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(54) Title: A QUALITY CONTROL SYSTEM FOR HOUSEHOLD GLASS PRODUCTS

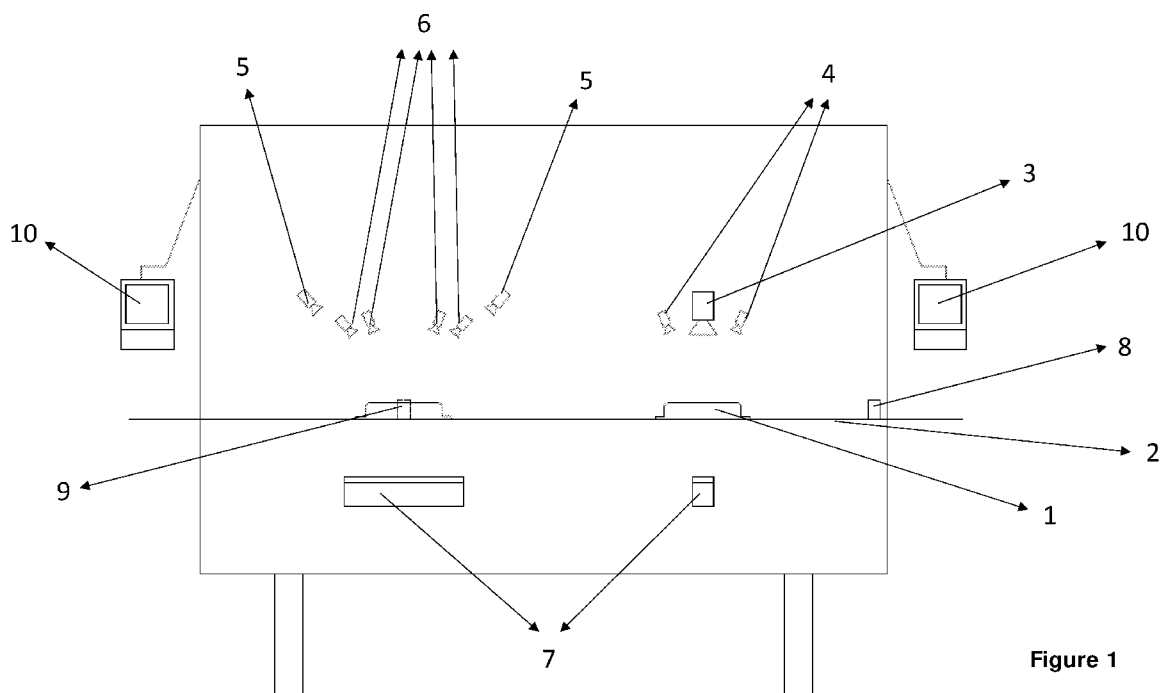


Figure 1

(57) Abstract: The present invention relates to an automated quality control system developed for inspection household glass products such as ovenware, cornered products, bowls and storage boxes made of borosilicate, soda-lime and crystal glasses against manufacturing defects.



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DESCRIPTION**A QUALITY CONTROL SYSTEM FOR HOUSEHOLD GLASS PRODUCTS****5 Field of the Invention**

The present invention relates to an automated quality control system developed for inspection household glass products such as ovenware, cornered products, bowls and storage boxes made of borosilicate, soda-lime and crystal glasses against manufacturing defects.

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Background of the Invention (Prior Art)

In the quality control methods employed in the state of the art, the household glass products manufactured of borosilicate, soda-lime and crystal glasses in press machines, are sorted according to defects at the end of the cooling process completely by manual inspection and human eye, wherein the quality control process takes place depending on the decision made by the operator by interpreting certain quality control criteria based on experience.

This manual method of the prior art causes varying interpretations from one operator to another, and thus delivery of the defective products to the user depending on the perspective of the operator due to the fact that glass products are sorted according to defects completely by manual inspection and human eye.

In this method, a proper quality control is significantly dependent on the competence and eyesight of the operator; and the inability to observe defects depending on the quantity of light in the environment where quality control is performed and on the viewpoint of the operator to the product presents an important problem in terms of quality control.

