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(54) **APPARATUS AND METHOD FOR THE ALIGNMENT OF PLANT LEAF MATERIAL**

(57) An apparatus for aligning plant leaf material transversely to a reference direction comprises a conveyor for advancing the material along the reference direction and first and second aligning means, coupled with the conveyor and configured to be movable between respective closed and open configurations. In their respective closed configurations, first and second aligning means intercept the advancing plant leaf material, so that it accumulates upstream. In their respective open con-

figurations, first and second aligning means enable advancement of the accumulated material. The apparatus further comprises control means connected to first and second aligning means and configured to time the switching of the aligning means between open and closed configurations, so that at least part of the plant leaf material that has accumulated upstream of the first aligning means is further intercepted by the second aligning means.

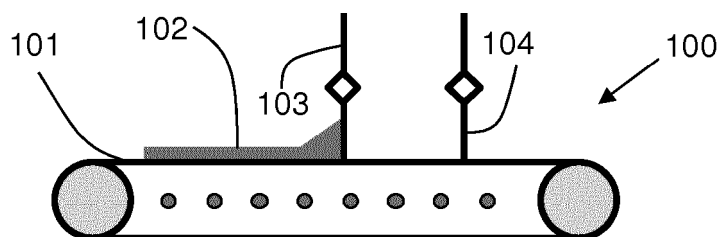


Fig. 1

Description

[0001] The present invention relates to an apparatus and method for the alignment of plant leaf material, especially plant leaf material intended for cutting.

[0002] In particular, the invention finds application for the alignment of elongated plant leaf material, such as tobacco leaves and portions thereof. Tobacco leaves, for example available as tobacco whole leaves or butted loose tobacco leaves, are typically cut into strips of a predetermined width for incorporation into tobacco blends. In particular, tobacco leaves are preferably cut in a way such that the length of the strips is maximised. This has a desirable effect, in that an increased amount of long tobacco fibres is provided in the blend. Long fibres in the blend can then be incorporated into cigarette cut filler and blends for other tobacco products ("OTP"), for example tobacco blends intended for "roll your own" ("RYO") or "make your own" ("MYO") tobacco, pipe tobacco or chewing tobacco. The long fibres make manual assembly of smoking articles easier for the consumer.

[0003] In order to reduce the content of stems or ribs in the blend, it has been proposed that the leaves be aligned before they are cut so that they are arranged substantially perpendicular to the cutting edge of the blade. Thus, the undesirable portions of the leaves such as the stems and ribs can be removed more consistently.

[0004] Methods and apparatuses for aligning plant leaf material are known. However, it would be desirable to improve the efficiency with which the plant leaf material is aligned in preparation for cutting.

[0005] In particular, it would be desirable to provide an improved apparatus and method for the alignment of elongated plant leaf material, particularly tobacco leaf material, that has an increased alignment efficiency. Furthermore, it would be desirable to provide such improved apparatus and method for the alignment of plant leaf material that is simple and inexpensive and requires only minimal additional capital investment on existing equipment.

[0006] According to a first aspect of the present invention, there is provided an apparatus for aligning plant leaf material transversely to a reference direction. The apparatus comprises a conveyor configured to advance the plant leaf material along the reference direction. Further, the apparatus comprises first aligning means, as well as second aligning means arranged downstream of the first aligning means. The first and second aligning means are operatively coupled with the conveyor and are configured to be alternately movable between respective closed and open configurations. In the closed configuration, each aligning means intercepts the advancement of the plant leaf material along the reference direction, so that plant leaf material accumulates upstream of said aligning means. In the open configuration, each aligning means enables advancement of the accumulated plant leaf material along the reference direction. Furthermore, the apparatus comprises control means operatively connected

to the first and second aligning means and configured to time switching of the first and second aligning means between the respective closed and open configurations, so that at least part of the plant leaf material that has accumulated upstream of the first aligning means is further intercepted by the second aligning means and thus accumulates between the first and second aligning means.

