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(72) Inventor: **Esen, Cem**
Istanbul (TR)

(74) Representative: **Mutlu, Aydin**
Invokat Intellectual Property Services
Agaoglu My Office 212-D:241
Basin Ekspres Yolu Tasocagi
Cad. No: 3 Bagcilar
34218 Istanbul (TR)

(71) Applicant: **Visys Makine Sanayi ve Dis Ticaret Ltd. Sti.**
Istanbul (TR)

(54) **Electro-optic product sorting apparatus and sorting method**

(57) The present invention relates to a sorting apparatus comprising; at least one light source (1) generating a scanning line by sending concentrated light beam (2) onto a product stream (6, 27) for detecting and sorting of the unwanted objects (27) on said product stream (6, 27); detection means (11, 13) analyzing the light reflected

from said product stream and generating electrical signals, and at least one diaphragm mirror with a hole (23) directing the reflected light component to the detection means (11, 13) without any loss. The invention also provides a sorting method implemented by this sorting apparatus.

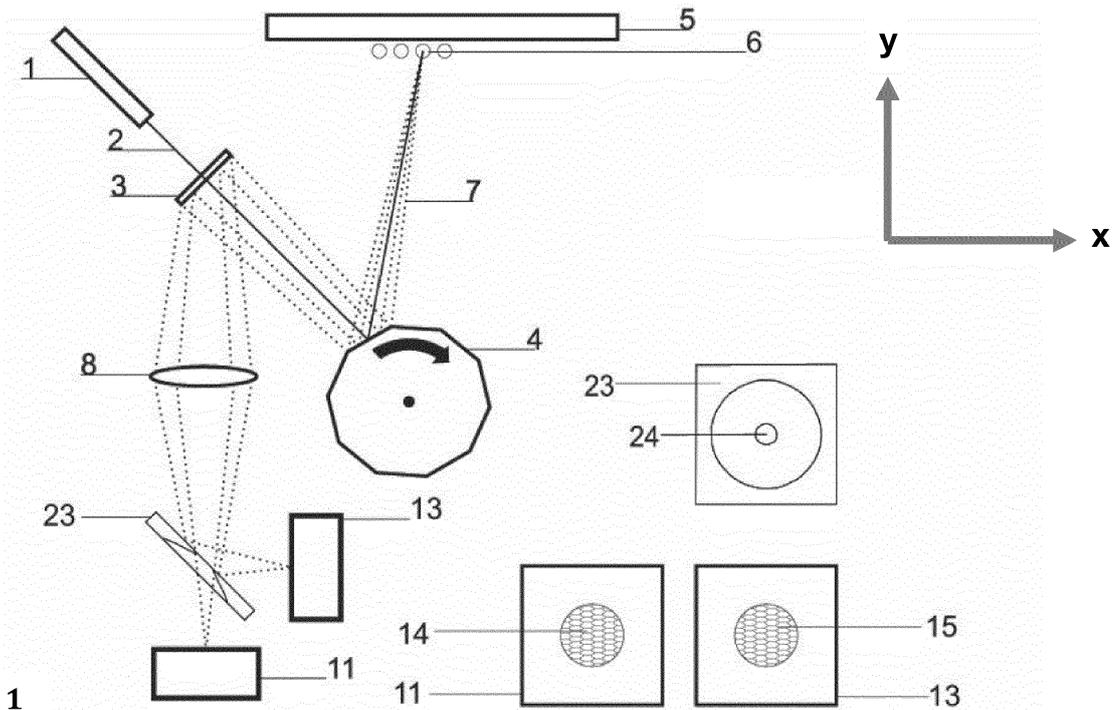


Figure 1

Description

Technical Field of the Present Invention

[0001] The present invention relates to sorting of products or items, which are unwanted or required to be separated from a product stream, especially a sorting apparatus used for sorting the unwanted products from a product line in the sectors like dry food or frozen food industry, recycling industry and mining. Additionally, the present invention is related to a product sorting method enhanced for being used in said sorting apparatuses.

Background of the Invention (Prior Art)

[0002] Various types of apparatus working with different principles for sorting the unwanted parts of the product streams required to be sorted or separated out by means of analyzing the characteristic features such as color, structure, surface and shape are available in the prior art. These equipment are generally worked with the principle of that directing a concentrated light beam on a product and thus collecting the reflected light from the product with optical elements, and eventually removing the unwanted objects from the product stream by means of producing a control signal after processing the collected information from the reflected light.

[0003] In abovementioned basic method, the reflected light gives important information in terms of sorting the unwanted parts from a product stream. Yet, there are other components of the reflected light and each of them provides important information in terms of the characteristic features of the product. Once a concentrated light beam is directed to an object, the light may reflect and/or scattered in various ways.

