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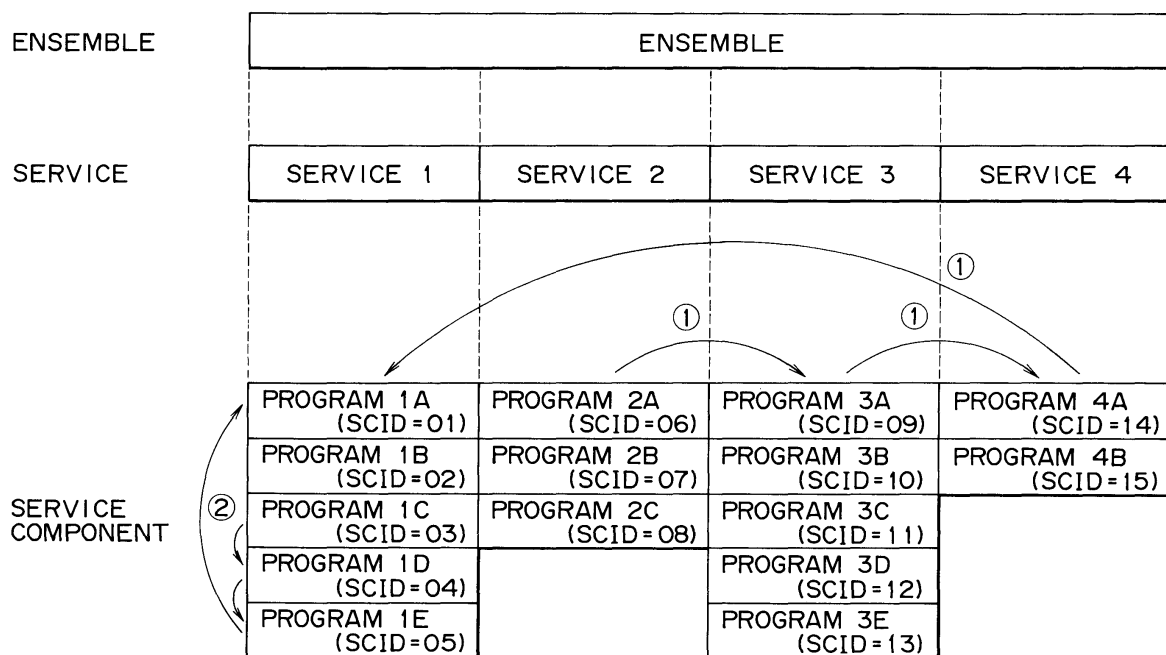
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(54) **Receiver for receiving Digital Audio Broadcast (DAB) programmes**

(57) A receiver of digital audio broadcasting for broadcasting a plurality of programs through a single transmission band, comprising: a scanning operation section and a scanning stop operation section which are connected to a control section, wherein, by operating said scanning operation section, at least some of said

plurality of programs are selected in sequence and broadcast respectively for the designated time and, by operating said scanning stop operation section during the broadcasting of a specified program of said plurality of programs for the designated time, the specified program is broadcast successively, thus enabling an easy search for a favorite program.

FIG. 5



Description

[0001] This invention relates to a receiver for receiving digital audio broadcasts.

[0002] In Europe, DAB (digital audio broadcasting conforming to Eureka 147 Standard) has been performed as a digital audio broadcast. The DAB employs 1.5 MHz transmission band width, OFDM (orthogonal frequency division multiplex) modulation system, and MPEG audio layer II for data compression of audio signals and can broadcast a maximum of 64 programs of digital audio signal and digital data.

[0003] In the DAB, a program is hierarchized, for example, as shown in FIG. 5. In detail, the DAB uses 1.5 MHz transmission band for 1 channel as described herein above, the channel is called "ensemble", and the ensemble is tuned by tuning to the center frequency of this ensemble.

[0004] The ensemble is divided into groups called "service". In the case of FIG. 5, the ensemble is divided into four services. A service corresponds to one general FM broadcasting station, and a service is further divided into several "service components", each service component corresponds to one digital audio signal or digital data. A service component is added with codes called "sub-channel ID" namely codes SCID 01 to SCID 15 in the case shown in FIG. 5 to identify the service component.

[0005] Therefore, it is necessary to listen to a broadcast that an ensemble (frequency) is selected, one service is selected from among a plurality of services in the ensemble, and an desired service component (program) is selected from among the selected services.

[0006] However, it is troublesome and inconvenient to perform the operation as described herein above to listen to a broadcast. Furthermore, it takes a considerable amount of time to find a desired program from among many programs (service component) In addition, it is dangerous to do such an operation when a user wants to listen to DAB while driving a car.

[0007] It is the object of the present invention to alleviate such a problem.

