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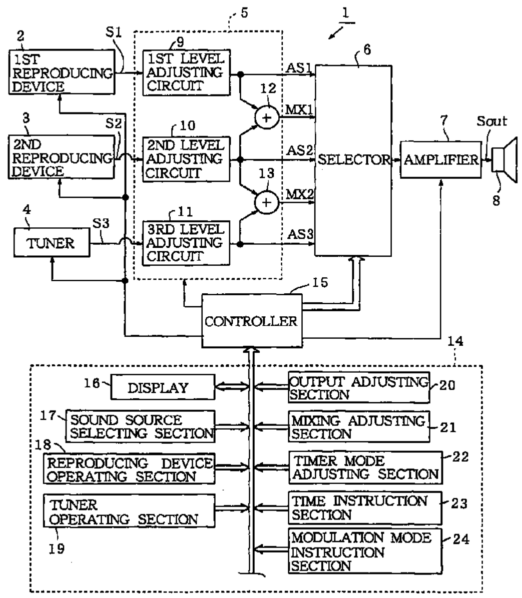
(54) **Audio system having a mixing function**

(57) An audio system (1) has a plurality of sound sources, each producing an audio signal. There is provided a plurality of timer means for operating one of the sound sources to produce a first audio signal for a predetermined period before a start time instructed by a user, and for operating another sound source to produce a second audio signal at the start time. A plurality of mixing circuits (5) are provided for mixing the first and second audio signals from two sound sources.

FIG.1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an audio system having a sound mixing function and a timer function for the time management of the mixing function.

[0002] Recent years, Japanese Patent Laid Open Publications 7-85586, 7-85587 and 7-85590 disclose audio systems each having a mixing function. Each of these audio systems has a mixing function for mixing main music and background music such as natural sounds, thereby providing a fresh and comfortable acoustic space.

SUMMARY OF THE INVENTION

[0003] An object of the present invention is to provide an audio system having a mixing function which may be selected in accordance with the taste of the user.

[0004] According to the present invention, there is provided an audio system comprising, a plurality of sound sources, each producing an audio signal, timer means for operating one of the sound sources to produce a first audio signal for a predetermined period before a start time instructed by a user, and for operating another sound source to produce a second audio signal at the start time, mixing means for mixing the first and second audio signals from two sound sources.

[0005] The present invention further provides an audio system comprising, a plurality of sound sources, each producing an audio signal, timer means for operating one of the sound sources to produce a first audio signal for a predetermined period from a start time instructed by a user, and for operating another sound source to produce a second audio signal after the predetermined period, mixing means for mixing the first and second audio signals from two sound sources.

[0006] The present invention still further provides an audio system comprising, a plurality of sound sources, each producing an audio signal, timer means for operating one of the sound sources to produce a first audio signal and for operating another sound source to produce a second audio signal, and for stopping one of the first and second audio signals at a stop time instructed by the user, and for producing the other audio signal for a predetermined period from the stop time, mixing means for mixing the first and second audio signals from two sound sources.

[0007] The present invention further provides an audio system comprising, a plurality of sound sources, each producing an audio signal, timer means for operating one of the sound sources to produce a first audio signal and for operating another sound source to produce a second audio signal, and for producing only one of the first and second audio signals for a predetermined period before a stop time, mixing means for mixing the first and second audio signals from two sound sources.

[0008] These and other objects and features of the present invention will become more apparent from the following detailed description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

Fig. 1 is a block diagram showing an audio system of the present invention;

Fig. 2 is a flowchart showing a program for a WAKE-UP mode;

Fig. 3 is a flowchart showing a program for a fade-in operation;

Fig. 4 is a flowchart showing a program for a fade-out operation;

Figs. 5a to 5c show level changes in fade-in operations;

Fig. 6 is a flowchart showing a program for a SLEEP mode;

Figs. 7a to 7c show level changes in fade-out operations;

Figs. 8a to 8e show various volume changes in mixing operations; and

Figs. 9a to 9e show other volume changes in mixing operations.

[0010] These and other objects and features of the present invention will become more apparent from the following detailed description with reference to the accompanying drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] Referring to Fig. 1 showing a block diagram of an audio system according to the present invention, the audio system 1 is provided with three sound sources and comprises a first reproducing device 2 for producing a first audio signal S1 by reproducing an optical recording medium such as a CD (compact disc), a second reproducing device 3 for producing a second audio signal S2 by reproducing a magnetic recording medium each as an MD (mini disc), and a tuner 4 for producing a third audio signal S3 by receiving electric waves such as AM, FM and TV broadcasts. There is provided a mixing circuit 5, a selector 6, an output amplifier 7 and a speaker 8.

[0012] The mixing circuit 5 comprises a first level adjusting circuit 9 for adjusting the level of the first audio signal S1, second and third level adjusting circuits 10 and 11 for the second and third audio signals S2 and S3, a first adder 12 for adding audio signals AS1 and AS2 from the first and second level adjusting circuits 9 and 10 and for producing a mixed audio signal MX1, and a second adder 13 for adding audio signals AS2 and AS3 from the second and third level adjusting circuits 10 and 11 and for producing a mixed audio signal MX2.

[0013] The selector 6 comprises a changeover device such as an analog multiplexer and a relay circuit for supplying one of the audio signals AS1, MX1, AS2, MX2, AS3 from the mixing circuit 5 to the amplifier 7.

[0014] The system further comprises an operating section 14 for giving the system instructions in accordance with the user's taste, and a controller 15 for controlling the audio system in accordance with the instruction.

[0015] The operating section 14 has a display 16 and a plurality of input sections 17 - 24. When the user operates the input sections, a microprocessor provided in the controller 15 recognizes the input instruction and controls the operation of the audio system in accordance with the system program installed in the controller. The display 16 displays the order of the manipulation of the input sections 17 - 14 and others.

[0016] A sound source selecting section 17 is provided for selectively instructing one or two sound sources 2, 3 and 4. For example, when the user instructs the tuner 4 only, the controller 15 causes the tuner 4 to operate and the reproducing devices 2 and 3 to be inoperative.

[0017] When two sound sources are selected from the first and second reproducing devices 2 and 3 and the turner 4, the user must determine one of the sound sources as a main source and the other as a subsource.

[0018] A reproducing device operating section 18 is provided for starting, stopping, fast-playing, rewinding and others in the first and second reproducing devices, and for instructing music to be played.

[0019] A tuner operating section 19 is provided for changing the AM, FM and TV broadcasts and instructing a channel in TV.

[0020] An output adjusting section 20 is provided for adjusting the amplification factor of the amplifier 7, thereby adjusting the volume of the speaker 8.

[0021] A mixing adjusting section 21 is provided for adjusting the amplification factor of each of the first, second and third level adjusting circuits 9, 10 and 11, thereby adjusting the mixing balance at each of the adders 12 and 13.

[0022] The controller 15 operates to distribute the predetermined maximum amplification factor to two level adjusting circuits. More particularly, the maximum amplification factor $M\alpha$ is expressed as follows,

$$M\alpha = \alpha 1 + \alpha 2 \qquad 1$$

$$M\alpha = \alpha 2 + \alpha 3 \qquad 2$$

where $\alpha 1$ is the amplification factor of the first level adjusting circuit 9, $\alpha 2$ is the amplification factor of the second level adjusting circuit 10, and $\alpha 3$ is the amplification factor of the third level adjusting circuit 11.

[0023] Therefore, when the user increases the amplification factor $\alpha 1$ by operating the mixing adjusting section 21, the amplification factor $\alpha 2$ decreases dependent on the maximum amplification factor $M\alpha$.

[0024] When the second reproducing device 3 and the tuner 4 are selected, the amplification factors $\alpha 2$ and $\alpha 3$ are adjusted based on the formula 2.

