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Nakada

[11] **3,838,202**

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[54] **DEVICE FOR IMPARTING TO A MUSICAL TONE A TONE COLOR VARIED WITH TIME**

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Sept. 19, 1972 Japan 47-93863

[52] **U.S. Cl.** **84/1.24,** 84/1.01
[51] **Int. Cl.** **G10h 1/02**
[58] **Field of Search** ..... 179/1 J; 84/1.01, 1.24, 84/1.25

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Assistant Examiner—U. Weldon
Attorney, Agent, or Firm—Flynn & Frishauf

[57] **ABSTRACT**

A device comprises a variable delay circuit for delaying a musical tone signal; means for varying a delay time of the variable delay circuit; a frequency spectrum modifier to which an output signal from the delay circuit is applied; and a feedback loop for feeding an output of the frequency spectrum modifier back to the input side of the variable delay circuit; whereby a musical tone signal to which is applied a tone color varied with time is obtained from the output side of the variable delay circuit.

21 Claims, 7 Drawing Figures

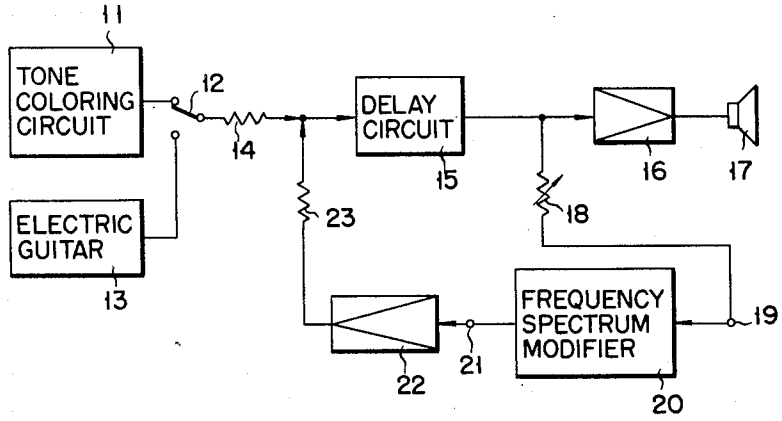


FIG. 1

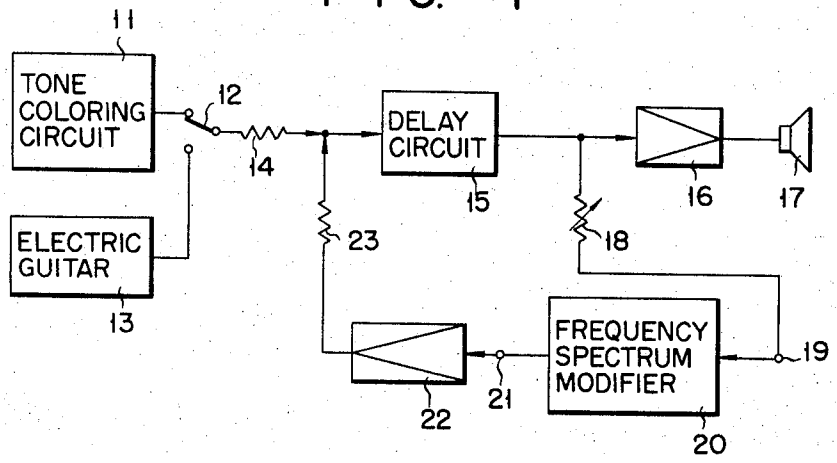


FIG. 2

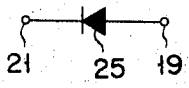


FIG. 3

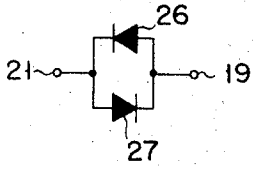


FIG. 4

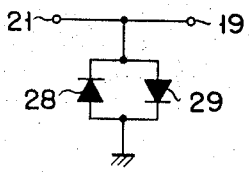


FIG. 5

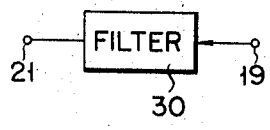


FIG. 6

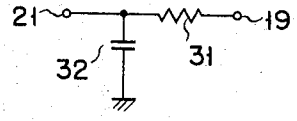
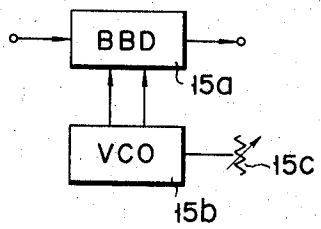


FIG. 7



DEVICE FOR IMPARTING TO A MUSICAL TONE A TONE COLOR VARIED WITH TIME

BACKGROUND OF THE INVENTION

This invention relates to a device for imparting to a musical tone a tone color, such as a fuzz effect etc., varied with a lapse of time.

