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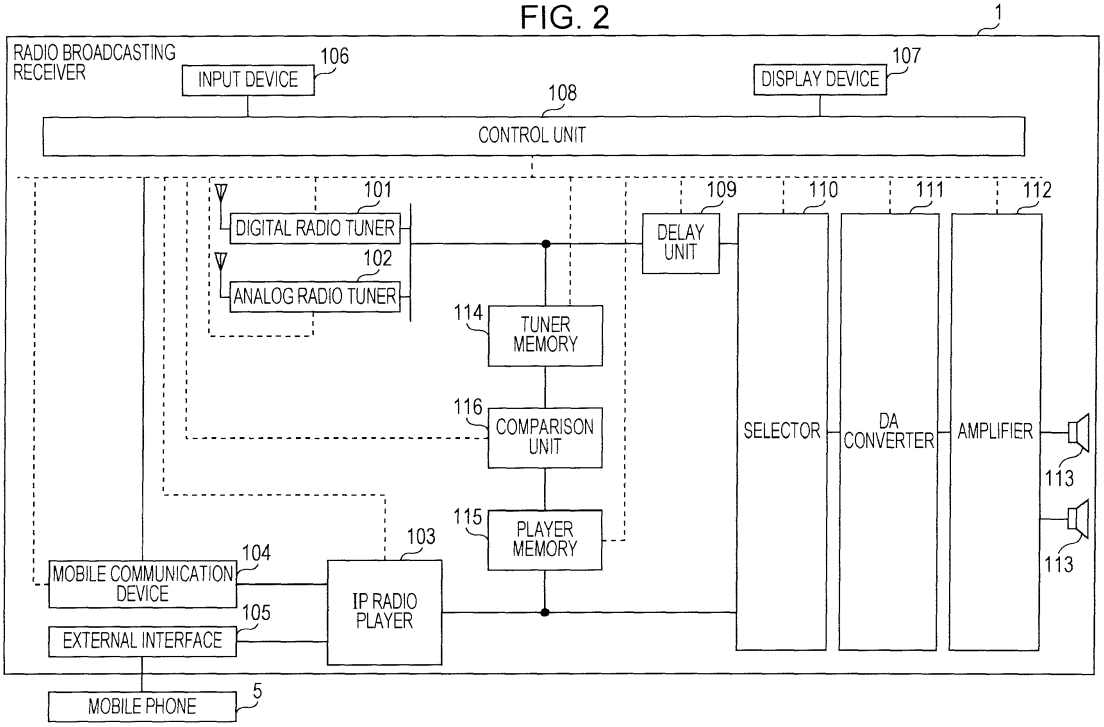
(54) **RADIO BROADCASTING RECEIVING DEVICE AND SEAMLESS SWITCHING METHOD**

(57) At the time of switching a voice to be output from radio broadcasting to IP radio broadcasting, a time stretch operation for extending, in a temporal axis direction, a received voice of the IP radio broadcasting is initiated (312), and a delay time of the received voice of the IP radio broadcasting with respect to a specific received voice of the radio broadcasting is calculated (314) in parallel to the time stretch operation. If the received voice of the radio broadcasting is delayed by an amount of the calculated delay time (318), the voice to be output is switched to the IP radio broadcasting (320).

FIG. 2



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Description

[0001] The present invention relates to a technology for switching, in a radio broadcasting receiving device, an output voice from broadcasting currently outputting a received voice to a received voice of other broadcasting currently performing broadcasting whose content is the same as that of the former broadcasting.

[0002] As the technology for switching, in a radio broadcasting receiving device, an output voice from broadcasting currently outputting a received voice to a received voice of other broadcasting currently performing broadcasting whose content is the same as that of the former broadcasting (broadcasting in a simultaneous-broadcasting-relationship with the former broadcasting currently outputting the received voice), there is known a technology in which, in a radio broadcasting receiving device that receives both FM broadcasting and IP radio broadcasting in a simultaneous-broadcasting-relationship with the FM broadcasting, at the time of switching an output voice from a voice received by means of the FM broadcasting to a voice received by means of the IP radio broadcasting, a delay time of the voice received by means of the IP radio broadcasting with respect to the voice received by means of the FM broadcasting is calculate and after the voice received by means of the FM broadcasting is delayed, by a time period corresponding to the calculated delay time, by using time stretch for extending the voice in a temporal axis direction, the output voice is seamlessly switched from the voice received by means of the FM broadcasting to the voice received by means of the IP radio broadcasting (see, for example, JP 2013-201469 A).

[0003] Here, in this technology, by comparing the voice received by means of the IP radio broadcasting and the voice previously received by means of the FM broadcasting with each other, a voice portion, which is located within the voice previously received by means of the FM broadcasting and whose correlation with a portion of the voice recently received by means of the IP radio broadcasting is strong, is estimated, and a difference in reception time between the portion of the voice recently received by means of the IP radio broadcasting and the estimated voice portion located within the voice previously received by means of the FM broadcasting is calculated as the delay time of the voice received by means of the IP radio broadcasting with respect to the voice received by means of the FM broadcasting.

[0004] According to the above-mentioned technology for switching the output voice from the voice received by means of the FM broadcasting to the voice received by means of the IP radio broadcasting, before switching of the output voice to the voice received by means of the IP radio broadcasting is completed, a time period obtained by adding a time taken to delay the voice, by a time period corresponding to the calculated delay time, by using the time stretch to a time taken to calculate the delay time is required. Therefore, it takes a relatively long time to switch the output voice to the voice received by means of the IP radio broadcasting.

[0005] Therefore, an issue of the present invention is to more swiftly perform seamless switching of a voice output to a user from a voice received from currently received radio broadcasting to a voice received from other broadcasting currently performing broadcasting whose content is the same as that of the radio broadcasting.

[0006] The invention relates to a device and method according to the independent claims. Embodiments are disclosed in the dependent claims.

[0007] According to an aspect, there is provided a radio broadcasting receiving device that is capable of receiving radio broadcasting and concurrent broadcasting serving as broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting and that includes a radio receiving unit configured to receive the radio broadcasting and to output audio data expressing a received voice, a concurrent broadcasting receiving unit configured to receive the concurrent broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting received by the radio receiving unit and to output audio data expressing a received voice, a delay time calculation unit configured to calculate a delay time of the audio data output by the concurrent broadcasting with respect to the audio data output by the radio receiving unit, a delay unit configured to delay, by a time period corresponding to a set delay target time, the audio data output by the radio receiving unit, and to output the audio data, a control unit configured to set, as the delay target time, the delay time calculated by the delay time calculation unit in the delay unit, and a selection unit configured to selectively define, as output target audio data, one of the audio data output by the delay unit and the audio data output by the concurrent broadcasting receiving unit and to output a voice of the output target audio data to a user. Here, the control unit causes the concurrent broadcasting receiving unit to initiate reception of the concurrent broadcasting at the time of switching the output target audio data from the audio data output by the delay unit to the audio data output by the concurrent broadcasting receiving unit, the control unit causes the delay unit to initiate a time-extended output operation for extending, in a temporal axis direction, the audio data output by the radio receiving unit and outputting the audio data and causes the delay time calculation unit to initiate calculation of the delay time if the concurrent broadcasting receiving unit initiates outputting of the audio data, the control unit sets, as the delay target time, the calculated delay time in the delay unit if the delay time calculation unit calculates the delay time, and the control unit causes the selection unit to switch the output target audio data to the audio data output by the concurrent broadcasting receiving unit if a delay time of the audio data output by the delay unit reaches the delay target time, and after the delay target time is set, the delay unit continuously performs the time-extended output operation until the delay of the audio data output by the delay unit reaches the delay target

time.

[0008] According to such a radio broadcasting receiving device, in a case of switching, from the received voice of the radio broadcasting to the received voice of the concurrent broadcasting, a voice to be output after the received voice of the radio broadcasting is delayed by an amount of the delay time of the received voice of the concurrent broadcasting with respect to the received voice of the radio broadcasting, while not delaying, by the amount of the delay time, the audio data of the radio broadcasting by initiating, subsequent to calculation of the delay time, time-extended outputting for extending, in the temporal axis direction, the audio data of the radio broadcasting and outputting the audio data and by gradually delaying the audio data of the radio broadcasting, the time-extended outputting is initiated without waiting for the calculation of the delay time, and the audio data of the radio broadcasting is delayed in some extent in parallel to the calculation of the delay time before the calculation of the delay time is completed. Therefore, according to the present radio broadcasting receiving device, a time period required to delay, by an amount of the calculated delay time by means of the time-extended outputting after the calculation of the delay time, the audio data of the radio broadcasting is only a short time period, compared with a case of initiating the time-extended outputting after the delay time, and it becomes possible to swiftly switch the output voice from the received voice of the radio broadcasting to the received voice of the concurrent broadcasting.

