A paper or board web is manufactured in an on-line manufacturing process, in which the web is passed from a paper or board machine (15) directly to a finishing device/finishing devices (60, 50, 10). The state of the finishing device/finishing devices (60, 50, 10) is monitored and, during a shutdown of a finishing device (60; 50; 10), said finishing device is bypassed, the web coming from the paper or board machine (15) is wound into machine reels and/or treated by means of some finishing device/finishing devices and wound into machine reels. A paper or board machine forms an on-line manufacturing process together with a finishing device/finishing devices.
METHOD AND DEVICE FOR MANUFACTURING A PAPER OR BOARD WEB WHERE THE FINISHING DEVICE CAN BE BYPASSED

CROSS REFERENCES TO RELATED APPLICATIONS
[0001] This application is a U.S. national stage application of International Application No. PCT/FI01/00176, filed Feb. 21, 2001, and claims priority on Finnish Application No. 20000441 filed Feb. 25, 2000, the disclosures of these applications being hereby incorporated by reference herein.

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT
[0002] Not applicable.

BACKGROUND OF THE INVENTION
[0003] The present invention relates to methods and apparatus for manufacturing paper or board webs in an on-line manufacturing process, in which the web is passed directly to a finishing device and the web is wound into machine reels.

[0004] Recently, the use of on-line manufacturing processes has become more common in making paper and board webs, in which processes the entire paper or board machine operates as an integrated production line from the beginning to the end, thus also comprising the desired means for finishing the web. A manufacturing process such as this is, however, problematic in the sense that when a partial entity is damaged, in particular in an unscheduled shutdown and/or in maintenance of a finishing device, the utilization rate of the entire production line has to be reduced and the entire production process even has to be stopped. It goes without saying that this is extremely expensive and involves high costs.

[0005] Thus, methods are known in the state of the art for producing a paper or board web in which the web is passed from the dryer section directly to finishing, that is, we are discussing an on-line manufacturing process in which the utilization rate of the entire manufacturing line has to be dropped if there is some disturbance or a roll is replaced in a finishing device. In that connection, the web also usually has to be run into the pulper. In some cases, the entire production line has to be stopped because of a problem that occurs in a finishing device. In addition, in manufacturing processes in which the web is passed from the dryer section directly to on-line finishing, it has been possible to run only grades that can be finished at the running speed used in the manufacturing line, in which connection it has not been possible to make this process, for example, grades which are calendered to very high quality, which generally require speeds lower than the normal running speed of the machine, but, instead, it has been necessary to perform calendering with a separate calander, for example, with an off-line calander.

[0006] A problem in the production of a paper or board web has also been that if at some stage of production a web has been produced which is not suitable for the purpose desired in respect of its quality requirements, it has been necessary to run it into the pulper, from which it has been passed into pulp towers, in which connection the volumes of the pulp towers have been dimensioned to be large, for instance, such that they can hold the broke of 8 hours' running time.

SUMMARY OF THE INVENTION
[0007] An object of the invention is to provide a solution to the problems described above.
[0008] A particular object of the invention is to provide an arrangement by which the utilization rate of a paper or board machine is maximized and attempts are made to reach a situation where the paper machine can operate without interrupting in spite of problems occurring in finishing devices.
[0009] As taught by the invention, in the process of manufacturing a paper or board web, the state of the finishing devices is monitored in connection with the finishing devices and, when the web cannot be conducted to a finishing device for treatment, for example, because of a disturbance situation or roll replacement, the web is passed via other finishing devices or so as to be directly wound and it is wound into a machine reel in order to be stored, from which machine reel the paper or board web is later unwound and finished, for example, during a shutdown of the paper machine caused by something other than a finishing device, or the machine reel is taken to a finishing device of another line of the mill or to a finishing device of another mill, either an on-line or an off-line finishing device, in order to be finished. The winding is performed either with a reel-up placed at the end of the machine or the winding is performed with a reel-up placed at a suitable location in connection with the finishing devices. When needed, unwind stations are also placed in connection with the finishing devices, from which stations the web can be passed so as to be finished during a shutdown of the other parts of the production line. The reel-up may also be such that it operates both as an unwind and as a windup station. When outdated paper or board machines are modernized, it is possible to make use of reel-ups which already exist in the machine and which can be modified, for example, such that they function both as unwind and as windup stations.

