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(54) **ADHESIVE APPLICATION SYSTEM AND METHOD**

(57) The present invention provides an adhesive application system which includes an adhesive station (100) having an application head (101) with an application nozzle (102) and an application head controller (110). The application nozzle applies the adhesive on a product when the application head is in an open position. The application head controller generates a close command to move the application head into a closed position, and an open command to move the application head into the open position to apply the adhesive on the product on adhesive tracks (1,2,3) based on a predefined adhesive saving amount. The application head controller has a pattern definition unit (111) which positions each of the adhesive applications along a respective adhesive track, and positions each of the adhesive tracks which are adjacent to each other at a distance and parallel with respect to each other. Each of the length of the adhesive applications and the distance between adjacent adhesive tracks is based on the predefined adhesive saving amount. The present invention also provides a method of applying an adhesive to a product, and an application head controller.

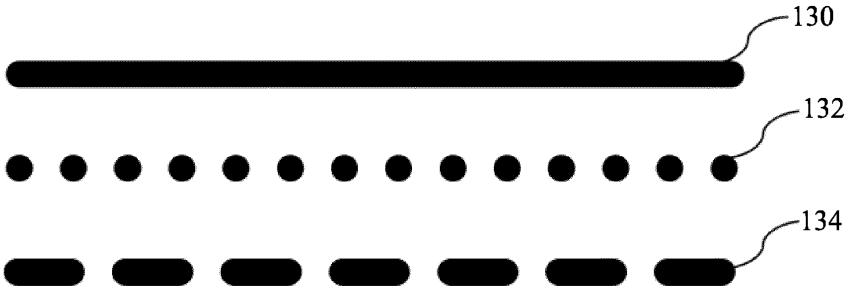

Fig. 1

(PRIOR ART)

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Description

[0001] The present invention relates to an adhesive application system for providing an adhesive to a product, to a method of applying an adhesive to a product, and to an application head controller.

[0002] Automated adhesive application systems are used in modern packaging manufacturing machines to achieve the repeated application of adhesives to different substrates. These automated adhesive application systems are used to apply adhesive to a substrate, which is in turn used to connect together layers in order to ultimately form a package, for example, a box.

[0003] Some corrugated cardboard packaging (boxes) are produced on flexo folder gluer, which is also referred to as "inliner". When a corrugated cardboard blank is transported through a gluing station, one or more continuous adhesive traces or rows of dots of short adhesive traces with gaps in between are applied to the adhesive flaps or other areas of the corrugated cardboard blank. In the gluing station, the corrugated cardboard blank is introduced into a gap between two product guide rails so that an aligned product is glued after product detection and, if necessary, the adhesive application is monitored via a sensor or camera.

[0004] Flexo folder gluer or inliner produce a folding box in one operation. This type of machine is a compact machine comprising a series of several individual machines. These can include the following individual machines: a feed station, a printing unit(s), a creasing and slitting machine(s), a rotating punch(es), a folding station(s) with a gluing station(s), a counting and stacking station(s), and an ejecting and stacking station(s). All processing steps thereby follow one after the other in one line. The cut corrugated cardboard formats are printed, grooved, slit to the desired box format and punched in one operation.

[0005] The folding boxes made in Flexo-Folder-Gluer or inliner usually consist of one piece with a factory edge ("manufactures joint") as well as top and bottom flaps. They are sent folded flat, are ready for use, and are closed with the flaps.

[0006] Adhesive stations have previously been described which are configured so that the adhesive is applied to the substrate either from above (top-down) or from below (bottom-up). The adhesive application head is thereby converted from an upper installation position to a lower installation position and vice versa. The adhesive application station can also comprise two adhesive application heads which are arranged above and below the substrate. The upper and/or the lower adhesive application head is then controlled via a pattern control.

[0007] The adhesive is applied without contact, i.e., the adhesive that emerges from an application nozzle of one or more adhesive application valves after the adhesive application valve has been actuated is applied to the substrate via an air gap between the nozzle opening and the substrate. Contactless adhesive systems offer considerable advantages over adhesive application nozzles which must touch the surface of the cardboard box or the corresponding substrate (so called contact application systems). For example, with contact application systems, the adhesive can be smeared via contact with the application nozzle and carried over into areas of the corrugated cardboard blank that is not intended for the adhesive application. This leads to boxes being joined together by adhesive in undesired places. The boxes can as a result no longer be properly constructed.

[0008] Folded boxes are also produced in folder gluing machines. Folding box gluing machines for the production of folding boxes from folding box blanks have at least the following modules as processing stations: an insert that pulls the blanks to be processed from a stack one after the other and feeds them individually to the subsequent first processing station, at least one adhesive application device that applies an adhesive strip or adhesive dots to the folding flaps to be glued or other areas of the folding box, and a folding station in which the cut parts provided with the adhesive are turned over by 180° to produce an adhesive connection, i.e., folds and joins them. A so-called transfer station is usually arranged following the folding station, in which the boxes can be counted, and discharged. This is followed by a collecting and pressing station, at the beginning of which an inhibited flow of folded blanks is formed, which is maintained under pressure in the pressing station so that the two cut parts are maintained under pressure until the adhesive has the ability to coagulate and permanently join the adhesive seam.

[0009] The variety of formats of the different embodiments of folding boxes is very large, so that folding box machines mostly use individual adhesive application valves or adhesive application heads with several application nozzles, which are connected to a holder and which can thus be freely positioned in the machine.

[0010] The folding box blank can be provided at a distance from the nozzle opening of the application nozzle by machine elements of the folding box gluing machine, such as conveyor belts, sliding surfaces or a skid. The important property is here the noncontact application of adhesive to the substrate via an air gap, for example, in the form of a folding box blank. In addition to the adhesive application head, which can comprise one or more application nozzles, the adhesive application device can comprise further components which are arranged one behind the other in a conveying direction. The adhesive application head is followed by a monitoring device, which checks the property profile of the adhesive application, and, if necessary, determines characteristic values that serve as the basis of a target/actual comparison, while taking tolerance limits into account, the evaluation being able to take place in the monitoring device itself. The monitoring device then only transmits "good" or "bad" data to a higher-level controller or the evaluation takes place in a higher-level controller itself, the monitoring device transmitting characteristic values, images or other

suitable features of the adhesive application to this higher-level controller.

[0011] The control of the adhesive application valves is calculated in a pattern control. This is typically performed taking into account the speed of the substrate, the position of the substrate, which is detected, for example, with a light barrier or a light sensor that detects a leading edge of the substrate and delay times, and the delay time of the adhesive application valve, i.e., the period of time between activation of the valve and the impact of the adhesive on the substrate passes. The pattern control can be a central part of an adhesive application system or a decentralized control assigned to an individual adhesive application valve. The operator in this case typically only enters the parameters in the central control, which are then processed in a decentralized, often modular valve control.

[0012] In the manufacture of the packaging, it is known to apply adhesive in the form of a continuous bead of adhesive. The adhesive application valve is thereby activated by the valve control during the entire path thereof. The control is based on an adhesive pattern stored in the control, which defines, for example, the location of the adhesive bead and its length.

[0013] Instead of applying a continuous bead of adhesive, the application of a sequence of points (also called "dotting") has also previously been described. In the transition from a low production speed to a higher production speed, small lines sometimes appear in dots because the opening time of the adhesive application valve is no longer sufficient to create individual dots.

[0014] Despite this industry preference, methods for calculating intermittent adhesive patterns for saving adhesive depending on the percentage of adhesive which should be saved have previously been investigated and described.

[0015] EP 2 638 978 B1, for example, describes a method of controlling fluid discharge from an applicator head for a fluid. The method includes the application of intermittent, short-pulsed segments in order to provide an adequate adhesive effect while using a reduced amount of fluid or adhesive. The method thereby also includes the steps of supplying a primary discharge signal for controlling the applicator head, and transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected and supplying the secondary discharge signal to the applicator head. The secondary discharge signal of EP 2 638 978 B1 has a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, for example, as a percentual part. The amount of fluid to be saved, for example, 50 %, is thereby provided as predefined parameter. The subdivision of the primary discharge signal into the portions of the secondary discharge signal is then calculated on the basis of these parameters.

[0016] It is an object of the invention to provide an adhesive application system and a method which dispenses an adhesive to a substrate product to thereby join layers to one another which maintains mechanical strength while simultaneously reducing the used adhesive amount.

[0017] This object is achieved by the features of the independent claims. Further implementation forms are apparent from the dependent claims, the description and the figures.

