

[54] **ELECTRONIC MUSICAL INSTRUMENT OF VOLTAGE-CONTROLLED TONE PRODUCTION TYPE**

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[51] Int. Cl.² **G01H 5/04**

[58] Field of Search 84/1.01, 1.11-1.13, 84/1.19, 1.24, 1.26, DIG. 2, DIG. 8, DIG. 20, 84/DIG. 26

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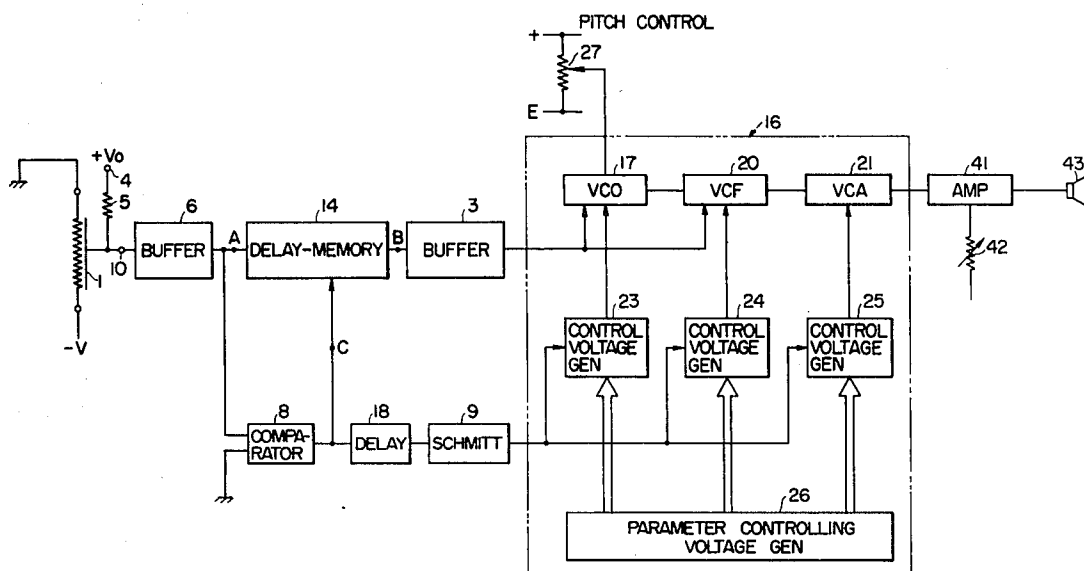
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[57] **ABSTRACT**

An electronic musical instrument comprises a playing-board section for generating a voltage signal of one polarity by a depression on the board for determining a tone frequency corresponding to the depressed position and a voltage signal of the opposite polarity by the release of the depression, a comparator for comparing the voltage signal with the ground potential and providing a keying signal, a delay-memory circuit for giving a delay to the voltage signal and holding the voltage until a new depression under the control of the keying signal, a voltage-controlled musical tone synthesizer connected to the delay-memory circuit for generating a musical tone signal of a frequency determined by the voltage, and a delay circuit connected between the comparator and the voltage-controlled musical tone synthesizer for keying the musical tone with a delayed keying signal. An undesirable transient voltage change is prevented effectively by the combination of the delay-memory and the delay circuit.

8 Claims, 13 Drawing Figures



SHEET 1 OF 8

FIG. 1
PRIOR ART

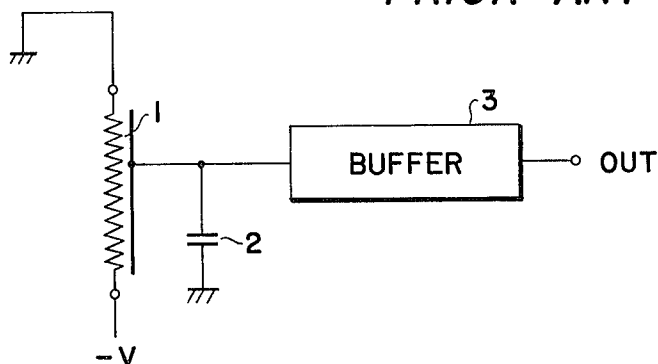


FIG. 2
PRIOR ART

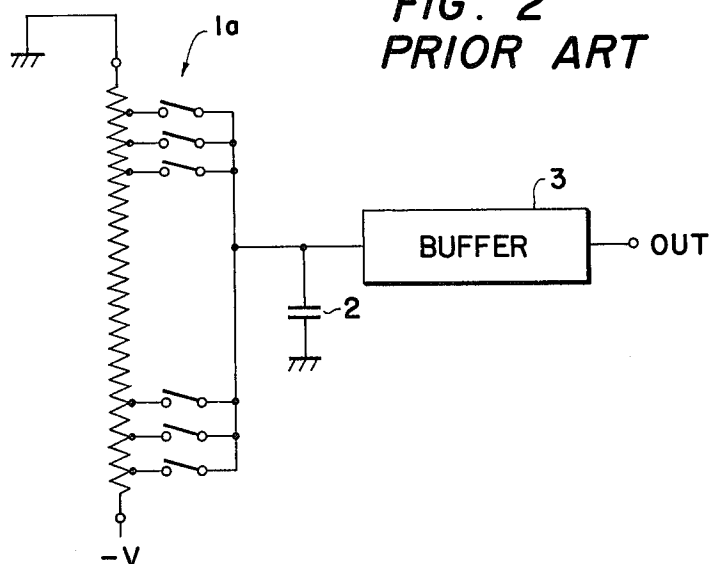
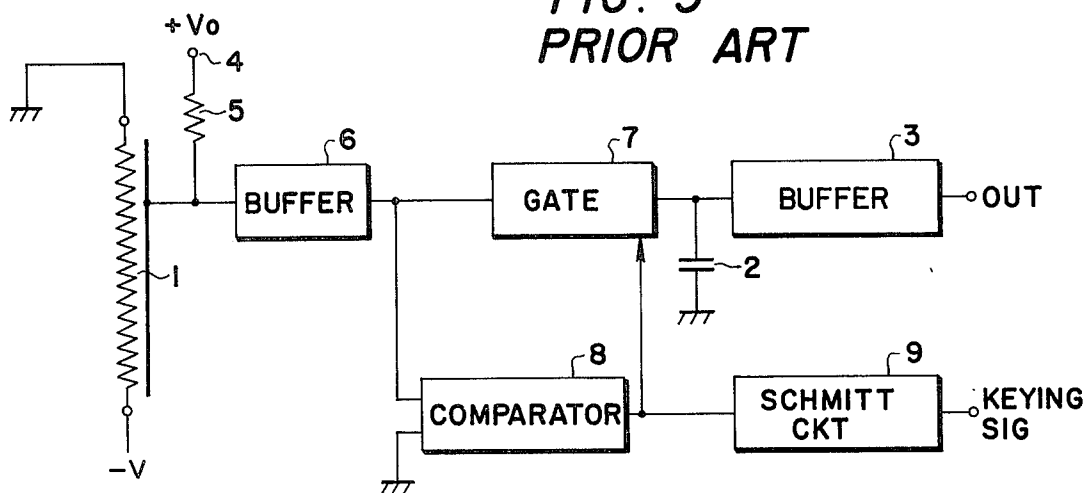


