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(54) A device for generating, detecting and recognizing a contour image of a liquid container

(57) A device for generating, detecting and recognizing a contour image of a liquid container (5), comprising a light source (1), light detector means (4), means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container, and for conveying to said light detector means light rays which are not refracted or hidden by said container, processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and means for comparing such processed signals with predetermined container feature data to recognize said contour image of the container. The means for directing light rays suitably comprise Fresnel lenses (2, 3) which are coaxially and respectively located at opposite longitudinal sides of said path, said light source (1) suitably being a stationary light emitting diode capable of emitting light towards said first Fresnel lens (2). Said light detector means (4) is

a TV camera, e.g. of the CCD type capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour and any light passing through said container.

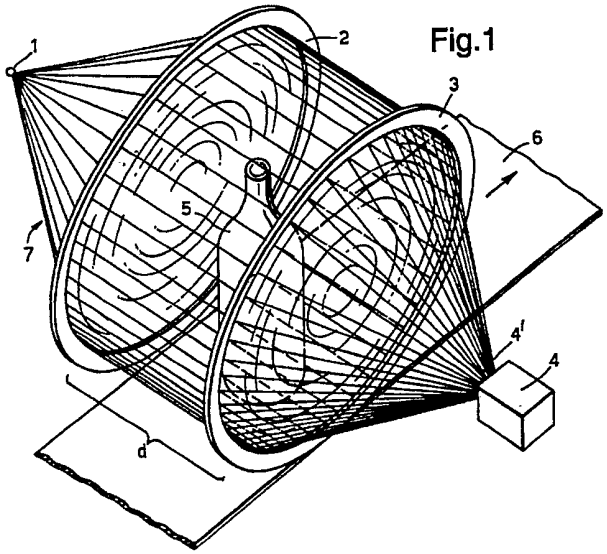

Fig.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1

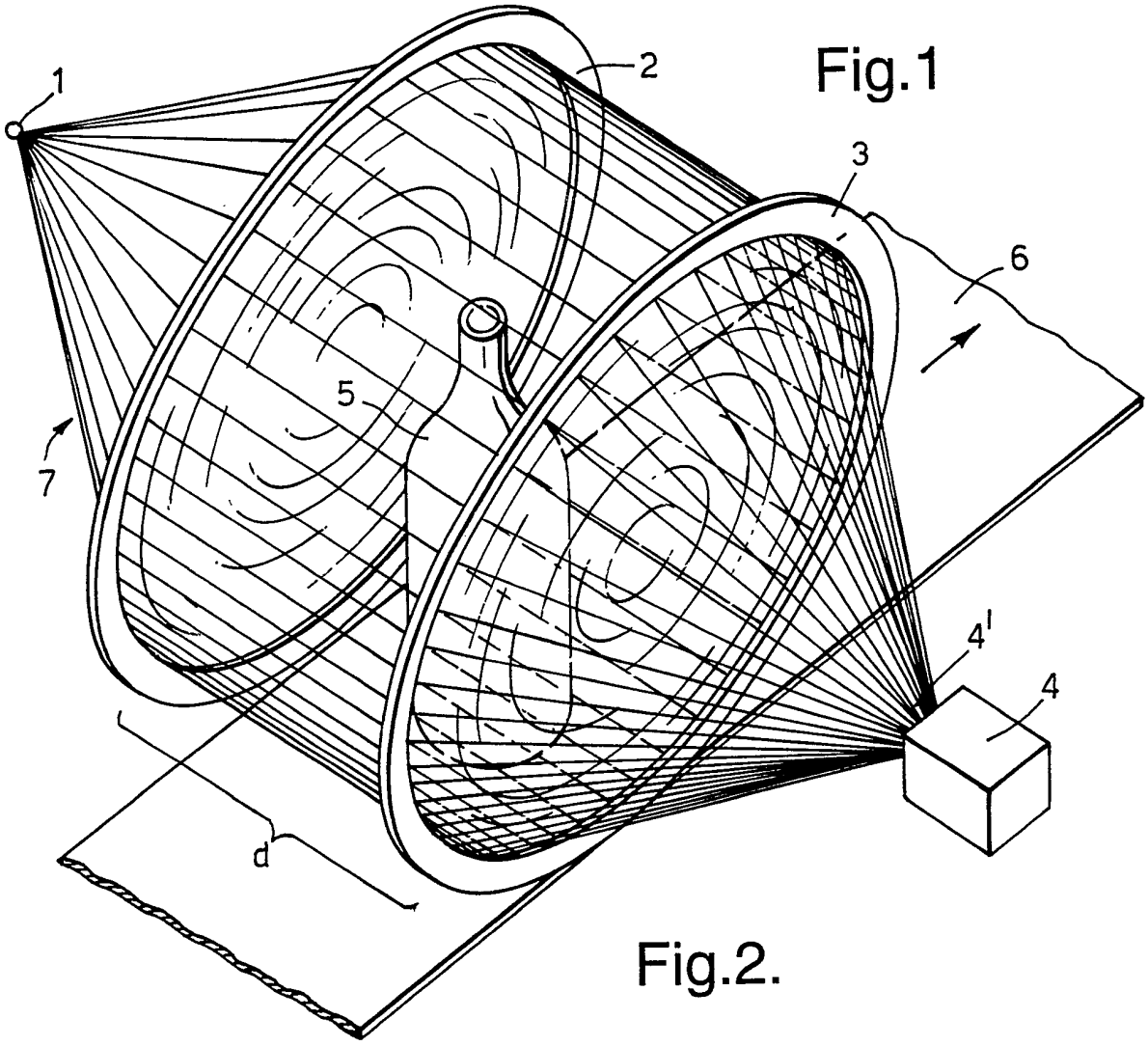
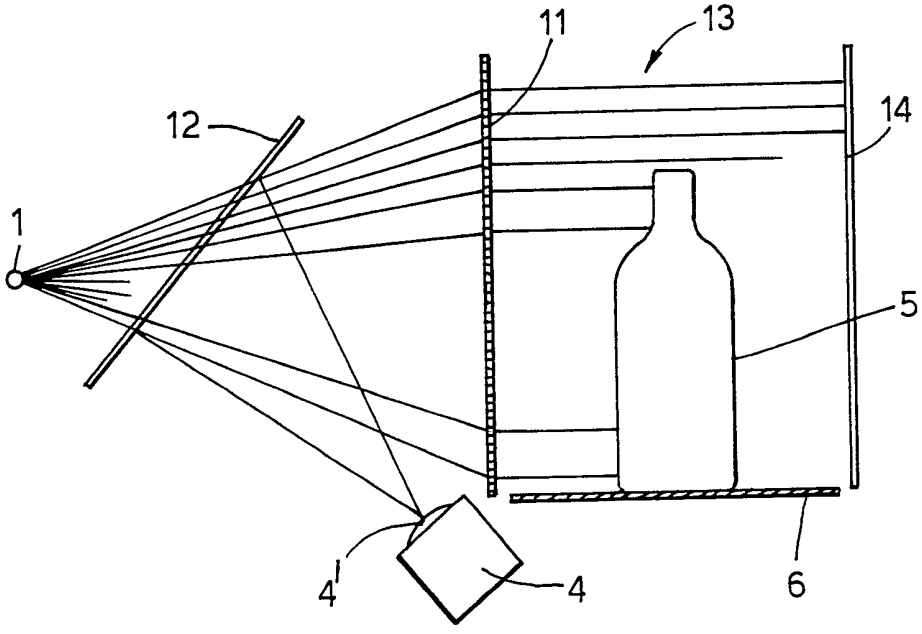


