(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 637 325 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.09.2013 Bulletin 2013/37

(51) Int Cl.:
H04H 20/10 *(2008.01)* ***H04H 20/22*** *(2008.01)*
H04H 20/26 *(2008.01)*

(21) Application number: **13157203.4**

(22) Date of filing: **28.02.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **05.03.2012 JP 2012047739**

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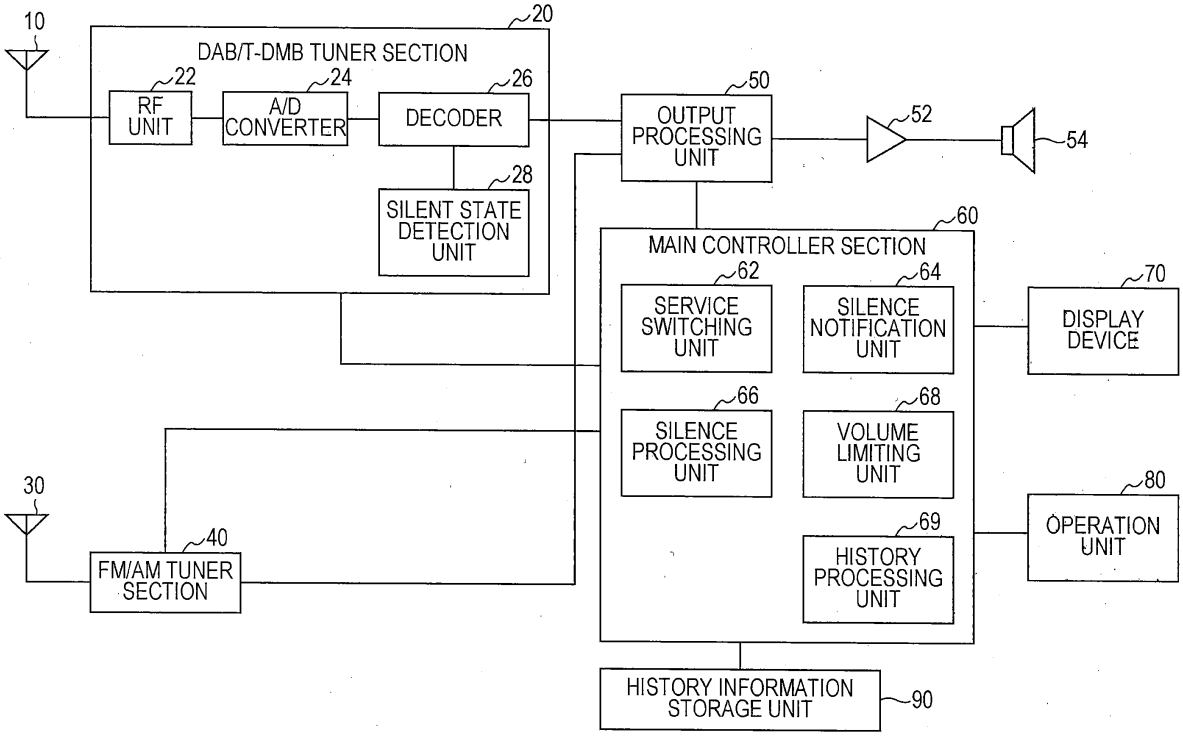
(54) Digital broadcast receiver

(57) A digital broadcast receiver includes an RF unit (22), an analog-to-digital converter (24), and a decoder (26) that receive a broadcast signal and that perform a certain audio reproduction operation; a silent state detection unit (28) that detects a silent state in a reproduced audio signal; and a service switching unit (62) that switches, upon detection of a silent state by the silent state detection unit (28), a received service to a service that has the same content and that is included in another ensemble.

FIG. 1



EP 2 637 325 A1

Description

[0001] The present invention relates to a digital broadcast receiver that receives program data that conforms to a broadcasting standard, such as DAB (Digital Audio Broadcasting) or T-DMB (Terrestrial-Digital Media Broadcasting).

[0002] Hitherto, there has been known a digital broadcast receiver that notifies the user of various causes of a silent state so as to assist the user in dealing with the individual causes (see, for example, JP 2005-354505 A). This digital broadcast receiver considers, as causes of a silent state, 1) a case where no broadcasting wave is receivable, 2) a case where a non-subscribed channel is selected, 3) a case where a currently down channel is selected, 4) a case where a channel subjected to parental controls is selected, and 5) a case where a channel that is not supported by the digital broadcast receiver is selected. Upon detecting a silent state, the digital broadcast receiver outputs a warning sound corresponding to the cause of the silent state.

[0003] When the digital broadcast receiver disclosed in JP 2005-354505 A fails to decode audio of a received program because of a deviation from the broadcasting standard at the broadcasting station side and consequently a periodic or continuous silent state occurs, the digital broadcast receiver is unable to detect these silent states. For example, in the case of broadcasting based on the DAB or T-DMB standard, which is receivable in cities in Europe, typical causes of such silent states include the following five cases A) to E).

A) An SC (Service Component) is registered in an FIC (Fast Information Channel), but the content of the SC is null (filled with 0xFF).
B) An SC is registered in an FIC and also the SC and its content which is an MPEG-2 TS (Moving Picture Experts Group-2 Transport Stream) exist, but a PAT (Program Association Table) or PMT (Program Map Table) which serves as the table of contents is missing.
C) An SC is registered in an FIC and also a PAT and a PMT which serve as the tables of contents exist, but an audio TS (the body of audio) is missing.
D) An MPEG-2 TS is normal, but MPEG-4 content is abnormal. For example, sound is absent because an IOD (Initial Object Descriptor) is missing, or within an IOD a flag "idleFlag" is set or a counter "continuity_counter" is invalid.
E) MPEG-4 content is normal, but actual audio sound is absent.

[0004] Among the above cases, the cases A) to D) are cases of broadcasting standard violation, whereas the case E) is a case of unintended broadcasting interruptions. Because the FIC of received data is normal in these five cases A) to E), FIC-based abnormality determination is not applicable.

[0005] When attempting to perform error correction on received data including many errors due to broadcasting standard violation, a digital broadcast receiver ultimately fails to correct the errors. Consequently, a silent state occurs periodically (for example, once every 3 seconds with a duration of approximately 500 milliseconds).

[0006] When such program data is received, output sound will have a periodic or continuous silent state, causing an issue that the quality of received sound lowers although digital broadcasting originally has a good sound quality. Such an issue is avoidable, if there is another program having the same content, by switching the current program to the other program. This switching, however, requires an operation for actually switching between the programs in order to search for a target program, causing a new issue that the operation becomes more complicated. Furthermore, when a silent state continues, the user who mistakenly considers that sound is off because of a low volume setting turns up the volume. If the user thereafter performs an operation (such as an operation for switching the current program to another program, or an operation for switching the source to another music source, such as a CD (Compact Disc)), sound at a high volume is abruptly output undesirably.

SUMMARY OF THE INVENTION

[0007] Thus, it may be an object of the present invention to provide a digital broadcast receiver capable of preventing, without performing a complicated operation, the quality of received sound from being lowered by a periodic or continuous silent state due to broadcasting standard violation or unintended broadcasting interruptions.

[0008] It may be another object of the present invention to provide a digital broadcast receiver capable of preventing sound at a high volume from being abruptly output as a result of mistakenly turning up the volume when a silent state occurs.

[0009] At least one of the objects is solved by the features of the independent claim. Further embodiments and developments are defined in the dependent claims.

[0010] To this end, a digital broadcast receiver according to an aspect of the present invention includes broadcast signal reception reproduction means for receiving a broadcast signal and for performing a certain audio reproduction operation; silent state detection means for detecting a silent state in an audio signal reproduced by the broadcast signal reception reproduction means; and broadcast signal switching means for sending, upon detection of a silent state by the silent state detection means, an instruction to the broadcast signal reception reproduction means so as to switch a received broadcast signal to another broadcast signal having the same content.

