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(54) **Method in a reel-up in a grade change situation**

(57) In a grade change situation in a continuously operated process of reeling a paper web, the grade of the paper web is changed in the paper manufacturing process preceding the reel-up by changes in the operations performed in this process, and the paper web of the new grade is introduced around a reel spool. The continuous web entering the reel-up is guided to form broke past the reeling process directly into a pulper located in connection with the reel-up at the same time when the grade of the paper web is being changed.

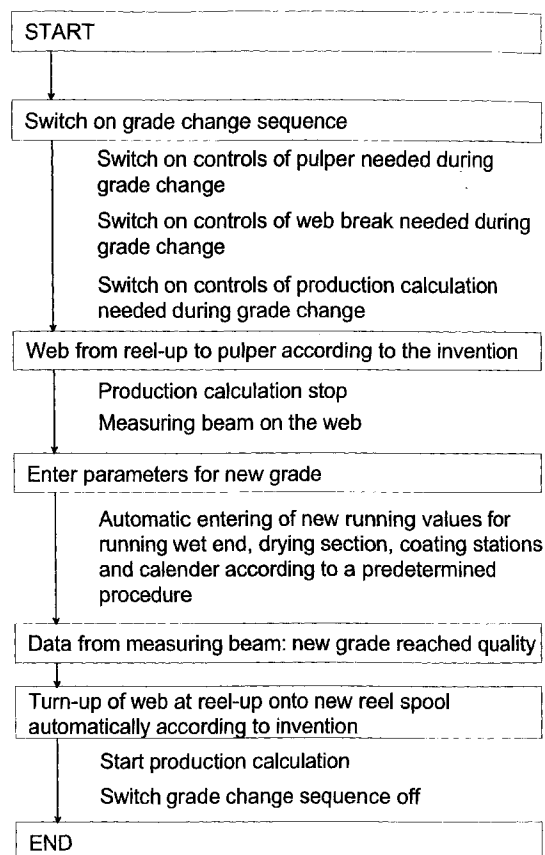


Fig. 2

EP 0 964 099 A2

Description

[0001] The invention relates to a method in a reel-up when changing paper grade, *i.e.* in a grade change situation.

[0002] When changing the paper grade, one or several properties of the paper are changed. The composition of the stock to be supplied from the headbox can be changed and/or the paper manufacturing process can be changed in other respects to correspond to the new grade. During the change, there is a break in the production of completed paper suitable for sale or further processing, and the paper web accumulated during this time is passed to broke.

[0003] According to prior art, the grade change is conducted in the following way: When the last reel of a certain grade has become full on a reel-up, the reel is changed in the normal manner and the production process is changed in a way that one or some of the characteristics of the paper to be produced are changed. Paper which is produced during the grade change and which does not yet fulfil the requirements of the new grade is reeled on the bottom of the new reel. When the new grade has been stabilized, *i.e.* it fulfils the requirements set for it, this point is marked in some way at the end face of the roll. After this, it is known in further processing which part of the reel consists of broke, and this bottom part of the reel can be discharged into a pulper. This method requires extra labour both in reeling and in unwinding during further processing of the reel. The part of the reel that does not meet the requirements of the new grade must be removed by cutting it off the reel in a separate operation known as "slabbing".

[0004] The purpose of the invention is to present a novel grade change sequence whereby the grade change can be performed in a controlled manner without wasting employee resources to extraneous reel handling. For achieving this purpose, the invention is primarily characterized in what will be presented in the appended claims.

[0005] It is characteristic of the method to guide the paper web to form broke instead of guiding it to a reel in a reel-up during the grade change, when the new grade is not yet stabilized. The length of such grade change web where the properties are gradually changing to comply with the new grade can be several kilometres, depending on the running speed and the duration of the grade change. By guiding the grade change web to broke *e.g.* directly to a pulper, a new reel is obtained after the grade change, containing a web that is fully available for the next step of further processing without a need to remove unwanted grade from it, and unwinding does not need to be interrupted. By means of the invention, it is possible to produce machine reels containing the same grade from the bottom up to the surface, irrespective of the fact whether the reel is the first reel after a grade change or whether the reel is preceded by several reels reeled of the same grade. As to

the practical realization of a grade change, reference is also made to international application published under no. WO 99/04090, the publication date of which is later than the priority date of the present application.

[0006] In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 shows a reel-up of a paper machine in a side view, and

Fig. 2 illustrates a grade change sequence in a flow chart.

