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(54) **Portable electronic device with an audio jack**

Tragbare elektronische Vorrichtung mit einer Audiobuchse

Dispositif électronique portable avec une prise audio

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EP 2 224 748 B1

Description

Technical Field

[0001] The present disclosure relates to audio jacks for portable electronic devices.

Background

[0002] In recent years, the accessibility and affordability of handheld technologies has made it commonplace for a single consumer to own several different portable electronic devices. Depending on the type of portable electronic device, accessories such as battery chargers and head phones, for example, may be provided in the packaging. Whether replacing a cell phone year after year or adding a portable music player, digital video camera or portable video game player to one's collection, duplication of accessories is very common.

[0003] Currently, there are no industry standards in place that dictate audio jack pin-out configuration for electronic devices having audio input and output capability. Therefore, the same headset, for example, will generally not work with portable electronic devices from different manufacturers. In order to avoid this problem, some electronic device vendors have begun to dictate the audio jack pin-out of the portable electronic devices that it will sell in order to ensure that the same accessories will work with the different devices. It is common for vendors in different countries to have different pin-out preferences, therefore, portable electronic device manufacturers who sell their devices to more than one vendor must incur additional costs to produce devices having different audio jack pin-outs.

[0004] One solution to this problem is to sell adapters that enable communication between incompatible accessories and portable electronic devices. This solution results in additional costs to the manufacturer and the consumer and also has the added inconvenience of requiring the consumer to keep track of adapters specific to each accessory. It is, therefore, desirable to provide an improved solution to the incompatibility of portable electronic devices and accessories.

[0005] Document US 2007/0047745 A1 discloses a portable media player, wherein different types of input/output connector, such as a USB connector, an earphone or a microphone connector can be inserted into the same jack. A detection circuit is provided, which send a signal to a processor based on the connector type. Transmission pins are then switched between signal input pins and signal output pins depending on the type of connector.

[0006] Document US 2007/0104332 A1 discloses a method and a system for performing automatic plug detection. When a plug is inserted into an audio jack, the plug is detected and a determination is made as to whether the plug is a stereo plug or a mono plug.

Summary

[0007] The invention is defined by the subject matter of the independent claims. Preferred embodiments can be derived from the dependent claims.

[0008] In one example useful for understanding the invention, there is provided a portable electronic device including: a processor provided in a housing, a jack provided in the housing, the jack being sized for receiving a plug of an audio accessory, electrical connectors provided in the jack for enabling communication between the audio accessory and the processor, the electrical connectors for contacting corresponding electrical connectors of the plug and a switching circuit in communication with the processor and the electrical connectors, the switching circuit for determining a pin-out of the plug; wherein the switching circuit routes signals between ungrounded ones of the corresponding electrical connectors of the plug and the processor.

[0009] In another example useful for understanding the invention, there is provided a portable electronic device including: a processor provided in a housing, a jack provided in the housing, the jack being sized for receiving a plug of an audio accessory, electrical connectors provided in the jack for enabling communication between the audio accessory and the processor, each of the electrical connectors for contacting a corresponding electrical connector of the plug and a switching circuit in communication with the processor and two of the electrical connectors, the switching circuit for selectively routing audio signals, such as microphone signals, for example, between a second one of the corresponding electrical connectors of the plug and the processor; wherein the switching circuit routes the audio signals between a second one of the corresponding electrical connectors of the plug and the processor when a first one of the corresponding electrical connectors of the plug is electrically grounded.

[0010] In yet another example useful for understanding the invention, there is provided a method for connecting a plug of an audio accessory to a portable electronic device, the method including: receiving a plug of the audio accessory in a jack of the portable electronic device, the jack having electrical connectors for enabling communication between the audio accessory and a processor of the portable electronic device, the electrical connectors for contacting corresponding electrical connectors of the plug, determining a pin-out of the plug and routing signals between ungrounded ones of the corresponding electrical connectors of the plug and the processor.

[0011] In still another example useful for understanding the invention, there is provided a method for connecting a plug of an audio accessory to a portable electronic device, the method including: receiving a plug of the audio accessory in a jack of the portable electronic device, the jack having electrical connectors for enabling communication between the audio accessory and a processor of the portable electronic device, each of the electrical connectors for contacting a corresponding electrical con-

nector of the plug, determining if a first one of the corresponding electrical connectors of the plug is electrically grounded and routing audio signals between a second one of the corresponding electrical connectors of the plug and the processor when the first one of the corresponding electrical connectors of the plug is electrically grounded.

[0012] The embodiments provided herein allow audio accessories having pin-outs that do not match a pin-out of the portable electronic device to be operated therewith. The inclusion of a switching circuit in the portable electronic device may reduce or eliminate the need for separate adapter components.

Drawings

[0013] The following figures set forth embodiments in which like reference numerals denote like parts. Embodiments are illustrated by way of example and not by way of limitation in the accompanying figures.

[0014] Figure 1 is a block diagram of a portable electronic device according to an embodiment;

[0015] Figure 2 is a perspective view of the portable electronic device of Figure 1;

[0016] Figure 3 is a schematic side view of an audio jack of the portable electronic device of Figure 1 in section and a side view of a plug of an audio accessory for use with the audio jack;

[0017] Figure 4 is a circuit diagram of a switching circuit of the portable electronic device of Figure 1;

[0018] Figures 5 is a state diagram corresponding to the circuit diagram of Figure 4;

[0019] Figure 6 is a schematic side view of a plug and headset for use with the portable electronic device of Figure 1;

[0020] Figure 7 is a side view of a plug for use with the portable electronic device of Figure 1;

[0021] Figure 8 is a schematic side view of a plug and headset for use with the portable electronic device of Figure 1;

[0022] Figure 9 is a side view of a plug for use with the portable electronic device of Figure 1;

[0023] Figure 10 is a side view of a plug for use with the portable electronic device of Figure 1;

[0024] Figure 11 is a flowchart depicting a method for connecting a plug of an audio accessory to the portable electronic device of Figure 1 according to an embodiment; and

[0025] Figure 12 is a flowchart depicting a method for connecting a plug of an audio accessory to the portable electronic device of Figure 1 according to another embodiment.

Description of Preferred Embodiments

[0026] Referring now to Figure 1, components of a portable electronic device 10 according to an embodiment are generally shown. The portable electronic device 10 includes data communication capabilities and may communicate with other electronic devices directly or through a wireless network. The portable electronic device 10 is based on the computing environment and functionality of a handheld computer, such as a wireless personal digital assistant (PDA), for example. It will be understood, however, that the portable electronic device 10 is not limited to a wireless personal digital assistant. Other portable electronic devices are possible, such as cellular telephones, smart telephones, portable music players and laptop computers.

[0027] The portable electronic device 10 includes a number of components including processor 14, which controls the overall operation of the device 10. A communication subsystem 40 controls data and voice communication functions, such as email, PIN (Personal Identification Number) message functions, SMS (Short Message Service) message functions and cellular telephone functions, for example. The communication subsystem 40 is in communication with a wireless network 12, which may be a data-centric wireless network, a voice-centric wireless network or a dual-mode wireless network.

[0028] In Figure 1, the communication subsystem 40 is a dual-mode wireless network that supports both voice and data communications. The communication subsystem 40 is configured in accordance with the Global System for Mobile Communication (GSM) and General Packet Radio Services (GPRS) standards. The communication subsystem 40 may alternatively be configured in accordance with Enhanced Data GSM Environment (EDGE) or Universal Mobile Telecommunications Service (UMTS) standards. Other wireless networks may also be associated with the portable electronic device 10, including Code Division Multiple Access (CDMA) or CDMA2000 networks. Some other examples of data-centric networks include WiFi 802.11, Mobitex™ and DataTAC™ network communication systems. Examples of other voice-centric data networks include Personal Communication Systems (PCS) networks like GSM and Time Division Multiple Access (TDMA) systems.

