(19) Europäisches Patentamt
European Patent Office
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(11) **EP 2 940 709 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.11.2015 Bulletin 2015/45

(51) Int Cl.:
H01H 85/02 *(2006.01)* ***H05K 13/04*** *(2006.01)*

(21) Application number: **15159241.7**

(22) Date of filing: **16.03.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **28.04.2014 ES 201430625**

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(54) **Device and procedure for the insertion of elements into fuse boxes**

(57) The present invention reveals a device and a procedure for the insertion of elements (20) enabling the automatic insertion of elements into fuse boxes (2) in such a way that a connection is produced. Said device is comprised of:

• a tray designed to receive fuse boxes (2);
• an actuator (1) comprising displacement means along at least two coordinate axes;
• an actuator controller;
• at least one tool, linked to the actuator (1) by detachable linking means;

In addition, said actuator (1) features a means of measurement of the force exerted by the actuator (1) on at least one of the coordinates, which enables verification of the correct execution of the insertion process.

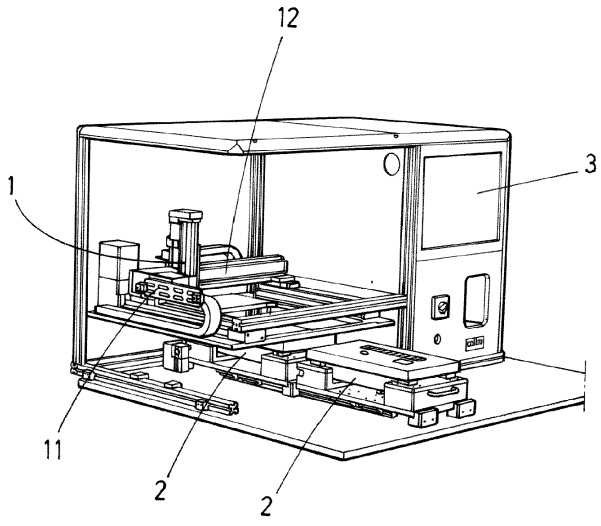

FIG.1

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Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a device for the insertion of elements arranged within a fuse box. Specifically, the aim of the present invention is the insertion of the various elements which form part of fuse boxes, in the automotive sector in particular.

BACKGROUND OF THE INVENTION

[0002] In existing devices, the insertion of the fuses into the boxes may be performed automatically or manually, but in either case, errors may arise in the insertion of the components which would affect the correct functioning of the same. Generally, the electrical components of a fuse box are comprised of at least one pair of metal tabs which are inserted into the corresponding electrified slots, in such a way that said connection acts as a mechanical attachment of the component to the box while also enabling electrical continuity for the correct operation of the electronic/electrical component (fuses, relays, among others). The correct functioning of the fuse box, for example in the electrical system of a vehicle, depends on the correct insertion of said components.

[0003] When inserting the components, errors may arise, such as the component not being totally inserted; or the component being inserted sidewards; that the metal tabs of the component have not been inserted between the metal tracks within the slot, but laterally through one of them; that the components have not been inserted in their correct position; or that the components are not the correct items for that position.

[0004] The devices of the prior art feature pneumatic modules whose function it is to press the elements arranged within fuse boxes; these devices lack precision and it is not possible to monitor the force exerted by the same; it is thus difficult to determine whether a fault has arisen during the insertion of an element into the fuse box.

DESCRIPTION OF THE INVENTION

[0005] In order to solve the drawbacks posed by the devices of the prior art, the present invention reveals a device for the insertion of elements into fuse boxes, incorporating the advantage of having diagnostic capability on the insertion of the elements.

[0006] Specifically, the present invention reveals a device for the insertion of elements into fuse boxes which is comprised of:

- a tray designed to receive fuse boxes;
- an actuator comprising displacement means along at least two coordinate axes;
- an actuator controller;
- at least one tool, attached to the actuator by detachable linking means;

where the actuator comprises a means of measurement of the force exerted by the actuator on at least one of the coordinates.

[0007] Preferably, the displacement means comprises at least one electric motor. Said electric motor may be one electric motor for each of the coordinates.

