(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 845 644 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.10.2007 Bulletin 2007/42

(51) Int Cl.:
H04H 7/00 *(2006.01)*

(21) Application number: **06380075.9**

(22) Date of filing: **11.04.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(71) Applicant: **Ecler laboratorio de electroacústica**
08038 Barcelona (ES)

(72) Inventors:
- **Mele Barrena, Domingo**
  c/o Ecler Laboratorio de Electroacústica, S.A.
  08038 Barcelona (ES)
- **Sanuy Sarroca, Angel**
  c/o Ecler Laboratorio de Electroacústica, S.A.
  08038 Barcelona (ES)
- **Mas Mas, José Maria**
  c/o Ecler Laboratorio de Electroacústica, S.A.
  08038 Barcelona (ES)

(74) Representative: **Gislon, Gabriele et al**
Torner, Juncosa i Associats, S.L.
c/ Bruc, 21
08010 Barcelona (ES)

(54) Audio mixer

(57) It comprises:
- a crossfader to perform a weighted mixing of two or more analogue audio signals (A_1, A_2),
- a selector device (SW) to alternatively select a first operating mode, in which operating said crossfader (Xf) only affects a first mix signal to be fed to said main output (Ao_1), or a second mode, in which said crossfader (Xf) operation only affects a second mix signal to be fed to a monitor output (Ao_2), and
- a control unit (1) associated with the selection device (SW) and adapted to make the mixer operate according to said first or said second selected operating mode, conditional on that output signals from the crossfader (Xf), or one signal representative of said output signals, have certain determined values.

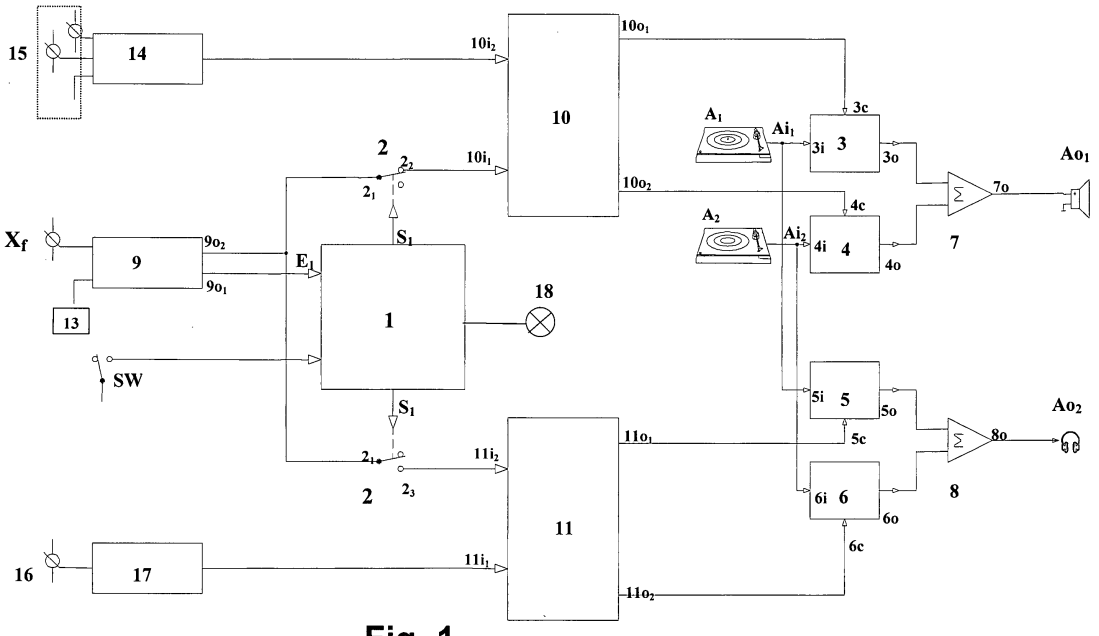

Fig. 1

EP 1 845 644 A1

Description

Field of the invention

[0001] This invention concerns to in general to an audio mixer of the type that comprises one or more control elements operable by an operator to make a weighted mix of two or more analogue audio signals and, in particular, to an audio mixer adapted to selectively supply said mix to a main audio output and/or to a monitor output.

State of the art

[0002] In a conventional audio mixer a "crossfader" is defined as the control element that allows to make a gradual transition of two audio signals at the equipment output by means of movement between two end positions, with only one of the two audio signals present at the equipment output when the "crossfader" is in a first end position, whereas, when the "crossfader" is in the other end position, only the other audio signal is present. When the crossfader is moved from one end position to the other, a gradual transition is produced between the two audio signals.

[0003] Moreover, a conventional mixer generates a monitoring signal, called monitor signal, that permits the input signals to be heard in headphones. Its main function is to control the signals before sending them to the main output, by which the audience will receive the mixing result.

[0004] In general, in conventional mixers, the crossfader was associated with the main mixer output and had no effect on the monitor signals.

[0005] There was therefore, a significant limitation: it was not possible to hear in the headphones the effect produced by crossfader movement, without this movement also affecting the output signal.

[0006] The new musical trends, such as "scratch", have encouraged the use of the crossfader to the point where it has become an "instrument" for producing effects and rhythms based on the transition of two musical piece. The previously described limitation forces the operator to always carry out the effects "live", directly at the output, without any possibility of monitoring them and preparing beforehand.

[0007] Audio mixers are known that do make it possible for the operator to perform the mixing while listening to it through headphones.

[0008] One such mixer is described in application US-A-2003/0039373, which comprises an operating mode selector switch that allows a mixer user to change the monitor signal to be heard through respective headphones. That mixer comprises a monitor circuit operable to receive first and second audio signals entering the mixer and an audio signal result of producing sound effects in said second input audio signal or in a first mix signal resulting from a weighted mix of the first and second audio signals, produced by operating a corresponding crossfader.

[0009] Said monitoring circuit is also adapted to produce a second mix signal resulting from a weighted mix of two of said received signals, allowing the user, who has, for example, headphones connected to the monitor circuit output, to hear the second mix signal, but preventing the audience from hearing it.

[0010] Said application refers to audio mixers prior to that proposed in US-A-2003/0039373, which already permitted the operator to monitor the mix signal while the audience was hearing one of the two mixer input audio signals.

[0011] Neither of the two cited previous art documents (that of application US-A-2003/0039373 and the one there described as being prior to said application) makes any reference to the possibility of employing more than one selection system conditioned simply to the wish of the operator to monitor ones or others mix signals, said wish being carried out by operating a mode selection switch.

