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(54) **Receiving apparatus and reception control method**

(57) A receiving apparatus (100) includes: a first receiving unit (11) configured to receive a broadcasting of a first program and generate a first audio signal indicating a sound content of the first program; a second receiving unit (12) configured to receive any one of a broadcasting of a second program provided by a second source that is a broadcasting station and a service different from a first source that is a broadcasting station and a service providing the broadcasting of the first program; a determination unit (13) configured to determine a comparison condition; a comparing unit (14) configured to compare the first audio signal with the second audio signal based on the comparison; and a reproducing unit (15) configured to reproduce a sound based on the second audio signal.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a receiving apparatus and a reception control method.

2. Description of the Related Art

[0002] It has been known that, when the reception sensitivity is degraded during receiving a program provided by a selected broadcasting station or a selected service, stable reproduction of the sound is realized by receiving another program that is provided by another broadcasting station or another service and has the same sound content as the program being received.

[0003] For example, Japanese Patent Application Laid-open No. 8-130488, discloses a receiver configured to reproduce the sound based on the audio signal output from a receiving unit that is selected out of a receiving unit for receiving a first broadcasting (hereafter, referred to as "first receiving unit") and a receiving unit for receiving a second broadcasting (hereafter, referred to as "second receiving unit"). This receiver determines that the first broadcast and the second broadcast are of the same content when the audio signal pattern output from the first receiving unit matches the audio signal pattern output from the second receiving unit.

[0004] While Japanese Patent Application Laid-open No. 8-130488 does not disclose a specific process for comparing two audio signal patterns, long time is required in general to obtain a highly accurate comparison result. On the other hand, it is desirable that the time required for the comparison process be shorter. Thus, there is a demand for reducing the time required for the comparison process while maintaining the accuracy of the comparison result.

[0005] The present invention has been made taking such situation into consideration and is to provide a receiving apparatus and a reception control method that allows for a highly accurate and short time comparison of a plurality of audio signals that indicate respective contents of a plurality of programs being received.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to at least partially solve the problems in the conventional technology.

[0007] According to an aspect of the present invention a receiving apparatus includes: a first receiving unit configured to receive a broadcasting of a first program and generate a first audio signal indicating a sound content of the first program; a second receiving unit configured to receive any one of a broadcasting of a second program provided by a second source that is a broadcasting station and a service different from a first source that is a broadcasting station and a service providing the broadcasting of the first program when a reception sensitivity of the broadcasting of the first program at the first receiving unit is not good, and generate a second audio signal indicating a sound content of the second program; a determination unit configured to determine a comparison condition based on at least one of first program information for the first program and second program information for the second program; a comparing unit configured to compare the first audio signal with the second audio signal based on the comparison condition determined by the determination unit, and obtain a comparison result indicating whether or not the sound content of the second program is the same as the sound content of the first program; and a reproducing unit configured to reproduce a sound based on the second audio signal in place of a sound based on the first audio signal when the comparison result obtained by the comparing unit indicates that the sound content of the second program is the same as the sound content of the first program.

[0008] According to another aspect of the present invention a reception control method includes: a first receiving step for receiving a broadcasting of a first program and generating a first audio signal indicating a sound content of the first program; a second receiving step for receiving any one of a broadcasting of a second program provided by a second source that is a broadcasting station and a service different from a first source that is a broadcasting station and a service providing the broadcasting of the first program when a reception sensitivity of the broadcasting of the first program at the first receiving unit is not good, and generating a second audio signal indicating a sound content of the second program; a determination step for determining a comparison condition based on at least one of first program information for the first program and second program information for the second program; a comparing step for comparing the first audio signal with the second audio signal based on the comparison condition determined by the determination unit, and deriving a comparison result indicating whether or not the sound content of the second program is the same as the sound content of the first program; and a reproducing step for reproducing a sound based on the second audio signal in place of a sound based on the first audio signal when the comparison result obtained by the comparison unit indicates that the sound content of the second program is the same as the sound content of the first program.

[0009] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a block diagram illustrating a hardware configuration of a receiving apparatus according to an embodiment of the present invention.

FIG. 2 is a block diagram illustrating a functional configuration of the receiving apparatus according to the embodiment of the present invention.

FIG. 3 is a view illustrating a configuration of program information.

FIG. 4A to 4F illustrate conditions of comparison. FIG. 4A is a view illustrating a relationship between the program type and the capture time. FIG. 4B is a view illustrating a relationship between the encode type and the initial value of delay time. FIG. 4C is a view illustrating a relationship between the program type and the timeout time. FIG. 4D is a view illustrating a relationship between the program type and the success determination factor. FIG. 4E is a view illustrating a relationship between the program type and the number of trials. FIG. 4F is a view illustrating a relationship between the encode type and the number of trials.

FIG. 5A is a view illustrating a digital audio signal and FIG. 5B is a view illustrating an FM audio signal before modulated.

FIG. 6A is a view illustrating an FM audio signal after adjustment of the delay time and FIG. 6B is a view illustrating an FM audio signal after adjustment of the delay time and the volume.

FIG. 7 is a flowchart illustrating a reception control process executed by a receiving apparatus according to the embodiment of the present invention.

FIG. 8 is a flowchart illustrating a comparison condition determination process illustrated in FIG. 7.

FIG. 9 is a flowchart illustrating a comparison process illustrated in FIG. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] A receiving apparatus according to the embodiment of the present invention will be described below by referring to the drawings.

[0012] First, by referring to FIG. 1, described will be the configuration of a receiving apparatus 100 according to the present embodiment. It is noted that the receiving apparatus to which the present invention is applied is not limited to the receiving apparatus 100 illustrated in FIG. 1. For example, the present invention may be applied to an apparatus in which various components are incorporated in the receiving apparatus 100, and the present invention may be applied to an apparatus in which appropriate components are removed from the receiving apparatus. Further, the number of the components provided to the receiving apparatus 100 is not limited to that in the example illustrated in FIG. 1.

[0013] The receiving apparatus 100 is an apparatus that is capable of simultaneously receiving the radio broadcastings provided in a plurality of modulation systems. The modulation system that the receiving apparatus 100 is able to demodulate may be an analog modulation such as AM (Amplitude Modulation), FM (Frequency Modulation), and the like; and may be a digital modulation conforming with the specification such as DAB (Digital Audio Broadcast), DAB+ (Digital Audio Broadcast Plus), DMB (Digital Multimedia Broadcasting), and the like. In the present embodiment, it is assumed that the receiving apparatus 100 is able to simultaneously receive and demodulate the radio broadcasting modulated by the FM and the radio broadcasting modulated by the DAB specification, the DAB+ specification, and the DMB specification.

[0014] As illustrated FIG. 1, the receiving apparatus 100 includes: an FM antenna 101; an FM tuner 102; an audio buffer 103; a digital antenna 104; a digital tuner 105; a digital decoder 106; an audio buffer 107; a comparator 108; an audio switch 109; a controller 110; and a speaker 115.

[0015] The FM antenna 101 receives the FM-modulated radio wave and converts the received radio wave into the electrical signal.

[0016] The FM tuner 102 extracts an electrical signal corresponding to a designated receiving frequency from an electrical signal supplied from the FM antenna 101 and demodulates the extracted electrical signal. The FM tuner 102 generates an FM audio signal and RDS (Radio Data System) information by the demodulation of the extracted electrical signal.

[0017] The FM audio signal is a signal that indicates the content in the sound of the radio program that is broadcast by the selected broadcasting station (the broadcasting station corresponding to the received frequency). The RDS information is a signal that indicates various sorts of information such as the broadcasting station that is being selected, the program that is being broadcast, the name of the music that is being broadcast.

[0018] The audio buffer 103 amplifies (attenuates) the FM audio signal supplied from the FM tuner 102 according to the designated amplification ratio (attenuation ratio) and outputs it after further delaying it by the designated time. Therefore, the audio buffer 103 includes an amplification circuit (attenuation circuit) and a delay circuit. It is noted that the amplification ratio and the delay time are designated by the correction data supplied from the comparator 108.

[0019] The digital antenna 104 receives the radio wave that is digitally modulated by the DAB specification, the DAB+ specification, the DMB specification, and the like, and converts the received radio wave into the electrical signal.

[0020] The digital tuner 105 extracts the electrical signal corresponding to the designated service from the electrical signal supplied from the digital antenna 104 and demodulates the extracted electrical signal. The digital tuner 105 generates a digital IF (Interface) signal by the demodulation of the extracted electrical signal.

[0021] The digital decoder 106 decodes the digital IF signal supplied from the digital tuner 105 and generates a digital audio signal and service related information.

[0022] The digital audio signal is a signal that indicates the sound content of the program provided by the designated service. The service related information includes various types of information that relate to the designated service such as the encode type, the program type, and the like.

[0023] The audio buffer 107 amplifies (attenuates) the digital audio signal supplied from the digital decoder 106 according to the designated amplification ratio (attenuation ratio) and outputs it after further delaying it by a designated time. Therefore, the audio buffer 107 includes an amplification circuit (attenuation circuit) and a delay circuit. It is noted that the amplification ratio and the delay time are designated by the correction data supplied from the comparator 108.

[0024] The comparator 108 compares the corrected FM audio signal supplied from the audio buffer 103 with the corrected digital audio signal supplied from the audio buffer 107 according to the comparison condition supplied from the controller 110. Further, the comparator 108 obtains an amplification ratio and delay time based on the comparison condition and supplies it to the audio buffer 103 and the audio buffer 107 as the correction data. The comparator 108 then supplies the comparison result to the controller 110. It is noted that the comparison result concerns whether or not the FM audio signal and the digital audio signal indicate the same sound content, what degree the volume ratio is when they are of the same sound content, what degree the time difference is when they are of the same sound content, and so on.