[0008] In the event of featuring said electric motors, the measurement of the force exerted by the actuator may be performed by means of a sensor reading the energy required to actuate the motor. Specifically, the sensor may be a current sensor.

[0009] An example of a preferred embodiment of the present invention comprises an element for the calibration of the measuring means of the force exerted by the actuator. Said calibration element may be a force transducer such as, for example, a load cell.

[0010] As a supplement to this calibration, a calibration may also be performed of the position of the actuator, by using a position calibration element that may be, for example, limit switches for the coordinates corresponding to the plane parallel to the plane of the fuse box (that is, the X and Y coordinates of a cartesian axis), and the remaining coordinate (that is, the Z coordinate of a cartesian axis) may be measured by means of a limit switch or any other means of presence detection.

[0011] Preferably, the actuator position calibration element and the calibration element of the means of measurement of the force exerted by the actuator are arranged substantially in the same location.

[0012] Furthermore, the device of the present invention features more than one tool for the manipulation of the fuses. Said tool shall feature different dimensions depending on the fuse or element to be fixed in the box.

[0013] On the other hand, for the attachment of the tools to the actuator element, the device may comprise at least one tool attachment element.

[0014] In a particular embodiment of the present invention, the detachable linking means between the tool and the actuator is a pneumatic and/or electromechanical means.

[0015] More preferably, the actuator controller comprises a database wherein is stored, at least, a value representing the maximum force to be exerted on at least one of the elements to be inserted into the fuse box. In this actuator controller database the following values may be stored, among other: values representing the minimum force to be exerted on at least one of the elements to be inserted into the fuse box; values representing the coordinate at which at least one of the elements to be inserted into the fuse box is to be found, etc. These values may be preset values or user-configurable values for each of the fuse boxes.

[0016] Likewise, the present invention also reveals a procedure for the insertion of elements into a fuse box by means of a device which features:

- a tray designed to receive fuse boxes;
- an actuator comprising displacement means along

at least two coordinate axes;

- an actuator controller;
- at least one tool, linked to the actuator by detachable linking means;
- a calibrator;

wherein the actuator comprises a means of measurement of the force exerted by the actuator on at least one of the coordinates, characterised in that it comprises the following stages:

a) attachment of at least one of the tools to the actuator;
b) calibration of the position of the tool, by bringing the tool into contact with the calibrator;
c) moving the actuator to a location above the element to be inserted;
d) displacement of the actuator in such a way that it presses the element, and simultaneously to the displacement, performing measurements of the force and position of the actuator.

[0017] Preferably, at stage c) the actuator moves towards a point on a plane which is substantially parallel to the plane of the box.

[0018] More preferably, stage d) is executed by moving the actuator in a substantially normal direction with regard to the plane defined by the fuse box.

[0019] In a particular embodiment, stage b) is executed by moving the actuator to a measuring coordinate featuring at least one position sensor. Furthermore, stage b) may be executed by moving the actuator to a calibration coordinate featuring at least one force sensor; said force sensor and at least one of the position sensors may be arranged substantially at the same coordinate or may form part of one single calibrator.

[0020] Preferably, said force measurement is executed by measuring the electrical energy consumed by the motor in order to move the actuator.

[0021] In order to supplement the analysis, it may be verified that each of the elements arranged within the fuse box is correct by means of an artificial vision system comprised of a camera and digital image processing means.

DESCRIPTION OF THE DRAWINGS

[0022] The above characteristics and advantages of the invention, as well as others, may be highlighted more clearly by the detailed description below of the preferred embodiments, included as illustrative and non-limitative examples, and referring to the attached drawings.

Figure 1 portrays a perspective view of a device according to the present invention.
Figure 2 portrays a perspective view of an example of the actuator of the device in Figure 1.
Figure 3 portrays the insertion procedure by means of an actuator of a device according to the present invention.
Figure 4 portrays a detailed view of an example of the device according to the present invention.
Figure 5 portrays an enlarged view of the actuator of the device in Figure 4, and an example of a tool attachment means.

PREFERRED EMBODIMENT OF THE INVENTION

[0023] Figure 1 shows a preferred embodiment of a device according to the present invention, in which the device comprises a surface on which the fuse boxes (2), into which a series of components are to be inserted, are arranged.

