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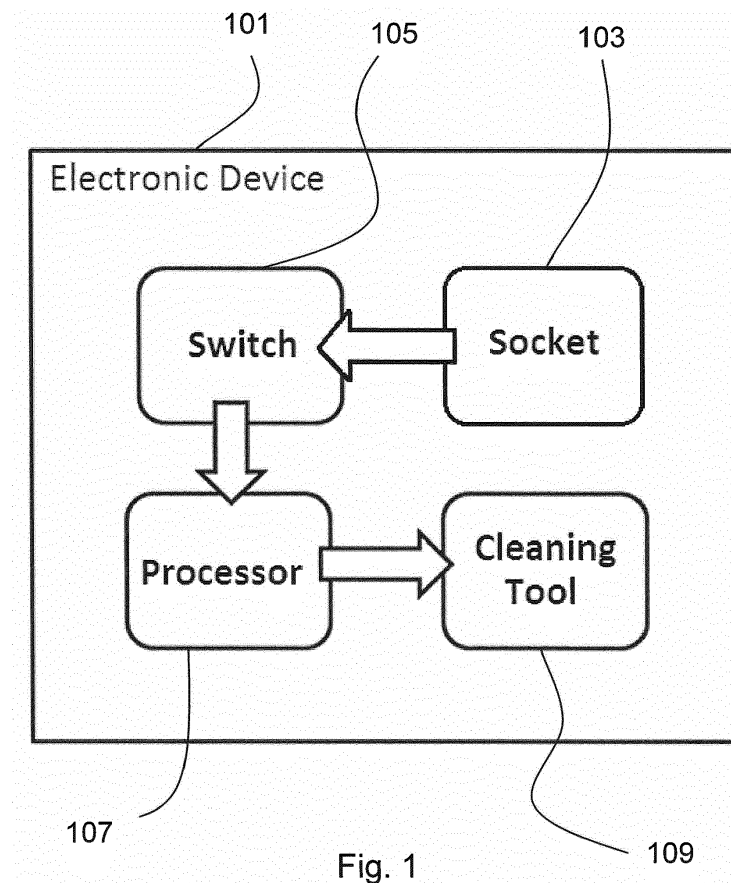
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(54) **METHOD AND DEVICE FOR CLEANING AN ELECTRICAL SOCKET**

(57) A method and device for cleaning an electrical socket (103) is disclosed. An electronic device (101) has an electrical socket (103) for receiving a connector and a cleaning tool (109) for cleaning the interior of the elec-

trical socket (103). The electronic device (101) also has a drive arrangement for driving the cleaning tool (109) to clean the interior of the electrical socket (103).



Description

Technical Field

[0001] The present disclosure relates to a method and device for cleaning an electrical socket.

Background

[0002] Consumer electronic devices, such as smart phones, tablets, laptops and television sets (TVs), etc., comprise a variety of different electrical sockets. These electrical sockets are vital for connectivity with other electronic devices and with external accessories such as headphones/earphones, microphones, battery chargers, etc. It is important that in electronic devices there is a good connection between a connector and a socket in order for there to be a good transfer of energy or information or both.

[0003] Electrical sockets are prone to debris, such as fibres, dust and other particulates, liquids, etc., entering into the inside of the socket which can cause connection problems when a connector is inserted into the socket.

Summary

[0004] According to a first aspect disclosed herein, there is provided an electronic device comprising:

an electrical socket for receiving a connector;
a cleaning tool for cleaning the interior of the electrical socket; and
a drive arrangement for driving the cleaning tool to clean the interior of the electrical socket.

[0005] In an example, the electronic device comprises a switch configured to detect the presence of a connector inserted into the electrical socket, the drive arrangement being arranged to drive the cleaning tool to clean the interior of the electrical socket in response to a said connector not making electrical contact with the socket when the switch detects that a said connector is inserted into the electrical socket.