[0011] When a silent state is detected in a received audio signal, the received audio signal is successfully switched to another broadcast signal having the same

content. Accordingly, even in the case where a periodic or continuous silent state occurs because of broadcasting standard violation or unintended broadcasting interruptions, an alternative broadcasting signal is successfully received and normal sound is successfully output. Thus, lowering of the quality of received sound may be prevented. Also, user friendliness may improve because the user need not perform any complicated operation for switching.

[0012] The broadcast signal reception reproduction means desirably receives a digital broadcast signal that has been modulated with a digital modulation scheme. The broadcast signal switching means desirably sends, if another digital broadcast signal having the same content as a currently received digital broadcast signal exists, an instruction to the broadcast signal reception reproduction means so as to switch the currently received digital broadcast signal to the other digital broadcast signal. With this configuration, the quality of output sound may be maintained substantially completely.

[0013] The broadcast signal reception reproduction means is desirably capable of receiving both a digital broadcast signal that has been modulated with a digital modulation scheme and an analog broadcast signal that has been modulated with an analog modulation scheme. The broadcast signal switching means desirably sends, if an analog broadcast signal having the same content as a currently received digital broadcast signal exists, an instruction to the broadcast signal reception reproduction means so as to switch the currently received digital broadcast signal to the analog broadcast signal. With this configuration, silent-state-free sound is successfully output although the quality of sound possibly lowers slightly. Consequently, lowering of the quality of received sound may be prevented compared to the case where a silent state occurs.

[0014] The broadcast signal switching means desirably sends, if both another digital broadcast signal having the same content as the currently received digital broadcast signal and an analog broadcast signal having the same content as the currently received digital broadcast signal exist, an instruction to the broadcast signal reception reproduction means so as to switch the currently received digital broadcast signal to the other digital broadcast signal. By prioritizing reception of digital broadcasting which has a better sound quality, lowering of the quality of output sound may be prevented as much as possible.

[0015] The silent state desirably includes a periodic silent state and a continuous silent state. The digital broadcast receiver desirably further includes first silence processing means for forcibly stopping, if another broadcasting signal having the same content as a currently received digital broadcast signal does not exist upon detection of a silent state by the silent state detection means, output of an audio signal reproduced by the broadcast signal reception reproduction means so as to maintain a continuous silent state. With this configuration, unpleasant output sound due to occurrence of a periodic silent state may be avoided.

[0016] The digital broadcast receiver desirably further includes silent state notification means for notifying, upon detection of a silent state by the silent state detection means, the user of occurrence of the silent state. With this configuration, the user may be notified that, when the broadcast signal is switched, the switching is based on occurrence of the silent state.

[0017] The digital broadcast receiver desirably further includes volume limiting means for limiting, if another broadcast signal having the same content as the currently received digital broadcast signal does not exist upon detection of a silent state by the silent state detection means, processing of changing a volume setting at which an audio signal reproduced by the broadcast signal reception reproduction means is to be output. With this configuration, it may be prevented that the user turns up the volume so high without knowing occurrence of a continuous silent state and sound at a high volume is abruptly output later.

[0018] The digital broadcast receiver desirably further includes history information storage means for storing history information on a silent state detection history of the silent state detection means; and second silence processing means for forcibly stopping, when the broadcast signal reception reproduction means receives a broadcast signal that matches history information stored in the history information storage means until an operation of the silent state detection means and an operation of the broadcast signal switching means end, output of an audio signal reproduced by the broadcast signal reception reproduction means so as to maintain a continuous silent state. With this configuration, by setting a continuous silent state in advance for a broadcast signal for which a silent state is highly likely to occur, occurrence of an unpleasant periodic silent state may be prevented in advance.

[0019] The broadcast signal reception reproduction means desirably receives at least a digital broadcast signal that has been modulated with a digital modulation scheme corresponding to a broadcasting standard that includes digital audio broadcasting or terrestrial-digital media broadcasting. The silent state detection means desirably detects a silent state on the basis of audio data on which the certain audio reproduction operation has been performed by the broadcast signal reception reproduction means. Specifically, the silent state detection means desirably detects a silent state on the basis of a result obtained by calculating a square of an amplitude value of the audio data and then integrating the square. Alternatively, the silent state detection means desirably detects a silent state on the basis of a content of a service component that is registered in a fast information channel contained in a broadcast signal received by the broadcast signal reception reproduction means. Specifically, the silent state detection means desirably detects a silent state if the content of the service component is null. The silent

state detection means desirably makes a determination of a silent state if a program association table or a program map table is missing in a moving picture experts group-2 (MPEG-2) transport stream (TS) contained in the service component. The silent state detection means desirably makes a determination of a silent state if an audio TS is not included in a MPEG-2 TS contained in the service component. The silent state detection means desirably makes a determination of a silent state if an audio TS included in a MPEG-2 TS contained in the service component is abnormal MPEG-4 content. With this configuration, a silent state caused by broadcasting standard violation or unintended broadcasting interruptions may be detected with a higher certainty.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a diagram illustrating the configuration of a digital broadcast receiver according to an embodiment;

Fig. 2 is a diagram illustrating the structure of a frame of a broadcast signal that conforms to the DAB or T-DMB standard;

Fig. 3 is a flowchart illustrating a procedure of an operation of dealing with a silent state which is performed mainly by a main controller section;

Fig. 4 is a diagram illustrating examples displayed during reception of a service; and

Fig. 5 is a flowchart illustrating a procedure of an operation of dealing with a silent state by using history information which is performed mainly by the main controller section in accordance with a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] A digital broadcast receiver according to an embodiment of the present invention will be described below with reference to the accompanying drawings. Fig. 1 is a diagram illustrating the configuration of a digital broadcast receiver according to an embodiment. This digital broadcast receiver is a receiver for receiving a digital broadcast signal that conforms to the DAB or T-DMB standard, which is used mainly in Europe. The digital broadcast receiver also has a configuration for receiving an AM (Amplitude Modulation) broadcast signal and an FM (Frequency Modulation) broadcast signal, which are analog broadcast signals. In addition, this digital broadcast receiver is mounted in a vehicle, for example.

[0022] As illustrated in Fig. 1, the digital broadcast receiver according to this embodiment includes a DAB/T-DMB tuner section 20, an FM/AM tuner section 40, an output processing unit 50, an amplifier 52, a speaker 54, a main controller section 60, a display device 70, an operation unit 80, and a history information storage unit 90.

[0023] The DAB/T-DMB tuner section 20 receives a digital broadcast signal that is broadcast using a multi-carrier scheme, which adopts OFDM (Orthogonal Frequency Division Multiplexing) as its modulation scheme. The DAB/T-DMB tuner section 20 then performs a demodulation process and a decoding process on the received digital broadcast signal so as to reproduce audio data. For example, this DAB/T-DMB tuner section 20 is configured as a module, and includes an RF (Radio Frequency) unit 22, an A/D (Analog-to-Digital) converter 24, a decoder 26, and a silent state detection unit 28. The RF unit 22 converts a broadcast signal received via an antenna 10 into an intermediate-frequency signal. The A/D converter 24 converts the analog intermediate-frequency signal into digital data (intermediate-frequency data). The decoder 26 performs a demodulation process and a decoding process on the intermediate-frequency data so as to generate audio data of each service. Based on the processing content of the decoder 26, the silent state detection unit 28 detects a silent state that possibly occurs during reception of a service. In this embodiment, silent states due to broadcasting standard violation and due to unintended broadcasting interruptions are mainly dealt with. Specific examples of these silent states and a detection method therefor will be described later.

[0024] In the DAB/T-DMB tuner section 20, a demodulation process and a decoding process are performed by the decoder 26 after an intermediate-frequency signal output from the RF unit 22 is converted into digital data. However, to which part of processing is performed in an analog form and from which part of processing is performed in a digital form may be appropriately altered. Also, instead of configuring the DAB/T-DMB tuner section 20 as one module, the DAB/T-DMB tuner section 20 and another configuration may be configured as one module or the similar processing may be performed by using individual components in combination.