[0009] According to an embodiment such a radio broadcasting receiving device may be configured so that the delay unit continuously performs the time-extended output operation until the delay of the audio data output by the delay unit reaches the delay target time in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit is smaller than the set delay target time and the delay unit stops the time-extended output operation, initiates a time-shortened output operation for shortening, in the temporal axis direction, the audio data output by the radio receiving unit and outputting the audio data, and continuously performs the time-shortened output operation until the delay of the audio data output by the delay unit reaches the delay target time in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit is larger than the set delay target time.

[0010] According to an embodiment such a radio broadcasting receiving device may be configured so that the delay unit stops, at a point of time when the delay of the audio data output by the delay unit reaches the delay target time, the time-extended output operation and initiates an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit and outputting the audio data in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit is smaller than the set delay target time, and the delay unit stops the time-extended output operation, initiates a time-shortened output operation for shortening, in the temporal axis direction, the audio data output by the radio receiving unit and outputting the audio data, stops the time-shortened output operation at a point of time when the delay of the audio data output by the delay unit reaches the delay target time, and initiates an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit and outputting the audio data in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit is larger than the set delay target time, and the control unit causes the selection unit to switch the output target audio data to the audio data time-delayed, by an amount of the delay target time, and output by the delay unit, at the time of switching the output target audio data from the audio data output by the concurrent broadcasting receiving unit to the audio data output by the delay unit.

[0011] According to an embodiment such a radio broadcasting receiving device may be configured so that the control unit causes the concurrent broadcasting receiving unit to initiate reception of the concurrent broadcasting in a case where the delay time calculated by the delay time calculation unit is set, as the delay target time, in the delay unit at the time of switching the output target audio data from the audio data output by the delay unit to the audio data output by the concurrent broadcasting receiving unit, wherein the control unit causes the delay time calculation unit to initiate calculation of the delay time without causing the delay unit to initiate the time-extended output operation if the concurrent broadcasting receiving unit initiates outputting of the audio data, the control unit sets, as the delay target time, the calculated delay time in the delay unit if the delay time calculation unit calculates the delay time, and the control unit causes the selection unit to switch the output target audio data to the audio data output by the concurrent broadcasting receiving unit if a delay time of the audio data output by the delay unit reaches the delay target time. In this regard, however, in this case, the delay unit performs the time-extended output operation until the delay of the audio data output by the delay unit reaches the delay target time in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit is smaller than the set delay target time, wherein the delay unit stops the time-extended output operation and initiates an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit and outputting the audio data if the delay of the audio data output by the delay unit reaches the delay target time, and the delay unit performs a time-shortened output operation for shortening, in the temporal axis direction, the audio data output by the radio receiving unit and outputting the audio data until the delay of the audio data output by the delay unit reaches the delay target time in a case where, at a point of time when

the delay target time is set, the delay time of the audio data output by the delay unit is larger than the set delay target time, wherein the delay unit stops the time-shortened output operation and initiates an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit and outputting the audio data if the delay of the audio data output by the delay unit reaches the delay target time.

[0012] According to an embodiment in a case where the radio broadcasting receiving device is configured in this way, the control unit only causes the selection unit to switch the output target audio data to the audio data time-delayed, by an amount of the delay target time, and output by the delay unit, thereby enabling the output target audio data to be seamlessly switched from the audio data output by the concurrent broadcasting receiving unit to the audio data output by the delay unit.

[0013] According to an embodiment in such a radio broadcasting receiving device described above, the concurrent broadcasting may be IP radio broadcasting, and the concurrent broadcasting receiving unit may be an IP radio player that receives the IP radio broadcasting and that outputs audio data expressing a received voice.

[0014] According to an embodiment in such a radio broadcasting receiving device described above, the radio broadcasting may be one or both of digital radio broadcasting and analog radio broadcasting.

[0015] According to an embodiment such a radio broadcasting receiving device described above may be an in-vehicle type radio broadcasting receiving device installed in a vehicle.

[0016] As described above, according to aspects of the present invention, it is possible to swiftly perform seamless switching of a voice output to a user from a voice received from currently received radio broadcasting to a voice received from other broadcasting currently performing broadcasting whose content is the same as that of the radio broadcasting.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a block diagram illustrating a configuration of a radio broadcasting system according to an embodiment of the present invention;

Fig. 2 is a block diagram illustrating a configuration of a radio broadcasting receiver according to an embodiment of the present invention;

Fig. 3 is a flowchart illustrating seamless switching processing according to an embodiment of the present invention;

Fig. 4 is a diagram illustrating an example of an operation of the seamless switching processing according to an embodiment of the present invention; and

Fig. 5 is a diagram illustrating an example of an operation of the seamless switching processing according to an embodiment of the present invention.

[0018] Hereinafter, embodiments of the present invention will be described.

[0019] Fig. 1 illustrates a configuration of a radio broadcasting system according to the present embodiment.

[0020] As illustrated in the drawing, a radio broadcasting receiver 1 is the radio broadcasting receiver 1 whose location moves, such as a radio broadcasting receiver installed in a vehicle or a portable radio broadcasting receiver, and the radio broadcasting receiver 1 receives, from radio broadcasting stations 2, digital radio broadcasting based on a broadcasting standard such as DAB or DAB+ and analog radio broadcasting such as FM radio broadcasting. In addition, the radio broadcasting receiver 1 is connected to a WAN 3 such as the Internet via mobile communication and receives IP radio broadcasting from an IP radio server 4 on the WAN 3.

[0021] Here, the IP radio broadcasting performed by the IP radio server 4 includes IP radio broadcasting in a simultaneous-broadcasting-relationship with digital radio broadcasting or analog radio broadcasting, in other words, IP radio broadcasting in which broadcasting whose content is the same as that of the digital radio broadcasting or the analog radio broadcasting is performed.

[0022] Note that, in the present embodiment, it is assumed that a voice received from the IP radio broadcasting in a simultaneous-broadcasting-relationship with or the digital radio broadcasting or the analog radio broadcasting is inevitably delayed in comparison with a voice broadcast by the digital radio broadcasting or the analog radio broadcasting with which the relevant IP radio broadcasting is in a simultaneous-broadcasting-relationship.

[0023] Next, Fig. 2 illustrates a configuration of the radio broadcasting receiver 1.

[0024] As illustrated in the drawing, the radio broadcasting receiver 1 includes a digital radio tuner 101, which receives the digital radio broadcasting and reproduces and outputs received audio data, an analog radio tuner 102, which receives the analog radio broadcasting and digital-converts and outputs, as audio data, a voice received by means of the analog radio broadcasting, and an IP radio player 103, which receives the IP radio broadcasting and outputs received audio data.

[0025] Here, the IP radio player 103 is connected to the IP radio server 4 on the WAN 3 via a mobile communication device 104 that performs mobile communication, and the IP radio player 103 receives an audio stream distributed by the IP radio server 4 by using the IP radio broadcasting and reproduces and outputs audio data. In this regard, however, instead of providing the mobile communication device 104 in the radio broadcasting receiver 1, the radio broadcasting receiver 1 may be con-

figured so that an external interface 105 to which a mobile phone 5 for performing mobile communication is to be connected and the IP radio player 103 is connected to the IP radio server 4 on the WAN 3 via the mobile communication performed by the mobile phone 5, receives, reproduces, and outputs an audio stream distributed by the IP radio server 4 by using the IP radio broadcasting.

[0026] In addition, the radio broadcasting receiver 1 includes an input device 106, a display device 107, and a control unit 108.

[0027] In addition, the radio broadcasting receiver 1 includes a delay unit 109 that delays, by an amount of a set delay target time, and outputs the audio data output by the digital radio tuner 101 or the analog radio tuner 102, a selector 110 that selects and outputs one of the audio data output by the delay unit 109 and the audio data output by the IP radio player 103, a DA converter 111 that converts the audio data output by the selector 110 into an analog voice signal and outputs the analog voice signal, an amplifier 112 that amplifies the analog voice signal output by the DA converter 111, and speakers 113 that are driven by the voice signal amplified by the amplifier 112 and that each output a voice.

[0028] In addition, the radio broadcasting receiver 1 includes a tuner memory 114, a player memory 115, and a comparison unit 116.

[0029] And now, in such a configuration, in a case where, via the input device 106, a user instructs the control unit 108 to receive radio broadcasting of a specific one of the radio broadcasting stations 2, the control unit 108 sets the digital radio tuner 101 as a currently-used tuner if the radio broadcasting station 2, reception from which is designated, is a broadcasting station for the digital radio broadcasting, the control unit 108 sets the analog radio tuner 102 as a currently-used tuner if the radio broadcasting station 2, reception from which is designated, is a broadcasting station for the analog radio broadcasting, and the control unit 108 initiates reception of radio broadcasting of the radio broadcasting station 2 from which the currently-used tuner is instructed to receive and outputting of audio data. In addition, the control unit 108 clears the storage contents of the tuner memory 114 and the player memory 115, sets, as a delay target time, "0" in the delay unit 109, and causes the delay unit 109 to output, to the selector 110 without change, the audio data input by the currently-used tuner. In addition, by causing the selector 110 to output, to the DA converter 111, the audio data input by the delay unit 109, the control unit 108 causes the speakers 113 to output a voice received by the currently-used tuner from the radio broadcasting station 2, reception from which is designated by the user.

