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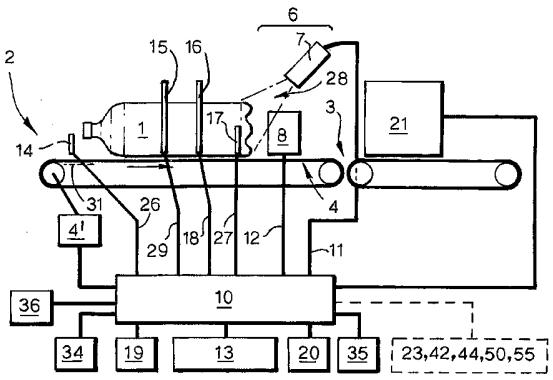
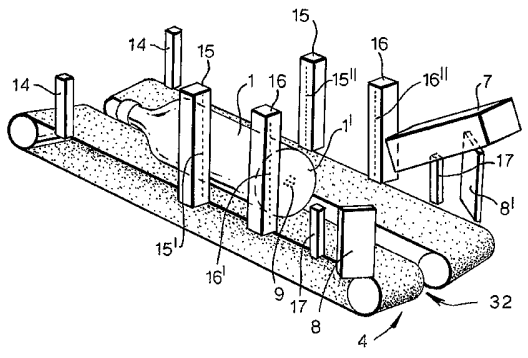
(54) Title: METHOD AND DEVICE FOR OBSERVING FEATURES OF AN OBJECT





(57) Abstract: A device for observing a feature on an object (1), e.g., an empty bottle or can, the device having an object inlet (2) and object outlet (3), means (4) designed to allow the object (1) to move from the inlet (2) towards the outlet (3), a detector station (6) arranged for observing at least one feature (9) that is representative for the object, means (10, 13, 20) adapted to compare an observed feature with predetermined feature data, and means (20) arranged, on the basis of the comparison, to output a result signal. The detector station has a light source (8; 8'') that illuminates on the inserted object (1) an end region (1') facing the outlet which includes the bottom of the object, and at least one camera (7) arranged to view the end region (1') that includes the bottom of the object for observing any feature (9) present. At least three object presence detectors (14; 15; 16; 17) are arranged mutually spaced between the inlet (2) and the detector station (6), of which at least two of the detectors (15, 16) form light curtains transverse to the direction of travel of the object. One of the object presence detectors (17) is optionally adapted to activate the detector station (6) to take at least one picture of the end area. The feature can be selected from the group: phosphorescent or fluorescent mark, bar code marking, physical embossing in or on the material of the object, a symbol having a characteristic spectral reflectance, and a symbol having characteristic shape. A processor (10) will, on the basis of compared signal status of the lightreceiver elements (15''; 16''), determine the direction of travel of the object (1).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Method and device for observing features on an object

The present invention relates to a method and device for observing features on an object, as disclosed in the preamble of attached claims 1 and 10.

It is previously known to detect movement of an object, as for instance an empty beverage container, into a reverse vending machine and to detect with the aid of a camera whether the object comes bottom first or top first. At the same time, the camera is used to recognise shape and any other characteristic features the object has when it is essentially viewed from the side.

Recently, standards have been developed for the indication of, for example, deposit value and other relevant features of an empty beverage container by placing such features at a region of the bottom of the container.

The characteristic features which thus are indicated on the bottom exterior of the container or object must therefore be viewed from a different angle of view than that from which such objects are usually viewed. At the same time, there is also a desire to detect in a simple but efficient manner the direction of travel of the object relative to a detector station.

The characteristic features of the aforementioned inventive method and device are set forth in attached patent claims 1 and 10, and further embodiments are apparent from their respective subsidiary claims 2 - 9 and 11 - 25.

The invention will now be described in more detail with reference to exemplary embodiments, but these exemplary embodiments should by no means be regarded as limiting for the scope and idea of the invention.

Figure 1 is a schematic diagram of the device according to the invention.

Figure 2 is a perspective, simplified view of the device as shown in Fig. 1.

Figure 3 shows a variant of the solution illustrated in Figs. 1 and 2.

Figure 4 shows a variant of the solution illustrated in Fig. 3.

Figure 5 illustrates the object return aspect.

Figure 6 illustrates a two-way sorting system.

Fig. 1 shows a device according to the invention adapted to observe the features on an object 1, for example, in the form of an empty beverage container such as a bottle or can. The device has an object inlet 2 and an object outlet 3. The object 1 is allowed to move from the inlet towards the outlet, for example, with the aid of a conveyor 4, preferably of the V type, as shown in more detail in Fig. 2. The conveyor belt is driven by a motor 4'. Alternatively, the object may be allowed to move along a slideway 5, for example, a slip plane, as shown in Fig. 3, or in a vertical guide 37 (for example, a tube) as will be explained in more detail in connection with Fig. 4.

A detector station 6, consisting of a camera 7 and light source 8, 8', is adapted to observe at least one feature, such as a feature 9 located on the bottom of the object, as can be seen from Fig. 2. Such a feature 9 may, for example, be a phosphorescent or fluorescent mark, a bar code marking, physical embossing in or on the material of the object, a symbol having characteristic spectral reflectance and/or a symbol that has a characteristic shape. The feature will be essential for providing the detector station with an identity in respect of the object. The camera 7 and the light sources 8, 8' are controlled in an appropriate manner from a central processing unit or processor 10, as shown schematically in Fig. 1, and the camera 7 is connected to this unit 10 via cabling 11. The light sources 8, 8' are also connected to the unit 10 via a connection 12. The unit 10 will also be capable of being adapted, on the basis of signals from the camera 7, to compare the observed features with predetermined feature data in a memory 13, and on the basis of such a comparison to output a result signal.

