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(54) SLICE CLASSIFICATION SYSTEM AND METHOD, FOR A FOOD SLICER MACHINE

SCHEIBENKLASSIFIZIERUNGSSYSTEM UND -VERFAHREN FÜR EINE AUFSCHNITTMASCHINE
SYSTÈME DE CLASSIFICATION DE TRANCHES ET PROCÉDÉ POUR UNE MACHINE DE DÉCOUPAGE D'ALIMENTS

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Description**OBJECT OF THE INVENTION**

[0001] The present invention belongs to the technical field of food processing.

[0002] More particularly, this invention relates to a system and a method for a food slicer machine, which are capable of classifying the slices of food by capturing and processing digital matrix images, taken at high speed during the process of cutting the food into slices. Thanks to said image classification, the system and the method of the invention enable possible quality failures to be detected in the slices obtained, prior to the packaging thereof.

[0003] Furthermore, the system and the method according to the present invention enable the slices of food to be classified according to different preconfigurable quality parameters.

BACKGROUND OF THE INVENTION AND TECHNICAL PROBLEM TO BE SOLVED

[0004] In the food processing sector, a multitude of industrial machines are known for cutting foods into slices, which are also called "slicer" machines or "slicing" machines.

[0005] These machines are intended to slice foods (for example and without limitation: cheeses, sausages, or ham) which initially have an elongated shape, usually a shape similar to a bar, in order to obtain slices thereof.

[0006] Each set of slices is grouped vertically in a portion in the shape of a stack of products, which is subsequently carried by a conveyor belt. Said belt can tilt in different positions in order to direct them to different lines. One of the positions usually enables distinguishing the set of slices if it has an excess or lack of weight, rejecting the portion of slices.

[0007] Likewise, between each pair of adjacent slices of one same stack, a plastic sheet can also be arranged, also known as "interleaver", intended to separate said pair of slices and prevent them from sticking together.

[0008] Cutting devices of this type are disclosed, for example, in US 5 129 298A or in DE 199 06 021 A1.

[0009] However, sometimes the slices obtained by cutting the foods "in bars" do not meet the quality requirements required for them to be sold. The most common defects that slices usually have in these types of foods are: the presence of contaminants (for example, blood, rust or bones in the ham), the deformation of some region of the product (for example, excess subcutaneous or central fat in the ham), the lack of interleaver (or breakage thereof), or breakage of the slices.

[0010] On the market, there are different sets of equipment with computer vision which inspect the portions formed by stacks of slices, after packaging, although given the stack arrangement thereof, it is only possible to detect defects in the slices that are at the top or bottom

of the stack if transparent packaging is used.

[0011] Therefore, in the technical field of food processing there is a need to incorporate into the food slicer machines, especially in the case of foods with irregular surfaces, such as ham, slice classification systems and methods which enable, on the one hand, the entirety of the slices making up each stack to be analysed and that, furthermore, are able to perform said analysis before the packaging process.

[0012] The slicer machines currently used on an industrial scale work at high cutting speeds, in the order of 900-2000 cuts/minute. This fact makes it difficult for computer vision equipment to be able to take at least one image of each of the slices created, and this in turn significantly complicates the possibility to classify said images in a time frame compatible with the processing speed of the food. Document EP 0 449 512 A1 discloses A slice classification system for a food slicer machine, said slicer machine comprising: a feeder mechanism configured to carry food to a cutting region; a cutting region wherein a cutting blade is provided, configured to cut the food into slices; a conveyor belt configured to transport slices of food, from a first area adjacent to the cutting region, to a second area spaced away from the cutting region; classification means for slices adjacent to the second area so that in case of a lean/ fat ration being unacceptable a commercially unacceptable slice or a portion containing an unacceptable slice may be diverted, said means being provided with image capture means, configured to capture a sequence of digital images from a viewing area located inside the cutting region and transmit said sequence of digital images to processing means, as the image data is periodically sampled, to update the Grey Level thresholds; processing means, configured to analyse at least one predetermined control area of each image of the sequence of images to compare at least one region of interest of the preferred images with at least one reference pattern and to classify the preferred images according to said comparison with the reference pattern and to send classification instructions to actuation means; and actuation means, configured to actuate the classification means for slices according to the classification instructions of the processing means.

DESCRIPTION OF THE INVENTION

[0013] The present invention aims to solve the difficulties and disadvantages of the prior art, indicated above.

[0014] More particularly, as defined in claim 1, a first object of the invention relates to a slice classification system for a food slicer machine, said slicer machine comprising:

- a feeder mechanism configured to carry food to a cutting region;
- a cutting region wherein a cutting blade is provided, configured to cut the food into slices;
- a conveyor belt configured to transport stacks of slic-

es of food, from a first area adjacent to the cutting region, to a second area spaced away from the cutting region; and

- classification means for stacks of slices, adjacent to the second area (far from the cutting region),

said slice classification system being characterised in that it is provided with:

- image capture means, configured to capture a sequence of digital images from a viewing area located inside the cutting region and transmit said sequence of digital images to processing means;
- processing means, configured to analyse at least one predetermined control area of each image of the sequence of images; to select from the entire sequence some preferred images based on said analysis of the control area; to compare at least one region of interest of the preferred images with at least one reference pattern; to classify the preferred images according to said comparison with the reference pattern and to send classification instructions to actuation means; and
- actuation means, configured to actuate the classification means for stacks of slices according to the classification instructions of the processing means.

[0015] As will be explained in more detail below, the present invention enables, in spite of the high cutting speeds of the commonly used slicer machines, all the slices making up the formed stacks of slices to be analysed before they are packaged. This represents a significant improvement in the detection of possible defects, with respect to the prior art.

[0016] As set forth above, in accordance with the present invention the image capture means exclusively take images of a viewing area of the camera included inside the cutting region, inside of which there is a final end of the food which will be cut into a slice. Also, inside the viewing area, one or several control regions are established, which enable the position of the cutting blade and one or several regions of interest to be detected, which enable the quality of the slicing to be examined.

[0017] The processing means, when analysing said control regions, preferably by means of computer vision algorithms, are able to select the specific images (or frames) from the complete sequence of images wherein the regions of interest can be processed, since they are not hidden (either by the cutting blade, or by an interleaver). The images thereby selected are precisely called "preferred images" and each one shows one of the slices obtained by the slicer machine.

[0018] Preferably, in the present invention, when analysing the control area of each of the images in the sequence, the hue of the pixels of said control area is compared with at least one predetermined chromatic hue, corresponding to the colour of the cutting blade and/or the colour of the separating sheet (or interleaver). Since

both the cutting blade and the interleaver have a colour that is notably different from the colour of the food, thanks to said comparison it is possible to determine the presence of the cutting blade and/or the interleaver and choose as preferred images those wherein none of these elements are present.

[0019] Moreover, the analysis of each preferred image is only carried out in those image portions corresponding to the region or regions of interest, reducing the load of computing operations and the volume of data used by the processing means. This enables the preferred images to be processed quickly and enables the slices shown in said images to be classified (as acceptable slices or slices with defects) and enables decisions to be made online (accepting or rejecting the stack wherein said slice is located), in other words, making decisions before the stack of slices reaches the classification means.

[0020] In this manner, the present invention enables deciding whether a stack of slices meets the quality requirements and therefore continues to the packaging line, or, on the other hand, if the presence of a defect is detected, ordering the rejection thereof by sending a corresponding instruction to the actuation means of the classification means.