In order to overcome these technical problems in the state of the art, the quality control process needs to be standardized by performing said process using automated systems instead of manual inspection and human eye.

One of the system used in the state of the art with a view to overcome these technical problems is the Patent Application No. US5729340. Said invention discloses

performing the inspection and recording by means of cameras via transmitting a diffused beam of light for detecting the flaws in glass bottles. Thus, the flaws on the bottles can be detected from different directions.

Another exemplary document is the Patent Application No. DE3611536. Said invention
5 discloses at least one camera and illumination apparatus for testing glass objects which are distanced at certain intervals, for use as a testing device in order to test transparent objects, in particular glass bottles, for automatically detecting manufacturing faults. The transparent objects arranged on a linear plane are scanned by at least one or more cameras and the faults thereon are detected.

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Summary and Objects of the Invention

The quality control system according to the invention consists of 9 cameras, 2 light sources, and two separate control sections, wherein the defect inspection criteria can be adjusted and the quality control assessment can be stably performed over these criteria.
15 Thus, different interpretations of the quality control criteria on the same product are prevented.

The sufficient lighting is ensured using one or more fixed light sources within the system and images are taken from the angles in which the measurement is desired to be made using one or more cameras. This, in turn, inspects quality control errors resulting from
20 the quantity of light and the viewpoint to the product.

The newly developed system allows sorting the defective products at the rate of 100%.

It is aimed by developing the quality control system according to the invention to:

- Ensure the standardization of the quality control criteria and an assessment
25 complying with the standards,
- Eliminate the dependency on the manual control performed by humans,
- Perform the assessment under sufficient light and from a fixed viewpoint to the product,
- Perform dimensional measurements,
- Shorten the process time by means of the automated quality control process, and
30

- Observe the defects along with their sizes and to perform statistical evaluation regarding the defects by means of recording.

Description of the Drawings

5 The drawings for a better understanding of the quality control system developed with the present invention and the explanations related thereto are given below.

Fig. 1: Schematic view of the quality control system along the tunnel.

Description of the Part References

10 The parts and components which are shown in the drawings illustrating the quality control system developed with the present invention for a better understanding of the invention are enumerated individually and the reference numbers corresponding thereto are presented below.

1. Glass product
- 15 2. Conveyor
3. Bottom surface camera
4. Side surface camera
5. Handle camera
6. Corner camera
- 20 7. Fixed light source
8. Entry photocell
9. Trigger photocell
10. Computer system

25 Detailed Description of the Invention

The glass products (1) such as ovenware, cornered products, bowls and storage boxes made of borosilicate, soda-lime and crystal glasses are fed to the annealing lehrs or tempering units through the automatic line subsequent to being formed in press/press

blowing machines at the hot end. The products exiting the annealing lehrs or tempering units are transferred to the quality control system according to the invention over the conveyor (2) in a single row.

5 The quality control system according to the invention operates as a defect inspection system consisting of at least 9 cameras (3, 4, 5 and 6), at least 2 fixed light sources (7), and two separate control sections.

10 In the first control section, as in the state of the art, the bottom surface and side surfaces of the glass product (1) are inspected by means of at least one bottom surface camera (3), at least two side surface cameras (4), and at least one fixed light source (7). The entry of the product to the quality control system is determined by a photocell (8) disposed in the entry of the system and this product (1) is monitored until it gets out of the system.

The fixed light source (7) and the cameras (3 and 4) are activated by the signals coming from the photocell (8) used within the system.

15 The images recorded by the cameras (3, 4, 5 and 6) are processed by the control algorithm depending on the speed of the conveyor (2) belt and the product (1) image is formed in the computer system (10). These recorded images are processed in the computer (10) in the quality control system. It is possible with these processed images to detect the defects on the glass product (1) which are formed during or after the manufacturing process
20 by way of the difference in the contrast. If there is any defect on the glass product (1), the system stores the defective product in its memory to be rejected at the exit of the machine.