As shown in Figs. 1-3, the detector station has at least one light source 8, 8' that is arranged to illuminate an end area 1' of the inserted object 1 facing the outlet 3. At least one camera 7 is arranged to view the end area and the bottom of the object 1 so as to be able to observe any feature 9 present on the object 1.

At least three object presence detectors can be arranged mutually spaced between the inlet 2 and the detector station 6. In Figs. 1, 2 and 3 a total of four such object presence detectors are indicated by the reference numerals 14, 15, 16 and 17 respectively. In Figs. 1-3 at least two of these presence detectors, indicated by the reference numerals 15, 16 in these figures, are designed to form light curtains transverse to the direction of

travel of the object. One of the object presence detectors, for example, the detector 17, is adapted to activate the detector station 6 to take at least one picture of the said end region 1'. However, it is possible to conceive that, for example, the presence detector 16 has properties which enable it to activate the detector station to take said picture.

Advantageously, the light curtains are arranged adjacent to each other. Each light curtain forming detector is formed of a row of lightemitter elements 15'; 16' and a respectively arranged row of lightreceiver elements 15"; 16". The lightreceiver elements will each be arranged to view respective lightemitter elements in the row of lightemitters.

The row of lightemitters and the row of lightreceivers are, as shown in Fig. 2, placed on each side of the movement path of the object, i.e., in the solution shown in Fig. 2 on opposite sides of the conveyor 4. However, it is possible to envisage that the row of lightemitter elements 15', 16' and the row of lightreceiver elements 15", 16" are placed on the same side of the object's movement path, a retroreflector, indicated schematically by the reference numerals 15'" and 16'", being arranged on the opposite side of the path or on the opposite side of the conveyor for reflecting light emitted from a lightemitter element 15', 16' towards a respective lightreceiver element 15", 16".

In a preferred embodiment there is a plurality of lightemitter elements 15', 16' and a corresponding plurality of lightreceiver elements 15", 16", each single lightemitter element of the elements 15'; 16' being arranged to be activated successively at the same time as a respective one of the lightreceiver elements 15"; 16", i.e., that these elements operate in pairs. It is also possible to envisage activation of lightemitters and lightreceivers in respective detectors in predetermined groups by the control means or control unit 10.

Advantageously, the light emitted from a lightemitter element 15'; 16' may be coded, e.g., with a selected pulse pattern or selected modulation frequency, whereby a respective lightreceiver element 15", 16" can easily identify which lightemitter is emitting light.

The lightemitter elements and lightreceiver elements of the light curtains are connected to the unit 10 via respective cabling 17, 18 as shown in Fig. 1. As indicated above, the unit 10 is adapted to be able, on the basis of a compared state of the light curtain

lightreceiver elements 15", 16", to determine the direction of travel of the object, as will be explained in more detail below.

The light curtains represented by the reference numerals 15 and 16 in the chosen exemplary embodiment are adapted to be able to effect continuous monitoring of objects, such as the object 1, to ensure they do not go the wrong way, i.e., move back towards the inlet 2 instead of moving towards the outlet 3.

If there is movement in the opposite direction, this may indicate that someone is either trying to move the object in from the outlet 3 towards the inlet 2, or trying to retrieve the object after it has been observed and registered by the camera 7.

In the following sequences **1** denotes light on all lightreceiver elements 15"; 16" in the respective rows, whilst **0** denotes absence of light on at least one of the lightreceiver elements 15"; 16" in the respective rows, and **A** = light curtain 15; **B** = light curtain 16.

a)

The following sequence will trigger an alarm:

A B
1 1
1 0
0 0
0 1
1 1

This sequence may be an indication that an attempt is being made to insert the object from the back of the machine or to withdraw the object using a fishing line or the like.

b)

If the light curtain **B** is shaded continuously for more than a time Δt = e.g., 1 second after the object 1 has been detected and accepted and acceptance for deposit refund is ready, the deposit refund will be annulled. This state indicates that something or someone is trying to hold onto the article, thus preventing it from moving.

c)

If the following sequence occurs after the object has been recognised and acceptance for deposit refund is ready, the deposit refund will be annulled:

A B
0 0
0 1
1 1

This indicates a situation in which the object 1 is withdrawn.

If scenario b) or c) is repeated several times for one customer or user, the machine will go into an alarm state.

d)
If an alarm is given according to scenario a), b) or c), a deposit refund will not be provided in any case.

e)
Criteria which do not trigger an alarm, i.e., normal or almost normal operations:

f)
Normal acceptance

A B
0 0
1 0
1 1

g)
Approved acceptance, and next object follows at a short distance:

A B
0 0
1 0
0 0 ← a new object enters the light curtain A here
0 1 ← a new acceptance round starts here.

h)
Light curtain **A** is shaded (state **0**) without the object being seen by a presence detector 14 located at the inlet, and the normal acceptance process starts as in f).

i)
If neither of the light curtains **A; B** (i.e., 15; 16) is blocked after the object has been photographed, and the correct code has been read, it is assumed that the object 1 has been thrown or almost flung into the reversing vending machine and thus through the light curtains **A, B**, and that the object has not stopped before it has passed the light curtain **B**. If a check with the fraud monitoring explained above indicates that the object was moving in the inward direction, the object 1 is accepted.

As stated above, an alarm will be given by an alarm device 19 under the control of the unit 10 if movement of an object 1 takes place in a direction from the detector station 6 towards the inlet 2, i.e., in the opposite direction to the normal direction of transport of the object.