[0018] According to a first aspect of the present invention, the object is solved by an adhesive application system comprising an application head which comprises at least one application nozzle and an application head controller. The application nozzle can be coupled with a traversing unit. The application head is configured to operate in a closed position where an adhesive is not transported to the at least one application nozzle, and in an open position where the adhesive is transported to the at least one application nozzle. The at least one application nozzle is configured to apply the adhesive on a product when the application head is in the open position. The application head controller is configured to generate a close command so as to move the application head into the closed position, and to generate an open command so as to move the application head into the open position so as to thereby apply the adhesive on the product on each of at least two adhesive tracks based on a predefined adhesive saving amount. Each of the at least two adhesive tracks comprise adhesive dashes. Each of the adhesive dashes are separated from each other by a gap having no adhesive. The term adhesive dashes refers to glue beads or glue lines. The adhesive dashes and the gaps together form an interrupted adhesive pattern. Each of the adhesive dashes have a dash length which is in at least one section of said at least two adhesive tracks the same. Each dash length has a start point and an end point, and each of the gaps have a gap length which is the same. The application head controller comprises a pattern definition unit which is configured to position the at least two adhesive tracks adjacent to each other and at a distance and parallel with respect to each other. The start point of each of the adhesive dashes of a first adhesive track of the at least two adhesive tracks is positioned at a linear shift with respect to the start point of each of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto. Each of the dash length and the gap length is based on the predefined adhesive saving amount.

[0019] In an embodiment of the present invention, each of the adhesive dashes further has a length with a length midpoint which is arranged between the start point and the end point of each adhesive dash. The start point and/or the end point of each of the adhesive dashes of the first adhesive track is thereby positioned substantially at the length midpoint of a respective one of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, so that the start point, the end point, and the length midpoint can be connected to form a triangle where at least two sides have an equal

length. In an alternative embodiment of the present invention, all three sides of the triangle can, for example, have an equal length.

[0020] The term "substantially at the length midpoint" as used herein means that a respective adhesive dash is for the most part equidistantly positioned. A person skilled in the art will know that as the speed at which the method of applying an adhesive to a product increases, that the adhesive will not be applied in a purely, for example, rectangular shape, but that the adhesive will potentially have an uneven shape, for example, with an "arrow" shape in the front end, and with a "tailing" at the rear end, whereby "front" is here understood to be the area where the adhesive is applied first, while "rear" is the area where the adhesive is applied last. Such an uneven application is in particular visible using, for example, UV light. An adhesive application differential of +/- 5-20 %, for example, 10-15 %, for example, 5 %, 6 %, 7 %, 8 %, 9, %, 10, %, 11, %, 12, %, 13 %, 14 %, 15%, 16 %, 17 %, 18 %, 19 % or 20 % in any direction is here therefore considered to still be "substantially at the length midpoint" within the context of the present invention.

[0021] In an embodiment of the present invention, the length of each adhesive dash can, for example, be from 5 to 25 mm, for example, from 10 to 20 mm, for example, from 12-18 mm, for example, from 14- 16 mm, for example, approximately 15 mm, for example, exactly 15 mm. The length of each adhesive dash can, for example, be, exactly 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, 11 mm, 12 mm, 13 mm, 14 mm, 15 mm, 16 mm, 17 mm, 18 mm, 19 mm, 20 mm, 21 mm, 22 mm, 23 mm, 24 mm or 25 mm.

[0022] In an embodiment of the present invention, the length of each gap can, for example, be from 5 to 25 mm, for example, from 10 to 20 mm, for example, from 12-18 mm, for example, from 14- 16 mm, for example, approximately 15 mm, for example, exactly 15 mm. The length of each gap can, for example, be, exactly 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, 11 mm, 12 mm, 13 mm, 14 mm, 15 mm, 16 mm, 17 mm, 18 mm, 19 mm, 20 mm, 21 mm, 22 mm, 23 mm, 24 mm or 25 mm. The length of each adhesive dash can, for example, be substantially equal to or exactly equal to the length of each gap.

[0023] In an embodiment of the present invention, a number of the at least one application nozzle equals a number of the at least two adhesive tracks. The adhesive application system can, for example, be provided to have exactly three application nozzles as the at least one application nozzle, and exactly three adhesive tracks are provided as the at least two adhesive tracks. The adhesive application system can, of course, have any number of application nozzles and adhesive tracks, for example, 2, 3, 4, 5, 6, 7, 8, 9, 10 or more than 10.

[0024] In an embodiment of the present invention, the linear shift of the adhesive application system is between 20 and 80 %, for example, between 25 and 75 %, for example, between 30 and 70 %, for example, between 35 and 65 %, for example, between 40 and 60 %, for example, between 45 and 55 %, for example, substantially 50 %. The Linear shift can, for example, be substantially 30 % or substantially 33 %. The Linear shift can, for example, be exactly 30 % or exactly 33 %.

[0025] The adhesive application system may, for example, be configured so that each of at least two adhesive tracks further comprise at least one of a beginning adhesive application which is arranged at a beginning of each of the at least two adhesive tracks, and an ending adhesive application which is arranged at an end of each of the at least two adhesive tracks.

[0026] In an embodiment of the present invention, the length X of an adhesive dash can be determined based on a distance D between two adjacent adhesive tracks so that all three sides of the triangle can, for example, have an equal length.

[0027] This can even be achieved in application systems in which a distance between two adjacent adhesive tracks is determined by the distance between the adjacent applying nozzles. The distance between two adjacent adhesive tracks is D. In order to apply force optimized glue patterns, the length X of the adhesive dash can be determined depending on the distance D between two adjacent adhesive tracks in order to calculate equilateral triangles. Assuming that D is the height of the equilateral triangle, the length X of the adhesive dash can be determined using the following Equation I:

$$X = \frac{2*D}{\sqrt{3}}$$

[0028] In an embodiment of the present invention, the predefined adhesive saving amount can, for example, be manually provided to the application head controller via a computer or via another external apparatus, such as a cell phone or a tablet, which is/are directly or indirectly connect to the application head controller via Wi-Fi, Bluetooth etc., and/or independently calculated, in each case, based on Equation I. The predefined adhesive saving amount can alternatively be pre-calculated based on Equation I and set forth in a database which can then be referenced and inputted into the application head controller.

[0029] The application of Equation I for the predefined adhesive saving amount results in rows of interrupted adhesive patterns where adhesive dashes or dots are applied instead of a solid line. This has a number of advantages. An important advantage is the saving of adhesive, i.e., 70 % of adhesive can always be saved. The current market situation is characterized by the sharp rise in raw materials and thus adhesive prices, so that the issue of cost savings is increasingly important. The sharply increasing need for adhesives due to the conversion of plastic packaging into paper-based packaging, the strong e-commerce boom combined with declining production capacities has led to a lack of adhesives. Increases in costs and the lack of availability of adhesives

has therefore driven a renewed interest in dotting and/or stitching.

[0030] The application of Equation I for the predefined adhesive saving amount also provides benefits in terms of sustainability. This is because a majority of adhesives are based on petrochemical principles. Finite fossil resources are thereby conserved due to reduced consumption. However, a lower consumption also has positive effects even if adhesives based on a renewable biomass are used. This is because land use is reduced by lower cultivation requirements. Food competition is reduced when a food, such as starch, is used as an adhesive base. The individual adhesive points also generate fewer CO_2 emissions and thus protect the environment.

[0031] In an embodiment of the present invention, the predefined adhesive saving amount can, for example, be manually provided to the application head controller via a computer or via another external apparatus, such as a cell phone or a tablet, which is/are directly or indirectly connect to the application head controller via Wi-Fi, Bluetooth etc. The predefined adhesive saving amount can additionally or alternatively, for example, be independently calculated based on an algorithm which calculates an optimum of adhesive force based on data which includes at least one of an adhesive savings, an adhesive strength of the adhesive on the product, and a current speed of production of the product. The algorithm can, for example, be or include Equation I. The algorithm can alternatively, for example, be based on a spread sheet, a graph etc. In an embodiment of the present invention, the adhesive application system can further include a classifier which independently calculates the predefined adhesive saving amount by analyzing, for example, via a trained learning algorithm, a property profile and the algorithm. The algorithm can thereby include factors such as the intended adhesive savings, the adhesive strength of the adhesive on the product, the current speed of production of the product and/or Equation I.

[0032] The trained learning algorithm of the classifier can, for example, be an artificial neural network trained by a backpropagation method or a pre-trained convolutional neural network. It is generally known that machine learning is able to recognize patterns in signals. The trained learning algorithm of the classifier can therefore be based on known machine learning methods, such as "Decision Tree Learning", "k-Nearest Neighbor", "Linear Regression", "Logistic Regression", "Winnow", "LASSO", "Ridge-Regression", "ARIMA", "Perceptron", "Artificial Neural Networks", "Deep Learning", "Naive Bayes", "Bayesian Network", "Support Vector Machines", "Boosting", "Reinforcement Learning", "Markov Chain", "Hidden Markov Model", or other state of the art machine learning methods. Many of these known machine learning methods, including Perceptron, Winnow and Logistic Regression, have online versions capable of continuously learning from data. By utilizing such online learning methods, the quality of the calculation of the predefined adhesive saving amount can be continuously improved during operation.

