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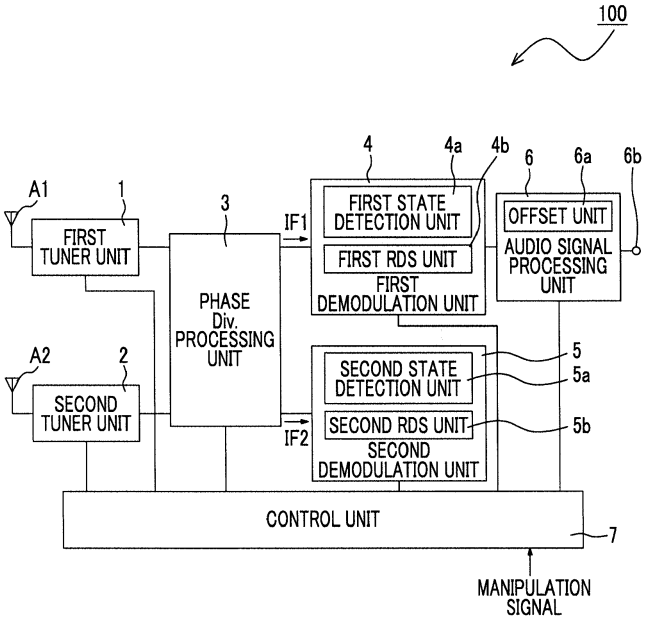
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(54) BROADCAST RECEIVER

(57) A control unit 7 selects a diversity reception operation of controlling a first tuner unit 1 and a second tuner unit 2 to select a first broadcast and controlling a phase diversity processing unit 3 to perform a diversity operation and a search operation of performing control so that the first tuner unit 1 selects the first broadcast, and the second tuner unit 2 searches for a second broadcast, based on reception states acquired from a first state detection unit 4a and a second state detection unit 5a. When the control unit 7 performs switching from the diversity reception operation to the search operation, the control unit 7 controls an audio signal processing unit 6 to set a small volume change amount per unit time, and performs switching to the search operation. When the control unit 7 performs switching from the search operation to the diversity reception operation, the control unit 7 performs the switching and then controls the audio signal processing unit 6 to set a large amount of change in volume per unit time.

FIG. 1



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Description

[0001] This application claims benefit of Japanese Patent Application No. 2014-226178 filed on November 6, 2014.

[0002] The present invention relates to a broadcast receiver and, more particularly, to a broadcast receiver that performs diversity reception using two tuners.

[0003] It has been conventionally known that, when an FM broadcast is received in a mobile body such as a vehicle, an electric field intensity is greatly changed due to an influence of a terrain or the like or an influence of a multipath, and particularly, an S/N ratio is significantly degraded in a low electric field intensity. To cope with such a change in an electric field intensity, an automatic separation function, a soft muting function, and the like in a broadcast receiver are continuously operated so as to reduce noise. Further, in order to reduce a variation in field intensity caused by fading of the multipath or the like, diversity reception in which received signals from a plurality of antennas are combined is generally performed.

[0004] A broadcast receiver 900 (related art) described in JP 2009-246651 A includes a main tuner unit 912a, and a sub-tuner unit 912b, as illustrated in Fig. 3. In a phase diversity period, the main tuner unit 912a and the sub-tuner unit 912b select the same RDS broadcast. Technology in which in the phase diversity period, for example, when a received signal of higher quality among corresponding received signals as reception states detected by respective reception state detectors 921a and 921b is at a predetermined level or lower, the tuner unit in which a reception state is good is caused to select an original channel, and the tuner unit in which a reception state is poor d performs alternative frequency (AF) search is disclosed.

[0005] However, in the example of the related art described above, when switching is performed from a diversity reception operation to a search operation, an IF signal input to an FM demodulation unit includes only an output of one of the tuners, and accordingly, a level of the IF signal is degraded. Therefore, there is a problem in that a soft muting operation is performed according to a change in the level of the IF signal, and set volume is changed.

[0006] The present invention provides a broadcast receiver capable of suppressing a volume change that occurs when switching is performed between a diversity reception operation and a search operation.

[0007] A broadcast receiver according to an aspect of the present invention includes a first tuner unit connected to a first antenna; a second tuner unit connected to a second antenna; a phase diversity processing unit configured to combine or select an output of the first tuner unit and an output of the second tuner unit, and output a first IF signal and a second IF signal; a first demodulation unit configured to include a first state detection unit that detects a quality of the first IF signal, and a first RDS unit that extracts a multiplex data signal, and demodulate the first IF signal; a second demodulation unit configured to include a second state detection unit that detects a quality of the second IF signal, and a second RDS unit that extracts a multiplex data signal, and demodulate the second IF signal; an audio signal processing unit configured to have a muting function of processing an audio signal output from the first demodulation unit and adjusting a volume output, an amount of change in volume per unit time of the muting function being capable of being set; and a control unit connected to the first tuner unit, the second tuner unit, the phase diversity processing unit, the first demodulation unit, the second demodulation unit, and the audio signal processing unit, in which the control unit selects, based on a result of determining a reception state acquired from the first state detection unit and the second state detection unit, any one of a diversity reception operation of controlling the first tuner unit and the second tuner unit to select a first broadcast, and controlling the phase diversity processing unit to perform a diversity operation, and a search operation of performing control so that any one of the first tuner unit and the second tuner unit selects a first broadcast, and the other searches for a second broadcast, when the control unit performs switching from the diversity reception operation to the search operation, the control unit controls the audio signal processing unit to set a small amount of change in volume per unit time, and then performs the switching from the diversity reception operation to the search operation, and when the control unit performs switching from the search operation to the diversity reception operation, the control unit performs the switching and then controls the audio signal processing unit to set a large amount of change in volume per unit time.