[0025] Fig. 2 is a diagram illustrating the structure of a frame of a broadcast signal that conforms to the DAB or T-DMB standard. As illustrated in Fig. 2, one frame is constituted by a synchronization channel, a fast information channel FIC, and a main service channel MSC.

[0026] The synchronization channel is constituted by the null symbol NULL and the phase reference symbol PRS. The synchronization channel is used to detect the start of the frame and to achieve frame synchronization. The fast information channel FIC is an area describing the content of the main service channel MSC, and includes date-and-time data, service (program) arrangement data, service labels (names), and service identification codes SIDs. A plurality of energy-dispersed fast information groups FIGs constitute one fast information block FIB, which is a predetermined information unit. Each FIB is convolutionally encoded. Three convolutionally encoded FIBs constitute one fast information channel FIC. The main service channel MSC mainly contains music data for each of a plurality of services. This main service channel MSC includes a plurality of energy-dispersed, convolutionally encoded, and time-interleaved

sub channels SubChs.

[0027] The FM/AM tuner section 40 performs demodulation processes (an FM detection process and an AM detection process) corresponding to an FM broadcast signal and an AM broadcast signal, which are analog broadcasting received via an antenna 30, so as to reproduce audio data. Each program that corresponds to an FM broadcast signal is associated with a program identification code (PI). An FM broadcast program having the same content as a service contained in a digital broadcast signal is associated with the program identification code PI that is equal to the service identification code SID associated with the service. Thus, when searching for an FM broadcast program having the same content as a digital broadcast service, the FM/AM tuner section 40 just detects a program having the program identification code PI that is equal to the service identification code SID.

[0028] To the output processing unit 50, audio data output from the DAB/T-DMB tuner section 20 and audio data output from the FM/AM tuner section 40 are input. The output processing unit 50 performs processing, such as switching audio data to be output, controlling the volume change, and superposing another sound (e.g., operation sound) onto audio data. The amplifier 52 amplifies the audio data output from the output processing unit 50, and outputs the amplified sound from the speaker 54. In practice, the audio data on which various kinds of processing have been performed by the output processing unit 50 needs to be converted into an analog audio signal. This conversion may be performed in the output processing unit 50 or by a D/A (Digital-to-Analog) converter, which may be provided at the subsequent stage of the output processing unit 50.

[0029] The main controller section 60 controls a reception operation of the digital broadcast receiver, and deals with a silent state upon the silent state detection unit 28 detecting a silent state. In order to deal with a silent state, the main controller section 60 includes a service switching unit 62, a silence notification unit 64, a silence processing unit 66, a volume limiting unit 68, and a history processing unit 69. Fig. 1 omits illustration of components related to control of a normal reception operation (such as components needed in an operation of selecting a service to be received and an operation of displaying received content regarding the currently received service) other than those for dealing with a silent state.

[0030] Upon the silent state detection unit 28 detecting a silent state for the currently received service, the service switching unit 62 searches for a service having the same service identification code SID as this service on another frequency (ensemble) and switches the service to the retrieved one. The service switching unit 62 also searches for an FM broadcast program having the program identification code PI that is equal to the service identification code SID of this service and switches the service to the retrieved one.

[0031] The silence notification unit 64 notifies the user of occurrence of a silent state when the silent state detection unit 28 detects the silent state for the currently received service. For example, the silence notification unit 64 makes this notification by displaying a certain message on the display device 70. The silence processing unit 66 performs processing of turning off sound output from the speaker 54 when the silent state detection unit 28 detects a silent state for the currently received service. For example, a periodic silent state lowers the quality of received sound and makes the user feel unpleasant. Such unpleasantness is successfully eliminated by tuning off the output sound.

[0032] When the silent state detection unit 28 detects a silent state for the currently received service, the volume limiting unit 68 limits processing of changing the volume that is performed in accordance with a user operation on the operation unit 80. This "limitation" includes not only the case of disabling the volume changing processing but also the case of preventing the volume from being changed to be equal to or higher than a certain level even if an instruction to turn up the volume is given.

[0033] Upon the silent state detection unit 28 detecting a silent state for the currently received service, the history processing unit 69 stores, in the history information storage unit 90, history information including the service identification code SID of this service, information on an ensemble containing this service, and the type (e.g., periodic or continuous) of the silent state.

[0034] The display device 70 displays a screen that shows the operating state of the digital broadcast receiver, screens on which various operations are to be performed, and so forth. The operation unit 80 is used by the user to input operation instructions, and includes various operation keys and operation buttons. By using the operation unit 80, the user inputs an instruction to change the volume, an instruction to switch the service to be received, etc.

[0035] The RF unit 22, the A/D converter 24, and the decoder 26 described above correspond to a broadcast signal reception reproduction means. The silent state detection unit 28 corresponds to a silent state detection means. The service switching unit 62 corresponds to a broadcast signal switching means. The silence processing unit 66 corresponds to a first silence processing means and a second silence processing means. The silence notification unit 64 corresponds to a silent state notification means. The volume limiting unit 68 corresponds to a-volume limiting means. The history information storage unit 90 corresponds to a history information storage means.

[0036] The digital broadcast receiver according to this embodiment has the configuration described above. The following describes an operation of dealing with a silent state when a silent state is detected for the currently received service.

[0037] Fig. 3 is a flowchart illustrating a procedure of an operation of dealing with a silent state which is performed mainly by the main controller section 60. After the digital broadcast receiver is activated to start receiv-

ing a service (step 100), the main controller section 60 displays received content regarding this received service on the display device 70 (step 102). The main controller section 60 also instructs the output processing unit 50 to output sound corresponding to the received service so as to output the sound from the speaker 54 (step 104).

[0038] Fig. 4 is a diagram illustrating examples displayed during reception of a service. Fig. 4 illustrates an example of a screen D1 that is displayed in step 102 described above. Specifically, this example displays the screen D1 of a station list, which indicates that a specific ensemble specified by "13F: CR DAB+ ROMA" contains five services (such as "KISS KISS ITALIA" and "Radio 105"), and "KISS KISS ITALIA" is selected from among these services and is being received.

[0039] In parallel to such a service reception operation, the silent state detection unit 28 detects a silent state for output sound of this service and the service switching unit 62 determines whether or not a silent state has been detected on the basis of this detection result (step 106).

[0040] Typical silent states to be detected in this embodiment include the following five cases A) to E).

A) An SC (Service Component) is registered in an FIC (Fast Information Channel), but a sub-channel SubCh of a main service channel MSC which is the content of the SC is null (filled with 0xFF).

B) An SC is registered in an FIC and also a sub-channel SubCh of a main service channel MSC, which is the body of the SC, and its content an MPEG-2 TS (Moving Picture Experts Group-2 Transport Stream) exist, but a PAT (Program Association Table) or PMT (Program Map Table), which serves as the table of contents, is missing.

C) An SC is registered in an FIC and also a PAT and a PMT which serve as the tables of contents exist, but an audio TS (the body of audio) is missing in a sub-channel SubCh of an MSC.

D) An MPEG-2 TS is normal, but MPEG-4 content of an audio TS is abnormal. For example, sound is absent because an IOD (Initial Object Descriptor) is missing, or within an IOD a flag "idleFlag" is set or a counter "continuity_counter" is invalid.

E) MPEG-4 content of an audio TS is normal, but actual audio sound is absent.

[0041] Among these cases, regarding the cases A) to D), which are cases of broadcasting standard violation, the presence or absence of a silent state of each case is successfully detected by checking the content of the data while the decoder 26 is performing a decoding process. Regarding the case E), which is a case of unintended broadcasting interruptions, the presence or absence of a silent state of this case is successfully detected by checking the content of audio data having undergone the decoding process performed by the decoder 26 or of compressed audio data obtained in the middle of the decoding process.