[0033] In an embodiment of the present invention, the predefined adhesive saving amount is 20 to 90 %, for example, from 30 to 80 %, for example, from 40 to 70 %, for example, from 50 to 60 %, for example, substantially 50 %, for example, exactly 50 %. The predefined adhesive saving amount can, for example, be exactly 20 %, 21 %, 22 %, 23 %, 24 %, 25 %, 26 %, 27 %, 28 %, 29 %, 30 %, 31 %, 32 %, 33 %, 34 %, 35 %, 36 %, 37 %, 38 %, 39 %, 40 %, 41 %, 42 %, 43 %, 44 %, 45 %, 46 %, 47 %, 48 %, 49 %, 50 %, 51 %, 52 %, 53 %, 54 %, 55 %, 56 %, 57 %, 58 %, 59 %, 60 %, 61 %, 62 %, 63 %, 64 %, 65 %, 66 %, 67 %, 68 %, 69 %, 70 %, 71 %, 72 %, 73 %, 74 %, 75 %, 76 %, 77 %, 78 %, 79 %, 80 %; 81 %, 82 %, 83 %, 84 %, 85 %, 86 %, 87 %, 88 %, 89 %, or 90 %.

[0034] In an embodiment of the present invention, the adhesive application system can further include a monitoring device which comprises an illumination. The monitoring device is thereby configured to examine a property profile of the adhesive applications on the product and to communicate the property profile to the adhesive application controller.

[0035] The application head controller can therefore provide the predefined adhesive saving amount to the application head controller based on a variety of information/factors.

[0036] The application head controller can, for example, provide the predefined adhesive saving amount to the application head controller based on Equation I. The application head controller can, for example, provide the predefined adhesive saving amount to the application head controller based on a calculation of an optimum of the sample application, while taking into account the adhesive savings and the adhesive strength. This information can be supplemented by including the current speed of production so that an optimum is found while taking into account the opening and closing times of the application nozzle(s). This can mean, for example, that a minimum strength is specified as a constant and that the predefined adhesive saving amount varies or vice versa. The speed can be adjusted in stages so that not every adhesive valve activation cycle must be recalculated when the system is started up. Any adjustment can, for example, be performed between the blanks so that a uniform pattern on a blank is always provided.

[0037] The application head controller can, for example, pre-calculate an interrupted adhesive pattern based on a predefined adhesive saving amount for different speed ranges so that this information can immediately be provided during production. This dispenses with calculations and allows any required adaptation to be performed dynamically.

[0038] The application head controller can, for example, calculate an interrupted adhesive pattern and for a subsequent production while a previous production is still being processed.

[0039] All calculation results leading to the predefined

adhesive saving amount can be part of a protocol that serves, for example, as evidence of the production conditions for the end customer of the packaging manufacturer. Almost all essential features of optimization tasks can, for example, be provided to be read off from graphical representations. A power and/or savings curve can, for example, be shown on a monitor. The operating point can thereby, for example, be represented by a conspicuous point or another suitable marking. The predefined adhesive saving amount can also be provided as a slide control function, i.e., movable by touching and moving the working point marking. The values so moved can then be taken over as setpoints.

[0040] According to a second aspect of the present invention, the object is solved by a method of applying an adhesive to a product with an adhesive application system.

[0041] The adhesive application system includes an application head which comprises at least one application nozzle and an application head controller. The application head is configured to operate in a closed position where an adhesive is not transported to the at least one application nozzle, and in an open position where the adhesive is transported to the at least one application nozzle. The at least one application nozzle is configured to apply the adhesive on a product when the application head is in the open position. The application head controller is configured to generate a close command so as to move the application head into the closed position, and to generate an open command so as to move the application head into the open position so as to thereby apply the adhesive on the product on each of at least two adhesive tracks based on a predefined adhesive saving amount.

[0042] The method comprises:

- Providing the predefined adhesive saving amount to the application head controller;
- Providing, via the application head controller, the open command to the at least one application nozzle of the application head;
- Equidistantly applying, via the at least one application nozzle, the adhesive to the product on each of the at least two adhesive tracks based on the predefined adhesive saving amount, each of the at least two adhesive tracks comprises adhesive dashes, each of the adhesive dashes being separated from each other by a gap having no adhesive, the adhesive dashes and the gaps together forming an interrupted adhesive pattern, each of the adhesive dashes having a dash length which is the same, each dash length having a start point and an end point, and each of the gaps having a gap length which is the same;
- Providing, via the pattern definition unit of the application head controller, that each of the adhesive dashes of a respective interrupted adhesive pattern along a respective adhesive track is substantially equidistantly positioned, and that each of the at least two adhesive tracks which are adjacent to each other are positioned at a distance and parallel with respect to each other; and
- Providing, via the pattern definition unit of the application head controller, that the start point of each of the adhesive dashes of a first adhesive track of the at least two adhesive tracks is positioned at a linear shift with respect to the start point of each of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto,
- wherein, each of the dash length and the gap length is based on the predefined adhesive saving amount.

[0043] Each of the adhesive dashes further has a length with a length midpoint which is arranged between the start point and the end point of each adhesive dash. In an embodiment of the present invention, the method further comprises positioning the start point and/or the end point of each of the adhesive dashes of the first adhesive track substantially at the length midpoint of a respective one of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, so that the start point, the end point, and the length midpoint can be connected to form a triangle where at least two sides have an equal length. In an alternative embodiment of the present invention, all three sides of the triangle can, for example, have an equal length. In an embodiment of the present invention, the linear shift of the adhesive application system is between 20 and 80 %, for example, between 25 and 75 %, for example, between 30 and 70 %, for example, between 35 and 65 %, for example, between 40 and 60 %, for example, between 45 and 55 %, for example, substantially 50 %. The Linear shift can, for example, be substantially 30 % or substantially 33 %. The Linear shift can, for example, be exactly 30 % or exactly 33 %.

[0044] In an embodiment of the present invention, the method of applying an adhesive to a product can, for example, further comprise applying to each of the at least two adhesive tracks, via the at least one application nozzle, at least one of a beginning adhesive application which is arranged at a beginning of each of the at least two adhesive tracks, and an ending adhesive application which is arranged at an end of each of the at least two adhesive tracks.

[0045] In an embodiment of the present invention, the method of applying an adhesive to a product can, for example, further comprise at least one of manually providing the predefined adhesive saving amount to the application head controller via or via another external apparatus, such as a cell phone or a tablet, which is/are directly or indirectly connect to the application head controller via Wi-Fi, Bluetooth etc., and/or independently calculating the predefined adhesive saving amount for the application head controller, in each case, based on based on Equation I:

$$X = \frac{2*D}{\sqrt{3}}$$

where X is the length of a base of the triangle which is positioned along the length of a respective adhesive dash, and D is the distance between adjacent adhesive tracks. The predefined adhesive saving amount can alternatively be pre-calculated based on the above equation and set forth in a database which can then be referenced and inputted into the application head controller.

[0046] In an embodiment of the present invention, the method of applying an adhesive to a product can, for example, further comprise manually providing the predefined adhesive saving amount into the application head controller via a computer or via another external apparatus, such as a cell phone or a tablet, which is/are directly or indirectly connect to the application head controller via Wi-Fi, Bluetooth etc., and/or independently calculating the predefined adhesive saving amount based on an algorithm which calculates an optimum of adhesive force based on data which includes at least one of an adhesive savings, an adhesive strength of the adhesive on the product, and a current speed of production of the product. The algorithm can, for example, be Equation I.

[0047] In an embodiment of the method of applying an adhesive to a product of the present invention, the adhesive application controller can, for example, further comprise a monitoring device and a classifier. The monitoring device can, for example, comprises an illumination. The monitoring device is configured to examine a property profile of the adhesive applications on the product and to communicate the property profile to the adhesive application controller. The classifier independently calculates the predefined adhesive saving amount by analyzing, for example, via a trained learning algorithm, the property profile and the algorithm. The algorithm can thereby include factors such as the intended adhesive savings, the adhesive strength of the adhesive on the product, the current speed of production of the product and/or Equation I. The algorithm can alternatively, for example, be based on a spread sheet, a graph etc. The trained learning algorithm of the classifier can, for example, be an artificial neural network trained by a backpropagation method or a pre-trained convolutional neural network as was discussed above.

[0048] In an embodiment of the present invention, the product can, for example, be a folding box blank.

