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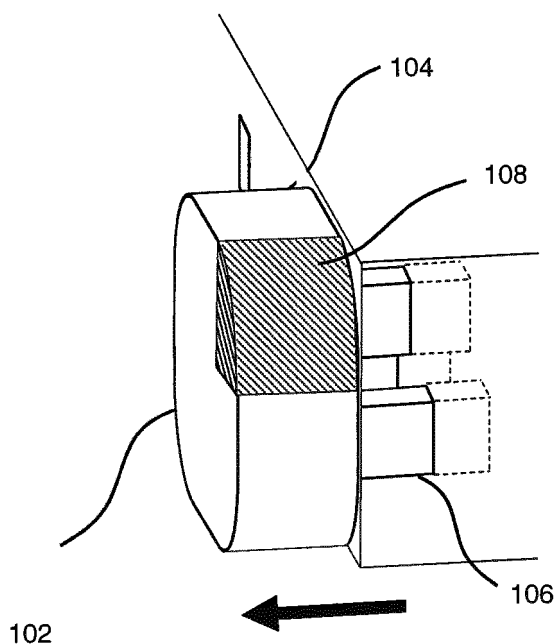
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(54) **ELECTRIC ARCING PROTECTION ARRANGEMENT AND METHOD**

(57) An electric arcing protection arrangement has a sensor (108) for monitoring the presence of electrical arcing between a plug (102) and a socket (104). The electric arcing protection arrangement also has a mechanism ar-

ranged to cause the pins (106) of the plug (102) to be withdrawn from the socket (104). When electric arcing between the plug (102) and the socket (104) is detected by the sensor (108), the mechanism is activated.



**Fig. 2A**

## Description

### Technical Field

**[0001]** The present disclosure relates to an electric arcing protection arrangement and method.

### Background

**[0002]** Electric arcing between a plug and a socket can cause serious damage to appliances and the electrical conductivity of the sockets. When electric arcing occurs, pins of plugs and metal contacts on the sockets can burn. As they become pitted and blackened, their electrical conductivity reduces, eventually even becoming highly resistive. This can, for example, cause the damaged pins and contacts to heat up, and will eventually fail or burn up. This leaves electrical appliances and outlets in an unsafe condition, even when the damage appears minimal.

### Summary

**[0003]** According to a first aspect disclosed herein, there is provided an electric arcing protection arrangement comprising:

a sensor for monitoring the presence of electrical arcing between a plug and a socket; and  
a mechanism arranged to cause the pins of the plug to be withdrawn from the socket upon detection of electric arcing between the plug and the socket by the sensor.

**[0004]** In an example, the arrangement comprises a plug, wherein the plug comprises:

the sensor for monitoring the presence of electrical arcing; and  
the mechanism arranged to cause the pins of the plug to be withdrawn from the socket.

**[0005]** In an example, the arrangement comprises a socket, wherein the socket comprises:

the sensor for monitoring the presence of electrical arcing; and  
the mechanism arranged to cause the pins of the plug to be withdrawn from the socket.

**[0006]** In an example, the sensor comprises a heat sensor arranged to monitor the temperature in a region of the connection of the plug and the socket, the electric arcing protection arrangement being such that if the temperature detected by the heat sensor is above a threshold value, the mechanism causes the pins of the plug to be withdrawn from the socket.

**[0007]** In an example, the sensor comprises a light sen-

sor arranged to monitor the light level in a region of the connection of the plug and the socket, the electric arcing protection arrangement being arranged such that if the light level detected by the light sensor is above a threshold value, the mechanism causes the pins of the plug to be withdrawn from the socket.

**[0008]** In an example, the sensor comprises a heat sensor and a light sensor, the sensor being arranged such that:

the heat sensor monitors the temperature in a region of the connection of the plug and the socket;  
the light sensor monitors the light level in a region of the connection of the plug and the socket; and  
if the temperature in the region of the connection of the plug and the socket detected by the heat sensor is above a threshold value and the light level in the region of the connection of the plug and the socket detected by the light sensor is above a threshold value, the mechanism causes the pins of the plug to be withdrawn from the socket.