[0007] Figure 1 shows a known reel-up in a paper machine, reeling a continuous web W passed from preceding stages of the paper manufacturing process or paper aftertreatment process into a machine reel R. The web W is passed via a reeling cylinder 1, and it is wound via a peripheral moving surface of a web guiding means to the reel R, such as via a rotatable reeling nip between the reeling cylinder and the reel onto the reel. The core of the reel is constituted by a reel spool 2, which is rotated with a centre drive and is loaded at its ends towards the reeling cylinder 1 by loading devices known as such. Below the reeling cylinder 1 there is a pulper P, a so-called dry-end broke pulper, which in this example is shared by a machine calender K preceding the reel-up.

[0008] An initial reeling device, which is arranged pivotable around an axis parallel to the rotation axis of the reeling cylinder 1 and which brings an empty reel spool 2 in connection with the reeling cylinder 1, is indicated with the reference numeral 3.

[0009] The ends of the reel spool 2 rest on reeling rails 4 and are coupled with a reeling carriage 5 movable in the direction of the reeling rails by the loading devices. The loading can be transmitted to the reel spool 2 also via another mechanism.

[0010] The reel-up operates continuously in a manner that paper web emerging from the process runs at the production speed during the reel change as well, that is, the reel is changed by breaking the web going to the full reel and guiding the leading end of the web around a new empty reel spool at the full production speed of the paper web.

[0011] Before the reeling cylinder, there is one or several measuring devices M for measuring one or several properties of the web to be manufactured and thereby also properties indicating a grade change. The measuring devices can be sensing heads traversing in a known way across the moving web and fixed to a measuring frame extending across the web.

[0012] The following is a description on an embodiment of the invention. Before running a grade change sequence, the paper machine produces a paper grade A which is reeled up into a machine reel R. The grade change sequence is started at the reel-up when the last

required reel of grade A is almost complete. The reel is separated from the reeling cylinder 1 and after this it is slowed down, wherein the slackening web travels towards the pulper and breaks. At the latest at the stage of slowing down the reel, an empty reel spool 2 is in a nip contact with the reeling cylinder 1. The nip contact, which must exist at the time of the web break, is used to secure a sufficient web tension and draw before the reel-up and a reliable course of the process during the grade change. Changes in the paper web can be started immediately after the web has broken or possibly already slightly before it, taking into account the delay due to the point of change in the process and the running speed, after which the change will appear in the web coming to the reel-up. During the sequence, the paper machine produces grade change broke which is run as a full-width web from the reel-up directly to the pulper P as well as from there, immediately or with a delay, e.g. to a couch pit and further to broke processing. The web W that is run from the reeling cylinder 1 to the pulper P is shown with a broken line. When a new grade B is stabilized, i.e. when it fulfils the quality requirements for the grade, the web is changed to a new empty reel spool and the reeling of the first machine reel containing the grade B is started. After the grade change sequence, the paper machine produces paper grade B, which is reeled into subsequent machine reels by changing the web from reels being completed to new reel spools.

[0013] The grade change sequence of the reel-up makes it possible to adjust automatically or manually the manipulated variables of the paper machine required by the grade change, as well as to utilize the measuring signals given by the measuring device on an on-line measuring beam extending transversely to the travel direction of the web, whereby production time of the machine is saved in the grade change situation. When the grade change sequence of the reel-up is integrated as part of the operation of the paper machine, it is possible to control the production more accurately and efficiently than at present.

[0014] The grade change sequence can be performed as a manual run from the local control panel of the reel-up. It can also be implemented as a fully automatic function in the machine. Figure 2 shows the grade change sequence in a flow chart.

[0015] For clarity, Fig. 1 shows also some elements of the pulper P, such as slope water showers 6, follower water showers 7, and possible other water showers 8. A control device (photosensitive cell), located below the reeling cylinder 1 and detecting the web entering the pulper, is indicated with the reference numeral 9. A second control device, which is located before the reeling cylinder 1 and which can also be accomplished in form of a photosensitive cell, is indicated with the numeral 10. The numeral 11 refers to air vents located in the upper part of the pulper and connected with a fan to secure that no moist air gets from the pulper to the machine hall, and the numeral 12 refers to a discharge pump ar-

ranged to pump broke pulp from the pulper e.g. to a stock handling system.

