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(54) **COMBINED SPEAKER AND AUDIO JACK**

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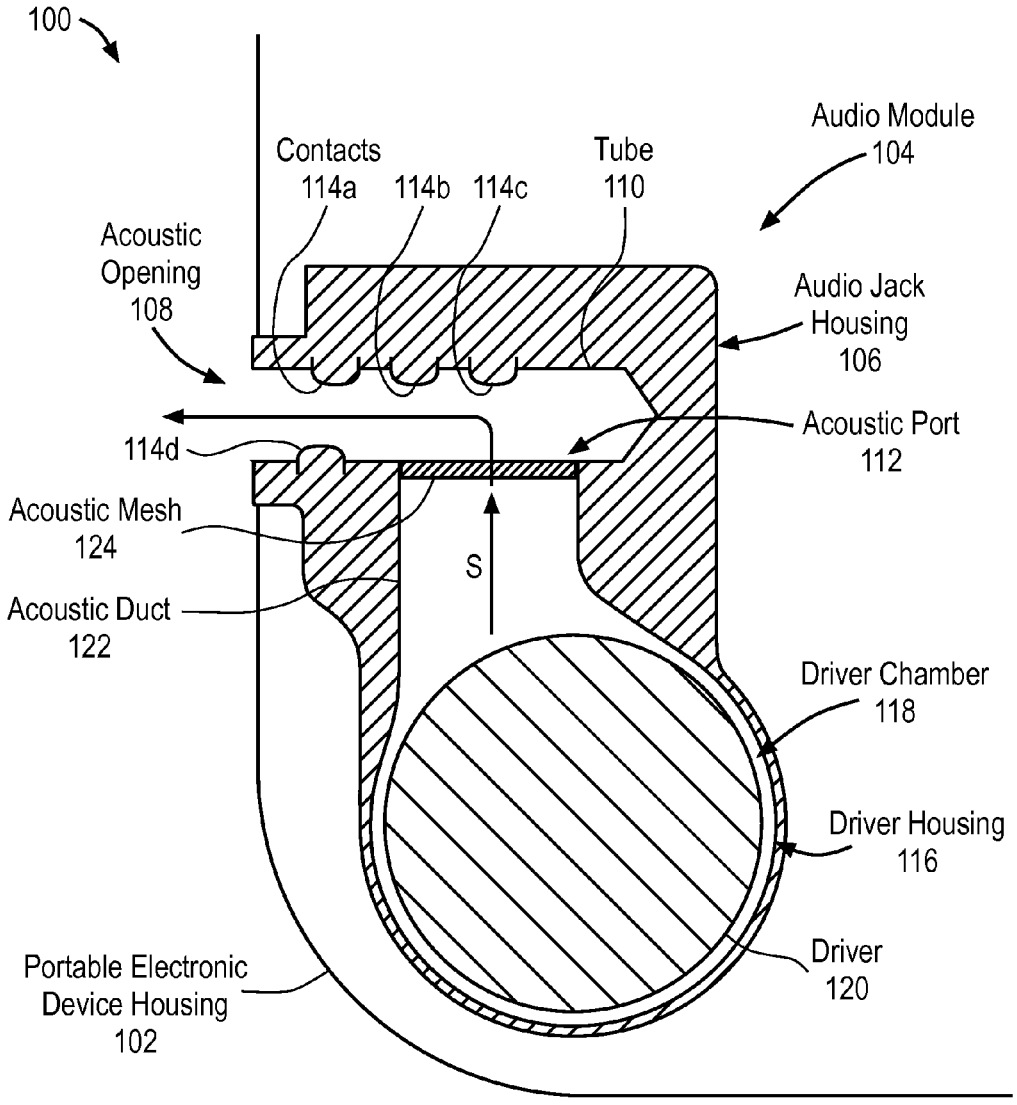
USPC **381/394**

(57) **ABSTRACT**

A speaker and audio jack module for a portable electronic device. The module includes an audio jack housing having a tube dimensioned to receive an audio plug. An acoustic port is formed through a side of the tube so as to acoustically connect a speaker housing having a speaker contained therein to the audio jack housing. The audio jack housing is capable of receiving an audio input when the audio plug is inserted therein and outputting an audio output from the speaker when the audio plug is removed.



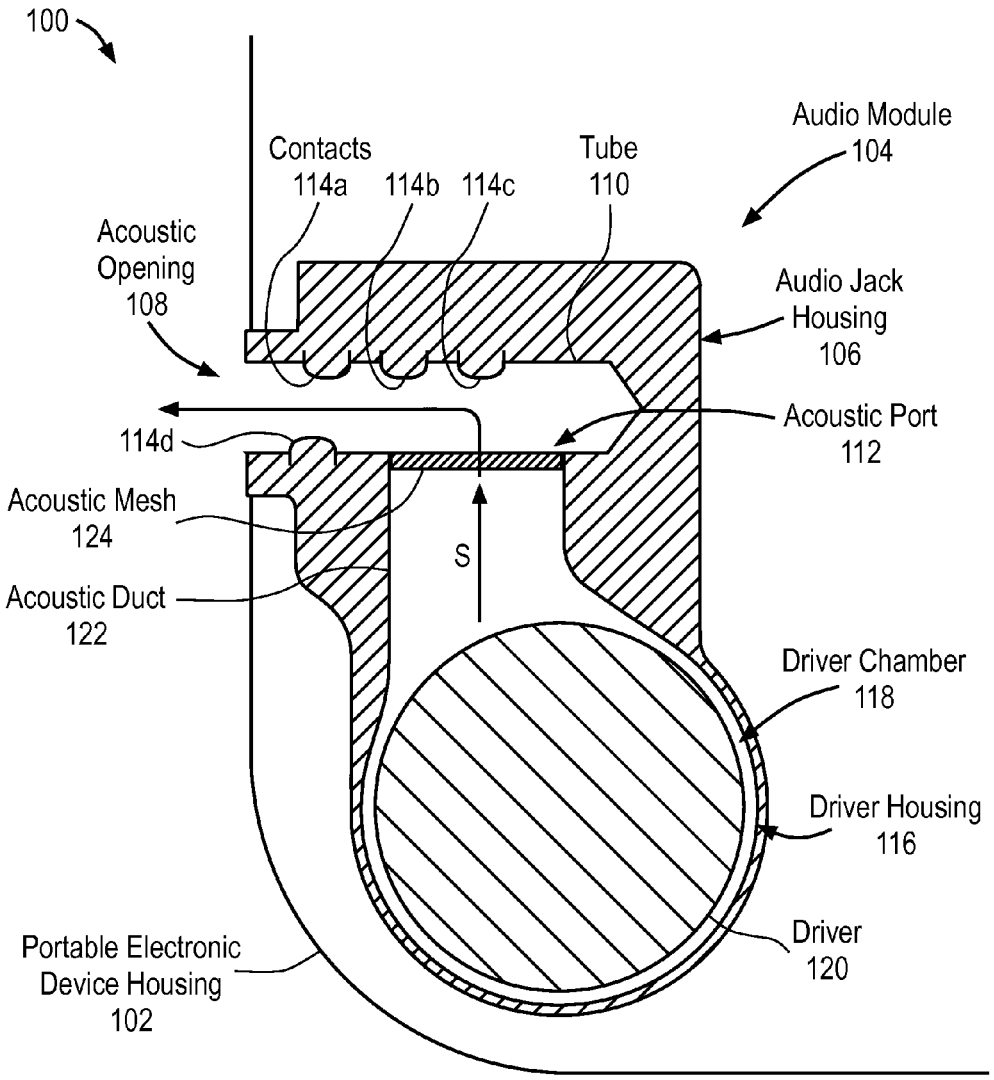

100
Audio Module
104
Contacts
114a
114b
114c
Tube
110
Acoustic
Opening
108
Audio Jack
Housing
106
Acoustic Port
112
114d
Acoustic Mesh
124
S
Acoustic Duct
122
Driver Chamber
118
Driver Housing
116
Driver
120
Portable Electronic
Device Housing
102

