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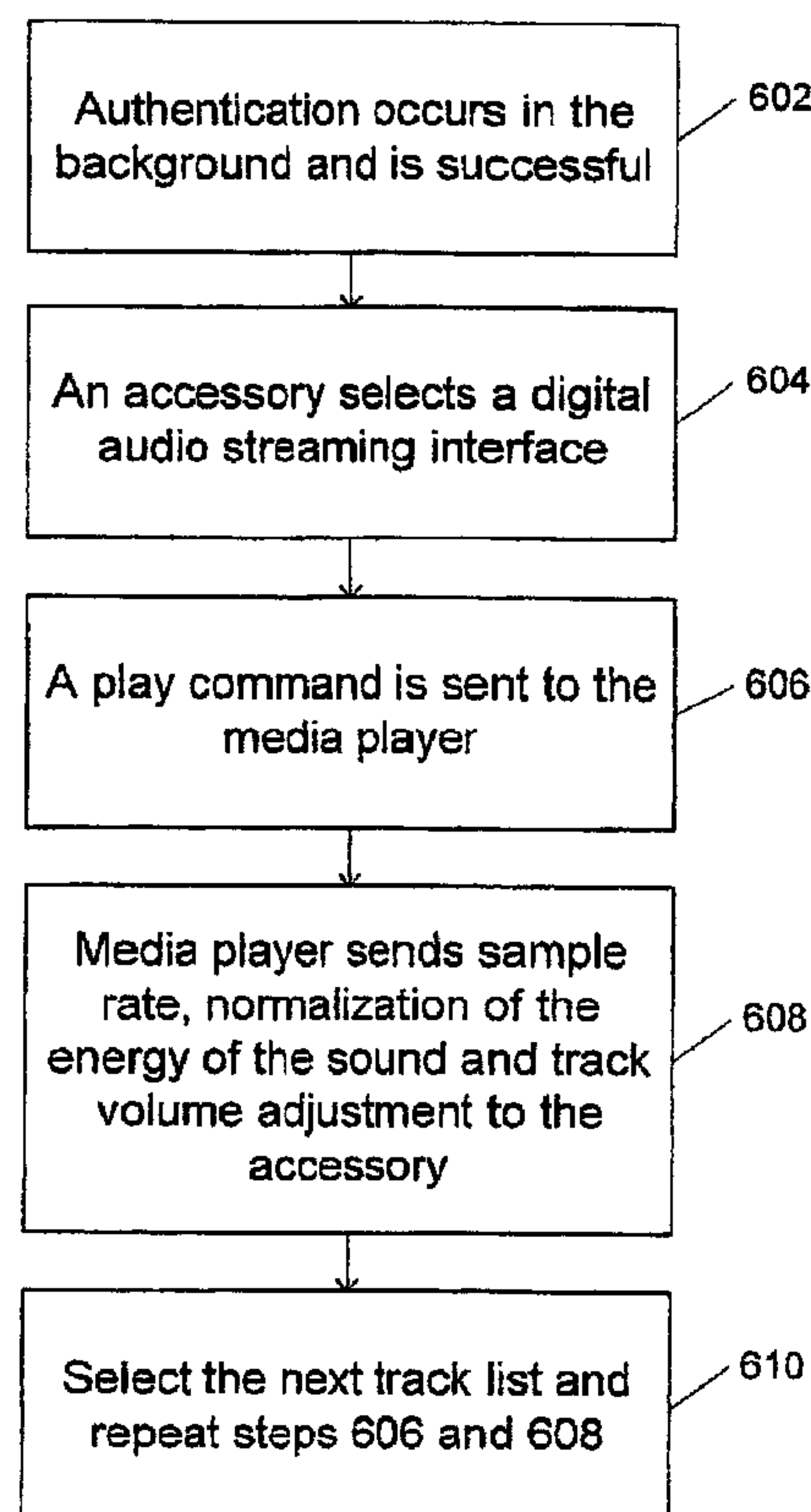
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(54) Titre : PROCEDE ET SYSTEME POUR PERMETTRE A UN LECTEUR MEDIA DE TRANSFERER UN SON
NUMERIQUE A UN ACCESSOIRE

(54) Title: METHOD AND SYSTEM FOR ALLOWING A MEDIA PLAYER TO TRANSFER DIGITAL AUDIO TO AN
ACCESSORY



(57) Abrégé/Abstract:

A method and system for allowing a media player to transfer digital audio to an accessory is disclosed. The method and system comprises sending a play command to the media player; returning information about the media player; and providing digital audio

(57) **Abrégé(suite)/Abstract(continued):**

to the accessory based upon the information about the media player. In a system and method in accordance with the present invention a plurality of commands allow a media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information.

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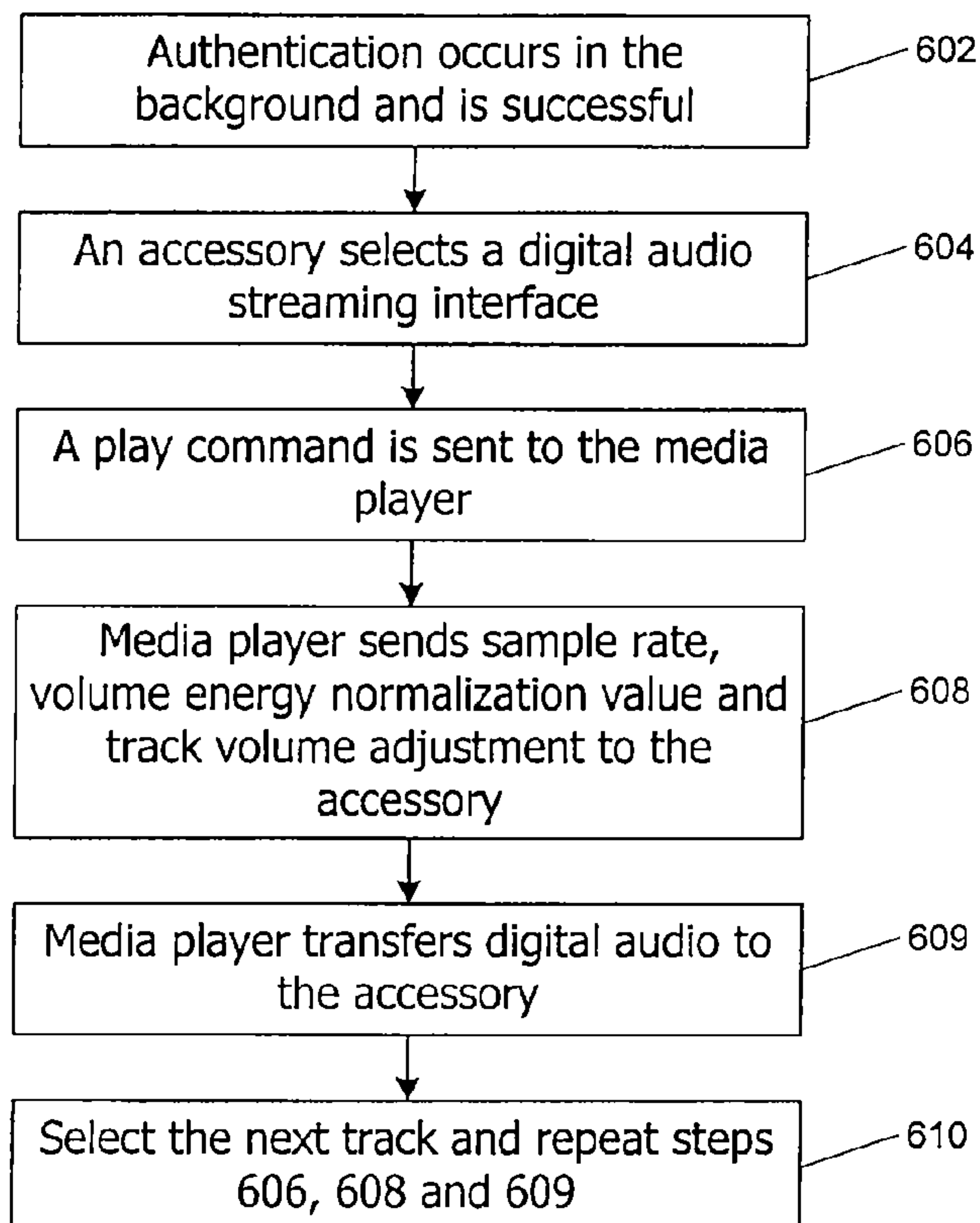
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(54) Title: METHOD AND SYSTEM FOR ALLOWING A MEDIA PLAYER TO TRANSFER DIGITAL AUDIO TO AN ACCESSORY



(57) Abstract: A method and system for allowing a media player to transfer digital audio to an accessory is disclosed. The method and system comprises sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player. In a system and method in accordance with the present invention a plurality of commands allow a media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information.

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METHOD AND SYSTEM FOR ALLOWING A MEDIA PLAYER TO TRANSFER DIGITAL AUDIO TO AN ACCESSORY

CROSS-REFERENCES TO RELATED APPLICATIONS

5 [0001] NOT APPLICABLE

FIELD OF THE INVENTION

[0002] The present invention relates generally to electrical devices and more particularly to electrical devices such as media players that communicate with accessory devices.

BACKGROUND OF THE INVENTION

10 [0003] A media player stores media assets, such as audio tracks, videos, and photos that can be played or displayed on the media player. One example of a media player is the iPod™ media player, which is available from Apple Inc. of Cupertino, CA. Often, a media player acquires its media assets from a host computer that serves to enable a user to manage media assets. As an example, the host computer can execute a media management application to
15 manage media assets. One example of a media management application is iTunes®, version 6.0, produced by Apple Inc.

[0004] A media player typically includes one or more connectors or ports that can be used to interface to the media player. For example, the connector or port can enable the media player to couple to a host computer, be inserted into a docking system, or receive an
20 accessory device. There are today many different types of accessory devices that can interconnect to the media player. For example, a remote control can be connected to the connector or port to allow the user to remotely control the media player. As another example, an automobile can include a connector and the media player can be inserted onto the connector such that an automobile media system can interact with the media player, thereby
25 allowing the media content on the media player to be played within the automobile.

[0005] Many accessories such as USB speakers are capable of receiving digital audio. Accordingly, it is desirable that the media player be able to provide digital audio to these types of accessories. Heretofore, only analog audio signals have been provided from the media player to an accessory.

[0006] Thus, there is a need for improved techniques to enable manufacturers of media players to provide digital audio tracks to associated accessories. The present invention addresses such a need.

BRIEF SUMMARY OF THE INVENTION

5 [0007] A method and system for allowing a media player to transfer digital audio to an accessory is disclosed. The method and system comprises sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player.

[0008] In a system and method in accordance with the present invention a plurality of
10 commands allow a media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information.

[0008a] Accordingly, in one aspect, the present invention provides a method for transferring digital audio data from a media player to an accessory, the method
15 comprising, by the accessory: sending to the media player a list of sample rates supported by the accessory; receiving from the media player track information including a first sample rate for a first track, wherein the first sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory; configuring a digital audio interface of the accessory according to the
20 first sample rate; and receiving digital audio samples of the first track from the media player at the first sample rate via the digital audio interface.