Similarly, the alarm device 19, as indicated above, could be activated if the light curtain 16 which is closest to the detector station 6 is wholly or partly shaded by the object 1 for more than the predetermined time Δt (cf. the same time Δt in scenario b) above) after the feature 9 has been observed by the camera 7 and accepted by the unit 10.

A comparison means 20 that is connected to the unit 10 or is a part thereof is designed, in the event of there being no feature 9 on the object or a feature that does not match any of the predetermined feature data in the memory 13, either to initiate return of the object 1 to the inlet area 2 or removal of the object as a non-acceptable object. Return of the object to the inlet area 2 may, for example, be done by reversing the normal direction of transport of the conveyor 4. Alternatively, as shown in Fig. 1, there may be a removal sorter, generally indicated by the reference numeral 21 downstream of the detector station 6.

In the alternative embodiment shown in Fig. 3 there may be, for the removal of the object, a gate 22 controlled by an activator 23, the activator being connected to the unit 10. If the object 1 in the embodiment shown in Fig. 3 is to be removed from the guide 5 upstream of the outlet 5' of the guide, the unit 10 will cause the activator 23 to move the gate 22 into the position indicated by the reference numeral 22', whereby the object 1 can be moved down to a region 24. Depending on the feature observed on the object,

the object may alternatively be moved to a region 25. The regions 24 and 25 may optionally be, for example, of the type collecting bin, further conveyor, disintegrator, compactor. However, it is also possible to envisage that, for example, the region 24 may represent a feedback route to forward a non-acceptable object back to the customer.

In the alternative embodiment shown in Fig. 4, the vertical guide for the object 1 is indicated by the reference numeral 37. The rows 15'; 16' of lightemitter elements and the rows 15"; 16" of lightreceiver elements are placed at slits in the guide. Similarly, the light sources 8, 8' are placed in openings in the guide 37 wall, and the camera 7 looks through an opening in the guide 37 wall. In this figure the insertion opening for objects is designated by the reference numeral 38. The numerals 39, 40 indicate further handling stations for observed objects. The further handling stations may consist of, for example, collecting bins, compactors or distintegrators. No gate control is required to guide objects into position 39. A gate in the form of, for example, an object ejector 41 which is operated by an activator 42 is used for guiding into position 40. The activator 42 is controlled by the unit 10. There may be provided, for example, a further object ejector 43, offset through 90° relative to the object ejector 41, which is operated by an activator 44 to be able to eject objects of a particular category to a further handling station indicated symbolically by the reference numeral 45. The reference numeral 46 indicates a guide to guide an ejected object from the guide 37 to the position 40.

As indicated in Fig. 5, there is in this figure a reverse vending machine 47, essentially designed like that shown in Figs. 1 and 2. The conveyor 4 is followed by a further conveyor 48. A gate 49, controllable from the unit 10 via a motor 50 is designed to be able to guide objects that are not recognised back to the customer via a feedback unit 51, here shown as a guide chute, so that the customer can receive the object at an opening 52. The return object is in this figure shown as a bottle 53. Such return may for example take place if the object does not have required feature or the object, e.g., has been inserted into the inlet 2 or 38 the wrong way, for example, with the mouth of the object first, feature then not being observable by the camera 7.

Fig. 6a and fig. 6b indicate how two-way sorting is possible, seen in relation to, for example, a vertical guide 37. Here a "propeller" 54 is used which has "blades" 54', 54", and where the propeller is arranged to be able to rotate one way or the other through open portions 37, 37" of the guide 37. It will thus be possible to move an object sideways out of the guide 37 in the direction of the arrow 57 or the arrow 58. The propeller 54 is driven by a motor 55 that is connected to the unit 10, and is expediently

also supported by a bearing 56. With this solution, it is thus possible to move the object to one of a total of three outlets, the reference numeral 37''' indicating the axially aligned outlet of the guide 37.

In another embodiment of the device, the presence detector, for example, indicated by the reference numeral 16 will be arranged to initiate a brief reduction in speed or standstill of the object whilst it is in the detector station. Such reduction in speed or standstill can be initiated by causing the motor 4' that moves the conveyor 4 to have a brief loss of power.

As indicated above, located at the inlet 2 is a presence detector 14, for example, a photocell 14, which causes start-up of the conveyor 4 or causes, on the immediate or closely following further insertion of objects, continued movement of the conveyor 4. The signal from the detector 14 is passed via a connection 26 to the unit 10. The unit 10 is arranged to control the conveyor 4 motor 4'. The presence detector 17 is, as indicated above, designed to trigger the camera 7 and/or the light source 8 to take a picture of the bottom portion of the object and thus observe and register any feature 9 present. The detector 17 is connected to the unit 10 via a connection 27. The exact position of the object is essential for exact exposure time, so that detection is accurate.

As can be seen from Fig. 1, the field of view 28 of the camera will be arranged to observe one end area 1' of the object.

The reference numeral 34 in Fig. 1 shows schematically a printer or other data output device for providing the user of the device with a token for payment of the deposit refund for the returned, acceptable objects. The reference numeral 35 represents a display and 36 denotes operating buttons or the like. The units indicated by the reference numerals 13, 19, 20, 34-36 are all connected to the unit 10 via respective connections.

Patent claims

1.