FIG. 1

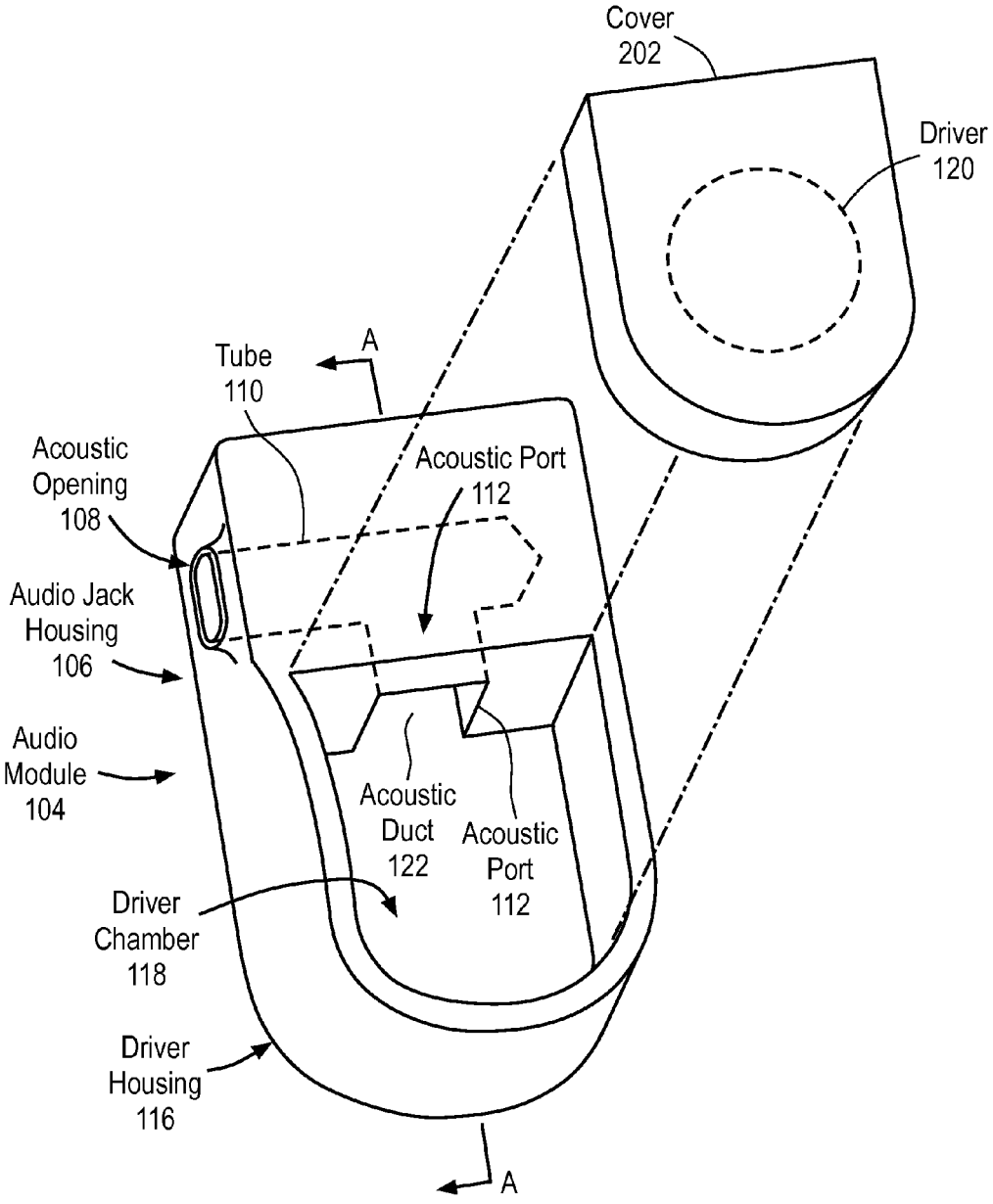

Cover
202
Driver
120
Tube
110
A
Acoustic
Opening
108
Acoustic Port
112
Audio Jack
Housing
106
Audio
Module
104
Acoustic
Duct
122
Acoustic
Port
112
Driver
Chamber
118
Driver
Housing
116
A

FIG. 2

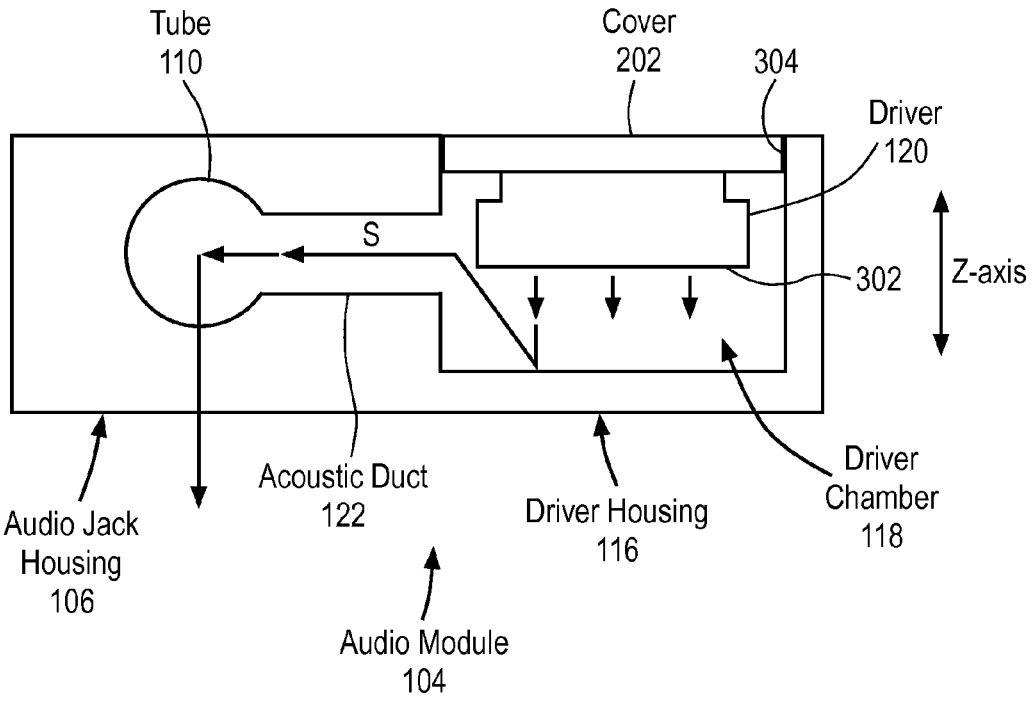

Tube
110
Cover
202
304
Driver
120
S
302
Z-axis
Acoustic Duct
122
Audio Jack
Housing
106
Driver Housing
116
Driver
Chamber
118
Audio Module
104