[0006] In an example, the electronic device is arranged such that the cleaning of the interior of the socket is only performed after a said connector is removed from the socket.

[0007] In an example, the drive arrangement in the electronic device comprises a stepper motor connected to the cleaning tool to rotate the cleaning tool.

[0008] In an example, the cleaning tool is arranged to move in and out of the socket when cleaning the socket.

[0009] The cleaning tool can move in and out of the socket along the length of the socket.

[0010] In an example, the electronic device comprises a processor configured to provide a prompt to a user of the electronic device to remove a said connector if the determination is that there is no electrical contact being

made between the connector and socket.

[0011] In an example, the socket is a headphone socket for receiving a headphone jack.

[0012] The socket may alternatively or additionally be a microphone socket for receiving a microphone jack. Other socket types may also be provided with a cleaning tool as described herein.

[0013] In an example, the cleaning tool is a cleaning brush.

[0014] According to a second aspect disclosed herein, there is provided method for cleaning a socket in a device, the method comprising:

the device detecting that an electrical socket requires cleaning when a connector has been inserted into the socket;
the device providing a prompt for a user to remove a connector from the socket; and
operating a cleaning tool of the device to clean the interior of the electrical socket after the connector has been removed from the socket.

[0015] In an example, the detecting that an electrical socket requires cleaning comprises detecting that a connector inserted into the socket cannot make electrical contact with the socket..

[0016] In an example, the method comprises providing a second prompt for a user to re-insert the connector into the socket once the cleaning of the socket has been completed.

[0017] In an example, the cleaning of the interior of the socket comprises rotating the cleaning tool by powering a motor attached to the cleaning tool.

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 an example of an electronic device according to embodiments of the present disclosure;

Figure 2 shows an example flow chart of how an electronic device may function according to embodiments of the present disclosure; and

Figure 3 shows schematically a specific example of an electronic device wherein the connector is a headphone jack and the socket is a headphone socket.

Detailed Description

[0019] Consumer electronic devices, such as smart phones, tablets, laptops, TVs, etc., comprise a variety of different electrical ports or sockets. These electrical sock-

ets are used for connectivity with other electronic devices and with external accessories such as headphones/earphones, microphones, battery chargers, etc. It is important that in electronic devices there is a good connection between the connector and the socket in order for there to be a good transfer of energy or information or both.

[0020] Electrical sockets are prone to debris, such as fibres, dust and other particulates, liquids, etc., entering the socket which can cause connection problems when connectors are inserted into the sockets. A connector may not be able to make electrical contact with the electrical socket if there is too much debris between the connector and socket.

[0021] Some devices have covers which enable the user to cover the socket when not in use, to try to prevent debris entering the socket when not in use. However, with this method there is no way of removing the debris if they have already entered the electrical socket.

[0022] In examples disclosed herein, there is provided an electronic device having an electrical socket for receiving a connector. The device has a cleaning tool that can clean the interior of the electrical socket and a drive arrangement for driving the cleaning tool in order for it to clean the interior of the socket.

[0023] Thus, the present disclosure provides a way to clean the interior of an electrical socket if debris has entered the socket. The driven cleaning tool forces the debris out of the socket or otherwise clean the socket so that a connector inserted into the socket will experience a better connection with the socket.

[0024] Referring now to the drawings, Figure 1 shows schematically an example of an electronic device 101 according to embodiments of the present disclosure. The electronic device comprises a socket 103 for receiving a connector. A switch 105 is connected to the socket 103. The switch 105 can detect the presence of the connector inside the socket. The switch 105 may be, for example, a mechanical switch which switches when engaged or contacted by the connector. In this example, the switch 105 communicates with a processor 107. The processor 107 can communicate with a cleaning tool 109 which is powered by a motor. (In other examples, the processor may be omitted for this purpose and the switch 105 can directly cause the cleaning tool 109 to operate.) The motor may rotate the cleaning tool 109 so that it can clean the interior of the socket 103. In examples, the cleaning tool 109 may be a cleaning brush. The socket 103, the switch 105, the processor 107 and the cleaning tool 109 are all housed within the electronic device 101.