[0025] Thus, each of the audio signals AS1, AS2 and AS3 applied to the first and second adders 12 and 13 is prevented from increasing to an excessive level.

[0026] Furthermore, there is provided a timer mode instruction section 22, a time instruction section 23 for setting a starting time tON of the timer mode and a stop time tOFF, and a modulation mode instruction section 24 for setting the manner of fade-in and fade-out.

[0027] When the user instructs the timer mode by the timer mode instruction section 22, a program timer installed in the controller 15 operates to set the timer mode.

[0028] When the starting time tON is set by operating the timer mode instruction section 22 and the time instruction section 23, the controller starts the timer operation dependent on the program timer, so that the audio system is started at the starting time tON. Here, the mode is referred to as WAKE-UP mode.

[0029] When the user instructs the stop time tOFF and the start of the mode by operating the timer mode instruction section 22 and the time instruction section 23, the controller 15 starts the timer operation and cuts off the main source of the audio system at the stop time tOFF. Here, the mode is referred to as SLEEP mode.

[0030] When the starting time tON and the stop time tOFF are instructed by operating the timer mode instruction section 22 and the time instruction section 23, the controller starts the audio system at the starting time tON and cuts off the main source at the time tOFF.

[0031] The modulation mode instruction section 24 is provided for setting the fade-in function where the volume of the speaker 8 gradually increases at the starting time tON in the WAKE-UP mode, and for setting the fade-out function where the volume is gradually reduced at the stop time tOFF in the SLEEP mode. Furthermore, the changing manner of the fade-in and fade-out can be instructed.

[0032] More specifically, there is provided a ROM in the controller 15, wherein the ROM stores a plurality of function programs for changing the volume of the speaker with the elapsed time τ based on function programs such as a linear function, quadratic function, square root function, polygonal line function, and others, or stores fade-in data and fade-out data for changing the volume with the elapsed time.

[0033] If the user selects the function programs and data stored in the ROM, it is possible to change the output increasing manner in the fade-in mode and the output decreasing mode in the fade-out mode. Here, if the fade manner is not selected, the fade-in and the fade-out are not performed.

[0034] The first and second operations of the audio system are described hereinafter with respect to Figs. 2 - 6.

[0035] In the first operation, the user designates the first reproducing device 2 as the main means, and the second reproducing device 3 as the sub-means, further designates the WAKE-UP mode and the fade-in mode.

[0036] Referring to Fig. 2, the second reproducing device 3 is designated as the sub-source at a step S100. The WAKE-UP mode is instructed and the fade-in is instructed at a step S101. At steps S102 and S103, the starting time tON and stop time tOFF are instructed. The volume VL is instructed at a step S104, and the mixing balance is instructed at a step S105. Furthermore, the modulation mode is instructed at a step S106.

[0037] At a step S107, it is determined whether the sub-sound source is designated. If not, it is determined whether the starting time tON is instructed at a step S108. When it is the case, the volume is set to an instructed volume VL and the reproduction of the main sound source is started at a step S109. At a step S110, if it is the time tOFF to stop the reproduction, the electric source is cut off.

[0038] In the system, there is preliminarily determined a fade-in start time tFW which is T time before the operation start time tON of the reproduction. Hence, when the sub-source is instructed at the step S107, it is determined whether it is the fade-in start time tFW (tON - T) at a step S112. If yes, the electric source is turned on, the volume is set to zero, the reproduction of the sub-source is started at a step S113. Furthermore, the amplification factors of the first and second level adjusting circuits 9 and 10 are set to $\alpha 1 = \alpha 2$, the selector 6 operates to connect the first adder 12 to the amplifier 7, and the operation of second reproduction device 3 is started.

[0039] At a step S114, the fade-in operation is started where the amplification factor of the second level adjusting circuit 10 is changed with the elapsed time τ in accordance with the function for the fade-in or the data stored in the ROM.

[0040] The fade-in process continues until the operation starting time tON (step S115).

[0041] Figs. 3 and 4 are flowcharts showing processes in the step S114 in detail. Fig. 3 shows the fade-in process based on the fade-in data stored in the ROM. Fig. 4 shows the fade-in operation based on the fade-in function.

[0042] When the fade-in data in the ROM is instructed at the step S106, the process of Fig. 3 is performed.

[0043] At a step S200, the controller 15 calculates the elapsed time τ from the fade-in start time tFW based on the calculated time of the first program timer. At a step S201, a fade-in data MEM(τ) is obtained at the elapsed time τ by memory accessing the ROM based on the elapsed time τ .

[0044] Thereafter, the fade-in data MEM(τ) is multiplied with an amplification factor $\alpha 2$ of the second level adjusting circuit 10 which is determined by the initialization process at the step S105 at a step S202 to produce a coefficient K2 (τ) which is set as the amplification factor of the second level adjusting circuit 10 at the elapsed time τ.

[0045] Since the processes at the steps S200 - S202 are repeated in synchronism with a predetermined very short frequency $\Delta \tau$, the amplification factor of the second level adjusting circuit 10 approximately continuously changes with the elapsed time τ.

[0046] Therefore, in dependency on the variation of the amplification factor of the second level adjusting circuit 10, the amplitude of the audio signal S2 from the second reproducing device 3 is gradually increased, thereby gradually increasing the volume of the speaker 8, and hence providing the fade-in effect.

[0047] In the case where the output volume of the speaker 8 is simply increased during the time T from tFW to tON, there is stored in the ROM a plurality of data 0, $\Delta \tau/T$, $2\Delta \tau /T$, $3\Delta \tau/T$...1 as the fade-in data MEM(τ). Thus, the fade-in process shown in Fig. 3 is carried out in synchronism with the elapsed time τ.

[0048] On the other hand, when the square root function is instructed as the function for fade-in at the step S106, the process of Fig. 4 is performed. At steps S300 and S301, the controller 15 calculates the time T from the time tFW to the start time tON and the elapsed timer from the time tFW. Furthermore, the square root of t/T which is expressed here as B(τ) is obtained at a step S302. The value B(τ) is multiplied with the amplification factor $\alpha 2$ of the second level adjusting circuit 10 to produce the function K2 (τ) which is set as the amplification factor $\alpha 2$ of the adjusting circuit 10 at the elapsed time τ (step S303).

[0049] If the fade-in process is carried out based on the square root function, the amplification factor of the second level adjusting circuit 10 for the second audio signal S2 from the second reproducing device 3 gradually increases from zero at the time tFW to $\alpha 2$ at the starting time tON as shown in Fig. 5a, thereby gradually increasing the volume from the speaker 8.

[0050] Referring back to Fig. 2, the first and second level adjusting circuits 9 and 10 are set to the amplification factors $\alpha 1$ and $\alpha 2$ which have been set by the initialization process at a step S116. At the same time, the amplification factor of the amplifier 7 is set to the volume VL, and the operation of the first reproducing device 2 is started, so that the sound instructed by the initialization process is reproduced.

[0051] Thus, the audio signals S1 and S2 from the first and second reproducing devices 2 and 3 are amplified by the amplification factors $\alpha 1$ and $\alpha 2$ and added by the adder 12 to be mixed. The mixed signal is amplified by the amplifier 7 and mixed sound is emitted from the speaker 8.

[0052] The amplification factor of the second level adjusting circuit 10 in the fade-in process becomes $\alpha 2$ at the operation starting time tON and is kept at $\alpha 2$ after the start time tON. Therefore, the amplification factor is continuously kept before and after the operation starting time tON. Consequently, harsh noises are not produced at the time when the fade-in process changes to the mixing process.

[0053] The reproduction operation is continued until the calculating value of the program timer becomes the end time tOFF (step S117), and at a step S118, the electric source of the audio system is cut off.

[0054] Fig. 8a shows the variation of the volume of the sound from the speaker 8 in the above described operation in the WAKE-UP mode.