**[0009]** In an example, the mechanism comprises at least one biasing arrangement to cause the pins of the plug to be withdrawn from the socket upon detection of electric arcing between the plug and the socket by the sensor.

**[0010]** In an example, the biasing arrangement comprises one or more springs arranged to push or pull the pins of the plug out of the socket.

**[0011]** According to a second aspect disclosed herein, there is provided an electric arcing protection method comprising:

monitoring the presence of electrical arcing between a plug and a socket; and  
actuating a mechanism to cause the pins of the plug to be withdrawn from the socket upon detection of electric arcing between the plug and the socket.

**[0012]** In an example, the detection of electric arcing between the plug and the socket by a sensor comprises monitoring the temperature in a region of the connection of the plug and the socket by a heat sensor; and  
the mechanism is actuated if the temperature detected by the heat sensor is above a threshold value.

**[0013]** In an example, the detection of electric arcing between the plug and the socket by a sensor comprises:

monitoring the light level in a region of the connection of the plug and the socket by a light sensor; and  
causing the pins of the plug to be withdrawn from the socket if a change in the light level detected by the light sensor is above a threshold value.

**[0014]** In an example, the detection of electric arcing between the plug and the socket by a sensor comprises:

monitoring the temperature in a region of the connection of the plug and the socket by a heat sensor; monitoring the light level in a region of the connection of the plug and the socket by a light sensor; and causing the pins of the plug to be withdrawn from the socket if a change in the temperature detected by the heat sensor is above a threshold value and a change in the light level detected by the light sensor is above a threshold value.

**[0015]** In an example, causing the pins of the plug to be withdrawn from the socket comprises activating at least one biasing arrangement to cause the pins of the plug to be withdrawn from the socket upon detection of electric arcing between the plug and the socket.

**[0016]** In an example, the electric arcing protection method is carried out by components in a plug.

**[0017]** In an example, the electric arcing protection method is carried out by components in a socket.

#### Brief Description of the Drawings

**[0018]** To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a plug and socket arrangement;

Figures 2A and 2B shows schematically the plug and socket arrangement of Figure 1, comprising an example mechanism for withdrawing the plug from the socket;

Figures 3A and 3B shows schematically the plug and socket arrangement of Figure 1, comprising another example mechanism for withdrawing the plug from the socket.

#### Detailed Description

**[0019]** As mentioned, electric arcing can damage electrical plugs and sockets, and even leave them in an unsafe condition due to failed and burnt out metal contacts.

**[0020]** According to examples disclosed herein, an electric arcing protection arrangement has a sensor for monitoring the presence of electrical arcing between a plug and a socket. When electric arcing is detected by the sensor, a mechanism causes the pins of the plug to be withdrawn from the socket.

**[0021]** Unwanted electric arcing can occur between plug pins and metal contacts of a socket. Electric arcing can cause pins and contacts to burn, becoming pitted and less conductive over time. With further use, the socket or appliances can become faulty. Electrical arcing can cause damage to devices, inlets/outlets, and even cause electrical shocks and fires. There is required an appara-

tus and method for protecting plugs and sockets from damage due to electric arcing.

**[0022]** Referring now to the drawings, Figure 1 shows a plug 102 connected to a socket 104. Pins 106 of the plug 102 are in contact with electrical contacts (not shown) within the socket holes 107. The plug 102 may, for example, be connected to a white goods machine, such as a refrigerator or a washing machine. Other examples of devices the plug 102 may be associated with include a television set or other electronic devices, a heater or a fan. The plug 102 and socket 104 shown in this figure are a British 3-pin plug 102 and socket 104. The plug 102 may have a different number of pins 106 and the socket 104 may have a corresponding different number of holes 107 for the pins 106 to enter. For example, the plug 102 and socket 104 may follow the European or the American 2-pin standards. The plug 102 may be directly associated with an electronic or device or apparatus or be an adapter or a plug for an extension lead (which may lead to one or more sockets for other plugs).