[0021] The slice classification system according to the present invention is independent of the cutting machine, being able to be coupled to any type of new or already-existing slicer machine. To do so, the shape and size of the image capture means can be adapted to the geometry of the slicer machine.

[0022] In the present invention, at least one control region is preferably located in the highest portion, or in the lowest portion, of the viewing area (meaning, in the vicinity of the upper edge or the lower edge of the viewing area, that which is determined by the size of the slice with a margin on the perimeter thereof of at least two centimetres). These specific positions are preferred because they can more easily detect the position of the cutting blade with respect to the slice, as well as the presence and position of the interleaver.

[0023] Also, in the present invention, the processing means preferably processes the region (or regions) of interest of the selected images, also called preferred images, transforming them into a predetermined colour model.

[0024] Furthermore, preferably, in the present invention the processing means quantify the pixels of at least one predetermined hue which are present in the region of interest of the preferred images, grouping them into portions with a predetermined hue and analysing the outline and surface of said portions. Subsequently, the processing means compare the outline and surface of said portions with a predetermined hue, comparing them with the reference patterns. This enables the processing means to classify said regions of interest, determining by means of simple comparisons if they meet the necessary requirements. For example, if a feature of the food can be inscribed with a circumference having a certain

diameter, or if a possible defect can be circumscribed in a circle having a certain diameter or if a percentage of a certain hue of the pixels contained in a region is exceeded.

[0025] The reference patterns can be, for example and without limitation, reference patterns for shape, size and hue.

[0026] Thanks to the present invention, it is also possible to determine whether or not the slice has been cut, since the slicer machine stops cutting between one portion of the stack of slices and another. This makes it possible to count the number of slices in each stack, which in turn enables the initial and final cut of the bar of food to be determined, since a smaller number of slices is cut than that of the stack in both cases.

[0027] The present invention also enables certain regions to be discriminated according to the shape thereof, such that areas that are not of interest can be removed from the comparison in order to determine whether or not a product has the quality necessary.

[0028] Preferably, in the present invention, the image capture means comprise a digital camera with a speed for recording sequences of images that is greater than 120 frames per second. Said digital camera is preferably far from the cutting area in order to avoid splashing due to waste projected from the cutting, although the lens of said camera focuses on the viewing area.

[0029] Likewise, the image capture means preferably comprise an elongated lighting device, arranged parallel to a cutting edge and provided with a semi-diffusion filter. Said semi-diffusion filter reduces the appearance of glare in the slices being cut.

[0030] The image capture means are also preferably provided with a protective casing equipped with an elastomeric sealing gasket, fastened by means of mechanical fasteners. These mechanical fasteners enable the easy opening thereof for maintenance operations and in turn guarantee the seal during the cleaning operations with pressurised hot water.

[0031] Furthermore, the image capture means may be provided with a communication cable connected to the processing means by which they transmit the sequence of digital images.

[0032] The processing means may be provided with a computer. Said computer is preferably located in a control cabinet, far from the cutting area in order to avoid splashing.

[0033] Moreover, the classification instructions can be control signals from a PLC (Programmable Logic Controller). Also, the actuation means may comprise at least one pneumatic solenoid valve which can be actuated by means of control signals from a PCL.

[0034] The slice classification system according to the present invention is preferably provided with a monitor configured to show images of the sequence of images captured by the image capture means. The images shown may be images of the defects detected.

[0035] The slice classification system according to the

present invention is preferably provided with a touch interface. Said touch interface may preferably enable, among other functions, parameters to be set for the operation of the processing means and/or it may enable the historical record of classified stacks to be consulted.

[0036] A second aspect of the invention, as defined in claim 8, relates to a method for classifying slices of food cut by a slicer machine, said slicer machine comprising:

- 10 - a feeder mechanism configured to carry food to a cutting region;
- a cutting region wherein a cutting blade is provided, configured to cut the food into slices;
- 15 - a conveyor belt configured to transport stacks of slices of food, from a first area adjacent to the cutting region, to a second area spaced away from the cutting region; and
- classification means for stacks of slices, adjacent to the second area (far from the cutting region),

20 said classification method being characterized in that it comprises the following steps:

- 25 - providing image capture means, such that they focus on a viewing area located inside the cutting region of the slicer machine;
- actuating the image capture means, capturing a sequence of digital images of the viewing area and transmitting said sequence of digital images to processing means;
- 30 - analyzing, with the processing means, at least one predetermined control area of each image of the sequence of images;
- selecting, with the processing means, preferred images from the entire sequence of images, depending on the result of the analysis of the control area;
- 35 - comparing, with the processing means, at least one region of interest of the preferred images with at least one reference pattern;
- 40 - classifying, with the processing means, the preferred images according to the result of said comparison of the region of interest thereof with the reference pattern; and
- 45 - sending classification instructions to actuation means configured to actuate the classification means for stacks of slices according to the classification instructions of the processing means.

[0037] Unless expressly stated otherwise, any technical feature explained in relation to a slice classification system according to the first aspect of the present invention is also fully applicable to a slice classification method according to the second aspect of the present invention.

55 BRIEF DESCRIPTION OF THE FIGURES

[0038] What follows is a very brief description of a series of drawings that aid in better understanding the in-

vention and which are expressly related to an embodiment of said invention that are presented by way of non-limiting examples of the same.

Fig. 1 is a schematic side view of a first embodiment of a slice cutting system according to the present invention;

Fig. 2 is a schematic cross-sectional view of the slice cutting system shown in Figure 1;

Figs. 3A-3C show a sequence of images obtained by the image capture means; and

Figs. 4 and 5 show a preferred embodiment of the slice classification system coupled to a slicer machine from the state of the art.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0039] Next, a detailed description of several preferred embodiments of the present invention is provided with the help of the attached Figures 1 to 5.

[0040] Throughout the present invention, as well as in the attached figures, the elements with equal or similar functions will be designated with the same numerical references.

[0041] **Figure 1** shows a schematic representation of a cutting device according to the invention.

[0042] The device for cutting food (10), such as, for example, sausage, ham or cheese, has a product feeder mechanism with a product seat, which is open towards a cutting region (13). The product (10) to be cut is located in the food feeder mechanism on the seat surface and in contact with a tightening roller (24). Said food (10) can be led to the cutting region (13) with the help of an advancing mechanism (not shown), which acts on the rear end of the product.

[0043] In the cutting region (13), slices (11) of product (10) are separated in a rapid sequence with the help of a cutting blade (20), for example, a rotating blade, which are stacked in a portion of a stack of slices (25) as the conveyor belt (16) advances.

[0044] Furthermore, it has a cutting edge (14) in the seat surface of the cutting region (13).

[0045] The separated product slices (25) are withdrawn separately or in portions by means of an endless belt (16) outside the cutting region (13). Between the withdrawal mechanism (16) and the cutting edge (14), there is a withdrawal belt (15), responsible for rejecting the initial and final ends of the bar of product, which are led to a tank.

[0046] In the half-space in front of the cutting region (13), means (1) for capturing the images at a high speed have been arranged above the cutting edge (14).

[0047] Said capture means (1) are used to obtain images of the viewing area (22) focused on the cutting area (13) of the product with the aim of being able to determine whether the slices have any quality defects.