[0024] In order to execute said insertion, the device consists of an actuator (1) comprising a means of displacement in at least three coordinates; namely, a means of displacement along the X-axis (11), a means of displacement along the Y-axis (12) and a means of displacement along the Z-axis, it being understood that both the X- and Y-axes are the axes of the coordinates of a plane substantially parallel to the plane of the fuse box (2), and that the Z-axis is an axis which is substantially perpendicular to the plane defined by said fuse box (2). In other words, the actuator features capability of movement to any point on a plane substantially parallel to the plane of the fuse box (movement capability on the X-Y plane) and features capability of movement in a substantially normal direction with regard to the plane defined by the fuse box (movement capability on the Z-axis).

[0025] Although in the present embodiment the actuator features capability of movement along three coordinate axes, in particular embodiments of the present invention the actuator may feature capability of movement along only two coordinate axes (e.g. X and Z).

[0026] Furthermore, Figure 1 shows that the device may feature a screen (3) for the observation of, for example, the status of the device, the operating parameters, its current position or images obtained by means of a video camera.

[0027] Figure 3 shows an actuator (1) of the type encompassed in the present invention. Said actuator (1), in addition to the means of displacement along the X- and Y-axes, comprises a tool (10) featuring capability of movement along an axis perpendicular to the plane of the fuse box (2) in such a way that it may insert elements into the latter. This capability of movement is executed by means of displacement along the Z-axis which may be comprised of, for example, an electric motor, a pneumatic actuator, among others.

[0028] Figure 4 shows a figure in which the actuator (1) is to be found in three different positions: a first position (100') where the actuator (1) is set at a point where the tool makes contact with the element (20) to be inserted into the slot (2) of the fuse box; a second position (100") where the actuator (1) displaces the tool along the Z-axis in order to insert the element (20) into the fuse box, and

a third position (100"') where the actuator (1) has completed insertion of the element (20) into the fuse box.

[0029] In said first position (100'), the actuator moves to a point on the X- and Y-coordinate axes (although in particular embodiments of the present invention it may be displaced solely along the X-axis, or solely along the Y-axis) where an element (20) to be inserted into the fuse box (2) is to be found. In particular embodiments of the present invention, the elements (20) to be inserted into the fuse box are pre-installed in a frame (22) arranged over the fuse box (2). Consequently, the action to be performed by the actuator is that of pressing the elements (20) through the frame (22) until at least one terminal (24) of the element (20) enters at least one of the connectors (21) of the fuse box (2).

[0030] In the second position (100") the actuator (1) commences exertion of pressure on the element (20) by means of the tool (10) until the terminal (24) of the element (20) makes contact with the connector (21) of the fuse box (2). In order to perform this action on the element (20), the actuator (1) (or the tool (10)) features a means of displacement along the Z-axis. In turn, these displacement means may feature force and position sensors to enable determination of the distance travelled along this axis and the force exerted by the actuator (1) in order to perform this displacement. These force and displacement data enable determination of whether the terminal (24) has made contact with the connector (21), whether a fault has arisen (for example, if contact has not been made with the connector (21) or if the exertion of excessive force has been necessary, which would imply that damage may be caused to the terminal (24) or the fuse box), or if the device is functioning in accordance with the pre-established parameters.

[0031] Finally, in the third position (100"') the actuator (1) presses (by means of the tool (10)) the element (20) until the terminal (24) becomes connected with the connector (21) of the fuse box (2). While the actuator (1) is moving between the second position (100") and the third position (100"'), the force exerted and the distance travelled is measured continuously in real time, in order to detect possible faults. This measurement is performed, for example, by means of a force transducer.

[0032] In particular embodiments of the present invention, the actuator (1) and particularly the tool (10) may feature a clamp in order that the elements (20) may not only be pressed but may also be held by said tool (10) in such a way that not only may pre-installed elements (10) be inserted, but they may also be collected by the clamp and then connected in a particular position in the fuse box (2).

[0033] Figures 4 and 5 show a preferred spatial configuration of an insertion device in accordance with the present invention. In particular, it reveals an arrangement in which the device is comprised of a means of displacement along the X-axis (11), a means of displacement along the Y-axis (12), a tray on which a fuse box (2) is arranged and three different tools for the insertion of the elements into said fuse box (2).

