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(54) Title: DETECTOR, SECURITY CONTAINER, AND METHOD FOR PROCESSING RECOVERED ITEMS

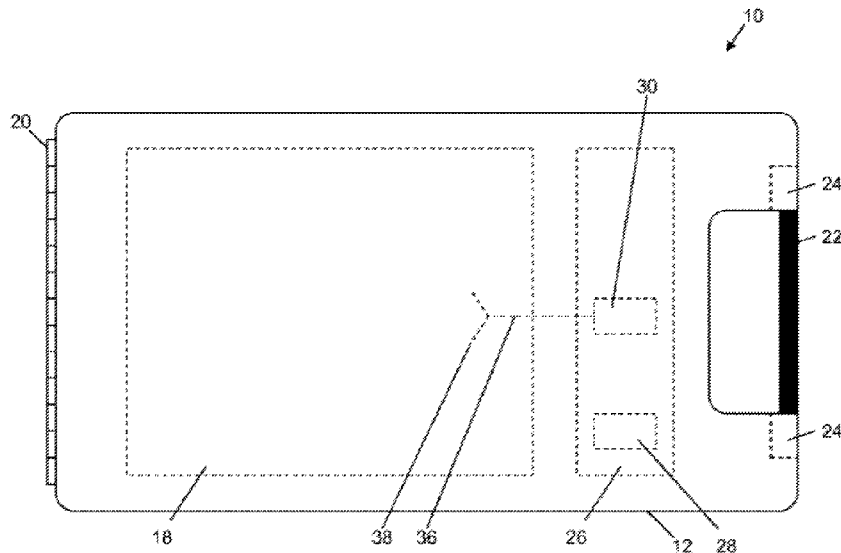


Figure 1

(57) Abstract: A detector and method for detecting a security marker on a recovered item, the detector comprising a light source configured to illuminate the item, a sensor configured to detect returned light from the item at a first wavelength and at a second wavelength that is distinct from the first wavelength, and a data processor configured generate an output signal when the sensor detects both the first and second wavelengths.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
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DETECTOR, SECURITY CONTAINER, AND METHOD FOR PROCESSING RECOVERED ITEMS

BACKGROUND TO THE INVENTION

To deter would-be thieves of bank notes in transit or storage, it has become commonplace for bank notes to be stored and transported in security containers which release a degradation medium onto the bank notes in the event that the security container is stolen or otherwise interfered with, to degrade the bank notes, thus rendering them worthless and unusable. It is almost impossible to completely restore notes which have been degraded, and thus they cannot be used in normal transactions involving a human cashier.

Whilst known ink or dye-based marking systems provide an effective deterrent to would-be thieves, it can be difficult to identify the owner of any recovered items. An owner can be a company such as a bank. It is known to include a unique identifier in a marking system so that a recovered item can be analysed and the owner identified.

The present inventors have devised a new marking systems including a unique identifier than can result in a more accurate determination of the presence of the unique identifier on a recovered item.

SUMMARY

According to a first aspect of the present invention, there is provided a detector for detecting a security marker on a recovered item, the detector comprising:

- a light source configured to illuminate the item;
- a sensor configured to detect returned light from the item at a first wavelength and at a second wavelength that is distinct from the first wavelength; and
- a data processor configured generate an output signal when the sensor detects returned light at both the first and second wavelengths.

A provider of known security liquid can include a wavelength converter, such as an IR up converter, in the security liquid which causes light to be returned at a particular wavelength. Once the security liquid has been dispensed on a valuable item it can dry to form a security marker. The wavelength converter can be used as a sign that the security marker contains a unique identifier. The present inventors have found that markings such as visual features on a valuable item can cause light to be returned at the

particular wavelength. Moreover, the present inventors have found that it is possible to provide a security liquid with one or more wavelength converter components arranged to provide response signals at distinct wavelengths. The detector of the first aspect is therefore arranged such that it must detect both response signals before providing a positive output indicative of the presence of a wavelength converter being present in the security marker, thus reducing the chance of a visible feature on the item leading to a false positive. As such, the detector according to the first aspect can result in a more accurate determination of the presence of a unique identifier on a recovered item.

