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Sorting detection system for detecting passage of an object through one of a plurality of openings

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The present invention relates to a sorting detection system which detects the passage of an object through one of several openings, according to the preamble of claim 1.

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Letter and parcel service providers sort objects comprising letters, packages or parcels into a large number of containers, each with its own opening. After identification, the objects are transported manually or automatically in the direction of the respective openings of the containers assigned to the identified objects, so that the objects fall into the respective containers intended for the objects. This sorts the objects into the containers.

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However, this sorting has the disadvantage that the object cannot be reliably and unambiguously detected when it passes through the opening of the assigned container provided for the object, so that an incorrect sorting of the object or an object falling into an incorrect container can occur unnoticed.

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Incorrect sorting can occur, for example, when the object being transported hits an edge between two openings and then falls through the wrong opening into the wrong container. It can also occur, for example, if operating personnel incorrectly identify the object or move it in the direction of an incorrect container.

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From US 7,516,848 B1 a sorting detection system according to the features of the preamble of the claim 1 is known. In particular, in the known sorting detection system, a movement sensor is provided in each container so that the insertion or removal of a component from the respective container can be detected.

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It is therefore an object of the present invention to improve a sorting detection system of the type mentioned above in such a way that a correct sorting or correct passing of the object through the intended opening is reliably detected, wherein the sorting detection system is constructed inexpensively.

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The object is solved according to the invention by a sorting detection system with the features of claim 1.

The invention has the advantage that an object transported through the opening can be assigned exactly to the container belonging to the opening. In other words, if the object hits an edge between two openings, the inventive sorting detection system can determine exactly through which opening, or in which container belonging to the opening, the object finally fell after the object has passed the detection surface inside the container. Furthermore, the selected second sensors have a field of view that can be parameterized or adjusted very well, so that the detection area is clearly defined within the containers.

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By parameterizing the detection area below the edge of the openings, it is ensured that an irreversible entry of the object into the respective container is detected. In this context, parameterization of the detection area means that the operating personnel can freely define a depth of the detection area within the containers or below the openings as required for setting up the sorting detection system, so that, for example, even a larger object only triggers the detection signal if it is already so far below the opening and thus inside the container that it can only fall into this container.

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According to a preferred embodiment, the first sensor includes a scanner, barcode reading sensor, 2D camera or RFID reader.

According to another preferred embodiment, the control unit activates a visual indicator on the assigned container based on the identification signal, or a projector indicates the assigned opening to visually indicate the assignment of the identified object to the respective container. This allows a clear visual reference between the identified object and the assigned container to be provided for the operating personnel. Advantageously, the control unit evaluates the identification signal and the detection signal to produce a first sorting signal representative of correct sorting of the object into a container assigned to the object when the object triggers the detection signal in a container assigned to it. Furthermore, it is advantageous that the control unit evaluates the identification signal and the detection signal in order to generate a second sorting signal representing a wrong sorting of the object when the object triggers the detection signal in a container other than the one assigned to it. Preferably, the control unit activates an optical indicator on the container receiving the object, or a projector indicates the respective opening of the container receiving the object based on the sorting signal, in order to optically indicate the sorting of the object in this container as correct or wrong.

This not only gives the operating personnel the optical option of tracking the sorting of the identified object, but the sorting detection system also provides the operating personnel with the option of reversing the wrong sorting by means of simple optical tracking and reliable detection of a possible wrong sorting of the object. The first sorting signal can, for example, trigger the activation of a green lamp and the second sorting signal can, for example, trigger the activation of a red lamp.

Furthermore, according to a preferred embodiment, the object can be transported manually or automatically in the direction of the assigned container after identification. This enables fast and error-proof sorting of the objects under secure monitoring by the sorting detection system. Preferably the container belongs to a logistics rack with several containers arranged on the same level or on different levels to each other. This means that the sorting detection system enables room-covering monitoring of all openings of the containers, so that a flexible arrangement of the second sensor in relation to the containers is possible.

Furthermore, in accordance with a preferred embodiment, the second sensor is designed in such a way that the object conveyed through the field of view can be identified with the sensor. This makes it advantageously possible for the object to be identified by the second sensor. This means that the identification of the object by the first sensor can either be checked or, if the identification failed for whatever reason, can be carried out by the second sensor.

