

[54] **ELECTRONIC MUSICAL INSTRUMENT
WITH SURROUNDING LIGHT SENSITIVE
MUSICAL EFFECT CONTROL**

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[52] U.S. Cl..... **84/1.24, 84/1.25, 84/1.26,**
84/DIG. 19

[51] Int. Cl. **G10h 1/02**

[58] Field of Search 84/1.01, 1.09, 1.13, 1.18,
84/1.24, 1.26, DIG. 19; 331/65

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Assistant Examiner—U. Weldon

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[57] **ABSTRACT**

An electronic musical instrument comprising a light-sensitive variable resistor whose resistance varies with the intensity of surrounding light and a musical effect control circuit for controlling musical effects such as the volume and color of tones in accordance with the varying resistance of the variable resistor. The musical effect control circuit comprises a variable gain amplifier, tone coloring filter, vibrato oscillator or tremolo oscillator, and the light-sensitive variable resistor is used in the musical effect control circuit to vary, for example, the volume and color of tones, and the speed of vibrato and tremolo according to the condition of surrounding light.

11 Claims, 27 Drawing Figures

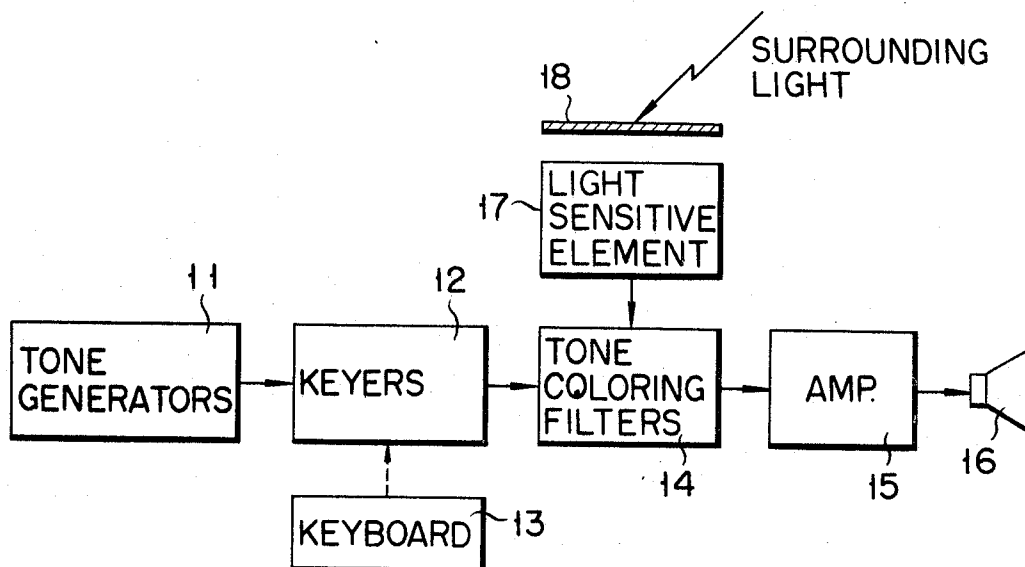


FIG. 1

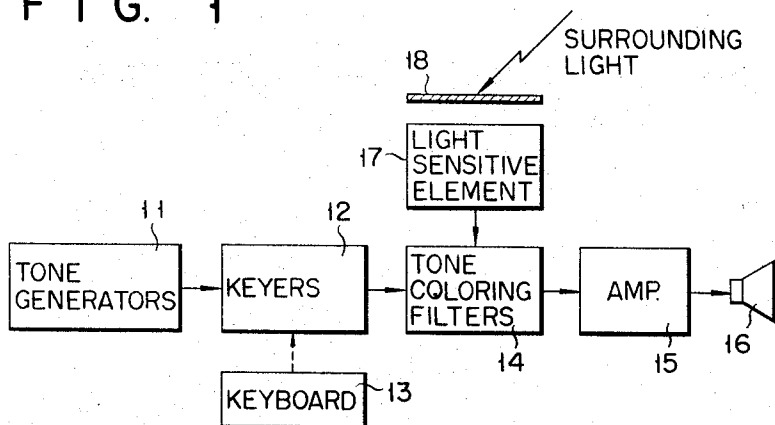


FIG. 2A

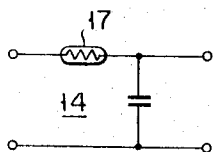


FIG. 2B



FIG. 3A

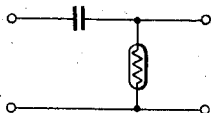


FIG. 3B

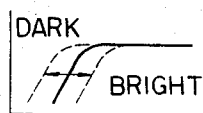


FIG. 4A

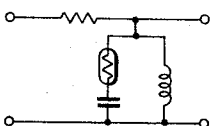


FIG. 4B

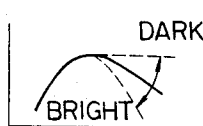


FIG. 5A

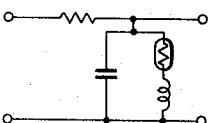


FIG. 5B



FIG. 6A

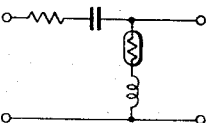


FIG. 6B

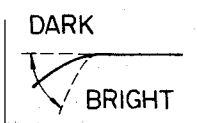


FIG. 7A

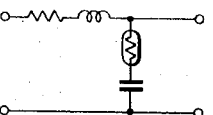
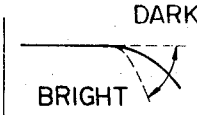


FIG. 7B



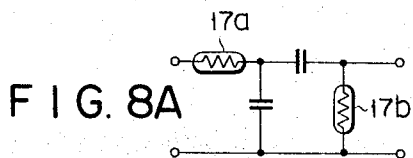


FIG. 8B

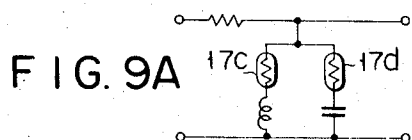
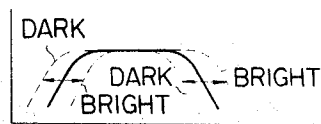


