(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 319 787 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.05.2011 Bulletin 2011/19

(51) Int Cl.:
B65H 18/20 *(2006.01)*

(21) Application number: **10188060.7**

(22) Date of filing: **19.10.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **05.11.2009 FI 20096142**

(71) Applicant: **Metso Paper Inc.**
00130 Helsinki (FI)

(72) Inventors:
- **Virtanen, Timo**
  02660, Espoo (FI)
- **Akerlund, Kenneth**
  00890, Helsinki (FI)
- **Haapanen, Jaakko**
  04400, Järvenpää (FI)

(74) Representative: **TBK-Patent**
Bavariaring 4-6
80336 München (DE)

(54) Method and apparatus for controlling the slitting of a web-like material

(57) The invention relates to a method for controlling the slitting of a web-like material on the slitter-winder, in which method, slitting the web into several partial webs which are wound into partial web reels, and monitoring the travel of the web on the slitter-winder with a monitoring device (100) which automatically detects events deviating from the normal winding such that an image is created of a monitoring area (104) being monitored and, triggered by a fault detected in the image, taking measures to eliminate the fault or to minimise its effects. In the method, determining in the monitoring area a fixed point and, simultaneously when an image is created of the monitoring area (104) being monitored substantially continuously, determining the position of the fixed point and, if the position of the fixed point changes more than predetermined, re-determining the position of the monitoring area such that the monitoring area (104) is located in a new place determined by the changed position of the fixed point.

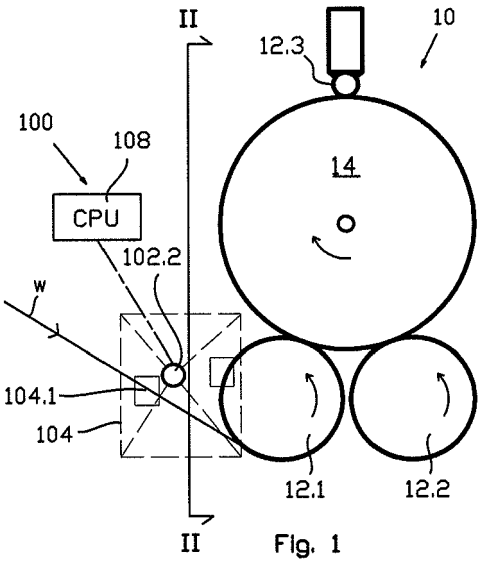

Fig. 1

EP 2 319 787 A2

Description

[0001] The invention relates to a method for controlling the slitting of a web-like material according to the preamble of claim 1.

[0002] The invention relates to an apparatus for controlling the slitting of a web-like material according to the preamble of claim 6.

[0003] A material web coming from a material web machine, such as a paper machine, is wound with a wind-up into large machine reels possibly even having the width of over 10 m and the diameter of over 4 m. The material web is slit into narrower partial webs and wound into smaller so-called customer reels on the slitter-winder. In a fault situation, these partial webs can break before the reel and thread around e.g. a carrier roll supporting the reels from below. It is also possible that the web can thread around e.g. a rider roll of a slitter-winder of the carrier-roll type or fall freely to the basement. Particularly in a slitter-winder of the carrier-roll type, such a break of the web can cause serious damages to the machine or persons tending it. The worst results are a mechanical breakdown of the machine, a fire or off-throwing of reels from the machine, whereby there is a risk of injury or even death of the operators. The off-throwing of reels from the machine is due to the fact that a reel, on which paper no longer accumulates, remains smaller of its diameter than the other reels and the rider roll cannot then support the reel any longer.

[0004] It is naturally advantageous both to detect a fault situation of the slitter-winder operating with high speed and to perform the required corrective measure to eliminate the fault and/or to minimise damages as quickly as possible. For this, e.g. specification WO2005097646A1 describes a method and apparatus for the reeling control of a web. The specification depicts the automatic control of reeling such that the reeling is monitored by a monitoring device which is a line camera and/or a digital camera and/or a video camera and/or a line laser and/or one or more distance-measuring lasers and/or a computer vision apparatus which detect electromagnetic radiation occurring on the visible or invisible wavelength, which monitoring device automatically detects any events deviating from the normal reeling: interferences in the shape of an airbag, extra objects appearing near the reeling nip, such as loose pieces of paper, or a double web edge or a web drifting into a wrong place or piling up of the web or a web split in the machine direction.