According to another preferred embodiment, the openings are arranged at different distances to the second sensor, with the advantage that the second sensor is set in such a way that each container has its individually set detection surface. This provides a high degree of flexibility for an arrangement of the second sensor in relation to the containers, so that it is easier to set up the sorting detection system or integrate the sorting detection system into an existing logistics warehouse. In particular, the individual detection surfaces have the same or different distances to the opening of their respective container compared to each other, which provides a high degree of flexibility in the parameterization of the sorting detection system or the detection surface.

Advantageously, the detection surface of the second sensor forms a flat, two-dimensional plane, so that a simple alignment of the second sensor to the openings of the containers is possible.

Furthermore, according to a preferred embodiment, it is possible to identify the object by means of an optical marker, in particular a barcode, on the object, a structural feature of the object and/or an RFID chip on the object. This ensures fast and reliable identification of the object by the first and/or second sensor.

The system according to the invention can be designed in similar ways by further features and it shows similar advantages. Such further features are exemplary but not exhaustively described in the dependent claims following the independent claim.

The invention is also explained below with regard to further advantages and features by reference to the attached drawing with reference to embodiments. The figures of the drawing show in:

- 5 Fig. 1 a schematic representation of a first preferred embodiment of an inventive sorting detection system, and
Fig. 2 a schematic representation of a second preferred embodiment of the inventive sorting detection system.

10 Figure 1 schematically shows a first preferred embodiment of a sorting detection system 1 according to invention with which objects O1 to O3 are sorted into containers B1 to B3 intended for the respective objects O1 to O3. Objects O1 to O3, for example, represent postal deliveries that are to be sorted into delivery containers assigned to postal codes. Objects O1 to O3 could also be different industrially
15 manufactured parts, which are also to be sorted into correspondingly provided containers for the respective parts.

Each container B1, B2 and B3 has in each case an opening 2a, 2b and 2c with an edge R, wherein the containers B1 to B3 are arranged side by side on a same
20 plane, so that the openings 2a to 2c form a field with several passage possibilities to the containers B1 to B3 for the objects O1 to O3.

The sorting detection system 1 comprises at least one first sensor S1 which is intended to identify the incoming objects O1 to O3 and to generate a corresponding
25 identification signal IS in each case. Advantageously, the first sensor S1 identifies the objects O1 to O3 by means of an optical marker, for example a barcode, on the object O1, O2 and O3, a structural feature of the object O1, O2 and O3 or an RFID chip on the object O1, O2 and O3. For a very reliable identification of the objects O1 to O3, the optical marker and the structural characteristic could also be detected
30 simultaneously, so that a comparison between the two detections would be possible.

Either the identification of the objects O1 to O3 can be carried out automatically as described or manually, whereby in the case of manual identification, operating

personnel holds objects O1 to O3, for example, under the first sensor S1 and then moves them on in the direction of containers B1 to B3.

5 The first sensor S1 transmits the identification signal IS to a control unit 3, which receives the identification signal IS of the first sensor S1 and assigns the identified object O1, O2 and O3 to a container B1, B2 and B3 on the basis of the identification signal IS. Hereby, the control unit 3 preferably activates an optical display 4a, 4b and 4c on the associated container B1, B2 and B3 on the basis of the identification signal IS or the completed assignment, so that the assignment of the next object O1
10 to be sorted to the corresponding container B1 is also optically recognizable. This means, for example, that display 4a on the container B1 intended for the identified object O1 lights up, while displays 4b and 4c on the other containers B2 and B3 remain switched off.

15 In this context, the control unit 3 comprises, for example, a programmable memory unit, a so-called "*electronic control unit ECU*" or "*central processing unit CPU*".

After identifying and assigning the objects O1 to O3, the objects O1 to O3 are transported in the direction of the respective containers B1 to B3, whereby the
20 transport can be carried out automatically or manually.

At least one second sensor S2 with a field of view Sf is provided which is arranged in the direction of the containers B1 to B3 in such a way that the field of view Sf is directed towards the openings 2a to 2c of the containers B1 to B3 and comprises at
25 least one detection surface Df. The field of view Sf comprises in particular a three-dimensional (3D) space.

In accordance with the invention, the second sensor S2 is set such that the detection surface Df of the second sensor S2 lies within the respective container B1, B2 and B3 at a predetermined distance A from an edge R of a respective opening
30 2a, 2b and 2c. In particular, the detection surface Df forms a straight two-dimensional (2D) plane within the containers B1 to B3.

