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(54) Device and method for the inspection of elements inside a fuse box

(57) The present invention discloses a device (1) and method to verify the correct arrangement of fuses inside a fuse box (2) and, consequently, their proper electrical connection. Said device (1) comprises a tray to receive the fuse boxes (2) and a generation and reading mechanism (10) for the generation of waves and reading thereof in said fuse boxes (2), wherein the generation and reading mechanism comprises:

a) a guide matrix (100) disposed parallel on the tray;
b) a wave generator; and
c) a wave reader;

wherein both the wave generator and the wave reader are connected to the guide matrix (100) being movable between at least two points in the guide matrix (100).

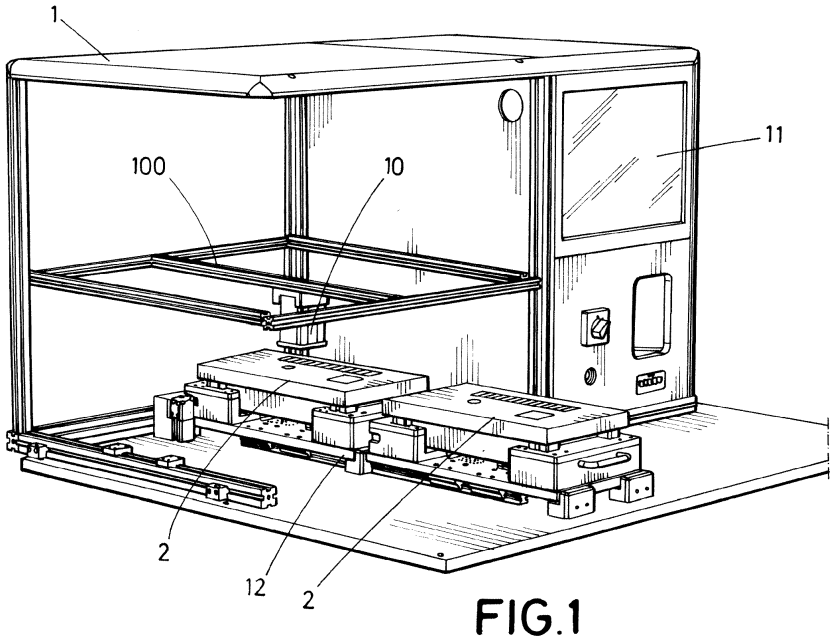

FIG.1

EP 2 931 015 A1

Description

OBJECT OF THE INVENTION

[0001] The present invention discloses a device for the inspection of elements inside a fuse box. In particular, the present invention aims to verify the proper arrangement of the fuses inside the box and, consequently, their proper electrical connection.

BACKGROUND OF THE INVENTION

[0002] In known devices, the fuses can be inserted into the boxes automatically or manually but, in both cases, errors in the insertion of components may occur, which would affect the operation of the boxes. Generally, the electrical components of a fuse box comprise at least one pair of metal tabs which are inserted into corresponding electrified slots, whereby said connection serves as a mechanical fastening of the component to the fuse box, while allowing the electrical continuity for the proper operation of the electronic / electrical components (fuses and relays, among others). The correct insertion of such components determines the proper operation of the fuse box, for example, in the electrical system of a vehicle.

[0003] During insertion of the components, errors such as any of the following may occur: the component is not fully inserted, the component is inserted sideways, the metal pins of the component have not been inserted between the metal tracks of the slot but laterally along only one, or the components are not inserted in the preset position, or that the components which have been inserted do not correspond to the position wherein they have been inserted.

[0004] Various techniques are known in the market for the inspection of the correct connection of elements comprising pins, such as fuses, to a baseplate or, in particular, to a fuse box.

[0005] One of the most used techniques is based on the use of stereoscopic vision to detect such faulty connections

[0006] This technique involves the provision of at least two cameras at a given angle relative to each other. Subsequently, the data obtained by these cameras is processed to generate a three-dimensional model which, once received the images, requires the processing of the data obtained which are compared with a master model for faults.