[0005] Even though the arrangement described in the above specification is advantageous as such, now there are some requirements for intensifying the operational reliability of the partial web winding section particularly by improving the automatic detection of an event deviating from the normal situation.

[0006] The objects of the invention are mainly provided with the method for controlling the slitting of a web-like material on the slitter-winder, in which method, the web is slit into several partial webs which are wound into partial web reels such that the slitting is monitored in connection with a moving and/or stationary part of the slitter-winder, and the travel of the web on the slitter-winder is monitored with a monitoring device which automatically detects events deviating from the normal winding such that an image is created of a monitoring area being monitored and, triggered by a fault detected in the image, measures are taken to eliminate the fault or to minimise its effects. The invention is mainly characterised by that, in the method, in connection with the moving part of the slitter-winder, determining a fixed point for the monitoring area and, simultaneously as an image is created of the monitoring area substantially continuously, determining the position of the fixed point and, if the position of the fixed point changes more than pre-determined, re-determining the position of the monitoring area such that the monitoring area is located in a new place determined by the changed position of the fixed point and/or, in the method, in connection with the stationary part of the slitter-winder, separating at least one partial area of the image being created of the monitoring area which is monitored with criteria specific to it.

[0007] Then, the operational reliability of the partial web winding section is better than previously, inter alia, due to the quicker detection of a fault.

[0008] According to an embodiment, at least one partial area is separated of the monitoring area in which said fixed point is arranged, and the position of the fixed point being in the partial area is determined such that, if the position changes more than pre-determined, the position of the partial area is re-determined such that the partial area is located in a new place determined by the changed position of the fixed point.

[0009] According to another embodiment, at least two partial areas are separated of the monitoring area for which are determined criteria of faults differing from each other in order to take measurements.

[0010] Advantageously, the fixed point of the monitoring area is arranged during winding depending on the diameter of the partial web reels to the moving part of the partial web winder and, simultaneously as an image is created of the monitoring area substantially continuously to monitor the moving part, the position of the fixed point is determined and, if the position of the fixed point changes more than pre-determined, the position of the monitoring area is re-determined such that the monitoring area is located in a new place determined by the changed position of the fixed point of the moving part.

[0011] Advantageously, said moving part supports partial web reels being wound during winding.

[0012] The objects of the invention are also provided with an apparatus for controlling the slitting of a web-like material, which comprises an unwinder, a slitting section and a winding section, the partial-web winder of which comprises a movable support element, such as a rider roll or a carrier roll, supporting the partial web reels as the winding process proceeds, and a monitoring device

which automatically detects any events deviating from the normal winding such that an image is created of the monitoring area being monitored and, triggered by a fault detected in the image, measures are taken to eliminate the fault or to minimise its effects. The invention is mainly characterised by the support element of the partial web winder comprising a fixed point and by having arranged the monitoring area to observe the fixed point during winding.

[0013] The fixed point advantageously consists of an image part or point determined for the monitoring device.

[0014] According to an advantageous embodiment of the invention, the monitoring device comprises camera devices which are arranged in the cross-direction outside a path w' of partial webs w.

[0015] Other additional properties characteristic of the invention will become evident from the enclosed claims and the following description of the embodiments in the figures.

[0016] The invention and its operation will now be described with reference to the accompanying schematic drawings in which

Fig. 1 schematically shows an embodiment of a partial web winder according to the invention,
Fig. 2 shows a view of the partial web winder of Fig. 1 from direction II-II and
Fig. 3 schematically shows yet another embodiment according to the invention.

[0017] Fig. 1 schematically shows an embodiment of a partial web winder 10 of a fibrous web according to the invention. In more detail, the partial-web winder is here the so-called carrier-roll winder 10, but it is evident that the invention can be applied in connection with partial web winders of other types. Fig. 2 shows a view of the carrier-roll winder of Fig. 1 from direction II-II and, in the following, reference is made to both Fig. 1 and Fig. 2.

