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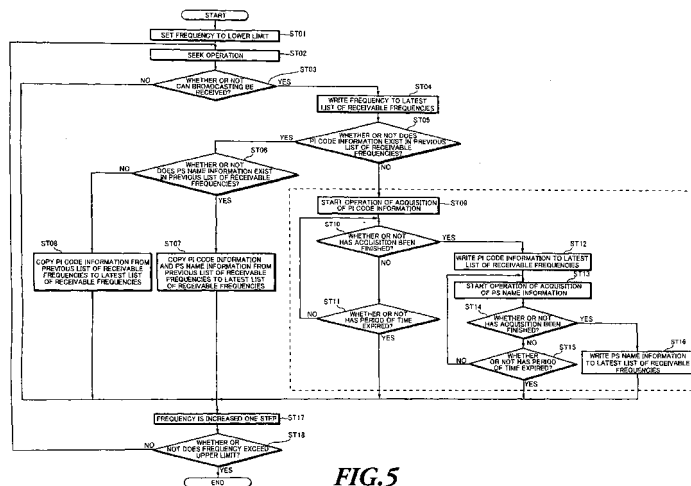
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(54) **Radio broadcasting receiver**

(57) A radio broadcasting receiver is provided that can reduce the period of time required for band scanning. The radio broadcasting receiver that receives a radio broadcast wave multiplexed with an audio signal corresponding to a broadcast program and a broadcast-related information signal including first information about the broadcast program. The radio broadcasting receiver includes a control part that performs band scanning to detect whether or not broadcasting can be received for each

frequency. At a time of the band scanning, the control part performs operation of acquisition of the first information when both following conditions are satisfied: a condition that the broadcasting can be received at a selected frequency; and a condition that the first information corresponding to the selected frequency does not exist in a previous list of receivable frequencies created at a time of previous band scanning when the previous list of receivable frequencies is referred.



**FIG. 5**

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**Description**

Technical field

5 **[0001]** The present invention relates to, for example, an RDS radio broadcasting receiver.

Background art

10 **[0002]** Patent Literature 1 discloses a radio broadcasting receiver that: preferentially extracts PI code information from all the multiple broadcasting signals in the broadcast band; preferentially stores this PI code information in a storage means; and then, extracts information data other than the PI code information; and stores and updates the information data other than the PI code information in the storage means.

15 **[0003]** Patent Literature 2 discloses a radio broadcast receiver that: executes seek operation (band scanning) in response to a predetermined operation by the user; PI code information just before the seek operation is stored in a RAM; a timer is prepared; the timer is started when the PI code of a broadcasting station detected during the seek operation does not match the PI code stored in the RAM; when a predetermined operation is detected before a predetermined period of time has lapsed, the PI code of the broadcasting station detected during the seek operation is additionally stored in the RAM; and a seek operation is restarted.

20 **[0004]** Patent Literature 3 discloses a technology that, upon receiving communication data, sequentially packets the communication data and transmits the result.

Citation list

Patent Literature

25 **[0005]**

PLT1: Japanese Patent Application Laid-Open Publication JP-A-2004-023 542

30 PLT2: Japanese Patent Application Laid-Open Publication JP-A-09-247 022

PLT3: Japanese Patent Application Laid-Open Publication JP-A-03-125 538

Summary of the Invention

35 Technical Problem

**[0006]** However, the methods described in Patent Literatures 1 and 2 have a problem that it is not possible to reduce the period of time to perform band scanning for all the frequencies.

40 **[0007]** The present invention was accomplished in view of the above-described problems. It is therefore an object of the present invention to provide a radio broadcasting receiver that can reduce the period of time required for band scanning.

Solution to the Problem

45 **[0008]** A radio broadcasting receiver is provided that receives a radio broadcast wave multiplexed with an audio signal corresponding to a broadcast program and a broadcast-related information signal including first information about the broadcast program. The radio broadcasting receiver includes a control part that performs band scanning to detect whether or not broadcasting can be received for each frequency.

50 At a time of the band scanning, the control part performs operation of acquisition of the first information when both following conditions are satisfied: a condition that the broadcasting can be received at a selected frequency; and a condition that the first information corresponding to the selected frequency does not exist in a previous list of receivable frequencies created at a time of previous band scanning when the previous list of receivable frequencies is referred.

55 Brief Description of the Drawings

**[0009]**

- FIG. 1 is a block diagram showing the configuration of a radio broadcasting receiver according to Embodiment 1 of the present invention;
- Figs. 2(a) and 2(b) explain band scanning of the radio broadcasting receiver according to Embodiment 1 of the present invention;
- 5 Figs. 3(a) and (b) explain arrangement of the period of times for band scanning and the period of times for data acquisition;
- Figs. 4(a) and (b) each explain a list of receivable frequencies;
- FIG. 5 is a flowchart explaining a process of a control part according to Embodiment 1 of the present invention; and
- 10 FIG. 6 is a flowchart explaining a process of the control part according to Embodiment 2 of the present invention.

Description of Embodiments

15 **[0010]** FIG. 1 is a block diagram showing the configuration of a radio broadcasting receiver according to Embodiment 1 of the present invention.

**[0011]** Now, Embodiment 1 of the present invention will be described in detail with reference to FIG. 1. The radio broadcasting receiver shown in FIG. 1 is an RDS (radio data system) radio broadcasting receiver that multiplexes an FM broadcasting signal with an RDS data signal (hereinafter referred to as "broadcast-related information signal") in the frequency domain.

The broadcast-related information signal carries various information elements related to broadcasting with information content data including an audio signal and traffic information associated with a broadcast program.

20 These various information elements contained in this broadcast-related information signal include, for example, the following information elements: PI code information that allows identification of the program and is unique to a broadcasting station; TP code information that indicates whether or not the station can support traffic information; PTY code information that indicates program types (news, sport, music and so forth); PS name information that indicates data showing the name of a broadcasting station; and RT data information that is character data transmitted with an audio signal from the broadcasting station side.

25 With embodiments of the present invention, PI code information and PS name information will be used among the above-described various information elements (see FIG. 4). However, it is by no means limiting, and it is possible to combine and replace information with any information as long as these various information elements are contained in a broadcast-related information signal.

30 **[0012]** Various convenient methods of using this PI code information have been known. For example, there is a method of using PI code information as follows. A case is possible where one program is broadcasted using different frequencies. In addition, another case is possible where one program is broadcasted from different broadcasting stations. In this case, the program is broadcasted with different frequencies and also different PS name information (the names of broadcasting stations).

35 Here, the user essentially requires to continuously listen to the program which the user is listening to without any particular operation. In order to support this user's request, PI code information is used. To be more specific, when the reception condition of the program which the user is listening to becomes worse (including inability to hear), an RDS radio broadcasting receiver automatically changes the frequency for the subsequent reception to another frequency having the same PI code information as that of the program which the user is listening to.

40 For such a use, an RDS radio broadcasting receiver needs to always have the latest PI code information. In addition, PS name information is also required to provide broadcasting station information to the user. Nonetheless, the urgent need of PS name information is lower than of PI code information.

45 Incidentally, although details will be explained later with reference to FIG. 2 and FIG. 3, it is not preferable to search always PI code information and PS name information for all the frequencies because of reducing the most important period of time over which a broadcasting station with the frequency being tuned acquires broadcast content data, and therefore the reception capability of the broadcasting station deteriorates.