**[0023]** The plug 102 is shown as having a sensor 108. The sensor 108 is arranged to detect a change in the region of the plug 102 and socket 104 that indicates electric arcing is occurring between the pins 106 of the plug 102 and the electric contacts of the socket 104. The region of the plug 102 and the socket 104 may comprise for example at least one of the electrical contacts of the socket 104, the pins 106 of the plug 102, the housing 110 of the plug 102 or the cover 112 of the socket 104, depending on for example the change that is being detected and/or the detection technique used, as will be discussed further.

**[0024]** The sensor 108 may comprise for example a heat sensor 108, arranged to detect whether the temperature of the region of the plug 102 and socket 104 rises above a threshold value. In such a case, the region may be for example at least one of the pins 108, all or part of the plug housing 110, the socket holes 107 and all or part of the socket covering 112.

**[0025]** The rise in temperature may be due to arcing taking place and/or because of overheating of burnt out/faulty electrical contacts or pins 106. In this example, the heat sensor 108 is shown on or in the housing of the plug 102. Alternatively or additionally, the heat sensor 108 may be located inside the plug 102, on the socket 104 or inside the socket 104.

**[0026]** Alternatively, the sensor 108 may comprise a light sensor 108, arranged to detect whether the light level of the region of the plug 102 and socket 104 rises above a threshold value. In the example of a light sensor 108, the region of the plug 102 and socket 104 may for example be the space between the pins 106 of the plug 102 and the electrical contacts within the socket holes 107. Such a space may arise for example because of poor fitting of the pins 106 in the socket holes 107 or because for example the pins 106 have not been fully inserted into the socket holes 107.

**[0027]** When a spark occurs between the pins 106 and

the socket 104 due to electric arcing, the light sensor 108 detects the light level of the region as being above a threshold value. The light sensor 108 is shown as being located on or in the plug 102. The light sensor 108 may alternatively be on or in the socket 104. The light level in the region may increase because of a spark occurring between the pins 108 and the electrical contacts within the socket holes 107.

**[0028]** The sensor 108 may in one example be arranged to constantly monitor the region of the plug 102 and the socket 104, thereby enabling action to be taken to prevent electric arcing when factors such as the light level or temperature are determined as being above a threshold. In another example, the sensor 108 may be arranged to activate or trigger only when factors such as the light level or temperature of the region of the plug 102 and the socket 104 increase above a threshold value.

**[0029]** The plug 102 may comprise one sensor 108, for example a heat sensor 108 or a light sensor 108, and the socket 104 may comprise another (different) sensor 108, for example a light sensor 108 or a heat sensor 108 respectively.

**[0030]** As another alternative, both a heat sensor 108 and a light sensor 108 may be provided in the plug 102 or the socket 104. The heat sensor and the light sensor may be provided as separate items or as a unitary sensor.

**[0031]** In examples where both a heat sensor and a light sensor are provided (whether both in the plug 102 or the socket 104, or one in the plug 102 and the other in the socket 104), electric arcing is considered to be present if the detected temperature and light level are both above the respective temperature and light level threshold values.

**[0032]** When it is determined that arcing is taking place, a mechanism (not shown) is activated to cause the pins 106 to be withdrawn from the electrical contacts of the socket holes 107. In an example, the mechanism comprises a biasing arrangement for withdrawing the pins 106 from the socket 104. The biasing arrangement may for example be or include a spring system.

**[0033]** Referring to Figure 2A, in this example the plug 102 comprises a mechanism for pulling the pins 106 into the plug 102 when electric arcing is detected between the plug 102 at the socket 104. The plug 102 has a sensor 108 for detecting a change in the region of the plug 102 and the socket 104. The plug 102 also has a mechanism for withdrawing the pins 106 from the socket 104. The mechanism may be arranged such that in a default position the pins 106 protrude from the plug 102. The plug 102 is arranged such that when the sensor(s) 108 indicates that arcing is taking place, the mechanism is activated to extract the pins 106 from the socket 104 and into the body of the plug 102.