[0008] Accordingly, since the control unit controls the audio signal processing unit to set the small volume change amount per unit time and then performs switching from the diversity reception operation to the search operation when the control unit performs switching from the diversity reception operation to the search operation, it is possible to suppress a rapid change in the volume. Further, since the control unit performs the switching and then controls the audio signal processing unit to set the large volume change amount per unit time when the control unit performs switching from the search operation to the diversity reception operation, it is possible for the volume to rapidly return to volume close to an original state after returning to the diversity state. Therefore, when switching to the search operation is performed, the change in the volume with respect to a change in the intensity of the signal input to the first demodulation unit is reduced, and accordingly, it is possible to provide the broadcast receiver capable of suppressing the change in the volume that occurs when switching is performed between the diversity reception operation and the search operation.

[0009] Further, in the broadcast receiver according to an aspect of the present invention, the audio signal

processing unit may include an offset unit that adjusts an audio output based on offset data set by the control unit, first data that is offset data at the time of the diversity reception operation and second data that is offset data at the time of the search operation may be set in the control unit, and the control unit may set the second data in the offset unit when the control unit performs switching from the diversity reception operation to the search operation, and may set the first data in the offset unit when the control unit performs switching from the search operation to the diversity reception operation.

[0010] Accordingly, since it is possible to suppress a difference in the volume using the offset data even when the signal intensity of the first IF signal greatly differs between the diversity reception operation and the search operation, it is possible to further suppress the change in the volume.

[0011] Further, in the broadcast receiver according to an aspect of the present invention, when the control unit performs switching from the diversity reception operation to the search operation, the control unit may control the audio signal processing unit to set a small amount of change in volume per unit time, set the second data in the offset unit, and then perform the switching from the diversity reception operation to the search operation, and when the control unit performs switching from the search operation to the diversity reception operation, the control unit may perform the switching, and then set the first data in the offset unit and control the audio signal processing unit to set a large amount of change in volume per unit time.

[0012] Accordingly, when switching is performed between the diversity reception operation and the search operation, the setting of the offset is changed in a state in which the small amount of change in volume per unit time is set. Thus, it is possible to moderate the change in the volume due to a change in the setting, and further suppress the change in the volume.

[0013] According to the aspects of the present invention, it is possible to provide a broadcast receiver capable of suppressing a change in the volume that occurs when switching is performed between the diversity reception operation and the search operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

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

Fig. 2 is a flowchart illustrating an operation of the broadcast receiver according to this embodiment; and

Fig. 3 is a block diagram illustrating a configuration of a broadcast receiver of the related art.

[0015] Hereinafter, a broadcast receiver 100 according to an embodiment of the present invention will be described.

[0016] First, a configuration of the broadcast receiver 100 in the present embodiment will be described with reference to Fig. 1. Fig. 1 is a block diagram illustrating a configuration of the broadcast receiver 100 according to an embodiment of the present invention.

[0017] The broadcast receiver 100 includes a first tuner unit 1, a second tuner unit 2, a phase diversity processing unit 3 (described as a phase div. processing unit in Fig. 1), a first demodulation unit 4, a second demodulation unit 5, an audio signal processing unit 6, and a control unit 7, as illustrated in Fig. 1.

[0018] The first tuner unit 1 is connected to a first antenna A1, and connected to the phase diversity processing unit 3 and the control unit 7. The first tuner unit 1 selects a broadcast from a broadcast signal received by the first antenna A1 under control of the control unit 7, converts the broadcast into an IF signal, and outputs the IF signal to the phase diversity processing unit 3.

[0019] The second tuner unit 2 is connected to a second antenna A2, and connected to the phase diversity processing unit 3 and the control unit 7. The second tuner unit 2 selects a broadcast from a broadcast signal received by the second antenna A2 under control of the control unit 7, converts the broadcast into an IF signal, and outputs the IF signal to the phase diversity processing unit 3.

[0020] The phase diversity processing unit 3 is connected to the first tuner unit 1, the second tuner unit 2, the first demodulation unit 4, the second demodulation unit 5, and the control unit 7. In the phase diversity processing unit 3, switching between ON and OFF of a diversity operation is controlled by the control unit 7. When the phase diversity processing unit 3 performs the diversity operation, a signal obtained by combining the IF signal output from the first tuner unit 1 and the IF signal output from the second tuner unit 2 is output as a first IF signal (IF1) to the first demodulation unit 4, and a second IF signal is not output. When the phase diversity processing unit 3 does not perform the diversity operation, the IF signal output from the first tuner unit 1 is selected as the first IF signal (IF1) and output to the first demodulation unit 4. Further, the IF signal output from the second tuner unit 2 is selected as the second IF signal (IF2) and output to the second demodulation unit 5.

[0021] The first demodulation unit 4 includes a first state detection unit 4a, and a first RDS unit 4b, and is connected to the phase diversity processing unit 3, an audio signal processing unit 6, and the control unit 7. The first demodulation unit 4 demodulates the first IF signal (IF1) output from the phase diversity processing unit 3, and outputs an audio signal to the audio signal processing unit 6. The first state detection unit 4a detects a quality of the first IF signal based on intensity of the first IF signal (IF1) or a signal to noise ratio (S/N ratio) of the demodulated audio signal, and outputs the quality as a received signal strength indication (RSSI) signal or an S/N ratio

signal to the control unit 7. Further, the first RDS unit 4b extracts a multiplex data signal from the first IF signal (IF1), and outputs the multiplex data signal to the control unit 7.

[0022] The second demodulation unit 5 includes a second state detection unit 5a, and a second RDS unit 5b, and is connected to the phase diversity processing unit 3, and the control unit 7. The second demodulation unit 5 demodulates the second IF signal output from the phase diversity processing unit 3. The second state detection unit 5a detects a quality of the first IF signal based on intensity of the second IF signal (IF2) or a signal to noise ratio (S/N ratio) of the demodulated audio signal, and outputs the quality as an RSSI signal or an S/N ratio signal to the control unit 7. Further, the second RDS unit 5b extracts a multiplex data signal from the second IF signal (IF2), and outputs the multiplex data signal to the control unit 7.