50 Moreover, there is another problem that by searching always PI code information and PS name information for all the frequencies, the period of time for acquisition of data of traffic information contained in a broadcast-related information signal is reduced. It is therefore another object of the present invention to solve this problem with embodiments.

**[0013]** The RDS radio broadcasting receiver obtains an FM broadcasting signal obtained by receiving a broadcast wave and demodulates an audio signal corresponding to this broadcast. Moreover, the RDS radio broadcasting receiver detects the broadcast-related information signal from the FM broadcasting signal to obtain the above-described various information elements. Then, the RDS radio broadcasting receiver uses this broadcast-related information signal to realize various functions.

Embodiment 1

**[0014]** Now, the configuration of the RDS radio broadcasting receiver will be described with reference to FIG. 1. An antenna 1 supplies to a frontend 2 an FM wave receiving signal obtained by receiving an FM broadcasting wave with which a broadcast-related information signal is multiplexed. This FM wave receiving signal is converted to the intermediate frequency (IF) of 10.7 MHz after the radio wave for a desired broadcasting station is selected at frontend 2.

Then, the FM wave receiving signal is amplified by an IF amplifier 3. Here, the frontend 2 has a mixer 2a and a PLL circuit 2b. Then, the frontend 2 obtains a local signal to the mixer 2a by a PLL synthesizer method using the PLL circuit 2b including a programmable divider (not shown). The frontend 2 sets a receivable frequency according to a command for a tuning frequency transmitted from a control part 10 described later. In this case, the frontend 2 performs tuning according to the frequency of this local signal.

**[0015]** The FM signal of 10.7 MHz is amplified by the IF amplifier 3 to satisfactorily control the amplitude, output to the FM wave demodulator 4, and demodulated as an audio signal. A level detector 14 detects the level (field intensity) of a received signal based on the IF signal level in the IF amplifier 3 and supplies the detected level to the control part 10. A local detector 8 outputs a local detection signal when both the following conditions are satisfied: a condition that the IF signal level in the IF amplifier 3 is equal to or higher than a predetermined level; and detected output with an S-curve characteristic in the FM demodulator 4 is within the range of a predetermined level. Here, this local detection signal indicates that tuning for the broadcast wave from the broadcasting station has been finished.

Then, this local detection signal is supplied to the control part 10. The control part 10 performs control of the frontend 2, according to the level of the received signal supplied from the level detector 14 and the local detection signal supplied from the local detector 8. In addition, using the local detection signal, the control part 10 determines whether or not a broadcast signal is sent at the selected frequency (step ST02 and step ST03 in FIG. 6 described later).

**[0016]** A stereo demodulating circuit 5 demodulates the audio signal from the FM demodulator 4 to a stereo signal, and supplies the stereo signal to an amplifier. The amplifier 6 appropriately amplifies the audio signal supplied from the stereo demodulating circuit 5, and supplies the result to a speaker 7. The speaker 7 converts the audio signal amplified by the amplifier 6 into an acoustic oscillation.

**[0017]** The storage part 11 stores necessary information according to commands from the control part 10. In particular, with Embodiment 1 of the present invention, the storage part 11 serves to store a latest list of receivable frequencies and provide the latest list to the control part 10 according to need. Here, the list of receivable frequencies is referred and updated every band scanning.

With the present embodiment, the list of receivable frequencies before update is referred to as the previous list of receivable frequencies, which is targeted for reference. That is, in FIG. 5 described later, the list of receivable frequencies before band scanning may be the previous list of receivable frequencies.

**[0018]** The RDS signal detecting circuit 9 detects a broadcast-related information signal (e.g., PI code information and PS name information) from the detected output from the FM modulator 4, and supplies the signal to the control part 10. The operating part 13 generates operation signals according to various operations by the user and supplies these signals to the control part 10.

The display part 12 displays images or characters based on various display data supplied from the control part 10. With Embodiment 1 of the present invention, the display part 12 displays the name of a broadcasting station based on PS name information.

**[0019]** When the operating part 13 issues a command to fully search for channel selection, the control part 10 performs full search operation for channel selection. During this full search operation for channel selection, all the frequencies that can be used for FM broadcasting, are sequentially searched.

Then, all of the various information elements such as the frequency used for the broadcast and the broadcast-related information signal corresponding to this frequency are obtained by the search. The control part 10 generates the latest full list of receivable frequencies, based on the acquired various information elements.

Then, the generated list of receivable frequencies is stored in the storage part 11. It is preferred to automatically issue a command for full search for channel selection by the control part 10. Alternatively, such a command may be issued by pushing for example, a search key for channel selection provided in the operating part 13, by the user.

In addition, full search for channel selection may be automatically performed by the control part 10 every predetermined period of time. The control part 10 may perform search with a less amount of information slightly than in full search for channel selection.

The band scanning performed with Embodiment 1 of the present invention is simpler than the full search for channel selection (the obtained amount of information is less than in the full search for channel selection), and therefore can be performed appropriately in a short period of time and at a high frequency. Moreover, band scanning is usually performed by the control part 10 without the user's operation.

**[0020]** Here, band scanning with Embodiment 1 of the present invention will be explained with reference to FIG. 2 and FIG. 3. Figs. 2(a) and 2(b) explain band scanning of the radio broadcasting receiver according to Embodiment 1 of

the present invention. Figs. 3(a) and 3(b) explain arrangement of the period of times for band scanning and the period of times for data acquisition when band scanning is performed with the method shown in FIG. 2.

To be more specific, FIG. 2(b) and FIG. 3(b) explain a method of band scanning according to Embodiment 1 of the present invention. FIG. 2(a) and FIG. 3(a) are comparative examples in a case of full search for channel selection.

**[0021]** When band scanning is simply performed, full search for channel selection is performed as shown in FIG. 2 (a), and therefore operation of acquisition of PI code information and PS name information is performed for all the frequencies at which radio broadcasting can be received. Then, it takes a predetermined period of time to perform operation of acquisition of PI code information and PS name information.

Here, as shown in FIG. 2(a), it generally takes a longer period of time to acquire PS name information than a period of time to acquire PI code information. It is because PS name information has a larger amount of information than PI code information.

Here, in FIG. 2(a), there are bars in which operation of acquisition of PI code information is performed but operation of acquisition of PS name information is not performed. It is because PI code information cannot be acquired within a predetermined period of time, and naturally there is no PS name information.

In addition, when operation of acquisition of PI code information is performed but operation of acquisition of PS name information is not performed, a case is possible where there is PS name information but the reception condition is poor, so that acquisition of the PS name information is not finished within a predetermined period of time.

**[0022]** For band scanning, a basic operation is performed for each frequency. The basic operation for each frequency includes: determining whether or not it is possible to receive radio broadcasting; when it is possible, performing operation of acquisition of PI code information; when it is possible to acquire PI code information, performing operation of acquisition of PS name information (the basic operation corresponds to the process from step ST02 to step ST16 shown in FIG. 5). This basic operation of band scanning for each frequency is performed from the lowest frequency at which FM broadcasting can be received. Then, after one basic operation is finished, the frequency is increased one step and the same basic operation of band scanning is performed. The basic operation of band scanning is repeatedly performed until the

highest frequency at which FM broadcasting can be received (see FIG. 5).