[0008b] In a further aspect, the present invention provides a method for transferring digital audio data from a media player to an accessory, the method comprising, by the media player: requesting from the accessory a list of sample rates
25 supported by the accessory; receiving from the accessory the list of sample rates supported by the accessory; selecting from the list of sample rates supported by the accessory a first sample rate to be used for playing a first track of digital audio data; sending track information including the first sample rate to the accessory; and sending digital audio samples of the first track via a digital audio interface to the accessory at
30 the first sample rate.

[0008c] In a still further aspect, the present invention provides an accessory for use with a media player, the accessory comprising: a digital audio interface configured to receive digital audio samples of a track of digital audio data from the media player; a playback unit configured to play a track of digital audio data received via the digital audio interface; and a command interface configured to communicate with the media player using a plurality of commands, the plurality of commands including: a first command sendable by the accessory to the media player, the first command providing to the media player a list of sample rates supported by the accessory; and a second command receivable by the accessory from the media player, the second command providing to the accessory track information for a track of digital audio data, the track information including a sample rate for the track, the sample rate for the track being selected by the media player from the list of sample rates supported by the accessory.

[0008d] In a further aspect, the present invention provides a media player for use with an accessory, the media player comprising: a digital audio interface configured to send digital audio samples of a track of digital audio data to the accessory; a storage device configured to store a plurality of tracks of digital audio data; a playback engine configured to select a sample rate for one of the stored tracks of digital audio data and to deliver the one of the stored tracks to the digital audio interface at the selected sample rate; and a command interface configured to communicate with the accessory using a plurality of commands, the plurality of commands including: a first command receivable by the media player from the accessory, the first command providing to the media player a list of sample rates supported by the accessory; and a second command sendable by the media player to the accessory, the second command providing to the accessory track information for a track of digital audio data to be sent to the accessory, the track information including the sample rate selected by the playback engine for the track, wherein the selected sample rate is one of the sample rates on the list of sample rates supported by the accessory.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figures IA and IB illustrate a docking connector in accordance with the present invention.

[0010] Figure 2A is a front and top view of a remote connector in accordance with the present invention.

[0011] Figure 2B illustrates a plug that can be utilized in the remote connector of Figure 2A.

5 [0012] Figure 2C illustrates the plug of Figure 2B inserted into the remote connector of Figure 2A.

[0013] Figure 3A illustrates connector pin designations for the docking connector.

[0014] Figure 3B illustrates connection pin designations for the remote connector.

10 [0015] Figure 4A illustrates a typical FireWire connector interface for the docking connector.

[0016] Figure 4B illustrates a reference schematic diagram for an accessory power source.

[0017] Figure 4C illustrates a reference schematic diagram for a system for detecting and identifying accessories for the docking connector.

[0018] Figure 4D is a reference schematic of an electret microphone that may be connected to the remote connector.

5 [0019] Figure 5A illustrates a media player coupled to different accessories.

[0020] Figure 5B illustrates the media player coupled to a computer.

[0021] Figure 5C illustrates the media player coupled to a car or home stereo system.

[0022] Figure 5D illustrates the media player coupled to a dongle that communicates wirelessly with other accessories.

10 [0023] Figure 5E illustrates the media player coupled to a speaker system.

[0024] Figure 6 is a flow chart illustrating how a media player provides digital audio to an accessory.

[0025] Figure 7 is a table that lists examples of media player supported sample rates.

15 DETAILED DESCRIPTION OF THE INVENTION

[0026] The present invention relates generally to electrical devices and more particularly to electrical devices such as media players that communicate with accessory devices. The following description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements.

20 Various modifications to the preferred embodiment and the generic principles and features described herein will be readily apparent to those skilled in the art. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

[0027] In a system and method in accordance with the present invention a plurality of
25 commands allow a media player to transfer digital audio to an accessory. The method and system comprise sending a play command to the media player; returning information about the media player; and providing digital audio to the accessory based upon the information about the media player. The media player may perform sample rate conversion internally to transfer digital audio at a supported sample rate. The plurality of commands could be utilized

in a variety of environments. One such environment is within a connector interface system environment such as described in detail hereinbelow.

Connector Interface System Overview

[0028] To describe the features of the connector interface system in accordance with the present invention in more detail, refer now to the following description in conjunction with the accompanying drawings.

Docking Connector

[0029] Figures 1A and 1B illustrate a docking connector 100 in accordance with the present invention. Referring first to Figure 1A, the keying features 102 are of a custom length 104. In addition, a specific key arrangement where one set of keys are separated by one length are at the bottom and another set of keys are separated by another length at the top of the connector is used. The use of this key arrangement prevents noncompliant connectors from being plugged in and causing potential damage to the device. The connector for power utilizes a Firewire or USB specification for power. The connector includes a first make/last break contact to implement this scheme. Figure 1B illustrates the first make/last break contact 202 and also illustrates a ground pin and a power pin related to providing an appropriate first make/last break contact. In this example, the ground pin 204 is longer than the power pin 206. Therefore, the ground pin 204 would contact its mating pin in the docking accessory before the power pin 206. Therefore internal electrical damage of the electronics of the device is minimized.

[0030] In addition, a connector interface system in accordance with the present invention uses both USB and Firewire interfaces as part of the same docking connector alignment, thereby making the design more compatible with different types of interfaces, as will be discussed in detail hereinafter. In so doing, more remote accessories can interface with the media player.

Remote Connector

[0031] The connector interface system also includes a remote connector which provides for the ability to output audio, input audio, provides I/O serial protocol, and to provide an output for video. Figure 2A is a front and top view of a remote connector 200 in accordance with the present invention. As is seen, the remote connector 200 includes a top headphone receptacle 202, as well as a second receptacle 204 for remote devices. Figure 2B illustrates a plug 300 to be utilized in the remote connector. The plug 300 allows the features to be provided via the

remote connector. Figure 2C illustrates the plug 300 inserted into the remote connector 200. Heretofore, all these features have not been implemented in a remote connector. Therefore, a standard headphone cable can be plugged in but also special remote control cables, microphone cables and video cables could be utilized with the remote connector.

- 5 [0032] To describe the features of the connector interface system in more detail, please find below a functional description of the docking connector, remote connector and a command set in accordance with the present invention.

Docking and Remote Connector Specifications

- 10 [0033] For an example of the connector pin designations for both the docking connector and for the remote connector for a media player such as an iPod™ device by Apple Inc., refer now to Figures 3A and 3B. Figure 3A illustrates the connector pin designations for the docking connector. Figure 3B illustrates the connection pin designations for the remote connector.

Docking Connector Specifications

- 15 [0034] Figure 4A illustrates a typical Firewire connector interface for the docking connector. The following are some exemplary specifications:

[0035] Firewire Power: 8V - 30V DC IN, 10 W max. Firewire can be designed to IEEE 1394 A Spec (400 Mb/s).

USB Interface

- 20 [0036] The media player provides two configurations, or modes, of USB device operation: mass storage and media player USB Interface (MPUI). The MPUI allows the media player to be controlled using a media player accessory protocol (MPAP) which will be described in detail later herein, using a USB Human Interface Device (HID) interface as a transport mechanism.

Accessory 3.3 V Power

[0037] Figure 4B illustrates the accessory power source. The media player accessory power pin supplies voltages, for example, 3.0 V to 3.3V+/-5% (2.85 V to 3.465 V) over the docking connector and remote connector (if present). A maximum current is shared between the docking and remote connectors.

- 30 [0038] By default, the media player supplies a particular current such as 5mA. Proper software accessory detect is required to turn on high power (for example, up to 100 mA)

during active device usage. When devices are inactive, they must consume less than a predetermined amount of power such as 5mA current.

[0039] Accessory power is switched off for a period of, for example, approximately 2 seconds during the media player bootstrap process. This is done to ensure that accessories are in a known state and can be properly detected. All accessories are responsible for re-identifying themselves after the media player completes the bootstrap process and transitions accessory power from the off to the on state.

[0040] Accessory power is grounded through the Digital GND pins.

[0041] Figure 4C illustrates a reference schematic diagram for a system for detecting and identifying accessories for the docking connector. The system comprises a resistor to ground that allows the device to determine what has been plugged into the docking connector. There is an internal pullup on Accessory Identify within the media player. Two pins (Accessory Identify & Accessory Detect) are used.

[0042] Figure 4D is a reference schematic of an electret microphone that is within the remote connector.

[0043] Serial Protocol Communication:

[0044] a) Two pins used to communicate to and from device (Rx & Tx)

[0045] b) Input & Output (OV=Low, 3.3V=High)

[0046] As before mentioned, media players connect to a variety of accessories. Figures 5A-5E illustrate a media player 500 coupled to different accessories. Figure 5A illustrates a media player 500' coupled to a docking station 502. Figure 5B illustrates the media player 500" coupled to a computer 504. Figure 5C illustrates the media player 500' coupled to a car or home stereo system 506. Figure 5D illustrates the media player 500"" coupled to a dongle 508 that communicates wirelessly with other devices. Figure 5E illustrates the media player 500' coupled to a speaker system 510. As is seen, what is meant by accessories includes but is not limited to docking stations, chargers, car stereos, microphones, home stereos, computers, speakers, and accessories which communicate wirelessly with other accessories.

[0047] As before mentioned, this connector interface system could be utilized with a command set for allowing the transfer of digital audio from a media player to an associated accessory. In the USB environment, the transfer is performed by streaming the digital audio

to the accessory. It should be understood by one of ordinary skill in the art that although the above-identified connector interface system could be utilized with the command set a variety of other connectors or systems could be utilized and they would be within the spirit and scope of the present invention. To describe the utilization of a digital audio command set in more
5 detail refer now to the following description in conjunction with the accompanying drawings.

[0048] The command set allows the media player to transfer digital audio to an accessory. These commands are used by the media player to gather a list of supported sample rates from the accessory and to inform the accessory of the media player's information such as current sample rate, sound check (e.g., volume or sound energy normalization) value, and track
10 volume adjustment value. The media player may perform sample rate conversion internally to transfer digital audio at a supported sample rate.

Typical transactions for digital audio

[0049] Under normal circumstances, the media player and the accessory requesting digital audio over USB audio will perform the following steps:

15 [0050] 1. User connects the media player to the accessory using the connector interface system 100 to a USB cable.

[0051] 2. Media player provides a plurality of configurations to the accessory, for example, mass storage and USB audio.

[0052] 3. The accessory selects the USB audio configuration using an USB standard
20 request.

[0053] The accessory may authenticate with the media player before digital audio is enabled. When the accessory identifies as one supporting digital audio signal, authentication can be provided and the media player can proceed immediately as if the process was successful. If the authentication process fails, digital audio on the media player can be
25 disabled immediately.