[0012] In addition, said application US-A-2003/0039373 is centred on mixes, including effects, subsequent to a first signal already mixed by a common crossfader (referred to as "crossfader signal", "dry signal" or "first intermediate signal"), with the signals of said subsequent mixes (or mixed signal) being the ones that are not offered to the audience when the operator is producing and listening to them, thanks to switching elements, an example of which are FETs (Field Effect Transistors) controlled by a switch.

[0013] This document does not describe any type of restriction referring to activation of said switching elements, no the negative effects that such switching could produce on the signal heard by the audience, if the moment at which to switch is not carefully chosen.

[0014] Moreover the monitored mixes are produced by control elements which are specific of the monitoring unit, that do not affect the output offered to the audience. Said patent application does not mention what happens if the operator uses the common crossfader to produce the mix to be monitored, thus varying the so-called first intermediate mix signal and how such possible manipulation would affect the signal being heard by the audience.

[0015] With respect to the mixer defined as being prior to that proposed in said application, it is not described that there are specific control elements to produce a mix for monitoring only, but instead possibilities are offered to the operator to adjust one of the two signals to be mixed, and to mix them to verify the result of said adjustments, in order to subsequently permit the mixing of the adjusted signal with the other audio signal by means of a corresponding crossfader, while the audience listens to said mix, thus understanding that said crossfader is common, in other words employed to produce both mixes, the one only heard by the operator and the one heard by the audience. Nor does it indicate that there are restrictions referring to when it is possible to use the crossfader for one or the other mixes by means of a corre-

sponding switching, nor the negative effects that said switching could produce in the signal to be heard by the audience if the moment of switching is not suitably chosen.

[0016] Said negative effects (also extrapolable to the activation of the switching elements of application US-A-2003/0039373) are produced because at the moment of switching off the crossfader from the main output (because it is to be used for the mix to be monitored) the mixer output signal is the sum of the two inputs weighted according to the crossfader position at that moment and if, when the crossfader is switched on again to act on the main output, the same weighting it had at the switch off moment is not maintained, the output signal will suddenly change.

[0017] If, for example, the operator using the mixer defined as prior to that proposed in US-A-2003/0039373, has just made the mix to be monitored leaving the crossfader in an intermediate position, while the audience was listening to only one of the two signals to be mixed, if, at this moment crossfader control is returned to the mix to be supplied to the audience, the latter will suddenly hear the two signals mixed according to said intermediate crossfader position and experience a very brusque change in the signal heard.

Description of the invention

[0018] It appears to be necessary to offer an alternative to the state of the art that covers the gaps there found, by overcoming said cited negative effects caused by an at will switching of the mentioned common crossfader, or of other switching elements the activation or deactivation of which affects the mixer output signal to be heard by the audience, such as those described in US-A-2003/0039373.

[0019] To achieve that aim, this invention concerns to a mixer with a control unit that decides how to switch on and off the crossfader (or any other common control element) at the main output with the priority that the output signal does not undergo sudden changes when switching occurs.

[0020] With that aim, this control unit does not switch off the crossfader at the main output until it reaches a determined position, for example one of the two ends.

[0021] In a similar fashion, once the operator wishes to return crossfader control to the mix to be supplied to the main output, the control unit will not allow the crossfader to recover control on the signals to be supplied to the main output until it returns to the same "position" as when it was switched off.

[0022] The term "position" is between inverted commas because the invention is applicable to any control element whose operation does not necessarily involve the movement of any of its parts.

[0023] More specifically, this invention concerns to an audio mixer of the type that comprises the following conventional elements:

- two or more audio inputs to receive two corresponding analogue audio input signals to be mixed,
- a first audio output, or main output, for supplying an audience with a corresponding main analogue audio signal,
- a second audio output, or monitor output, for supplying an operator of said mixer with an analogue audio monitor signal,
- a minimum of one control element, such as the mentioned crossfader, operable by said operator, for, in collaboration with an electronic circuitry to which it is connected, regulating at least the gain or attenuation of each of said two audio input signals, by means of output signals from said control element, and prior to their mixing into a mix signal resulting from the weighted combination of both,
- a selection device operable by said operator to select at least two alternative operating modes: a first mode in which operating said control element only affects a first mix signal to be fed to said main output, and a second mode in which said operating of the control element only affects a second mix signal to be fed to said monitor output.

[0024] The mixer proposed by this invention comprises, as a characteristic element, a control unit associated with said selection device and adapted to make said mixer work according to whether said first or said second selected operating mode, conditional on that at least said output signals from the control element, or at least one signal representative of said output signals, have certain determined values.

[0025] The control unit is an electronic system with access to said control element output signals and/or said signal representative of the same, with one or more storage devices, such as memories containing said determined values, together with one or more switching elements actionable by the electronic system for making the mixer work according to the selected operating mode, for which the electronic system is adapted to compare the stored values with those of the accessed signals and activate said switching element or elements when the comparison results in a coincidence.

[0026] In general, although not limited to this, the control element comprises at least one part fixed with respect to a support of said mixer and a moving part that can move with respect to said fixed part.

[0027] In one embodiment, the control element is a potentiometer, with said moving part being a wiper and the fixed part comprising one or more resistances on which a portion of said wiper contacts.

[0028] In said embodiment, the output signals from the control element, or that representative of the same, are, for example, the value of the voltage drop produced between the wiper and each of the far ends of the resistance or resistances.

[0029] In another embodiment, the control element or the associated electronic circuitry comprises a position

detector adapted and arranged to detect the position of said moving part, or of a portion of the same, with respect to at least the position of a point of said fixed part of the control element, and to generate at least one output signal representative of said position, or position signal, which is said output signal from the control element, if said position detector is comprised by the same, or is said signal representative of the control element output signal, if said position detector is comprised by said associated electronic circuitry.

[0030] In another embodiment, said position detector is adapted to detect the position of said moving part, or of a portion of the same, with respect to the positions of two points of said fixed part of the control element, and to generate at least one output signal representative of said position.

[0031] This means that in the case in which the control element comprises a part that can be moved with respect to another part, such as the case of conventional crossfaders, in association with a corresponding position detector, the control element output signals, or those representative of the same, are, in general, voltage values generated by, or from, the readings made by said position detector, and hence, the conditions for passing from the first operating mode to the second, and vice versa, are relative to the position adopted by the control element, just as indicated at the beginning of this section.