[0042] If a silent state is not detected, a negative determination is made in step 106. The process then returns to step 100, in which the service reception operation continues. If a silent state is detected, a positive determination is made in step 106. Next, the service switching unit 62 determines whether or not a service having the same service identification code SID (service having the same content) as the currently received service exists on a frequency (ensemble) that is different from the frequency (ensemble) of the currently received service (step 108). If a service having the same SID is found, the service switching unit 62 makes a positive determination and sends an instruction to the DAB/T-DMB tuner section 20 so as to switch the service to the service having the same SID on the different frequency (step 110). Thereafter, the silence notification unit 64 displays the received content regarding the switched service on the display device 70 (step 112). The service switching unit 62 instructs the output processing unit 50 to output sound corresponding to the switched service so as to output the sound from the speaker 54 (step 114). Fig. 4 illustrates an example of a screen D2 that is displayed in step 112 described above. Specifically, this example displays the screen D2 of a station list, which indicates that the service has been switched to the service "KISS KISS ITALIA" that has the same SID and is contained in an ensemble specified by "14F: CR DAB+ MILANO" and the switched service is being received. This screen D2 includes an icon A, which indicates that the service has been switched to the service having the same SID. The procedure of displaying the station list is the same as that performed in the normal service reception operation. Thus, the main controller section 60 may create the station list screen D2 described above and the silence notification unit 64 may create only the icon A included in the screen D2 so as to notify the user that the service has been switched.

[0043] Next, the main controller section 60 determines whether or not an instruction to switch the service has been given by the user through operation of the operation unit 80 (step 116). If an instruction to switch the service has not been given, a negative determination is made. The process then returns to step 110, in which the service reception operation continues for the switched service. If an instruction to switch the service has been given, a positive determination is made in step 116. The main controller section 60 switches the service in accordance with the instruction (step 118). Thereafter, the process returns to step 100, in which the service reception operation continues for the switched service.

[0044] If no service having the same SID is found, a negative determination is made in step 108. Next, the silence notification unit 64 displays a notification indicating that output sound is abnormal (silent state) (step 120). In the example illustrated in Fig. 4, a notification screen D3 that notifies the user of occurrence of a silent state is created and displayed by the silence notification unit 64. This notification screen D3 includes an indication, such as "DAB sound is abnormal!", which indicates that output

sound is abnormal.

[0045] Additionally, the service switching unit 62 determines whether or not an FM broadcast program having the program identification code PI that is equal to the service identification code SID of the currently received service exists (step 122). If an FM broadcast program having the same PI as the SID is found, the service switching unit 62 makes a positive determination and sends an instruction to the FM/AM tuner section 40 so as to switch the service to the FM broadcast program having the same content as the hitherto received service (step 124). Thereafter, the silence notification unit 64 displays the received content regarding the switched FM broadcast program on the display device 70 (step 126). The service switching unit 62 instructs the output processing unit 50 to output sound corresponding to the switched FM broadcast program so as to output the sound from the speaker 54 (step 128). Fig. 4 illustrates an example of a screen D4 that is displayed in step 126 described above. Specifically, this example displays the screen D4 of a station list, which indicates that an FM broadcast program corresponding to the previous service "KISS KISS ITALIA" contained the ensemble specified by "13F: CR DAB+ ROMA" is being received. This screen D4 includes an icon B, which indicates that the service has been switched to the FM-broadcast program.

[0046] The procedure of displaying the station list is the same as that performed in the normal service reception operation. Thus, the main controller section 60 may create the station list screen D4 described above and the silence notification unit 64 may create only the icon B included in the screen D4 so as to notify the user that the service has been switched to the FM broadcast program.

[0047] Next, the main controller section 60 determines whether or not an instruction to switch the service has been given by the user through operation of the operation unit 80 (step 130). If an instruction to switch the service has not been given, a negative determination is made. The process then returns to step 124, in which the reception operation of the switched FM broadcast program continues. If an instruction to switch the service has been given, a positive determination is made in step 130. The main controller section 60 switches the service in accordance with the instruction (step 132). Thereafter, the process returns to step 100, in which the service reception operation continues for the switched service.

[0048] If no FM broadcast program having the same PI as the SID is found, a negative determination is made in step 122. Next, the silence processing unit 66 sends a sound turn-off instruction to the output processing unit 50 so as to turn off the sound output from the speaker 54 (step 134). Also, the volume limiting unit 68 limits processing of changing the volume that is performed in accordance with a user operation on the operation unit 80 (step 136). In this case, the notification screen D3, which notifies the user of occurrence of a silence state, is continuously displayed.

[0049] Next, the main controller section 60 determines whether or not an instruction to switch the service has been given by the user through operation of the operation unit 80 (step 138). If an instruction to switch the service has not been given, a negative determination is made. The process then returns to step 134, in which the silence process continues. If an instruction to switch the service has been given, a positive determination is made in step 138. The main controller section 60 switches the service in accordance with the instruction (step 140). Thereafter, the process returns to step 100, in which the service reception operation continues for the switched service.

[0050] As described above, upon detecting a silent state in a received audio signal, the digital broadcast receiver according to this embodiment successfully switches the received audio signal to another broadcast signal having the same content. Accordingly, even in the case where a periodic or continuous silent state occurs because of broadcasting standard violation or unintended broadcasting interruptions, the digital broadcast receiver successfully receives an alternative broadcasting signal and outputs normal sound. Thus, lowering of the quality of received sound may be prevented. Also, user friendliness may improve because the user need not perform any complicated operation for switching.

[0051] In particular, in the case where the service is switched to another service having the same SID, the quality of output sound may be maintained substantially completely. In the case where the service is switched to an FM broadcast program having the same PI as the SID, silent-state-free sound is successfully output although the quality of sound possibly lowers slightly. Consequently, lowering of the quality of received sound may be prevented compared to the case where a silent state occurs. By prioritizing switching of the service to another service having the same SID over switching of the service to an FM broadcast program, lowering of the quality of output sound may be prevented as much as possible.

[0052] Output sound is turned off (step 134 in Fig. 3) if a service having the same SID and an FM broadcast program having the same PI are not found. With this configuration, unpleasant output sound due to occurrence of a periodic silent state may be avoided. Also, a notification regarding occurrence of a silent state is displayed (step 120 in Fig. 3) when a silent state is detected. With this configuration, the user may be notified that, when the broadcast signal is switched, the switching is based on occurrence of a silent state. The operation in step 120 in Fig. 3 may be performed prior to step 108 (determination operation for the same SID).

Changing the volume setting is limited (step 136 in Fig. 3) when a service having the same SID and an FM broadcast program having the same PI are not found and sound is set to be off. With this configuration, it may be prevented that the user turns up the volume so high without knowing occurrence of a continuous silent state and sound at a high volume is abruptly output later.

[0053] The present invention is not limited to the above embodiment, and may be variously modified within the

scope of the claims.

[0054] For example, in the above-described embodiment, a silent state is detected and is dealt with, without using history information stored in the history information storage unit 90. However, this history information may be used.

[0055] Fig. 5 is a flowchart illustrating a procedure of an operation of dealing with a silent state by using history information which is mainly performed by the main controller section 60 in accordance with a modification. The operation procedure illustrated in Fig. 5 differs from the operation procedure illustrated in Fig. 3 in that steps 200 and 202 are added. A description will be given below, in which each of these added steps is focused on.

