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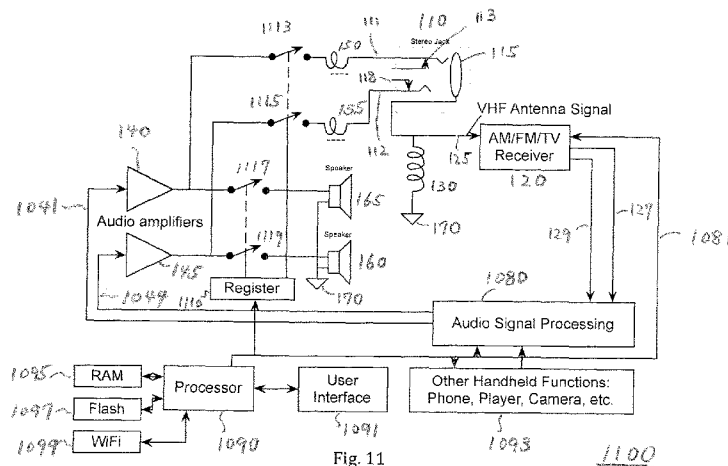


Fig. 11

(57) **Abstract:** The present disclosure is directed to an apparatus for receiving broadcast signals with a headphone antenna. The apparatus comprising a broadcast signal receiver (120), including a tuner and a demodulator, the broadcast signal receiver (120) having input (125) and output (127; 129) points, the input point (125) receiving over-the-air broadcast RF signals and the output point (127; 129) providing an audio output signal; a connector (110) having first (115) and second (111; 112) contacts, the first contact (115) coupled between an antenna external to the apparatus and the input point (125) operative to provide the over-the-air broadcast RF signals for the receiver (120), the first contact (115) being a sole point internal to the apparatus providing the over-the-air broadcast RF signals for the receiver (120), the connector (110) operative to provide an audio signal for an external audio sound reproduction device via the second contact (111; 112); an audio speaker (160; 165) internal to the apparatus operative to reproduce an acoustic audio sound from the audio output signal; and a signal selector (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119) coupled between the output point (127; 129) of the receiver (120) and the second contact (111; 112) of the connector (110) and the audio speaker (160; 165) operative to provide the audio output signal selectively for one of the external audio sound reproduction device and the audio speaker (160; 165) in response to a selection made by a user, wherein the

[Continued on next page]

connector (110) includes a switching structure automatically selecting the external audio reproduction device for the audio output signal when the antenna is connected to the connector, and the signal selector (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119) overrides the automatic selection of the external audio reproduction device in response to user's selection of the audio speaker (160; 165).

AN APPARATUS FOR RECEIVING BROADCAST SIGNALS WITH A HEADPHONE ANTENNA

CROSS REFERENCE TO RELATED APPLICATIONS

5 The present application is related to the co-pending, commonly owned patent applications: PCT Application No. PCT/US20XX/XXXXXX entitled "An Antenna Connector Plug," having an international filing date of XXXXXXXX (Attorney Docket No. PU120173);

TECHNICAL FIELD

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 The present application discloses an antenna connector plug suitable for an apparatus for receiving broadcast signals with a headphone antenna and an apparatus for receiving broadcast signals with a headphone antenna.

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BACKGROUND OF THE INVENTION

 Today, on mobile audio devices, a stereo headset, including a connector plug, conductive wires, and a pair of headphones, is often used for reproducing audio sounds as well as for receiving over-the-air broadcast RF signals. Such a dual-use
20 headset is referred as a "headphone antenna" in this application. Furthermore, the mobile audio devices described herein may receive and/or process analog and/or digital audio signals as well as analog and/or digital video signals. Such audio devices include, but are not limited to, for example, so-called "smart phones." The over-the-air broadcast RF signals may be analog broadcast signals, such as AM/FM
25 radio signals, and/or digital broadcast signals, such as ATSC, ATSC M/H, ATSC 3.0, DVB-T, DVB-H, DVB-T2, or DVB-T2Lite television signals.

 A problem arises when a user of such a mobile audio device wishes to listen to over-the-air broadcast programs with built-in audio speakers. This is because, typical conventional audio devices are designed to select automatically a headphone audio
30 output (i.e., to de-select the built-in audio speakers automatically) when a headphone antenna is inserted into the audio output connector jack, which also functions as a broadcast RF signal input terminal. Since the headphone antenna is the only device

that receives over-the-air broadcast RF signals, a user is dictated to use the headset (not the built-in audio speakers) as an audio sound reproduction device. As a result, the user cannot enjoy listening to over-the-air broadcast programs with the built-in audio speakers. Providing an additional antenna in the audio device is not a desirable solution under the cost conscious manufacturing environment today.

SUMMARY OF THE INVENTION

In accordance with one aspect of an embodiment, an antenna connector plug is provided. The connector plug comprises an electrode having a cylindrical-shape conductive member coupled to an antenna element, the electrode capable of being inserted into a connector jack of an apparatus, the connector jack having first and second contacts, the first contact providing an input point for RF signals for the apparatus, the second contact providing an audio signal output point for the apparatus, the connector jack having a switch operative in response to a physical insertion of a plug; and a plurality of spring contacts having a spring structure associated with the electrode operative to hold an electrical contact between the electrode and the first contact of the connector jack, wherein the electrode is capable of being inserted into the connector jack without rendering the switch operative.

In accordance with another aspect of the embodiment, an antenna connector plug is provided. The connector plug comprises first means, such as an electrode, having a cylindrical-shape conductive member coupled to an antenna element for being inserted into a connector jack of an apparatus, the connector jack having first and second contacts, the first contact providing an input point for RF signals for the apparatus, the second contact providing an audio signal output point for the apparatus, the connector jack having a switch operative in response to a physical insertion of a plug; and a plurality of second means, such as spring contacts, having a spring feature associated with the first means for holding an electrical contact between the first means and the first contact of the connector jack, wherein the first means is capable of being inserted into the connector jack without rendering the switch operative.

In accordance with another aspect of an embodiment, an apparatus is provided. The apparatus comprises a broadcast signal receiver, including a tuner and a demodulator, the broadcast signal receiver having input and output points, the input point receiving over-the-air broadcast RF signals and the output point providing an

audio output signal; a connector having first and second contacts, the first contact coupled between an antenna external to the apparatus and the input point operative to provide the over-the-air broadcast RF signals for the receiver, the first contact being a sole point internal to the apparatus providing the over-the-air broadcast RF signals for the receiver, the connector operative to provide an audio signal for an external audio sound reproduction device via the second contact; an audio speaker internal to the apparatus operative to reproduce an acoustic audio sound from the audio output signal; and a signal selector coupled between the output point of the receiver and the second contact of the connector and the audio speaker operative to provide the audio output signal selectively for one of the external audio sound reproduction device and the audio speaker in response to a selection made by a user, wherein the connector includes a switching structure automatically selecting the external audio reproduction device for the audio output signal when the antenna is connected to the connector, and the signal selector overrides the automatic selection of the external audio reproduction device in response to user's selection of the audio speaker.