[0008] To achieve the object of the present invention, the present invention provides a receiver of digital voice broadcasting for broadcasting a plurality of programs through a single transmission band, comprising: a scanning operation section and a scanning stop operation section which are connected to a control section, wherein, by operating said scanning operation section, at least any of said plurality of programs are selected in sequence and broadcast respectively for the designated time and, by operating said scanning stop operation section during the broadcasting of a specified program of said plurality of programs for the designated time, the specified program is broadcast successively. If the second key operation is performed when any favorite program is being received, the program can be listened to continuously after that time.

[0009] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

[0010] FIG. 1 is a system diagram for illustrating 1 embodiment of the present invention.

[0011] FIG. 2 is a flowchart for describing 1 embodiment of the present invention.

[0012] FIG. 3 is a flowchart for describing 1 embodiment of the present invention.

[0013] FIG. 4 is a flowchart for describing 1 embodiment of the present invention.

[0014] FIG. 5 is a hierarchical diagram for describing the present invention.

[0015] In FIG. 1, a broadcast wave signal of DAB is received by antenna 11, the received signal is supplied to a superheterodyne type tuner circuit 12 and converted to an intermediate frequency signal, and the intermediate frequency signal is supplied to an A/D converter circuit 13 to generate a digital signal.

[0016] The digital signal is supplied to an orthogonal demodulation circuit 14 to demodulate the same phase component (real axis) and orthogonal component (imaginal axis), these data are supplied to an FFT (fast Fourier transform) circuit 15 for complex Fourier transformation to generate frequency component for each symbol, the output is supplied to a Viterbi decoder circuit 16 for deinterleaving and error correction and selecting a program (service component) to select a digital audio data of a desired program.

[0017] Subsequently, the selected data is supplied to an audio decoder 17 for performing decoding processing such as MPEG data expansion, and the decoder circuit 17 generates the digital audio data of a desired program. The generated digital audio data is supplied to a D/A converter circuit 18 to D/A-convert to an analogue audio signal, and the audio signal is supplied to a speaker 21 by way of an amplifier 19.

[0018] Furthermore, a synchronizing circuit 31 comprising, for example, DSP performs AFC of the tuner circuit 12, and performs processing such as synchronization in the FFT circuit 15. A control section, that is, a microcomputer 32 is provided for system controlling to thereby take access to predetermined signal between the synchronizing circuit 31 and Viterbi decoder circuit 16 and audio decoder circuit 17, and selection of reception frequency (ensemble) in the tuner circuit 12 is performed by way of the synchronizing circuit 31. Furthermore, operation means 33 comprising various operational keys such as a menu key, selection keys, an introduction scanning introduction scanning stop key, and an introduction time setting key as input means is connected to the microcomputer 32, and, for example, a display element 34 comprising an LCD is also connected to the microcomputer 32.

[0019] When a key corresponding to a desired program (service component) out of the operation means 33, the Viterbi decode circuit 16 selects the program by way of the microcomputer 32, the audio signal of the

program is supplied to the speaker 21, thus the program can be listened to. At that time, the display element 34 displays the information on the selected program.

[0020] Furthermore, for example, program selection routines 100 to 300 as shown in FIG. 2 to FIG. 4 are ready for use in the microcomputer 32 as a part of the program executed in the microcomputer 32, and the selection of a program is realized by any one of selection modes ① to ③. The case in which an ensemble of the program content shown in FIG. 5 is received is described herein under.

① Service mode

[0021] For example, when this mode is implemented during listening to a program 1B in the active state of the receiver, the program is selected in the order from program 2A, program 3A, program 4A, and to program 1A, and these programs are received (reproduced) and changed for, for example, 10 seconds for each program. For example, when a desired key is pressed during reception of program 3A, after that, program 3A is received continuously.

[0022] In other words, in this service mode, service components of the minimum sub-channel ID out of respective services are selected and received for a predetermined amount of time for each service component successively (introduction scanning operation), and when the introduction scanning introduction scanning stop key of the operation means 33 is operated during reception of an arbitrary program, the service component (program) which is being received, that is, program 3A in this case is listened to continuously.

[0023] In detail, when the menu key of the operation means 33 is pressed, the menu which indicates names of processing or function is displayed on the display element 34, and if "introduction function" is selected from among names, then item names "service mode", "component mode", and "all mode" are displayed.

[0024] In this case, if "service mode" is instructed and selected by a selection key, processing of the microcomputer 32 starts from step 101 of the routine 100, and the number of services included in the ensemble which is now being received is counted in the next step 102.

[0025] Next, the processing proceeds to step 111, the first service component next to the service including the service component which is received until now is selected and received. In this case, program 1B is being received and the service which includes program 1B is the service 1, and the next service is the service 2 and the first service component is the service component 2A, therefore program 2A is scanned and selected. The service next to the service 4 which is the last service is the service 1.