[0007] According to a second aspect of the present invention, there is further provided a method of aligning plant leaf material transversely to a reference direction. According to the method, the plant leaf material is advanced on an advancement path extending substantially parallel to the reference direction. First aligning means are operated to move into a respective closed configuration, wherein the first aligning means intercept the advancement of the plant leaf material at a first position along the advancement path, so that an amount of plant leaf material accumulates upstream of the first position. Further, the first aligning means are operated to move into a respective open configuration, wherein they enable advancement of the accumulated plant leaf material along the reference direction past the first position. Second aligning means are operated to move into a respective closed configuration, wherein they intercept the advancement of the plant leaf material at a second position along the advancement path downstream of the first position, so that at least a fraction of the plant leaf material previously accumulated upstream of the first position accumulates between the first and the second position.

[0008] It will be appreciated that any features described with reference to one aspect of the present invention are equally applicable to any other aspect of the invention.

[0009] The term "conveyor" is used throughout the specification to refer to a piece of handling equipment that is configured to move materials from one location to another in an apparatus or within a manufacturing facility. In some embodiments, the term "conveyor" may refer to a belt conveyor, that is a conveyor system comprising two or more pulleys with an endless loop of a carrying medium - the conveyor belt - that rotates about them. The conveyor belt is formed from a web material and defines a plane upon which the material lies while being conveyed.

[0010] By the term "plant leaf material" reference is made throughout this specification to whole leaves or portions of leaves, such as whole leaves that have been cut, shredded, or threshed, or to parts of the leaf structure that have been separated, including butted loose leaves or portions of the lamina that have been separated from the stems and stalk. In more detail, each whole leaf or portion of leaf or part of leaf structure shall have a main longitudinal direction. This may be identified, for example, by a main stem or where the stem is not present, to the lengthwise direction of the portions. In practice, it shall therefore always be possible to identify a main longitudinal direction that the plant leaf material extends along.

[0011] The invention could be advantageously applied to any field where plant leaf material requires more efficient alignment prior to cutting. In some preferred embodiments, the term "plant leaf material" refers to tobacco leaves. These may be in particular the leaves of tobacco varieties such as Virginia, Oriental and Burley tobaccos.

[0012] The expression "aligned transversely to a reference direction" is used throughout this specification to indicate that the plant leaf material is manipulated so that its main longitudinal direction forms an angle at or between 45 and 135 degrees with the reference direction. In preferred embodiments, the plant leaf material is aligned perpendicular to the reference direction.

[0013] The term "alignment efficiency" as used throughout this specification is intended to refer to the fraction of plant leaf material fed to the apparatus that transversely aligns (within the meaning given above) the plant leaf material.

[0014] It shall be understood that, in general, a fraction of the plant leaf material gets to cooperate directly with an aligning means. In other words, a fraction of the plant leaf material is conveyed to lie directly against a surface of the aligning means and is thus brought in substantial alignment with said surface of the aligning means. On the other hand, another fraction of the plant leaf material generally gets to cooperate only indirectly with the aligning means. This means that, in practice, this other fraction of the plant leaf material is conveyed to lie against other plant leaf material that has already accumulated at a downstream location.

[0015] According to the present invention, two aligning means arranged in series along a conveyor are provided for the plant leaf material to cooperate with. The first and second aligning means are moved by the control means between respective closed and open configurations to alternately intercept and enable the advancement of the plant leaf material, so that at least part of plant leaf material fed to the apparatus cooperates with both aligning means.

[0016] Thus, in the apparatus of the present invention, at least some of the plant leaf material that has not been properly aligned after cooperating with the first aligning means, for example because said plant leaf material has cooperated only indirectly with the first aligning means, is properly aligned by cooperating to some degree with the second aligning means. The overall alignment efficiency of the apparatus is, therefore, advantageously increased, as shall be explained in more detail below.

[0017] Because the relative timing and frequency of opening and closing of the first and second aligning means may be selectively adjusted by control means, the apparatus and method of the invention allow for an improved, fine tuning of the alignment operation. By way of example, the amount of plant leaf material having accumulated upstream of the first aligning means and being let through towards the second aligning means with every operative cycle can be adjusted by varying the amount of time during which the first aligning means is kept in

the closed configuration before being moved into the open configuration, as well as the amount of time during which the first aligning means is kept in the open configuration before being moved back into the closed configuration. The fraction of plant leaf material that is effectively put in alignment with a cooperating flat surface of an aligning means rather than allowed to pile more randomly against other leaves previously intercepted by a surface, can thus be generally increased. Similarly, by accurately timing opening and closing of the second aligning means, the fraction of plant leaf material that positively cooperates with both first and second aligning means before leaving the apparatus can be maximised. This contributes to increasing the alignment efficiency with respect to existing apparatuses and methods.