[0007] This technique requires processing a lot of data and also requires very high definition cameras when the elements detected are small. Therefore, the computational cost to perform this technique is very high.

[0008] Another known technique is the use of a visible light beam that travels longitudinally or transversely along the fuse box at a given angle of incidence. Additionally, a camera for the reading of said beam is arranged and element layout errors are detected.

[0009] The main drawback of this technique is that some objects may not be detected by the device since the beam is incident from a certain angle, so there may be a shadow effect that prevents the light beam from reaching certain elements.

[0010] Another drawback of this technique is that some of the elements arranged in the fuse boxes produce a dispersion effect which at minimum reduces the accuracy of measurement when using this technique.

DESCRIPTION OF THE INVENTION

[0011] In order to solve the problems presented by devices of the prior art, the present invention discloses a device for the inspection of elements inside a fuse box comprising a tray designed so as to receive the fuse boxes, and a generation and reading mechanism to generate waves and read said waves, wherein the generation and reading mechanism comprises:

- a guide matrix arranged parallel to the fuse box;
- a wave generator; and
- a wave reader;

wherein both the wave generator and the wave reader are connected to the guide matrix and are movable between at least two points in the guide matrix.

[0012] In particular embodiments of the present invention, the guide matrix comprises at least one row in a longitudinal direction of said tray. In addition, preferably, the guide matrix comprises at least one column in a transverse direction to said tray. Ultimately, the guide matrix can be a row matrix, a column matrix or it may comprise several rows and / or columns.

[0013] Preferably, the connection between the guide matrix and the wave generator comprises bearings and / or belts to facilitate movement of the wave generator between different points in the guide matrix. Said bearing and / or belt system can be replaced by magnetic means or may comprise a worm - spindle mechanism or any other means for moving a piece on a guide among those known in the prior art. Additionally, the wave reader may comprise coupling means to attach the wave reader to the wave generator, thus forming a single piece in which movement of the wave generator involves movement of the wave reader.

[0014] In one embodiment, the device of the invention comprises control means for controlling the displacement of the wave generator, said control means comprising, for example, a motor and a processor.

[0015] Regarding the wave generator, said wave generator can be a sound wave generator, electromagnetic generator, etc. Additionally, it may be an infrared laser or a laser of visible light. Said laser may also be a line laser so that with a single laser a larger area may be measured using a single laser and multiple light sensors.

[0016] Moreover, the present invention discloses a method for the inspection of elements in fuse boxes using the device described above, wherein the method com-

prises the following steps:

a) provision of a fuse box in the tray;
b) moving the wave generator along at least one of the rows or columns of the guide matrix;
c) performing simultaneously to the movement at least one reading of the distance between the wave generator and the box using a wave reader;
d) comparing at least one of the distances obtained with a pre-set distance.

[0017] Preferably, the pre-set distance is a distance determined by the user for at least one of the points of the guide matrix and, in a particular embodiment, step c) is performed for each of the points for which the user has determined a pre-set distance.

[0018] Another form of inspection may be performed using the present invention, wherein the user pre-set distance is a threshold distance, i.e., the allowed tolerance of differences between distances is below this threshold distance. In this regard, step c) of the method would involve the measurement of at least two distances corresponding to two points of the matrix guide and, step d) entails comparing the subtraction between these two distances with the pre-set distance or threshold distance.

[0019] To complement the analysis, each of the elements arranged in the fuse box may be checked as to verify suitability using an artificial vision system comprising a camera and digital image processing means.

DESCRIPTION OF THE DRAWINGS

[0020] These and other characteristics and advantages of the invention will be more readily apparent from the following detailed description of preferred embodiments, provided only by way of illustration and not in any way limiting the scope of the invention, with reference to the attached figures.

Figure 1 shows a perspective view of a device according to the present invention.
Figure 2 shows a front view of the device of Figure 1.
Figure 3 shows a fuse box verifiable using the device of Figures 1 and 2.
Figure 4 shows an example of a signal obtained after inspection of a first fuse box.
Figure 5 shows a second example of a signal obtained after inspection of a second fuse box.