[0049] In an embodiment of the method of applying an adhesive to a product of the present invention, the adhesive application system can, for example, further comprise a folding station which is arranged downstream of the adhesive station in the production flow direction. The folding station is thereby configured to fold the folding box blank with the adhesive applied thereto into a box. In an embodiment of the method of applying an adhesive to a product of the present invention, the method can, for example, further comprise moving the folding box blank with the adhesive applied thereto from the adhesive station to the folding station, and folding the folding box blank in the folding station so as to provide a folded box blank.

[0050] In an embodiment of the method of applying an adhesive to a product of the present invention, the adhesive application system can, for example, further comprise a transfer station which is arranged downstream of the folding station in the production flow direction. The transfer station is thereby configured to at least one of count and discharge the folded box blank. In an embodiment of the method of applying an adhesive to a product of the present invention, the method can, for example, further comprise moving the folded box blank from folding station to the transfer station, and at least one of counting and discharging the folded box blank in the folding station.

[0051] In an embodiment of the method of applying an adhesive to a product of the present invention, the adhesive application system can, for example, further comprise a collecting and pressing station which is arranged downstream of the transfer station in the production flow direction. The collecting and pressing station is thereby configured to apply a pressure to the folded box blank until the adhesive coagulates. In an embodiment of the method of applying an adhesive to a product of the present invention, the method can, for example, further comprise moving the folded box blank from transfer station to the collecting and pressing station, and applying the pressure to the folded box blank in the collecting and pressing station until the adhesive coagulates so as to provide a box.

[0052] The present invention also provides a box which is produced pursuant to the above method.

[0053] According to a third aspect of the present invention, the object is solved by an application head controller which is configured to generate a close command so as to move an application head into a closed position where an adhesive is not transported to at least one application nozzle, and to generate an open command so as to move the application head into an open position where the adhesive is transported to at least one application nozzle. The at least one application nozzle is configured to apply the adhesive to a product on each of at least two adhesive tracks based on a predefined adhesive saving amount. Each of the at least two adhesive tracks comprises adhesive dashes. Each of the adhesive dashes are separated from each other by a gap having no adhesive. The adhesive dashes and the gaps together form an interrupted adhesive pattern. Each of the adhesive dashes have a dash length which is the same. Each dash length has a start point, an end point, and a length with a length midpoint which is arranged between the start point and the end point of each adhesive dash, and each of the gaps has a gap length which is the same. The application head controller comprises a pattern definition unit which is configured to position the at least two adhesive tracks adjacent to each other and at a distance and parallel with respect to each other. The start point and/or the end point

of each of the adhesive dashes of a first adhesive track is positioned substantially at the length midpoint of a respective one of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, so that the start point, the end point, and the length midpoint can be connected to form a triangle where at least two sides have an equal length. Each of the dash length and the gap length is based on the predefined adhesive saving amount.

[0054] All three sides of the triangle can, for example, have the equal length.

DETAILED DESCRIPTION

[0055] The present invention is described in greater detail below on the basis of embodiments and of the drawings in which:

Fig. 1 shows examples of prior art adhesive tracks;

Fig. 2 shows an embodiment of the an adhesive application system of the present invention;

Fig. 3 shows a flow chart of the various stations which are used to produce a box pursuant to the present invention;

Fig. 4 shows a first example of an interrupted adhesive pattern of the present invention;

Fig. 5 shows a second example an interrupted adhesive pattern of the present invention;

Fig. 6 shows an third example of an interrupted adhesive pattern of the present invention with the relationship between the various adhesive dashes;

Fig. 7 shows a fourth example an interrupted adhesive pattern of the present invention;

Fig. 8 shows a detailed view of an interrupted adhesive pattern of the fourth example;

Fig. 9 shows a second detailed view of an interrupted adhesive pattern of the fourth example; and

Fig. 10 shows a folding box blank and a folded box blank.

[0056] As mentioned above relating to the manufacture of the packaging, it is known to apply adhesive in the form of a continuous bead of adhesive. The adhesive application valve is thereby activated by the valve control during the entire path thereof. The control is based on an adhesive pattern stored in the control, which defines, for example, the location of the adhesive bead and its length.

[0057] Fig. 1 shows examples of prior art adhesive tracks. Instead of applying a continuous solid adhesive line/bead 130, the application of a sequence of points 132 (also called "dotting") or a series of short lines or dashes 134 (also called "stitching") are known from the prior art.

[0058] There can also be a smooth transition between dotting and stitching. In the transition from a low production speed to a higher production speed, small lines sometimes appear in dots because the opening time of the adhesive application valve is no longer sufficient to create individual dots.

[0059] Several approaches can be used to create a dotting line or a stitching line. A first approach is to provide a signal during the entire course of the adhesive application. This is typical, for example, when the control signals come from the machine control of the higher-level production machine. These signals are then chopped up or subdivided in the adhesive application system based on a pattern or a specification as a percentage of the adhesive consumption/area coverage of the adhesive application or by specifying the line/dot gap ratio or specifying the desired adhesive savings. The modified signal is then used to control the adhesive application valves, which then apply an adhesive pattern on the basis of this modified pattern.

[0060] A second approach is to generate the signals directly in a pattern control that is assigned to the adhesive application system. The operator typically specifies the length of a path for a desired adhesive application, and this path is then converted into a sequence of application areas and gaps in the control system. The conversion can take place on the basis of stored characteristics, parameters and algorithms. It is, for example, taken into account that an adhesive path always ends with a dot or dash. The opening and closing times of the selected adhesive application valve type can be taken into account. More interruptions can be generated with a "fast valve" than with a slower switching adhesive application valve. The route between the two end points is then interrupted based on the desired pattern. The pattern can be selected from a variety of specifications. The operator is typically shown the pattern graphically in a selection menu from which he/she can select the desired pattern. The pattern can also be specified, for example, by specifying the order/gap ratio or by selecting the desired adhesive savings in percent.

[0061] If several glue application valves are used, the sample calculation for dotting/stitching in the pattern control can be provided globally for all valves, or individually for each glue application valve. The pattern control can be dynamically adapted to the production speed, i.e., the order area/gap ratio is adapted to the changed production speed. This can be necessary because the control time (opening and closing times) of the adhesive application valve remains constant, while the distance covered by the substrate during the control time increasing speed becomes longer. This can lead to a close sequence of

individual points again becoming a solid line. The speed signal on which this adaptation is based can be obtained from the machine control of the production machine or from an encoder connected to the control of the adhesive application system or from another suitable means that detects the speed of the production machine.

[0062] In inliner machines, there are often multiple heads that apply two or more lines of adhesive, typically 3 or 6 lines. This is due to the fact that corrugated cardboard packaging or the adhesive connections are more heavily loaded than is the case in folding box packaging. Instead of continuous adhesive beads, a line sequence (stitching) is in this case applied, the graduation lines of the adhesive tracks being offset from one another. This has the advantage that there is always at least one graduation of an adhesive application along the intended area of the entire adhesive bottle. Passageways or channels are also avoided, as they arise when tick marks and gaps are arranged in parallel.

[0063] Packaging must fulfill a packaging function, i.e., the packaging must protect the contents thereof, i.e., the packaged product. The value of the packaged product is usually a high multiple of the value of the packaging itself. If the packaging opens and the packaged products are destroyed, all the energy and effort that went into the production of the packaged product is lost. A widespread belief therefore exists that it is better to use more adhesive than less in order to prevent the packaging from opening. An industry preference therefore exists to use a continuous solid adhesive line in packaging instead of providing the adhesive as dotting and/or stitching, i.e., as an intermittent adhesive pattern.

[0064] Fig. 2 shows an adhesive application device in the form of an adhesive station 100 in a flexo folder gluer (inliner). In this embodiment, the adhesive is applied to the product (which is also sometimes referred to as a substrate, which can, for example, be a folding box blank 160) via an application head 101. The application head 101 is shown in Fig. 2 to have three application nozzles 102. For the purpose of applying the adhesive, the product 103 is introduced between an upper product guide 104 and a lower product guide 105, which together serve to guide the product 103 and to prevent contact of the product 103 with the three application nozzles 102. A monitoring device 106 is arranged downstream of the application head 101 in the product flow direction 109. The monitoring device 106 monitors a property profile of the adhesive dashes 4, 138 on the product 103 and communicates the property profile to the application head controller 110. In other words, the monitoring device 106 monitors the quality and the position of the adhesive dashes on the product 103. The monitoring device 106 can be provided as an optical camera and/or as a thermal camera (i.e., a thermal imaging camera), an optical sensor, and/or a capacitive sensor, or any other monitoring device which is suitable for monitoring adhesive. The monitoring device 106 can also be provided as any combination thereof. The monitoring device 106 can also include an illumination 107 which illuminates the product 103 with the adhesive tracks located thereon in order to improve the contrast between the product surface and the adhesive track for the purpose of recognition. The adhesive station 100 here also includes a cleaning device 108 which is activated during production breaks in order to clean the application nozzles 102 and/or to protect the residual adhesive present in the application nozzles 102 from drying out. The cleaning device 108 can, for example, be provided as a water bath, in the water surface of which the nozzle tips of the application nozzles 102 are immersed and are thus protected, among other things, from drying out.

