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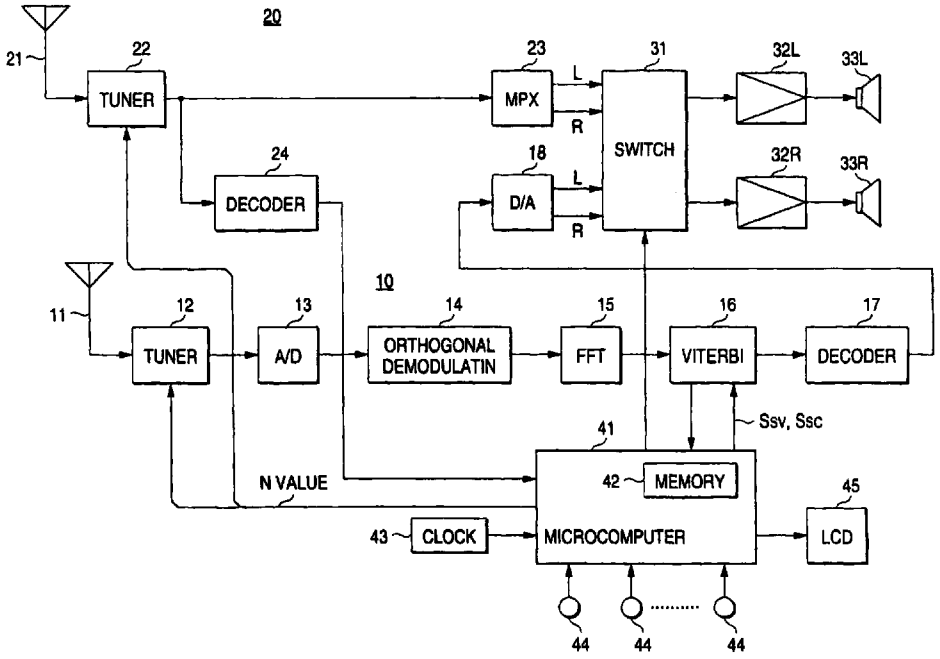
(54) Receiver for receiving both Digital Audio Broadcasts (DAB) as well as frequency modulated (FM) broadcasts comprising supplementary information

(57) The invention relates to a broadcast receiver in which in response to broadcast content data added to a received FM signal, program data of digital audio broadcasting corresponding to the FM program content data are searched from a historical table of frequency data and program data of the digital audio broadcasting, and when the corresponding program data are detected, frequency data are extracted from the historical table, and a reception frequency is set to the extracted frequency data, so that the digital audio broadcasting is received.

FIG. 3



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Description

[0001] The present invention relates to a broadcast receiver for receiving digital audio broadcasting in accordance with broadcast content data added to a received FM signal.

[0002] In FM (Frequency Modulation) broadcasting stations in Europe, there are broadcasting stations which perform an RDS (Radio Data System) service. This RDS service is such that broadcasting is done after adding digital data called RDS data to an original audio signal. The RDS data include the following:

PI (Program Identification) code • • • broadcasting station identification code (program identification code)

PS (Program Service) data • • • character data indicating the name of a broadcasting station

PTY (Program Type) code • • • identification code indicating the content of a program

AF (Alternative Frequencies) list • • • list of alternative frequencies.

[0003] Encode processing for error correction is carried out on the RDS data, and a subcarrier signal having a frequency of 57 kHz, which is a value thee times a frequency of 19 kHz of a stereo pilot signal, is subjected to equilibrium modulation with the RDS data to which this encode processing has been carried out. The modulated signal is added to a stereo composite signal of a main signal to be frequency multiplexed, and a main carrier signal is FM modulated by this multiplexed signal and is transmitted.

[0004] On the other hand, as digital audio broadcasting, there is DAB (Digital Audio Broadcasting) regulated by Eureka 147 standard. The DAB adopts

transmission band width: 1.5 MHz,
modulation system: OFDM (Orthogonal Frequency Division Multiplexing), and
data compression system of an audio signal: layer II of MPEG (Moving Picture Experts Group) audio, so that 64 sets of digital audio signals or digital data at the maximum can be simultaneously broadcast.

[0005] Thus, in the DAB, broadcasting of programs is made a hierarchical structure, for example, as shown in Fig. 1. That is, in the DAB, although one channel uses a transmission band of 1.5 MHz as described above, this transmission channel is called an "ensemble", and the ensemble is selected by tuning to the center frequency of this ensemble.

[0006] This ensemble is divided into groups called "services". In the case of Fig. 1, it is divided into four services. Each service is further divided into some "service components", and each of the service components is made a digital audio signal or digital data constituting one program.

[0007] In this case, one service corresponds to one of the broadcasting stations in FM broadcasting or the like, and is used in such a manner that, for example, a first service component of a first service broadcasts soccer in a first ground (program 1A), a second service component broadcasts soccer in a second ground (program 1B), ...

[0008] Identification codes called "ensemble ID (Identification)" and "service ID" are given to the ensemble and the service, respectively, and the data of the ensemble ID and the service ID are also transmitted. Further, a serial number is given to each service in the service components, and the serial number is transmitted.

[0009] Thus, in the case where a user listens to a program of the DAB, he or she selects a frequency of an ensemble, selects one service or group of a plurality of services contained in the ensemble, and further selects an objective service component, that is, a program in the selected service.

[0010] In the case where programs having the same content are broadcast in the same area and in both the DAB and the FM broadcasting, that is, in the case where the simulcast of the DAB and the FM broadcasting is carried out, if the reception is switched from the FM broadcasting to the DAB, the user can listen to the program in more excellent sound quality. Then, for the purpose of easily realizing this switching, a function called "DAB_FM link" or the like is prepared in the RDS service of the DAB and the FM broadcasting.

[0011] In the DAB_FM link, for example, as shown in Figs. 2A and 2B, when the content of some service of the DAB is identical to some program of the FM broadcasting, the service ID of the service is made identical to the PI code in the FM broadcasting. In the case of Figs. 2A and 2B, since a service 1 of an ensemble α has the same content as an FM station A, the service ID of the service 1 is made identical to the PI code of the FM station A. Besides, since a service 2 has the same content as an FM station B, the service ID of the service 2 is made identical to the PI code of the FM station B.

[0012] Moreover, in order to enrich the DAB_FM link, in the RDS service of the DAB and the FM broadcasting, an identifier called "LSN (Linkage Set Number)" is also transmitted. For example, as shown in Figs. 2A and 2B, when some service of the DAB has the same content as some program of the FM broadcasting, the LSNs of both are made identical to each other. In the case of Figs. 2A and 2B, since the services 1 to 3 of the ensemble α respectively have the same content as the FM stations A to C, the LSNs of the services 1 to 3 are respectively made identical to the LSNs of the FM stations A to C.

[0013] Thus, in the case where the simulcast of the DAB and the FM broadcasting is carried out, by using

the DAB_FM link function to change the FM broadcasting to the DAB, the user can listen to a program in more excellent sound quality.

[0014] If the foregoing DAB_FM link function, that is, the function of searching the services of the DAB by the PI code and the LSN code as keywords is used at the time of listening to the FM broadcasting, the reception can be automatically switched from the FM broadcasting to the DAB.

