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(54) APPARATUS AND METHOD FOR DETECTING DEFECTS IN A FOODSTUFF

VORRICHTUNG UND VERFAHREN ZUM ERKENNEN VON FEHLERN IN LEBENSMITTELN

DISPOSITIF ET PROCÉDÉ POUR DÉTECTER DES FAUTES DANS DES PRODUITS
ALIMENTAIRES

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Description

[0001] The invention concerns an apparatus and a method for detecting defects in a foodstuff, such as fruit, vegetables, pods, seeds or the like, e.g. known from WO-A-96/40452.

[0002] More in detail, the invention relates to an apparatus and to a method that allows defects on the outer surface of a foodstuff to be detected even when this latter has a substantially uniform and intact colour.

[0003] The invention is particularly effective for application in systems for the selection of fruit and vegetables provided with a shell (or endocarp), of pods or of seeds, the outermost part of which is damaged or dented, for example by insects, parasites or the like.

[0004] To date, apparatus for analysing and selecting foodstuffs and in particular fruit, vegetables, legumes or the like, are known.

[0005] These apparatus are typically provided with optical systems configured to inspect the surface of the foodstuff and to detect any defects such as marks, foreign bodies, damaged or dented areas, or a different colour to the desired colour (for example due to incorrect ripening or to deterioration of the product).

[0006] Known optical systems generally comprise one or more video cameras and control units provided with software that processes the images filmed and identifies, among the products filmed, those with abnormalities in the shades of colour.

[0007] Typically, these optical systems cooperate with selection or separation devices configured to separate, in a volume of intact products, those with the aforesaid defects.

[0008] The optical systems known today offer good performance when the areas involved by the defects or abnormalities have a colour that differs in a sufficiently marked manner from the colour of the rest of the shell or outer surface of the foodstuff.

[0009] However, in some cases the surface in the defective area can maintain a very similar colour to the surrounding colour.

[0010] This occurs, for example, in fruits such as chestnuts, nuts (hazelnuts, almonds, Brazil nuts), in some seeds (sunflower seeds, pine nuts) or in some legumes.

[0011] In this situation, it is difficult to calibrate the optical system so that it identifies as rejects only products that are effectively defective or dented.

[0012] In fact, a more conservative calibration of the system can cause intact fruit, which only has variations in the colour of the surface but no actual defects, to be removed. On the contrary, with less limiting calibration, some defective fruit might not be identified and therefore conveyed together with the intact fruit in the subsequent steps of the process chain.

[0013] For the aforesaid reasons, the selection of some of the foodstuffs mentioned, such as chestnuts or nuts, is still performed manually on sorting belts or the like.

[0014] In this context, an object of the present invention

is to propose an apparatus for detecting defects in a foodstuff, and the related method, that overcomes the problems of the prior art mentioned above.

[0015] In particular, an object of the present invention is to propose an apparatus and a method that allow identification of defects on the outer surface of products such as fruit, vegetables, pods or seeds, which would be difficult to detect optical systems according to the prior art.

[0016] Therefore, an object of the present invention is to propose an apparatus and a method capable of emphasizing the aforesaid defects with respect to the surrounding surface of the foodstuff.

[0017] Another object of the present invention is to propose an apparatus for detecting defects in a foodstuff, which is of simple construction and can use known optical systems.

[0018] A further object of the present invention is to provide a system for the selection of foodstuffs that operates with greater precision with respect to known systems.

[0019] Besides those mentioned above, an object of the present invention is also to provide a system for the selection of foodstuffs with a production capacity equal to or greater than that of known systems.

[0020] These objects are achieved by an apparatus for detecting defects on the outer surface of foodstuffs as defined in independent claim 1. It comprises

- transport means configured to convey a quantity of foodstuffs through the apparatus; and
- an optical system configured to analyse the surface of the foodstuffs and detect the presence of any defects.

[0021] The apparatus according to the invention also comprises application means, adapted to distribute a dry or fluid contrast material onto the surface of the foodstuffs, such that said contrast material can penetrate into any surface defects.

[0022] The contrast material therefore has the task of making the defects more visible with respect to the rest of the surface.

[0023] For this purpose, advantageously, the contrast material can have a different colour to that of the surface of the foodstuff and more preferably can have a shade that contrasts with the shade of the surface of the foodstuff.

[0024] This different colour can be perceptible in conditions of natural lighting or by illuminating the products with artificial lights such as.

[0025] Preferably, the apparatus also comprises removal means adapted to remove excess contrast material from the surface of the product, so that the contrast material remains inside the surface defects only. These removal means, if provided, are positioned in the apparatus so as to act before the foodstuffs are inspected by the optical system.

[0026] Therefore, the removal means contribute to

make the area of the surface involved by any defects even more evident and circumscribed, limiting possible reading errors of the optical system.