[0029] The wireless network 12 includes base stations (not shown) that provide a wireless link to the portable electronic device 10. Each base station defines a coverage area, or cell, within which communications between the base station and the portable electronic device 10 can be effected. It will be appreciated that the portable electronic device 10 is movable within the cell and can be moved to coverage areas defined by other cells. Data is delivered to the portable electronic device 10 via wireless transmission from base station. Similarly, data is sent from the portable electronic device 10 via wireless transmission to the base station.

[0030] The communication subsystem 40 further includes a short range communications function, which enables the device 10 to communicate directly with other devices and computer systems without the use of the network 106 through infrared or Bluetooth™ technology, for example.

[0031] Prior to the portable electronic device 10 being

able to send and receive communication signals over the wireless network 12, network registration or activation procedures must have been completed. In order to enable network communication, a SIM (Subscriber Identity Module) card 24 is inserted into a card interface 26. The SIM card, or Removable User Identity Module card, is used to identify the user of the mobile device, store personal device settings and enable access to network services, such as email and voice mail, for example, and is not bound to a particular portable electronic device 10.

[0032] The processor 14 is also connected to a Random Access Memory (RAM) 16 and a flash memory 18. An operating system and device software are typically stored in flash memory 18 and are executable by the processor 14. Some device software components may alternatively be stored in RAM 16. Software applications that control basic device operation, such as voice and data communication, are typically installed during manufacture of the device 10. For devices that do not include a SIM card 24, user identification information may be programmed into the flash memory 18. The flash memory 18 may alternatively be a persistent storage, a Read-Only Memory (ROM) or other non-volatile storage.

[0033] The processor 14 receives input from various input devices including a keypad 38 and other input devices 36. The other input devices 36 typically complement the keypad 38 to facilitate input and may include devices such as: single or multi-function buttons, a touch screen, a mouse, a trackball, a capacitive touch sensor or a roller wheel with dynamic button pressing capability.

[0034] The processor 14 outputs to various output devices including an LCD display screen 20. A microphone 32 and speaker 22 are connected to the processor 14 for cellular telephone functions. A data port 34 is connected to the processor 14 for enabling data communication between the portable electronic device 10 and another computing device. The data port 34 may include data lines for data transfer and a supply line for charging a battery 30 of the portable device 10. Battery interface 28 is provided for receiving one or more rechargeable batteries 30. Jack 42 is provided for receiving an audio accessory such as headphones, a headset, amplified speakers or amplified headphones, for example. Jack 42 may also receive other accessories such as a multi-media accessory including play, pause, stop and rewind buttons or a TV-out accessory that allows for connection of the portable electronic device to a TV, for example.

[0035] Only a limited number of device subsystems have been described. It will be appreciated by a person skilled in the art that additional subsystems corresponding to additional device features may also be connected to the processor 14.

[0036] Referring also to Figure 2, the portable-electronic device 10 includes a housing 44 in which the display 20 and keypad 38 are mounted. The jack 42 is provided in an opening 43 in a side surface 46 of the housing 44. It will be appreciated by a person skilled in the art that the arrangement of Figure 2 is provided by way of example. The display 20, the keypad 38, the jack 42 and also other input devices 36 may be provided in any arrangement that allows the user to interact with the portable electronic device 10.

[0037] As shown in Figure 3, the jack 42 includes a sleeve 70 having a closed end 86 and four electrical connectors 72, 74, 76 and 78. A plug-receiving cavity 82 of the jack 42 is generally defined by an inner surface 84 of the sleeve 70 and is sized to receive a plug 48 of a headset (not shown). The electrical connectors 72, 74, 76, 78 each include a conductive surface 80 that extends into the plug-receiving cavity 82. When the plug 48 of the headset is received in the jack 42, the conductive elements 80 of the electrical connectors 72, 74, 76, 78 mate with corresponding conductive surfaces of electrical connectors 58, 60, 62 and 64 of the plug 48, respectively, to provide an electrical path between headset components, which include a microphone, a left speaker and a right speaker, and matching ports of the processor 14.

[0038] It will be appreciated by a person skilled in the art that rather than including the sleeve 70, the plug-receiving cavity 82 may be defined by the housing 44 or one or more other components of the portable electronic device 10.

[0039] Electrical connectors 58, 60, 62 and 64 are provided in order between a base 66 and a tip 68 of the plug 48. Therefore, when the plug 48 is received in the jack 42, electrical connector 72 of the jack 42 mates with electrical connector 58 of the plug 48, electrical connector 74 of the jack 42 mates with electrical connector 60 of the plug 48, electrical connector 76 of the jack 42 mates with electrical connector 62 of the plug 48 and electrical connector 78 of the jack 42 mates with electrical connector 64 of the plug 48.

[0040] In order for the left speaker, the right speaker, the microphone and a ground of the headset to operate as expected, a pin-out of the plug 48 and a pin-out of the jack 42 should match. The term pin-out is well known in the art and describes the purpose of each connector, which is commonly referred to as a pin, in a connecting device, such as a jack or a plug, for example. The pin-out of the jack 42 of the portable electronic device 10 of Figure 1 is as follows:

Electrical connector 72	Microphone
Electrical connector 74	Ground
Electrical connector 76	Right Audio channel
Electrical connector 78	Left Audio Channel

[0041] As shown in Figure 3, the electrical connectors 72, 74, 76, 78 are electrically coupled to the processor 14 via a switching circuit 88, which is shown in Figure 4. In general, the switching circuit 88 is provided to determine the pin-out of the plug 48 and swap microphone and ground signals when the pin-out of the plug 48 does

not match the pin-out of the jack 42. Specifically, the switching circuit 88 determines if electrical connector 58 is electrically grounded and, if so, routes audio signals from electrical connector 60 of the plug 48, if ungrounded, through electrical connector 72 of the jack 42 to the processor 14. The switching circuit 88 uses impedance testing to determine the pin-out of the plug 48.

[0042] Voltages are measured with respect to some sort of reference voltage, which is called the ground. In some cases, the voltage of the Earth itself serves as the reference, or ground. On a portable electronic device that is not electrically connected by a wire to the Earth, one electrical node is selected to be the "ground node," and it is with reference to the voltage of this node that other voltages are measured. To say that a connector is "electrically grounded" can be to mean that the connector is electrically coupled to, or is at substantially the same electric potential as, that ground node. As a practical matter, the voltage of a grounded connector has substantially zero difference in voltage with the ground node, and so would be measured as having a substantially constant voltage of about zero volts. Since typical electrical signals involve voltage changes, a connector that is electrically grounded typically is carrying no signal.

[0043] Referring to Figures 4 and 5, the switching circuit 88 includes a normally closed switch 98 between electrical connector 78 of the jack 42, which corresponds to the left audio channel, and an accessory detection circuitry 92. At state 100, the switching circuit 88 is in an idle mode when no plug 48 is received in the jack 42. When a plug 48 is received in the jack 42, the normally closed switch 98 opens and a signal interrupt is sent to the processor 14 to notify the processor 14 that an audio accessory has been inserted into the jack 42. When the audio accessory is detected, at state 102, the processor 14 performs a test to determine if the electrical connector 58 of the plug 48 is electrically grounded. The test is an impedance test that the processor 14 performs by: 1) applying a voltage to a microphone bias connector 94 to bias the electrical connector 72; 2) reading a direct current (dc) voltage at a microphone detection connector 96; and 3) comparing the dc voltage reading to a predetermined threshold value, Vth. At state 102, a switch 90 of the switching circuit is in a first position, which is the default position, to route audio signals from electrical connectors 58 and 60 of the plug 48 to mating electrical connectors 72 and 74 of the jack 42. A dc voltage reading that is high indicates that the electrical connector 58 is not electrically grounded. Therefore, it follows that the electrical connector 58 is connected to a microphone and the audio accessory is a headset, as indicated at state 104.