[0065] The application head controller 110 is connected to the application head 101. The application head controller 110 is configured to generate open and close commands for the application head 101 to dispense an adhesive dash 4, 138 of, for example, glue, onto the product 103 so as to provide an interrupted adhesive pattern 140 on each of at least two adhesive tracks 1, 2, 3, 136 depending on a predefined adhesive saving amount. The application head controller 110 comprises a pattern definition unit 111 which is configured to substantially equidistantly position each of the adhesive dashes 4, 138 of a respective interrupted adhesive pattern 140 along a respective adhesive track 1, 2, 3, 136, and to position each of the at least two adhesive tracks 1, 2, 3, 136 which are adjacent to each other at a distance D and parallel with respect to each other. The length of each adhesive dash 4, 138 is generally from 5 to 25 mm, for example, approximately 15 mm.

[0066] Each of the adhesive dashes 4, 138 thereby has a length L, a start point 142, an end point 144, and a length midpoint 146 which is arranged between the start point 142 and the endpoint 144.

[0067] In Fig. 2, the predefined adhesive saving amount is provided to the application head controller 110 via a computer 113 having a mouse 114, a keyboard 115, and a monitor 116. The computer 113 can be connected to an external database 117 where various predefined adhesive saving amounts are stored based on the product and adhesive used. A skilled person would also realize that instead of a computer, that the predefined adhesive saving amount could also be provided to the application head controller 110 via a cell phone or via a tablet which are connected via a wired connection, or wirelessly, for example via Wi-Fi or Bluetooth etc. The predefined adhesive saving amount can also be independently calculated via a classifier 112 of the application head controller 110. The classifier 112 independently calculates the predefined adhesive saving amount by analyzing, via a trained learning algorithm, the property profile and the algorithm (the algorithm thereby including factors such as the intended adhesive savings, the adhesive strength of the adhesive on the product, and the current speed of production of the product and/or Equation I as set forth above). The trained learning algorithm of the classifier 112 can, for example, be an artificial neu-

ral network trained by a backpropagation method or a pre-trained convolutional neural network.

[0068] Fig. 3 shows a flowchart of the method for applying an adhesive to a product 103. The first step in the process is providing a product 103, for example, the folding box blank 160 shown in Fig. 10, to the adhesive station which was described above. The application nozzles 102 here equidistantly apply the adhesive to the product 103 on each of at least two adhesive tracks 136 based on the predefined adhesive saving amount, as controlled by the application head controller 110. A folding station 200 is arranged downstream of the adhesive station 100 in the production flow direction 109. The folding station 200 folds the product 103 (here the folding box blank 160) with the adhesive applied thereto to provide a folded box blank 162. See Fig. 10. A transfer station 210 is arranged downstream of the folding station 200 in the production flow direction 109. The transfer station 210 counts and/or discharges the folded box blank 162 after it has left the transfer station 210. A collecting and pressing station 220 is arranged downstream of the transfer station 210 in the production flow direction 109. The collecting and pressing station 220 applies a pressure to the folded box blank 162 until the adhesive coagulates so as to provide a box as a final product.

[0069] Two interrupted adhesive pattern samples arranged with adhesive dashes and gaps as per the present invention were tested, whereby a first interrupted adhesive pattern was based on a predefined adhesive saving amount of 30 %, with a 12.7 mm gap, and a second interrupted adhesive pattern was based on a predefined adhesive saving amount of 70 %, with a 19.05 mm gap. Each of these samples were tested on a tensile tester from Instron® Corp. to determine how much energy was required before a separation of two pieces of cardboard, which had been glued together resulted. The tests clearly showed the respective force which is required to initiate a respective continuous tearing through an adhesive layer. Tests showed that the first interrupted adhesive pattern was only slightly stronger than the second interrupted adhesive pattern despite the first interrupted adhesive pattern having a predefined adhesive saving amount of 30 % while the second interrupted adhesive pattern had a predefined adhesive saving amount of 70 %, i.e., 40 % less adhesive. It is believed that this is due to the fact that while both the first and the second interrupted adhesive pattern comport with Equation I above, that the first interrupted adhesive pattern yielded an isosceles triangle having two substantially equal sides and angles, while the second interrupted adhesive pattern yielded an equilateral triangle having three substantially equal sides and angles (i.e., 60°-60°-60°). This latter arrangement is believed to be the "sweet spot" where adhesive savings (i.e., the predefined adhesive saving amount) is maximized while adequate mechanical strength is still maintained.

[0070] It is generally known that a relatively high tear force must be applied to an adhesive connection in order to peel or notch the adhesive connection. Tests have shown that providing a large number of individual adhesive tracks arranged in adhesive dashes and gaps as per the present invention would continually require an initial force which would, in the aggregate, equal or in fact exceed the force required once a continuous tearing of an adhesive connection has been initiated.

[0071] A basic assumption of the present invention was therefore that a start of the adhesive application, which is formed by an adhesive dash, presents force peaks as a result of fiber tear initiation.

[0072] Fig. 4 shows two adhesive tracks 1, 2 comprising in at least one section 6 of the adhesive tracks 1, 2 a number of adhesive dashes 4 with gaps 5 arranged there between so as to together form an interrupted adhesive pattern, as generated by an application head controller. Each one of the adhesive dashes 4 has a dash length which is the same, the adhesive dashes 4 having a start point and an end point, and each one of the gaps 5 having a gap length which is the same. The application head controller is configured to generate a close command so as to move the application head into the closed position, and to generate an open command so as to move the application head into the open position, so as to thereby apply the adhesive dashes 4 on the product on each of the two adhesive tracks 1, 2 based on a predefined adhesive saving amount.

[0073] Fig. 5 shows three adhesive tracks 1, 2, 3 comprising in at least one section 6 of the adhesive tracks 1, 2, 3 a number of adhesive dashes 4 with gaps 5 arranged there between so as to form an interrupted adhesive pattern, as generated by an application head controller. As above, each of the adhesive dashes 4 has a dash length which is the same, each dash length having a start point and an end point, and each of the gaps 5 having a gap length which is the same. The start point of each of the adhesive dashes 4 of the second adhesive track 1 is positioned at a linear shift with respect to the start point of each of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto (i.e., adhesive tracks 1 and 3). The linear shift here is equal one third of the length of an adhesive dash 4. Each of the adhesive tracks 1, 2, 3 are arranged parallel with respect to each other.

[0074] Further tests thereby demonstrated that an optimal configuration appeared to be an equilateral triangle created between glue line endpoints as shown in Figs. 6, 7, 8 and 9. Further tests showed that strength is lost as the triangle becomes skewed farther from equilateral. Under reference to Fig. 6, it was thereby approximated that:

Glue line 1 (adhesive track 1), start 0, end X
Glue line 2 (adhesive track 2), start 0.5 X, end 1.5 X
Glue line 3 (adhesive rack 3) start X, end 2 X

[0075] Where X = length of the adhesive dash. The resultant pattern is created where the glue endpoints (ei-

ther start or end) can be connected by imaginary lines which forms an equilateral triangle having equal length sides and measured angles 60°-60°-60°.

[0076] As is shown in particular in Fig. 8, at least one of the start point 142 and the end point 144 of each of the adhesive dashes 138 of a first interrupted adhesive pattern 140 of a first adhesive track 136 (for example, the middle adhesive track shown in Fig. 8) is positioned substantially at the length midpoint 146 of the one of the adhesive dashes 138 of a second interrupted adhesive pattern 140 of a second adhesive track 136 which is arranged parallel to the first adhesive track 136 (for example, the uppermost adhesive tack shown in Fig. 8), so that the start point 142, the end point 144, and the length midpoint 146 can be connected to form a triangle 148 (see Fig. 9) where at least two sides 150 have an equal length. The triangles shown in each of Figs. 8 and 9 are isosceles triangles where the length of the base X is equal to the length of each of the at least two sides 150 which is equal to the length L of the adhesive dashes 138. Each of the length L of the adhesive dashes 138 and the distance D between adjacent adhesive tracks 136 is thereby based on the predefined adhesive saving amount. Fig. 8 also shows that each of the adhesive tracks 136 also includes a beginning adhesive application 154 which is arranged at a beginning of a respective adhesive track 136, and an ending adhesive application 156 which is arranged at an end a respective adhesive track 136. The adhesive station 100 in the shown embodiment has three application nozzles 102 so as to produce three adhesive tracks 136.

[0077] The present invention is not limited to embodiments described herein; reference should be had to the appended claims.