[0018] The thus increased alignment efficiency generally results in the enhanced precision of a cutting operation carried out at a downstream location and a better consumer product produced with this method. In some embodiments, a cutting edge of a blade intended for cutting the plant leaf material may advantageously be arranged substantially parallel to the reference direction.

[0019] It is expected that, because the plant leaf material reaches the blade with a predetermined orientation, cuts shall be more consistently made along a desired direction relative to an axis of the leaves, for example relative to the stem or stalk. In the case of tobacco leaves destined for use in a blend for OTP uses, this desirably reduces the content in relatively big particles of tobacco stems or ribs in the cut tobacco material. Thus, a better blend for OTP uses may advantageously be obtained.

[0020] Preferably, the control means are configured to time switching of the first and second aligning means between the respective closed and open configurations so that substantially all the plant leaf material that has accumulated upstream of the first aligning means is further intercepted by the second aligning means. In other words, the apparatus is preferably configured such that all the plant leaf material fed to the apparatus gets to cooperate with both aligning means before advancing past the position at which the second aligning means are located. This contributes to further increasing the alignment efficiency with respect to existing apparatuses and methods.

[0021] In some embodiments, the first and second aligning means comprise respective flaps rotatable about axes extending transversely to the reference direction. By "transversely" to the reference direction it is meant that the axis of a rotatable flap of an aligning means forms an acute angle with the reference direction. Preferably, the axis of a rotatable flap of an aligning means forms an angle from about 45° to about 90° with the reference direction. More preferably, the axes of the flaps extend substantially perpendicular to the reference direction.

[0022] Each flap has a substantially flat cooperating surface. Upon rotation of the flap about its axis, the flat surface is movable between a first position, which corresponds to the closed configuration of the aligning means,

and a second position, which corresponds to the open configuration of the aligning means.

[0023] In the first position, the cooperating surface of the flap intercepts the incoming flow of plant leaf material. Thus, the conveyor transports the plant leaf material to lie against the cooperating surface of the flap. Preferably, in the first position, the cooperating surface is held perpendicular to the surface of the conveyor.

[0024] In the second position, the cooperating surface is raised from the surface of the conveyor such that the plant leaf material can travel further on. Preferably, in the second position, the cooperating surface of the flap is held substantially parallel to the surface of the conveyor.

[0025] The distance between the first and the second aligning means as measured along the reference direction may vary depending on several parameters, such as the length and speed of the conveyor belt, the size of the flaps, the average size of the leaves to be aligned, the flow rate of plant leaf material fed to the apparatus, and so forth. In a preferred embodiment, the second aligning means is arranged at least 380 mm downstream of the first aligning means. Thus, sufficient room is made available on the conveyor belt for tobacco leaves to accumulate between the first and second aligning means and, therefore, for a significant amount of tobacco leaves to undergo two alignment steps for every operative cycle of the apparatus, as shall be described in more detail below.

[0026] The control means should be configured so as to ensure that when the first aligning means are brought from the closed to the open configuration, the second aligning means are closed. Further, the control means should be configured so as to ensure that only after the first aligning means have been brought from the open to the closed configuration, the second aligning means may be brought from the closed to the open configuration, in order for the plant leaf material to be released.

[0027] In other words, the control means are configured to only bring the first aligning means from the closed to the open configuration after bringing the second aligning means from the open configuration to the closed configuration. Preferably, the control means are configured to bring the first aligning means from the closed configuration to the open configuration immediately after bringing the second aligning means from the open configuration to the closed configuration.

[0028] Further, the control means are configured to only bring the second aligning means from the closed to the open configuration at after bringing the first aligning means from the open configuration to the closed configuration. Preferably, the control means are configured to bring the second aligning means from the closed to the open configuration immediately after bringing the first aligning means from the open configuration to the closed configuration.

