

[54] **MANDOLINE EFFECT PRODUCING  
CIRCUIT FOR ELECTRONIC MUSICAL  
INSTRUMENT**

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84/1.24, 1.25, 1.01, 1.12, 1.13, 1.2, 1.21,  
1.23, 1.26

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[57] **ABSTRACT**

A mandoline effect producing circuit included in an electronic musical instrument, comprising an oscillator for generating a low frequency signal corresponding to the frequency of the tremulous performance of the mandoline, a waveform converter which converts the low-frequency signal to a signal having a waveform repeatedly rising sharply and decaying slowly, an amplitude-modulation circuit which controls the envelope in amplitude of a music tone signal in conformance with the output of the waveform converter, and a tone-color modulation circuit which controls the harmonic components within the music tone signal depending on the same output of the waveform converter, whereby the amplitude and the tone color are varied synchronously.

**5 Claims, 2 Drawing Figures**

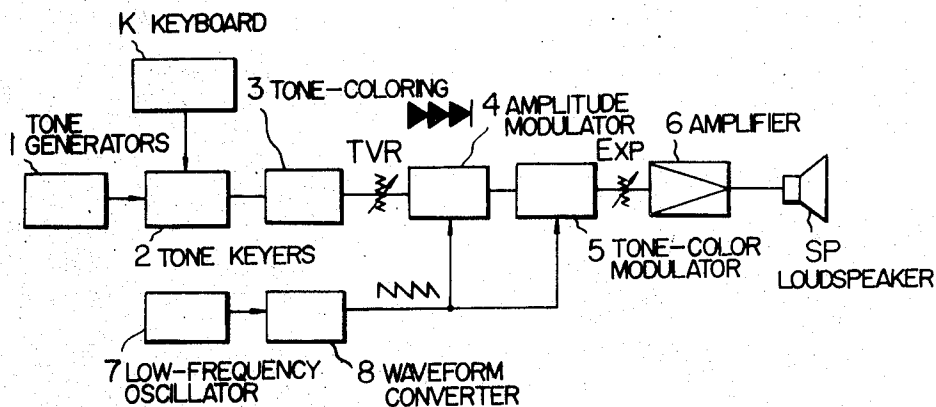


FIG. 1

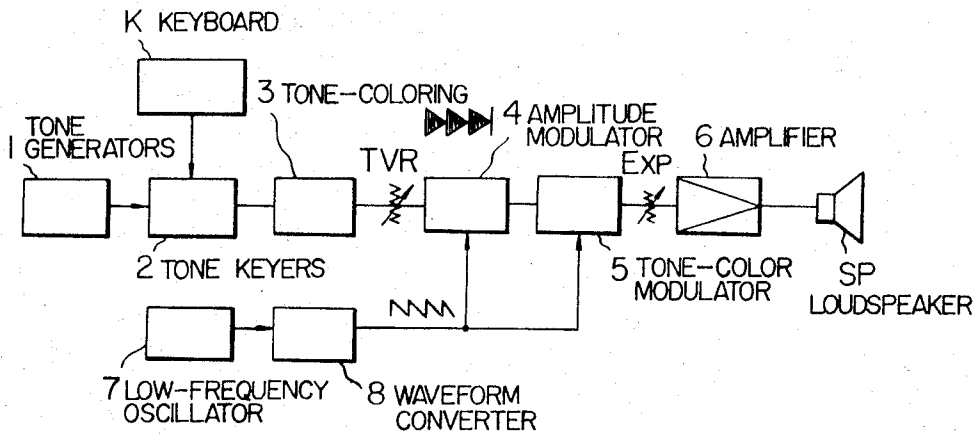
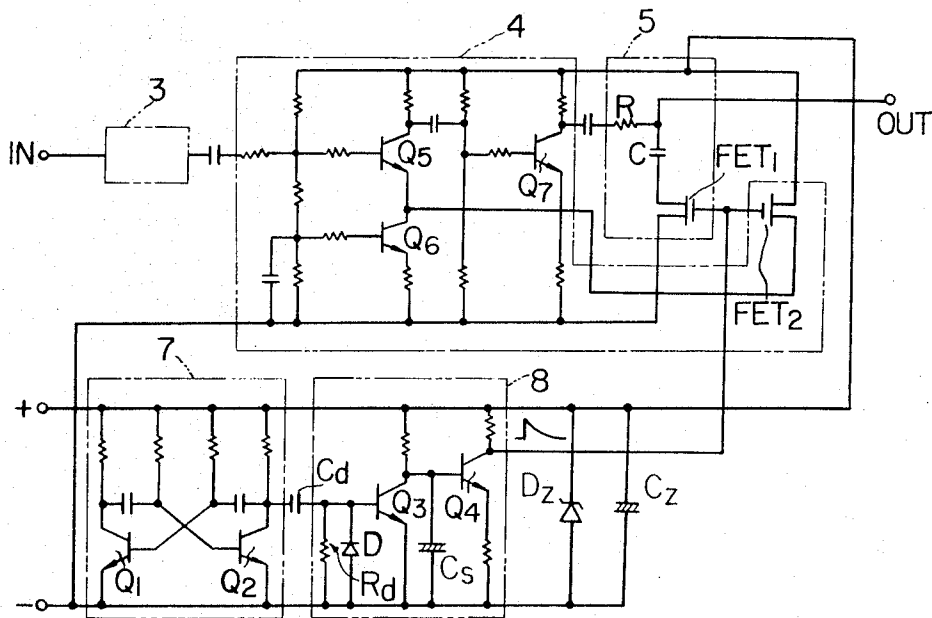