FIG. 3
PRIOR ART



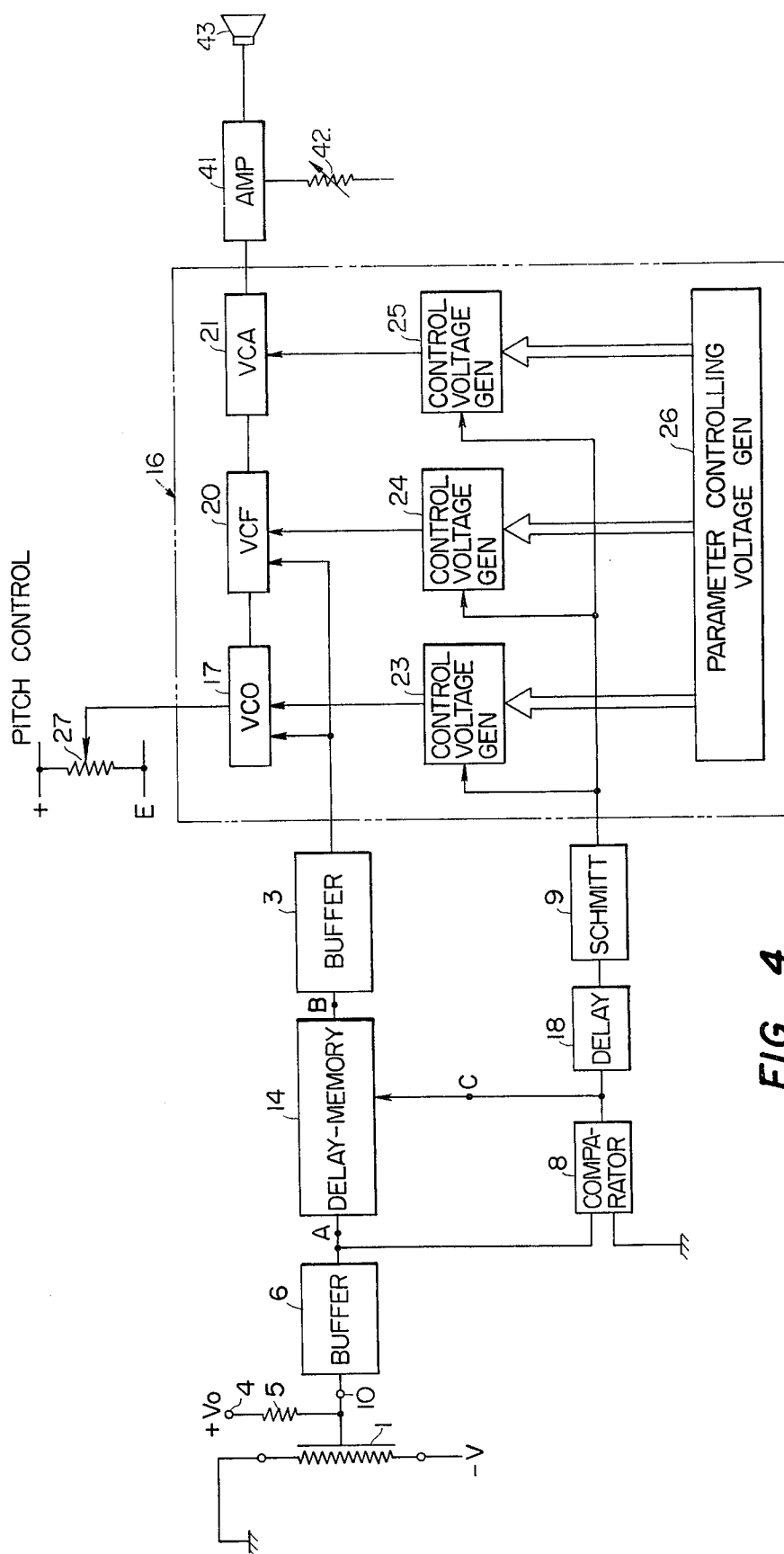


FIG. 4

FIG. 5

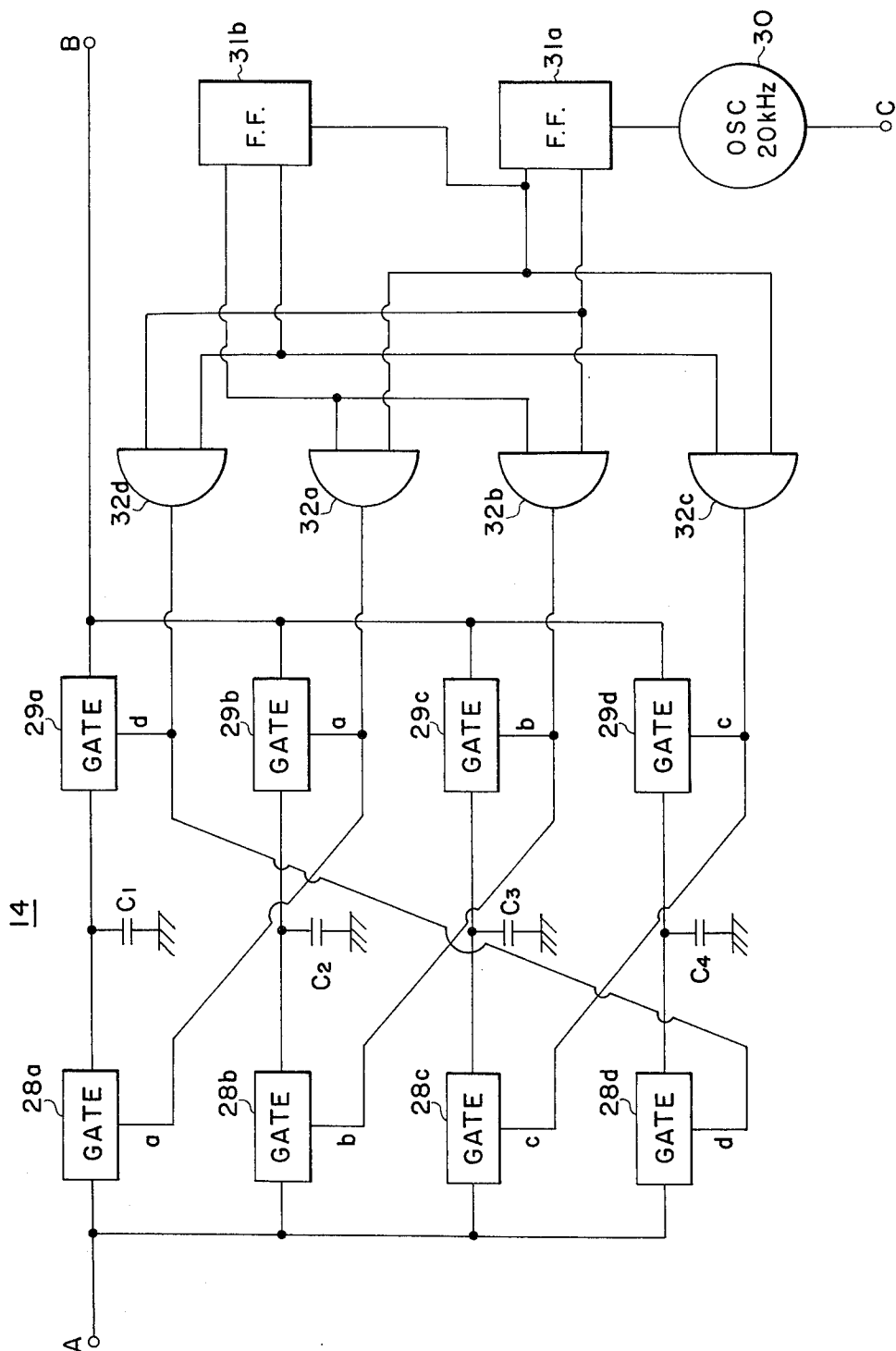


FIG. 6

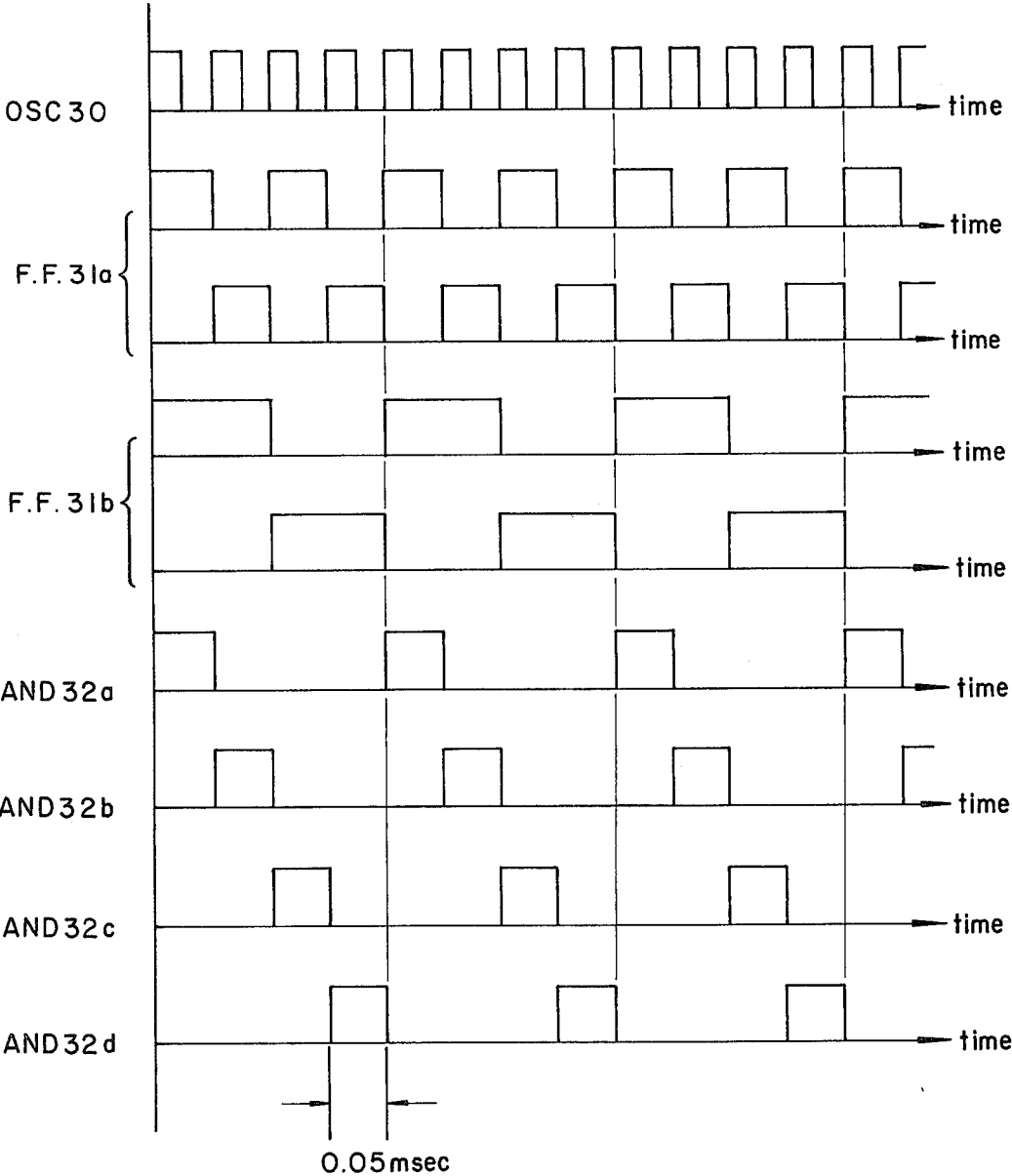


FIG. 7

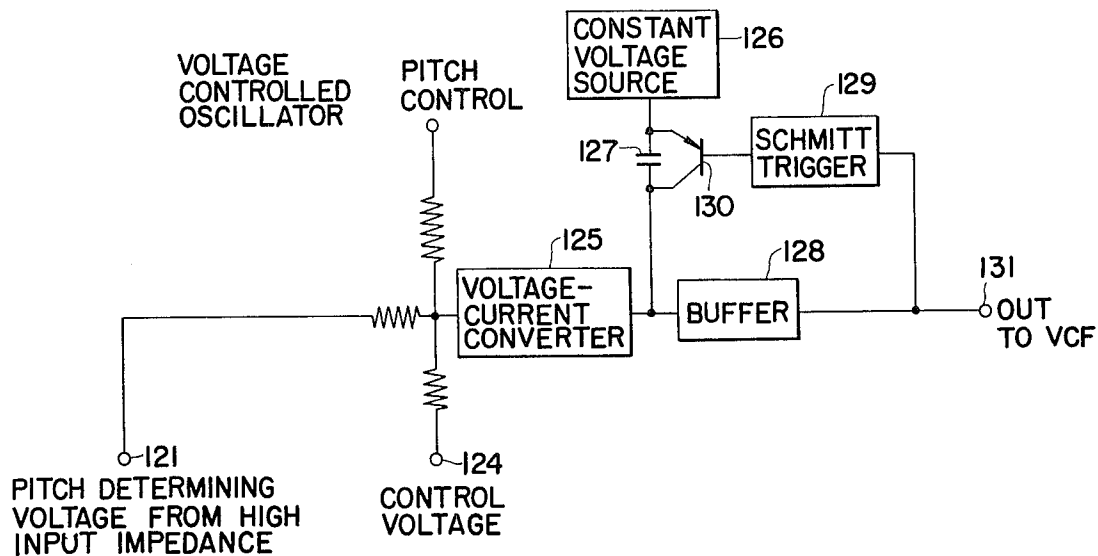


FIG. 8

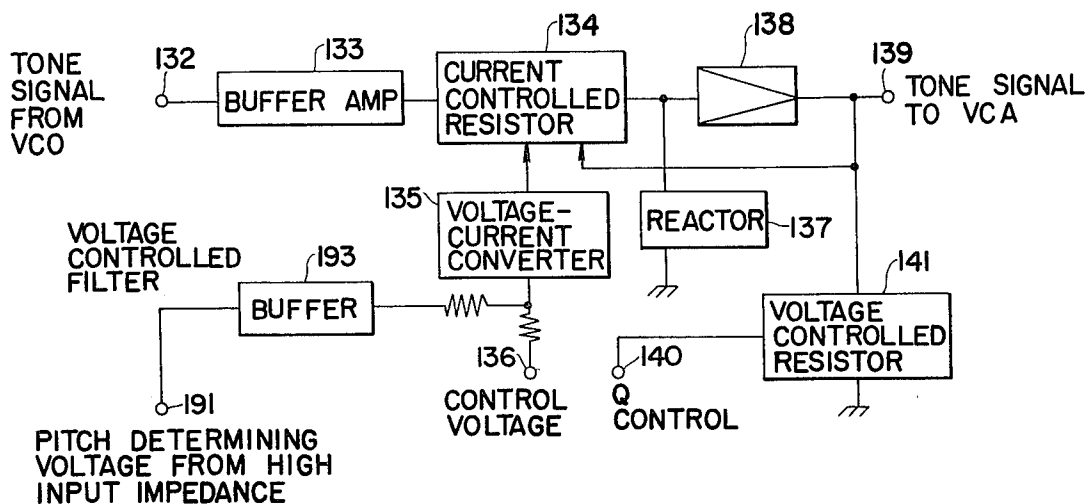