25 The defective or non-defective products (1) having undergone the first control section are transferred to the second control section by the conveyor (2). Here, at least one fixed light source (7) disposed between the two-section conveyor (2) is illuminated by being triggered by a trigger photocell (9) when the product (1) assumes the suitable position; in the meantime, the images are recorded by triggering the at least four corner cameras (6) facing the corners of the product (1) in the advancing direction, and if any, at least two handle cameras (5) facing the handle portion of the product (1). The same process is also performed by the cameras (5 and 6) at the other side facing the handle and corners of the
30 product (1), if any. The cameras (6) facing the corners of the product (1) are located such that they will correspond to the top of each corner. The cameras (5) facing the handles of the product (1), on the other hand, are located above the cameras (6) facing the corners in an angular manner. The images thus taken are recorded in the memory of the computer system (10). These recorded images are processed by the system and the defective products

are detected by way of the difference in the contrast. The defective products (1) are stored in the memory to be rejected at the exit of the machine. At the exit of the machine, the defective products (1) are rejected while the non-defective products (1) are delivered to the packaging section by the conveyors (2) according to the incoming information from both control sections of the quality control system. The fact that the process in which the defective products (1) are rejected and the non-defective products are sent to the packaging section is conducted accurately by the machine is ensured by monitoring the product (1) entering the machine until the exit of the machine.

CLAIMS

1. A quality control system developed as a supplementary system to the quality control systems in which the glass products (1) such as ovenware, cornered products, bowls and storage boxes made of borosilicate, soda-lime and crystal glasses are transferred to the annealing lehrs or tempering units through the automatic line subsequent to being formed at the hot end, and then being transferred by the conveyor (2) in a single row for bottom surface and side surface inspection, characterized in comprising:
- A two-section conveyor (2) by which the defective or non-defective glass product (1) having undergone the first control section is carried along the line,
 - At least one trigger photocell (9) activating the fixed light source (7) and the cameras (5 and 6),
 - at least one fixed light source (7) being illuminated by being triggered by the at least one trigger photocell (9) when the product (1) assumes the suitable position,
 - At least four corner cameras (6) facing the corners of the product (1) in the advancing direction,
 - At least two handle cameras (5) facing the handle portion of the product (1) in the advancing direction, and
 - At least one computer system (10) by which the images recorded by the cameras (5 and 6) are stored in the memory and processed, and also the product (1) is monitored along the quality control system.
2. The quality control system according to Claim 1, characterized in that the glass product (1) is an ovenware, a cornered product, or a bowl.
3. The quality control system according to Claim 1, characterized in that the cameras (6) facing the corners of the product (1) are located such that they will correspond to the top of each corner.
4. The quality control system according to Claim 1, characterized in that the cameras (5) facing the handles of the glass product (1) are located above the cameras (6) facing the corners in an angular manner.

5. A method for operating the quality control system according to Claim 1, characterized in that it comprises the process steps of:

- Transferring the defective or non-defective products (1) having passed from the first control section to the second control section by the conveyor (2),
- 5 • Illuminating the at least one fixed light source (7) disposed between the two-section conveyor (2) by the at least one trigger photocell (9) when the product (1) assumes the suitable position,
- In the meantime, recording the images by the at least four corner cameras (6) facing the corners of the product (1) in the advancing direction, and if any, at
10 least two handle cameras (5) facing the handle portion of the product (1),
- Performing the same process by the cameras (5 and 6) at the other side facing the handle and corners of the product (1), if any,
- Recording the images thus taken in the memory of the computer system (10),
- Processing the recorded images by the system and detecting the defective
15 products by way of the difference in the contrast,
- Storing the defective products (1) in the memory to be rejected at the exit of the machine,
- At the exit of the machine, rejection the defective products (1) according to the incoming information from both control sections of the quality control system,
- 20 • Delivering the non-defective products (1) to the packaging section by the conveyors (2), and
- Monitoring the product (1) entering the machine until the exit of the machine in order to ensure that the process in which the defective products (1) are rejected and the non-defective products (1) are sent to the packaging section is
25 conducted accurately by the machine.

