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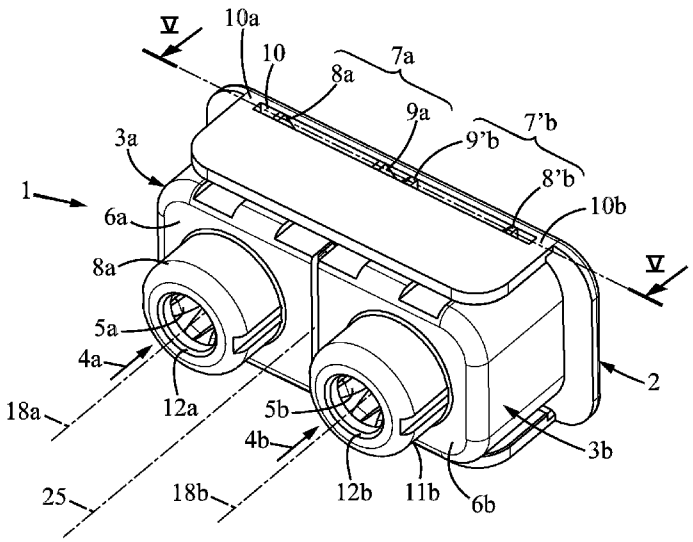


FIG. 1

(57) **Abstract**: Electrical connection device (1) for vehicle electrical equipment, comprising a first and a second connection portions(4a,4b). Each of said connection portions is adapted to be electrically connected with a corresponding electrical device. At least one of said connection portions is disconnectable from the corresponding electrical device. The electrical connecting device further comprises at least one electrical link electrically connecting the first and the second portion together and a guiding body (2) guiding the second connection portion (4b) along a course of the second connection portion which respect to the first connection portion(4a). The electrical link electrically connects the first and the second portion together all along said course.

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ELECTRICAL CONNECTION DEVICE

FIELD OF THE INVENTION

The present invention relates to an electrical connection device. The electrical connection device can be applied in vehicle electrical equipment, in particular for battery modules. The invention also relates to a battery comprising battery modules electrically interconnected by said electrical connection devices and to a manufacturing method of said electrical connection devices.

STATE OF THE ART

Traditionally, electrical terminals of adjacent battery modules were electrically connected by a conductive metallic rigid bar having two holes adapted to receive these terminals. The bar is electrically connected to the terminal by the pression of a screw mechanism. A draw-back of such a connection device is that the electrical connection depends on the distance between the two terminals to be connected. This may lead to have a precise location and alignment of the different modules of the battery.

SUMMARY OF THE INVENTION

The invention provides an electrical connection device which can be implemented for instance in electrical equipment, such as a battery. The invention further relates to a manufacturing method for such electrical connection device which remedy to at least one of the above draw-backs.

A goal of the invention is to provide an electrical connection less dependent on the relative position of the equipment terminals to be connected.

According to one aspect, the invention covers an electrical connecting device, comprising a first and a second connection portions, each of said connection portions being adapted to be electrically connected with a corresponding electrical device, at least one of said connection portions being disconnectable from the corresponding electrical device. The electrical connecting device further comprises at least one electrical link electrically connecting the first and the second portion together.

According to an embodiment of the invention, the electrical connecting device comprises a guiding body guiding the second connection portion along a course of the second connection portion which respect to the first connection portion. The electrical link electrically connects the first and the second portion together all along said course.

Thanks to the guiding body, a relative course between the first and the second connection portion is provided and limited. The electrical link avoids power cut during movement of the second connection portion with respect to the first connection portion. Therefore, the relative position of the first and the second connection portions may be tuned in order to correspond to the distance between the terminals to be connected.

The electrical device corresponding to each of the first and the second connection portion may be a terminal of two adjacent battery modules.

In some other embodiments, one might also use one or

more of the features as defined in dependant claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the invention will readily appear from the following description of some of its embodiments, provided as a non-limitative example, and of the accompanying drawings. On the drawings:

- Figure 1 is a perspective view of an embodiment of the electrical connection device.
- Figure 2 is a perspective view of a movable sub-assembly of the device of figure 1.
- Figure 3 is a partial cut view of an electrical link of the device of figure 1 following the plane III-III of figures 4 or 5.
- Figure 4 is a longitudinal cut view of the electrical link of the device figure 1 following the arrow IV of figure 3.
- Figure 5 is a side view of the electrical connection device following the plane V-V of figure 1.
- Figure 6 is a perspective view of a second embodiment of electrical connection device.
- Figure 7 is a longitudinal cut view of the electrical link of the second embodiment following plane VII-VII of figure 6.
- Figure 8 is an embodiment of a battery.

DETAILED DESCRIPTION

As illustrated in figure 1, the electrical connection device 1 comprises a guiding body 2, a first sub-assembly 3a and a second sub-assembly 3b. The first sub-assembly 3a comprises a connection portion 4a of a

female type including a plurality of spring tongues 5a extending around an axis 18a. The electrical connection device 1 further comprises a first body 6a receiving the spring tongues 5a and provided with a guiding member 7a consisting of two tenons 8a, 9a sliding in a guiding slot 10 of the guiding body 2. The first body 6a comprises a cylindrical skirt 11a surrounding the spring tongues 5a and including a guiding annular chamfer 12a located axially beyond the spring tongues 5a for guiding the introduction of a male device (not shown) into the connection portion 4a following the connection axis 18a.

The second sub-assembly 3b comprises a second body 6b provided with a guiding member 7'b consisting of two tenons 8'b, 9'b sliding in the same guiding slot 10 than the guiding member 7a of the first body 6a. The second body 6b comprises a cylindrical skirt 11b surrounding spring tongues 5b and including an annular chamfer 12b located axially beyond the spring tongues 5b for guiding the introduction of a male device not shown into a connection portion 4b following a connection axis 18b.