FIG. 9

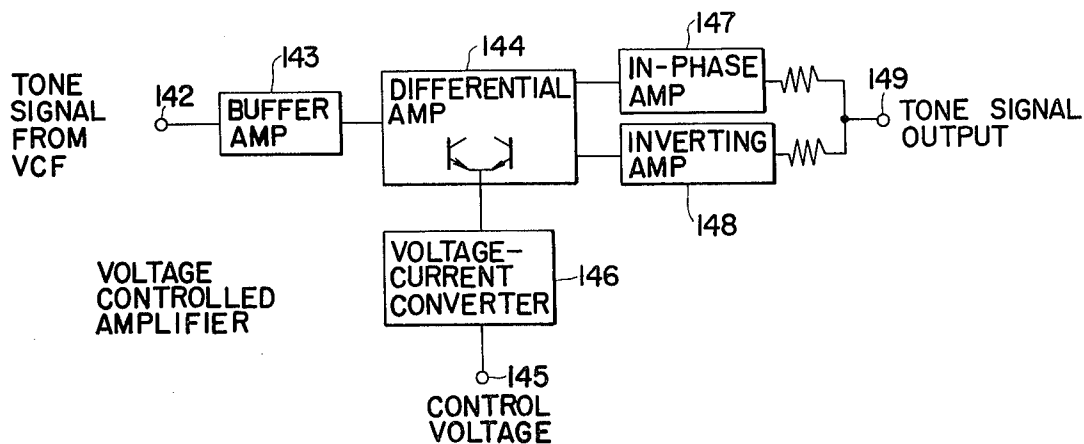


FIG. 10

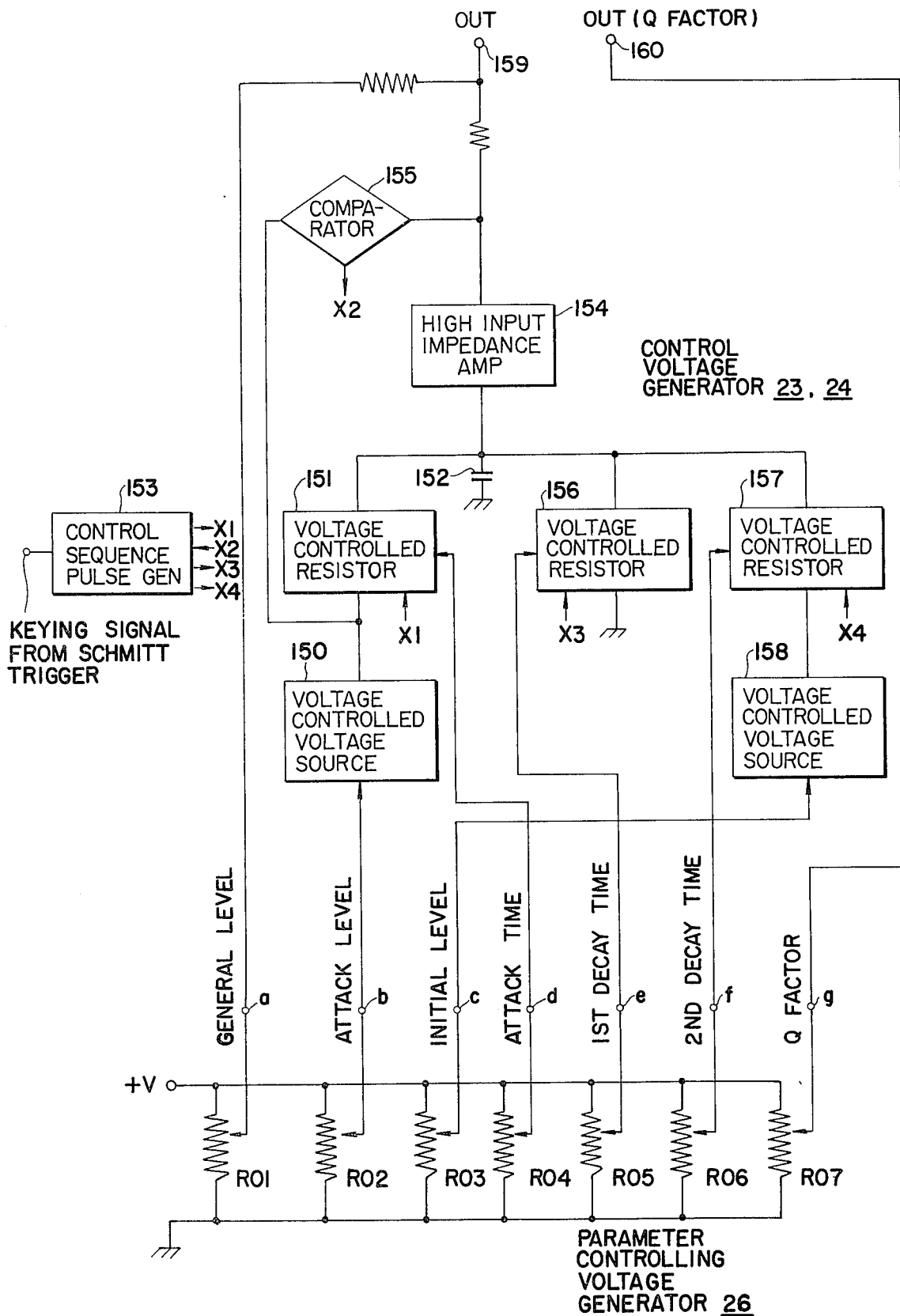


FIG. 11

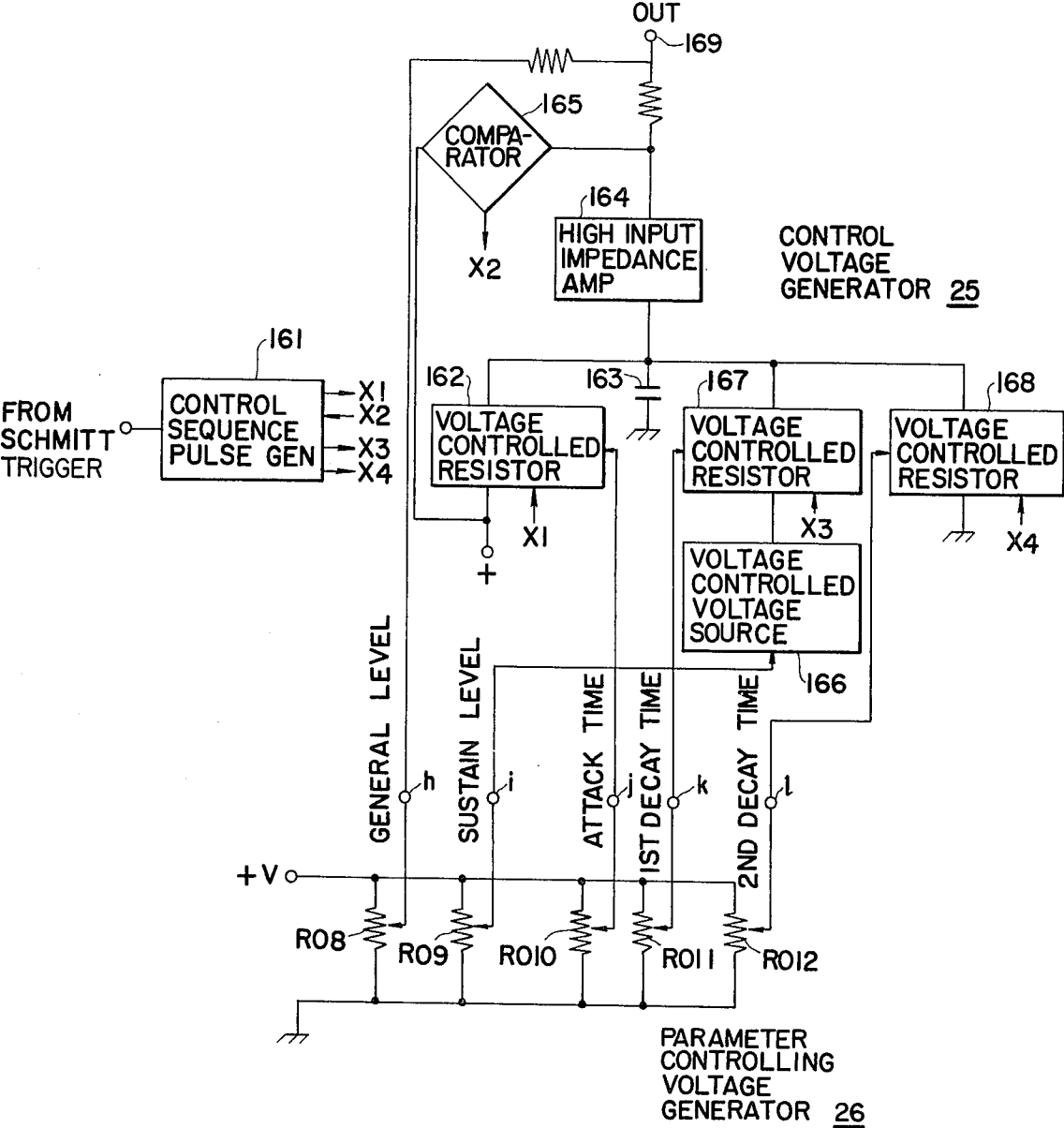
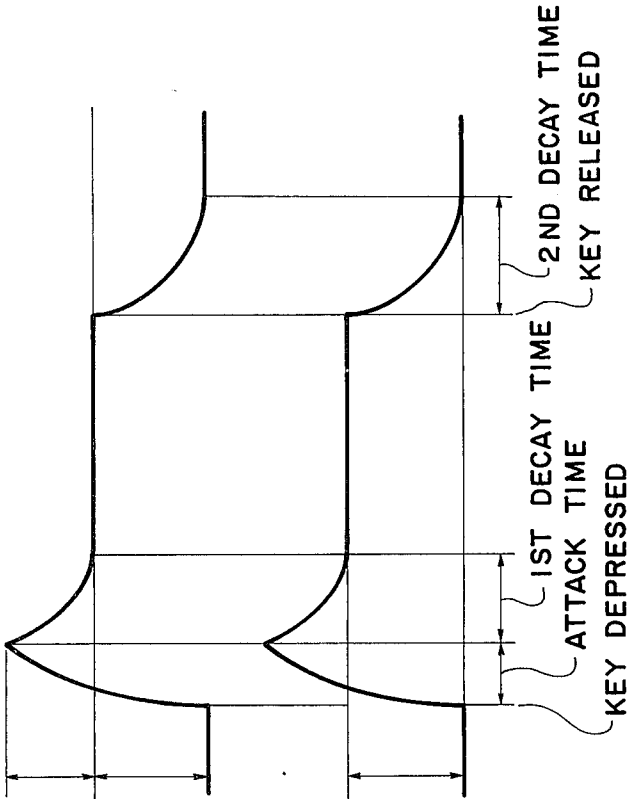


FIG. 12A

ATTACK LEVEL
NORMAL LEVEL
INITIAL LEVEL

FIG. 12B

SUSTAIN LEVEL
CUTOFF LEVEL



ELECTRONIC MUSICAL INSTRUMENT OF VOLTAGE-CONTROLLED TONE PRODUCTION TYPE

BACKGROUND OF THE INVENTION

a. Field of the Invention

This invention relates to an electronic musical instrument of a voltage-controlled tone production type, and more particularly, to such an electronic musical instrument employing a composite controlling signal including a voltage signal component determining the tone frequency and a keying signal component expressing the operation of a playing-board.

