from 1,5 m/s^2 to 3,0 m/s^2.

[0025] By the high acceleration rate the partial fiber web rolls are wound to good roundness and thus vibrations do not occur during acceleration period or during winding. The high acceleration rate also results as increased capacity since the time needed for one period of slitting and winding one set of partial fiber web rolls is considerably shortened and as in a slitter-winder from one parent roll typically is slitted and winded five sets of partial web rolls and during one day typically is slitted and winded 25 parent rolls the saved time per day amounts to 125 times of the time decrease achieved by the high acceleration rate in slitting and winding one set of fiber web rolls. Increased capacity is thus 5 - 10%.

[0026] According to an advantageous feature of the invention in the method the fiber web/-s is/are guided in the slitter-winder over freely rotating rolls (for example guide rolls) using wrap angle over 20° and the freely rotating rolls do not cause problems in acceleration.

[0027] Also capacity losses of the winder can be avoided as due to good roundness of the partial fiber web rolls achieved during high acceleration rate no vibrations oc-

cur and thus no need to decrease speed or use low acceleration rates exists so fast acceleration period is achieved providing thus capacity increase.

[0028] As a further advantage good quality partial fiber web rolls are achieved due to already at beginning achieved good roundness of the partial fiber web rolls which provides for a good beginning for winding.

[0029] The invention is utilizable in winding of partial fiber web rolls in winders of slitter-winders, especially in two-drum winders and in multistation winders. In this description and the claims by fiber web is meant paper web, board web and pulp web even though often is referred to paper web in the disclosure.

[0030] In the following the invention is further described referring to the accompanying schematic figures in which

[0031] In figure 1 is shown examples of running speed as a function time.

[0032] In figure 1 the vertical axis is presented the running speed (m/s) and the horizontal axis is presented time (s). The time is directly comparable to the fiber web rolls' diameter i.e. to the lengths of the partial webs that have been wound around the winding cores in the slitter-winder.

[0033] In the figure1 by the dashed line 9 is shown the time period of slitting and winding the first set (1. set) of partial web rolls and the beginning of the time period of slitting and winding the second set (2. set) of partial web rolls when a new parent roll is unwound. After the change of a new parent roll to be unwound the speed of the slitter-winder is accelerated during the acceleration period 9A from 0 m/s to normal running speed of the slitter-winder. The normal running speed period 9N is followed by deceleration period 9D. There after the set change is performed and after the set change the next time period of slitting and winding begins by acceleration period.

[0034] By the line 10 is shown the time period of slitting and winding the first set (1.set) of partial web rolls and the beginning of the time period of the slitting and winding of the second set (2. set). As shown in figure the periods, acceleration period 10A, normal running period 10N, deceleration period 10D form the time period of slitting and winding, which is followed by the set change and after which the next time period of slitting and winding begins by acceleration period. In the method according to the invention during acceleration period 10A significantly higher acceleration rates are used than used in prior art 9A as can be seen from the figure 1. According to the invention in operating the winder the speed of the winder is accelerated to the normal running speed of winding in the beginning of winding fiber webs roll by using high acceleration rate from 1,3 m/s^2 to 3,0 m/s^2, advantageously from 1,5 m/s^2 to 3,0 m/s^2, during acceleration period 10A.

[0035] As can be seen from the figure 1 the time saved by the fast acceleration period 10A in accordance with the invention takes time Tacc10 and the acceleration period 9A when accelerated in accordance with known methods takes time Tacc9 and thus the saved time Tsav is considerable and it cumulates during slitting and winding of further sets of partial web rolls. The same saved time Tsav is achieved when comparing the total time needed for slitting and winding one set of partial web rolls, Tset9-Tset10=Tsav. The deceleration periods in accordance with the invention and with the prior art take substantially same time Tdec10= Tdec9 and correspondingly times needed for set change are substantially same in the method according to the invention and according to prior art, Tchg10=Tchg9. In particular in connection with slitting and winding of thick fiber web grades, for example pulp and thick board grades, acceleration period is very important, since typically the normal running period is very short or in practice deceleration period follows directly the acceleration period and thus normal running period does not exist and the significance of the time used during the acceleration period is even more significant.