The data processor can generate the output signal when the sensor detects both the first and second wavelengths within a predetermined time period less than or equal to 30 minutes. Preferably, the time period is less than or equal to 15 minutes, more preferably less than or equal to 5 minutes, more preferably less than or equal to 1 minutes, more preferably less than or equal to 30 seconds, more preferably less than or equal to 10 seconds, more preferably less than or equal to 1 second. The smaller the time period, the faster a user can scan successive recovered items without a reading from a first item combining with a reading from a further item to result in a false positive.

The detector can comprise a single light source. This can allow for a simple design that can reduce the weight of the device.

The sensor can be further configured to detect returned light at a third wavelength that is distinct from the first and second wavelengths. This can increase the reliability of measurements by introducing another authentication

The detector can be further configured to measure the intensity of the returned light at each wavelength. This can increase the reliability of the detector as to generate a positive output signal, the intensity of each wavelength peak must match the expected result. Therefore, the positive output being given for false readings can be reduced.

The detector can further comprise a sound transducer to generate an audible signal in response to the output signal and optionally the detector is a hand held portable device. The detector can further comprise a means of showing a visual signal in response to the output signal, such as a monitor screen or an LED. The audible and visual signals help to inform a user of the detector whether the security marker has been detected.

The mass of the detector can be up to 30kg, preferably less than 20kg, more preferably less than 10 kg, more preferably less than 5kg, more preferably 1kg or less, more

preferably less than 50g and even more preferably less than or equal to 20g. This can result in a portable detector that can be transported and manipulated easily.

According to a second aspect of the invention, there is provided an apparatus for storing or transporting a valuable item and dispensing a security marker on the item in the event of interference, the apparatus comprising:

- a compartment for receiving an item to be stored or transported;
- an interference detection system which is operative to detect interference with the apparatus;

- a reservoir containing a security liquid; and

- a dispensing mechanism, operative, on detection of interference with the apparatus, to dispense the security liquid into the compartment,

wherein the security liquid comprises a unique identifier and one or more wavelength converter components arranged to provide a response signal at a first wavelength and a second wavelength wherein the wavelengths of the first and second signals are distinct from one another in response to an excitation signal.

Thus, when the apparatus detects that the contents are being interfered with, for example stolen, the security liquid is dispensed into the compartment and thus onto the valuable item(s). The security liquid can then dry to become a permanent security marker on the valuable item which can indicate that it has been stolen. The unique identifier results in two distinct response signals at two distinct wavelengths, thus reducing the chance of a feature on the item leading to a false positive when a detector is used to look for the presence of the security marker.

The security liquid can comprise a degradation medium such as a dye, ink, adhesive or the like.

The unique identifier can comprise a DNA sample. Alternatively, the unique marker can comprise a rare earth metal sample.

The security liquid can comprise a plurality of wavelength converter components wherein the wavelength converter components can be additionally configured to provide a third wavelength in response to the excitation signal. This can provide further reliability when identifying the security marker as a further wavelength must be present in order for the data processor to generate the positive output.

One or more of the wavelength converter components can comprise infrared up-converter components. This can allow for the light source to be an infrared source so that the security marker cannot be seen with the naked eye under normal lighting conditions. This can be advantageous as the security marker is hidden in normal lighting.

The security liquid can comprise a single IR up-converter which provides the response signals at the first and second wavelengths. This can be advantageous as a single infrared up-converter can provide both wavelength responses.

The wavelengths of the response signals can be spaced at least 100 nm apart from one another. This can enable the wavelengths to be distinct from each other to reduce the response signals from merging into a single response.

The valuable item can comprise a bank note.

The excitation signal can be an infrared source. The excitation signal can for example have a wavelength between 700 nm and 1 mm. In some embodiments the excitation signal can for example have a wavelength between 780nm and 1500 nm, in some embodiments between 948nm and 983nm.

The detector can be installed into a bank note acceptance machine, wherein the data processor generates an output signal upon detection of the wavelength signals on items entered into the bank note acceptance machine. The data processor can be further configured to generate an output signal which prevents the bank note acceptance machine from dispensing any items upon detection.