Fig.2.



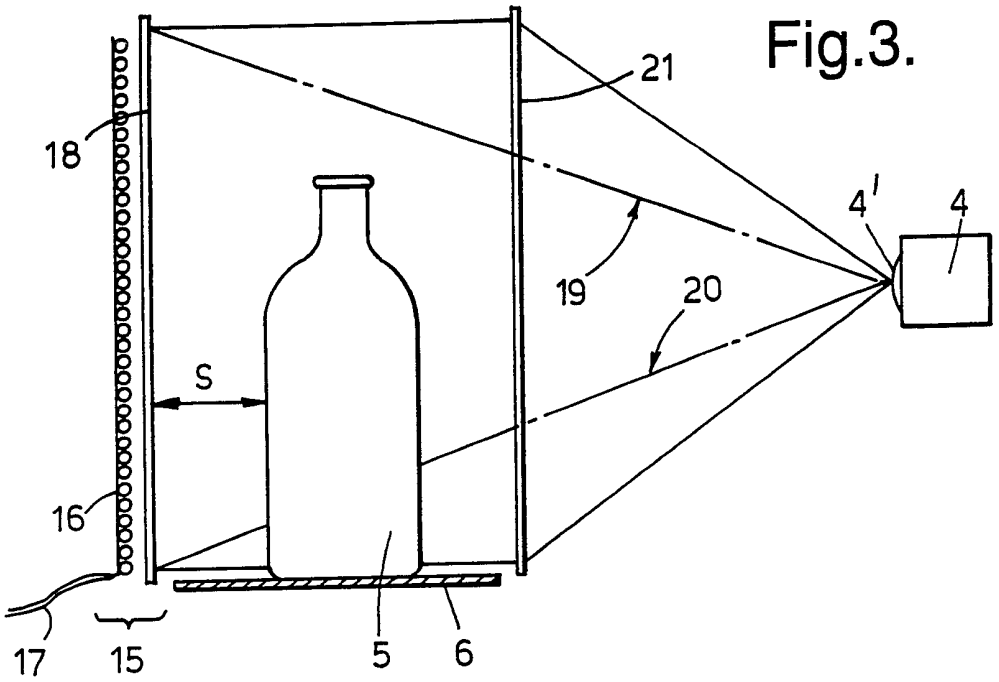


Fig.3.

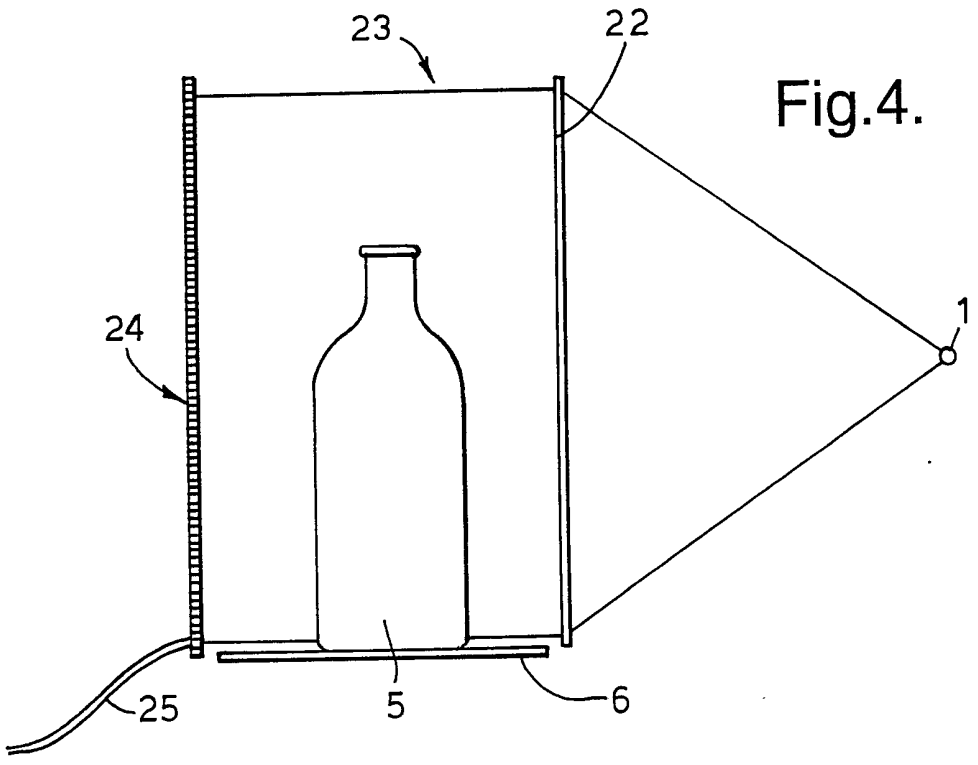


Fig.4.

Fig.5.