**[0023]** With the method of band scanning as shown in FIG. 2(a), it takes a long period of time for band scanning as shown in FIG. 3(a). Therefore, for example, when band scanning operations are performed at predetermined time intervals, the proportion of data acquisition time to the processing time required for one band scanning operation reduces, and therefore an available amount of information on data transmitted by the broadcasting station may be reduced.

Here, the data that can be acquired at the time of data acquisition is information content data such as traffic information. However, it is by no means limiting to information content data such as traffic information.

Here, with Embodiment 1 of the present invention, it is assumed that band scanning operations is performed at predetermined time intervals. However, it is by no means limiting and band scanning operations may not be necessarily performed at predetermined time intervals.

**[0024]** With Embodiment 1 of the present invention, a period of time for band scanning is reduced by keeping and using the previous list of receivable frequencies. To be more specific, as shown in FIG. 2(b), for band scanning, operation of acquisition is performed for only PI code information and PS name information corresponding to the reception frequency which is not in the previous list of receivable frequencies.

That is, at the first band scanning, operation of acquisition of PI code information (with PS name information) is performed for all frequencies as shown in FIG. 3(a). Then, after the first band scanning, operation of acquisition of PI code information (with PS name information) is performed for only a newly-receivable frequency as shown in FIG. 3(b).

That is, the period of time required for the first band scanning is the same as in FIG. 3(a), but the period of time required for each band scanning after the first band scanning is significantly shorter than that. This means that the proportion of the period of time to acquire the data transmitted from the broadcasting station to the processing time required for band scanning, increases.

The period of time for band scanning is reduced, so that it is possible to perform band scanning and data acquisition at a higher frequency (see Figs. 3(a) and 3(b), comparing the respective frequencies of band scanning). That is, it is possible to perform band scanning at a high frequency.

**[0025]** FIG. 4(a) and FIG. 4(b) each explain a list of receivable frequencies according to Embodiment 1 of the present invention.

**[0026]** As shown in Figs. 4(a) and (b), each list of receivable frequencies includes receivable frequencies, PI code information corresponding to the receivable frequencies and PS name information corresponding to the receivable frequencies. However, it is by no means limiting, and a list may include other various information elements (for example, TP code information, PTY code information, RT data information, and other information generated and used by the radio broadcasting receiver).

FIG. 4(a) shows a list of receivable frequencies having already been created before band scanning (i.e. the previous list of receivable frequencies). FIG. 4 (b) shows a list of receivable frequencies after band scanning is performed (i.e. the latest list of receivable frequencies).

Here, the part written as "←new" is newly created by performing band scanning. In FIG. 4, at frequency f14, a program with PI code information C009 and PS name information "FM Yokohama", is detected by band scanning. In addition, at frequency f29, a program with PI code information C025 and PS name information "Saitama FM," is detected by band scanning.

5 **[0027]** FIG. 5 is a flowchart explaining a process of the control part 10 according to Embodiment 1 of the present invention.

**[0028]** When band scanning is started, the control part 10 starts step ST01 in the process. In step ST01, in order to perform band scanning, the control part 10 commands to the frontend 2 to tune the frequency to the lowest frequency among the frequencies at which FM broadcasting can be received (hereinafter, see FIG. 1 in addition to FIG. 5).

10 By this means, an FM signal at the tuned frequency (=lowest frequency) is provided to the IF amplifier 3 and the FM modulator 4. After step ST01 has been executed, the step in the process of the control part 10 moves to the next step ST02.

**[0029]** In step ST02, seek operation is performed. To be more specific, the control part 10 detects a local detection signal from the local detector 8. Here, the local detector 8 outputs the local detection signal when both the following conditions are satisfied: a condition that the IF signal level in the IF amplifier 3 is equal to or higher than a predetermined level; and a condition that detected output with an S-curve characteristic in the FM demodulator 4 is within the range of a predetermined level. After step ST02 has been executed, the step in the process of the control part 10 moves to the next step ST03.

15 **[0030]** In step ST30, the control part 10 determines whether or not radio broadcasting can be received at the set frequency. To be more specific, the control part 10 detects whether or not a local detection signal is output from the local detector 8, and, when a local detection signal is output, determines that radio broadcasting can be received. On the other hand, when a local detection signal is not output, the control part 10 determines that FM broadcasting cannot be received.

Then, when the control part 10 determines that FM broadcasting can be received, the step in the process of the control part 10 moves to step ST04. On the other hand, when the control part 10 determines that FM broadcasting cannot be received, the step in the process of the control part 10 moves to step ST17.

25 **[0031]** In step ST04, the control part 10 writes the set frequency to the latest list of receivable frequencies, as a receivable frequency. Here, at this step, the PI code information and the PS name information corresponding to this new frequency has not been stored yet. After step ST04 has been executed, the step in the process of the control part 10 moves to the next step ST05.

30 **[0032]** In step ST05, the control part 10 determines whether or not the PI code information corresponding to the frequency set in the latest list of receivable frequencies exists in the previous list of receivable frequencies. To be more specific, the control part 10 refers to the storage part 11 and determines whether or not the PI code information corresponding to the frequency set in the latest list of receivable frequencies, is written in the previous list of receivable frequencies.

35 Then, when the PI code information is written in the previous list of receivable frequencies, the step in the process of the control part 10 moves to step ST06. On the other hand, when the PI code information is not written in the previous list of receivable frequencies, the step in the process of the control part 10 moves to step ST09.

**[0033]** In step ST06, the control part 10 determines whether or not the PS name information corresponding to the frequency set in the latest list of receivable frequencies exists in the previous list of receivable frequencies. To be more specific, the control part 10 refers to the storage part 11, and determines whether or not the PS name information corresponding to the frequency set in the latest list of receivable frequencies, is written in the previous list of receivable frequencies.

40 Then, when the PS name information is written in the previous list of receivable frequencies, the step in the process of the control part 10 moves to step ST07. On the other hand, the PS name information is not written in the previous list of receivable frequencies, the step in the process of the control part 10 moves to step ST08.

**[0034]** In step ST07, the control part 10 reads PI code information and PS name information from the previous list of receivable frequencies, and writes (copies) the PI code information and the PS name information to the latest list of receivable frequencies. After step ST07 has been executed, the step in the process of the control part 10 moves to the next step ST17.

50 **[0035]** In step ST08, the control part 10 reads PI code information from the previous list of receivable frequencies and writes (copies) the PI code information to the latest list of receivable frequencies. After step ST08 has been executed, the step in the process of the control part 10 moves to the next step ST17. Here, in this case, operation of acquisition of PS name information is not performed in the present embodiment.

It is intended to avoid consuming the processing time for acquisition of PS name information because PS name information is not likely to exist. However, another embodiment is possible where a process flow including acquisition of PS name information is executed.

55 **[0036]** Step ST09, the control part 10 starts operation of acquisition of PI code information. To be more specific, the control part 10 starts operation of acquisition of PI code information output from the RDS signal detecting circuit 9. After

step ST09 has been executed, the step in the process of the control part 10 moves to the next step ST10.

**[0037]** In step ST10, the control part 10 determines whether or PI code information has been acquired. To be more specific, the control part 10 detects whether or not PI code information is output from the RDS signal detecting circuit 9, and, when PI code information is output, determines that PI code information has been acquired.