**[0034]** Referring to Figure 2B, the plug 102, having withdrawn the pins 106 away from the socket 104, is able to fall away from the socket 104, thereby reducing the chance of damage to the plug 102 and/or socket 104 by electric arcing.

**[0035]** Figures 3A and 3B show another example of the plug 102 and socket 104 in use, wherein the mechanism to cause the pins 106 to be withdrawn is contained in the socket 104. The mechanism is arranged such that when electric arcing is detected the pins 106 of the plug 102 are pushed out of the socket 104. Referring to Figure 3A, when the sensor 108 detects the temperature and light level of the region between the plug 102 and the socket 104 as being above the threshold heat and light values respectively, the mechanism pushes the pins 106 of the plug 102 out of the socket 104. Referring to Figure 3B, the plug 102 is free to fall away from the socket 104, thereby reducing or eliminating damage to the plug 102 and/or socket 104 by electric arcing.

**[0036]** The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

## Claims

1. An electric arcing protection arrangement comprising:

a sensor (108) for monitoring the presence of electrical arcing between a plug (102) and a socket (104); and  
a mechanism arranged to cause the pins (106) of the plug (102) to be withdrawn from the socket (104) upon detection of electric arcing between the plug (102) and the socket (104) by the sensor (108).

2. An electric arcing protection arrangement according to claim 1, comprising a plug (102), wherein the plug (102) comprises:

the sensor (108) for monitoring the presence of electrical arcing; and  
the mechanism arranged to cause the pins (106) of the plug (102) to be withdrawn from the socket (104).

3. An electric arcing protection arrangement according to claim 1, comprising a socket (104), wherein the socket (104) comprises:

the sensor (108) for monitoring the presence of

electrical arcing; and  
the mechanism arranged to cause the pins (106)  
of the plug (102) to be withdrawn from the socket  
(104).

4. An electric arcing protection arrangement according  
to any of claims 1 to 3, wherein the sensor (108)  
comprises a heat sensor (108) arranged to monitor  
the temperature in a region of the connection of the  
plug (102) and the socket (104), the electric arcing  
protection arrangement being such that if the tem-  
perature detected by the heat sensor (108) is above  
a threshold value, the mechanism causes the pins  
(106) of the plug (102) to be withdrawn from the sock-  
et (104).

5. An electric arcing protection arrangement according  
to any of claims 1 to 4, wherein the sensor (108)  
comprises a light sensor (108) arranged to monitor  
the light level in a region of the connection of the plug  
(102) and the socket (104), the electric arcing pro-  
tection arrangement being arranged such that if the  
light level detected by the light sensor (108) is above  
a threshold value, the mechanism causes the pins  
(106) of the plug (102) to be withdrawn from the sock-  
et (104).

6. An electric arcing protection arrangement according  
to any of claims 1 to 3, wherein the sensor (108)  
comprises a heat sensor (108) and a light sensor  
(108), the sensor (108) being arranged such that:

the heat sensor (108) monitors the temperature  
in a region of the connection of the plug (102)  
and the socket (104);  
the light sensor (108) monitors the light level in  
a region of the connection of the plug (102) and  
the socket (104); and  
if the temperature in the region of the connection  
of the plug (102) and the socket (104) detected  
by the heat sensor (108) is above a threshold  
value and the light level in the region of the con-  
nection of the plug (102) and the socket (104)  
detected by the light sensor (108) is above a  
threshold value, the mechanism causes the pins  
(106) of the plug (102) to be withdrawn from the  
socket (104).

7. An electric arcing protection arrangement according  
to any of claims 1 to 6, wherein the mechanism com-  
prises at least one biasing arrangement to cause the  
pins (106) of the plug (102) to be withdrawn from the  
socket (104) upon detection of electric arcing be-  
tween the plug (102) and the socket (104) by the  
sensor (108).

8. An electric arcing protection arrangement according  
to claim 7, wherein the biasing arrangement com-

prises one or more springs arranged to push or pull  
the pins (106) of the plug (102) out of the socket  
(104).