[0023] The audio signal processing unit 6 includes an offset unit 6a, and is connected to the first demodulation unit 4 and the control unit 7. The audio signal processing unit 6 has a muting function of processing the audio signal output from the first demodulation unit 4 under the control of the control unit 7, and adjusting volume output. For the muting function of the audio signal processing unit 6, the amount of change in volume per unit time can be set by the control unit 7, and the volume can gradually decrease or increase based on the volume change amount per unit time set under the control of the control unit 7. When the amount of change in volume per unit time is large, a short time can be taken to reach predetermined volume by the muting function, and when the amount of change in volume per unit time is small, a long time is taken.

[0024] The offset unit 6a has a function of adjusting the audio output based on offset data set by the control unit 7, and can change the volume based on the set offset data. When the offset data is changed and the volume is changed, the volume gradually decreases or increases according to the amount of change in volume per unit time set using the muting function.

[0025] In the control unit 7, a micro processing unit (MPU) or the like is used, a timer function or a memory (not illustrated) is included, and management of a control interval based on the timer function, storage of an operation result for control, or the like can be performed. In the memory included in the control unit 7, a threshold value required for control, first data that is offset data at the time of a diversity reception operation, and second data that is offset data at the time of a search operation are stored in advance. The control unit 7 is connected to the first tuner unit 1, the second tuner unit 2, the phase diversity processing unit 3, the first demodulation unit 4, the second demodulation unit 5, and the audio signal processing unit 6. A manipulation signal by a broadcast selection manipulation or the like of a user is input to the control unit 7. The control unit 7 controls broadcast selection of the first tuner unit 1 to receive an audio broadcast, acquires the RSSI signal or the S/N ratio signal detected as a quality of the first IF signal (IF1) from the first state detection unit 4a, and acquires the multiplex data signal from the first RDS unit 4b. Further, the control unit 7 controls broadcast selection of the second tuner unit 2 to receive an audio broadcast, acquires the RSSI signal or the S/N ratio signal detected as a quality of the second IF signal (IF2) from the second state detection unit 5a, and acquires the multiplex data signal from the second RDS unit 5b. Further, the control unit 7 sets the amount of change in volume per unit time and the offset data with respect to the audio signal processing unit 6, and controls the muting function based on the signal intensity of the first IF signal (IF1). The control unit 7 controls the muting function such that the volume increases when the signal intensity of the first IF signal (IF1) is high, and the volume decreases when the signal intensity is low.

[0026] Next, an operation of the broadcast receiver 100 of this embodiment will be described with reference to Figs. 1 and 2. Fig. 2 is a flowchart illustrating an operation of the broadcast receiver 100 of the present embodiment, and illustrates a processing procedure executed by the control unit 7 of the broadcast receiver 100. The processing procedure shown in the flowchart of Fig. 2 is periodically repeatedly performed using the timer function of the control unit 7. In the memory included in the control unit 7, a predetermined value is assumed to be set as a threshold value for determining a reception status is good in advance.

[0027] Description will be given on the assumption that in an initial state of the broadcast receiver 100, the first tuner unit 1 and the second tuner unit 2 select the same broadcast, and the phase diversity processing unit 3 is in a diversity reception operation state in which the diversity operation is performed. It is also assumed that, in the diversity reception operation state, the control unit 7 sets a large amount of change in volume per unit time of the muting function in the audio signal processing unit 6, and first data that is offset data at the time of the diversity reception operation is set in the offset unit 6a.

[0028] The control unit 7 determines whether or not there is a broadcast selection manipulation based on the input manipulation signal in step S1 of the flowchart illustrated in Fig. 2. The control unit 7 proceeds to step S2 when it is determined that there is a broadcast selection manipulation, and proceeds to step S5 when it is determined that there is no broadcast selection manipulation.

[0029] In step S2, the control unit 7 controls the first tuner unit 1 (described as a first Tu in Fig. 2) to select a broadcast corresponding to the broadcast selection manipulation, and proceeds to step S3.

[0030] In step S3, the control unit 7 controls the second tuner unit 2 (described as a second Tu in Fig. 2) to select the same broadcast as that selected by the first tuner unit 1 in step S2, and proceeds to step S4.

[0031] In step S4, the control unit 7 controls the phase diversity processing unit 3 to perform the diversity oper-

ation, and proceeds to step S5. In a state in which the phase diversity processing unit 3 is performing the diversity operation, the IF signal output from the first tuner unit 1 and the IF signal output from the second tuner unit 2 are combined and output as the first IF signal (IF1) to the first demodulation unit 4.

[0032] In step S5, the diversity reception operation is performed when it is determined that a broadcast selection manipulation is not performed from the initial state in step S1 or when the broadcast selection and the diversity operation start in step S4 from step S2 in which a broadcast selection operation has been performed. A broadcast that the first tuner unit 1 and the second tuner unit 2 select in a step following step S5 is assumed to be a first broadcast.

[0033] In step S5, the control unit 7 acquires multiplex data of a first broadcast from the first RDS unit 4b included in the first demodulation unit 4. Data of another broadcast in which the same program as that broadcast in the first broadcast is broadcast is included in this multiplex data. The control unit 7 stores the acquired multiplex data of the first broadcast in the memory included in the control unit 7, and proceeds to step S6.

[0034] In step S6, the control unit 7 acquires the RSSI signal or the S/N ratio signal indicating a reception state from the first state detection unit 4a included in the first demodulation unit 4, and proceeds to step S7.

[0035] In step S7, the control unit 7 performs comparison between the RSSI signal or the S/N ratio signal indicating the reception state acquired in step S6 and a previously set and stored threshold value, and ends the process when determining that the RSSI signal or the S/N ratio signal is greater than the threshold value and the reception state is good. Further, the control unit 7 proceeds to step S8 when determining that the RSSI signal or the S/N ratio signal is smaller than the threshold value and the reception state is degraded.

[0036] In step S8, the control unit 7 controls the audio signal processing unit 6 to set a small amount of change in volume per unit time of the muting function, and proceeds to step S9. Since the small amount of change in volume per unit time is set, the volume is gradually decreased or increased by the muting function, and a long time is taken to reach predetermined volume.