5 On the other hand, when PI code information has not been output, PI code information has not been acquired. Then, the control part 10 determines that PI code information has been acquired, the step in the process of the control part 10 moves to step ST12. On the other hand, when the control part 10 determines that PI code information has not been acquired, the step in the process of the control part 10 moves to step ST11.

**[0038]** In step ST11, the control part 10 determines whether or not the expended period of time exceeds the period of time permitted for operation of acquisition of PI code information. To be more specific, the control part 10 compares between the limited time for operation of acquisition of PI code information set and stored in the storage part 11 and the elapsed period of time from the start of the operation of acquisition of PI code information.

10 Then, when the elapsed period of time from the start of the operation of acquisition of PI code information is shorter than the limited time for operation of acquisition of PI code information, the step in the process of the control part 10 moves to step ST10 to continue the operation of acquisition of PI code information.

15 On the other hand, when the elapsed period of time from the start of the operation of acquisition of PI code information is longer than the limited time for operation of acquisition of PI code information, the operation of acquisition of PI code information is stopped and the step in the process of the control part 10 moves to step ST17. Here, the limited time for operation of acquisition of PI code information is, in other words, the time to stop operation of acquisition of PI code information.

**[0039]** In step ST12, the control part 10 writes PI code information in association with the frequency set in the latest list of receivable frequencies. To be more specific, the control part 10 writes PI information in association with the frequency set in the latest list of receivable frequencies in the storage part 11. Here, in this step, PS name information corresponding to this new frequency has not been stored. After step ST12 has been executed, the step in the process of the control part 10 moves to the next step ST13.

20 **[0040]** In step ST13, the control part 10 performs operation of acquisition of PS name information. To be more specific, the control part 10 performs operation of acquisition of PS name information output from the RDS signal detecting circuit 9. After step ST13 has been executed, the step in the process of the control part 10 moves to the next step ST14.

**[0041]** In step ST14, the control part 10 determines whether or not PS name information has been acquired. To be more specific, the control part 10 detects whether or not PS name information has been output from the RDS signal detecting circuit 9, and, when PS name information has been output, determines that PS name information has been acquired.

25 On the other hand, when PS name information has not been output, the control part 10 determines that PS information has not been acquired. Then, when the control part 10 determines that the PS name information has been acquired, the step in the process of the control part 10 moves to step ST16. On the other hand, when the control part 10 determines that PS name information has not been acquired, the step in the process of the control part 10 moves to step ST15.

**[0042]** In step ST15, the control part 10 determines whether or not the expended period of time exceeds the period of time permitted for operation of acquisition of PS name information. To be more specific, the control part 10 compares between the limited time for operation of acquisition of PS name information set and stored in the storage part 11 and the elapsed period of time from the start of the operation of acquisition of PS name information.

30 Then, when the elapsed period of time from the start of the operation of acquisition of PS name information is shorter than the limited time for operation of acquisition of PS name information, the step in the process of the control part 10 moves to step ST14 to continue the operation of acquisition of PS name information.

35 On the other hand, when the elapsed period of time from the start of the operation of acquisition of PS name information is longer than the limited time for operation of acquisition of PS name information, the operation of acquisition of PS name information is stopped and the step in the process of the control part 10 moves to step ST17. Here, the limited time for operation of acquisition of PS name information is, in other words, the time to stop operation of acquisition of PS name information.

40 Here, it is preferred that the period of time from the beginning to the end of an operation of acquisition of PI code information (shown in step ST11) is set shorter than the period of time from the beginning to the end of an operation of acquisition of PS name information (shown in step ST15).

45 It is because PI code information is smaller than PS name information in quantity, and therefore can be acquired for a shorter period of time. This allows completion of band scanning for a short period of time.

**[0043]** In step ST16, the control part 10 writes PS name information in association with the frequency set in the latest list of receivable frequencies. To be more specific, the control part 10 writes the PS name information in association with the frequency set in the latest list of receivable frequencies in the storage part 11. After step ST16 has been executed, the step in the process of the control part 10 moves to step ST17.

50 **[0044]** Here, the steps from step ST02 to step ST16 in the process correspond to the basic operation for each frequency.

That is, the steps for the basic operation are sequentially executed for each frequency, so that the band scanning is finished for all the frequencies.

**[0045]** In step ST17, the set frequency is increased one step. After step ST17 has been executed, the step in the process of the control part 10 moves to the next step ST18.

**[0046]** In step ST18, the control part 10 determines whether or not the frequency set in step ST17 exceeds the highest frequency (upper limit). Then, when the frequency does not exceed the highest frequency, the control part 10 moves the step in the process to step ST02 to perform the basic operation for the frequency having been increased one step in step ST17.

On the other hand, when the frequency exceeds the highest frequency, the process of the control part 10 ends.

**[0047]** With Embodiment 1 of the present invention having the above-described configuration, it is possible to skip the steps to acquire PI code information enclosed in the dashed line shown in FIG. 5 when the steps do not need to be executed, and therefore finish band scanning for a short period of time.

This allows execution of band scanning at a high frequency. That is, the proportion of the period of time for data acquisition to the processing time required for band scanning is increased, and therefore it is possible to acquire increased amount of data on FM broadcasting.

As a result, it is possible to increase an amount of received data such as traffic information on FM broadcasting. In addition, since it is possible to perform band scanning at a high frequency, the control part 10 can change the frequency at a high speed, referring to PI code information according to need, in order to allow the user to continue to listen to the program which the user being listening to.

Moreover, the period of time from the beginning to the end of an operation of acquisition of PI code information is set shorter than the period of time from the beginning to the end of an operation of acquisition of PS name information, and therefore it is possible to finish band scanning for a short period of time.

Furthermore, with the above-described configuration, it is possible to perform band scanning at a high frequency and for a short period of time without sacrifice which is decrease in the proportion of the period of time for data acquisition to the processing time required for band scanning.

Then, since it is possible to perform band scanning at a high frequency and for a short period of time, even if the reception condition rapidly changes at such as the exit of a long tunnel, it is possible to provide a significant effect that the latest list of receivable frequencies can be updated for a short period of time.

## Embodiment 2

**[0048]** FIG. 6 is a flowchart explaining a process of the control part 10 according to Embodiment 2 of the invention. Basically, the configuration, operation and effect shown in FIG. 6 are the same in FIG. 5 except that step ST19 and step ST20 are added to the process. Therefore, description of the same parts as in FIG. 5 will be omitted.

**[0049]** In step ST19, the control part 10 determines whether or not there is PS name information corresponding to the PI code written in the latest list of receivable frequencies. To be more specific, the control part 10 refers to the storage part 11 and determines whether or not PS name information corresponding to the PI code written in the latest list of receivable frequencies, exists.

When the PS name information exists in the storage part 11, the step in the process of the control part 10 moves to step ST20. On the other hand, when the PS name information does not exist in the storage part 11, the step in the process of the control part 10 moves to step ST13.

**[0050]** In step ST20, the control part 10 reads the PS name information from the previous list of receivable frequencies, and writes the PS name information to the latest list of receivable frequencies. After step ST20 has been performed, the step in the process of the control part 10 moves to the next step ST17.