[0027] In an aspect of the invention, the contrast material preferably comprises an edible compound or substance. In this way any residues of this material do not compromise the edibility of the product even when it has no shell.

[0028] This material can be dispensed in dry form, for example a powder, or in liquid form.

[0029] In another aspect of the invention, the application means comprise a chamber with at least one opening through which the foodstuffs and/or the contrast material be introduced and/or extracted.

[0030] Typically, for example, the chamber is delimited by a container.

[0031] Advantageously, said container can be provided with rotation means that rotate it, so as to mix the foodstuffs with the contrast material.

[0032] In this way a better distribution of the contrast material over the whole of the surface of the foodstuff is obtained, ensuring its penetration into any defects.

[0033] In a preferred variant, said container comprises a first opening through which the foodstuffs to be covered are introduced, and a second opening from which the foodstuffs covered with the contrast material are extracted. This container, served by the transport means, enable operation in a continuous cycle, maximising the productivity of the apparatus.

[0034] In another aspect of the invention, the application means can comprise delivery means adapted to deposit the contrast material on the surface of the foodstuff.

[0035] Advantageously, said delivery means can be associated with handling means, such as rollers or the like, which allow the foodstuff to rotate during the application step of the contrast material so that this latter covers the whole of the surface of the foodstuff.

[0036] These delivery means are appropriately chosen to dispense the material both dry and in liquid form.

[0037] According to another aspect of the invention, the removal means of the contrast material comprise mechanical means adapted to interact with the surface of the foodstuff, such as brushes, pads or the like. These means are preferably usable when the contrast material is of dry or powder type.

[0038] Alternatively, said removal means can comprise distributor means adapted to spread a liquid or gaseous fluid onto the surface of the foodstuff.

[0039] This fluid can, for example, be compressed air or water, optionally mixed with other substances for food use. This last variant is more effective when the contrast material is also applied in liquid form.

[0040] According to a further variant, said removal means can comprise vibrating means adapted to shake the foodstuff to cause the contrast material to be detached from the outer surface.

[0041] Alternatively, other means such as centrifuges or washing tanks can be used to remove the excess con-

trast material from the surface of the product.

[0042] The invention also concerns a system for the selection of foodstuffs provided with an apparatus for identifying defects according to one of the variants described above.

[0043] Separation of the products on which the presence of at least one defect has been detected is performed by a separation device, connected to the optical system of the apparatus.

[0044] The present invention also concerns a method for detecting defects on the surface of foodstuffs as defined in independent claim 9. According to the invention, the method comprises a first step consisting of distributing a contrast material on the surface of the foodstuff so that the contrast material penetrates into the defects.

[0045] This distribution can advantageously be performed with application means such as those described above.

[0046] Subsequently, the method provides for removing the excess contrast material from the surface so that it remains inside the defects only.

[0047] Removal of the excess material is preferably performed with removal means such as those of the apparatus according to the invention.

[0048] Subsequently, with an optical system, it is possible to analyse the surface of the foodstuffs to detect the presence of defects.

[0049] The properties of the contrast material used, just as the effects and the advantages of the analysis performed with the aforesaid method, are the same described above.

[0050] Advantageously, according to another aspect of the invention, the method also provides for identification of the products with defects and their separation from conforming products.

[0051] In another aspect of the invention, the aforesaid steps are carried out continuously in a system provided with foodstuff transport means.

[0052] Further characteristics and advantages of the present invention will become more apparent from the description of an example of a preferred, but not exclusive, embodiment of an apparatus for detecting defects on the outer surface of a foodstuff, as illustrated in the accompanying figures, wherein:

- Fig. 1 is a schematic side view of a system for the selection of foodstuffs that includes the apparatus according to a variant of the invention;
- Fig. 2 is a schematic side view of a system for the selection of foodstuffs that includes the apparatus according to another variant of the invention;
- Figs. 3a, 3b and 3c show a fruit with a defect on the surface before treatment in the system, after application of the contrast material and after removal of the material from the surface

[0053] With reference to Fig. 1, the reference numeral 1 indicates as a whole a system for the selection of food-

stuffs.

[0054] The system according to the invention is particularly, but not exclusively, useful in the selection of fruits provided with a shell, such as chestnuts, hazelnuts, walnuts, almonds, Brazil nuts, pods in general, or products without a shell such as pine nuts, peanuts, sunflower seeds or the like.

[0055] In fact, these products are often attacked by insects or other parasites that damaging the shell, if present, or the outer surface, cause deterioration of the product.

[0056] A fruit (chestnut) with some defects on the surface is represented by way of example in Fig. 3a.

[0057] The selection system 1 comprises an apparatus 10 for identifying the products with the aforesaid defects and a separation device 50 for separating these products with defects from conforming products.