In accordance with another aspect of the embodiment, an apparatus is provided. An apparatus comprises first means, such as a broadcast signal receiver, including a tuner and a demodulator, the first means having input and output points, the input point receiving over-the-air broadcast RF signals and the output point providing an audio output signal; second means, such as a connector, having first and second contacts, the first contact coupled between an antenna external to the apparatus and the input point operative to provide the over-the-air broadcast RF signals for the first means, the first contact being a sole point internal to the apparatus providing the over-the-air broadcast RF signals for the first means, the second means operative to provide the audio output signal for an external audio sound reproduction device via the second contact; third means, such as an audio speaker, internal to the apparatus for reproducing an acoustic audio sound from the audio output signal; and fourth means, such as a signal selector coupled between the output point of the first means and the second contact of the second means and the third means for providing the audio output signal selectively for one of the external audio sound reproduction device and the third means in response to a selection made by a user, wherein the fourth means exhibits a switching function automatically selecting the external audio reproduction device for the audio output signal when the antenna is connected to the

connector, and the fourth means overrides the automatic selection of the external audio reproduction device in response to user's selection of the third means.

BRIEF DESCRIPTION OF THE DRAWINGS

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These, and other aspects, features and advantages of the present disclosure will be described or become apparent from the following detailed description of the preferred embodiments, which is to be read in connection with the accompanying drawings.

10 In the drawings, wherein like reference numerals denote similar elements throughout the views:

Fig. 1 depicts a relevant portion of schematic diagram for a conventional mobile audio device using a headphone set as an RF antenna for receiving over-the-air broadcast signals;

15 Fig. 2 depicts a typical conventional stereo headphone antenna having a 3.5 mm mini-stereo headphone plug;

Fig. 3 depicts a physical structure of an exemplary embodiment of an antenna in accordance with the present disclosure;

20 Fig. 4 depicts a magnified view of the physical structure of the body of the connector plug, used in conjunction with the antenna shown in Fig. 3, in accordance with the present disclosure;

Fig. 5 depicts a physical structure of the spring contact assembly, used on the body of the connector plug shown in Fig. 4, in accordance with the present disclosure;

25 Fig. 6 depicts an exemplary embodiment of a default configuration user-interface screen in accordance with the present disclosure;

Fig. 7 depicts an exemplary embodiment of a popup control window in accordance with the present disclosure;

30 Fig. 8 depicts, in the form of a flowchart, the operations of a piece of exemplary popup control application software when a headphone antenna plug is inserted in accordance with the present disclosure;

Fig. 9 depicts, in the form of flowchart, the operations of a piece of exemplary popup control application software when a headphone antenna plug is removed in accordance with the present disclosure;

5 Fig. 10 depicts, in the form of schematic diagram, a relevant portion of an exemplary embodiment of mobile audio device, which uses a headphone antenna for receiving over-the-air broadcast signals in accordance with the present disclosure;

Fig. 11, in the form of schematic diagram, a relevant portion of another exemplary embodiment of mobile audio device, which uses a headphone antenna for receiving over-the-air broadcast signals in accordance with the present disclosure;

10 Fig. 12 depicts, in the form of schematic diagram, an exemplary embodiment of circuitry for the detection of the insertion of a headphone antenna plug in accordance with the present disclosure;

Fig. 13 depicts, in the form of schematic diagram, another exemplary embodiment of circuitry for the detection of the insertion of a headphone antenna plug
15 in accordance with the present disclosure; and

Fig. 14 depicts, in the form of schematic diagram, another exemplary embodiment of circuitry for the detection of the insertion of a headphone antenna plug in accordance with the present disclosure.

20 DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT(S)

In order to solve the problem of automatic selection of the headphone set for audio sound reproduction while a headphone plug is being inserted in the audio/RF connector jack, this application discloses two solutions. The first solution is a
25 connector plug, which is capable of interface between the audio/RF connector jack of a mobile audio device and an RF antenna element without rendering the audio device to select its headphone audio output jack automatically. The connector plug for an RF antenna disclosed herein is advantageous since a user can solve the above-mentioned problem with a conventional mobile audio device designed for the use of conventional
30 antenna headphones. The second solution is an audio device capable of letting a user override its automatic selection of the headphone audio output jack, while a headphone plug is being inserted in the audio/RF connector jack, in response to user's selection.

All examples and conditional language recited herein are intended for informational purposes to aid the reader in understanding the principles of the disclosure and the concepts contributed by the inventors to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions. Although the exemplary embodiments refer to a stereo headphone (i.e., a stereo headset having a pair of earphones), the inventive concept disclosed herein can be implemented in conjunction with a single monaural earphone or a headset including a microphone. The first solution is explained below in reference to Figs. 1 to 5. More specifically, Figs. 1 and 2 describe a typical conventional audio device designed for the use of headphone antenna and a typical conventional headphone antenna, respectively, as background information. Figs. 3 to 5 describe an exemplary embodiment of the first inventive solution disclosed herein.

Turning to Fig. 1, a relevant portion of the conventional implementation of audio device 100 using a headphone antenna is described. When headphone antenna plug 200 is inserted into stereo headphone jack 110, built-in speakers 160 and 165 are automatically decoupled from audio amplifiers 140 and 145, respectively, and a headphone antenna is automatically coupled to audio amplifiers 140 and 145, due to switches 113, 118 associated with stereo headphone jack 110. Then antenna element 270 in Fig. 2 is coupled to outer contact 115 of stereo headphone jack 110 via sleeve 235 of connector plug 200.

Outer contact 115 of stereo headphone jack 110 is coupled to AM/FM/TV receiver 120 via RF signal path 125. Matching inductor 130 is coupled between RF signal path and reference potential 170. Matching inductor 130 improves the impedance matching between headphone antenna element 270 and AM/FM/TV receiver 120 and provides sufficient RF isolation between RF signal path 125 and reference potential 170. The value of matching inductor 130 may be, for example, 300nH. Audio output signal paths 127 and 129 are coupled to audio amplifiers 140 and 145, respectively. The output signal of audio amplifier 140 is coupled to inner contact 111 of stereo headphone jack 110 via ferrite bead 150, and the output signal of audio amplifier 145 is coupled to inner contact 112 of stereo headphone jack 110 via ferrite bead 155. Ferrite beads 150 and 155 provide sufficient RF isolation, for example an impedance of around $3K\Omega$ at 100MHz, between audio amplifiers 140 and 145 and antenna element 270 of headphone antenna 200 inserted in stereo headphone jack 110.

Tuning to Fig. 2, typical conventional stereo headphone antenna 200 having 3.5 mm mini-stereo headphone plug 250 is described. Headphone plug 250 has a cylindrical-shape conductive member, and the cylindrical-shape conductive member has three separate contact elements 239, 237, and 235—all of which are electrically separated by insulating rings 238 and 236. Contact element 239 is often described as “tip” and is coupled to audio signal wire 260, which usually carries the left-hand channel signal for stereo audio signals. Contact element 237 is often described as “ring” and coupled to audio signal wire 265, which usually carries the right-hand channel signal for stereo audio signals. Contact element 235 is often described as “sleeve” and is connected to an RF antenna element 270. RF antenna element 270 provides a ground potential in a range of audio signal frequency but functions as an RF antenna in a range of RF signal frequencies due to matching inductor 130. In this example, audio-RF cable 275 includes three wires 260, 265, and 270.