[0037] In step S9, the control unit 7 sets the second data that is offset data at the time of the search operation in the offset unit 6a of the audio signal processing unit 6, and proceeds to step S10. For the second data, a value for setting a large volume offset is set in order to compensate for an amount of decrease in the volume due to degradation of the signal intensity of the first IF signal (IF1) since the first IF signal (IF1) input to the first demodulation unit 4 when switching to the search operation is performed includes only the IF signal output from the first tuner unit 1.

[0038] In step S10, the control unit 7 controls the phase diversity processing unit 3 to set the diversity operation to OFF, and proceeds to step S11. Since the phase diversity processing unit 3 stops the diversity operation, the IF signal output from the first tuner unit 1 is output as the first IF signal (IF1), and the IF signal output from the second tuner unit 2 is output as a second IF signal (IF2).

[0039] In step S11, the control unit 7 controls the second tuner unit 2 based on the multiplex data of the first broadcast acquired in step S5, selects the second broadcast in which the same program as that broadcast in the first broadcast is broadcast, and proceeds to step S12. In this state, the search operation of performing control so that the first tuner unit 1 selects the first broadcast and the second tuner unit 2 searches for the second broadcast is selected.

[0040] In step S12, the control unit 7 acquires multiplex data of the second broadcast from the second RDS unit 5b included in the second demodulation unit 5. Data of another broadcast in which the same program as that broadcast in the second broadcast is broadcast is included in the multiplex data. The control unit 7 stores the acquired multiplex data of the second broadcast in the memory included in the control unit 7, and proceeds to step S13.

[0041] In step S13, the control unit 7 acquires the RSSI signal or the S/N ratio signal indicating the reception state from the second state detection unit 5a included in the second demodulation unit 5, and proceeds to step S14.

[0042] In step S14, the control unit 7 performs comparison between the RSSI signal or the S/N ratio signal indicating the reception state acquired in step S13 and a previously set and stored threshold value, and proceeds to step S15 when determining that the RSSI signal or the S/N ratio signal is greater than the threshold value and the reception state is good. Further, the control unit 7 proceeds to step S19 when determining that the RSSI signal or the S/N ratio signal is smaller than the threshold value and the reception state is not good.

[0043] In step S15, since it is determined in step S14 that the reception state of the second broadcast is good, the control unit 7 controls the first tuner unit 1 to select the second broadcast, and proceeds to step S16.

[0044] In step S16, the control unit 7 controls the phase diversity processing unit 3, sets the diversity operation to ON, and proceeds to step S17. Since the phase diversity processing unit 3 performs the diversity operation, the signal obtained by combining the IF signal output from the first tuner unit 1 with the IF signal output from the second tuner unit 2 is output as the first IF signal (IF1) to the first demodulation unit 4. In this state, the control unit 7 controls the first tuner unit 1 and the second tuner unit 2 to select the first broadcast, and controls the phase diversity processing unit 3 to select the diversity reception operation in which the diversity operation is performed.

[0045] In step S17, the control unit 7 sets the first data that is offset data at the time of the diversity reception operation in the offset unit 6a of the audio signal processing unit 6, and proceeds to step S18.

[0046] In step S18, the control unit 7 controls the audio signal processing unit 6 to set a large amount of change

in volume per unit time of the muting function, and ends the process. Since the large amount of change in volume per unit time is set in the audio signal processing unit 6, the volume is gradually decreased or increased by the muting function, and a short time is taken to reach predetermined volume.

[0047] Step S19 is performed when it is determined in step S14 that the RSSI signal or the S/N ratio signal is smaller than the threshold value and the reception state is not good. In step S19, the control unit 7 confirms whether an unsearched broadcast among other broadcasts in which the same program as that broadcast in the first broadcast is broadcast, which are included in the multiplex data of the first broadcast acquired in step S5. The process returns to step S11 to repeat the process up to step S14 when it is determined that there is the unsearched broadcast, and proceeds to step S20 when it is determined that there is no unsearched broadcast.

[0048] In step S20, other broadcasts in which the same program as that broadcast in the first broadcast is broadcast, which are included in the multiplex data of the first broadcast in step S19, are all searched for, and it is determined in step S14 that the RSSI signal or the S/N ratio signal is smaller than the threshold value and the reception state is not good. Accordingly, the control unit 7 controls the second tuner unit 2 to re-select the first broadcast which has first been received, proceeds to step S16, sequentially performs control up to step S18, and ends the process.

[0049] Hereinafter, effects of the present embodiment will be described.

[0050] In the broadcast receiver 100 of the present embodiment, the control unit 7 is configured to select any one of the diversity reception operation of controlling the first tuner unit 1 and the second tuner unit 2 to select the first broadcast, and controlling the phase diversity processing unit 3 to perform the diversity operation and the search operation of performing control so that any one of the first tuner unit 1 and the second tuner unit 2 selects the first broadcast, and the other searches for the second broadcast, based on a result of determining the reception states acquired from the first state detection unit 4a and the second state detection unit 5a. When the control unit 7 performs switching from the diversity reception operation to the search operation, the control unit 7 controls the audio signal processing unit 6 to set a small volume change amount per unit time, and performs switching from the diversity reception operation to the search operation. When the control unit 7 performs switching from the search operation to the diversity reception operation, the control unit 7 performs the switching and then controls the audio signal processing unit 6 to set a large amount of change in volume per unit time.

[0051] Accordingly, since the control unit 7 controls the audio signal processing unit 6 to set the small volume change amount per unit time and then performs switching from the diversity reception operation to the search operation when the control unit 7 performs switching from the diversity reception operation to the search operation, it is possible to suppress a rapid change in the volume. Further, since the control unit 7 performs the switching and then controls the audio signal processing unit 6 to set the large volume change amount per unit time when the control unit 7 performs switching from the search operation to the diversity reception operation, it is possible for the volume to rapidly return to volume close to an original state after returning to the diversity state. Therefore, when switching to the search operation is performed, the change in the volume with respect to a change in the intensity of the signal input to the first demodulation unit 4 is reduced, and accordingly, it is possible to provide the broadcast receiver capable of suppressing the change in the volume that occurs when switching is performed between the diversity reception operation and the search operation.