[0058] In the variant illustrated, the apparatus 10 is provided with transport means, such as belts, rollers, elevators or the like, to transport the foodstuffs P (hereinafter also only products P), continuously, through the apparatus.

[0059] The products P from a storage basin 11 are conveyed toward application means, indicated as a whole with 20.

[0060] In the variant of Fig. 1, said application means 20 comprise a chamber 21 into which the products P are conveyed.

[0061] Said chamber 21 is delimited by a container 22 and has at least one opening through which the products P can be introduced and/or extracted, for example by means of an elevator 12.

[0062] A contrast material 23 is contained inside the chamber 21. When the products are transported into the chamber, their outer surface comes into contact with the contrast material. In this way, if the surface of a product has defects, such as a hole, a scratch or the like, the contrast material can penetrate into these defects, as visible in Fig. 3b.

[0063] The aim of the contrast material is to make the aforesaid defect evident so that it can be easily identified by an optical inspection system, better described below.

[0064] The contrast material is preferably an edible compound or substance, preferably for food use. In this way, any traces of the contrast material that might remain on the shell or on the outer surface of the product do not compromise its edibility.

[0065] The contrast material can be dry, for example a powder, or fluid, for example liquid.

[0066] A dry and powdery material may be preferable, both for the ease with which it penetrates into surface defects, even of small dimension, and due to the fact that, subsequently, it is easily removable from the rest of the surface.

[0067] Suitable dry materials are, for example, flours or other milled plant products.

[0068] The yield of the contrast material depends on the difference between its colour and the colour of the

surface of the product P. Typically, a contrast material with a different and contrasting shade to the shade of the shell or of the surface of the product P is chosen.

[0069] This contrast, depending on the type of material, can be perceptible with the product illuminated by natural light or with artificial light.

[0070] Moreover, the contrast can also be perceived by the naked eye or even only by an optical vision system.

[0071] In the variant illustrated, the container 22 has an inlet 22a through which the products picked up from the basin 11 are introduced and an outlet 22b from which the products P covered with the contrast material are extracted, for example by means of a screw conveyor 13. Advantageously, the container 22 can be connected to rotation means, not illustrated in the figure, that rotate it to allow the products to mix with the contrast material inside the container. The apparatus according to the invention can also comprise removal means 30, provided to clean the surface of the product so that the contrast material remains inside the surface defects only, as visible in Fig. 3c.

[0072] In this way, the defect is more evident with respect to the rest of the surface that surrounds it, facilitating identification by the optical system.

[0073] These means can be mechanical means that interact directly with the surface of the product, for example through contact and rubbing.

[0074] Means such as brushes 31 (Fig. 1), pads made of flexible materials or other similar means can be used for this purpose.

[0075] According to the invention, analysis of the products to detect the defects is performed by an optical system indicated as a whole with 40.

[0076] This system comprises at least one filming device 41, typically one or more video cameras, that film a group of moving products transported by the transport means. The system also comprises a control unit 43 that processes the images of the video camera to identify any defects on one or more of the products filmed in a given image.

[0077] In the variant illustrated, the system comprises a set 41 of linear video cameras capable of filming a band of moving products having a given width.

[0078] To allow the whole surface of each product to be filmed, the system preferably comprises two sets of video cameras 41, 42 positioned so as to film the products from opposite directions.

[0079] For this purpose, the products are dispensed by a belt 44 in a single uniform layer to allow the video cameras to film each product entirely.

[0080] Artificial lighting devices can be provided to emphasize the colour of the products filmed and/or of the contrast material.

[0081] The selection system 1, as already mentioned, is also provided with a separation system 50.

[0082] The separation system 50 is connected to the control unit 43 and is configured to separate, from a group of products, those on which the presence of at least one

defect has been detected.

[0083] Separation is performed by mechanical devices, such as moving side panels, diverters or the like, or by means of suitably driven air jets.

[0084] Other means known to those skilled in the art can also be used for the purpose described above.

[0085] Fig. 2 illustrates another variant of the selection system, indicated as a whole with 100.

[0086] The system comprises an apparatus 110 for identifying defects to separate products with defects from conforming products and a separation device 150 to separate products with defects from conforming products.

[0087] In this variant, the optical system 140 and the separation system 150 are identical to those of Fig. 1 described above.

[0088] Instead, the application means 120 comprise delivery means adapted to deposit the contrast material 123 on the surface of the products P.

[0089] The delivery means can, for example, be nozzles 121 or the like, configured to dispense a dry powder material or a fluid or liquid.

[0090] Advantageously, rollers 122 or the like can be provided to rotate the products during their transport so that the contrast material is distributed uniformly on the surface.

[0091] Similarly, the removal means 130 also comprise distributor means 131, such as nozzles or the like, adapted to deliver a fluid onto the surface of the foodstuff.

[0092] This fluid can be a liquid, for example water, or compressed air or, alternatively, a mixture of both.