[0032] As will be described in greater detail in a later section, the mixer is adapted so that, when it passes from the first operating mode to the second, it maintains the same signal at the main output that was present during operation in the first mode, and vice versa.

[0033] In a preferred embodiment, the determined values correspond to one or both end positions of the crossfader, in other words, when the resulting mix signal only contains one of the two input signals, a moment in which (if in the first operating mode) the audience is listening to said input signal and the control unit permits the crossfader to be switched off from the main output to pass to the second operating mode, and only allows a return to the first operating mode when the crossfader is again in said end position.

[0034] Obviously, this invention is not limited to said end positions of the crossfader and any other intermediate position can also be used as corresponding to the determined values taken as the reference to be reached.

A brief description of the drawings

[0035] The previous and other advantages and characteristics will be more fully understood from the following detailed description of some embodiments, with reference to the attached drawings, that are to be taken in an illustrative and non-limiting manner, in which:

Fig. 1 is a diagram of the mixer proposed by this invention for an embodiment, and

Fig. 2 is another diagram of the mixer proposed by this invention for another embodiment.

Detailed description of some embodiments

[0036] Just as shown by both drawings, this invention concerns to an audio mixer, of the type that, for both illustrated embodiments, comprises:

- two audio inputs Ai_1, Ai_2 to receive two corresponding analogue audio input signals A_1, A_2 to be mixed,
- a first audio output Ao_1, or main output, for supplying an audience with a corresponding main analogue audio signal,
- a second audio output Ao_2, or monitor output, for supplying an operator of said mixer with an analogue audio monitor signal,
- a minimum of one control element Xf, preferably a crossfader, operable by said operator, for, in collaboration with an electronic circuitry to which it is connected, regulating the gain or attenuation of each of said two audio input signals A_1, A_2, by means of output signals from said crossfader Xf, and prior to their mixing into a mix signal resulting from the weighted combination of both.

[0037] Said mixer comprises a selection device SW operable by said operator to select at least two alternative operating modes: a first mode in which operating said crossfader Xf only affects a first mix signal to be fed to said main output Ao_1, and a second mode in which operating said crossfader Xf only affects a second mix signal to be fed to said monitor output Ao_2.

[0038] The proposed mixer comprises a control unit 1 associated with said selection device SW and adapted to make said mixer work according to whether said first or said second selected operating mode, conditional on that at least said output signals from the at least one crossfader Xf, or at least one signal representative of said output signals, have certain determined values.

[0039] Once the user operates said selection device SW in order to select the first or second mode, the control unit 1, which is connected to the selection device SW, checks whether the cited conditions are met and only if they are will it allow said user's selection to be made, in other words, permitting the mixer to operate according to the selected mode.

[0040] Just as described in a previous section, for the embodiment in which the control element Xf comprises a part that can be moved with respect to another part, as in the case of conventional crossfaders, in association with a corresponding position detector, said position detector output signal, or position signal, is said output signal from the crossfader Xf, if said position detector is comprised by the same, or is said signal representative of the crossfader Xf output signal, if said position detector is comprised by said associated electronic circuitry.

[0041] The crossfader Xf output signals, or those representative of the same, are, in general, voltage values

generated by, or from, the readings made by said position detector, and hence, the conditions for passing from the first operating mode to the second, and vice versa, are relative to the position taken by the control element, in this case a crossfader Xf, just as described in a previous section, so that said values stored in said memory correspond, in general, to digitised voltage values relative to determined positions to be reached by the crossfader Xf to allow the mixer pass from the first operating mode to the second, and vice versa.

[0042] In the embodiment of Fig. 1, the mentioned control unit 1 is an electronic system 1, with:

- a processing system,
- a minimum of one storage device, or memory, which stores certain determined values of said position signals,
- an input E_1, connected to a first point of said electronic circuitry or of said crossfader Xf, adapted to receive a sampling signal from said position signals so that said electronic system 1 is aware of their actual values at all times and compares them, by means of the processing system, with the stored value or values, and
- a minimum of one output S_1, connected to at least one switching element 2 of said electronic circuitry,

with said electronic system 1 being adapted for, if said comparison results in coincidence, activating at least said switching element 2 via sending at least one corresponding signal by said output S_1, to switch from the first operating mode to the second, or vice versa.

[0043] In the embodiment illustrated in Fig. 2, said control unit 1 is an electronic system 1 comprising the following elements:

i) a first block 1a, forming part of said electronic circuitry and comprising:

- a processing system,
- one or more storage devices, which store said determined values of said position signals, with said first block 1 a being adapted to receive said sampling signal of the position signals in order to know their actual values at all times and, by means of said processing system, compare them with the stored determined value or values, and generate an enabling signal when the comparison results in coincidence,
  and

ii) a second block 1 b comprising:

- an input E_2, connected to an output from the first block 1 a and adapted to receive said enabling signal,
- a minimum of one output S_1, connected to at least one switching element 2 of said electronic circuitry, with said second block 1b being adapted to activate, when it receives said enabling signal, at least said switching element 2, via sending the corresponding signal by said output S_1, in order to switch from the first operating mode to the second, or vice versa.

[0044] As can be seen in both figures, the electronic circuitry comprises a control section 9 of the crossfader Xf, with a minimum of one sampling and digitising block comprising one or more A/D converters, with said block having an input connected to the output of said position detector to sample and digitise the output signal provided by the same, in other words said position signal, and an output connected to the electronic system 1 via an output $9o_1$ of said control section 9.

[0045] In the embodiment of Fig. 1 said output $9o_1$, of said control section 9, corresponds to the mentioned first point of the electronic circuitry, with said digitised output signal being said sampling signal of the position signals.

[0046] In the embodiment of Fig. 2, the first block 1a of the electronic system forms part of the control section 9, with said output $9o_1$ of said control section 9 being the output from the first block 1 a, to which said input E_2 of the second block 1b is connected, so that the first block 1 a is able to send the enabling signal to the second block 1 b.

[0047] The mixer shown in Fig. 2 comprises two switching elements 2, 12, each of which having two respective terminals 2_1-2_2, 12_1-12_2, and connected to respective outputs S_1, S_2 of the second block 1 b of the electronic system, the operation of which allows the mixer to operate according to third and fourth operating modes, which will be described later. However, the mixer of Fig. 2 could operate, for a non-illustrated embodiment, just as described above, with a single switching element 2, as shown in Fig. 1.