[0018] The carrier-roll winder 10 comprises two support elements 12.1, 12.2, i.e. carrier rolls or equivalents, arranged to support web reels 14 being wound from below and at least one loading device 12.3 to support the reels 14 substantially from above. In practice, the loading device is advantageously a roll. Slit partial webs w are arranged to travel onto the first support element 12.1 and to transfer from its surface into partial web reels via a nip formed by the first carrier roll 12.1 and each web reel in a way known as such.

[0019] The partial-web winder is provided with a monitoring device 100 by means of which the ongoing winding process of partial webs w is monitored. The monitoring device 100 comprises camera devices 102.1, 102.2. The camera devices are arranged in the cross-direction outside a path w' of partial webs w and, simultaneously, also at a distance from the plane of the path of the web w. Arranged such, a monitoring area 104 of the camera devices extends at least on the path of the web travelling onto the first carrier roll 12.1 and onto an uncovered surface of the first carrier roll preceding a contact line of the web travelling onto the carrier roll and the carrier roll. The monitoring area 104 comprises partial areas 104.1, 104.2. The first 104.1 and the second partial area 104.2 are under the simultaneous observation of the monitoring device. Furthermore, the monitoring device simultaneously monitors the travel of each partial web onto the first carrier roll 12.1 and the surface of the first carrier roll at the point of each partial web. This is enabled by the above positioning of the camera devices at a distance from the plane of the web and in the cross-direction outside the path w' of the partial webs w.

[0020] The monitoring device 100 is the so-called computer vision apparatus which, by continuously analysing the monitoring area, distinguishes such faults/features which require measures.

[0021] As seen from Fig. 2, the monitoring areas 104 of the camera devices 102.1, 102.2 extend at least partially on top of each other, whereby at least partially even a three-dimensional model can be formed of the area being monitored.

[0022] In the method for winding partial webs, the slit web is brought onto the first carrier roll 12.1 of the partial web winder 10 of the winding section of the slitter-winder and each partial web is controlled from the carrier roll into each partial web reel being formed on the partial web winder 10. During the winding of the partial webs, the camera devices 102.1, 102.2 belonging to the monitoring device 100 of the partial web winder create substantially continuously an image of the bringing of the web onto the first carrier roll 12.1 such that the whole set of partial webs w is simultaneously shot by at least two different camera devices 102.1, 102.2. The shooting is performed such that the monitoring area 104 is formed of both sides of the set of partial webs directed towards the partial web winder extending over the whole set of the partial webs.

[0023] When the camera devices are located on the sides of the set of partial webs (on the tending and driving side of the partial web set path) and when simultaneously the monitoring area 104 is formed of both sides of the set of partial webs directed towards the partial web winder, the monitoring area can be formed suitable such that even two camera devices can arrange the monitoring of the operation of even a wide partial web set and, thus, of the winding section.

[0024] The monitoring device comprises a data processing unit 108 or it is connected to a data processing unit. According to an embodiment of the invention, the created image is continuously monitored. The data processing unit 108 has been taught to detect features in a real-time image which indicate a fault and/or problem situation or the creation of such on the partial web winder. This way is very reliable e.g. against changes occurring in lighting. It is also possible to exclude other disturbing factors, such as paper shred, a foreign object etc., and to separate them from an actual web break better than just e.g. by comparing the current image with an image saved in an earlier situation. The monitoring area 104 is

thus practically analysed in real-time. In a situation in which a feature caused by a fault is detected in the real-time image, the data processing unit gives an instruction and/or a signal based on which measures are taken to eliminate the fault or to minimise its effects.

[0025] An image created according to another embodiment of the invention is continuously monitored such that at least one image of the image created of the monitoring area corresponding to normal operation has been saved in the data processing unit. The system being in use, the data processing unit compares the real-time image with the saved image corresponding to the normal operation. In a situation in which a difference greater than pre-determined caused by a fault is detected between the real-time image and the saved image, the data processing unit gives an instruction and/or a signal based on which measures are taken to eliminate the fault or to minimise its effects.