[0004] For example, it is possible for the light beam to reflect directly from the point on the object that the light beam impinges upon. The amount of the directly reflected light may change depending on the light transmittance, namely transparency of the object. However, while the transparency increases, the light diffuses within the object and spreads. In this case, when the amount of the directly reflected light decreases, the amount of the scattered light increases. The change in the amount of the scattered light provides important information especially about the color and the structure of the object which is inspected. Beside this, although some objects are non-transmittant, they reflect the imposed concentrated light beam by scattering because of having the irregular surface characteristics. Said reflected light by scattering also provides important information about the surface structure and geometry of the object. In the scope of the present invention, both diffused light and dispersed light by irregularly emitted will be referred to as "scattered light". As mentioned above, sorting machines designed for detecting the directly reflected light and scattered light and sorting the unwanted objects by producing a control signal accordingly are available in prior art. For example,

Elbiscan 5000 and LS 9000 sorting machines used in sorting industry for many years, generally have at least one light source, a polygonal mirror for redirecting the produced light beams on the product at certain intervals to conduct a scanning function, a scanning zone, detection means with various detectors, and a removal unit to eliminate impurities. Detectors of said detection ways are designed to receive all the reflected light, only directly reflected light and also scattered light. This design is provided by using three types of diaphragms positioned in front of the photodetectors. First of them can allow passage of all light reflected over the product (a diaphragm having large opening), second of them prevents the directly reflected central light beam (a scattering light diaphragm having a blind spot in the middle) which can allow passage of the rest of light, the third one allows only the directly reflected light beam to pass through (a diaphragm having small opening corresponding to directly reflected light; anti-scattering).

[0005] Similarly, in document US 4,723,659 and EP 1 332 353, it is aimed to obtain electrical information provided by various light components by means of using the photodetectors susceptible to only directly reflected light, only scattered light, and all the reflected light, and to use this information in sorting. However, the general problem of all these conventional systems is the necessity of using a separate diaphragms in front of each photodetector and is also that said diaphragms seriously cause decrease of signal strength by giving rise the loss of light in some cases.

[0006] The typical structure of the electro-optic detection means in the prior art is shown in figures 3 and 4. As shown in figure 3, a light source (1) sends a light beam (2) in a way to fall on the polygon mirror (4) and a scan line is generated at horizontal axis on the reference surface (5) by rotational motion of said polygon mirror (4). The products (6) flowing continuously on a scan line reflect the light in some way by being exposed to periodic beams sent by polygon mirror (4). A series of detection means (11, 13) are used for detection and analyzing of various components of reflected light (7). Various focusing means (8) and beam splitter devices (9) may be provided on an optical way followed by the reflected light (7) to reach said detection means. In addition, using a diaphragm (10, 12) to determine the field of view of said detection means (11, 13) is quite widespread. As shown in figure 4, these diaphragms, for example, can be the type of anti-scattering diaphragm (12) having a small opening (16) in a way to allow passage of the directly reflected concentrated light, and can be the scattered light diaphragm (10) having a large opening (18) designed in a way to receive only the scattered light. In the middle of the opening (18) belonging to this last diaphragm (10), related detection means (11) are made insensitive to the directly reflected light providing a blind spot (17) corresponding to the directly reflected concentrated light. In the direct reflection light diaphragm (12), on the other hand, it is allowed passage of only the directly

reflected light, and the scattered light is blocked by a surface (28) corresponding thereto. Also, it arises that use one or more beam splitters (9) on the optical way of the reflected light (7). Generally, when a beam splitter (9) in the shape of a prism is used, %50 (20) of the reflected light (7) directed perpendicular thereto is reached to a detection means (11) by transmitting in the same direction, while the other %50 (19) is transmitted by refracting at an angle of 90° to the second detection means (13) in front of which there is provided an anti-scattering diaphragm (12). The cause of the light (2) bisectioning in prior art is to enable the inspection of the same image at the same time with two different ways. In the first inspection, the scattering feature of the reflection is evaluated with the first detection means (11) positioned behind the diaphragm by directing the %50 (20) of the image to the scattering diaphragm (10). In the second inspection, the concentrated light feature by directing the other %50 (19) of the image to the anti-scattering diaphragm (12) is evaluated with the second detection means (13) positioned behind the diaphragm. The image is inspected as follows in this electro-optic detection apparatus used in prior art.

[0007] The scattering diaphragm (10) positioned in front of the first detection means (11) transmits the image (7) to the first detection means (11) by passing its peripheral regions (22) through the opening (18). The central part of the reflected light (7) is prevented to reach to the first detection means (11) by impinging upon the blind spot (17) positioned in the middle of the diaphragm opening (18), and the first detection means (11) therefore generates electrical voltage as much as the light received from this diaphragm (10).

[0008] In the case of that an unwanted product (27) passes over the reference surface (5), when the reflected light (7) comes on the diaphragm (10) of the first detection means (11), it cannot reach to the detection means (11) because of impinging on the blind spot (17) positioned in the center of the diaphragm opening (18). Therefore, the electrical voltage generated by the first detection means (11) from an empty reference surface (5) and the desired product image (6) will be different than the electrical voltage generated by the image of the unwanted product (27).

[0009] In another detection mode, the directly reflected concentrated part of the light (7) reflected from the product stream is focused on the second detection means (13). Anti-scattering diaphragm (12) having a small opening (16) in the middle is provided in front of the second detection means (13). Said diaphragm (12) prevents the reflected light (7) to reach to the second detection means (13) by obstructing the peripheral parts of the light. The central part of the reflected light (7) reaches to the second detection means (13) by passing through the opening (16) of the diaphragm. The second detection means (13) generates an electrical signal as much as the light that the second detection means (13) receives from the diaphragm (12).