[0048] Moreover, the mixer shown in Fig. 1 comprises a single switching element 2 with three terminals 2_1, 2_2, and 2_3, and associated with a respective output S_1, although for the purpose of clarity, two switching elements are drawn, but with the same reference number 2, as also happens with the output S_1.

[0049] However, in the mixer of Fig. 1, the switching element 2 associated with the output S_1, can also be replaced by the two switching elements 2, 12 associated with the two outputs S_1, S_2, shown in Fig. 2, for another embodiment, not shown.

[0050] The electronic circuitry of the proposed mixer comprises a minimum of two variable gain amplifiers 3-4, 5-6, each of which having an input 3i-4i, 5i-6i, connected to one of the two audio inputs Ai_1, Ai_2, that receive the two audio input signals A_1, A_2, and responsible for varying their respective amplitudes in function of corresponding gain control signals applied to respective control inputs 3c-4c, 5c-6c of the same, which are function of said position signals of the crossfader Xf and adjustable on acting on the control element Xf.

[0051] In the embodiments illustrated in Figs. 1 and 2, the electronic circuitry comprises first and second mixer groups, each of which having:

- two of said variable gain amplifiers 3-4, 5-6, one per audio input signal A_1, A_2, each controllable by corresponding gain control signals and comprising respective outputs 3o-4o, 5o-6o by which the regulated gain or attenuation audio signals are supplied,
- a combination unit 7, 8, connected to the outputs 3o-4o, 5o-6o from said two amplifiers 3-4, 5-6 and adapted to combine the audio signals coming therefrom and to supply the resulting signal, said mix signal, to a respective output 7o, 8o, with said output 7o, 8o being connected to the main output Ao_1, in the case of the first mixer group, or to the monitor output Ao2, in the case of the second mixer group.

[0052] In a non-illustrated embodiment, the mixer comprises only two of said amplifiers 3-4, 5-6 associated with only one of said combination units 7, 8, and in this non-illustrated case, the switching element 2 or elements 2, 12 are connected between the output of said combination unit and the two mixer outputs, the main output Ao_1 and the monitor output Ao_2, to switch between them in function of the selected operating mode.

[0053] Continuing with the illustrated embodiments, the proposed mixer is adapted so that when it is in the first operating mode, operating the crossfader Xf causes regulation of the gain control signals for the first mixer group, while those of the second mixer group remain fixed, and adapted so that when it is in the second operating mode, operating the crossfader Xf causes regulation of the gain control signals for the second mixer group, while those of the first mixer group remain fixed.

[0054] Each of said first and second mixer groups comprise respective first 10 and second 11 gain signal generator blocks, each adapted to generate two of said gain control signals and to apply them, via two corresponding outputs $10o_1$-$10o_2$, $11o_1$-$11o_2$, to the corresponding control inputs 3c-4c, 5c-6c of the amplifiers 3-4, 5-6 of the first or second mixer group, respectively.

[0055] Each of said gain signal generator blocks 10, 11 comprises an input $10i_1$, $11i_1$, which can be connected to an output $9o_2$ of said control section 9 of the crossfader Xf containing the digitised position detector output signal.

[0056] In the embodiment of Fig. 1 said inputs can be connected to the same output $9o_1$ which is connected to the input E_1 of the electronic system, which cannot be done in the embodiment of Fig. 2, since the digitised position signal is not present at the output $9o_1$ connected to input E_2, but an enabling signal instead, when this is the case.

[0057] Referring to Fig. 1, the illustrated switching element 2 comprises a first terminal 2_1, connected to said output $9o_2$ of said control section 9, and a second 2_2, and a third 2_3 terminals respectively connected to said inputs $10i_1$, $11i_1$ of the first 10 and second 11 gain signal generator blocks, with the switching element 2 being adapted to connect, on command from the electronic system 1, said first terminal 2_1, alternatively with said second 2_2 or said third 2_3 terminal, depending on whether the first or second operating mode is selected, respectively.

[0058] Referring to the embodiment shown in Fig. 2, each of the two illustrated switching elements 2, 12 comprises a first terminal 2_1, 12_1 connected to said output $9o_2$ of the control section 9 and second terminals 2_2, 12_2 respectively connected to the inputs $10i_1$, $11i_1$ of the first 10 and second 11 gain signal generator blocks, with the switching elements 2, 12 being adapted to connect, on command from the electronic system 1 (in the illustrated case, on command from the second block 1b after receiving the enabling signal from the first block 1a), their respective first terminals 2_1, 12_1, with their second respective terminals 2_2, 12_2, independently, in function of the operating mode, first, second, third or fourth established by the electronic system 1.

[0059] As previously indicated, in an embodiment, the mixer proposed by this invention is adapted to operate according to at least one third operating mode, intermediate between said first and second modes, in which the operating of the crossfader Xf affects both, the first mix signal to be fed to the main output Ao_1 and the second mix signal to be fed the monitor output Ao_2, with the control unit 1 being adapted to make said mixer operate according to the third operating mode since the second operating mode is selected, by means of the selection device SW and until conditions to pass from the first to the second operating mode are met.

[0060] This means that when an operator selects to enter the second operating mode, from the same moment when the operator operates the selection device SW and while the already described conditions are not met for the control unit 1 to allow it, the mixer will enter and remain in the third mode, with the crossfader movement affecting the mix signal heard by the audience, through Ao_1, as well as the one heard by the operator through the monitor output Ao_2.

[0061] In another embodiment, the mixer is adapted to operate according to a fourth operating mode, intermediate between the first and second operating modes, in which operating the crossfader has no effect on neither of the first and second mix signals, with the control unit 1 being adapted to make said mixer work according to said fourth operating mode since the first operating mode is selected, by means of the selection device SW, and until conditions to pass from the second to the first operating mode are met.

[0062] This means that when an operator selects to enter the first operating mode, from the same moment when the operator operates the selection device SW and while the already described conditions are not met for the control unit 1 to allow it, the mixer will enter and remain in the fourth mode, with the crossfader movement not affecting the mix signal heard by the audience, through Ao_1, nor the one heard by the operator through the mon-

itor output Ao_2.

[0063] The mixer is able to operate according to said third and fourth modes because of the two independent switching elements 2, 12, shown in Fig. 2, which are connected to two outputs S_1, S_2 of the second block 1b of the electronic system, with the second block 1b being adapted to activate, after receiving corresponding enabling signals generated by the first block 1 a, the switching elements 2, 12 independently, via sending corresponding signals by said outputs S_1, S_2, activating only one of said switching elements 2, 12 in order to pass into said third or fourth operating mode or, when the mentioned coincidence is produced, activating the two switching elements 2, 12 (or only one if the other is already activated) in order to enter into the first or second selected operating mode via connection of their respective first terminals 2_1, 12_1, to their respective second terminals 2_2, 12_2.

