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The invention relates to an apparatus for identifying empty containers in a reverse vending machine having a receiving unit containing a rotary element which is mounted about a horizontal rotation axis and which has at least one support surface for receiving the empty container in a first rotation position and for releasing said empty container in a second rotation position, having an optical identification unit for identifying characteristic features of the empty container, having a control unit for processing image data from the optical identification unit and for actuating the rotary element.

10 An apparatus for identifying empty containers in a reverse vending machine is known from WO 2011/089013 A1, which has a rotary element provided with vanes for receiving individually supplied empty containers. Three vanes, which are arranged offset to one another by 120° , are provided, which are rotatable about a horizontal rotation axis. To form a support surface for the empty containers to be received, two vanes are arranged inclined upward symmetrically in relation to a vertical plane. An optical identification unit is provided above the rotary element, by means of which characteristic features of the empty container positioned on the support surface, for example, the shape of the empty container, are identifiable. For example, the optical identification unit can be implemented as a camera, the image data of which are further processed in a control unit, so that after the empty container is identified, it can be supplied to a sorting unit. The shape identification of the empty container is based on the fact that the contour thereof can be established by the optical identification unit. It has been shown that in the case of empty containers having clear transparent lateral surfaces, an unambiguous establishment of the contour is not always possible because of reflections on these lateral surfaces.

The object of the present invention is therefore to refine an apparatus for identifying empty containers in a reverse vending machine in such a manner that the identification of characteristic features of the empty container is improved.

To achieve this object, the apparatus according to the invention in conjunction with the preamble of Patent Claim 1 is characterized in that an illumination device is provided for illuminating the empty container which is supported on the support surface of the rotary element in such a way that the empty container can be illuminated from a side of the empty container which is opposite the optical identification unit.

According to the invention, an illumination device is provided, by means of which an empty container to be detected by an optical identification unit is illuminated from a side of the empty container which is opposite the optical identification unit.

5 In this way, a back light is generated, which substantially improves the ability to identify the contour of the empty container by means of the optical identification unit located opposite. In particular, in this way improved contrast of the contour of the empty container in comparison to the support surface can be provided, so that characteristic features, such as the shape in particular, of clear glass empty

10 containers can be identified reliably and unambiguously.

According to one preferred embodiment of the invention, the illumination device comprises illumination means not only for generating a back light, but rather also illumination means, such that the empty container is illuminated from a side of

15 the empty container which faces the optical identification unit. In this way, improved illumination of the empty container and its surroundings is achieved in the identification direction of the optical identification unit. Reliable and unambiguous identification of characteristic features of the empty container is always ensured by this illumination from both sides or multiple sides of the empty container.

20 According to one refinement of the invention, the illumination device comprises a lower illumination unit and an upper illumination unit, wherein the lower illumination unit has at least one light source which is arranged below a horizontal longitudinal center plane of the empty container, and wherein the upper illumination

25 unit has at least one light source which is arranged above the horizontal longitudinal center plane of the empty container. In this way, comprehensive illumination of the empty container can advantageously be produced, which is preferably detectable by a single optical identification unit.

30 According to one refinement of the invention, the rotary element is in the form of a vane shaft, wherein the support surface for the empty container is formed by two vanes which project from the rotation axis at an obtuse angle in relation to one another, and which extend inclined upward with respect to a vertical plane and symmetrically to the vertical plane originating from the rotation axis. The

35 vanes are composed of a translucent material, so that the light emitted from the lower illumination unit can be incident on the empty container.

According to one preferred embodiment of the invention, the vanes of the rotary

element are in the form of flat light guides, which light can be coupled into via a narrow side thereof facing the rotation axis and can be coupled out on opposing flat sides thereof. In this way, a back light can be generated in a space-saving manner, since the at least one light source can press directly against a narrow side of the vane. The vanes are therefore used for the space-saving deflection and emission of the light emitted from the light source in the direction of the empty container.

According to one preferred embodiment of the invention, the light sources are in the form of LED light sources, which are arranged fixed in place along a rotation axis of the vane shaft. The light sources are positioned in this case so that in a receiving rotational position of the vane shaft, the light can always be coupled into narrow sides of the upper two vanes. The production expenditure can be significantly reduced in this way.