There are known many natural musical instruments producing such a musical tone as is varied in its frequency components and tone colors with a lapse of time, for example, percussion musical instruments are such that higher harmonic components are more quickly decreased with a lapse of time than lower frequency components, and the tone color is uniquely varied.

The known tone coloring circuit of an electronic musical instrument causing tone colors to vary with time is a type, the filter circuit of which has such characteristic as can be made to vary with a lapse of time from arrival of an input tone signal. That is, the arrival of an input tone signal is detected to obtain a detection signal and a time constant circuit is driven by the detection signal and the constants of the constituent elements of the filter circuit are controlled. In this case, a signal arrival detecting circuit is required and an intricate construction results. When a plurality of signals sequentially come, difficulty is presented in effectively control a time constant circuit.

With the conventional device, a tone color change is imparted immediately upon arrival of tone signals and a performance tone which is vague in the rise of the sound is produced and the performance expression is appreciably limited.

An object of this invention is to provide a device for imparting to a musical tone a tone color varied with time, which is capable of causing the frequency characteristics, i.e. tone colors, to be effectively varied with time to permit an effective musical tone to be generated without using any signal arrival detecting circuit and capable of clearly expressing a rise of a sound and gradually imparting a tone color change to a musical tone to permit a versatile musical tone to be produced.

SUMMARY OF THE INVENTION

According to this invention there is obtained a device comprising a delay circuit for delaying a musical tone signal, a frequency spectrum modifier to which an output signal from the delay circuit is applied, and a feedback loop for feeding an output of the frequency spectrum modifier back to the input side of the delay circuit, whereby a musical tone signal to which a tone color varied with time is imparted is obtained from the output side of the delay circuit. As a frequency spectrum modifier there may be used a type for non-linearly modifying a waveform of a signal applied thereto. For example, use is made of a half wave rectifying circuit, slicer and clipper, in which diodes are used. When the diode is used, increased distortion components are imparted to signals passed through the diodes so that a fuzz effect is imparted. On the other hand, when a filter is used, frequency components passed through the filter are emphasized and so emphasized signals are obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block circuit diagram showing one embodiment of a device according to this invention;

FIGS. **2** to **4** are views showing a non-linear circuit used as a frequency spectrum modifier of FIG. **1**;

FIG. **5** is a block diagram showing a filter used as a frequency spectrum modifier of FIG. **1**;

FIG. **6** is a circuit diagram of an integration circuit or a low pass filter used as the filter of FIG. **5**; and

FIG. **7** is a block diagram showing the essential part of the embodiment when use is made of BBD in place of a delay circuit of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. **1**, a musical tone signal from a tone coloring circuit **11** of an electronic musical instrument is coupled to one terminal of a change-over switch **12**. To the other terminal of the change-over switch **12** is coupled a musical tone signal from an electric musical instrument, an electric guitar for example, for electrically picking up a performance sound of an ordinary musical instrument. The musical tone signal from the switch **12** is supplied through a resistor **14** to the input side of a delay circuit **15** where it is delayed. The delayed musical tone signal is impressed through an amplifier **16** to a loud speaker **17** where a musical tone is generated. Part of an output of delay circuit **15** is, after suitably subjected to a level control at a variable resistor **18**, fed through a terminal **19** to a frequency spectrum modifier **20**. The frequency component of the musical tone signal input to the frequency spectrum modifier is "modified" i.e. increased or decreased when it is passed through the frequency spectrum modifier, and a signal different in waveform from an input signal is obtained at an output terminal **21**. This signal is, after amplified at an amplifier **22** to a predetermined level substantially free from any howling, applied through a resistor **23** to the input side of delay circuit **15**. Thus, the variable resistor **18**, frequency spectrum modifier **20** and amplifier **22** constitute a feedback loop to the delay circuit **15**.