[0064] Continuing with the description of the gain signal generator blocks 10, 11 shown in Figs. 1 and 2, each of them is adapted to process the digitised position detector output signal and generate two corresponding gain signals, one for each amplifier 3-4, 5-6.

[0065] In general, the gain blocks 10, 11 comprise, just as can be seen from Figs. 1 and 2, other inputs $10i_2$, $11i_2$, connected to the outputs of other additional control sections 14, 17 of other control elements 15, 16, or faders, which are specific for acting on only one of the mixer outputs, the main output Ao_1 or the monitor output Ao_2, with the gain blocks 10, 11 being also adapted to process the output signals of said additional control sections 14, 17.

[0066] In an embodiment, each of the gain signal generator blocks 10, 11 is adapted to carry out digital linearity handling, for which it comprises a digital processing unit to perform said processing of at least the digitised position detector output signal, for a plurality of consecutive values, and apply to them a function selected from a series of functions with different degrees of linearity, in order to generate said two corresponding gain signals, one for each amplifier 3-4, 5-6, with a sequence of values ordered according to the selected function.

[0067] Each of the gain signal generator blocks 10, 11 comprises a minimum of one digital-analogue converter, or D/A converter, for the generation of said gain signals from the processed digital signal.

[0068] In another embodiment, alternative to the one referring said digital linearity handling, each of the gain signal generator blocks 10, 11 is adapted to perform analogue linearity handling, for which it comprises an analogue unit or circuitry inserted between said D/A converter and the output from the respective gain signal generator block 10, 11, with said analogue unit being adapted to process the analogue output signal from said D/A converter to generate a corresponding gain signal with a determined degree of linearity.

[0069] Each of the gain signal generator blocks 10, 11 is adapted to, when its input $10i_1$, $11i_1$ is disconnected from the first terminal 2_1, 12_1 of the switching element 2, 12, maintain the gain signals fixed at their outputs $10o_1$-$10o_2$, $11o_1$-$11o_2$, with substantially the same value as immediately before said disconnection, when the gain signals applied to the other mixer block 11, 10 are being regulated. This achieves that when the mixer is operating in the first mode, i.e. with the audience hearing the mix made with the assistance of the crossfader, and it passes to the second operating mode, the audience continues hearing what it was listening to just prior to the operating mode changeover.

[0070] The mixer proposed by this invention also comprises an indicator device 18 connected to the electronic system 1, with the electronic system 1 being adapted to activate said indicator device 18 when conditions are met to pass from the first operating mode to the second, and vice versa.

[0071] In an embodiment, said indicator device 18 is a luminous indicator device 18, the purpose of which is to inform the operator who has selected the mode changeover, when the conditions for such a changeover occur and hence, when the changeover is produced automatically, emitting, for example, a red light while the changeover is still not allowed, and a green light when it occurs, both referring to a changeover from the first to second mode, as well as from the second to the first.

[0072] As can be seen from Figs. 1 and 2, the mixer also comprises a control member 13 for the crossfader Xf, connected to the control section 9 of the same, and adapted to, in collaboration with the control section 9, vary the linearity of the crossfader Xf output signal, prior or subsequent to its digitisation.

[0073] A person expert in the art could introduce changes and modifications to the described embodiments without leaving the scope of the invention as defined according to the attached claims.

Claims

1. Audio mixer, of the type comprising:

- at least two audio inputs (Ai_1, Ai_2) to receive two corresponding analogue audio input signals (A_1, A_2) that are to be mixed,
- a first audio output (Ao_1), or main output, for supplying an audience with a corresponding main analogue audio signal,
- a second audio output (Ao_2), or monitor output, for supplying an operator of said mixer with an analogue audio monitor signal,
- at least one control element (Xf), operable by said operator, for, in collaboration with an electronic circuitry, to which it is connected, regulating at least the gain or attenuation of each of said two audio input signals (A_1, A_2), by means of output signals from said control element (Xf), and prior to their mixing into a mix signal resulting from the weighted combination of both,

said mixer comprising a selection device (SW) operable by said operator to select at least two alternative operating modes: a first mode in which operating said control element (Xf) only affects a first mix signal to be fed to said main output (Ao_1), and a second mode in which said operating of the control element (Xf) only affects a second mix signal to be fed to said monitor output (Ao_2),
characterised in that it comprises a control unit (1) associated with said selection device (SW) and adapted to make said mixer work according to whether said first or said second selected operating mode, conditional on that at least said output signals from the at least one control element (Xf), or at least one signal representative of said output signals, have certain determined values.

2. A mixer according to claim 1, **characterised in that** it is adapted to operate according to at least one third operating mode, intermediate between said first and second modes, in which the operating of the control element (Xf) affects both, said first mix signal to be fed to the main output (Ao_1) and the second mix signal to be fed to said monitor output (Ao_2), with said control unit (1) being adapted to make said mixer work according to said third operating mode since the second operating mode is selected, by means of the selection device (SW), and until conditions to pass from the first to the second operating mode are met.

3. A mixer according to claim 1 or 2, **characterised in that** it is adapted to operate according to at least one fourth operating mode, intermediate between said first and second operating modes, in which said operating of said control element (Xf) has no effect on neither of said first and second mix signals, with said control unit (1) being adapted to make said mixer work according to said fourth operating mode since the first operating mode is selected, by means of the selection device (SW), until conditions to pass from the second to the first operating mode are met.

4. A mixer according to claim 1, 2 or 3, **characterised in that** said control unit (1) is an electronic system (1) comprising the following elements:

- a processing system,
- at least one storage device that stores said determined values of said output signals from the control element (Xf), or at least one determined value of said signal representative of said output signals,
- at least one input (E_1), connected to at least one first point of said electronic circuitry or of said control element (Xf), adapted to receive a sampling signal of said output signals from the control element (Xf), or of said at least one signal representative of the same, so that said electronic system (1) is aware of their actual values at all times and compares them with the stored determined value or values via said processing system, and
- at least one output (S_1), connected to at least one switching element (2) of said electronic circuitry,

with said electronic system (1) being adapted for, if said comparison results in coincidence, activating at least said at least one switching element (2), via sending at least one corresponding signal by said at least one output (S_1), to switch from the first operating mode to the second, or vice versa.