According to a further aspect of the invention, there is provided a system comprising a detector according to the first aspect and an apparatus according to the second aspect.

According to a further aspect of the invention, there is provided a method for processing a recovered item comprising illuminating the item with detector according to the first aspect.

BREIF DESCRIPTION OF DRAWINGS

Embodiments of the invention will now be described, strictly by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a schematic representation showing an example of an apparatus for storing or transporting a valuable item;

Figure 2 is a schematic representation showing an example of a detector for detecting a security marker on a recovered item; and

Figure 3 is a schematic representation of a return signal spectrum of a security marker.

DETAILED DESCRIPTION

Referring first to Figure 1, a security apparatus is shown generally at 10. In this example the security apparatus is a security container of the kind used to store and transport bank notes between a storage facility and a distribution facility such as a bank or an automated teller machine (ATM).

The security container 10 has a housing 12 which may be of metal or of a suitable plastics material such as polypropylene. The security container 10 defines a compartment, shown in dashed outline at 18, for receiving an item or items to be transported or stored.

In this example the security container 10 can be opened and closed by means of a hinge 20 positioned at one end of the security container 10.

A handle portion 22 is provided at an opposed end of the security container 10 to the hinge 20 to facilitate handling and carrying of the security container 10. One or more locking mechanisms 24 are provided on or close to the handle portion 22 to secure the base portion 14 to the lid 16 to impede opening of the security container 10. As will be appreciated by those skilled in the relevant art, the locking mechanism 24 may take a variety of forms. For example, the locking mechanism may be a physical lock which is operated by a key, or may be an electronically controlled lock requiring an alphanumeric combination to be entered or an electronic key such as an electronic tag to be presented to a detector of the locking mechanism 24 to activate or deactivate the locking mechanism 24.

In other embodiments the security container can take any suitable form and configuration in which it can securely house a valuable item.

The security container 10 includes a security system, indicated generally at 26 which is operative to cause a security liquid to be deployed into the compartment 18 and thus onto the items stored in the container in the event of the theft of the security container 10 or other unauthorised interference with the security container 10.

To this end, the security system 26 includes a theft or interference detection system, which is shown schematically at 28. The theft or interference detection system 28 may be operative, for example, to detect particular movements of the security container 10 and to activate a security liquid dispensing mechanism 30 of the security container 10 in the event that a theft or other interference is detected. Alternatively the theft or interference detection system 28 may be operative to activate the security liquid dispensing system 30 in the event that a predetermined period of time has elapsed since the security container 10 was removed from a docking station. It will be appreciated that these are merely examples of suitable theft or interference detection systems, and a variety of other suitable systems are known to those skilled in the art, and that any suitable theft or interference detection system 28 could be used in the security container 10.

The security liquid dispensing mechanism 30 provides a reservoir for the security liquid to be stored when the interference detection system has not detected a threat. After the security liquid has been dispersed, it will dry on the item and become a security marker, thus staining the items.

The security liquid includes a unique identifier, such as a DNA sample or a rare earth metal sample. Each security system 26 can be provided with a unique identifier so that when items are recovered, the security container 10 that the items originated from can be identified. Alternatively, if multiple security containers 10 are being used to transport or store items belonging to a single owner, all security containers 10 containing items owned by the same user can have the same unique identifier.

The unique identifier may not be visible to the naked eye, or may be very difficult to quickly identify as present, especially if there has been an attempt to wash the items to remove the security marker.

Referring additionally to Figure 2, a detector 40 is provide to check for the presence of a security marker containing the unique identifier on a recovered item.

An illumination module 50 is provided and arranged to illuminate a recovered item with an excitation light signal 46. The excitation signal 46 can be of any suitable wavelength range such as infrared, visible, or ultra violet, and can comprise one or more distinct signal components. The excitation signal can comprise a single beam or multiple beams at the same or different wavelengths. In one example the illumination module 50 can comprise a laser. The illumination module 50 can be operated by a switch or button located on the detector.

The security liquid has one or more wavelength converter components which interact with an excitation signal 46. The wavelength converter components can absorb the excitation signal and re-emit the signal at a different wavelength. The emitted signal is a response signal and can be at a longer or shorter wavelength than the excitation signal, depending on whether the wavelength converter is a down-converter or an up-converter, respectively.