[0029] Preferably, the control means are configured to maintain the first aligning means in the closed configuration for a time such that the plant leaf material being

conveyed towards the first aligning means accumulates to a height less than an intercepting height of the first aligning means. By the term "intercepting height", reference is made to the maximum height of a layer of accumulated plant leaf material that can freely travel past the first aligning means when they are brought from the closed configuration in the open configuration. By way of example, in the case where the first aligning means comprise a flap rotatable about an axis, the intercepting height shall be substantially defined by the height of the axis relative to a plane defined by the conveyor, preferably reduced by a quantity corresponding to the thickness of the flap.

[0030] In some embodiments, the control means may be mechanical. For example, the control means may comprise a timing belt, or a cam system. The control means may be operatively coupled with the conveyor and the first and second aligning means, such that, depending on the speed of the conveyor, they will alternately open and close the aligning means.

[0031] In other embodiments, the control means may be electronic. For example, the control means may operate based on the detection of plant leaf material accumulated on the conveyor at a given distance upstream of an aligning means. This condition may for example be taken as indicative that a sufficient amount of leaves has accumulated or partly aligned or properly aligned upstream of an aligning means, and therefore must be advanced further. Alternatively, the control means may operate based on the detection of a force greater than a threshold value being exerted on an aligning means by the leaves accumulated against it.

[0032] Accordingly, the apparatus may further comprise sensing means configured to detect the presence of plant leaf material on the conveyor, for example to detect plant leaf material accumulated at a given distance upstream of an aligning means. These sensing means may be optical sensors, weight sensors, or both.

[0033] In some preferred embodiments, the apparatus comprises first and second sensing means to detect the presence of plant leaf material at a given distance upstream of the first and second aligning means, respectively.

[0034] In particular, in some preferred embodiments, the apparatus may comprise first sensing means operatively coupled with the first aligning means. Thus, the presence of plant leaf material over a predetermined distance upstream of the position at which the first aligning means are located can be detected. In addition, or as an alternative, the apparatus may comprise second sensing means operatively coupled with the second aligning means. Thus, the apparatus detects the presence of plant leaf material over a predetermined distance between the positions at which the first and the second aligning means are located, respectively.

[0035] In some embodiments, sensor means may also be provided in combination with mechanical control means. In this case, operation of the mechanical control

means is substantially independent of the sensor means, unless the latter detect, for example, an anomalous condition which may lead to an undesirable jamming of the apparatus. In that case, operation of the apparatus may be configured to be interrupted in order to prevent undesirable consequences.

[0036] On the other hand, in electronically controlled embodiments, the control means may comprise a control unit, connected with the sensing means and programmed to time the switching of the first and second aligning means between the respective closed and open configurations in response to signals from the sensing means, for example from the first and second sensing means in combination as in the preferred embodiment described above.

[0037] In those embodiments where the apparatus comprises first and second sensing means, the control unit is preferably operatively connected with the first and second sensing means and programmed to time switching of the first and second aligning means between the respective closed and open configurations in response to signals from the first and second sensing means.

[0038] In methods according to the present invention, at least a portion of the incoming plant leaf material is made to cooperate with first and second aligning means arranged in series along a conveyor. The first and second aligning means are operated to move alternately between respective closed and open configurations so that the advancement of the plant leaf material is alternately intercepted and enabled. Preferably, in a method according to the invention, the plant leaf material is aligned perpendicularly to the reference direction.

[0039] Preferably, the step of operating the first aligning means to move into the respective open configuration is carried out only after carrying out the step of operating the second aligning means to move into the respective closed configuration. More preferably, the step of operating the first aligning means to move into the respective open configuration is carried out immediately after the step of operating the second aligning means to move into the respective closed configuration.

[0040] Preferably, the step of operating the second aligning means to move into the respective open configuration is carried out only after carrying out the step of operating the first aligning means to move into the respective closed configuration. More preferably, the step of operating the second aligning means to move into the respective open configuration is carried out immediately after the step of operating the first aligning means to move into the respective closed configuration.

[0041] In some embodiments, the method further comprises comprising detecting the presence of plant leaf material at a predetermined distance upstream of the first position or between the first and the second position or both. As an alternative, the method may further comprise detecting the presence of plant leaf material over a predetermined length of conveyor surface upstream of the first position or between the first and the second position

or both.