[0025] As an example only, the electronic device 101 may be a portable device such as a mobile phone (including "smart phones"), a tablet or a laptop computer, etc., but equally the device 101 may not be portable and could be a TV or a desktop computer, etc.

[0026] Figure 2 shows an example flow chart of how the electronic device 101 may function according to embodiments of the present disclosure.

[0027] At step 201 a user of the electronic device 101

inserts a connector into the appropriate socket 103.

[0028] At step 203, the switch 105 detects that the connector has been placed into the socket 103.

[0029] At step 205, the electronic device 101 detects that there is no electrical contact between the connector and the socket 103. The device 101 may detect that there is no electrical contact by measuring, for example, the change in impedance that would be expected by the addition of a connector inside the socket 103 due to termination. As an example only, if no connector is inside the socket 103 then an impedance of 1.3k ohms might be measured. After a connector is inserted into the socket 103, and electrical contact is made, then a measurement of 30 ohm may be taken. This change in impedance can be used to determine that an electrical connection has been made. If no change in impedance is measured after the switch 105 has detected that a connector has been inserted into the socket 103, then it can be determined that there is no electrical contact between the connector and the socket 103. This may be due to debris that has entered the socket 103.

[0030] At step 207, the user is prompted by the electronic device 101 to remove the connector from socket 103. This prompt may be, for example, a visual prompt that appears on a screen of the electronic device 101 and/or an aural prompt through a speaker of the electronic device 101. The user then removes the connector from the socket 103.

[0031] At step 209, the cleaning tool 109 extends into the interior of the socket 103. The motor will be powered so to rotate the cleaning tool 109 in order to clean the interior of the socket 103. The rotating cleaning tool 109 may expel debris, such as fibres, dust and other particulates, from the interior of the socket 103 and/or clean the interior face or surface of the socket 103.

[0032] At step 211, the cleaning tool 109 retracts out of the interior of the socket 103. The cleaning tool 109 may retract into the motor. In other examples, the cleaning tool 109 may simply retract into the electronic device 109 and not retract into the motor.

[0033] At step 213, as the cleaning of the interior of the socket 103 is completed, the user is prompted to re-insert the connector into the socket 103. At this point there should be electrical contact between the connector and the socket 103. If there is still not electrical contact then the method may go back to step 207 and the user will be prompted to remove the connector.

[0034] In other embodiments, the user of the electronic device 101 can start a clean of the interior of the socket 103 by activating the cleaning tool 109 at any time that the user wants. The user can initiate a clean using an application on the electronic device 101 or in the settings menu of the electronic device 101.

[0035] Figure 3 shows schematically an example of the electronic device 101 wherein the connector is a headphone jack 301 and the socket 103 is a headphone socket 303. The headphone socket 303 provides an opening to the outside of the electronic device 101 into

which the headphone jack 301 can be plugged. The headphone socket 303 also has an opening on the inside of the electronic device 101 on the opposite side to the outside opening, i.e. towards the interior of the electronic device 101. This allows a cleaning brush 311 located within the electronic device 101 to extend into the interior of the headphone socket 303 in order for cleaning of said headphone socket 303 to be performed.

[0036] In this example, a processor or microcontroller, etc. 305 in the electronic device 101 determines when cleaning of the headphone socket 303 is required. A switch within the headphone socket 303 can communicate to the microcontroller 305 to indicate that the headphone jack 301 is inserted into the headphone socket 303. If the microcontroller 305 knows that the headphone jack 301 is inserted into the headphone socket 303 but there is no electrical contact being made then the microcontroller 305 initiates a clean of the socket 303. The microcontroller 305 may provide a prompt to the user to remove the headphone jack 301. Once the headphone jack 301 has been removed then the cleaning can commence.