[0093] Further variants of the apparatus for identifying defects in foodstuffs, not shown, can be obtained by equipping the apparatus in Fig. 1 with the application or removal means of the variant in Fig. 2, or vice versa.

[0094] The invention has been described for illustrative and non-limiting purposes according to some preferred embodiments thereof. Those skilled in the art may find numerous other embodiments and variants, all falling within the scope of protection of the claims below.

Claims

1. Apparatus (10, 110) for detecting defects on the outer surface of foodstuffs (P) comprising:

- an optical system (40, 140) configured to analyse the surface of the foodstuffs (P) and detect the presence of any defects; and
- transport means configured to convey a quantity of foodstuffs through the apparatus; **characterised in that** it comprises application means (20, 120) adapted to distribute a dry or fluid contrast material (23, 123) onto the surface of the foodstuffs (P), such that said contrast material can penetrate into any surface defects, and removal means (30, 130) adapted to remove excess contrast material from the surface, so that

it remains inside the aforementioned surface defects only, said contrast material making the defects detectable by the optical system.

2. Apparatus according to claim 1, **characterised in that** said application means (20) comprise a chamber (21) with at least one opening through which the foodstuffs (P) and/or the contrast material (23) can be introduced and/or extracted.

3. Apparatus according to claim 2, **characterised in that** said chamber is delimited by a container (22).

4. Apparatus according to claim 3, **characterised in that** said container (22) comprises a first opening (22a) through which the foodstuffs (P) are introduced, and a second opening (22b) from which the foodstuffs (P) covered with the contrast material (23) are extracted.

5. Apparatus according to claim 3 or 4, **characterised in that** said container (22) is connected to rotation means that rotate it in order to mix the foodstuffs with the contrast material (23) inside the chamber (21).

6. Apparatus according to claim 1, **characterised in that** said application means (120) comprise delivery means (121) adapted to dispense the contrast material onto the surface of the foodstuffs (P).

7. Apparatus according to any of the previous claims, wherein said contrast material removal means (30, 130) are chosen from:

- mechanical means (30) adapted to interact with the surface of the foodstuff;
- distributor means (130) adapted to deliver a liquid or gaseous fluid onto the surface of the foodstuff;
- vibrating means adapted to shake the foodstuff to cause the contrast material to be detached from the surface.

8. System for the selection of foodstuffs, comprising:

- an apparatus (10, 110) for identifying defects in a foodstuff (P) according to any of the previous claims;
- a separation device (50, 150), connected to the optical system (40, 140), configured to separate into a group of foodstuffs those that have at least one defect.

9. Method for detecting defects on the surface of foodstuffs, comprising the following steps:

- distributing a contrast material (23, 123) onto the surface of the foodstuffs (P) by means of

application means (20, 120), so that the contrast material penetrates inside the defects;
 - removing the contrast material (23, 123) from the surface by means of removal means (30, 130), so that said contrast material remains inside the defects only;
 - analysing the surface of the foodstuffs by means of an optical system (40, 140) to detect the presence of defects.

10. Method according to claim 9, **characterised in that** the aforementioned steps are carried out continuously in an apparatus provided with foodstuff transport means.
11. Method for the selection of foodstuffs by which products with defects are identified and said products with defects are separated from conforming products, **characterised in that** defect identification is achieved using a method according to claim 9 or 10.
12. Apparatus or method, according to any of the previous claims, **characterised in that** said contrast material (23, 123) has a color that contrasts with that of the surface of the foodstuff.
13. Apparatus or method, according to any of the previous claims, **characterised in that** said contrast material (23, 123) comprises an edible compound or substance.
14. Apparatus or method, according to claim 13, **characterised in that** said contrast material (23, 123) is in a dry or fluid form.

Patentansprüche

1. Gerät (10, 110), um Defekte auf der Lebensmitteloberfläche (P) festzustellen, umfassend:
 - ein optisches System (40, 140), konfiguriert, um die Lebensmitteloberfläche (P) zu analysieren und das Vorhandensein eventueller Defekte festzustellen; und
 - Transportmittel, konfiguriert, um eine Anzahl von Lebensmitteln durch das Gerät zu befördern;**gekennzeichnet durch** die Tatsache, dass es Anwendungsmittel (20, 120) umfasst, geeignet, ein trockenes oder flüssiges Kontrastmaterial (23, 123) auf der Lebensmitteloberfläche (P) zu verteilen, so dass besagtes Kontrastmaterial in die eventuellen Oberflächendefekte eindringen kann, und Entnahmemittel (30, 130), geeignet, das überschüssige Kontrastmaterial von der Oberfläche zu entfernen, so dass dieses nur im Inneren der sogenannten Oberflä-

chendefekte bleibt, wobei besagtes Kontrastmaterial die Defekte vom optischen System feststellbar macht.