As frequency spectrum modifier **20**, for example, a half wave rectifier circuit consisting of a diode **25** as shown in FIG. **2** is connected between the terminals **19** and **21**; or a slicer circuit consisting of diodes **26** and **27** connected in parallel with reversed polarity as shown in FIG. **3** is connected between the terminals **19** and **21**; or a clipper circuit consisting of diodes **28** and **29** connected in parallel with reversed polarity is connected between ground and a junction between the terminals **19** and **21** as shown in FIG. **4**. And a signal waveform received from the terminal **19** is modified at these non-linear circuits. When a sine wave signal is applied to the delay circuit **15**, a sine wave output signal is at first impressed to the amplifier **16** and a half wave rectifying waveform from a half wave rectifier circuit as shown in FIG. **2** is then impressed to the input of the delay circuit **15** in a manner to be superposed on a sine waveform. At the succeeding feedback time, a half wave rectifying signal derived from a mixture of a sine wave signal and a half wave rectifying signal is superposed on a sine wave signal. Thus, the output signal waveform of the delay circuit **15** becomes gradually intricate with a lapse of time. When the output signal is fed back to the delay circuit **15** many times, there is finally obtained a signal, i.e. a fuzz signal, having a wave-

form as obtained by superposing a waveform similar to that of a white noise onto a sine waveform. A musical tone signal from the tone coloring circuit **11** or electric guitar **13** is selected by the switch **12** and supplied to the delay circuit **15.** The rise of the musical tone is simple at first and with a lapse of time there is obtained a fuzz effect-imparted musical tone which displays such a versatility of performance as bears a very close truthfulness to the natural musical instruments. The rapidity with which a fuzz effect is imparted is varied by varying the resistance of the variable resistor **18.**

As a frequency spectrum modifier **20** of FIG. **1,** use may be made of a filter **30** as shown in FIG. **5.** As such a filter **30,** use may be made of a low pass filter, a band pass filter or a high pass filter. As the low pass filter there can be used an integration circuit as shown in FIG. **6** in which a resistor **31** is connected between the terminals **19** and **21** and a capacitor **32** is connected between the terminal **21** and ground.

When a low pass filter is used as a frequency spectrum modifier **20,** an effective percussion instrument tone is obtained from the loud speaker **17.** That is, a white noise signal from the tone coloring circuit **11** is applied to the delay circuit **15.** The output signal of the delay circuit **15** has medium and high frequency components attenuated through the low pass filter **30** and a signal fed back to the input side of the delay circuit **15** is rich on low frequency components. The larger the frequency with which the feedback is effected through the low pass filter **30,** the smaller the high frequency components. Thus, a musical tone signal whose low frequency component is emphasized is supplied to the loud speaker **17** and an effective percussion instrument tone is obtained.

Where a low pass filter is used, a particularly effective result is obtained when a musical tone to which a "sustain" effect is imparted is fed to the delay circuit **15.** A greater effect is also obtained in presenting, in addition to a percussion instrument tone, a rhythm tone such as a bass tone etc. Furthermore, a unique reverberation effect is obtained.

With the above embodiment the delay circuit **15** is explained as having a prescribed delay time. However, if use is made of a variable delay circuit capable of suitably varying a delay time by operating a treadle, the changing state of a tone color can be adjusted and thus a versatile tonal change is obtained. FIG. **7** illustrates such one example. As a delay circuit a bucket brigade device (BBD) **15***a* is used and an arrangement is such that an output pulse from a voltage controlled oscillator (VCO) **15***b* is applied to the transfer electrodes of the bucket brigade device **15***a*. The frequency of the output pulse of VCO **15***b* is adapted to be changed in response to DC voltage from a variable resistor **15***c* connected in interlock with, for example, a treadle (not shown). BBD **15***a* has, as is well known, a delay time which is varied in response to a pulse frequency from VCO **15***b*. Typical BBD's are disclosed, for example, in U.S. Reissue Pat. No. 27,951; "Silicon Technology Simplifies Devices," Electronics, Mar. 30, 1970, pages 45–48; "New MOS Technique Points Way To Junctionless Devices," Electronics, May 11, 1970, pages 112–118; and "The New Concept for Memory and Imaging: Charge Coupling," Electronics, June 21, 1971, pages 50–59. When such variable resistor **15***c* is used, frequency is varied with a lapse of time from arrival of a signal and a very versatile tone color in which frequency is varied at different rates can be imparted to a musical tone.