[0026] Subsequently, the processing proceeds to step 112, whether the amount of time set by a user previously, or 10 seconds has passed after the service component which is now being received is selected is

checked, if the check result is NO, the processing proceeds to step 113 from step 112. It is checked whether the introduction scanning stop key of the operation means 33 is pressed in step 113, and if the check result is NO, the processing returns to step 112 from step 113.

[0027] Therefore, steps 112 and 113 are repeated after that time, the service component which is now being received is received at longest for, 10 minutes from selection of this service component.

[0028] If 10 seconds has passed without the stop pressed, it is detected in step 112, the processing proceeds to step 114 from step 112, and whether the first service component has been received is checked for all the services counted in step 102, that is in this case, whether all the programs 1A to 4A are received is checked.

[0029] If first service components of all the services are not received, then the processing returns to step 111 from step 114, the service component is switched to the first service component of the next service as described herein above and received.

[0030] Therefore, if the introduction scanning stop key is not pressed, the first service components of respective services are received for, for example, 10 seconds each successively as shown with the arrow ①

[0031] If the first service component of any one of services is received (at that time, steps 112 and 113 are repeated) and the introduction scanning stop key is pressed, then it is detected in step 113, and the processing proceeds to step 129 from step 113 and is brought to an end of the routine 100. Therefore, after that time, the program (service component) which is being received when the introduction scanning stop key is pressed is received continuously.

[0032] If it is detected that the first service components of all the services are received in step 114, the processing proceeds to step 121 from step 114, the service component which has been received before the routine 100 is implemented in step 121, namely program 1B in this case, is selected and received, and thereafter the routine 100 is brought to an end at step 129. Therefore if the first service component of any service is not selected, the processing is returns to reception of the original program.

[0033] Accordingly, in this service mode, as shown with the arrow ① the first programs (service components) of respective services can be listened to for, for example, 10 minutes each, and when the introduction scanning stop key is pressed during listening to the program which the user want to listen to, the program can be listened to continuously after that time. In this case, each program can be received for ten minutes. However, the user can set this reception time with the introduction time setting key in the range from the shortest time when the user can check the contents of each program, for example, 3 seconds to the time when the user can sufficiently check the contents of each program, for example, 20 seconds or so.

②Component mode

[0034] In FIG. 5, this mode is implemented when, for example, program 1B is listened to, then as shown in FIG. 5 with the arrow ② the program is selected in the order from program 1C, program 1D, program 1E, and to program 1A and respective programs are received (reproduced) for, for example, 10 seconds each. When the introduction scanning stop key is pressed during reception of, for example, program 3E, program 3E are received continuously after that time.

[0035] In other words, in the component mode, service components are selected successively and received for a predetermined amount of time each in the service which has been received until now, and when a predetermined key is operated during reception, the service component which is being received at that time is received continuously after that time.

[0036] In detail, when the menu is displayed on the display element 34, selection key "introduction function" item is selected, and selection key "component mode" is selected by use of the menu key, then the processing of the microcomputer 32 starts from step 201 of the routine 200, and the number of service components included in the service which is being received is counted in the next step 202.

[0037] Thereafter, the processing proceeds to step 211, the service component next to the service component which has been received until that time is selected and received. In this case, program 1B is being received, and the next service component is the service component 1C, therefore program 1C is selected and received. The service component next to the service component 1E is regarded as the service component 1A. Namely, the service component next to the last service component is regarded as the first service component.

[0038] Subsequently, the processing proceeds to step 212, whether, for example, 10 seconds has passed after the service component which is now being received is selected is checked, and if the check result is NO, the processing proceeds to step 213 from step 212, and it is checked whether the introduction scanning stop key of the operation means 33 is pressed in step 213, and if the check result is NO, the processing returns to step 212 from step 213.

[0039] Accordingly, steps 212 and 213 are repeated after that, the service component which is being received now is received at longest for, for example, 10 seconds after the service component is selected.

[0040] If 10 seconds has passed without the introduction scanning stop key pressed, it is detected in step 212, the processing proceeds to step 214 from step 212, and whether all the service components counted in step 202 are received is checked, in this case whether all the programs 1A to 1E are received is checked.

[0041] If all the service components are not received, then the processing returns to step 211 from step 214,

the service component is switched to the service component of the next service as described herein above and received.

[0042] Therefore if the introduction scanning stop key is not pressed, then respective service components are received successively for, for example, 10 seconds each as shown with the arrow ②

[0043] If the introduction scanning stop key is pressed during reception of any one of service components (at that time steps 212 and 213 are repeated), then it is detected in step 213, and the processing proceeds to step 229 from step 213 and the routine 200 is brought to an end. Therefore, the program (service component) which is being received when the introduction scanning stop key is pressed is received continuously after that time.

[0044] If it is detected that the service components of all the services are received in step 214, then the processing proceeds to step 221 from step 214, and the service component which has been received before the routine 200 is implemented, in this case program 1B, is selected and received, and thereafter the routine 200 is brought to an end at the step 229. Therefore, if any one of all service components of the service which is being received is not selected, then the processing returns to the reception of the original program.