2. Gerät, gemäß Anspruch 1, **gekennzeichnet durch** die Tatsache, dass besagte Anwendungsmittel (20) eine Kammer (21) mit mindestens einer Öffnung umfassen, durch die die Lebensmittel (P) und/oder das Kontrastmaterial (23) eingeführt und/oder entnommen werden können.
3. Gerät, gemäß Anspruch 3, **gekennzeichnet durch** die Tatsache, dass besagte Kammer von einem Behälter (22) umgrenzt wird.
4. Gerät, gemäß Anspruch 3, **gekennzeichnet durch** die Tatsache, dass besagter Behälter (22) eine erste Öffnung (22a) umfasst, durch die die Lebensmittel (P) eingeführt werden, und eine zweite Öffnung (22b), aus der die mit dem Kontrastmaterial (23) überzogenen Lebensmittel (P) entnommen werden.
5. Gerät, gemäß Anspruch 3 oder 4, **gekennzeichnet durch** die Tatsache, dass besagter Behälter (22) mit Rotationsmitteln verbunden ist, die ihn drehen, um die Lebensmittel mit dem Kontrastmaterial (23) im Inneren der Kammer (21) zu vermischen.
6. Gerät, gemäß Anspruch 1, **gekennzeichnet durch** die Tatsache, dass besagte Anwendungsmittel (120) Verteilungsmittel (121) umfassen, geeignet, das Kontrastmaterial auf der Lebensmitteloberfläche (P) zu verteilen.
7. Gerät, gemäß einem jeglichen der vorhergehenden Ansprüche, bei dem besagte Entnahmemittel (30, 130) des Kontrastmaterials ausgewählt werden zwischen:
 - mechanischen Mitteln (30), geeignet mit der Lebensmitteloberfläche zusammenzuarbeiten;
 - Sprühmitteln (130), geeignet, ein Fluid, flüssig oder gasförmig, auf die Lebensmitteloberfläche zu sprühen;
 - vibrierenden Mitteln, geeignet, die Lebensmittel zu schütteln, um die Loslösung des Kontrastmaterials von der Oberfläche zu bewirken.
8. Anlage für die Wahl der Lebensmittel, umfassend:
 - ein Gerät (10, 110) zur Feststellung von Defekten in Lebensmitteln (P) gemäß einem jeglichen der vorhergehenden Ansprüche;
 - eine Trennvorrichtung (50, 150), verbunden mit dem optischen System (40, 140), konfiguriert, um in einer Gruppe von Lebensmitteln diejenigen zu trennen, die mindestens einen Defekt aufweisen.

9. Methode zur Feststellung von Defekten auf der Lebensmitteloberfläche, die folgende Phasen umfasst, bestehend in der:

- Verteilung, durch Anwendungsmittel (20, 120), eines Kontrastmaterials (23, 123) auf der Lebensmitteloberfläche (P), so dass das Kontrastmaterial in das Innere der Defekte eindringt; 5
- Entnahme, durch Entnahmemittel (30, 130), des Kontrastmaterials (23, 123) von der Oberfläche, so dass besagtes Kontrastmaterial nur im Inneren der Defekte verbleibt; 10
- Analyse der Lebensmitteloberfläche mit einem optischen System (40, 140), um das Vorhandensein von Defekten festzustellen. 15

10. Methode, gemäß Anspruch 9, **gekennzeichnet durch** die Tatsache, dass die obigen Phasen in einem Gerät, das mit Lebensmittel-Transportmitteln ausgestattet ist, kontinuierlich ausgeführt werden. 20

11. Methode für die Auswahl von Lebensmitteln, bei der man Produkte mit Defekten ermittelt und besagte Produkte mit Defekten von konformen Produkten trennt, **gekennzeichnet durch** die Tatsache, dass die Feststellung der Defekte mit einer Methode gemäß Anspruch 9 oder 10 erzielt wird. 25

12. Gerät oder Methode, gemäß einem jeglichen der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass besagtes Kontrastmaterial (23, 123) eine Färbung aufweist, die mit der der Lebensmitteloberfläche im Kontrast steht. 30

13. Gerät oder Methode, gemäß einem jeglichen der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass besagtes Kontrastmaterial (23, 123) eine Mischung oder einen essbaren Stoff umfasst. 35

14. Gerät oder Methode, gemäß Anspruch 13, **gekennzeichnet durch** die Tatsache, dass besagtes Kontrastmaterial (23, 123) eine trockene oder flüssige Form aufweist. 40

Revendications

1. Appareil (10, 110) pour détecter les défauts sur la surface extérieure des produits alimentaires (P) comprenant : 50

- un système optique (40, 140) configuré pour analyser la surface des produits alimentaires (P) et détecter la présence d'éventuels défauts ; et 55
- des moyens de transports configurés pour convoier une quantité de produits alimentaires à travers l'appareil ;

caractérisé par le fait qu'il comprend des moyens d'application (20, 120) prévus pour distribuer un matériau de contraste (23, 123), sec ou fluide, sur la surface des produits alimentaires (P), de sorte que ledit matériau de contraste puisse pénétrer dans les éventuels défauts de surface, et des moyens d'élimination (30, 130) prévus pour éliminer le matériau de contraste en excès de la surface, de sorte que celui-ci reste uniquement à l'intérieur desdits défauts de surface, ledit matériau de contraste permettant de rendre les défauts détectables par le système optique.

