United States Patent

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[72] Inventor **Takeshi Adachi**
Hamamatsu, Japan

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[73] Assignee **Nippon Gakki Seizo Kabushiki**
Shizuoka-ken, Japan

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[33] **Japan**
[31] **44/9107**

[54] **ELECTRONIC MUSICAL INSTRUMENT WITH A TOUCH REPONSIVE DC VOLTAGE GENERATOR**
5 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **84/1.26,**
84/1.01, 84/1.13, 84/1.19
[51] **Int. Cl.** **G10h 1/02**
[50] **Field of Search** 84/1.01,
1.13, 1.19, 1.24, 1.26, 1.25, (D,E,F,O,P)

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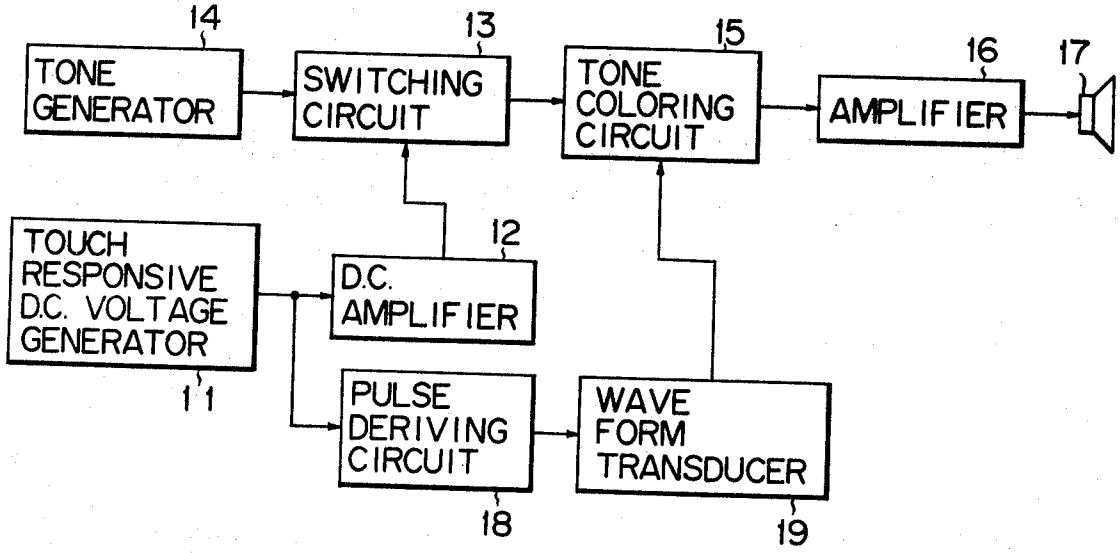
Primary Examiner—Milton O. Hirshfield
Assistant Examiner—U. Weldon
Attorney—George B. Oujevolk

ABSTRACT: An electronic musical instrument capable of controlling a tone color of a musical tone at the time of rise of the tone as well as the intensity of the tone in proportion to a key-depressing force so as to produce, in particular, a musical sound simulating to that produced by a wind instrument, whereby the expressionability of music can be improved. The said electronic musical instrument comprising a touch responsive DC voltage generator circuit for deriving a DC output at a level in response to a key-depressing force, a tone generator for generating a tone, signal, means for switching said tone signal by the output signal derived from said DC voltage generator circuit, a tone-coloring circuit including a filter for giving a musical tone color to the tone signal from said switching means, a pulse-deriving circuit for producing a pulse from the DC output of said DC voltage generator circuit at the time of rise of the DC output, the intensity of the pulse being proportional to the intensity of the DC output, and a wave from transducer for converting the pulse from the pulse-deriving circuit into a control signal having a predetermined rising and decaying wave form, said filter circuit having variable impedance means whose impedance is varied by and in response to the control signal from the wave form transducer and as a result the frequency characteristic of the filter circuit being carried in response to the control signal.