Turning to Fig. 3, a physical structure of an exemplary embodiment of an antenna connector plug in accordance with the present disclosure is described. RF antenna 300 includes connector plug 350 and antenna 375. Antenna 375 is covered by solid non-conductive material, and conductive antenna element 270 is embedded in antenna 375. Cylindrical-shape sleeve 335 has a predetermined size (for example, 3.5mm in diameter and 4.5mm in length), to have sufficient electrical contact with outer contact 115 of stereo headphone jack 110 but is not long enough to render switches 113 and 118 associated with stereo headphone jack 110 operative. As a result, mobile audio device 100 is able to receive over-the-air broadcast RF signals via its audio output jack while a user can enjoy the sound of the broadcast programs with the built-in speakers of audio device 100. A plurality of spring contacts 340 are located on sleeve 335 to reinforce the connection between connector plug 350 and stereo jack 110 and to ensure an electrical connection between sleeve 335 and outer contact 115 of stereo jack 110. Antenna 370 can be a solid object as shown in Fig. 3, or a wire, or a jointed or telescoping device.

Turning to Fig. 4, a magnified view of the physical structure of body 400 of connector plug 350 in accordance with the present disclosure is described. Body 400 is formed of cylindrical-shape sleeve 335 and spring contact assembly 500 that has a lip 470 and a plurality of spring contacts 340. Sleeve 335 is typically produced out of a brass base with an oxidation resistant conductive plating such as nickel or gold, and spring contact assembly 500 could be stamped out of a spring material, such as

Beryllium Copper or could be assembled out of spring leaf components and a cap and retaining ring (not shown). A plurality of channels 450 are provided to guide respective ones of a plurality of spring contacts 340, and lip 470 is provided at the end of sleeve 335 to hold a plurality of spring contacts 340 in place. Between lip 470 and main portion 480 of sleeve 335, the material is removed so that spring contact assembly 500 that holds lip 470, a plurality of spring contacts 340, and a plurality of detents 550 may remain at or inside the 3.5mm diameter of sleeve 335 of the body of plug 350.

Turning to Fig. 5, a physical structure of spring contact assembly 500 in accordance with the present disclosure is described. Spring contact assembly 500 provides a reliable electrical and mechanical contact between plug body 400 and outer contact 115 of stereo jack 110 of audio device 100 and can also be plated with an oxidation resistant conductive plating, such as gold. Spring assembly 500 snaps on plug body 400 to form a completed connector.

The second inventive solution is explained in reference to Figs. 6 -14 below. An exemplary embodiment of mobile audio device disclosed herein provides a user with a total control capability of headphone antenna operations as well as the selection of audio sound output devices, regardless of a headphone antenna plug is being inserted in its audio connector jack. As to conventional mobile audio devices, the default operation is to select a headphone set as the sound output device with the insertion of the headset plug. However, since all modern portable devices incorporate some kind of microprocessor-based control, with a software configuration of the device, a user could preset the device's default settings as well as could override the default settings themselves. These operating functions could be implemented in a software application for the device or could also be coded in keystrokes or via switches where such an interface is supported. These operations may include various aspects of audio/antenna functions—for example, (1) routing the audio signal to a built-in speaker(s), (2) routing the audio signal to a headset, (3) routing the audio signal to both a built-in speaker(s) and a headset, (4) enabling the broadcast RF signal reception with the insertion of a headset.

Turning to Fig. 6, an exemplary embodiment of operating configuration user interface (UI) screen 600 in accordance with the present disclosure is described. On default setting screen 600, a user can preconfigure the audio sound output device when headphone antenna plug 200 is inserted into the audio device. Here, indicators

in different colors show the default selections of the operation. A user can change the selection(s) by tapping the indicator button(s), each of which functions as a toggle “on” (green) - “off” (red) switch. More specifically, indicators 610 (in red) and 615 (in green) under the column “Default No Earphone” on a touch screen panel indicate that the built-in speaker is selected as the audio sound output device when no headphone antenna plug is inserted. Indicators 620 (in green) and 625 (in red) under the column “Default Earphone” indicate that the earphone is selected when the headphone antenna plug is inserted as the audio sound output device. Touching “cancel” button 695 would cause the current settings to remain unchanged while touching “save” button 691 would make the change(s) in the memory of the system if any change(s) has (have) been made. Furthermore, a user may add new application software to the device by touching “Add App” button 690. New application software may add additional control functions to screen 600 and could also be triggered from the headphone antenna plug insertion. In addition, a user may enable (indicator button 650 in green) or disable (indicator button 650 in red) popup window 700 shown in Fig. 7 by touching button 650. The default functions and the optional available selections may be summarized in the following table:

Function	Default Selection (example)	Available Selections
Headphone	Becomes audio sound output device on plug insertion	Does nothing on plug insertion; Becomes audio sound output device on plug insertion
Built-in Speaker(s)	Disabled on plug insertion	Disabled on plug insertion; Remains enabled on plug insertion
Receivers (FM, ATSC, NTSC, DVB, etc.)	Enabled on plug insertion	Enable on plug insertion; Enable manually; Block enabling if no headphone antenna inserted

Turning to Fig. 7, an exemplary embodiment of a popup control window in accordance with the present disclosure is described. When the popup feature is enabled (e.g., popup indicator 650 is green on screen 600), popup window 700 appears upon the insertion of the headphone plug. Popup control window 700 allows a user to override the default settings. Here, popup control window 700 appears for a few seconds and then disappears, leaving the audio device operating in the default selections preselected by a user. A user can change the default settings with the

available selections shown on popup control window 700 while popup window 700 is activated. For example, a user can select an audio output device and a piece of application software used for the reception of particular broadcast programs (e.g., FM Radio or Television). Any changes made on popup control window 700 are saved in the memory by touching save button 791. If any new application software had been added on default configuration setting screen 600, such new application software would also show up on popup control window 700.

Turning to Fig. 8, in the form of flowchart, the operations of a piece of exemplary popup control application software in accordance with the present disclosure are described. In step 801, the insertion of a headphone antenna plug is detected. In step 803, the preselected activation status of the popup control application software is determined. If the status is not to activate the popup control feature, then the operation is terminated, and no operational changes will occur automatically in response to the insertion of the headphone antenna plug. If the status is to activate the popup control feature, then the system proceeds to step 805. In step 805, the popup application software is activated, and popup control window 700 opens to accept user input. In step 806, the current configuration settings related to the headphone antenna are saved in the memory. In steps 808 and 822, the user input is identified during a predetermined time interval. A typical time interval may be a few seconds. In step 824, if no user input is identified, any optional application software starts after the predetermined time interval is past. In step 826, the default settings take effect. However, if any user input is identified, a user may update the existing settings in step 810. As to this particular exemplary embodiment, no predetermined time interval is provided for a user to change the settings. That is, there is no timeout for popup control window 700 once any user input is identified. It might be desirable to include a timeout feature here if popup control window 700 was falsely be triggered. Once all changes are made, a user needs to save the changes by touching "save" button 791. In step 814, any optional application software starts after the changes are saved. In step 816, the new settings take effect.

Should the headphone antenna be unplugged while the application software that started on plugging the headphone antenna are still running, all of such application software would be closed automatically. Then the saved configuration settings would be restored. As a result, the audio configuration would match the configuration saved when the headphone antenna plug was inserted last time. More

specifically, turning to Fig. 9, at step 901, a removal of headphone antenna plug is identified. At step 903, the system determines whether any application software is enabled. If no application software is running, the process ends. If any application software is running, all of such software is closed. At step 907, the last saved
5 configuration settings are restored.