b. Description of the Prior Art

An electronic musical instrument of a voltage-controlled tone production type is usually provided with a playing-board (regular keyboard type or portamento-board type) which generates a controlling voltage signal determining the tone frequency and a keying signal expressing the operation on the playing-board. The keying signal carries the information of the commencement and the termination of a tone to be produced and is utilized to control the voltage-controlled musical tone synthesizer. These frequency determining signal and keying signal may be combined into a composite controlling signal. In this case, the electric circuit in a playing-board section becomes very simple, but there should be provided means for removing the keying signal component from the composite signal, otherwise the tone synthesizer generates unwanted tones due to the existence of the keying signal component. There has been proposed an electronic musical instrument which includes a comparator and a gate connected to the playing-board section and arranged in such a manner that the comparator detects the commencement and the termination of each key depression with reference to a certain cut-off (reference) level and opens and closes the gate for selectively transferring the frequency determining signal to the tone synthesizer section. Such an arrangement also fails to completely remove the transient phenomena upon depression and release of the keyboard. This invention is intended to remove the drawbacks of the conventional electronic musical instrument as described above.

SUMMARY OF THE INVENTION

An object of this invention is to provide an electronic musical instrument of a voltage-controlled tone production type employing a composite controlling signal of tone-frequency-determining voltage signal and keying signal and performs tone generation free from the effects due to the coexistence of the keying signal.

Another object of this invention is to provide an electronic musical instrument using a composite controlling signal and comprising a first delay circuit including a gate circuit for transferring the frequency determining signal with some delay, a comparator for detecting the change of the frequency determining and forming a keying signal and controlling the gate circuit in the first delay circuit, and a second delay circuit for giving a delay to the keying signal.

According to this invention, the keying signal component is superposed on the tone frequency determining signal, but is effectively separated from the composite controlling signal so as to assure stable tone generation with a desired frequency and envelope.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an electric circuit of a conventional portamento playing system for producing a continuously variable voltage signal representing the tone frequency of a depressed point.

FIG. 2 is a block diagram of an electric circuit of a conventional keyboard playing system for producing a stepwisely variable voltage signal representing the tone frequency of a depressed key.

FIG. 3 is a block diagram of an electric circuit of a conventional portamento playing system for producing a composite signal of a tone frequency determining voltage signal and a keying signal and separating the two.

FIG. 4 is a block diagram of an electric circuit of an embodiment of the electronic musical instrument according to this invention.

FIG. 5 is an electric block diagram of a concrete example of a delay-memory circuit to be used in the circuit of FIG. 4.

FIG. 6 is a timing chart of various signals.

FIG. 7 is a block diagram of an electric circuit of a voltage-controlled oscillator.

FIG. 8 is a block diagram of an electric circuit of a voltage-controlled filter.

FIG. 9 is a block diagram of an electric circuit of a voltage-controlled amplifier.

FIG. 10 is a block diagram of an electric circuit of control voltage generators and a parameter controlling voltage generator.

FIG. 11 is a block diagram of an electric circuit of a control voltage generator.

FIGS. 12A and 12B are diagrams showing examples of control voltage waveforms.

DESCRIPTION OF A PREFERRED EMBODIMENT

Preceding to the description of a preferred embodiment according to this invention, conventional electronic musical instruments will be described for helping understanding of this invention.

FIG. 1 shows a portamento playing system in which a portamento playing-board 1 is connected through a voltage memorizing capacitor 2 to a buffer circuit 3 of a high input impedance. The portamento playing-board 1 is formed of an elongated resistive member applied was a voltage $-V$ thereacross and a resilient conductive member disposed in parallel with the elongated resistive member with a small gap provided therebetween. A voltage signal can be derived from the resilient conductive member by depressing a desired portion of the conductive member onto the resistive member to make contact therewith and deriving a divided voltage corresponding to the depressed position of the conductive member. Such an output voltage is supplied through the capacitor 2 and the buffer 3 to a voltage-controlled musical tone synthesizer (not shown in FIG. 1) to drive it. Thus, a continuous shifting of the depressing point can be transformed into a continuously varying voltage signal in the circuit shown in FIG. 1. Here, due to the existence of a memorizing capacitor 2, the tone frequency determining voltage is kept derived even after the operation on the playing-board 1 is released. When the depressed position on the playing-board 1 is changed successively, the stored voltage in the capacitor 2 changes correspondingly and the tone generation continues varying in frequency.

According to such an electronic musical instrument, however, the keying signal representing the commencement and release of a depression on the playing-board 1 and being important for keying the tone signal as well as adding various transient effects is not provided. Hence, the effect-adding control on the tone signal upon rising and trailing of each tone cannot be achieved.

FIG. 2 shows another type of conventional electronic musical instrument using a keyboard 1a in place of the portamento playing-board 1 in the circuit of FIG. 1. In this case, the tone frequency is set discrete (stepwise) in correspondence with a closed key switch in the keyboard 1a. Similar to the instance of FIG. 1, the keying signal cannot be obtained by the simple structure of FIG. 2.

For providing the keying signal, various arrangements can be adopted. They can be classified into two groups; one for generating the keying signal separately from the frequency determining voltage signal utilizing additional key switches and transferring the two separately, and the other for superposing the keying signal on the frequency determining voltage signal and thereafter separating the two. This invention concerns the latter type.

An arrangement as shown in FIG. 3 has been thought of for superposing the keying signal on the tone frequency determining voltage signal and separating the two thereafter. In FIG. 3, a portamento playing-board 1 is applied with a negative voltage $-V$ to derive a divided negative output voltage from the conductive member thereof, while a positive voltage $+V_0$ is applied to the conductive member through a terminal 4 and a high resistance 5. The conductive member of the portamento playing-board 1 is connected with a buffer circuit 6. Thus, the buffer circuit 6 is supplied with a negative voltage corresponding to the depressed position in the portamento playing-board 1 when the portamento playing-board is operated, and a positive voltage through the high resistance 5 when the portamento playing-board is released. The output of the buffer 6 is supplied to a gate circuit 7 and to a comparator circuit 8 for comparing this output with the ground potential. The comparator circuit 8 generates an output signal when the input voltage crosses over the ground potential and supplies the output signal to the gate circuit 7 for controlling this gate 7 and to a Schmitt circuit 9 for supplying the triggering signal for the Schmitt circuit 9. More precisely, the gate 7 is opened when the composite signal from the buffer 6 changes from a positive potential to a negative potential and is closed when the composite signal changes from a negative potential to a positive potential. The Schmitt circuit 9 provides a keying signal when the composite signal crosses over the ground potential. The output of the gate circuit 7 is stored in a capacitor 2 and is derived through a buffer circuit 3 of a high input impedance to a voltage-controlled musical tone synthesizer (not shown in FIG. 3). Thus, when the playing-board 1 is operated by depressing a desired portion, the gate circuit 7 is opened and the output voltage from the playing-board 1 through the buffer 6 is memorized in the capacitor 2 to provide a tone generation of a frequency determined by the stored voltage in the capacitor 2. When the depression in the portamento playing-board 1 is released, the gate circuit 7 is closed but the tone signal of a frequency determined by the stored potential in the ca-

pacitor 2 is kept generated. In such a case, tone generation is controlled in the musical tone synthesizer by the keying signal from the Schmitt circuit 9.