2. Appareil, selon la revendication 1, **caractérisé par le fait que** lesdits moyens d'application (20) comprennent une chambre (21) avec au moins une ouverture à travers laquelle peuvent être introduits et/ou extraits les produits alimentaires (P) et/ou le matériau de contraste (23).

3. Appareil, selon la revendication 3, **caractérisé par le fait que** ladite chambre est délimitée par un récipient (22).

4. Appareil, selon la revendication 3, **caractérisé par le fait que** ledit récipient (22) comprend une première ouverture (22a) à travers laquelle sont introduits les produits alimentaires (P) et une deuxième ouverture (22b) par laquelle sont extraits les produits alimentaires (P) recouverts avec le matériau de contraste (23).

5. Appareil, selon la revendication 3 ou 4, **caractérisé par le fait que** ledit récipient (22) est relié à des moyens de rotation qui le font tourner pour mélanger les produits alimentaires avec le matériau de contraste (23) à l'intérieur de la chambre (21).

6. Appareil, selon la revendication 1, **caractérisé par le fait que** lesdits moyens d'application (120) comprennent des moyens de distribution (121) prévus pour distribuer le matériau de contraste sur la surface des produits alimentaires (P).

7. Appareil, selon l'une des revendications précédentes, dans lequel lesdits moyens d'élimination (30, 130) du matériau de contraste sont choisis parmi :

- moyens mécaniques (30) prévus pour interagir avec la surface du produit alimentaire ;
- moyens de distribution (130) prévus pour distribuer un fluide, liquide ou gazeux, sur la surface du produit alimentaire ;
- moyens vibrants prévus pour secouer le produit alimentaire pour causer le détachement du matériau de contraste de la surface.

8. Installation pour la sélection de produits alimentaires

comprenant :

- un appareil (10, 110) pour l'identification des défauts dans un produit alimentaire (P) selon l'une des revendications précédentes ; 5
- un dispositif de séparation (50, 150), relié au système optique (40, 140), configuré pour séparer dans un groupe de produits alimentaires ceux qui présentent au moins un défaut. 10

9. Méthode pour la détection de défauts sur la surface des produits alimentaires qui comprend les phases suivantes consistant à :

- distribuer, avec des moyens d'application (20, 120), un matériau de contraste (23, 123) sur la surface des produits alimentaires (P) de sorte que le matériau de contraste pénètre à l'intérieur des défauts ; 15
- éliminer, avec des moyens d'élimination (30, 130), le matériau de contraste (23, 123) de la surface de sorte que ledit matériau de contraste reste uniquement à l'intérieur des défauts ; 20
- analyser la surface des produits alimentaires avec un système optique (40, 140) pour détecter la présence de défauts. 25

10. Méthode, selon la revendication 9, **caractérisée par le fait que** lesdites phases sont exécutées en continu dans un appareil équipé de moyens de transport des produits alimentaires. 30

11. Méthode pour la sélection de produits alimentaires dans laquelle on identifie les produits avec des défauts et on sépare lesdits produits avec des défaut des produits conformes, **caractérisée par le fait que** l'identification des défauts est réalisée avec une méthode selon la revendication 9 ou 10. 35

12. Appareil ou méthode, selon l'une des revendications précédentes, **caractérisé par le fait que** ledit matériau de contraste (23, 123) a une couleur qui contraste avec celle de la surface du produit alimentaire. 40

13. Appareil ou méthode, selon l'une des revendications précédentes, **caractérisé par le fait que** ledit matériau de contraste (23, 123) comprend un composé ou une substance comestible. 45

14. Appareil ou méthode, selon la revendication 13, **caractérisé par le fait que** ledit matériau de contraste (23, 123) est sous forme sèche ou fluide. 50