[0030] On the other hand, the audio data output by the currently-used tuner is stored in the tuner memory 114. Here, storing in the tuner memory 114 is performed so that the tuner memory 114 is put into a state of constantly storing therein latest audio data corresponding to a predetermined reproduction time period. In addition, the reproduction time period of the audio data constantly stored in the tuner memory 114 is set so as to become greater than or equal to a time period expected, as a maximum value of a delay time of the IP radio broadcasting with respect to the digital/analog radio broadcasting, the IP radio broadcasting being in a simultaneous-broadcasting-relationship with the relevant digital/analog radio broadcasting.

[0031] Hereinafter, in such a radio broadcasting receiver 1, the control unit 108 performs processing for seamlessly switching a voice to be output to the speakers 113 between a voice received by means of radio broadcasting currently received by the currently-used tuner and a voice received by means of IP radio broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting currently received by the currently-used tuner.

[0032] Hereinafter, seamless switching processing performed for such seamless switching by the control unit 108 will be described.

[0033] Fig. 3 illustrates a procedure of this seamless switching processing. Note that the seamless switching processing is started at the time of being instructed to receive radio broadcasting of a specific one of the radio broadcasting stations 2 by the user.

[0034] As illustrated in the drawing, in this processing, the processing waits for a state of the radio broadcasting receiver 1 to become a state of outputting, from the speakers 113, a voice of radio broadcasting received by the currently-used tuner (step 302), and if the state of outputting, from the speakers 113, the voice of the radio broadcasting occurs, the deterioration of reception quality of the radio broadcasting currently received by the currently-used tuner is monitored (step 304). Here, the reception quality of the radio broadcasting currently received by the digital radio tuner 101 or the analog radio tuner 102, which serves as the currently-used tuner, is estimated based on the received electric field strength, the SN ratio, the error occurrence rate, or the like of the currently received radio broadcasting, and the control unit 108 acquires the reception quality estimated by the currently-used tuner, thereby detecting the reception quality of the radio broadcasting currently received by the currently-used tuner.

[0035] Next, if the reception quality of the currently received radio broadcasting is deteriorated, initiation of reception of IP radio broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting currently received by the currently-used tuner is controlled in the IP radio player 103 (step 306).

[0036] In addition, if the reception of the IP radio broadcasting, performed by the IP radio player 103, is initiated (step 308), the control unit 108 determines whether the delay target time set in the delay unit 109 is "0" (step 310), and in a case of not being "0", the control unit 108 proceeds to a step 314 without change.

[0037] On the other hand, in a case where the delay target time currently set in the delay unit 109 is "0" (step

310), the control unit 108 proceeds to a step 314 after causing the delay unit 109 to initiate a time stretch operation for extending audio data in a temporal axis direction and outputting the audio data while maintaining the pitch of the voice of the audio data (step 312).

[0038] Next, if proceeding to the step 314 as described above, the control unit 108 calculates a delay time of the voice received by means of the IP radio broadcasting with respect to the voice received by means of the radio broadcasting currently received by the currently-used tuner.

[0039] Here, this calculation of the delay time is performed as follows.

[0040] In other words, by stopping an operation for storing the audio data in the tuner memory 114, the control unit 108 controls so that a storage content of the audio data of the tuner memory 114 does not change from that point of time.

[0041] In addition, the control unit 108 controls storing of audio data in the player memory 115, the audio data being initially received by means of the IP radio broadcasting output by the IP radio player 103 and corresponding to a predetermined reproduction time period.

[0042] In addition, the control unit 108 causes the comparison unit 116 to search for a portion within the audio data stored in the tuner memory 114, whose voice pattern is matched with that of the audio data stored in the player memory 115, the searching being based on a comparison between the audio data stored in the tuner memory 114 and the audio data stored in the player memory 115. In addition, a difference between the reception time of the audio data stored in the player memory 115 and the reception time of the portion searched within the audio data stored in the tuner memory 114 is calculated as a delay time. Note that the reception time of the portion searched within the audio data stored in the tuner memory 114 is able to be obtained from a position of the searched portion within a continuum body of the audio data stored in the tuner memory 114.

[0043] Next, the delay time calculated in the step 314 is set, as a delay target time, in the delay unit 109 (step 316). Note that in a case where such a setting of the delay time as a delay target time in the delay unit 109 is performed, it is determined, in the step 310 performed thereafter, that the delay target time is not "0".

[0044] Here, the delay unit 109, in which the delay target time is set, time-stretches audio data to be output, to the extent that the set delay target time and the delay time of the audio data to be output by the delay unit 109 with respect to the audio data input to the delay unit 109 coincide with each other. In other words, in a case where the set delay target time is larger than the delay time of the audio data output by the delay unit 109 at that point of time, the delay unit 109 continues the time stretch operation for extending the audio data in the temporal axis direction and outputting the audio data, while maintaining the pitch of the voice of the relevant audio data, until the set delay target time and the delay time of the audio data to be output by the delay unit 109 coincide with each other.

[0045] On the other hand, in a case where the set delay target time is smaller than the delay time of the audio data output by the delay unit 109 at that point of time, the delay unit 109 performs a time stretch operation for shortening the audio data in the temporal axis direction and outputting the audio data, while maintaining the pitch of the voice of the relevant audio data, until the set delay target time and the delay time of the audio data to be output by the delay unit 109 coincide with each other.

[0046] Note that the time stretch of the audio data is performed so that the length of the audio data in the temporal axis direction does not change to be greater than an original length by a predetermined length or more (for example, 20% of the original length).

[0047] In addition, if the set delay target time and the delay time of the audio data output by the delay unit 109 coincide with each other, by stopping the time stretch, the delay unit 109 returns to outputting of the audio data at a usual reproduction speed and informs the control unit 108 of the coincidence of the delay times.

[0048] In addition, if the delay time (delay target time) calculated in the step 314 and the delay time of the audio data output by the delay unit 109 coincide with each other and the control unit 108 is informed of the coincidence of the delay times by the delay unit 109 (step 318), the control unit 108 switches a voice to be output to the speakers 113 to the voice received from the IP radio broadcasting by the IP radio player 103 (step 320). Here, since, at this point of time, the delay unit 109 is in a state of delaying, by an amount of the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data currently received by the currently-used tuner by means of the radio broadcasting, the audio data received by the currently-used tuner by means of the radio broadcasting and outputting the audio data, the audio data output by the speakers 113 is seamlessly switched, based on switching of the audio data output by the selector 110, from the audio data received by means of the radio broadcasting to the audio data output by the IP radio player 103.

[0049] In addition, if outputting of a voice from the speakers 113 is initiated, the voice being received by the IP radio player 103 by means of the IP radio broadcasting, whether the reception quality of the radio broadcasting currently received by the currently-used tuner is restored to good reception quality is monitored (step 322), and if the reception quality is restored to good reception quality, the selector 110 switches, to the audio data output by the delay unit 109, audio data to be output to the DA converter 111, thereby switching a voice output to the speakers 113 to the voice of the radio broadcasting currently received by the currently-used tuner (step 324). Here, at this point of time, the delay unit 109 delays, by an amount of the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting,

the audio data received by means of the radio broadcasting and outputs the relevant audio data. Therefore, based on switching of the audio data output by the selector 110, the audio data output by the speakers 113 is seamlessly switched from the audio data output by the IP radio player 103 to the audio data by means of the radio broadcasting.

[0050] In addition, the operation for storing the audio data in the tuner memory 114 is resumed and the IP radio player 103 is caused to stop receiving the IP radio broadcasting (step 326), and the processing returns to the processing operations starting from the step 304. Here, at the time of stopping receiving the IP radio broadcasting, the IP radio player 103 disconnects mobile communication of the mobile communication device 104 or the mobile phone 5 with the WAN 3.

[0051] As above, the seamless switching processing performed by the control unit 108 is described.

[0052] Note that such seamless switching processing as described above is terminated if the user instructs to terminate reception of the currently received radio broadcasting. In addition, such seamless switching processing as described above is restarted if the user instructs to receive a new one of the radio broadcasting stations 2.

[0053] Hereinafter, an example of processing of such seamless switching processing will be described.

[0054] First, Fig. 4 illustrates a first example of processing of the seamless switching processing.

[0055] At this moment, in Fig. 5, while a reproduction time period of a predetermined time length (for example, 2 ms) is defined as a unit time, quadrangles surrounding numeric characters each express audio data or a voice, which corresponds to the unit time. In addition, quadrangles surrounding numeric characters without "'" each express audio data or a voice, received by the currently-used tuner by means of the radio broadcasting (the digital radio broadcasting or the analog radio broadcasting), and quadrangles surrounding numeric characters with "'" each express audio data or a voice, received by the IP radio player 103 by means of the IP radio broadcasting. In addition, quadrangles whose values of respective numeric characters within the quadrangles are the same (for example, "4" and "4'") each express audio data or a voice, whose content is the same. In addition, it is assumed that the tuner memory 114 stores therein audio data corresponding to the 5 unit times.