Claims

1. An adhesive application system comprising:

an application head which comprises at least one application nozzle, the application head being configured to operate in a closed position where an adhesive is not transported to the at least one application nozzle, and in an open position where the adhesive is transported to the at least one application nozzle,
the at least one application nozzle being configured to apply the adhesive on a product when the application head is in the open position; and
an application head controller which is configured,

to generate a close command so as to move the application head into the closed position, and to generate an open command so as to move the application head into the open position so as to thereby apply the adhesive on the product on each of at least two adhesive tracks based on a predefined adhesive saving amount,
each of the at least two adhesive tracks comprising in at least one section of said tracks adhesive dashes, each of the adhesive dashes being separated from each other by a gap having no adhesive, the adhesive dashes and the gaps together forming an interrupted adhesive pattern,
each of the adhesive dashes having a dash length which is the same, each dash length having a start point and an end point, and each of the gaps having a gap length which is the same,

the application head controller comprising a pattern definition unit which is configured to position the at least two adhesive tracks adjacent to each other and at a distance and parallel with respect to each other,
wherein,
within the at least said section the start point of each of the adhesive dashes of a first adhesive track of the at least two adhesive tracks is positioned at a linear shift with respect to the start point of each of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, and
each of the dash length and the gap length is based on the predefined adhesive saving amount.

2. The adhesive application system of claim 1, wherein,

each of the adhesive dashes further has a length with a length midpoint which is arranged between the start point and the end point of each adhesive dash, and
the start point and/or the end point of each of the adhesive dashes of the first adhesive track is positioned substantially at the length midpoint of a respective one of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, so that the start point, the end point, and the length midpoint can be connected to form a triangle where at least two sides have an equal length.

3. The adhesive application system of claim 2, wherein all three sides of the triangle have the equal length.

4. The adhesive application system of claim 2, wherein the predefined adhesive saving amount is at least one of manually provided to the application head controller via a computer and independently calculated, in each case, based on the equation:

$$X = \frac{2*D}{\sqrt{3}}$$

wherein,

X = of a length of a base of the triangle which is positioned along the length of a respective adhesive dash, and
D = the distance between adjacent adhesive tracks.

5. The adhesive application system of any of the above claims, wherein the adhesive application controller further comprises

a monitoring device comprising an illumination, the monitoring device being configured to examine a property profile of the at least two adhesive tracks on the product and to communicate the property profile to the adhesive application controller, and
a classifier which independently calculates the predefined adhesive saving amount by analyzing, via a trained learning algorithm, the property profile and the algorithm.

6. The adhesive application system of any of the above claims, wherein a number of the at least one application nozzle equals a number of the at least two adhesive tracks.

7. The adhesive application system of claim 6, wherein, exactly three application nozzles are provided as the at least one application nozzle, and exactly three adhesive tracks are provided as the at least two adhesive tracks.

8. The adhesive application system of claim 1, wherein the linear shift is substantially 30 %.

9. The adhesive application system of any of the above claims, wherein each of at least two adhesive tracks further comprise at least one of a beginning adhesive application which is arranged at a beginning of each of the at least two adhesive tracks, and an ending adhesive application which is arranged at an end of each of the at least two adhesive tracks.

10. A method of applying an adhesive to a product with an adhesive application system which comprises,

an application head which comprises at least one application nozzle, the application head being configured to operate in a closed position where an adhesive is not transported to the at least one application nozzle, and in an open position where the adhesive is transported to the at least one application nozzle, the at least one application nozzle being configured to apply the adhesive on a product when the application head is in the open position; and
an application head controller which is configured to generate a close command so as to move the application head into the closed position, and to generate an open command so as to move the application head into the open position so as to thereby apply the adhesive on the product on each of at least two adhesive tracks based on a predefined adhesive saving amount, the method comprising:

- providing the predefined adhesive saving amount to the application head controller;
- providing, via the application head controller, the open command to the at least one application nozzle of the application head;
- equidistantly applying, via the at least one application nozzle, the adhesive to the product on each of the at least two adhesive tracks based on the predefined adhesive saving amount, each of the at least two adhesive tracks comprises adhesive dashes, each of the adhesive dashes being separated from each other by a gap having no adhesive, the adhesive dashes and the gaps together forming an interrupted adhesive pattern, each of the adhesive dashes having a dash length which is the same, each dash length having a start point and an end point, and each of the gaps having a gap length which is the same;
- providing, via the pattern definition unit of the application head controller, that each of the adhesive dashes of a respective interrupted adhesive pattern along a respective adhesive track is substantially equidistantly positioned, and that each of the at least two adhesive tracks which are adjacent to each other are positioned at a distance and parallel with respect to each other; and
- providing, via the pattern definition unit of the application head controller, that the start point of each of the adhesive dashes of a first adhesive track of the at least two adhesive tracks is positioned at a linear shift with respect to the start point of each of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto,
- wherein, each of the dash length and the gap length is based on the predefined adhesive saving amount.

11. The method of claim 10, further comprising:
applying to each of the at least two adhesive tracks,

via the at least one application nozzle, at least one of a beginning adhesive application which is arranged at a beginning of each of the at least two adhesive tracks, and an ending adhesive application which is arranged at an end of each of the at least two adhesive tracks.

12. The method as recited in claim 10 or 11, wherein,

each of the adhesive dashes further has a length with a length midpoint which is arranged between the start point and the end point of each adhesive dash, and
the method further comprises:
positioning the start point and/or the end point of each of the adhesive dashes of the first adhesive track substantially at the length midpoint of a respective one of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, so that the start point, the end point, and the length midpoint can be connected to form a triangle where at least two sides have an equal length.

13. The method as recited in claim 10 or 11, wherein the linear shift is substantially 30 %.

14. The method as recited in claim 13, wherein the adhesive application controller further comprises,

a monitoring device comprising an illumination, the monitoring device being configured to examine a property profile of the at least two adhesive tracks on the product and to communicate the property profile to the adhesive application controller, and
a classifier which independently calculates the predefined adhesive saving amount by analyzing, via a trained learning algorithm, the property profile and the algorithm.

15. An application head controller which is configured,

to generate a close command so as to move an application head into a closed position where an adhesive is not transported to at least one application nozzle, and
to generate an open command so as to move the application head into an open position where the adhesive is transported to at least one application nozzle,
the at least one application nozzle being configured to apply the adhesive to a product on each of at least two adhesive tracks based on a predefined adhesive saving amount, each of the at least two adhesive tracks comprises adhesive dashes, each of the adhesive dashes being separated from each other by a gap having no adhesive, the adhesive dashes and the gaps together forming an interrupted adhesive pattern, each of the adhesive dashes having a dash length which is the same, each dash length having a start point, an end point, and a length with a length midpoint which is arranged between the start point and the end point of each adhesive dash, and each of the gaps having a gap length which is the same,
the application head controller comprising a pattern definition unit which is configured to position the at least two adhesive tracks adjacent to each other and at a distance and parallel with respect to each other,
wherein,
the start point and/or the end point of each of the adhesive dashes of a first adhesive track is positioned substantially at the length midpoint of a respective one of the adhesive dashes of the adhesive track(s) which is/are arranged immediately adjacent thereto, so that the start point, the end point, and the length midpoint can be connected to form a triangle where at least two sides have an equal length, and
each of the dash length and the gap length is based on the predefined adhesive saving amount.