[0054] Figure 6 is a flow chart illustrating a process by which a media player provides a digital audio signal to an accessory. First, authentication occurs in the background and is successful, via step 602. Next, the accessory selects a digital audio streaming interface for streaming the digital audio, via step 604. Then, a play command is sent to the media player,
30 via step 606. Next, the media player sends a sample rate, a normalization of the audio tracks, and a track volume adjustment to the accessory, via step 608. The media player transfers

digital audio to the accessory through the selected audio streaming interface via step 609. Thereafter, a next track is selected and steps 606, 608 and 609 are repeated, via step 610.

[0055] To describe this process in more detail refer now to the following description in conjunction with the accompanying information. The steps shown hereinbelow illustrate enabling and disabling digital audio by the media player over a USB interface of the connector interface system 100.

[0056] 1. Connect the media player to an accessory.

[0057] 2. Select a media player configuration that has a USB Audio interface.

[0058] 3. Identify the supported commands and authenticate the accessory. The media player requests from the accessory the list of sample rates it supports. The sample rates should be taken from the list of media player supported sample rates (for example as listed in Figure 7).

[0059] 4. Successfully respond to a command that requests the list of sample rates supported by the accessory. The sample rate sent to the accessory for a track taken from the list of sample rates returned to the media player. If the accessory supports the sample rate of the current audio track, then that rate can be sent as the current sample rate. If the accessory does not support the sample rate, the media player will resample the audio data to a supported sample rate in real-time and will send this new supported sample rate as the current sample rate.

[0060] 5. Enable the appropriate streaming interface on the media player.

[0061] 6. Enter a mode that allows for the media player to provide digital audio.

[0062] 7. Place the media player in the play state.

[0063] 8. Accessory receives a sample rate, normalization of the energy of the sound and track volume adjustment from the media player.

[0064] 9. Configure the accessory using the media player information of step 8 above.

[0065] 10. Transfer digital audio from the media player to the accessory through the selected digital interface.

[0066] In one embodiment, digital audio is disabled when the USB connection between the media player and the accessory is lost. The accessory can also disable digital audio by selecting a zero bandwidth USB audio streaming interface on the media player.

5 [0067] To re-enable digital audio after the accessory has disabled it, steps 5-10 are repeated.

[0068] If the accessory requests digital audio data before digital audio is enabled or before the correct digital sample rate has been negotiated, the media player will return packets filled with zeros. The media player will also return packets filled with zeros if authentication fails.

10 [0069] A method and system in accordance with the present invention provides a plurality of commands that allow a media player to provide digital audio to an accessory. In so doing, an accessory can play digital audio media from the media player.

[0070] Although the present invention has been described in accordance with the embodiments shown, one of ordinary skill in the art will readily recognize that there could be variations to the embodiments and those variations would be within the spirit and scope of the present invention. For example, the present invention can be implemented using hardware, software, a computer readable medium containing program instructions, or a combination thereof. Software written according to the present invention is to be either stored in some form of computer-readable medium such as memory or CD-ROM, or is to be transmitted over a network, and is to be executed by a processor. Consequently, a computer-readable medium is intended to include a computer readable signal, which may be, for example, transmitted over a network. It should be also understood that although the present invention was disclosed in the context of a wired USB streaming environment, the present invention could be utilized in any wired or wireless environment and that use would be within the spirit and scope of the present invention. Accordingly, many modifications may be made by one of ordinary skill in the art without departing from the spirit and scope of the appended claims.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for transferring digital audio data from a media player to an accessory, the method comprising, by the accessory:
 - sending to the media player a list of sample rates supported by the accessory;
 - receiving from the media player track information including a first sample rate for a first track, wherein the first sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory;
 - configuring a digital audio interface of the accessory according to the first sample rate; and
 - receiving digital audio samples of the first track from the media player at the first sample rate via the digital audio interface.
2. The method of claim 1 further comprising:
 - authenticating the accessory to the media player prior to sending the list of supported sample rates to the media player.
3. The method of claim 1 wherein the track information received from the media player further includes a normalization of sound energy and a track volume adjustment.
4. The method claim 1 further comprising:
 - receiving from the media player additional track information including a second sample rate for a second track of digital audio data, wherein the second sample rate is selected by the media player and is one of the sample rates on the list of sample rates supported by the accessory; and
 - receiving the second track from the media player at the second sample rate via the digital audio interface.
5. The method of claim 4 further comprising:

in the event that the second sample rate is different from the first sample rate, reconfiguring the digital audio interface of the accessory according to the second sample rate.

6. The method of claim 1 further comprising:

receiving a request from the media player for the list of sample rates supported by the accessory, wherein the act of sending the list is performed in response to receiving the request.

7. A method for transferring digital audio data from a media player to an accessory, the method comprising, by the media player:

requesting from the accessory a list of sample rates supported by the accessory;
receiving from the accessory the list of sample rates supported by the accessory;
selecting from the list of sample rates supported by the accessory a first sample rate to be used for playing a first track of digital audio data;
sending track information including the first sample rate to the accessory; and
sending digital audio samples of the first track via a digital audio interface to the accessory at the first sample rate.

8. The method of claim 7 further comprising:

performing an authentication operation to determine whether the accessory is authenticated; and
disabling the digital audio interface in the event that the accessory is not authenticated.

9. The method of claim 7 wherein the track information sent by the media player further includes a normalization of the sound energy and a track volume adjustment.

10. The method of claim 7 further comprising:

disabling the digital audio interface in the event that the accessory becomes disconnected from the media player.

11. The method of claim 7 further comprising:
 - determining a stored sample rate with which the first track is stored in the media player,
 - wherein selecting the first sample rate includes:
 - in the event that the stored sample rate matches one of the sample rates on the list of sample rates supported by the accessory, selecting the stored sample rate as the first sample rate; and
 - in the event that the stored sample rate does not match any of the sample rates on the list of sample rates supported by the accessory, selecting one of the sample rates on the list of sample rates supported by the accessory as the first sample rate.
12. The method of claim 7 wherein sending the first track to the accessory includes:
 - in the event that the first sample rate does not match a stored sample rate with which the first track is stored in the media player, converting the first track of digital audio data to the first sample rate, wherein the converted first track of digital audio data is sent to the accessory.
13. The method of claim 7 further comprising:
 - selecting from the list of sample rates supported by the accessory a second sample rate to be used for playing a second track of digital audio data;
 - sending to the accessory additional track information including the second sample rate; and
 - sending the second track to the accessory at the second sample rate via the digital audio interface.
14. The method of claim 13 wherein sending the second track to the accessory includes:
 - in the event that the second sample rate does not match a stored sample rate with which the second track is stored in the media player, converting the second track of digital audio data to the second sample rate, wherein the converted second track of digital audio data is sent to the accessory.

15. An accessory for use with a media player, the accessory comprising:
 - a digital audio interface configured to receive digital audio samples of a track of digital audio data from the media player;
 - a playback unit configured to play a track of digital audio data received via the digital audio interface; and
 - a command interface configured to communicate with the media player using a plurality of commands, the plurality of commands including:
 - a first command sendable by the accessory to the media player, the first command providing to the media player a list of sample rates supported by the accessory; and
 - a second command receivable by the accessory from the media player, the second command providing to the accessory track information for a track of digital audio data, the track information including a sample rate for the track, the sample rate for the track being selected by the media player from the list of sample rates supported by the accessory.
16. The accessory of claim 15 wherein the plurality of commands further includes:
 - a third command receivable by the accessory from the media player, the third command requesting the list of sample rates supported by the accessory.
17. The accessory of claim 15 wherein the track information provided by the second command further includes a normalization of sound energy and a track volume adjustment.
18. The accessory of claim 15 wherein the digital audio interface includes a wireless interface.
19. The accessory claim 15 wherein the digital audio interface includes a connector having a plurality of signal contacts.
20. The accessory of claim 15 wherein the digital audio interface includes a Universal Serial Bus (“USB”) audio interface.

21. A media player for use with an accessory, the media player comprising:
a digital audio interface configured to send digital audio samples of a track of digital audio data to the accessory;
a storage device configured to store a plurality of tracks of digital audio data;
a playback engine configured to select a sample rate for one of the stored tracks of digital audio data and to deliver the one of the stored tracks to the digital audio interface at the selected sample rate; and
a command interface configured to communicate with the accessory using a plurality of commands, the plurality of commands including:
a first command receivable by the media player from the accessory, the first command providing to the media player a list of sample rates supported by the accessory; and
a second command sendable by the media player to the accessory, the second command providing to the accessory track information for a track of digital audio data to be sent to the accessory, the track information including the sample rate selected by the playback engine for the track,
wherein the selected sample rate is one of the sample rates on the list of sample rates supported by the accessory.
22. The media player of claim 21 wherein the plurality of commands further includes:
a third command sendable by the media player to the accessory, the third command requesting the list of sample rates supported by the accessory.
23. The media player of claim 21 wherein the track information provided by the second command further includes a normalization parameter and a track volume adjustment parameter.
24. The media player of claim 21 wherein the digital audio interface includes a wireless interface.

25. The media player of claim 21 wherein the digital audio interface includes a connector having a plurality of signal contacts.