[0010] In accordance with the invention, the paper or board web production line comprises means for monitoring the state of the finishing devices and for controlling the production line such that, when there occurs a disturbance situation or a roll is replaced in a finishing device, the production line is controlled such that the web is passed so as to be reel-ed, and the wound paper reels are unwound and finished during a shutdown caused by a disturbance situation in the paper machine or by something other than a finishing device.

[0011] In accordance with an advantageous application of the invention, in connection with a finishing device there is an apparatus for unwinding the machine reel and it is also possible to pass the web from the unwind station to the reel-up and to run the finishing device as an independent off-line device. The unwind apparatus is placed, for example, in connection with a finishing device at a suitable location in the line, for example, on top of the machine or after the reel-up. This kind of equipment used in connection with the invention is advantageously as simple as possible, including primarily means needed for control of tension.

[0012] In some applications of the invention, the manufacturing line is provided with means required for tail threading and transfer of the web bypassing a finishing device in situations where the web is wound by means of the reel-up into machine reels to be placed in storage, and the web is thus not finished on-line. The web can also be passed to the reel-up through the finishing devices, in which connection the finishing devices are run, so to speak, with the stations open.
The threading which bypasses a finishing device can be accomplished by means of separate equipment, for instance, at an edge of the web opposite to that of the tail threading proper, and the transfer of the web bypasses a finishing device most advantageously above or below. In off-line situations, threading can be accomplished in a suitable manner known in itself. As such, any threading methods known in themselves can be used for tail threading: manually, using threading ropes, threading bands, blowings, etc.

When using the method according to the invention, the problems occurring in a finishing device do not drop the utilization rate of the entire production line. For instance, when a finishing device is out of operation because of a damaged roll, a new threading operation is performed and production is continued during replacement of the roll and the web is wound into machine reels. The unfinished machine reels are moved, for example, onto storage rails to wait and during the next shutdown, not caused by a finishing device, the machine reels are finished off-line. Moreover, when using the invention, the reel replacement time is not critical because the web being produced can be stored on machine reels.

The invention also allows running of paper and board grades which cannot be accomplished at on-line speeds, in which connection the machine reels run during roll replacement or another disturbance situation in a finishing device can be finished, when needed, into high-quality rolls at a lower speed during a subsequent shutdown instead of running down the entire line or running the output into the dry end pulper during roll replacement or another disturbance, as done today.

When a new paper machine is started up, in the arrangement according to the invention, a paper or board web from an adjacent machine or a neighboring mill can be introduced into a finishing device before the initial end of the machine has been assembled.

In accordance with an advantageous application of the invention, for instance, broke is wound into a reel on a reel-up, which broke can be transferred later into pulp towers or possibly to another suitable use. In that connection, the volume of the pulp tower can be reduced to correspond, for instance, to a running time of three hours. On a reel, the broke takes the smallest storage space.

The invention can be applied in connection with all types of on-line finishing devices, for example, calenders and coating machines. The calender can be, for example, a multi-roll or a soft calender.

In accordance with an advantageous embodiment of the invention, the invention is used in producing on-line sack paper, White top liner, sack and liquid packaging board. This embodiment relates to an on-line calendering method in which, for example, an Metso Paper, Inc. OptiDwell® calender is used as a calender. The web is passed to a reel-up after calendering.

The invention is also suitable for use in connection with the manufacture of many types of board and paper, for example, in LWC paper production lines, in which, for example, an on-line two-side coating device marketed by Metso Paper, Inc. under the trademark SymSizer and, for example, a calender marketed by the applicant under the trademark OptiLoad® are used.

In the following, the invention will be described in more detail with reference to the figures in the accompanying drawing, to the details of which the invention is, however, not by any means intended to be narrowly confined.