[0056] At this moment, it is assumed that "0" is set, as the delay target time, in the delay unit 109 at a time T0. In addition, during a time period from the time T0 to a time T1, during which the currently-used tuner receives the radio broadcasting in a state of good reception quality, the selector 110 is set so as to output the audio data output by the delay unit 109 to the DA converter 111, and pieces of audio data (0 to 3) received from the radio broadcasting by the currently-used tuner are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112 while not being delayed by the delay unit 109. In addition, the piece of audio data (0 to 3) sequentially output by the currently-used tuner are sequentially stored in the tuner memory 114, and the tuner memory 114 in time is put into a state of constantly storing therein audio data corresponding to 5 unit time lengths.

[0057] If, in this state, the deterioration of the reception quality of the radio broadcasting is detected at the time T1, an reception operation of the IP radio broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting currently received by the currently-used tuner is initiated in the IP radio player 103. In addition, at a time T2, reception of the audio data of the IP radio broadcasting is initiated. On the other hand, during a time period from the time T1 to the time T2, pieces of audio data (4 and 5) received from the radio broadcasting by the currently-used tuner are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112 while not being delayed by the delay unit 109, and the pieces of audio data (4 and 5) are sequentially stored in the tuner memory 114.

[0058] In addition, if, at the time T2, the reception of the audio data of the IP radio broadcasting is initiated, storing of the audio data in the tuner memory 114 is stopped, and a storage content of the tuner memory 114 is frozen. In addition, a piece of audio data (4') initially received by means of the IP radio broadcasting is stored in the player memory 115.

[0059] In addition, if, at the time T2, the reception of the audio data of the IP radio broadcasting is initiated, searching based on a comparison is initiated in the comparison unit 116, audio data whose voice pattern is the same as that of the piece of audio data (4') in the player memory 115 is searched for within a continuum body of the pieces of audio data (1 to 5) stored in the tuner memory 114, during a time period from the time T2 to a time T3, and the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting is calculated based on the reception time of the searched piece of audio data (4), obtained from a storage position of the piece of audio data (4) within a continuum body of the pieces of audio data (1 to 5) stored in the tuner memory 114. Here, in the time period from the time T2 to the time T3, the piece of audio data (4') in the player memory 115 and the piece of audio data (4) in the tuner memory 114 are matched with each other, and 2 unit times are calculated as the delay time.

[0060] In addition, if, at the time T2, the reception of the audio data of the IP radio broadcasting is initiated, the time stretch operation for extending, in the temporal axis direction, the audio data input by the currently-used tuner and outputting the relevant audio data while maintaining the pitch thereof until the delay time is calculated at the time T3 is initiated in the delay unit 109, and a piece of audio data (6) extended in the temporal axis direction is output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0061] In addition, if, at the time T3, the delay time is calculated, the calculated delay time is set, as the delay

target time, in the delay unit 109. The set delay target time (2 unit times) is larger than the delay time (1 unit time) at this point of time. Therefore, the delay unit 109 continues the time stretch operation for extending, in the temporal axis direction, the audio data input by the currently-used tuner and outputting the relevant audio data while maintaining the pitch thereof, and a piece of audio data (7) extended in the temporal axis direction is output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0062] In addition, if, at a time T4 when outputting of the piece of audio data (7) extended in the temporal axis direction is completed, the delay time (2 unit times) of the audio data output by the delay unit 109 with respect to the audio data input to the delay unit 109 coincides with the set delay target time (2 unit times), the selector 110 switches audio data to be output to the DA converter 111 from the audio data output by the delay unit 109 to the audio data output by the IP radio player 103. As a result, each of voices output by the speakers 113 is switched from the voice received by means of the digital radio broadcasting or the analog radio broadcasting to the voice received by means of the IP radio broadcasting, and pieces of audio data (8' to 13') output by the IP radio player 103 turn out to be output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0063] Here, at the time T4, the delay unit 109 is in a state of delaying, by an amount of the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by the currently-used tuner by means of the radio broadcasting, the audio data received by means of the radio broadcasting and outputting the audio data. Therefore, the audio data output by the speakers 113 is seamlessly switched from the audio data received by means of the radio broadcasting to the audio data output by the IP radio player 103.

[0064] As illustrated in the drawing, in this example, it takes 2 unit times to calculate the delay time, and it takes 4 unit times for a delay based on the time stretch to reach the delay target time. In addition, seamless switching is performed at the time T4 4 unit times after the reception of the audio data of the IP radio broadcasting is initiated at the time T2. On the other hand, in a case where delaying based on the time stretch is initiated after the calculation of the delay time, a time period required to perform seamless switching after initiating the reception of the audio data of the IP radio broadcasting turns out to be 6 unit times (2 unit times + 4 unit times). Therefore, according to the present embodiment, compared with a case of initiating delaying based on the time stretch after calculation of the delay time, it is possible to more swiftly perform seamless switching of an output voice.

[0065] And now, next, at the time T4 when the outputting of the piece of audio data (7) extended in the temporal axis direction is completed, the time stretch based on the delay unit 109 is stopped, and after the time T4, pieces of audio data (8 to 15) currently received from the radio broadcasting by the currently-used tuner are output by the delay unit 109 at a usual reproduction speed.

[0066] Here, the delay unit 109 includes therewithin a FIFO type buffer, and in a case where a time other than "0" is set as the delay target time, the delay unit 109 extracts audio data from the buffer while storing input audio data in the buffer and outputs the audio data by time-stretching the audio data in such a manner as the pieces of audio data (6 and 7) or by time-delaying the audio data, by an amount of the delay target time, in such a manner as the pieces of audio data (8 to 15) while not time-stretching the audio data. Note that pieces of audio data of thick-bordered quadrangles of the buffer in the drawing each express audio data currently output by the delay unit 109.

[0067] Next, if, at a time T5 when outputting of the pieces of audio data (8' to 13') output by the IP radio player 103 to the speakers 113 is completed, the reception quality of the currently-used tuner is restored to good reception quality, the selector 110 switches audio data to be output to the DA converter 111 from the audio data output by the IP radio player 103 to the audio data output by the delay unit 109. In addition, after the time T5, the pieces of audio data (14 and 15), received from the radio broadcasting by the currently-used tuner and delayed in the delay unit 109 by an amount of the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting, are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0068] Here, at the time T5, the delay unit 109 delays, by an amount of the delay time (2 unit times) of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting, the audio data received by means of the radio broadcasting and outputs the relevant audio data. Therefore, the audio data output by the speakers 113 is seamlessly switched from the audio data output by the IP radio player 103 to the audio data received by means of the radio broadcasting.

[0069] Next, Fig. 5 illustrates a second example of processing of the seamless switching processing.

[0070] The second example of processing is an example in which the delay time of the audio data of the IP radio broadcasting with respect to the audio data of the radio broadcasting currently received by the currently-used tuner is smaller than that of the first example of processing illustrated in Fig. 4 and it takes a long time to calculate the delay time.

[0071] In Fig. 5, it is assumed that "0" is set, as the delay target time, in the delay unit 109 at a time T0. In addition, during a time period from the time T0 to a time T1, during which the currently-used tuner receives the radio broadcasting in a state of good reception quality, the selector 110 is set so as to output the audio data output by the delay unit 109 to the DA converter 111, and pieces of audio data (0 to 3) received from the radio broadcasting by the currently-used tuner are output by

the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112 while not being delayed by the delay unit 109. In addition, the piece of audio data (0 to 3) sequentially output by the currently-used tuner are sequentially stored in the tuner memory 114, and the tuner memory 114 in time is put into a state of constantly storing therein audio data corresponding to 5 unit time lengths.

[0072] If, in this state, the deterioration of the reception quality of the radio broadcasting is detected at the time T1, the reception operation of the IP radio broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting currently received by the currently-used tuner is initiated in the IP radio player 103. In addition, at a time T2, reception of the audio data of the IP radio broadcasting is initiated. On the other hand, during a time period from the time T1 to the time T2, pieces of audio data (4 and 5) received from the radio broadcasting by the currently-used tuner are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112 while not being delayed by the delay unit 109, and the pieces of audio data (4 and 5) are sequentially stored in the tuner memory 114.

[0073] In addition, if, at the time T2, the reception of the audio data of the IP radio broadcasting is initiated, storing of the audio data in the tuner memory 114 is stopped, and a storage content of the tuner memory 114 is frozen. In addition, a piece of audio data (5') initially received by means of the IP radio broadcasting is stored in the player memory 115.