According to a further embodiment of the invention, the lower illumination unit can have at least one light source which is arranged at a distance to the vanes forming the support surface and below said vanes. The at least one light source is positioned so close in the direction of the vertical plane extending through the rotation axis that the sorting of the empty containers is not obstructed.

Further advantages of the invention result from the further dependent claims.

Exemplary embodiments of the invention will be explained in greater detail hereafter on the basis of the figures.

In the figures:

Figure 1 shows a schematic side view of a receiving unit according to a first embodiment,

Figure 2 shows a schematic side view of the receiving unit according to a second embodiment,

Figure 3 shows a perspective illustration of a receiving unit according to a third embodiment, and

Figure 4 shows a front view of the receiving unit according to Figure 3.

The apparatus according to the invention for identifying empty containers in a reverse vending machine essentially comprises a receiving unit 1 for receiving empty containers 2 to be supplied sequentially, an optical identification unit 3 for identifying characteristic features of the supplied empty container 2, and an illu-

mination device 4 for illuminating the empty container 2 positioned in the receiving unit.

5 The empty container 2 is preferably in the form of a transparent bottle, which can be produced from a glass or plastic material (PET).

The receiving unit 1 is arranged integrated in a reverse vending machine and is accessible via an opening (not shown) of the reverse vending machine. The receiving unit 1 has a rotary element 5 which is mounted so it is rotatable about a
10 horizontal rotation axis D and is in the form of a vane shaft. This vane shaft 5 has three vanes 6, 6', 6'', which are arranged offset by 120° about the rotation axis D and which preferably have equal axial and radial lengths. To receive an empty container 2, the vane shaft 5 is located in a first rotational position shown in Figure 1, in which two upper vanes 6, 6' are arranged symmetrically to a vertical
15 plane V extending through the rotation axis D. They each enclose an angle of 60° in relation to the vertical plane. In this first rotational position, the upper sides of the upper vanes 6, 6' form a support surface on which the empty container 2 can be placed by a user. Subsequently thereto, identification of characteristic features of the empty container 2 is performed before the vane shaft 5 is activated by
20 means of a control unit in such a way that the vane shaft 5 moves into a second rotational position, in which the empty container 2 is supplied for the sorting to a determined collection container. After all empty containers have been identified, a receipt having the corresponding deposit value of the empty containers is printed out for the user. If it is identified by the apparatus according to the invention that
25 the empty container 2 is not suitable for further processing, a feedback signal is generated so that the user can remove the rejected empty container 2 from the receiving unit 1.

The illumination device 4 is provided for identifying characteristic features of the
30 empty container 2, such as preferably the shape of the empty container 2. It comprises illumination means, so that the empty container 2 positioned in the receiving unit 1 can be illuminated from at least two opposite sides of the empty container 2. The illumination device 4 has, on the one hand, an upper illumination unit 4', which is arranged on the same side as the optical identification unit 3 in
35 relation to the empty container 2 or the vane shaft 5. The upper illumination unit 4' is arranged – like the identification unit 3 – above a horizontal center plane M of the empty container 2. The upper illumination unit 4' has two lights 7, for example, which are arranged on both sides of the vertical plane V at a vertical dis-

tance to the empty container 2 and the vane shaft 5. As can be seen from Figure 1, the lights 7 of the upper illumination unit 4 are arranged at the height of the optical identification unit 3, which is in the form of a CCD camera. The upper illumination unit 4' preferably generates a diffuse incident light illumination L1, by means of which the empty container 2 is illuminated in the identification direction 8 of the optical identification unit 3.

Furthermore, the illumination device 4 comprises a lower illumination unit 4" having lights 9 or LED light sources as the illumination means, which are arranged in rows in the axial direction in the region of the rotation axis D and which couple light L2 into the two upper vanes 6, 6', which are in the form of flat light guides. The light coupled into the vanes 6, 6' is totally reflected in the region of flat sides 10, 10' of the vanes 6, 6' and coupled out by means of coupling elements (not shown) at least in the direction of a side facing the empty container 2. The vanes 6, 6', 6" have a translucent material, so that the light L2 which is coupled in can be coupled out by means of integrated coupling-out elements on the flat sides 10, 10' and can be used for illuminating the empty container 2 from below. Since in the case of sequential receiving of the empty containers 2, each vane 6, 6', 6" on both sides of the vertical plane V can assume a rotational position which receives the empty container 2, the light L2 must be able to be coupled out on both flat sides 10, 10'. The vane shaft 5 is preferably driven in a predefined rotational direction 11. The upper vanes 6, 6' therefore form self-illuminated surfaces, which can be used to illuminate the empty container 2 from below.

