To detect product defects during the production of mailing products, hygiene products or folded paper products, optical imaging sensors or capacitive sensors monitor at least one characteristic parameter or feature of the products successively moving through the production machine, to detect an actual value of each characteristic parameter or feature of each product. The detected actual value is compared with a stored nominal value for the respective characteristic parameter or feature. The result of the comparison is used to initiate or control a further measure, such as ejecting a defective product from the production line, marking a defective product so that it can be visually recognized and manually removed from the production line, or initiating corrective measures to correct the cause of the defect. The characteristic parameters or features relate to the dimensions, the position, and/or the form of the product or parts of the product.
METHOD AND APPARATUS FOR DETECTING PRODUCT DEFECTS DURING THE PRODUCTION OF MAILING PRODUCTS, HYGIENE PRODUCTS, OR FOLDED PAPER PRODUCTS

PRIORITY CLAIM

[0001] This application is based on and claims the priority under 35 U.S.C. §119 of German Patent Application 101 61 424.1, filed on Dec. 13, 2001, the entire disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The invention relates to a method and an apparatus for detecting product defects in mailing products such as envelopes, mailers, shipping bags or the like, hygiene products such as disposable diapers, incontinence products, feminine sanitary napkins, pads, panty liners, or the like, or folded paper products such as paper napkins, paper towels, paper tissues, and the like, while these products are being manufactured on a corresponding production machine including several machine components or stations. The invention thus generally relates to product monitoring for product defects in the manner of an inline quality control.

BACKGROUND INFORMATION

[0003] Modern machines for the production of the above mentioned mailing products, hygiene products or folded paper products operate at an extremely high speed in terms of product items per minute, for example. As a result, it often occurs that suddenly arising errors or defects in the products being produced are not immediately recognized or noticed, but instead continue on through the rest of the production and packaging process. Due to the high production speed, this can lead to considerable product waste as well as other considerable damages and losses. Basically, it is essentially impossible to notice or detect defective products during the production thereof. It is therefore important to provide preventive or protective measures.

SUMMARY OF THE INVENTION

[0004] In view of the above, it is an object of the present invention to provide a method and an apparatus by which product defects of mailing products, hygiene products or folded paper products can be reliably and quickly detected during the production of these products, so that these defective products can be removed from the production line or otherwise treated to prevent further waste, loss or damage from occurring. The invention further aims to avoid or overcome the disadvantages of the prior art, and to achieve additional advantages, as apparent from the present specification. The attainment of these objects is, however, not a required limitation of the present invention.

[0005] The above objects have been achieved according to the invention in a method and an apparatus for detecting product defects during the production of mailing products, hygiene products or folded paper products, wherein at least two or three characteristic parameters or features of the product are monitored so as to sense or detect actual values of these parameters or features during the production of the product, and the detected actual values are then compared with previously stored nominal values for these characteristic parameters or features. Then, control commands are provided to the production machine on the basis of the testing and comparison results, so that a product that has not been correctly produced or is otherwise defective can be immediately ejected from the production line and/or marked so that it may be recognized and removed from the production line by the operating personnel, and so that the error or defect can be corrected.

[0006] The above mentioned product monitoring is carried out with the aid of optical and/or electrical and/or electronic means, whereby each individual product item (i.e. each individual item of a particular type of product) is individually monitored for defects, with the result that the defect-free products can be ejected or sorted out at the end of the production line.

[0007] Preferably, line cameras are utilized for carrying out the monitoring, whereby these line cameras provide a line or stripe-shaped image of portions of each respective product item passing by the line camera. However, alternatively, other types of sensors operating in different manners may be used instead of or in addition to the line cameras, depending on the particular application purpose.