Turning to Fig. 10, in the form of schematic diagram, a relevant portion of an exemplary embodiment of mobile audio device, which uses a headphone antenna for receiving over-the-air broadcast signals in accordance with the present disclosure is described. In this exemplary embodiment, switches 113 and 118 associated with
10 stereo jack 110 are not utilized. The selection of audio sound output device is made by a user with user interface device 1091, processor 1090, and audio signal processor 1080 along with proper application software. Here, a user can override the default selection of headphone antenna as an audio sound reproduction device so that the user may enjoy over-the-air broadcast programs with built-in speaker 165 and 160 while
15 the headphone antenna is plugged in stereo jack 110. User interface device 1091 may include a touch panel display screen, which functions with the application software as described above in conjunction with Figs. 6 and 7. It may be desirable to have additional independent amplifiers 1047 and 1049 for built-in speakers 165 and 160, respectively.

Turning to Fig. 11, in the form of schematic diagram, a relevant portion of another exemplary embodiment of mobile audio device, which uses a headphone antenna for receiving over-the-air broadcast signals in accordance with the present disclosure is described. Here, the audio signal-processing path is simplified. Only a single pair of amplifiers 140 and 145 is utilized. Analog multiplexer or relay
20 functions may be implemented on the audio amplifier outputs. For example, an array of software-controlled switches 1113, 1115, 1117, and 1119 are provided for the control of audio sound reproduction devices, such as headphones and speakers. Switches 113, 1115, 1117, and 1119 may be implemented as a MOSFET switches, CMOS analog switches, relay, or other means operative to connect or disconnect the
25 audio sound reproduction devices from the outputs of amplifiers 140 and 145, respectively.

Figs. 12 – 14 describe three exemplary embodiments for the detection of the insertion of a headphone antenna plug. Turning to Fig. 12, in the form of schematic diagram, an exemplary embodiment of circuitry for the detection of the insertion of a
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headphone antenna plug in accordance with the present disclosure is described. Plug sensing circuit 1200 includes stereo jack with isolated switch 1216. For example, the mid mount power jack model "SJ-3506" manufactured by CUI INC® has an isolated switch suitable for sensing the presence of a plug without interfering with audio or antenna functions. Isolated switch 1216 is coupled between the controller, such as processor 1090, and a point of reference potential 170.

Turning to Fig. 13, in the form of schematic diagram, another exemplary embodiment of circuitry for the detection of the insertion of headphone antenna plug in accordance with the present disclosure is described. Plug sensing circuit 1300 includes voltage comparator 1325, which senses the breaking of speaker disconnecting switch 113 by the insertion of a headphone antenna plug. In the event that audio amplifier 140 is capacitively coupled, resistance 1315 provides a relatively low impedance path (e.g., $1\text{K}\Omega$) to ground potential 170. Resistance 1315 would not be needed in the event where a DC coupled amplifier or an output transformer is utilized. The voltage divider, formed by resistance elements 1310 (e.g., $1\text{K}\Omega$) and 1317 (e.g., $100\text{K}\Omega$), insures that comparator 1325 stays in the "off" state while switch 113 is closed. Resistance element 1210 (e.g., $10\text{K}\Omega$) pulls up the voltage at switch element 117 when the plug is inserted (i.e., when switch 113 is open). As a result, comparator 1325 changes to the "on" state. The activation of comparator 1325 indicates to the controller, such as processor 1090, the insertion of a headphone antenna plug.

Turning to Fig. 14, in the form of schematic diagram, another exemplary embodiment of circuitry for the detection of the insertion of headphone antenna plug in accordance with the present disclosure is described. Audio amplifier 140 is capacitively coupled to stereo jack 110 via capacitor 1415. Resistance elements 1310 and 1315 form a voltage divider. The voltage divider creates at a negative input terminal of voltage comparator 1325 a voltage level that exceeds a positive peak level of the audio signal but that is less than a voltage level of positive reference potential (V_{dd}) minus a negative peak level of the audio signal. Comparator 1325 outputs a steady "high" output when coupling capacitor 1415 is charged to near the positive reference voltage level (V_{dd}). However, when a headphone antenna plug is inserted, a relatively low impedance DC path (less than 600Ω), provided by a headphone antenna, causes coupling capacitor 1325 to discharged through the headphone

antenna, which creates a popping sound. As a result, the output of comparator 1325 becomes "low," which indicates the insertion of the headphone antenna plug in stereo jack 110.

5 It should be understood that the elements shown in the Figs. 6 – 14 might be implemented in various forms of hardware, software or combinations thereof. Preferably, these elements are implemented in a combination of hardware and software on one or more appropriately programmed general-purpose devices, which may include a processor, memory and input/output interfaces.

10 The present description illustrates the principles of the present disclosure. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the disclosure and are included within its scope. For example, audio sources may be various forms of audio information, including but not limited to, an FM receiver, a TV receiver, processor D/A converters for digital media playback and
15 telecommunication applications, a tape playback subsystems, a microphone (either embedded in the audio device or external to the audio device), a comfort noise generator.

All statements herein reciting principles, aspects, and embodiments of the disclosure, as well as specific examples thereof, are intended to encompass both
20 structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

Thus, for example, it will be appreciated by those skilled in the art that the
25 block diagrams presented herein represent conceptual views of illustrative circuitry embodying the principles of the disclosure. Similarly, it will be appreciated that any flow charts, flow diagrams, state transition diagrams, pseudocode, and the like represent various processes that can be substantially represented in computer readable media and so executed by a computer or processor, whether or not such computer or
30 processor is explicitly shown. The computer readable media and code written on can be implemented in a transitory state (signal) and a non-transitory state (e.g., on a tangible medium such as CD-ROM, DVD, Blu-Ray, Hard Drive, flash card, or other type of tangible storage medium).

The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware, including a processor (not shown in the drawings herein) capable of executing software in association with appropriate software. The functions of such a processor may be provided by a single
5 dedicated processor, by a single shared processor, or by a plurality of individual processors, some of which may be shared. Moreover, explicit use of the term “processor” or “controller” should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation, digital signal processor (“DSP”) hardware, read only memory (“ROM”) for storing software,
10 random access memory (“RAM”), and nonvolatile storage.

Other hardware, conventional and/or custom, may also be included. Similarly, any switches shown in the figures are conceptual only. Their function may be carried out through the operation of program logic, through dedicated logic, through the interaction of program control and dedicated logic, or even manually, the particular
15 technique being selectable by the implementer as more specifically understood from the context.

Although embodiments which incorporate the teachings of the present disclosure have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings.
20 It is noted that modifications and variations can be made by persons skilled in the art in light of the above teachings. All such modifications and variations are considered within the scope of the concepts disclosed herein and the claims that follow.

CLAIMS

1. An apparatus comprising:

- a broadcast signal receiver (120), including a tuner and a demodulator,
5 said broadcast signal receiver (120) having input (125) and output (127; 129) points,
said input point (125) receiving over-the-air broadcast RF signals and said output
point (127; 129) providing an audio output signal;
a connector (110) having first (115) and second (111; 112) contacts,
said first contact (115) coupled between an antenna external to said
10 apparatus and said input point (125) operative to provide said over-the-air broadcast
RF signals for said receiver (120), said first contact (115) being a sole point internal to
said apparatus providing said over-the-air broadcast RF signals for said receiver
(120),
said connector (110) operative to provide an audio signal for an external
15 audio sound reproduction device via said second contact (111; 112);
an audio speaker (160; 165) internal to said apparatus operative to
reproduce an acoustic audio sound from said audio output signal; and
a signal selector (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119)
coupled between said output point (127; 129) of said receiver (120) and said second
20 contact (111; 112) of said connector (110) and said audio speaker (160; 165)
operative to provide said audio output signal selectively for one of said external audio
sound reproduction device and said audio speaker (160; 165) in response to a
selection made by a user, wherein
said connector (110) includes a switching structure automatically selecting
25 said external audio reproduction device for said audio output signal when said antenna
is connected to said connector, and
said signal selector (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119)
overrides said automatic selection of said external audio reproduction device in
response to user's selection of said audio speaker (160; 165).