A method for observing a possible feature on an object, e.g., an object in the form of an empty beverage container such as a bottle or can, during the movement of the object from an object inlet in direction towards an outlet, wherein at least one feature that is representative for the object is observable by a detector station, wherein any observed feature can be compared with predetermined features data, and wherein on the basis of the comparison a result signal is output,

characterised by

- detecting the movement of the object with the aid of at least three object presence detectors arranged mutually spaced between the inlet and the detector station, of which at least two of the detectors form light curtains transverse to the direction of travel of the object;
- illuminating on the inserted object an end region facing the outlet which includes the bottom of the object, and with the aid of a camera viewing the end region including the bottom of the object for observing and registering any feature present on the object; and
- allowing one of the object presence detectors to activate the detector station to take at least one picture of said end region which includes the bottom of the object.

2.

A method as disclosed in claim 1, characterised in

- that on the basis of a signal state of the light curtains as a whole, the direction of travel of the object is determined.

3.

A method as disclosed in claim 1 or 2, characterised by

- triggering an alarm if the movement of an object, registered using said light curtains, takes place from the detector station towards the inlet, i.e., in a direction opposite to normal direction of transport of the object.

4.

A method as disclosed in claim 1 or 2, characterised by

- triggering an alarm if the light curtain closest to the detector station indicates a shadow formed by the object for more than a predetermined time after the feature has been observed by the camera and accepted.

5.

A method as disclosed in claim 1 or 2, characterised in

- that the object is returned to an object inlet area if there is no feature on the object or if the feature present does not match any of the predetermined feature data, e.g., by a reversing movement of the object, or that the object is removed from the conveyor as a non-acceptable object.

6.

A method as disclosed in one or more of the preceding claims, characterised in

- that lightemitters and lightreceivers that form the respective light curtains are activated in pairs or in predetermined groups.

7.

A method as disclosed in one or more of the preceding claims, characterised in

- that the light from the respective lightemitters is coded, e.g., by using a selected pulse pattern or a selected modulation frequency.

8.

A method as disclosed in one or more of the preceding claims, characterised in

- that a feature which is observed by the camera on said end area is selected from the group: phosphorescent or fluorescent mark, bar code marking, physical embossing in or on the material of the object, a symbol having a characteristic spectral reflectance, and a symbol having a characteristic shape.

9.

A method as disclosed in one or more of the preceding claims, characterised in

- that a brief reduction in speed of the object is initiated for brief standstill or reduced speed of the object in the detector station.

10.

A device for observing features on an object, e.g., an object in the form of an empty beverage container such as a bottle or can, the device having an object inlet and an object outlet, a means designed to allow the object to move from the inlet in direction towards the outlet, a detector station arranged for observing at least one feature that is

representative for the object, a means adapted to compare an observed feature with predetermined feature data, and a means adapted, on the basis of the comparison, to output a result signal, characterised in

- that the detector station has at least one light source arranged to illuminate on the inserted object an end region facing the outlet which includes the bottom of the object, and at least one camera arranged to view the end region for observing any feature present;
- that at least three object presence detectors are arranged at regular intervals between the inlet and the detector station, of which at least two of the detectors are designed to form light curtains transverse to the direction of travel of the object; and
- that one of the object presence detectors is arranged to activate the detector station to take at least one picture of said end area which includes the bottom of the object.

11.

A device as disclosed in claim 10, characterised in

- that the light curtains are arranged adjacent to each other.

12.

A device as disclosed in claim 10 or 11, characterised in

- each light curtain forming detector is formed of a row of lightemitter elements and aligned therewith a row of lightreceiver elements, the individual lightreceiver elements being arranged to view respective lightemitter in the lightemitter row.

13.

A device as disclosed in claim 12, characterised in

- that the row of lightemitter elements and the row of lightreceiver elements are placed on the same side of the object's movement path, a retroreflector being arranged on the opposite side of the object's movement path for reflecting light emitted by a lightemitter element towards a lightreceiver element.

14.

A device as disclosed in claim 12 or 13, characterised in

- that the lightemitter elements and the lightreceiver elements in the respective detector are arranged to be activated in pairs, for example one after the other in succession, or in groups by a control means.

15.

A device as disclosed in claim 12, 13 or 14, characterised in

- that the light from the respective lightemitter element is coded, e.g., with a selected pulse pattern or with a selected modulation frequency.

16.

A device as disclosed in one or more of claims 10 - 15, characterised in

- that the camera is arranged to observe a feature in said end region selected from the group: phosphorescent or fluorescent mark, bar code marking, physical embossing in or on the material of the object, a symbol having a characteristic spectral reflectance, and a symbol having a characteristic shape.

17.

A device as disclosed in one or more of claims 10 - 16, characterised in

- that the lightemitter elements and lightreceiver elements of the light curtains are connected to a processor; and
- that the processor, on the basis of a compared signal state of the lightreceiver elements of the light curtains, is designed to determine the direction of travel of the object.

18.

A device as disclosed in one or more of claims 10 - 17, characterised by

- an alarm device that is activatable by a signal from the processor if movement of an object takes place in a direction from the detector station towards the inlet, i.e., in a direction opposite to the normal transport direction of the object.

19.

A device as disclosed in one or more of claims 10 - 17, characterised by

- an alarm device that is activatable by a signal from the processor if the light curtain closest to the detector station is wholly or partly shaded by the object for

more than a predetermined time after the feature has been observed by the camera and accepted.

20.

A device as disclosed in one or more or claims 10 - 17, characterised in

- that the comparing means is arranged, if no feature is observed on the object or if the observed feature does not match any of the predetermined feature data, to initiate:
- either return of the object to the object inlet of the device;
- or return of the object to an inlet area of the device via a separate feedback route;
- or removal of the object for further handling, for example, collection, compaction or disintegration.

21.

A device as disclosed in one or more of claims 10 - 20, characterised in

- that said means for allowing the object to move is a conveyor.

22.

A device as disclosed in claim 20 and 21, characterised in

- that said feedback takes place by means of a reverse movement of the conveyor.