**BRIEF DESCRIPTION OF THE DRAWINGS**

- **FIG. 1** schematically shows a basic application of the method according to the invention as a block diagram illustration.
- **FIG. 2A** schematically shows an application of the method according to the invention when using the normal running mode.
- **FIG. 2B** schematically shows the application shown in **FIG. 2A** when a finishing device is under maintenance.
- **FIG. 2C** schematically shows the application shown in **FIGS. 2A and 2B** when the paper or board machine is under maintenance.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

As shown in the schematic block diagram illustration of **FIG. 1**, a web produced on a paper or board machine 15 and dried on its dryer section 20 is passed to finishing devices, for example, to an intermediate calender 60, a coating machine 50 and therefrom to a calender 10 and further to a reel-up 30 and a storage 40. The finishing steps 60, 50, 10, 30 are monitored in monitoring units 61, 51, 11 and, during a possible shutdown of a finishing device 60, 50, 10, the web W that is being produced is passed to the reel-up 30 in order to be wound into machine reels and stored in the storage 40. When the system detects that there is a shutdown in the paper or board machine 15, the machine reel/reels in the storage 40 is/are unwound and the web is passed to the finishing devices, for example, to the intermediate calender 60 and/or to the coating machine 50 and/or to the calender 10 in order to be finished, after which the web is wound on the reel-up 30. The flow of information is schematically denoted by arrows, and data 22 from the control system of the paper machine are passed to monitoring data 42, to which also data from the monitoring units 61, 51, 11 and from the reel-up are passed, and the operation of the intermediate calender 60, the coating machine 50, the calender 10 and the reel-up 30 is controlled by means of feed-back 43. Of course, from the monitoring data 42 there is control to the reel-up 30 and to the storage data in the storage 40. In this manner, in the method according to the invention, a paper or board web can be continuously manufactured at desired speed on the paper machine 15, and the machine need not be stopped because of a fault that occurs in a finishing device, for example, in the intermediate calender 60 or in the coating machine 50 or in the calender 10, but, instead, the web that is being produced can be stored and treated at a later stage with said finishing device 60, 50, 10 or, alternatively, with a finishing device of another line or with an off-line finishing device of the mill. In other words, when needed, any finishing device can be bypassed and a reel-up can be situated between any two of the devices.

In the schematic embodiment example shown in **FIG. 2A**, in normal running, a web W is passed from a dryer section 20 of a paper or board machine via a guide roll 13 to a calender 10 and, after that, via a guide roll 33 to a reel-up 30, on which the paper web is wound into a machine reel R. The reel-up drum of the reel-up 30 is denoted by the reference numeral 34. Finished machine reels Rs have been transferred onto storage rails 40 to await further processing.
The guide rolls of the web W which are not used in normal running are denoted by the reference numerals 43A, 43B.

[0028] As shown in FIG. 2B, during a shutdown that occurs in the calendar 10, the web W is conducted from the dryer section 20 via guide rolls 13, 43A, 33 past the calendar 10 to the reel-up 30, on which it is wound into machine reels R₁, R₃, which are transferred to a storage 40 or to another calendar (not shown) to await finishing.

[0029] As shown in FIG. 2C, during a shutdown of the paper machine caused by something other than the finishing device, a machine reel/reels Rₙ contained in an unfinished web, situated in the storage 40, is/are unwound by means of an unwind station 70, and the web W is passed to the calendar 10 by means of guide rolls 43B, 43A, 13 in order to be calendared and then further via the guide roll 33 in order to be wound. Other possible positions of an unwind station 70, 70* are denoted by broken lines in the figure.