[0052] Further, in the broadcast receiver 100 of the present embodiment, the audio signal processing unit 6 includes the offset unit 6a that adjusts the sound output based on the offset data set by the control unit 7. The first data that is offset data at the time of the diversity reception operation and the second data that is offset data at the time of the search operation are set in the control unit 7. The control unit 7 sets the second data in the offset unit 6a when switching is performed from the diversity reception operation to the search operation, and sets the first data in the offset unit 6a when switching is performed from the search operation to the diversity reception operation.

[0053] Accordingly, since it is possible to suppress a difference in the volume using the offset data even when the signal intensity of the first IF signal (IF1) greatly differs between the diversity reception operation and the search operation, it is possible to further suppress the change in the volume.

[0054] Further, in the broadcast receiver 100 of the present embodiment, when the control unit 7 performs switching from the diversity reception operation to the search operation, the control unit 7 controls the audio signal processing unit 6 to set the small amount of change in volume per unit time, sets the second data in the offset unit 6a, and then performs the switching from the diversity reception operation to the search operation. When the control unit 7 performs switching from the search operation to the diversity reception operation, the control unit 7 performs the switching, and then sets the first data in the offset unit 6a and controls the audio signal processing unit 6 to set a large amount of change in volume per unit time.

[0055] Accordingly, when switching is performed between the diversity reception operation and the search operation, the setting of the offset is changed in a state in which the small amount of change in volume per unit time is set. Thus, it is possible to moderate the change in the volume due to a change in the setting, and further suppress the change in the volume.

[0056] While the broadcast receiver 100 according to

an embodiment of the present invention has been specifically described above, the present invention is not limited to the above-described embodiments, and the present invention can be variously modified and implemented without departing from the scope of the present invention. For example, the present invention can be modified and implemented as follows, and these embodiments also fall within the technical scope of the present invention.

(1) In the present embodiment, while the example in which the first demodulation unit 4 demodulates the first IF signal (IF1) and outputs the audio signal to the audio signal processing unit 6 has been shown and described, the audio signal may be an audio data signal converted into a digital signal or may be an analog audio signal.
(2) In the present embodiment, while the example in which the first data and the second data are stored in the memory included in the control unit 7 in advance has been shown and described, the first data and the second data may be changed through an operation from the signal intensity of the IF signal.
(3) In the present embodiment, while the example in which the search is sequentially performed based on the multiplex data acquired from the first broadcast in the state of the search operation has been shown and described, the broadcast included in the multiplex data may be divided and modified so that the search operation and the diversity operation are alternately performed.

[0057] It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims of the equivalents thereof.

Claims

1. A broadcast receiver (100), comprising:

a first tuner unit (1) connected to a first antenna (A1);
a second tuner unit (2) connected to a second antenna (A2);
a phase diversity processing unit (3) configured to combine or select an output of the first tuner unit (1) and an output of the second tuner unit (2), and output a first IF signal and a second IF signal;
a first demodulation unit (4) configured to include a first state detection unit (4a) that detects a quality of the first IF signal, and a first RDS unit (4b) that extracts a multiplex data signal, and demodulate the first IF signal;
a second demodulation unit (5) configured to include a second state detection unit (5a) that detects a quality of the second IF signal, and a second RDS unit (5b) that extracts a multiplex data signal, and demodulate the second IF signal;
an audio signal processing unit (6) configured to have a muting function of processing an audio signal output from the first demodulation unit and adjusting a volume output, an amount of change in volume per unit time of the muting function being capable of being set; and
a control unit (7) connected to the first tuner unit (1), the second tuner unit (2), the phase diversity processing unit (3), the first demodulation unit (4), the second demodulation unit (5), and the audio signal processing unit (6),
wherein the control unit (7) is configured to select, based on a result of determining a reception state acquired from the first state detection unit (4a) and the second state detection unit (5a), any one of
a diversity reception operation of controlling the first tuner unit (1) and the second tuner unit (2) to select a first broadcast, and controlling the phase diversity processing unit (3) to perform a diversity operation, and
a search operation of performing control so that any one of the first tuner unit (1) and the second tuner unit (2) selects a first broadcast, and the other searches for a second broadcast,
when the control unit (7) performs switching from the diversity reception operation to the search operation, the control unit (7) is configured to control the audio signal processing unit (6) to set a small amount of change in volume per unit time, and then to perform the switching from the diversity reception operation to the search operation, and
when the control unit (7) performs switching from the search operation to the diversity reception operation, the control unit (7) is configured to perform the switching and then to control the audio signal processing unit to set a large amount of change in volume per unit time.

2. The broadcast receiver according to claim 1,
wherein the audio signal processing unit (6) includes an offset unit (6a) that is configured to adjust an audio output based on offset data set by the control unit,
first data that is offset data at the time of the diversity reception operation and second data that is offset data at the time of the search operation are set in the control unit (7), wherein the control unit (7)is configured to
set the second data in the offset unit (6a) when the control unit (7) performs switching from the diversity reception operation to the search operation, and to

set the first data in the offset unit (6a) when the control unit (7) performs switching from the search operation to the diversity reception operation.

3. The broadcast receiver according to claim 2, wherein when the control unit (7) performs switching from the diversity reception operation to the search operation, the control unit (7) is configured to control the audio signal processing unit to set a small amount of change in volume per unit time, to set the second data in the offset unit (6a), and then to perform the switching from the diversity reception operation to the search operation, and
when the control unit (7) performs switching from the search operation to the diversity reception operation, the control unit (7) is configured to perform the switching, and then to set the first data in the offset unit (6a) and to control the audio signal processing unit (6) to set a large amount of change in volume per unit time.