[0074] In addition, if, at the time T2, the reception of the audio data of the IP radio broadcasting is initiated, searching based on a comparison is initiated in the comparison unit 116, audio data whose voice pattern is the same as that of the piece of audio data (5') in the player memory 115 is searched for within a continuum body of the pieces of audio data (1 to 5) stored in the tuner memory 114, during a time period from the time T2 to a time T3, and the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting is calculated based on the reception time of the searched piece of audio data (5), obtained from a storage position of the piece of audio data (5) within a continuum body of the pieces of audio data (1 to 5) stored in the tuner memory 114. Here, in the time period from the time T2 to the time T3, the piece of audio data (5') in the player memory 115 and the piece of audio data (5) in the tuner memory 114 are matched with each other, and 1 unit time is calculated as the delay time.

[0075] In addition, if, at the time T2, the reception of the audio data of the IP radio broadcasting is initiated, the time stretch operation for extending, in the temporal axis direction, the audio data input by the currently-used tuner and outputting the relevant audio data while maintaining the pitch thereof until the delay time is calculated at the time T3 is initiated in the delay unit 109, and pieces of audio data (6) and (7) extended in the temporal axis direction are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0076] In addition, if, at the time T3, the delay time is calculated, the calculated delay time is set, as the delay target time, in the delay unit 109. The set delay target time (1 unit time) is smaller than the delay time (2 unit times) at this point of time. Therefore, the delay unit 109 continues the time stretch operation for shortening, in the temporal axis direction, the audio data input by the currently-used tuner and outputting the relevant audio data while maintaining the pitch thereof, and pieces of audio data (8) and (9) shortened in the temporal axis direction are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0077] In addition, if, at a time T4 when outputting of the piece of audio data (9) shortened in the temporal axis direction is completed, the delay time (1 unit time) of the audio data output by the delay unit 109 with respect to the audio data input to the delay unit 109 coincides with the set delay target time (1 unit time), the selector 110 switches audio data to be output to the DA converter 111 from the audio data output by the delay unit 109 to the audio data output by the IP radio player 103. As a result, each of voices output by the speakers 113 is switched from the voice received by means of the digital radio broadcasting or the analog radio broadcasting, currently received by the currently-used tuner, to the voice received by means of the IP radio broadcasting, and pieces of audio data (10' to 14') output by the IP radio player 103 turn out to be output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0078] Here, at the time T4, the delay unit 109 is in a state of delaying, by an amount of the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting, the audio data received by means of the radio broadcasting and outputting the audio data. Therefore, the audio data output by the speakers 113 is seamlessly switched from the audio data received by means of the radio broadcasting to the audio data output by the IP radio player 103.

[0079] As illustrated in the drawing, in this example, seamless switching is performed, at the time T4, 5 unit times after the reception of the audio data of the IP radio broadcasting is initiated at the time T2. On the other hand, in a case where delaying based on the time stretch is initiated after the calculation of the delay time, a time period required to perform seamless switching after initiating the reception of the audio data of the IP radio broadcasting turns out to be 6 unit times (4 unit times + 2 unit times) in sum total. The reason is that a time period required to delay the audio data, by 1 unit time, based on the time stretch for extending in the temporal axis direction turns out to be 2 unit times in this example. Therefore, in this example, compared with a case of initiating delaying based on the time stretch after calculation of the delay time, it is possible to more swiftly perform seamless switching of an output voice.

[0080] And now, next, at the time T4 when the outputting of the piece of audio data (9) shortened in the temporal axis direction is completed, the time stretch based on the delay unit 109 is stopped, and after the time T4, pieces of audio data (10 to 16) currently received from the radio broadcasting by the currently-used tuner are output by the delay unit 109 at a usual reproduction speed.

[0081] Next, if, at a time T5 when outputting of the pieces of audio data (10' to 14') output by the IP radio player 103 to the speakers 113 is completed, the reception quality of the currently-used tuner is restored to good reception quality, the selector 110 switches audio data to be output to the DA converter 111 from the audio data output by the IP radio player 103 to the audio data output by the delay unit 109. In addition, after the time T5, the pieces of audio data (15 and 16), received from the radio broadcasting by the currently-used tuner and delayed in the delay unit 109 by an amount of the delay time of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting, are output by the speakers 113 via the selector 110, the DA converter 111, and the amplifier 112.

[0082] Here, at the time T5, the delay unit 109 delays, by an amount of the delay time (1 unit time) of the audio data received by means of the IP radio broadcasting with respect to the audio data received by means of the radio broadcasting, the audio data received by means of the radio broadcasting and outputs the relevant audio data. Therefore, the audio data output by the speakers 113 is seamlessly switched from the audio data output by the IP radio player 103 to the audio data received by means of the radio broadcasting.

[0083] As above, embodiments of the present invention are described.

[0084] As described above, according to the present embodiment, in a case of switching, from a voice received by a currently-used tuner to a voice received by means of IP radio broadcasting, a voice to be output after the voice received by the currently-used tuner is delayed by an amount of a delay time of the voice received by means of the IP radio broadcasting with respect to the voice received by the currently-used tuner, while not delaying, by the amount of the delay time, a voice by initiating, subsequent to calculation of the delay time, time stretch for extending, in a temporal axis direction, the voice received by the currently-used tuner and by gradually delaying the relevant voice, the time stretch for extending in the temporal axis direction and outputting the voice is initiated without waiting for the calculation of the delay time, and the voice received by the currently-used tuner is delayed in some extent before processing for calculating the delay time is completed. Therefore, a time period required to delay, by an amount of the calculated delay time by means of the time stretch after the calculation of the delay time, the voice received by the currently-used tuner is only a short time period, compared with a case of initiating the time stretch after the delay time. Therefore, according to the present embodiment, it becomes possible to swiftly switch the output voice from a voice received by means of digital radio broadcasting or analog radio broadcasting to the voice received by means of IP radio broadcasting.

[0085] Here, in place of the IP radio player 103, the above-mentioned radio broadcasting receiver 1 according to an embodiment may include a receiver configured to receive broadcasting of an arbitrary broadcasting system or broadcasting medium in a simultaneous-broadcasting-relationship with the digital radio broadcasting or the analog radio broadcasting. Note that, in this case, audio data output by the receiver provided in place of the IP radio player 103 is processed in the same way as the audio data output by the IP radio player 103.

Claims

1. A radio broadcasting receiving device (1) capable of receiving radio broadcasting and concurrent broadcasting serving as broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting, the radio broadcasting receiving device comprising:

a radio receiving unit (101, 102) configured to receive the radio broadcasting and to output audio data expressing a received voice;

a concurrent broadcasting receiving unit (103) configured to receive the concurrent broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting received by the radio receiving unit (101, 102) and to output audio data expressing a received voice;

a delay time calculation unit (108) configured to calculate a delay time of the audio data output by the concurrent broadcasting with respect to the audio data output by the radio receiving unit (101, 102);

a delay unit (109) configured to delay, by a time period corresponding to a set delay target time, the audio data output by the radio receiving unit (101, 102), and to output the audio data;

a control unit (108) configured to set, as the delay target time, the delay time calculated by the delay time calculation unit (108) in the delay unit (109); and

a selection unit (110) configured to selectively define, as output target audio data, one of the audio data output by the delay unit (109) and the audio data output by the concurrent broadcasting receiving unit (103) and to output a voice of the output target audio data to a user, wherein the control unit (108) is configured to cause the concurrent broadcasting receiving unit (103) to initiate reception of the concurrent broadcasting at the time of switching the output target audio

data from the audio data output by the delay unit (109) to the audio data output by the concurrent broadcasting receiving unit (103), the control unit (108) is configured to cause the delay unit (109) to initiate a time-extended output operation for extending, in a temporal axis direction, the audio data output by the radio receiving unit (101, 102) and outputting the audio data and to cause the delay time calculation unit (108) to initiate calculation of the delay time if the concurrent broadcasting receiving unit (103) initiates outputting of the audio data, the control unit (108) is configured to set, as the delay target time, the calculated delay time in the delay unit (109) if the delay time calculation unit (108) calculates the delay time, and the control unit (108) is configured to cause the selection unit (110) to switch the output target audio data to the audio data output by the concurrent broadcasting receiving unit (103) if a delay time of the audio data output by the delay unit (109) reaches the delay target time, and
after the delay target time is set, the delay unit (109) is configured to continuously perform the time-extended output operation until the delay of the audio data output by the delay unit (109) reaches the delay target time.

2. The radio broadcasting receiving device (1) according to Claim 1, wherein
the delay unit (109) is configured to
continuously perform the time-extended output operation until the delay of the audio data output by the delay unit (109) reaches the delay target time in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit (109) is smaller than the set delay target time, and
to stop the time-extended output operation, to initiate a time-shortened output operation for shortening, in the temporal axis direction, the audio data output by the radio receiving unit (101, 102) and outputting the audio data, and to continuously perform the time-shortened output operation until the delay of the audio data output by the delay unit (109) reaches the delay target time in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit (109) is larger than the set delay target time.