PREFERRED EMBODIMENT OF THE INVENTION

[0021] Figure 1 shows a preferred embodiment of a device (1) according to the present invention. For the sake of a better understanding of the present invention, Figure 1 discloses a device (1) comprising a single row guide matrix, however, the same concept can be extrapolated to embodiments with multiple rows and columns.

[0022] Specifically, Figure 1 shows a device (1) for the inspection of the elements disposed within a fuse box (2). This inspection is based primarily on the measurement of distances between elements and a reference point, so it can be determined, for example, if a fuse is properly connected to the junction box, if disconnected and even if there is no fuse in a given position.

[0023] To perform this inspection, the present invention has a generating and reading mechanism (10) for the generation and reading of waves, wherein said generating and reading mechanism (10) comprises a laser type wave generator, and a laser type wave reader (or a light sensor) which is arranged on a guide (100) so as to allow movement which, in this case, is a longitudinal movement along the fuse box (2). However, particular embodiments of the invention comprise several guides (100) which may be arranged so that the beam moves in both a longitudinal and transverse direction relative to the fuse box (2).

[0024] The method for determining the distance between the wave generator and the fuse box (2) is a widely known process in the prior art and is based on determining the time between signal generation and reception of the signal which bounces off the fuse and is read by the wave reader. By knowing the wave displacement time and speed data, the space covered by said wave is obtained.

[0025] Additionally, the input of the fuse boxes (2) to the device (1) is performed by a fuse box (2) conveyor (12) which may be, for example, a conveyor belt system.

[0026] Moreover, the device (1) object of the present invention has a display screen (11) which allows viewing the data corresponding to the measurements made.

[0027] Figure 2 shows a front view of the device (1) of Figure 1 further representing the capacity of the laser generation and reading mechanism (10) to move in a transverse direction relative to the fuse box (2).

[0028] Figure 3 schematically shows a form of operation of the device (1) object of the present invention.

[0029] This figure shows the fuse box (2) with multiple elements connected to it. Additionally shown is the laser generation and reading mechanism (10) which moves along the fuse box (2). In this embodiment, the laser generator may be a line laser to perform a measurement of all the elements through a single sweep.

[0030] Figure 4 shows an example of an inspection conducted using the device (1) of the present invention.

[0031] In particular, a first step (201) is observed corresponding to the inspection of a first element (21), and a second step (203) corresponding to the inspection of a second element (23), and through the inspection of these two first and second elements (21, 22) details that cannot be observed by known inspection techniques are obtained, such as, for example, the presence of a small projection in a space (22) existing between these two first and second elements. Said projection is determined by the presence of the peak (202) in the measurement.

[0032] Another reading example is shown in Figure 5. In particular, this figure depicts the presence of a third

element (24), a fourth element (25) and a fifth element (26). As can be seen from inspection of these third (24), fourth (25) and fifth (26) elements, the third (24) element corresponds to a third step (204) wherein there is a distance between the generation and reading mechanism (10) and the third element (24) of less than 66.5 mm, the fourth element (25) corresponds to a fourth step (205) wherein there is a distance between the generation and reading mechanism (10) and the fourth element (25) of approximately 67 mm, and the fifth element (26) corresponds to a fifth step (206) wherein there is a distance between the generation and reading mechanism (10) and the fifth element (26) of approximately 68 mm. With these measurements if, for example, the user knows that with a distance under 70mm the fuse would not be properly connected to the fuse box (2), the inspection would imply that the third (24), fourth (25) and fifth (26) elements are not properly connected to the fuse box (2).

[0033] Therefore, the device (1) could generate an alarm, or show on a display screen the elements that are not properly connected and thus the user would conduct an inspection and manual repair.