[0044] A four pole stereo headset plug is shown in Figure 6 and a four pole mono headset plug is shown in Figure 7. When headset plugs of Figures 6 and 7 are inserted into the jack 42, the switching circuit 88 determines that the electrical connector 58 is not electrically grounded and the processor 14 operates the audio accessory with the adapter switch 90 in the first position.

[0045] A dc voltage reading from the impedance test that is low indicates that the electrical connector 58 is electrically grounded, and therefore, the accessory is either a headset or headphones. In response to the outcome of the test, at state 106, the switch 90 is changed to a second position in which the electrical connector 72 of the jack 42 is in communication with the electrical connector 60 of the plug 48. The processor 14 then performs a second test in order to determine if the electrical connector 60 of the plug 48 is electrically grounded. If the dc voltage reading of the second test is high, the electrical connector 60 is not electrically grounded. Therefore, it follows that the electrical connector 60 is connected to a microphone and the audio accessory is a headset, as indicated at state 108.

[0046] A stereo headset plug having the microphone and ground connectors reversed, when compared to the jack 42, is shown in Figure 8. This pin-out configuration is often found in headphones and headsets that are manufactured in China. When the headset plug of Figures 8 is inserted into the jack 42, the switching circuit 88 allows the processor 14 to operate the audio accessory with the switch 90 in the second position.

[0047] A dc voltage reading from the second test that is low indicates that the electrical connector 60 is electrically grounded, and therefore, the accessory is a set of headphones, as indicated at state 110. Plugs for stereo headphones and mono headphones are shown in Figures 9 and 10, respectively.

[0048] Once the pin-out of two of the electrical connectors of the plug 48 has been determined, a further detection scheme may be performed in order to determine the entire pin-out of the plug 48, as indicated in Figure 5. Detection schemes for determining whether a headset or headphones is mono or stereo are known in the art and therefore will not be described further.

[0049] Referring to Figure 11, a method for connecting the plug 48 of an audio accessory to a portable electronic device is generally shown. At step 112, the plug 48 is received in the jack 42 of the portable electronic device. The pin-out of the plug 48 is then determined at step 114, as has been previously described, and audio signals from electrically ungrounded electrical connectors of the plug 48 are routed to matching ports of the processor 14 at step 116.

[0050] Referring to Figure 12, another method for connecting a plug of an audio accessory to a portable electronic device is generally shown. At step 118, the plug 48 is received in the jack 42 of the portable electronic device. At steps 120 and 122, it is determined if a first electrical connector of the plug 48 is electrically grounded and, if so, audio signals are routed between a second electrical connector of the plug 48 and the processor 14.

[0051] The jack 42 shown in Figure 3 is sized to receive a 3.5 mm plug, however, it will be appreciated by a person skilled in the art that the jack 42 may alternatively be sized to receive a 2.5 mm plug or another size of plug.

[0052] In another embodiment, the jack 42 includes a pin-out of:

Electrical connector 72	Ground
Electrical connector 74	Microphone
Electrical connector 76	Right Audio channel
Electrical connector 78	Left Audio Channel

In this embodiment, the switching circuit 88 is modified to first test if electrical connector 60 of the plug 48 is electrically grounded and, if not, change switch 90 to the second position and re-test.

[0053] The switching circuit 88 of the described embodiments is suitable for use with plugs having microphone and ground electrical connectors that are located adjacent to one another at the base of the plug and in which at least one of the two connectors located adjacent to the tip of the plug are speaker electrical connectors. Plug pin-outs having this general configuration are shown in Figures 6-10 and are the most common pin-out configurations of headset and headphone accessories. It will, however, be appreciated by a person skilled in the art that a modified switching circuit including additional switches and further impedance testing could be provided to allow for pin-out determination of any pin-out configuration. The modified switching circuit would route audio signals between ungrounded ones of the electrical connectors of the plug and matching ports of the processor.

[0054] In another embodiment, the processor 14 executes software that is stored on the device 10 to allow a user to select different pin-out options via the keypad 38, display 20 or other input devices 36. In this embodiment, the processor 14 would not perform a test to determine the pin-out of the audio accessory. Instead, when the switching circuit 88 detects that an audio accessory has been inserted into the jack 42, the user would be prompted to select the type of audio accessory. The user would be able to select the type of audio accessory from a drop-down list, for example, which could include a list of pin-outs, product manufacturers, product serial numbers or a list of countries corresponding to where the accessory was manufactured.

[0055] Specific embodiments have been shown and described herein. However, modifications and variations may occur to those skilled in the art. All such modifications and variations are believed to be within the scope and sphere of the present embodiments.

Claims

1. A portable electronic device (10) having a connection for a plurality of audio accessories, comprising:

a processor (14) provided in a housing (44);
a jack (42) provided in said housing (44), said jack (42) being sized for receiving a plug (48) of an audio accessory of said plurality of audio accessories;
electrical connectors (72, 74, 76, 78) provided in said jack (42) for enabling communication between said audio accessory and said processor (14), each of said electrical connectors (72, 74, 76, 78) for contacting a corresponding electrical connector (58, 60, 62, 64) of said plug (48); and
a switching circuit (88) in communication with said processor (14) and two of said electrical connectors (72, 74, 76, 78), said switching circuit (88) for selectively routing audio signals between said corresponding electrical connectors (58, 60, 62, 64) of said plug (48) and said processor (14),
wherein:

said processor (14) is adapted to perform an impedance test on a first one of said electrical connectors (72, 74, 76, 78) to determine if a first one of said corresponding electrical connectors (58, 60, 62, 64) after insertion of said plug into said jack is electrically grounded; and
said switching circuit (88) is adapted to route said audio signals between a second one of said corresponding electrical connectors (58, 60, 62, 64) of said plug (48) and said processor (14), when said first one of said corresponding electrical connectors (58, 60, 62, 64) is electrically grounded; and
it is determined that said first one of said corresponding electrical connectors (58, 60,62, 64) is connected to a microphone of said audio accessory, if it is determined that said first one of said corresponding electrical connectors (58, 60, 62, 64) is not electrically grounded.

2. A portable electronic device (10) as claimed in claim 1, wherein said plurality of audio accessories comprises any of: a microphone, stereo headsets, stereo headphones, mono headsets and mono headphones.

3. A portable electronic device (10) as claimed in any of claim 1 or claim 2, wherein said first one of said corresponding electrical connectors (58, 60, 62, 64) and said second one of said corresponding electrical connectors (58, 60, 62, 64) are located adjacent to one another at a base (66) of said plug (48).

4. A portable electronic device (10) as claimed in any one of the preceding claims,
wherein said switching circuit (88) comprises a

switch (90) having a default position and a second position, said audio signals being routed between said first one of said corresponding electrical connectors (58, 60, 62, 64) of said plug (48) and said processor (14) when said switch (90) is in said default position.

5. A portable electronic device as claimed in any one of the preceding claims, wherein said plug (48) is one of a 2.5 mm plug and a 3.5 mm plug.

6. A method for connecting of an audio accessory of a plurality of audio accessories to a portable electronic device (10), said method comprising:

receiving a plug (48) of said audio accessory in a jack (42) of said portable electronic device (10), said jack (42) having electrical connectors (72, 74, 76, 78) for enabling communication between said audio accessory and a processor (14) of said portable electronic device (10), each of said electrical connectors (72, 74, 76, 78) for contacting a corresponding electrical connector (58, 60, 62, 64) of said plug (48);
after receiving of said plug (48) into said jack (42), conducting an impedance test on said electrical connectors (72, 74, 76, 78) to determine if a first one of said corresponding electrical connector (58, 60, 62, 64) is electrically grounded;
routing audio signals between a second one of said corresponding electrical connectors (58, 60, 62, 64) of said plug (48) and said processor (14) when said first one of said corresponding electrical connectors (58, 60, 62, 64) of said plug (48) is electrically grounded; and
determining that said first one of said corresponding electrical connectors (58, 60, 62, 64) is connected to a microphone of said audio accessory, if it is determined that said first one of said corresponding electrical connectors (58, 60, 62, 64) is not electrically grounded.