FIG. 9B

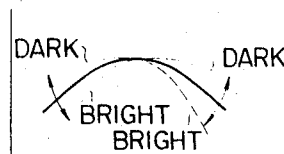


FIG. 10A

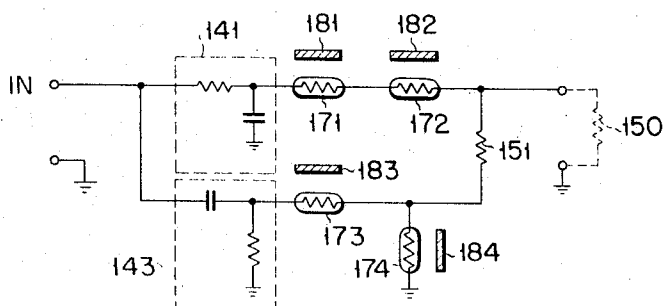


FIG. 10B

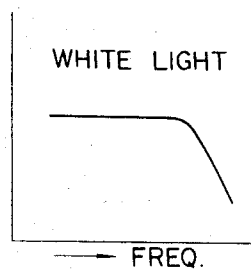


FIG. 10C

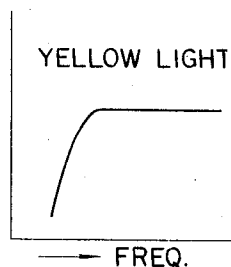


FIG. 11

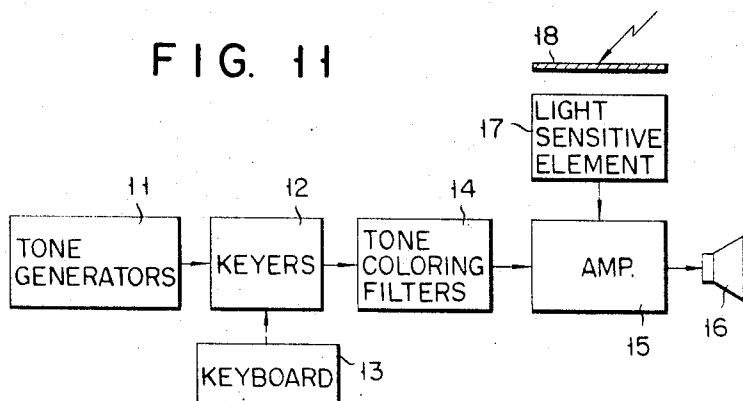


FIG. 12A

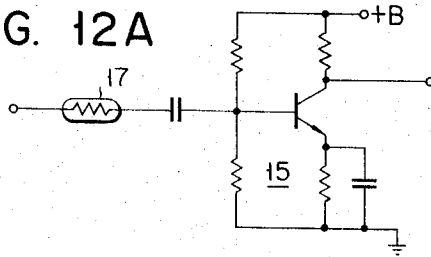


FIG. 12B

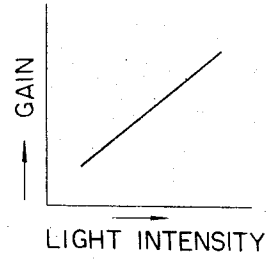


FIG. 13A

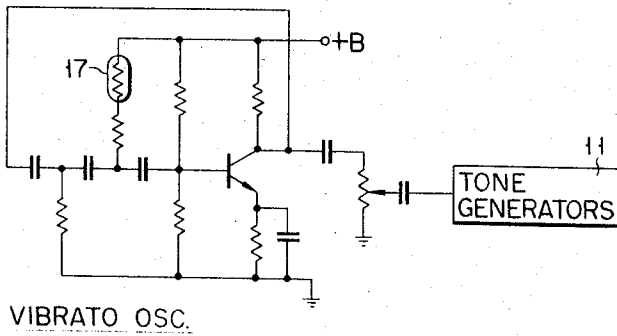


FIG. 13B

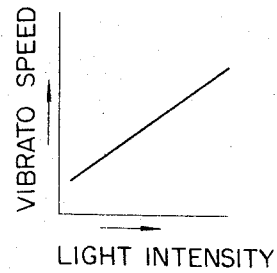


FIG. 14A

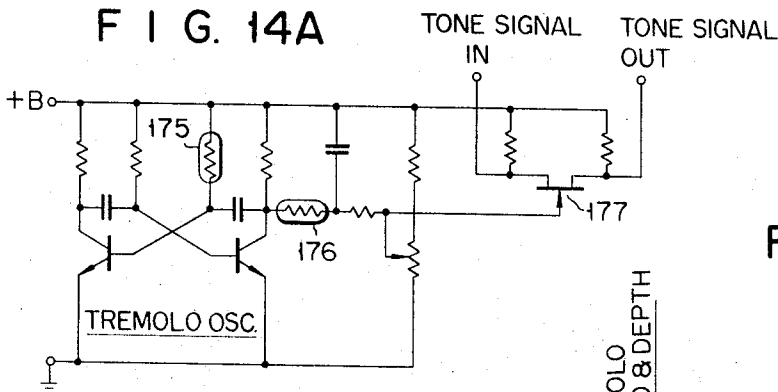
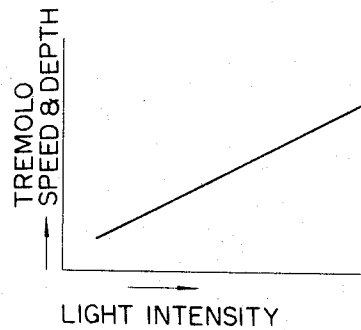


FIG. 14B



ELECTRONIC MUSICAL INSTRUMENT WITH SURROUNDING LIGHT SENSITIVE MUSICAL EFFECT CONTROL

BACKGROUND OF THE INVENTION

This invention relates to an electronic musical instrument capable of controlling musical effects according to the condition of external light in particular.

When playing a musical instrument, a player generally controls the volume and color of tones at his discretion. Further in a concert hall, the player makes a performance vigorously or gently with his own intention in view of the environmental condition within said hall.

It is the object of this invention to provide an electronic musical instrument capable of automatically varying musical effects such as the volume and color of tones with the condition of light prevailing in a concert hall.