9. An electric arcing protection method comprising:

monitoring the presence of electrical arcing be-  
tween a plug (102) and a socket (104); and  
actuating a mechanism to cause the pins (106)  
of the plug (102) to be withdrawn from the socket  
(104) upon detection of electric arcing between  
the plug (102) and the socket (104).

10. An electric arcing protection method according to  
claim 9, wherein the detection of electric arcing be-  
tween the plug (102) and the socket (104) by a sen-  
sor (108) comprises monitoring the temperature in  
a region of the connection of the plug (102) and the  
socket (104) by a heat sensor (108); and  
the mechanism is actuated if the temperature detect-  
ed by the heat sensor (108) is above a threshold  
value.

11. An electric arcing protection method according to  
claim 9 or claim 10, wherein the detection of electric  
arcing between the plug (102) and the socket (104)  
by a sensor (108) comprises:

monitoring the light level in a region of the con-  
nection of the plug (102) and the socket (104)  
by a light sensor (108); and  
causing the pins (106) of the plug (102) to be  
withdrawn from the socket (104) if a change in  
the light level detected by the light sensor (108)  
is above a threshold value.

12. An electric arcing protection method according to  
claim 9, wherein the detection of electric arcing be-  
tween the plug (102) and the socket (104) by a sen-  
sor (108) comprises:

monitoring the temperature in a region of the  
connection of the plug (102) and the socket  
(104) by a heat sensor (108);  
monitoring the light level in a region of the con-  
nection of the plug (102) and the socket (104)  
by a light sensor (108); and  
causing the pins (106) of the plug (102) to be  
withdrawn from the socket (104) if a change in  
the temperature detected by the heat sensor  
(108) is above a threshold value and a change  
in the light level detected by the light sensor  
(108) is above a threshold value.

13. An electric arcing protection method according to  
any of claims 9 to 12, wherein causing the pins (106)  
of the plug (102) to be withdrawn from the socket  
(104) comprises activating at least one biasing ar-

rangement to cause the pins (106) of the plug (102) to be withdrawn from the socket (104) upon detection of electric arcing between the plug (102) and the socket (104).

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14. An electric arcing protection method according to any of claims 9 to 13 carried out by components in a plug (102).

15. An electric arcing protection method according to any of claims 9 to 13 carried out by components in a socket (104).

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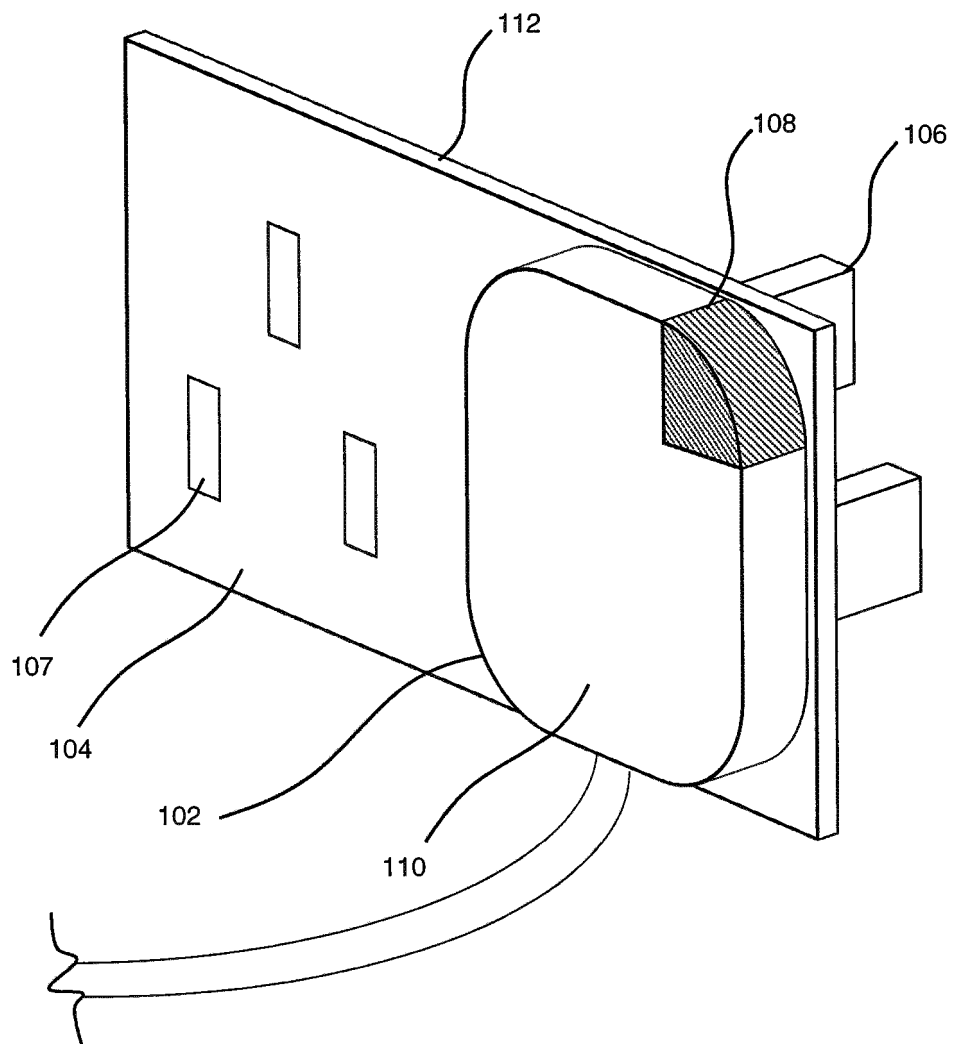