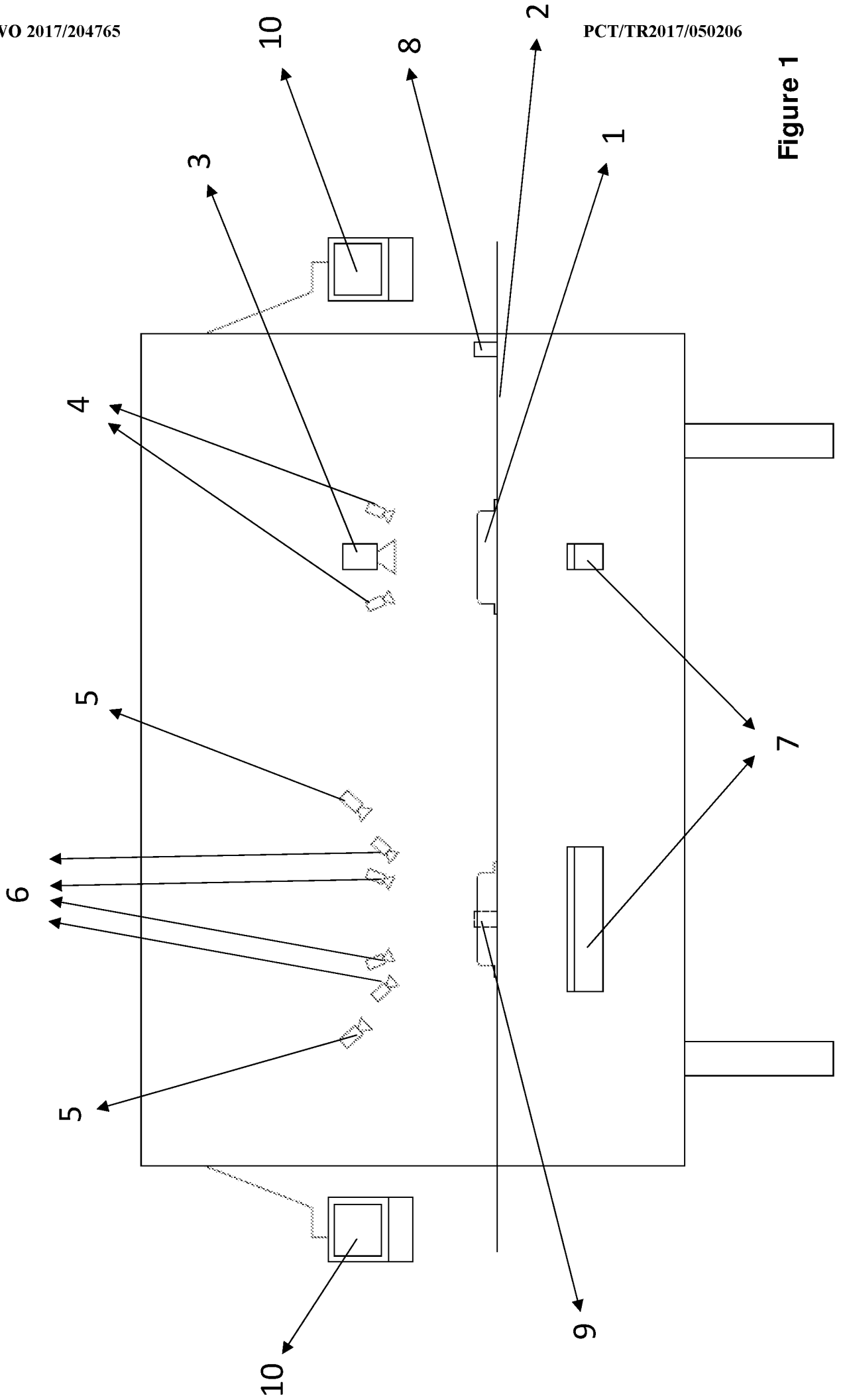


Figure 1