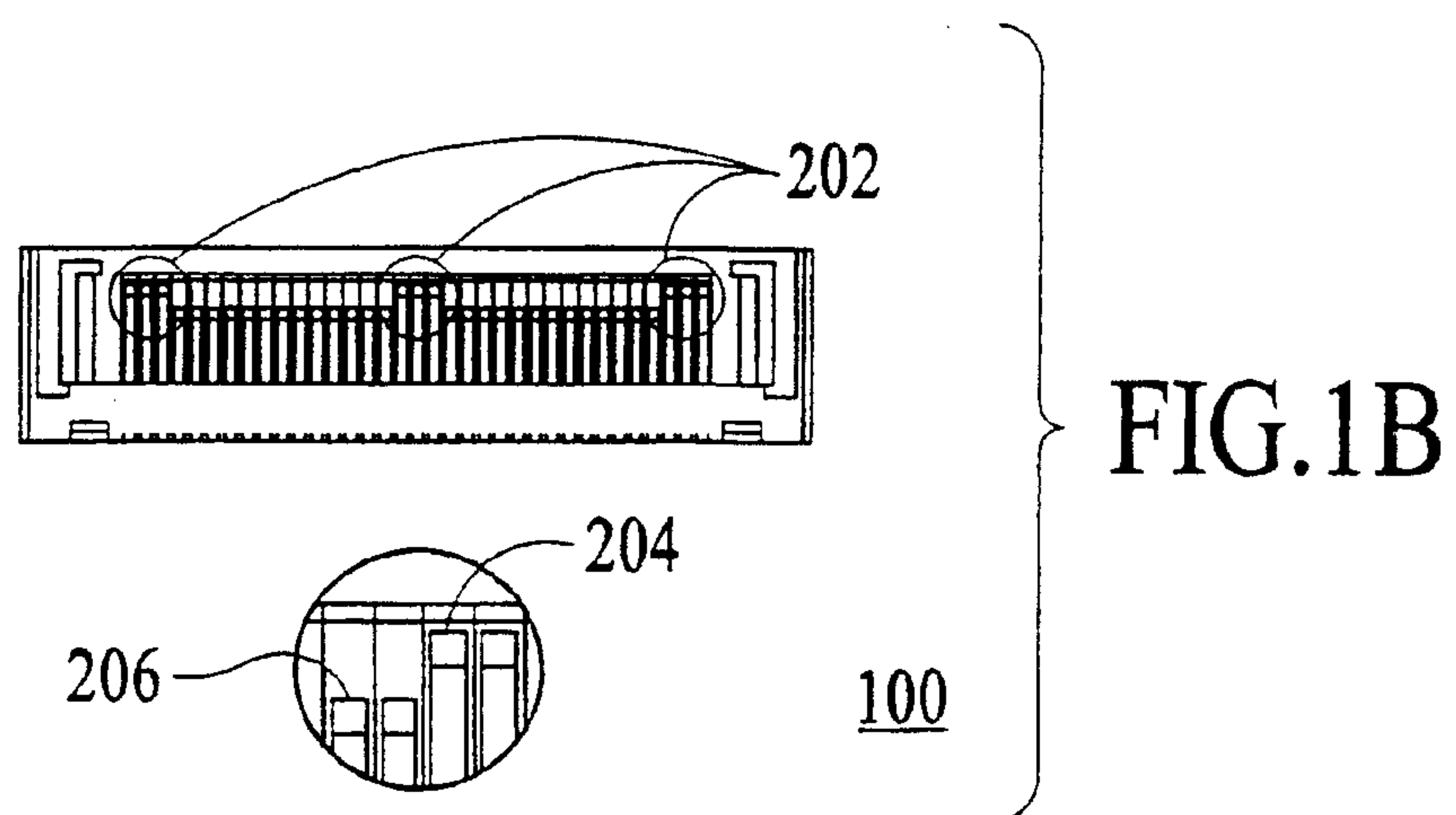
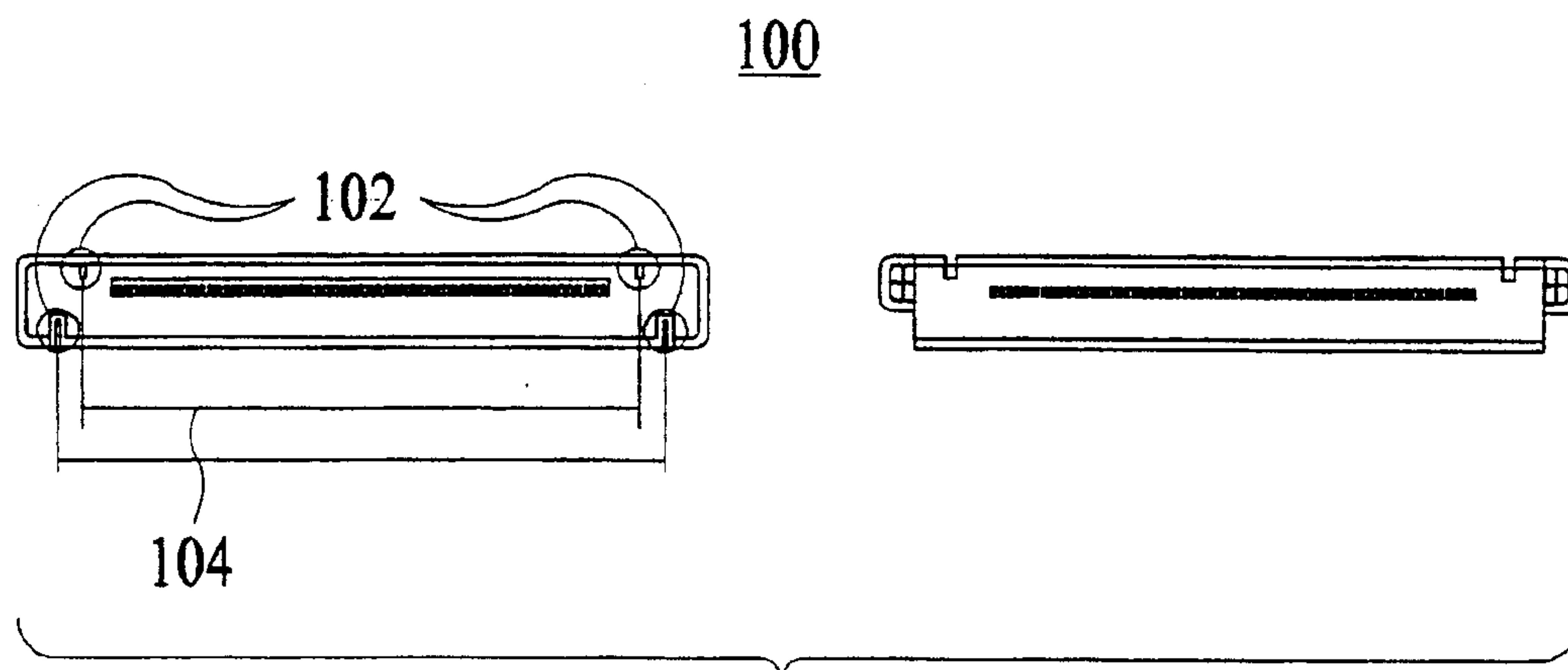
26. The media player of claim 21 wherein the digital audio interface includes a Universal Serial Bus (“USB”) audio interface.

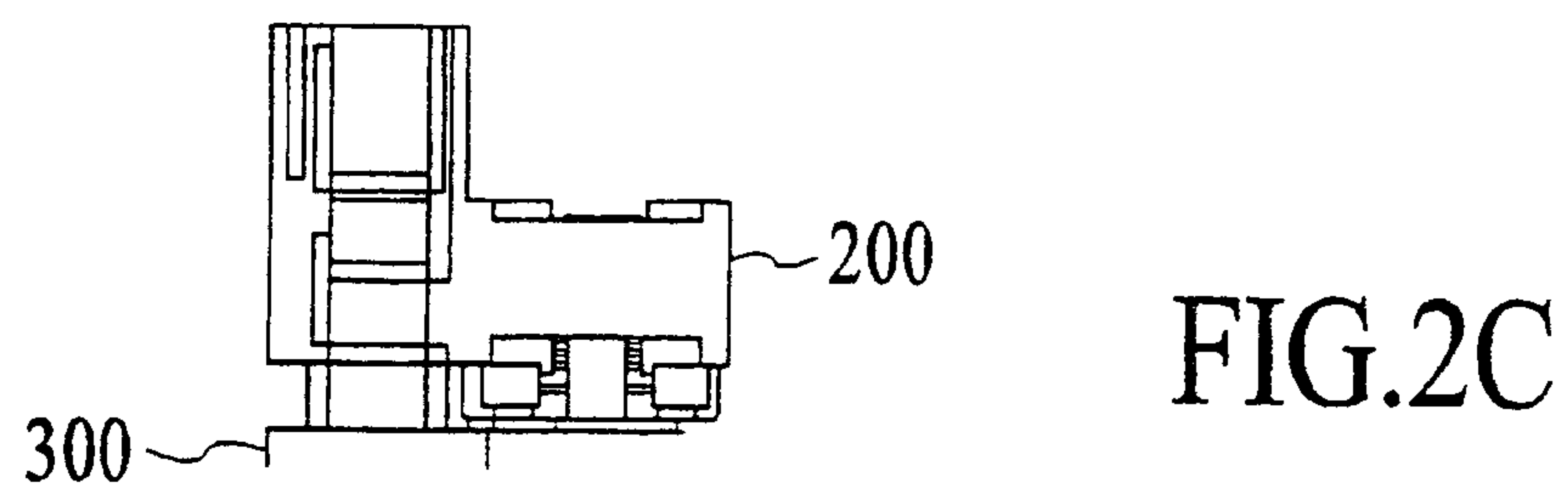
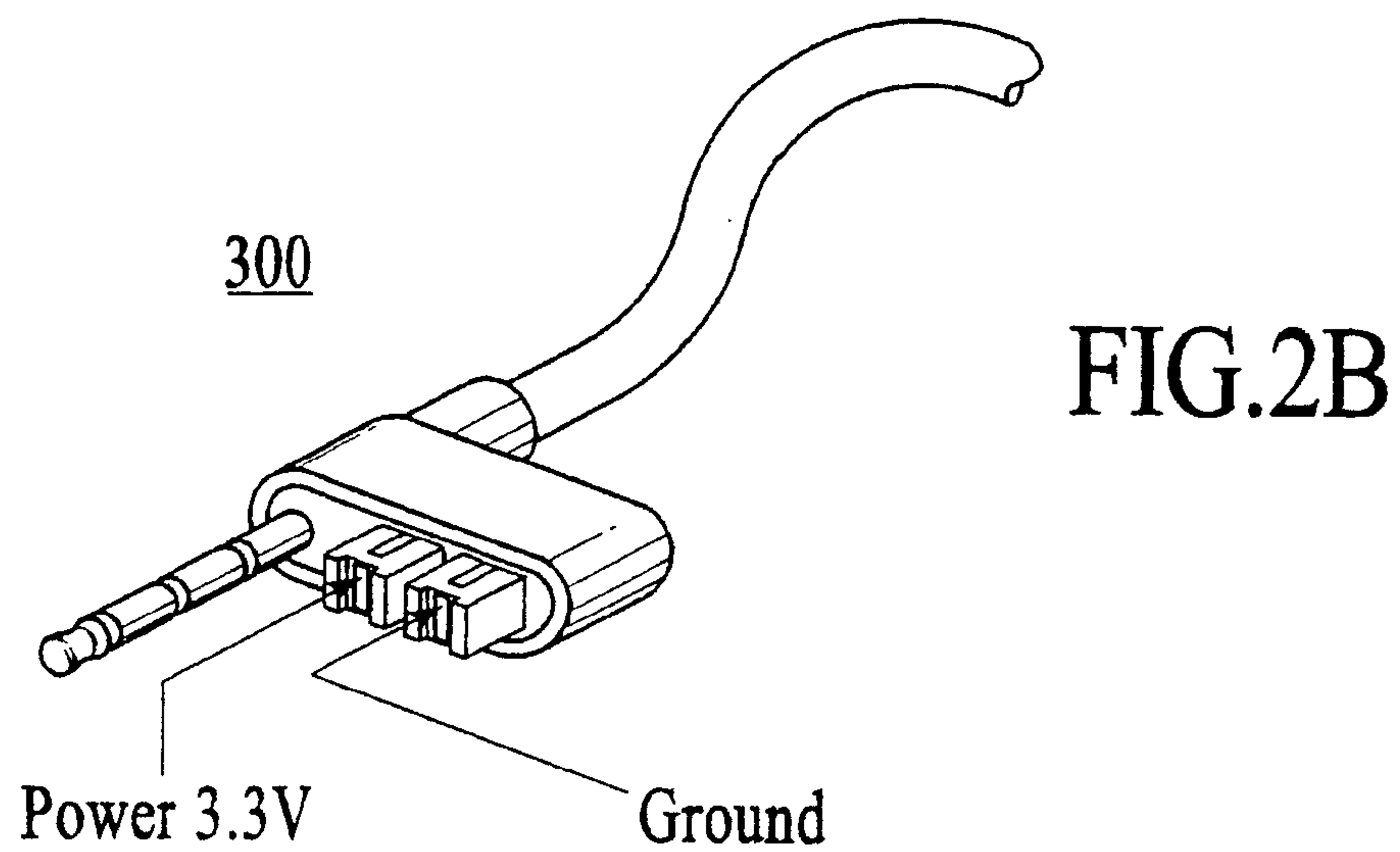
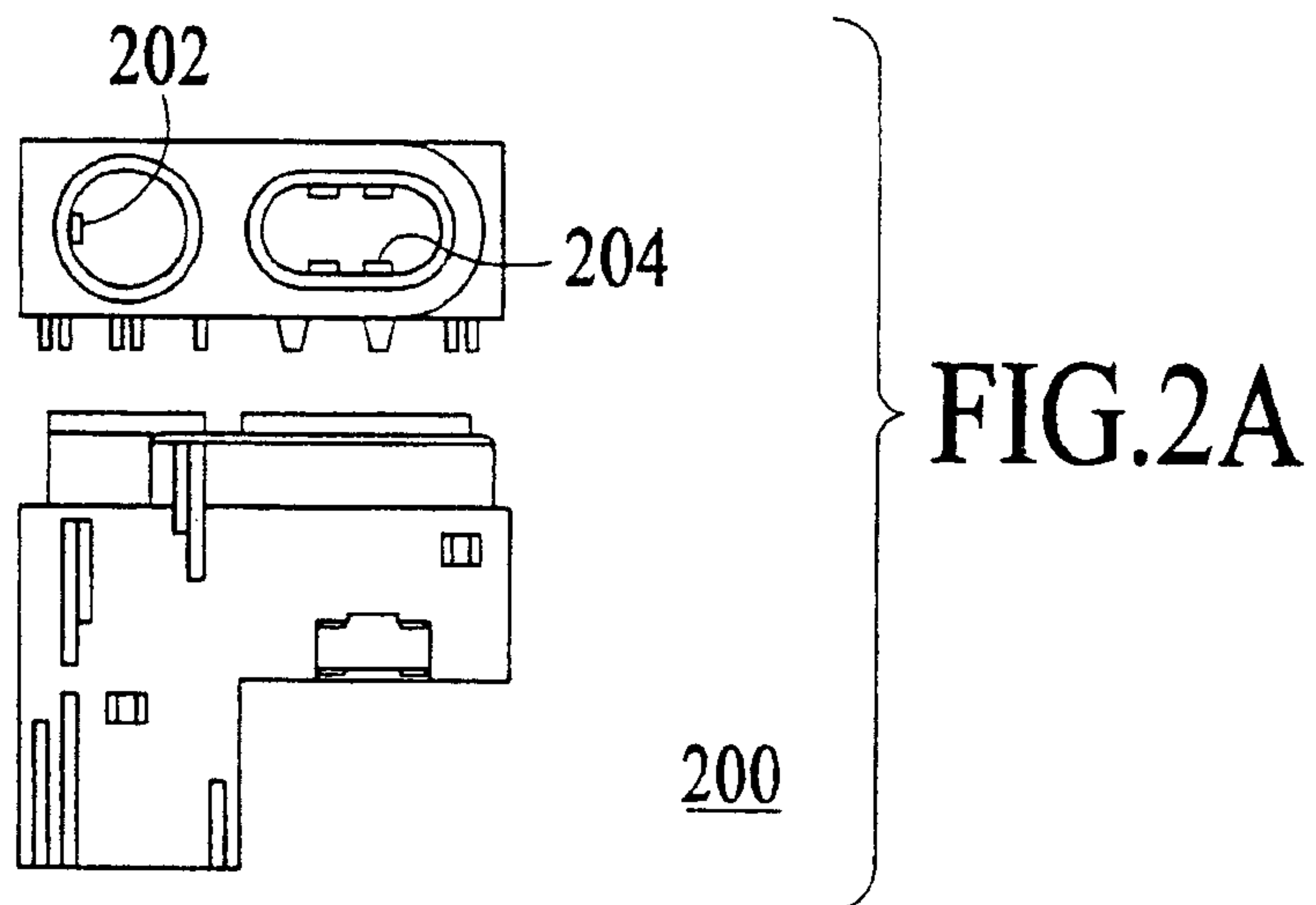
27. The media player of claim 21 wherein the playback engine is further configured to determine a stored sample rate with which the first track is stored in the media player and wherein the playback engine is further configured such that:

in the event that the stored sample rate matches one of the sample rates on the list of sample rates supported by the accessory, the stored sample rate is selected as the first sample rate; and

in the event that the stored sample rate does not match any of the sample rates on the list of sample rates supported by the accessory, one of the sample rates on the list of sample rates supported by the accessory is selected as the first sample rate.

28. The media player of claim 21 wherein the playback engine is further configured such that in the event that the stored track has a sample rate different from the selected sample rate, the playback engine converts the track to the selected sample rate and delivers the converted track to the digital audio interface at the selected sample rate.





3.1 CONNECTOR PIN DESIGNATIONS:

3.1.1 OMNI: JAE DDI 30 pin connector series

Pin	Signal name	I/O	Function
1	DGND	I	Digital Ground
2	DGND	I	Digital Ground
3	TPA+	I/O	Firewire signal
4	USB D+	I/O	USB signal
5	TPA-	I/O	Firewire signal
6	USB D-	I/O	USB signal
7	TPB+	I/O	Firewire signal
8	USB PWR	I	USB power in. NOT for powering; only to detect USB host
9	TPB-	I/O	Firewire signal
10	Accessory Identify	I	Pull down in dock to notify iPod of specific device
11	F/W PWR+	I	Firewire and charger input power (8V to 30V dc)
12	F/W PWR+	I	Firewire and charger input power (8V to 30V dc)
13	ACCESSORY PWR(3V3)	O	3.3V output from iPod. Current limited to 100mA.
14	Reserved		
15	DGND	GND	Digital ground in iPod
16	DGND	GND	Digital ground in iPod
17	Reserved		
18	Dock Tx	I	Serial protocol (Data to iPod)
19	Dock Rx	O	Serial protocol (Data from iPod)
20	Accessory Detect	I/O	
21	S video Y	O	Luminance Component

22	S video C	O	Chrominance Component
23	Video Composite	O	Composite Signal
24	Remote Sense	I	Detect Remote
25	LINE-IN L	I	Line level input to the iPod for the left channel
26	LINE-IN R	I	Line level input to the iPod for the right channel
27	LINE-OUT L	O	Line level output to the iPod for the left channel
28	LINE-OUT R	O	Line level output to the iPod for the right channel
29	Audio Return	GND	Audio return - Singal, never to be grounded inside accessory
30	DGND	GND	Digital ground iPod
31	Chassis		Chassis ground for connector shell
32	Chassis		Chassis ground for connector shell

FIG.3A

3.1.2 AUDIO/REMOTE: 8 pin Foxconn Apple Custom

Pin	Signal name	I/O	Function
1	Audio Out Left / Mono Mic In	I/O	30mW audio out left channel, also doubles as mono mic in
2	HP Detect	I	Internal Switch to detect plug insertion
3	Audio Return	GND	Audio teturn for left and right audio
4	Audio Out Right	O	30mW audio out right channel
5	Composite Video	O	Video Signal
6	Accessory 3.3V	O	3.3V Accessory power 100mA max
7	Tx	O	Serial protocol (Data from iPod to Device)
8	Rx	I	Serial protocol (Data to iPod from Device)
9	D-GND	GND	Digital ground for accessory