23.

A device as disclosed in one or more of claims 10 - 22, characterised in

- that one of the presence detectors is adapted to initiate a brief reduction in speed or standstill of the object in the detector station.

24.

A device as disclosed in one or more of claims 10 - 23, characterised in

- that one of the presence detectors is located at the object inlet.

25.

A device as disclosed in one or more of claims 10 – 24, characterised in

- that one of the presence detectors is arranged immediately upstream of the detector station, seen in the normal direction of travel of the object.

Fig.1.

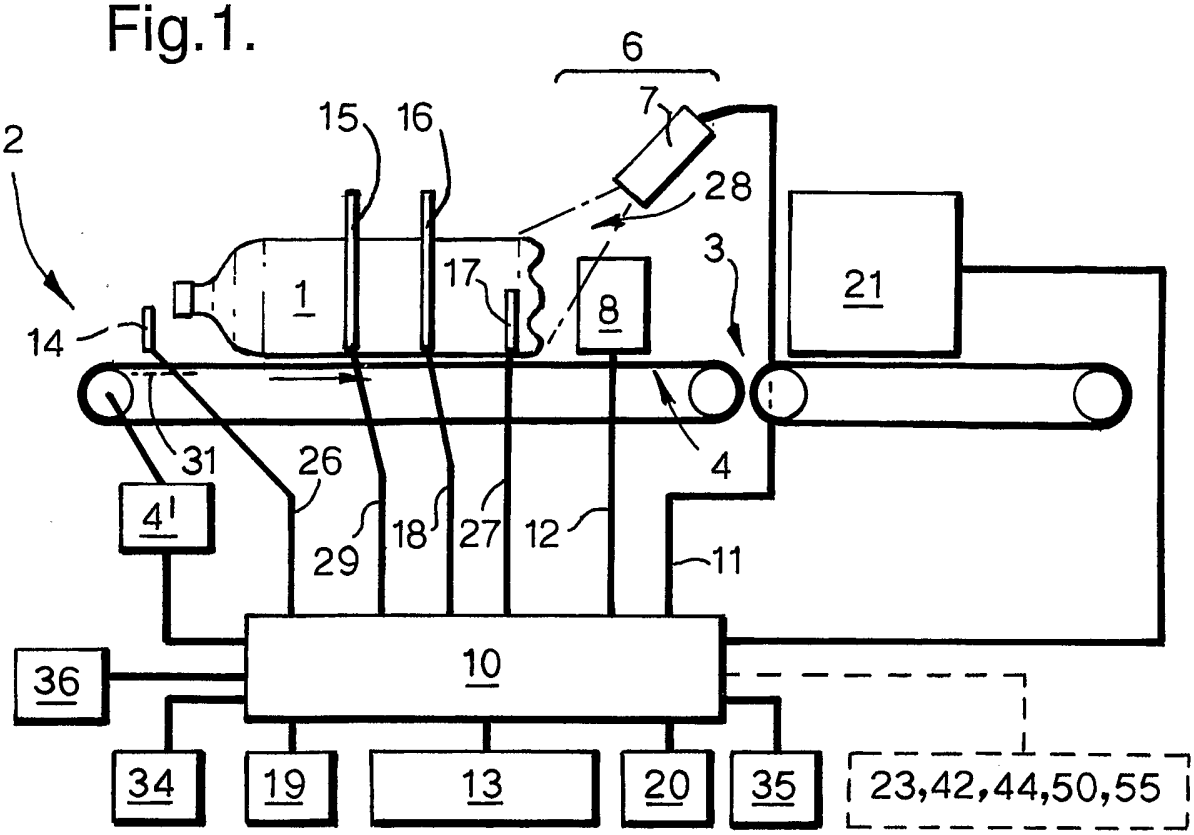
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Fig.2.