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4 Sheets-Sheet 1

FIG. 1

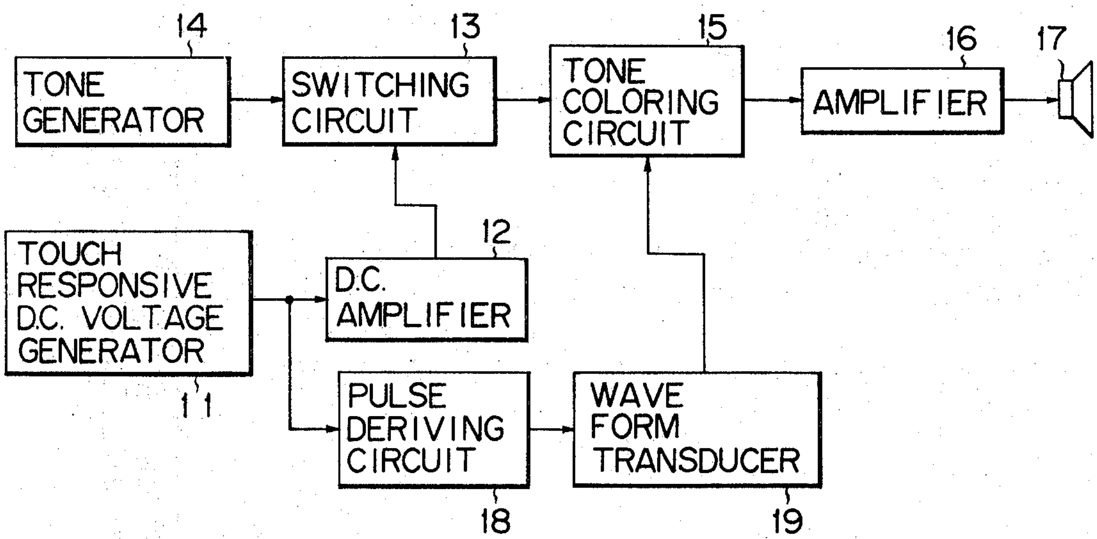
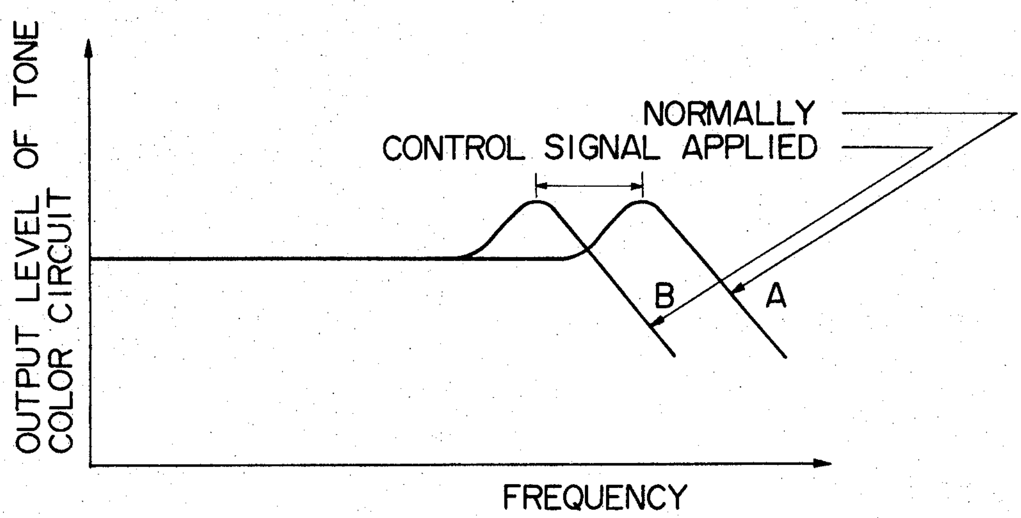


FIG. 3



Takeshi Adachi
INVENTOR.