As illustrated in figure 2, the sub-assembly 3a comprises a first electrical conductive member 13a made of a punched and rolled metallic sheet. The conductive member 13a has a global U-shape with a bottom 14a, a right side 15a and a left side 16a. The connection portion 5a is made of a punched and rolled metallic sheet. The spring tongues 5a extend axially from a C-shaped ring 17a which is press-fitted into the bottom 14a of the conductive member 13a.

The first sub-assembly 3a further comprises two right tongues 19a extending from the right side 15a and

two left tongues 20a extending from the left side 16a. Each of the left and right tongues 19a, 20a extend in a plane perpendicular to the connection axis 18a and substantially in a direction parallel to a plane of symmetry III-III passing by both connection axis 18a, 18b. More details about these tongues will be given later in reference to the figures 3 and 4.

The two right tongues 19a are shifted from the two left tongues 20a with respect to the direction of the connection axis 18a. The two right tongues 19a alternate with right free spaces 21a which are slightly wider than the width of the left tongues 20a. The two left tongues 20a also alternate with some left free spaces 22a which are slightly wider than the right tongues 19a.

As illustrated in figures 2 and 5, the first body 6a further comprises another guiding member 7'a made of two tenons 8'a, 9'a, symmetrical from the tenons 8a, 9a with respect to the plane of symmetry III-III.

The guiding body 2 comprises two stops 10a,10b located at each ends of the slot 10, and two stops 10'a, 10'b located at each ends of the symmetrical slot 10'. The largest distance between the two sub-assemblies 3a,3b, as well as the largest distance between the connection portions 4a,4b, corresponds to a configuration of the electrical connection device 1, in which at least one of the guiding members 7a, 7'a of the first body 6a is in contact with one of the stops 10a, 10'a, and simultaneously, at least one of the guiding members 7b,7'b of the second body 6b is in contact with one of the stops 10b,10'b.

The shortest distance between the two sub-assemblies 3a,3b, as well as the shortest distance

between the connection portions 4a,4b correspond to a configuration of the electrical connection device 1 in which the first and the second body 6a,6b are in contact to one another. Therefore, the course of the second connection portion 4b with respect with the first connection portion 4a is equal to the largest distance less the shortest distance in between both connection portions 4a,4b.

In the particular case of the embodiment illustrated in figures 1 to 5, the second sub-assembly 3b is strictly identical to the first sub-assembly 3a previously described and is located symmetrically to an axis 25 of symmetry which is exactly in the middle of the two parallel connection axis 18a, 18b. The second sub-assembly 3b includes the same features 4b to 9b and 11b to 22b named with the adjective "second". These second features are, each of them, identical to the corresponding first feature 4a-9a, 11a-22a previously described for the first sub-assembly 3a.

As illustrated in figure 4, the right tongues 19a of the first sub-assembly 3a enter into the left free spaces 22b, slide along the left side 16b of the second electrical conductive member 13b and provide an electrical connection between both electrical conductive member 13a, 13b and both connection portions 4a, 4b.

Similarly, the left tongues 20a of the first sub-assembly 3a enter into the right free spaces 21b and slide along the right side 15b of the second electrical conductive member 13b and therefore, provide an electrical connection between both connection portions 4a, 4b. The right tongues 19b of the second sub-assembly 3b enter into the left free spaces 22a, slide

along the left side 16a of the first electrical conductive member 13a and therefore provide an electrical connection between both connection portions 4a, 4b. The left tongues 20b of the second sub-assembly 3b enter into the right free spaces 21a, slide along the right side 15a of the first electrical conductive member 13a and therefore, provide again an electrical connection between both connection portions 4a, 4b.

In other words, the electrical connection device 1 comprises an electrical link between both connection portions 4a, 4b. Such electrical link consists in two electrically conductive members 13a, 13b, each of them holding and being electrically connected with one of the two connection portions 4a, 4b.

At least, one electrically conductive member 13a holds and is electrically connected with a spring tongue. Said spring tongue slides along a receiving portion of the other electrically conductive member 13b and is electrically connected with said other electrically conductive member 13b all along a course of displacement of one of the connection portions 4a, 4b with respect to the other.

The spring tongue 19a and/or 20a may form one electrically conductive piece part together with the conductive member 13a, like in the illustrated embodiment. However, in a variant, the spring tongue 19a, 20a may be a piece part different from the conductive member 13a.

The spring tongues 19a,20a are resiliently urged on the receiving portion 16b,15b through the free space 22b,21b of the corresponding part, so that a suitable friction retains the two portions 4a,4b together within

the whole above-mentioned course. This course is as high as one centimetre, so as to adapt to the relative locations of the two axes 18a,18b. This course is limited by the stops 10a,10b,10'a,10'b contacting the respective guiding member 7a, 7'a or 7b,7'b and by the contact between the two bodies 4a,4b.

An electrical link between two electrical devices to be connected can cross an electrical field within the conductive material of the link all along an electrical path between the two electrical devices. The electrical cross section of the electrical link is by definition perpendicular to said electrical field.

The electrical cross-section of the electrical link is designed to be larger than a reference electrical cross-section all along the electrical path between the two connection portions 4a, 4b.

In the particular case of the first embodiment, such the electrical cross-section is provided as hereafter. The connection portions 4a, 4b are adapted to receive a male contact which has a geometrical cross-section. Said geometrical cross-section is considered as the reference cross-section for the electrical link. The number of spring tongues 5a,5b and the shape of their extremity are such that the total area, corresponding to the sum of the contact areas of the spring tongues 5a, 5b on said male contact (not shown) is larger or equal to the reference cross-section. The press-fit area between the ring 17a, 17b and the bottom 14a, 14b is designed so as to have a conductive area larger than the reference cross-section. The extremity of each right or left spring tongues 19a, 19b,20a,20b is designed so as the total area corresponding to the sum of all contact areas between

said spring tongues and their respective receiving portion 15a,15b,16a,16b, is larger or equal to the reference cross-section. The total area equal to the addition of the geometrical cross-section of each spring tongues 19a, 19b, 20a, 20b is also larger than the reference cross-section. Therefore, such an electrical link does not introduce a point of linear electrical resistance higher than the linear resistance of the electrical device to be connected.