[0055] In the mixing operation after the operation starting time tON, the volume of the main source and the volume of the sub-source are set to $\alpha 1$ x VL and $\alpha 2$ x VL in accordance with the volume VL and the mixing balance set by the user. As a result, the whole volume of the mixing sound becomes VL, thereby providing the sound having the optimum volume set by the user.

[0056] Fig. 5a shows the change of the amplification factor of the second level adjusting circuit 10 in the fade-in processing based on the square root function. When the quadratic function is selected, the amplification factor of the second level adjusting circuit changes as shown in Fig. 5b.

[0057] When the polygonal line function is selected, the amplification factor changes as shown in Fig. 5c. Thus, it is possible to select a fade-in mode in accordance with user's taste.

[0058] Although the first reproducing device 2 is designated as the main sound source means in the above described embodiment, the second reproducing device 3 may be designated as the main sound source means, and the tuner 4 may be designated as the sub-source means.

[0059] In the case where the second reproducing device 3 is designated as the main sound source means, and the tuner 4 is designated as the sub-sound source means, and the WAKE-UP mode and the fade-in function are instructed, the mixing is carried out by the formula 2, and the amplification factors $\alpha 2$, $K2(\tau)$ and $\alpha 1$ shown in Figs. 3-5 and 8a are substituted with the amplification factor $\alpha 3$, K3 (τ) of the third level adjusting circuit 11 and the amplification factor $\alpha 2$ of the second level adjusting circuit 10.

[0060] As described above, in accordance with the present embodiment, various combinations of the WAKE-UP mode and the fade-in function may be possible.

[0061] Hereinafter described is the operation of SLEEP mode with reference to the flowchart of Fig. 6, wherein the first reproducing device 2 is designated as the main sound source means and the second reproducing device 3 is designated as the sub-source means, and the SLEEP mode and the fade-out function are instructed.

[0062] Referring to Fig. 6, the first reproducing device 2 is designated as the main source and the second reproducing device 3 is designated as the sub-source at a step S400. The SLEEP mode is instructed and the fade-out is instructed at a step S401. At a step S402, the stop time tOFF is instructed. The volume VL is instructed at a step S403, and the mixing balance is instructed at a step S404. Furthermore, the modulation mode is instructed at a step S405.

[0063] At a step S406, it is determined whether the sub-sound source is designated. If not, the volume is set to an instructed volume VL and the reproduction of the main sound source is started at a step S407. At a step S408, when it is the time tOFF to stop the reproduction, the electric source is cut off (step S409).

[0064] When the sub-source is instructed at the step S406, the reproduction of the main and sub-sound source is started and volumes are set to the set volumes VLs at a step S410.

[0065] When it is the stop time tOFF at a step S411, the main sound source is cut off at a step S412. At a step S413, the fade-out process is started.

[0066] The fade-out process continues until the time becomes (tOFF + T) (step S414 and S415).

[0067] When the fade-out data in the ROM is instructed at the step S405, a process of similar to Fig. 3 is performed.

[0068] The controller 15 calculates the elapsed time τ from the stop time tOFF based on the calculated time of the third program timer. A fade-out data MEM(τ) is obtained at the elapsed time τ by accessing the ROM based on the elapsed time τ.

[0069] Thereafter, the fade-out data MEM(τ) is multiplied with an amplification factor $\alpha 2$ of the second level adjusting circuit 10 which is determined by the initialization process to produce a coefficient K2 (τ) which is set as the amplification factor of the second level adjusting circuit 10 at the elapsed time τ.

[0070] The amplification factor of the second level adjusting circuit 10 approximately continuously changes with the elapsed time τ.

[0071] Therefore, in dependency on the variation of the amplification factor of the second level adjusting circuit 10, the amplitude of the audio signal S2 from the second reproducing device 3 is gradually reduced, thereby gradually reducing the volume of the speaker 8, and hence providing the fade-out effect.

[0072] In the case where the output volume of the speaker 8 is simply increased during the time T from tOFF to tBW, there is stored in the ROM a plurality of data 1, $1 - \Delta\tau/T$, $1 - 2\Delta\tau/T$, $1 - 3\Delta\tau/T \ldots 0$ as the fade-out data MEM (τ). Thus, the fade-out process shown in Fig. 3 is carried out in synchronism with the elapsed time τ.

[0073] On the other hand, when the square root function is instructed as the function for fade-out, the amplification factor of the second level adjusting circuit 10 is automatically set based on the function expressed by $\alpha 2 \times (1-\mathrm{SQRT}(\tau/T))$ in which the elapsed time τ is parameter. As a result, the amplification factor changes as shown in Fig. 7a.

[0074] When the square function is instructed as the function for fade-out, the amplification factor of the second level adjusting circuit 10 is set based on the function expressed by the formula of $\alpha 2 \times (1-(\tau/T)^2)$ having parameter τ . As a result, the amplification factor changes as shown in Fig. 7b.

[0075] When the polygonal line function is instructed as the function for the fade-out, the amplification factor of the second level adjusting circuit 10 changes as shown in Fig. 7c.

[0076] When it is the stop time tBW(= tOFF + T)at a step S414, the electric source is cut off at a step S415.

[0077] As described above, in accordance with the SLEEP mode of the steps S410 - S415, as shown in Fig. 8b, the sound reproduced by the first and second reproducing devices 2 and 3 are mixed before the end time tOFF, and the sub-music by the second reproducing device 3 is reduced in the fade-out mode during the time T from the end time tOFF to the time tBW.

[0078] Although the first reproducing device 2 is designated as the main sound source means in the above described embodiment, the second reproducing device 3 may be designated as the main sound source means, and the tuner 4 may be designated as the sub-source means.

[0079] In the case where the second reproducing device 3 is designated as the sub-sound source means, and the tuner 4 is designated as the main sound source means, and the SLEEP mode and the fade-out function are instructed, the mixing is carried out by the formula 2, and the amplification factors $\alpha 2$, $K2(\tau)$ and $\alpha 1$ shown in Figs. 3-5 and 8a are substituted with the amplification factor $\alpha 3$, $K3(\tau)$ of the third level adjusting circuit 11 and the amplification factor $\alpha 2$ of the second level adjusting circuit 10.

[0080] As described above, in accordance with the present embodiment, various combinations of the SLEEP mode and the fade-out function may be possible.

[0081] When the user instructs the WAKE-UP, SLEEP, fade-in and fade-out, the audio signal form the sub-sound source may be faded in and the audio signal from the main sound source may be faded out.

[0082] Referring to Fig. 8d, the audio signal of the main sound source may be faded in from the time tON to tON1, and faded from the time tOFF2 to tOFF.

[0083] Referring to Fig. 8e, the audio signal from the main sound source may be increased to a larger volume than the volume VL at the time tON and reduced to tON1, and reduced from tOFF to tBW.

[0084] As shown in Figs. 9a - 9e, the fade-in and fade-out may be started and stopped from the time tON and at the time tOFF.

[0085] In accordance with the present invention, various mixing effects can be provided based on the user's instructions.

[0086] While the invention has been described in conjunction with preferred specific embodiment thereof, it will be understood that this description is intended to illustrate and not limit the scope of the invention, which is defined by the following claims.

Claims

1. An audio system (1) comprising:

a plurality of sound sources, each producing an audio signal;

timer means for operating one of the sound sources to produce a first audio signal for a predetermined period before a start time instructed by a user, and for operating another sound source to produce a second audio signal at the start time;

mixing means (5) for mixing the first and second audio signals from two sound sources.

2. An audio system (1) comprising:

a plurality of sound sources, each producing an audio signal;

timer means for operating one of the sound sources to produce a first audio signal for a predetermined period from a start time instructed by a user, and for operating another sound source to produce a second audio signal after the predetermined period;

mixing means (5) for mixing the first and second audio signals from two sound sources.