[0048] The images captured at high speed by the means (1) are transmitted by a communication cable to

processing means, which in this embodiment of the invention include a computer (8) located in the control cabinet (18), which processes the images received by means of computer vision software which uses the image classification method claimed in this patent, determining whether the slice (11) has a quality defect, communicating, if affirmative, a signal to actuation means, which in this embodiment of the invention include a PLC (9) in order to remove the portions (26) of product actuating once it reaches the classification means, which in this embodiment of the invention, include a tilting classifying belt (17).

[0049] In the embodiment of the slice classification system (11) shown in Fig. 1, a monitor (19) is further provided wherein a control panel is displayed on which the images that are being captured by the image capture means (1) are displayed, in addition to counters which show operating parameters of the equipment, as well as quality failures detected in the stacks (25) of slices.

[0050] **Figure 2** shows a schematic representation of the viewing area of the device.

[0051] As seen in said figure, the viewing area (22) of the camera is contained in the cutting region (13), and inside of it the slice (11), the lower cutting edge (14) and the tightening roller (24) are located (not visible in Fig. 2). Inside the viewing area (22), several control areas (21) and one region (23) of interest are established, said control areas are processed in the processing means by computer vision algorithms with the aim of detecting the position of the cutting blade (20) and the interleaver with respect to the slice (11) and being able to determine the precise moment at which to process the region of interest (23) by means of computer vision algorithms with which a classification is performed based on the quality thereof.

[0052] **Figures 3A-3C show** sequences of images of slicing wherein they illustrate, among other aspects of the invention, how the cut or uncut state of a slice is detected by means of the processing of the different control regions.

[0053] More particularly, Fig. 3A shows a sequence of images taken during the process of cutting a slice of food. The space shown in said images corresponds to the viewing area (22).

[0054] In this embodiment of the invention, the pixels corresponding to four different control areas designated with the numerical reference (21) are processed.

[0055] When the two upper control areas (21) are activated, the images of the areas of said control areas (21) are shown in green, the presence of the interleaver is evaluated. It is possible to detect the presence of the interleaver because, since it is translucent, if said interleaver is present it modifies the colour of the region. If the occupation of the blade is not detected, according to a method similar to that for detecting the interleaver, in the entirety of the lower cutting region, a slice is subsequently counted.

[0056] The images in Fig. 3B show a sequence of steps of the cutting blade wherein the slice is not cut.

[0057] As in the previous case, the pixels corresponding to four different control areas designated with the numerical reference (21) are processed. When the two upper control areas (21) are activated, the images of the areas of said control areas (21) are shown in green, the presence of the interleaver is evaluated. If said interleaver is not subsequently detected, this may be due to a quality error or to the fact that a slice is not going to be cut. When the cutting blade is detected in the inner control region, the processing means of the system of the invention determine that a slice has not been cut.

[0058] The images in Fig. 3C show an example of processing the region (23) of interest, once the frame of interest of the captured sequence of images has been selected. In the images shown, corresponding to slices of serrano ham, the processing means identify the presence of central fat and subcutaneous fat (shown in red and blue in the images) in order to detect if they are within predefined quality values.

[0059] Figures 4 and 5 show an embodiment of the slice classification system coupled to a slicer machine from the state of the art.

[0060] More particularly, Figure 4 shows in two isometric views the different elements of the slice classification system according to the invention already described in Figures 1 and 2, with the aim of facilitating an understanding of the diagrams.

[0061] Figure 5 shows two views from different angles of the image capture means (1).

[0062] In this particular embodiment of the invention, the image capture means (1) are provided with a protective casing (4) provided with an inner cavity (5) on the inside of which a high speed camera (2) and lighting means (3) are housed. The casing (4) also has an elastomeric sealing gasket (7), fastened by means of mechanical joints (6) which enable it to be opened for maintenance operations and which in turn guarantees the seal during the cleaning operations with pressurised hot water.

[0063] The present invention is in no way limited to the embodiments herein disclosed. For a person skilled in the art, other possible different embodiments of this invention will be evident in light of the present description. As a result, the scope of protection of the present invention is exclusively defined by the claims that follow.

Claims

1. A slice classification system (11) for a food (10) slicer machine, said slicer machine comprising:
 - a feeder mechanism configured to carry food (10) to a cutting region (13);
 - a cutting region (13) wherein a cutting blade (20) is provided, configured to cut the food (10) into slices (11);
 - a conveyor belt (16) configured to transport

stacks (25) of slices (11) of food (10), from a first area (A) adjacent to the cutting region (13), to a second area (B) spaced away from the cutting region (13); and

- classification means (17) for stacks (25) of slices (11) adjacent to the second area (B),

said slice classification system being **characterized in that** it is provided with:

- image capture means (1), configured to capture a sequence of digital images from a viewing area (22) located inside the cutting region (13) and transmit said sequence of digital images to processing means;

- processing means (8), configured to analyse at least one predetermined control area (21) of each image of the sequence of images; to select from the entire sequence some preferred images based on said analysis of the control area (21); to compare at least one region of interest (23) of the preferred images with at least one reference pattern; to classify the preferred images according to said comparison with the reference pattern and to send classification instructions to actuation means (9); and

- actuation means (9), configured to actuate the classification means (17) for stacks (25) of slices (11) according to the classification instructions of the processing means.

2. The system according to claim 1, wherein the image capture means (1) comprise a digital camera with a recording speed greater than 120 frames per second.
3. The system according to any of the preceding claims, wherein the image capture means (1) comprise an elongated lighting device (3), arranged parallel to a cutting edge (14) and provided with a semi-diffusion filter.
4. The system according to any of the preceding claims, wherein the actuation means (9) comprise at least one pneumatic solenoid valve which can be actuated by means of control signals from a programmable logic controller.
5. The system according to any of the preceding claims, further comprising a monitor (19) configured to show images of the sequence of images captured by the image capture means (1).
6. The system according to any of the preceding claims, further comprising a touch interface.
7. The system according to any of the preceding claims, wherein the image capture means (1) are provided

with a protective casing (4) equipped with an elastomeric sealing gasket (7), fastened by means of mechanical fasteners (6).

8. A method for classifying slices (11) of food (10) cut by a slicer machine, said slicer machine comprising:

- a feeder mechanism configured to carry food (10) to a cutting region (13);
- a cutting region (13) wherein a cutting blade (20) is provided, configured to cut the food (10) into slices (11);
- a conveyor belt (16) configured to transport stacks (25) of slices (11) of food (10), from a first area (A) adjacent to the cutting region (13), to a second area (B) spaced away from the cutting region (13); and
- classification means (17) for stacks (25) of slices (11) adjacent to the second area (B),

said classification method being **characterised in that** it comprises the following steps:

- a) providing image capture means (1), such that they focus on a viewing area (22) located inside the cutting region (13) of the slicer machine;
- b) actuating the image capture means (1), capturing a sequence of digital images of the viewing area (22) and transmitting said sequence of digital images to processing means (8);
- c) analyzing, with the processing means (8), at least one predetermined control area (21) of each image of the sequence of images;
- d) selecting, with the processing means (8), preferred images from the entire sequence of images, depending on the result of the analysis of the control area (21);
- e) comparing, with the processing means (8), at least one region (23) of interest of the preferred images with at least one reference pattern;
- f) classifying, with the processing means (8), the preferred images according to the result of said comparison of the region (23) of interest thereof with the reference pattern; and
- g) sending classification instructions to actuation means (9) configured to actuate the classification means (17) for stacks (25) of slices (11).