BY George B. Oujevolk
Attorney

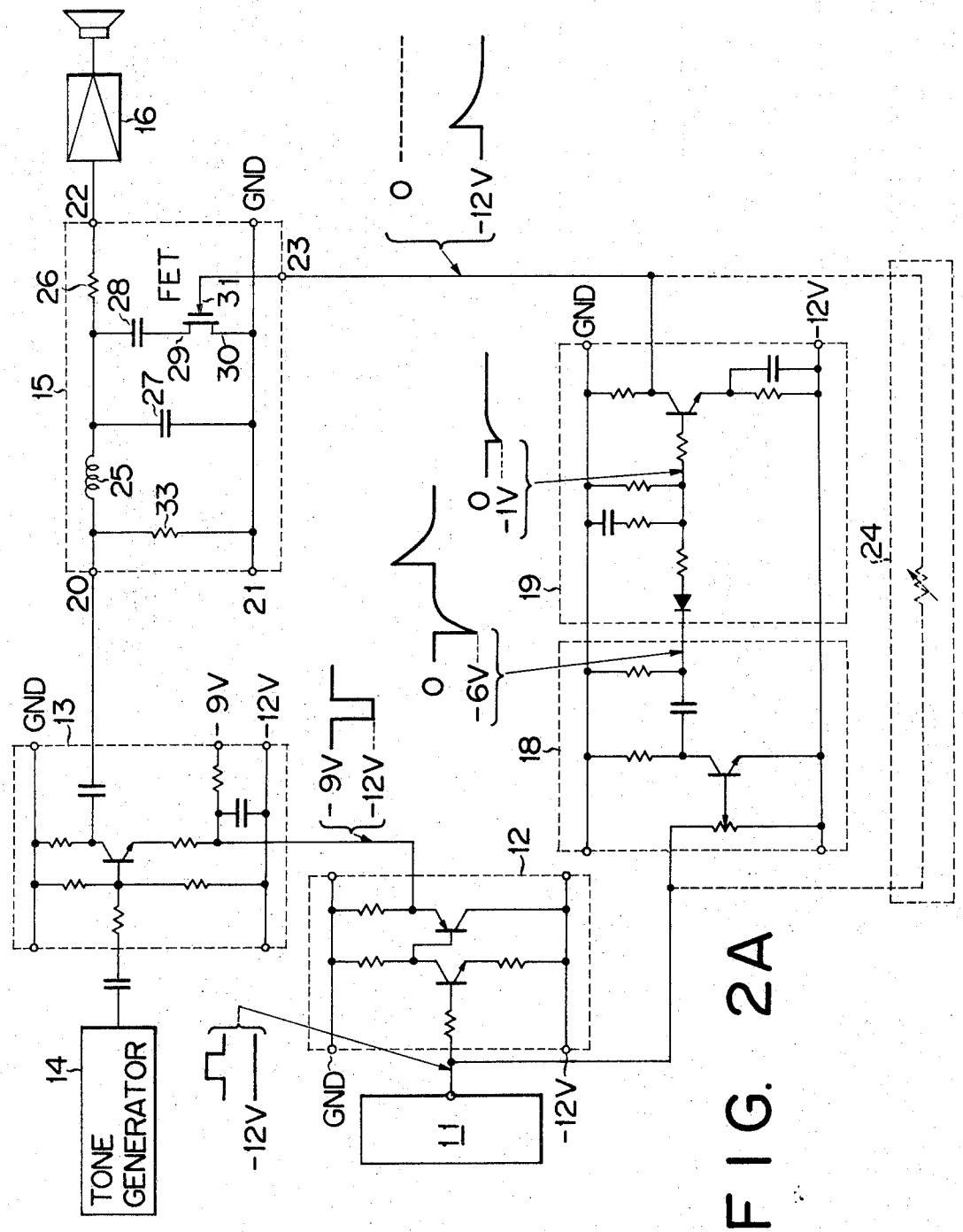
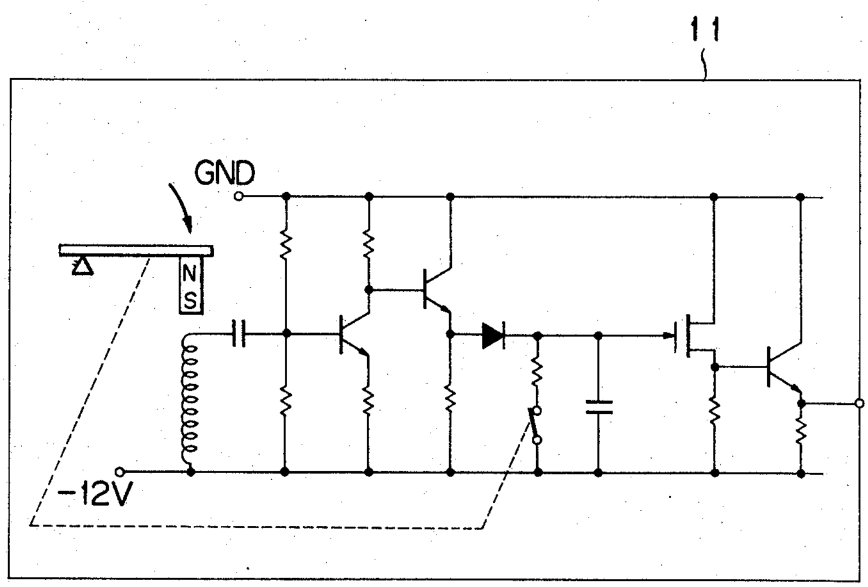