[0045] Accordingly, in the case of this component mode, all the programs (service components) of the service which is being received until that time are listened to successively for, for example, 10 minutes each, and when the introduction scanning stop key is pressed during reception of any favorite program, the program can be listened to continuously after that time.

③All mode

[0046] When this mode is implemented when, for example, program 1B is listened to, the program is selected in the order from program 2A program 2C, program 3A, ..., program 3E, program 4A, program 4B, and to program 1A, ..., program 1E and received (reproduced) for, for example, 10 seconds each. When the introduction scanning stop key is pressed during reception of, for example, program 3A, then the program 3A is received continuously after that time.

[0047] In other words, in the all mode, all the service components are received for a predetermined amount of time each with changing the service component from the service component next to the service component which is being received at that time in the order of sub-channel ID for a predetermined amount of time each, and when a predetermined key is operated during reception of a service component, the service component which is being received at that time is received continuously after that time.

[0048] In other words, when the menu is displayed on the display element 34 with the menu key, "introduction function" item is selected with the selection key, and "all mode" is selected with the selection key, then the

processing of the microcomputer 32 starts from step 301 of the routine 300, and the number of services included in the ensemble which is being received now is counted in step 302.

[0049] Thereafter, the processing proceeds to step 311, the first service component of the service next to the service including the service component which is being received until that time is selected and received. In this case, the program 1B is being received, the service which includes program 1B is the service 1, the next service is the service 2, and the first service component of the service 2 is the service component 2A, therefore program 2A is selected and received.

[0050] Next, the processing proceeds to step 312, and the number of service components included in the service which is being received now is counted. Subsequently, the processing proceeds to step 313, it is checked whether, for example, 10 seconds has passed from selection of the service component which is now being received, and if the check result is NO, the processing proceeds to step 314 from step 313. It is checked whether the introduction scanning stop key of the operation means 33 is pressed in step 314, and if the check result is NO, the processing returns to step 313 from step 314.

[0051] Accordingly, steps 313 and 314 are repeated after that time, the service component is received for at longest, for example, 10 seconds from the time when the service component which is now being received is selected.

[0052] If 10 seconds has passed without the introduction scanning stop key pressed, it is detected in step 313, then the process proceeds to step 315 from step 313, and it is checked whether all the service components which have been counted in step 312 are received, in this case whether all the programs 2A to 2C are received.

[0053] If it is detected that all the service components of the service which is now being received are not received as the result of the check, the processing proceeds to step 316 from step 315, and the service component next to the service component which has been received until that time is selected and received. In this case, program 2A is being received and the next service component is the service component 2B, therefore program 2B is selected and received. Thereafter, the processing returns to step 313.

[0054] Therefore, if the introduction scanning stop key is not pressed after that time, respective service components in the service which is now being received are received successively for, for example, 10 seconds each.

[0055] If the introduction scanning stop key is pressed during reception of any service component (at that time steps 313 and 314 are repeated), it is detected in step 314, then the processing proceeds to step 329 from step 314, and the routine 300 is brought to an end. Accordingly, the program (service component) which is being

received at the time when the introduction scanning stop key is pressed is received continuously after that time.

[0056] On the other hand, if it is detected that all the service components in the service which is being received are received in step 315, then the processing proceeds to step 317 from step 315, whether, for example, the first service components in all the services counted in step 302 are received, in this case whether all the programs 1A to 4A are received, is checked.

[0057] If it is detected that the first service components of all the services are not received, then the processing returns to step 311 from step 317, the service component is switched to the first service component of the next service and received.

[0058] Therefore, if the introduction scanning stop key is not pressed, then the service is changed successively, and all the service components in the service are received successively for, for example, 10 seconds for each service.

[0059] If the first service components in all the services counted in step 302 are received in step 317, then the processing proceeds to step 321 from step 317, and the service component which has been received in step 321 until the time when the routine 300 is implemented, in this case program 1B, is selected and received, thereafter the routine 300 is brought to an end at step 329. Therefore, if any one of all the service components in the service which is being received is not selected, then the processing returns to the reception of the original program.

[0060] Therefore, in the case of all mode, the service is changed successively, all the programs (service components) in the service can be listened to, for 10 seconds each, and if the introduction scanning stop key is pressed when any favorite program is being listened to, then the program can be listened to continuously after that time.

[0061] As described herein above, according to the receiver shown in FIG. 1, the program is not only selected and received by general key operation but also selected and received additionally by service mode, component mode, or all mode. When the program is selected and received by service mode, component mode, or all mode, the respective programs are received for, for example, 10 seconds each, and the introduction scanning stop key may be pressed when a favorite program is being listened to.

[0062] Therefore, according to the receiver shown in FIG. 1, a preferable program is selected and received simply with less key operation. Because it is not necessary to see the display element 34 when a program is selected, safety is secured in the case that a program is selected and listened to during car driving.