[0037] The microcontroller 305 can send a drive signal to a motor driver 307. The motor driver 307 powers a stepper motor 309. The cleaning brush 311 is attached to the shaft of the stepper motor 309. Thus, when the stepper motor is powered then the cleaning brush 311 rotates. The microcontroller 305 may cause the cleaning brush 311 first to move or extend into the interior of the headphone socket 303 prior to the cleaning brush 311 being rotated.

[0038] The rotating cleaning brush 309 in the interior of the headphone socket 303 forces any dust/dirt/lint/particles or other debris out of the headphone socket 303 or otherwise clean the socket 303. The cleaning of the headphone socket may be performed for a set time, e.g. few seconds, such as 2 seconds or so.

[0039] This process may be repeated as many times as is necessary if an electrical contact between the headphone jack 301 and headphone socket 303 fails to be formed when the headphone jack 301 is re-inserted. After the cleaning has been completed then the cleaning brush 311 will be retracted from within the interior of the headphone socket 303. The microcontroller 305 may cause the cleaning brush 311 to be retracted. In other examples, the stepping motor 309 may cause the cleaning brush 311 to be retracted using a reverse rotation/gear. Once the cleaning brush 311 has been retracted, the microcontroller 305 causes a prompt to be provided to the user to indicate that the headphone jack 301 can be re-inserted into the headphone socket 303.

[0040] This process can be repeated multiple times if no electrical contact is made between the headphone jack 301 and headphone socket 303. If there is still no electrical contact after multiple cleaning cycles (e.g. no sound in the headphones) then the user may be provided with a prompt to indicate that the electronic device 101 may have an electrical fault.

[0041] The cleaning of the interior of the headphone socket 303 will not occur if the headphone jack 301 remains inserted in the headphone socket 303. If a user attempts to insert the headphone jack 301 into the headphone socket 303 while cleaning is in progress then an error may occur. In this situation, the electronic device 101 may provide the user with a prompt that warns them that an error may occur if the headphone jack 301 is inserted during cleaning.

[0042] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0043] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0044] 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 electronic device comprising:

an electrical socket for receiving a connector;
a cleaning tool for cleaning the interior of the electrical socket; and
a drive arrangement for driving the cleaning tool to clean the interior of the electrical socket.

2. An electronic device according to claim 1, comprising a switch configured to detect the presence of a connector inserted into the electrical socket, the drive arrangement being arranged to drive the cleaning tool to clean the interior of the electrical socket in response to a said connector not making electrical contact with the socket when the switch detects that a said connector is inserted into the electrical socket.

3. An electronic device according to claim 2, arranged such that the cleaning of the interior of the socket is only performed after a said connector is removed from the socket.

4. An electronic device according to any of claims 1 to 3, wherein the drive arrangement comprises a stepper motor connected to the cleaning tool to rotate the cleaning tool.

5. An electronic device according to any of claims 1 to 4, wherein the cleaning tool is arranged to move in and out of the socket when cleaning the socket.

6. An electronic device according to any of claims 1 to 5, comprising a processor configured to provide a prompt to a user of the electronic device to remove a said connector if the determination is that there is no electrical contact being made between the connector and socket.

7. An electronic device according to any of claims 1 to 6, wherein the socket is a headphone socket for receiving a headphone jack.

8. An electronic device according to any of claims 1 to 7, wherein the cleaning tool is a cleaning brush.

9. A method for cleaning a socket in a device, the method comprising:

the device detecting that an electrical socket requires cleaning when a connector has been inserted into the socket;
the device providing a prompt for a user to remove a connector from the socket; and

operating a cleaning tool of the device to clean the interior of the electrical socket after the connector has been removed from the socket.

10. A method according to claim 9, wherein detecting that an electrical socket requires cleaning comprises detecting that a connector inserted into the socket cannot make electrical contact with the socket..

11. A method according to claim 9 or claim 10, comprising providing a second prompt for a user to re-insert the connector into the socket once the cleaning of the socket has been completed.