The LED light sources 9, which are arranged in rows, are preferably arranged fixed in place in the region of the rotation axis D, so that the design outlay can be kept low. The vanes 6, 6', 6" preferably each have convex narrow sides as the light coupling-in surfaces, which face the rotation axis D, but are mounted rotatably at a distance to the fixedly arranged LED light sources 9.

The lower illumination unit 4" therefore enables illumination of the empty container 2 from below or a back light illumination which is oriented opposite to the identification direction 8. The lower illumination unit 4" is located below the horizontal center plane M of the empty container 2 or the LED light sources 9 are located below the empty container 2.

According to a second embodiment of the invention according to Figure 2, an apparatus for identifying empty containers 2 is shown, which differs from the em-

bodiment according to Figure 1 by way of a different embodiment of the lower illumination unit 14.

5 Identical components or component functions are provided with identical reference signs.

The lower illumination unit 14 is formed by two lights 15, which are arranged on both sides of the vertical plane V and below the upper vanes 6, 6'. They each emit a light bundle L2', which is oriented on the upper vanes 6, 6'. The lights 15 are
10 positioned sufficiently far inward or in the direction of the vertical plane V that sorting of the empty containers 2 is not obstructed. In contrast to the vanes 6, 6', 6" of the lower illumination unit 4" according to the first embodiment according to Figure 1, the vanes 6, 6', 6" of the lower illumination unit 14 according to the second embodiment according to Figure 2 must only be transparent, so that the
15 light bundle L2' for illuminating the empty container 2 can be conducted through from below. The vanes 6, 6', 6" of the lower illumination unit 14 do not have to have additional coupling-out elements.

According to a further embodiment of the invention according to Figures 3 and 4,
20 the rotary element 5 consists of vanes 16, 16', 16", which are in the form of a propeller and taper radially outward, and which are rotatably mounted with respect to the rotation axis D in the rotational direction 11. The vanes 16, 16', 16" run together centrally to a shared bearing tube 17, which is rotatably mounted with respect to the rotation axis D. A triangular mounting is provided within this
25 bearing tube 17, on which the LED light sources 9 described according to the embodiment according to Figure 1 are arranged fixed in place so that the light emitted thereby is coupled into the narrow sides of the upper vanes 16, 16'. For this purpose, the LED light sources 9 are arranged in two axial rows, wherein one row is arranged oriented toward the first vane 16 and the second row of the LED light
30 sources 9 is arranged oriented toward the second vane 16'.

The rotary element 5 is mounted in a housing frame 19, which is also used to receive an optical identification unit 3'. Said unit is fastened on one side of the housing frame 19 and cooperates with a mirror 20 fastened on an opposite side of
35 the housing frame 19 so that an empty container arranged on the upper vanes 16, 16' is detectable.

The vanes 16, 16', 16" have – as in the first embodiment of the invention accord-

ing to Figure 1 – flat sides 10, 10' made of a translucent material. A light guide (not shown), which deflects the light L3 emitted from the LED light sources 9 homogeneously by an acute or obtuse angle in the direction of the empty container, is provided between opposing flat sides 10, 10' of each vane 16, 16', 16".

5

It is obvious that the above-mentioned features can be used alone or in groups in any desired combination with one another. The described exemplary embodiments are not to be understood as an exhaustive list, but rather have exemplary character for the description of the invention. In particular, the vanes can also consist of a transparent and translucent material. For example, the upper illumination unit can also be omitted if sufficient illumination from above is ensured in another manner.