[0034] In particular, Figures 4 and 5 depict how the actuator (1) features a tool (10) attached to the same for the insertion of the elements into said fuse box. Additionally, the device features a second tool (13), of a smaller volume than that of tool (10), attached to the actuator (1), and a third tool (14) of a still greater volume. Therefore, the second tool (13) would be used for the insertion of elements larger than those inserted by tool (10) attached to the actuator (1), but smaller than those inserted by the third tool (14).

[0035] Furthermore, the embodiment in Figure 4 features a means for the automatic changeover of tools. To this end, the actuator (1) features detachable linking means between each of the tools (10, 13, 14) and the actuator (1). These detachable linking means may be electrical, pneumatic or hydraulic means, or any detachable linking means known in the state of the art.

[0036] In order to perform this automatic tool changeover, the device must feature data storage means, in order to store the position of each of the tools and tool holders (15) to enable the actuator to remove the tools without the intervention of an operative being necessary.

[0037] In an embodiment of the present invention, said tool holders (15) are clips which transversally grip the tools. This enables the actuator (1) to insert said tools in the clips and to withdraw them from the same with ease.

[0038] Furthermore, it may be observed in Figure 5 that the device features a calibrator (16), which is of particular usefulness when the actuator changes tools.

[0039] Specifically, when changing tools it is possible that a change in the total dimension of the actuator (that is, of the actuator-tool combination) may arise, due to the fact that the tools may present different mechanical wear, or simply may be of different initial lengths. This may pose a problem regarding the measurement of the displacements and in particular, the position of the actuator with regard to the Z-axis.

[0040] In order to solve this problem, the present invention envisages the provision of a calibrator (16) at a fixed position with regard to the X-axis and the Y-axis. This position serves as a reference position for the device.

[0041] Furthermore, this calibrator may be equipped with different sensors such as, for example, a load cell which, in addition to calibrating the position, may enable calibration of the force exerted by the actuator.

Claims

1. Device for the insertion of elements (20) into fuse boxes (2), comprising:

   - a tray designed to receive fuse boxes (2);
   - an actuator (1) comprising displacement means along at least two coordinate axes;
   - an actuator controller;

• at least one tool, linked to the actuator (1) by detachable linking means;

characterised in that the actuator (1) features a means of measurement of the force exerted by the actuator (1) on at least one of the coordinates.

2. Device, according to claim 1, **characterised in that** the displacement means comprises at least one electric motor.

3. device, according to claim 2, **characterised in that** the displacement means comprises one electric motor for each of the coordinates.

4. Device, according to claim 2, **characterised in that** the means of measurement of the force exerted by the actuator (1) is comprised of a sensor of the energy required to move the motor.

5. Device, according to claim 1, **characterised in that** it comprises a calibrator (16) of the means of measurement of the force exerted by the actuator (1).

6. Device, according to claim 5, **characterised in that** the calibrator (16) of the means of measurement of the force exerted by the actuator (1) is a force transducer.

7. Device, according to claim 6, **characterised in that** said calibrator (16) of the means of measurement of the force exerted by the actuator (1) is a load cell.

8. Device, according to claim 1, **characterised in that** it comprises a calibrator (16) of the position of the actuator.

9. Device, according to claims 5 and 8, **characterised in that** the calibrator (16) of the position of the actuator (1) and the calibrator of the means of measurement of the force exerted by the actuator (1) are arranged substantially in the same location.

10. Device, according to claim 1, **characterised in that** it comprises more than one tool.

11. Device, according to claim 10, **characterised in that** it features at least one tool holder (15).

12. Device, according to claim 1, **characterised in that** the detachable linking means between the tool and the actuator (1) are pneumatic means.

13. Device, according to claim 1, **characterised in that** the detachable linking means between the tool and the actuator (1) are electromechanical means.

14. Device, according to claim 1, **characterised in that** the actuator controller is comprised of a database containing, at least, the maximum force to be exerted on at least one of the elements (20) to be inserted into the fuse box (2).