[0025] The audio switch 109 supplies, to the speaker 115, either one of the corrected FM audio signal supplied from the audio buffer 103 and the corrected digital audio signal supplied from the audio buffer 107 according to the switching instruction signal supplied from the controller 110.

[0026] The controller 110 controls the entire operation of the receiving apparatus 100. The controller 110 includes a CPU (Central Processing Unit) 111, a ROM (Read Only Memory) 112, a RAM (Random Access Memory) 113, an interface 114, and so on. The components included in the controller 110 are connected to each other by buses.

[0027] The CPU 111 controls the entire operation of the controller 110. It is noted that the CPU 111 operates according to the program stored in the ROM 112 and uses the RAM 113 as a work area.

[0028] The ROM 112 stores programs and data used for controlling the entire operation of the controller 110.

[0029] The RAM 113 functions as the work area of the CPU 111. That is, the CPU 111 temporarily writes the program and data to the RAM 113 and refers to that program and data if necessary.

[0030] The interface 114 accepts the operating input from the user. It is noted that the interface 114 may communicate various data and command to some external device through the radio communication and the wired communication. The interface 114 is configured with a touch screen and a communication module, for example.

[0031] The controller 110 determines the receiving frequency designated to the FM tuner 102 and the service designated to the digital decoder 106 according to the program that has been pre-stored in the ROM 112 and the instruction by the user and the like accepted by the interface 114. Further, the controller 110 determines the comparison condition based on the RDS information supplied from the FM tuner 102 and the service related information supplied from the digital decoder 106 and supplies the determined comparison condition to the comparator 108. Furthermore, the controller 110 supplies the switching instruction signal to the audio switch 109 based on the comparison result supplied from the comparator 108.

[0032] The speaker 115 outputs the sound according to the audio signal supplied from the audio switch 109. The speaker 115 may include a D/A (Digital/Analog) converter and an amplifier.

[0033] Next, by referring to FIG. 2, a fundamental function of the receiving apparatus 100 according to the present embodiment will be described. FIG. 2 is a block diagram illustrating a functional configuration of the receiving apparatus 100. As illustrated in FIG. 2, the receiving apparatus 100 includes, in terms of the function, a first receiving unit 11, a second receiving unit 12, a determination unit 13, a comparing unit 14, and a reproduction unit 15.

[0034] It is noted that the configuration of the receiving apparatus 100 is not limited to the example illustrated in FIG. 2. For example, the receiving apparatus 100 may include a component that is not illustrated in FIG. 2 and may not include a part of the components that are illustrated in FIG. 2. Further, the information transacted among a plurality of components is not limited to what is illustrated by the arrows in FIG. 2. Therefore, the receiving apparatus 100 may transact the information that is not illustrated by the arrows in FIG. 2 and may not transact a part of the information that is illustrated by the arrows in FIG. 2.

[0035] The first receiving unit 11 receives a broadcasting of a first program and generates a first audio signal indicating the sound content of the first program. The first program is, for example, a program that is broadcast by the digital broadcasting and supplied by the designated service. The first receiving unit 11 includes the digital antenna 104, the digital tuner 105, and the digital decoder 106, for example.

[0036] The second receiving unit 12 receives a second program supplied by a second source that is different from a first source when the reception sensitivity of the first program by the first receiving unit 11 is no longer good (for example, under the state where the receiving apparatus 100 is mounted on a moving vehicle, it is likely to be out of the receivable area of the first program broadcasting due to the movement of the vehicle). Here, the first source is a broadcasting station or a service providing the first program. Further, the second source is a broadcasting station or a service providing the second program. The second receiving unit 12 generates a second audio signal indicating the sound content of the second program. The second receiving unit 12 includes the FM antenna 101 and the FM tuner 102, for example.

[0037] It is noted that there is a case where the service related information supplied along with the first program from the first source includes information that associates the first program with the second program. In this case, this information may be used to identify and receive the second program supplied from the second source.

[0038] The determination unit 13 determines the comparison condition based on at least one of first program information related to the first program and second program information related to the second program. The first program information is the service related information, for example. The second program information is the RDS information, for example. The determination unit 13 includes the controller 110, for example.

[0039] The comparing unit 14 compares the first audio signal with the second audio signal based on the comparison condition determined by the determination unit 13 and obtains the comparison result indicating whether or not the sound content of the second program is the same as the sound content of the first program. The comparing unit 14 includes the comparator 108, for example.

[0040] When the comparison result obtained by the comparing unit 14 indicates that the sound content of the second program is the same as the sound content of the first program, the reproduction unit 15 reproduces the sound based on the second audio signal in place of the sound based on the first audio signal. The reproduction unit 15 includes, for example, the audio switch 109, the controller 110, and the speaker 115.

[0041] Here, the comparison condition may include a prediction value of the difference between the reproduction timing of the sound based on the first audio signal and the reproduction timing of the sound based on the second audio signal.

[0042] Also, the comparison condition may include a prediction value of the ratio between the volume of the sound based on the first audio signal and the volume of the sound based on the second audio signal.

[0043] Further, the first program information may include first feature information indicating the feature of the sound based on the first audio signal, or the second program information may include second feature information indicating the feature of the sound based on the second audio signal. In this case, the comparison condition may include a comparison condition that is based on the first feature information or the second feature information.

[0044] Further, the first program information may be included in the information transmitted by the broadcasting of the first program, or the second program information may be included in the information transmitted by the broadcasting of the second program.

[0045] Next, by referring to FIG. 3, the program information will be described.

[0046] The program information is the RDS information and the service related information, that is, various types of information concerning the program being broadcast. For example, the program information can include the information indicating the program ID of the program, the information indicating the broadcasting station and service that is providing the program, the information indicating the encode type (compressing system) used in the broadcasting of the program, the information indicating the program type that indicates what sort of sound the program is, and so on.

[0047] As illustrated in FIG. 3, although the program information can include the information indicating the program ID, the encode type, and the program type, other information may also be included. FIG. 3 illustrates an example that the program ID is D201, the encode type is DAB, and the program type is speech.

[0048] Next, by referring to FIG. 4, the comparison condition will be described. FIG. 4 exemplifies, as the comparison conditions, the capture time, the initial value of the delay time, the timeout time, the success determination factor, the number of trials. It is noted that the information indicating the comparison condition is stored in the ROM 112 and the RAM 113.

[0049] FIG. 4A is a view illustrating the relationship between the capture time and the program type. The capture time is a length of time to be compared in the comparison of the audio signals. When the sampling frequency is constant, the number of samplings of the audio data to be compared is determined by the capture time. The program type indicates the sort of the sound that is being broadcast in the program.

[0050] Here, it is desirable that the capture time is adjusted according to the sort of sound represented by the compared audio signal. For example, it is considered that the larger change in the level of the sound represented by the compared audio signal allows for the shorter capture time in the comparison of the sound. Therefore, when the program type is such as classical music or speech that has a smaller change in the level of the sound or is the program that is likely to have a long continuous no-sound state, the capture time is set to relatively longer time (for example, about 5 seconds). On the other hand, when the program type is such as rock or pops that has a larger change in the level of the sound or is the program that is not likely to have a long continuous no-sound state, the capture time is set to relatively shorter time (for example, about 4 seconds).

[0051] FIG. 4B illustrate the relationship between the initial value of the delay time and the encode type. The initial value of the delay time is delay time that is predicted to be generated by the encoding of the sound (or both encoding of the sound and decoding of the sound). Here, the difference in the initial values of the delay time is set to the initial value of the delay time that is provided to one of the audio signals. It is noted that, for the encode type that requires more time for the encoding (or both encoding of the sound and decoding of the sound), the longer initial value of the delay time is set.

[0052] For example, for the FM that requires substantially no time for the encoding, the initial value of the delay time is set to 0 to 1 second, for example. On the other hand, for the DAB and the DAB+ that require long time to some extent for the encoding, the initial value of the delay time is set to about 3 seconds, for example. Further, for the DMB that requires longer time for the encoding than the DAB and the DAB+, the initial value of the delay time is set to about 4.5 seconds, for example.

[0053] FIG. 4C is a view illustrating the relationship between the timeout time and the program type. The timeout time is the time from when the comparison of the audio signals is started to when the failure of the comparison of the audio signals is determined. However, the time until the failure is determined includes the processing time in the extended capture time and comparison time in the case where the comparison result is not obtained within the set comparison time. Then, even just once a success is determined from the time when the comparison of the audio signals is started to the time when the timeout time elapses, the comparison result of the audio signals will be successful.

[0054] It is desirable here that the timeout time is adjusted according to the sort of the sound the audio signals to be compared represents. For example, it is considered that the larger change in the level of the sound the audio signals to be compared represents causes less problem (is less likely to cause erroneous determination) even when the comparison of the sound is made by the shorter timeout time. Therefore, when the program type is such as classical music or speech that has a smaller change in the level of the sound or is the program that is likely to have a long continuous no-sound state, the timeout time is set to relatively longer time (for example, about 10 seconds). On the other hand, when the program type is such as rock or pops that has a larger change in the level of the sound or is the program that is not likely to have a long continuous no-sound state, the timeout time is set to relatively shorter time (for example, about 6 seconds).

[0055] FIG. 4D is a view illustrating the relationship between the success determination factor and the program type. The success determination factor is a factor that is necessary for the success determination in the comparison of the audio signals.