[0015] However, in this case, a broadcasting station can arbitrarily change the structure of the ensemble. For example, such usage is permitted that only when there are soccer games, the service 1 is prepared and the soccer game in each ground is broadcast, and when there is no game, the service 1 is stopped, that is, it is not contained in the ensemble. Thus, there is a case where when the user tries to receive some service, the service is stopped so that it can not be received.

[0016] Then, in the case where the services of the DAB are searched by using the PI code and the LSN as keywords and are received, it has been considered to execute a routine as set forth below.

[0017] That is,

① The reception frequency of the DAB is set to a minimum value.
② It is judged whether the DAB can be received at the current reception frequency.
③ As a result of ②, when the DAB can not be received, the reception frequency is raised by a prescribed value and the procedure returns to ②.
④ As a result of ②, when the DAB can be received, the service ID or LSN to which the PI code or LSN is identical, is searched.
⑤ As a result of ④, when the identical service ID or LSN can not be detected, the reception frequency is raised by a prescribed value, and the procedure returns to ②.
⑥ As a result of ④, when the identical service ID or LSN can be detected, the service is selected.
⑦ The audio output of the FM broadcasting is switched to the audio output of the DAB.

[0018] Thus, according to the foregoing routine, in the case where the simulcast of the DAB and the FM broadcasting is carried out, it is possible to automatically switch the FM broadcasting to the DAB.

[0019] However, in the foregoing routine, the service having the same content is detected by repeating such processing that an ensemble is detected while seeking the frequency band of the DAB, and the objective service is searched in the ensemble, and the FM broadcasting is switched to the DAB. At this time, 64 service components are prepared for the frequency band of the DAB.

[0020] Thus, it takes a very long time to switch the FM broadcasting to the DAB.

[0021] The present invention is intended to solve such a problem.

[0022] In view of the foregoing problem, the present invention has an object to provide a broadcast receiver comprising:

digital audio broadcast receiving means for receiving broadcast signals of digital audio broadcasting in which a plurality of programs and program data indicating contents of the plurality of programs are broadcast through broadcast signals having predetermined frequencies in a digital audio broadcast band; and FM broadcast receiving means for receiving FM broadcasting added with broadcast content data indicating broadcast contents,

in which the broadcast receiver is characterized by comprising:

storage means for storing a history of frequency data of the digital audio broadcasting and the program data;

FM broadcast content data extracting means for extracting the broadcast content data added to the FM broadcasting under reception by the FM broadcast receiving means; and

setting means for detecting program data from the stored history in response to the extracted broadcast content data to obtain frequency data of the program data, and for setting a frequency of the digital audio broadcasting by the frequency data.

[0023] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Fig. 1 is a hierarchical diagram of an ensemble in a preferred embodiment of the invention;

Fig. 2A is a view of services of DAB for indicating the correspondence between the services of the DAB and programs of FM broadcasting in a preferred embodiment of the invention;

Fig. 2B is a view of the programs of the FM broadcasting for indicating the correspondence between the services of the DAB and the programs of the FM broadcasting in the preferred embodiment of the invention;

Fig. 3 is a structural view showing a DAB • FM receiver in a preferred embodiment of the invention;

Fig. 4 is a flowchart showing a search routine in a preferred embodiment of the invention;

Fig. 5 is a flowchart showing an identical service

search routine in a preferred embodiment of the invention;

Fig. 6 is an explanatory view of a historical table in a preferred embodiment of the invention;

Fig. 7 is a flowchart showing a routine for searching a service having the same content as FM broadcasting under reception from an ensemble not registered in a historical table in a preferred embodiment of the invention; and

Fig. 8 is a flowchart showing a search routine in a case where a program type of a service in a different ensemble is transmitted as data of a different station in a preferred embodiment of the invention.

[0024] In Fig. 3, reference numeral 10 designates a DAB receiving circuit, and reference numeral 20 designates an FM broadcast receiving circuit. In the DAB receiving circuit 10, a broadcast signal of the DAB is received by an antenna 11, and this received signal is supplied to a tuner circuit 12. This tuner circuit 12 includes a PLL (Phase Locked Loop) and is constructed into a superheterodyne form, and a reception frequency can be changed by changing a division ratio N of a variable frequency dividing circuit of the PLL. A baseband signal of the DAB is extracted from this tuner circuit 12, and the baseband signal is supplied to an A/D (Analog/Digital) converter circuit 13 and is A/D converted into a digital signal.

[0025] This digital signal is supplied to an orthogonal demodulating circuit 14, and data of a same phase component (real axis component) and an orthogonal component (imaginary component) are demodulated. These data are subjected to complex Fourier transform at an FFT (Fast Fourier Transform) circuit 15, and a frequency component is outputted for every symbol. The output is supplied to a Viterbi decoder circuit 16, so that de-interleave and error correction are carried out, and digital audio data of an objective service component, that is, a program are selected.

[0026] Subsequently, the selected data are supplied to an audio decoder circuit 17, decode processing such as MPEG data expansion is carried out, and the digital audio data of the objective program is extracted from the decoder circuit 17. The extracted digital audio data are supplied to a D/A (Digital/Analog) converter circuit 18 and are D/A converted into audio signals L (Left) and R (Right), and the signals L and R are supplied to a switch circuit 31.

[0027] This switch circuit 31 is switched between the time of reception of the DAB and the time of reception of the FM broadcasting. At the time of reception of the DAB, the audio signals L and R from the D/A converter circuit 18 are extracted through the switch circuit 31, and the extracted signals L and R are supplied to speakers 33L and 33R through amplifiers 32L and 32R. Thus, in the foregoing case, the user can listen to a service of the DAB.

[0028] Further, in the FM receiving circuit 20, an FM broadcast signal is received by an antenna 21, and this received signal is supplied to a tuner circuit 22. This tuner circuit 22 also includes a PLL and is structured into a superheterodyne form, and a reception frequency can be changed by changing a division ratio N of a variable frequency dividing circuit of the PLL. From this tuner circuit 22, a frequency multiplexing signal of a stereo composite signal and a modulated signal by RDS data is extracted. This multiplexing signal is supplied to a stereo demodulating circuit 23, and audio signals L and R are demodulated. The signals are supplied to the switch circuit 31.

[0029] At the time of reception of the FM broadcasting, the audio signals L and R from the stereo demodulating circuit 23 are extracted through the switch circuit 31, and the extracted signals L and R are supplied to the speakers 33L and 33R through the amplifiers 32L and 32R. Thus, the user can listen to the FM broadcasting.

[0030] At this time, the signal from the tuner circuit 22 is supplied to a decoder circuit 24 and the RDS data are demodulated, and further, they are subjected to error correction and are extracted.

[0031] Moreover, a microcomputer 41 is provided for system control, and as frequency data for selecting an ensemble (reception frequency), data of the division ratio N of the variable frequency dividing circuit in the PLL is supplied from the microcomputer 41 to the tuner circuit 12. Besides, as frequency data for setting a reception frequency, data of the division ratio N of the frequency variable dividing circuit in the PLL is supplied from the microcomputer 41 to the tuner circuit 22.