15. Device, according to claim 14, **characterised in that** the actuator controller database contains a value representing the minimum force to be exerted on at least one of the elements (20) to be inserted into the fuse box (2).

16. Device, according to claim 14, **characterised in that** the actuator controller database contains a value representing the coordinate at which at least one of the elements (20) to be inserted into the fuse box (2) is to be found.

17. Device, according to claim 1, **characterised in that** the tool is comprised of a clamp.

18. Procedure for the insertion of elements (20) into a fuse box (2) by means of a device which comprises:

• a tray designed to receive fuse boxes;
• an actuator (1) comprising displacement means along at least two coordinate axes;
• an actuator controller;
• at least one tool, linked to the actuator (1) by detachable linking means;
• a calibrator (16);

where the actuator comprises a means of measurement of the force exerted by the actuator on at least one of the coordinates, **characterised in that** it comprises the following stages:

a) attachment of at least one of the tools to the actuator (1);
b) calibration of the position of the tool, by bringing the tool into contact with the calibrator (16);
c) moving the actuator (1) to a location above the element to be inserted;
d) displacement of the actuator (1) in such a way that it presses the element (20) and, simultaneously, performing measurements of the force and position of the actuator (1).

19. Procedure, according to claim 18, **characterised in that** at stage c) the actuator (1) moves towards a point on a plane which is substantially parallel to the plane of the fuse box (2).

20. Procedure, according to claim 19, **characterised in that** stage d) is executed by moving the actuator (1) in a substantially normal direction with regard to the plane defined by the fuse box (2).

21. Procedure, according to claim 18, **characterised in**

that stage b) is executed by moving the actuator (1) to a calibration coordinate comprising at least one position sensor.

22. Procedure, according to claim 18, **characterised in that** stage b) is executed by moving the actuator (1) to a calibration coordinate comprising at least one force sensor.

23. Procedure, according to claims 21 and 22, **characterised in that** the force sensor and at least one of the position sensors are arranged substantially at the same coordinate.

24. Procedure, according to claim 18, **characterised in that** the measurement of the force is executed by measuring the electrical energy consumed by the motor in order to move the actuator (1).