12. A method according to any of claims 9 to 11, wherein the cleaning of the interior of the socket comprises rotating the cleaning tool by powering a motor attached to the cleaning tool.

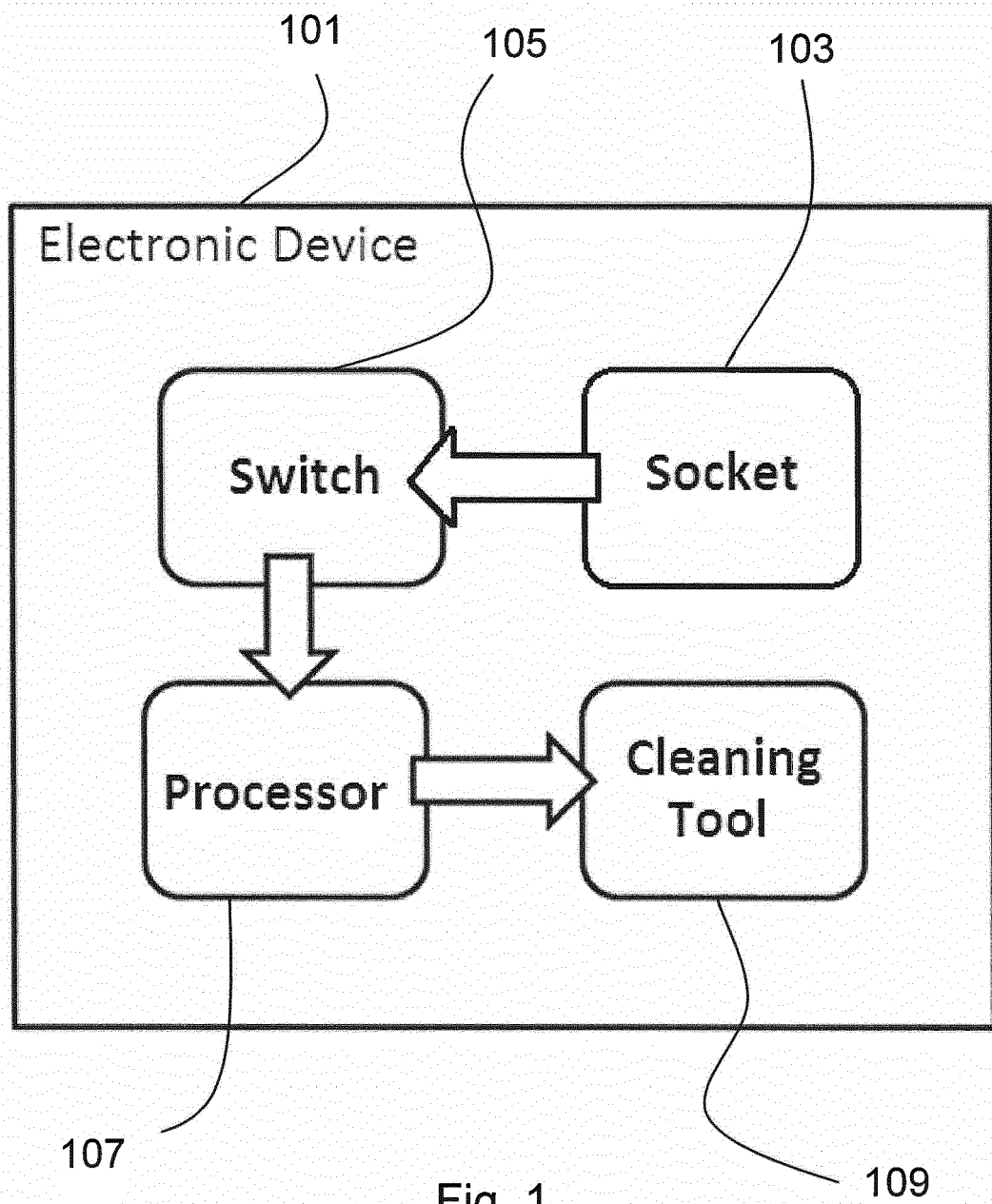
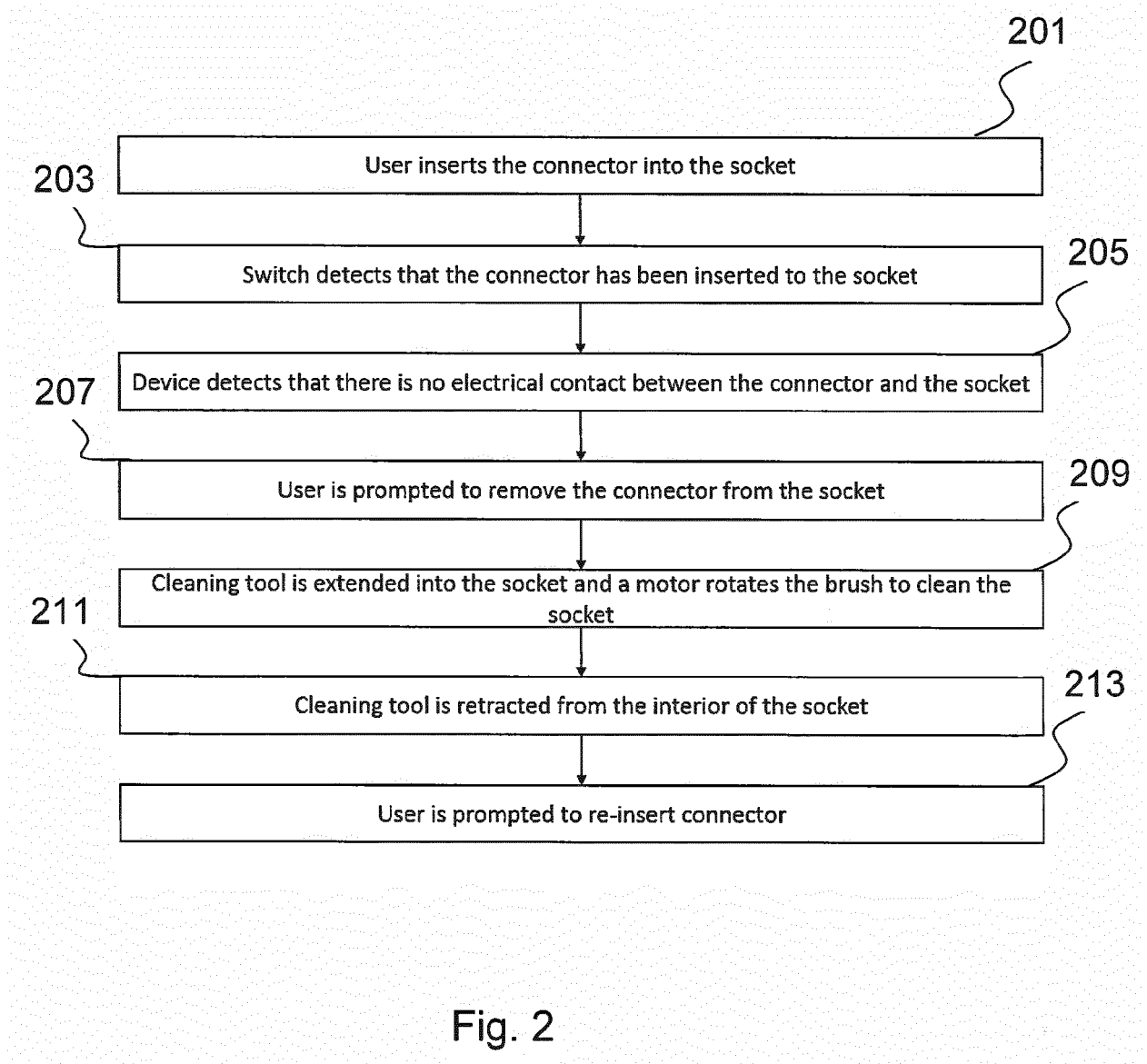
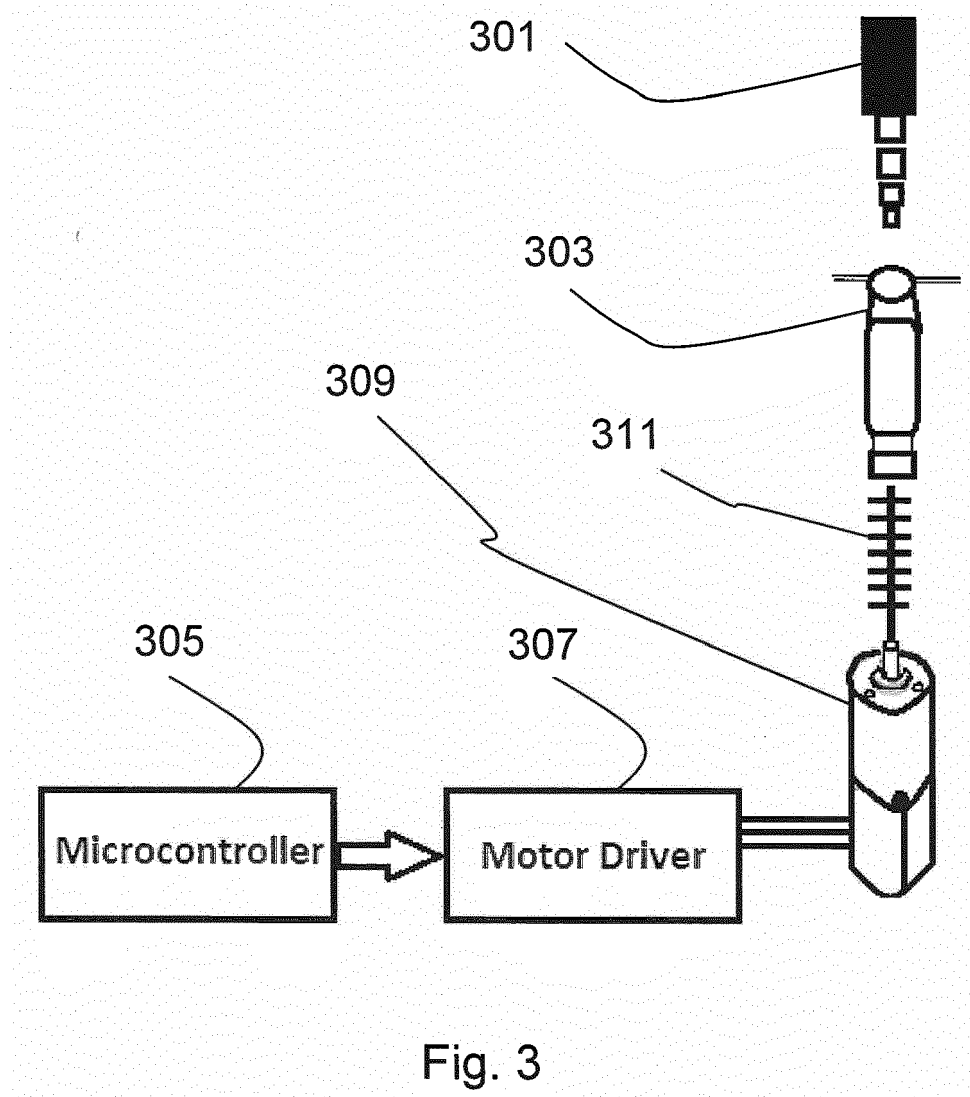


Fig. 1







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Application Number
EP 17 20 6009

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 April 2018	Examiner Georgiadis, Ioannis
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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