FIG. 3

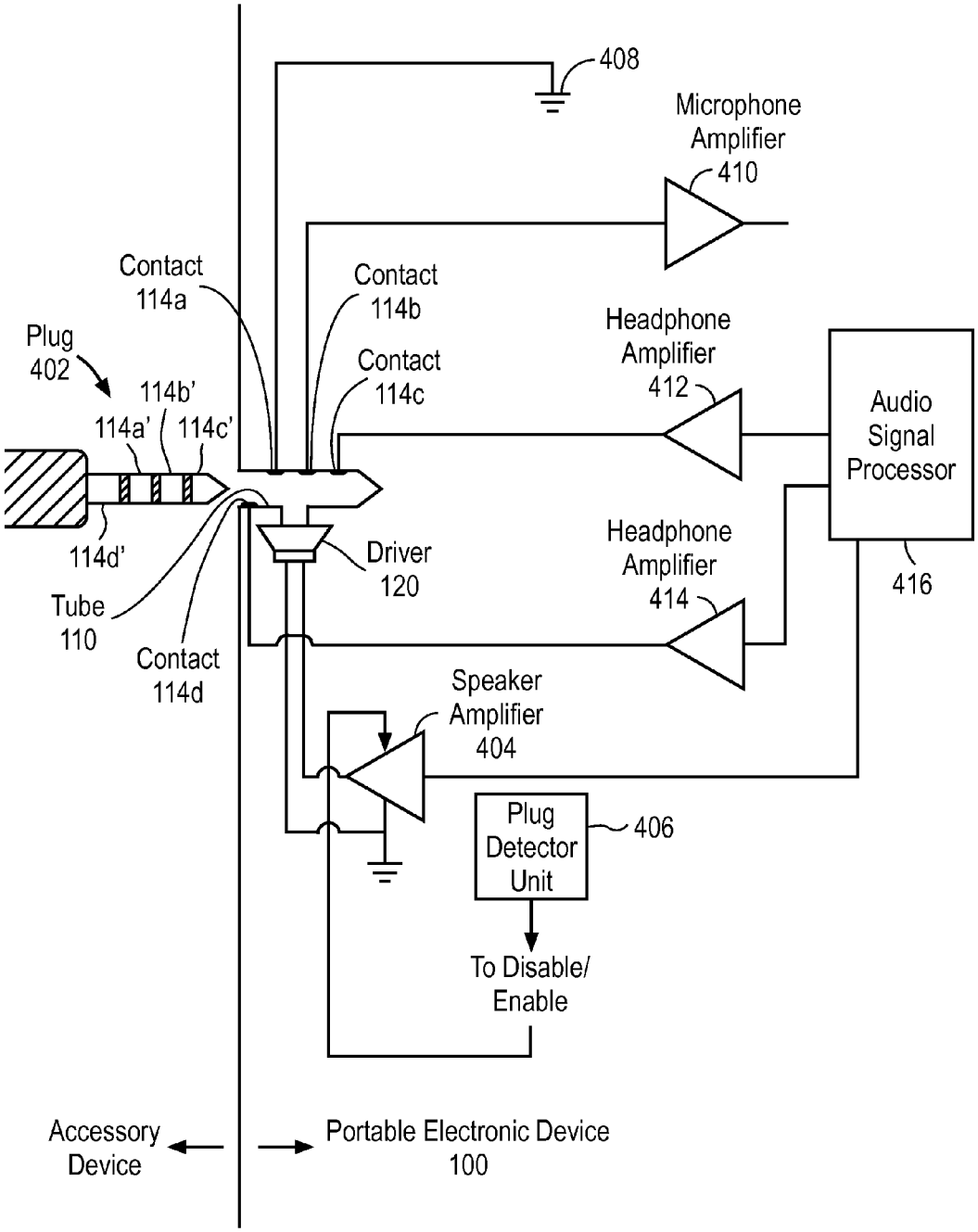

408
Microphone Amplifier 410
Contact 114a
Contact 114b
Contact 114c
Plug 402
114b'
114a'
114c'
Headphone Amplifier 412
Audio Signal Processor
114d'
Driver 120
Headphone Amplifier 414
416
Tube 110
Contact 114d
Speaker Amplifier 404
Plug Detector Unit
406
To Disable/ Enable
Accessory Device
Portable Electronic Device 100