The electrical connection device 1 is therefore suitable for transmitting high intensity of electric current of several hundreds of Amperes as it may be needed in a battery of vehicles. The electrical connection device 1 does not introduce "hot spots" within the electrical transmission.

As illustrated in figure 5, the guiding members 7a, 7b,7'a,7'b of the bodies 6a, 6b are each made of a pair of tenons 8a-9a, 8b-9b, 8'a-9'a, 8'b-9'b. Each of these tenons is located at the extremity of a flexible arm and includes a chamfer so as the first body 6a can be introduced within the guiding body 2 following the arrow F1, and so as, the second body 6b can be introduced within the guiding body 2 following the arrow F2.

The second embodiment 40 illustrated in figures 6 and 7 is very similar to the first embodiment 1 previously described. There are only two differences, everything else being identical. The first difference is that the second embodiment 40 comprises two connection portions 30a, 30b which are male contacts. Preferably, the male contacts 30a,30b have a smooth extremity, for example of an ogival type, adapted to enter a female connector. The male contact 30a, 30b may have an enlarged

base 32a,32b so that the previously described electrical conductive member 13a,13b can receive either the female connection portion 4a,4b of the first embodiment 1 or the male contact 30a,30b of the second embodiment 40. The second difference is that the electrical connection device 40 comprises a first and a second bodies 33a,33b which differ from the bodies 6a,6b previously described only by the fact that there is no skirt 11a and that the male contact 30a,30b is press fitted into it.

One can understand that the invention covers a large combination of different bodies, electrically conductive members, connection portions, or electrical links.

In another embodiment of electrical connection device, the two sub-assemblies 3a, 3b may be different. For example, only the first and the second electrical conductive member 13a, 13b and the lateral spring tongues 19a-20a, 19b-20b are identical and symmetrically positioned with respect to the axis of symmetry 25. However, the type of the first end second connection portion 4a,4b may be different. The first and the second bodies 6a,6b are adapted to the corresponding type of the connection portions 4a,4b as described in the first or the second embodiments 1,40.

In a variant, the type of each of the connection portion can be chosen independently in a list comprising for example: a male contact, a female contact, a through hole. Additionally, one of the connection portions 4a or 4b may be a non disconnectable connection like a crimped or a wrapped flexible electrical wire.

In a variant, there is no first body 6a and the first electrical conductive member 13a directly slides into the guiding body 2.

In a variant, the guiding body 2 may comprise an electrically conductive material which may contribute to the electrical link between both connection portions.

In a variant, there is no first body 6a and the guiding body 2 directly holds the first connection portion 4a. In other words, the guiding body 2 and the first electrical conductive member 13a form the same piece part which has both functions of being part of the electrical link and of mechanically guiding the second connection portion 4b all along a course. Such piece part may include stops for limiting the course.

In another variant, the electrical link may comprise a spring tongue directly sliding along one or along the two connection portions. A holding mechanism may hold each of the two connection portions without electrical connecting said connection portion, and allows a relative movement between the two connection portions. Said spring tongue may extend directly from one connection portion or may be held by the holding mechanism.

In another variant, the second electrical conductive member 13b, holding and electrically connecting the second connecting portion 4b or 30b is a telescopic member with respect to the guiding body 2 which may be or may include the first electrical conductive member 13a which holds and is electrically connected with the first connection portion, or forms a simple piece part with the first connection portion 4a or 30a.

In reference to figure 8, the battery 50 comprises a series of battery modules 52 arranged side by side. Each battery module 52 comprises a positive and a negative terminals 51. The battery 50 further comprises a series of electrical connection devices as previously described,

assembled between one positive terminal of a module and one negative terminal of an adjacent module. Therefore, different battery modules are electrically interconnected in series. Thanks to the relative course between the two connection portion 4a,4b, or 30a,30b, the connection between the battery module terminals 51 is made easier as it does not request a precise alignment of two adjacent modules 52. Moreover, this is achieved in a packed environment (modules are very close to one another).

CLAIMS

1. Electrical connection device (1,40), comprising a first and a second connection portions (4a-4b, 30a-30b), each of said connection portions being adapted to be electrically connected with a corresponding electrical device, at least one of said connection portions being disconnectable from the corresponding electrical device, the electrical connecting device further comprising at least one electrical link (13a-19a-13b) electrically connecting the first and the second portion together, **characterized in that** it further comprises a guiding body (2,13a) guiding the second connection portion (4b,30b) along a course of the second connection portion which respect to the first connection portion (4a,30a), **and in that** the electrical link (13a-19a-13b) electrically connects the first and the second connection portions together all along said course.

2. Electrical connection device (1,40) according to claim 1, wherein the first connection portion (4a,30a) is movable with respect to the guiding body (2) and is guided by the guiding body.

3. Electrical connection device (1,40) according to the claim 1 or 2, wherein the guiding body (2) is configured such that movement of the second connection portion (4b, 30b) with respect to the first connection portion (4a, 30a) is a translation, preferably along a translation axis passing through both connection portions.

4. Electrical connection device (1,40) according to claim 3, wherein the translation axis is normal to a connection axis of at least one, preferably both said connection portions.

5. Electrical connection device according to the claim 1 or 2, wherein the guiding body is configured such that movement of the second connection portion with respect to the first connection portion is a rotation with respect to a rotation axis remote from both connection portions (4a,4b).

6. Electrical connection device (1,40) according to any of the preceding claims, wherein the electrical link (13a-19a-13b) comprises a first electrically conductive member (13a) holding the first connection portion (4a,30a) and a second electrically conductive member (13b) holding the second connection portion (4b,30b).