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2. An apparatus comprising:

- first means (120) including a tuner and a demodulator, said first means
(120) having input (125) and output (127, 129) points, said input point (125) receiving

over-the-air broadcast RF signals and said output point (127, 129) providing an audio output signal;

second means (110) having first (115) and second (111, 112) contacts,

5 said first contact (111) coupled between an antenna external to said apparatus and said input point (125) operative to provide said over-the-air broadcast RF signals for said first means (120), said first contact (115) being a sole point internal to said apparatus providing said over-the-air broadcast RF signals for said first means (120),

10 said second means (110) operative to provide said audio output signal for an external audio sound reproduction device via said second contact (111, 112);

third means (160, 165) internal to said apparatus for reproducing an acoustic audio sound from said audio output signal; and

15 fourth means (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119) coupled between said output point (111, 112) of said first means (120) and said second contact (111, 112) of said second means (110) and said third means (160, 165) for providing said audio output signal selectively for one of said external audio sound reproduction device and said third means (160, 165) in response to a selection made by a user, wherein

20 said fourth means (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119) exhibits a switching function automatically selecting said external audio reproduction device for said audio output signal when said antenna is connected to said connector (110), and

25 said fourth means (1080, 1090, 1091, 1110; 1113, 1115, 1117, 1119) overrides said automatic selection of said external audio reproduction device in response to user's selection of said third means (160, 165).

1/7

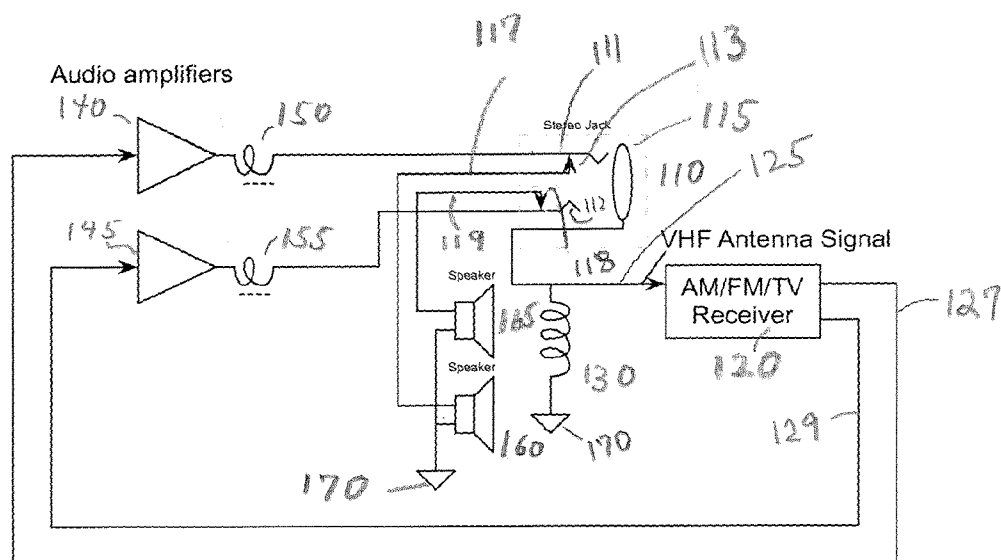


Fig. 1 (Prior Art)