[0056] It is desirable here that the success determination factor is adjusted according to the sort of the sound the audio signal to be compared represents. For example, in the case where the program type is such as classical music and it is therefore difficult to determine the difference in the volume, only the time delay is included in the success determination factor. On the other hand, in the case where the program type is such as speech, rock, or pops and it is therefore easy to determine the difference in the volume, the time delay and the volume are included in the success determination factor.

[0057] FIG. 4E is a view illustrating the relationship between the number of trials and the program type. The number of trials is the number for which the comparison is tried until it is determined that there is likelihood of inconsistency of the programs. That is, the number of trials is the retry times plus 1.

[0058] Here, the number of trials may be adjusted according to the sort of the sound represented by the compared audio signal. For example, for the program whose program type is such as classical music, rock, or pops, the program provided by a key station is directly broadcast by the local station in most cases. Thus, there is little likelihood that the program indicated by the RDS information or the service related information is different in content from the program that is originally supposed to be broadcast. Therefore, in this case, it is desirable that the greater number of trials be set in order to further increase the accuracy. On the other hand, for the program whose program type is such as news, there are cases where the local station broadcasts the area-specific news in place of the news that is broadcast by the key station. Thus, in this case, there is higher likelihood that the program indicated by the RDS information or the service related information is different in content from the program that is originally supposed to be broadcast than the programs such as classical music, rock, and pops described above. Therefore, in this case, the smaller number of trials may be set.

[0059] FIG. 4F indicates the relationship between the number of trials and the encode type. The number of trials can be adjusted by the encode type instead of the sort of the sound represented by the audio signal to be compared. For example, when the comparison result of the audio signal is likely to be unsuccessful as the case of the FM, it is desirable to set the greater number of trials. On the other hand, when the comparison result of the audio signal is not likely to be unsuccessful as the case of the DAB or the DAB+, it is desirable to set the smaller number of trials. Further, when the comparison result of the audio signal is highly likely to be unsuccessful as the case of the DMB, it is desirable to set the number of trials to infinite.

[0060] Next, by referring to FIG. 5 and FIG. 6, a method of adjusting the volume level and the delay time when switching the sound output from the speaker 115 will be described. There is a case where, when the broadcasting source of the sound is switched, the delay time from the time when the encoding of the sound is started to the time when the sound is reproduced is different and the volume level of the audio is different even if the sound content of the programs are the same. Therefore, when the broadcasting source of the sound is switched, it is desirable that the delay time and the volume level of the sound that is provided after the switching is adjusted in accordance with the delay time and the volume level of the sound that has been provided before the switching. Description will be provided below for the case where the sound provided before the switching is the sound by the digital broadcasting, while the sound provided after the switching is the sound by the FM broadcasting. In this case the sound by the FM broadcasting being after the switching is adjusted.

[0061] FIG. 5A is a graph illustrating the relationship between the elapsed time from the current time and the voltage level of the digital audio signal. Here, the horizontal axis of the graph represents the elapsed time from the current time and the vertical axis represents the voltage level of the digital audio signal output from the digital decoder 106. It is noted that, in FIG. 5A, FIG. 5B, FIG. 6A, and FIG. 6B, the voltage level of the left end on the horizontal axis represents the voltage level of the audio signal at the current time, and older voltage level of the audio signal is represented closer to the right end.

[0062] FIG. 5B is a graph illustrating the relationship between the elapsed time from the current time and the voltage level of the FM audio signal before the correction. Here, the horizontal axis of the graph represents the elapsed time from the current time, and the vertical axis of the graph represents the voltage level of the FM audio signal output from the FM tuner 102. As illustrated in FIG. 5B, the FM audio signal before the correction has a smaller volume level and shorter delay time than the digital audio signal. Therefore, the volume level of the FM audio signal before the correction is increased and the delay time of the FM audio signal before the correction is increased.

[0063] FIG. 6A is a graph illustrating the relationship between the elapsed time from the current time and the voltage level of the FM audio signal after the adjustment of the delay time. Here, the horizontal axis of the graph represents the elapsed time from the current time, and the vertical axis of the graph represents the voltage level of the FM audio signal that is the delayed version of the FM audio signal output from the FM tuner 102. As illustrated by the solid line in FIG. 6A, the FM audio signal after the adjustment of the delay time is the signal indicating the sound encoded at an earlier time than the FM audio signal before the adjustment of the delay time. It is noted that, in FIG. 6A, the FM audio signal before the adjustment of the delay time is illustrated by the broken line. Further, the sound represented by the FM audio signal after the adjustment of the delay time is the sound encoded at the same time as the sound represented by the digital audio signal.

[0064] FIG. 6B is a graph illustrating the relationship between the elapsed time from the current time and voltage level of the FM audio signal after the adjustment of the delay time and the volume. Here, the horizontal axis of the graph represents the elapsed time from the current time, and the vertical axis of the graph represents the voltage level of the FM audio signal that is provided by adjusting the volume of the FM audio signal whose delay time has been adjusted, that is, the FM audio signal output from the audio buffer 103. As illustrated in the solid line in FIG. 6B, the FM audio signal after the adjustment of the volume is the signal indicating the sound of a large volume than the FM audio signal before the adjustment of the volume. It is noted that, in FIG. 6B, the FM audio signal before the adjustment of the volume is illustrated by the broken line. Further, the sound represented by the FM audio signal after the adjustment of the volume is the sound having the same volume level as the sound represented by the digital audio signal.

[0065] Tc in FIG. 5A and FIG. 6B represents the capture time when the switching to the FM is made in the DAB, the DAB+, or the DMB. As such, the audio data captured from the digital audio signal and the audio data captured from the FM audio signal in which the delay time and the volume have been adjusted are the data indicating the sound encoded in the same time zone after the delay process has been made by the delay time predicted by the delay initial value. Instead, employed may be the audio data in which the timing of the capture is adjusted by the delay initial value and which is individually captured without the delay process being applied. Therefore, the determination as to whether or not the sound content represented by the digital audio signal matches the sound content represented by the FM audio signal can be implemented by the waveform comparison between the captured digital audio signal and the captured FM audio signal. Further, the higher accuracy of the delay initial value allows for the increased accuracy of the comparison result.

[0066] Next, by referring to the flowchart illustrated in FIG. 7, the reception control process executed by the receiving apparatus 100 will be described. It is assumed that the receiving apparatus 100 repeats the execution of the reception control process illustrated in FIG. 7 during the power source being supplied.

[0067] First, the CPU 111 receives a broadcasting of a program from a predetermined source (step S101). Specifically, the CPU 111 designates the digital decoder 106 for a service. The digital decoder 106 then designates the digital tuner 105 for the service. Then, the digital tuner 105 generates, from the electrical signal supplied from the digital antenna 104, a digital IF signal indicating the sound content of the designated service. The digital tuner 105 then supplies the generated digital IF signal to the digital decoder 106. The digital decoder 106 supplies, to the audio buffer 107, a digital audio signal obtained by decoding the supplied digital IF signal.

[0068] Upon completion of the process of step S101, the CPU 111 starts the process of detecting the reception sensitivity (step S102). For example, when the digital decoder 106 stores the number of error counts at the demodulation in the decoded digital audio signal and the information indicating the S/N ratio in the embedded memory, the CPU 111 is able to detect the reception sensitivity of the broadcasting of the currently receiving program by referring to the number of error counts and the S/N ratio stored in the memory. The CPU 111 determines that the reception sensitivity is good if, for example, the number of error counts is less than a predetermined threshold, while determines that the reception sensitivity is not good if the number of error counts is equal to the predetermined threshold or greater. It is assumed that the reception sensitivity detection process is always repeatedly executed in parallel to each subsequently executed step. Then, it is always monitored whether or not the reception sensitivity is good and, when there is a change in the reception sensitivity, the CPU 111 executes the interruptive process to the process being executed. The specific process will be described later.

[0069] Next, upon completion of the process of step S102, the CPU 111 obtains the program information of the currently receiving program (step S103). Here, the digital decoder 106 is able to extract the digital audio signal indicating the sound content of the program of the designated service and the service related information from the digital IF signal supplied by the digital tuner 105. In this case, the CPU 111 obtains the service related information extracted by the digital decoder 106 as the program information of the currently receiving program. Hereafter, the currently receiving program will be referred to as a pre-switch program.

[0070] Upon completion of the process of step S103, the CPU 111 selects the post-switch source (step S104). The post-switch source is a different source than the pre-switch source and is a broadcasting station or a service that provides the broadcasting of the program of the same sound content as the pre-switch source. An arbitrary method may be employed at the CPU 111 to identify the post-switch source. For example, the CPU 111 obtains the RDS information from the FM tuner 102 while switching the receiving frequency designated to the FM tuner 102 and thus is able to identify the post-switch source based on the obtained RDS information and the service related information obtained from the digital decoder 106.

[0071] Alternatively, the CPU 111 may identify the post-switch source based on the information of the program table stored in the RAM 113, the information of the program table obtained from the external device via the interface 114, and so on. When there are multiple candidates of the post-switch source, the CPU 111 selects an optimal one source out of the candidates of the post-switch source. In the present embodiment, it is possible to receive the program provided from one FM broadcasting station and the program provided from one service in the digital broadcasting. In the present embodiment, since the pre-switch source is one service in the digital broadcasting, the post-switch source is the one FM broadcasting station. On the other hand, when the pre-switch source is the one FM broadcasting station, the post-switch source is one service in the digital broadcasting.