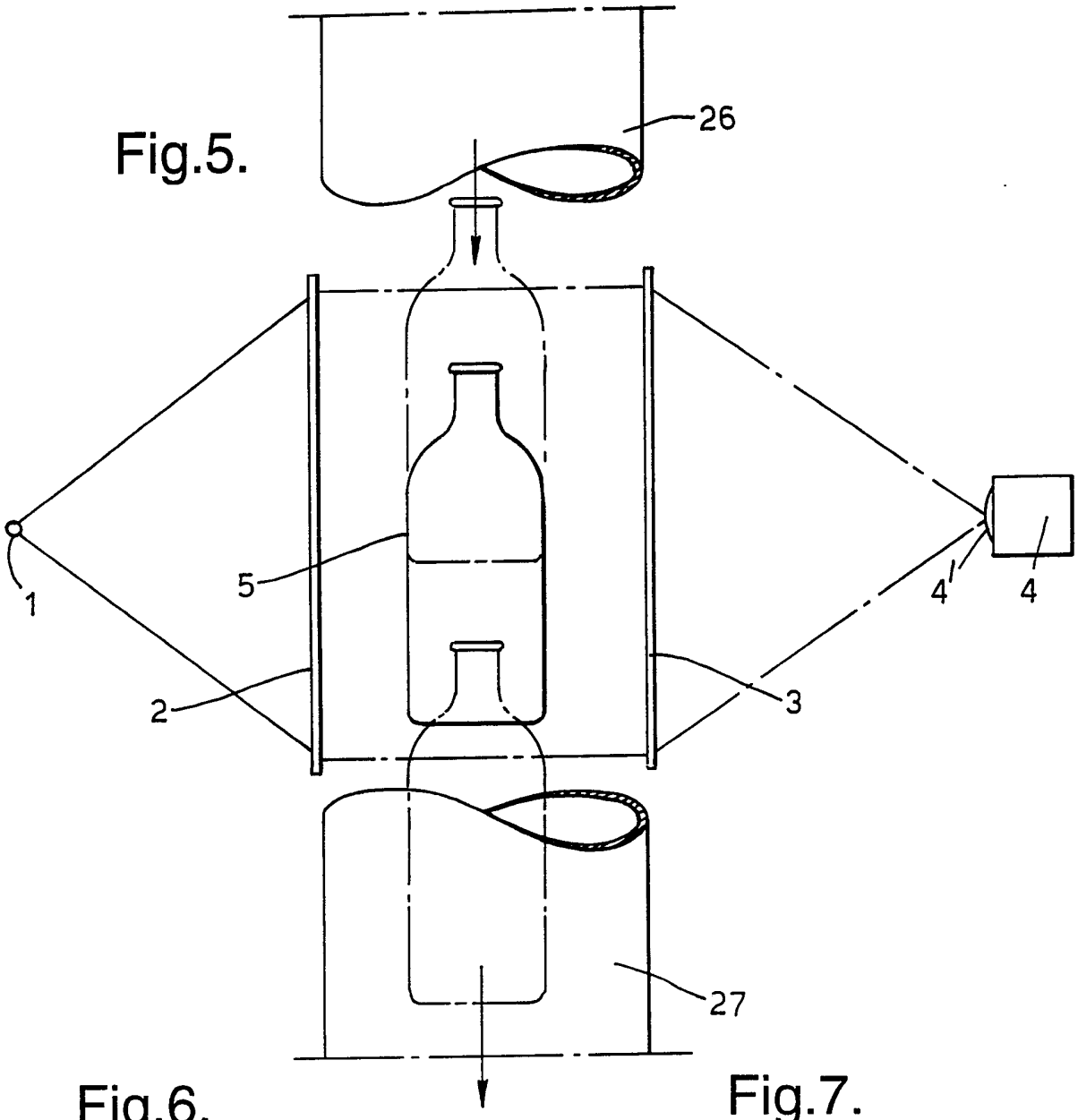


Fig.6.

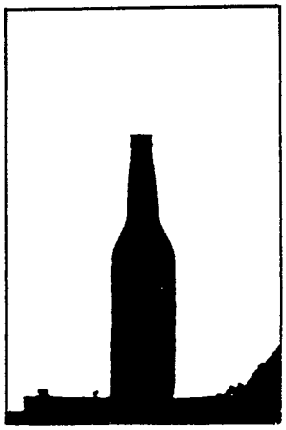


Fig.7.

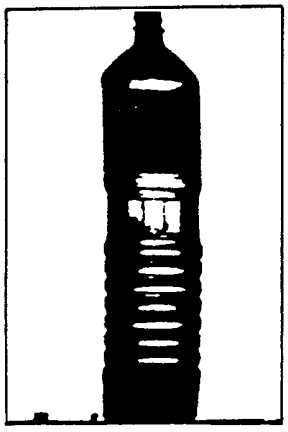


Fig.8a.

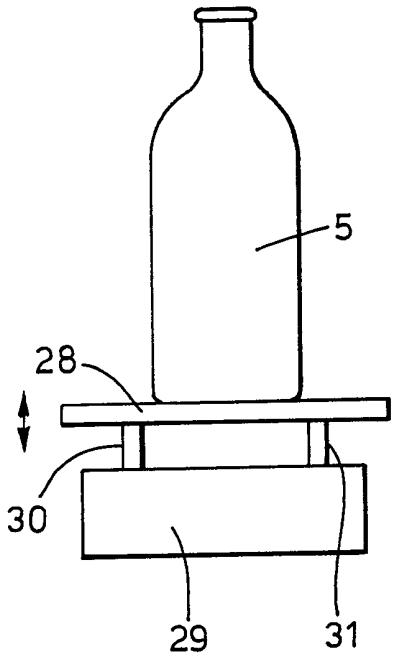


Fig.8b.