[0010] The technical problems of the electro-optic detection apparatus and the electro-optic detection method as described insofar is explained in detail as follows.

[0011] Although the detection means (11 and 13) are the devices that can generate electrical signal according to the light energy that is perceived by them, because the first generated analogue electrical voltage signal is at mv level, it is quite hard to inspect and use an electrical signal at this level effectively and said situation prevents to have effective results. Therefore, the signal has to be amplified in order to be used. However, there are also unwanted distortions in this first raw image of the electrical signal and said distortions increase more during the amplification process made with an electronic circuit. Said distortions have to be filtered in order to make this amplification in an efficient manner. Filtering process is also made with an electronic circuit. However, this results in losses over the signal. The important thing in this point is to keep the quality of the first raw signal high. Because the quality of the signal after the correction is directly proportional with the first analogue and raw signal quality. In other words, the quality of the first raw form of the signal is directly proportional with light intensity (19 and 20) projected onto the detection means (11 and 13). Light intensity is inversely proportional with the number of equipment used along the light pathway. Especially, the diaphragms (10, 12) used before the detection means (11, 13) intrinsically cause some losses in the light while fulfilling the desired function.

[0012] The conventional systems are extremely dependent on the filtering means (10, 12) like said diaphragms and also there is need for optical means like a beam splitter (9) to distribute the reflected light (7) from the product stream (6, 27) to the detectors, and therefore defects in quality of the signal arise. Although, the beam splitting means (9) in the form of translucent mirror generally distributes the reflected light (7) to the detection means (11, 13), it causes additional signal losses by absorbing a quantity of light. More importantly, all light as reflected cannot reach to the related detection means (11, 13) because of that the beam splitter (9) divides the reflected light. For example, as shown in figures 3 and 4, the reflected light is distributed to the detection means (11, 13) as %50-50. This causes the deficiencies in quality of the signal. When all of these reasons are thought together, it is clear that a novelty is required in the sorting apparatus of the prior art. The present invention solves the aforementioned problems with a sorting apparatus as provided according to claim 1, and with a sorting method provided according to claim 11.

Brief Description of the Invention

[0013] In the electro-optic product sorting apparatus and method of the invention, the need for the equipment called prism or beam splitter (9) is eliminated, and both scattering and direct reflection features of the product (6, 27) passing in front of the reference surface (5) are in-

spected at the same time by using the all image (7) reflected from the reference surface (5).

[0014] The diaphragms (10, 12) having been used in prior art are eliminated by means of the presently developed apparatus and the method, and thus the signal losses are prevented. By this way, significant increases in the signal quality are obtained by decreasing the noise in the said signals. In this manner, the control circuit receiving the electrical signals generated by the detection means (11, 13) can considerably decrease the error margin in sorting by generating more precise and consistent control signals. By means of the invention, the system can also be simplified in a cost effective way by decreasing the optical elements on the optical pathway through the detection means (11, 13).

[0015] The sorting apparatus presented in the scope of the invention useful for detecting and sorting the unwanted objects (27) in the product stream (6, 27) comprises at least one light source (1) generating a scanning line on said product stream (6, 27) by sending concentrated light beam (2) onto the product stream (6, 27); at least one scanning means (4) for transmitting the concentrated light beam (2) to the scanning line and for collecting and directing the reflected light (7); a first detection means (11) for receiving the directly reflected light component (25) from the point that the light impinges upon said product stream (6, 27) and generating an electrical signal proportional thereto; a second detection means (13) for receiving the scattering light component (26) around the periphery of said impingement point and generating an electrical signal proportional thereto; a control circuit for generating at least one control signal by processing the electrical signals received from said first and second detection means (11, 13) proportional to each of the electrical signals or a combination thereof; and a removal unit operated with said control signals.

[0016] The apparatus presented according to the invention also comprises at least one diaphragm mirror (23) with a hole positioned in the optical field of view of the first and second detection means (11, 13). Said diaphragm mirror (23) comprises an opening (24) which makes the first detection means (11) sensitive only to the directly reflected light component by means of allowing only the directly reflected light component (25), and is advantageously positioned to make the second detection means (13) sensitive only to the scattered light component (26) by directing said scattering light component (26) to the second detection means (13).

Description of the Figures

[0017] The definition of the prepared figures is given below for explaining electro-optic product sorting apparatus and method developed by this invention more consistently.

Figure 1 - A representative drawing showing the optical part of electro-optic product sorting apparatus

presented according to the current invention.

Figure 2 - A detailed drawing showing the orientation of the returning light to the detection means in an electro-optic product sorting apparatus presented according to the instant invention.

Figure 3 - A representative view of the optical way of an electro-optic product sorting apparatus according to prior art.

Figure 4 - A detailed drawing showing the orientation of the returning light to the detection means in electro-optic product sorting apparatus available in prior art.