SUMMARY OF THE INVENTION

An electronic musical instrument generally includes an amplifier, tone coloring filter, vibrato oscillator and tremolo oscillator. According to this invention, at least one light-sensitive variable resistor such as a cadmium sulfide (CdS) cell whose resistance varies with the intensity of light prevailing, for example, in a concert hall is used as an element for varying the gain of an amplifier, the frequency characteristic of a tone coloring filter, or the oscillation frequency of a vibrato oscillator or tremolo oscillator, thereby controlling musical effects such as the volume and color of tones and the speed of vibrato or tremolo.

The light-sensitive variable resistor may be so designed as to respond only to predetermined colored lights, using a plurality of optical filters, thereby attaining different musical effects according to the various colors of surrounding light.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a block diagram of an electronic musical instrument according to an embodiment of this invention which is capable of controlling tone colors according to the condition of surrounding light;

FIGS. 2A to 9A present the typical circuits of a plurality of tone coloring filters usable in FIG. 1;

FIGS. 2B to 9B indicate the frequency characteristics of the tone coloring filters of FIGS. 2A to 9A;

FIG. 10A shows a circuit representing another embodiment of the invention for controlling the outputs of a plurality of tone coloring filters having different frequency characteristics according to the condition of surrounding light;

FIGS. 10B and 10C illustrate the frequency characteristics of the circuit of FIG. 10A;

FIG. 11 is a block diagram of an electronic musical instrument according to still another embodiment of the invention which can control the volume of tones according to the condition of surrounding light;

FIG. 12A is a circuit diagram of the amplifier of FIG. 11;

FIG. 12B shows the characteristics of the amplifier of FIG. 12A;

FIG. 13A is a circuit diagram of a vibrato oscillator according to a further embodiment of the invention;

FIG. 13B shows the characteristics of the vibrato oscillator of FIG. 13A;

FIG. 14A illustrates a circuit according to a still further embodiment of the invention for controlling the tremolo effect; and

FIG. 14B illustrates the characteristics of the circuit of FIG. 14A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The electronic musical instrument of FIG. 1 according to the first embodiment of this invention includes, like an ordinary instrument, tone generators 11, keyers 12, keyboard 13, tone coloring filters 14, amplifier 15 and loudspeaker 16. According to the invention, however, there is further provided a light-sensitive element 17 for varying the frequency characteristic of one or more of the tone coloring filters 14 in accordance with the condition of light prevailing in an area or concert hall in which there is placed an electronic musical instrument. The light-sensitive element 17 is fitted to that part of the body of an electronic musical instrument (not shown) which is convenient for the light-sensitive element 17 to receive surrounding light. The light-sensitive element 17 may optionally be provided with an optical filter 18 so as to be illuminated only by a predetermined colored light.

The tone coloring filter 14 generally comprises a bandpass filter, high-pass filter or low pass filter. In the electronic musical instrument of this invention, the tone coloring filter has its frequency characteristic varied by the light-sensitive element 17. To this end, there is used, as shown in FIG. 2A, a light-sensitive variable resistor 17 such as a cadmium sulfide cell as an element for defining the frequency characteristic of the tone coloring filter 14. The frequency characteristic of the tone coloring filter of FIG. 2A presents changes, as indicated in FIG. 2B, between the bright and dark states of surrounding light. The tone coloring filter may be arranged as shown in not only FIG. 2A, but also as in FIGS. 3A and 9A. Further, it is possible to allow the tone coloring filter to be provided, as illustrated in FIGS. 8A and 9A, with two light-sensitive elements 17a-17b and 17c-17d respectively. The tone coloring filters of FIGS. 3A to 9A have their frequency characteristics varied as shown in FIGS. 3B to 9B.

When used with an electronic musical instrument, the above-mentioned tone coloring filters have their frequency characteristic controlled according to the intensity of light prevailing in the concert hall in which the electronic musical instrument is placed. Accordingly, the instrument can be so constructed that the tones produced in a bright area have a bright color (namely, includes a great deal of high frequency component), and the tones given forth in a dark place have a dark color (that is, contains a large amount of low frequency component). Therefore, control of illumination in a concert hall enables the tones generated therein to be varied in color.