[0056] The received content regarding the received service is displayed on the display device 70 (step 102). Thereafter, the history processing unit 69 determines whether or not history information that matches the received service is stored in the history information storage unit 90 (step 200). Here, if both the ensemble and the SID of the history information are the same as those of the received service, the history information is determined to be the matching history information. If history information that matches the received service is not stored, a negative determination is made. The process proceeds to step 104 (in which sound is output). If history information that matches the received service is stored, a positive determination is made in step 200. In this case, the silence processing unit 66 sends a sound turn-off instruction to the output processing unit 50 so as to turn off the sound output from the speaker 54 (step 202). The process then proceeds to step 106 (in which a silent state is determined). As described above, when a service that matches the history information is newly received, output sound is set to be off. With this configuration, a continuous silent state may be set in advance for a service for which a silent state is highly likely to occur, and occurrence of an unpleasant periodic silent state may be prevented in advance. It takes a certain period to accurately detect occurrence of a silent state. However, because it is known in advance from the history information that a silent state is highly likely to occur, occurrence of a silent state just needs to be checked based on an assumption that a silent state will occur. Thus, the time for accurately detecting a silent state may shorten.

[0057] In the above-described embodiment, the silent state detection unit 28 that is included in the DAB/T-DMB tuner section 20 detects a silent state that possibly occurs during reception of a service, on the basis of the processing content of the decoder 26. However, the silent state detection unit 28 may be included in the main controller section 60, and may detect a silent state that possibly occurs during detection of a service, on the basis of audio data (audio data having undergone an audio reproduction operation performed by the DAB/T-DMB tuner section 20) that is input to (or output from) the output processing unit 50. Specifically, a silent state may be detected on the basis of a result obtained by calculating a square of an amplitude value of audio data that is input to (or output from) the output processing unit 50 and then integrating the square. By appropriately setting cycles at which a silent state is to be detected (for example, by setting cycles at which a silent state is to be detected to be shorter than 500 milliseconds when it is assumed that a silent state of a duration of approximately 500 milliseconds periodically occurs once every several seconds), the silent state that possibly occurs during reception of a service may be detected with a higher certainty.

[0058] In the above-described embodiment, the description has been given of the DAB/T-DMB tuner section 20 that receives a broadcast signal that conforms to the DAB or T-DMB standard. However, the present invention is also applicable to other digital broadcast receivers capable of identifying another service (program) that has the same content as the currently received service (program). Also, in the above-described embodiment, the case of receiving an FM broadcast program having the same PI as the SID by using the FM/AM tuner section 40 has been considered. However, the present invention is also applicable to receivers that do not include the FM/AM tuner section 40. In this case, steps 122 to 132 included in Figs. 3 and 5 are omitted.

[0059] As described above, in accordance with the embodiment of the present invention, a received audio signal is successfully switched to another broadcast signal having the same content when a silent state is detected in the received audio signal. Thus, even in the case where a periodic or continuous silent state occurs because of broadcasting standard violation or unintended broadcasting interruptions, an alternative broadcast signal is successfully received and normal sound is successfully output. Accordingly, lowering of the quality of received sound may be prevented.

Claims

1. A digital broadcast receiver comprising:

broadcast signal reception reproduction means (22, 24, 26) configured to receive a broadcast signal and to perform a certain audio reproduction operation;

silent state detection means (28) configured to detect a silent state in an audio signal reproduced by the broadcast signal reception reproduction means (22, 24, 26); and

broadcast signal switching means (62) configured to send, upon detection of a silent state by the silent state detection means (28), an instruction to the broadcast signal reception reproduction means (22, 24, 26) so as to switch a received broadcast signal to another broadcast signal having the same content.

2. The digital broadcast receiver according to Claim 1,

wherein the broadcast signal reception reproduction means (22, 24, 26) is configured to receive a digital broadcast signal that has been modulated with a digital modulation scheme, and
wherein the broadcast signal switching means (62) is configured to send, if another digital broadcast signal having the same content as a currently received digital broadcast signal exists, an instruction to the broadcast signal reception reproduction means (22, 24, 26) so as to switch the currently received digital broadcast signal to the other digital broadcast signal.

3. The digital broadcast receiver according to Claim 1 or 2,
wherein the broadcast signal reception reproduction means (22, 24, 26) is configured to receive both a digital broadcast signal that has been modulated with a digital modulation scheme and an analog broadcast signal that has been modulated with an analog modulation scheme, and
wherein the broadcast signal switching means (62) is configured to send, if an analog broadcast signal having the same content as a currently received digital broadcast signal exists, an instruction to the broadcast signal reception reproduction means (22, 24, 26) so as to switch the currently received digital broadcast signal to the analog broadcast signal.

4. The digital broadcast receiver according to Claim 3, wherein the broadcast signal switching means (62) is configured to send, if both another digital broadcast signal having the same content as the currently received digital broadcast signal and an analog broadcast signal having the same content as the currently received digital broadcast signal exist, an instruction to the broadcast signal reception reproduction means (22, 24, 26) so as to switch the currently received digital broadcast signal to the other digital broadcast signal.

5. The digital broadcast receiver according to any one of Claims 1 to 4,
wherein the silent state includes a periodic silent state and a continuous silent state, and
wherein the digital broadcast receiver further comprises
first silence processing means (66) configured to forcibly stop, if another broadcasting signal having the same content as a currently received digital broadcast signal does not exist, upon detection of a silent state by the silent state detection means (28), output of an audio signal reproduced by the broadcast signal reception reproduction means (22, 24, 26) so as to maintain a continuous silent state.

6. The digital broadcast receiver according to any one of Claims 1 to 5, further comprising
silent state notification means (64) configured to notify, upon detection of a silent state by the silent state detection means (28), the user of occurrence of the silent state.

7. The digital broadcast receiver according to Claim 6, further comprising
volume limiting means configured to limit, if another broadcast signal having the same content as the currently received digital broadcast signal does not exist, upon detection of a silent state by the silent state detection means (28), processing of changing a volume setting at which an audio signal reproduced by the broadcast signal reception reproduction means (22, 24, 26) is to be output.

8. The digital broadcast receiver according to any one of Claims 1 to 7, further comprising:

history information storage means (90) configured to store history information on a silent state detection history of the silent state detection means (28); and
second silence processing means (66) configured to forcibly stop, when the broadcast signal reception reproduction means (22, 24, 26) receives a broadcast signal that matches history information stored in the history information storage means (90) until an operation of the silent state detection means (28) and an operation of the broadcast signal switching means (62) end, output of an audio signal reproduced by the broadcast signal reception reproduction means (22, 24, 26) so as to maintain a continuous silent state.

9. The digital broadcast receiver according to any one of Claims 1 to 8, wherein the broadcast signal reception reproduction means (22, 24, 26) is configured to receive at least a digital broadcast signal that has been modulated with a digital modulation scheme corresponding to a broadcasting standard that includes digital audio broadcasting or terrestrial-digital media broadcasting.

10. The digital broadcast receiver according to Claim 9, wherein the silent state detection means (28) is configured to detect a silent state on the basis of audio data on which the certain audio reproduction operation has been performed by the broadcast signal reception reproduction means (22, 24, 26).

11. The digital broadcast receiver according to Claim 10, wherein the silent state detection means (28) is configured to detect a silent state on the basis of a result obtained by calculating a square of an amplitude value of the audio data and then integrating the square.

12. The digital broadcast receiver according to Claim 9,

wherein the silent state detection means (28) is configured to detect a silent state on the basis of a content of a service component that is registered in a fast information channel contained in a broadcast signal received by the broadcast signal reception reproduction means (22, 24, 26).

13. The digital broadcast receiver according to Claim 12, wherein the silent state detection means (28) is configured to detect a silent state if the content of the service component is null.

14. The digital broadcast receiver according to Claim 12, wherein the silent state detection means (28)is configured to make a determination of a silent state

- if a program association table or a program map table is missing in a moving picture experts group-2, MPEG-2, transport stream contained in the service component, or alternatively
- if an audio transport stream is not included in a moving picture experts group-2, MPEG-2, transport stream contained in the service component, or alternatively
- if an audio transport stream included in a moving picture experts group-2, MPEG-2, transport stream contained in the service component is abnormal moving picture experts group-4, MPEG-4, content.