Definition of the Created Elements/Parts/Pieces

[0018] The elements/parts/pieces placed in the prepared figures are numbered individually to explain the electro-optic sorting apparatus and method developed by this invention in detail, whereas the definitions of the numberings are given below.

1. Light source
2. Scanning light
3. Means for redirecting the light
4. Scanning means
5. Reference surface
6. Desired product
7. Reflected light
8. Focusing means
9. Beam splitter
10. Scattering diaphragm
11. First detection means
12. Anti-scattering (direct reflection) diaphragm
13. Second detection means
14. The image generated on the first detection means
15. The image generated on the second detection means
16. The aperture of the anti-scattering (direct reflection) diaphragm
17. Blind spot of the scattering diaphragm
18. The aperture of the scattering diaphragm
19. A light component transmitted to the anti-scattering (direct reflection) diaphragm, but lost by being prevented
20. A light component transmitted directly to the scattering diaphragm
21. The image generated on the second detection means by the light component passed through the anti-scattering (direct reflection) diaphragm
22. The image generated on the first detection means by the light component passed through the scattering diaphragm
23. Diaphragm mirror with a hole
24. Aperture of the diaphragm mirror

- 25. Directly reflected light component passing through the hole of diaphragm mirror without loss
- 26. Scattering light component redirected from the diaphragm mirror without loss
- 27. Unwanted product/object
- 28. The surface corresponding to the scattered light

Detailed Description of the Invention

[0019] The sorting apparatus described within the scope of the invention is generally suitable for being used in continuous sorting processes having a product stream, and works with the principle of directing a concentrated light beam onto said product stream and of generating a sorting control signal with analyzing the reflected light by way of electro-optic principles. The light reflection characteristics of desired (6) and/or unwanted (27) products are calibrated according to the reference surface (5) in the presently disclosed apparatus. The concentrated light beam coming from the light source (1) operates as a scanning light (2) and is directed onto the scanning means (4) by passing preferably through a means for redirecting the light (3). In the preferred embodiments of the invention, said light source (1) may be a laser tube and preferably more than one laser tubes generating laser light in different wave lengths. Also in said preferred embodiments, although the scanning means (4) may be a polygonal mirror having multiple reflection surfaces, as appreciated by those skilled in the art, any scanning means (4), which is designed to be able to perform a scanning line on the reference surface (5) and to send concentrated light onto the scanning line continuously or intermittently, can be used.

[0020] Every product or object on the scanning line generated by the scanning light (2) directed onto the product stream (6, 27) reflects and/or absorbs said scanning light (2) in some way. The light reflection characteristics of the desired (6) and unwanted products/objects (27) are different from each other. Therefore, the other components of the reflected light (7) from the scanning line should be detected and analyzed. By this means, the reflected light (7) coming from the scanning line is taken back by means of the scanning means (4) and directed to the detection means (11, 13). Preferably at least one focusing means (8) is provided on the optical way of the reflected light (7) up to the detection means (11, 13). Although, the focusing means, as shown in figure 1, may be in the form of a convex lens, or it can be comprised of a composition of more than one lenses comprising different concave and convex lenses.

[0021] As described above in detail, the reflected light (7) coming from the impingement point on the product stream (6, 27) comprises the components of directly reflected light (25) and the scattering light (26). Said light components are sorted by means of the filtering elements or diaphragms (10, 12) positioned in front of each detection means (11, 13) in the prior art. Furthermore, directing the reflected light (7) to more than one detection means

(11, 13) at the same time is generally performed with beam splitter (9). The apparatus of the prior art are given in figure 3 and 4 as an example. However, weak electrical signals depending on the weak light intensity are generated because of the light losses in both diaphragm means (10, 12) and beam splitter (9) in these systems. These drawbacks of the prior art are eliminated by the diaphragm mirror (23) with a hole as presented within the scope of the present invention, and therefore it is now possible to generate better quality signals with low noise ratio.

[0022] Therefore, in the scope of the solution presented by the current invention, the reflected light coming from the product stream (6, 27) and the scanning line is separated in a way that is not performed previously, and is redirected to the related detection means (11, 13) at the same time by means of that a specifically designed diaphragm mirror (23) with a hole that is positioned in front of the first and second detection means (11, 13). As shown in figure 1 presenting a preferred embodiment of the invention, a focusing means (8) of the type indicated above may be placed in a proper position in front of said diaphragm mirror (23) with a hole. The aim of this is to allow passage of the concentrated part of the reflected light (7) representing the direct reflection part (25) of the light through the opening (24) of the diaphragm mirror (23) and to direct it to the first detection means (11), and at the same time to redirecting the rest of the light component (26) to the second detection means (13) without any loss.