[0063] In the case of service mode described herein above, the case that, for example when program 1B is listened to, the program is selected successively in the order from program 2A, program 3A, program 4A, and to program 1A and received for 10 seconds each, how-

ever otherwise, the case that the program is selected successively in the order from program 2B, program 3B, and to program 4B for 10 seconds each may be employed.

[0064] In other words, if the service component which is being received when the service mode is started is the n-th service component in the service, n-th service components of respective services are selected successively and received for 10 seconds each. At that time, if there is no n-th service component in a service, then the selection and reception of the service component are skipped, or otherwise the service component having the maximum sub-channel ID in the service may be selected and received.

[0065] In the case described herein above, the all mode is implemented when, for example, program 1B is listened to, the program is selected successively in the order from program 2A, → ... → program 2C → program 3A → ... → program 3E → program 4A → program 48 → program 1A → ... → program 1E and received for 10 seconds each, however otherwise, the program is selected in the order of sub-channel ID, namely from program 1C → ... program 1E → program 2A → ... → program 2C → program 3A → ... → program 3E → program 4A → program 48 → program 1A → ... program 1E, and received for 10 seconds each.

[0066] Furthermore, in the above-mentioned case, after 1 cycle of service components is received, the operation returns to the original program, however otherwise, the selection and reception of the service component may be continued for 2 cycles or more or a predetermined amount of time.

[0067] According to the present invention, a preferred program is selected and listened to simply with less operation. Furthermore, because it is not necessary to see the display, safety is secured when a program is selected and listened to while driving a car.

Claims

1. A receiver for receiving digital audio broadcasting in which a plurality of programs are broadcast through a single transmission band, said digital audio broadcasting receiver comprising:

a control section comprised of a microcomputer; and

a scanning operation section and a scanning stop operation section which are connected to said control section, in which

the operation of said scanning operation section is such that at least some of said plurality of programs are selected in sequence and the selected programs are received respectively for a designated time, and

when said scanning stop operation section is operated while an arbitrary program of said plu-

rality of programs is being received, said arbitrary program is selected to be received subsequently.

2. A digital audio broadcasting receiver as claimed in claim 1, wherein a mode of operation of said scanning operation section is such that said plurality of programs are classified into a plurality of groups and one program only in each of said groups is selected in sequence from each of said groups and received respectively for the designated time.
3. A digital audio broadcasting receiver as claimed in claim 1 or 2, wherein said plurality of programs are classified into a plurality of groups and a mode of operation of said scanning operation section is such that each program in the group including the program being broadcast during the operation of the scanning operation section is selected in sequence and received for the designated time.
4. A digital audio broadcasting receiver as claimed in claim 1, 2 or 3, wherein a mode of operation of said scanning operation section is such that all of said plurality of programs are selected in sequence and received respectively for the designated time.
5. A digital audio broadcasting receiver as claimed in claim 1, wherein

said plurality of programs are broadcast separately in group units,

if a first mode is selected, one program only from each group is selected successively and received for a predetermined amount of time, and

when said scanning stop operation section is operated during reception, the program which is being received at that time is received continuously after that time,

if a second mode is selected, respective programs in the group including the program which is being received when the second mode is selected are selected successively and received for a predetermined amount of time each, and when said scanning stop operation section is operated, the program which is being received at that time is received continuously after that time, and

if a third mode is selected, all said plurality of programs are selected successively and received for a predetermined amount of time each, and

when said scanning stop operation section is operated, the program which is being received at that time is received continuously after that time.

6. A digital audio broadcasting receiver as claimed in any one of the preceding claims, wherein said amount of time for which each program is selected and received is settable by a user.

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7. A digital audio broadcasting receiver as claimed in any one of the preceding claims, wherein

said digital audio broadcast is DAB,
said transmission band is an ensemble,
said group is a service, and
said program is a service component.