Fig. 1

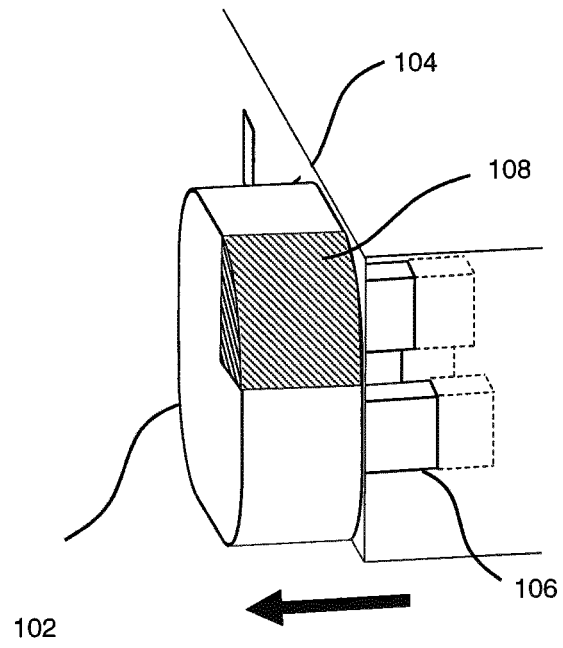


Fig. 2A

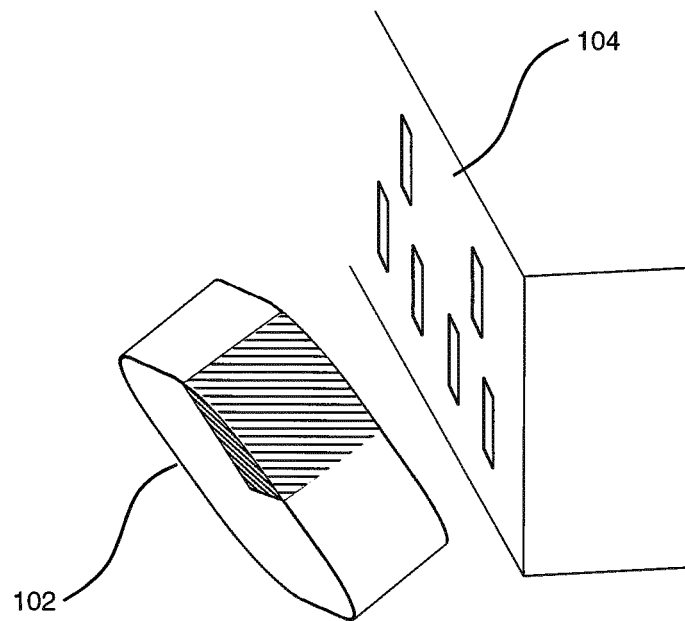


Fig. 2B

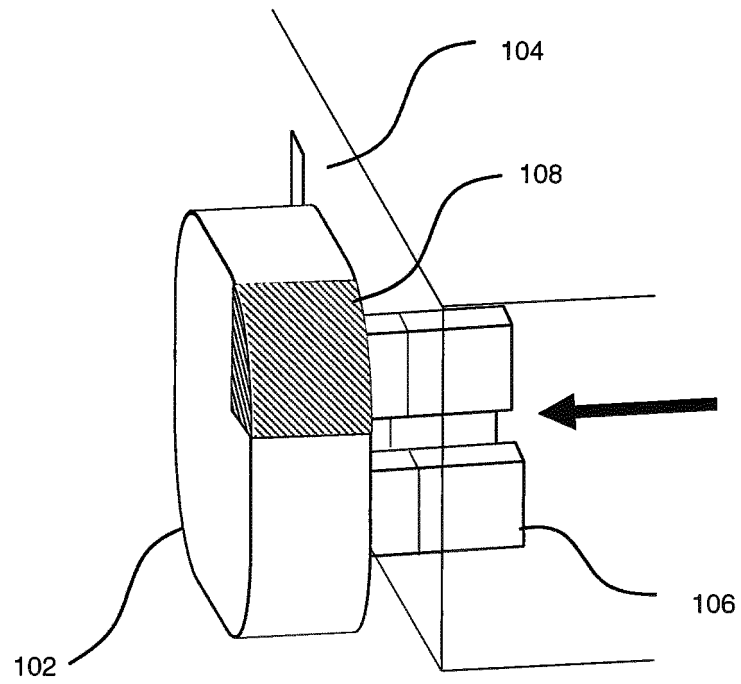


Fig. 3A

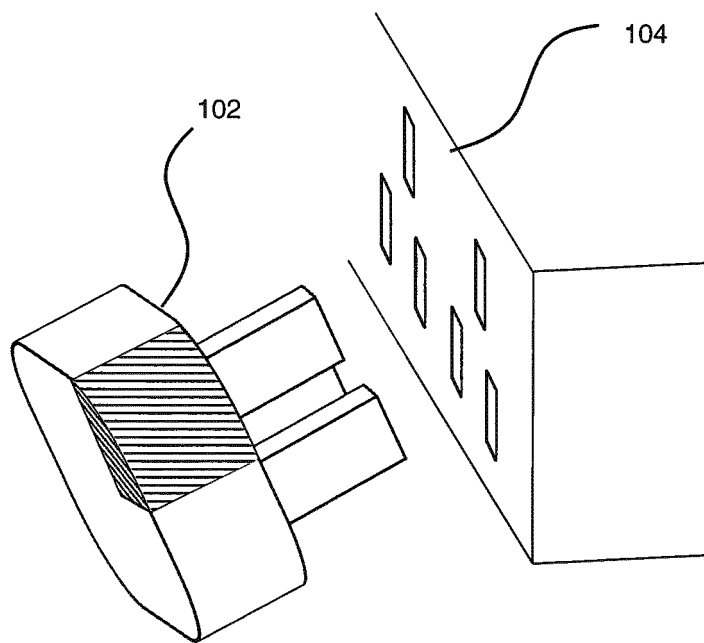


Fig. 3B



## EUROPEAN SEARCH REPORT

Application Number  
EP 17 20 2433

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                    |                                                         |                                                           |
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| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                      | Relevant to claim                                       | CLASSIFICATION OF THE APPLICATION (IPC)                   |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                    |                                                         | H01R                                                      |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                    |                                                         |                                                           |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                    | Date of completion of the search<br><b>6 March 2018</b> | Examiner<br><b>Georgiadis, Ioannis</b>                    |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                    |                                                         |                                                           |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 17 20 2433

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