FIG. 1

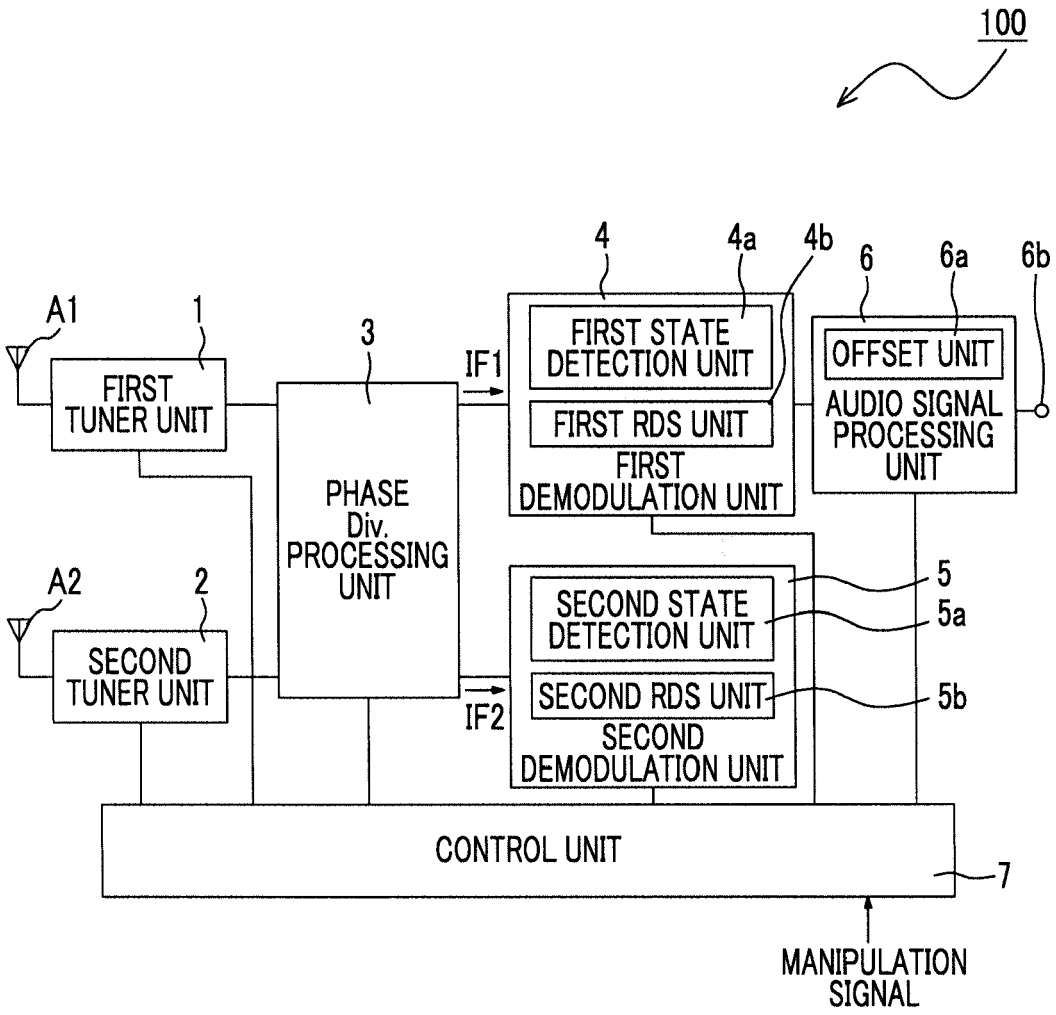
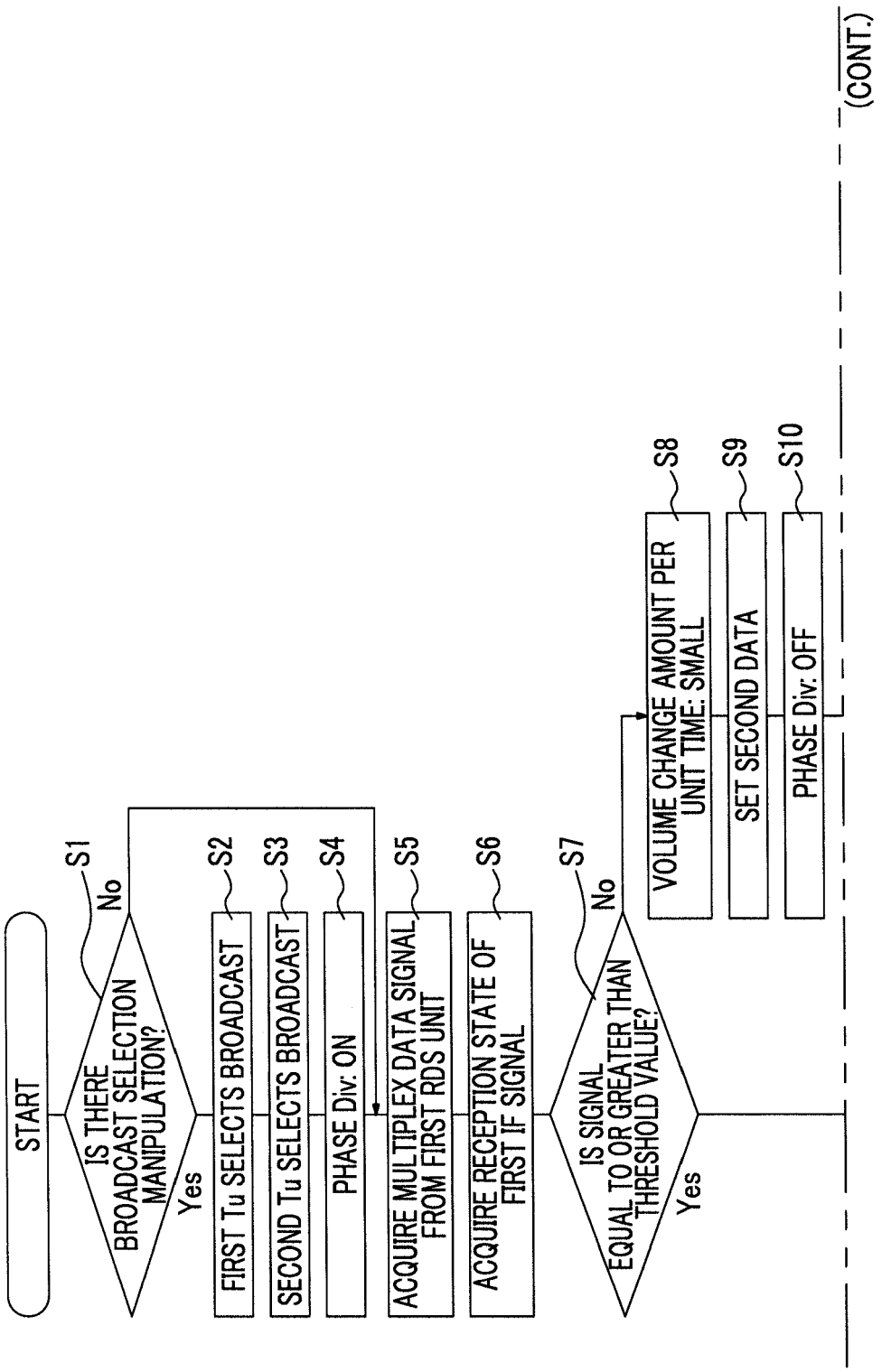