7. Electrical connection device (1,40) according to the claim 6, wherein the electrical link (13a-19a-13b) comprises a spring tongue (19a) extending from one (13a) of the first and the second electrically conductive members and sliding along a receiving portion (16b) of the other (13b) of the first and the second electrically conductive members.

8. Electrical connection device (1, 40) according to any of the claims 6 and 7, wherein the first (13a) and second (13b) electrically conductive members are identical to one another and symmetrically arranged with

respect to an axis of symmetry (25).

9. Electrical connection device (1,40) according to any of the claims 6 to 8, wherein at least one of the first and second electrically conductive members (13a, 13b) is made of a punched and rolled metal sheet.

10. Electrical connection device according to claim 1, wherein the first connection portion (4a) is in a fixed position with respect to the guiding body (2).

11. Electrical connection device (1,40) according to any of the claims 6 to 10, comprising a first body (6a,33a) receiving the first electrically conductive member (13a) and a second body (6b,33b) receiving the second electrically conductive member (13b).

12. Electrical connection device (1,40) according the claim 11, wherein at least one of the first and second bodies (6a,6b,33a,33b) is made of an insulating material.

13. Electrical connection device (1,40) according any of the claims 11 and 12, wherein each of the first and second bodies (6a,6b,33a,33b) comprises a guiding member (7a,7'a,7b,7'b) cooperating with the guiding body.

14. Electrical connection device (1,40) according to any of the claims 11 to 13, wherein the first (6a,33a) and second (6b,33b) bodies are identical and symmetrically arranged with respect to an axis of symmetry (25).

15. Electrical connection device (1) according to any of the claims 11 to 14, wherein at least one of the first and second bodies (6a,6b) surrounds at least partially the corresponding connection portion (4a,4b) and/or is adapted to mechanically guide the electrical connection between the corresponding connection portion (4a,4b) and the corresponding electrically conductive member.

16. Electrical connection device (1,40) according to any of the claims 13 to 15, wherein the guiding member of at least one of the first and second bodies comprises a feature chosen in the group of: a longitudinal slot, a longitudinal nerve, one or several retractable tenon (8a,8'a,9a,9'a).

17. Electrical connection device (1) according to any of the preceding claims, wherein at least one of the connection portions (4a,4b) is a female contact including at least one conductive spring tongue (5a,5b).

18. Electrical connection device (40) according to any of the preceding claims, wherein at least one of the connection portions is a male contact (30a,30b) including an extremity adapted to smoothly slide into a female contact.

19. Electrical connection device (40) according to any of claims 1-18, wherein the guiding body (2) comprises a stop (10a,10b,10'c,10'b) adapted to define a maximal course of the second portion with respect to the first portion.

20. Battery (50) comprising a first and a second battery module (52) including each at least one electrical terminal (51), the battery further comprising an electrical connection device (1,40) according to any of the preceding claims, wherein the first connection portions is connected with one of said at least one electrical terminal of the first battery module and the second connection portion is connected with one of said at least one electrical terminal of the second battery module.

21. Method for manufacturing an electrical connection device comprising the steps of:

- assembling a first connection portion (4a,33a) to a guiding body (2),
- assembling a second connection portion (4b,33b) to said guiding body (2),
- electrically connecting said first and second portions together,

characterised in that said electrically connecting step and said second connection portion (4b) assembling step are such that the second portion is still movable with respect to the guiding body (2).