[0008] According to a further preferred embodiment of the invention, at least one characteristic parameter or feature of the product is monitored with respect to the position and form thereof, and/or several characteristic parameters or features are monitored relative to one another with respect to the position and form thereof, so the corresponding actual values thereof can be permanently detected and, as in the above mentioned first case, compared with stored nominal values for these respective characteristic parameters or features, so that the result of the comparison can then be used for further measures. In this context, the nominal values of the characteristic parameters or features are either prescribed values and/or machine-learned values or quantities.

[0009] In this manner, it becomes possible to detect or recognize defect locations on products directly at the time point at which the respective defect arises, which, in many circumstances, is a time point at which these defects have not yet had an influence on the further production. It is also possible to eject the defective product and to immediately correct the cause of the defect. Thus, a secure and reliable production can be achieved in a much higher measure than could previously be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In order that the invention may be clearly understood, it will now be described in connection with example embodiments, with reference to the accompanying drawings, wherein:

[0011] FIG. 1 is a schematic illustration of the apparatus according to the invention, with reference to a production machine;

[0012] FIG. 2 is an illustration of the apparatus according to FIG. 1 in a larger scale;

[0013] FIG. 3 is a schematic illustration of a measuring location behind a window gluing station, whereby a line camera is arranged as a testing or detecting unit in a housing with mirrors deflecting the beam path;

[0014] FIG. 4 is a schematic illustration of optical image-providing sensors in a larger scale, for monitoring the glue strips or tracks on the side flaps of a letter envelope comprising a window;
FIG. 5 is an illustration of the image-providing sensor above one of the glue strips, rotated by 90° relative to FIG. 4.

FIG. 6 is a schematic illustration of capacitively functioning sensors in a multiple arrangement for monitoring the glue strips of the closure flaps of letter envelopes that are arranged in a staggered manner; and

FIG. 7 is an illustration of a capacitive sensor for monitoring the glue strips on the closure flaps, rotated by 180° relative to FIG. 6.

DETAILED DESCRIPTION OF A PREFERRED EXAMPLE EMBODIMENT AND OF THE BEST MODE OF THE INVENTION

An apparatus 2 according to FIGS. 1 and 2 is provided for monitoring the production of letter envelopes 1 and the like by means of production machines 1'. The apparatus 2 comprises one or more sensors in the form of line cameras 3, 3', respectively with an associated light source 4, 4', and/or capacitively functioning sensors 5, 5'. For example, imaging sensors are provided for monitoring and inspecting the glue that has been provided as a strip, line or track along the side flaps of the envelopes 1, while capacitive sensors are predominantly provided for inspection and monitoring of the glue provided as a strip or track along the closure flaps of the envelopes 1.

The line cameras 3, 3' and the capacitive sensors 5, 5' respectively provide signals to an evaluating electronics 6, e.g. an evaluating electronic circuit 6. A rotation transmitter or pickup 7, to which a measuring wheel can be allocated, is further connected to the evaluating electronics 6, and basically the same applies to a timing disk 8, to which are associated a timing cycle initiator and a timing shaft 9 connected with the machine. The respective output signals of the evaluating electronics 6, with the aid of and in connection with a control electronics 10, lead to the formation of control signals that are provided to an ejector 11, which ejects the detected defective products 12 and moves them into a waste or reject container 13. Instead of the ejector 11, the control electronics 10 could alternatively activate a marking device 14, by means of which the defective products 12' are first marked with a visibly apparent ink or paint mark, for example, so that these defective products 12' can later be removed from the production line, for example manually by the machine operating personnel.

As seen in FIG. 1, respective arrows A to F point from parts of the apparatus 2 carrying out the product monitoring to respective corresponding parts or areas of the production machine 1'. As is apparent from these arrows A to F and the corresponding illustrations of FIG. 1, the electronically functioning line cameras 3, 3' or the optical sensors 5, 5' on the one hand, and the capacitively functioning sensors 5, 5' on the other hand, are allocated to and respectively arranged at defined locations or exactly defined stations of the production machine 1'.

Station 15 (arrow A) is a printing station, in which a certain predefined text, picture, or other printed material is printed onto the original starting material 16, which is initially still in a continuous web shape. In this station, the exact position of the text or picture or other printed material is determined by the respective sensor or sensors.