100
A1
1
FIRST TUNER UNIT
3
PHASE Div. PROCESSING UNIT
IF1
4
4a
4b
FIRST STATE DETECTION UNIT
FIRST RDS UNIT
FIRST DEMODULATION UNIT
6
6a
6b
OFFSET UNIT
AUDIO SIGNAL PROCESSING UNIT
A2
2
SECOND TUNER UNIT
IF2
5
5a
5b
SECOND STATE DETECTION UNIT
SECOND RDS UNIT
SECOND DEMODULATION UNIT
CONTROL UNIT
7
MANIPULATION SIGNAL

FIG. 2


START
S1
IS THERE BROADCAST SELECTION MANIPULATION?
No
Yes
S2
FIRST Tu SELECTS BROADCAST
S3
SECOND Tu SELECTS BROADCAST
S4
PHASE Div: ON
S5
ACQUIRE MULTIPLEX DATA SIGNAL FROM FIRST RDS UNIT
S6
ACQUIRE RECEPTION STATE OF FIRST IF SIGNAL
S7
IS SIGNAL EQUAL TO OR GREATER THAN THRESHOLD VALUE?
No
Yes
S8
VOLUME CHANGE AMOUNT PER UNIT TIME: SMALL
S9
SET SECOND DATA
S10
PHASE Div: OFF
(CONT.)