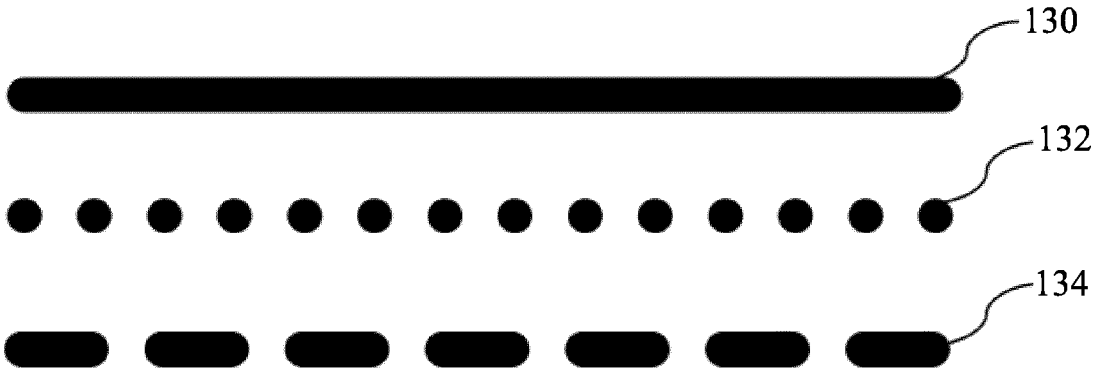
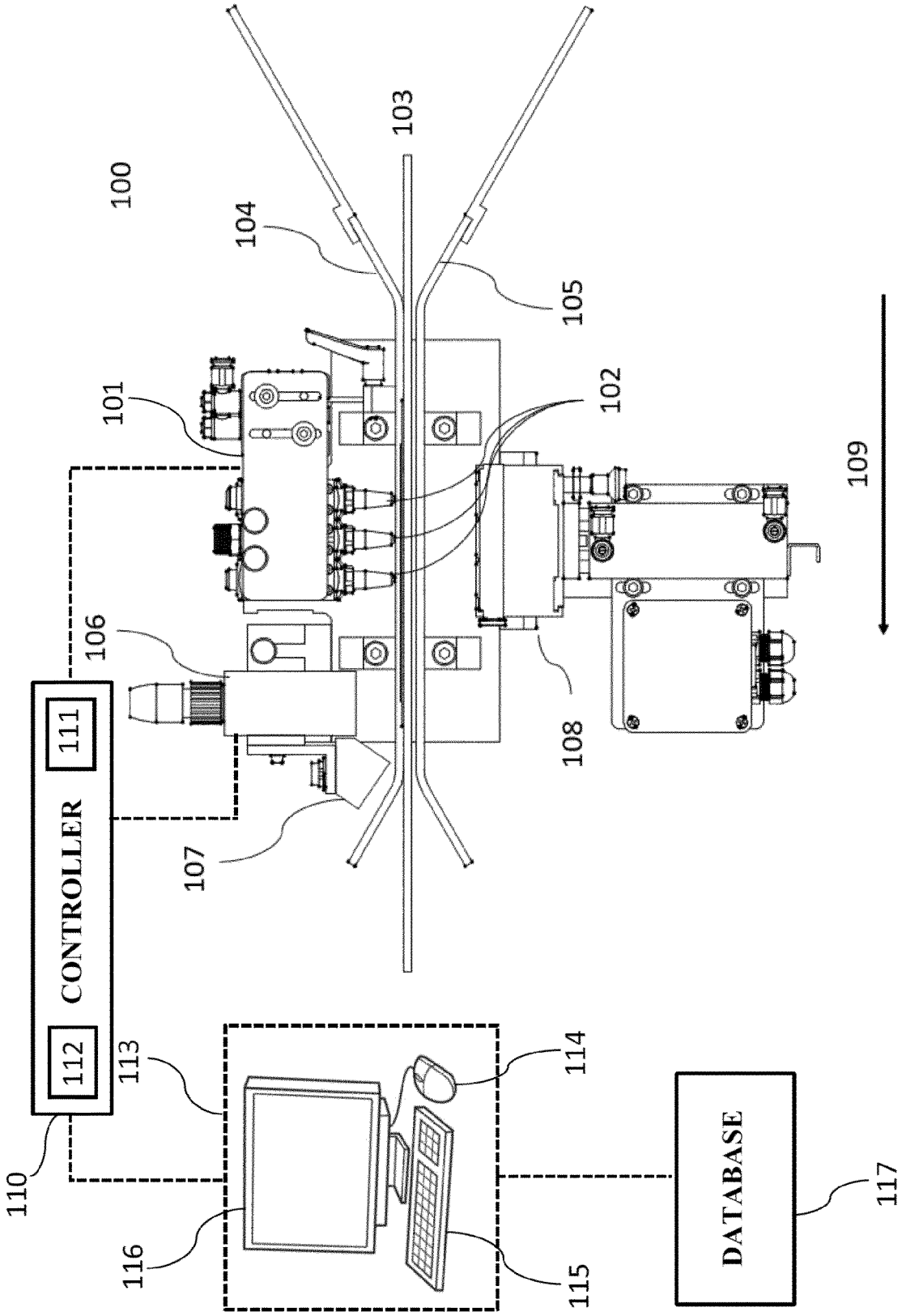


Fig. 1

(PRIOR ART)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CONTROLLER
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DATABASE