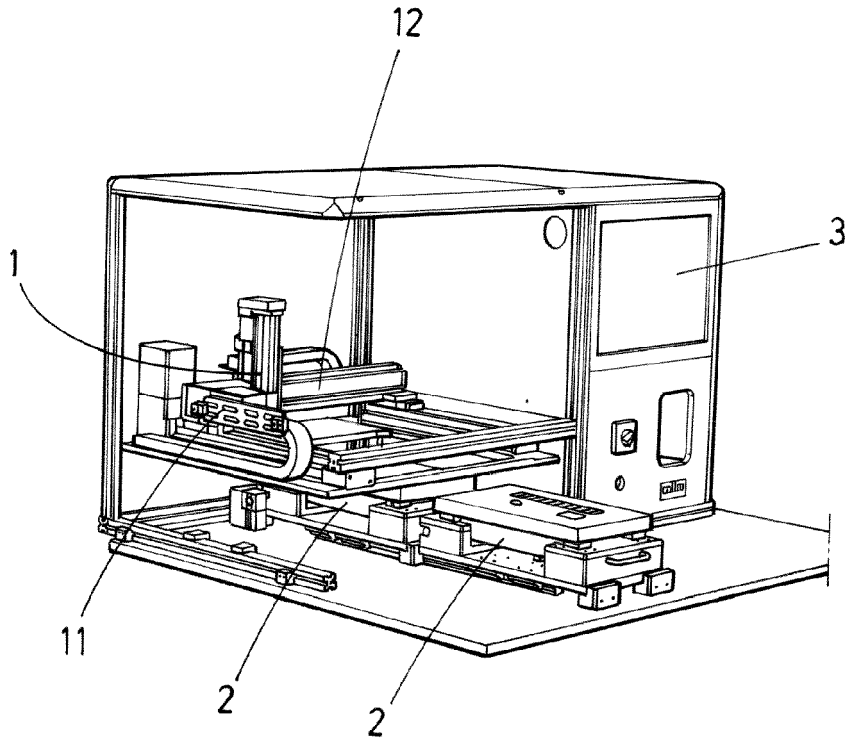

FIG.1

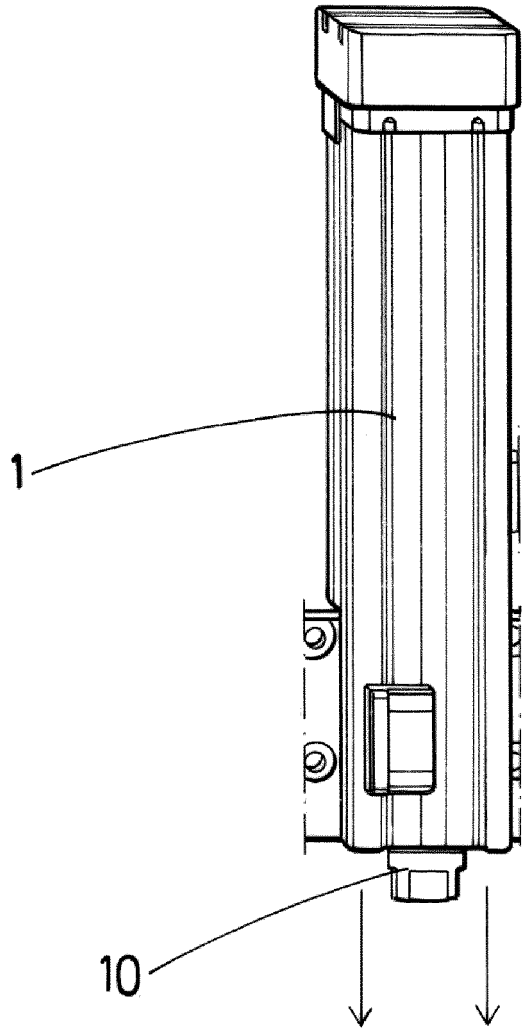

FIG. 2

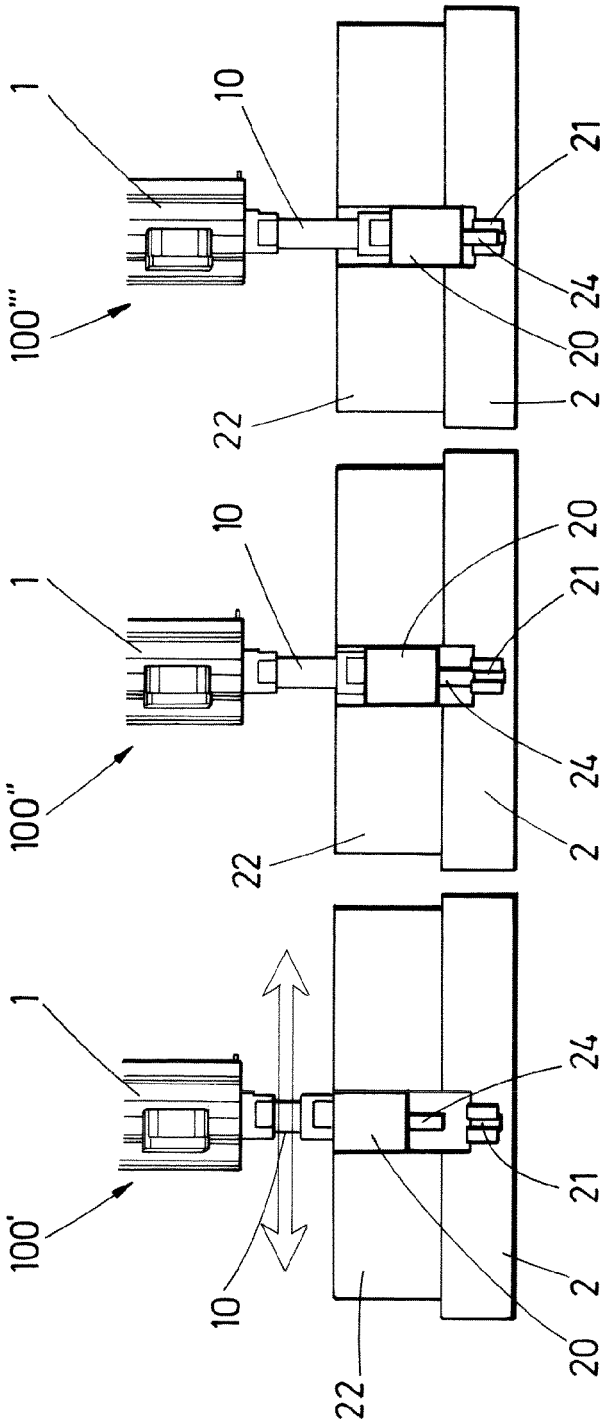

FIG.3

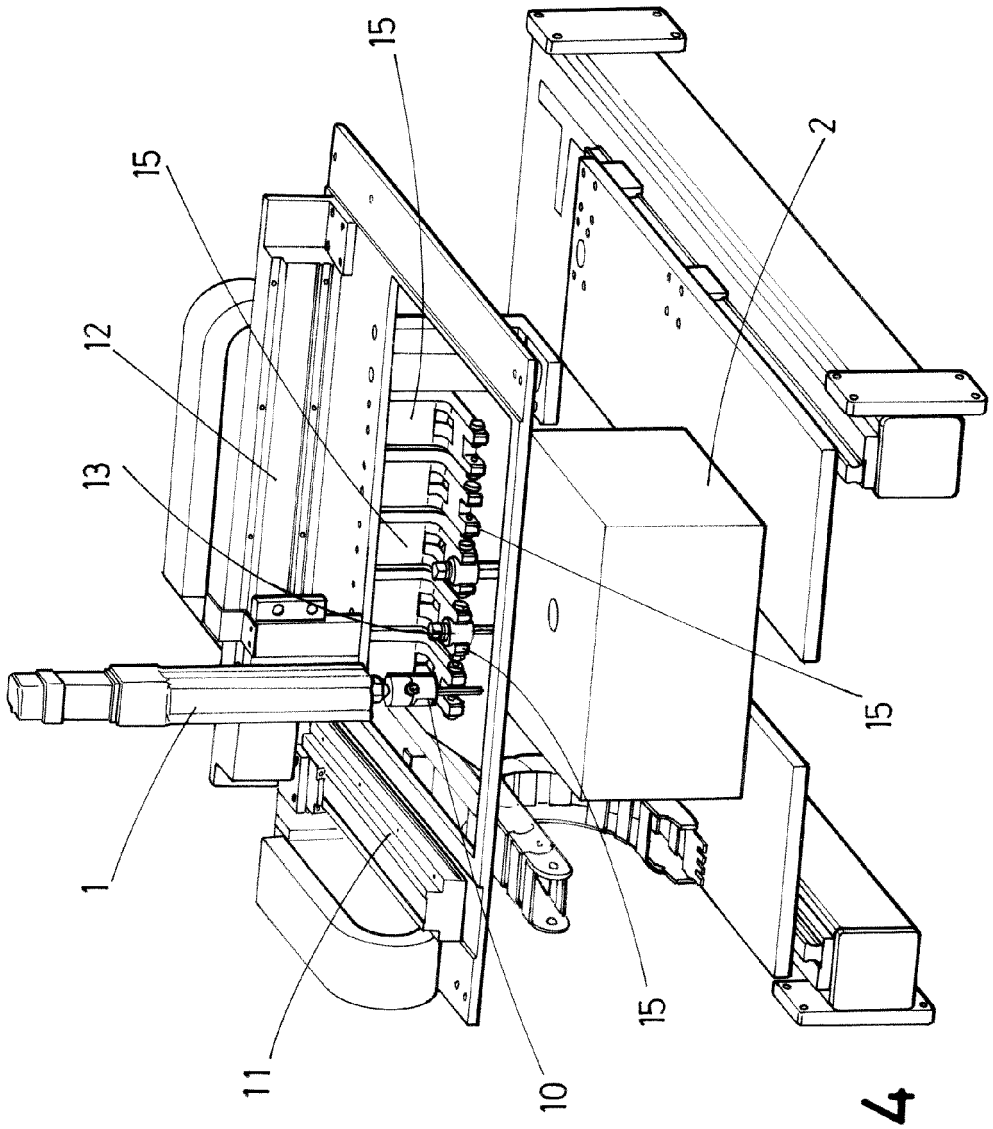