This means that the second sensor S2 detects the object O1, O2 and O3 not only up to the edge R of the openings 2a to 2c of the containers B1 to B3, but also behind the respective openings 2a, 2b and 2c, if the object O1, O2 and O3 is already inside the container B1, B2 and B3.

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Accordingly, an object O1, O2 and O3 passing the detection surface Df triggers a detection signal ES of the second sensor S2. Thus, the objects O1, O2 and O3 are counted exactly in the respective containers B1, B2 and B3 and are correctly assigned to them.

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The control unit 3 preferably evaluates the identification signal IS and the detection signal ES and generates a first sorting signal which reflects a correct sorting of the object O1, O2 and O3 into the associated container B1, B2 and B3 if the object O1, O2 and O3 in a container B1, B2 and B3 associated with it, triggers the detection signal ES.

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This means that if, for example, object O1 is identified and assigned to container B1, the detection signal ES of the second sensor S2 must be triggered by object O1 in container B1 so that control 3 generates the first sorting signal for correct sorting. Here, the first sorting signal preferably triggers a green light on the display A1 of container B1.

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If the generated detection signal ES is triggered by the object O1 in a container B2 or B3 other than the container assigned to it, then the control unit 3 generates a second sorting signal which represents an incorrect sorting of the object O1, preferably the second sorting signal triggers a red light on the display A2 or A3 of the container B2 or B3.

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In particular, as shown in this example, the detection area Df of the second sensor S2 is divided into three areas by the three containers B1 to B3, each area being clearly assignable to the respective container B1 to B3. By passing of object O1, O2 and O3 through one of the three areas of the detection area Df, the control unit 3

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can precisely assign the input of object O1, O2 and O3 to the respective container B1, B2 or B3.

This ensures a reliable detection of a correct or incorrect sorting of the objects O1 to O3 to the respective assigned containers B1 to B3 and a simple tracking of an
5 incorrect sorting by the optical display 4a to 4c is feasible.

Figure 2 shows schematically a second preferred embodiment of the sorting
detection system 1. In this embodiment, the containers B1 to B3 belong to a logistics
rack, which containers are arranged to each other on different levels. The same
10 elements as in the first example are provided with the same reference signs and in
the following, are not described in detail again.

In this embodiment, two second sensors S2, which are arranged at different angles
to the containers B1 to B3, are directed in particular at the containers B1 to B3. As a
15 result, two fields of view Sf1 and Sf2 are directed onto the openings 2a to 2c of the
containers B1 to B3 by the two second sensors S2. Each field of view Sf1 and Sf2
has a detection area Df1 and Df2, respectively, which are arranged at different
angles to the openings 2a to 2c of the containers B1 to B3.

20 The objects O1 to O3 are identified by the first sensor S1, as described in the
previous embodiment, so that the control unit 3 assigns the identified object O1, O2
and O3 to the respective container B1, B2 or B3 on the basis of the identification
signal IS.

25 As can be seen from Figure 2, the two detection areas Df1 and Df2 of the two
second sensors S2 allow a complete detection of the areas behind the respective
openings 2a to 2c from two different angles, so that the detection areas Df1 and Df2
lie in particular in correspondingly different depths behind the edge R of the
openings 2a to 2c. This means that, due to the arrangement of the two second
30 sensors S2, shading of the fields of view Sf1 and Sf2 by the structure of the
containers B1 to B3 has no negative effect on the detection capability of the sorting
detection system 1.

The specified distance A of the detection area Df1 and Df2 to the edge R of the respective openings 2a to 2c is set to different sizes, in particular depending on a distance of the respective openings 2a to 2c to the second sensors S2.

5 This means that for container B1, for example, the distance A of the detection surface Df2 of the upper second sensor S2 (referred to Figure 2) to the edge R of the opening 2a is greater than the distance A of the detection surface Df1 of the lower second sensor S2 (referred to Figure 2), since the upper second sensor S2 is located closer to the opening 2a than the lower second sensor S2. This simplifies
10 the parameterization of the detection areas Df1 and Df2, since the detection areas Df1 and Df2 can be specified as a straight two-dimensional (2D) plane with a defined distance to the respective second sensor S2.