FIG. 2A

INVENTOR.
Tadeshi Adachi
BY George B. Oujevolk
Attorney

FIG. 2B



Takashi Adachi
INVENTOR.

BY George B. Oujevolk
Attorney

FIG. 4

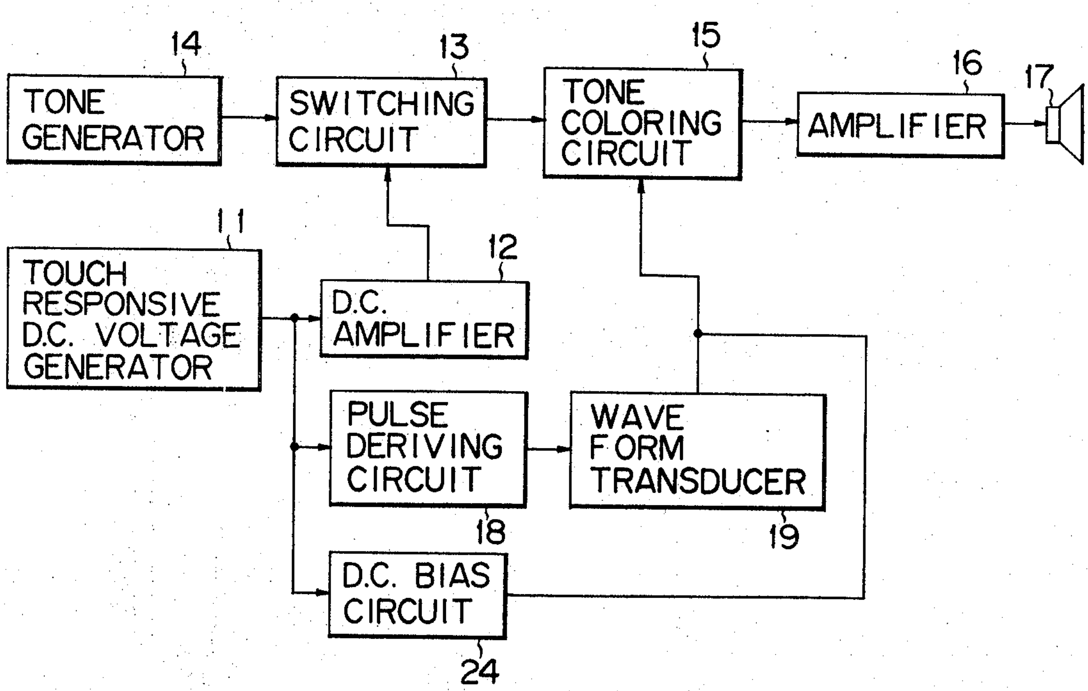


FIG. 5A

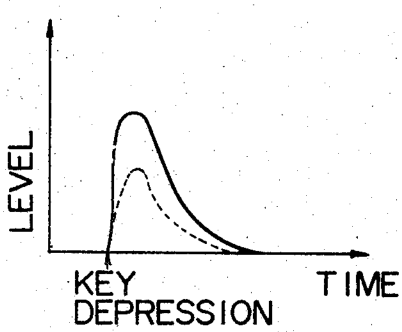
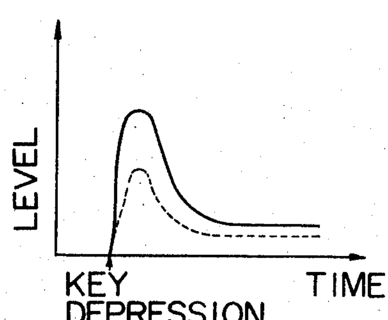


FIG. 5B



INVENTOR.
Takeshi Ca[illegible]
BY George B. [illegible]
Attorney

ELECTRONIC MUSICAL INSTRUMENT WITH A TOUCH REPONSIVE DC VOLTAGE GENERATOR

BACKGROUND OF THE INVENTION

This invention relates to electronic musical instruments and more particularly to an electronic keyboard instrument capable of controlling a tone color at the time of rise of a musical sound as well as the intensity of the musical tone in proportion to a key-depressing force, thereby to improve musical expressionability.

A usual electronic keyboard instrument in which musical sounds are produced merely by switching the electrical system to ON and OFF positions in response to key depressing and releasing operations tends to produce musical sounds which are plain in terms of tonal intensity and color, and thus lacks, for example, powerfulness and sharpness with the result that "expression" of music is inferior.

In order to solve this problem, it has been proposed to control a tone intensity in proportion to a key-depressing force. This, however, is not yet entirely satisfactory, while in a wind instrument a tonal color should be controllably changed as well as a tonal quality depending upon a blowing force.

summary of THE INVENTION

The object of this invention is to provide an electronic musical instrument provided with means to control a tone color of a musical tone at the time of rise of a musical tone as well as the intensity thereof in response to the force with which the key is depressed (struck). Another object of this invention