[0030] Corresponding parts in Figs. 2A to 2C are denoted by identical reference numerals, and the running direction of the web W is denoted by arrows S. The embodiment example of the invention shown in Figs. 2A to 2C is highly schematic and the finishing devices may, in addition to the calendar 10 shown in the figures, comprise many other types of calendriers and, in addition, different types of coating machines or other finishing devices. In addition to the application shown in the figures, transfer of the web W can also be accomplished above the finishing device/finishing devices or by running the web through the finishing devices with the finishing stations open. Both the unwind and the windup stations can be situated at suitable locations in connection with the finishing devices, above or below or between/after the finishing devices. When desired, the reel-up 30 proper may also serve as an unwind station. The storage may also be located somewhere else instead of the position shown in the figures. The unfinished machine reels Rₙ are moved, when needed, for example, with a hall crane (not shown) or by other suitable means to an unwind station.

1. A method of manufacturing a paper or board web, in which method the web (W) is manufactured in an on-line manufacturing process, in which the web (W) is passed from a paper or board machine (15) directly to a finishing device/finishing devices (60, 50, 10) and the web (W) is wound onto machine reels (R₁, R₃), characterized in that, in the method, the state of the finishing device/finishing devices (60, 50, 10) is monitored and that, during a shutdown of a finishing device (60, 50; 10) due to a disturbance situation or roll replacement, said finishing device is bypassed, the web (W) coming from the paper or board machine (15) is wound onto machine reels (R₁, R₃) or treated by means of some other finishing device/finishing devices and wound onto machine reels (R₁, R₃).

2. A method according to claim 1, characterized in that, in the method, the state of the paper or board machine (15) is monitored and a machine reel/machine reels (R₁, R₃) wound during a shutdown of a finishing device/finishing devices (60, 50, 10) is/are transferred to the storage 40 after a shutdown of the paper or board machine not caused by a finishing device.

3. A method according to claim 1, characterized in that machine reels (R₁, R₃) wound during a shutdown of a finishing device/finishing devices are finished with another other equivalent on-line or off-line finishing device/finishing devices.

4. A method according to any one of claims 1 to 3, characterized in that, in the method, an unfinished web is unwound from a machine reel during a shutdown of the paper or board machine not caused by a finishing device and finished at a speed different from the normal running speed of the machine.

5. A method according to claim 1, characterized in that, in the method, the quality of the web being manufactured is also monitored and, when a web of undesirable quality is detected, the web is wound into machine reels in order to be transferred into pulp towers for processing.

6. A method according to any one of claims 1 to 5, characterized in that, in the method, the web (W) is wound into machine reels (R₁, R₃) by means of a reel-up placed in connection with a finishing device (60, 50; 10).

7. A method according to claim 1 to 6, characterized in that, in the method, the web (W) is wound into machine reels (R₁, R₃) by means of a reel-up (30) placed after a finishing device/finishing devices (60, 50, 10).

8. A method according to any one of claims 1 to 7, characterized in that, in the method, the web (W) is both wound and unwound by means of the same reel-up.

9. A paper or board machine comprising an on-line finishing device/finishing devices (60, 50, 10) and means for winding a web (W) into machine reels (R₁, R₃), characterized in that the paper or board machine (15) comprises means (61, 51, 11) for monitoring the state of the paper or board machine and the finishing device/finishing devices, as well as means (42, 43) for directing the web (W) produced on the paper or board machine (15) during a shutdown of a finishing device due to a disturbance situation or roll replacement to a reel-up (30) in order to be wound into machine reels (R₁, R₃).

10. A paper or board machine according to claim 9, characterized in that the apparatus includes means for unwinding the machine reel (R₁, R₃) and means (13, 33, 43A, 43B) for passing the web (W) so as to be finished during a shutdown of the paper or board machine not caused by a finishing device.

11. A paper or board machine according to claim 9, characterized in that the reel-up is arranged in connection with a finishing device.

12. A paper or board machine according to claim 9, characterized in that the reel-up (30) is placed after a finishing device/finishing devices.

13. A paper or board machine according to claim 9 or 10, characterized in that a reel-up (30) and an unwind station/unwind stations (70, 70*, 70) are placed in connection with the finishing devices (60, 50, 10).

14. A paper or board machine according to any one of claims 9 to 12, characterized in that the reel-up (30) is both a windup and an unwind station.

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