[0032] Moreover, data necessary for identifying or specifying a service and a service component, that is, data such as a service ID are extracted from the Viterbi decoder circuit 16, and the data are supplied to the microcomputer 41. Besides, selection signals SSV and SSC are supplied from the microcomputer 41 to the Viterbi decoder circuit 16, and the service is selected by the signal SSV, and further, digital audio data of the objective service component are selected from the selected service by the signal SSC.

[0033] Besides, the RDS data outputted from the decoder circuit 24 are supplied to the microcomputer 41.

[0034] Moreover, in the microcomputer 41, as part of programs executed in this microcomputer 41, for example, identical search routines 100 and 200 as shown in Fig. 4 and Fig. 5 are prepared. Although the details of the routines 100 and 200 will be described later, in Fig. 4 and Fig. 5, only portions relating to this invention are selected and shown.

[0035] A memory 42 is provided in the microcomputer 41. This memory 42 is, for example, a flash memory, or although not shown, a nonvolatile memory such

as a RAM backed up by a battery, so that even if a power source is turned off, written data can be held.

[0036] In this memory 42, for example, as shown in Fig. 6, a historical table HTBL including a history of ensembles received in the past is provided. That is, this historical table HTBL stores and holds a plurality of sets, each set being composed of a division ratio N of the variable frequency dividing circuit in the PLL of the tuner circuit 12, an ensemble ID, and a reception time expressed by, for example, year, month, day, and hours, as data when an arbitrary service is received. In the case of Fig. 6, as data when some DAB station is received, the division ratio N1 at that time, the ensemble ID ENID01, and the reception time TIME01 are held at the first line.

[0037] The microcomputer 41 supplies the switch circuit 31 with its control signal, and a clock circuit 43 indicating the current time is connected to the microcomputer 41. Moreover, various operation keys 44 constituted by, for example, push switches are connected, and a display device for displaying various information, for example, an LCD (Liquid Crystal Display) 45 is connected.

[0038] In the foregoing structure, in the case where an ensemble of the DAB is selected by a manual operation or the like and the service is received, the historical table HTBL is updated. That is, in the case where the selected ensemble is not contained in the historical table HTBL, one set of the dividing ratio N at that time, the ensemble ID, and the time indicated by the clock circuit 43 is added to the historical table HTBL. In the case where the selected ensemble is contained in the historical table HTBL, the reception time paired with the division ratio N at that time in the historical table HTBL, that is, the reception time at the same line is updated to the current time indicated by the clock circuit 43.

[0039] Thus, in the historical table HTBL, with respect to the ensemble received in the past, the set of the division ratio N, the ensemble ID, and the reception time at the last reception is registered. When the content of the historical table HTBL is updated, sorting is made so that, for example, the set of data with the latest reception time becomes first.

[0040] When a menu key of the operation key 44 is pressed, a menu is displayed on the LCD 45, and the DAB_FM link function is set effective or ineffective by operating a cursor key and a decision key.

[0041] At the time of reception of FM broadcasting, the switch circuit 31 is connected to the side of the FM receiving circuit 20 by the microcomputer 41, so that the user can listen to the FM broadcasting as described above. In the case where the FM broadcasting is received and the DAB_FM link function is set ineffective, nothing is executed. However, in the case where the DAB_FM link function is set effective, a procedure as set forth below is executed by the microcomputer 41.

[0042] That is, when the received FM broadcasting is changed, the PI code contained in the RDS data from the decoder circuit 24 is changed, and a procedure in the microcomputer 41 starts from step 101 of the routine 100.

[0043] Next, at step 102, it is judged whether the PI code of the RDS data has been obtained from the decoder circuit 24, and in the case where it has been obtained, the procedure proceeds from step 102 to step 103. At this step 103, the routine 200 is executed, and in the case where the service ID or LSN identical to the PI code or LSN of the RDS data is obtained from the DAB receiving circuit 10, the service giving the service ID is selected in the DAB receiving circuit 10.

[0044] That is, in the routine 200, the processing of the microcomputer 41 starts from step 201, and next, at step 202, it is judged whether reception has been executed for all division ratios N registered in the historical table HTBL. In the case where there is a division ratio N at which reception has not been executed, the procedure proceeds from step 202 to step 203. At this step 203, the division ratio N of a frequency at which reception has not been executed in the historical table HTBL is read out from the historical table HTBL and is set in the tuner circuit 12, and the reception frequency is set.

[0045] Subsequently, at step 204, it is judged whether an ensemble can be received at the current reception frequency, and when it can not be received, the procedure returns from step 204 to step 202. Thus, the steps 202 to 204 are repeated until the ensemble can be received, and the ensemble is changed.

[0046] Then, at step 204, when it is judged that the ensemble can be received at the current reception frequency, the procedure proceeds from step 204 to step 211, and at this step 211, the historical table HTBL is updated. In the foregoing case, in the historical table HTBL, the reception time paired with the division ratio N which is set at step 203 and gives the current reception frequency is updated by the current time indicated by the clock circuit 43.

[0047] Next, at step 212, it is searched whether a service having the same content as the program under reception in the FM receiving circuit 20 is contained in the services of the ensemble received by the DAB receiving circuit 10. This search is executed in such a manner that the PI code and the LSN of the RDS data outputted from the decoder circuit 24 are sequentially used as key words to search the service ID and the LSN obtained from the Viterbi decoder circuit 16.

[0048] The result of this search is judged at step 213, and in the case where a service having the same content as the program under reception in the FM receiving circuit 20 is not contained in the services of the ensemble received by the DAB receiving circuit 10, the procedure returns from step 213 to step 202. Thus, the steps 202 to 213 are repeated until the service having the same content as the program under reception in the FM receiving circuit 20 comes to be contained in the services of the ensemble received by the DAB receiving circuit 10, and the ensemble is changed.

[0049] When the service having the same content as the program under reception in the FM receiving circuit 20 comes to be contained in the services of the ensemble received by the DAB receiving circuit 10, this is detected at step 213, and the procedure proceeds from step 213 to step 221.

[0050] At step 221, the selecting signal SSV for specifying the service having the same content as the program under reception in the FM receiving circuit 20, and the selecting signal SSC for specifying, for example, the first service component in the service are supplied to the Viterbi decoder circuit 16, so that the service is selected and the service component is selected. Thus, from this point of time, the DAB receiving circuit 10 receives the service having the same content as the program under reception in the FM receiving circuit 20.

[0051] Next, at step 222, a service setting flag SFLG is set to "1", and then, this routine 200 is ended at step 223.

[0052] At step 202, when the service having the same content as the program under reception in the FM receiving circuit 20 is not contained in the services of the ensemble received by the DAB receiving circuit 10 though reception has been executed for all division ratios N registered in the historical table HTBL, the procedure proceeds from step 202 to step 224, and at step 224, SFLG = "0" is set, and then, the routine 200 is ended at step 223.

[0053] As described above, according to the routine 200, in the case where the service having the same content as the program under reception in the FM receiving circuit 20 is contained in the services of the ensemble of the DAB, the ensemble and the service are received and selected in the DAB receiving circuit 10, and SFLG = "1" is set. In the case where the service having the same content as the program under reception in the FM receiving circuit 20 is not contained in the services of the ensemble of the DAB, SFLG = "0" is set.