FIG. 1

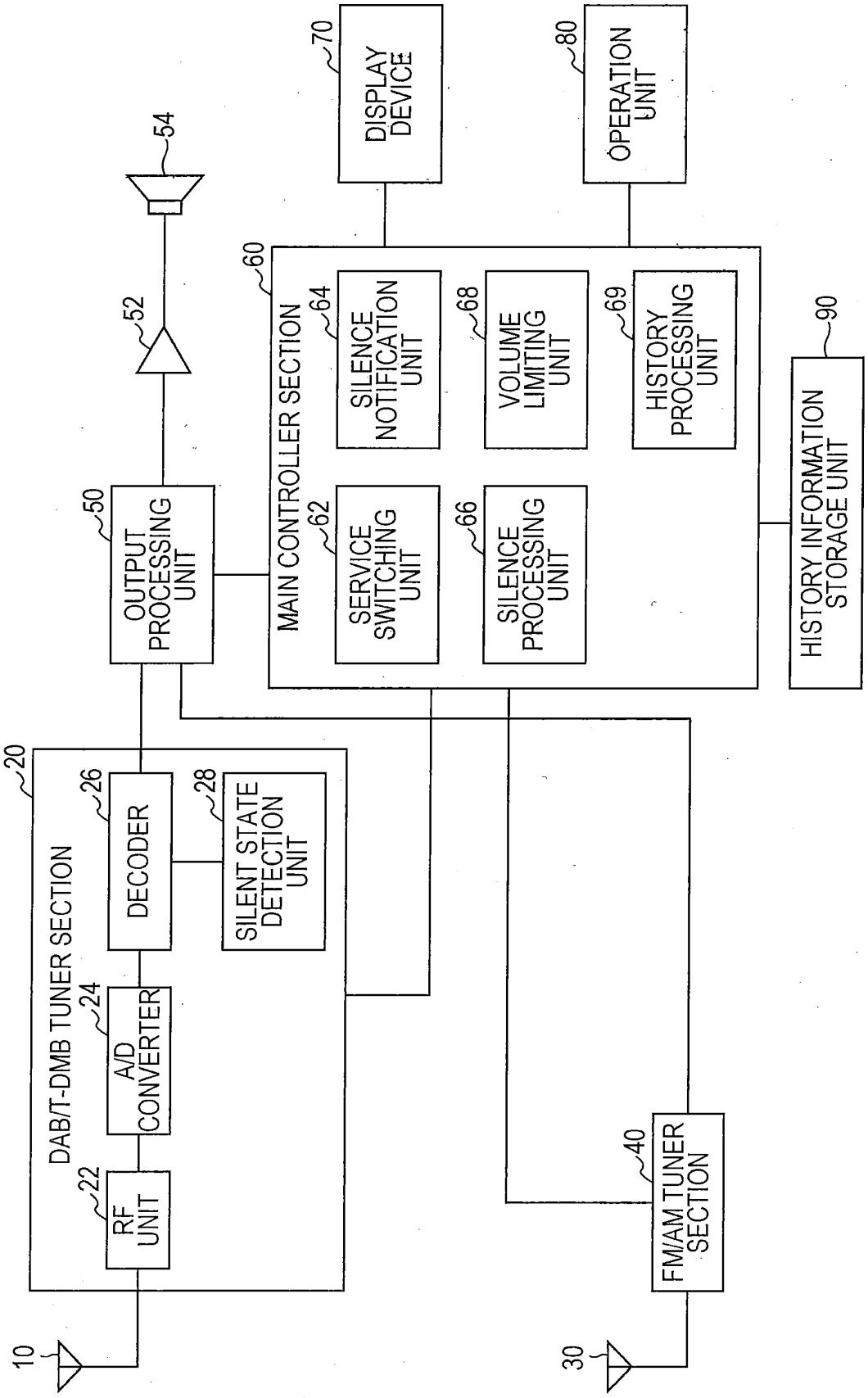

DISPLAY DEVICE
70
OPERATION UNIT
80
54
52
MAIN CONTROLLER SECTION
60
SILENCE NOTIFICATION UNIT
64
VOLUME LIMITING UNIT
68
HISTORY PROCESSING UNIT
69
HISTORY INFORMATION STORAGE UNIT
90
OUTPUT PROCESSING UNIT
50
SERVICE SWITCHING UNIT
62
SILENCE PROCESSING UNIT
66
DAB/T-DMB TUNER SECTION
20
DECODER
26
SILENT STATE DETECTION UNIT
28
A/D CONVERTER
24
RF UNIT
22
FM/AM TUNER SECTION
40
10
30