[0023] Therefore, the opening (24) of the diaphragm mirror with a hole (23) is arranged only to allow the passage of the directly reflected light component (25). The directly reflected light (25) has a cross-sectional area and a certain diameter. After said light component (25) passes through the focusing means (8), its cross-sectional area and diameter may change to a certain extend. However, the important thing here is that the diameter of the opening (24) of the diaphragm mirror (23) is arranged to correspond to the diameter of the directly reflected light beam (25) reaching thereto. As those skilled in the art would appreciate, the diameter of the mirror opening (24) and the diameter of the concentrated light (25) can be easily matched, for instance by means of moving and positioning the focusing means (8) and/or the diaphragm mirror (23) with a hole properly at the vertical axis (y). The rest of the light corresponds to the scattering light component (26) as described above in detail, and it goes directly to the detection means (13) with angular diffraction provided by the mirror without having any loss in its intensity. Said diaphragm mirror (23) with a hole is positioned to be able to reflect the scattered light partition (26) to the second detection means (13) by making angular diffraction. Namely, said directly reflected light (25) is reached to the first detection element (11) by passing through the opening (24) of the aperture mirror (23) without being reflected. The scattering part (26) is reflected to the second detection means (13) by means of the re-

flection surface around the opening (24).

[0024] Light components (25, 26) described in the scope of the invention are of the type which are well known by the skilled person in the art. For example, the directly reflected light component (25) means that the light reflects directly without spreading or scattering according to the principles of reflection laws after impinging upon the product stream (6, 27). All of the reflected light (7) contain this light component within itself, and therefore the opening (24) on the diaphragm mirror (23) with a hole, as appreciated by the skilled person in the art, can be arranged to be in a corresponding size to the directly reflected concentrated light component (25), for example by using the focusing means (8) and/or apertured mirror (23) properly in a suitable position. Beside this, the angle of the diaphragm mirror (23) with a hole to the horizontal axis, as shown in detail in figure 2, may be arranged to direct the scattering light component (26) largely and without any loss to the second detection means (13). Said angle and the size of the opening (24) of the apertured diaphragm mirror (23) can be adjusted in a standard optical design process. In the exemplary embodiment according to figure 2, when the first detection means (11) is positioned at the horizontal axis (x) and the second detection means is positioned in perpendicular direction (y), said apertured mirror (23) can be arranged to make an appropriate angle to both of them. Said aperture mirror (23) is preferably positioned to make a 45° angle with the vertical axis (y).

[0025] The detection means (11, 13) of the sorting apparatus provided in the scope of the invention generate electrical signals proportional to the intensity of received light component. In this respect, said detection means (11, 13) can be any detection means which is able to operate as a photodetector. For example, photomultiplier tubes can be used in the context of the present invention.

[0026] The electrical signals generated by said detection means (11, 13) are sent to a control circuit (not shown) and processed. Said control circuit can generate a control signal independently and proportional to the signal coming from each detection means (11, 13). Beside this, the control circuit can generate a control signal proportional to the total electrical signal by gathering said electrical signals. Therefore, the total electrical signal is an electrical signal proportional to all reflected light (7).

[0027] In an alternative embodiment, the total electrical signal can also be obtained by adding an additional detection means (not shown) to the system. In this case, the field of view of the additional detection means is arranged to receive all reflected light (7). For example, the detection means equipped with a diaphragm having an opening large enough to receive all returning light (7) can be made sensitive to all of the reflected light.

[0028] By means of the apparatus and the method of the invention, the detection of the unwanted products (27) is more reliable and precise as compared to the methods and the apparatus of prior art, because the electrical signals generated by the first and the second detection

means (11, 13) provide more clear and certain signals distinguishable from each other, when an unwanted product (27) passes in front of the reference surface (5).

[0029] The invention also comprises a sorting method practiced with the sorting apparatus described in aforementioned embodiments. Said method principally comprises forming a scanning line by directing concentrated light beam (2) onto a product stream (6, 27); gathering and redirecting the reflected light (7) coming from the product stream (6, 27) in the scanning line; receiving the directly reflected light component (25) reflected from the point of impingement on the product stream (6, 27) and providing a first detection means (11) generating an electrical signal proportional to this directly reflected light; receiving the scattering light component (26) reflected from around the periphery of said impingement point and providing a second detection means (13) generating an electrical signal proportional to this scattering light; processing said signals and generating at least one control signal proportional to each of said electrical signals or to a combination of thereof; and activating a removal unit said by using said control signals, for detection and sorting the unwanted objects (27) in a product stream (6, 27).

[0030] The characteristic feature of the method of the invention is positioning of at least one diaphragm mirror with a hole (23) in optical field of view of the first and second detection means (11, 13), and making the first detection means (11) sensitive only to the directly reflected light component (25) with an opening (24) positioned on said diaphragm mirror (23), directing the scattering light component (26) to the second detection means (13) by means of the rest of the surface of said diaphragm mirror with hole (23), thus making said detection means (13) sensitive only to the scattered light component (26).

[0031] The aforementioned preferred embodiments of the invention can be modified without departing from the appended claims and this scope is not limited with the figures incorporated hereto.