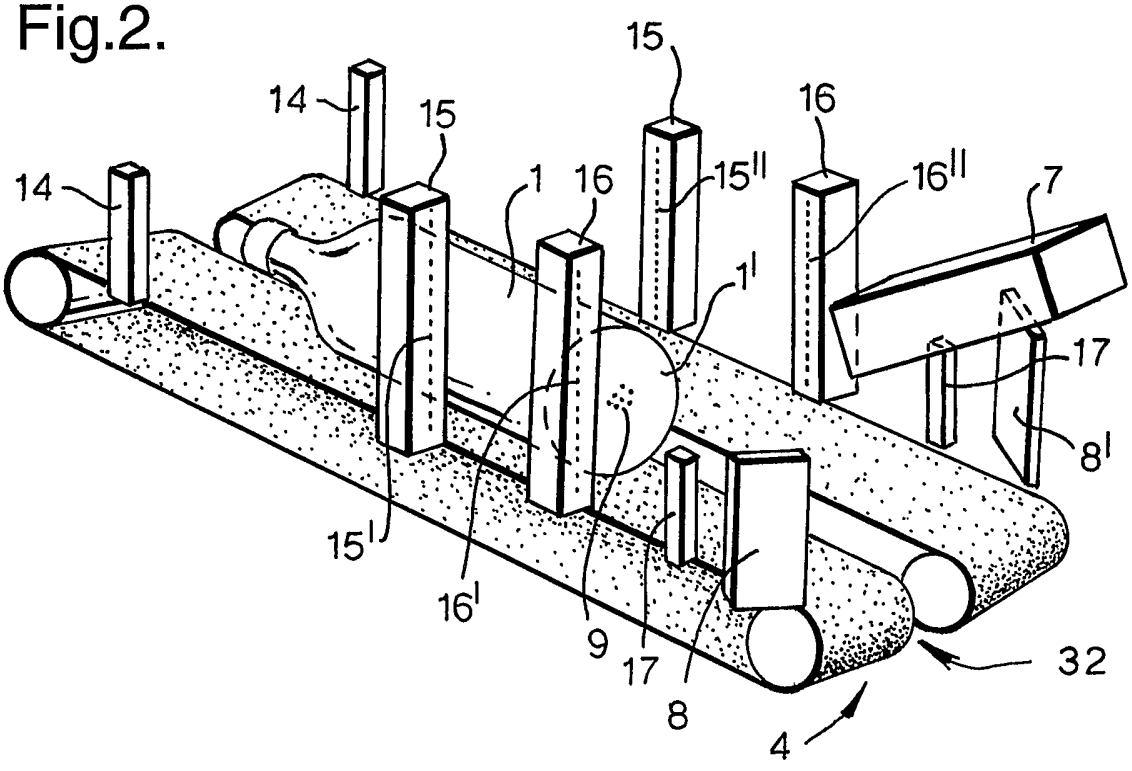
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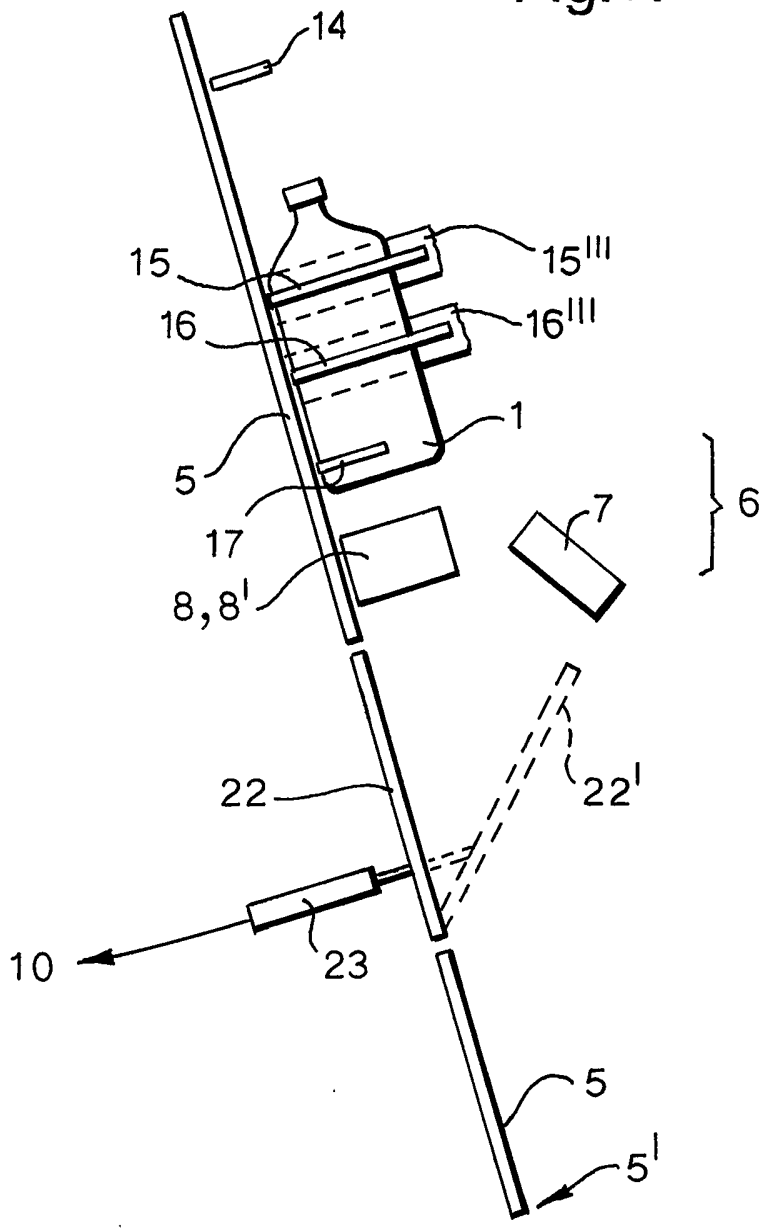
Fig.3.



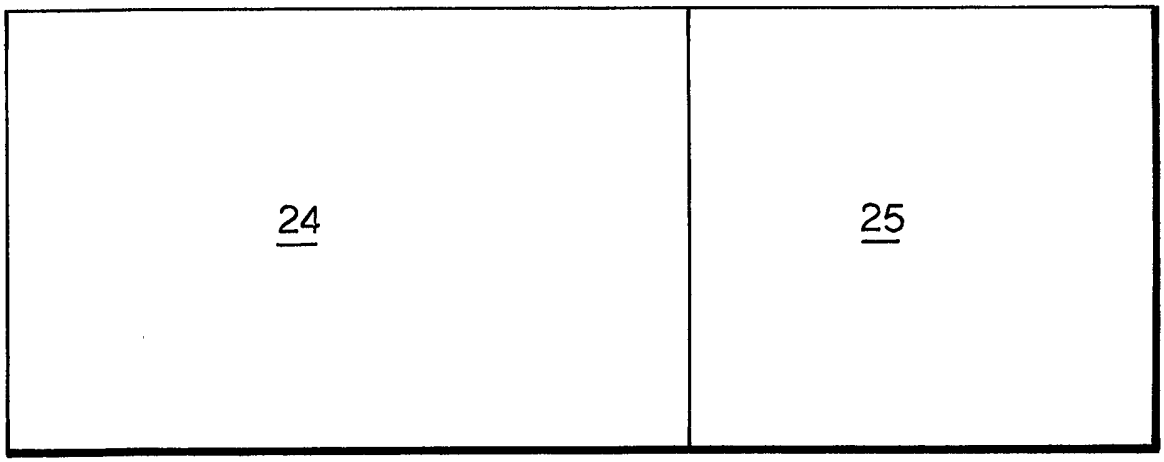


Fig.4.