FIG. 2

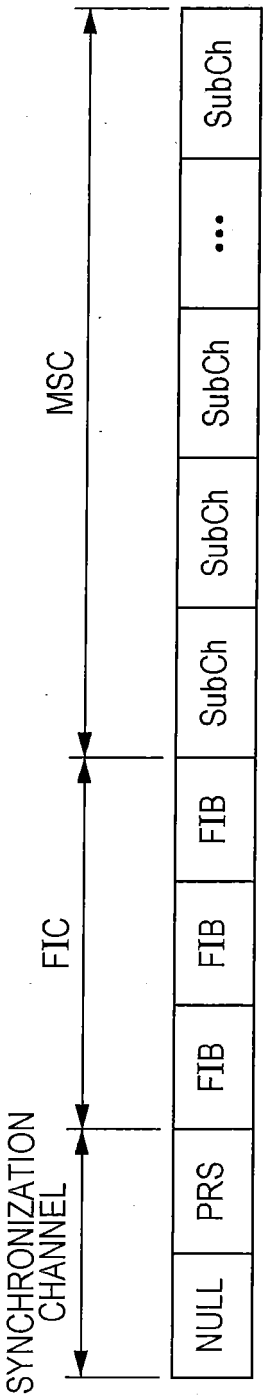

SYNCHRONIZATION CHANNEL
FIC
MSC
NULL
PRS
FIB
FIB
FIB
SubCh
SubCh
SubCh
...
SubCh

FIG. 3

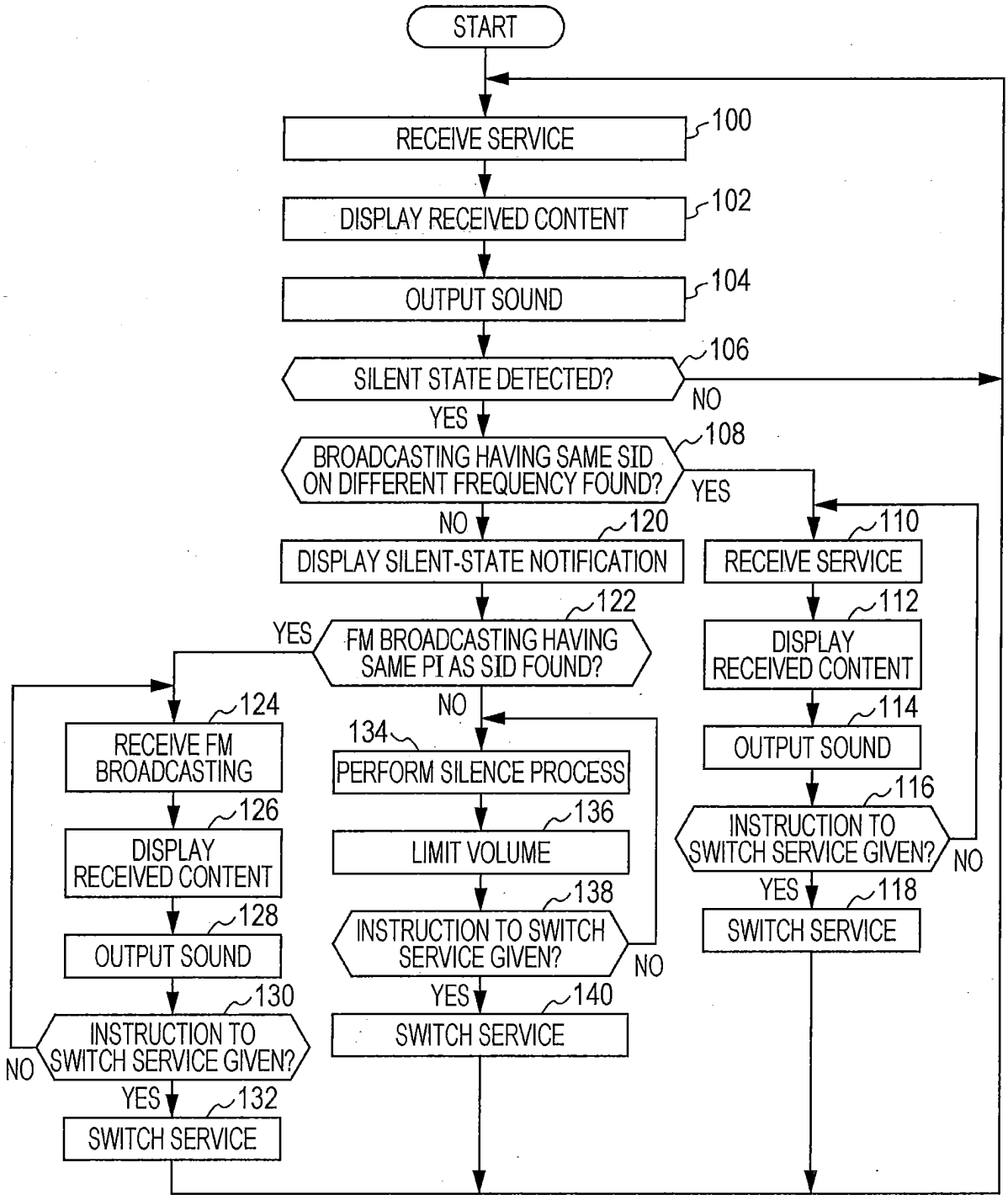

START
RECEIVE SERVICE
100
DISPLAY RECEIVED CONTENT
102
OUTPUT SOUND
104
SILENT STATE DETECTED?
106
NO
YES
BROADCASTING HAVING SAME SID ON DIFFERENT FREQUENCY FOUND?
108
YES
NO
DISPLAY SILENT-STATE NOTIFICATION
120
RECEIVE SERVICE
110
DISPLAY RECEIVED CONTENT
112
OUTPUT SOUND
114
INSTRUCTION TO SWITCH SERVICE GIVEN?
116
NO
YES
SWITCH SERVICE
118
FM BROADCASTING HAVING SAME PI AS SID FOUND?
122
YES
NO
RECEIVE FM BROADCASTING
124
DISPLAY RECEIVED CONTENT
126
OUTPUT SOUND
128
INSTRUCTION TO SWITCH SERVICE GIVEN?
130
NO
YES
SWITCH SERVICE
132
PERFORM SILENCE PROCESS
134
LIMIT VOLUME
136
INSTRUCTION TO SWITCH SERVICE GIVEN?
138
NO
YES
SWITCH SERVICE
140

FIG. 4

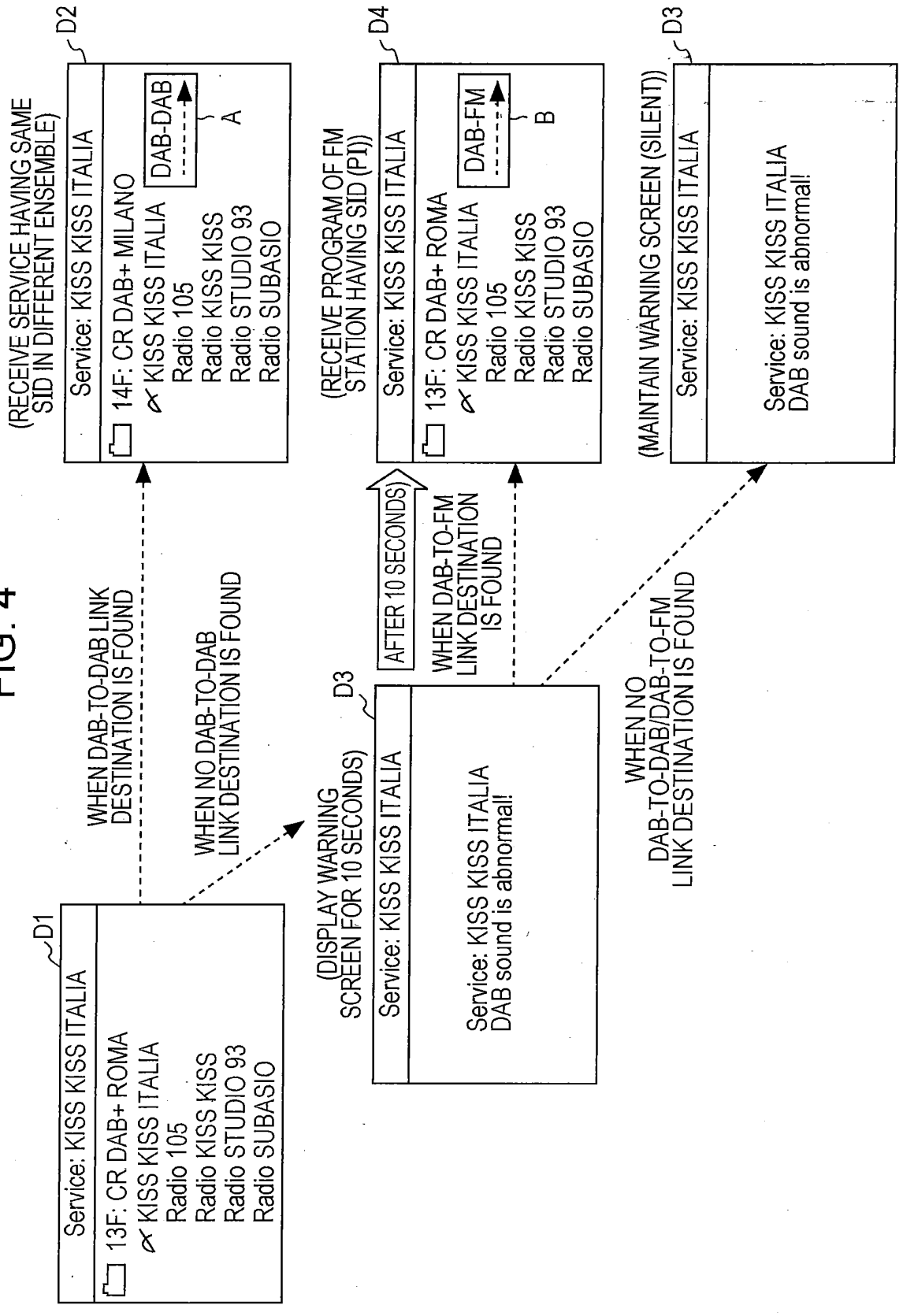
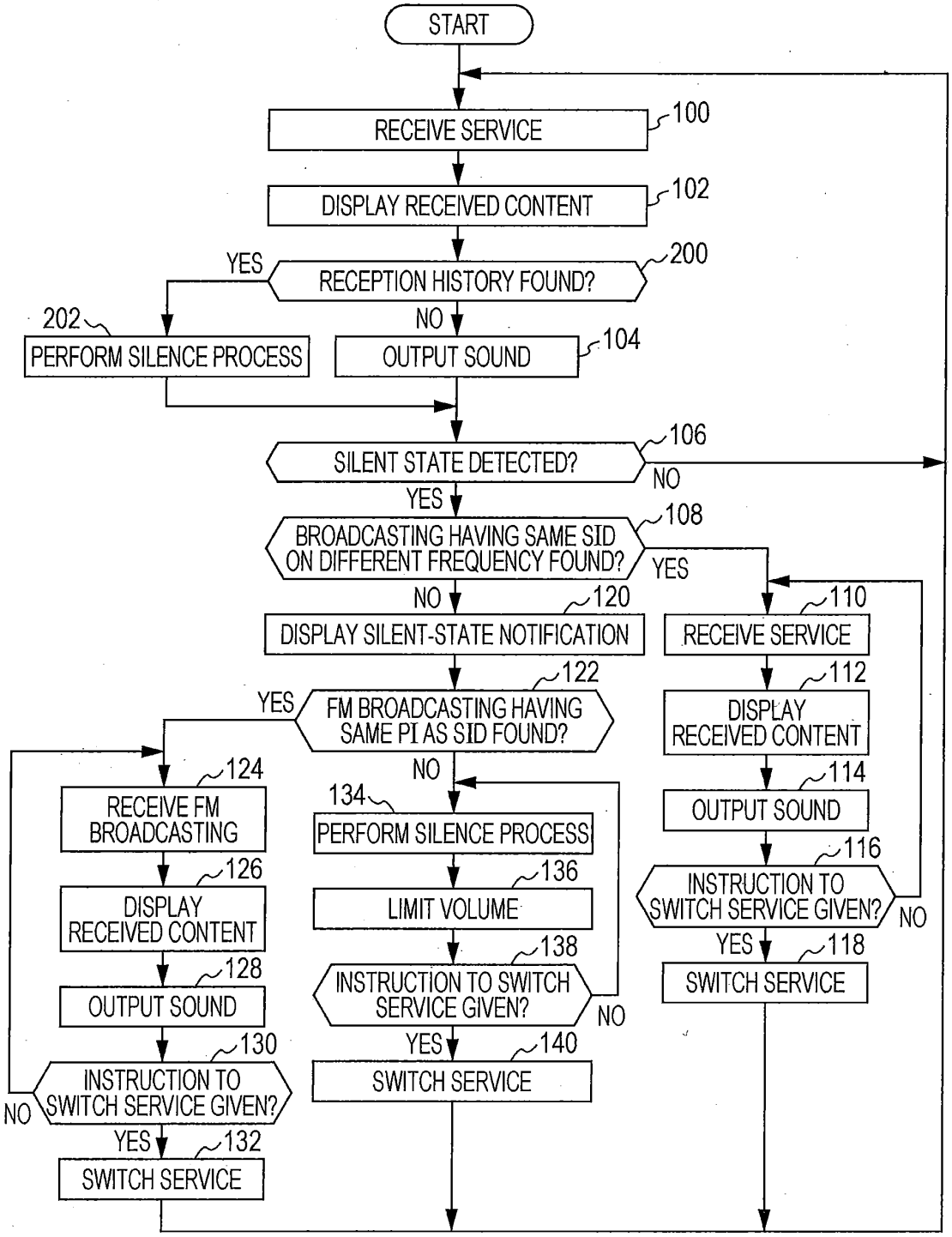