Claims

1. A sorting apparatus for detecting and sorting unwanted objects (27) in a flowing product stream (6, 27) comprising;
 - at least one light source (1) generating a scanning line on said product stream (6, 27) by directing concentrated light beam (2) onto the product stream (6, 27),
 - at least one scanning means (4) for directing the concentrated light beam (2) onto the scanning line and for gathering and redirecting the reflected light (7),
 - a first detection means (11) for receiving the directly reflected light component (25) reflected from the point of impingement in said product stream (6, 27) and generating an electrical sig-

nal proportional thereto,

- a second detection means (13) for receiving the scattering light component (26) reflected from around the periphery of point of impingement and generating an electrical signal proportional thereto,
- a control circuit for processing and generating a control signal proportional to each of said electrical signals or to a combination of said electrical signals received from said first and second detection means (11, 13), and
- a removal unit operated with said control signals,

characterized in that said apparatus further comprises at least one diaphragm mirror with a hole (23) positioned in optical field of view of the first and second detection means (11, 13), said diaphragm mirror (23) having an opening (24) so as to make the first detection means (11) sensitive only to the directly reflected light component (25) by allowing only the passage of the directly reflected light component (25), and wherein said diaphragm mirror with a hole (23) directing the scattering light component (26) to the second detection means (13) and is being positioned such that said detection means (13) is sensitive only to the scattering light component (26).

2. A sorting apparatus according to claim 1, wherein said light source (1) comprises a laser.
3. A sorting apparatus according to claim 2, wherein said apparatus comprises more than one light source (1) generating laser light at different wavelengths.
4. A sorting apparatus according to claim 1, wherein said second detection means (13) is arranged at vertical axis (y), wherein the diaphragm mirror with a hole (23) is arranged to make a 45° angle to the detection means (13) at the vertical axis (y).
5. A sorting apparatus according to claim 1, wherein said apparatus comprises at least one focusing means (8) which focuses the light onto said diaphragm mirror with a hole (23) on the optical way on which the reflected light (7) goes to the detection means (11, 13).
6. A sorting apparatus according to claim 1, wherein said focusing means (8) comprises a convex lens.
7. A sorting apparatus according to claim 4, wherein said diaphragm mirror with a hole (23) is in the optical field of view of the first and second detection means (11, 13), and the first detection means (11) is positioned at the horizontal axis (x) and the second detection means (13) is positioned perpendicular (y) thereto, whereby said diaphragm mirror with a hole

(23) is positioned to make a 45° angle with both detection means (11, 13).

8. A sorting apparatus according to claim 1, wherein said diaphragm mirror with a hole (23) is not transparent or translucent.
9. A sorting apparatus according to claim 1, wherein said scanning means (4) is a polygonal mirror.
10. A sorting apparatus according to claim 1, wherein said removal unit comprises a plurality of air nozzles activated with a control signal received from the control circuit.
11. A sorting method for detecting and sorting unwanted objects (27) on a flowing product stream (6, 27) comprising the steps of;
 - generating a scanning line on the product stream (6, 27) by directing concentrated light beam (2) onto the product stream (6, 27);
 - gathering and redirecting the reflected light (7) coming from the product stream (6, 27) in the scanning line;
 - receiving the anti-scattering light component (25) reflected from the point of impingement on said product stream (6, 27) and providing a first detection means (11) generating an electrical signal proportional thereto;
 - receiving the scattering light component (26) reflected from around the periphery of said impingement point and providing a second detection means (13) generating an electrical signal proportional thereto;
 - generating at least one control signal proportional to each of said electrical signal or to a combination thereof after processing of said electrical signals; and
 - activating a disposal unit with said control signals, wherein said method further comprising; positioning of at least one diaphragm mirror with a hole (23) in optical field of view of the first and second detection means (11, 13), and making the first detection means (11) sensitive only to the directly reflected light component (25) by way of an opening (24) positioned on said diaphragm mirror with a hole (23), directing the scattering light component (26) to the second detection means (13) by means of the rest of the surface of said diaphragm mirror with a hole (23), thus making said detection means (13) sensitive only to the scattering light component (26).
12. A sorting method according to claim 11, wherein said concentrated light beam (2) is laser and said light beam (2) is provided with more than one wavelengths.
13. A sorting method according to claim 11, wherein said second detection means (13) is arranged at the ver-

tical axis (y) and the diaphragm mirror with a hole (23) being positioned to make a 45° angle with the detection means (13) at the vertical axis (y).

14. A sorting method according to claim 11, wherein said method further comprising the step of focusing of the reflected light (7) onto the diaphragm mirror with a hole (23) on the way that the light (7) goes to the detection means (11, 13).
15. Use of the apparatus according to claim 1 in a process for sorting dry and frozen food products.