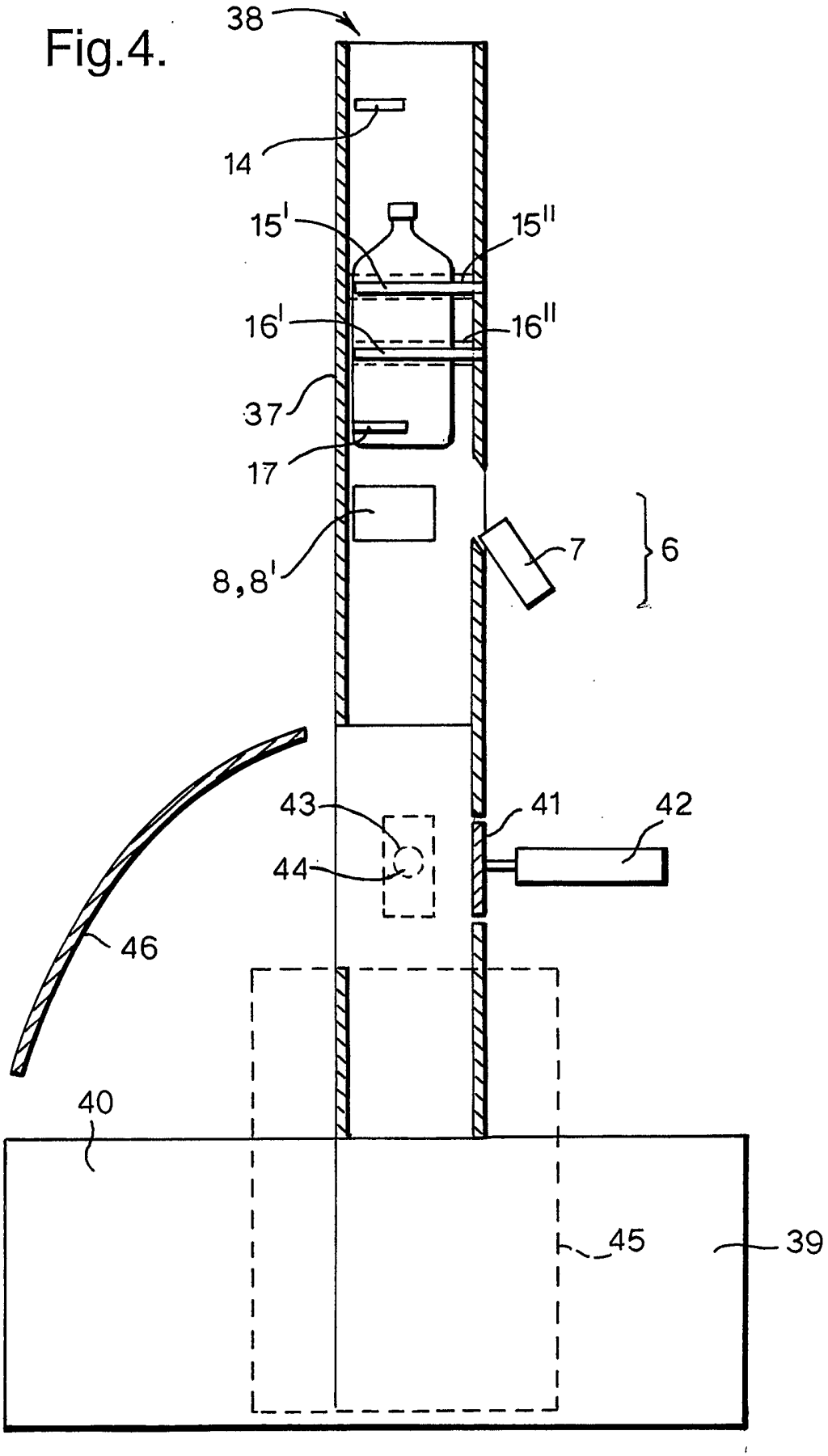


Fig.5.