9. The method according to claim 8, further comprising transforming the region (23) of interest of the preferred images into a predetermined colour model.

10. The method according to claim 9, further comprising quantifying the pixels of at least one predetermined hue which are present in the region (23) of interest of the preferred images, grouping them into portions with a predetermined hue and analysing the outline and surface of said portions with a predetermined

hue.

11. The method according to any of claims 8 to 10, wherein at least one area (21) is located in the highest portion, or in the lowest portion, of the viewing area (22).

12. The method according to any of claims 8 to 11, wherein, in step c) when analyzing the control area (21) of each of the images in the sequence, the hue of the pixels of said control area (21) is compared with at least one predetermined chromatic hue, corresponding to the colour of the cutting blade and/or the colour of the separating sheet.

Patentansprüche

1. Scheibenklassifizierungssystem (11) für eine Schneidemaschine für Lebensmittel (10), wobei die Scheibenschneidemaschine umfasst:

- einen Zuführmechanismus, der dazu eingerichtet ist, Lebensmittel (10) zu einem Schneidbereich (13) zu befördern;
- einen Schneidbereich (13), in dem eine Schneidklinge (20) vorgesehen ist, die dazu eingerichtet ist, die Lebensmittel (10) in Scheiben (11) zu schneiden;
- ein Förderband (16), das dazu eingerichtet ist, Stapel (25) von Scheiben (11) von Lebensmitteln (10) von einem ersten Bereich (A), der an den Schneidbereich (13) angrenzt, zu einem zweiten Bereich (B) zu transportieren, der von dem Schneidbereich (13) beabstandet ist; und
- eine Klassifizierungseinrichtung (17) für Stapel (25) von Scheiben (11), die an den zweiten Bereich (B) angrenzt,

wobei das Scheibenklassifizierungssystem **dadurch gekennzeichnet ist, dass** es ausgestattet ist mit:

- einer Bilderfassungseinrichtung (1), die dazu eingerichtet ist, eine Folge digitaler Bilder von einem Sichtbereich (22), der sich innerhalb des Schneidbereichs (13) befindet, zu erfassen und die Folge digitaler Bilder an eine Verarbeitungseinrichtung zu senden;
- eine Verarbeitungseinrichtung (8), die dazu eingerichtet ist, wenigstens einen vorbestimmten Steuerbereich (21) jedes Bildes der Bildfolge zu analysieren; aus der gesamten Folge einige bevorzugte Bilder auf der Grundlage der Analyse des Steuerbereichs (21) auszuwählen; wenigstens einen Interessensbereich (23) der bevorzugten Bilder mit wenigstens einem Referenzmuster zu vergleichen; die bevorzugten Bil-

- der gemäß dem Vergleich mit dem Referenzmuster zu klassifizieren und Klassifizierungsanweisungen an eine Betätigungseinrichtung (9) zu senden; und
- eine Betätigungseinrichtung (9), die dazu eingerichtet ist, die Klassifizierungseinrichtung (17) für Stapel (25) von Scheiben (11) gemäß den Klassifizierungsanweisungen der Verarbeitungseinrichtung zu betätigen.
2. System nach Anspruch 1, bei dem die Bilderfassungseinrichtung (1) eine Digitalkamera mit einer Aufnahmegeschwindigkeit von mehr als 120 Bildern pro Sekunde umfasst.
3. System nach einem der vorangehenden Ansprüche, bei dem die Bilderfassungseinrichtung (1) eine längliche Beleuchtungsvorrichtung (3) umfasst, die parallel zu einer Schneidkante (14) angeordnet und mit einem Halbdiffusionsfilter versehen ist.
4. System nach einem der vorangehenden Ansprüche, bei dem die Betätigungseinrichtung (9) wenigstens ein pneumatisches Magnetventil umfasst, das mit Hilfe von Steuersignalen von einer programmierbaren logischen Steuereinheit betätigt werden kann.
5. System nach einem der vorangehenden Ansprüche, weiterhin umfassend einen Monitor (19), der dazu eingerichtet ist, Bilder der von der Bilderfassungseinrichtung (1) erfassten Bildfolge anzuzeigen.
6. System nach einem der vorangehenden Ansprüche, weiterhin umfassend eine Tastschnittstelle.
7. System nach einem der vorangehenden Ansprüche, bei dem die Bilderfassungseinrichtung (1) mit einem Schutzgehäuse (4) versehen ist, das mit einer elastomeren Dichtung (7) ausgestattet ist, die mit Hilfe mechanischer Befestigungseinrichtungen (6) befestigt ist.
8. Verfahren zur Klassifizierung von Scheiben (11) von Lebensmitteln (10), die von einer Schneidemaschine geschnitten werden, wobei die Schneidemaschine umfasst:
- einen Zuführmechanismus, der dazu eingerichtet ist, Lebensmittel (10) zu einem Schneidbereich (13) zu befördern;
 - einen Schneidbereich (13), in dem eine Schneidklinge (20) vorgesehen ist, die dazu eingerichtet ist, die Lebensmittel (10) in Scheiben (11) zu schneiden;
 - ein Förderband (16), das dazu eingerichtet ist, Stapel (25) von Scheiben (11) von Lebensmitteln (10) von einem ersten Bereich (A), der an den Schneidbereich (13) angrenzt, zu einem
- zweiten Bereich (B) zu transportieren, der von dem Schneidbereich (13) beabstandet ist; und
- eine Klassifizierungseinrichtung (17) für Stapel (25) von Scheiben (11), die an den zweiten Bereich (B) angrenzen,
- wobei das Klassifizierungsverfahren **dadurch gekennzeichnet ist, dass** es die folgenden Schritte umfasst:
- a) Bereitstellen einer Bilderfassungseinrichtung (1), die auf einen Sichtbereich (22) fokussiert ist, der sich innerhalb des Schneidbereichs (13) der Schneidemaschine befindet;
 - b) Betätigen der Bilderfassungseinrichtung (1), Erfassen einer Folge digitaler Bilder des Sichtbereichs (22) und Senden dieser Folge digitaler Bilder an die Verarbeitungseinrichtung (8);
 - c) Analysieren wenigstens eines vorbestimmten Steuerbereichs (21) jedes Bildes der Bildfolge mit der Verarbeitungseinrichtung (8);
 - d) Auswählen von bevorzugten Bildern aus der gesamten Folge der Bilder mit Hilfe der Verarbeitungseinrichtung (8), je nach dem Ergebnis der Analyse des Steuerbereichs (21);
 - e) Vergleichen wenigstens eines interessierenden Bereichs (23) der bevorzugten Bilder mit wenigstens einem Referenzmuster mit der Verarbeitungseinrichtung (8);
 - f) Klassifizieren der bevorzugten Bilder mit der Verarbeitungseinrichtung (8) entsprechend dem Ergebnis des Vergleichs des interessierenden Bereichs (23) mit dem Referenzmuster; und
 - g) Senden von Klassifizierungsanweisungen an eine Betätigungseinrichtung (9), die dazu eingerichtet ist die Klassifizierungseinrichtung (17) für die Stapel (25) von Scheiben (11) zu betätigen.
9. Verfahren nach Anspruch 8, bei dem der interessierende Bereich (23) der bevorzugten Bilder in ein vorgegebenes Farbmodell transformiert wird.
10. Verfahren nach Anspruch 9, weiterhin umfassend das Quantifizieren der Pixel mit wenigstens einem vorbestimmten Farbton, die in dem interessierenden Bereich (23) der bevorzugten Bilder vorhanden sind, das Gruppieren dieser Pixel in Abschnitte mit einem vorbestimmten Farbton und das Analysieren des Umrisses und der Oberfläche dieser Abschnitte mit einem vorbestimmten Farbton.
11. Verfahren nach einem der Ansprüche 8 bis 10, bei dem wenigstens ein Bereich (21) im höchsten oder im niedrigsten Abschnitt des Sichtbereichs (22) angeordnet ist.
12. Verfahren nach einem der Ansprüche 8 bis 11, bei

dem in Schritt c) beim Analysieren des Steuerbereichs (21) jedes der Bilder in der Folge der Farbton der Pixel des Steuerbereichs (21) mit wenigstens einem vorbestimmten chromatischen Farbton verglichen wird, der der Farbe der Schneidklinge und/oder der Farbe des Trennblatts entspricht.