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FIG. 1

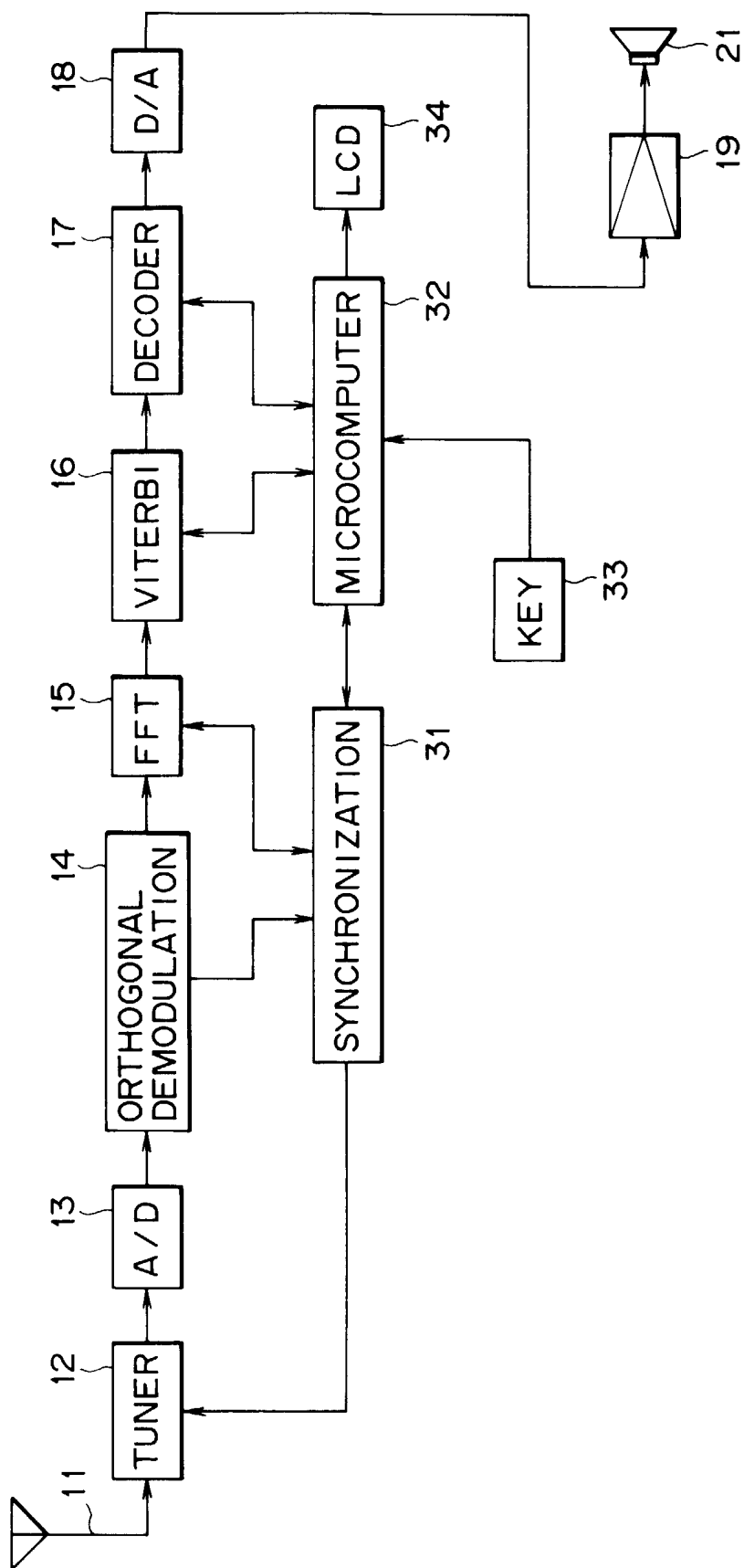