[0016] In the starting situation, the paper machine is in a normal running state, and the old grade is being run into a machine reel R for the last time before changing the paper grade to one that deviates from the preceding one with respect to one or several properties which can be grammage, colour, stock composition, or another property that can be used to define a grade. Production that does not comply with the new quality requirements during the grade change is passed to broke immediately on the reel-up in a way that labour as well as broke handling capacity are saved for more important purposes on the production line. Before the change situation of the reel-up, the operator starts the grade change sequence at the display terminal of the control room, which results in starting e.g. the following sequence of operations before the moment of change:

1) The pulper P of the reel-up is started, i.e. the functions are started in the pulper which make it possible to run the full-width web from the reeling cylinder down to the pulper, such as

- the pulper agitator is started,
- the follower water showers are turned on,
- the slope water showers are turned on,
- the discharge pump is turned on,
- the air exhaust fan is turned on (typically, the air exhaust fan is always on when the pulper is on),
- the broke handling system is switched over to a grade change situation, in which e.g. some of the pulp of the pulper of the reel-up is pumped faster into the couch-pit or elsewhere in the process.

The discharge pump of the pulper can be controlled e.g. by level control, wherein it is turned on according to the filling up of the pulper P.

2) The control of the web break is informed of the grade change situation.

3) The drive of the initial reeling device accelerates an empty reel spool 2 to the running speed of the web.

4) At the moment of grade change, the initial reeling device 3 is turned to a threading position, and the nip between the empty reel spool 2 and the reeling cylinder 1 is closed when the initial reeling device 3 achieves the threading angle which is used in re-starting of reeling and is suitable for the operation of the exchange device used in threading.

5) Blowing of the air doctor (doctor of the reeling cylinder 1) is started.

6) The follower blowing of the pulper P is started.

7) The pressing device is moved into a work position in contact with the surface of the reel R, and after this the reeling carriage 5 and the full machine reel R with it is guided on the rails to the dry end to a distance from the reeling cylinder 1.

8) During the movement of the reeling carriage 5, the centre drive in the carriage is slowed down, and when the rotating speeds of the reel spool 2 and the reel R are slowed down, respectively, the slackening web falls from the reeling cylinder 1 to the pulper P and the web is broken. The full-width web entering the reel-up will now start to run in full width from the reeling cylinder 1 down to the pulper P.

9) When the control of the web break at the reel-up detects that the web falls down to the pulper P, the calculation of the production to the mill system is stopped. The grade change itself can be performed as an automatic function of the process control computer (XD function) or by changing the control parameters manually. The sensing head of the measuring frame located before the reel-up continues scanning normally and registers changes taking place in the product.

10) The reeling carriage 5 is guided to the removal position of the full reel R, and preferably the centre drive or a mechanical brake stops the full machine reel.

11) After the full reel R has stopped, the coupling of the centre drive is released and the guides of the reeling carriage 5 are moved down, wherein the full reel spool 2 rolls into a stop station. Secondary jaws move down and the guides rise.

12) The change device used for threading in the reel-up, e.g. a change blowing device, such as a gooseneck, is guided into the work position.

13) When the product fulfils the quality requirements of the new grade (data from the measuring frame), the web is changed with the change device onto the new reel spool 2. The change can take place manually or controlled by automatics, after which the change device returns to its home position.

14) After the change, the web is no longer passed into the pulper. The control of the pulper P returns to the status corresponding to the situation before starting the grade change sequence. The air doctor and the follower blowing of the pulper are also turned off.

15) The mill system starts the calculation of the production when the diameter of the initial reeling device 3 increases and/or the change with the change device is made.

16) The initial reeling device 3 turns to the reeling rails 4.

17) The reeling carriage 5 switches to loading, and the centre drive is accelerated to the running speed of the web.

18) The torque and the load is changed from the initial reeling device 3 to the reeling carriage 5.

19) The grade change sequence is passivated, and reeling is continued according to the normal procedure.

20) **[0017]** This grade change sequence can be started also automatically, if it has been automatized in the production control system.

25 **[0018]** The above description contains as many steps of the grade change sequence as possible. All steps do not necessarily take place in the order described above, and some less important steps can be deleted. In a concise manner, the essential steps are the following:

A) Starting the functions of the pulper required during the grade change.

B) Releasing the reel that has gathered the old grade from the reeling cylinder and slowing down the reel.

C) Guiding the full-width web into the pulper after the web has broken.

D) Changing the process parameters for grade change in a manner that one or more properties that characterize the paper web change.

E) Changing the paper web onto a new reel spool after the grade change.