Revendications

1. Système de classification de tranches (11) pour une machine à trancher de la nourriture (10), ladite machine à trancher comprenant :

- un mécanisme d'alimentation configuré pour transporter de la nourriture (10) vers une région de coupe (13) ;
- une région de coupe (13) dans laquelle une lame de coupe (20) est prévue, configurée pour couper la nourriture (10) en tranches (11) ;
- une courroie de transport (16) configurée pour transporter des piles (25) de tranches (11) de nourriture (10), depuis une première zone (A) adjacente à la région de coupe (13), vers une seconde zone (B) espacée de la région de coupe (13) ; et
- des moyens de classification (17) pour des piles (25) de tranches (11) adjacentes à la seconde zone (B),

ledit système de classification de tranches étant **caractérisé en ce qu'il** est prévu avec :

- des moyens de capture d'image (1), configurés pour capturer une séquence d'images numériques depuis une zone de visualisation (22) située à l'intérieur de la région de coupe (13) et transmettre ladite séquence d'images numériques à des moyens de traitement ;
- des moyens de traitement (8), configurés pour analyser au moins une zone de contrôle (21) prédéterminée de chaque image de la séquence d'images ; pour sélectionner à partir de la séquence entière quelques images préférées sur la base de ladite analyse de la zone de contrôle (21) ; pour comparer au moins une région d'intérêt (23) des images préférées avec au moins un motif de référence ; pour classier les images préférées en fonction de ladite comparaison avec le motif de référence et pour envoyer des instructions de classification à des moyens d'actionnement (9) ; et
- des moyens d'actionnement (9), configurés pour actionner les moyens de classification (17) pour des piles (25) de tranches (11) en fonction des instructions de classification des moyens de traitement.

2. Système selon la revendication 1, dans lequel les moyens de capture d'image (1) comprennent une caméra numérique avec une vitesse d'enregistrement supérieure à 120 trames par seconde.

3. Système selon l'une quelconque des revendications précédentes, dans lequel les moyens de capture d'image (1) comprennent un dispositif d'éclairage allongé (3), agencé parallèlement à un bord de coupe (14) et prévu avec un filtre semi-diffusant.

4. Système selon l'une quelconque des revendications précédentes, dans lequel les moyens d'actionnement (9) comprennent au moins une soupape à solénoïde pneumatique qui peut être actionnée au moyen de signaux de commande depuis un dispositif de commande logique programmable.

5. Système selon l'une quelconque des revendications précédentes, comprenant en outre un dispositif de surveillance (19) configuré pour montrer des images de la séquence d'images capturées par les moyens de capture d'image (1).

6. Système selon l'une quelconque des revendications précédentes, comprenant en outre une interface tactile.

7. Système selon l'une quelconque des revendications précédentes, dans lequel les moyens de capture d'image (1) sont prévus avec un boîtier de protection (4) équipé d'un joint d'étanchéité élastomère (7), fixé au moyen de pièces de fixation (6) mécaniques.

8. Procédé de classification de tranches (11) de nourriture (10) coupée par une machine à trancher, ladite machine à trancher comprenant :

- un mécanisme d'alimentation configuré pour transporter de la nourriture (10) vers une région de coupe (13) ;
- une région de coupe (13) dans laquelle une lame de coupe (20) est prévue, configurée pour couper la nourriture (10) en tranches (11) ;
- une courroie de transport (16) configurée pour transporter des piles (25) de tranches (11) de nourriture (10), depuis une première zone (A) adjacente à la région de coupe (13), vers une seconde zone (B) espacée de la région de coupe (13) ; et
- des moyens de classification (17) pour des piles (25) de tranches (11) adjacentes à la seconde zone (B),

ledit procédé de classification de tranches étant **caractérisé en ce qu'il** comprend les étapes suivantes :

- a) fourniture de moyens de capture d'image (1), tels qu'ils se concentrent sur une zone de visualisation (22) située à l'intérieur de la région de coupe (13) de la machine à trancher ;
- b) actionnement des moyens de capture d'image (1), capture d'une séquence d'images numériques de la zone de visualisation (22) et transmission de ladite séquence d'images numériques à des moyens de traitement (8) ; 5
- c) analyse, avec les moyens de traitement (8), d'au moins une zone de contrôle (21) prédéterminée de chaque image de la séquence d'images ; 10
- d) sélection, avec les moyens de traitement (8), d'images préférées à partir de la séquence entière d'images, en fonction du résultat de l'analyse de la zone de contrôle (21) ; 15
- e) comparaison, avec les moyens de traitement (8), d'au moins une région d'intérêt (23) des images préférées avec au moins un motif de référence ; 20
- f) classification, avec les moyens de traitement (8), des images préférées en fonction du résultat de ladite comparaison de la région (23) d'intérêt de celles-ci avec le motif de référence ; et 25
- g) envoi d'instructions de classification à des moyens d'actionnement (9) configurés pour actionner les moyens de classification (17) pour des piles (25) de tranches (11). 30
- 9.** Procédé selon la revendication 8, comprenant en outre la transformation de la région (23) d'intérêt des images préférées en un modèle de couleur prédéterminé. 35
- 10.** Procédé selon la revendication 9, comprenant en outre la quantification des pixels d'au moins une tonalité prédéterminée qui sont présents dans la région (23) d'intérêt des images préférées, leur regroupement en parties avec une tonalité prédéterminée et l'analyse du contour et de la surface desdites parties avec une tonalité prédéterminée. 40
- 11.** Procédé selon l'une quelconque des revendications 8 à 10, dans lequel au moins une zone (21) est située dans la partie la plus haute, ou dans la partie la plus basse, de la zone de visualisation (22). 45
- 12.** Procédé selon l'une quelconque des revendications 8 à 11, dans lequel, dans l'étape c) lors de l'analyse de la zone de contrôle (21) de chacune des images dans la séquence, la tonalité des pixels de ladite zone de contrôle (21) est comparée avec au moins une tonalité chromatique prédéterminée, correspondant à la couleur de la lame de coupe et/ou à la couleur de la feuille de séparation. 50 55