[0026] According to an embodiment of the invention, at least two partial areas 104.1, 104.2 are separated from the image created from the monitoring area 104. The data processing unit 108 includes their own criteria saved for both separate partial areas, specific of them of such features in the image which indicate a fault and/or a problem situation or the creation of such on the partial web winder. In the data processing unit, at least one image corresponding to normal operation can be saved created from a partial image created of said at least two partial areas 104.1,104.2, i.e. an operation situation. In a situation in which a feature caused by a fault, fulfilling the criteria of one or the other partial area, is detected in the real-time image, the data processing unit gives an instruction and/or a signal based on which measures are taken to eliminate the fault or to minimise its effects. When fault criteria differing from each other have been determined for the partial areas 104.1 and 104.2, creating an image of the monitoring area enables the simultaneous monitoring of the occurrence of several different disturbance factors.

[0027] According to a yet other embodiment, it is possible to have an image corresponding to normal operation saved in the data processing unit for the formed partial areas. The system being in use, the data processing unit compares the real-time image with said saved image. In a situation in which a difference greater than pre-determined is detected between the real-time image and the saved image, the data processing unit gives an instruction and/or a signal based on which measures are taken to eliminate the fault or to minimise its effects.

[0028] In this embodiment, there are several alternative measures. When the data processing unit 108 detects a difference greater than predetermined between the real-time image and the saved image only in the first partial area 104.1, the first measure is taken. When again the data processing unit 108 detects a difference greater than pre-determined between the real-time image and the saved image only in the second partial area 104.2, the second measure is taken. Equivalently when the data processing unit 108 detects a difference greater than predetermined between the real-time image and the saved image both in the first 104.1 and the second partial area 104.2, the third measure is taken. This way, it is possible to react to exceptional situations with one image creation more accurately than earlier.

[0029] For example, when detecting on the path of the web travelling onto the first carrier roll 12.1 (first partial area 104.1) an exceptional situation of the missing of a partial web from the path, and on an uncovered surface of the first carrier roll preceding the contact line of the partial web travelling onto the carrier roll and the carrier roll (second partial area) the situation is normal i.e. no partial web is threaded around the carrier roll, the partial web has broken before the winding section 10 and, thus, the above first measure is the measure to correct this situation.

[0030] Furthermore, when e.g. on the path of the web travelling onto the first carrier roll 12.1 (first partial area 104.1) the situation is normal i.e. the partial webs travel onto the first carrier roll 12.1, but detecting on the surface of the first carrier roll preceding the contact line of the partial web travelling onto the carrier roll and the carrier roll (second partial area) an exceptional situation of the threading of a partial web around the carrier roll, the partial web has broken on the winding section and, thus, the above second measure is the measure to correct this situation.

[0031] Yet as another example can be considered a situation in which e.g. detecting on the path of the web travelling onto the first carrier roll 12.1 (first partial area 104.1) an exceptional situation of the missing of a partial web from the path, and detecting on the surface of the first carrier roll preceding the contact line of the partial web travelling onto the carrier roll and the carrier roll (second partial area) an exceptional situation of the threading of another partial web on the carrier roll, the first partial web has broken before the winding section 10 and the second partial web has broken on the winding section and, thus, the above third measure is the measure to correct this situation. It is evident that the first, second and third measure can be the same measure. Advantageously, this measure is to end the coming of the web from the unwinder by stopping the unwinder and/or by cutting the web being unwound controllably.

[0032] The image can be created in the range of visible wavelength or e.g. in the IR range or both of these.

[0033] Fig. 3 shows an embodiment of the invention in which the monitoring device is arranged by way of an example into connection with the rider roll 12.3. The monitoring area 104 extends on the length of the rider roll over the width of the set of partial webs for detecting a fault situation. A typical fault situation on the rider roll can be e.g. the winding of a broken partial web around the rider roll 12.3. The monitoring area 104 is arranged changing of its position as the winding process proceeds. In the method, a fixed point is chosen in the monitoring area or one is arranged there which distinguishes from

the created image clearly enough in order to determine it as a fixed point 110 to be monitored. In the system of Fig. 3, the beam of the rider roll is advantageously provided with an identification pattern 110 by means of which the rider roll is detected in the image. The image area being monitored is searched by means of co-ordinates attached in this identification pattern 110. Simultaneously when creating an image of the winding event of the partial web winder substantially continuously, the position of the fixed point is determined. If the position changes more than pre-determined, the position of the monitoring area is re-determined such that the monitoring area 104 is located in a new place determined by the changed position of the fixed point. Thus, the monitoring area 104 is made to observe the rider roll 12.3 as the winding proceeds.