[0034] Furthermore, in particular embodiments of the present invention, the graph resulting from the inspection procedure (for example, a graph like that shown in Figures 4 and 5) may be compared with a master graph showing how the elements should be arranged in the device (1). Thus it would be possible to determine, for example, if a given space should be free for a fuse and has been occupied.

Claims

1. Device (1) for the inspection of elements inside a fuse box (2) comprising a tray to receive the fuse boxes (2) and a generation and reading mechanism (10) to generate waves and read said waves, wherein the generation and reading mechanism (10) comprises:

   - a guide matrix (100) arranged parallel on the fuse box (2);
   - a wave generator; and
   - a wave reader;

   characterized in that both the wave generator and the wave reader are connected to the guide matrix (100) being movable between at least two points in the guide matrix (100).

2. Device (1) according to claim 1, wherein the guide matrix (100) comprises at least one row in a longitudinal direction of said tray.

3. Device (1) according either claim 1 or 2, **characterized in that** the guide matrix (100) comprises at least one column in a transverse direction relative to said tray.

4. Device (1) according to any of the preceding claims, **characterized in that** the connection between the guide matrix (100) and the wave generator comprises bearings and/or belts.

5. Device (1) according to any of the preceding claims, **characterized in that** the connection between the guide matrix (100) and the wave generator comprises magnetic means.

6. Device (1) according to any of the preceding claims, **characterized in that** the connection between the guide matrix (100) and the wave generator comprises a worm and a spindle.

7. Device (1) according to any of the preceding claims, **characterized in that** it comprises control means to control the displacement of the wave generator.

8. Device (1) according to claim 7, **characterized in that** said control means comprise at least a motor and a processor.

9. Device (1) according to any of the preceding claims, **characterized in that** the wave reader comprises coupling means joining it to the wave generator.

10. Device (1) according to claim 1, **characterized in that** the wave generator is a laser.

11. Device (1) according to claim 10, **characterized in that** the wave reader is a light sensor.

12. Method for the inspection of elements inside a fuse box using the device (1) described in claim 1 **characterized in that** it comprises the steps of:

    a. arranging a fuse box (2) in the tray;
    b. moving the wave generator along at least one of the rows or columns of the guide matrix (100);
    c. simultaneously with the movement of step b), conducting at least one reading of the distance between the wave generator and the fuse box (2) by means of the wave reader;
    d. comparing at least one of the distances obtained with a pre-set distance

13. Method according to claim 12 **characterized in that** the pre-set distance is determined by the user for at least one of the points of the guide matrix (100).

14. Method according to claim 13, **characterized in that** step c) is performed for each of the points at which the user has determined a pre-set distance.

15. Method according to claim 12, **characterized in that**

in step c) at least two distances are measured corresponding to two points of the guide matrix (100).

16. The method according to claim 15, **characterized in that** during step d) the pre-set distance is compared with a subtraction between the distances measured in step c).

17. Method according to claim 12, **characterized in that** it further comprises a step e) in which an additional verification is performed by means of a camera and digital image processing.