[0042] The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Figures 1 to 4 are schematic side views of an apparatus for aligning plant leaf material transversely to a reference direction according to an embodiment the present invention seen in four consecutive moments;

Figure 5 is a diagrammatic representation of operation of the apparatus of Figure 1.

[0043] Figures 1 to 4 are schematic views of an apparatus 100 for aligning plant leaf material transversely to a reference direction according to an embodiment the present invention as seen in four consecutive moments. The apparatus 100 comprises a conveyor 101 configured to advance the plant leaf material 102 along the reference direction A identified by the arrow in the Figures. Further, the apparatus 100 comprises first aligning means 103, operatively coupled with the conveyor 101 and configured to be alternately movable between a respective closed configuration (see Figures 1, 3 and 4) and an open configuration (see Figure). In the closed configuration, the first aligning means 103 intercept the advancement of the plant leaf material 102 along the reference direction A, so that plant leaf material accumulates upstream of the first aligning means 103. In the open configuration, the first aligning means 103 enable advancement of the accumulated plant leaf material 102 along the reference direction. Furthermore, the apparatus 100 comprises second aligning means 104, operatively coupled with the conveyor 101, arranged downstream of the first conveyor means 103 and configured to be alternately movable between a respective closed configuration (see Figures 1, 2 and 3) and an open configuration (see Figure 4). In the closed configuration, the second aligning means 104 intercept the advancement of the plant leaf material 102 along the reference direction, so that plant leaf material 102 accumulates between the first and second aligning means. In the open configuration, the second aligning means 104 enable advancement of the accumulated plant leaf material along the reference direction. Further, the apparatus comprises control means (not illustrated) operatively connected to the first and second aligning means 103, 104 and configured to time the switching of the first and second aligning means 103, 104 between the respective closed and open configurations, so that the plant leaf material that has accumulated upstream of the first aligning means 103 is further intercepted by the second aligning means 104. Figure 4 further shows a second conveyor, arranged downstream of the second aligning means 104, to which the plant leaf material 102 having advanced past the second aligning means 104 is transferred, for example to be conveyed further on to an operating station, for example a cutting station.

[0044] In more detail, the first and second aligning

means 103, 104 comprise respective flaps rotatable about axes extending substantially perpendicular to the reference direction. Each flap has a substantially flat cooperating surface. Upon rotation of the flap about its axis, the flat surface is movable between a first position, wherein the cooperating surface is held substantially perpendicular to the surface of the conveyor, so that the flap intercepts the incoming flow of plant leaf material, and a second position, wherein the cooperating surface is held substantially parallel to the surface of the conveyor, so that the plant leaf material can travel further on along the reference direction.

[0045] The distance between the first and the second aligning means 103, 104 as measured along the reference direction is about 380 mm.

[0046] Figure 5 shows how the control means of the apparatus 100 of Figures 1 to 4 time the switching of aligning means 103, 104 between the respective open and closed configurations. The top configuration-vs.-time plot 501 refers to the first aligning means 103, whereas the bottom configuration-vs.-time plot 502 refers to the second aligning means 104. The control means are configured to ensure that when the first aligning means 103 are brought from the closed to the open configuration (see plot 501 in Figure 5), the second aligning means 104 are closed (see plot 502 in Figure 5). Further, the control means are configured to ensure that only after the first aligning means 103 have been brought from the open to the closed configuration (see plot 501 in Figure 5), the second aligning means 104 may be brought from the closed to the open configuration (see plot 502 in Figure 5), in order for the plant leaf material to be released. In more detail, the control means of the apparatus 100 are configured to bring the first aligning means 103 from the closed configuration to the open configuration immediately after bringing the second aligning means 104 from the open configuration to the closed configuration.