FIG.3B

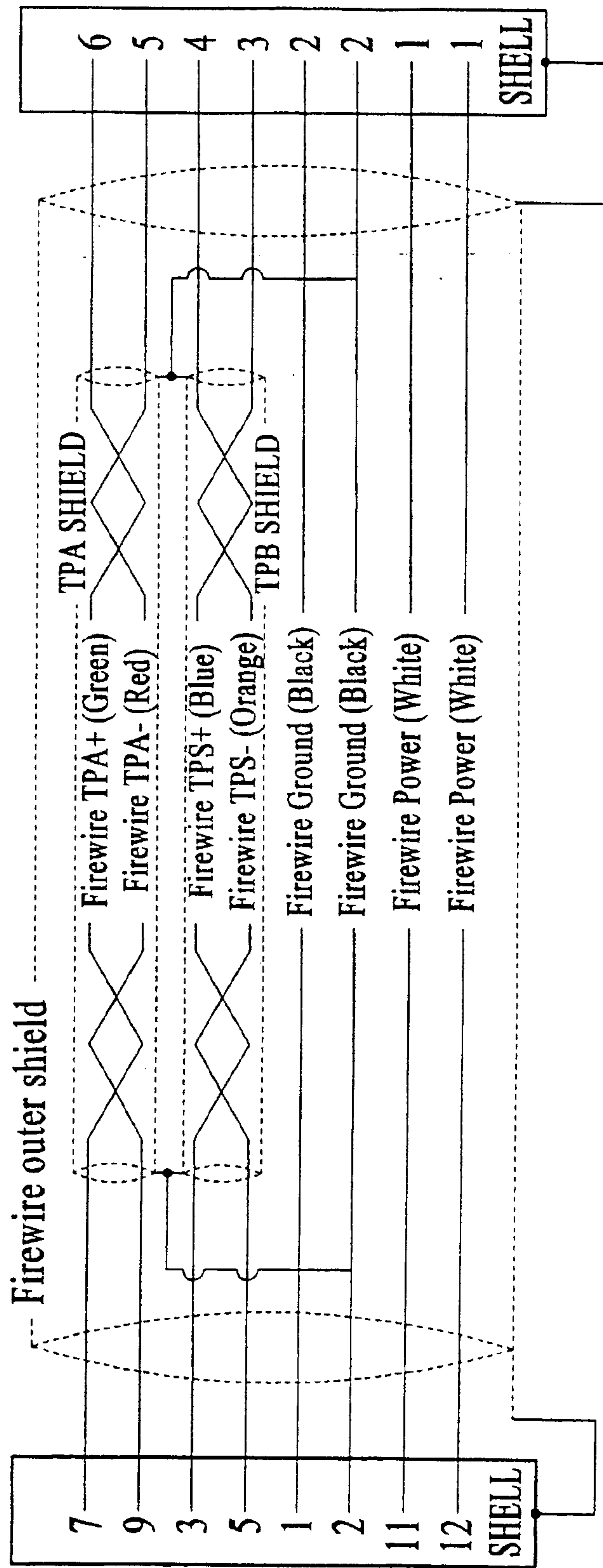


FIG.4A

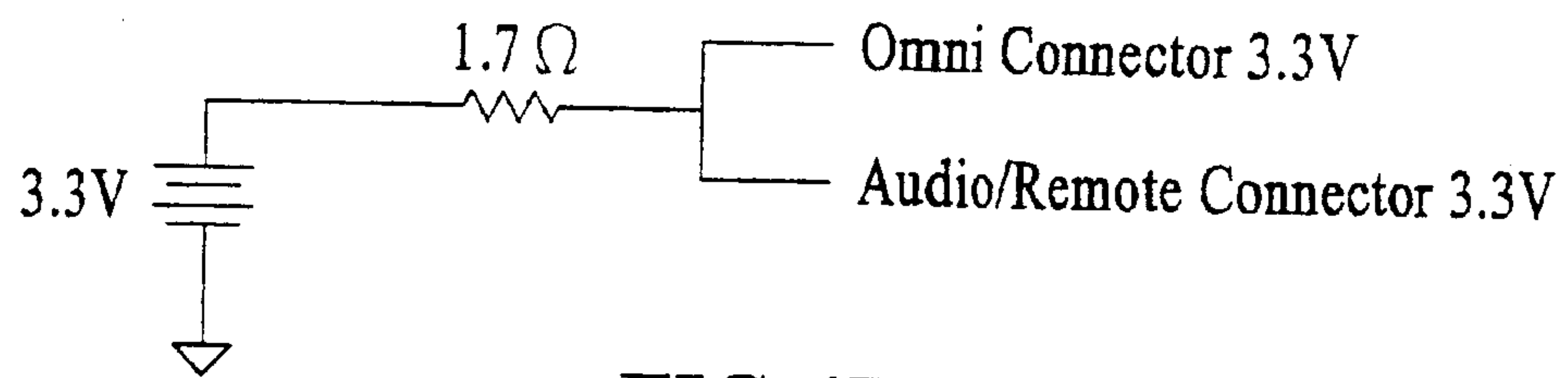


FIG. 4B

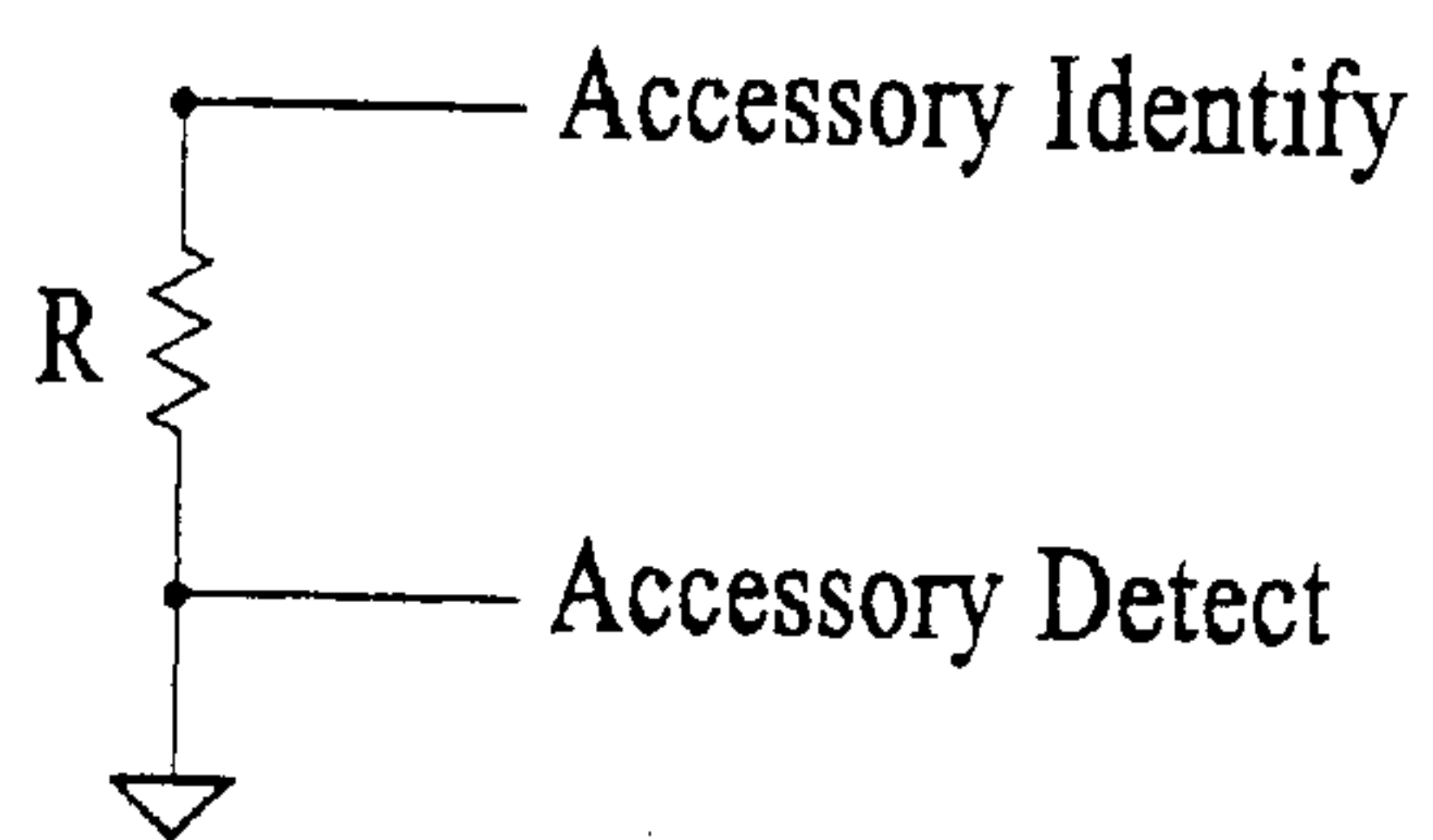


FIG. 4C

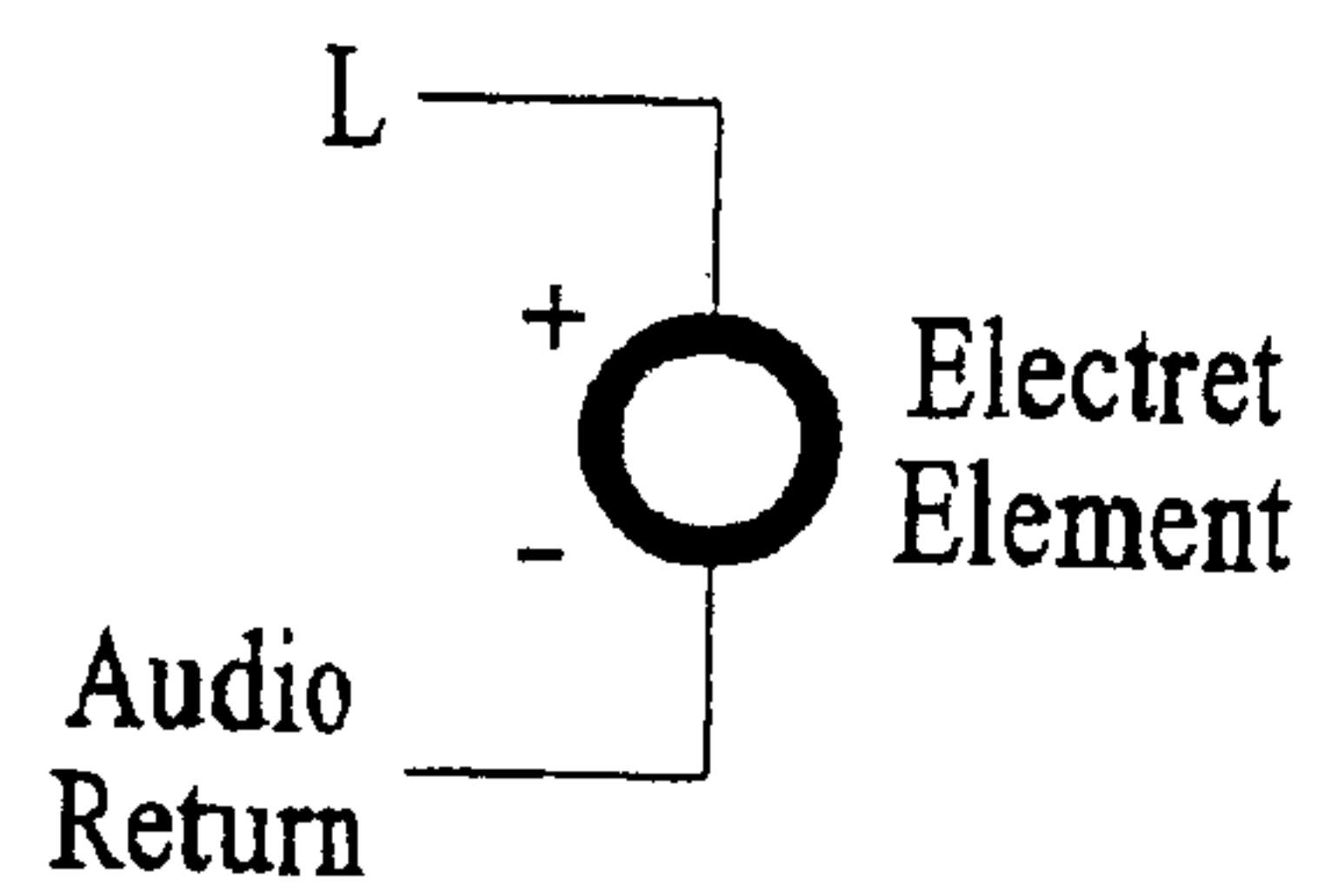


FIG. 4D

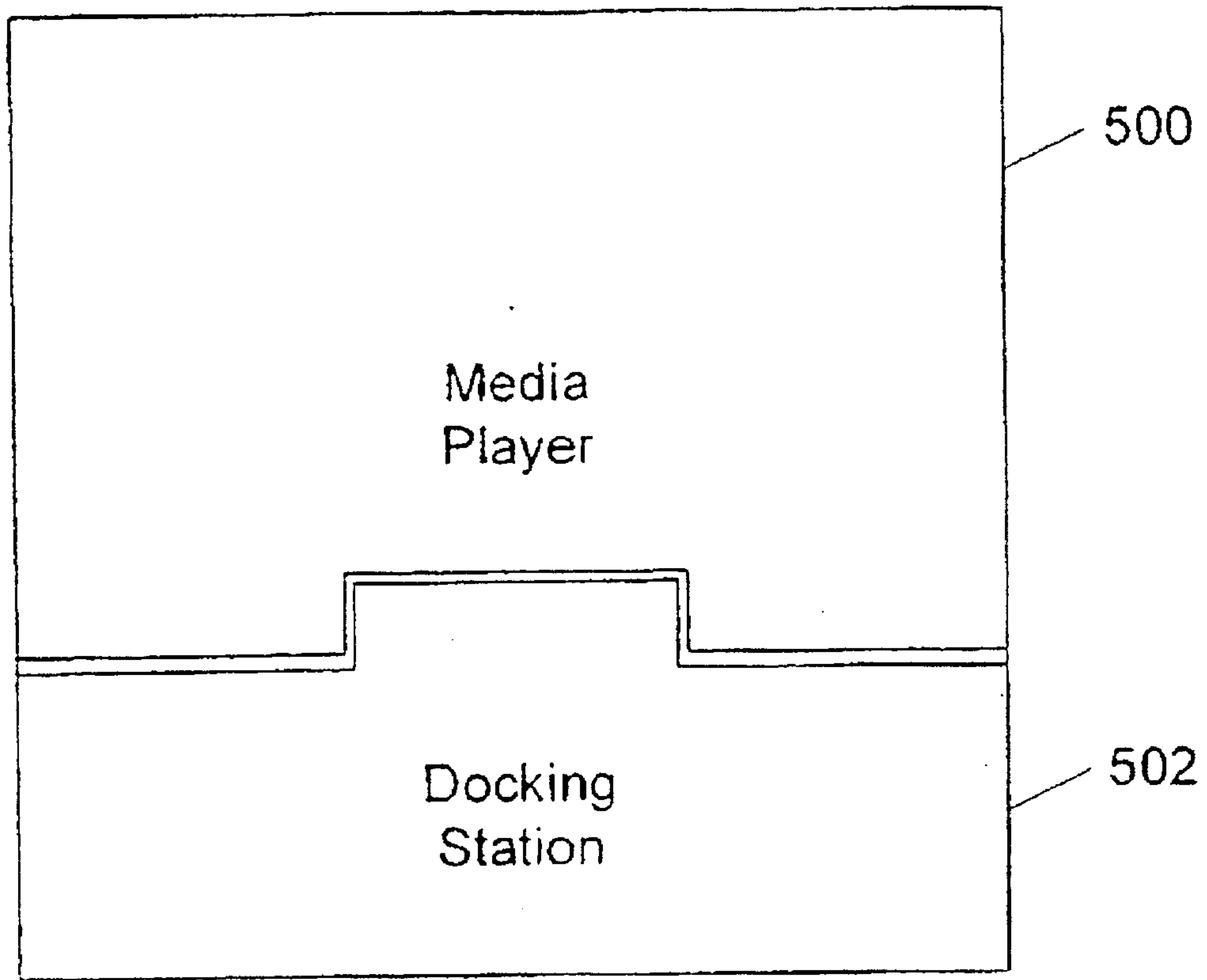


Fig. 5A

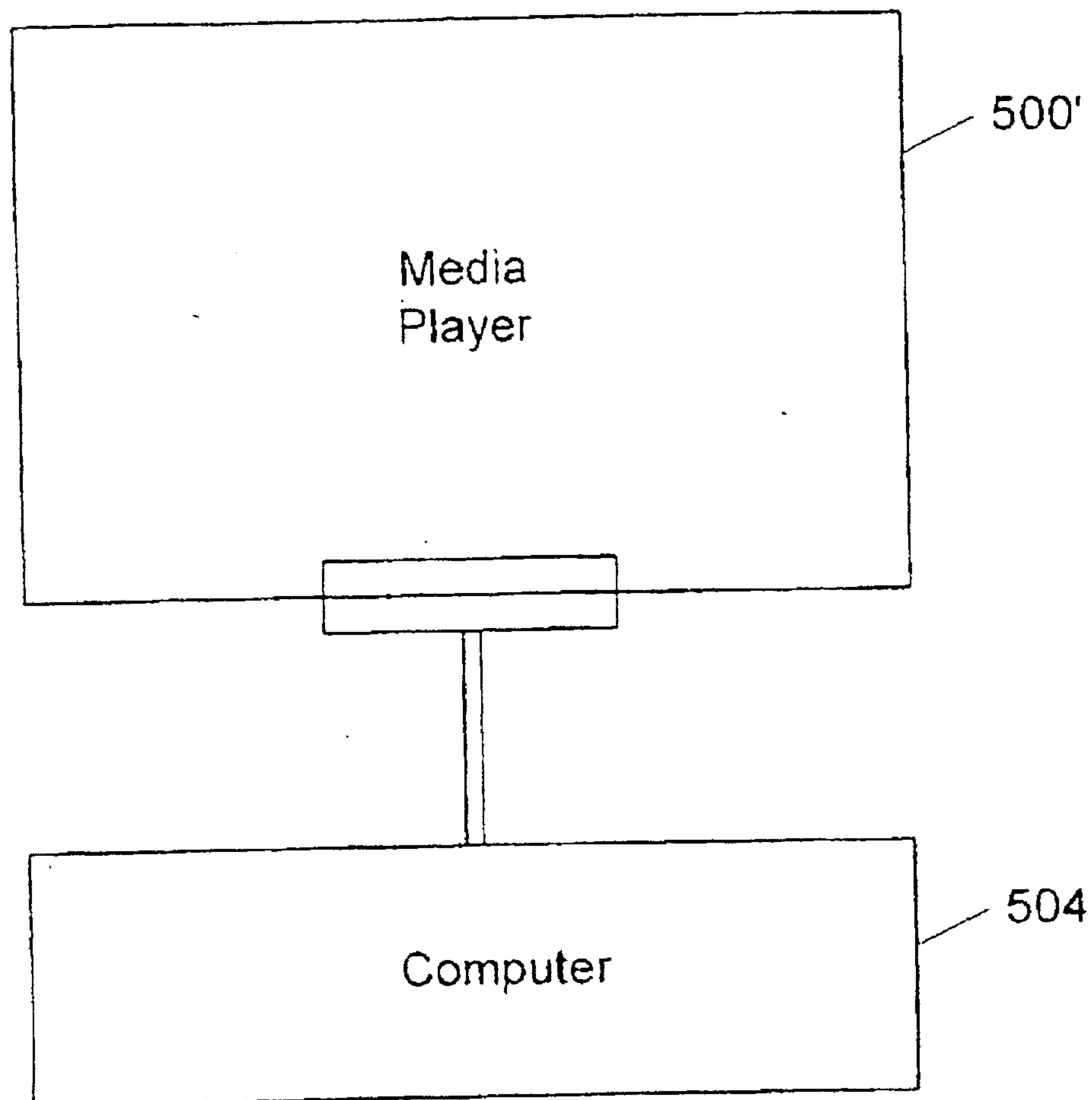


Fig. 5B

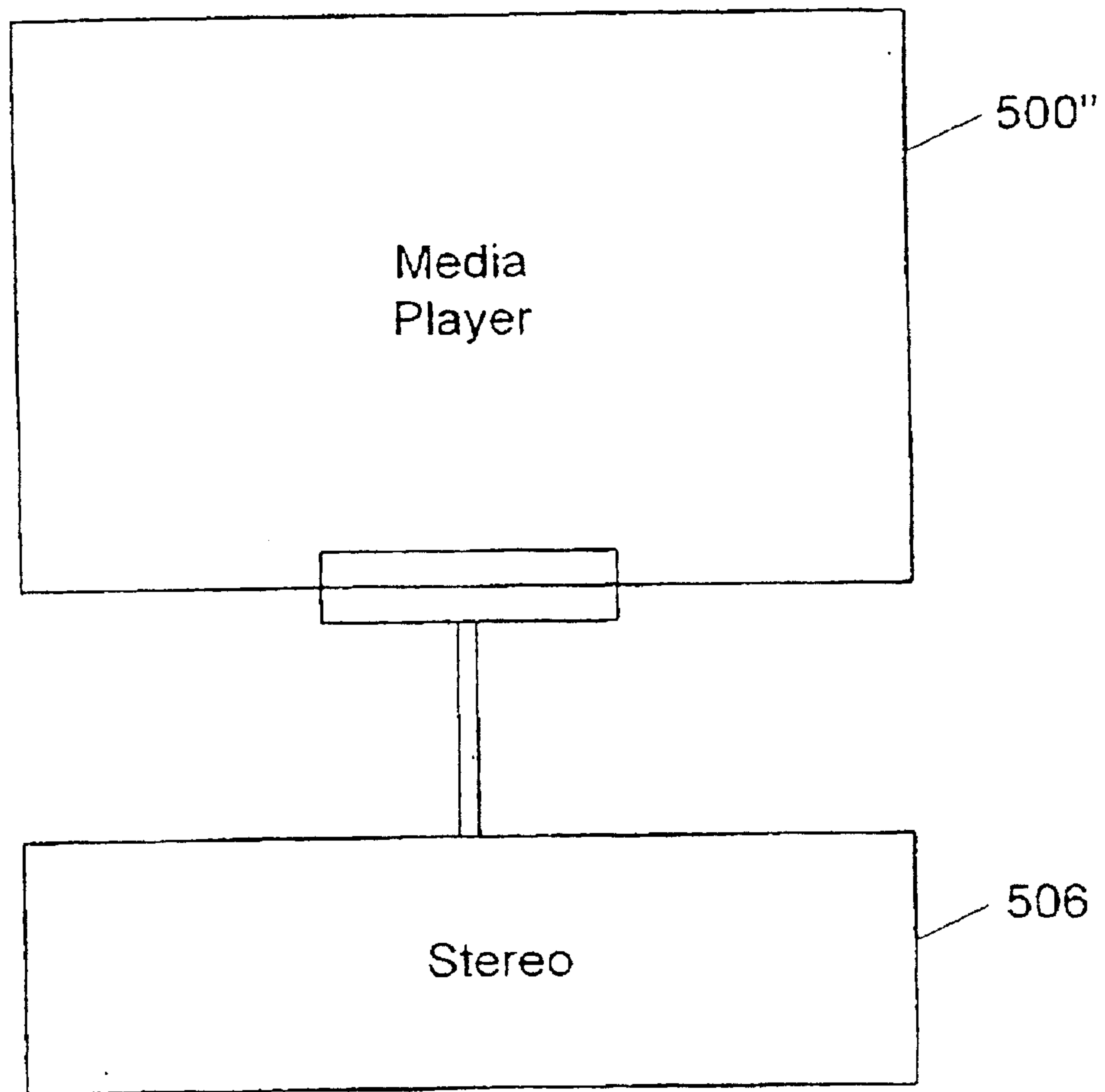


Fig. 5C