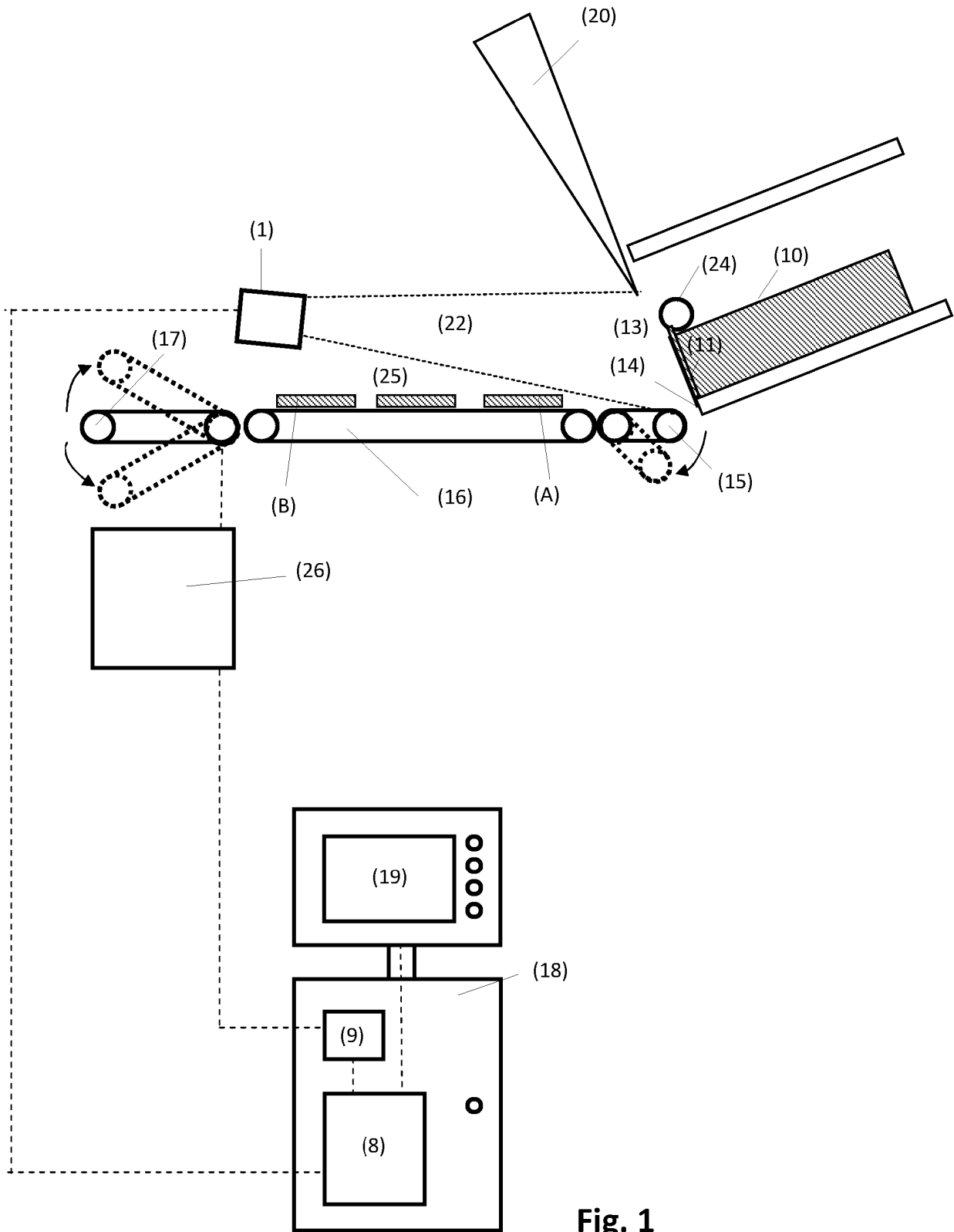


Fig. 1

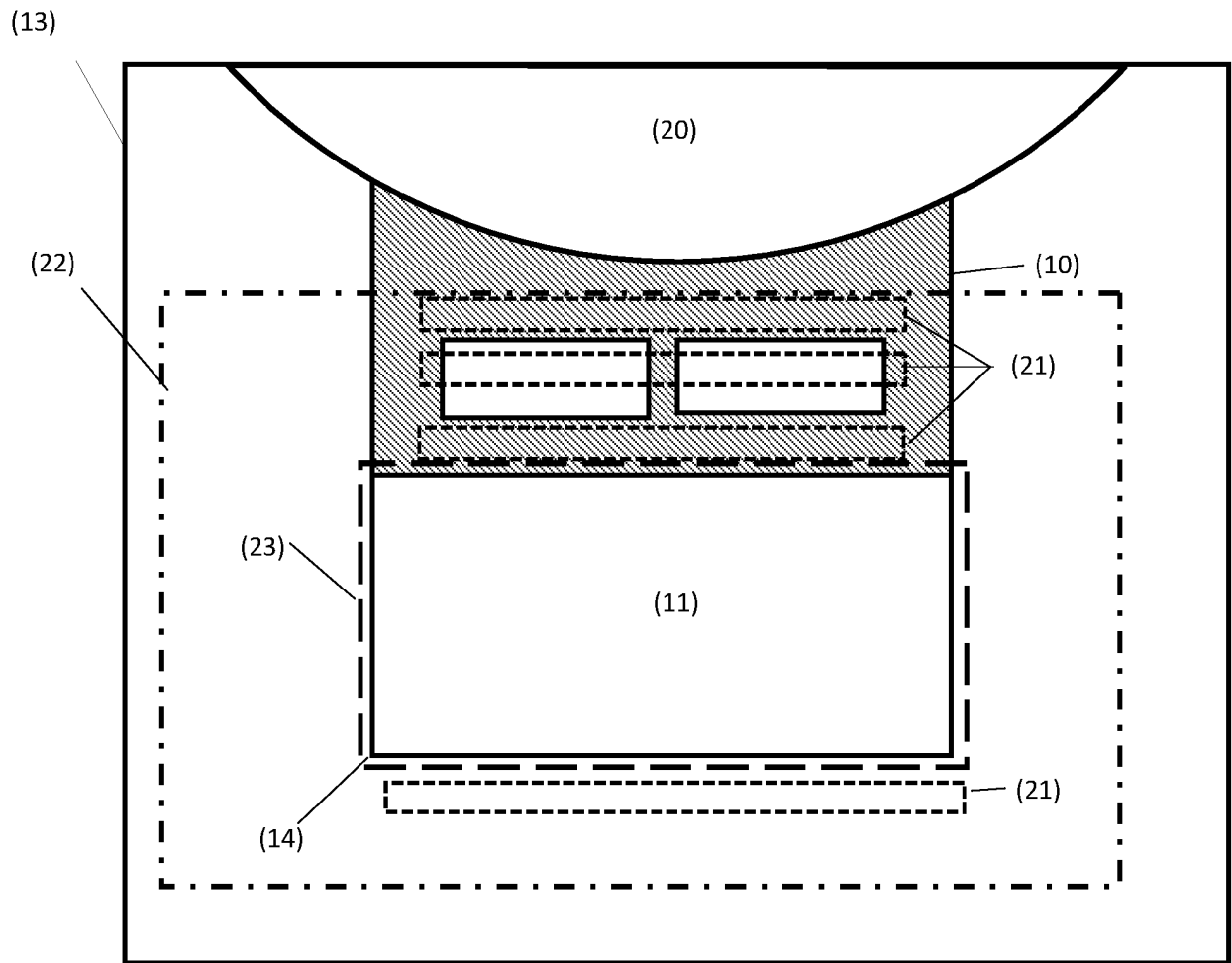