Referring additionally to Figure 3, the wavelength converter components can provide a first response signal W_1 at a first wavelength and second response signal W_2 at a second, distinct wavelength when illuminated by the excitation signal 46. The wavelength converter components are arranged such that the first W_1 and second W_2 wavelength responses are distinct from each other and as such, are at least separated by 100 nm.

The security liquid can contain any suitable number and configuration of wavelength converter components which provide at least two wavelength peaks in the emitted signal. For example the security liquid can be configured so that a single wavelength converter component can provide multiple wavelength responses. Suitable security liquids that can provide multiple wavelength responses from a single wavelength converter component include Infra-red up converter phosphors. Alternatively, the security liquid can be configured with multiple wavelength components, each component providing a single wavelength response.

In one example, the wavelength converter components can be IR up-converter components. Therefore, the components can absorb IR light and re-emit visible light. The wavelength converter components can individually provide response signals at multiple, different wavelengths.

A sensor 52 is provided and arranged to detect the emitted signals from the security liquid and generate a response signal. The response signal can indicate the wavelengths contained in the emitted signal. Any suitable sensor can be used, such as a

photomultiplier tube (PMT) or two infrared receiver LED's, where each LED is tuned to detect a specific wavelength.

The detector can be configured to measure the intensity of the returned light at each wavelength to provide further authentication and further reduce the occurrence of false positives.

A data processor 54 is provided, coupled to the sensor 52 and output device 56. The data processor is arranged to receive the response signals from the sensor 52 and generate an output 56. If all wavelength responses expected are present in the response signal within a predetermined time period of less than 30 minutes, the data processor 54 will generate a positive output signal. Preferably, the time period will be less than 1 second, to allow for efficient scanning of multiple items.

The output device 56 can be a sound transducer in order to produce an audible positive output, or a screen, or LED in order to produce a visual positive output.

The data processor 54 can be arranged to also receive an intensity measurement of the emitted signals 42, 44 and only generate the positive output if the expected wavelengths are present in the emitted signals 42, 44 and the intensity of the emitted signals 42, 44 is within an expected range.

The data processor 54 can be further coupled to the illumination module 50 so that it is only active in generating an output 56 when the illumination module 50 has been activated.

The detector 40 can be a handheld device or a desk mounted device. When the detector 40 is a handheld device, the mass of the detector must be less than 30kg. Preferably, the detector 40 is arranged so that its mass is less than 1kg. In this embodiment, lightweight components can be used, such as solid state emitter and sensor, lithium ion battery etc.

Alternatively, the detector 40 can be installed into a bank note acceptance machine, such as an automated teller machine (ATM) to help recover items such as banknotes if there is an attempt to deposit stolen items into an ATM. As the security marker can be non-visible to the human eye, thieves could attempt to deposit the stolen items whilst being unaware that they have been marked.

In such an embodiment, the data processor 54 can be coupled to the sensor 52 and generate an output signal upon receiving all wavelength response signals within a predetermined time period. The output signal can notify the ATM that the banknotes have been stolen so that the ATM can react accordingly. For example, the ATM can record the details of the card owner attempting to deposit the banknotes or send a signal to notify the ATM owner that stolen banknotes have been deposited.

Other bank note acceptance machines can include, but are not limited to, vending machines and fixed odds betting machines.

CLAIMS

1. A detector for detecting a security marker on a recovered item, the detector comprising:
 - a light source configured to illuminate the item;
 - a sensor configured to detect returned light from the item at a first wavelength and at a second wavelength that is distinct from the first wavelength;
 - and
 - a data processor configured generate an output signal when the sensor detects both the first and second wavelengths.
2. The detector according to claim 1, wherein the data processor generates the output signal when the sensor detects both the first and second wavelengths within a predetermined time period less than or equal to 30 minutes.
3. The detector according to any of claims 1 or 2, wherein the detector comprises a single light source.
4. The detector according to any of claims 1 to 3, wherein the sensor is further configured to detect returned light at a third wavelength that is distinct from the first and second wavelengths.
5. The detector according to any of claims 1 to 4, wherein the detector is further configured to measure the intensity of the returned light at each wavelength.
6. The detector according to any of claims 1 to 5, wherein the detector further comprises a sound transducer to generate an audible signal in response to the output signal and optionally the detector is a hand held portable device.
7. Apparatus for storing or transporting a valuable item and dispensing a security marker on the item in the event of interference, the apparatus comprising:
 - a compartment for receiving an item to be stored or transported;
 - an interference detection system which is operative to detect interference with the apparatus;
 - a reservoir containing a security liquid; and