FIG. 2

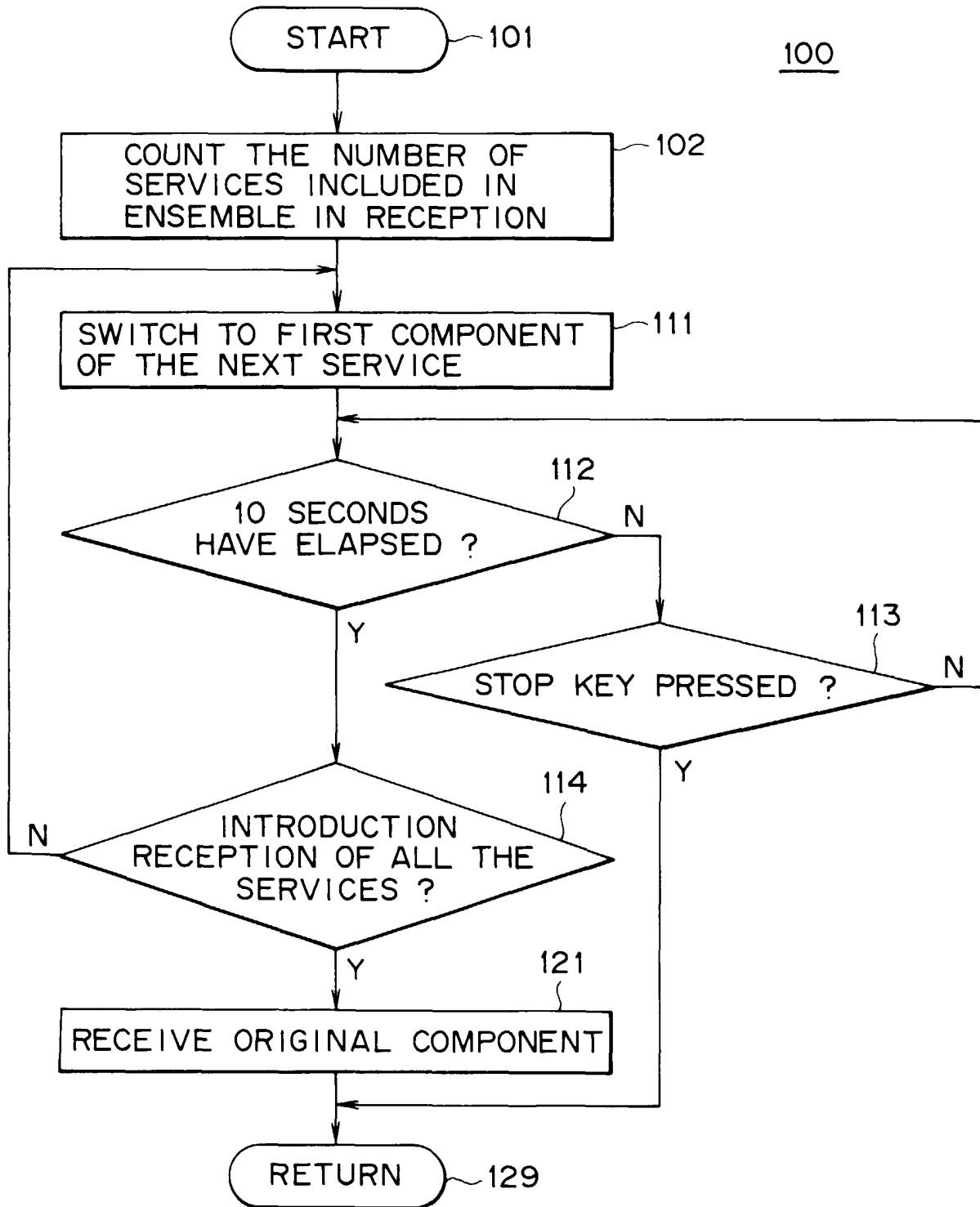


FIG. 3