FIG. 4

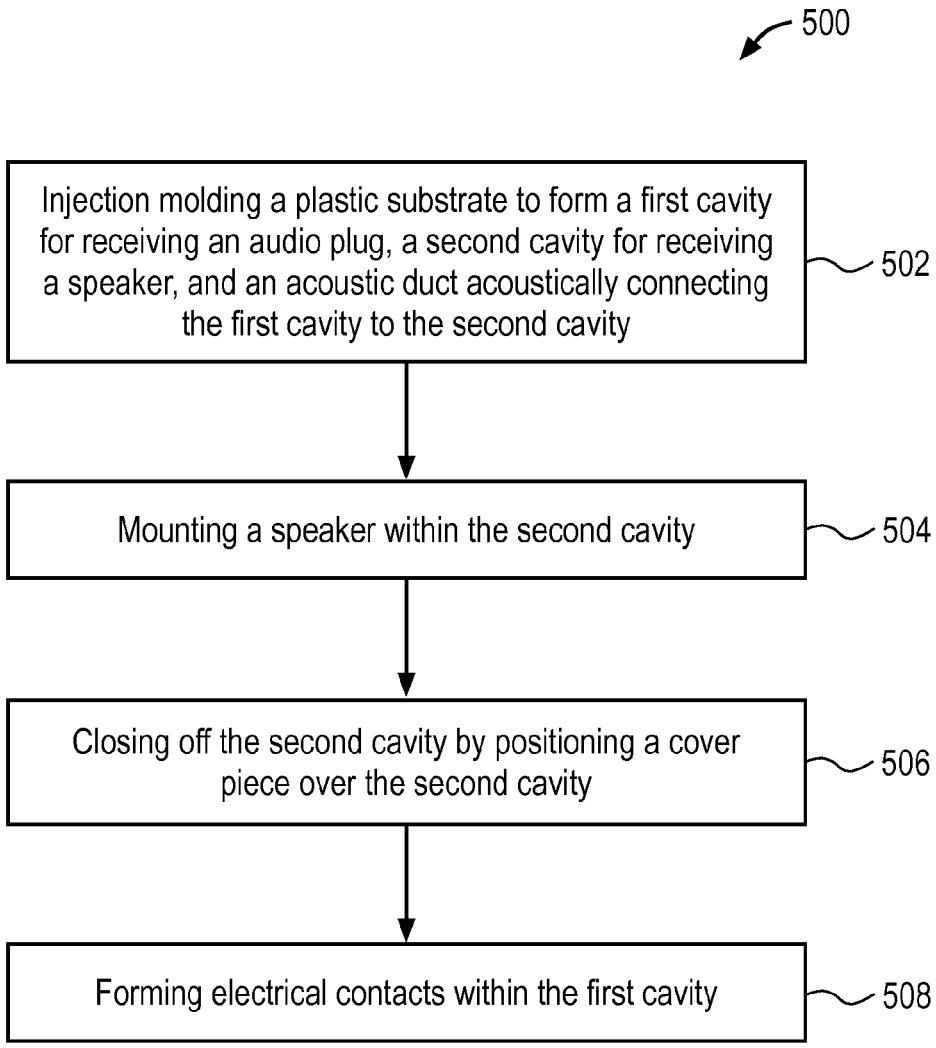

500
Injection molding a plastic substrate to form a first cavity for receiving an audio plug, a second cavity for receiving a speaker, and an acoustic duct acoustically connecting the first cavity to the second cavity
502
Mounting a speaker within the second cavity
504
Closing off the second cavity by positioning a cover piece over the second cavity
506
Forming electrical contacts within the first cavity
508

FIG. 5

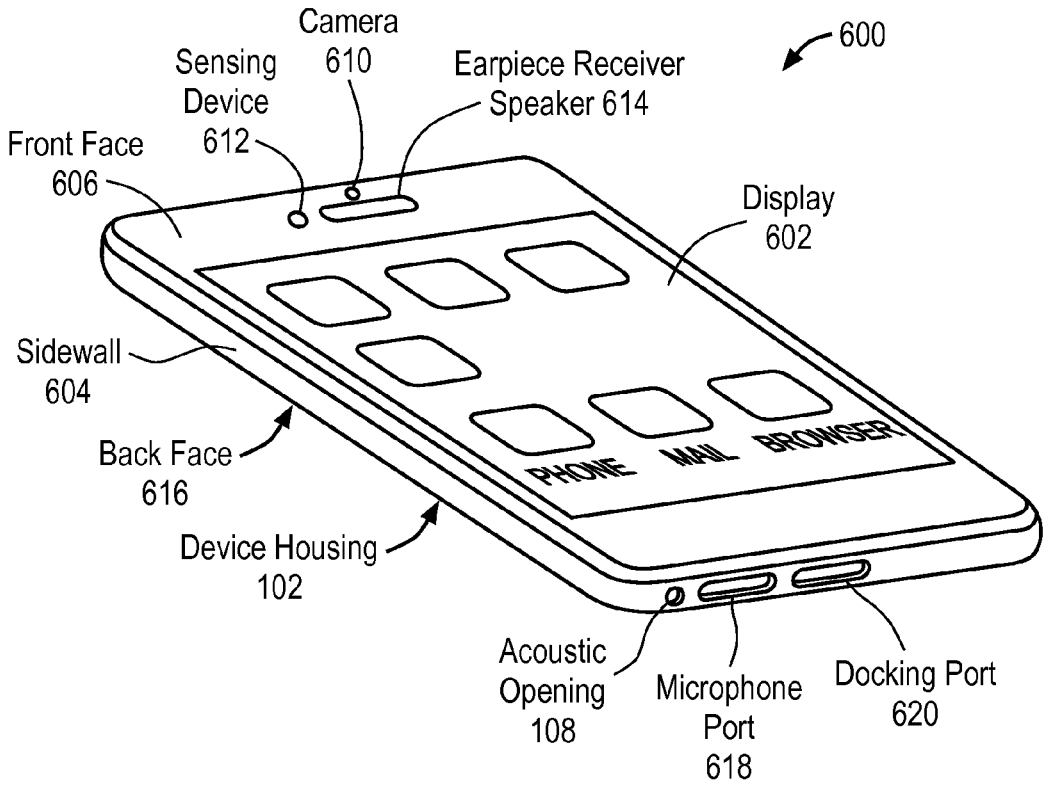

600
Camera
610
Sensing
Device
612
Earpiece Receiver
Speaker 614
Front Face
606
Display
602
Sidewall
604
Back Face
616
Device Housing
102
PHONE
MAIL
BROWSER
Acoustic
Opening
108
Microphone
Port
618
Docking Port
620