a dispensing mechanism, operative, on detection of interference with the apparatus, to dispense the security liquid into the compartment,

wherein the security liquid comprises a unique identifier and one or more wavelength converter components arranged to provide a response signal at a first wavelength and a second wavelength wherein the wavelengths of the first and second signals are distinct from one another in response to an excitation signal.

8. The apparatus according to claim 7, wherein the unique identifier comprises a DNA sample.
9. The apparatus of according to claims 7 or 8, wherein the security liquid comprises a plurality of wavelength converter components wherein the wavelength converter components are additionally configured to provide a third wavelength in response to the excitation signal.
10. The apparatus according to any of claims 7 to 9, wherein one or more of the wavelength converter components comprises infrared up-converter components.
11. The apparatus according to any of claims 7 to 10, wherein the security liquid comprises a single IR up-converter which provides the response signals at the first and second wavelengths.
12. The apparatus according to any of claims 7 to 11, wherein the wavelengths of the response signals are spaced at least 100 nm apart from one another.
13. The apparatus according to any one of the preceding claims wherein the valuable item comprises a bank note.
14. A system comprising an apparatus according to any of claims 7 to 13 and a detector according to any of claims 1 to 6.
15. A method for processing a recovered item comprising illuminating the item with a device according to any of claims 1 to 6.

AMENDED CLAIMS

received by the International Bureau on 30 September 2020 (30.09.2020)

1. A detector for detecting a security marker on a recovered item, the detector comprising:
 - a light source configured to illuminate the item;
 - a sensor configured to detect returned light from the item at a first wavelength and at a second wavelength that is distinct from the first wavelength;
 - and
 - a data processor configured generate an output signal when the sensor detects both the first and second wavelengths,
 - the detector being arranged such that it must detect returned light from the item at the first wavelength and the second wavelength before providing the output signal indicative of the presence of a wavelength converter being present in the security marker.
2. The detector according to claim 1, wherein the data processor generates the output signal when the sensor detects both the first and second wavelengths within a predetermined time period less than or equal to 30 minutes.
3. The detector according to any of claims 1 or 2, wherein the detector comprises a single light source.
4. The detector according to any of claims 1 to 3, wherein the sensor is further configured to detect returned light at a third wavelength that is distinct from the first and second wavelengths.
5. The detector according to any of claims 1 to 4, wherein the detector is further configured to measure the intensity of the returned light at each wavelength.
6. The detector according to any of claims 1 to 5, wherein the detector further comprises a sound transducer to generate an audible signal in response to the output signal and optionally the detector is a hand held portable device.

7. Apparatus for storing or transporting a valuable item and dispensing a security marker on the item in the event of interference, the apparatus comprising:
- a compartment for receiving an item to be stored or transported;
 - an interference detection system which is operative to detect interference with the apparatus;
 - a reservoir containing a security liquid; and
 - a dispensing mechanism, operative, on detection of interference with the apparatus, to dispense the security liquid into the compartment,
- wherein the security liquid comprises a unique identifier and one or more wavelength converter components arranged to provide a response signal at a first wavelength and a second wavelength wherein the wavelengths of the first and second signals are distinct from one another in response to an excitation signal.
8. The apparatus according to claim 7, wherein the unique identifier comprises a DNA sample.
9. The apparatus according to claims 7 or 8, wherein the security liquid comprises a plurality of wavelength converter components wherein the wavelength converter components are additionally configured to provide a third wavelength in response to the excitation signal.
10. The apparatus according to any of claims 7 to 9, wherein one or more of the wavelength converter components comprises infrared up-converter components.
11. The apparatus according to any of claims 7 to 10, wherein the security liquid comprises a single IR up-converter which provides the response signals at the first and second wavelengths.
12. The apparatus according to any of claims 7 to 11, wherein the wavelengths of the response signals are spaced at least 100 nm apart from one another.
13. The apparatus according to any one of the preceding claims wherein the valuable item comprises a bank note.