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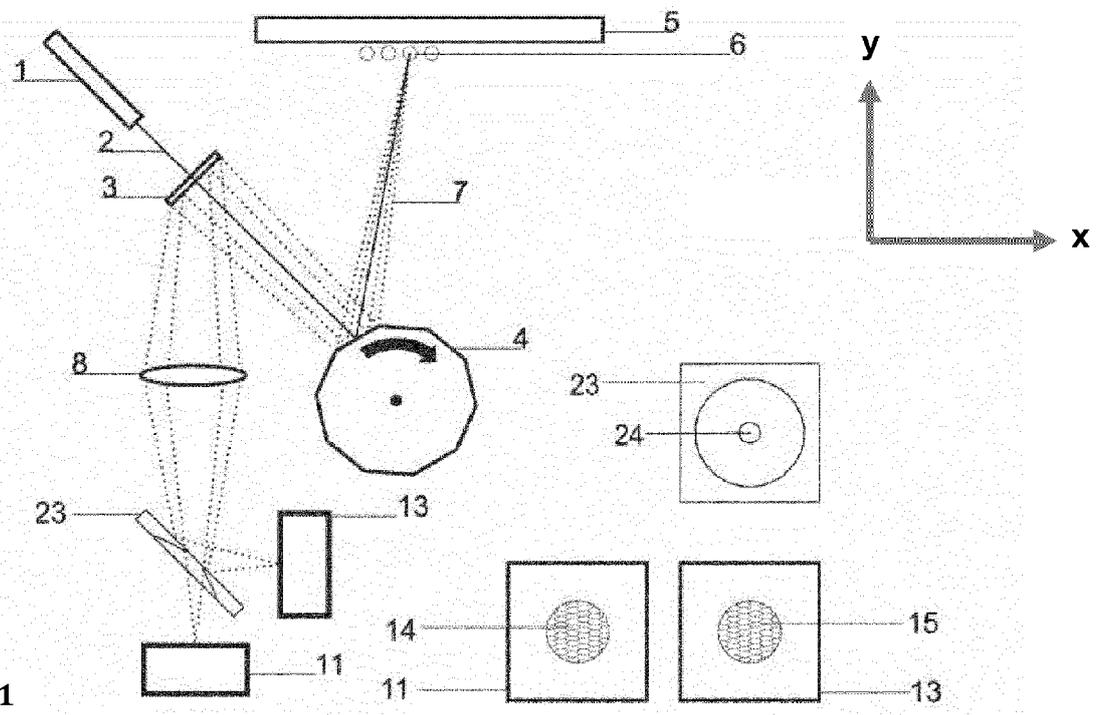