7. A method as claimed in claim 6, wherein said audio accessory is any of: a microphone, stereo headsets, stereo headphones, mono headsets and mono headphones.

8. A method as claimed in claim 6 or claim 7, wherein said first one of said corresponding electrical connectors (58, 60, 62, 64) and said second one of said corresponding electrical connectors (58, 60, 62, 64) are located adjacent to one another at a base (66) of said plug (48).

9. A method as claimed in any one of claims 6 to 8, wherein said audio signals are routed by a switching circuit (88).

10. A method as claimed in claim 9, wherein said switching circuit (88) has a switch (90) having a default position and a second position, said audio signals being routed between said first one of said corresponding electrical connectors (58, 60, 62, 64) of said plug (48) and said processor (14) when said switch (90) is in said default position.

11. A method as claimed in any of claims 6 to 10, wherein said impedance test comprises applying a voltage to a microphone bias connector (94), reading a voltage at a microphone detection connector (96) and comparing the voltage reading to a predetermined threshold value.

Patentansprüche

1. Tragbare elektronische Vorrichtung (10) mit einem Anschluss für eine Vielzahl von Audiozubehör, die aufweist:

einen Prozessor (14), der in einem Gehäuse (44) vorgesehen ist;
eine Buchse (42), die in dem Gehäuse (44) vorgesehen ist, wobei die Buchse (42) eine Größe hat zum Aufnehmen eines Steckers (48) eines Audiozubehörs der Vielzahl von Audiozubehör;
elektrische Verbinder (72, 74, 76, 78), die in der Buchse (42) vorgesehen sind, zum Ermöglichen einer Kommunikation zwischen dem Audiozubehör und dem Prozessor (14), wobei jeder der elektrischen Verbinder (72, 74, 76, 78) vorgesehen ist zum Kontaktieren eines entsprechenden elektrischen Verbinders (58, 60, 62, 64) des Steckers (48); und
eine Schaltung (88) in Kommunikation mit dem Prozessor (14) und zwei der elektrischen Verbinder (72, 74, 76, 78), wobei die Schaltung (88) vorgesehen ist zum selektiven Leiten von Audiosignalen zwischen den entsprechenden elektrischen Verbindern (58, 60, 62, 64) des Steckers (48) und dem Prozessor (14),
wobei:

der Prozessor (14) ausgebildet ist zum Durchführen eines Impedanztests an einem ersten der elektrischen Verbinder (72, 74, 76, 78) nach einem Einführen des Steckers in die Buchse, um zu bestimmen, ob ein erster der entsprechenden elektrischen Verbinder (58, 60, 62, 64) elektrisch geerdet ist; und
die Schaltung (88) ausgebildet ist zum Leiten der Audiosignale zwischen einem zweiten der entsprechenden elektrischen Verbinder (58, 60, 62, 64) des Steckers (48) und dem Prozessor (14), wenn der erste der

entsprechenden elektrischen Verbinder (58, 60, 62, 64) elektrisch geerdet ist; und bestimmt wird, dass der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) mit einem Mikrofon des Audiozubehörs verbunden ist, wenn bestimmt wird, dass der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) nicht elektrisch geerdet ist.

2. Tragbare elektronische Vorrichtung (10) gemäß Anspruch 1, wobei die Vielzahl von Audiozubehör eines aufweist aus: ein Mikrofon, Stereo-Headsets, Stereokopfhörer, Mono-Headsets und Monokopfhörer.

3. Tragbare elektronische Vorrichtung (10) gemäß Anspruch 1 oder Anspruch 2, wobei der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) und der zweite der entsprechenden elektrischen Verbinder (58, 60, 62, 64) angrenzend aneinander an einer Basis (66) des Steckers (48) angeordnet sind.

4. Tragbare elektronische Vorrichtung (10) gemäß einem der vorhergehenden Ansprüche, wobei die Schaltung (88) einen Schalter (90) aufweist, der eine Standardposition und eine zweite Position hat, wobei die Audiosignale zwischen dem ersten der entsprechenden elektrischen Verbinder (58, 60, 62, 64) des Steckers (48) und dem Prozessor (14) geleitet werden, wenn der Schalter (90) in der Standardposition ist.

5. Tragbare elektronische Vorrichtung gemäß einem der vorhergehenden Ansprüche, wobei der Stecker (48) einer aus einem "2,5 mm"-Stecker und einem "3,5 mm"-Stecker ist.

6. Vorfahren zum Verbinden eines Audiozubehörs aus einer Vielzahl von Audiozubehör mit einer tragbaren elektronischen Vorrichtung (10), wobei das Vorfahren aufweist:

Aufnehmen eines Steckers (48) des Audiozubehörs in einer Buchse (42) der tragbaren elektronischen Vorrichtung (10), wobei die Buchse (42) elektrische Verbinder (72, 74, 76, 78) hat zum Ermöglichen einer Kommunikation zwischen dem Audiozubehör und einem Prozessor (14) der tragbaren elektronischen Vorrichtung (10), wobei jeder der elektrischen Verbinder (72, 74, 76, 78) vorgesehen ist zum Kontaktieren eines entsprechenden elektrischen Verbinders (58, 60, 62, 64) des Steckers (48);
nach dem Aufnehmen des Steckers (48) in der Buchse (42), Durchführen eines Impedanztests an den elektrischen Verhindern (72, 74, 76, 78), um zu bestimmen, ob ein erster der entsprechenden elektrischen Verbinder (58, 60, 62, 64) elektrisch geerdet ist;
Leiten von Audiosignalen zwischen einem zweiten der entsprechenden elektrischen Verbinder (58, 60, 62, 64) des Steckers (48) und dem Prozessor (14), wenn der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) des Stekkers (48) elektrisch geerdet ist; und
Bestimmen, dass der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) mit einem Mikrofon des Audiozubehörs verbunden ist, wenn bestimmt wird, dass der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) nicht elektrisch geerdet ist.

7. Verfahren gemäß Anspruch 6, wobei das Audiozubehör eines ist a us: ein Mikrofon, Stereo-Headsets, Stereokopfhörer, Mono-Headsets und Monokopfhörer.

8. Vorfahren gemäß Anspruch 6 oder Anspruch 7, wobei der erste der entsprechenden elektrischen Verbinder (58, 60, 62, 64) und der zweite der entsprechenden elektrischen Verbinder (58, 60, 62, 64) angrenzend aneinander an einer Basis (66) des Stekkers (48) angeordnet sind.

9. Vorfahren einem der Ansprüche 6 bis 8, wobei die Audiosignale von einer Schaltung (88) geleitet werden.

10. Verfahren gemäß Anspruch 9, wobei die Schaltung (88) Schalter (90) hat, der eine Standardposition und eine Position hat, wobei die Audiosignale zwischen dem ersten der entsprechenden elektrischen Verbinder (58, 60, 62, 64) des Steckers (48) und dem Prozessor (14) geleitet werden, wenn der Schalter (90) in der Standardposition ist.

11. Vorfahren gemäß einem der Ansprüche 6 bis 10, wobei der Impedariztest aufweist ein Anlegen einer Spannung an einen Mikrofon-Bias-Verbinder (94), Ablesen einer Spannung an einem Mikrofon-Erfassungs-Verbinder (96) und Vergleichen der Spannungsablesung mit einem vorgegebenen Schwellenwert.