In the following or subsequent station 17 (arrow B), the window material 19 (FIG. 1 or 3) is arranged and e.g. glued onto the window cut-out opening for the window 18 of a partially fabricated letter envelope 1 or a corresponding intermediate product 20, for an envelope 1 that is ultimately to have a window 18. In this station 17, at least one line camera 3 monitors the size and position of the window material 19 relative to the opening for the window 18.

In a further station 21 (arrow C) of the production machine 1', glue strips or tracks 22 have been provided on the side flaps 23 of a partially fabricated letter envelope 1', and respective imaging sensors carry out a monitoring or sensor detection of the presence, proper size, and proper position of the respective glue strips 22 on the side flaps 23, as this is also shown in FIGS. 4 and 5.

Next, in the area of the final closure flap folding station 26 (arrow D), or at the inlet of a drying path, the invention carries out a monitoring or sensing of the respective glue strips or tracks 24 that have been provided on the closure flaps 25 of the letter envelopes 1. In this context, the substantially completed letter envelopes 1 run through the closure flap folding station 26 in a staggered position or arrangement, as can be seen in FIGS. 1 and 6.

The ejection of the detected defective products 12 (arrow E) by means of the ejector 11 is carried out in the area of a stacking station 27, and/or, the marking of defective products 12' (arrow F) is carried out in the area of a stacking area or stacking range 28 of the stacking station 27, or before or upstream of the ejector 11.

Alternatively, the marking of defective products 12 according to arrow F can be achieved in a variable manner farther toward the front in the production path or production line, so that especially the marking can be carried out before the defective product 12' arrives at the ejector 11.

It should further be understood, that the line cameras 3, 3' can also be used for detecting the outer contour 29 (as shown in FIG. 4) of the individual cut envelope blanks 30 according to FIG. 2, or for detecting the respective corresponding forms or shapes in the case of web-shaped intermediate products 20 according to FIG. 1. Also, the text printed onto letter envelopes and shipping bags, and especially the inside printing, can be monitored by means of respective appropriately arranged line cameras. The same considerations essentially also apply for using such line cameras for monitoring pre-fold, score or crease lines in the lengthwise direction or the crosswise direction of the envelope being fabricated, or for all other characteristic features and parameters of the respective products.

There may be machine components located in the individual stations of the production machine, which make it difficult to monitor the respective characteristic parameter of interest using sensors. For example, in the area of the station 31 serving to glue the window material 19 onto the window cut-out of the envelope, various machine components may be arranged “in the way” of a direct arrangement of monitoring sensors, so that an interfering contour 32 must be taken into consideration. Such an interfering contour 32 of a machine component or the like is merely schematically indicated as a contour line 33 in FIG. 3. This interfering contour 32 makes it necessary to arrange the line camera 3 serving as a sensor at a sloping angle relative to the product.
being monitored, i.e. concretely relative to the partially fabricated letter envelope 1, because the interfering contour 32 of the machine component makes it impossible to arrange the line camera 3 in an orientation perpendicular to the partially fabricated letter envelope 1.

[0029] As shown in the illustration in FIG. 3, the optical sensor or the line camera 3 is arranged offset relative to the product to be monitored, and oriented with its image receiving optics 34 facing away from the product to be monitored. Furthermore, plural mirrors 35, and particularly in the present example embodiment five mirrors 35, are arranged appropriately to deflect the beam path 36 of the image of the product, so that this beam path 36 first extends perpendicularly from the product, and is then multiply deflected to finally enter in an axis-parallel manner into the receiving optics 34 of the line camera 3. Both the line camera 3 and the mirrors 35 are suitably arranged in a housing 37, of which the outer contour is littered or adapted to the space still remaining in consideration of the interfering contour 32 of the station 31. In the embodiment concretely illustrated in FIG. 3, this results in the fact that the beam path 36 includes a beam path portion or leg 38 which at first extends nearly parallel to the axis 39 of the optics 34 of the line camera 3. The image received by the first mirror 35 is thus deflected at angles multiple times before it can be evaluated.