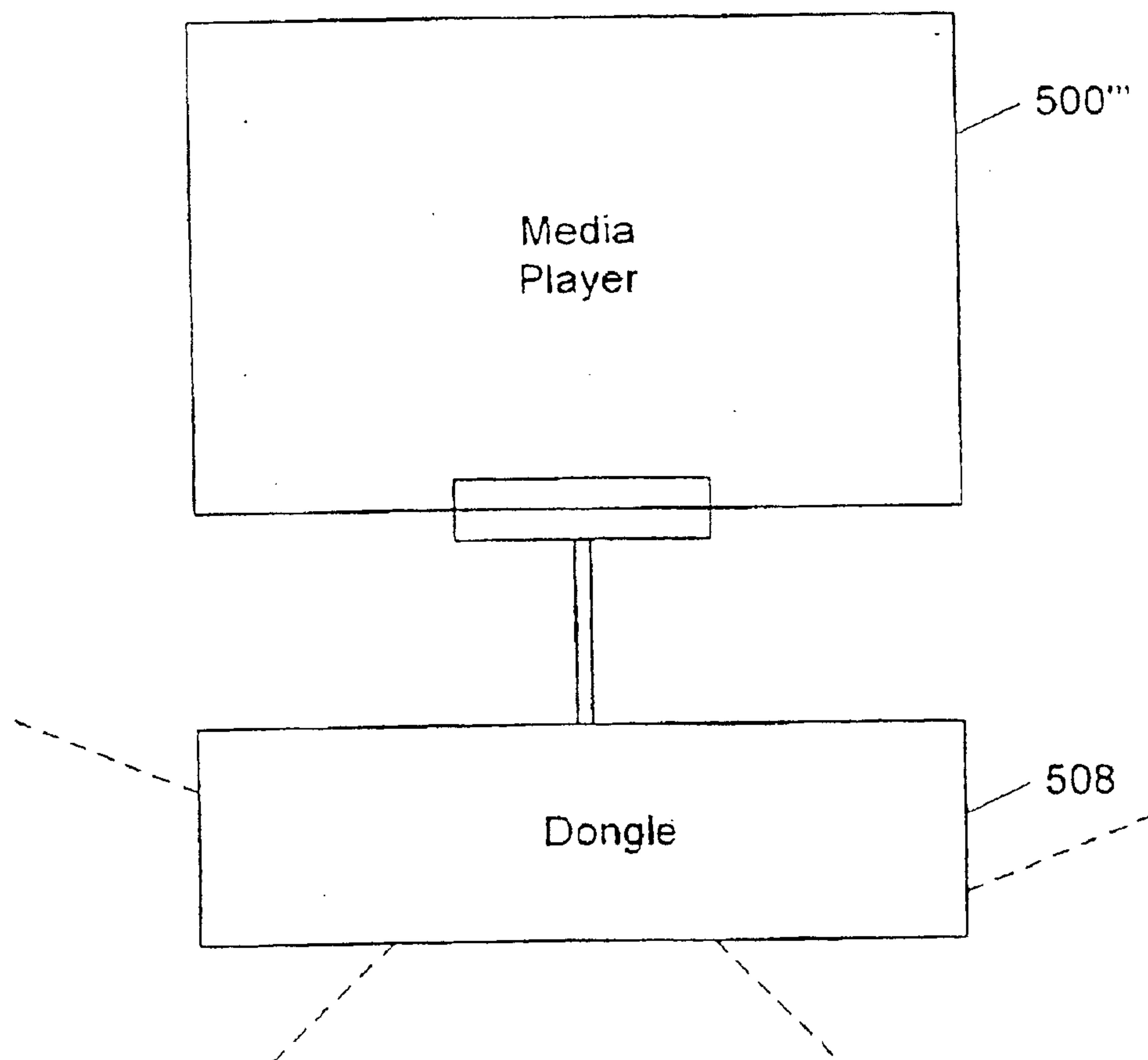


Fig. 5D

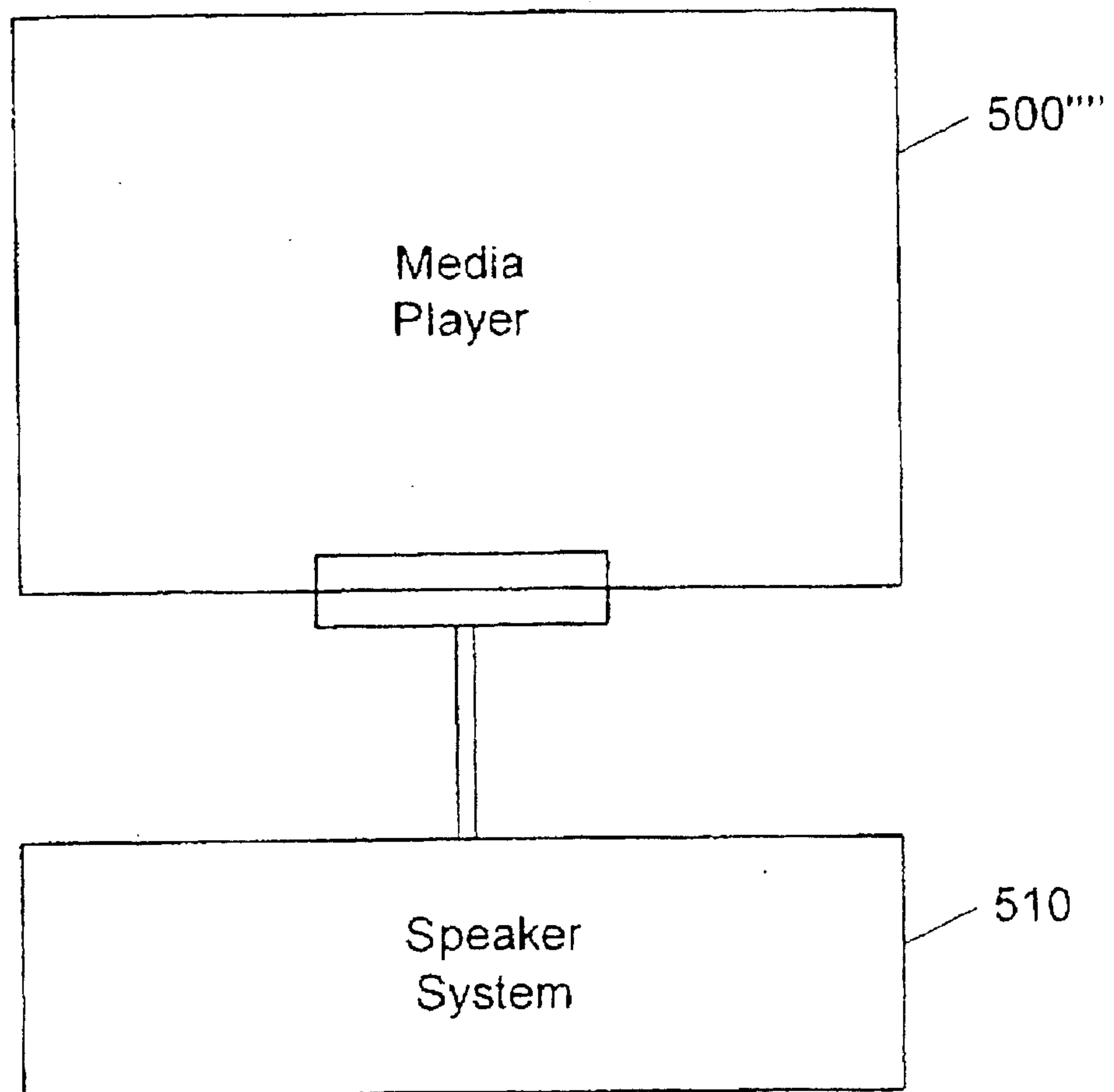


Fig. 5E

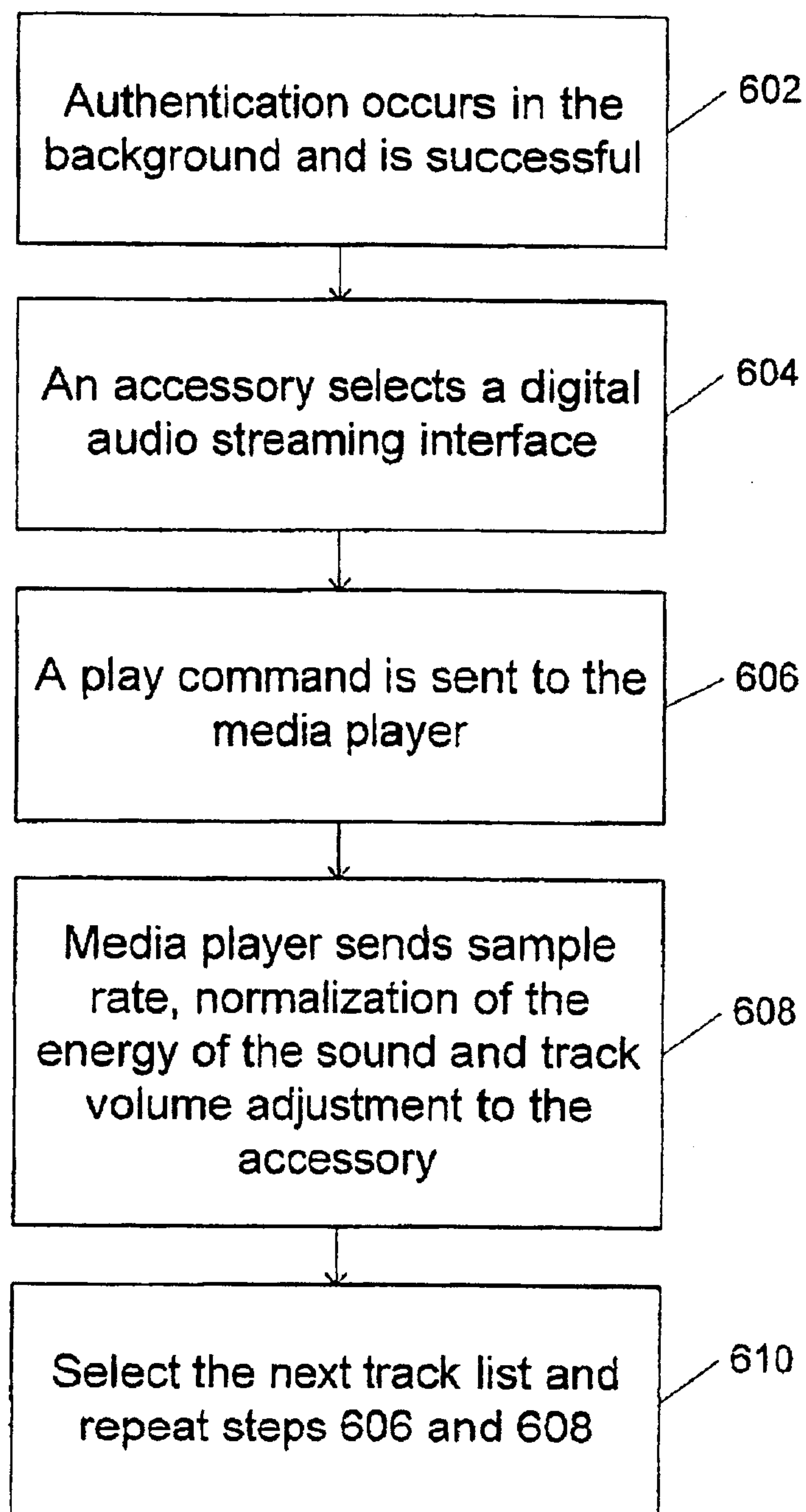


Fig. 6

Decimal Sample Rate (Hz)	Hex Sample Rate (Hz)
8,000	0x00001F40
11,025	0x00002B11
12,000	0x00002EE0
16,000	0x00003E80
22,050	0x00005622
24,000	0x00005DC0
32,000*	0x00007D00*
44,100*	0x0000AC44*
48,000*	0x0000BB80*

Fig. 7

Authentication occurs in the background and is successful

602

An accessory selects a digital audio streaming interface

604

A play command is sent to the media player

606

Media player sends sample rate, normalization of the energy of the sound and track volume adjustment to the accessory

608

Select the next track list and repeat steps 606 and 608

610