Revendications

1. Dispositif électronique portatif (10) possédant une connexion pour une pluralité d'accessoires audio, comprenant :

un processeur (14) place dans un boîtier (44) ; une prise femelle (42) platée dans ledit boîtier (44), ladite prise femelle (42) étant dimensionnée pour recevoir une fiche mâle (48) d'un ac-

cessoire audio parmi ladite pluralité d'accessoires audio ;
des connecteurs électriques (72, 74, 76, 78) placés dans ladite ladite prise femelle (42) pour permettre la communication entre ledit accessoire audit et ledit processeur (14), chacun desdits connecteurs électriques (72, 74, 76, 78) étant destiné à établir le contact avec un connecteur électrique correspondant (58, 60, 62, 64) de ladite fiche mâle (48) ; et
un circuit de commutation (88) en communication avec ledit processeur (14) est deux desdits connecteurs électriques (72, 74, 76, 78), ledit circuit de commutation (88) étant destiné à router sélectivement des signaux audit entre lesdits connecteurs électriques correspondants (58, 60, 62, 64) et ledit processeur (14) ;
dans lequel :

ledit processeur (14) est conçu pour exécuter un essai d'impédance sur un premier desdits connecteurs électriques (72, 74, 76, 78) après l'insertion de ladite fiche mâle dans ladite prise femelle, afin de déterminer si un premier desdits connecteurs électrique correspondants (58, 60, 62, 64) est mis à la masse électriquement ; et
ledit circuit de commutation (88) est conçu pour router lesdits signaux audio entre un second desdits connecteurs électriques correspondants (58, 60, 62, 64) de ladite fiche mâle (48) et ledit, processeur (14) lorsque ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) est mis à la masse électriquement ; et
il est déterminé que ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) est connecte à un microphone dudit accessoire audio s'il est déterminé que ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) n'est pas mis à la masse électriquement.

2. Dispositif électronique portatif (10) selon la revendication 1, dans lequel ladite plurality d'accessoires audio comprend l'un quelconque des suivants : microphone, casque stéréo, écouteurs stéréo, casque mono et écouteurs mono.

3. Dispositif électronique portatif (10) selon l'une quelconque des revendications 1 et 2, dans lequel redit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) et ledit second desdits connecteurs électrique correspondants (58, 60, 62, 64) sont situés l'un à côté de l'autre à la base (66) de ladite fiche mâle (48).

4. Dispositif électronique portatif (10) selon l'une quelconque des revendications précédentes, dans lequel ledit circuit de commutation (88) comprend un commutateur (90) ayant une position par défaut et une seconde positron, lesdits signaux audio étant routés entre ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) de ladite fiche mâle (48) et ledit processeur (14) lorsque ledit commutateur (90) est dans ladite position par défaut.

5. Dispositif électronique portatif selon l'une quelconque des revendications précédentes, dans lequel ladite fiche mâle (48) est une fiche de 2,5 mm ou une fiche de 3,5 mm.

6. Procédé de connexion d'un accessoire audio, parmi une pluralité d'accessoires audio, sur un dispositif électronique portatif (10), ledit Procédé comprenant les étapes consistant à :

recevoir une fiche mâle (48) dudit accessoire audio dans une prise femelle (42) dudit dispositif électronique portatif (10), ladite prise femelle (42) possédant des connecteurs électriques (72, 74, 76, 78) destinés à permettre la communication entre ledit accessoire audio et un processeur (14) dudit dispositif électronique portatif (10), chacun desdits connecteurs électriques (72, 74, 76, 78) étant destiné à établir un contact avec un connecteur électrique correspondant (58, 60, 62, 64) de ladite fiche mâle (48) ;
après la réception de ladite fiche mâle (48) dans ladite prise femelle (42), exécuter un essai d'impédance sur lesdits connecteurs électriques (72, 74, 76, 78) afin de déterminer si un premier desdits connecteurs électriques correspondants (58, 60, 62, 64) est mis à la masse électriquement ;
router des signaux audio entre un second desdits connecteurs électriques correspondants (58, 60, 62, 64) de ladite fiche mâle (48) et ledit processeur (14) lorsque ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) de ladite fiche mâle (48) est mis à la masse électriquement ; et
déterminer que ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) est connecté à un microphone dudit accessoire audio s'il est déterminé que ledit premier desdits connecteurs électriques correspondants (58, 60, 62, 64) n'est pas mis à la masse électriquement.

7. Procédé selon la revendication 6, dans lequel ledit accessoire audio est l'un quelconque des suivants : microphone, casque stéréo, écouteurs stéréo, casque mono et écouteurs mono.

8. Procédé selon la revendication 6 ou 7, dans lequel

ledit premier desdits connecteurs électrique correspondants (58, 60, 62, 64) et ledit second desdits connecteurs électriques correspondants (58, 60, 62, 64) sont situés l'un à côté de l'autre à la base (66) de ladite fiche mâle (48).

9. Procédé selon l'une quelconque des revendications 6 à 8, dans lequel lesdits signaux audio sont routés par un circuit de commutation (88).

10. Procédé selon la revendication 9, dans lequel ledit circuit de commutation (88) comprend un commutateur (90) ayant une position par défaut et une seconde position, lesdits signaux audio étant routés entre ledit premier desdite connecteurs électriques correspondants (58, 60, 62, 64) de ladite fiche mâle (48) et ledit processeur (14) lorsque ledit commutateur (90) est dans ladite position par défaut.

11. Procédé selon l'une quelconque des revendications 6 à 10, dans lequel ledit essai d'impédance comprend les étapes consistant à appliquer une tension à un connecteur de polarisation du microphone (94), litre une tension sur une connecteur de détection du microphone (96) et comparer la valeur de tension lue avec une valeur de seuil prédéterminés.

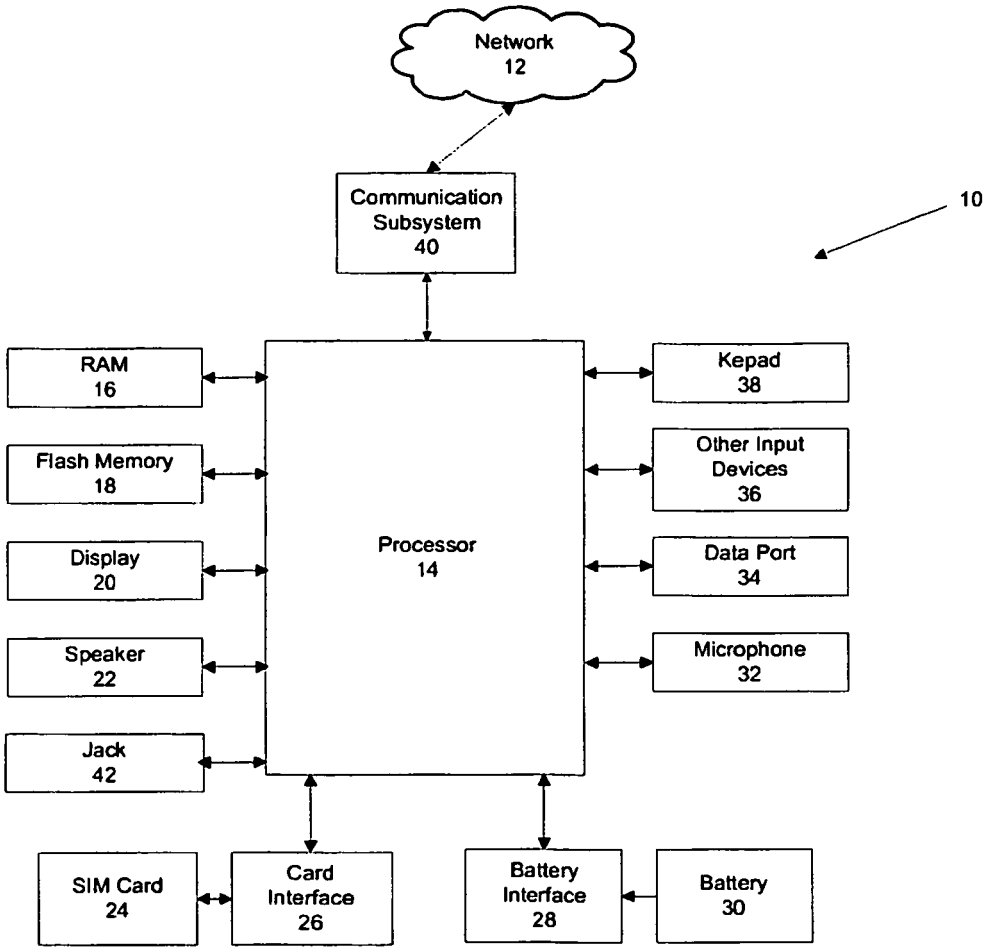
Network
12
Communication
Subsystem
40
10
RAM
16
Flash Memory
18
Display
20
Speaker
22
Jack
42
Processor
14
Kepad
38
Other Input
Devices
36
Data Port
34
Microphone
32
SIM Card
24
Card
Interface
26
Battery
Interface
28
Battery
30