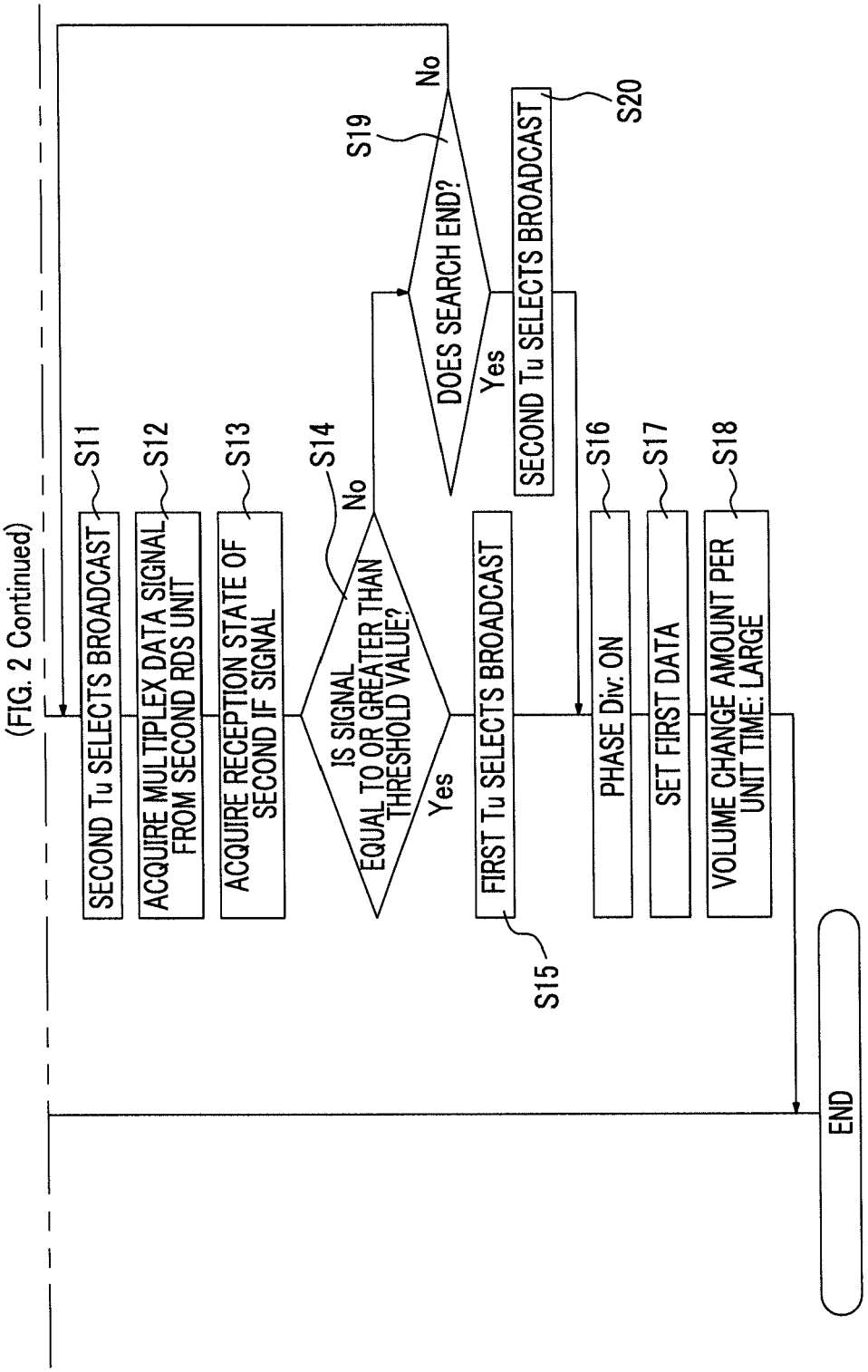
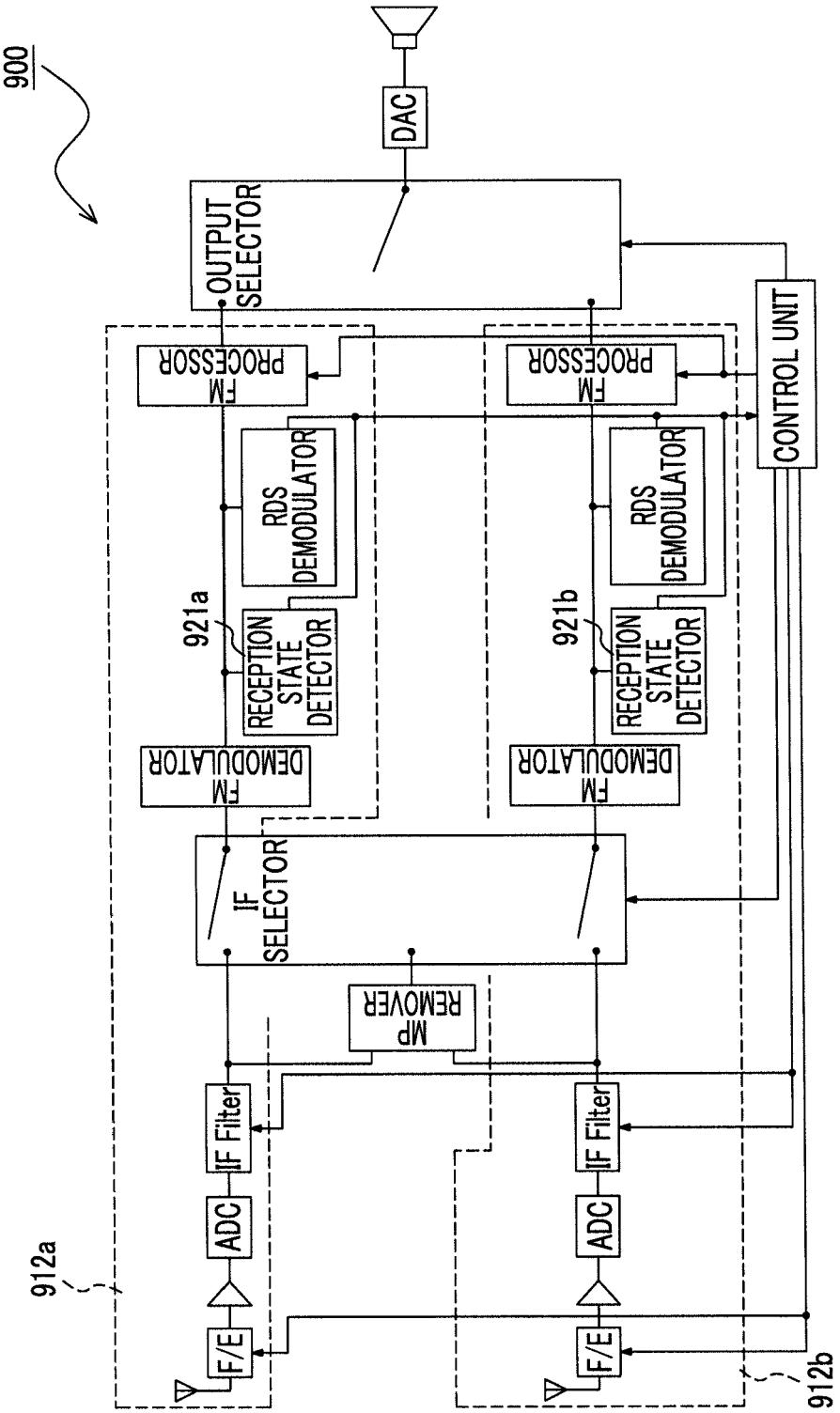

(FIG. 2 Continued)
SECOND Tu SELECTS BROADCAST
S11
ACQUIRE MULTIPLEX DATA SIGNAL FROM SECOND RDS UNIT
S12
ACQUIRE RECEPTION STATE OF SECOND IF SIGNAL
S13
IS SIGNAL EQUAL TO OR GREATER THAN THRESHOLD VALUE?
S14
No
Yes
FIRST Tu SELECTS BROADCAST
S15
PHASE Div: ON
S16
SET FIRST DATA
S17
VOLUME CHANGE AMOUNT PER UNIT TIME: LARGE
S18
DOES SEARCH END?
S19
No
Yes
SECOND Tu SELECTS BROADCAST
S20
END

FIG. 3


900
DAC
OUTPUT SELECTOR
CONTROL UNIT
FM PROCESSOR
FM PROCESSOR
RDS DEMODULATOR
RDS DEMODULATOR
921a
921b
RECEPTION STATE DETECTOR
RECEPTION STATE DETECTOR
FM DEMODULATOR
FM DEMODULATOR
IF SELECTOR
MP REMOVER
IF Filter
IF Filter
ADC
ADC
F/E
F/E
912a
912b

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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 3163

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2009 246651 A (KENWOOD CORP) 22 October 2009 (2009-10-22) * paragraphs [0014], [0019], [0036] - [0049]; figures 1,3 * * abstract *	1-3	INV. H04H40/18 ADD. H04H20/26
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			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	24 March 2016	Van Hoorick, Jan

CATEGORY OF CITED DOCUMENTS

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24-03-2016

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

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