[0034] According to an embodiment, a partial area 104.3 of the monitoring area 104 is arranged changing of its position as the winding process proceeds. This is advantageous if the actual monitoring area is particularly large. In the method, a fixed point is chosen in the partial area of the monitoring area which distinguishes from the created image clearly enough in order to determine it as a fixed point 110 to be monitored. In the system of Fig. 3, the beam of the rider roll is advantageously provided with the identification pattern 110 by means of which the rider roll is detected in the image. The partial area being monitored is searched by means of co-ordinates attached in this identification pattern 110. The same monitoring area can also include several partial areas separately changing of their positions. It is evident that the changing of the monitoring area according to the invention can also be arranged into connection with some other moving part of the partial web winder than the rider roll, such as into connection with a movable carrier roll.

[0035] Simultaneously when an image is created of the winding event of the partial web winder substantially continuously, the position of the fixed point in the partial area is determined. If the position changes more than pre-determined, the position of the partial area 104.3 is re-determined such that both the monitoring area 104 and the partial area 104.3 are located in a new place determined by the changed position of the fixed point. Thus, the monitoring area 104 is made to observe the rider roll 12.3 as the winding proceeds.

[0036] Also in this embodiment, the monitoring device 100 comprises the camera devices 102.1, 102.2 which are advantageously arranged in the cross-direction outside the path w' of the partial webs w.

[0037] According to an embodiment of the invention in the method, for repairing an existing slitter-winder, the winding section of the slitter-winder is provided with a monitoring device according to the invention which is connected to the control apparatus of the slitter-winder such that, due to an exceptional situation detected by the monitoring device, it is possible to react to the operation of the slitter-winder without delay.

[0038] By means of the invention, a partial web break can be detected almost in real-time. By means of the invention, it is e.g. possible to distinguish a partial web threaded around the carrier roll or the rider roll from other faults. Such other faults are, inter alia, changes in lighting conditions, web shreds drifting in the image area or e.g. a foreign object falling in the image area.

[0039] The invention can be applied such that the slitting is simultaneously monitored in connection with a moving and/or stationary slitter-winder part of the slitter-winder. Then in the method, in connection with the moving part of the slitter-winder, a fixed point 110 is determined for the monitoring area and, simultaneously when creating an image of the monitoring area 104 substantially continuously, the position of the fixed point 110 is determined and, if the position of the fixed point changes more than pre-determined, the position of the monitoring area is re-determined such that the monitoring area 104 is located in a new place determined by the changed position of the fixed point and/or, in the method, in connection with the stationary part of the slitter-winder, at least one partial area 104.3 of the image being created of the monitoring area 104 is separated which is monitored with criteria specific to it.

[0040] It should be noted that only a few of the most advantageous embodiments of the invention were described above. Thus, it is evident that the invention is not limited to the above embodiments, but it can be applied in many ways within the scope defined by the enclosed claims. It is also possible to use features described in connection with different embodiments within the scope of the basic idea of the invention in connection with other embodiments and/or to combine various units of the described features, if so required and technical possibilities for this existing.

The invention relates to a method for controlling the slitting of a web-like material on the slitter-winder, in which method, slitting the web into several partial webs (w) which are wound into partial web reels (14), and monitoring the travel of the web on the slitter-winder with a monitoring device (100) which automatically detects events deviating from the normal winding such that an image is created of a monitoring area (104) being monitored and, triggered by a fault detected in the image, taking measures to eliminate the fault or to minimise its effects. In the method, determining in the monitoring area a fixed point (110) and, simultaneously when an image is created of the monitoring area (104) being monitored substantially continuously, determining the position of the fixed point (110) and, if the position of the fixed point changes more than pre-determined, re-determining the position of the monitoring area such that the monitoring area (104) is located in a new place determined by the changed position of the fixed point.