As for the voltage stored in the capacitor 2, when a portion in the portamento playing-board is depressed, the gate circuit 7 is open and the capacitor 2 stores a potential corresponding to the depressed portion. When the depression is released, however, the gate circuit 7 cannot be closed before the output voltage of the buffer 6 exceeds the ground potential, and hence the stored voltage in the capacitor 2 has changed from a negative potential established by the depression to the ground potential. Thus, the stored voltage is no longer equal to the voltage which has been stored while a portion in the portamento playing-board 1 has been depressed. Therefore, even though it is desired to continue tone generation by the voltage which has been stored in the capacitor 2 even after the release in the playing-board, only a tone of a varied frequency can be obtained actually. For example, in the case of providing a sustain effect by the use of the keying signal from the Schmitt circuit 9, the tone pitch (frequency) in the sustaining portion becomes altered. Therefore, it becomes practically impossible to add the true sustain effect.

According to this invention, the above-mentioned drawback is eliminated as can be seen in the following embodiment. FIG. 4 shows an embodiment of portamento-type electronic musical instrument according to this invention. It will be apparent that this invention is similarly applicable to the keyboard type as well as to the portamento type. In the figure, a portamento playing-board 1 provides a negative potential corresponding to a depressed position in the playing-board. A positive voltage V_0 is applied from a terminal 4 and through a high resistance 5 to the output terminal 10 of the portamento playing-board 1. The common output terminal 10 provides, when the playing-board is depressed, a negative potential representing the depressed position in the portamento playing-board or a positive potential expressing the release of the playing-board 1, to a buffer circuit 6 of a high input impedance. This buffer 6 supplies an output voltage to a delay-memory circuit 14 and to a comparator circuit 8 which compares the input voltage with the ground potential. The comparator circuit 8 detects the moments when the voltage from the buffer 6 crosses the ground potential and provides an output when the buffer 6 provides a negative voltage. Upon receipt of this comparator output, the delay-memory circuit 14 starts transmitting the inputted voltage to its output with a predetermined time delay from time to time, and upon disappearance of the comparator output, the delay-memory circuit 14 now starts continuous giving out of the same one voltage which was inputted the above-mentioned delay time before the disappearance of the comparator output (finger release). The output voltage signal from the delay-memory 14 is supplied to a voltage-controlled frequency-variable oscillator 17 (hereinafter referred to as VCO) and to a voltage-controlled frequency-variable filter (VCF) 20 in a voltage-controlled musical tone synthesizer 16 through a high input-impedance buffer circuit 3 to provide a tone signal of a frequency determined by the supplied voltage. Further, the output signal from the comparator circuit 8 is supplied to a Schmitt circuit 9 through a delay circuit 18 to provide a keying signal for the control of the musical tone synthesizer 16 in response to the commencement and ter-

mination of an operation on the portamento playing-board 1.

The output signal of the VCO 17 is supplied through the VCF 20 to a voltage-controlled gain-variable amplifier 21 (referred to as VCA hereinbelow) so as to generate a musical tone signal to be sounded through an amplifier 41 including an expression control 42 from a loudspeaker 43. Here, the VCO 17, the VCF 20 and the VCA 21 are controlled by the respective control voltage varying with time and supplied from respective control voltage generators 23, 24 and 25. These control voltage generators 23 to 25 generate control voltage on the trigger with the keying signal from the Schmitt circuit 9 on the basis of the information supplied from a parameter controlling voltage generator 26. This generator 26 may comprise voltage dividing resistor circuits for providing parameter determining information to supply information such as about the attack level, the attack time, and the decay times. The resistor circuits can be appropriately preset and selected. A pitch control circuit 27 is connected to the VCO 17. Detailed description on the musical tone synthesizer 16 will be given later.

FIG. 5 shows a concrete example of the delay-memory circuit 14 in which an input terminal A, an output terminal B and a controlling terminal C correspond to the similar terminals in FIG. 4. A signal voltage from the input terminal A is supplied in parallel to four input gate circuits 28a to 28d. Storing capacitors C_1 to C_4 are connected with the output side of the gate circuit 28a to 28d, respectively. The output sides of the storing capacitors C_1 to C_4 are connected with output gate circuits 29a to 29d, respectively. The output sides of the gate circuits 29a to 29d are connected commonly to the output terminal B. The controlling terminal C is connected to an oscillator 30, e.g. an oscillator which oscillates at 20kHz when the comparator output is supplied. By the oscillation output of the oscillator 30, a first flip-flop circuit 31a is driven. This flip-flop 31a then drives a second flip-flop circuit 31b. Four signals of a frequency ratio 2:1 and opposite phases are derived from the first and second flip-flop circuits 31a and 31b. These four signals are appropriately combined into four pairs and supplied to AND circuits 32a and 32d to supply successively retarding cyclic outputs. Namely, the AND circuits 32a to 32d provides successively rotational output signals with a time interval of $1/(20\text{kHz}) = 0.05 \text{ m sec}$. FIG. 6 shows the timing chart for the outputs of the flip-flops 31a and 31b and of the AND circuits 32a to 32d.

The output of the AND circuit 32a is supplied to the gate circuits 28a and 29b, the output of the AND circuit 32b to the gate circuits 28b and 29c, the output of the AND circuit 32c to the gate circuits 28c and 29d, and the output of the AND circuit 32d to the gate circuits 28d and 29a, respectively, to open the respective gates.

Namely, when the portamento playing-board 1 is operated in the above electronic musical instrument, a voltage corresponding to a depressed position is supplied to the delay-memory circuit 14 through the terminal A. At the same time, the comparator 8 (shown in FIG. 4) detects that the voltage supplied from the buffer 6 (shown in FIG. 4) has now turned negative and supplies an output to the oscillator 30 in the delay-memory circuit 14 through the terminal C to start the oscillator 30 and to supply successively rotational gat-

ing signals to the gate circuits 28a to 28d and 29a to 29d. Thus, the voltage corresponding to the depressed position is successively stored in the capacitors C_1 to C_4 . The voltages stored in the capacitors C_1 to C_4 are successively read out through the gate circuits 29a to 29d which are similarly controlled by the outputs of the AND circuits. The voltage which is read out is supplied through the common terminal B to the VCO 17. Thus, the VCO oscillates a tone signal of a frequency corresponding to the depressed position in the playing-board 1. The tone signal is subjected to a tone coloring in the VCF 20 and to an envelope control in the VCA 21 so as to provide a musical tone signal to be sounded through the amplifier 41 and the loudspeaker 43. Here, the frequency, the tone color, and the envelope of the tone signal are modulated as desired by the control voltage signals from the control voltage generators 23 to 25 which are triggered by the signal from the Schmitt circuit 9 representing the operation on the playing-board 1 and based on the information supplied from the parameter controlling voltage generator 26. Thus, effective tone signals rich in variations are provided.