[0030] In the example embodiment concretely illustrated in FIG. 3, the housing 37 comprises a first housing part 40 arranged immediately adjacent to the product, a second housing part 41 that adjoins and extends at an angle from the first housing part 40 and receives the line camera, and a third housing part 42 in which the respective mirrors 35 are arranged, which deflect the beam path 36 back into the optics 34 of the line camera 3.

[0031] The components illustrated in FIG. 3 form a monitoring arrangement 43 with an image deflection. This monitoring arrangement 43 concretely serves for monitoring the proper defect-free fabrication of the window 18 of the resultant product such as the letter envelope 1.

[0032] Similarly, the monitoring of the glue strips 22 on the side flaps 23 of the still not-yet-finished letter envelope 1 is carried out according to FIG. 4 using imaging sensors 5, past which the envelope 1 is conveyed. Each imaging sensor 5 includes a line camera 3 and a light source 4, respectively, as this is shown in FIG. 5.

[0033] A respective imaging sensor 5 is provided for each glue strip 22. Suitably, the line camera 3 and the light source 4 are arranged one after another in the motion direction of the almost completed letter envelope 1, as this is shown in FIG. 5. However, other variants in this regard are basically also suitable depending on the particular application.

[0034] The monitoring of the glue strips 24 on the closure flaps 25 is suitably carried out using plural capacitively functioning sensors 5, which together or in common respectively sense one or more glue strips 24. Respectively one capacitive sensor 5 is arranged over each one of the two ends of the glue strips 24, while a third capacitive sensor 5 is located approximately at the middle above the respective glue strip or glue strips 24. Together, these capacitive sensors 5 form a monitoring device or arrangement 43.

[0035] The capacitive sensor or sensors 5 respectively each comprise a measuring electrode 46 and a shielding electrode 47. A component of the production machine 1 itself serves as the counter electrode.

[0036] Through the aid of the inventive features of the various example embodiments described herein, it is possible to permanently detect or sense and measure actual existing values of one or more characteristic parameters or features of the product with respect to its length or dimensions and/or form or shape, or with respect to the position and/or form relative to each other, in a permanent manner, and to compare these detected actual values with stored nominal values respectively associated with these characteristic parameters or features of the product (for example stored nominal values defining the proper size, shape and position of the window opening, the window film material, the glue strips, the folded flaps, the printed text, etc. of the envelope being produced).

[0037] Then, the result of this comparison (e.g. the actual value is equal to the nominal value, or the actual value is within an acceptable tolerance range around the nominal value, or the actual value is unacceptably greater than the nominal value, or the actual value is unacceptably less than the nominal value) is used for controlling further measures. For example, the result of the comparison can be indicated on a control panel or the like for informing the machine operating personnel, and/or the result can be used to initiate corrective measures and/or for marking the respective detected defective product, and/or for ejecting the respective detected defective product out of the production line or production machine, and/or the result can be permanently documented for later review and analysis.

[0038] The invention is not limited to the concrete measures that have been described and illustrated in connection with the drawing figures herein, and especially is not limited to the monitoring of the glue strips and windows. For example, other characteristic parameters or features of the product, for example such as the rim or edge of the window cut-out opening in the cut envelope blank, as well as other cut lines of the blank, may be advantageously monitored according to the invention.

[0039] Also, the invention is not limited to use in connection with production machines for producing letter envelopes, shipping bags, and other such mailing products, as described in the detailed embodiments herein. To the contrary, the inventive method and apparatus can also be used in machines and/or stations and/or methods for stamping, cutting, folding, or producing inter-folded towels or the like, folded paper tissues or folded paper napkins or the like, of which various characteristic parameters can be detected by imaging and/or capacitive sensors.