FIG. 1

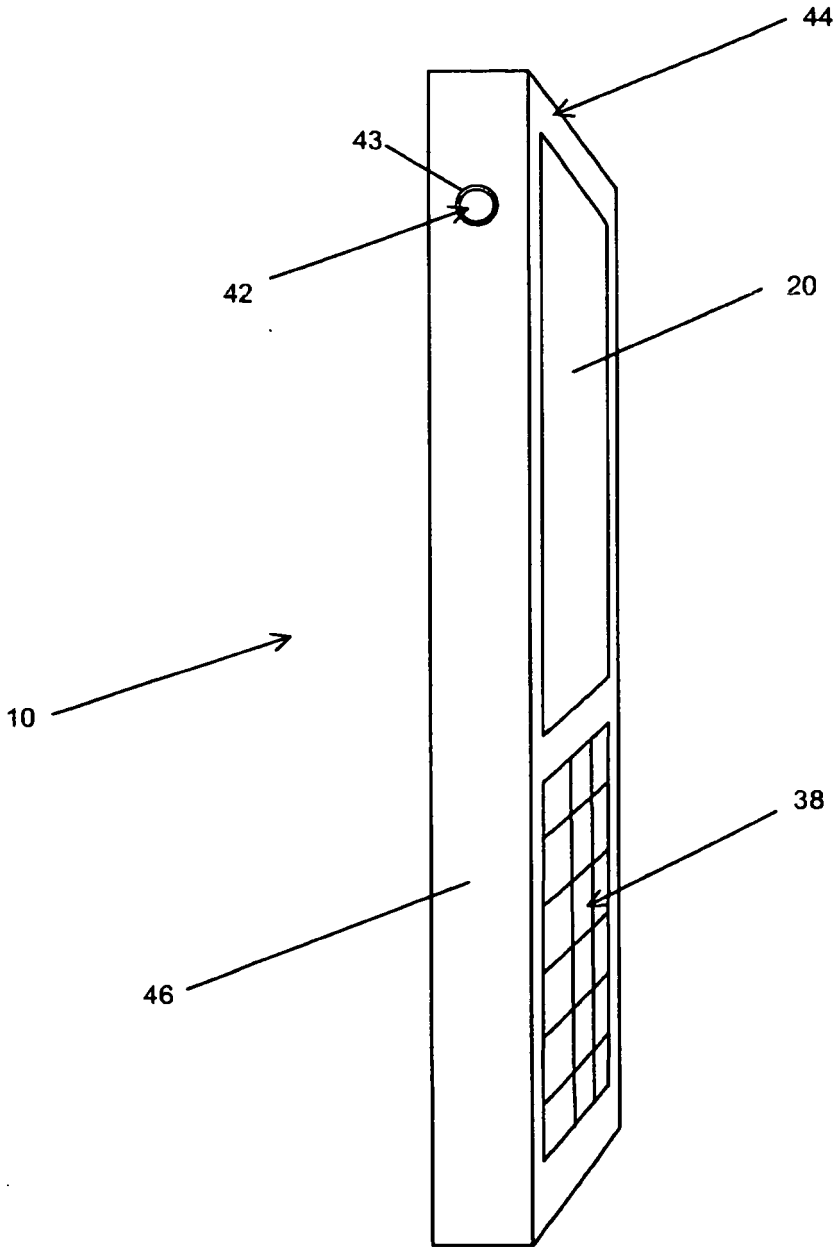

FIG. 2

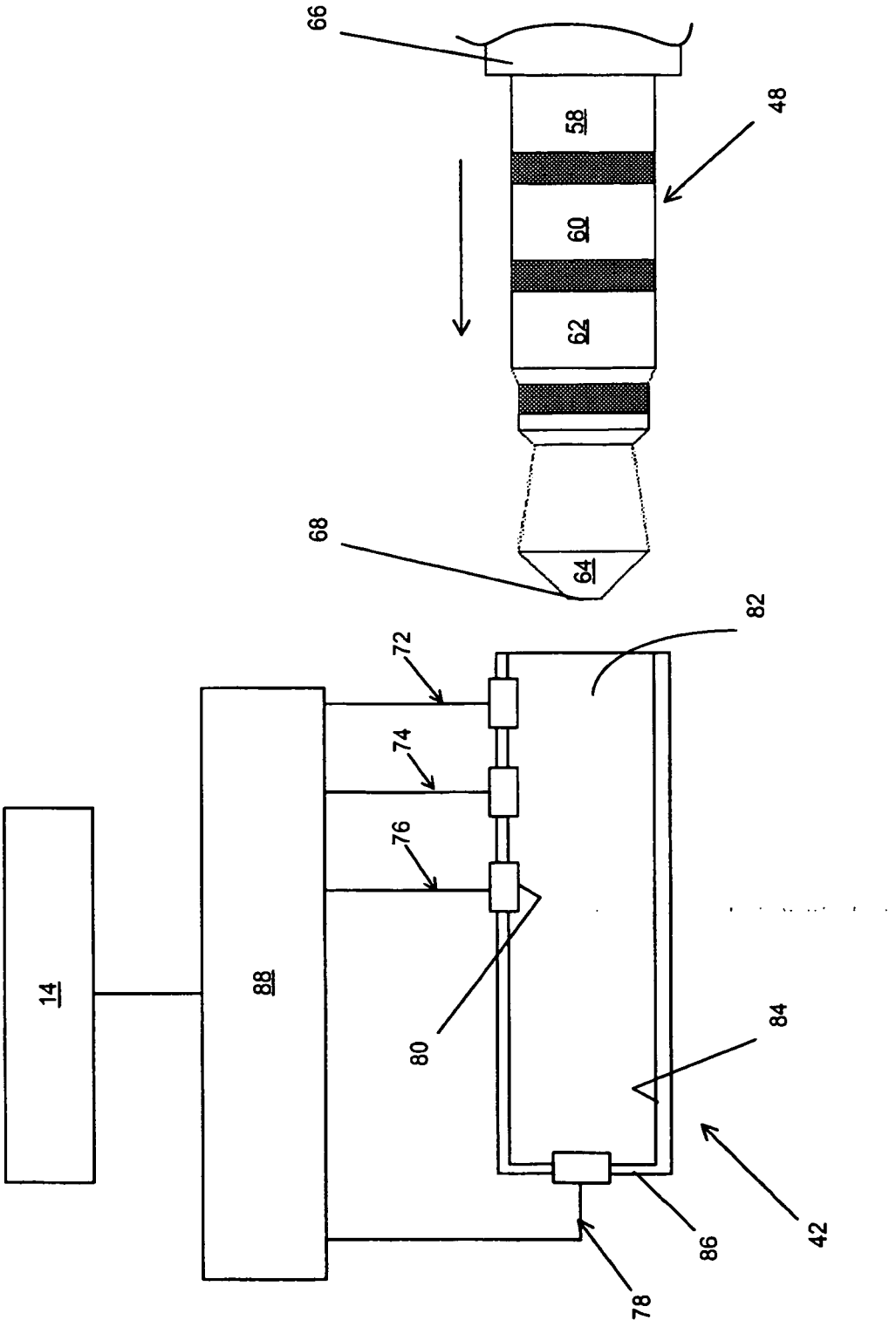

FIG. 3

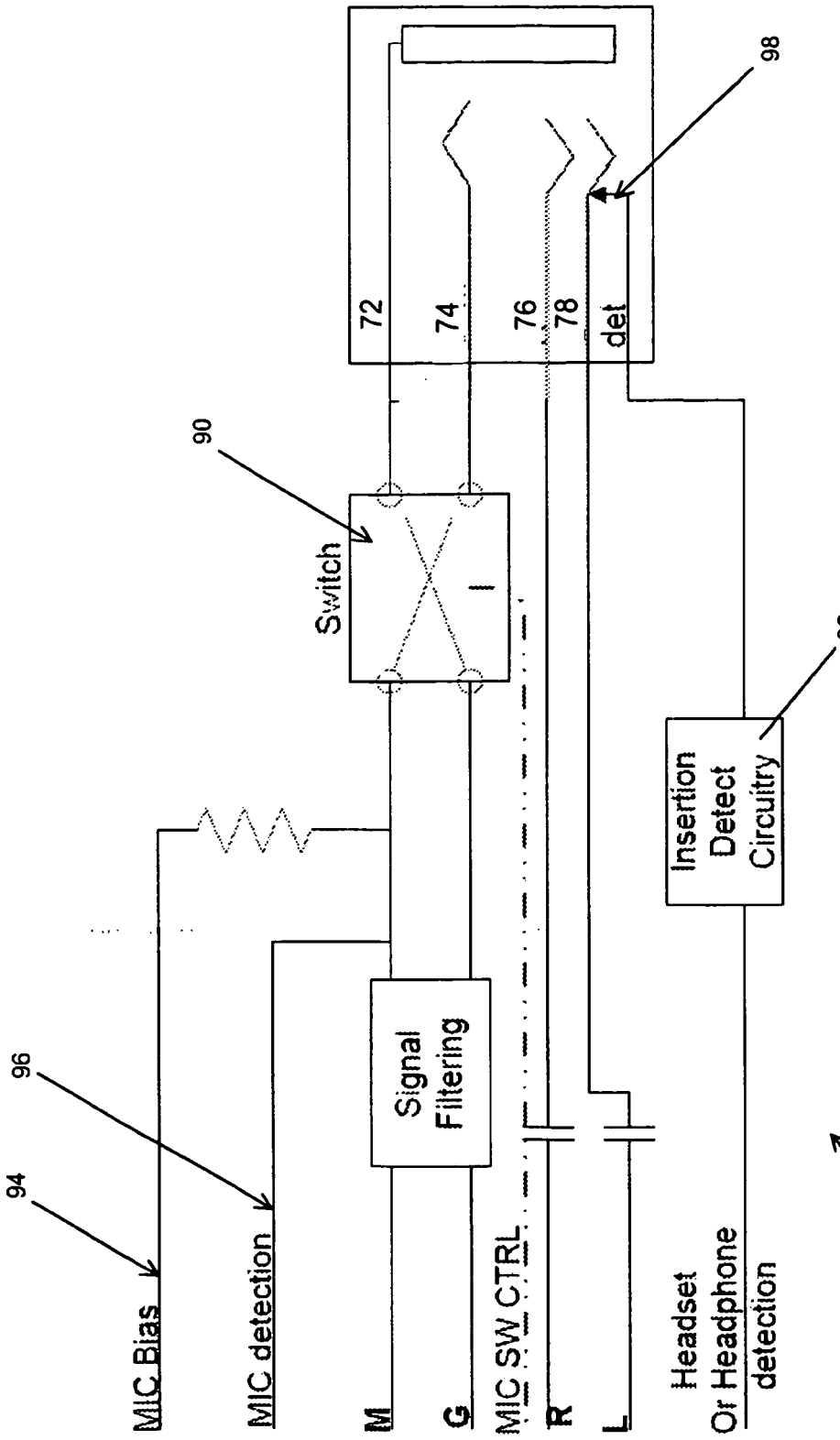
72
74
76
78
det
98
90
Switch
92
Insertion
Detect
Circuitry
96
94
Signal
Filtering
MIC Bias
MIC detection
M
G
MIC SW CTRL
R
L
Headset
Or Headphone
detection
88

FIG. 4

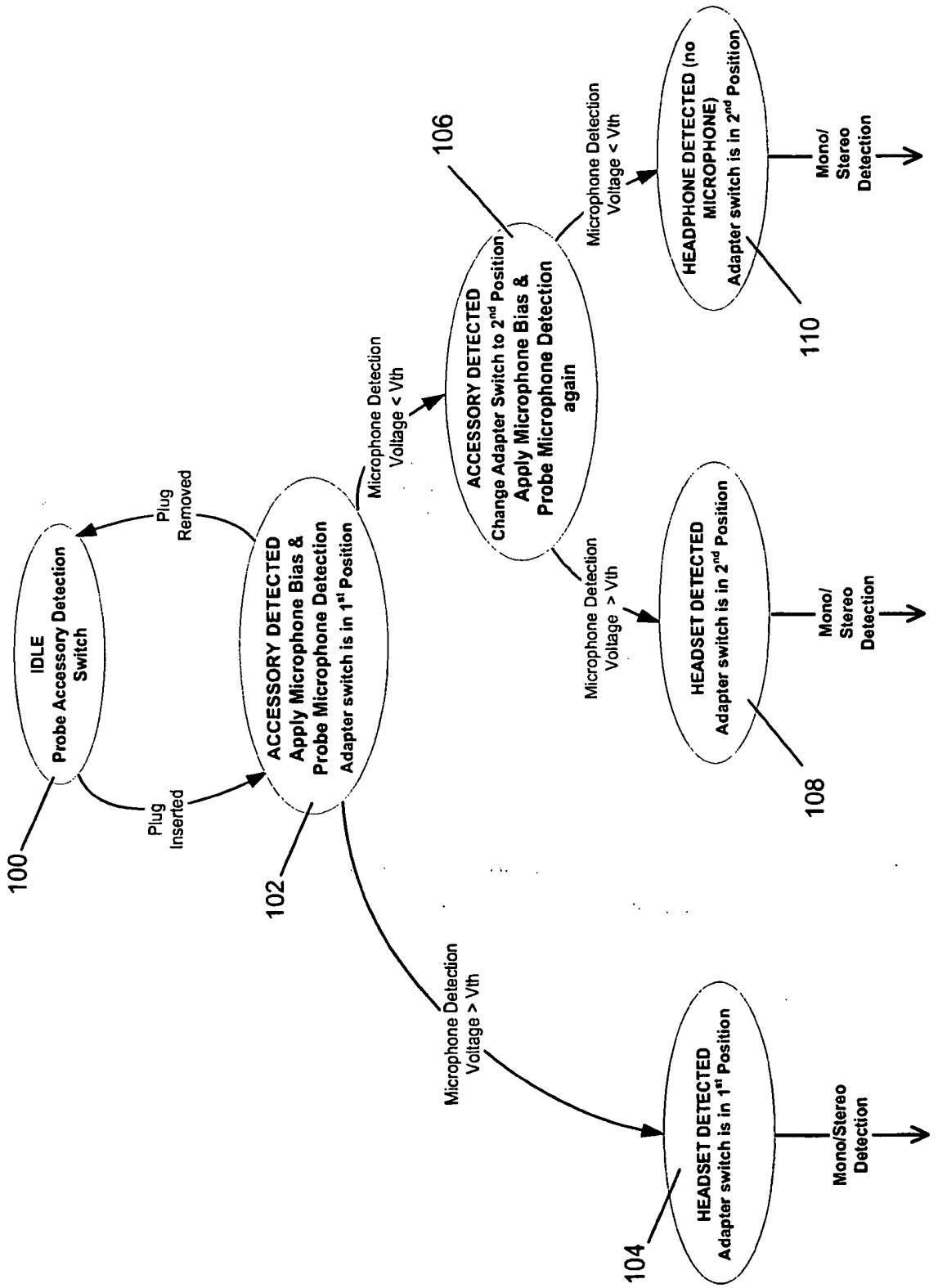
IDLE
Probe Accessory Detection Switch
100
Plug Inserted
Plug Removed
ACCESSORY DETECTED
Apply Microphone Bias & Probe Microphone Detection
Adapter switch is in 1st Position
102
Microphone Detection Voltage < Vth
ACCESSORY DETECTED
Change Adapter Switch to 2nd Position
Apply Microphone Bias & Probe Microphone Detection again
106
Microphone Detection Voltage < Vth
HEADPHONE DETECTED (no MICROPHONE)
Adapter switch is in 2nd Position
110
Mono/ Stereo Detection
Microphone Detection Voltage > Vth
HEADSET DETECTED
Adapter switch is in 2nd Position
108
Mono/ Stereo Detection
Microphone Detection Voltage > Vth
HEADSET DETECTED
Adapter switch is in 1st Position
104
Mono/Stereo Detection