Figure 1

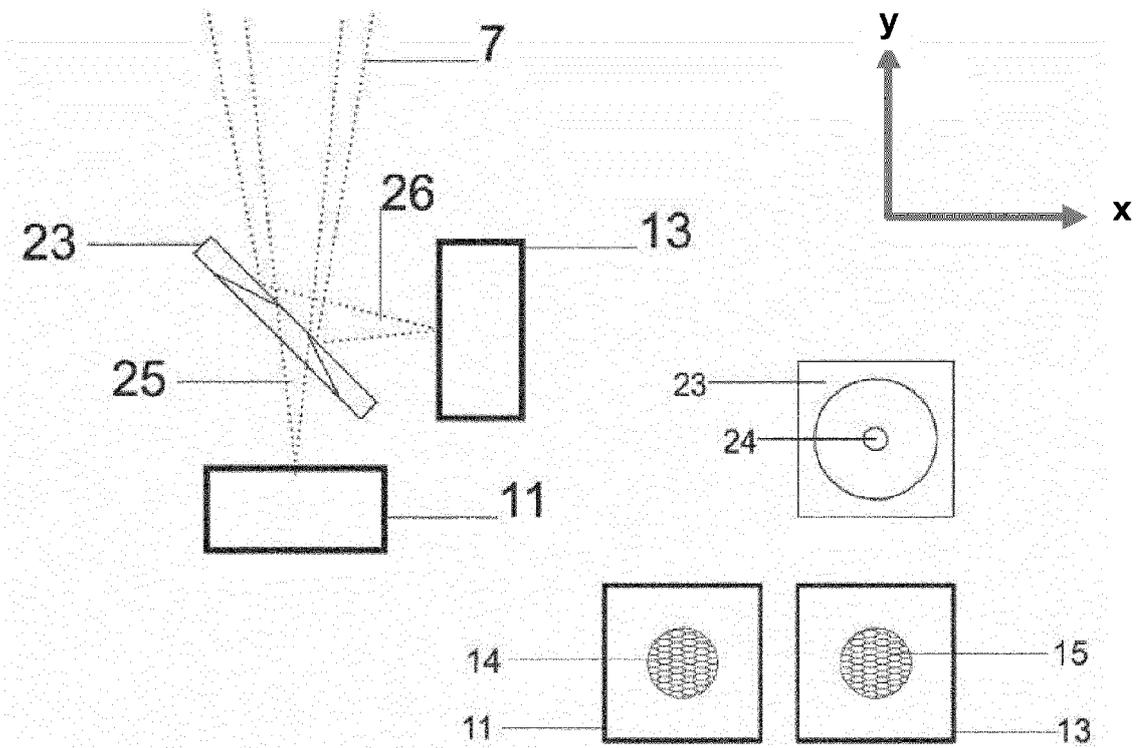


Figure 2

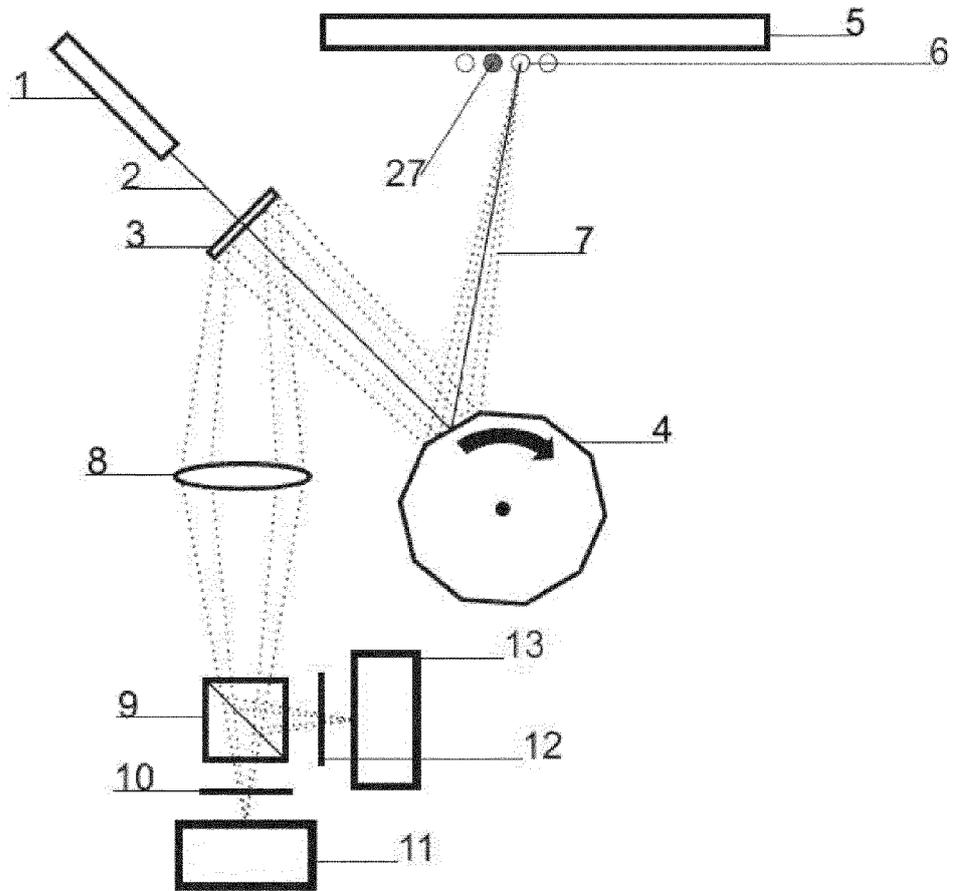


Figure 3

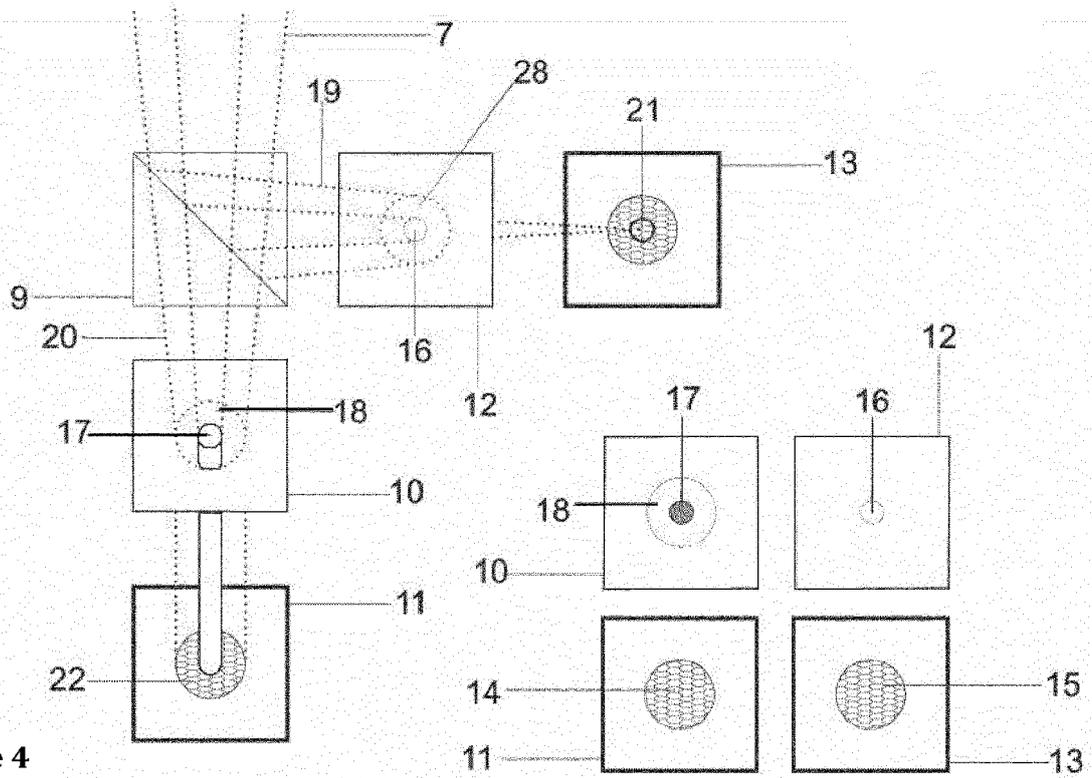


Figure 4



EUROPEAN SEARCH REPORT

Application Number
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| Place of search Munich | | Date of completion of the search 2 July 2015 | Examiner Wich, Roland |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p> | | | |

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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