FIG. 2



# MANDOLINE EFFECT PRODUCING CIRCUIT FOR ELECTRONIC MUSICAL INSTRUMENT

## BACKGROUND OF THE INVENTION

This invention relates to a circuit included in an electronic musical instrument for simulating the sound of a string instrument, particularly of a mandoline.

When the sound of a string musical instrument of a type wherein the string is plucked by a plectrum is analyzed, it is found that the sound has a number of characteristic features such that the envelope has a configuration rising sharply at its leading edge and subsequently decaying non-linearly during its trailing portion, and the harmonic components included in the sound decay more rapidly when compared with fundamental component thereof. Furthermore, the sound of the mandoline is characterized by its quickly repeated variation in its amplitude and tone-color since the mandoline is ordinarily played tremulously.

For this reason, if it is desired to simulate the sound of a mandoline in an electronic musical instrument, there must be provided a circuit producing an effect for controlling the volume (or amplitude) and the tone color of a sound in conformance with the above described features.

## SUMMARY OF THE INVENTION

A primary object of the present invention is to provide a circuit included in an electronic musical instrument for producing an effect realistically simulating the sound of a mandoline, which circuit can be economically and easily manufactured.

These and other objects of the present invention can be achieved by a circuit included in an electronic musical instrument for producing a mandoline effect, the circuit comprising an oscillator for generating a low frequency signal corresponding to the frequency of the tremulous performance of the mandoline, a waveform converter which converts the low-frequency signal to a signal of a waveform repeatedly rising sharply and decaying gradually, an amplitude-modulation circuit which controls the envelope in amplitude of a music tone signal in conformance with the output of the waveform converter, and a tone-color modulation circuit which controls the harmonic components within the music tone signal depending on the same output of the waveform converter.

The nature, principle, and utility of the present invention can be more clearly understood from the following detailed description of the invention when read in conjunction with the accompanying drawing.

## BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a block diagram showing the essential organization of one example of an electronic musical instrument wherein a mandoline effect producing circuit according to the present invention is included; and

FIG. 2 is a circuit diagram showing an example of an actual construction of the mandoline effect producing circuit according to the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, there is indicated an organization of an electronic musical instrument comprising tone generators 1, tone keys 2 for selectively keying tone signals from the tone generators 1 to a subsequent

stage as a result of a manipulation of the keyboard K, a tone coloring circuit 3 to impart a tone color of a mandoline, i.e., a tone color of a string voice on the tone signals passed through the tone keys 2, an amplitude modulator 4 which modulates the output signal from the tone coloring circuit 3 according to a modulating wave signal formed separately as described hereinafter, a tone color modulator 5 for varying the harmonics of the amplitude modulated tone signal according to the separately formed modulating wave signal, and an amplifier 6 for amplifying the signal from the tone-color modulator 5 and sending it to a loudspeaker SP.

With further reference to FIG. 1, variable resistor TVR is a tone control volume which serves to vary the level of the tone colored output from the tone coloring circuit, while the other variable resistor EXP is an expression control which serves to vary the level of the musical signal of the whole instrument.

The electronic musical instrument, in that part relating to the subject matter of this invention, further comprises a low-frequency oscillator 7 for generating a signal of a low frequency (of about 13 Hz) corresponding to the tremolo-rendition frequency of the mandoline, and a waveform converter 8 which converts the low-frequency signal generated from the oscillator 7 into a repeated triangular waveform (preferably of a non-linear or an exponential decay) having a sharply rising forward edge and a slowly decaying slope. The triangular signal thus converted constitutes the above described separately formed signal which applied to the above mentioned amplitude modulator 4 and the tone-color modulator 5 simultaneously as a control (modulating) signal. Of the above described circuits, the low-frequency oscillator 7, waveform converter 8, and the amplitude modulator 4, tone-color modulator 5 constitute a mandoline effect producing circuit according to the present invention, which is illustrated in greater detail in FIG. 2.