45 **[0019]** Of the steps mentioned above, the steps B and C take place in succession, the step C being an immediate outcome of the step B. Also the other steps are performed preferably in the above-mentioned order. If the functions of the pulper required during the grade change are started in time, the pulper is at once ready to receive the web passed into the pulper at the running speed. Without deviating from the basic idea of the invention, it is also possible to perform the step A simultaneously with or slightly after the step B. Similarly, the step D could, in principle, be performed simultaneously with the step B, if the changes in the parameters do not have time to affect the web still running into the reel for a short time after the releasing.

55 **[0020]** The invention is not limited to the embodiment presented above, but it can be modified within the inventive idea presented in the claims. The invention can

be applied particularly in connection with a paper machine but also in a machine for after-treatment of paper when changing the way of treatment and thereby the grade, if a broke handling system of a suitable capacity is available, it being understood that paper manufacture in this context also encompasses manufacturing finished paper in an aftertreatment process. The term paper web is used here to refer to all continuous webs made of a fibre material, irrespective of their grammage.

Claims

1. A method in a reel-up in a grade change situation in a continuous process of reeling a paper web, in which the grade of the paper web is changed in the process of paper manufacture preceding the reel-up by changes in the operations performed in this process and the paper web of the new grade is introduced around a reel spool (2), **characterized** in that the continuous web (W) entering the reel-up is passed to form broke past the reeling process at the same time when the grade of the paper web is being changed.

2. A method according to claim 1, **characterized** in that when a change in the paper grade is detected in the properties of the continuous web (W) entering the reel-up, the new grade of the paper web is guided into the reeling process around a new reel spool (2).

3. A method according to claim 1 or 2, **characterized** in that the continuous web (W) entering the reel-up during the grade change is passed directly into a pulper (P) located in connection with the reel-up.

4. A method according to any of the foregoing claims, **characterized** in that the continuous web (W) entering the reel-up during the grade change is passed to form broke between a web guiding means of the reel-up such as a reeling cylinder (1) and a new reel spool (2) brought onto its periphery.

5. A method according to any of the foregoing claims, **characterized** in that after the web (W) is passed to form broke, e.g. into a pulper (P), the grade change is performed by changing the control parameters of the paper manufacturing process manually or as an automatic function of the process control computer.

6. A method according to any of the foregoing claims, **characterized** in that before starting the grade change, the complete reel (R) is separated from the continuous web (W) entering the reel by increasing the mutual distance of the reel (R) and a web guiding means of the reel-up such as a reeling cylinder

(1), after which the paper web is cut or it is let to break off and the web (W) after the break point is passed to form broke.

7. A method according to claim 6, **characterized** in that the rotating speed of the complete reel (R) separate from the web guiding means such as reeling cylinder (1) is slowed down to slacken the continuous paper web (W) entering the reel.

8. A method according to any of the foregoing claims 1 to 7, **characterized** in that the empty reel spool (2) is at least at the moment of the web (W) break on the periphery of a web guiding means of the reel-up such as the reeling cylinder (1), in contact with the web (W) running on the periphery.

9. A method according to any of the foregoing claims 1 to 8, **characterized** in that before starting of and during the grade change, at least the following operations of the grade change sequence in the reel-up are performed in a suitable order:

- starting the pulper (P) in connection with the reel-up,
- bringing an empty reel spool (2) onto the periphery of a web guiding means of the reel-up such as a reeling cylinder (1),
- starting the control blowing guiding the web (W) into the pulper (P),
- increasing the mutual distance of the complete reel (R) and the web guiding means such as reeling cylinder (1), and cutting the web (W) running onto the complete reel or letting it to break off in the area between the web guiding means and the reel (R) and guiding it into the pulper, and
- monitoring the properties of the web (W) entering the reel-up continuously, and, when they fulfil the requirements of the new grade, guiding the web (W) around the new reel spool (2).

10. A method according to any of the foregoing claims 1 to 8, **characterized** in that before starting and during the grade change, at least the following operations of the grade change sequence in the reel-up are performed in the following order:

- detecting, when the web (W) is guided into the pulper (P),
- monitoring the properties of the web (W) entering the reel-up and to be guided to the pulper (P) continuously, and when they fulfil the requirements of the new grade, guiding the web (W) around the new reel spool (2).