FIG. 6

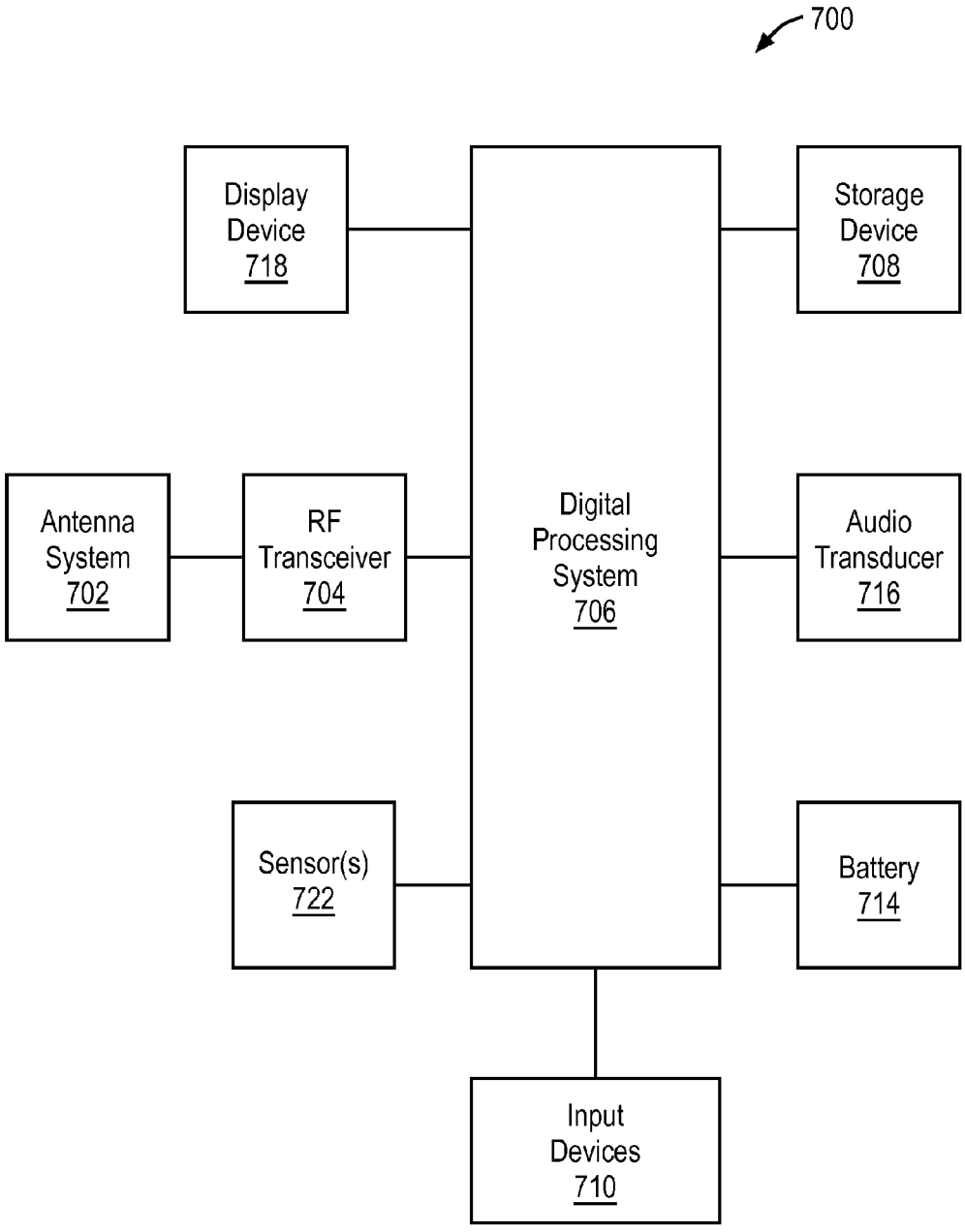

700
Display Device 718
Storage Device 708
Antenna System 702
RF Transceiver 704
Digital Processing System 706
Audio Transducer 716
Sensor(s) 722
Battery 714
Input Devices 710

FIG. 7

COMBINED SPEAKER AND AUDIO JACK

FIELD

[0001] An embodiment of the invention is directed to an audio jack capable of outputting sound from a speaker. Other embodiments are also described and claimed.

BACKGROUND

[0002] Portable handheld electronic devices, such as the iPhone® multifunction device by Apple Inc., typically weigh less than a pound and fit in a pocket. These handhelds generally provide some combination of personal information management, database functions, word processing, and spreadsheets as well as voice memo recording and telephony functions. Because of the small size and portability of handhelds, strict adherence to hardware constraints, such as input hardware, must be maintained. It is conventional to have buttons or switches on the handheld computer for providing user input to the handheld computer. Handheld computers may also include one or more audio jacks that provide for connecting auxiliary devices to the handheld device (e.g., headphones). The "jack" or opening for the audio jack is typically formed through a portion of the handheld housing.

[0003] In addition to an audio jack opening, handheld devices may also include separate speaker and microphone ports formed through the housing to accommodate sound output and sound input, respectively. A separate docking port may also be formed through the housing. Each of these separate openings uses up the limited housing real estate on the handheld device. In addition to using housing real estate, sound input/output apertures and electrical connectors introduce openings in the housing and breach the barrier that protects components inside the housing.

SUMMARY

[0004] An embodiment of the invention is directed to an audio jack for receiving an audio plug which is acoustically coupled to a driver housing having a driver contained therein such that the audio jack can both receive an audio plug for a audio jack functionality and provide a pathway for sound to travel to/from the driver. In some cases, the driver is a speaker contained within the driver housing. The driver housing is acoustically coupled to an opening formed in a side of a tube (e.g., an electrical socket) of the audio jack with an acoustic duct. In this aspect, sound output by the speaker travels from the driver housing, through the acoustic duct and out an acoustic opening at the end of the tube of the audio jack for output to a user. Since the audio jack can be used for input of an audio plug as well as output of a sound from a speaker, the number of ports or openings formed through an outer case of the associated portable electronic device can be reduced.

[0005] The above summary does not include an exhaustive list of all aspects of the present invention. It is contemplated that the invention includes all systems and methods that can be practiced from all suitable combinations of the various aspects summarized above, as well as those disclosed in the Detailed Description below and particularly pointed out in the claims filed with the application. Such combinations have particular advantages not specifically recited in the above summary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings in which like references indicate similar elements. It should be noted that references to "an" or "one" embodiment in this disclosure are not necessarily to the same embodiment, and they mean at least one.

[0007] FIG. **1** is a top schematic view of a portion of a portable electronic device having a combined audio jack and speaker module incorporated therein.

[0008] FIG. **2** is a perspective view of the combined audio jack and speaker module of FIG. **1**.

[0009] FIG. **3** is a side cross sectional view along line A-A' of the combined audio jack and speaker module of FIG. **2**.

[0010] FIG. **4** is a circuit diagram of an embodiment the invention.

[0011] FIG. **5** is a flow diagram of an embodiment of a method of manufacturing a combined audio jack and speaker module.

[0012] FIG. **6** is a perspective view of one embodiment of a portable electronic device within which a combined audio jack and speaker module may be implemented.

[0013] FIG. **7** is a block diagram of a system in which embodiments of a combined audio jack and speaker may be implemented.

DETAILED DESCRIPTION

[0014] In this section we shall explain several preferred embodiments of this invention with reference to the appended drawings. Whenever the shapes, relative positions and other aspects of the parts described in the embodiments are not clearly defined, the scope of the invention is not limited only to the parts shown, which are meant merely for the purpose of illustration. Also, while numerous details are set forth, it is understood that some embodiments of the invention may be practiced without these details. In other instances, well-known structures and techniques have not been shown in detail so as not to obscure the understanding of this description.

[0015] FIG. **1** is a top schematic view of a portion of a portable electronic device having a combined audio jack and speaker module incorporated therein. Representatively, electronic device **100** includes a device housing **102** which can be formed in two or more parts. FIG. **1** shows a portion of a lower part of the device housing **102**. An upper part of the housing, which would be used to form the enclosed electronic device, is omitted to allow the invention to be seen more clearly.

[0016] Audio module **104** is shown mounted within device housing **102**. Audio module **104** may include an audio jack housing **106** and a driver housing **116**. Audio jack housing **106** may form a cavity or tube **110** having an open end aligned with an acoustic opening **108** of device housing **102**. Tube **110** may be dimensioned to receive an audio plug of an audio accessory device (e.g., a headphone). For example, tube **110** may be an electrical socket dimensioned to receive an audio plug such as a 3.5 mm TRRS connector that is associated with a headset. A plurality of electrical contacts **114***a*, **114***b*, **114***c* and **114***d* may be formed along tube **110** to provide electrical connections with the audio plug when it is received in tube **110**. At least one of the electrical contacts **114***a*, **114***b*, **114***c* and **114***d* may be dimensioned to mechanically engage and retain the audio plug when it is inserted into tube **110**. While four electrical contacts are shown, it will be appreciated that

audio jack housing **106** may have any number of electrical contacts (e.g. more than four, such as five, or less than four).

[0017] Audio jack housing **106** may be acoustically coupled to driver housing **116**. Representatively, in one embodiment, acoustic port **112** may be formed through a side of tube **110**. An acoustic duct **122** may extend from acoustic port **112** to driver housing **116**. In this aspect, when a driver **120** is positioned within driver chamber **118** formed within driver housing **116**, sound S output by driver **120**, in the case of a speaker, can travel through acoustic duct **122**, to tube **110** and out acoustic opening **108** to the user.