5. A mixer according to claim 1, 2 or 3, **characterised in that** said control unit (1) is an electronic system (1) comprising the following elements:

i) a first block (1a), forming part of said electronic circuitry and comprising:

- a processing system,
- at least one storage device that stores said determined values of said output signals from the control element (Xf), or at least one determined value of said signal representative of said output signals,
with said first block (1a) being adapted to receive said sampling signal of the output signals from the control element (Xf), or of the at least one signal representative of the same, in order to know their actual values at all times and, by means of said processing system, compare them with the stored determined value or values and generate an enabling signal when the comparison results in coincidence,
and

ii) a second block (1 b) comprising:

- an input (E_2), connected to an output from the first block (1a) and adapted to receive said enabling signal,
- at least one output (S_1), connected to at least one switching element (2) of said electronic circuitry, with said second block (1b) being adapted to activate, if it receives said enabling signal, at least said at least one switching element (2), via sending said corresponding signal by said at least one output (S_1), to switch from the first operating mode to the second, or vice versa.

6. A mixer according to claim 4 or 5, **characterised in that** the electronic system (1) comprises two outputs

(S_1, S_2), connected to two respective switching elements (2, 12) of said electronic circuitry, and **in that** it is adapted to activate said switching elements (2, 12) independently, via sending corresponding signals by said outputs (S_1, S_2), activating only one of said switching elements (2, 12) in order to enter said third or fourth operating mode or, when said coincidence is produced, activating both switching elements (2, 12) to enter the selected first or second operating mode.

7. A mixer according to claim 4, 5 or 6, **characterised in that** said electronic circuitry comprises at least two variable gain amplifiers (3-4, 5-6), each of which having an input (3i-4i, 5i-6i), connected to one of the two audio inputs (Ai_1, Ai_2) that receive the two audio input signals (A_1, A_2), and responsible for varying their respective amplitudes in function of corresponding gain control signals applied to respective control inputs (3c-4c, 5c-6c) of the same, which are function of the output signals from the control element (Xf), or of the at least one signal representative of the same, and adjustable on acting on the control element (Xf).

8. A mixer according to claim 7, **characterised in that** the electronic circuitry comprises at least a first and a second mixer groups, each of which having:

- two of said variable gain amplifiers (3-4, 5-6), one per audio input signal (A_1, A_2), each controllable by corresponding gain control signals, and comprising respective outputs (3o-4o, 5o-6o) through which supplying the regulated gain or attenuation audio signals,
- a combination unit (7, 8), connected to the outputs (3o-4o, 5o-6o) of said two amplifiers (3-4, 5-6) and adapted to combine the audio signals coming therefrom and to supply the resulting signal, said mix signal, to a respective output (7o, 8o), with said output (7o, 8o) connected to the main output (Ao_1) in the case of the first mixer group, or to the monitor output (Ao_2), in the case of the second mixer group.

9. A mixer according to claim 8, **characterised in that** it is adapted so that when it is in said first operating mode, operating the control element (Xf) causes regulation of the gain control signals for the first mixer group, while those of the second mixer group remain fixed, and so that when it is in said second operating mode, operating the control element (Xf) causes regulation of the gain control signals for the second mixer group, while those of the first mixer group remain fixed.

10. A mixer according to any of the previous claims, **characterised in that** said control element (Xf) comprises at least one part fixed with respect to a support of said mixer and a moving part that can move with respect to said fixed part.

11. A mixer according to claim 10, **characterised in that** said control element (Xf) is a potentiometer, with said moving part being a wiper and said fixed part comprising a resistance on which a portion of said wiper makes contact.

12. A mixer according to claim 10 when it depends on claim 9, **characterised in that** the control element (Xf) or the associated electronic circuitry comprises a position detector adapted and arranged to detect the position of said moving part, or of a portion of the same, with respect to at least the position of a point of said fixed part of the control element (Xf), and to generate at least one output signal representative of said position, or position signal, which is said output signal from the control element (Xf), if said position detector is comprised by the control element (Xf), or is said signal representative of the control element (Xf) output signal, if said position detector is comprised by said associated electronic circuitry.

13. A mixer according to claim 12, **characterised in that** said position detector is adapted to detect the position of said moving part, or of a portion of the same, with respect to the positions of two points of said fixed part of the control element (Xf), and to generate at least one output signal representative of said position.

14. A mixer according to claim 12 or 13, **characterised in that** the electronic circuitry comprises at least one control section (9) of said control element (Xf) with at least one sampling and digitising block that comprises at least one analogue-digital converter, or A/D converter, with said block having at least one input connected to the output of said position detector to sample and digitise the at least one output signal provided by the same, and an output connected to the electronic system (1) via an output ($9o_1$) of said control section (9), which corresponds to said first point of the electronic circuitry, with said digitised output signal being said sampling signal of said output signals from the control element (Xf), or of said at least one signal representative of the same, or said enabling signal.

15. A mixer according to claim 14, **characterised in that** each of said first and second mixer groups comprises respective first (10) and second (11) gain signal generator blocks, each adapted to generate at least two of said gain control signals and to apply them, via two corresponding outputs ($10o_1$-$10o_2$, $11o_1$-$11o_2$), to the corresponding control inputs (3c-4c, 5c-6c) of the amplifiers (3-4, 5-6) of the first or second mixer

group, respectively.

16. A mixer according to claim 15, **characterised in that** each of said gain signal generator blocks (10, 11) comprises at least one input ($10i_1$, $11i_1$) that can be connected to said output ($9o_1$) of said control section (9) of the control element (Xf), or to another output ($9o_2$) at which the digitised position detector output signal is also present.

17. A mixer according to claim 16 when it depends on claim 4, **characterised in that** said switching element (2) comprises at least one first terminal (2_1) connected to said control section (9) output ($9o_1$ or $9o_2$) that can be connected to said inputs ($10i_1$, $11i_1$) of said gain signal generator blocks (10, 11), and one second (2_2) and one third (2_3) terminals that are respectively connected to said inputs ($10i_1$, $11i_1$) of said first (10) and second (11) gain signal generator blocks, with the switching element (2) being adapted to connect, on command from the electronic system (1), said first terminal (2_1) alternatively with said second (2_2) or said third (2_3) terminal, in function of whether the first or the second mixer operating mode, respectively, has been selected.