11. A method according to claim 10, **characterized** in that at least the following operations of the grade

change sequence in the reel-up are performed in the following order:

- switching the pulper (P) in connection with the reel-up over to a control used during the grade change, 5
- detecting when the web (W) is passed into the pulper (P),
- entering the parameters of the new grade in the paper manufacturing process preceding the reel-up, 10
- continuously monitoring the properties of the web (W) entering the reel-up and to be guided into the pulper (P), and when they fulfil the requirements of the new grade, guiding the web (W) around the new reel spool (2). 15

12. A method according to claim 9, 10 or 11, **characterized** in that said operations are performed automatically in a preprogrammed order. 20

13. A method according to claim 12, **characterized** in that when the web (W) is guided into the pulper (P), the calculation of the production into the mill system is automatically stopped. 25

14. A method according to any of the foregoing claims, **characterized** in that the guiding of the web (W) to form broke, *e.g.* into the pulper (P), is detected with a device for detecting a web break. 30

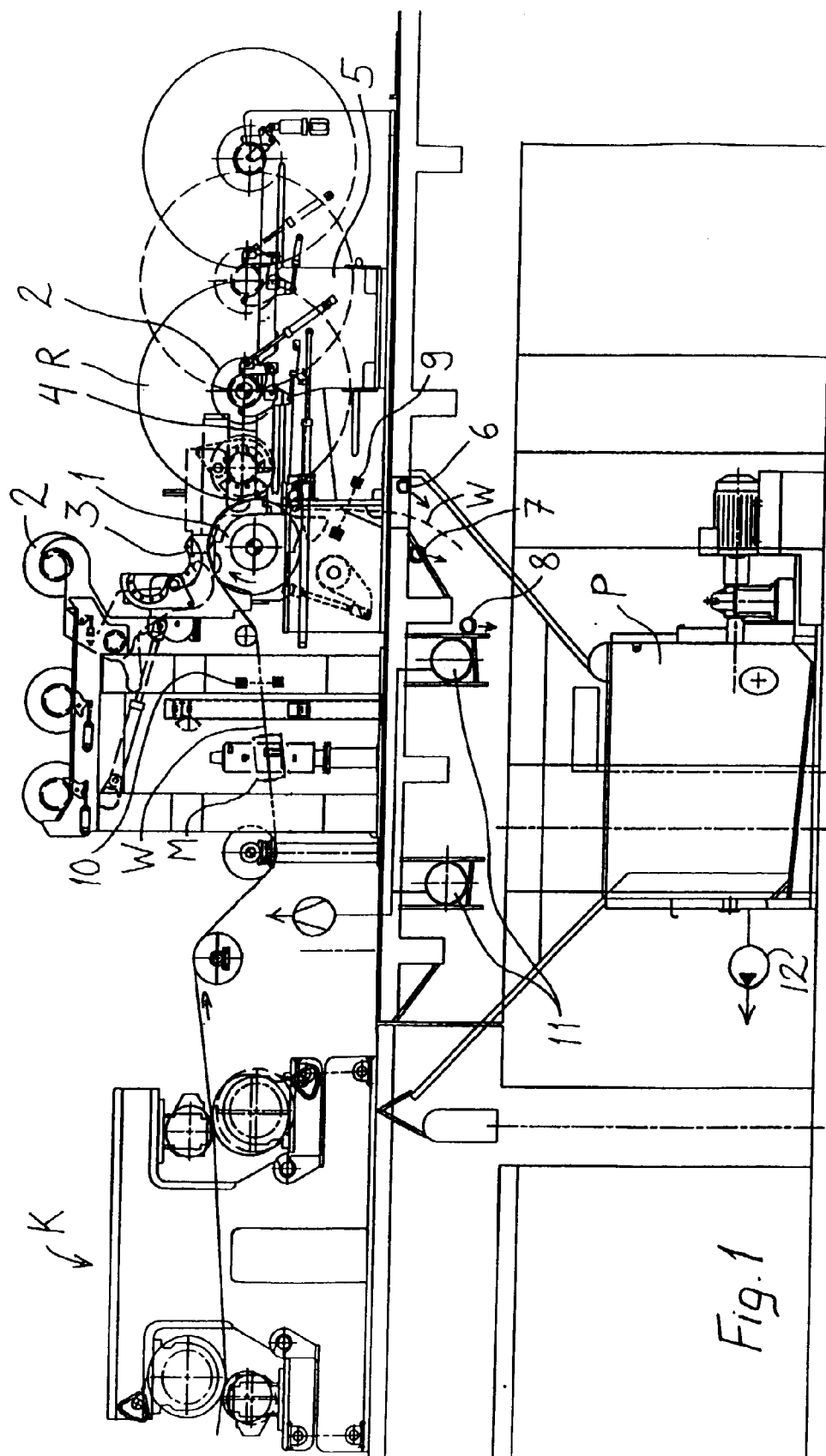
15. A method according to claim 14, **characterized** in that the device for detecting a web break gives the information automatically to the automatics controlling the grade change sequence of the reel-up. 35