100

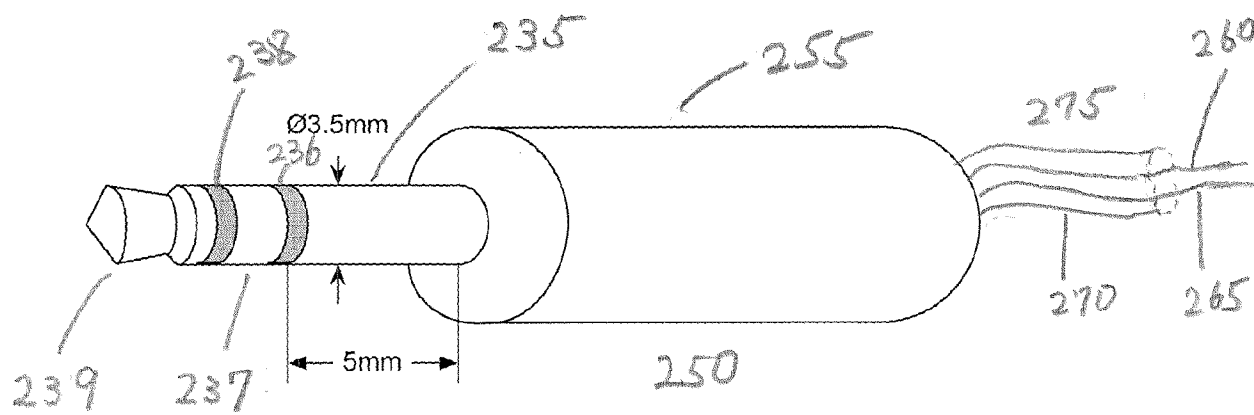


Fig. 2 prior Art

200

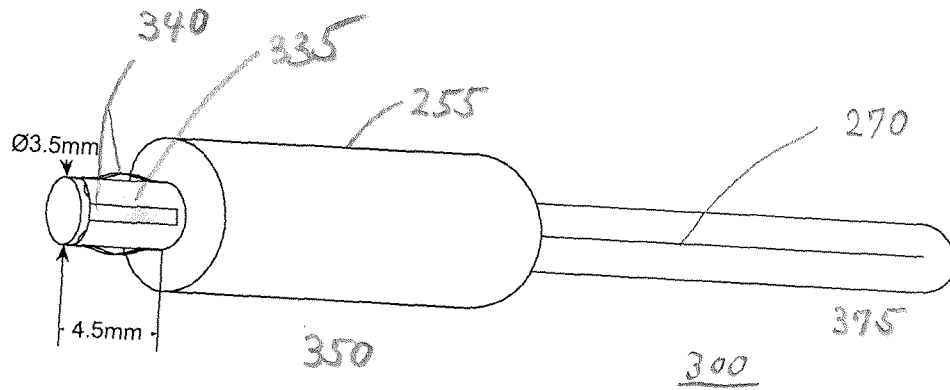


Fig. 3

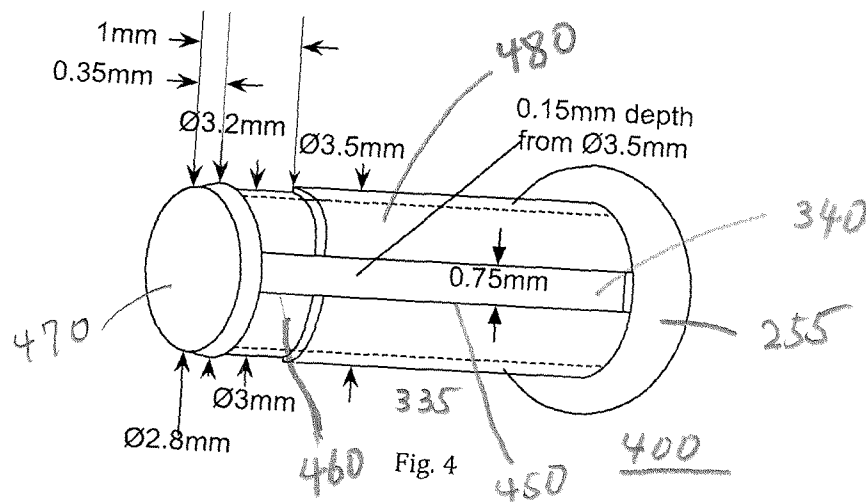


Fig. 4

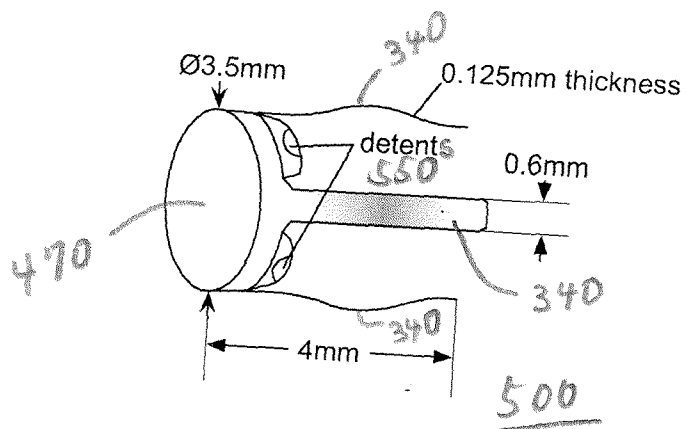


Fig. 5

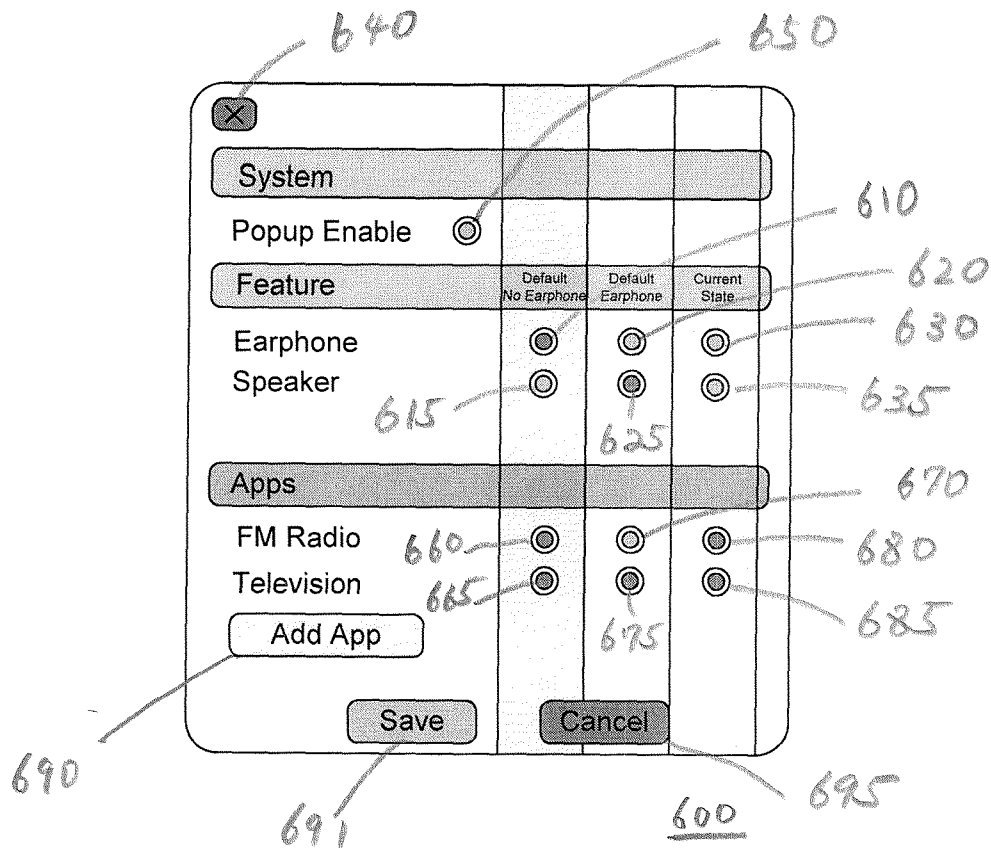


Fig. 6

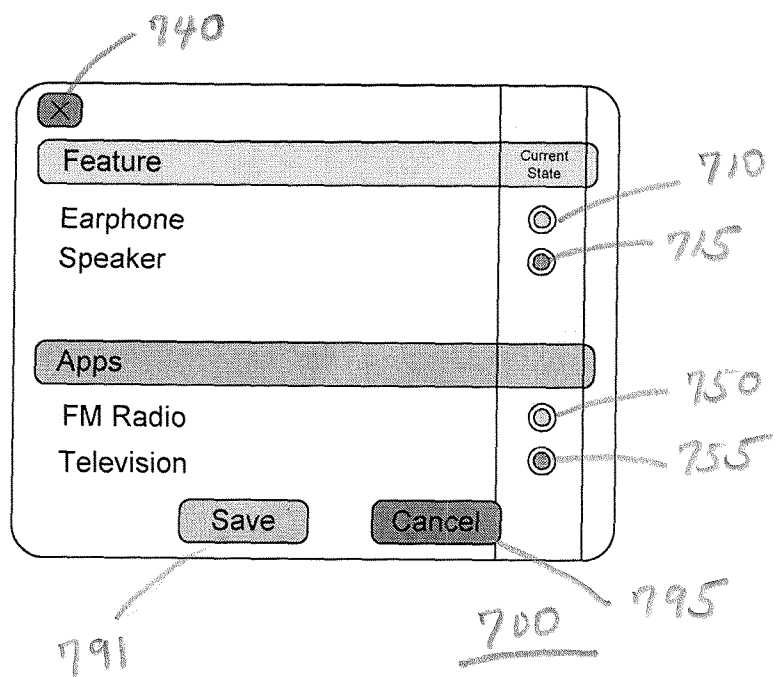


Fig. 7

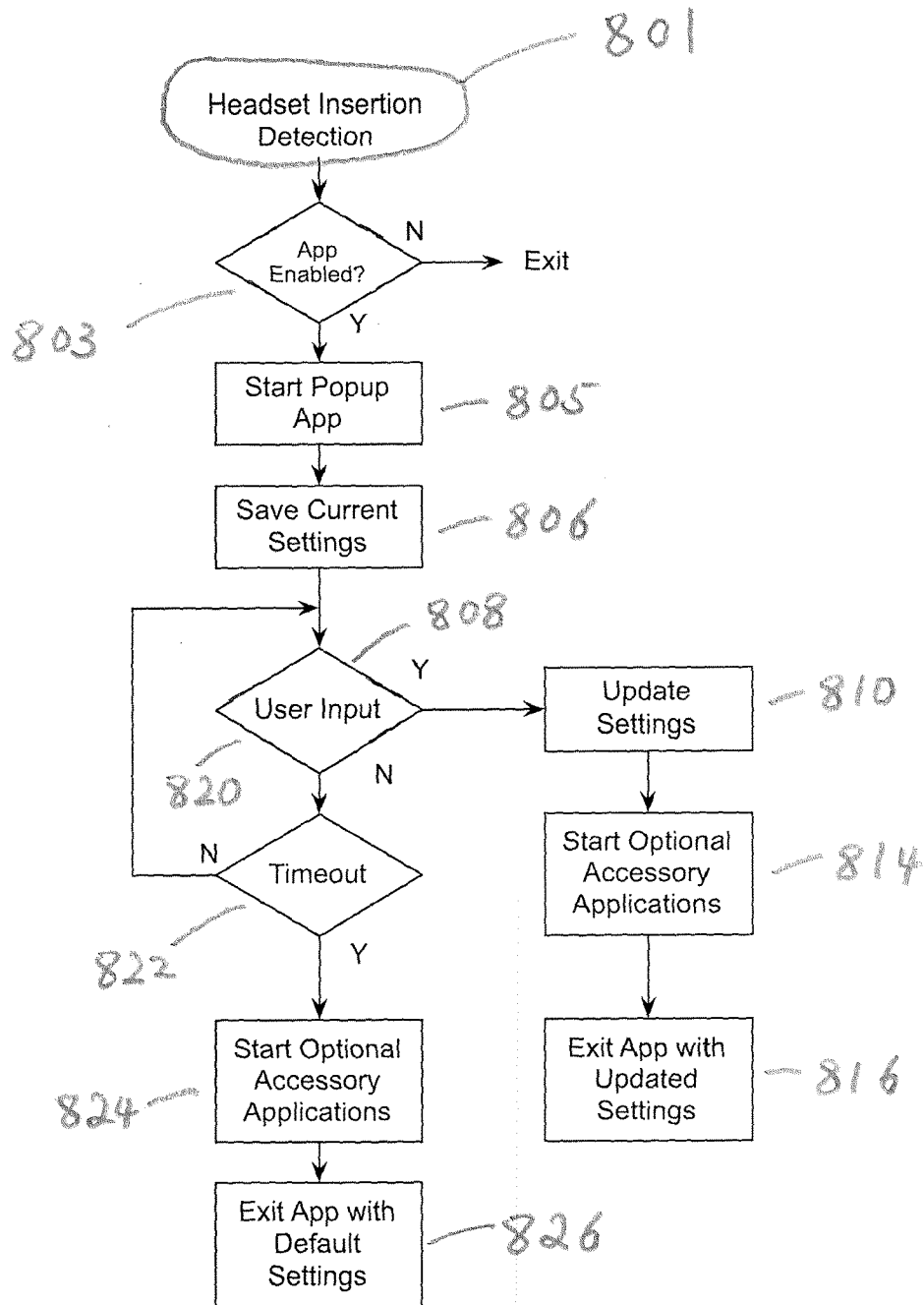


Fig. 8

800

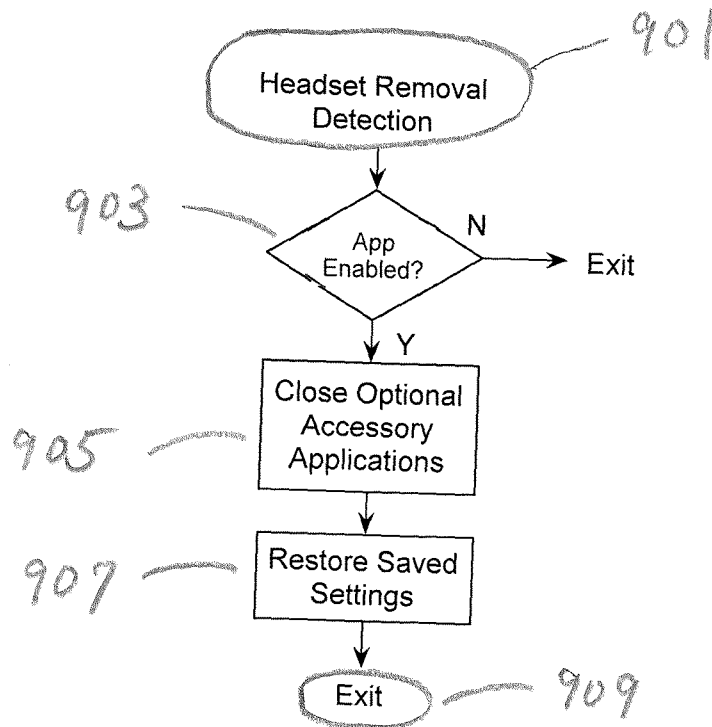


Fig. 9

900

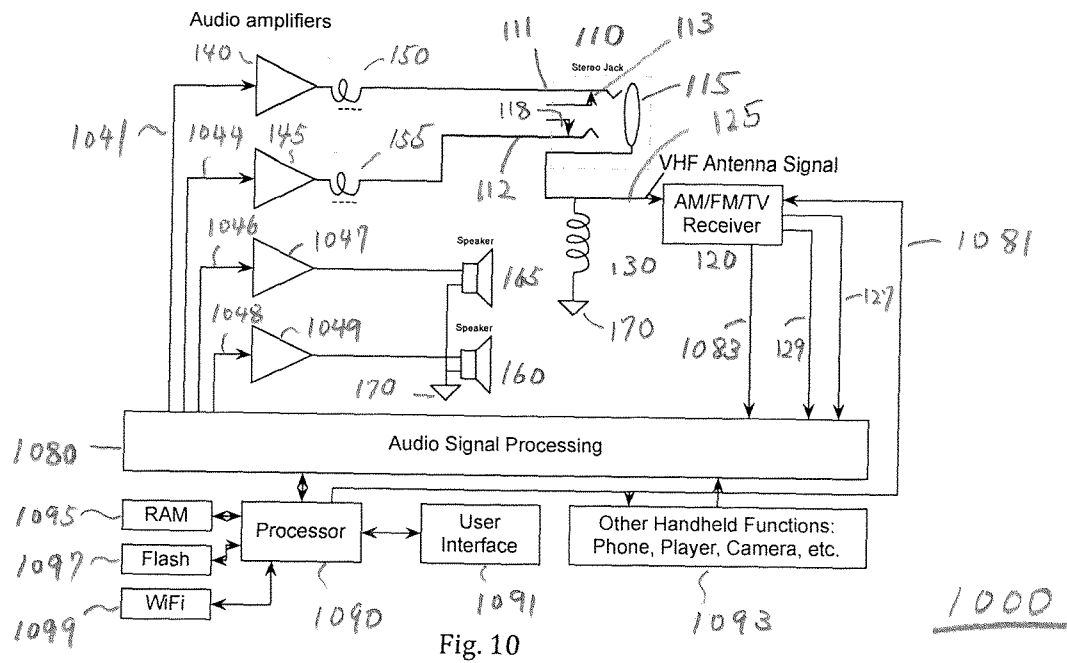


Fig. 10

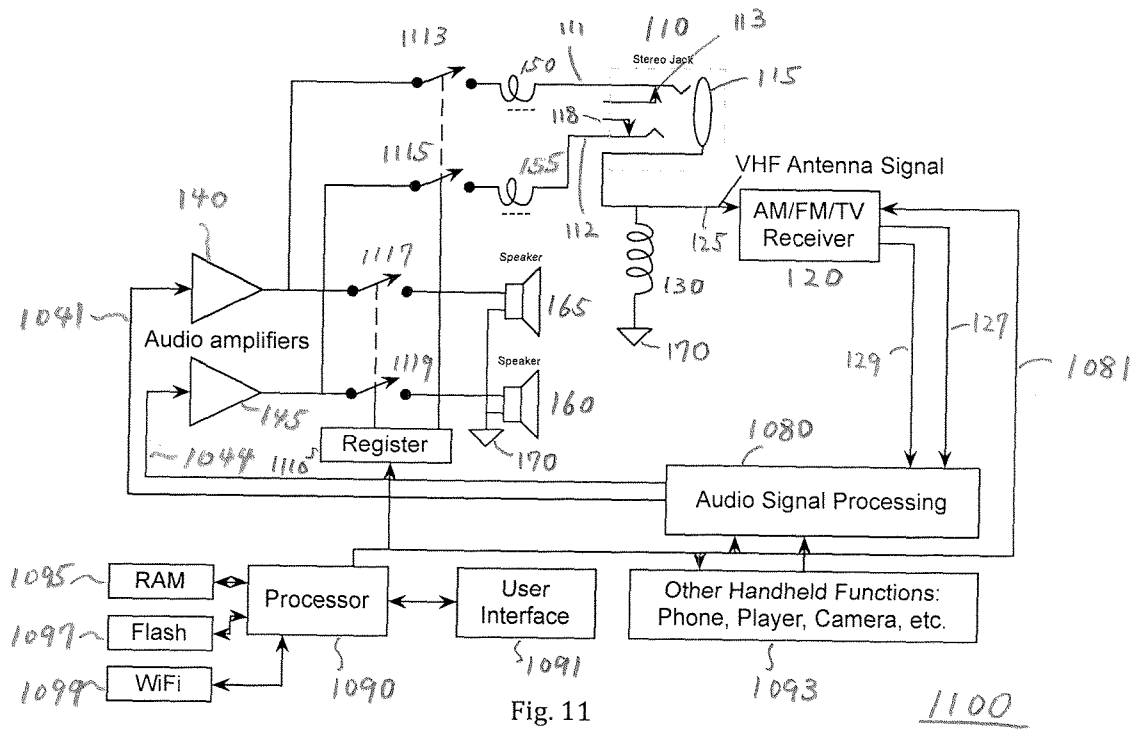


Fig. 11

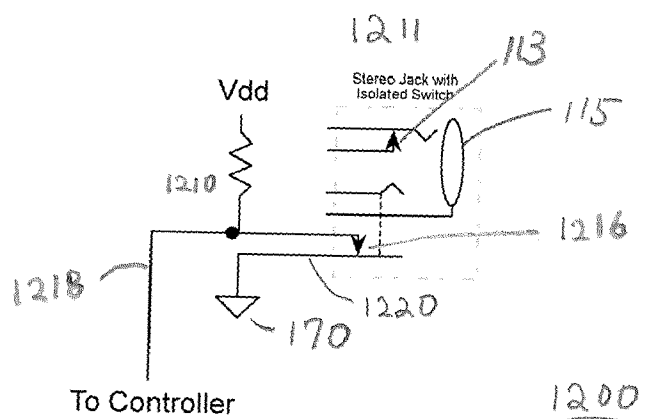


Fig. 12

1200

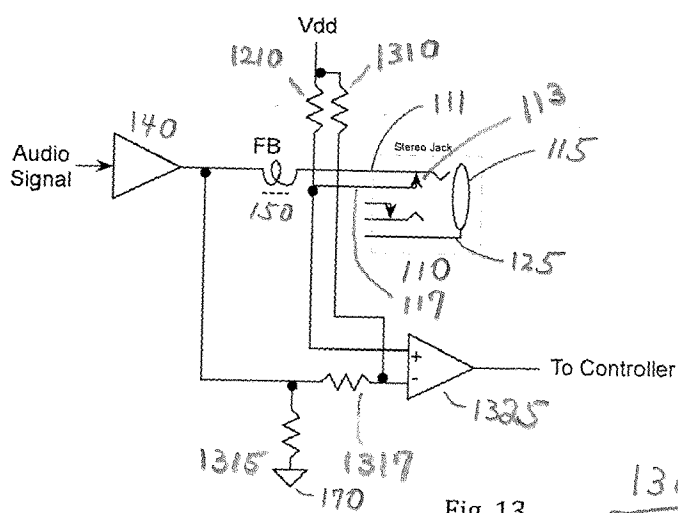


Fig. 13

1300

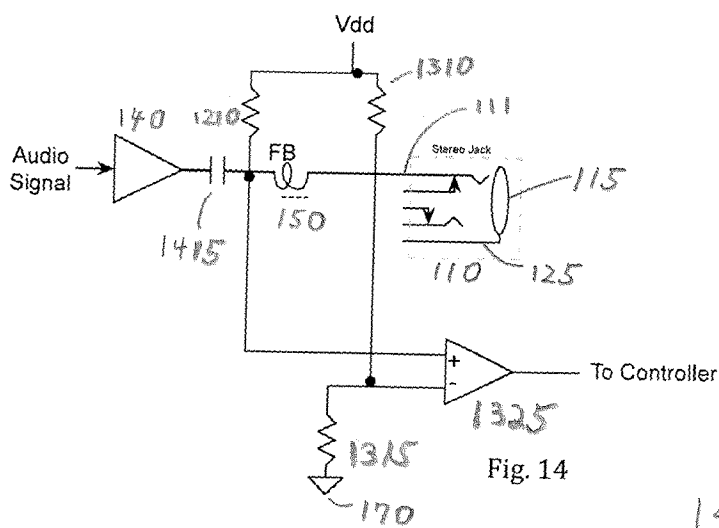


Fig. 14

1400

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/072263