Referring to FIG. 10A, there are provided first and second tone coloring filters 141 and 143, for example, a flute voice filter and a string voice filter which have different frequency characteristics. These tone coloring filters 141 and 143 are so connected as to receive tone signals from the terminal IN. An output from the first tone coloring filter 141 passes through first and second light-sensitive variable resistors 171 and 172 connected in series and is conducted to a load 150, which may be substituted by the input impedance of

the amplifier 15. An output from the second tone coloring filter 143 passes through a third light-sensitive variable resistor 173 and resistor 151 and is conducted to said load 150. A fourth light-sensitive variable resistor 174 is connected to shunt the output terminal of the second tone coloring filter 143. Numeral 181 denotes a first optical filter substantially allowing the passage of only a first colored light, for example, a yellow light and numeral 182 represents a second optical filter substantially permitting the passage of only a second colored light, for example, a blue light. Numerals 183 and 184 show third and fourth optical filters of the same type as the first and second ones respectively. Accordingly, the first and third variable resistors 171 and 173 respond to the first colored light or yellow light alone, while the second and fourth variable resistors 172 and 174 respond to the second colored light or blue light alone.

In white light in which both the yellow and blue light components are included, all of the above-mentioned variable resistors 171 to 174 present a small resistance. Since, in this case, an output from the string voice filter 143 is shunted by the resistor 174, substantially only an output from the flute voice filter 141 is conducted to the load 150. In white light, the circuit of FIG. 10A has much the same frequency characteristics as those of the flute voice filter 141 as illustrated in FIG. 10B. But in blue light, the light-sensitive resistor 171 exhibits a high resistance thereby blocking a flute voice signal, and the light-sensitive resistor 174 exhibits a low resistance thereby shunting a string voice signal. Consequently, neither voice can be heard.

In yellow light, however, the resistors 171 and 173 have small resistance, whereas the resistors 172 and 174 present increased resistance. In this case, the division ratio for an output from the flute voice filter 141 defined by the resistor 172 and load 150 has a smaller value than the division ratio for an output from the string voice filter 143 determined by the resistor 151 and load 150. Accordingly, the load 150 is mainly supplied with an output from the string voice filter 143. Thus in yellow light, the circuit of FIG. 10A has substantially the same frequency characteristic as that of the string voice filter 143 as shown in FIG. 10C. Where there is used the circuit of FIG. 10A, there can be obtained a tone color corresponding to the changed color of illumination.

FIG. 11 represents an embodiment of this invention capable of controlling tone volumes according to the intensity of illumination. In this case the light-sensitive element 17 is used to vary the gain of the amplifier 15.

FIG. 12A illustrates a manner in which the light-sensitive variable resistor 17 is coupled with the amplifier 15 to vary its gain. While coupling may be effected by various methods, the variable resistor 17 of FIG. 12A is used to control the level of A.C. signals supplied to the amplifier 15, thereby varying its gain with respect to the A.C. signals. FIG. 12B shows the characteristic of the amplifier gain with respect to the intensity of light.

FIG. 13A represents another embodiment of this invention where the light-sensitive variable resistor 17 is used to determine the frequency of a vibrato oscillator. An output from the vibrato oscillator is conducted to the tone generator 11 to impart a vibrato effect by subjecting tone signals to frequency modulation using the known process. Namely, the vibrato speed is con-

trolled, as shown in FIG. 13B, according to the intensity of light.

FIG. 14A indicates a further embodiment of this invention where there are used first and second light-sensitive variable resistors 175 and 176 in a tremolo effect producing circuit. The first resistor 175 is used to control the tremolo speed as an element for determining the frequency of a tremolo oscillator such as an astable multivibrator. The second resistor 176 is connected to the output of the tremolo oscillator to control the level of output signals therefrom, namely, the tremolo depth. To impart a tremolo effect to tone signals, there may be used a field effect transistor 177 receiving a tone signal input from a tone generator or keyer as shown in FIG. 14A. The first and second variable resistors 175 and 176 may be so designed as to be controlled by different colored lights. The speed and depth of the tremolo varies with the intensity of light as illustrated in FIG. 14B.

In the foregoing embodiments, there were used a light-sensitive variable resistor such as a cadmium sulfide (CdS) cell. However, it is possible to use other photoelectric conversion elements such as a phototransistor.