18. A mixer according to claim 16 when it depends on claim 6, **characterised in that** each of said two switching elements (2, 12) comprises at least one first terminal (2_1, 12_1) connected to said control section (9) output ($9o_1$ or $9o_2$) that can be connected to said inputs ($10i_1$, $11i_1$) of said gain signal generator blocks (10, 11), and second terminals (2_2, 12_2) that are respectively connected to said inputs ($10i_1$, $11i_1$) of said first (10) and second (11) gain signal generator blocks, with the switching elements (2, 12) being adapted to connect, on command from the electronic system (1), their respective first terminals (2_1, 12_1) with their respective second terminals (2_2, 12_2), independently, in function of the operating mode, first, second, third or fourth, established by the electronic system (1).

19. A mixer according to claim 17 or 18, **characterised in that** each of the gain signal generator blocks (10, 11) is adapted to process at least the at least one digitised position detector output signal, and to generate two corresponding gain signals, one for each amplifier (3-4, 5-6).

20. A mixer according to claim 19, **characterised in that** each of the gain signal generator blocks (10, 11) comprises at least one digital processing unit for performing said processing of at least the digitised position detector output signal, for a plurality of consecutive values, and applying a function, selected from a series of functions with different degrees of linearity, to them in order to generate said two corresponding gain signals, one for each amplifier (3-4, 5-6), with an ordered sequence of values according to the selected function.

21. A mixer according to claim 19 or 20, **characterised in that** each of the gain signal generator blocks (10, 11) comprises at least one digital-analogue converter, or D/A converter, to generate said gain signals from the processed digital signal.

22. A mixer according to claim 21 when it depends on claim 19, **characterised in that** each of the gain signal generator blocks (10, 11) comprises at least one analogue unit or circuitry, inserted between said D/A converter and the output of the respective gain signal generator block (10, 11), with said analogue unit being adapted to process at least the analogue signal from said D/A converter in order to generate a corresponding gain signal with a determined degree of linearity.

23. A mixer according to claim 20, **characterised in that** each of the gain signal generator blocks (10, 11) is adapted to maintain, when its input ($10i_1$, 11 i_1) is disconnected from the first terminal (2_1, 12_1) of the switching element (2, 12), the gain signals fixed at their outputs ($10o_1$-$10o_2$, $11o_1$-$11o_2$), with substantially the same value they had immediately prior to said disconnection, when the gain signals applied to the other mixer block (11,10) are being regulated.

24. A mixer according to any of claims 2 to 23, **characterised in that** it comprises an indicator device (18) connected to said electronic system (1), being said electronic system (18) adapted to activate said indicator device (18) when the conditions for passing from the first operating mode to the second mode are met, and vice versa.

25. A mixer according to claim 24, **characterised in that** said indicator device (18) is a luminous indicator device.

26. A mixer according to claim 13, **characterised in that** it comprises at least one control member (13) of said control element (Xf), connected to said control section (9) of the control element (Xf) and adapted to, in collaboration with the control section (9), at least vary the linearity of said control element (Xf) output signal, in a manner prior or subsequent to its digitisation.

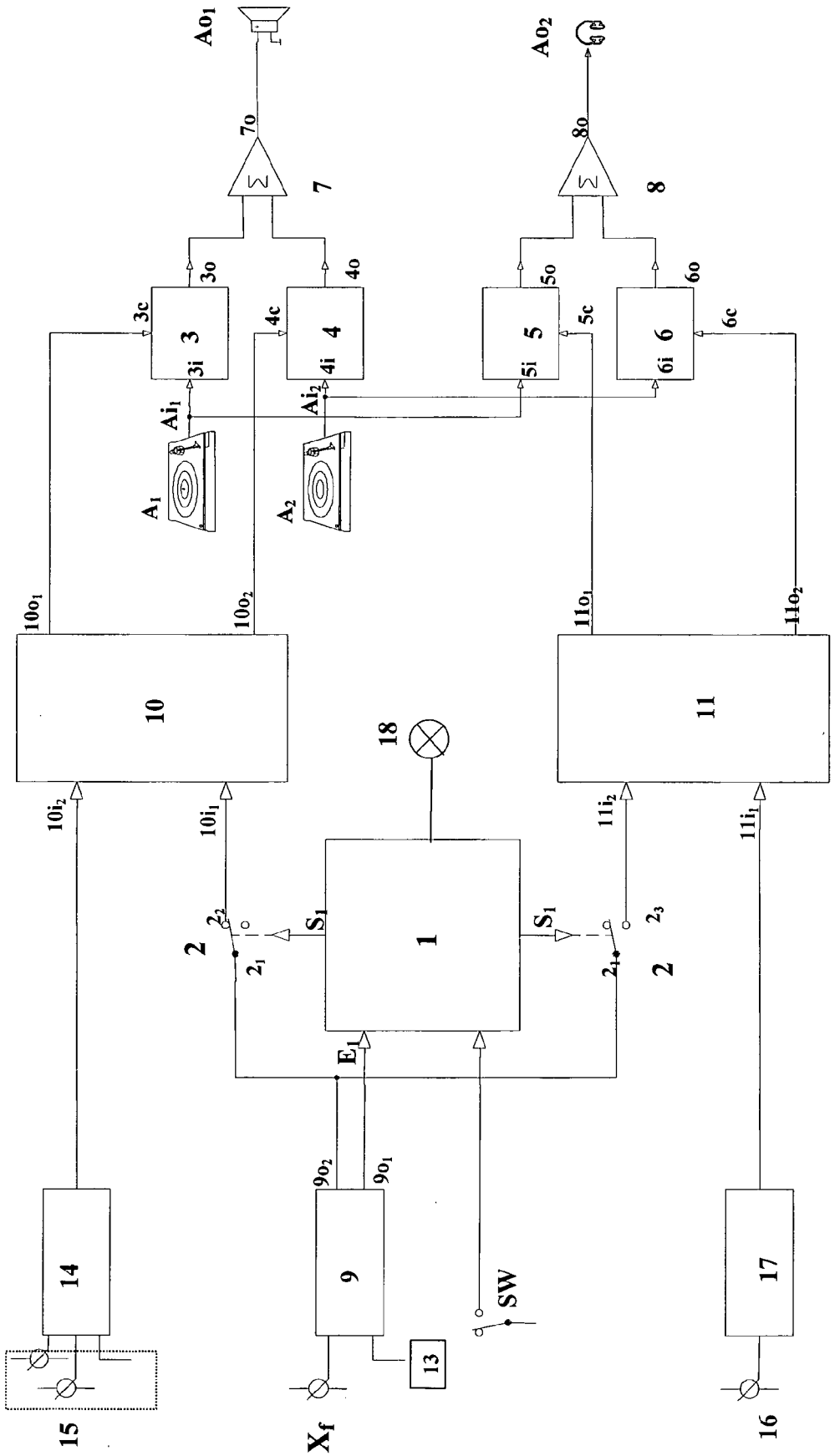
Ao1
Ao2
7o
8o
7
8
3o
4o
5o
6o
3c
4c
5c
6c
3
4
5
6
3i
4i
5i
6i
Ai1
Ai2
A1
A2
10o1
10o2
11o1
11o2
10
11
18
10i2
10i1
11i2
11i1
2
2
2
2
2
2
S1
S1
1
E1
9o2
9o1
9
14
17
SW
13
15
Xf
16