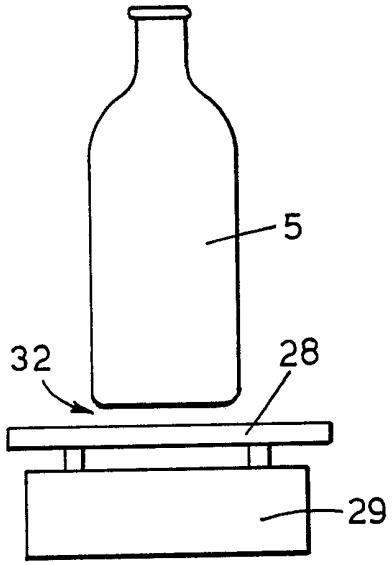


Fig.9

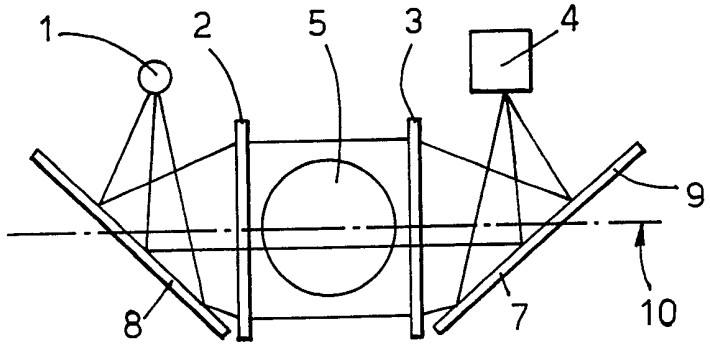
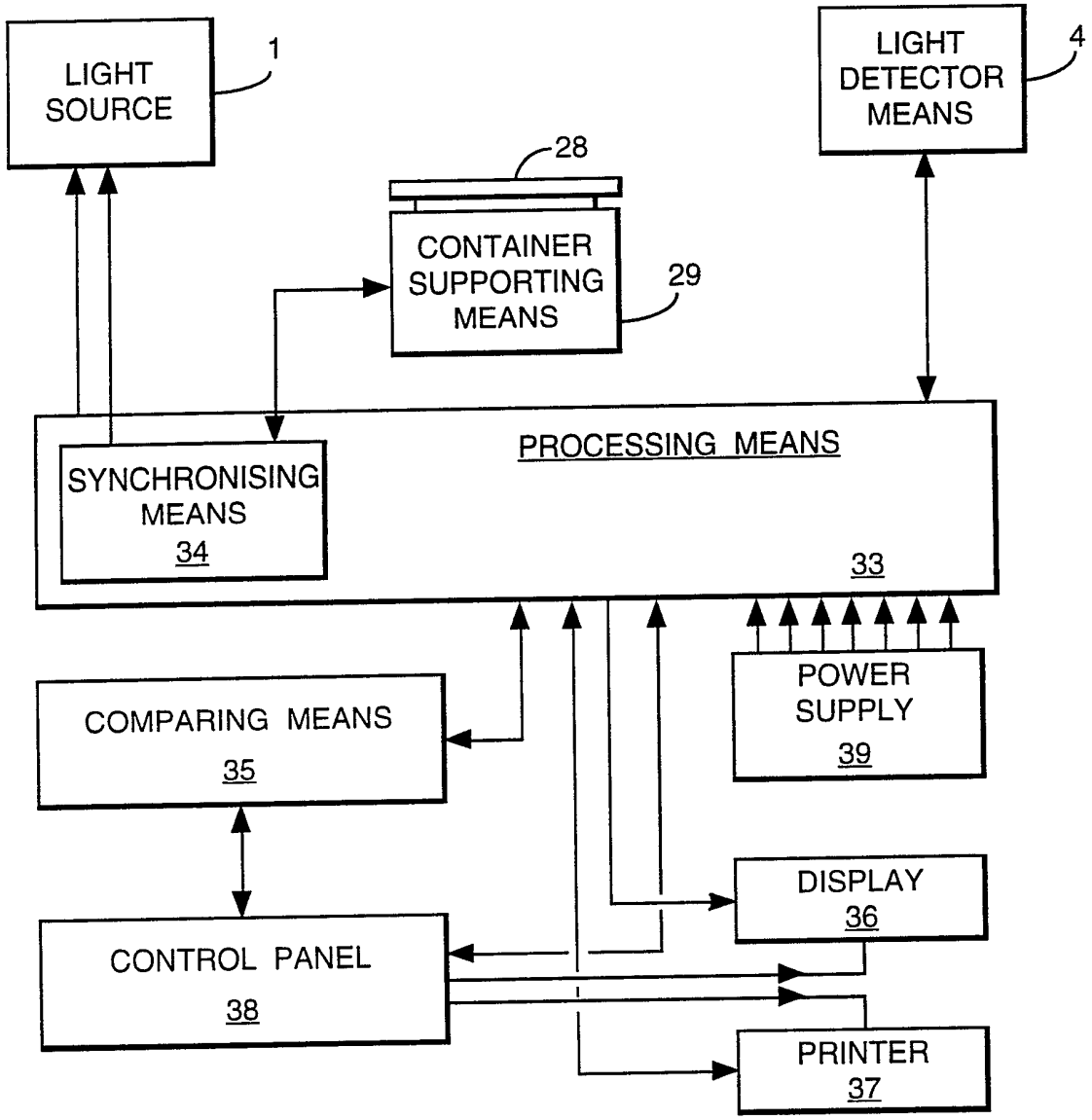


Fig.10.


LIGHT SOURCE
1
LIGHT DETECTOR MEANS
4
28
CONTAINER SUPPORTING MEANS
29
PROCESSING MEANS
SYNCHRONISING MEANS
34
33
POWER SUPPLY
39
COMPARING MEANS
35
DISPLAY
36
CONTROL PANEL
38
PRINTER
37

The present invention relates to a device for generating, detecting and recognizing a contour image of a liquid container. In the prior art technique there is often present problems with making images of liquid containers, such as bottles, in order to present the shape of such container. Materials like glass and plastics both reflect and convey light, in a way to cause the shape of the article not to be properly shown by an imaging system.

In the prior art there are known several ways and means for generating, detecting and characterizing an image of an object. US patent 4859862 (Planke et al), issued August 22, 1989, relates to a light source, means for directing light rays received from light source as parallel rays transversely of a path travelled by a liquid container, light reflective means for receiving such parallel light rays which are not refracted or hidden by said container, and retro-reflecting such received parallel light rays back transversely of said path and through said directing means, said means for directing light rays being a single light path controlling means located at a first longitudinal side of said path, and said light retro-reflective means being located at a second longitudinal side of said path. Inclined mirror means can be provided, according to said US patent 4859862 for receiving and redirecting said reflected light rays which leave said directing means. Light detector means are arranged for receiving the redirected light, and processing means are connected to the light detector means for processing signals from the detector means which are indicative of such detected light rays. Further, means are provided for comparing such processed signals with predetermined container feature data to recognize the contour image of the container. According to the prior art the light source is suitably a laser beam directed towards a rotary mirror to cause the laser beam to scan the light towards a collimating optical element, e.g. a holographic element.

A further example of the prior art for generating, detecting and recognizing a contour image of a liquid container is described in US patent number 4625107 (Planke), issued November 25, 1986. That patent refers to a method for contour recognition of totally or partly transparent objects, e.g. bottles, where the object is advanced through an illumination and detector station and there being illuminated on at least part of its circumference. The light reflected by the object is viewed by a detector against a background that is dark relative to the object, and the viewed image is recorded and converted to pulse signals that are processed to yield a numerical code characteristic of the object. The method requires a particular positioning of light sources to avoid the light sources being directly viewable by a TV camera, e.g. a CCD camera.