55

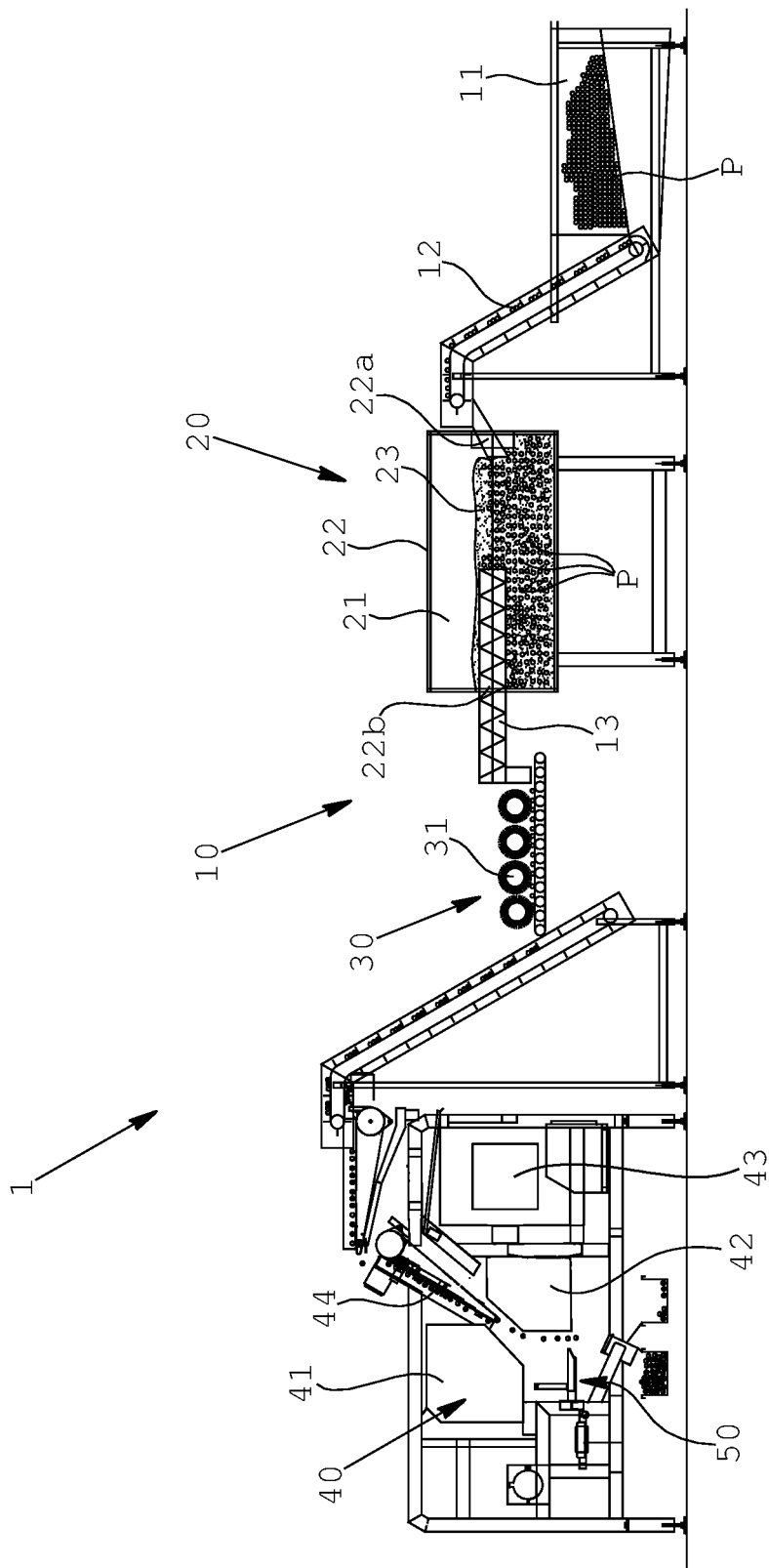


Fig. 1

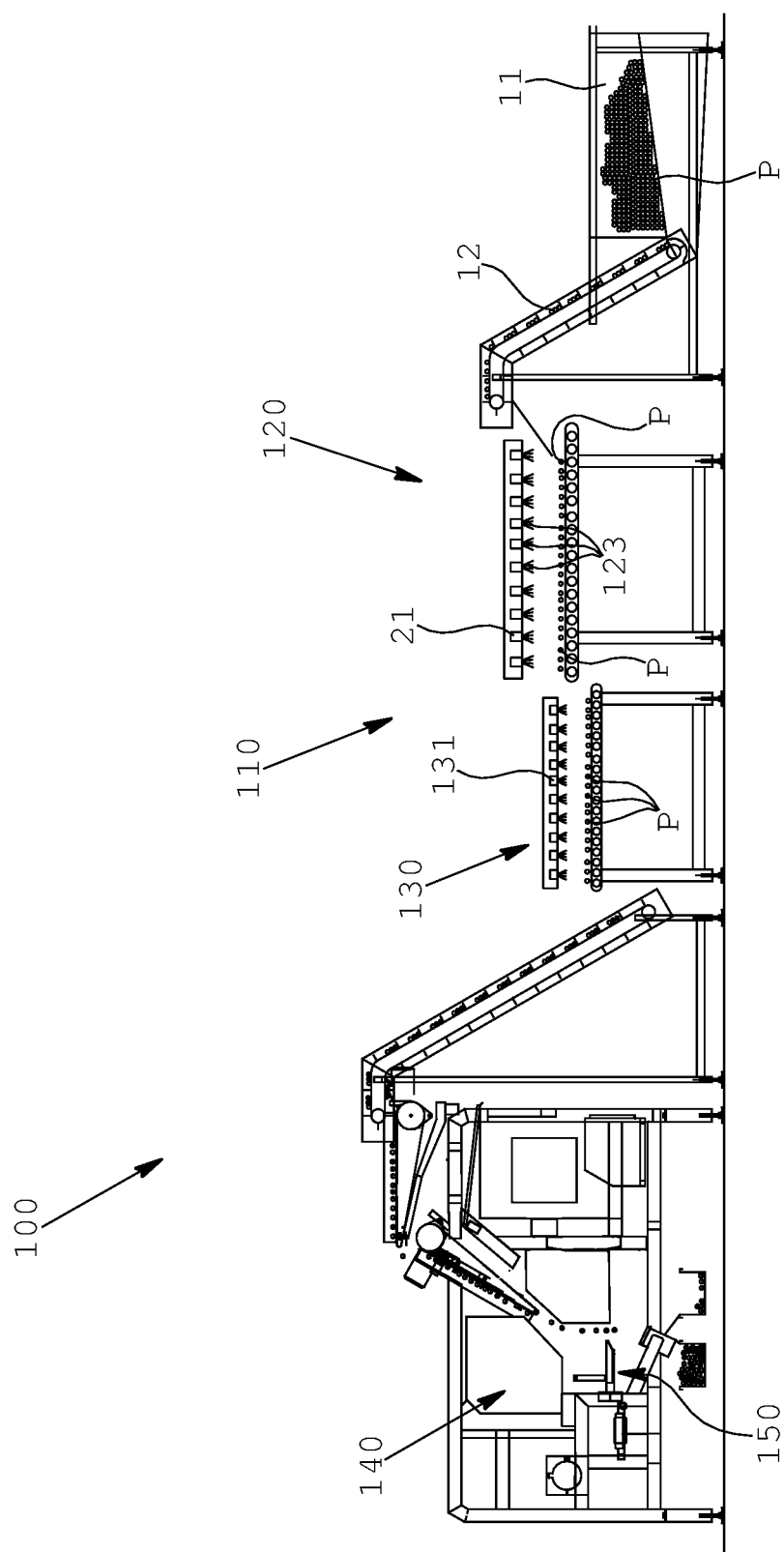


Fig. 2

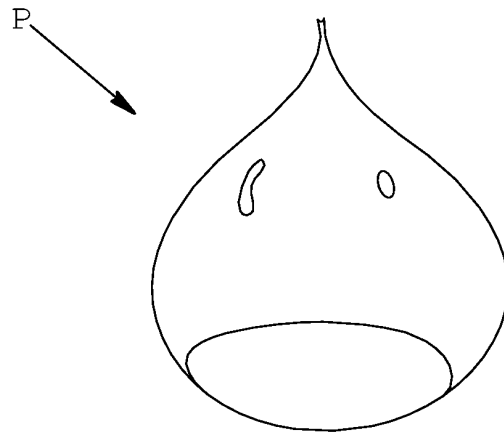


Fig. 3a