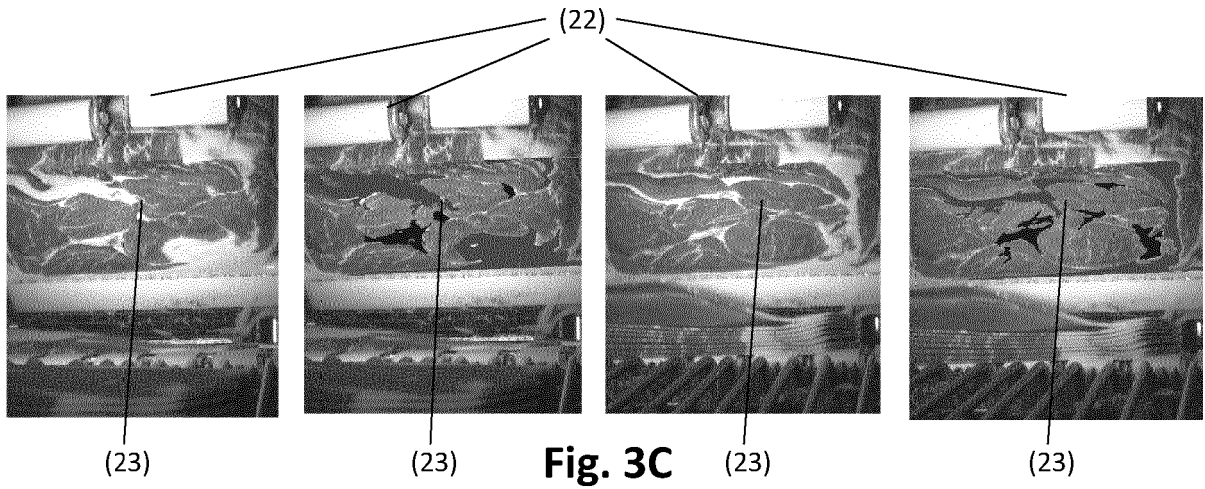
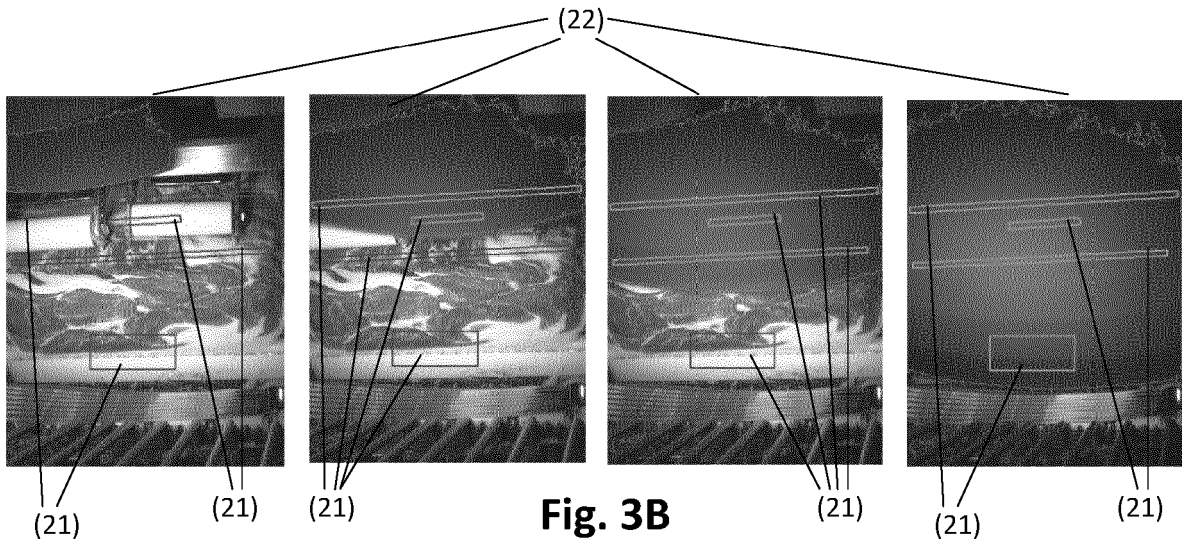
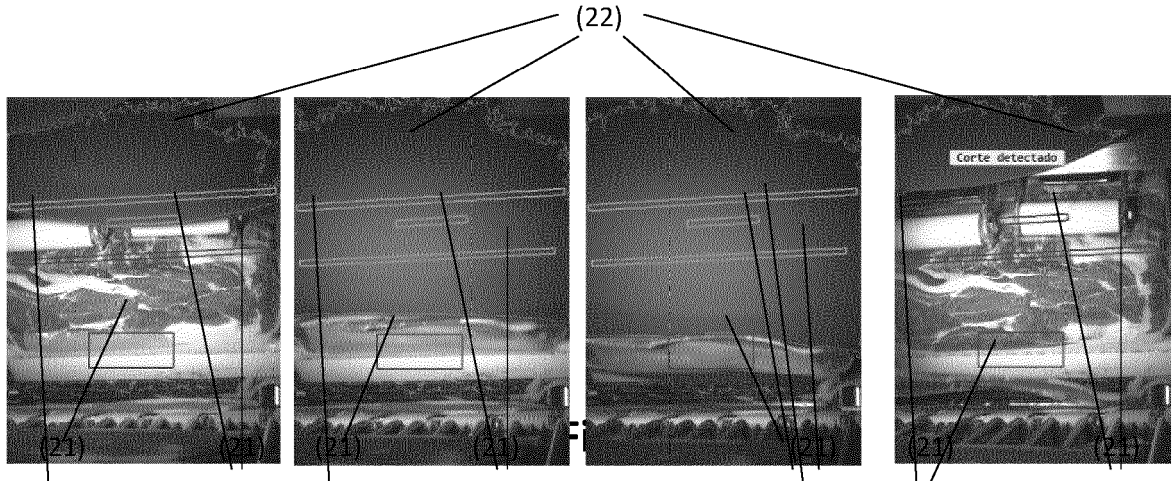