The present invention, however aims at providing a device which generates, detects and recognizes a more correct contour image of a liquid container than that which has been previously obtainable.

In a first embodiment of the present invention, there is provided a device for generating, detecting and recognizing a contour image of a liquid container, comprising a light source, light detector means, means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container, and for conveying to said light detector means light rays which are not refracted or hidden by said container, processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays and means for comparing such processed signals with predetermined container feature data to recognize said contour image of the container, wherein said means for directing light rays are first and second light path controlling means coaxially and respectively located at

opposite longitudinal sides of said path, wherein said light source is a stationary, substantially point light source capable of emitting light towards said first light path controlling means, and wherein said light detector means is a TV camera capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing trough said container.

According to further features of said device, said light source is preferably a light emitting diode. Still further, means may be provided for synchronizing operation of said light emitting diode with container location relative to said directing means. More specifically, the LED may be pulse operated, the duration of the pulse being short enough to freeze any movements of the bottle.

According to another feature of the device, said TV camera is preferably a CCD camera, although any technical equivalent thereof lies within the scope of the present invention. Yet, a further feature of the present device is that said first and second light path controlling means are first and second positive lenses, respectively, suitably Fresnel lenses.

Further, said light source is preferably located at the focus of the first Fresnel lens, and said TV-camera is preferably located at the focus of said second Fresnel lens.

A first mirror could be located at an acute angle, e.g. in the range of 30°-60°, suitably approx. 45°, to a common central axis through said Fresnel lenses to convey light between said light source and said first Fresnel lens. Further, a second mirror could be located at an acute angle, e.g. in the range of 30°-60°, suitably approx. 45°, to a common central axis through said Fresnel lenses to convey light not refracted or hidden by said container between said second Fresnel lens and said camera.

According to a second embodiment of the present invention, there is provided a device for generating, detecting and recognizing a contour image of a liquid container, comprising a light source, means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container, light retro-reflective means for receiving such a parallel light rays which are not refracted or hidden by said container, and retro-reflecting such received parallel light back transversely of said path and through said directing means, said means for directing light rays being a single light path controlling means located at a first longitudinal side of said path, and said light retro-reflective means being located at a second longitudinal side of said path, inclined a mirror means for receiving and redirecting said reflected light rays leaving said directing means, light detector means for receiving said redirected light, processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and means for comparing such processed signals with predetermined container feature data to recognize said contour image of a container, wherein said light source is a stationary, substantially point light source capable of emitting light towards said first light path controlling means, and wherein said light detector means is a TV camera capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

According to a further feature of said second embodiment of the present device is that said light source is light emitting diode. Suitably, said TV camera is a CCD camera, although any technical equivalent thereof could be used.

Further, said single light path controlling means is preferably a positive lens of the Fresnel lens type. Said

light emitting diode is preferably located at the focus of said Fresnel lens. Also, said inclined mirror is a semi-transparent mirror capable of passing through light rays emitted by said light emitting diode towards said Fresnel lens.

Still a further feature of the second embodiment of the present device is the further provision for means for synchronising operation of said light emitting diode with a container location relative to said directing means. More specifically, the LED may be pulse operated, the duration of the pulse being short enough to freeze any movements of the bottle.

According to a third embodiment of the present invention there is provided a device for generating, detecting and recognizing a contour image of a liquid container, comprising a stationary light source means for emitting light transversely of a path travel by said container, light detector means for receiving light rays which are not hidden by said container, processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and means for comparing such processed signals with predetermined container feature data to recognize said contour image of a container, wherein means for directing light rays is provided in the form of a single light path controlling means located at a first longitudinal side of said path, said light source means being located at a second longitudinal side of said path, and wherein said light detector means is a TV camera capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

Preferably, said light source means provides a plane of light across said path. Said TV camera is preferably a CCD camera, although any technical equivalent thereof could be used.

Said single light path controlling means is, according to a preferred feature of said third embodiment, a positive lens, suitably of the Fresnel lens type.

In view of the light source means creating a plane of light across said path, said Fresnel lens may suitably have a rectangular shape.

According to a fourth feature of the present invention, there is provided a device for generating, detecting and recognizing a contour image of a liquid container, comprising a light source, light detector means, means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container, and for conveying to said light detector means light rays which are not refracted or hidden by said container, processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and means for comparing such processed signals with predetermined container feature data to recognize said contour image of a container, wherein said means for directing light rays is a single light path controlling means located at a first longitudinal side of said path, and said light detector is located at a second longitudinal side of said path, wherein said light source is a stationary, substantially point light source capable of emitting light towards said first light path controlling means, and wherein said light detector means is one-dimensional or two-dimensional array of light sensitive elements for detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

Suitably, said light source is a light emitting diode. Further, said light sensitive elements could be e.g.

photodiodes, phototransistors or any technical equivalent thereof.

In a further feature of the said fourth embodiment of the present device, said single light path controlling means is a positive lens of the Fresnel lens type. Said light emitting diode is preferably located at the focus of the Fresnel lens.

In the said fourth embodiment of the device, it could be envisaged the provision of a mirror located at an acute angle, e.g. in the range of 30°-60°, suitably approx. 45°, to a central axis through said Fresnel lens to convey a light between said light emitting diode and said Fresnel lens.

The possibilities of generating, detecting and recognizing an image of an article at the absolutely lower most part of the article is difficult. Thus, there is, according to the present invention for all embodiments thereof, provided means for enabling said container path of travel to be a free fall path.

In a particular embodiment of such a free fall feature, said device could comprise means for supporting said container along a specific length of said path, said supporting means having container supporting platform and further having actuator means for instantaneous dropping and subsequent position restoring of said supporting platform to provide detection of said lowermost portion of said container when the container is subjected to a short distance unsupported drop due to said platform dropping.

Further features of the present invention will appear from the attached patent claims as well as from the following description of the preferred, non-limitative embodiments of the present invention.

The present invention is now to be described further with reference to the following description and the enclosed drawing figures.

Fig. 1 shows a first embodiment of the device according to the present invention.

Fig. 2 shows a second embodiment of the device according to the present invention.

Fig. 3 shows a third embodiment of the present invention.

Fig. 4 shows a fourth embodiment of the present invention.

Fig. 5 shows a modification of the embodiments of the present invention in connection with a free fall of a liquid container.

Fig. 6 is a test picture of an image of a bottle generated and detected according to the principles of the embodiment of Fig. 1.

Fig. 7 is a further test picture of a further bottle image generated and detected according to the principles of the embodiment of Fig. 1.