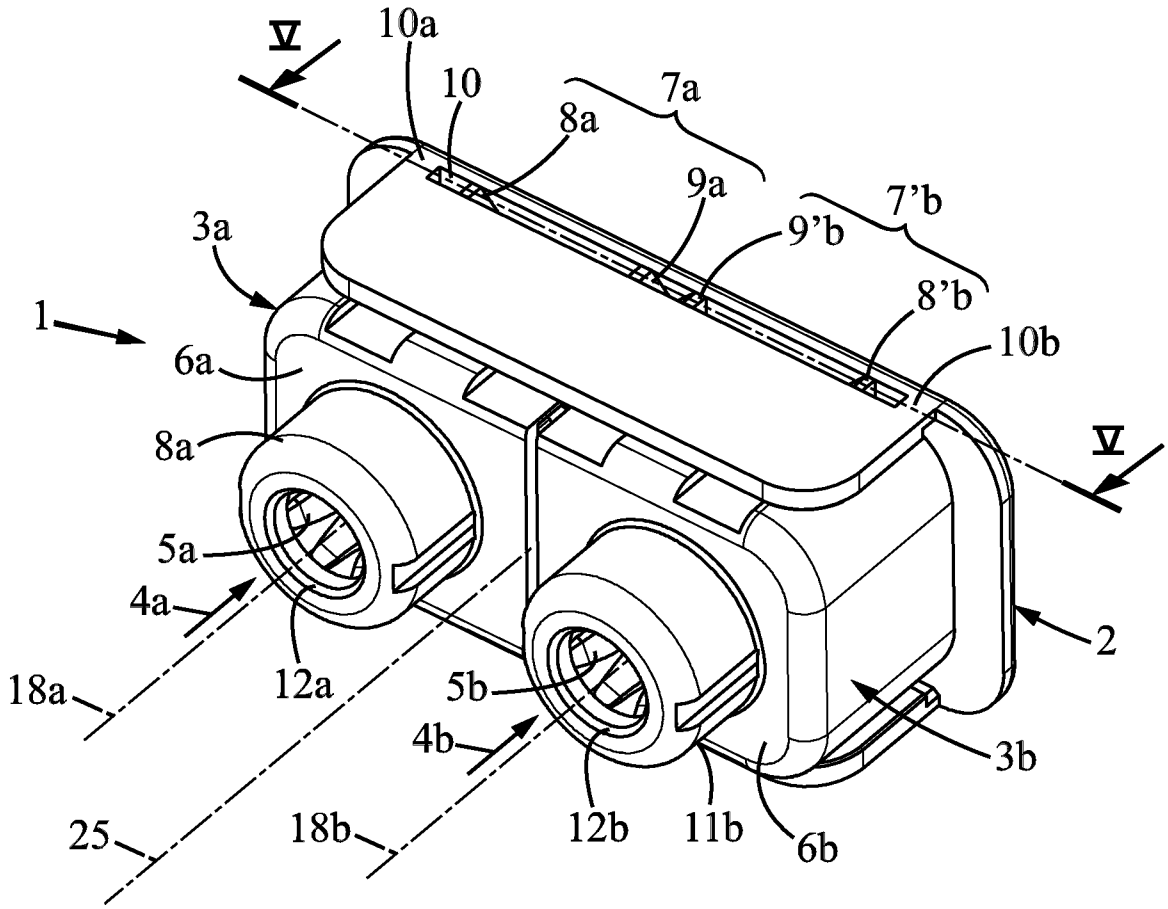

V
10a
10
7a
8a
9a
7'b
9'b
3a
8'b
1
10b
6a
V
8a
5a
4a
2
18a
12a
5b
4b
3b
25
18b
12b
11b
6b

FIG. 1

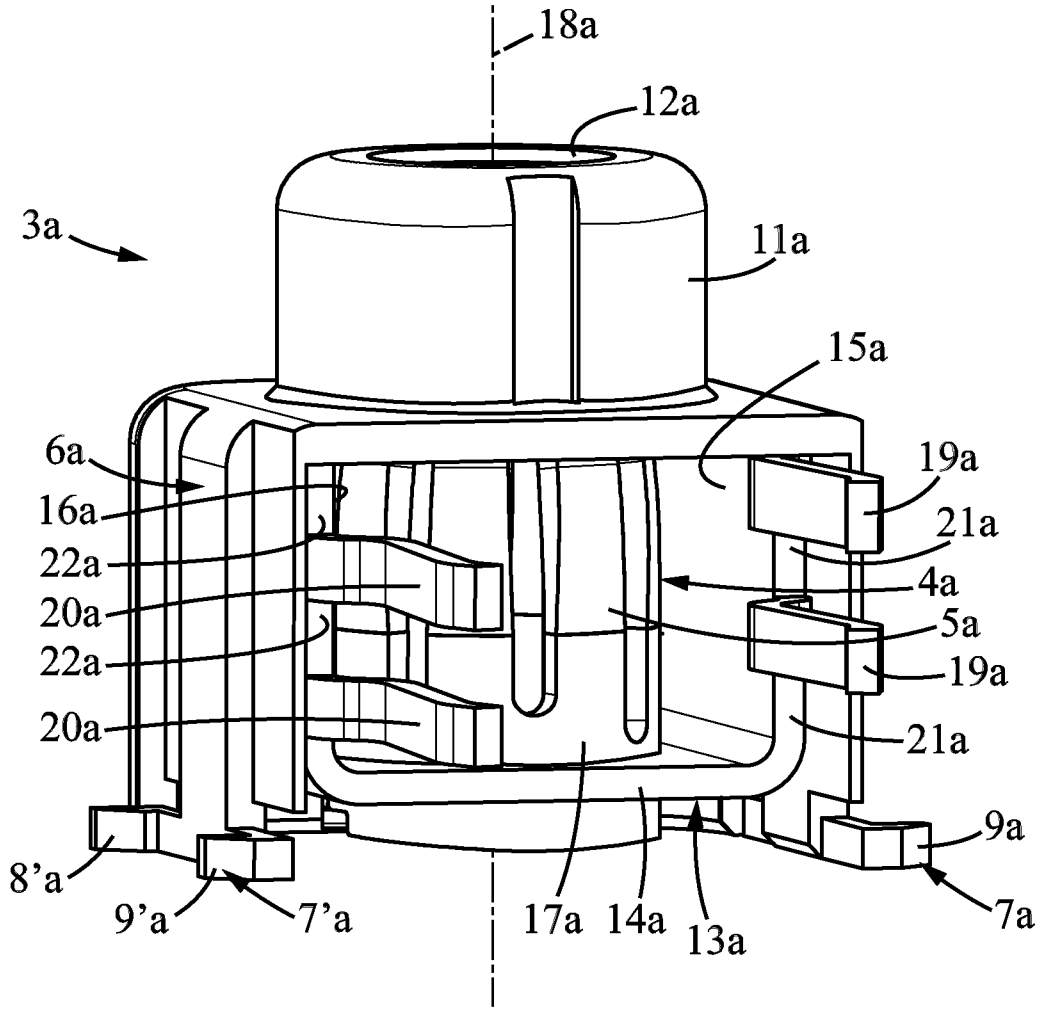

18a
12a
3a
11a
15a
6a
19a
16a
21a
22a
4a
20a
5a
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14a
13a
7a