[0072] Upon completion of the process of step S104, the CPU 111 executes the comparison condition determination process (step S105). The comparison condition determination process will be described in detail by referring to the flowchart illustrated in FIG. 8.

[0073] First, the CPU 111 identifies an encode type of the pre-switch source (step S201). For example, the CPU 111 is able to identify the encode type of the pre-switch source based on the service related information obtained from the digital decoder 106.

[0074] Upon completion of the process of step S201, the CPU 111 identifies the encode type of the post-switch source (step S202). For example, the CPU 111 is able to identify the encode type of the post-switch source based on the RDS information supplied from the FM tuner 102. It is noted that, when the post-switch source is the FM broadcasting station, the post-switch source may be determined to be the FM broadcasting station without identifying the encode type.

[0075] Upon completion of the process of step S202, the CPU 111 determines the comparison condition that depends on the encode type (step S203). For example, the CPU 111 determines the initial value of the delay time and the number of trials based on at least one of the encode type of the pre-switch source and the encode type of the post-switch source.

[0076] Upon completion of the process of step S203, the CPU 111 identifies the program type of the pre-switch source (step S204). For example, the CPU 111 is able to identify the program type of the pre-switch source based on the service related information obtained from the digital decoder 106.

[0077] Upon completion of the process of step S204, the CPU 111 identifies the program type of the post-switch source (step S205). For example, the CPU 111 is able to identify the program type of the post-switch source based on the RDS information obtained from the FM tuner 102.

[0078] Upon completion of the process of step S205, the CPU 111 determines the comparison condition that depends on the program type (step S206). For example, the CPU 111 determines the capture time, the success determination factor, and the number of trials based on at least one of the program type of the pre-switch source and the program type of the post-switch source. It is noted that, since the program type of the pre-switch source basically matches the program type of the post-switch source, the CPU 111 is able to identify the program type based on either one of the service related information and the RDS information.

[0079] Upon completion of the process of step S206, the CPU 111 completes the comparison condition determination process of step S105.

[0080] Upon completion of the process of step S105, the CPU 111 executes the comparison process (step S106). The comparison process will be described in detail by referring to the flowchart illustrated in FIG. 9.

[0081] First, the CPU 111 starts receiving the broadcasting of the program from the post-switch source (step S301). Specifically, the CPU 111 designates the receiving frequency corresponding to the post-switch source to the FM tuner 102 and causes the FM tuner 102 to start receiving the broadcasting of the program. Then, the FM tuner 102 starts the process for supplying the FM audio signal indicating the sound content of the received broadcasting to the audio buffer 103.

[0082] Upon completion of the process of step S301, the CPU 111 obtains the post-switch program information (step S302). It is noted that the CPU 111 is able to obtain the RDS information supplied from the FM tuner 102 as the post-switch program information.

[0083] Upon completion of the process of step S302, the CPU 111 adjusts the delay time and the volume by using the initial value (step S303). Specifically, the CPU 111 supplies the comparison condition including the initial value of the delay time and the initial value of the volume ratio to the comparator 108. Then, the comparator 108 adjusts the delay time and the volume of the FM audio signal supplied from the audio buffer 103 based on the initial value of the delay time and the initial value of the volume ratio included in the supplied comparison condition. It is noted that the initial value of the delay time and the initial value of the volume ratio are associated with the encode type and the program type of the pre-switch source and the encode type and the program type of the post-switch source; and are stored in the RAM 113 and the like.

[0084] Upon completion of the process of step S303, the CPU 111 compares the pre-switch audio signal with the post-switch audio signal (step S304). Specifically, the CPU 111 causes the comparator 108 to compare the digital audio signal with the FM audio signal in which the delay time and the volume have been adjusted. Then, the comparator 108 supplies the comparison result to the CPU 111. It is noted that the comparison result may include the results as to whether or not the two audio signals are identical to each other, the delay time if they match, the volume ratio if they match, and so on.

[0085] Upon completion of the process of step S304, the CPU 111 determines whether or not the two audio signals are identical to each other (step S305). It is noted that the CPU 111 is able to determine whether or not two audio signals are identical to each other based on the comparison result supplied from the comparator 108. If the CPU 111 determines that the two audio signals are identical to each other (step S305: YES), it decides the comparison result as successful (step S306).

[0086] On the other hand, if the CPU 111 determines that the two audio signals are not identical to each other (step S305: NO), it determines whether or not the number of trials have been exceeded (step S307).

[0087] If the CPU 111 determines that the number of trials has been exceeded (step S307: YES), it decides the comparison result as there being likelihood of the program inconsistency, because the program contents are likely to be inconsistent (step S308). Upon completion of the process of step S306 or step S308, the CPU 111 saves the comparison result as history (step S309). The CPU 111 is able to associate the information with the encode type and the program type of the pre-switch source and the encode type and the program type of the post-switch source and store, in the RAM 113, the information such as the delay time in the case of being successful, the volume ratio in the case of being successful, and the like along with the comparison result as the history. Further, when the comparison result is that there is likelihood of the program inconsistency, a re-searching process of another program of the same content may be performed, because the program content of the post-switch source is not likely to be identical to the program content of the pre-switch source.

[0088] It is noted that the CPU 111 is able to utilize the history stored in the RAM 113 and the like as the initial value of the delay time and the initial value of the volume ratio. Further, the CPU 111 is able to identify the transmitting source that is likely to be successful in comparison result of the audio signal, by referring to the history stored in the RAM 113 and the like, when selecting one transmitting source out of the candidates of the post-switch transmitting source. Upon completion of the process of step S309, the CPU 111 completes the comparison process of step S106.

[0089] On the other hand, if the CPU 111 determines that the number of trials has not been exceeded (step S307: NO), it adjusts the delay time and the volume ratio again (step S310). For example, the CPU 111 instructs the comparator 108 to adjust the delay time and the volume ratio again. Then, the comparator 108 adjusts the delay time and the volume of the FM audio signal according to the instruction again. Upon completion of the process of step S310, the CPU 111 returns the process back to step S304.

[0090] It is noted that the number of trials is infinite in the case of the DMB of FIG. 4F, for example. Therefore, some conditions may cause the state where the processes of steps S304, S305, S307, and S310 are infinitely repeated. This state is called as a loop state. Even under this state, the reception of the currently receiving program will be continued when the reception sensitivity is good. When the reception sensitivity is degraded, however, the process that is decided by the combination of this loop state and the state of the degraded reception sensitivity will be executed.

[0091] Upon completion of the process of step S106 (in parallel with the process of step S106 when the loop state still remains), the CPU 111 determines whether or not there is likelihood of the comparison result being the program inconsistency (step S107). If the CPU 111 determines that there is likelihood of the comparison result being the program inconsistency (step S107: YES), it then returns the process to step S104. It is noted that the CPU 111 selects another source in step S104 and executes the processes of step S105 to step S107 again.

[0092] On the other hand, if the CPU 111 determines that there is no likelihood of the comparison result being the program inconsistency (or there is no comparison result and it is thus in the loop state) (step S107: NO), it then determines whether or not the reception sensitivity is good (step S108).

[0093] If the CPU 111 determines that the reception sensitivity is good (step S108: YES), it returns to step S102 to continue the reception of the currently receiving program. However, if the CPU 111 determines that the reception sensitivity is not good (step S108: NO), it determines whether or not the comparison result is successful (step S109). If the CPU 111 determines that the comparison result is successful (step S109: YES), it switches to a seamless source (step S110).

[0094] Specifically, the CPU 111 supplies the switching instruction signal to the audio switch 109 to instruct the switching of the source. Then, the audio switch 109 switches the source according to the instruction. Specifically, the audio switch 109 supplies, to the speaker 115, the FM audio signal supplied from the audio buffer 103 in place of the digital audio signal supplied from the audio buffer 107. It is noted that, in the FM audio signal supplied from the audio buffer 103, since the delay time and the volume have been adjusted in accordance with the digital audio signal supplied from the audio buffer 107, so that the audio can be switched in a seamless manner without discontinuation. Upon completion of the process of step S110, the CPU 111 returns the process to step S102.

[0095] On the other hand, if the CPU 111 determines that the comparison result is not successful (step S109: NO) or if it is in the loop state, it inserts no-sound state before and after the switching and switches the source (step S111). In this case, the sounds are not synchronized because the programs are different between before and after the switching. Thus, a sudden switching of the sound will cause the listener to feel discomfort. Therefore, an intentional insertion of the no-sound period allows the program switching to be provided without causing the listener to feel discomfort.

[0096] Upon completion of the process of step S111, the CPU 111 returns the process to step S102. It is noted that, when there is a change in the reception sensitivity in the reception sensitivity detection process repeatedly executed in parallel as described above, the processes from step S107 to step S111 are executed in an interruptive manner even when the CPU 111 is executing any process of the flowchart.

[0097] As described above, according to the present embodiment it is possible to compare the pre-switch audio signal and the post-switch audio signal accurately and in a short time when the source of the broadcasting of the program is switched. It is noted that, although the process regarding the timeout in the audio signal comparison has not been described in the above embodiment in order to provide easier understanding, it is further preferable that the timeout time is changed for every program type, as illustrated in FIG. 4C.

Modified Example

[0098] The present invention is not limited to those disclosed in the above-described embodiment.

[0099] According to the above-described embodiment the receiving apparatus includes: a receiving system capable of receiving the FM broadcasting; and another receiving system capable of receiving the digital broadcasting. In the present invention, however, the receiving system that is included in the receiving apparatus is not limited to the above described example. For example, the receiving apparatus may include: a receiving system capable of receiving the AM broadcasting; and another receiving system capable of receiving the digital broadcasting. Further, the receiving apparatus may include two similar receiving systems. For example, the receiving apparatus may include two receiving systems that are capable of receiving the digital broadcasting. Further, in the present invention, the number of receiving systems that is included in the receiving apparatus may be three or more.