In other words, every second sensor S2 is set in such a way that each container B1,
15 B2 and B3 has its individually set partial detection area, whereby the detection areas Df1 and Df2 of the second sensor S2 result from all the partial detection areas together. The individual partial detection areas have the same or different distances A to the respective openings 2a, 2b and 2c of their respective containers B1, B2 and B3.

20 If the identified object O1, O2 and O3 passes the corresponding assigned opening 2a, 2b or 2c of the respective container B1, B2 or B3, the object O1, O2 and O3 triggers the detection signal ES at the upper, lower second sensor S2 or at both second sensors S2. The sorting can be evaluated based on the triggered detection
25 signal ES. By comparing the two triggered detection signals ES, the correct function of the two second sensors S2 can also be checked.

This means, for example, that when object O1 enters the assigned container B1, object O1 must trigger a detection signal ES at each of the two second sensors S2
30 when it passes through the upper edge R of the opening 2a of the container B1, since it passes both detection surfaces Df1 and Df2. However, object O1 only triggers a detection signal ES at the upper second sensor S2 when it passes

through the lower edge R of the opening 2a of container B1, since the lower second sensor S2 in this area of container B1 has a shading of its detection area Df1.

5 Despite the arrangement of the second sensors S2 to the containers B1 to B3, the sorting detection system 1 is thus able to reliably detect the input of the objects O1 to O3 in the respective containers B1 to B3 and to distinguish between correct and incorrect sorting of the objects O1 to O3.

10 In the first and second preferred embodiment of the sorting detection system 1, the second sensor S2 is preferably designed in such a way that the object O1, O2 and O3 conveyed through the field of view Sf, Sf1 or Sf2 can additionally be identified. Here, the second sensor S2 carries out the identification of the object O1, O2 and O3, like the first sensor S1, using the optical marker on the object O1, O2 and O3 and/or the structural feature of the object O1, O2 and O3. In the event that the first
15 sensor S1 comprises an RFID reader, the objects O1, O2 and O3 are identified by means of an RFID chip on the objects O1, O2 and O3.

Thus, the identification of the objects O1, O2 and O3 can be verified by the first sensor S1.

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Furthermore, the first sensor S1 comprises a scanner, a barcode reading sensor, an RFID reader or a 2D camera. The second sensor S2 comprises a 3D-Time of Flight (TOF) system, a 3D stereo camera, a 3D stereo camera in combination with structured light, or a 3D laser scanner. With this usable second sensor S2, the field
25 of view Sf, Sf1 and Sf2 and the detection areas Df, Df1 and Df2 can be adjusted exactly and easily, so that a setup of the sorting detection system 1 can be easily carried out.

In particular, the sorting detection system 1 can be integrated into an existing sorting
30 system with little effort.

Reference signs list

1	sorting detection system
2a, 2b, 2c	opening
3	control unit
4a, 4b, 4c	optical display
A	preset distance
B1, B2, B3	container
Df, Df1, Df2	detection area
ES	detection signal
IS	identification signal
O1, O2, O3	object
R	edge
S1	first sensor
S2	second sensor
Sf, Sf1, Sf2	field of view

Patentkrav

1. Sorteringsdetektionssystem (1) til detektion af et objekt (O1, O2, O3) gennem én
5 af en flerhed af åbninger (2a til 2c), hvor hver åbning (2a, 2b, 2c) er associeret med en beholder (B1, B2, B3), som omfatter:
- beholderne (B1 til B3) til modtagelse af objektet (O1, O2, O3),
mindst en første sensor (S1), der identificerer objektet (O1, O2, O3) og
10 genererer et identifikationssignal (IS)
en styreenhed (3), der modtager identifikationssignalet (IS) fra den første sensor (S1) og tildeler en beholder (B1, B2, B3) det identificerede objekt (O1, O2, O3) på grundlag af identifikationssignalet (IS), og
mindst en anden sensor (S2),
15 **kendetegnet ved**, at den anden sensor (S2) omfatter et 3D Time of Flight-system (TOF), et 3D-stereokamera, et 3D-stereokamera i kombination med struktureret lys, eller en 3D-laserscanner og omfatter et visningsfelt (Sf; Sf1, Sf2), der er rettet mod åbningerne (2a til 2c) og omfatter mindst én detektionsflade (Df; Df1, Df2), detektionsfladen (Df; Df1, Df2) er placeret
20 med en forudbestemt afstand (A) fra en kant (R) på en respektiv åbning (2a, 2b, 2c) inden i den respektive beholder (B1, B2, B3), og
et objekt (O1, O2, O3), der passerer detektionsfladen (Df; Df1, Df2), udløser et detektionssignal (ES) fra den anden sensor (S2).
- 25 2. Sorteringsdetektionssystemet (1) ifølge krav 1, **kendetegnet ved**, at den første sensor (S1) omfatter en scanner, en stregkodelæsningssensor, et 2D-kamera eller en RFID-læser.
- 30 3. Sorteringsdetektionssystemet (1) ifølge krav 1 eller 2, **kendetegnet ved**, at styreenheden (3) bruger identifikationssignalet (IS) til at aktivere en optisk visning (4a, 4b, 4c) på den tilknyttede beholder (B1, B2, B3) eller en projektor, som angiver åbningen (2a, 2b, 2c) på den tilknyttede beholder (B1, B2, B3) på