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04B1/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/286436 A1 (ISOBE YASUHIKO [JP] ET AL) 13 December 2007 (2007-12-13) abstract paragraph [0009] paragraph [0015] paragraph [0021] paragraph [0025] paragraph [0100] - paragraph [0112]; figures 1,2,7 paragraph [0131] - paragraph [0136]; figures 13,14	1,2
X	JP 2006 108941 A (SONY CORP) 20 April 2006 (2006-04-20) abstract ----- -/-	1,2



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

9 September 2013

Date of mailing of the international search report

17/09/2013

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/072263

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/171976 A1 (CAIMI FRANK M [US]) 5 July 2012 (2012-07-05) abstract -----	1,2
Y	JP 2001 251697 A (AIWA CO) 14 September 2001 (2001-09-14) abstract -----	1,2
A	WO 2011/054228 A1 (ZTE CORP [CN]; SHEN SHAOWU [CN]) 12 May 2011 (2011-05-12) the whole document -----	1,2
A	EP 1 855 351 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 14 November 2007 (2007-11-14) the whole document -----	1,2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/072263

Patent document cited in search report			Publication date		Patent family member(s)			Publication date	
US 2007286436	A1	13-12-2007	US	2007286436	A1		13-12-2007		
			WO	2006064800	A1		22-06-2006		

JP 2006108941	A	20-04-2006	NONE						

US 2012171976	A1	05-07-2012	US	2012171976	A1		05-07-2012		
			WO	2012092236	A2		05-07-2012		

JP 2001251697	A	14-09-2001	NONE						

WO 2011054228	A1	12-05-2011	CN	102055490	A		11-05-2011		
			WO	2011054228	A1		12-05-2011		

EP 1855351	A1	14-11-2007	EP	1855351	A1		14-11-2007		
			JP	4961125	B2		27-06-2012		
			JP	2006279915	A		12-10-2006		
			WO	2006092913	A1		08-09-2006		