[0054] When the routine 200 is ended, the procedure proceeds from step 103 to step 104 in the routine 100, and at this step 104, the service setting flag SFLG is judged, and in the case of SFLG = 1, the procedure proceeds from step 104 to step 105, and at this step 105, the switch circuit 31 is connected to the side of the DAB receiving circuit 10, and then, this routine 100 is ended at step 106.

[0055] Thus, from the point of time when step 105 is executed, the program to which the user listens in the FM broadcasting is switched to the service having the same content in the DAB.

[0056] At step 102, when the PI code of the RDS data can not be obtained from the decoder circuit 24, the procedure proceeds from step 102 to step 106, and switching from the FM broadcast to the DAB is not executed.

[0057] At step 104, in the case where SFLG = "0" is set, that is, the service having the same content as the program under reception in the FM broadcasting can not be received in the DAB, the procedure proceeds from step 104 to step 106, and switching from the FM broadcasting to the DAB is not executed.

[0058] As described above, according to the DAB • FM receiver of Fig. 3, in the case where the service having the same content as the FM broadcasting under reception is broadcast through the DAB, the FM broadcasting can be automatically switched to the service of the DAB. In this case, especially according to the routines 100 and 200, it is designed such that the ensembles having been received in the past are received, and it is detected whether the objective service having the same content as the FM broadcasting is broadcast in the DAB. Thus, the detection can be made in a short time, and it becomes possible to listen to the objective service through the DAB in a short time.

[0059] In the above, in the case where the routine 200 is executed at step 103, and when the service having the same content as the FM broadcasting under reception can not be received from the ensemble registered in the historical table HTBL, the service having the same content as the FM broadcasting under reception is not searched any longer. In a routine 300 shown in Fig. 7, in the case where the routine 200 is executed at step 103, and when the service having the same content as the FM broadcasting under reception can not be received in the ensemble registered in the historical table HTBL, the service having the same content as the FM broadcasting under reception is further searched from an ensemble not registered in the historical table HTBL.

[0060] That is, the routine 300 of Fig. 7 is also executed at step 103 of the routine 100, and steps from step 201 to step 223 are constructed similarly to the routine 200. Thus, if the service having the same content as the FM broadcasting under reception is contained in the ensemble registered in the historical table HTBL, the service can be selected in a short time in the manner as described above, and the FM broadcasting is switched to the DAB.

[0061] However, in the case where it is judged at step 202 that the service having the same content as the FM broadcasting under reception is not contained in the ensemble registered in the historical table HTBL, the procedure proceeds from step 202 to step 331. At step 331, it is judged whether there is a division ratio N which is not registered in the historical table HTBL and at which search for services has not been executed.

[0062] In the case where there is a division ratio N at which search for the services has not been executed, the procedure proceeds from step 331 to step 332, and at this step 332, the division ratio N at which the service has not been searched is set in the tuner circuit 12, and then, the procedure proceeds to step 204.

[0063] Thus, even if the frequency of the division ration N is not registered in the historical table HTBL, if an ensemble is broadcast and the service having the same content as the FM broadcasting under reception

is contained in the ensemble, the service of the ensemble is received and selected in the DAB receiving circuit 10, and SFLG = "1" is set.

[0064] In the foregoing case, at step 211, the historical table HTBL is updated, and a set of the division ratio N, the ensemble ID, and the time indicated by the clock circuit 43 is added and registered in the historical table HTBL.

[0065] Besides, in the case where the service having the same content as the FM broadcasting under reception can not be received even at a frequency of a division ratio N not registered in the historical table HTBL, the procedure proceeds from step 331 to step 224, and at this step 224, SFLG = "0" is set, and then, the routine 300 is ended at step 223.

[0066] Thus, according to this routine 300, with respect to the service having the same content as the FM broadcasting under reception, the ensemble received in the past is first searched, and further, all ensembles are searched, so that the search can be made in a short time without fail.

[0067] In the DAB, it is possible to transmit a program type of a service in a different ensemble as the data of a different station. Then, in a routine 400 shown in Fig. 8, such a case is shown that in the case where the foregoing data are transmitted, the data are also used.

[0068] That is, the routine 400 is also executed at step 103 of the routine 100. In this routine 400, steps from step 201 to step 332 are constructed similarly to the routine 300, and a step 401 is provided between step 201 and step 202. At this step 401, it is judged whether program types of services in a different ensemble are transmitted.

[0069] When they are transmitted, the procedure proceeds from step 401 to step 402, and at this step 402, it is searched whether a program type of a service having the same content as the FM broadcasting under reception exists in the program types of the services of the transmitted different ensemble. In the case where the program type of the service having the same content as the FM broadcasting under reception exists, the procedure proceeds from step 402 to step 403. At this step 403, the reception frequency is set to the ensemble containing the service having the same content as the FM broadcasting under reception, and then, the procedure proceeds to step 204, and thereafter, the search and the reception of the service having the same content as the broadcasting under reception is executed.

[0070] At step 401, in the case where program types of services in a different ensemble are not transmitted, or at step 402, in the case where the program type of the service having the same content as the FM broadcasting under reception does not exist in program types of services in a transmitted different ensemble, the procedure proceeds from step 401 or step 402 to step 202, and thereafter, the search process is executed as described above.

[0071] In the foregoing case, at step 204, in the case where the ensemble can not be received, the procedure returns from step 204 to step 401. At step 213, in the case where the service having the same content as the FM broadcasting under reception is not contained in the ensemble under reception, the procedure returns from step 213 to step 401.

[0072] As described above, according to the routine 400, in the case where the program type of the service in the different ensemble is transmitted as data of the different station, search and reception of the objective service is executed by using the data. Thus, it is possible to switch to the service having the same content as the FM broadcasting under reception in a still shorter time.

[0073] In the routines 200 to 400, in the case where the reception frequency is set to the ensemble registered in the historical table HTBL, and when the ensemble can not be received, the set of the data with respective to the ensemble may be deleted from the historical table HTBL.

[0074] According to the present invention, in the case where a program having the same content as FM broadcasting under reception is broadcast in digital audio broadcasting, the FM broadcasting can be automatically switched to the program of the digital audio broadcasting. In that case, the program in the digital audio broadcasting can be received in a short time. Moreover, it is possible to certainly detect the program having the same content in the digital audio broadcasting.

Claims

1. A broadcast receiver comprising:

digital audio broadcast receiving means for receiving broadcast signals of digital audio broadcasting in which a plurality of programs and program data indicating contents of the plurality of programs are broadcast through broadcast signals having predetermined frequencies in a digital audio broadcast band; and

FM broadcast receiving means for receiving FM broadcasting added with broadcast content data indicating broadcast contents,
wherein the broadcast receiver further comprises:

storage means for storing a history of frequency data of the digital audio broadcasting and the program data;

FM broadcast content data extracting means for extracting broadcast content data added to FM broadcasting under reception by the FM broadcast receiving means; and

setting means for detecting program data from the stored history in response to the extracted broadcast content data to obtain frequency data of the program data, and for setting a reception frequency of the digital audio broadcast receiving means in response to the obtained frequency data.