3. The radio broadcasting receiving device (1) according to Claim 1 or 2, wherein
the delay unit (109) is configured to
stop, at a point of time when the delay of the audio data output by the delay unit (109) reaches the delay target time, the time-extended output operation and to initiate an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit (101, 102) and outputting the audio data in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit (109) is smaller than the set delay target time, and
to stop the time-extended output operation, to initiate a time-shortened output operation for shortening, in the temporal axis direction, the audio data output by the radio receiving unit (101, 102) and outputting the audio data, to stop the time-shortened output operation at a point of time when the delay of the audio data output by the delay unit (109) reaches the delay target time, and to initiate an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit (101, 102) and outputting the audio data in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit (109) is larger than the set delay target time, and
the control unit (108) is configured to cause the selection unit (110) to switch the output target audio data to the audio data time-delayed, by an amount of the delay target time, and output by the delay unit (109), at the time of switching the output target audio data from the audio data output by the concurrent broadcasting receiving unit (103) to the audio data output by the delay unit (109).

4. The radio broadcasting receiving device (1) according to one of Claims 1-3, wherein
the control unit (108) is configured to
cause the concurrent broadcasting receiving unit (103) to initiate reception of the concurrent broadcasting in a case where the delay time calculated by the delay time calculation unit (108) is set, as the delay target time, in the delay unit (109) at the time of switching the output target audio data from the audio data output by the delay unit (109) to the audio data output by the concurrent broadcasting receiving unit (103), wherein the control unit (108) is configured to cause the delay time calculation unit (108) to initiate calculation of the delay time without causing the delay unit (109) to initiate the time-extended output operation if the concurrent broadcasting receiving unit (103) initiates outputting of the audio data, the control unit (108) is configured to set, as the delay target time, the calculated delay time in the delay unit (109) if the delay time calculation unit (108) calculates the delay time, and the control unit (108) is configured to cause the selection unit (110) to switch the output target audio data to the audio data output by the concurrent broadcasting receiving unit (103) if a delay time of the audio data output by the delay unit (109) reaches the delay target time, and
the delay unit (109) is configured to
perform the time-extended output operation until the delay of the audio data output by the delay unit (109) reaches the delay target time in a case where, at a

point of time when the delay target time is set, the delay time of the audio data output by the delay unit (109) is smaller than the set delay target time, wherein the delay unit (109) is configured to stop the time-extended output operation and to initiate an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit (101, 102) and outputting the audio data if the delay of the audio data output by the delay unit (109) reaches the delay target time, and
to perform a time-shortened output operation for shortening, in the temporal axis direction, the audio data output by the radio receiving unit (101, 102) and outputting the audio data until the delay of the audio data output by the delay unit (109) reaches the delay target time in a case where, at a point of time when the delay target time is set, the delay time of the audio data output by the delay unit (109) is larger than the set delay target time, wherein the delay unit (109) is configured to stop the time-shortened output operation and to initiate an operation for time-delaying, by an amount of a delay target time, the audio data output by the radio receiving unit (101, 102) and outputting the audio data if the delay of the audio data output by the delay unit (109) reaches the delay target time.

5. The radio broadcasting receiving device (1) according to Claim 4, wherein
the control unit (108) is configured to cause the selection unit (110) to switch the output target audio data to the audio data time-delayed, by an amount of the delay target time, and output by the delay unit (109), at the time of switching the output target audio data from the audio data output by the concurrent broadcasting receiving unit (103) to the audio data output by the delay unit (109).

6. The radio broadcasting receiving device (1) according to any one of Claims 1, 2, 3, 4, and 5, wherein
the concurrent broadcasting is IP radio broadcasting, and
the concurrent broadcasting receiving unit (103) is an IP radio player (103) that receives the IP radio broadcasting and that outputs audio data expressing a received voice.

7. The radio broadcasting receiving device (1) according to any one of Claims 1, 2, 3, 4, 5, and 6, wherein
the radio broadcasting is at least one of digital radio broadcasting and analog radio broadcasting.

8. The radio broadcasting receiving device (1) according to any one of Claims 1, 2, 3, 4, 5, 6, and 7, wherein
the radio broadcasting receiving device (1) is an in-vehicle type radio broadcasting receiving device installed in a vehicle.

9. A seamless switching method for seamlessly switching a voice output to a user from a received voice of radio broadcasting to a received voice of concurrent broadcasting in a radio broadcasting receiving device (1) capable of receiving the radio broadcasting and the concurrent broadcasting serving as broadcasting in a simultaneous-broadcasting-relationship with the radio broadcasting, the seamless switching method comprising:

a step of initiating reception of the concurrent broadcasting (308);
a step of initiating a time-extended output operation, which is used for extending, in a temporal axis direction, the received voice of the radio broadcasting and which is used for outputting the received voice to the user, and initiating calculation of a delay time of the received voice of the concurrent broadcasting with respect to the received voice of the radio broadcasting if reception of the received voice of the concurrent broadcasting is initiated (312, 314); and
a step of switching, to the received voice of the concurrent broadcasting, the voice output to the user if a delay time based on the time-extended output operation of the received voice of the radio broadcasting reaches the delay target time after the delay time is calculated (318, 320).

10. The seamless switching method according to Claim 9, wherein
the concurrent broadcasting is IP radio broadcasting, and
the radio broadcasting is at least one of digital radio broadcasting and analog radio broadcasting.

11. The seamless switching method according to any one of Claims 9 and 10, wherein
the radio broadcasting receiving device (1) is an in-vehicle type radio broadcasting receiving device installed in a vehicle.