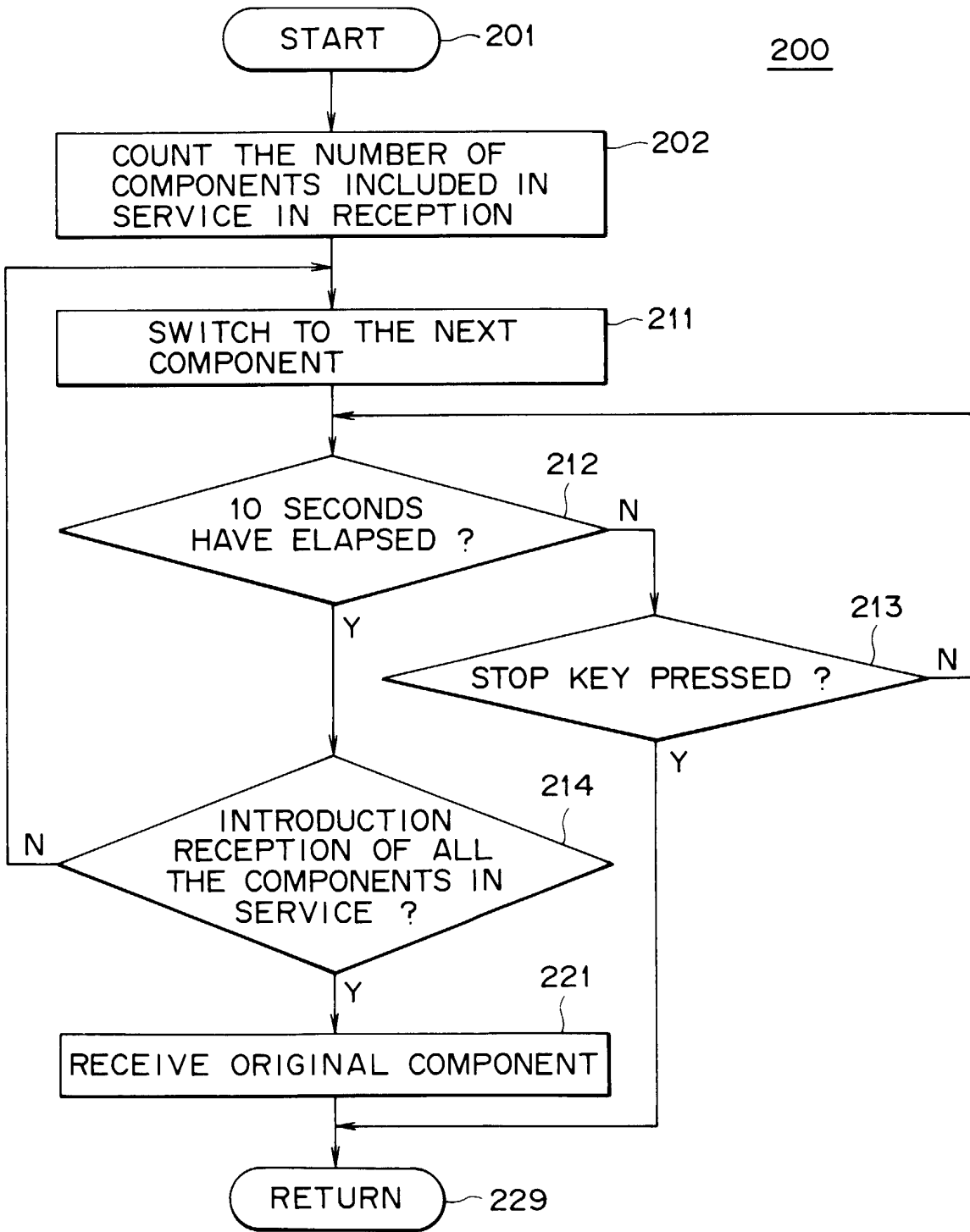


FIG. 4

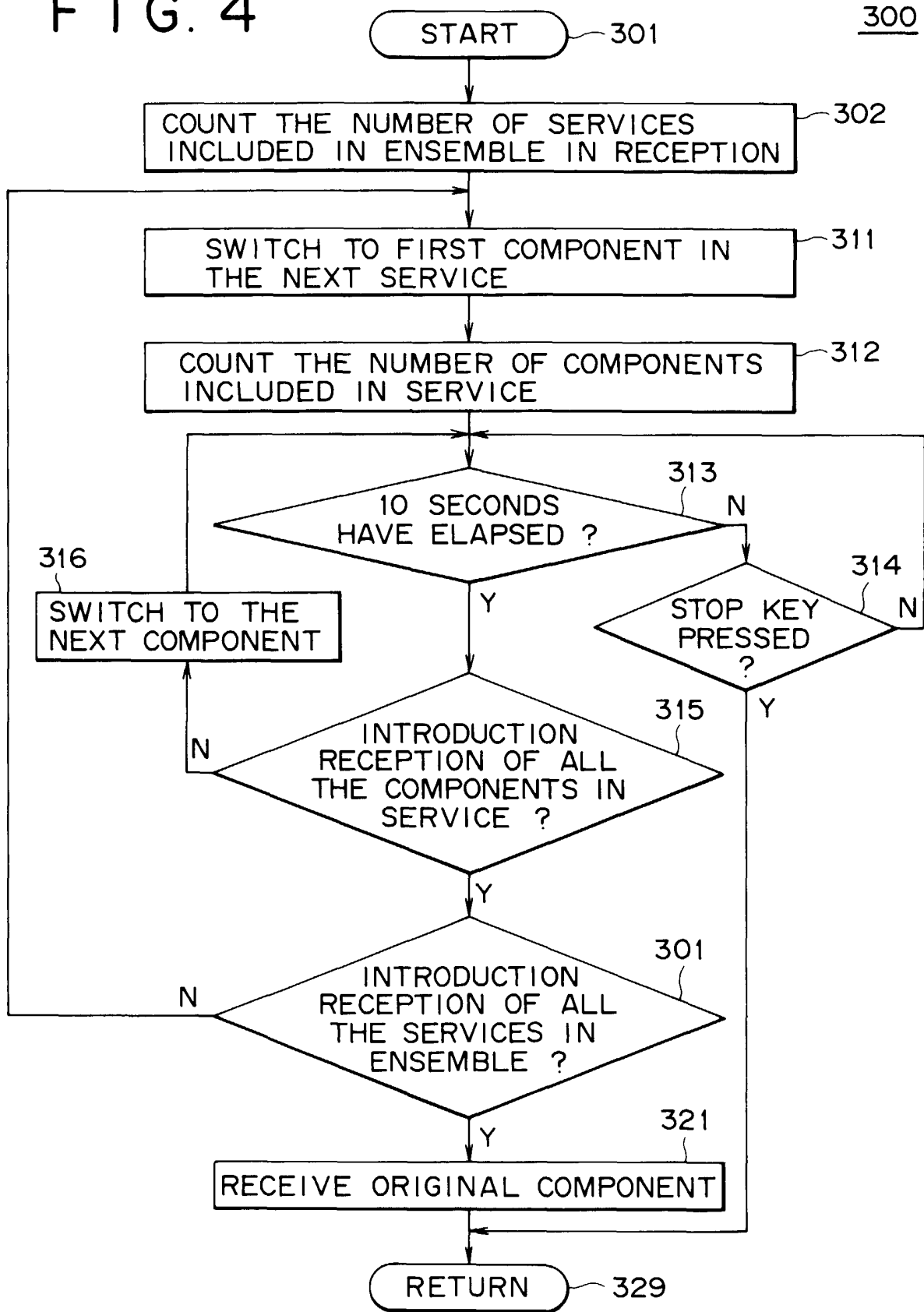


FIG. 5