2. A broadcast receiver according to claim 1, further comprising selecting means for selecting a program corresponding to the FM broadcasting under reception from the plurality of programs by the program data.

3. A broadcast receiver according to claim 1 or 2, wherein when the program data are not detected from the stored history, in response to the extracted broadcast content data, among the broadcast signals in the digital audio broadcast band, different program data are detected from a broadcast signal corresponding to program data not stored in the storage means, different frequency data corresponding to the different program data are obtained, and a reception frequency of the digital audio broadcast receiving means is set in response to the different frequency data.

4. A broadcast receiver according to claim 1, 2 or 3, wherein the storage means is a nonvolatile memory.

5. A broadcast receiver according to any one of the preceding claims, wherein the broadcast content data indicating the broadcast contents added to the FM broadcasting are RDS data.

6. A broadcast receiver according to any one of the preceding claims, wherein the frequency data of the digital audio broadcasting in the history stored in the storage means are a division ratio of a variable frequency dividing circuit in a PLL of the digital audio broadcast receiving means, and the program data are ensemble ID.

7. A broadcast receiver according to any one of the preceding claims, wherein the history includes a reception time.

8. A broadcast receiver according to any one of the preceding claims, wherein the history is updated in response to reception of the broadcast signal of the digital audio broadcasting.

9. A broadcast receiver comprising:

first receiving means for receiving a first broadcast signal; and

second receiving means for receiving a second broadcast signal,

wherein the broadcast receiver further comprises: code extracting means for extracting a first code contained in the first broadcast signal while the first broadcast signal is under reception; and

storage means for storing a second code contained in the second broadcast signal and frequency data of the second broadcast signal, wherein

the second code corresponding to the extracted first code is detected from the storage means to obtain frequency data of the second broadcast signal corresponding to the second code, and

reception by the first receiving means is replaced with a reception state by the second receiving means based on the obtained frequency data.

10. A broadcast receiver according to claim 9, wherein the second broadcast signal includes a plurality of programs, and

the broadcast receiver includes selecting means for selecting a program corresponding to the first broadcast signal under reception from the plurality of programs of the second broadcast signal by the detected second code.

11. A broadcast receiver according to claim 9 or 10, wherein when the second code corresponding to the extracted first code is not detected from the storage means while the first broadcast signal is under reception, the second code corresponding to the extracted first code is detected from the second broadcast signal, frequency data corresponding to the detected second code are obtained, and reception of the first broadcast signal is switched to reception of the second broadcast signal in response to the reception frequency data.

12. A broadcast receiver according to claim 9, 10 or 11, wherein storage contents of the storage means are updated in response to reception of the second broadcast signal.

13. A broadcast receiver according to claim 9, 10, 11 or 12, wherein the second broadcast signal is a digital signal.

FIG. 1

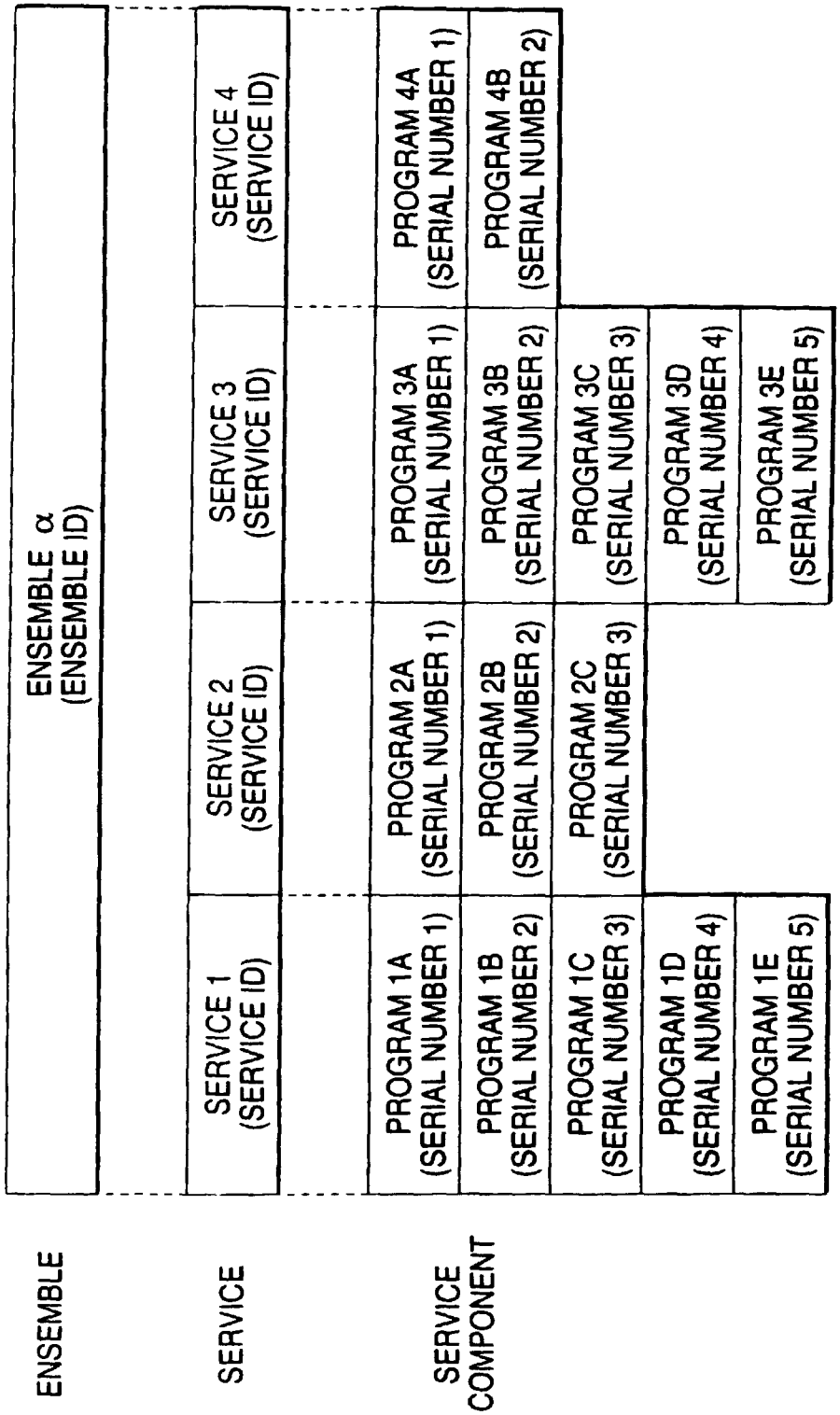

ENSEMBLE
SERVICE
SERVICE COMPONENT
ENSEMBLE α (ENSEMBLE ID)
SERVICE 1 (SERVICE ID)
SERVICE 2 (SERVICE ID)
SERVICE 3 (SERVICE ID)
SERVICE 4 (SERVICE ID)
PROGRAM 1A (SERIAL NUMBER 1)
PROGRAM 1B (SERIAL NUMBER 2)
PROGRAM 1C (SERIAL NUMBER 3)
PROGRAM 1D (SERIAL NUMBER 4)
PROGRAM 1E (SERIAL NUMBER 5)
PROGRAM 2A (SERIAL NUMBER 1)
PROGRAM 2B (SERIAL NUMBER 2)
PROGRAM 2C (SERIAL NUMBER 3)
PROGRAM 3A (SERIAL NUMBER 1)
PROGRAM 3B (SERIAL NUMBER 2)
PROGRAM 3C (SERIAL NUMBER 3)
PROGRAM 3D (SERIAL NUMBER 4)
PROGRAM 3E (SERIAL NUMBER 5)
PROGRAM 4A (SERIAL NUMBER 1)
PROGRAM 4B (SERIAL NUMBER 2)