FIG. 1

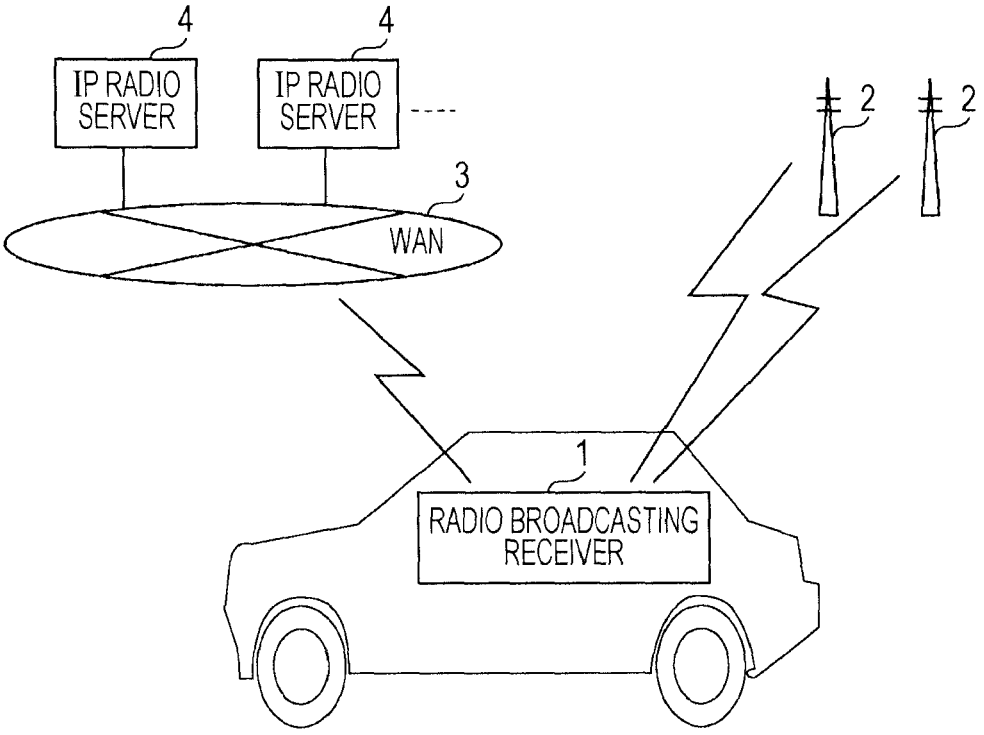

4
4
IP RADIO SERVER
IP RADIO SERVER
3
WAN
2
2
1
RADIO BROADCASTING RECEIVER

FIG. 2

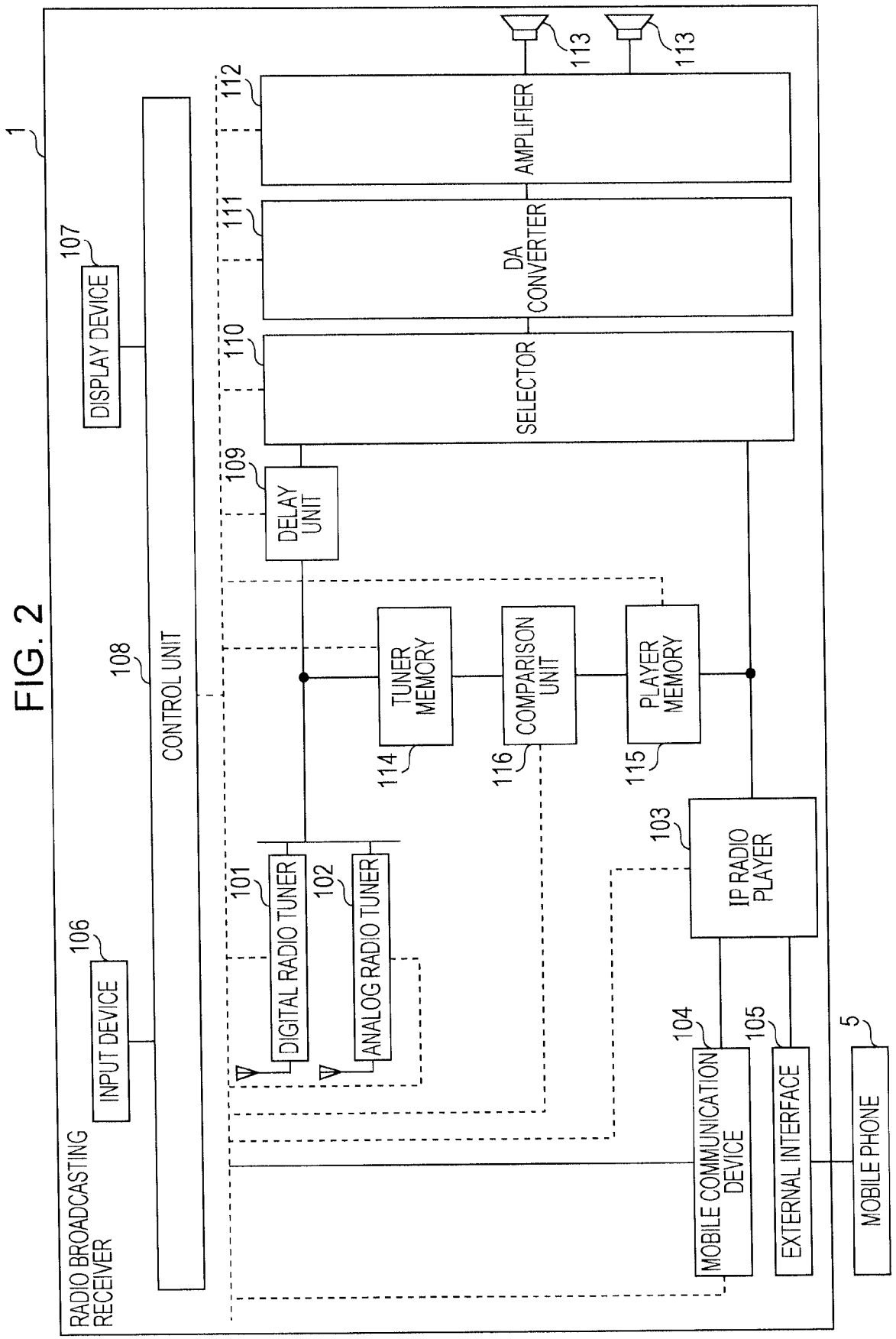

1
RADIO BROADCASTING RECEIVER
INPUT DEVICE
106
DISPLAY DEVICE
107
CONTROL UNIT
108
DIGITAL RADIO TUNER
101
ANALOG RADIO TUNER
102
DELAY UNIT
109
SELECTOR
110
DA CONVERTER
111
AMPLIFIER
112
113
113
TUNER MEMORY
114
COMPARISON UNIT
116
PLAYER MEMORY
115
IP RADIO PLAYER
103
MOBILE COMMUNICATION DEVICE
104
EXTERNAL INTERFACE
105
MOBILE PHONE
5

FIG. 3

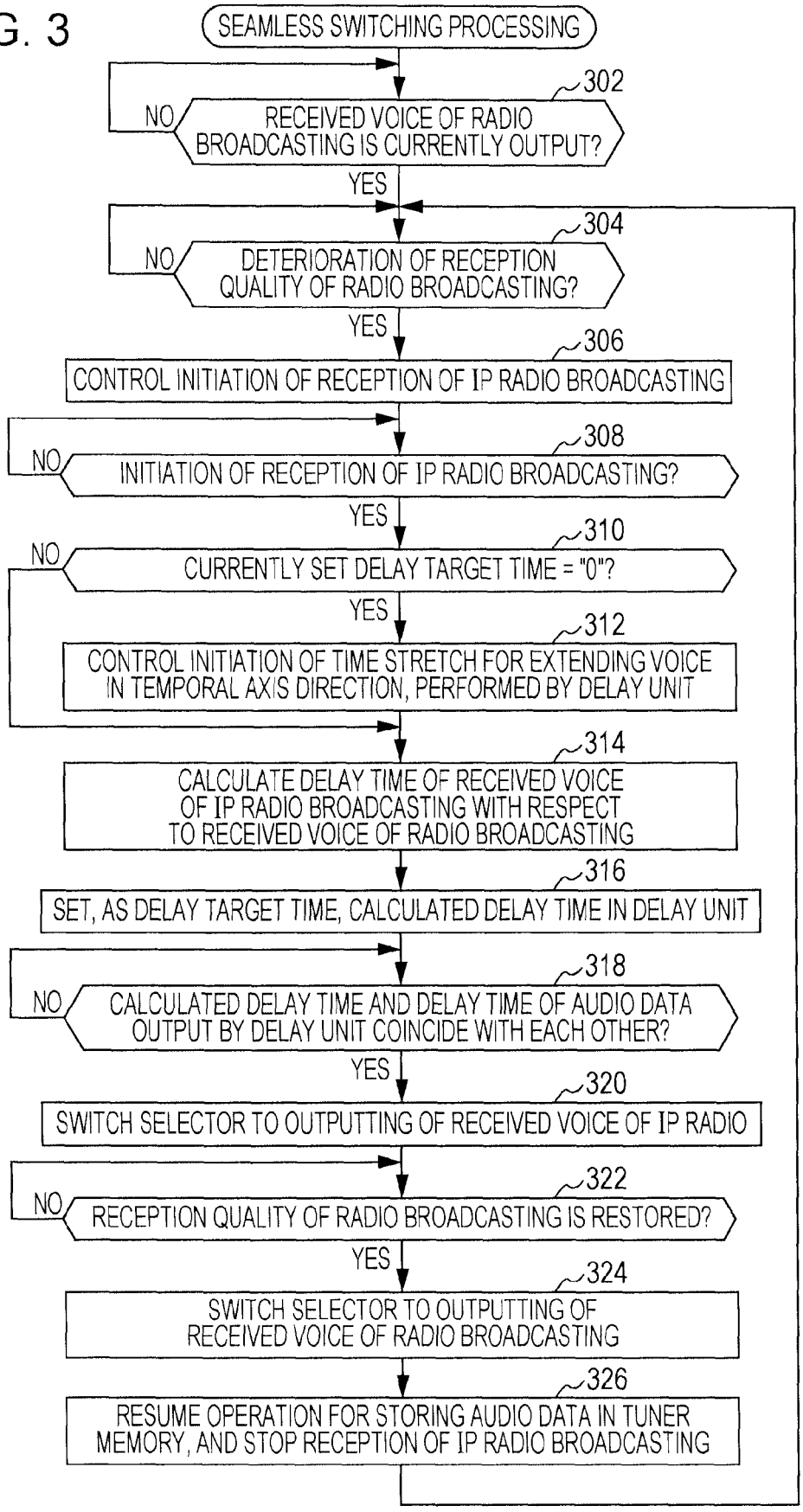

SEAMLESS SWITCHING PROCESSING
302
NO
RECEIVED VOICE OF RADIO BROADCASTING IS CURRENTLY OUTPUT?
YES
304
NO
DETERIORATION OF RECEPTION QUALITY OF RADIO BROADCASTING?
YES
306
CONTROL INITIATION OF RECEPTION OF IP RADIO BROADCASTING
308
NO
INITIATION OF RECEPTION OF IP RADIO BROADCASTING?
YES
310
NO
CURRENTLY SET DELAY TARGET TIME = "0"?
YES
312
CONTROL INITIATION OF TIME STRETCH FOR EXTENDING VOICE IN TEMPORAL AXIS DIRECTION, PERFORMED BY DELAY UNIT
314
CALCULATE DELAY TIME OF RECEIVED VOICE OF IP RADIO BROADCASTING WITH RESPECT TO RECEIVED VOICE OF RADIO BROADCASTING
316
SET, AS DELAY TARGET TIME, CALCULATED DELAY TIME IN DELAY UNIT
318
NO
CALCULATED DELAY TIME AND DELAY TIME OF AUDIO DATA OUTPUT BY DELAY UNIT COINCIDE WITH EACH OTHER?
YES
320
SWITCH SELECTOR TO OUTPUTTING OF RECEIVED VOICE OF IP RADIO
322
NO
RECEPTION QUALITY OF RADIO BROADCASTING IS RESTORED?
YES
324
SWITCH SELECTOR TO OUTPUTTING OF RECEIVED VOICE OF RADIO BROADCASTING
326
RESUME OPERATION FOR STORING AUDIO DATA IN TUNER MEMORY, AND STOP RECEPTION OF IP RADIO BROADCASTING