**[0051]** With Embodiment 2 of the present invention having the above-described configuration, it is possible to finish band scanning for a shorter period of time than in Embodiment 1 of the present invention. This allows band scanning at a high frequency.

It is because even if PI code information is not acquired and the steps enclosed in the dashed line shown in FIG.6 are performed, it is possible to skip operation of acquisition of PS name information, which needs to a longer period of time than the period of time to acquire PI code information.

**[0052]** With the above-described embodiments, the radio broadcasting receiver according to the present invention receives a radio broadcast wave multiplexed with information content data including an audio signal and traffic information associated with a broadcast program and a broadcast-related information signal including PI code information associated with the broadcast program.

Then, the radio broadcasting receiver according to the present invention has the control part 10 that performs band scanning for detecting whether or not it is possible to receive broadcasting for each frequency.

In addition, the control part 10 performs operation of acquisition of PI code information only when both the following conditions are satisfied: a condition that it is possible to receive broadcasting at the frequency selected at the time of

band scanning; and a condition that when the previous list of receivable frequencies created at the time of the previous band scanning is referred, there is no PI code information corresponding to the selected frequency in the previous list of receivable frequencies.

5 With this configuration, it is possible to finish band scanning for a short period of time. By this means, it is possible to perform band scanning at a high frequency. That is, the proportion of the period of time for data acquisition to the processing time required for band scanning increases, so that it is possible to acquire an increased amount of information content data including traffic information on FM broadcasting. As a result, it is possible to improve the sound quality of FM broadcasting and a success rate of acquiring information such as traffic information.

10 In addition, since it is possible to perform band scanning at a high frequency, the control part 10 can change the frequency at a high speed, referring PI code information according to need, in order to allow the user to continue to listen to the program which the user being listening to.

15 **[0053]** Here, the control part 10 according to the above-described embodiments is an example of control means. That is, the control means is not necessarily a single means as long as it provides control in one way or another. For example, distributed control may be provided by a plurality of control means. Either analog processing or digital processing is possible. In addition, the storage part 11 is an example of storage means.

That is, the storage means is not necessarily a single means as long as it provides storage in one way or another. Storage includes distributed storage. Moreover, either analog processing or digital processing is possible. The radio broadcasting receiver according to the present invention is not limited as long as it can receive radio broadcasting supporting a system for providing broadcast-related information such as an RDS.

20 For example, the radio broadcasting receiver according to the present invention may be an electronic device incorporated in a personal computer, a portable music player, a mobile phone, a television in a navigation apparatus (car navigation system) and a transportation device such as a car.

25 **[0054]** Step ST03 in the process according to the embodiments of the present invention is an example of a receivable frequency determination means for determining whether or not broadcasting can be received according to the present invention. Step ST05 in the process according to the embodiments of the present invention is an example of a first information reference and determination means for referring to and determining first information according to the present invention. Step ST19 in the process of Embodiment 2 of the present invention is an example of a second information reference and determination means for referring to and determining first information according to the present invention.

30 **[0055]** PI code information is an example of "first information" of the present invention. That is, the first information may be TP code information, PTY code information, RT data information and so forth. In addition, PS name information is an example of "broadcast-related information other than the first information" of the present invention. That is, broadcast-related information other than the first information may be TP code information, PTY code information, RT data information and so forth.

35 In brief, the present invention can apply any information as long as the order of the information to be acquired is determined like PI code information and PS name information, and the rule is established between two information elements such that the information acquired earlier inevitably determines the information to be acquired next.

40 **[0056]** Although with the present invention, the embodiments have been shown where band scanning is combined with acquisition of broadcast-related information as a tuner function, band scanning may be combined with another tuner function such as phase diversity. This tuner function reduces the period of time for band scanning, and therefore produce an effect to increase the proportion of period of time over which the tuner function can serve as a phase diversity tuner to the processing time required for band scanning in order to improve reception capability.

That is, the present invention applicable to any tuner function that can be combined with band scanning as long as the function does not need to constantly operate even when used by the user. It is because a certain period of time can be used for band scanning.

45 **[0057]** In addition, the radio broadcasting receiver according to the present invention does not necessarily receive an RDS signal in synchronization with an audio signal. That is, the radio broadcasting receiver according to the present invention is not limited as long as one can receive an RDS signal. In other words, the present invention is not limited as long as a radio broadcasting is provided to increase the speed and the frequency of band scanning.

50 List of Reference Signs

**[0058]**

- 55 1 = antenna  
 2 = frontend  
 2a = mixer  
 2b = PLL circuit  
 3 = IF amplifier

- 4 = FM demodulator
- 5 = stereo demodulating circuit
- 6 = amplifier
- 7 = speaker
- 5 8 = local detector
- 9 = RDS signal detecting circuit
- 10 = control part
- 11 = storage part
- 12 = display part
- 10 13 = operating part
- 14 = level detector

**Claims**

- 15
1. A radio broadcasting receiver that is adapted to receive a radio broadcast wave multiplexed with an audio signal corresponding to a broadcast program and a broadcast-related information signal including first information about the broadcast program, the radio broadcasting receiver including a control part (10) that is adapted to perform band scanning to detect whether or not broadcasting can be received for each frequency,
- 20
- wherein, at a time of the band scanning, the control part (10) performs operation of acquisition of the first information when both following conditions are satisfied: a condition that the broadcasting can be received at a selected frequency; and a condition that the first information corresponding to the selected frequency does not exist in a previous list of receivable frequencies created at a time of a previous band scanning when the previous list of receivable frequencies is referred.
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2. The receiver according to claim 1, wherein the control part (10) causes:
- 30
- a receivable frequency determination means to determine whether or not the broadcasting can be received at the selected frequency at the time of the band scanning;
  - a storage part (11) to store the selected frequency in the previous list of receivable frequencies when the receivable frequency determination means determines that the broadcasting can be received;
  - a first information reference and determination means to, when the receivable frequency determination means determines that the broadcasting can be received, refer to the previous list of receivable frequencies created at the time of the band scanning and determine whether or not the first information corresponding to the selected frequency exists in the previous list of receivable frequencies; and
  - the storage part (11) to store, when the first information reference and determination means determines that the first information exists in the previous list of receivable frequencies, the first information from the previous list of receivable frequencies into the latest list of receivable frequencies, in association with the selected frequency, and
  - the control part (10) performs the operation of acquisition of the first information corresponding to the selected frequency when the first information reference and determination means determines that the first information does not exist in the previous list of receivable frequencies.
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3. The receiver according to claim 1 or 2, wherein:
- the broadcast-related information signal includes broadcast-related information other than the first information; and
  - the control part (10) causes:
    - the storage part (11) to, when the first information is acquired through the operation of acquisition of the first information, store the acquired first information in the latest list of receivable frequencies;
    - a second information reference and determination means to determine whether or not the broadcast-related information corresponding to the selected frequency and the first information, other than the first information, exists in the latest list of receivable frequencies; and
    - the storage part (11) to store, when the second information reference and determination means determines that the broadcast-related information other than the first information exists in the latest list of receivable fre-
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quencies, the broadcast-related information other than the first information from the previous list of receivable frequencies into the latest list of receivable frequencies, in association with the selected frequency and the first information, and

5 - the control part (10) performs operation of acquisition of the broadcast-related information corresponding to the selected frequency and the first information, other than the first information when the second information reference and determination means determines that the broadcast-related information other than the first information does not exist in the latest list of receivable frequencies.