16. A method according to any of the foregoing claims, **characterized** in that the changing of the grade entering the reel-up is monitored continuously with a measuring device (M) located before the reel-up, such as a sensing head of a measuring frame. 40

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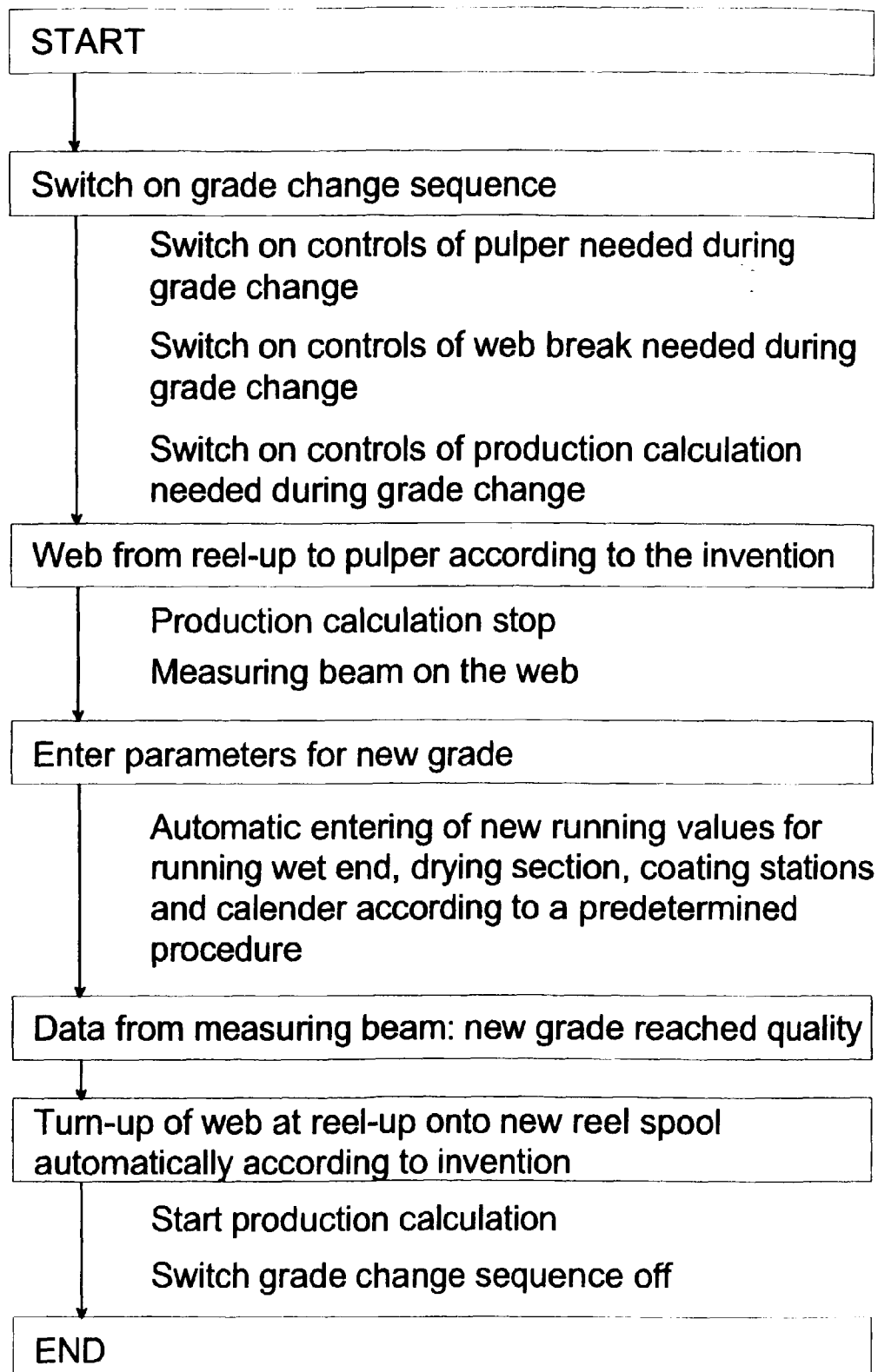


Fig. 2