3. An audio system (1) comprising:

a plurality of sound sources, each producing an audio signal;

timer means for operating one of the sound sources to produce a first audio signal and for operating another sound source to produce a second audio signal, and for stopping one of the first and second audio signals at a stop time instructed by the user, and for producing the other audio signal for a predetermined period from the stop time;

mixing means (5) for mixing the first and second audio signals from two sound sources.

4. An audio system (1) comprising:

a plurality of sound sources, each producing an audio signal;

timer means for operating one of the sound sources to produce a first audio signal and for operating another sound source to produce a second audio signal, and for producing only one of the first and second audio signals for a predetermined period before a stop time;

mixing means (5) for mixing the first and second audio signals from two sound sources.

5. The system (1) according to Claim 1 or 2, further comprising level adjusting means for increasing the level of the first audio signal with time for the predetermined period.

6. The system (1) according to Claim 3, further comprising level adjusting means for reducing the level of the other audio signal with time for the predetermined period.

7. The system (1) according to Claim 4, further comprising level adjusting means for reducing the level of the audio signal with time for the predetermined period.

8. A method for operating an audio system (1) comprising:

producing an audio signal from a plurality of sound sources;

operating one of the sound sources to produce a first audio signal for a predetermined period before a start time instructed by a user, and for operating another sound source to produce a second audio signal at the start time using a timer means;

mixing the first and second audio signals from two sound sources using a mixing means (5).

9. A method for operating an audio system (1) comprising:

producing an audio signal from a plurality of sound sources;

operating one of the sound sources to produce a first audio signal for a predetermined period from a start time instructed by a user, and for operating another sound source to produce a second audio signal after the predetermined period using a timer means;

mixing the first and second audio signals from two sound sources using a mixing means (5).

10. A method for operating an audio system (1) comprising:

producing an audio signal from a plurality of sound sources;

operating one of the sound sources to produce a first audio signal and for operating another sound source to produce a second audio signal, and for stopping one of the first and second audio signals at a stop time instructed by the user, and for producing the other audio signal for a predetermined period from the stop time using a timer means;

mixing the first and second audio signals from two sound sources using a mixing means (5).

11. A method for operating an audio system (1) comprising:

producing an audio signal from a plurality of sound sources;

operating one of the sound sources to produce a first audio signal and for operating another sound source to produce a second audio signal, and for producing only one of the first and second audio signals for a predetermined period before a stop time using a timer means;

mixing the first and second audio signals from two sound sources using a mixing means (5).

12. The method according to Claims 8 or 9, further comprising level adjusting means for increasing the level of the first audio signal with time for the predetermined period.

13. The method according to Claim 10, further comprising level adjusting means for reducing the level of the other audio signal with time for the predetermined period.

14. The method according to Claim 11, further comprising level adjusting means for reducing the level of the audio signal with time for the predetermined period.

FIG.1

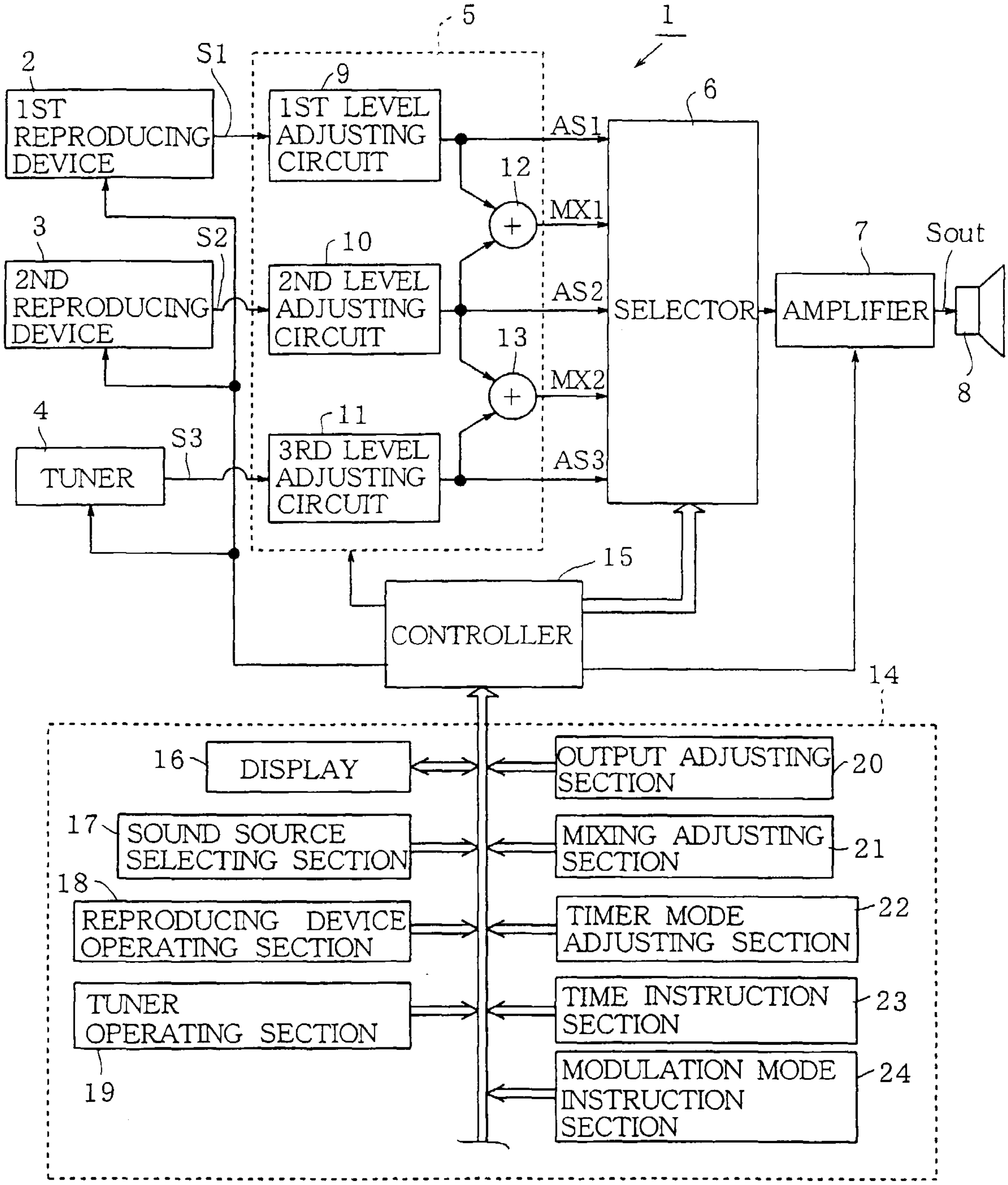
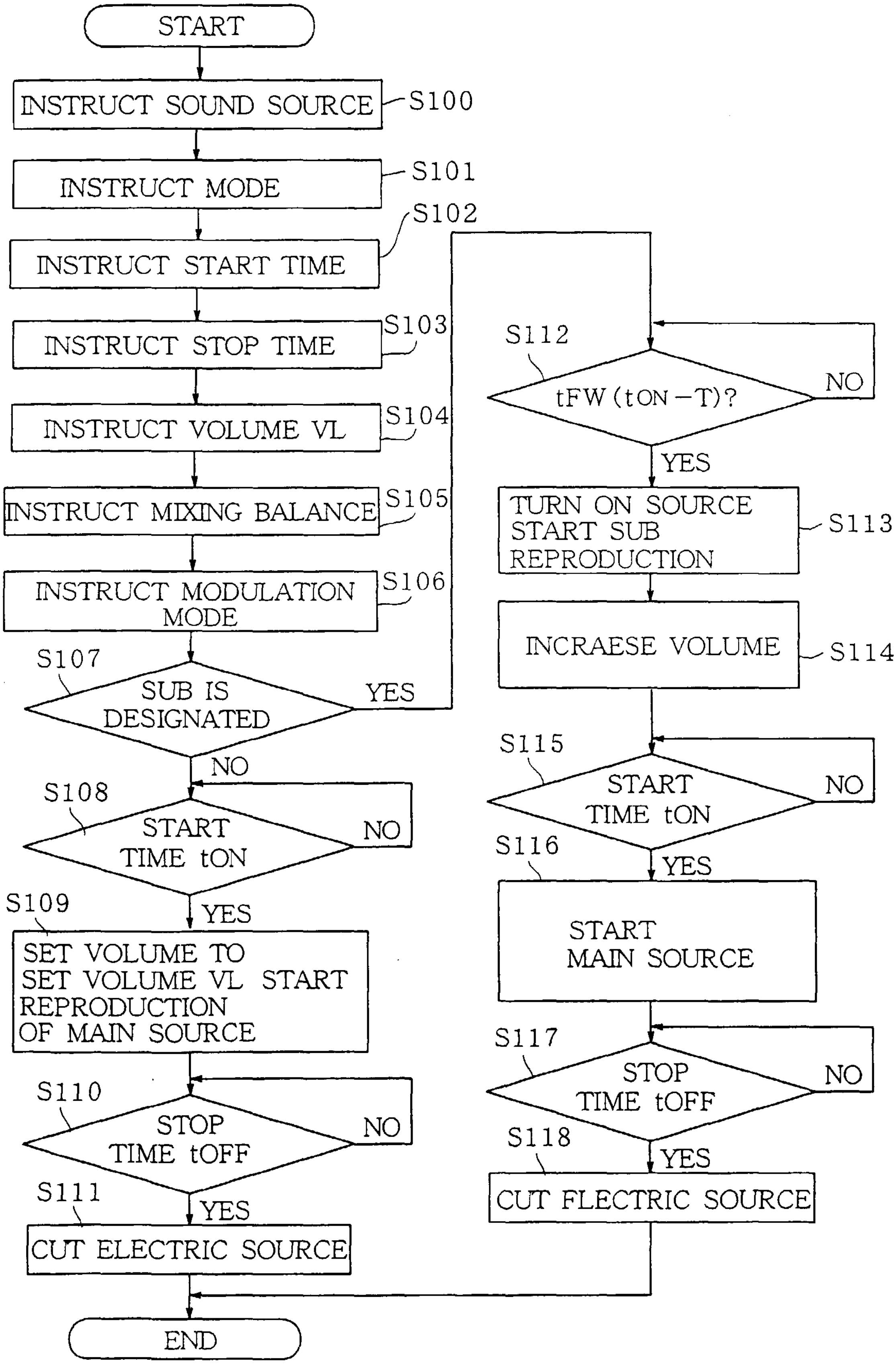