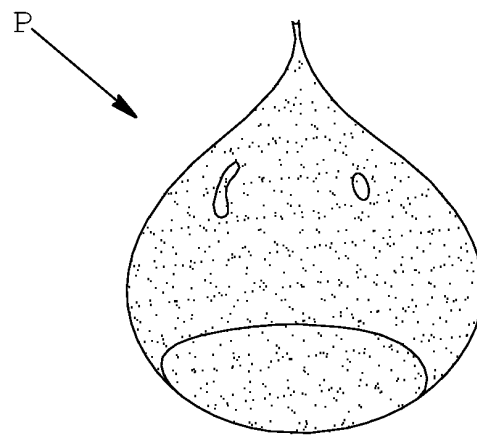


Fig. 3b

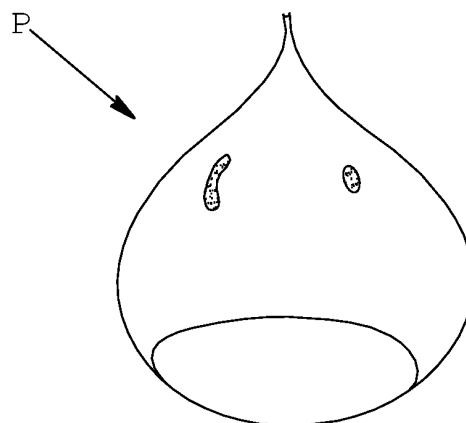


Fig. 3c

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 9640452 A [0001]