FIG.4

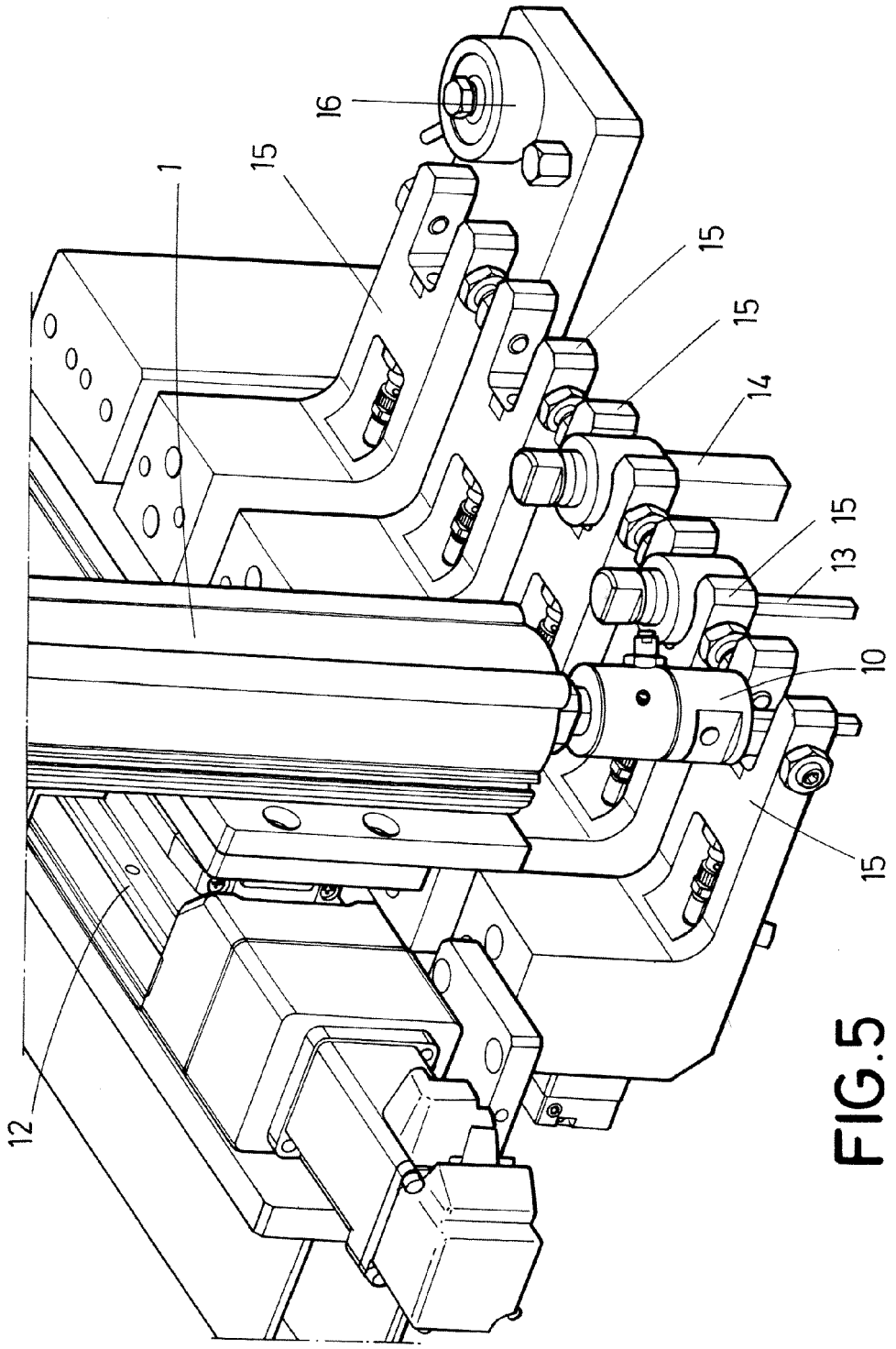

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 15 15 9241

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)
H01H
H05K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 August 2015	Bilard, Stéphane

CATEGORY OF CITED DOCUMENTS

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