[0040] Basically the same point also pertains to machines and processes for producing hygiene products, for example such as feminine sanitary napkins, pads, panty liners, disposable diapers, incontinence products, and the like. Not only production machines for producing the above described products, but also packaging machines for packaging the above described products can be monitored using the inventive method and sensor arrangement, so that it immediately becomes recognizable, if a product has not been properly packaged.

[0041] Furthermore, various types of sensors can be used according to the invention for monitoring the results of
printed text or images or the like produced by printing machines that are used in connection with the above mentioned machines.

[0042] Although the invention has been described with reference to specific example embodiments, it will be appreciated that it is intended to cover all modifications and equivalents within the scope of the appended claims. It should also be understood that the present disclosure includes all possible combinations of any individual features recited in any of the appended claims.

What is claimed is:

1. A method for detecting product defects of products selected from mailing products, hygiene products, and folded paper products, during producing or packaging of said products, comprising the steps:

a) producing or packaging said products in a machine including plural machine components;

b) storing a respective nominal value respectively for each one of at least one characteristic parameter or characteristic feature of said products, with respect to at least one of a dimension, a form, and a position of said products or respective parts of said products;

c) during said producing or packaging of said products, detecting a respective actual value of each said characteristic parameter or characteristic feature of said products, respectively for each individual one of said products;

d) respectively comparing each said actual value with said nominal value for each said respective characteristic parameter or characteristic feature, to provide a respective comparison result indicative of how said actual value compares to said nominal value, for each said individual one of said products; and

e) in response to and dependent on said comparison result, carrying out a further measure with respect to any defective product among said products for which said comparison result indicates that a defect exists.

2. The method according to claim 1, further comprising detecting a plurality of said actual values with respect to a dimension, a form, or a position of said product or of a part of said product, relative to each other.

3. The method according to claim 1, used for detecting said product defects of said mailing products during said producing of said mailing products.

4. The method according to claim 1, wherein said further measure of said step e) comprises at least one of indicating said comparison result, carrying out a corrective measure for correcting said defect, marking said defective product, documenting said comparison result, and ejecting said defective product out of said machine.

5. The method according to claim 1, wherein said detecting of said actual value is carried out electrically or electronically, using at least one of a line camera and a capacitive sensor.

6. The method according to claim 1, wherein said detecting of said actual value is carried out using an optical sensor or a line camera, and at least one mirror, so as to deflect an image beam of an image of said characteristic parameter or characteristic feature of said product via said at least one mirror to be received by said optical sensor or said line camera.

7. The method according to claim 1, wherein said characteristic parameter or characteristic feature of said product comprises at least one of a size, dimensions, a position, and a shape of a contour of a cut blank for said product, or of at least one glue strip of said product.

8. The method according to claim 1, used for detecting said defects in said folded paper products or said hygiene products during said producing of said folded paper products or said hygiene products, or for detecting said defects in said mailing products or said hygiene products during said packaging of said mailing products or said hygiene products.

9. The method according to claim 1, further for detecting defects in printed matter that is printed onto said products by a printing machine during said producing of said products.

10. An apparatus for producing mailing products, hygiene products, or folded paper products, and for detecting product defects of said products, comprising:

   a plurality of machine components forming plural machine stations for performing successive steps in producing said products;

evaluation electronics; and

   at least one of an imaging sensor and a capacitive sensor arranged to monitor said products in at least one of said machine stations and connected for signal transmission to said evaluating electronics.

11. The apparatus according to claim 10, wherein said sensor is arranged to monitor at least one of a size, dimensions, and a position of a contour of at least one of a cut blank for said products and glue strips for said products.

12. The apparatus according to claim 10, further comprising a housing and at least one mirror, wherein said sensor is arranged in said housing together with said at least one mirror which is arranged to deflect an image beam path from said product to said sensor.

13. The apparatus according to claim 10, comprising at least two of said sensors grouped together to form a monitoring device.