Claims

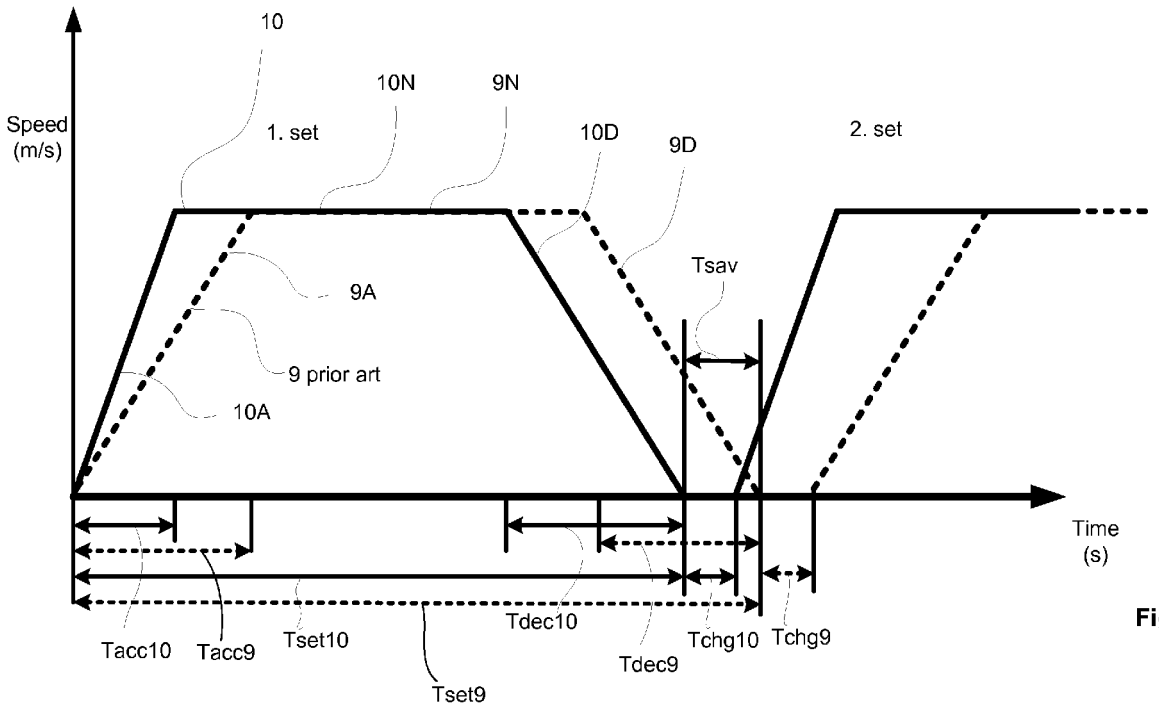
1. Method of operating a slitter-winder for winding fiber webs into partial fiber web rolls, in which time period (10) of slitting and winding of one set of partial web rolls comprises acceleration period (10A), normal running speed period (10N) and deceleration period (10D) in which during acceleration period (10a) the speed of the slitter-winder is accelerated to normal running speed of slitting and winding, **characterized in, that** in operating the slitter-winder the speed is accelerated to the normal running speed of slitting and winding in the beginning of winding the set of the partial fiber web rolls by using high acceleration rate from 1,3 m/s^2 to 3,0 m/s^2.

2. Method according to claim 1, **characterized in, that** in the method is used high acceleration rate from 1,5 m/s^2 to 3,0 m/s^2.

3. Method according to claim 1 or 2, **characterized in, that** in the method the fiber web/-s is/are guided in the slitter-winder over freely rotating rolls using wrap angle over 20°.

4. Method according to any of claims 1 - 3, **characterized in, that** in the method normal running period (10N) is very short or nonexistent, in particular when slitting and winding pulp or thick board webs.

5. Method according to any of claims 1 - 4, **characterized in, that** the method is used in a two-drum winder or in a multistation winder.


10
10N
9N
Speed
(m/s)
1. set
10D
9D
2. set
Tsav
9A
9 prior art
10A
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Tacc10
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Tset10
Tset9
Tdec10
Tdec9
Tchg10
Tchg9

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 12 19 9431

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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
The Hague	29 May 2013	Cescutti, Gabriel

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
EP 12 19 9431

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The Hague	29 May 2013	Cescutti, Gabriel

CATEGORY OF CITED DOCUMENTS

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