D1
Service: KISS KISS ITALIA
13F: CR DAB+ ROMA
KISS KISS ITALIA
Radio 105
Radio KISS KISS
Radio STUDIO 93
Radio SUBASIO
WHEN DAB-TO-DAB LINK DESTINATION IS FOUND
WHEN NO DAB-TO-DAB LINK DESTINATION IS FOUND
D2
(RECEIVE SERVICE HAVING SAME SID IN DIFFERENT ENSEMBLE)
Service: KISS KISS ITALIA
14F: CR DAB+ MILANO
KISS KISS ITALIA
Radio 105
Radio KISS KISS
Radio STUDIO 93
Radio SUBASIO
DAB-DAB
A
D3
(DISPLAY WARNING SCREEN FOR 10 SECONDS)
Service: KISS KISS ITALIA
Service: KISS KISS ITALIA
DAB sound is abnormal!
AFTER 10 SECONDS)
WHEN DAB-TO-FM LINK DESTINATION IS FOUND
D4
(RECEIVE PROGRAM OF FM STATION HAVING SID (PI))
Service: KISS KISS ITALIA
13F: CR DAB+ ROMA
KISS KISS ITALIA
Radio 105
Radio KISS KISS
Radio STUDIO 93
Radio SUBASIO
DAB-FM
B
WHEN NO DAB-TO-DAB/DAB-TO-FM LINK DESTINATION IS FOUND
D3
(MAINTAIN WARNING SCREEN (SILENT))
Service: KISS KISS ITALIA
Service: KISS KISS ITALIA
DAB sound is abnormal!

FIG. 5


START
RECEIVE SERVICE
100
DISPLAY RECEIVED CONTENT
102
RECEPTION HISTORY FOUND?
200
YES
NO
202
PERFORM SILENCE PROCESS
OUTPUT SOUND
104
SILENT STATE DETECTED?
106
NO
YES
BROADCASTING HAVING SAME SID ON DIFFERENT FREQUENCY FOUND?
108
YES
NO
120
DISPLAY SILENT-STATE NOTIFICATION
110
RECEIVE SERVICE
122
FM BROADCASTING HAVING SAME PI AS SID FOUND?
YES
112
DISPLAY RECEIVED CONTENT
NO
124
RECEIVE FM BROADCASTING
134
PERFORM SILENCE PROCESS
114
OUTPUT SOUND
116
INSTRUCTION TO SWITCH SERVICE GIVEN?
NO
126
DISPLAY RECEIVED CONTENT
136
LIMIT VOLUME
YES
118
SWITCH SERVICE
128
OUTPUT SOUND
138
INSTRUCTION TO SWITCH SERVICE GIVEN?
NO
130
INSTRUCTION TO SWITCH SERVICE GIVEN?
YES
140
SWITCH SERVICE
NO
YES
132
SWITCH SERVICE

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 7203

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 051 523 A1 (PANASONIC CORP [JP]) 22 April 2009 (2009-04-22) * paragraphs [0027], [0029] - [0030], [0035], [0040], [0071], [0074] * * pages 1-3 *	1,2,5,8, 9,12	INV. H04H20/10 H04H20/22 H04H20/26
X	US 2010/203823 A1 (APAAR TULI [FI]) 12 August 2010 (2010-08-12) * paragraphs [0159], [0162] - [0164] *	1-4,8,9, 12	
X	JP 2007 295468 A (FUJITSU TEN LTD) 8 November 2007 (2007-11-08) * paragraphs [0002], [0014], [0016], [0020], [0028], [0031], [0036], [0102] *	1,3-14	
A	US 2007/216807 A1 (OTSUKA ISAO [JP] ET AL) 20 September 2007 (2007-09-20) * paragraph [0043] *	11	
A	WO 2008/091102 A1 (KOREA ELECTRONICS TELECOMM [KR]; SEO JAE-HYUN [KR]; KIM JU-YEUN [KR];) 31 July 2008 (2008-07-31) * paragraph [0020] *	14	TECHNICAL FIELDS SEARCHED (IPC) H04H
A	"Digital Audio Broadcasting (DAB); DMB video service; User application specification European Broadcasting Union; ETSI TS 102 428", ETSI STANDARD, EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI), SOPHIA ANTIPOLIS CEDEX, FRANCE, vol. BC, no. V1.2.1, 1 April 2009 (2009-04-01), XP014043826, * chapter 1; page 6 *	14	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31 May 2013	Iovescu, Vladimir

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31-05-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2051523 A1	22-04-2009	CN 101536517 A	16-09-2009
		EP 2051523 A1	22-04-2009
		JP 4894858 B2	14-03-2012
		US 2010100923 A1	22-04-2010
		WO 2008056622 A1	15-05-2008
US 2010203823 A1	12-08-2010	CN 101682434 A	24-03-2010
		EP 2156581 A1	24-02-2010
		US 2010203823 A1	12-08-2010
		WO 2008155595 A1	24-12-2008
JP 2007295468 A	08-11-2007	NONE	
US 2007216807 A1	20-09-2007	JP 4657127 B2	23-03-2011
		JP 2007251711 A	27-09-2007
		US 2007216807 A1	20-09-2007
WO 2008091102 A1	31-07-2008	NONE	

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Patent documents cited in the description

- JP 2005354505 A **[0002] [0003]**