1
2
1ST REPRODUCING DEVICE
S1
5
9
1ST LEVEL ADJUSTING CIRCUIT
AS1
6
12
MX1
3
2ND REPRODUCING DEVICE
S2
10
2ND LEVEL ADJUSTING CIRCUIT
AS2
SELECTOR
7
AMPLIFIER
Sout
8
13
MX2
4
TUNER
S3
11
3RD LEVEL ADJUSTING CIRCUIT
AS3
15
CONTROLLER
14
16
DISPLAY
OUTPUT ADJUSTING SECTION
20
17
SOUND SOURCE SELECTING SECTION
MIXING ADJUSTING SECTION
21
18
REPRODUCING DEVICE OPERATING SECTION
TIMER MODE ADJUSTING SECTION
22
TUNER OPERATING SECTION
19
TIME INSTRUCTION SECTION
23
MODULATION MODE INSTRUCTION SECTION
24

FIG.2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INSTRUCT SOUND SOURCE
S100
INSTRUCT MODE
S101
INSTRUCT START TIME
S102
INSTRUCT STOP TIME
S103
INSTRUCT VOLUME VL
S104
INSTRUCT MIXING BALANCE
S105
INSTRUCT MODULATION MODE
S106
S107
SUB IS DESIGNATED
YES
NO
S108
START TIME tON
NO
S109
YES
SET VOLUME TO SET VOLUME VL START REPRODUCTION OF MAIN SOURCE
S110
STOP TIME tOFF
NO
S111
YES
CUT ELECTRIC SOURCE
END
S112
tFW (tON − T)?
NO
YES
TURN ON SOURCE START SUB REPRODUCTION
S113
INCRAESE VOLUME
S114
S115
START TIME tON
NO
S116
YES
START MAIN SOURCE
S117
STOP TIME tOFF
NO
S118
YES
CUT FLECTRIC SOURCE

FIG.3

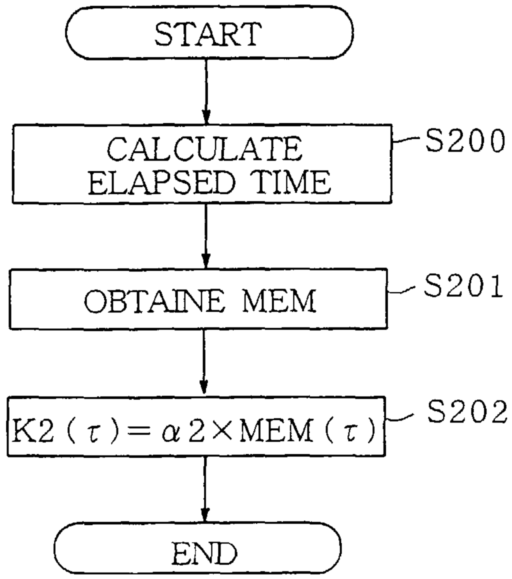
START
CALCULATE ELAPSED TIME
S200
OBTAINE MEM
S201
K2(τ)=α2×MEM(τ)
S202
END

FIG.4

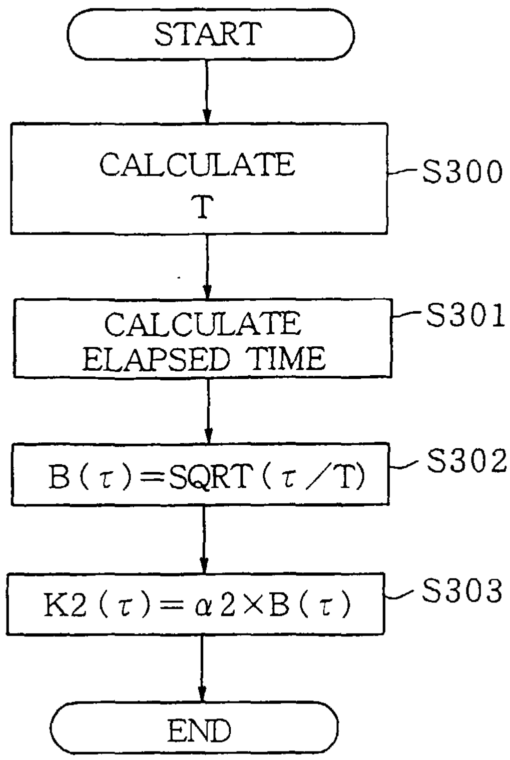
START
CALCULATE T
S300
CALCULATE ELAPSED TIME
S301
B(τ)=SQRT(τ/T)
S302
K2(τ)=α2×B(τ)
S303
END