Claims

1. A method for controlling the slitting of a web-like ma-

terial on a slitter-winder, in which method, the web is slit into several partial webs (w) which are wound into partial web reels (14) such that the slitting is monitored in connection with a moving and/or stationary part of the slitter-winder, and the travel of the web on the slitter-winder is monitored with a monitoring device (100) which automatically detects events deviating from the normal winding such that an image is created of a monitoring area (104) being monitored and, triggered by a fault detected in the image, measures are taken to eliminate the fault or to minimise its effects, **characterised by**, in the method, determining a fixed point (110) in the monitoring area in connection with the moving slitter-winder part and, simultaneously, when an image of the monitoring area (104) being monitored is created substantially continuously, determining the position of the fixed point (110) and, if the position of the fixed point changes more than predetermined, re-determining the position of the monitoring area such that the monitoring area (104) is located in a new place determined by the changed position of the fixed point and/or, in the method, separating from the image created of the monitoring area (104) in connection with the stationary slitter-winder part at least one partial area (104.3) which is monitored by criteria specific to it.

2. A method according to claim 1, **characterised by** separating from the monitoring area (104) at least one partial area (104.3) in which said fixed point (110) is arranged, and by determining the position of the fixed point in the partial area such that, if the position changes more than pre-determined, re-determining the position of the partial area (104.3) such that the partial area (104.3) is located in a new place determined by the changed position of the fixed point.

3. A method according to claim 1 or 2, **characterised by** separating from the monitoring area (104) at least two partial areas (104.1,104.2) for which are determined criteria of a fault different from each other for taking measures.

4. A method according to any one of preceding claims, **characterised by** arranging the fixed point (110) of the monitoring area during winding depending on the diameter of the partial web reels to the moving part of the partial web winder and, simultaneously as an image is created of the monitoring area (104) substantially continuously to monitor the moving part, determining the position of the fixed point (110) and, if the position of the fixed point changes more than pre-determined, re-determining the position of the monitoring area such that the monitoring area (104) is located in a new place determined by the changed position of the fixed point of the moving part.

5. A method according to claim 4, **characterised by** said moving part supporting partial web reels being wound.

6. An apparatus for controlling the slitting of a web-like material, which comprises an unwinder, a slitting section and a winding section, the partial-web winder of which comprises a movable support element, such as a rider roll or a carrier roll, supporting the partial web reels as the winding process proceeds, and a monitoring device (100) which automatically detects any events deviating from the normal winding such that an image is created of the monitoring area (104) being monitored and, triggered by a fault detected in the image, measures are taken to eliminate the fault or to minimise its effects, **characterised in that** the support element of the partial web winder comprises a fixed point (110) and that the monitoring area (104) is arranged to observe the fixed point during winding.

7. A partial-web winder according to claim 6, **characterised in that** the fixed point (110) consists of an image part or point determined for the monitoring device (100).

8. A partial-web winder according to claim 6 or 7, **characterised in that** the monitoring device (100) comprises camera devices (102.1, 102.2) which are arranged in the cross-direction outside a path w' of partial webs w.

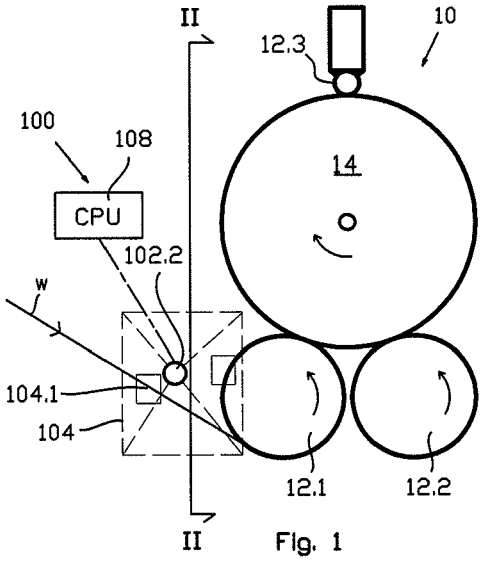
II
10
12.3
100
108
14
CPU
102.2
w
104.1
104
12.1
12.2
II