[0018] Acoustic port **112** and acoustic duct **122** may have any size and dimensions suitable for transmission of sound S between audio jack housing **106** and driver housing **116**. In addition, in some embodiments, acoustic duct **122** may be dimensioned to space driver housing **116** a distance from tube **110** such that driver **120** is indirectly, as opposed to directly, coupled to tube **110**. In this aspect, driver **120** is offset with respect to audio jack housing **106**, and more specifically, tube **110**. In still further embodiments, acoustic port **122** and/or acoustic duct **122** may be dimensioned to enhance or improve sound output via audio module **104**.

[0019] An acoustic mesh **124** may further be provided within audio module **104** to enhance or improve a sound output of audio module **104**. Representatively, in one embodiment, acoustic mesh **124** may be an acoustic mesh material disposed over acoustic port **112**. Acoustic mesh **124** may be a piece of acoustically engineered material that provides a defined and intentional acoustic resistance or filtering effect. For example, in one embodiment, acoustic mesh **124** is a mesh or foam material that is manufactured to filter certain sound pressure waves output from driver **120**. In some embodiments, acoustic mesh **124** may also help to protect the device by preventing dust, water or any other undesirable materials or articles from reaching driver **120**.

[0020] Referring now in more detail to driver housing **116** and driver **120**, driver chamber **118** may be dimensioned to position driver **120** such that it does not face tube **110**. For example, driver **120** may be positioned such that a face from which sound is output by driver **120** faces toward or away from a back face of device housing **102** and outputs sound S in a direction parallel to a z-axis (see FIG. **3**). In this aspect, driver **120** does not substantially increase a z-height of audio module **104**, and in turn, device housing **102**. In addition, due to the orientation of driver **120**, sound S is not directly input to tube **110**, but rather is redirected from driver **120** by acoustic duct **122** and tube **110** toward acoustic opening **108**. In one embodiment, driver **120** is an electroacoustic transducer that produces sound in response to an electrical audio signal input. It is contemplated, however, that driver **120** may be other types of transducer devices (e.g. a microphone).

[0021] Although not shown in FIG. **1**, driver **120** and other processing circuitry within audio module **104** (e.g., contacts **114***a*-**114***d*) may be electrically connected to a printed circuit board within device housing **102**. The printed circuit board may support and electrically connect processing electronics that provide functions to portable electronic device **100**. In addition, although a single driver **120** is illustrated, it is contemplated that more than one driver may be acoustically coupled to the tube **110** such that acoustic opening **108** may be used to output sound from multiple drivers.

[0022] During operation of portable electronic device **100**, audio module **104** provides an audio jack functionality when an audio plug of an auxiliary device is inserted into tube **110** and a speaker output functionality when the audio plug is not inserted into tube **110** as will be described in more detail in reference to FIG. **4**. In this aspect, audio module **104** provides an audio jack which can also be used to output sound to a user through a single opening within device housing **102**, namely acoustic opening **108**. Since the same opening can be used as the audio jack and for sound output, the number of acoustic openings formed in device housing **102** can be reduced. For example, in some embodiments, acoustic opening **108** is the only acoustic opening formed in a side of device housing **102** and any additional speaker ports are omitted. In other embodiments, acoustic opening **108** is an additional acoustic opening formed in the side of the device housing **102**.

[0023] In addition, although not illustrated, it is contemplated that in some embodiments, an acoustic damping material may be positioned within, for example, driver housing **116** or acoustic duct **122** to improve sound transmission and output from driver **120**. Alternatively, acoustic damping may be achieved by a size, shape and/or material of the driver housing **116** or the acoustic duct **122** such that a separate damping material is not necessary.

[0024] FIG. **2** is a perspective view of the combined audio jack and speaker module of FIG. **1**. From this view, it can be seen that the audio jack housing **106** and driver housing **116** of audio module **104** can be made as one integrally formed structure which is a single unit, aside from cover **202**. For example, in one embodiment, audio module **104** may be formed by injection molding a plastic substrate to form a first cavity (e.g., tube **110**) for receiving the audio plug, a second cavity (e.g., driver chamber **118**) for receiving driver **120** and acoustic duct **122** connecting the two together. The driver chamber **118** may be formed to include an open top or bottom side so that driver **120** can be mounted therein after audio module **104** is formed. For example, driver **120** may be mounted to a cover **202** dimensioned to close the open top or bottom side. Thus, to mount driver **120** within driver chamber **118**, cover **202** is positioned over the open top or bottom side so that driver **120** is within driver chamber **118** and then cover **202** is sealed to driver housing **116**. Alternatively, driver **120** may be separate from cover **202** such that driver **120** is mounted within driver chamber **118** prior to positioning cover **202** over the opening. Although not illustrated, openings for receiving contacts **114***a*-**114***d* may also be formed within tube **110**.

[0025] FIG. **3** is a side cross sectional view of the combined audio jack and speaker module of FIG. **2** along line A-A'. From this view, various aspects of audio module **104**, as well as the direction of sound transmission through audio module **104**, can be more clearly seen. In particular, it can be seen that audio jack housing **106** and driver housing **116** of audio module **104** are formed as one unitary structure. When cover **202** is placed over, in this case, the top opening **304** of driver housing **116**, driver **120** is positioned within driver chamber **118**. Driver **120** is positioned such that face **302** of driver **120**, which outputs sound S, faces the bottom side of driver housing **116**. The output sound S, is therefore output in a direction parallel to a z-axis, toward the bottom side of driver housing **116**. Sound S can then be redirected by a combination of driver housing **116**, acoustic duct **122** and tube **110** out the associated acoustic opening (e.g., acoustic opening **108**) to the ambient environment. It is noted that although driver **120** is shown with the sound emitting face **302** emitting sound S in a downward direction (as viewed in FIG. **3**), it may be reversed such that sound S is emitted in an upward direction.

For example, the opening **304** of driver housing **116** may be formed in the bottom side of driver housing **116**, instead of along the top side of driver housing **116**. In this aspect, when cover **202** is placed over the opening in the bottom side of driver housing **116**, face **302** of driver **120** faces a top of the driver housing **116** and emits sound in an upward direction.

[0026] It is further contemplated, that in some embodiments, the dimensions of the driver chamber **118** may be specially selected to improve an acoustic output of driver **120**. For example, a size of driver chamber **118** may be increased or decreased to modify sound attenuation within driver housing **116** and/or a bass response of driver **120**.

[0027] FIG. **4** is a circuit diagram of an embodiment the invention. In this embodiment, each of contacts **114***a*, **114***b*, **114***c* and **114***d* are shown electrically connected to ground **408**, microphone amplifier **410**, headphone amplifier **412** and headphone amplifier **414**, respectively. Each of contacts **114***a*-**114***d* are shown integrated within tube **110**, which forms an audio jack socket within portable electronic device **100** as previously discussed in reference to FIG. **1**. An audio plug **402** is further shown. Audio plug **402** may be, for example, a headset plug (e.g., a 3.5 mm TRRS connector) or any other electrical plug associated with any other type of device desired to be connected to the portable electronic device **100**. For example, suitable devices may be auxiliary devices including, but not limited to, a microphone-speaker combination headset unit, an auxiliary speaker, an auxiliary microphone, or the like. In addition, audio plug **402** may be associated with an audio adapter capable of outputting audio to a vehicle entertainment system or other entertainment system.