FIG.5 a

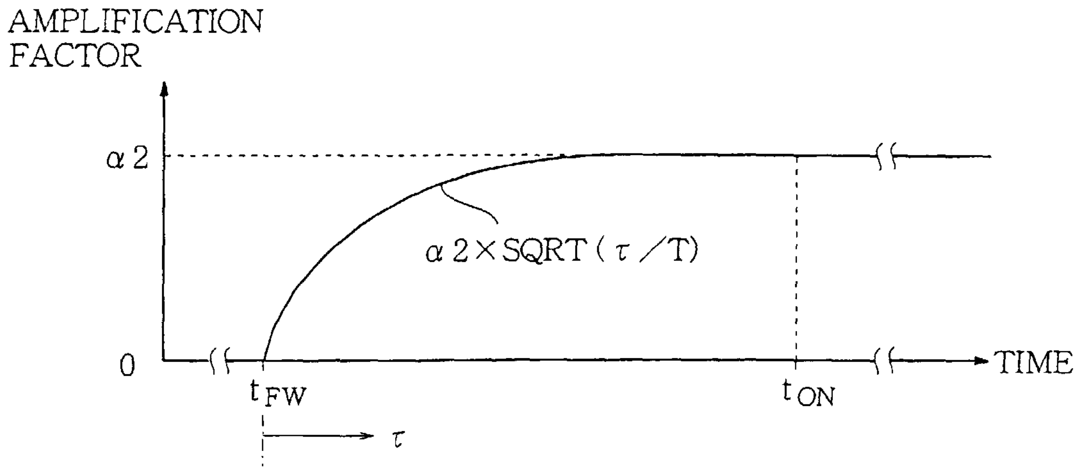

FIG.5 b

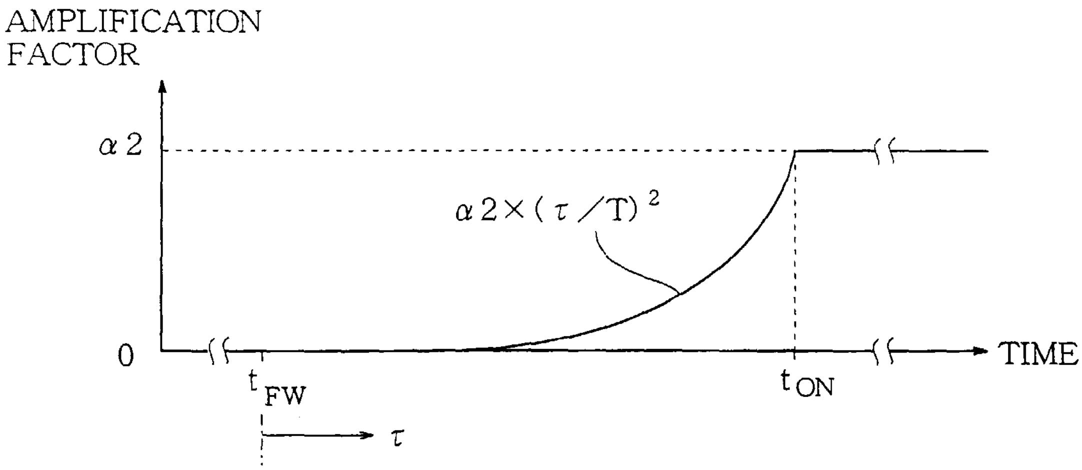

FIG.5 c

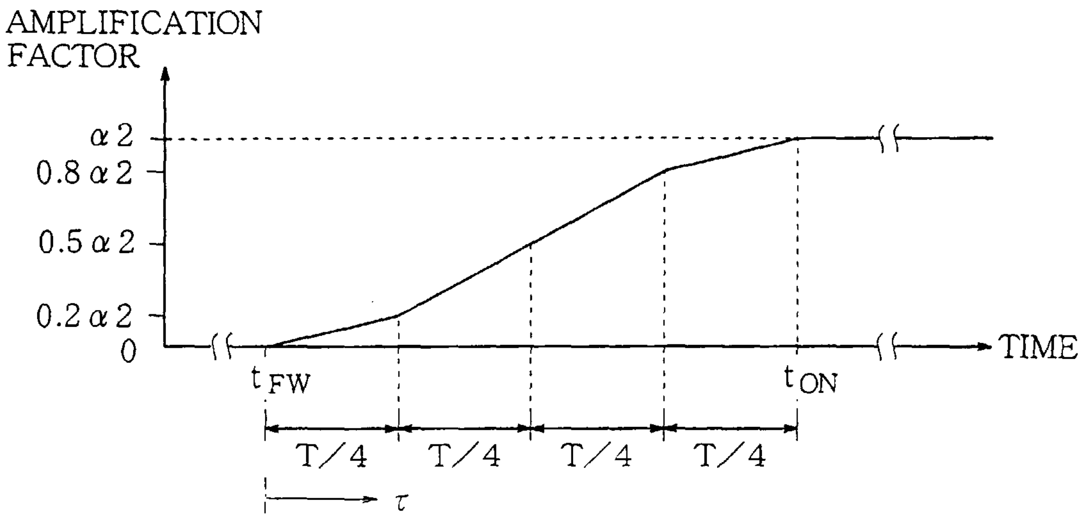

FIG.6

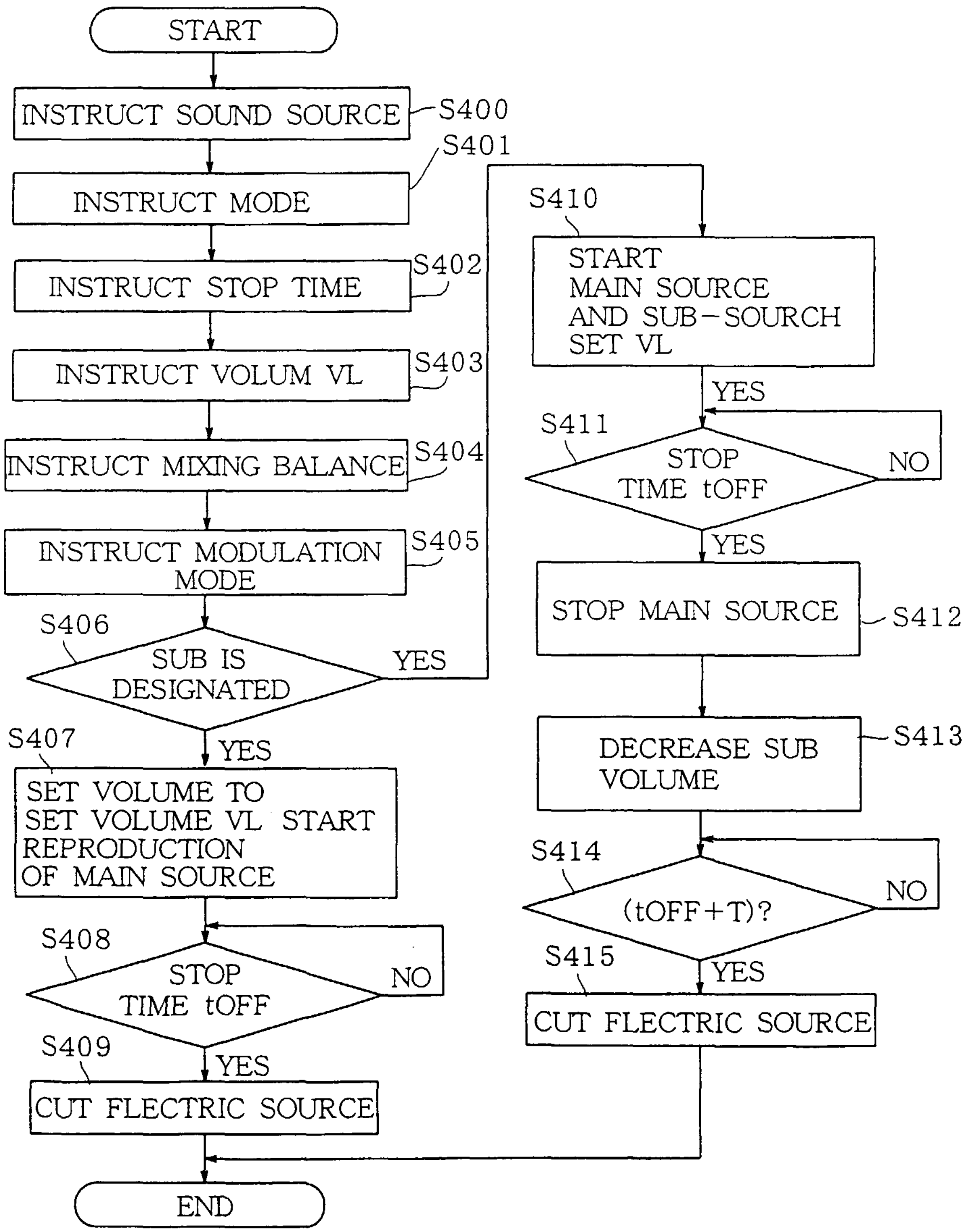
START
INSTRUCT SOUND SOURCE
S400
S401
INSTRUCT MODE
INSTRUCT STOP TIME
S402
INSTRUCT VOLUM VL
S403
INSTRUCT MIXING BALANCE
S404
INSTRUCT MODULATION MODE
S405
S406
SUB IS DESIGNATED
YES
S407
YES
SET VOLUME TO SET VOLUME VL START REPRODUCTION OF MAIN SOURCE
S408
STOP TIME tOFF
NO
S409
YES
CUT FLECTRIC SOURCE
END
S410
START MAIN SOURCE AND SUB-SOURCH SET VL
YES
S411
STOP TIME tOFF
NO
YES
STOP MAIN SOURCE
S412
DECREASE SUB VOLUME
S413
S414
(tOFF+T)?
NO
S415
YES
CUT FLECTRIC SOURCE