Figs. 8a and 8b illustrate an application of the embodiments of the present invention for creating a short-time, short-distance instantaneous drop of a bottle.

Fig. 9 illustrates a modification of the embodiment according to Figs. 1 and 5.

Fig. 10 is a block schematic over the overall system for operating the device, according to the present invention.

In the novel first embodiment of the invention, as shown in Fig. 1 the illumination system for contour imaging of bottles and other liquid containers consists of a small light source 1, suitably a light emitting diode, two large Fresnel lenses 2, 3 and a camera 4. A liquid container 5, e.g. a bottle is caused by means of conveyor means 6 to travel past the said Fresnel lenses 2, 3 in the space therebetween. In Fig. 1 the light rays are, for the purpose of the illustration indicated by a plurality of solid lines 7. The center of the light source 1 is located at the focal plane and on the optical axis of the Fresnel lens 2. The two Fresnel lenses 2, 3 have aligned, merging optical axes, and with a spacing d therebetween which is wide enough to let objects like liquid containers pass between said Fresnel lenses. The liquid container 5 is located between the two lenses 2,3 and the camera 4 is positioned to let the camera lens lie in the focal plane and centered on the optical axis of the Fresnel lens 3. Thus, the small light source 1 and the lens 4' of the camera 4 are located on the same optical axis.

The image viewed by the camera will show the contour of the bottle totally dark and with such sharp image as the camera is able to reproduce. Further, the image of the liquid container will be free of perspective distortions, as clearly demonstrated by the test images shown in Figs. 6 and 7.

The reason for the perfect, dark outline is as follows. Without any article located between the Fresnel lenses 2,3 the camera field of view will be filled by light from the light source 1, i.e. causing the image to be completely bright. If some part of that light is deflected relative to its normal direction, that part of the light will not reach the camera lens 4', and those portions will become dark. This is in particular the situation with a transparent bottle of glass or plastics. The material of such bottle will refract the light to cause it to change direction. Such refraction is in particular strong at the outline, which

therefor appears to be dark. The more thick walled bottle present, the wider the dark outline. A glass bottle having a somewhat thick wall will in most cases appear to be dark all over. Even quite thin walled bottles of plastics provide a sharp and excellent outline. As clearly demonstrated by the test images shown in Figs. 6 and 7, it is noted that the glass bottle shown in Figs. 6 appears with a bottle cross section which is fully dark, whereas the bottle of plastics shown in Fig. 7 appears with a sharp and excellent outline but has some brighter portions between the left and right outline.

The reason why the image will be free of perspective distortions is that the liquid container is in a space or field of light having parallel light rays. The liquid container is therefor capable of providing a shadow which is a plane view projection onto a plane normal to the optical axis, i.e. the plan of the Fresnel lens 3 as shown in the example of Fig. 1. A plan projection of a body has no perspective distortion.

The sensitivity of the contour or outline imaging can be expressed as minimum light deflection which provides shadow in the image. Increased sensivity implies that more thin walled articles provide excellent dark outline. The sensitivity of the arrangement will increase with reduced size of the light source, and with reduced size of the input pupil of the camera lens 4'.

A rather practical limitation in the arrangement is that Fresnel lenses have substantial lens errors, a feature which can reduce that field of view which can be used in practice. It could of course be envisaged to use corrected, conventional collimator lenses. Such technique could be used in extremely sensitive arrangements. However, as lens diameters of 40 centimetres or somewhat more is normally required for inspecting bottles and other liquid containers,

the size and weight of such conventional collimator lenses in an arrangement according to the present invention would be impractical, and the price thereof would be excessive. Thus, although the present invention discloses the use of Fresnel lenses, it would lie within the scope of the present invention and within that obvious to an expert in the art to use means other than Fresnel lenses for directing light rays. Such other means for light path controlling could e.g. be conventional collimating optical element, such as a common type optical lens or a holographic element. Thus, although Fresnel lenses are considered to constitute an important element in the preferred embodiment of the present invention, technically equivalent means yielding the same end result could be used.

An important and interesting feature of the present invention is the small light source 1. A great advantages of the present arrangement is light-efficiency. According to the invention, it has been discovered that a single light emitting diode is the ideal and preferred light source, in particular for the embodiments shown in Figs. 1, 2, 4 and 5. It has further been shown according to the invention, that such light emitting diode (LED) provides more than sufficient light for a TV camera of the CCD type, related types of cameras, or other types of light sensitive elements. A light emitting diode has a limited light spectrum. That reduces the effect of chromatic defects in the Fresnel lenses, something which is otherwise one of the great lens defects of such Fresnel lenses. A further advantage of using such type of light source is that its operation can be easily controlled, e.g by pulsing the light emitting diode. By synchronizing the pulsing to the camera image frequency, it is possible to remove any effect on the image caused by movement.

In practice, an arrangement as shown in Fig. 1 could be considered as bulky. It is therefore possible by the use of

simple means to provide a much more compact arrangement. That is further illustrated in Fig. 9. Only a small part of the faces of the Fresnel lenses need to be used. Thus, a substantial part of the Fresnel lenses 2,3, as shown in Fig. 1, could be removed, e.g. to let the Fresnel lenses 2,3 have a rectangular shape.

Further, it is possible by means of two mirrors 8, 9 located at an acute angle, e.g. in the range of30°-60°, suitably 45° to a common central axis to said Fresnel lenses 10 through said Fresnel lenses to convey light between said light source 1 and the Fresnel lens 2, and to convey light not refracted or hidden by said container between the Fresnel lens 3 and the camera 4, as clearly shown in Fig. 9. However, the length of the total optical axis of the Fresnel lenses will not be reduced. When locating an arrangement as shown in Fig. 9 in a cabinet for such device for generating, detecting and recognizing the contour image of a liquid container, it will be readily appreciated by the expert in the art that the arrangement must be adapted according to customer specifications.

In the second embodiment of Fig. 2 the light emitting diode 1 or other small size light source emits light towards a Fresnel lens 11 via a semi-transparent inclined mirror 12. The light rays 13 received by the lens 11 are directed across the path of the liquid container 5 as parallel light rays. At the other longitudinal side of the conveyer 6 there is located a light receiving and retro-reflecting element 14 the property of which is to direct received light rays back in the exact same direction as received.

Light rays which are not hidden or deflected by the liquid container 5 will thus be retro-reflected by the reflector means 14 back through the lens 11 and onto the mirror 12 which is located at an acute angle in the range of e.g. 30°-60°, suitably 45° relative to the optical axis of the lens 11

on which the light emitting diode 1 is located. Thus, the reflected light rays which have passed through the Fresnel lens 11 will reach the inclined mirror 12 and be deflected therefrom onto the lens 4' of the camera 4.