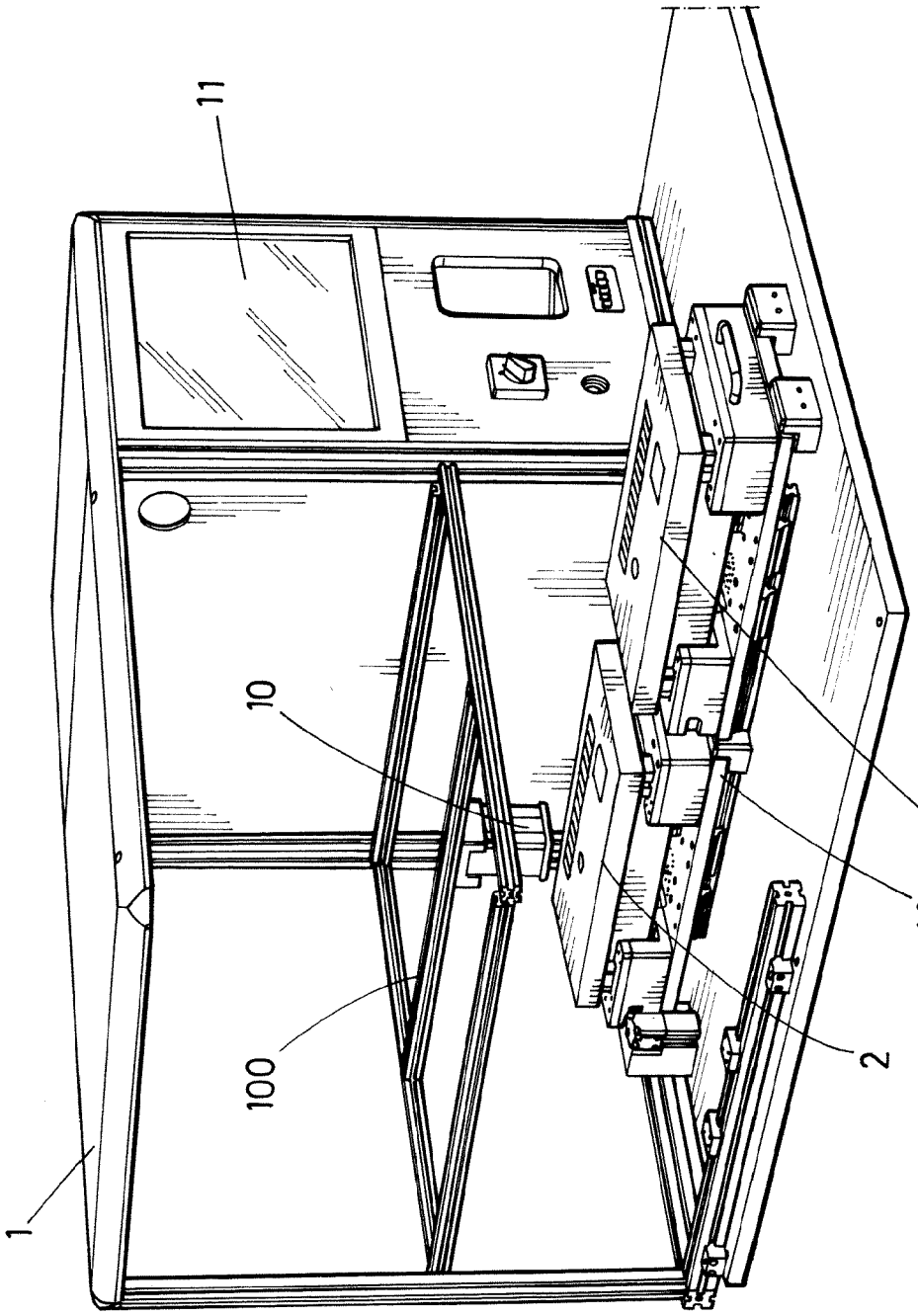

FIG.1

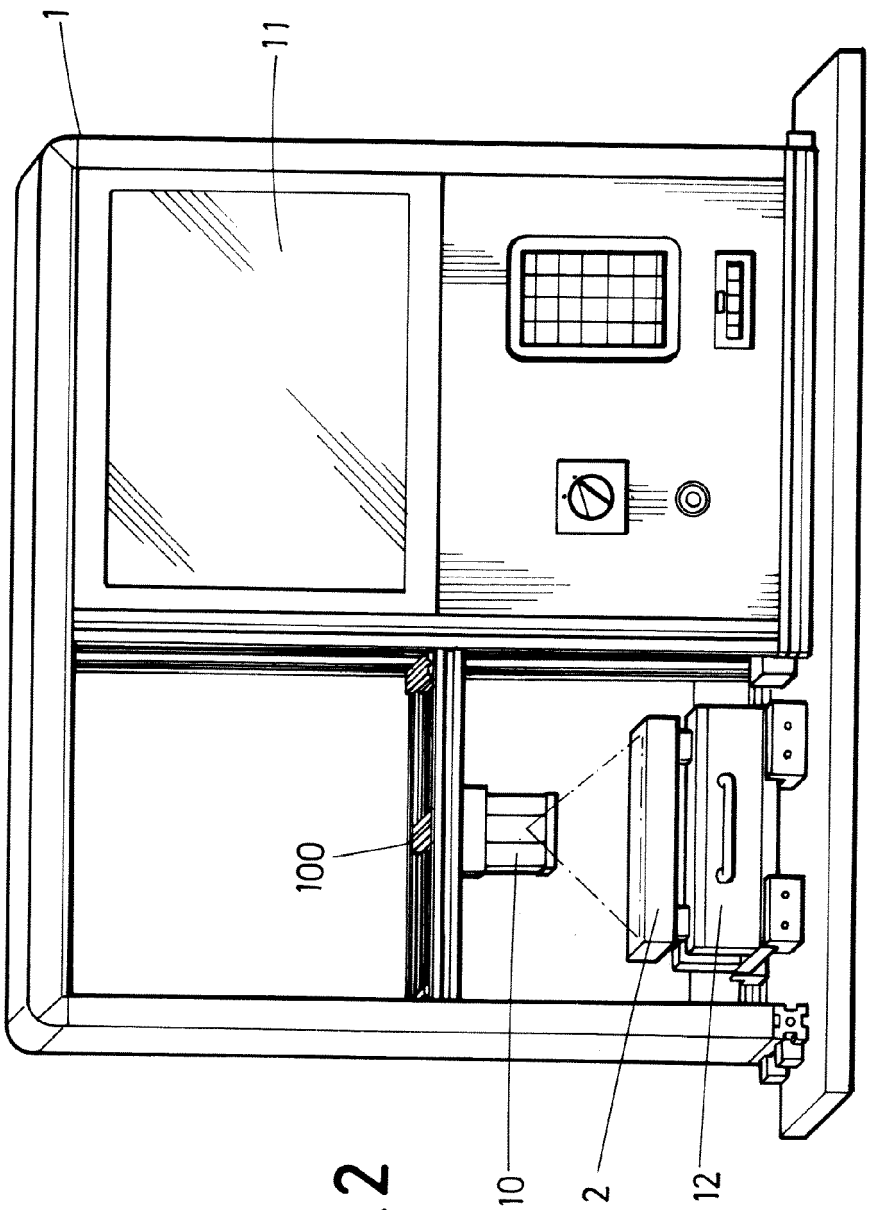

FIG.2

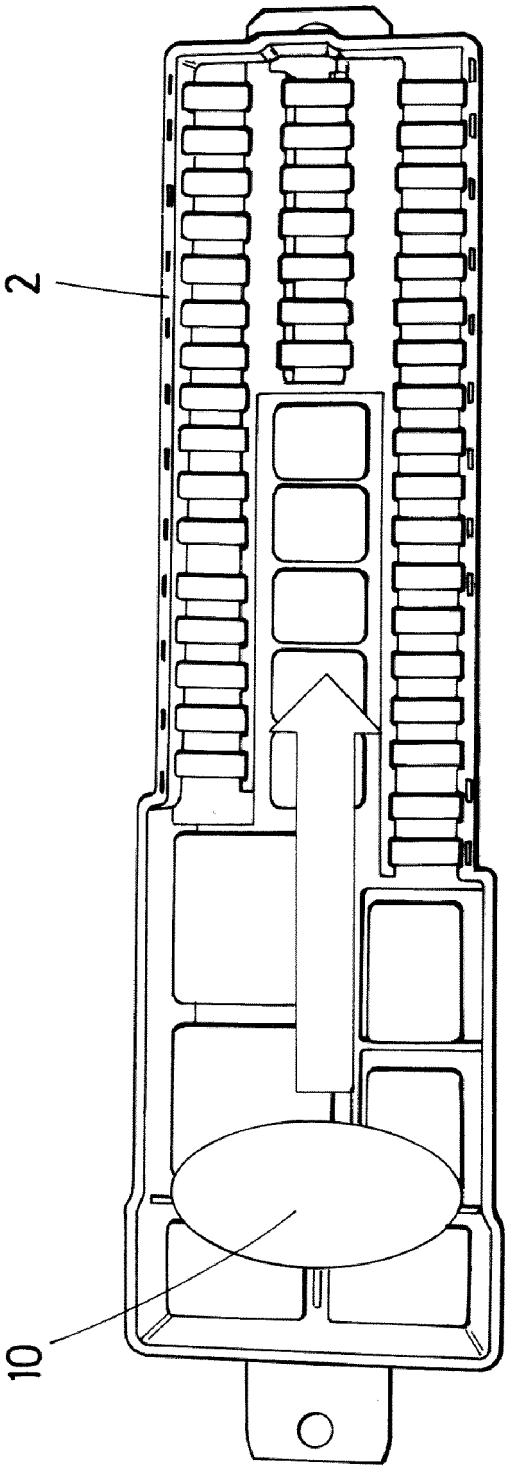

FIG.3

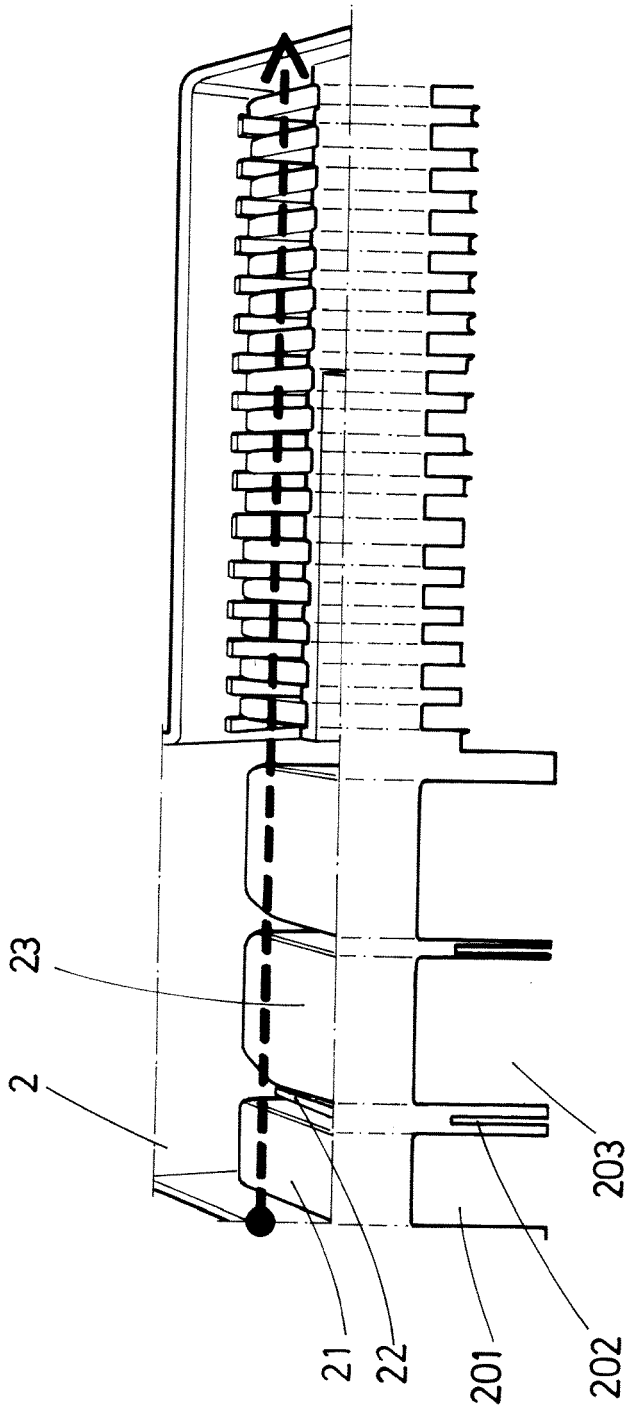

FIG. 4

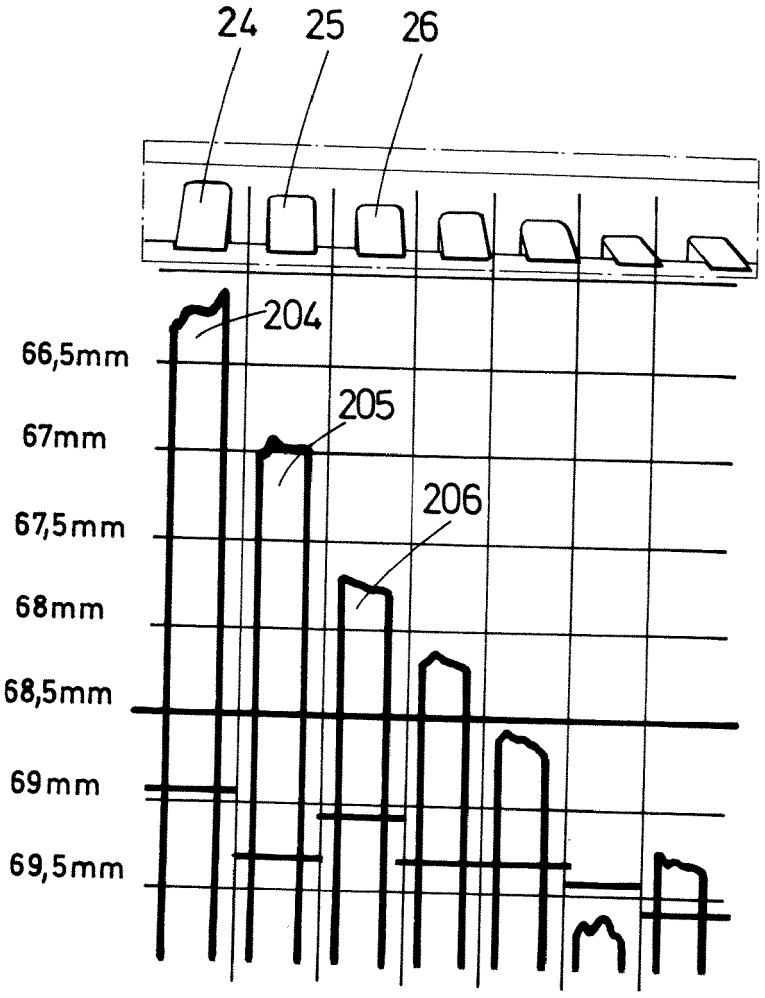

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 15 15 9187

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 6 577 757 B1 (DEYONG MARK R [US] ET AL) 10 June 2003 (2003-06-10) * column 6, line 64 - column 7, line 34 * * column 15, line 64 - column 16, line 7 * * column 17, line 46 - column 18, line 3 * * figure 1 *	1-17	INV. H05K13/08 G06T7/00 G01R31/309
Y	US 5 408 537 A (MAJOR KEVIN M [US]) 18 April 1995 (1995-04-18) * column 2, line 27 - line 49 * * page 1 * * claim 1 *	1-17	
Y	US 2007/047797 A1 (VILELLA JOSEPH L [US]) 1 March 2007 (2007-03-01) * paragraph [0039] - paragraph [0055] *	1-17	
Y	US 4 814 627 A (LEVKO FRED [US] ET AL) 21 March 1989 (1989-03-21) * column 2, line 52 - line 62 * * figure 1 *	1-17	TECHNICAL FIELDS SEARCHED (IPC)
Y	EP 1 863 331 A1 (EMDEP 3 S L [ES]) 5 December 2007 (2007-12-05) * claim 1 * * figure 1 *	1-17	H05K G06T G01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 August 2015	Fribert, Jan

CATEGORY OF CITED DOCUMENTS

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