FIG.7 a

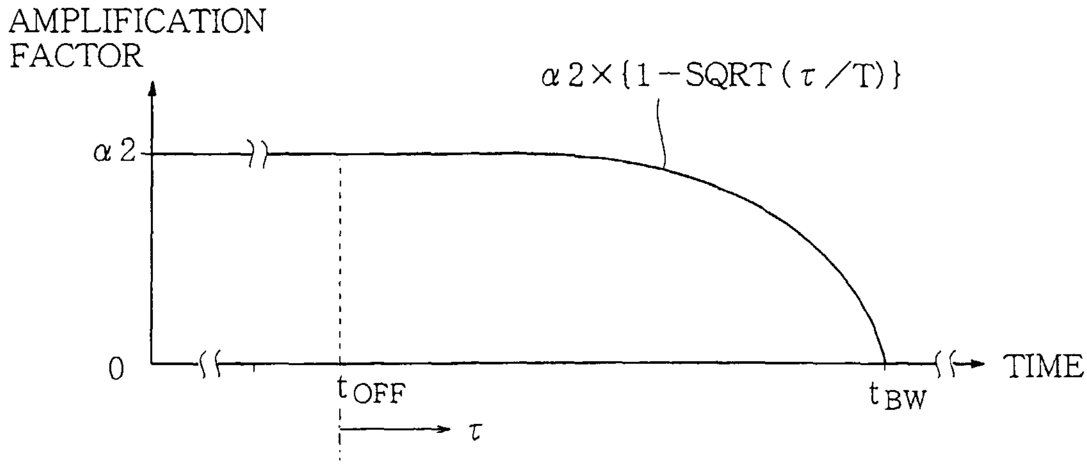

FIG.7 b

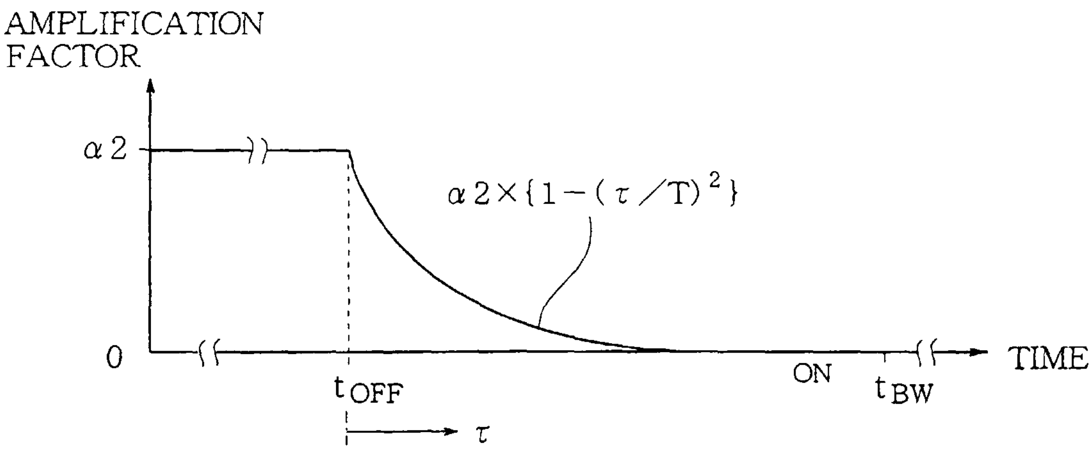

FIG.7 c

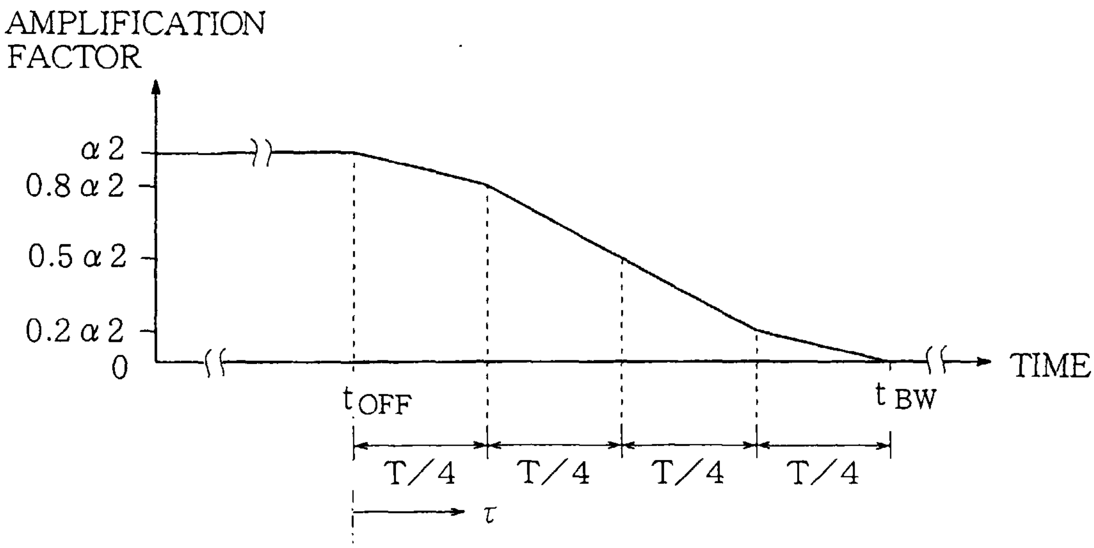

FIG.8 a

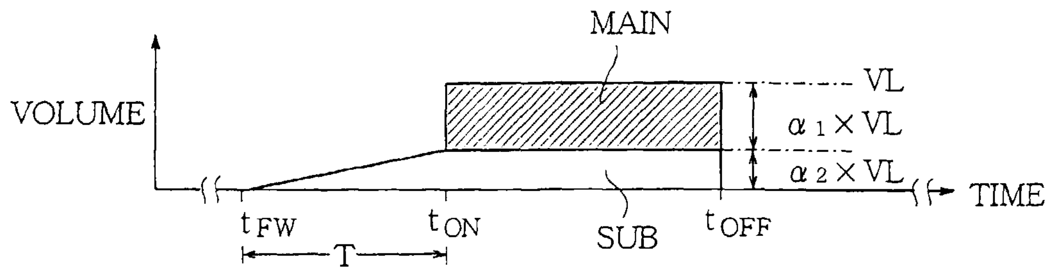

FIG.8 b

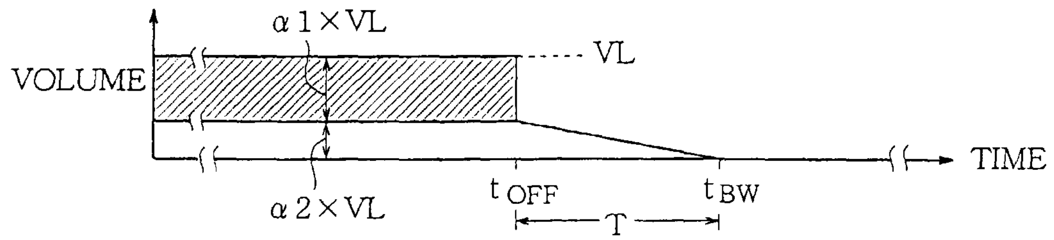

FIG.8 c

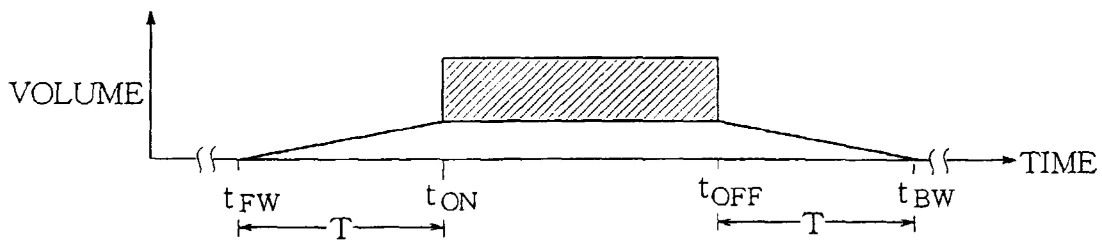