Claims

1. An apparatus for aligning plant leaf material transversely to a reference direction, the apparatus comprising:

a conveyor configured to advance the plant leaf material along the reference direction;
 first aligning means;
 second aligning means arranged downstream of the first aligning means;
 the first and second aligning means being operatively coupled with the conveyor and configured to be alternately movable between respective closed and open configurations, such that:

in the closed configuration, each aligning means intercepts the advancement of the plant leaf material along the reference di-

rection, so that plant leaf material accumulates upstream of said aligning means; and in the open configuration, each aligning means enables advancement of the accumulated plant leaf material along the reference direction;

the apparatus further comprising control means operatively connected to the first and second aligning means and configured to time switching of the first and second aligning means between the respective closed and open configurations, so that at least part of the plant leaf material that has accumulated upstream of the first aligning means is further intercepted by the second aligning means and thus accumulates between the first and second aligning means.

2. An apparatus according to claim 1, wherein the control means are configured to time switching of the first and second aligning means between the respective closed and open configurations, so that substantially all the plant leaf material that has accumulated upstream of the first aligning means is further intercepted by the second aligning means.
3. An apparatus according to claim 1, wherein the first and second aligning means comprise respective flaps rotatable about axes extending transversely to the reference direction.
4. An apparatus according to claim 3, wherein the axes extend perpendicular to the reference direction.
5. An apparatus according to any of the preceding claims, wherein the second aligning means is arranged at least 380 mm downstream of the first aligning means.
6. An apparatus according to any of the preceding claims, wherein the control means are configured to only switch the first aligning means from the closed to the open configuration after switching the second aligning means from the open configuration to the closed configuration.
7. An apparatus according to claim 6, wherein the control means are configured to switch the first aligning means from the closed to the open configuration immediately after switching the second aligning means from the open configuration to the closed configuration.
8. An apparatus according to any of the preceding claims, wherein the control means comprise mechanical timing means operatively coupled with the conveyor and the first and second aligning means.

9. An apparatus according to any of the preceding claims, wherein the apparatus comprises first and second sensing means to detect the presence of plant leaf material at a given distance upstream of the first and second aligning means, respectively. 5
10. An apparatus according to claim 9, wherein the control means comprise a control unit operatively connected with the first and second sensing means and programmed to time switching of the first and second aligning means between the respective closed and open configurations in response to signals from the first and second sensing means. 10
11. A method of aligning plant leaf material transversely to a reference direction, the method comprising: 15
- advancing the plant leaf material on an advancement path extending substantially parallel to the reference direction; 20
- operating first aligning means to move into a respective closed configuration, wherein they intercept the advancement of the plant leaf material at a first position along the advancement path, so that an amount of plant leaf material accumulates upstream of the first position; 25
- operating the first aligning means to move into a respective open configuration, wherein they enable advancement of the accumulated plant leaf material along the reference direction past the first position; 30
- operating second aligning means to move into a respective closed configuration, wherein they intercept the advancement of the plant leaf material at a second position along the advancement path downstream of the first position, so that an amount of plant leaf material previously accumulated upstream of the first position accumulates between the first and the second position. 40
12. A method according to claim 11, further comprising:
- operating the second aligning means to move into a respective open configuration, wherein they enable advancement of the accumulated plant leaf material along the reference direction past the second position. 45
13. A method according to claim 11 or 12, wherein the step of operating the first aligning means to move into the respective open configuration is carried out only after carrying out the step of operating the second aligning means to move into the respective closed configuration. 50 55
14. A method according to any one of claims 11 to 13, wherein the step of operating the first aligning means to move into the respective open configuration is carried out immediately after the step of operating the second aligning means to move into the respective closed configuration.
15. A method according to any of claims 11 to 14, further comprising detecting the presence of plant leaf material over a predetermined distance upstream of the first position or between the first and the second position or both.