In the mandoline effect producing circuit shown in FIG. 2, the low-frequency oscillator 7 is made in the form of an astable multivibrator comprising transistors  $Q_1$  and  $Q_2$ , and a square wave is generated from the low-frequency oscillator 7. This square wave is thereafter differentiated through a differentiator comprising a capacitor  $C_d$  and a resistor  $R_d$ , and amplified by transistors  $Q_3$  and  $Q_4$  in the waveform converter 8, so that a substantially triangular waveform (repeated as a saw-tooth waveform) having a sharply rising leading edge and slowly decaying trailing portion can be obtained a capacitor  $C_s$  (e.g., an electrolytic capacitor) causing a slow decay. A diode D is provided for eliminating a negative spike from said differentiator. The repeated triangular signal is thereafter applied to the amplitude modulator 4 and the tone-color modulator 5 as described hereinbefore. The Zener diode  $D_z$  and capacitor  $C_z$  connected in parallel with the waveform converter constitute a power source stabilizer.

The amplitude modulator 4 has a modulation circuit portion comprising transistors  $Q_5$ ,  $Q_6$ , and a field effect transistor FET<sub>1</sub>, and an output circuit portion comprising a transistor  $Q_7$  and related circuit components such as suitable resistances and capacitor, and an amplitude modulating operation is accomplished depending on a signal applied to the gate electrode of the FET<sub>1</sub>. The tone-color modulator 5 comprises a field effect transistor FET<sub>2</sub>, and a low pass filter including a resistor R and

a capacitor C and modulates the tone-color depending on a signal applied to the gate of the field effect transistor FET<sub>1</sub>. To both of the field effect transistors FET<sub>1</sub> and FET<sub>2</sub>, the repeated triangular wave formed by the waveform converter 8 is applied at the gate, whereby the effective resistances of these transistors are varied repeatedly.

The variation of the effective resistance in the transistor FET<sub>2</sub> causes the degree of modulation in the amplitude modulation circuit 4 to vary, thus imparting a triangular envelope to the output signal from the modulation circuit 4. On the other hand, the variation in the effective resistance of the field effect transistor FET<sub>1</sub> causes the time constant CR in the tone-color modulation circuit 5 to vary, whereby the harmonic components in the output tone signal is varied in a manner that when the amplitude is large, the harmonic contents are rich.

Accordingly, the tone signal applied to the input terminal IN of the tone coloring circuit 3 in FIG. 2 is thereafter passed through the amplitude modulator 4 and the tone-color modulator circuit 5, so that the tone signal is converted into a signal having a recurrent nature wherein the amplitude and the content of the harmonics are both varied recurrently. The signal thus converted is thereafter delivered through the output terminal OUT to the amplifier 6, wherein the signal is amplified and the output signal is supplied to the loudspeaker SP.

According to the present invention, since a low frequency signal corresponding to the frequency of tremolo rendition of a mandoline is generated and is converted into a triangular wave-form having a sharp leading edge and a slowly decaying trailing portion edge, and the amplitude and content of the harmonics of the tone signal are thereby controlled repetitively, a sound closely simulating the mandoline can be obtained, and the scope of performance of the electronic musical instrument can be thereby extended.

I claim:

1. In an electronic musical instrument having means for producing a musical tone signal, a mandoline effect producing circuit comprising, a low-frequency oscillator for generating a low frequency signal corresponding to the frequency of the tremulous performance of the mandoline; a waveform converter connected to said oscillator for converting said low frequency signal to a signal output having a waveform repeatedly rising sharply and decaying slowly; an amplitude modulator connected to receive said output signal for controlling an envelope in amplitude of said musical tone signal in conformance with said output of the waveform converter; and a tone-color modulator connected to said waveform converter and amplitude modulator output for controlling harmonic components within the musical tone signal depending on said output of the waveform converter.

2. A mandoline effect producing circuit as in claim 1 wherein said low-frequency oscillator comprises an astable multivibrator.

3. A mandoline effect producing circuit as in claim 1 wherein said waveform converter comprises means for differentiating and amplifying the low frequency signal from the low-frequency oscillator.

4. A mandoline effect producing circuit as in claim 1 wherein said amplitude modulator includes a field effect transistor which varies the degree of modulation in amplitude in accordance with a signal applied to the gate thereof.

5. A mandoline-effect producing circuit as in claim 1 wherein said tone color modulator includes a capacitor and a field effect transistor constituting a low pass filter, said field effect transistor varying the time constant as a low pass filter in the tone color modulator in accordance with a signal applied to the gate of the field effect transistor.

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