[0100] In the above-described embodiment the receiving apparatus receives the radio broadcasting in which the content of the broadcast program is the sound. In the present invention, however, the receiving apparatus may receive the television broadcasting in which the content of the broadcast program includes the sound and image.

[0101] The above-described embodiment has basically provided the example in which the relationship between the program information and the comparison condition is predefined. In the present invention, however, the relationship between the program information and the comparison condition may be updated according to the comparison result.

[0102] The above-described embodiment has provided the example in which the receiving apparatus 100 includes the CPU 111, the ROM 112, and the RAM 113 and the CPU 111 implements the reception control process by software according to the program stored in the ROM 112. However, the reception control process executed by the receiving apparatus 100 is not limited to those implemented by software. For example, the receiving apparatus 100 may include a microcomputer, an FPGA (Field Programmable Gate Array), a PLD (Programmable Logic Device), a DSP (Digital Signal Processor), and the like.

[0103] It is noted that the receiving apparatus according to the present invention can be realized also by using a general computer system instead of relying upon the dedicated system. For example, the receiving apparatus may be configured to store the program for executing the above-described operation in a computer readable recording medium such as a flexible disc, a CD-ROM (Compact Disk-Read Only Memory), a DVD (Digital Versatile Disk), an MO (Magneto Optical Disk), and the like to deliver the program to the computer, install it to the computer system, and thus execute the above-described process. Further, it may be configured to pre-store the program in the disc device and the like of the server apparatus on the Internet and, for example, superimpose it on the carrier for the download and the like to the computer.

[0104] The present invention allows for a highly accurate and short time comparison of a plurality of audio signals that indicate respective contents of a plurality of programs being received.

[0105] Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

Claims

1. A receiving apparatus (100) comprising:

a first receiving unit (11) configured to receive a broadcasting of a first program and generate a first audio signal indicating a sound content of the first program;
a second receiving unit (12) configured to receive any one of a broadcasting of a second program provided by a second source that is a broadcasting station and a service different from a first source that is a broadcasting station and a service providing the broadcasting of the first program when a reception sensitivity of the broadcasting of the first program at the first receiving unit (11) is not good, and generate a second audio signal indicating a sound content of the second program;
a determination unit (13) configured to determine a comparison condition based on at least one of first program information for the first program and second program information for the second program;
a comparing unit (14) configured to compare the first audio signal with the second audio signal based on the comparison condition determined by the determination unit (13), and obtain a comparison result indicating whether or not the sound content of the second program is the same as the sound content of the first program; and
a reproducing unit (15) configured to reproduce a sound based on the second audio signal in place of a sound based on the first audio signal when the comparison result obtained by the comparing unit (14) indicates that the sound content of the second program is the same as the sound content of the first program.

2. The receiving apparatus (100) according to claim 1, wherein the comparison condition includes a prediction value of a difference between a reproducing timing of the sound based on the first audio signal and a reproducing timing of the sound based on the second audio signal.

3. The receiving apparatus (100) according to claim 1 or 2, wherein the comparison condition includes a prediction value of a ratio of a volume of the sound based on the first audio signal and a volume of the sound based on the second audio signal.

4. The receiving apparatus (100) according to any one of claims 1 to 3,
wherein the receiving apparatus (100) includes any one of features that the first program information includes first feature information indicating a feature of the sound based on the first audio signal, and that the second program information includes second feature information indicating a feature of the sound based on the second audio signal, and
wherein the comparison condition includes a comparison condition based on any one of the first feature information and the second feature information.

5. The receiving apparatus (100) according to any one of claims 1 to 4, wherein the receiving apparatus (100) includes any one of features that the first program information is included in information transmitted by the broadcasting of the first program, and the second program information is included in information transmitted by the broadcasting of the second program.

6. A reception control method comprising:

a first receiving step for receiving a broadcasting of a first program and generating a first audio signal indicating a sound content of the first program;
a second receiving step for receiving any one of a broadcasting of a second program provided by a second source that is a broadcasting station and a service different from a first source that is a broadcasting station and a service providing the broadcasting of the first program when a reception sensitivity of the broadcasting of the first program at the first receiving unit is not good, and generating a second audio signal indicating a sound content of the second program;
a determination step for determining a comparison condition based on at least one of first program information for the first program and second program information for the second program;
a comparing step for comparing the first audio signal with the second audio signal based on the comparison condition determined by the determination unit (13), and deriving a comparison result indicating whether or not the sound content of the second program is the same as the

sound content of the first program; and

a reproducing step for reproducing a sound based on the second audio signal in place of a sound based on the first audio signal when the comparison result obtained by the comparison unit indicates that the sound content of the second program is the same as the sound content of the first program.

FIG.1

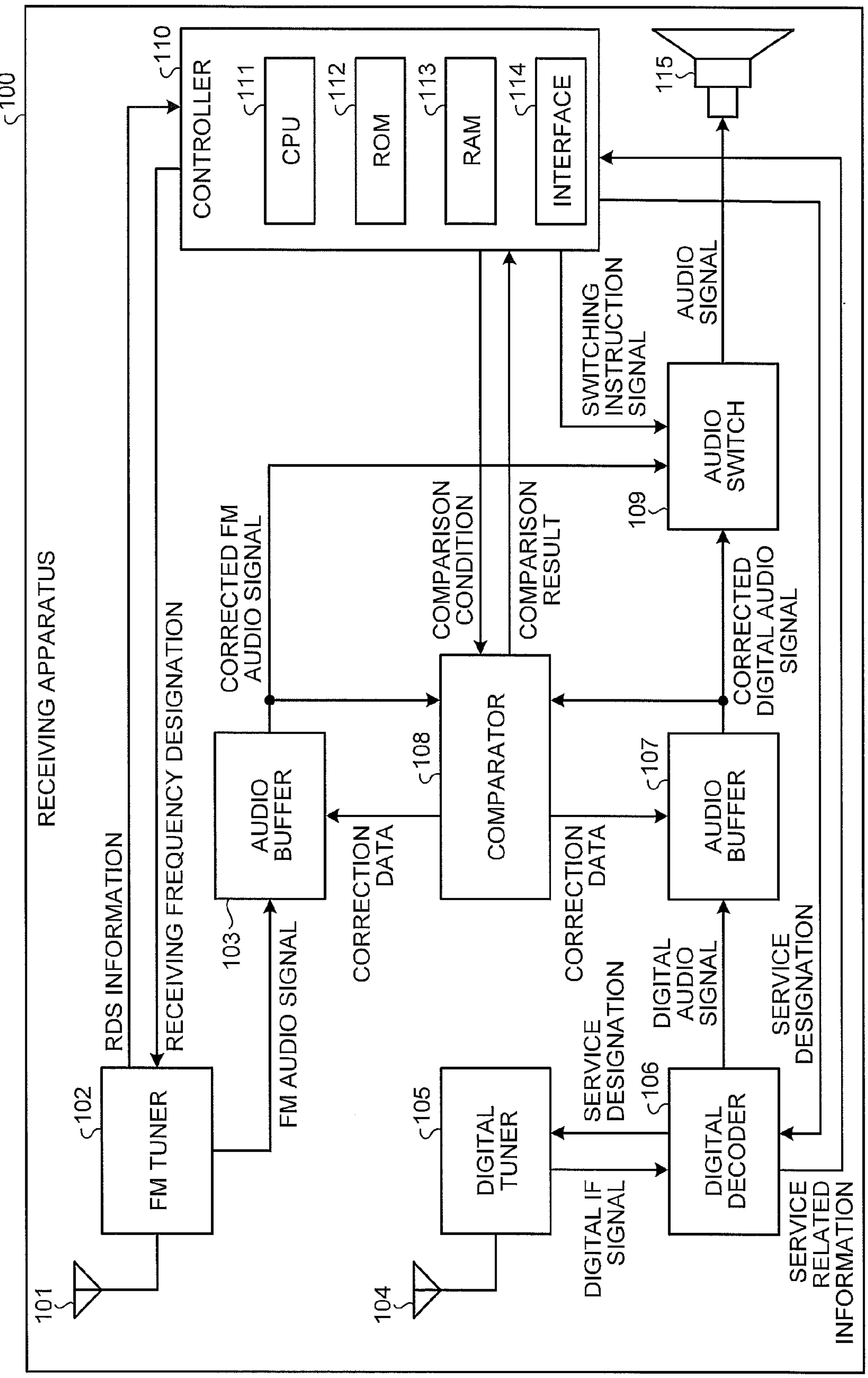

100
RECEIVING APPARATUS
101
102
FM TUNER
RDS INFORMATION
RECEIVING FREQUENCY DESIGNATION
FM AUDIO SIGNAL
103
AUDIO BUFFER
CORRECTED FM AUDIO SIGNAL
104
105
DIGITAL TUNER
DIGITAL IF SIGNAL
SERVICE DESIGNATION
106
DIGITAL DECODER
SERVICE RELATED INFORMATION
DIGITAL AUDIO SIGNAL
SERVICE DESIGNATION
107
AUDIO BUFFER
CORRECTED DIGITAL AUDIO SIGNAL
108
COMPARATOR
CORRECTION DATA
CORRECTION DATA
COMPARISON CONDITION
COMPARISON RESULT
109
AUDIO SWITCH
SWITCHING INSTRUCTION SIGNAL
AUDIO SIGNAL
110
CONTROLLER
111
CPU
112
ROM
113
RAM
114
INTERFACE
115