FIG.8 d

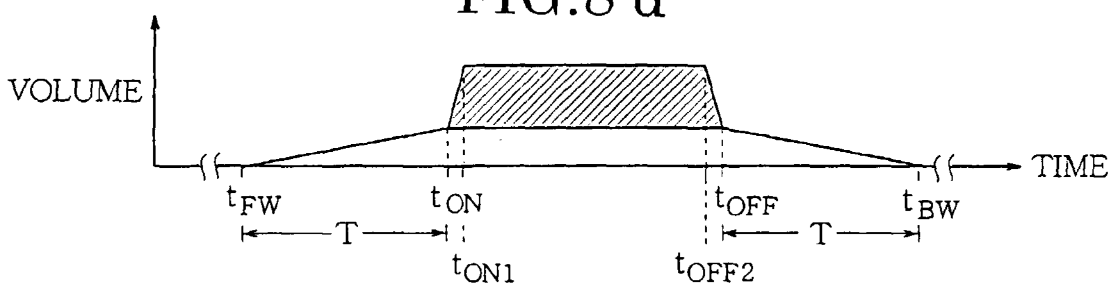

FIG.8 e

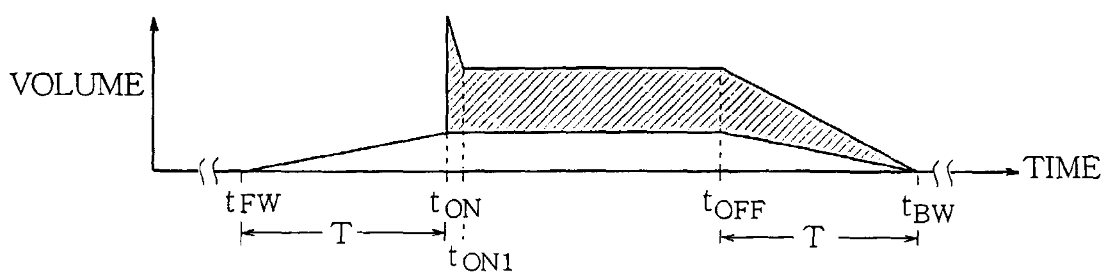

FIG.9 a

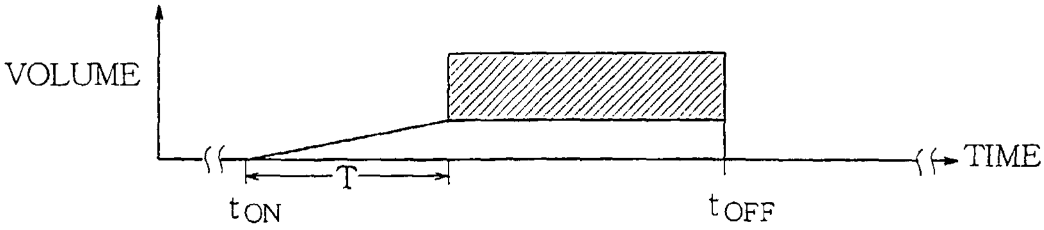

FIG.9 b

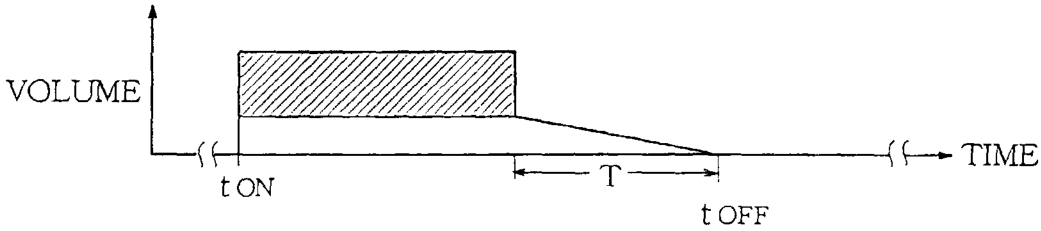

FIG.9 c

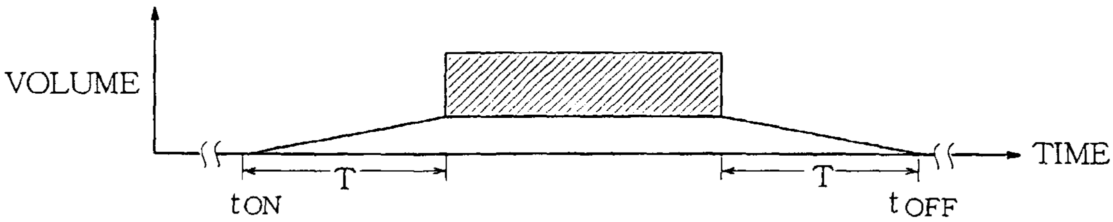

FIG.9 d

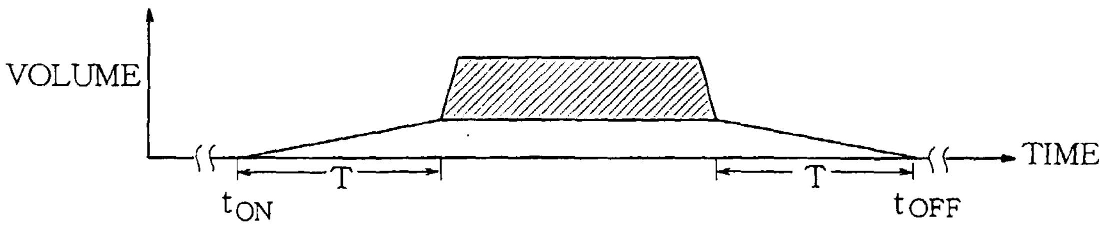

FIG.9 e