10 4. The receiver according to any of claims 1 to 3, wherein the first information is PI code information and the broadcast-related information other than the first information is PS name information.

15 5. The receiver according to claim 4, wherein the control part (10) stops operation of acquisition of the PI code information when the PI code information cannot be acquired even though the operation of acquisition of the PI code information continues for a predetermined period of time.

20 6. The receiver according to claim 4 or 5, wherein the control part (10) stops operation of acquisition of the PS name information when the PS name information cannot be acquired even though the operation of acquisition of the PS name information continues for a predetermined period of time.

25 7. The receiver according to claim 5 or 6, wherein a period of time until the control part (10) stops the operation of acquisition of the PI code information is shorter than a period of time until the control part (10) stops the operation of acquisition of the PS name information.

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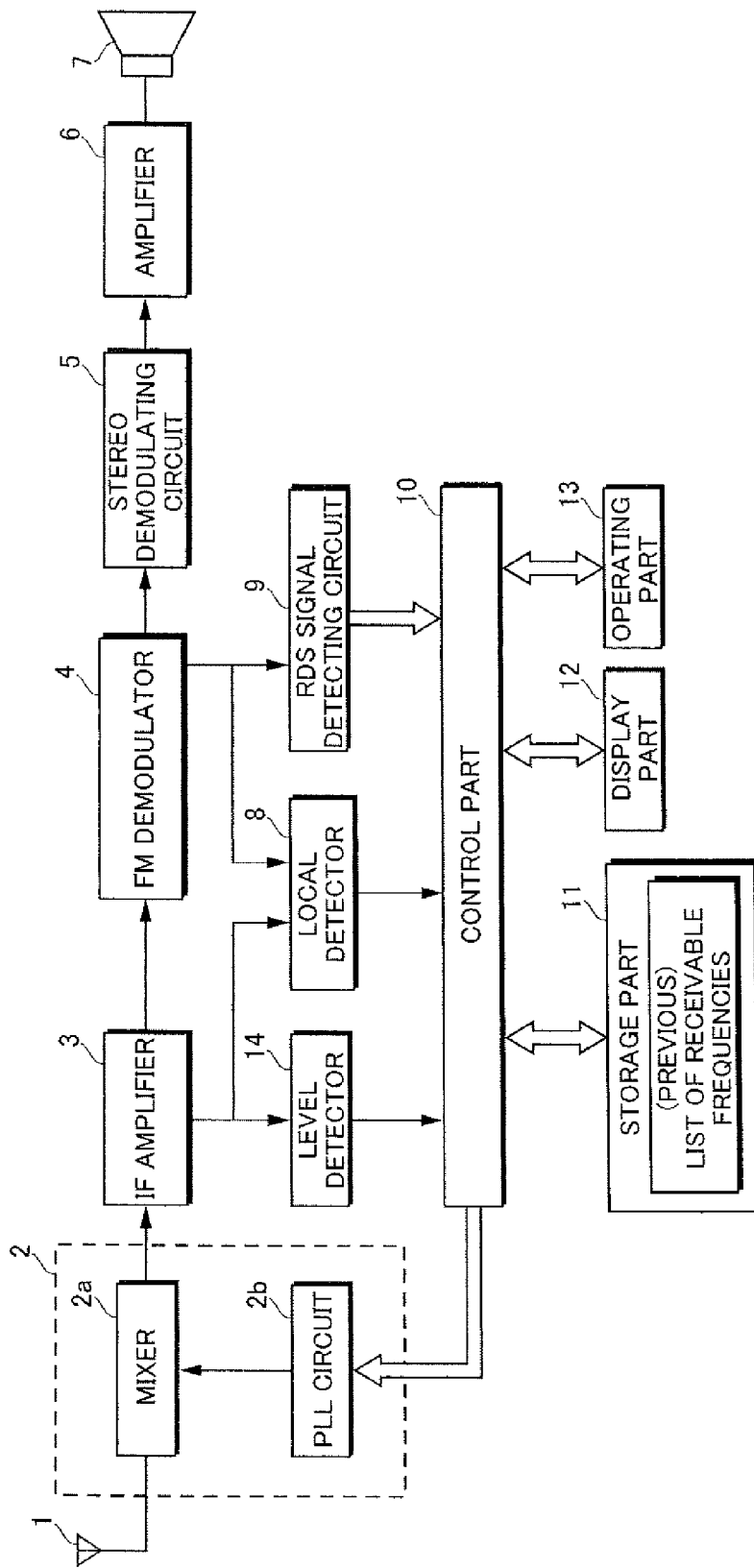