FIG.2

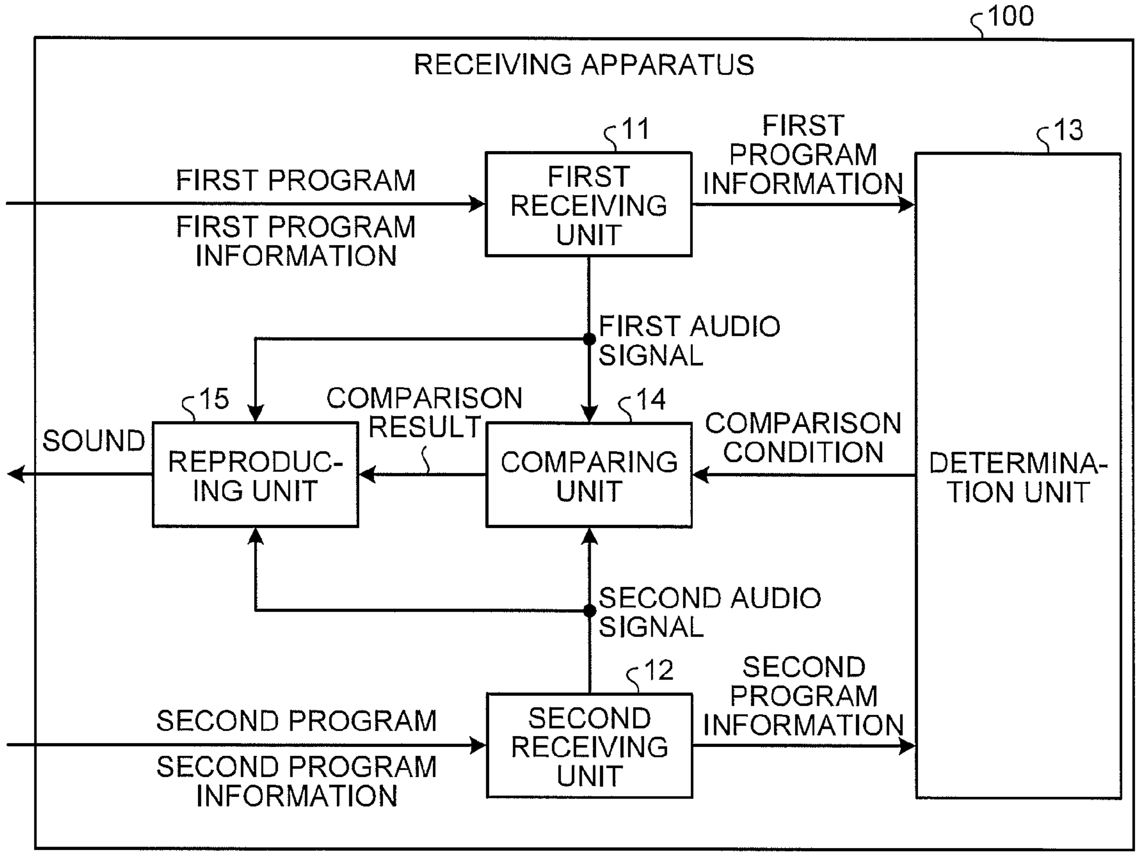


FIG.3

PROGRAM INFORMATION

PROGRAM ID	ENCODE TYPE	PROGRAM TYPE	...
D201	DAB	SPEECH	...

FIG.4A

CAPTURE TIME

PROGRAM TYPE	CLASSIC	SPEECH	ROCK, POPS
CAPTURE TIME	5 SECONDS	5 SECONDS	4 SECONDS

FIG.4B

DELAY TIME INITIAL VALUE

ENCODE TYPE	FM	DAB	DAB+	DMB
DELAY TIME INITIAL VALUE	0 TO 1 SECOND	3 SECONDS	3 SECONDS	4.5 SECONDS

FIG.4C

TIMEOUT TIME

PROGRAM TYPE	CLASSIC	SPEECH	ROCK, POPS
TIMEOUT TIME	10 SECONDS	10 SECONDS	6 SECONDS

FIG.4D

SUCCESS DETERMINATION FACTOR

PROGRAM TYPE	CLASSIC	SPEECH	ROCK, POPS
SUCCESS DETERMINATION FACTOR	TIME DELAY	TIME DELAY, VOLUME DIFFERENCE	TIME DELAY, VOLUME DIFFERENCE

FIG.4E

NUMBER OF TRIALS (PROGRAM TYPE)

PROGRAM TYPE	CLASSIC	SPEECH	ROCK, POPS
NUMBER OF TRIALS	10 TIMES	5 TIMES	10 TIMES

FIG.4F

NUMBER OF TRIALS (ENCODE TYPE)

ENCODE TYPE	FM	DAB	DAB+	DMB
NUMBER OF TRIALS	20 TIMES	10 TIMES	10 TIMES	INFINITE

FIG.5A

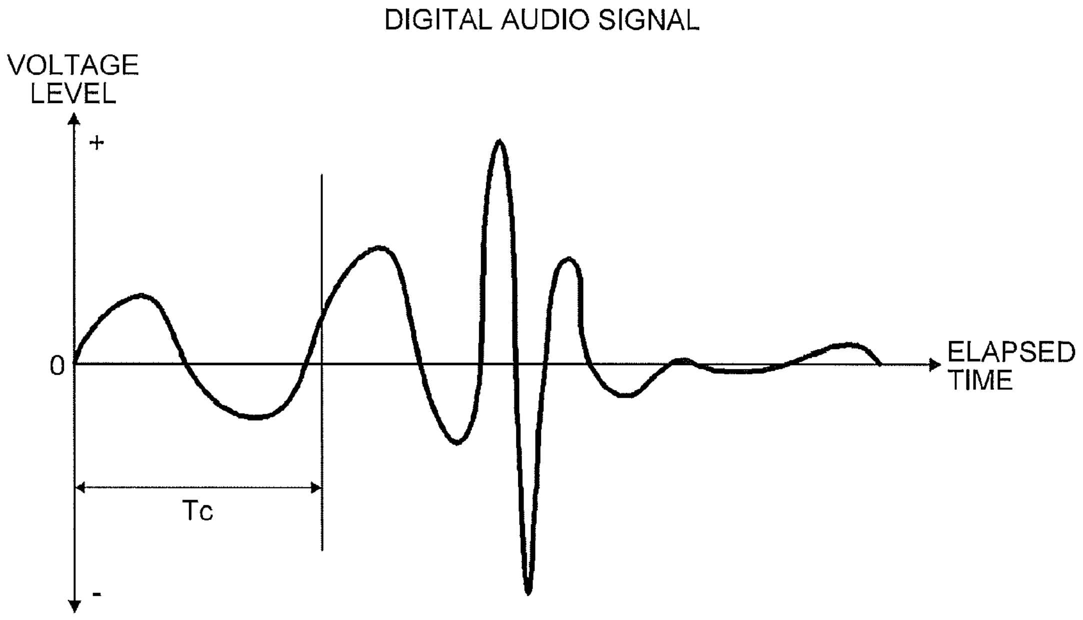

DIGITAL AUDIO SIGNAL
VOLTAGE LEVEL
+
0
-
Tc
ELAPSED TIME

FIG.5B

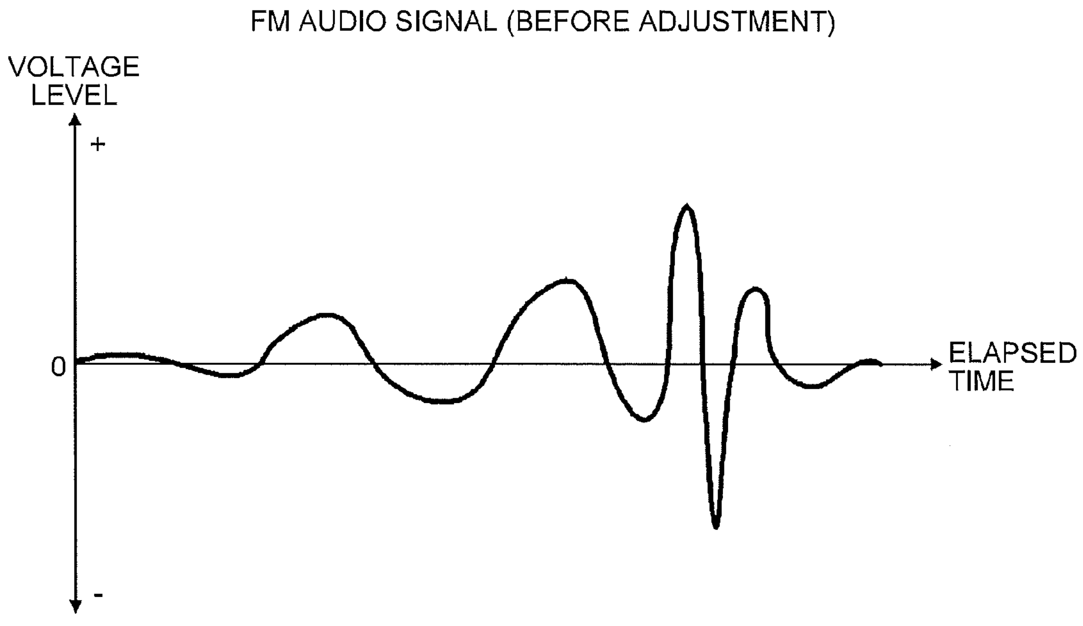

FM AUDIO SIGNAL (BEFORE ADJUSTMENT)
VOLTAGE LEVEL
+
0
-
ELAPSED TIME

FIG.6A

FM AUDIO SIGNAL
(AFTER ADJUSTMENT OF DELAY TIME)