FIG. 2

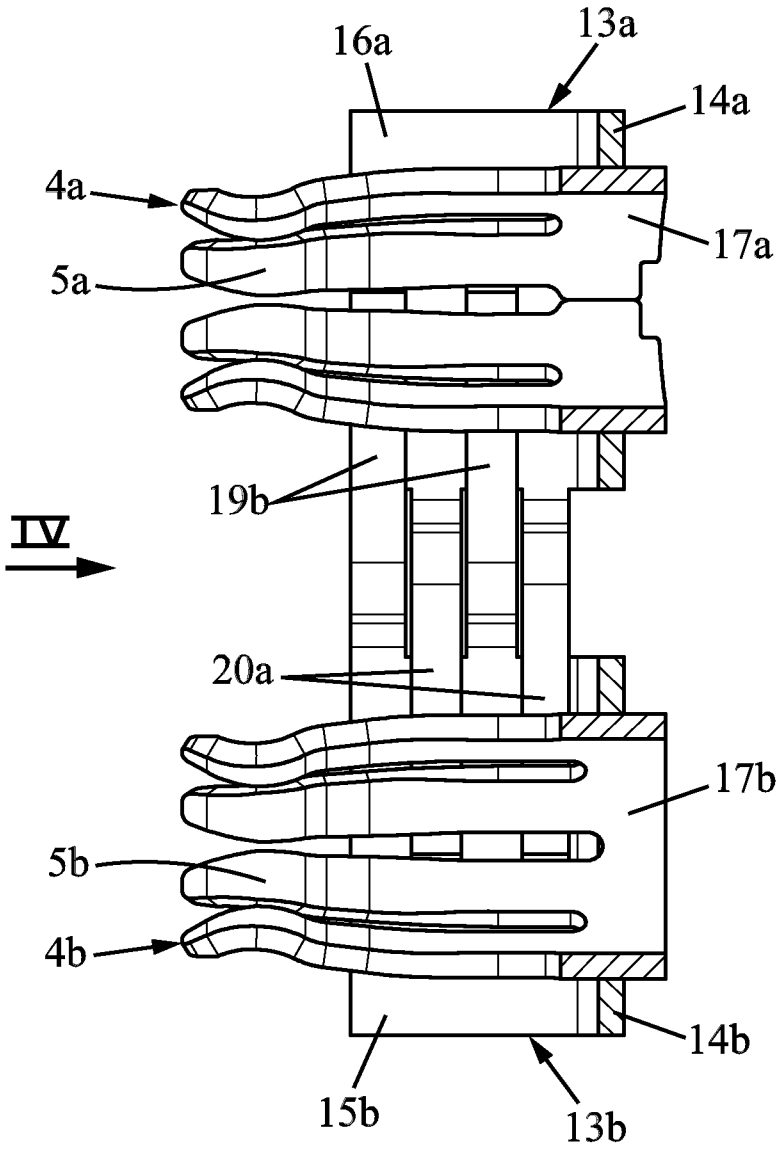


FIG. 3

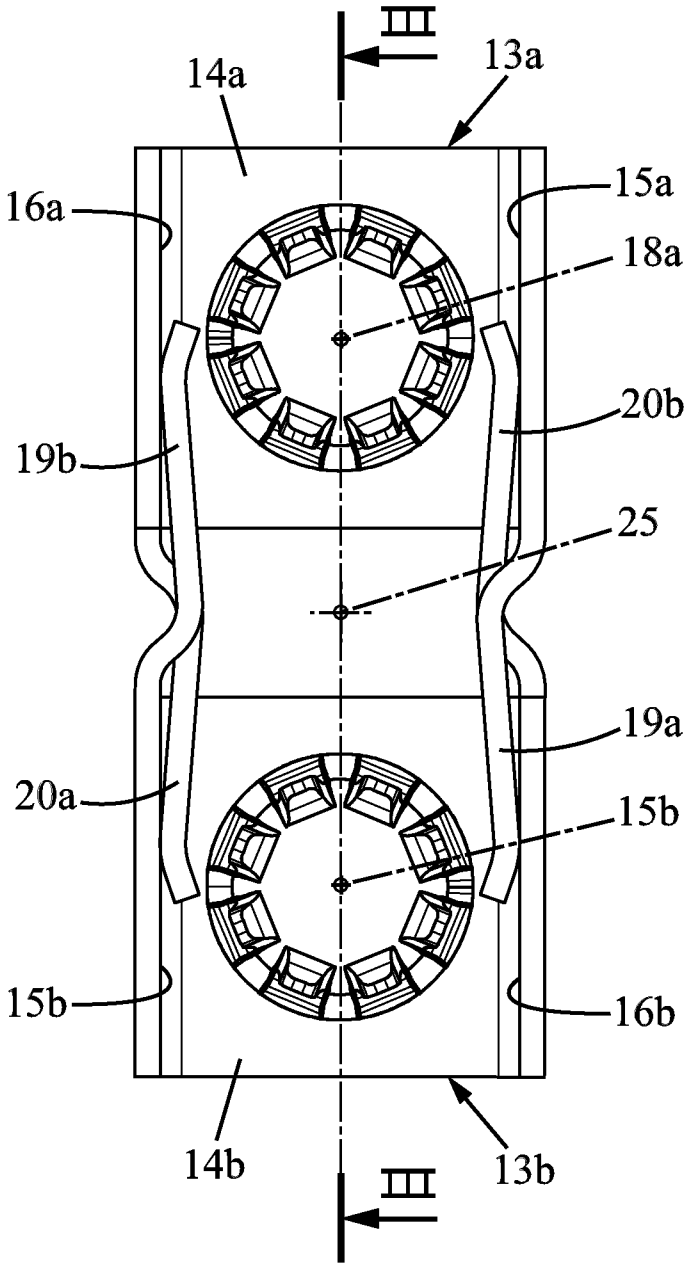

III
14a
13a
16a
15a
18a
20b
19b
25
19a
20a
15b
15b
16b
14b
13b
III

FIG. 4