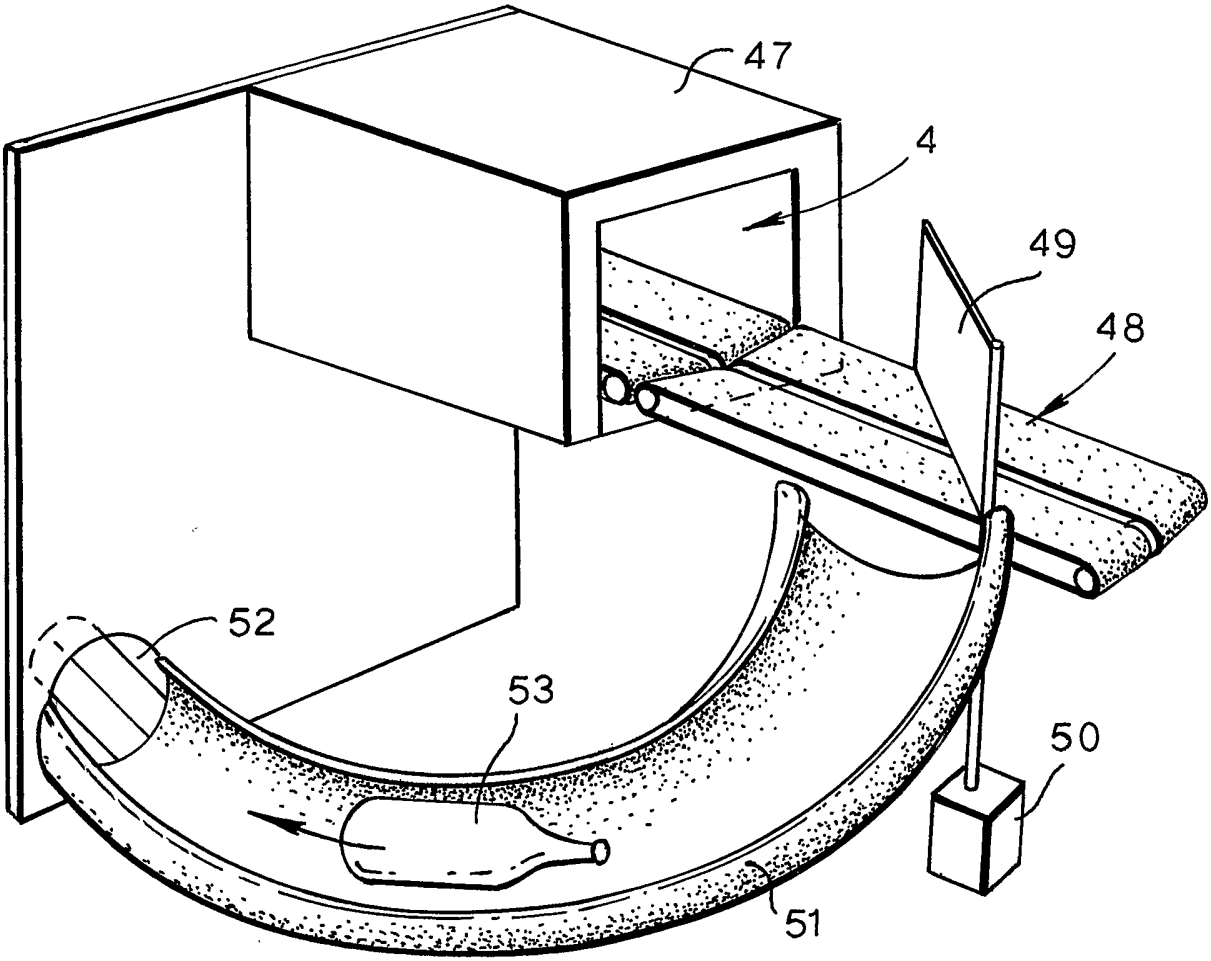


Fig.6a.

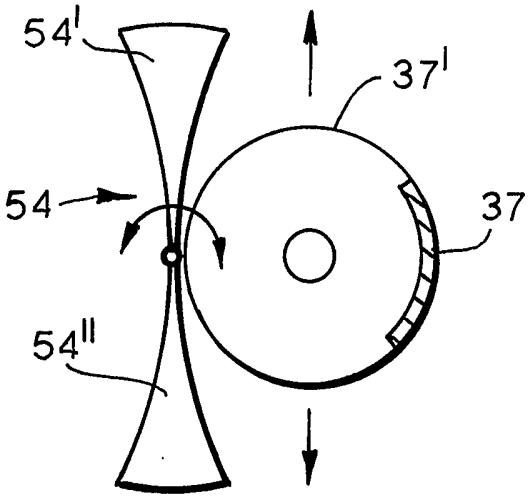
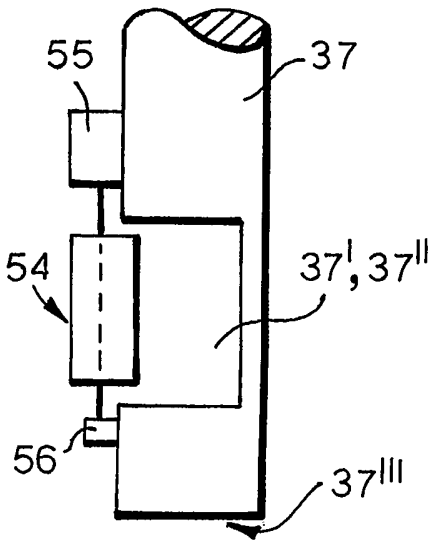


Fig.6b.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2005/000016

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G07F 7/06, B07C 5/342
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B07C, G07F, G06K, G06M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL,WPI,PAJ,INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 6137900 A (T.STEIDEL ET AL), 24 October 2000 (24.10.2000), column 3, line 24 - column 5, line 61, figures 1,2, abstract --	1-25
Y	US 4486776 A (H.YOSHIDA), 4 December 1984 (04.12.1984), column 2, line 60 - column 3, line 34, figure 1, abstract --	1-25
Y	US 4586080 A (M.HOYT ET AL), 29 April 1986 (29.04.1986), column 4, line 9 - column 6, line 6, figure 1, abstract --	1-25

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 May 2005	10 -05- 2005
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Gordana Ninkovic/itw Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2005/000016

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 0228554 A1 (REPANT AS), 11 April 2002 (11.04.2002), page 6, line 22 - page 10, line 4, figure 2, abstract ---	1-25
A	US 5641072 A (Y.OTAKE), 24 June 1997 (24.06.1997), abstract ---	1-25
A	WO 9428397 A1 (AXIOM BILDARBEITUNGSSYSTEME GMBH), 8 December 1994 (08.12.1994), abstract ---	1-25
A	WO 9106846 A1 (PRESSCO,INC.), 16 May 1991 (16.05.1991), abstract --- --------	1-25

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