grundlag af identifikationssignalet (IS) for visuelt at angive tildelingen af det identificerede objekt (O1, O2, O3) til den respektive beholder (B1, B2, B3).

4. Sorteringsdetektionssystemet (1) ifølge mindst ét af de foregående krav 1 til 3, **kendetegnet ved**, at styreenheden (3) evaluerer identifikationssystemet (IS) og detektionssignalet (ES) for at generere et første sorteringssignal, der repræsenterer en korrekt sortering af objektet (O1, O2, O3) ind i en beholder (B1, B2, B3), der er associeret med objektet (O1, O2, O3), når objektet (O1, O2, O3) i dens associerede beholder (B1, B2, B3) udløser detektionssignalet (ES), eller til at generere et andet sorteringssignal, der repræsenterer en forkert sortering af objektet (O1, O2, O3), hvis objektet (O1, O2, O3) udløser detektionssignalet (ES) i en beholder (B1, B2, B3) ud over den associerede.

5. Sorteringsdetektionssystemet (1) ifølge krav 4, **kendetegnet ved**, at styreenheden (3) aktiverer en optisk indikator (4a, 4b, 4c) på beholderen (B1, B2, B3), der modtager objektet (O1, O2, O3), på grundlag af sorteringssignalet, eller en projektor angiver den respektive åbning (2a, 2b, 2c) på grundlag af sorteringssignalet for optisk at indikere sorteringen af objektet (O1, O2, O3) i denne beholder (B1, B2, B3) som korrekt eller ukorrekt.

6. Sorteringsdetektionssystem (1) ifølge mindst ét af de foregående krav 1 til 5, **kendetegnet ved**, at beholderen (B1, B2, B3) hører til et logistikstativ, der omfatter en flerhed af beholdere (B1 til B3), der er arrangeret på samme niveau eller på forskellige niveauer i forhold til hinanden.

7. Sorteringsdetektionssystemet (1) ifølge mindst ét af de foregående krav 1 til 6, **kendetegnet ved**, at den anden sensor (S2) er designet på en sådan måde, at objektet (O1, O2, O3), der formidles gennem visningsfeltet (Sf; Sf1, Sf2), kan identificeres gennem det.

8. Sorteringsdetektionssystemet (1) ifølge mindst ét af de foregående krav 1 til 7, **kendetegnet ved, at** åbningerne (2a til 2c) er arrangeret i forskellige afstande fra den anden sensor (S2).
- 5 9. Sorteringsdetektionssystemet (1) ifølge mindst ét af de foregående krav 1 til 8, **kendetegnet ved, at** den anden sensor (S2) er indstillet på en sådan måde, at hver beholder (B1, B2, B3) respektivt har dens individuelt indstillede detektionsområde (Df; Df1, Df2).
- 10 10. Sorteringsdetektionssystemet (1) ifølge krav 9, **kendetegnet ved, at** de individuelle detektionsområder (Df; Df1, Df2) har lige store eller forskellige afstande (A) til åbningen (2a, 2b, 2c) på deres respektive beholdere (B1, B2, B3) sammenlignet med hinanden.
- 15 11. Sorteringsdetektionssystemet (1) ifølge krav 9 eller 10, **kendetegnet ved, at** den eller hver detektionsflade (Df; Df1, Df2) danner et planart, todimensionalt plan.
- 20 12. Sorteringsdetektionssystemet (1) ifølge ethvert af de foregående krav 1 til 11, **kendetegnet ved, at** identifikationen af objektet (O1, O2, O3) er mulig ved hjælp af en optisk markør, specielt en stregkode på objektet (O1, O2, O3), en strukturel egenskab ved objektet (O1, O2, O3) og/eller en RFID-chip på objektet (O1, O2, O3).