[0028] Audio plug **402** may include reference contacts **114***a*', **114***b*', **114***c*' and **114***d*'. Reference contacts **114***a*', **114***b*', **114***c*' and **114***d*' mate directly with contacts **114***a*, **114***b*, **114***c* and **114***d* of the portable electronic device **100**, respectively, when audio plug **402** is inserted into tube **110**. Mating of reference contacts **114***a*'-**114***d*' with contacts **114***a*-**114***d* allows for audio signal processing and audio output by audio signal processor **416**, which is electrically connected to each of headphone amplifier **412** and headphone amplifier **414**. When audio plug **402** is removed from tube **110**, however, audio processing of signals from audio plug **402** is disabled and tube **110** provides an open pathway for sound transmission from driver **120**.

[0029] Driver **120** (e.g., a speaker) may be acoustically connected to tube **110** and electrically connected to ground, a speaker amplifier **404** as well as audio signal processor **416** for processing of speaker audio signals. In this aspect, when audio plug **402** is removed from tube **110**, sound output by driver **120** may pass through tube **110** to the ambient environment. The presence or absence of audio plug **402** within tube **110** may be detected by plug detector unit **406**. Plug detector unit **406** may be electrically connected to the processing circuitry within portable electronic device **100** such that it can detect when audio plug **402** is inserted within tube **110**, such as by detecting a connection between contacts **114***a*-**114***d* and reference contacts **114***a*'-**114***d*'. Plug detector unit **406** may also detect when audio plug **402** is not within tube **110**, such as by detecting a disconnection between contacts **114***a*-**114***d* and reference contacts **114***a*'-**114***d*'. When it is determined that audio plug **402** is within tube **110**, speaker amplifier **404** may be disabled such that operation of driver **120** is disabled. When it is determined that audio plug **402** is not within tube **110**, speaker amplifier **404** may be enabled such that operation of driver **120** is enabled. When driver **120** is enabled, audio may be processed and output by audio signal processor **416** to speaker amplifier **406** so that sound can be output by driver **120** (e.g., a speaker) through tube **110** to the ambient environment. For example, the audio signal processor **416** may process music audio files, audio signals from a far end user, or any other audio data desired to be output by driver **120** to the user. It is further to be understood, that other and/or additional circuitry configurations may be used to allow for both audio output by driver **120** and audio input by audio plug **402** using a single tube **110** (e.g., an audio jack socket).

[0030] FIG. **5** is a flow diagram of an embodiment of a method of manufacturing a combined audio jack and speaker module. As previously discussed, in one embodiment, the combined audio jack and speaker module, also referred to herein as the audio module, is a single unitary structure having an audio jack housing dimensioned to receive an audio plug and a driver housing dimensioned to receive a driver. In one embodiment, the audio module may be formed according to an injection molding process as illustrated by flow diagram **500**. Representatively, a plastic substrate may be injection molded such that it includes a first cavity for receiving an audio plug, a second cavity for receiving a speaker and an acoustic duct acoustically connecting the first cavity to the second cavity (block **502**). Although a plastic substrate is described as the starting material, it is contemplated that other non-conductive starting materials may also be used (e.g., silicone or rubber). Once the plastic housing having each of the above described cavities is formed, a speaker may be mounted within the second cavity (block **504**). In one embodiment, the speaker may be mounted within the second cavity by inserting it through an opening formed in a top or bottom side of the second cavity. It is noted that although a top or bottom side opening is disclosed, the opening could be in any portion of the second cavity sufficient to allow for insertion of a driver there through. Once the driver is positioned within the second cavity, the second cavity is closed off by positioning a cover piece over the opening (block **506**). Electrical contacts may further be formed within the first cavity to allow for electrical connections to be made with an audio plug inserted within the first cavity (block **508**).

[0031] It is noted that FIG. **5** illustrates only one exemplary process for forming an audio module using an injection molding technique. It is contemplated that other manufacturing steps and/or processes may be used to form an integrated audio module. For example, molding processes other than injection molding, such as compression molding, may be suitable. In addition, the first cavity, which is part of the audio jack housing portion (e.g., audio jack housing **106**), and second cavity, which is part of the driver housing portion (e.g., driver housing **116**), may be formed together from a single substrate, or separately formed and then integrally connected together to form the audio module.

[0032] Turning now to FIG. **6**, FIG. **6** shows one exemplary portable electronic device within which the audio module may be implemented. Representatively, in this embodiment, the portable electronic device is a portable handheld electronic communications device **600** (also referred to as a mobile device or a wireless device), such as an iPhone® device by Apple Inc. of Cupertino, Calif. Portable device **600** may include an outer case or housing **102** that includes at least a front face **606** and a mating back face **616**, that when fitted to each other in large part define or close off a chamber in

which the constituent electronic components of the portable device **600** are housed. The front and back faces **606**, **616** may be connected together by a sidewall **604**, that extends around the entire device.

[0033] The front face **606** may form part of a display **602** (e.g., a touch screen display) as well as a port for accommodating an earpiece receiver speaker **614**. In addition, a sensing device **612** (e.g., proximity sensor) and a camera **610** may be positioned along the front face **606**.

[0034] Various other ports and/or openings may also be formed along sidewall **604**. For example, a docking port **620** for plugging device **600** into a peripheral device or power source and a microphone port **618** may be formed along a portion of sidewall **604** forming the end of portable device **600**.

[0035] In addition to these ports, an acoustic opening **108** may be formed within the sidewall. The acoustic opening **108** may be associated with the previously discussed audio module such that it can be used as both an audio jack for an audio plug as well as a sound output port for outputting sound from a speaker mounted within portable device **600**. Since acoustic opening **108** provides both functionalities, an additional speaker port, as is the case in typical communications devices, is not needed and the number of ports along the sidewall **604** is reduced. It is noted that although acoustic opening **108** is shown along a portion of sidewall **604** forming an end of portable device **600**, acoustic opening **108** may be formed along any portion of sidewall **604** (e.g., a portion forming the top or side of portable device **600**). Alternatively, acoustic opening **108** may be formed along face **606** or **616** of device housing **102**.

[0036] It is to be understood that although a handheld device such as an iPhone® from Apple Computer, Inc. of Cupertino, Calif., is illustrated in FIG. **6**, the audio module disclosed herein may be implemented within any number of electronic devices that could benefit from fewer audio ports. For example, the audio module may be implemented within a tablet computer, a notebook computer or other portable computing device. In still further embodiments, the audio module may be implemented within a digital media player, such as a portable music and/or video media player, entertainment systems or personal digital assistants (PDAs), or general purpose computer systems, or special purpose computer systems, or an embedded device within another device, or cellular telephones which do not include media players, or devices which combine aspects or functions of these devices (e.g., a media player, such as an iPod®, combined with a PDA, an entertainment system, and a cellular telephone in one portable device).