What is claimed is:

1. In an electronic musical instrument comprising a source of tone signals coupled through a keyer to a musical effect control means which includes at least one of an amplifier circuit, a tone coloring filter circuit, and a tremolo oscillator circuit coupled in the path of said tone signals to control said tone signals to create musical effects, a vibrato oscillator circuit connected to said source of tone signals, and sound producing means coupled to said musical effect control means, an ambient light detecting means located to receive surrounding light from the area in which said instrument is located, said ambient light detecting means comprising at least one light-sensitive element having a light variable characteristic and arranged to receive said surrounding light from the area in which said instrument is located, said at least one light sensitive element being connected within the circuit of at least one of said amplifier, tone color filter, vibrato oscillator, and tremolo oscillator to control the musical effects in accordance with the characteristic of said light-sensitive element which varies responsive to the condition of said surrounding light.

2. The electronic musical instrument according to claim 1 wherein said musical effect control means includes a tone coloring filter, and wherein said at least one light-sensitive element comprises a light-sensitive variable resistor coupled to said tone coloring filter for defining the frequency characteristic of said tone coloring filter.

3. The electronic musical instrument according to claim 1 wherein said musical effect control means includes a tone signal amplifier and wherein said at least one light-sensitive element includes a light-sensitive variable resistor coupled to said amplifier to vary its gain with respect to tone signals.

4. The electronic musical instrument according to claim 1 wherein said vibrato oscillator imparts a vibrato effect to tone signals and wherein said at least one light-sensitive element comprises a light-sensitive variable resistor coupled to said vibrato oscillator to determine the oscillation frequency of said vibrato oscillator.

5. The electronic musical instrument according to claim 1 wherein said musical effect control means includes a tremolo oscillator adapted to impart a tremolo effect to tone signals, and wherein said at least one light-sensitive element includes comprises a light-sensitive variable resistor coupled to said tremolo oscillator to determine the oscillation frequency of said tremolo oscillator.

6. The electronic musical instrument according to claim 1 wherein said musical effect control circuit includes a tremolo effect to tone signals, and wherein said at least one light-sensitive element comprises a light-sensitive variable resistor coupled to said tremolo oscillator to control the level of an output from said tremolo oscillator.

7. The electronic musical instrument according to claim 12 wherein said ambient light detecting means includes an optical filter permeable only to a predetermined colored light and located in the light path to said light-sensitive element.

8. The electronic musical instrument according to claim 1 wherein said at least one light-sensitive element is a cadmium sulfide cell.

9. An electronic musical instrument comprising:
a source of tone signals;

at least first and second tone coloring filters connected through a keyer to receive the tone signals from said source, said tone filters having different frequency characteristics;

an ambient light detecting means connected to receive surrounding light from the area in which the instrument is located, said ambient light detecting means being responsive to first and second surrounding colored lights and comprising light sensitive means coupled to the outputs of said first and second tone coloring filters so as to allow the pas-

sage of an output from said first tone coloring filter in response to said first surrounding colored light, but to substantially prevent the passage of an output from said second tone coloring filter for said first surrounding colored light, and to allow the passage of an output from said second tone coloring filter in response to said second surrounding colored light, but to substantially prevent the passage of an output from said first tone coloring filter for said second surrounding colored light, and sound producing means coupled to the outputs of said tone coloring filters.

10. The electronic musical instrument according to claim 9 wherein said ambient light detecting means comprises: first and second light-sensitive variable resistors connected in series with the output of said first tone coloring filter, said first and second variable resistors being adapted to respond to said first and second colored lights respectively; a third light-sensitive variable resistor connected in series with the output of said second tone coloring filter; and a fourth light-sensitive variable resistor connected to shunt the output of said second tone coloring filter, said third and fourth variable resistors being adapted to respond to said first and second colored lights respectively.

11. The electronic musical instrument according to claim 10 wherein said ambient light detecting means further comprises: at least one first optical filter in the light path of said first and third variable resistors for allowing the passage of only said first colored light to said first and third variable resistors; and at least one second optical filter in the light path of said second and fourth variable resistors for allowing the passage of only said second colored light to said second and fourth variable resistors.

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