Fig. 6

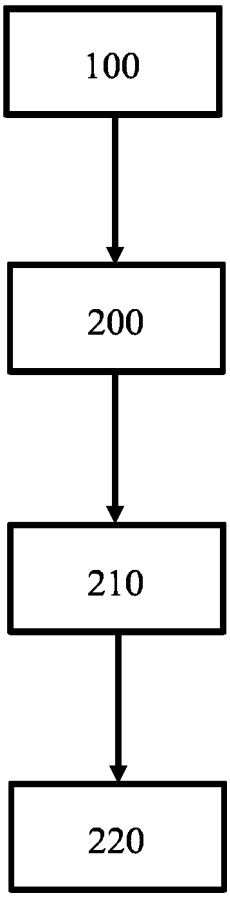

Fig. 3

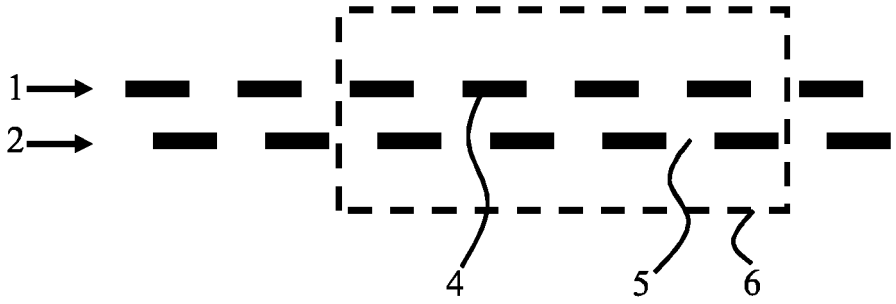

Fig. 4

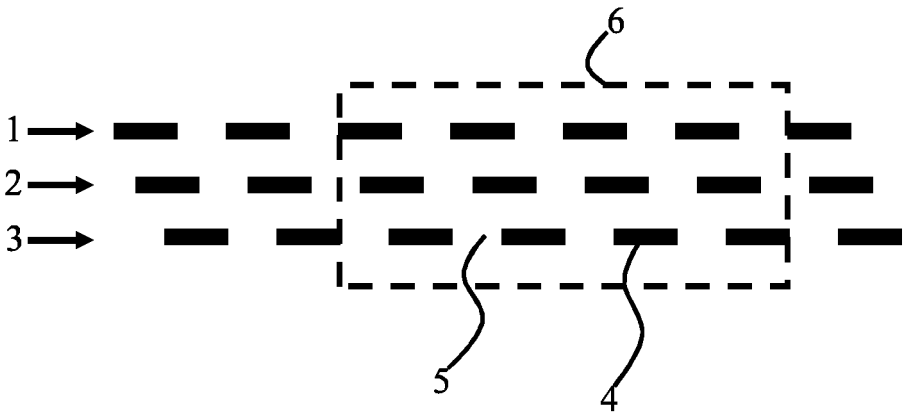

Fig. 5

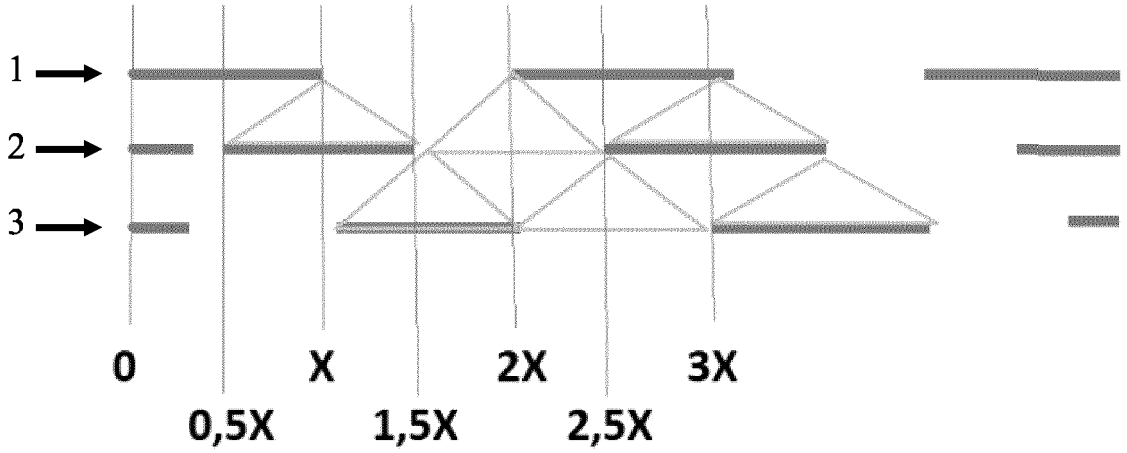

Fig. 6

Fig. 7

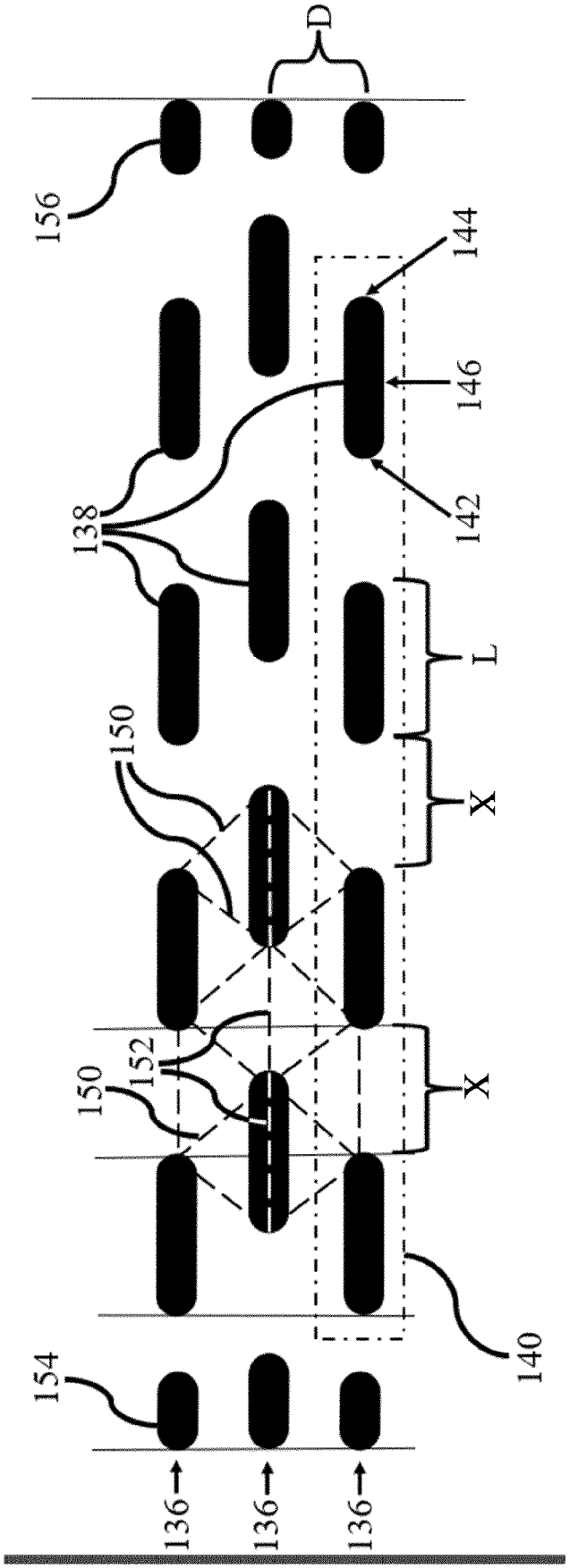

Fig. 8

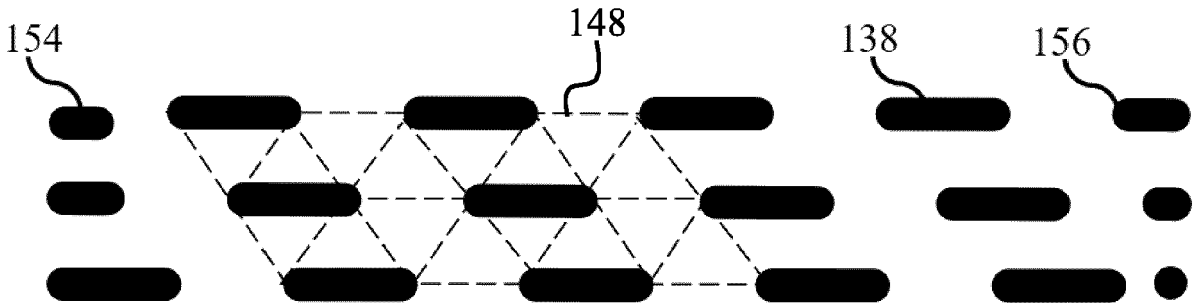

Fig. 9

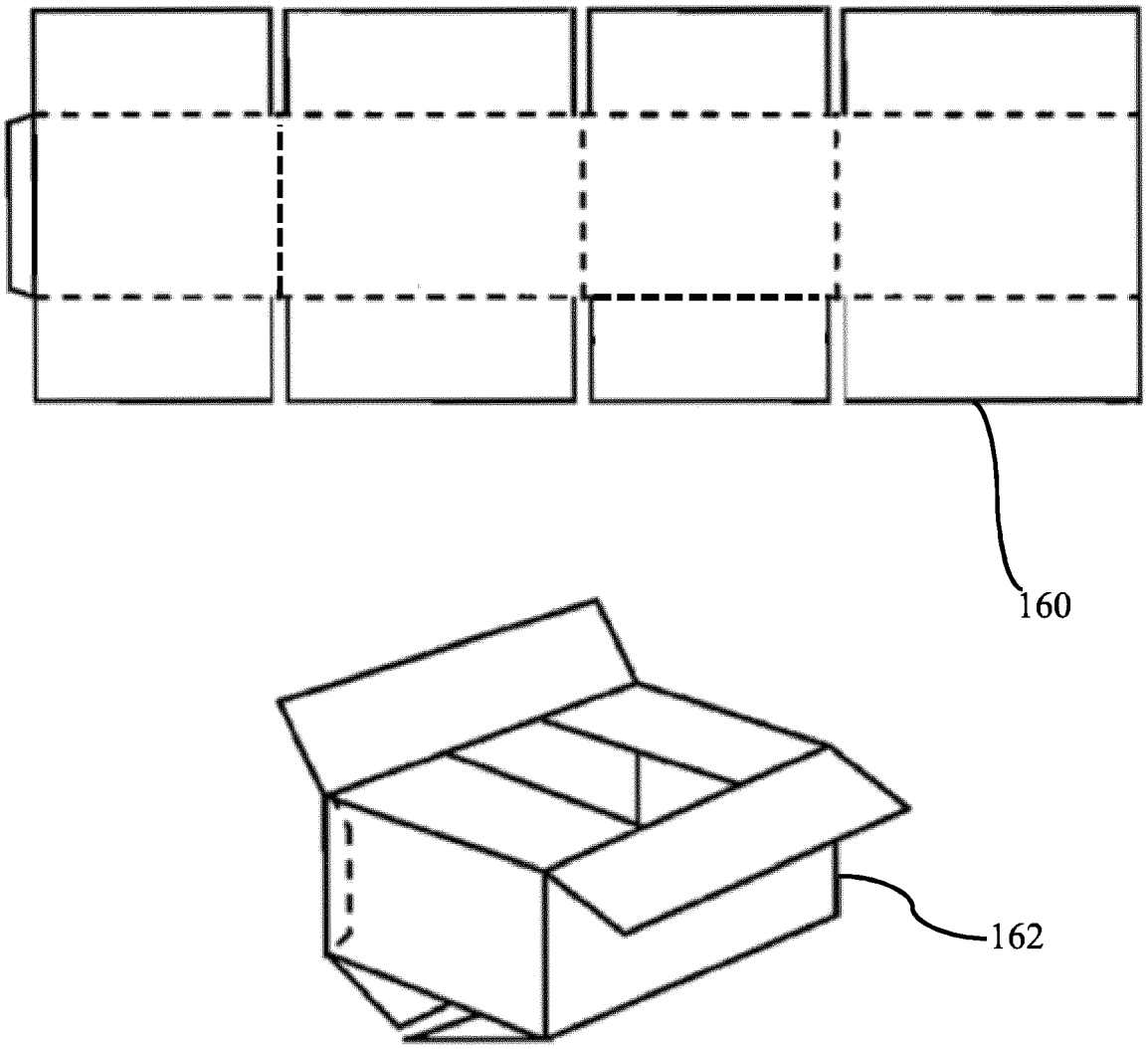

Fig. 10

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Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 21 4471

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 4 488 665 A (COCKS ERIC H [US] ET AL) 18 December 1984 (1984-12-18) * column 6, line 4 - line 28 * * figure 4 *	1,6-11, 13 2-5,12, 14,15	INV. B05C5/02 B05C11/10 B65B51/02
X A	US 2 896 569 A (FERGUSON SR JOHN L ET AL) 28 July 1959 (1959-07-28) * column 3, line 46 - line 59 * * figure 11 *	1,6-11, 13 2-5,12, 14,15	
X A	US 2016/332185 A1 (WALTER JAN-CHRISTIAN [DE] ET AL) 17 November 2016 (2016-11-17) * paragraph [0053] * * paragraph [0077] - paragraph [0084] * * figure 2 *	1,6-11, 13 2-5,12, 14,15	

TECHNICAL FIELDS SEARCHED (IPC)

B05C
B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 June 2022	Roldán Abalos, Jaime

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 21 4471

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