is to provide an electronic musical instrument having means to control a tone color of a musical tone during the sustaining time thereof together 2. Descriptin tone intensity. The invention thus provides an electronic keyboard instrument comprising a touch responsive DC voltage generator circuit for deriving a DC output at a level responsive to a key-depressing force, a tone generator for generating a tone signal, means for switching said tone signal by the output signal derived from said circuit, a tone-coloring circuit including a filter circuit for giving a musical tone color to the tone signal from said means, a pulse-deriving circuit for producing a pulse from the DC output of said DC voltage generator circuit at the time of rise of the DC output, the intensity of the pulse being proportional to the intensity of the DC output, and a waveform transducer for converting the pulse into the control signal having a suitable rising and decaying waveform, said filter circuit having variable impedance means whose impedance is varied by and in response to the control signal and as a result the frequency characteristic of the filter circuit being varied in response to the control signal.

BRIEF EXPLANATION OF THE DRAWINGS

FIG. 1 is a block diagram showing one embodiment of the invention;

FIG. 2A is a detailed circuit diagram with waveforms therein showing a tone color control section of a tone-coloring circuit and an associated circuitory in accordance with this invention;

FIG. 2B illustrates a circuit of the part 11 of FIG. 2A; frame" FIG. u.s. shows one example of the frequency characteristic the tone-coloring circuit; central

FIG. 4 is a block diagram showing a modification of the invention; and

FIGS. 5A and 5B show examples of control signals impressed to the tone-coloring circuit.