FIG. 2A

ENSEMBLE α		
SERVICE	SERVICE ID	LSN
SERVICE 1	C221	1
SERVICE 2	C222	2
SERVICE 3	****	4
SERVICE 4	****	5

FIG. 2B

FM (RDS)		
FM STATION	PI CODE	LSN
FM STATION A	C221	1
FM STATION B	C222	2
FM STATION C	C223	4

FIG. 3

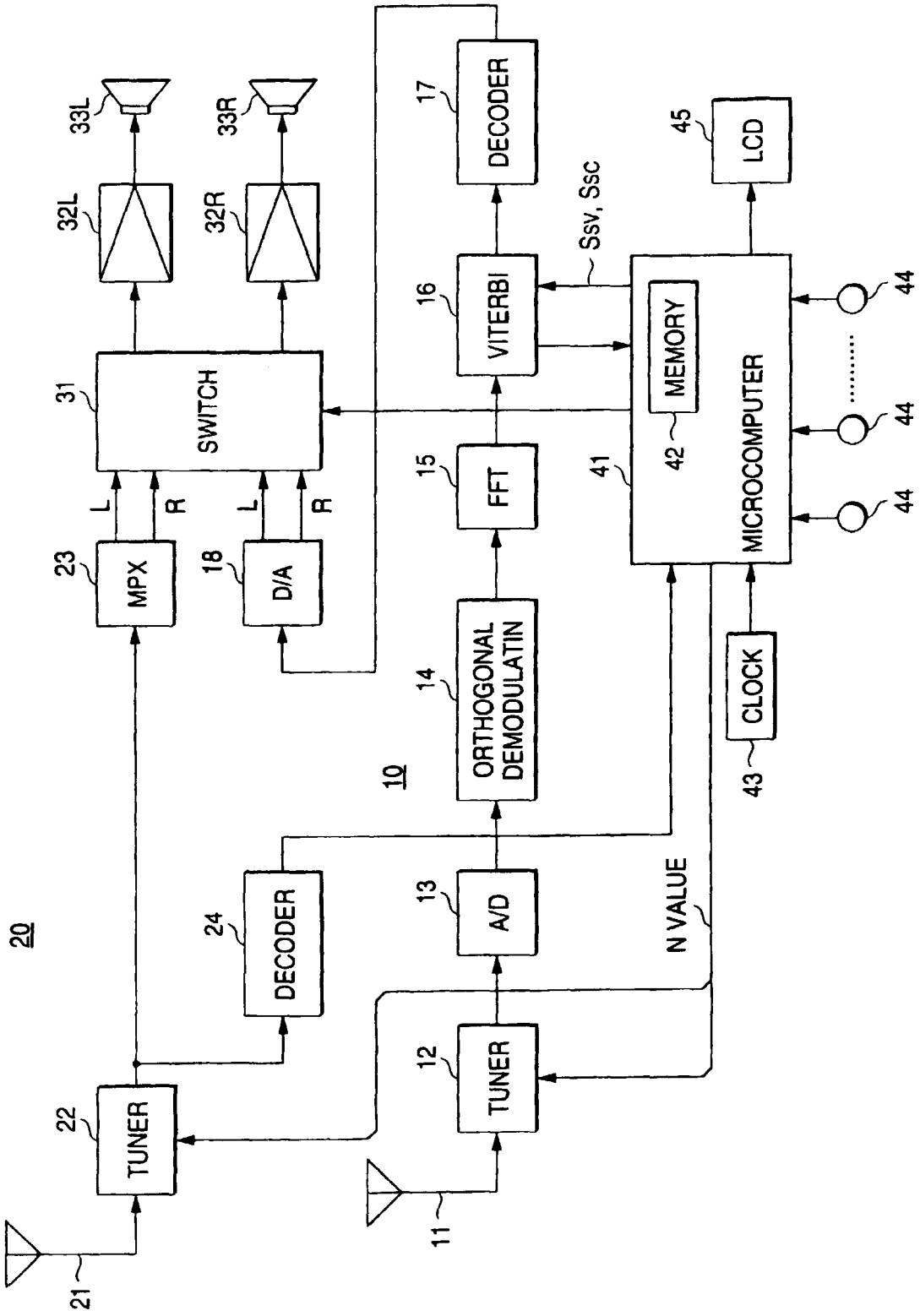

20
10
21
22
TUNER
23
MPX
L
R
31
SWITCH
32L
32R
33L
33R
24
DECODER
11
12
TUNER
13
A/D
14
ORTHOGONAL DEMODULATIN
15
FFT
16
VITERBI
17
DECODER
18
D/A
L
R
Ssv, Ssc
N VALUE
41
MICROCOMPUTER
42
MEMORY
43
CLOCK
45
LCD
44
44
44

FIG. 4

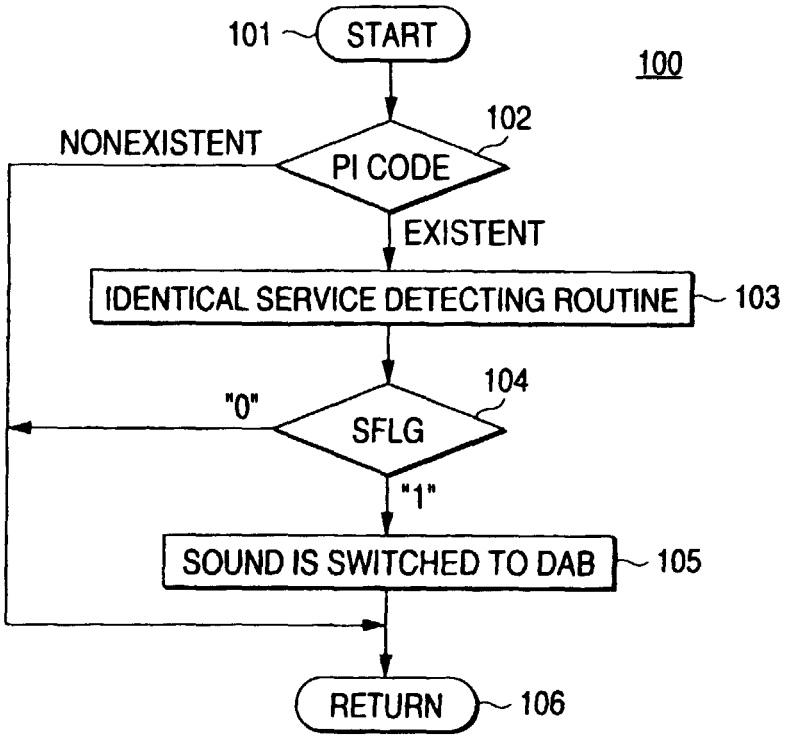

101
START
100
102
NONEXISTENT
PI CODE
EXISTENT
IDENTICAL SERVICE DETECTING ROUTINE
103
104
"0"
SFLG
"1"
SOUND IS SWITCHED TO DAB
105
RETURN
106