FIG. 5

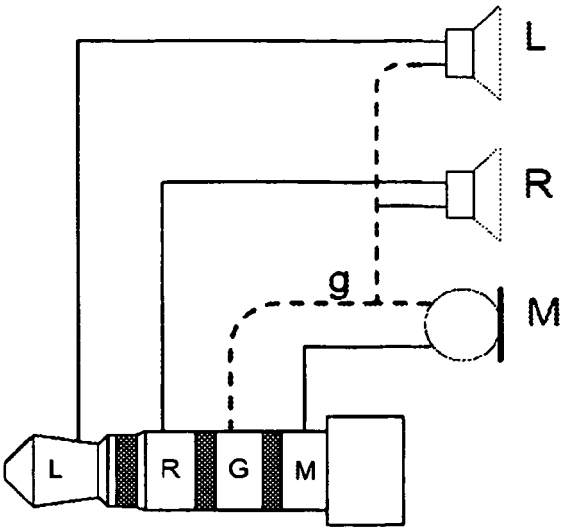

FIG. 6

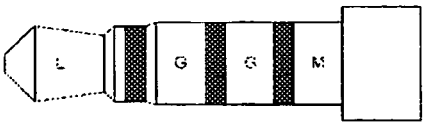

FIG. 7

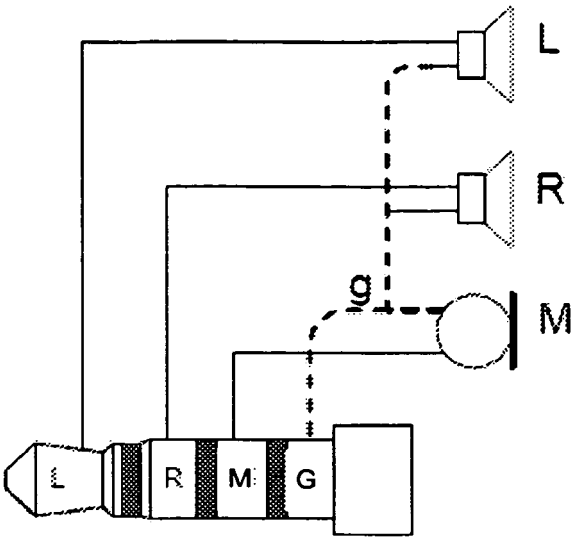

FIG. 8

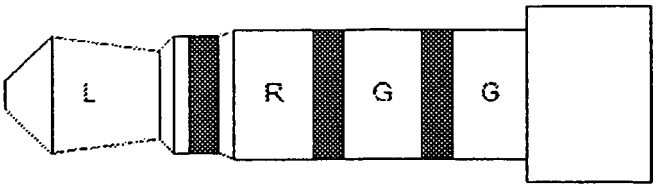

FIG. 9

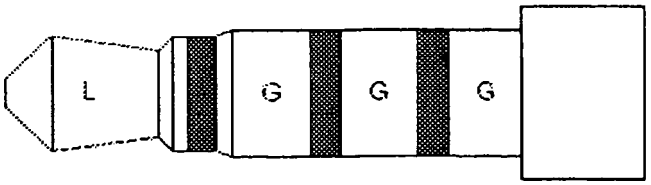

FIG. 10

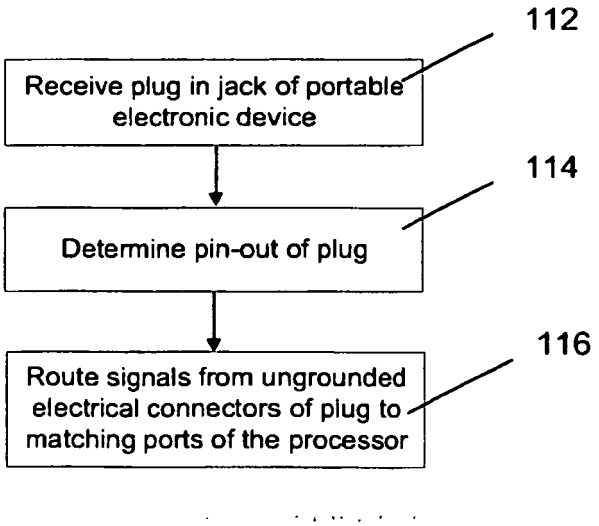
112
Receive plug in jack of portable electronic device
114
Determine pin-out of plug
116
Route signals from ungrounded electrical connectors of plug to matching ports of the processor

FIG. 11

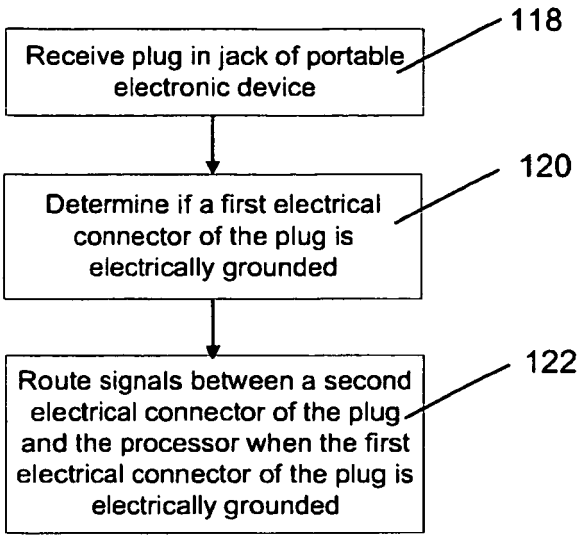
Receive plug in jack of portable electronic device
118
Determine if a first electrical connector of the plug is electrically grounded
120
Route signals between a second electrical connector of the plug and the processor when the first electrical connector of the plug is electrically grounded
122

FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 20070104332 A1 **[0006]**