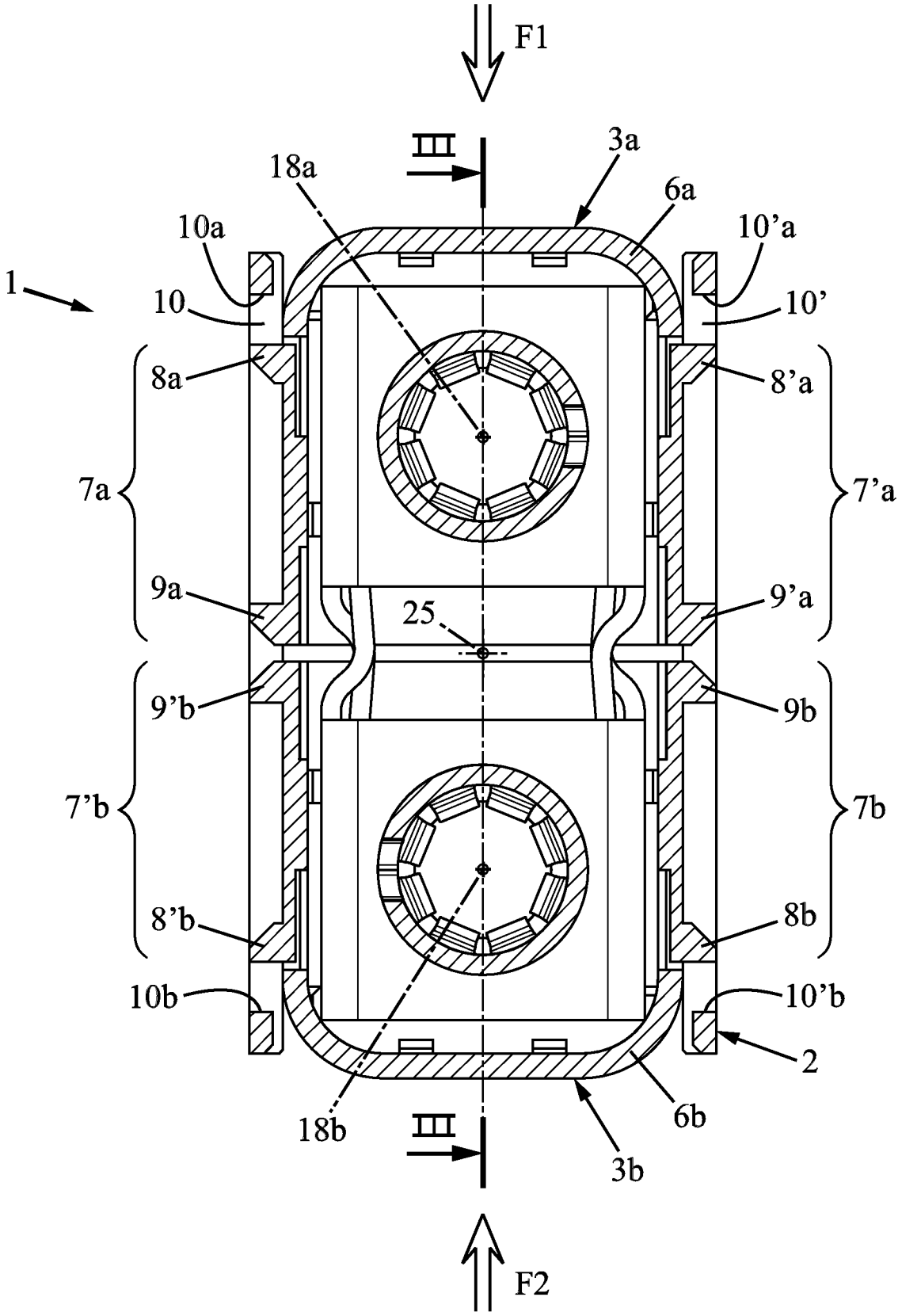

F1
III
3a
18a
6a
10a
10'a
1
10
10'
8a
8'a
7a
7'a
9a
9'a
25
9'b
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18b
6b
3b
III
F2