14. A system comprising an apparatus according to any of claims 7 to 13 and a detector according to any of claims 1 to 6.
15. A method for processing a recovered item comprising illuminating the item with a device according to any of claims 1 to 6.

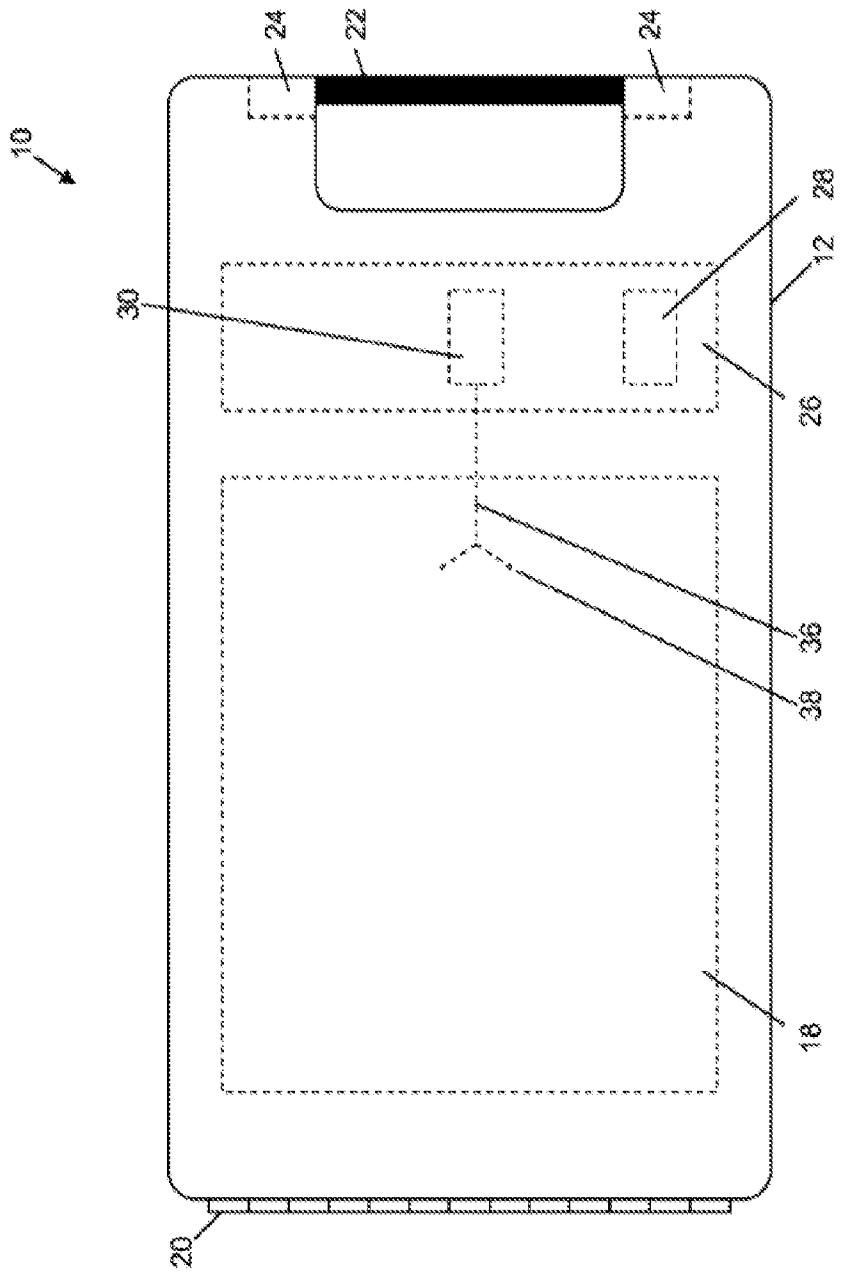


Figure 1

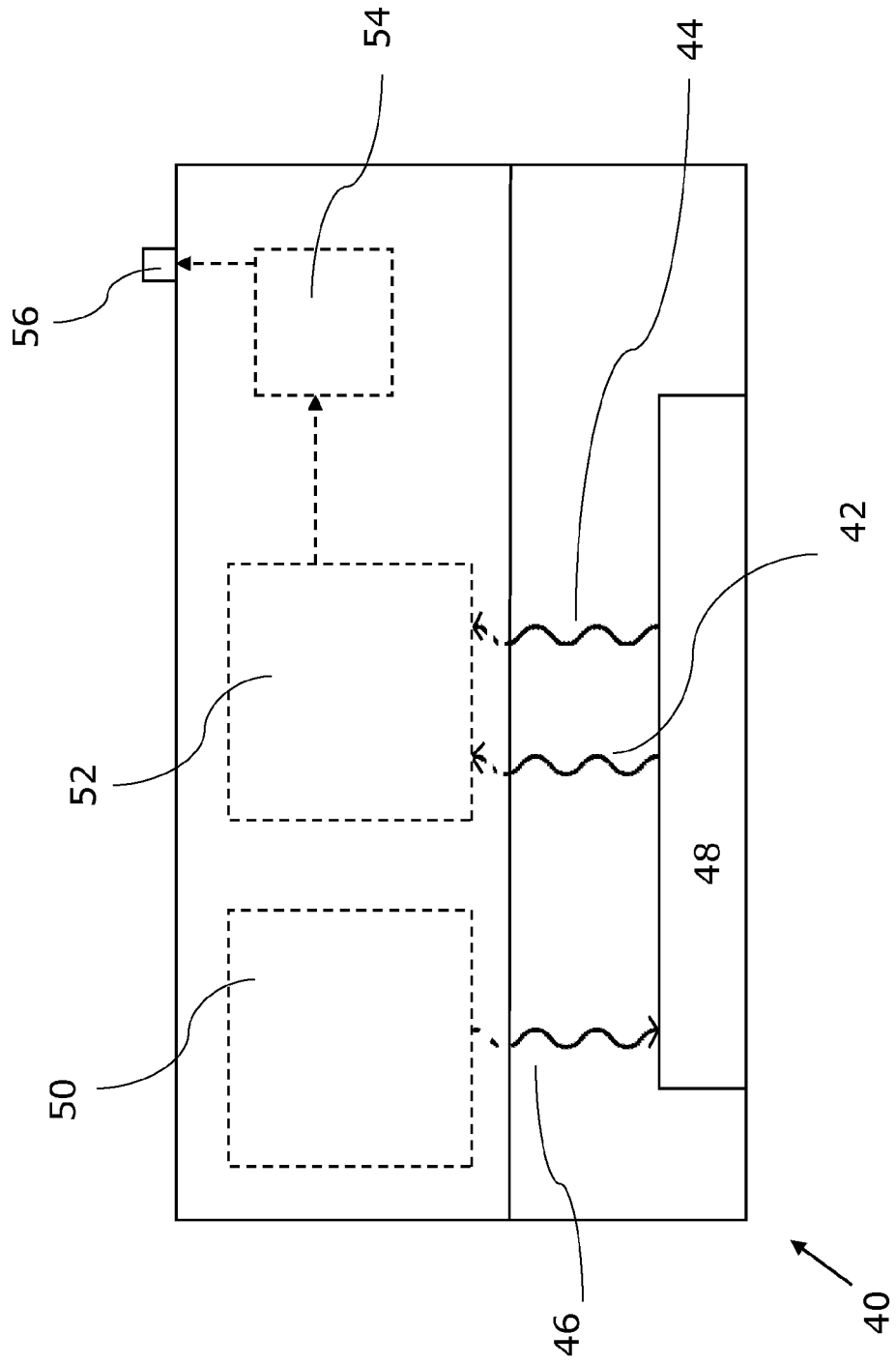


Figure 2

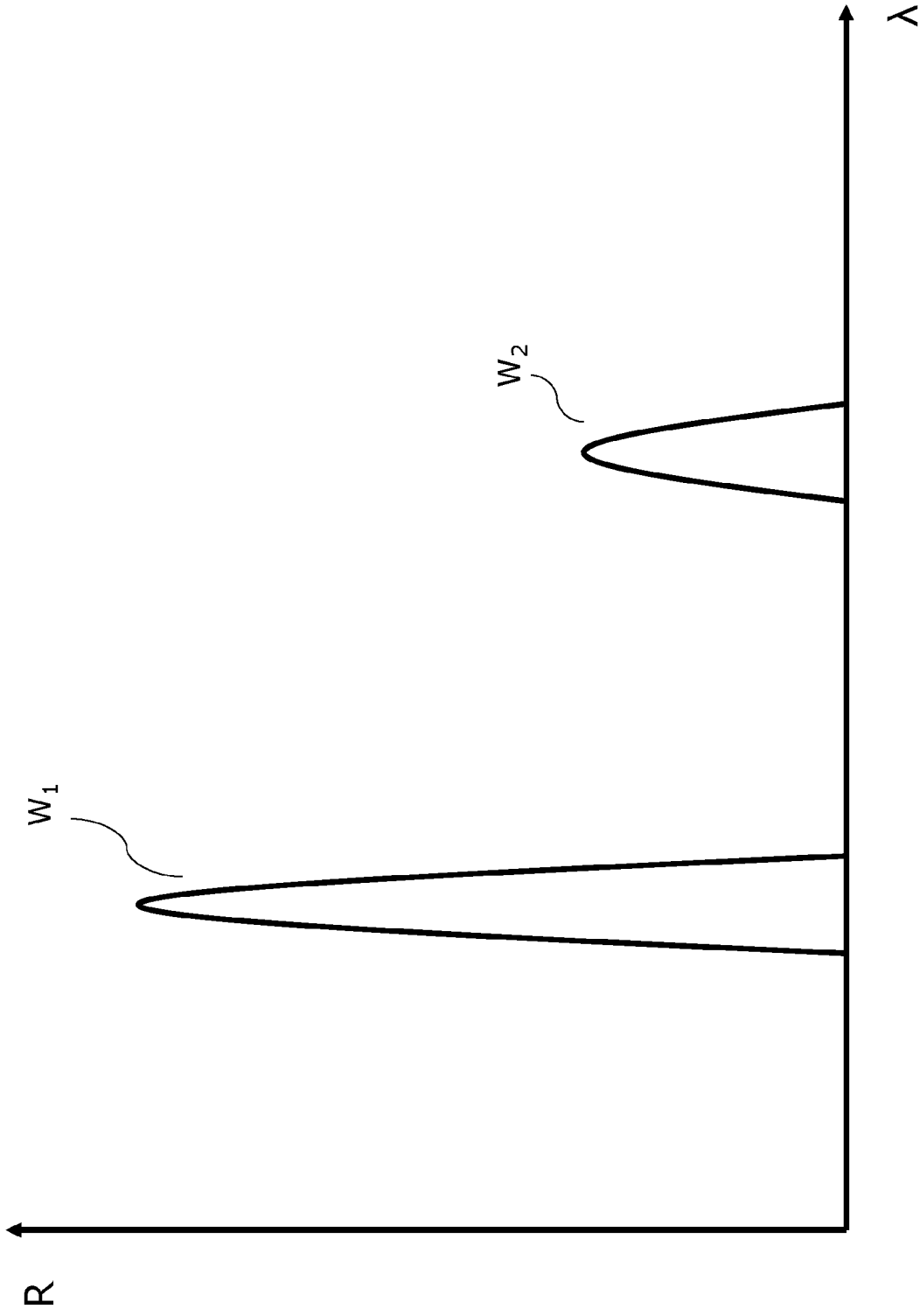


Figure 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/052809

A. CLASSIFICATION OF SUBJECT MATTER
INV. G07D7/12 G07D11/125 G07D11/225 G07D7/14 G07D7/1205
ADD.
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)
G07D

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

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- "O" document referring to an oral disclosure, use, exhibition or other means
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search 25 February 2020	Date of mailing of the international search report 03/03/2020
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Seifi, Mozhdkeh
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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/052809

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Information on patent family members

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