DETAILED DESCRIPTION OF THE INVENTION

In FIGS. 1, 2A and 2B, a touch responsive DC rotary generator 11 derives a DC output having a level proportional to a key-depressing force as long as the key is depressed. A preferred example is shown in FIG. 2B with a reference numeral 11, but this may be of any other conventional circuits which has the same or similar function. The DC output is amplified by a DC amplifier 12 and then impressed to a switching circuit 13 thereby to control the switching action of the circuit 13. The switching circuit 13 is connected to the output terminal of a tone generator 14 which produces a tone signal, and is controlled by the DC output such that a predetermined tone signal is obtained at the output terminal thereof at such a level that is proportional to the amplified DC output. The tone signal sent to the output terminal of the switching circuit 13 is supplied to a tone-coloring circuit 15, which modifies, for example, a harmonic component of the tone signal and produces a sound signal having a certain tone color, which is converted into a musical sound after being amplified by an amplifier 16 and emitted from a speaker 17. The DC output from the DC voltage generator 11 is also supplied to a pulse deriving circuit 18 which may be of a known type such as includes a differentiation circuit. Said circuit 18 detects the rise of the DC output to generate a pulse having a peak value proportional to the level of the output thus detected. The pulse is fed tone-coloring a known waveform transducer 19 including such as an integration circuit and conerted into a control signal having a waveform with a certain decay, the control signal then being supplied to the tone-coloring circuit 15. The frequency characteristic of the tone-olorig circuit 15 comprising, for example, a filter circuit as will be described later, is varied by and in response to said control signal in such a manner that the tone color of a sound emitted from the speaker 17 may be varied.

In an electronic instrument of the arrangement described, a DC output at a level proportional to a key-depressing force can be obtained from the DC voltage generator 11, and the DC output thus obtained is impressed to the switching circuit 13 through the DC amplifier 12, so that a predetermined tone signal generated at the tone generator 14 is introduced to the output terminal of the switching circuit 13 at a level in response to a key-depressing force. The tone signal emitted from the switching circuit is converted into a sound signal having a suitable musical tone color after being supplied to the tone-coloring circuit 15, an further converted into a sound after being sent to the speaker 17 via the amplifier 16. The DC output from the voltage generator 11 is, on the other hand, branched to be supplied to the pulse-deriving circuit 18. The pulse-deriving circuit 18 detects the rise of the DC output of the voltage generator 11 and produces a pulse having a peak value which is in proportion to the level of the voltage. After conversion of the pulse into a control signal by the waveform transducer 19 in the manner described above, the control signal is transmitted to the tone-coloring circuit 15 to vary the frequency characteristic thereof. Thus, a soud emitted from the speaker 17 will have a tone which varies in proportion to a key-depressing force at the time of rise of the sound. journal later waveforms

The tone-coloring circuit 15 which has a novel and (FET). The162In important function in this invention is also shown in detail in FIG. 2A as one preferred example. Between an input terminal 20 and a common terminal 21 of the circuit 15 is connected a first resistor 33. Between said input terminal 20 and an output terminal 22 is connected a series circuit of a coil 25 and a second resistor 26. A first condenser 27 is connected between a common junction of said series circuit and said common terminal 21, and said common junction is further connected through a second condenser 28 to a drain electrode 29 of a field effect transistor (FET).The field effect transistor (FET) has its source electrode 30 connected to said common terminal 21 and its gate electrode 31 connected to a control terminal 23 upon which the control signal generated by the pulse-deriving circuit 18 and converted by the wave form transducer 19 is impressed. I the figure, portions surrounded by broken lines corresp to those in FIG. 1 and are designated by the same reference numerals, together with the representation of wavorms at main portions thereof. Further, a circuit indicated by 24 shows a modification in which a DC bias circuit shown in FIG. 4 is applied.