FIG. 1

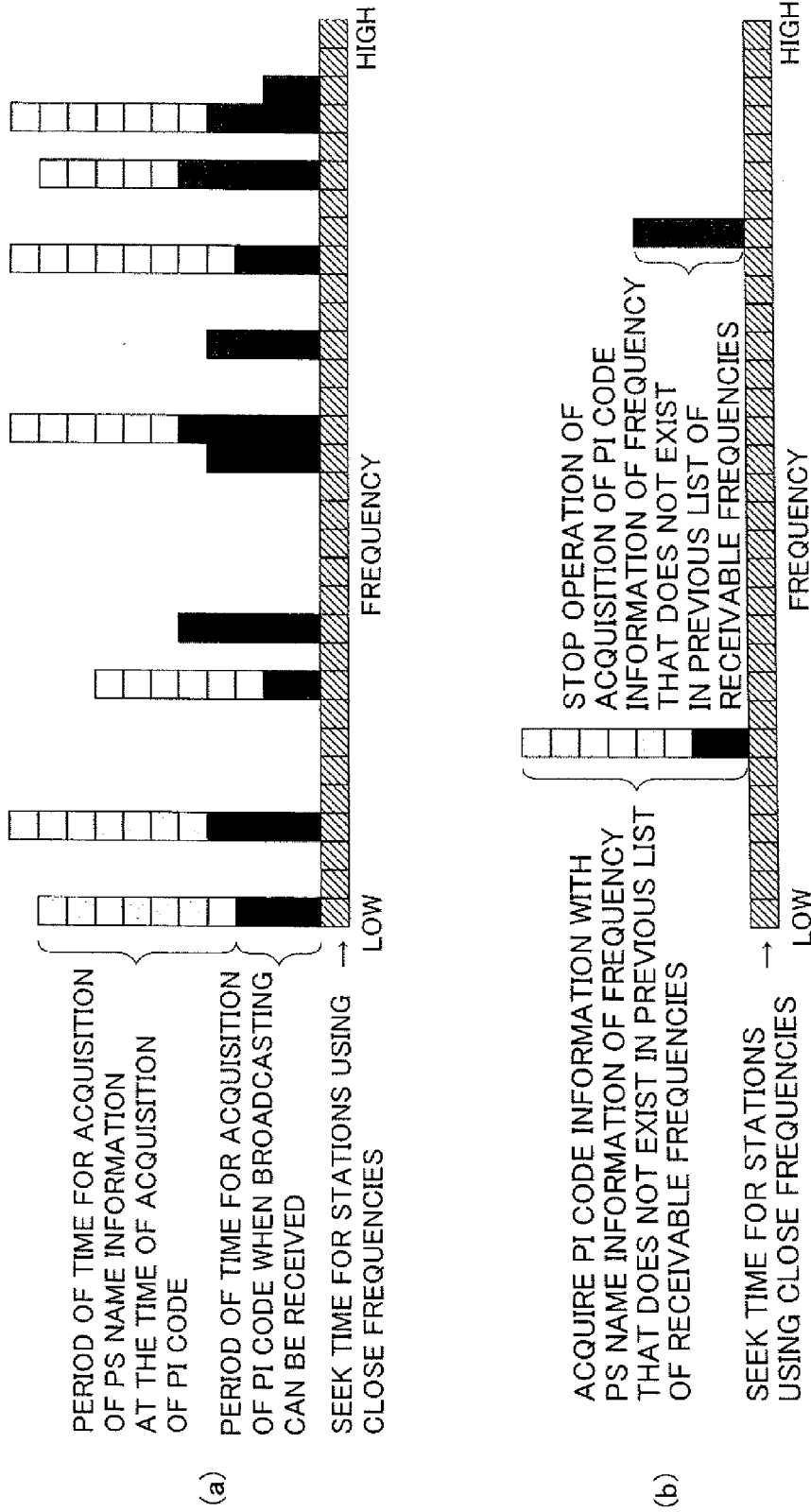


FIG.2

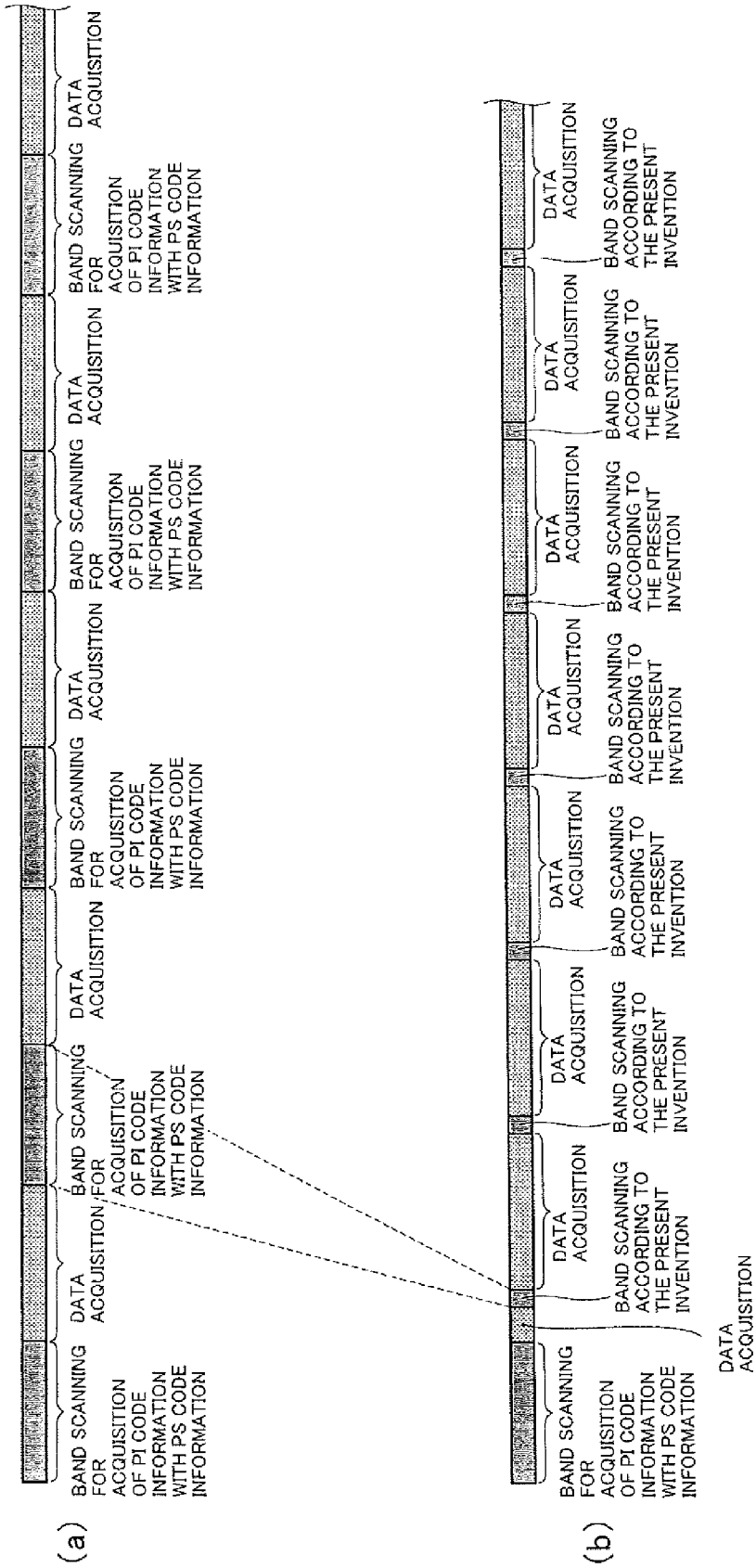


FIG.3

PREVIOUS LIST OF RECEIVABLE FREQUENCIES

(a)

FREQUENCY	PI CODE	PS NAME
f 2	C001	abc Radio
f 5	C003	def FM
f 7	C005	ghi Station
f 11	C007	jkl Wave
f 18	C014	mno Network
f 25	C021	pqr Radio
f 34	C030	stu FM
f 36	C032	vwx Station
f 43	C039	yz Wave

LATEST LIST OF RECEIVABLE FREQUENCIES

(b)

FREQUENCY	PI CODE	PS NAME	
f 2	C001	abc Radio	
f 5	C003	def FM	
f 7	C005	ghi Station	
f 11	C007	jkl Wave	
f 14	C009	FM Yokohama	← NEW
f 18	C014	mno Network	
f 25	C021	pqr Radio	
f 29	C025	Saitama FM	← NEW
f 34	C030	stu FM	
f 36	C032	vwx Station	
f 43	C039	yz Wave	