What is claimed is:

1. A device for imparting a tone color to a musical tone comprising:

a delay circuit for delaying a musical tone signal a prescribed time;

a non-linear circuit means coupled to an output of said delay circuit for modifying the frequency content of an output signal from the delay circuit, said non-linear circuit means defining a signal path for said output signal and including a diode coupled to the signal path defined thereby; and

a feedback loop for feeding an output of said non-linear circuit means back to the input side of the delay circuit;

whereby a musical tone signal to which is applied a tone color varied with time is obtained from the output side of the delay circuit.

2. The device according to claim **1** in which said delay circuit is a variable delay circuit having a variable delay time.

3. The device according to claim **2** in which said variable delay circuit includes a bucket brigade device; a voltage controlled oscillator for applying a pulse signal to said bucket brigade device; and a variable resistor for varying the frequency of an output pulse signal of said voltage controlled oscillator.

4. The device according to claim **1** in which said non-linear circuit comprises a half-wave rectifier circuit having one diode.

5. The device according to claim **1** in which said non-linear circuit comprises a slicer circuit having two diodes connected in parallel with each other and with reversed polarity.

6. The device according to claim **1** in which said non-linear circuit comprises a clipper circuit having two diodes connected in parallel with each other and with reversed polarity.

7. The device according to claim **1** wherein said diode of said non-linear circuit means is coupled in series with said signal path defined by said non-linear circuit means.

8. The device according to claim **1** wherein said diode of said non-linear circuit means is coupled in parallel with said signal path defined by said non-linear circuit means.

9. A device comprising:

a switch for selectively coupling out an output of a tone coloring circuit of an electronic musical instrument and an output of an electric musical instrument;

a delay circuit to which a signal from the switch is applied;

a frequency spectrum modifier to which an output of the delay circuit is applied;

a variable resistor for controlling the level of a signal supplied from the delay circuit to the frequency spectrum modifier;

an amplifier coupling the output of the frequency spectrum modifier to the input side of the delay circuit and amplifying the output of the frequency spectrum modifier; and

means for generating a musical tone signal by amplifying the output of the delay circuit;

whereby a tone color varied with time is imparted to the musical tone.

10. The device according to claim 9 in which said frequency spectrum modifier comprises means for modifying the frequency content of the output signal from the delay circuit.

11. The device according to claim 10 wherein said frequency content modifying means includes a non-linear circuit.

12. The device according to claim 10 wherein said non-linear circuit comprises diode rectifying means.

13. The device according to claim 10 wherein said frequency content modifying means includes a filter circuit.

14. The device according to claim 13 in which said filter circuit is a low pass filter circuit.

15. The device according to claim 9 in which said variable resistor is coupled in series between an output of the delay circuit and the input of the frequency spectrum modifier.

16. A device for imparting a tone color to a musical tone comprising:

a delay circuit for delaying a musical tone signal a prescribed time;

a filter circuit means having a predetermined pass-band coupled to an output of said delay circuit for modifying the frequency content of an output signal from the delay circuit; and

a feedback loop for feeding an output of said filter circuit means back to the input side of the delay circuit;

whereby a musical tone signal to which is applied a tone color varied with time is obtained from the output side of the delay circuit.

17. The device according to claim 16 in which said filter circuit means comprises a low pass filter circuit.

18. The device according to claim 16 in which said filter circuit means comprises a band-pass filter circuit.

19. The device according to claim 16 in which said filter circuit means comprises a high pass filter circuit.

20. The device according to claim 16 in which said delay circuit is a variable delay circuit having a variable delay time.

21. The device according to claim 16 in which said variable delay circuit includes a bucket brigade device; a voltage controlled oscillator for applying a pulse signal to said bucket brigade device; and a variable resistor for varying the frequency of an output pulse signal of said voltage controlled oscillator.

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