Fig. 1

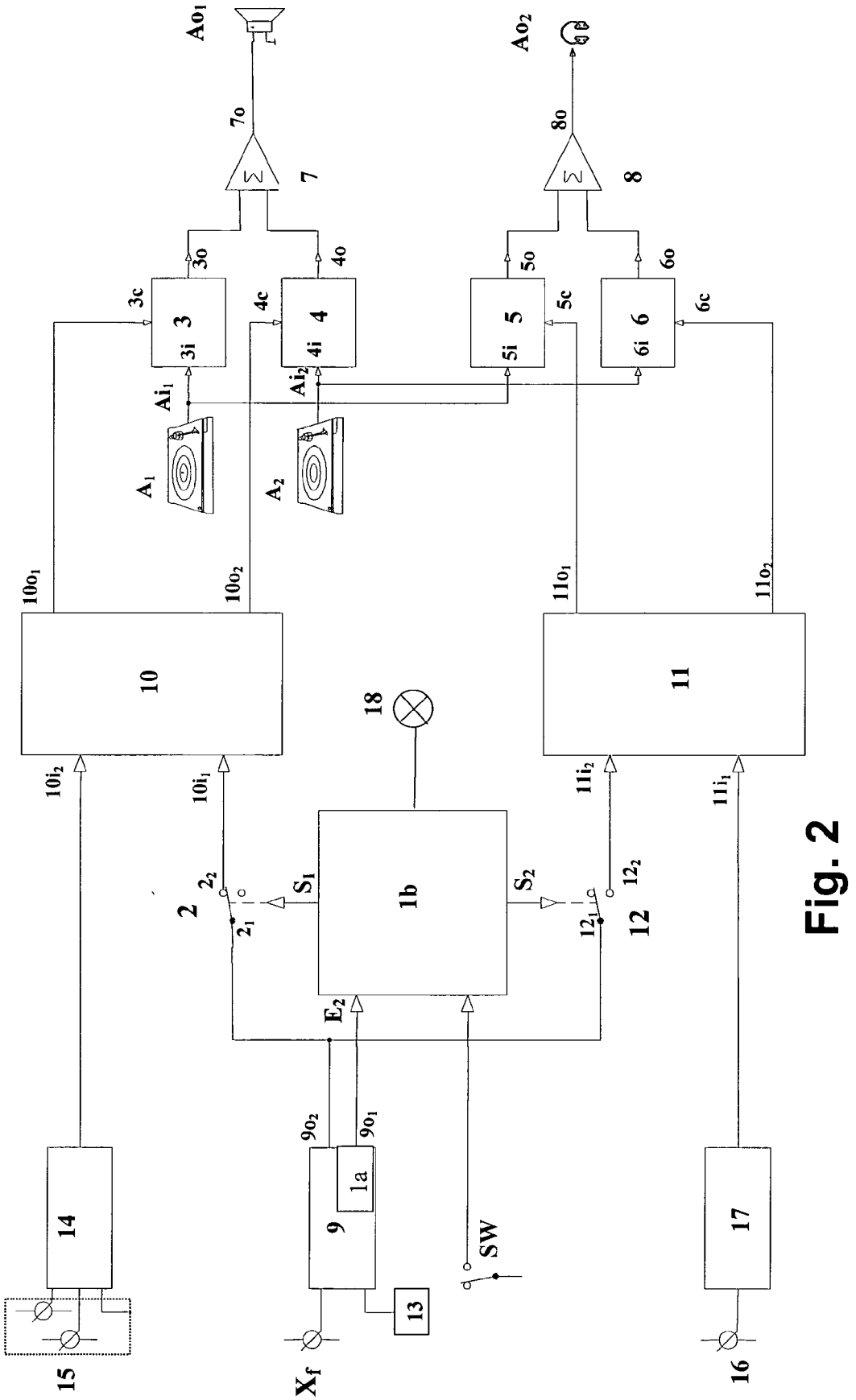
Ao1
Ao2
7o
8o
7
8
3o
4o
5o
6o
3c
4c
5c
6c
3
4
5
6
3i
4i
5i
6i
Ai1
Ai2
A1
A2
10o1
10o2
11o1
11o2
10
11
18
10i2
10i1
11i2
11i1
2
2₂
2₁
S1
1b
S2
12₂
12₁
12
E2
9o2
9o1
9
1a
SW
13
14
15
16
17
Xf

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 38 0075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2003/039373 A1 (LAWSON ADAM ET AL) 27 February 2003 (2003-02-27) * the whole document *	1-9, 24-26 10-23	INV. H04H7/00
Y A	US 2002/118848 A1 (KARPENSTEIN NISSIM) 29 August 2002 (2002-08-29) * the whole document *	10-23 1-9, 24-26	
A	US 5 319 359 A (ZAMPINI ET AL) 7 June 1994 (1994-06-07) * the whole document *	1-26	
A	US 5 488 669 A (ZAMPINI ET AL) 30 January 1996 (1996-01-30) * abstract *	1-26	
A	GB 2 276 519 A (* SONY ELECTRONICS INC) 28 September 1994 (1994-09-28) * the whole document *	1-26	

TECHNICAL FIELDS SEARCHED (IPC)

H04H
H04N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 September 2006	Willems, Brigitte

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 38 0075

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-09-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003039373 A1	27-02-2003	NONE	
US 2002118848 A1	29-08-2002	NONE	
US 5319359 A	07-06-1994	NONE	
US 5488669 A	30-01-1996	NONE	
GB 2276519 A	28-09-1994	JP 7006500 A	10-01-1995

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20030039373 A **[0008] [0010] [0011] [0012] [0016] [0017] [0018]**