**FIG.4**

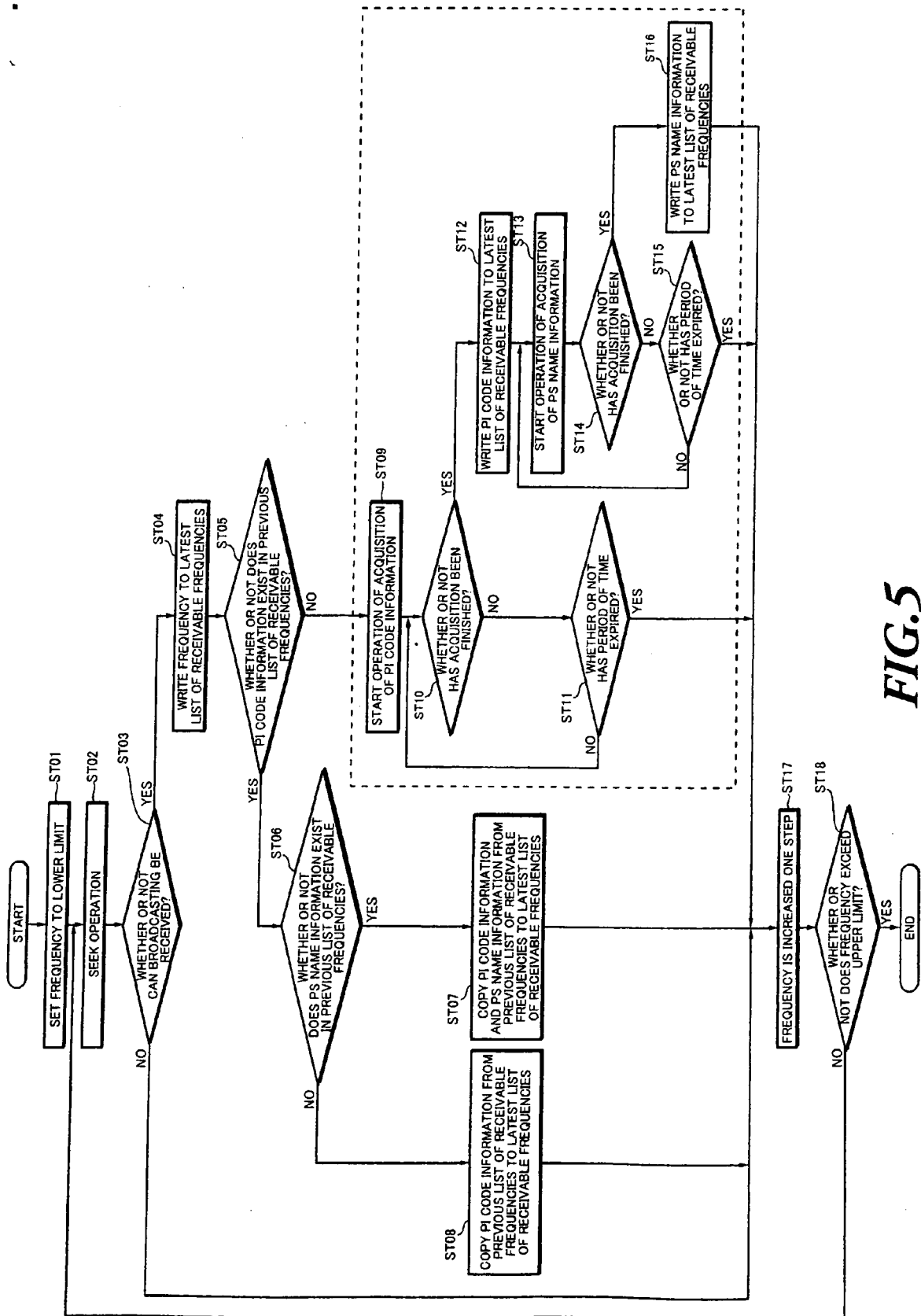


FIG. 5

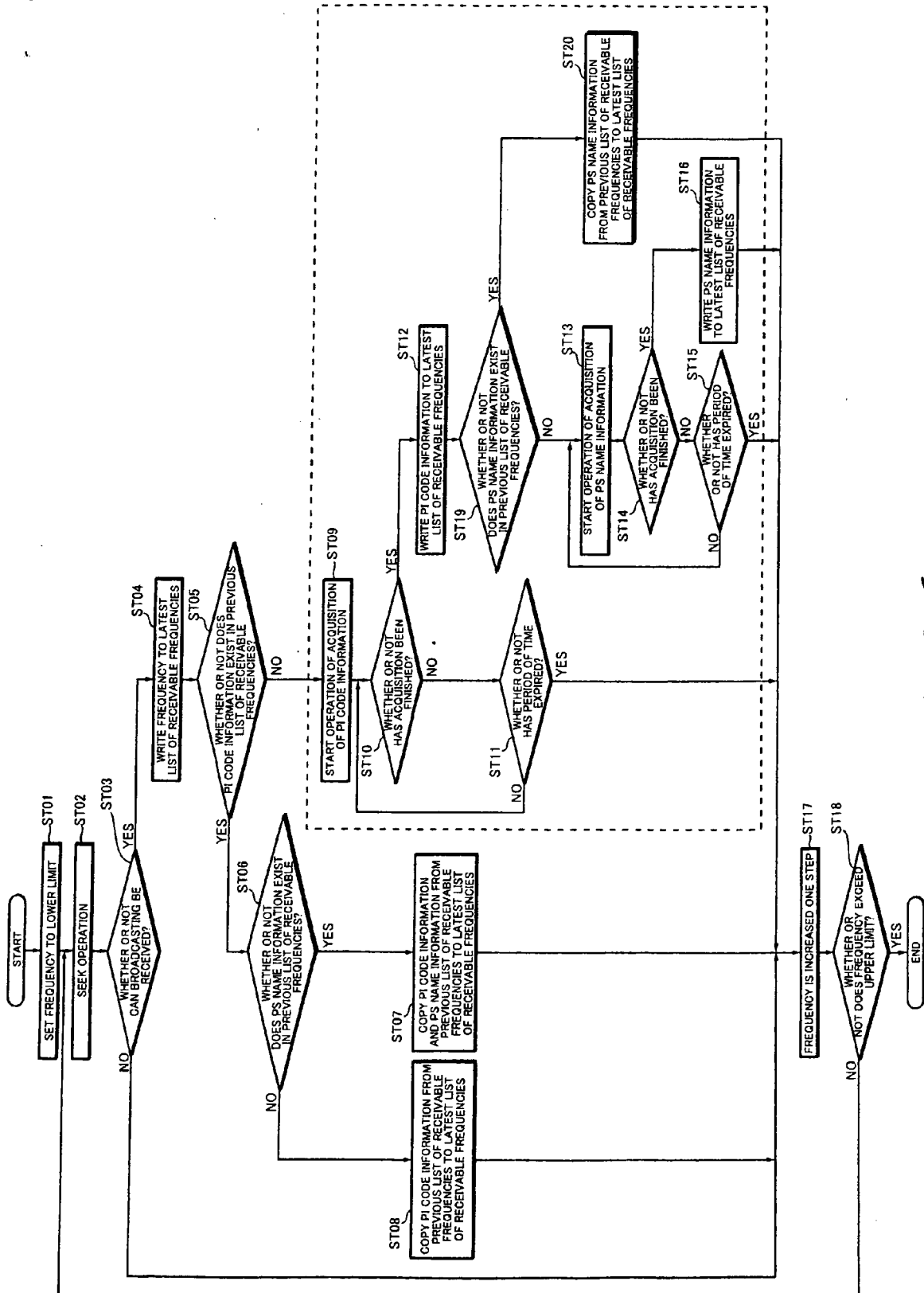


FIG. 6



EUROPEAN SEARCH REPORT

Application Number  
EP 12 15 6588

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 2 285 024 A2 (TOYOTA MOTOR CO LTD [JP]) 16 February 2011 (2011-02-16) * figure 4 * * paragraph [0036] * * paragraph [0040] * * paragraph [0046] * * paragraphs [0053] - [0054] * * paragraph [0060] * * paragraphs [0063] - [0066] * * paragraphs [0108], [0112]; figure 9 * -----	1-7	INV. H04H60/41 H04H20/42
			TECHNICAL FIELDS SEARCHED (IPC)
			H04H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 June 2012	Examiner Torcal Serrano, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 15 6588

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26-06-2012

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EP 2285024	A2	16-02-2011	EP 2285024 A2
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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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