As described for the embodiment of the Fig. 1 and the embodiment of Fig. 9, the light emitting diode 1 would preferably have the same features and also the possibility of having its operation controlled.

Thus, the major advantages of the embodiment of Fig. 2 are through the use of the light emitting diode 1 in combination with the Fresnel lens 11, thus compensating for the inherent chromatic defects of a Fresnel lens.

The third embodiment of the present invention is now to be described with reference to Fig. 3. From the prior art, it is known to have a stationary light source means which emits light transversally of the path travelled by the liquid container 5. The stationary light source means could e.g. be made in the form of a linear array 16 of small light emitting lamps or light emitting diodes powered through a common cable 17. In front of the light source 16 is suitably located a light diffusing panel so as to create a bright light emitting face as seen by the camera 4. The camera 4 is in this embodiment, as well as in any other suitable embodiment of the present invention typically a CCD camera or its technical equivalent.

In the prior art, the camera 4 would be able to view the light diffusing screen or panel 18 within the field of view set by the dotted lines 19 and 20. Thus, it will be readily understood by any expert in the art that the bottle image viewed by the camera 4 is first of all dependent on the spacing s between the liquid container 5 and the screen or panel 18 as well as the distance between said panel 18 and the camera 4. Thus, the present invention aims at providing

a means whereby the contour image of the liquid container will be the same irrespective of the distance s between said panel 18 and the liquid container 5. According to the present invention, there is therefor provided a Fresnel lens means 21 between the path to be travelled by the liquid container 5 and the camera 4. Thus, a sharp image of the liquid container 5 will be obtainable in view of the fact that the lens 4' of the camera 4 has its optical axis coaxial with the optical axis of the Fresnel lens 19. Further, it will also be appreciated that the camera lens 4' should be at the focal point of the Fresnel lens 21.

In a further and fourth embodiment of the present invention the light source 1 is suitably a light emitting diode located on the optical axis of a Fresnel lens 22 at the focal point thereof. The light emitting diode 1 emits light towards said Fresnel lens 22, and parallel light rays 23 are directed towards a one-dimensional or two-dimensional array 24 of light sensitive elements, e.g. photo diodes, phototransistors or any technical equivalent thereof, from which electrical signals are derivable through a cable means 25. Thus, the embodiment of Fig. 4 has the important property of providing a means for directing light rays as parallel rays across the path to be travelled by the liquid container 5 and using an inexpensive long-life, controllable light emitting diode as the only light source. Thus, also the Fig. 4 embodiment represents a practical application of the basic principles of the present invention.

In Fig. 5 there is illustrated an application of the present invention which could be used for any of the embodiments discussed and shown in connection with Figs. 1, 2, 3 and 4, subject to some modification. For the sake of explaining the application of the present invention in connection with the embodiment of Fig. 5, there is suitably made a reference to that which has been described and disclosed in connection with Fig. 1. Thus, there is, as in the embodiment of Fig. 5

a light source 1, Fresnel lenses 2, 3, a camera lens 4' installed in a camera 4.

Fig. 5 is included to illustrate means for enabling the liquid container path of travel to be a free fall path, at least past the image generating, detecting and recognizing arrangement as shown. Thus, there is provided an upper guide duct 26 and lower guide duct 27. Although not specifically shown on Fig. 5, it should be readily appreciated by the expert in the art that the said ducts 26 and 27 together with the Fresnel lenses 2, 3 and side panels (not shown) adjacent said lenses 2, 3 (and not interfering with the light rays between the lenses 2, 3) could form an uninterrupted guide duct for the liquid container 5 during its passage from the upper duct part 26 to the lower part duct 27, although the cross section of such duct inherently would be slightly different at the section of the arrangement spanned by the lenses 2, 3.

Thus, the embodiment of Fig. 5 clearly demonstrates how the complete liquid container, and in particular the bottom thereof may be inspected by the camera 4 without any obstructions e.g. caused by a conveyor on which such liquid container is located during its travel, as e.g. shown in Figs. 1-4.

A further application of the present invention, in particular to be able to inspect the lowermost portion of the liquid container without any interference from e.g. a conveyer or platform, is shown schematically in Fig. 8a and 8b. Again, there is provided means for supporting the liquid container along a specific length of its path of travel. Said supporting means has a container supporting platform 28 and actuator means 29 with retractable arms 30, 31 extending between said platform and said actuator means. The actuator means is, as a result of a synchronizing signal, capable of causing instantaneous dropping and subsequent position

restoring of the supporting platform 28 in order to provide said detection of a lowermost portion of the liquid container when the container is thus subjected to a short, but sufficient unsupported drop due to said platform dropping. As clearly demonstrated in Fig. 8b there is provided a short-time space 32 between the liquid container 5 and the platform 28. The actuating signal to the actuator means 29 could also cause a synchronized operation of the light emitting diode 1 and the camera 4 in order to make sure that both fully operate when said space 32 is available.

Finally, the invention is to be described in connection with the enclosed Fig. 10. The light source 1 is connected to processing means 33 which includes synchronizing means 34 for operating the light source as well as the actuator means of the container supporting means. The light detector means, suitably in the form of a camera 4 connects with the processing means 33. Further, there is included comparing means 35 capable of comparing an image detected by the light detector means 4 and processed by the processing means 33 to recognize a contour image of a particular container and communicating such recognition back to the processing means in order to operate by means of the processing means 33 a display 36 and/or a printer 37. A control panel 38 may suitably be provided in order to set anyone of said processing means 33, synchronizing means 34, comparing means 35, display 36 or printer 37. The data displayed and printed could include identification of a particular container detected and/or its possible redemption value, although in principle any type of data relevant to the recognition could be displayed and/or printed.

Further, a power supply 39 is provided for delivering power via said processing means 33 to said light source, said processing means 33, said synchronizing means 34, said activator means 29, said light detector 4, said comparing

means 35, said display 36, said printer 37 and said control panel 38.

It will be obvious to an expert in the art that the layout of the overall system as shown in Fig. 10, could be modified in any suitable way without departing from the scope and spirit of the present invention.

Further, the embodiments shown and described in the present specification are only intended to illustrate the present invention without necessarily limiting the scope thereof. Thus, any modification of the embodiments which would lie within the spirit and scope of the present invention could be envisaged.

C l a i m s.