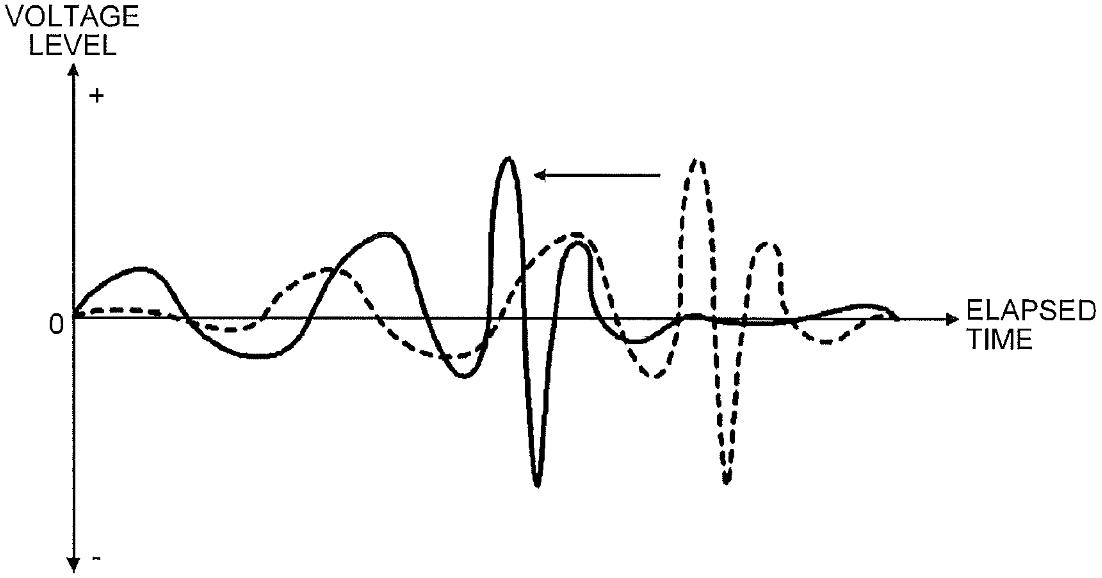


FIG.6B

FM AUDIO SIGNAL
(AFTER ADJUSTMENT OF DELAY TIME AND VOLUME)

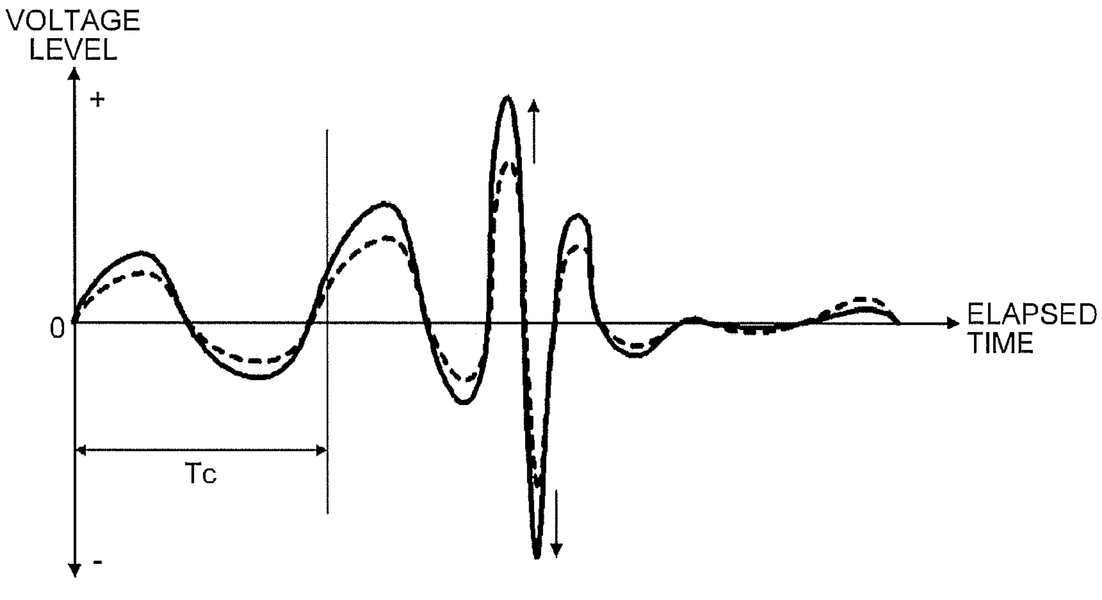


FIG.7

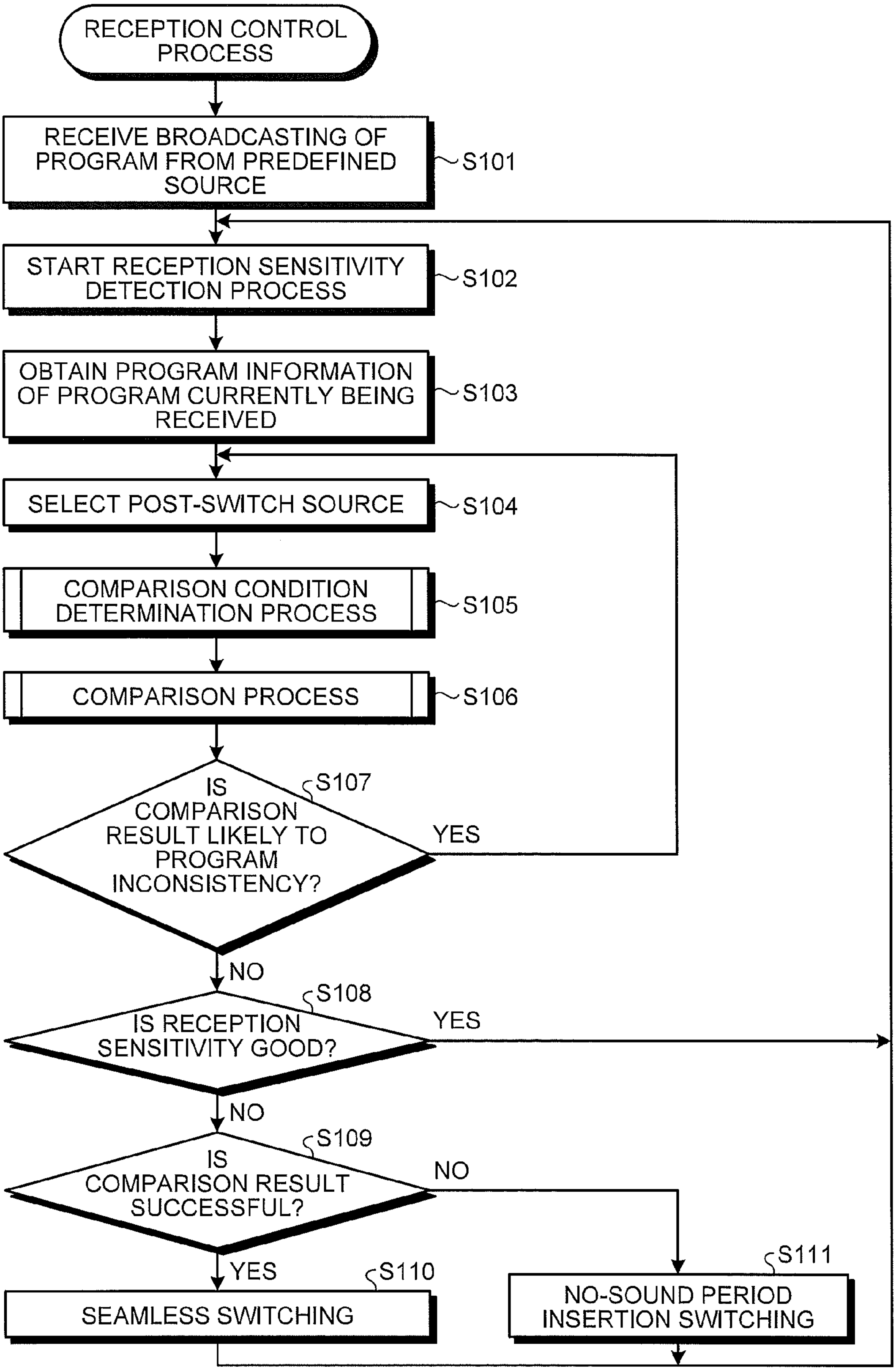

RECEPTION CONTROL PROCESS
RECEIVE BROADCASTING OF PROGRAM FROM PREDEFINED SOURCE
S101
START RECEPTION SENSITIVITY DETECTION PROCESS
S102
OBTAIN PROGRAM INFORMATION OF PROGRAM CURRENTLY BEING RECEIVED
S103
SELECT POST-SWITCH SOURCE
S104
COMPARISON CONDITION DETERMINATION PROCESS
S105
COMPARISON PROCESS
S106
IS COMPARISON RESULT LIKELY TO PROGRAM INCONSISTENCY?
S107
YES
NO
IS RECEPTION SENSITIVITY GOOD?
S108
YES
NO
IS COMPARISON RESULT SUCCESSFUL?
S109
NO
YES
SEAMLESS SWITCHING
S110
NO-SOUND PERIOD INSERTION SWITCHING
S111