[0037] Also, although not described here, the device **600** has within its outer housing the needed combination of electronic circuitry and stored software that operate the various input and output components (e.g., touch sensitive display, receiver, microphone, and antenna), to provide the user with mobile telephony functionality.

[0038] Referring now to FIG. **7**, FIG. **7** shows a block diagram of an embodiment of a wireless device **700** within which the previously described audio module may be implemented. In the illustrated embodiment, wireless device **700** is a wireless communication device. The wireless device **700** may be included in the device shown in FIG. **6**, although alternative embodiments of portable device **600** may include more or fewer components than the wireless device **700**.

[0039] Wireless device **700** may include an antenna system **702**. Wireless device **700** may also include a radio frequency (RF) transceiver **704**, coupled to the antenna system **702**, to transmit and/or receive voice, digital data and/or media signals through antenna system **702**.

[0040] A digital processing system **706** may further be provided to control the digital RF transceiver and to manage the voice, digital data and/or media signals. Digital processing system **706** may be a general purpose processing device, such as a microprocessor or controller for example. Digital processing system **706** may also be a special purpose processing device, such as an ASIC (application specific integrated circuit), FPGA (field-programmable gate array) or DSP (digital signal processor). Digital processing system **706** may also include other devices to interface with other components of wireless device **700**. For example, digital processing system **706** may include analog-to-digital and digital-to-analog converters to interface with other components of wireless device **700**.

[0041] A storage device **708**, coupled to the digital processing system, may further be included in wireless device **700**. Storage device **708** may store data and/or operating programs for the wireless device **700**. Storage device **708** may be, for example, any type of solid-state or magnetic memory device.

[0042] One or more input devices **710**, coupled to the digital processing system **706**, to accept user inputs (e.g., telephone numbers, names, addresses, media selections, etc.) or output information to a far end user may further be provided. Exemplary input devices may be, for example, one or more of a keypad, a touchpad, a touch screen, a pointing device in combination with a display device or similar input device.

[0043] Display device **718** may be coupled to the digital processing system **706**, to display information such as messages, telephone call information, contact information, pictures, movies and/or titles or other indicators of media being selected via the input device **710**. Display device **718** may be, for example, an LCD display device. In one embodiment, display device **718** and input device **710** may be integrated together in the same device (e.g., a touch screen LCD such as a multi-touch input panel which is integrated with a display device, such as an LCD display device). It will be appreciated that the wireless device **700** may include multiple displays.

[0044] Battery **714** may further be provided to supply operating power to components of the system including digital RF transceiver **704**, digital processing system **706**, storage device **708**, input device **710**, audio transducer **716**, sensor(s) **722** (e.g., a proximity sensor), and display device **718**. Battery **714** may be, for example, a rechargeable or non-rechargeable lithium or nickel metal hydride battery. Wireless device **700** may also include audio transducers **716**, which may include one or more speakers, receivers and at least one microphone.

[0045] While certain embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that the invention is not limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those of ordinary skill in the art. For example, although a speaker type drive is generally disclosed herein, it is contemplated that in some embodiments, the driver may be a microphone such that the audio jack housing, and in particular the tube portion provides a pathway for sound input to the microphone as well as an audio jack functionality. In still further embodiments, both a speaker and a microphone may

be acoustically coupled to the audio jack housing such that sound input to the microphone and/or sound output from the speaker may be accommodated by the audio jack housing when the audio plug is removed. In addition, although the host device for the audio module is described herein as a portable electronic device (e.g., a smart phone device or a media player device), it is further contemplated that the audio module may be integrated within any type of device which typically includes separate audio jack and speaker ports. For example, the audio module may be integrated within a stationary electronic device such as a desktop computer, a television set, a desk top telephone, an automobile audio system or the like. The description is thus to be regarded as illustrative instead of limiting.

1. A speaker and audio jack module for a portable electronic device, the module comprising:

an audio jack housing defining a tube dimensioned to receive an audio plug;

an acoustic port formed through a sidewall of the tube, the sidewall forming an inside inner radius of the tube; and

a speaker housing acoustically coupled to the acoustic port, the speaker housing dimensioned to contain a speaker therein, and

wherein the audio jack housing is capable of outputting sound from the speaker when the audio plug is absent.

2. The module of claim **1** wherein an acoustic duct acoustically couples the speaker to the acoustic port.

3. The module of claim **1** wherein the speaker is indirectly coupled to the tube.

4. The module of claim **1** wherein the speaker housing defines a chamber around the speaker, the chamber including a top surface and a bottom surface positioned along opposing faces of the speaker.

5. The module of claim **1** wherein the speaker is connected to a top surface of the speaker housing and emits sound waves toward a bottom surface of the speaker housing.

6. The module of claim **1** wherein the audio jack housing and the speaker housing are a single molded piece.

7. The module of claim **1** further comprising:

an acoustic mesh positioned over the acoustic port.

8. The module of claim **1** further comprising:

a plurality of electrical contacts formed within the tube so as to make electrical contact with the audio plug when inserted within the tube.

9. The module of claim **8** wherein the speaker is disabled when electrical contact is made with the audio plug and the speaker is enabled when electrical contact is not made with the audio plug.

10. The module of claim **1** wherein the portable electronic device is a mobile communications device.

11. A portable electronic device comprising:

a portable electronic device housing having an acoustic opening formed through a sidewall thereof;

an electrical socket extending from the acoustic opening and within the portable electronic device housing, the electrical socket having an open end and a closed end connected by a sidewall, wherein the open end is dimensioned to receive an audio plug; and

a driver housing acoustically coupled to the electrical socket by an acoustic duct extending from the sidewall of the electrical socket, and

wherein the electrical socket is capable of receiving an audio input when the audio plug is inserted therein and outputting an audio output from the driver when the audio plug is removed.

12. The portable electronic device of claim **11** wherein the driver is a speaker.

13. The portable electronic device of claim **11** wherein the audio output is a sound generated by the driver.

14. The portable electronic device of claim **11** wherein the acoustic opening is the only acoustic opening formed in the sidewall.

15. The portable electronic device of claim **11** wherein the electrical socket and the driver housing form one integrally molded single piece.

16. The portable electronic device of claim **11** further comprising:

processing circuitry contained within the housing, wherein the processing circuitry is electrically connected to the electrical socket.

17. The portable electronic device of claim **16** wherein the processing circuitry allows for activation of the driver when the audio plug is removed from the electrical socket and inactivation of the driver when the audio plug is inserted.

18. A method of manufacturing a speaker and audio jack module for a portable electronic device comprising:

injection molding a plastic substrate to form (a) a first cavity having a first end, a second end and a sidewall connecting the first end to the second end, the first end dimensioned for receiving an audio plug, and the sidewall having an acoustic port, (b) a second cavity for receiving a speaker, and (c) an acoustic duct extending from the acoustic port of the first cavity to the second cavity to acoustically connect the first cavity to the second cavity; and

mounting a speaker within the second cavity.

19. The method of claim **18** wherein the speaker is connected to a cover piece positioned over the second cavity to close off the second cavity.

20. The method of claim **18** further comprising:

forming electrical contacts within the first cavity.

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