1. A device for generating, detecting and recognizing a contour image of a liquid container, comprising
- a light source,
- light detector means
- means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container, and for conveying to said light detector means light rays which are not refracted or hidden by said container,
- processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and
- means for comparing such processed signals with predetermined container feature data to recognize said contour image of the container,
wherein
- said means for directing light rays are first and second light path controlling means coaxially and respectively located at opposite longitudinal sides of said path,
- said light source is a stationary, substantially point light source capable of emitting light towards said first light path controlling means , and
- said light detector means being a TV camera, E.G. a CCD-Camera capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

2. A device according to claim 1, wherein said light source is a light emitting diode.

3. A device according to claim 2, further comprising means for synchronizing operation of said light emitting diode with the operation of said TV-camera.

4. A device according to claim 3, wherein said synchronizing means is operative to synchronize the operation of the light emitting diode with container location relative to said directing means.

5. A device according to claim 1 or 2, wherein said first and second light path controlling means are first and second Fresnel lenses, respectively.

6. A device according to claim 5, wherein said light source is located at the focus of said first Fresnel lens.

7. A device according to claim 5, wherein said TV-camera is located at the focus of said second Fresnel lens.

8. A device according to claim 5 or 6, wherein a first mirror is located at angle of 45^{o} to a common central axis through said Fresnel lenses to convey light between said light source and said first Fresnel lens.

9. A device according to claim 5, wherein a second mirror is located at angle of 45^{o} to a common central axis through said Fresnel lenses to convey light not refracted or hidden by said container between said second Fresnel lens and said camera.

10. A device for generating, detecting and recognizing a contour image of a liquid container, comprising
- a light source,
- means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container,
- light retro-reflective means for receiving such parallel light rays which are not refracted or hidden by said container, and retro-reflecting such received parallel light rays back transversely of said path and through said directing means,

- said means for directing light rays is a single light path controlling means located at a first longitudinal side of said path, and said light reflective means is located at a second longitudinal side of said path,
- inclined mirror means for receiving and redirecting said reflected light rays leaving said directing means,
- light detector means for receiving said redirected light,
- processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and
- means for comparing such processed signals with predetermined container feature data to recognize said contour image of a container,

wherein

- said light source is a stationary, substantially point light source capable of emitting light towards said first light path controlling means, and
- said light detector means is a TV camera, e.g. a CCD Camera capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

11. A device according to claim 10, wherein said light source is a light emitting diode.

12. A device according to claim 10 or 11, wherein said single light path controlling means is a Fresnel lens.

13. A device according to claim 12, wherein said light emitting diode is located at the focus of said Fresnel lens.

14. A device according to claim 12, wherein said inclined mirror is a semi-transparent mirror capable of passing through light rays emitted by said light emitting diode towards said Fresnel lens.

15. A device according to claim 11, further comprising means for synchronizing operation of said light emitting diode with the operation of said TV-camera.

16. A device according to claim 15, wherein said synchronizing means is operative to synchronize the operation of the light emitting diode with container location relative to said directing means.

17. A device for generating, detecting and recognizing a contour image of a liquid container, comprising
- a stationary light source means for emitting light transversely of a path travelled by said container,
- light detector means for receiving light rays which are not hidden by said container,
- processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and
- means for comparing such processed signals with predetermined container feature data to recognize said contour image of a container,
wherein
- means for directing light rays is provided in the form of a single light path controlling means located at a first longitudinal side of said path, said light source means being located at a second longitudinal side of said path, and
- said light detector means being a TV camera, e.g. a CCD Camera capable of detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

18. A device according to claim 17, wherein said light source means provides a plane of light across said path.

19. A device according to claim 17, wherein said single light path controlling means is a Fresnel lens.

20. A device according to claim 19, wherein said Fresnel lens has a rectangular shape.

21. A device for generating, detecting and recognizing a contour image of a liquid container, comprising
- a light source,
- light detector means
- means for directing light rays received from said light source as parallel rays transversely of a path travelled by said container, and for conveying to said light detector means light rays which are not refracted or hidden by said container,
- processing means connected to said light detector means for processing signals from said detector means which are indicative of such detected light rays, and
- means for comparing such processed signals with predetermined container feature data to recognize said contour image of a container,
wherein
- said means for directing light rays is a single light path controlling means located at a first longitudinal side of said path, and said light detector is located at a second longitudinal side of said path,
- said light source is a stationary, substantially point light source capable of emitting light towards said first light path controlling means , and
- said light detector means being one-dimensional or two-dimensional array of light sensitive elements for detecting a container contour highlighted by light not hidden by the container, light refracted at the container contour, and any light passing through said container.

22. A device according to claim 21, wherein said light source is a light emitting diode.

23. A device according to claim 21 or 22, wherein said single light path controlling means is a Fresnel lens.

24. A device according to claim 22 and 23, wherein said light emitting diode is located at the focus of said Fresnel lens.

25. A device according to claim 23, wherein a mirror is located at an acute angle in the range of 30°-60°, suitably 45° to a central axis through said Fresnel lens to convey light between said light emitting diode and said Fresnel lens.

26. A device according to claim 1, 10, 17 or 21, further comprising means for enabling said container path of travel to be a free fall path.

27. A device according to claim 1, 10, 17 or 21, further comprising means for supporting said container along a specific length of said path, said supporting means having a container supporting platform and further having actuator means for instantaneous dropping and subsequent position restoring of said supporting platform to provide a detection of a lowermost portion of said container when the container is subjected to a short distance unsupported drop due to said platform dropping.

28. A device for generating, detecting and recognizing a contour image of a liquid container, substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
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Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Documents considered relevant following a search in respect of Claims :-
1-9

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Category	Identity of document and relevant passages		Relevant to claim(s)
X,Y	GB 2157824 A	(OWENS-ILLINOIS INC.) Figure 2, page 7 lines 19-43	X:1, 2 Y:1, 2, 5, 6 7, 8, 9
X	GB 2065299 A	(PHILIPS ELECTRONICS) Figure 1, page 1 lines 78-85	X:1, 2, 5, 6 7
Y	GB 1521406	(ERWIN SICK GESELLSCHAFT) Figure 2	Y:1, 2, 5, 6 7, 8, 9
X	US 5280170	(EMHART GLASS MACHINERY) whole document	X:1, 2, 5, 6 7
X	US 4664525	(EISAI CO.) Figures 3 & 5, column 5 lines 10-36	X:1, 2, 5
X	US 4577969	(EISAI CO.) Figure 2	X:1, 2, 5, 6 7

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