Fig. 2



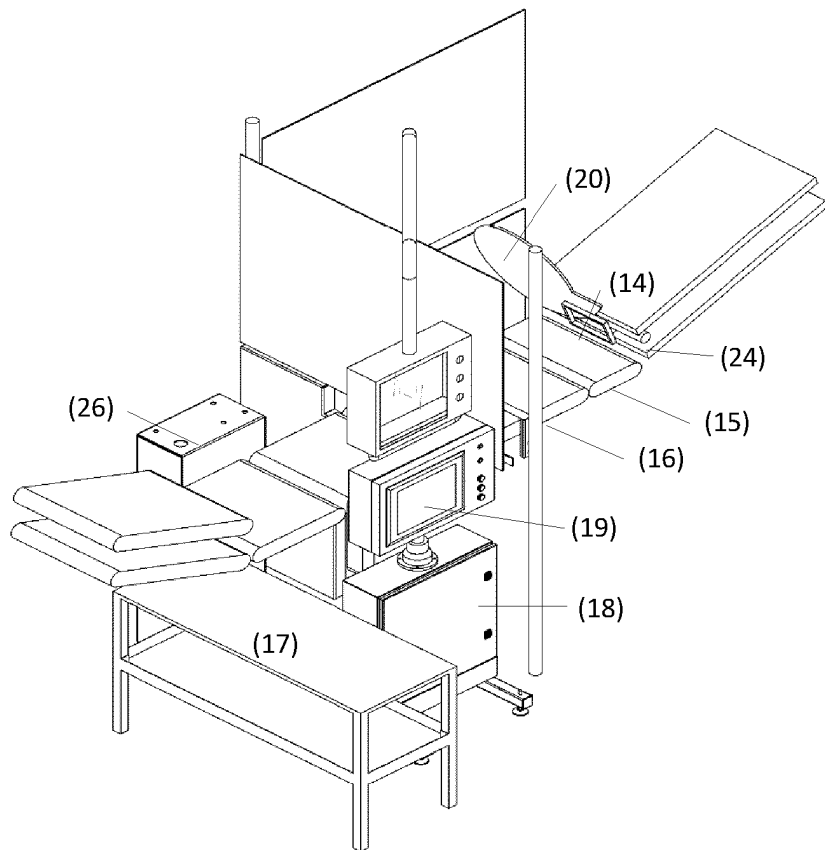
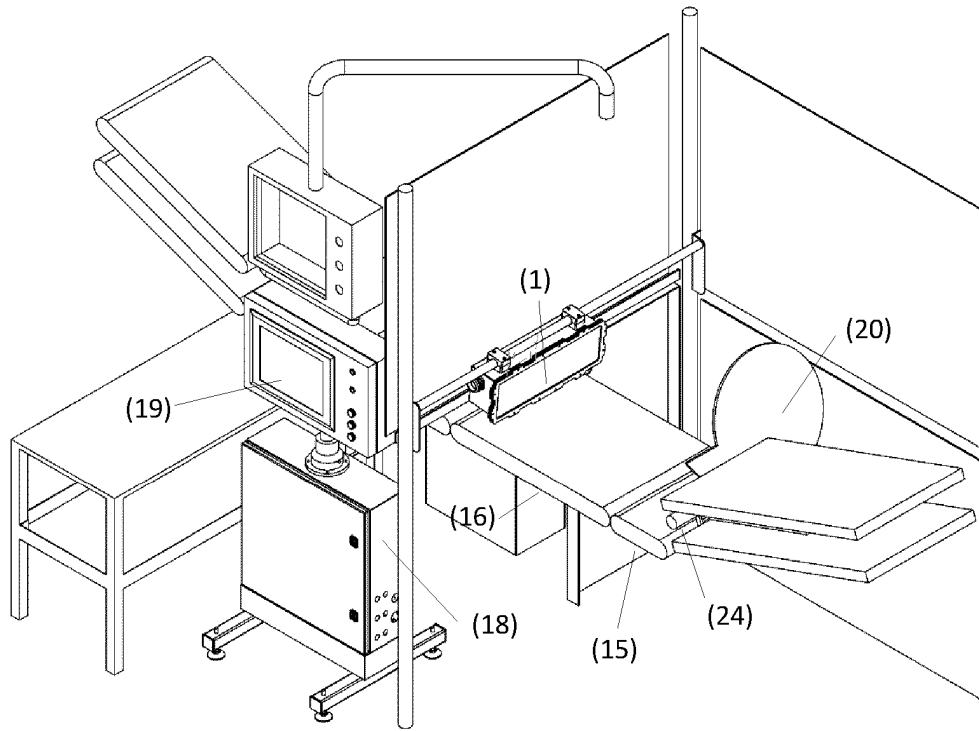


Fig. 4

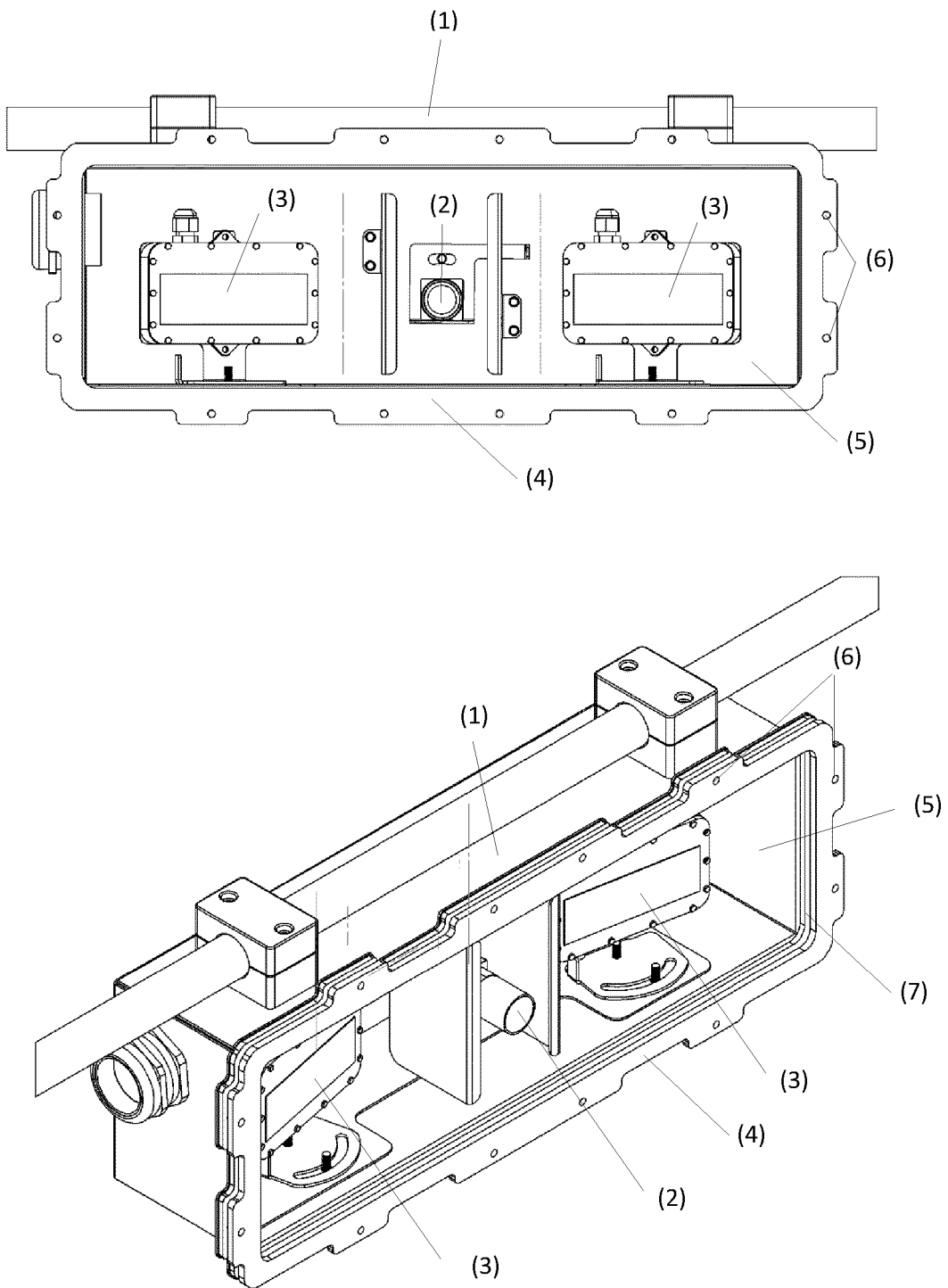


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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