FIG. 5

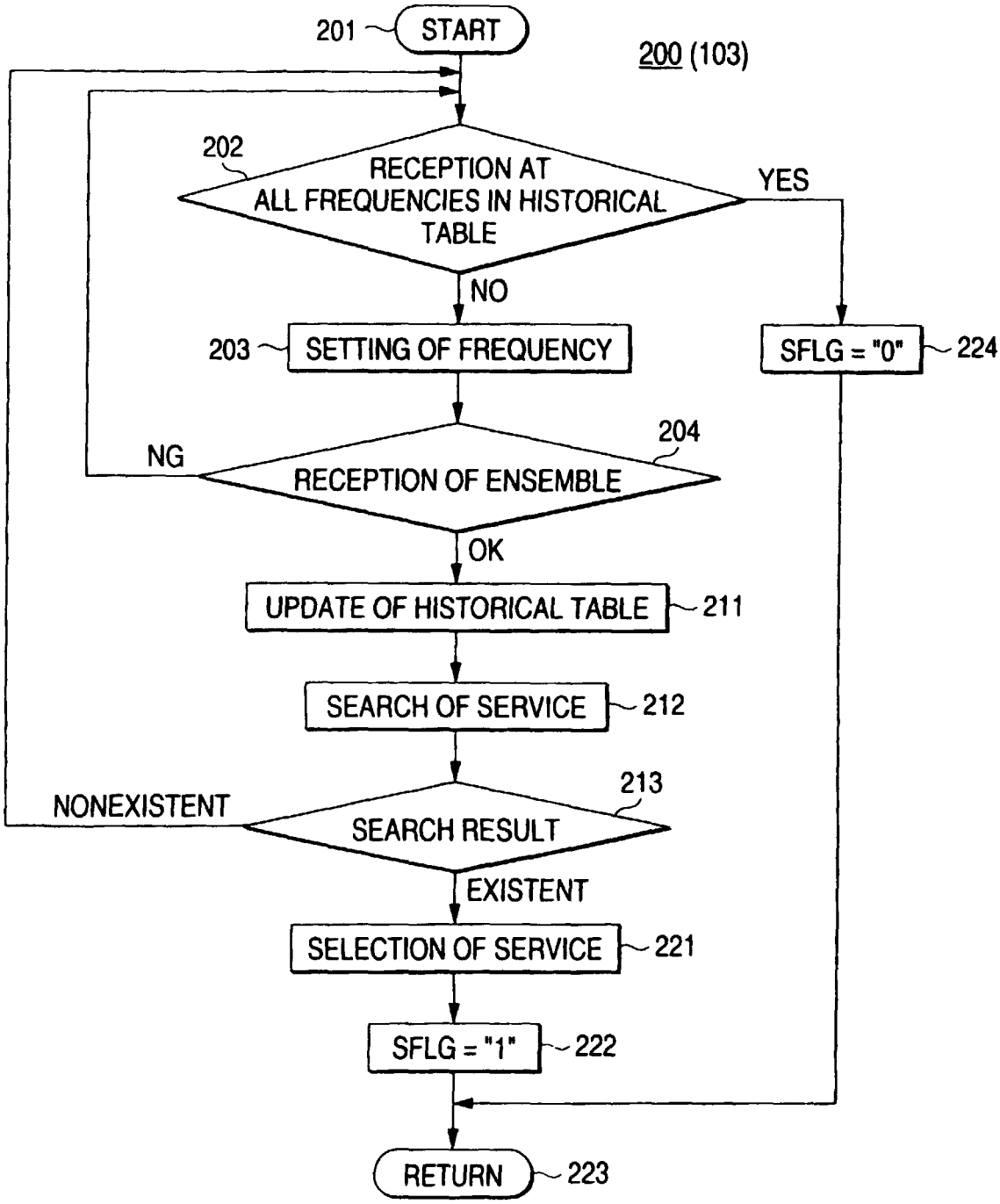

201
START
200 (103)
202
RECEPTION AT ALL FREQUENCIES IN HISTORICAL TABLE
YES
NO
203
SETTING OF FREQUENCY
SFLG = "0"
224
204
NG
RECEPTION OF ENSEMBLE
OK
UPDATE OF HISTORICAL TABLE
211
SEARCH OF SERVICE
212
213
NONEXISTENT
SEARCH RESULT
EXISTENT
SELECTION OF SERVICE
221
SFLG = "1"
222
RETURN
223