FIG.8

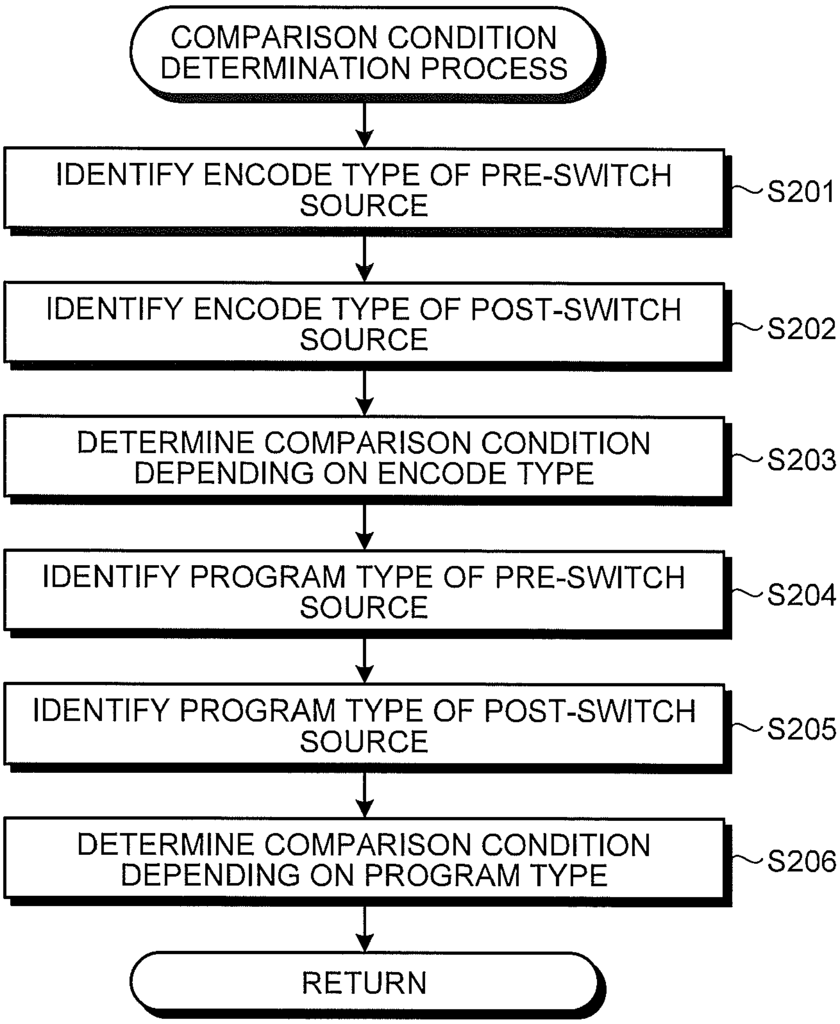
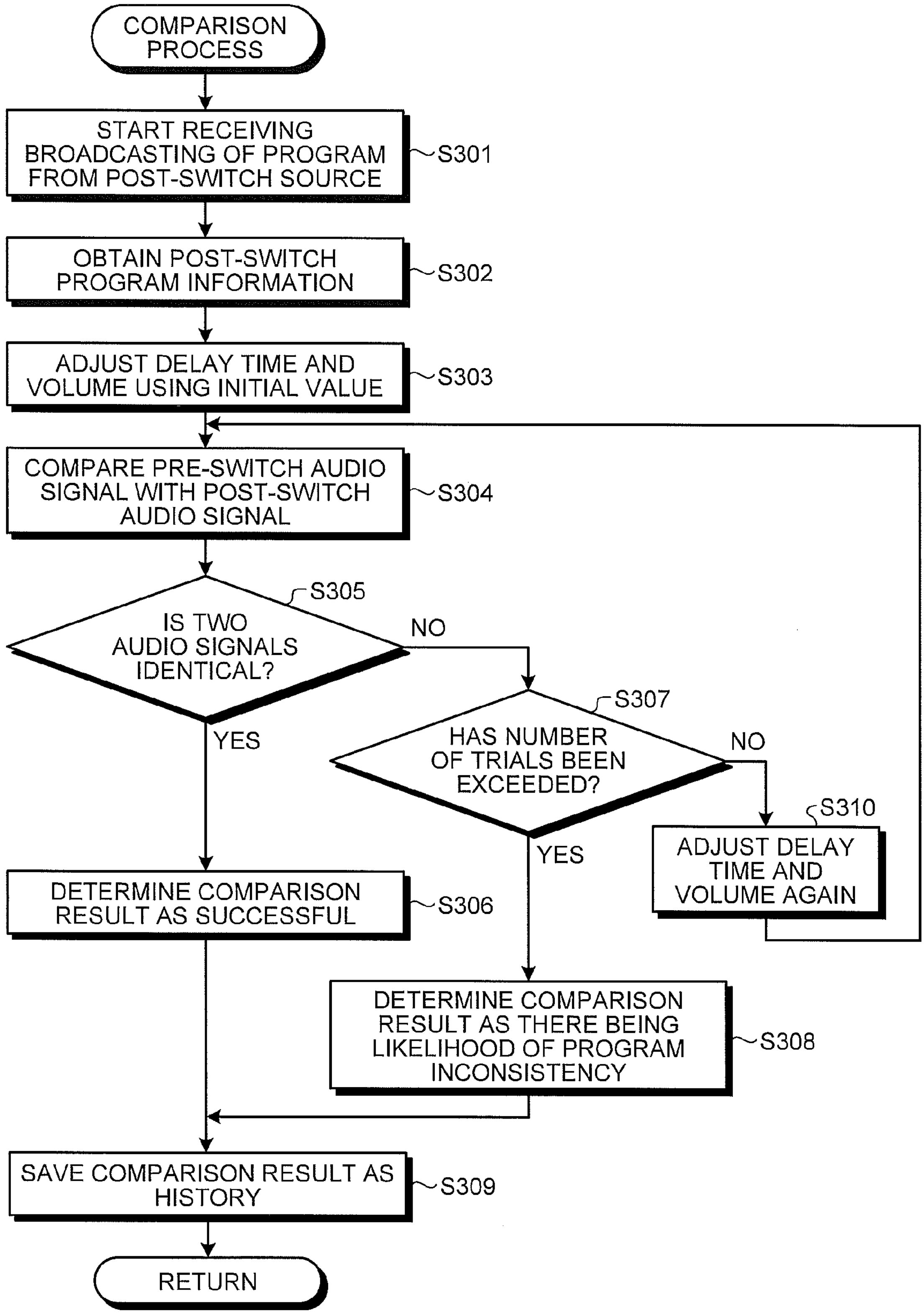

COMPARISON CONDITION DETERMINATION PROCESS
IDENTIFY ENCODE TYPE OF PRE-SWITCH SOURCE
S201
IDENTIFY ENCODE TYPE OF POST-SWITCH SOURCE
S202
DETERMINE COMPARISON CONDITION DEPENDING ON ENCODE TYPE
S203
IDENTIFY PROGRAM TYPE OF PRE-SWITCH SOURCE
S204
IDENTIFY PROGRAM TYPE OF POST-SWITCH SOURCE
S205
DETERMINE COMPARISON CONDITION DEPENDING ON PROGRAM TYPE
S206
RETURN

FIG.9


COMPARISON PROCESS
START RECEIVING BROADCASTING OF PROGRAM FROM POST-SWITCH SOURCE
S301
OBTAIN POST-SWITCH PROGRAM INFORMATION
S302
ADJUST DELAY TIME AND VOLUME USING INITIAL VALUE
S303
COMPARE PRE-SWITCH AUDIO SIGNAL WITH POST-SWITCH AUDIO SIGNAL
S304
IS TWO AUDIO SIGNALS IDENTICAL?
S305
NO
YES
HAS NUMBER OF TRIALS BEEN EXCEEDED?
S307
NO
YES
ADJUST DELAY TIME AND VOLUME AGAIN
S310
DETERMINE COMPARISON RESULT AS SUCCESSFUL
S306
DETERMINE COMPARISON RESULT AS THERE BEING LIKELIHOOD OF PROGRAM INCONSISTENCY
S308
SAVE COMPARISON RESULT AS HISTORY
S309
RETURN

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EUROPEAN SEARCH REPORT

Application Number
EP 13 02 0108

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 A	US 2011/205443 A1 (KAWAI HIROKI [JP] ET AL) 25 August 2011 (2011-08-25) * paragraphs [0035] - [0037], [0039], [0041] - [0042], [0045], [0065], [0072] - [0073], [0076], [0081] - [0083] * * figure 1 * -----	1,6 2-5	INV. H04H20/22 H04H20/26
X A	JP 2007 295468 A (FUJITSU TEN LTD) 8 November 2007 (2007-11-08) * paragraphs [0024] - [0025], [0027], [0031], [0050] - [0054], [0061], [0070] - [0071], [0081] - [0086], [0099] - [0101] * -----	1,6 2-5	
X A	US 2011/306313 A1 (JAISIMHA SHREE [US] ET AL) 15 December 2011 (2011-12-15) * paragraphs [0080], [0117] - [0119], [0127] * -----	1,5,6 2-4	
X A	US 7 061 542 B1 (IKEGUCHI YASUYUKI [JP]) 13 June 2006 (2006-06-13) * column 5, lines 40-48 * * column 6, lines 3-13 * * column 6, line 65 - column 7, line 15 * * column 7, lines 15-40 * -----	1,6 2-5	TECHNICAL FIELDS SEARCHED (IPC) H04H

1

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 January 2014	Iovescu, Vladimir

CATEGORY OF CITED DOCUMENTS

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17-01-2014

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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