Fig. 1

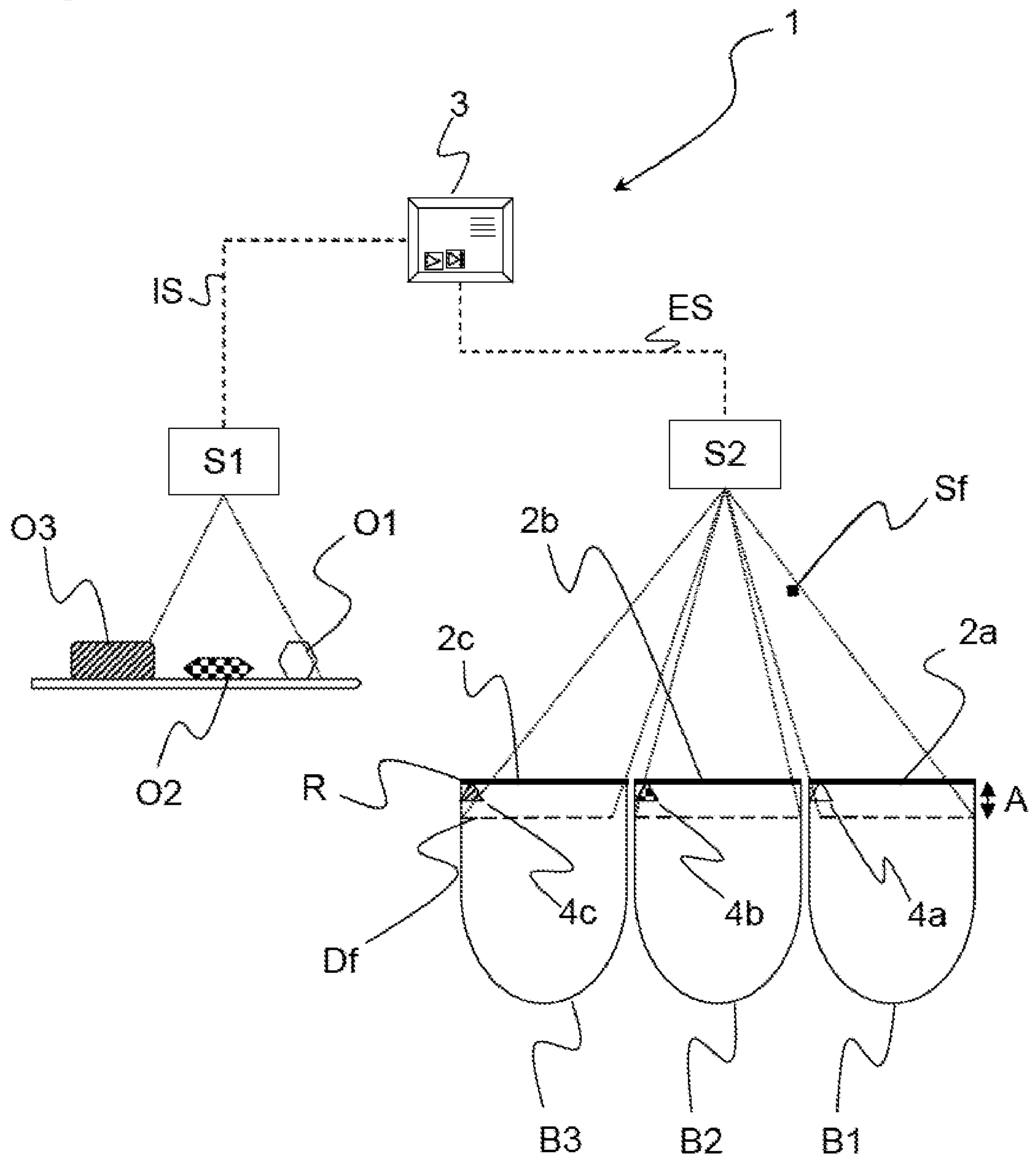


Fig. 2