10

List of reference signs	
	1 receiving unit
	2 empty container
	3 optical identification unit
5	4, 4', 4" illumination device
	5 rotary element/vane shaft
	6, 6', 6" vanes
	7 lights
	8 identification direction
10	9 lights/LED light sources
	10, 10' flat side
	11 rotational direction
	14 lower illumination unit
	15 light sources
15	16, 16', 16" vanes
	17 bearing tube
	18 mounting
	19 housing frame
	20 mirror
20	D rotation axis
	L1 diffuse incident light illumination
	L2 light
	L3 light
	M center plane
25	V vertical plane

Patentkrav

1. Apparat til identificering af tomme returbeholdere i en returautomat,
- med en modtageenhed indeholdende et drejeorgan, som er lejret om en vandret
5 rotationsakse, og som har mindst en støtteflade til optagelse af den tomme be-
holder i en første drejестilling og til frigørelse af den tomme beholder i en anden
drejестilling,
- med en optisk identifikationsenhed til identificering af karakteristiske træk ved
den tomme beholder,
10 - med en styreenhed til behandling af billeddata fra den optiske identifikationsen-
hed og til aktivering af drejeorganet,
kendetegnet ved, at en belysningsindretning (4) er tilvejebragt til belysning af
den tomme beholder (2), som ligger på drejeorganets (5) støtteflade (6, 6') på
sådan måde, at den tomme beholder (2) kan belyses fra en side af den tomme
15 beholder (2), som er overfor den optiske identifikationsenhed (3).
2. Apparat ifølge krav 1, **kendetegnet ved, at** belysningsindretningen (4) omfat-
ter belysningsmidler, sådan at den støttede tomme beholder (2) kan belyses både
fra en side af den tomme beholder (2), som vender mod den optiske identifikati-
20 onsenhed (3) såvel som fra den side af den tomme beholder (2), som vender væk
fra den optiske identifikationsenhed (3).
3. Apparat ifølge krav 1 eller 2, **kendetegnet ved, at** belysningsindretningen (4)
har en nedre belysningsenhed (4'', 14) til belysning af den tomme beholder (2)
25 fra den side af den tomme beholder (2), som er overfor den optiske identifikati-
onsenhed (3), hvilken nedre belysningsenhed omfatter mindst en lyskilde (9, 15),
som er arrangeret under et vandret midterplan (M) for den tomme beholder (2).
4. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** belys-
30 ningsindretningen (4) har en øvre belysningsenhed (4') til belysning af den tom-
me beholder (2) fra den side af den tomme beholder (2), som vender mod den
optiske identifikationsenhed (3), hvilken øvre belysningsenhed omfatter mindst en
lyskilde (7), som er arrangeret over et vandret midterplan (M) for den tomme
beholder (2).
35
5. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** drejeorga-
net (5) er i form af en vingeakse, hvori støttefladen er dannet af to vinger (6, 6'),
der rager ud fra rotationsaksen (D) i en stump vinkel i forhold til hinanden.

6. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** vingerne (6, 6', 6'') på drejeorganet (5) består af et gennemskinneligt og/eller gennemsigtigt materiale.
- 5
7. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** den nedre belysningsenhed (14) omfatter lyskilder (15) tilknyttet vingerne (6, 6'), som danner støttefladen, og hvilke lyskilder er arrangeret på begge sider af et lodret plan (V), der forløber gennem vingeakslens (5) rotationsakse (D) og under vingerne (6, 6'), der danner støttefladen.
- 10
8. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** den nedre belysningsenhed (4'') har et antal lyskilder (9), som er arrangeret i området for vingeakslens (5) rotationsakse (D), og at vingerne (6, 6', 6'') er udformet som flade lysledere, så at lyset (L2) udsendt fra lyskilderne på den drejeaksen (D) tilvendte smalside af vingerne, der danner støttefladen, kan tilkobles vingerne og udkobles på en flad side (10) af vingerne, og som vender mod den tomme beholder (2).
- 15
9. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** lyskilderne (9, 15) er arrangeret på stationær måde.
- 20
10. Apparat ifølge ethvert af de foregående krav, **kendetegnet ved, at** lyskilderne er i form af LED lyskilder (9).