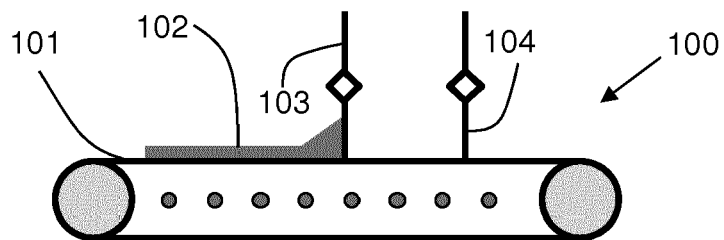


Fig. 1

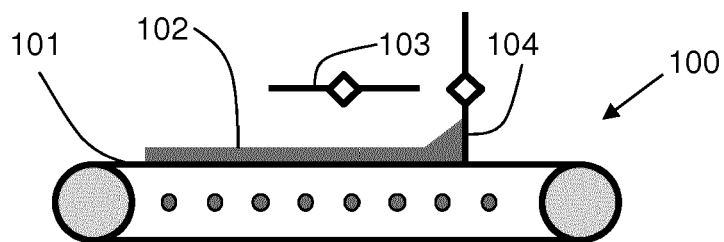


Fig. 2

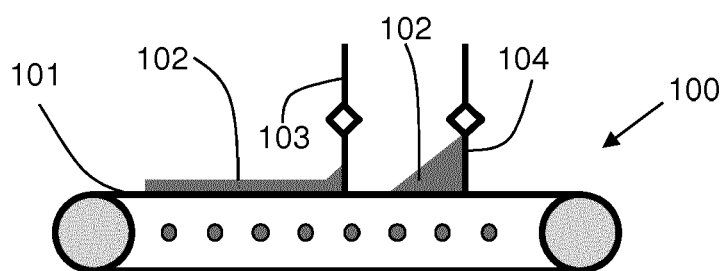


Fig. 3

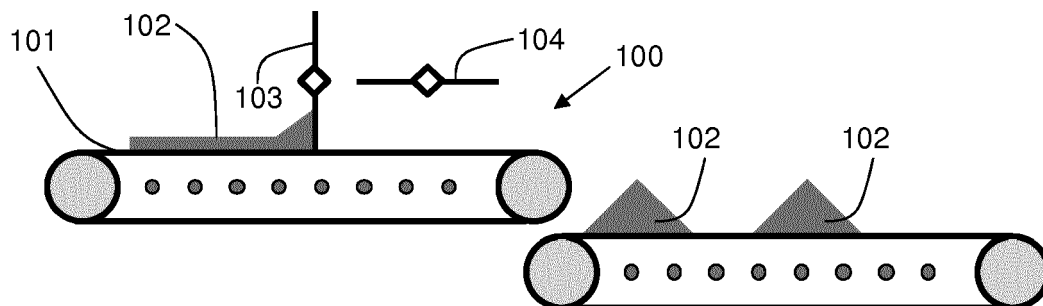


Fig. 4

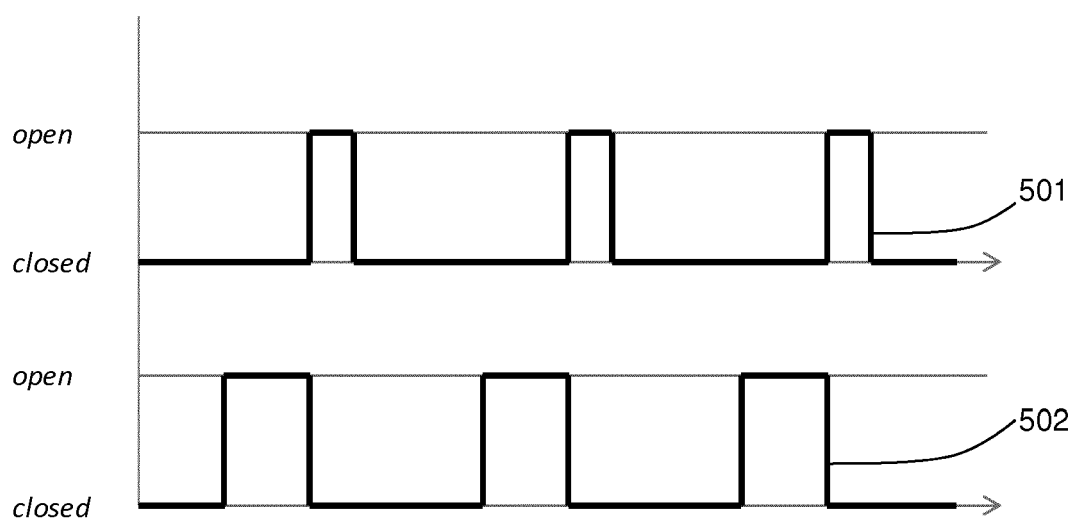


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 14 16 3887

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 October 2014	Examiner Kock, Søren
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 14 16 3887

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