FIG. 5

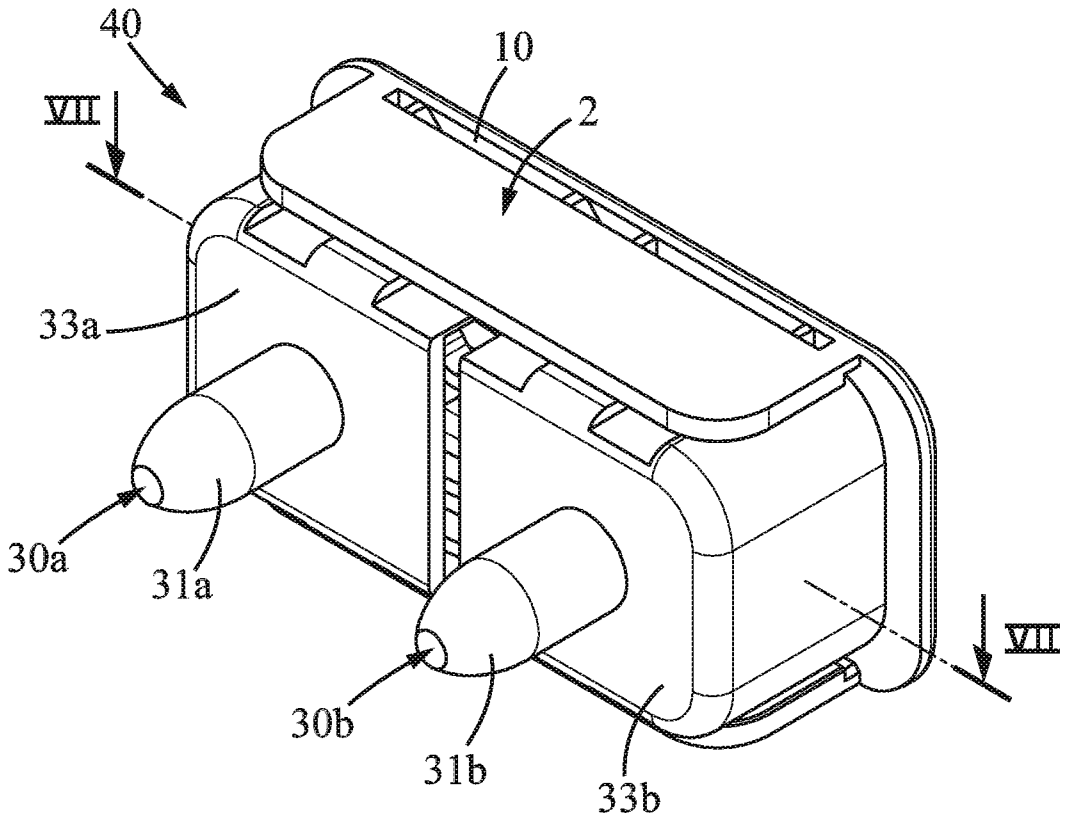


FIG. 6

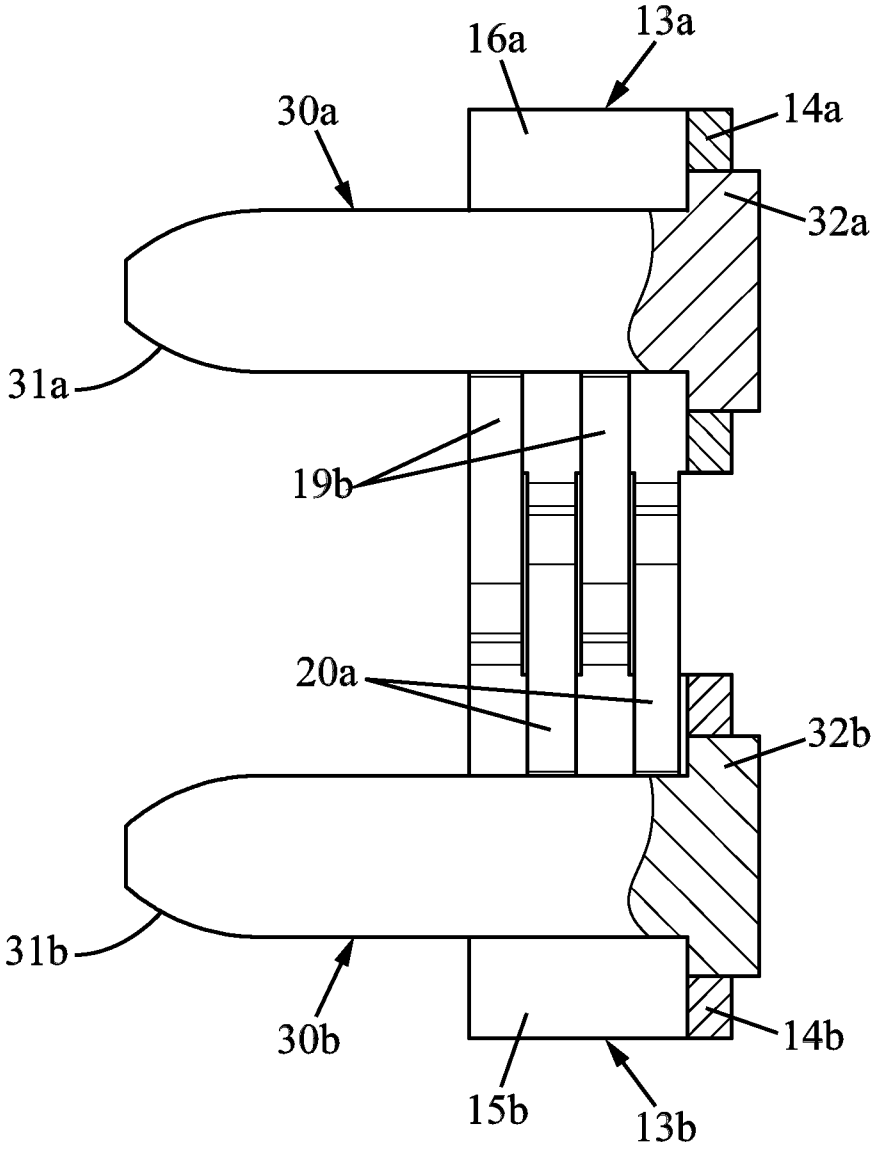


FIG. 7

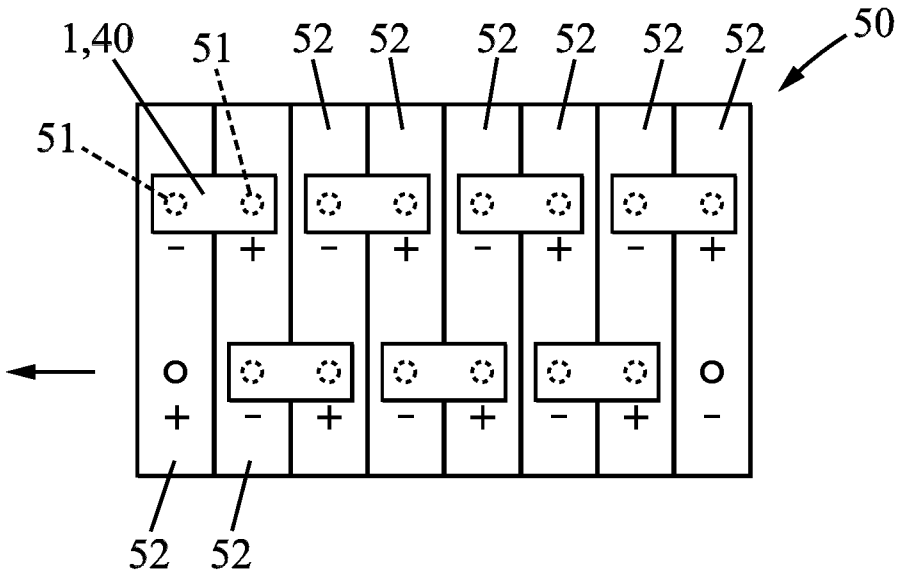


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/003195

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R13/631 H01R11/28
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)
H01R H01M

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 practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/270286 A1 (ZHAO WEIPING [US] ET AL) 30 November 2006 (2006-11-30) figures 3a-3c, 7a, 12-12b paragraphs [0049], [0056], [0077]	1-6,9, 10,17-21
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X	US 4 820 194 A (STINE JON D [US]) 11 April 1989 (1989-04-11) figures 1-2	1-3

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2012	25/04/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hugueny, Bertrand

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/003195

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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