Fig. 1

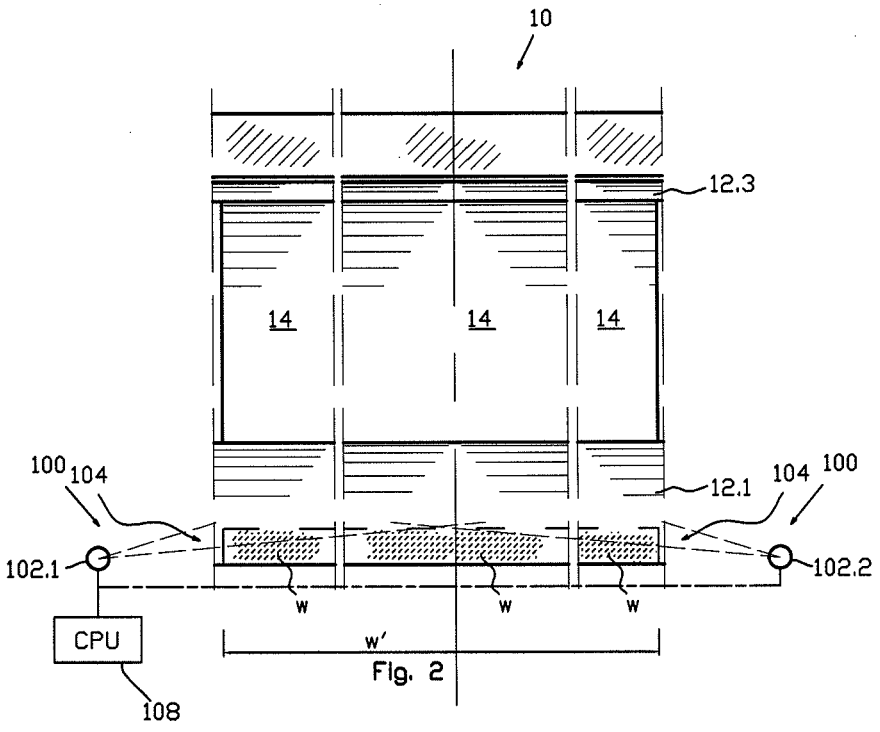
10
12.3
14
14
14
100
104
104
100
12.1
102.1
102.2
w
w
w
CPU
w'
108

Fig. 2

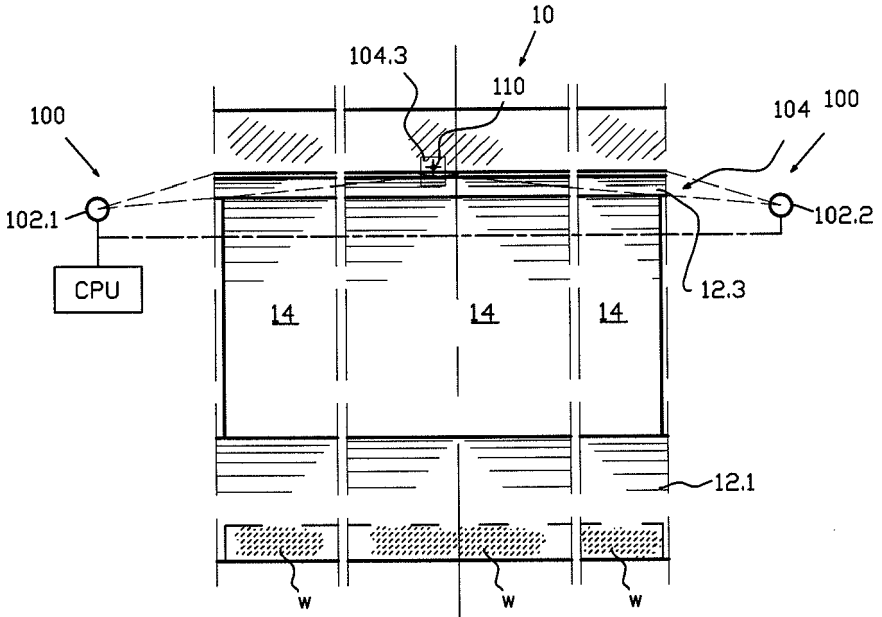

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2005097646 A1 **[0004]**