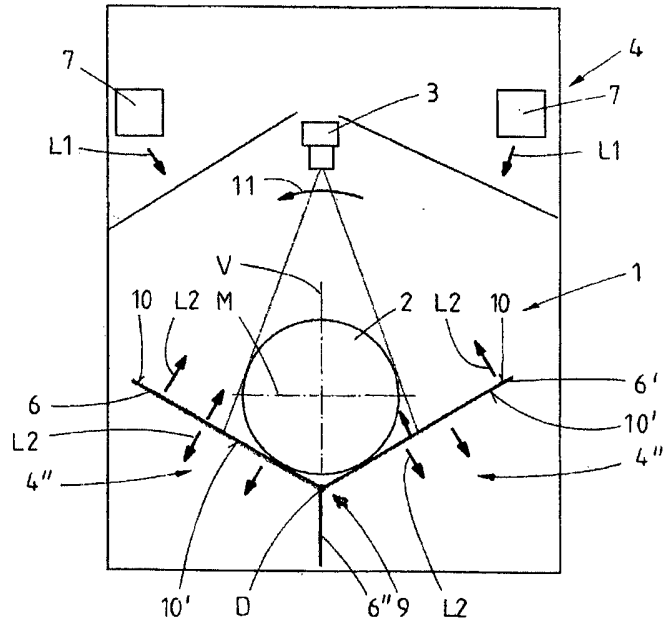


Fig. 1

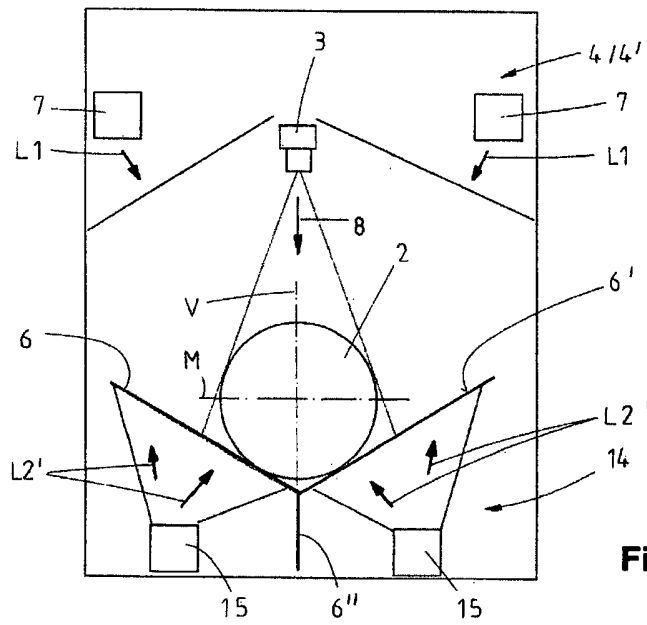


Fig. 2

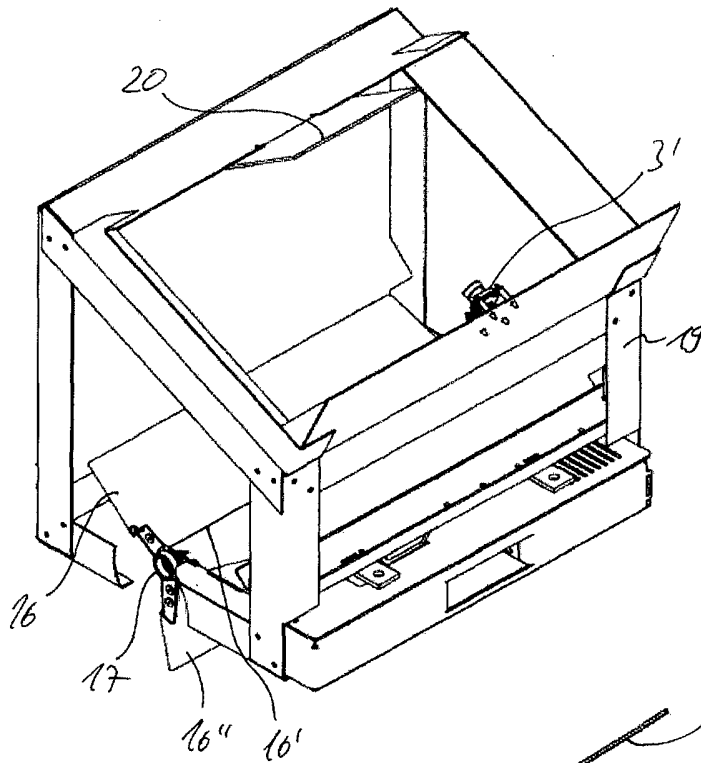


Fig. 3

Fig. 4