The tone control section of the tone-coloring circuit **15** of the arrangement shown defines a low-pass filter. Since the field effect transistor (FET) is inoperative when control signal (having positive voltage) is not supplied to the control terminal **23**, the sound signal supplied to the input terminal **20** at such a cutoff frequency as determined by the coil **25** and the first condenser **27** will appear at the output terminal **22** (Curve A in FIG. 3). When the control signal is impressed on the control terminal **23**, however, it will be impressed on the gate electrode **31** thereby to render said transistor (FET) conductive, with the result that the second condenser **28** is parallel connected to the first condenser **27** as for the capacitive component of the filter circuit. This causes the cutoff frequency in the low-pass filter to decrease, so that the sound signal introduced to the output signal **22** is so controlled that the level of its high frequency components are dropped (Curve B in FIG. 3). In this case, the level of the control signal is varied responsive to a key-depressing force, and the impedance of the transistor (FET) changes, whereby the cutoff frequency of the low-pass filter or a tone color component of the sound signal is controlled in response to the key-depressing force.

FIG. **4** is a block diagram illustrating a modification of the invention, in which a DC bias circuit **24** which produces a DC bias signal in proportion to the DC output from the voltage generator circuit **11** is connected in parallel with the pulse-deriving circuit **18** and the wave form transducer **19**. The arrangement shown generally performs a similar operation with similar results to those obtained from FIG. **1**. In particular, however, the control signal impressed on the tone-coloring circuit in the arrangement shown in FIG. **1** decays quickly as shown in FIG. **5A**, so that tone color control is terminated suddenly. In contract, with the arrangement of FIG. **4**, the control signal will not decay as shown in FIG. **5B**, but will be maintained at a certain constant level equal to that of the DC bias signal after the attack rise by the pulse is over, until the key depression is released. Control of tone-coloring can thus be made gently for a long period of time.

In FIG. **4**, portions corresponding to those in FIG. **1** are designated by the same reference numerals and a description thereof is omitted.

In the above-mentioned embodiments the filter circuit is of a construction in which the frequency characteristic curve is moved left (lowered) upon receiving the control signal, but otherwise it can also be so constructed that the frequency characteristic curve is moved right (heightened) upon receiving the control signal by those skilled in the art.

As has been described, this invention provides an electronic musical instrument in which the expressionability of music can be promoted and in particular the formation of tone color simulating to that of a wind instrument can be advantageously effected. These advantages can be attained, as described, by controlling tone volume of a musical sound in proportion to a key-depressing force and at the same time by controlling a tone color at the time of rise of a musical sound.

I claim:

1. An electronic musical instrument comprising a touch responsive DC voltage generator circuit for deriving a DC output at a level in response to a key-depressing force, a tone generator for generating a tone signal, means for switching said tone signal by the output signal derived from said DC voltage generator circuit, a tone-coloring circuit including a filter for giving a musical tone color to the tone signal from said switching means, a pulse-deriving circuit for producing a pulse from the DC output of said DC voltage generator circuit at the time of rise of the DC output, the intensity of the pulse being proportional to the intensity of the DC output, and a waveform transducer for converting the pulse from the pulse-deriving circuit into a control signal having a predetermined rising and decaying waveform, said filter circuit having variable impedance means whose impedance is varied by and in response to the control signal from the waveform transducer and as a result the frequency characteristic of the filter circuit being varied in response to the control signal.

2. An electronic musical instrument as claimed in claim **1** in which said variable impedance means is a field effect transistor with its gate connected to the output of said transducer so as to vary the impedance of itself by the pulse applied from said transducer

3. An electronic musical instrument as claimed in claim **1** further comprising a DC bias circuit of which the input is connected with the input of said pulse-deriving circuit and the output is connected with the output of said wave form transducer for controlling said tone-coloring circuit while the key is depressed.

4. An electronic musical instrument as claimed in claim **3** in which said variable impedance means is a field effect transistor with its gate connected to the outputs of said transducer and said bias circuit so as to vary the impedance of itself by the pulse applied from the outputs of said transducer and said bias circuit.

5. An electronic musical instrument as claimed in claim **4** in which said filter circuit comprises means to vary the capacitive component of said filter circuit by the variation of the impedance of said field effect transistor.