FIG. 4

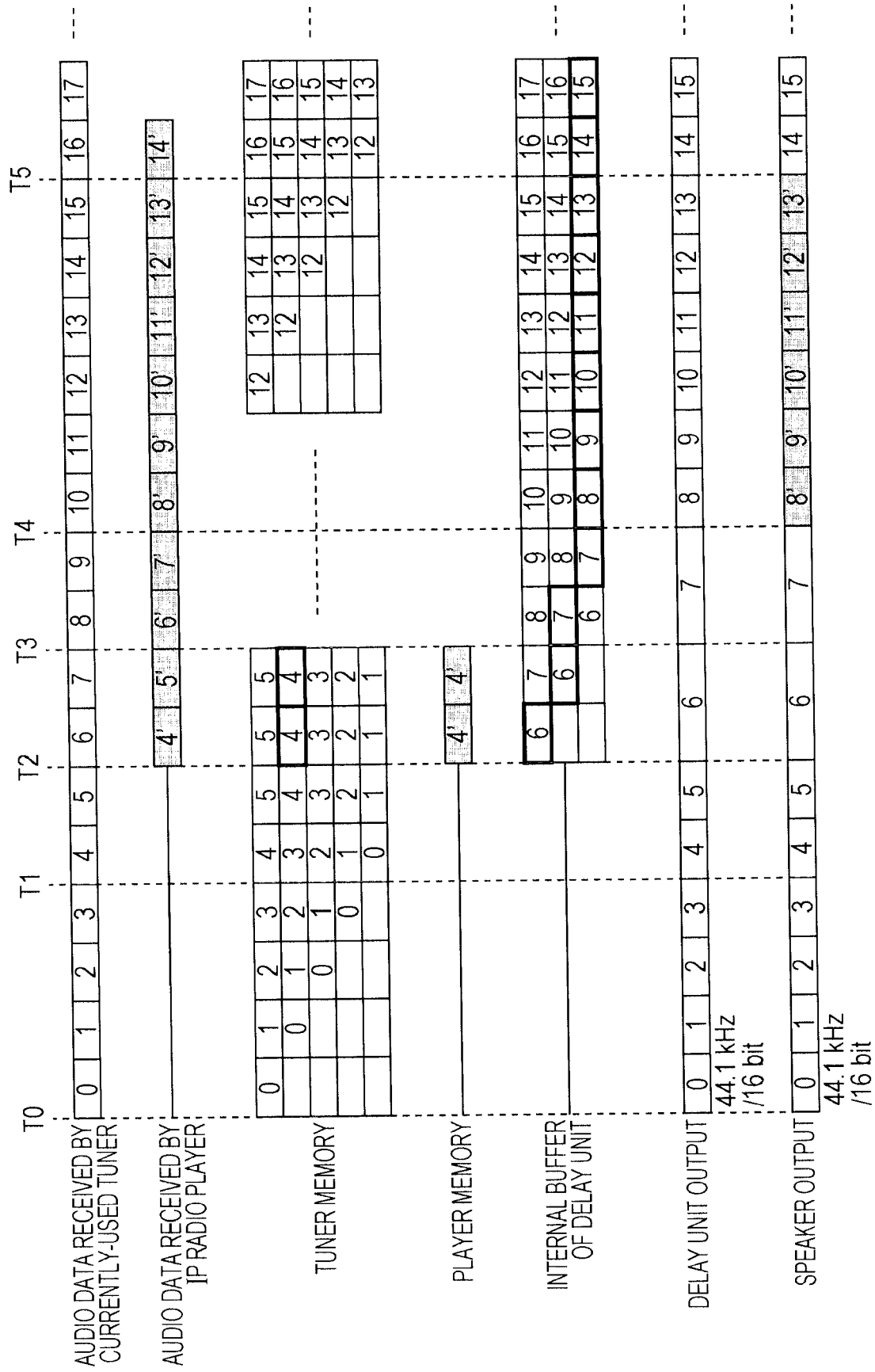
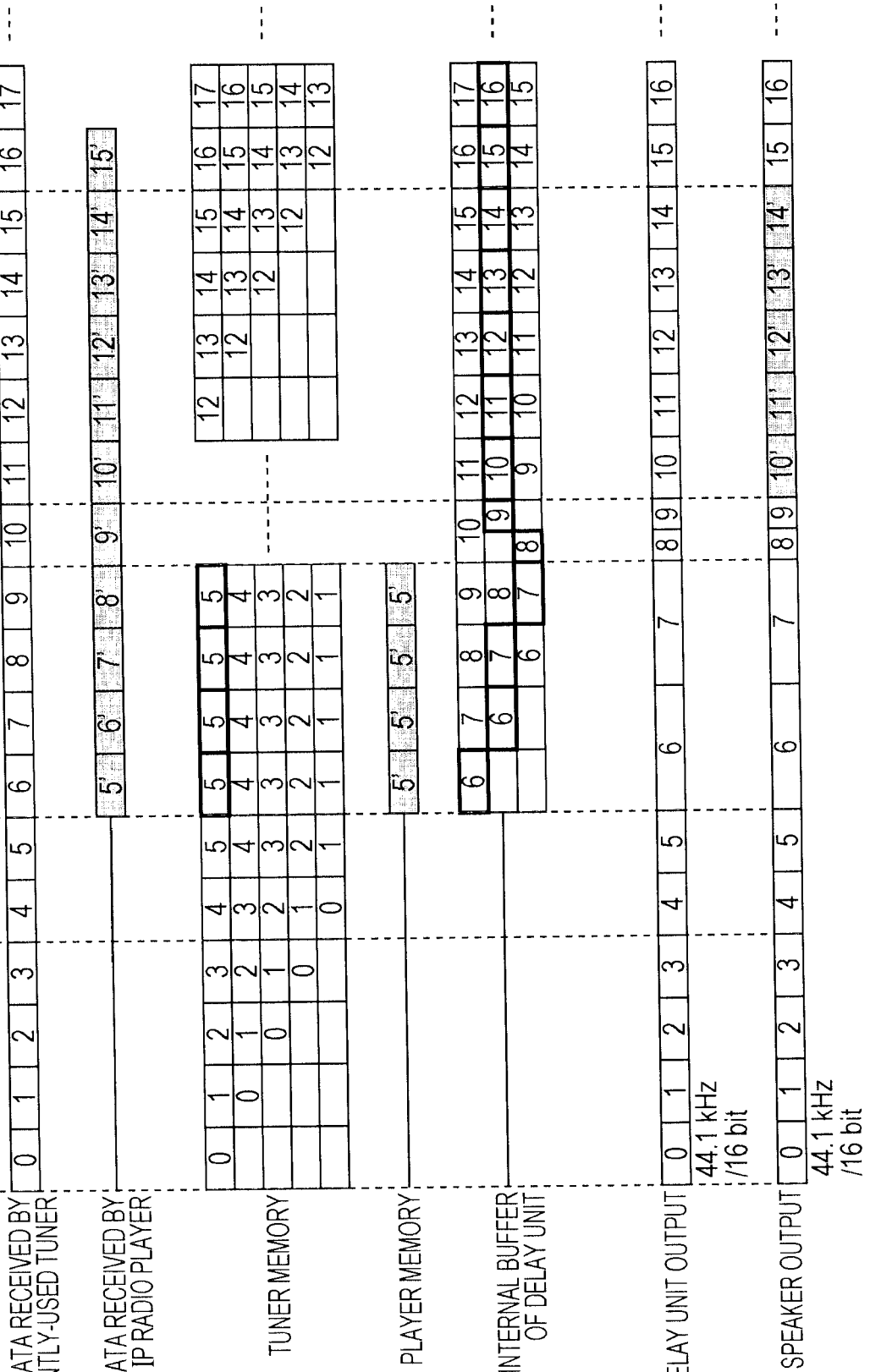

T0
T1
T2
T3
T4
T5
AUDIO DATA RECEIVED BY CURRENTLY-USED TUNER
AUDIO DATA RECEIVED BY IP RADIO PLAYER
TUNER MEMORY
PLAYER MEMORY
INTERNAL BUFFER OF DELAY UNIT
DELAY UNIT OUTPUT
44.1 kHz /16 bit
SPEAKER OUTPUT
44.1 kHz /16 bit

FIG. 5


T0
T1
T2
T3
T4
T5
AUDIO DATA RECEIVED BY CURRENTLY-USED TUNER
AUDIO DATA RECEIVED BY IP RADIO PLAYER
TUNER MEMORY
PLAYER MEMORY
INTERNAL BUFFER OF DELAY UNIT
DELAY UNIT OUTPUT
44.1 kHz /16 bit
SPEAKER OUTPUT
44.1 kHz /16 bit

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 15 8035

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 2 747 314 A1 (NXP BV [NL]) 25 June 2014 (2014-06-25) * paragraphs [0002] - [0009], [0011] - [0016], [0028] - [0042] *	1-11	INV. H04H20/24 ADD. H04H20/26
A	EP 2 355 381 A1 (ALPINE ELECTRONICS INC [JP]) 10 August 2011 (2011-08-10) * paragraphs [0001], [0005], [0006], [0019] - [0035] *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)
H04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31 August 2016	Van Hoorick, Jan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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