FIG. 6

VALUE N	ENSEMBLE ID	RECEPTION TIME
N 1	ENID01	TIME01
N 2	ENID02	TIME02
N 3	ENID03	TIME03
N 4	ENID04	TIME04
⋮	⋮	⋮

HLBL HISTORICAL TABLE

FIG. 7

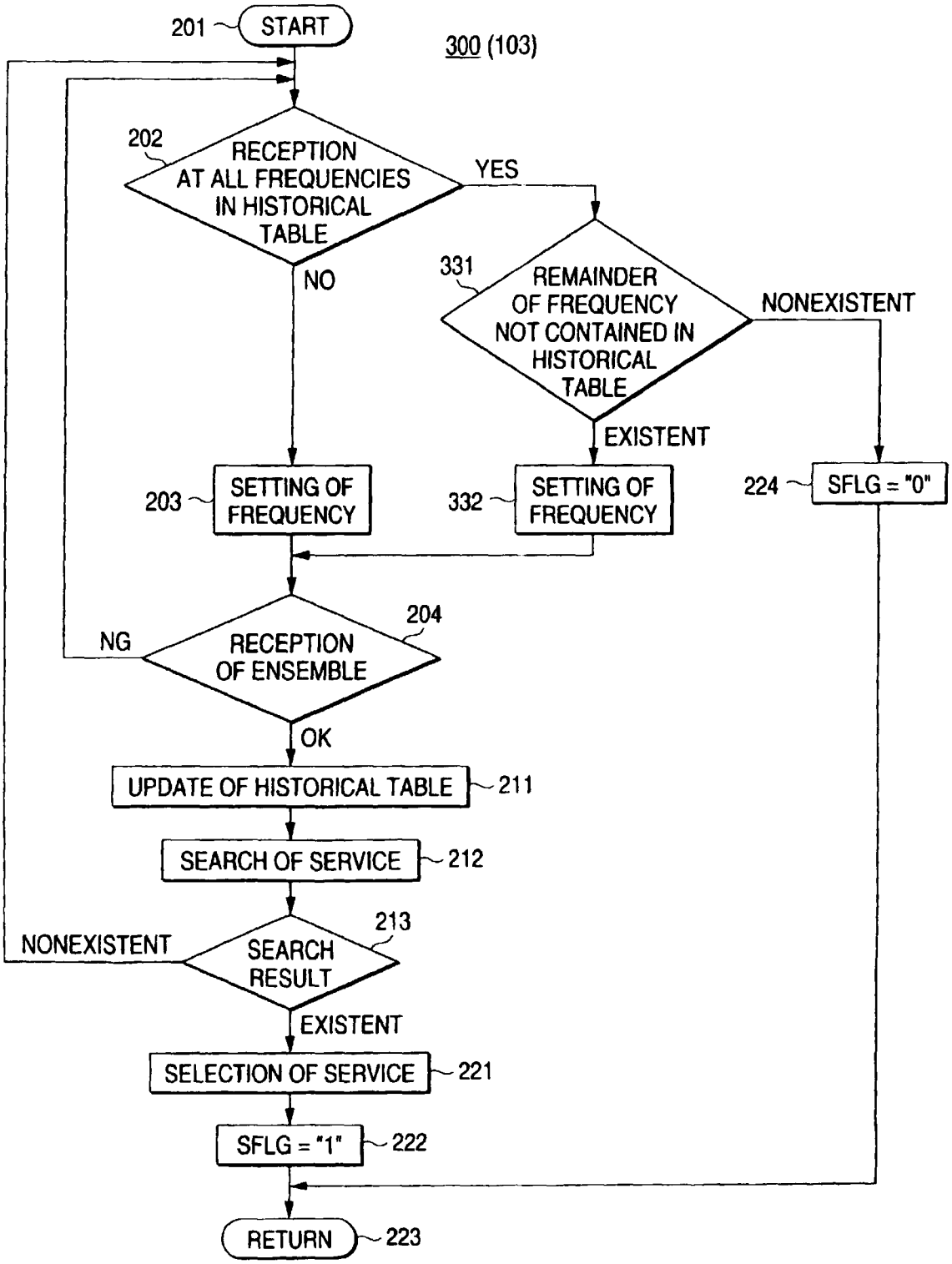
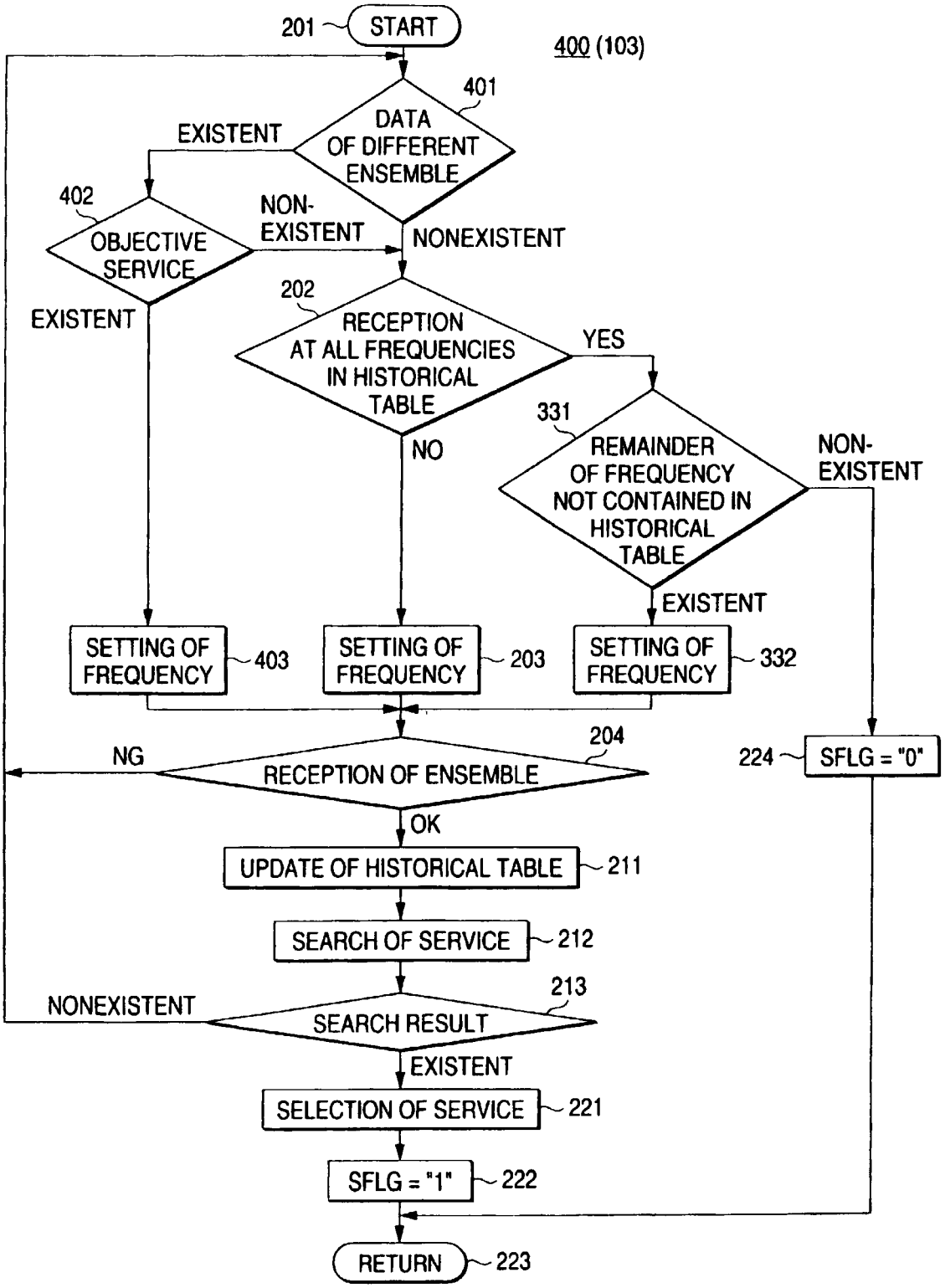

201
START
300 (103)
202
RECEPTION AT ALL FREQUENCIES IN HISTORICAL TABLE
YES
NO
331
REMAINDER OF FREQUENCY NOT CONTAINED IN HISTORICAL TABLE
NONEXISTENT
EXISTENT
203
SETTING OF FREQUENCY
332
SETTING OF FREQUENCY
224
SFLG = "0"
204
NG
RECEPTION OF ENSEMBLE
OK
UPDATE OF HISTORICAL TABLE
211
SEARCH OF SERVICE
212
213
NONEXISTENT
SEARCH RESULT
EXISTENT
SELECTION OF SERVICE
221
SFLG = "1"
222
RETURN
223

FIG. 8


201
START
400 (103)
401
DATA OF DIFFERENT ENSEMBLE
EXISTENT
402
OBJECTIVE SERVICE
NON-EXISTENT
NONEXISTENT
EXISTENT
202
RECEPTION AT ALL FREQUENCIES IN HISTORICAL TABLE
YES
NO
331
REMAINDER OF FREQUENCY NOT CONTAINED IN HISTORICAL TABLE
NON-EXISTENT
EXISTENT
SETTING OF FREQUENCY
403
SETTING OF FREQUENCY
203
SETTING OF FREQUENCY
332
204
NG
RECEPTION OF ENSEMBLE
224
SFLG = "0"
OK
UPDATE OF HISTORICAL TABLE
211
SEARCH OF SERVICE
212
213
NONEXISTENT
SEARCH RESULT
EXISTENT
SELECTION OF SERVICE
221
SFLG = "1"
222
RETURN
223