It is to be noted that the timing for storing voltages in the capacitors C_1 to C_4 and that for reading them out to the VCO 17 are different. Therefore, the voltage being given to the VCO is a voltage which was supplied from the playing-board 1 a certain time ago. In fact, the voltage continuously supplied from the playing-board 1 is normally constant, thus the capacitors C_1 to C_4 are of a same potential and the VCO 17 gives a stable oscillation.

When the depression in the playing-board 1 is released, the output voltage of the buffer 6 becomes positive by the positive voltage source connected through the high resistance 5 and the comparator 8 becomes to supply no output thereby stopping the oscillation of the oscillator 30. If, for example, the oscillation is stopped in the state where the AND circuit 32b is giving an output, the delay-memory circuit 14 is held in a state where the gate circuits 28b and 29c are open. Thus, the capacitor C_2 is now charged to the positive voltage $+V_0$ through the high resistor 5 and the gate 28b, and an output voltage at the terminal B is derived from the capacitor C_3 through the gate 29c. The voltage stored in this capacitor C_3 is what was supplied from the playing-board 1 during the time the gate 28c was open before the time of the latest opening of the gate 28b which accordingly is now open. At that previous moment the depression in the playing-board 1 was not yet released so that the VCO 17 keeps receiving the voltage signal in the depressed state and provides a stable oscillation. Therefore, tone modulation in the sustaining portion based on the keying signal from the Schmitt circuit 9 can also be done referring to a stable and correct tone signal.

In the above embodiment, the oscillation frequency of the oscillator 30 was 20kHz so that the AND circuits 32a and 32d generated rotational outputs each having a time width of 0.05 m sec, and the two sets of gate circuits 28a to 28d and 29a to 29d were controlled to have the largest time delay. Namely, the voltage being read out by the gating signal b, for example, from the AND circuit 32b, was stored by the gating signal c from the AND circuit 32c in the preceding cycle, i.e., at least $0.05 \times 2 = 0.10 \text{ m sec}$ before. In the case when it requires nearly 0.1 m sec for the comparator 8 to detect the release in the playing-board after the real release,

a pair of gate sets each comprising at least four gate circuits is necessary as in the above embodiment. Here, it is apparent that the frequency of the oscillator and the arrangement of gate circuits can be arbitrarily selected according to the requirements.

When a portion in the playing-board is depressed again after the release, a voltage corresponding to the freshly depressed position is supplied to the input terminal A of the delay-memory circuit 14 and to the comparator 8. The comparator 8 generates an output to activate the oscillator 30 and hence the gate circuits. At this moment, one capacitor C_2 stores the positive voltage and other capacitors C_1 , C_3 and C_4 store the voltages related with the preceding depression. The memories in the capacitors C_1 to C_4 cannot be revised and a correct tone frequency determining voltage cannot be supplied to the VCO 17 before the control for the gate circuits 28a to 28d finishes one cycle. Thus, unless the sound generation is delayed for one cycle of control for the gate circuits 28a to 28d ($0.05 \times 4 = 0.2$ m sec), the stored voltages in the capacitors C_1 to C_4 having no relation with the freshly depressed position in the playing-board 1 are supplied to the VCO 17 to generate clicking unstable tone. Therefore, the delay circuit 18 is provided between the comparator 8 and the Schmitt circuit 9 to provide tone generation having a correct frequency from the rising of the tone. The delay circuit 18 is required to delay only pulse signals while the delay-memory circuit 14 is required to delay an analog quantity.

Although the voltage-controlled musical tone synthesizer has already been proposed and is now on the market, the explanation thereof is made herein below for better understanding for the readers.

FIG. 7 shows the detailed arrangement of VCO 17. A pitch determining voltage applied from the high input impedance buffer 3 to an input terminal 121 is added to a control voltage applied from the control voltage generator 23 through an input terminal 124. The added voltage is converted, at a voltage-current converter 125 into a current signal. An output current of the converter 125 charges a capacitor 127 connected to a constant voltage source 126. The voltage of the capacitor 127 is applied through a buffer 128 to a Schmitt trigger 129. When the voltage of this capacitor 127 reaches a predetermined voltage value, the Schmitt trigger 129 is operative to render a transistor 130 conductive, causing the capacitor 127 to be discharged. An oscillation output of saw-tooth wave is delivered from an output terminal 131 by the repeated charge and discharge of the capacitor 127. The charging speed of the capacitor 127 is varied according to the magnitude of output current of the converter 125. Consequently, oscillation frequency is controlled by the pitch determining voltage from the high input impedance 3 and the controlled voltage from the control voltage generator 23.

FIG. 8 shows the detailed arrangement of VCF 20. A tone signal from an input terminal 132 is applied through a buffer amplifier 133 to a current controlled resistor 134. This current controlled resistor 134 is constituted by a diode etc. and controlled by an output current of a voltage-current converter 135 which receives a control voltage through a control terminal 136 together with a pitch determining voltage received at a terminal 191 and passed through a high input impedance buffer 93. The resistor 134 determines, together

with a reactance 137 (e.g. a capacitor), the cutoff frequency of the filter (e.g. an LPF)). A tone color imparted tone signal is obtained, through an amplifier 138, from an output terminal 139. A Q control input supplied to a control terminal 140 controls a voltage-controlled resistor 141, thereby controlling the feedback amount of the amplifier 138 (constituting an active filter) and thus the Q factor of the filter.

FIG. 9 shows the detailed arrangement of VCA 21. A tone signal from an input terminal 142 is supplied through a buffer amplifier 143 to a differential amplifier 144. The gain of this differential amplifier 144 is controlled by the output current of a voltage to current converter 146 which receives a control voltage from a control voltage generator 25 (shown in FIG. 4) through a control terminal 145. The output signals of the differential amplifier 144 are supplied through an in-phase amplifier 147 and a phase inverting amplifier 148 to an output terminal 149. In both the outputs of the differential amplifier 144, the tone signal is included in an opposite phase relationship and a direct current component is included in an in-phase relationship. Consequently, only the tone signal is derived from the output terminal 149.

FIG. 10 shows the detailed arrangement of the control voltage generators 23 and 24 and parameter controlling voltage generator 26. The pitch control voltage generator 23 and tone color control voltage generator 24 are identical in their arrangement, except that the latter has a Q factor control. The parameter controlling voltage generator 26 has potentiometers R01, R02, R03 . . . R07. R01 has a general level controlling voltage coupled to a control terminal a; R02 has an attack level controlling voltage coupled to a control terminal b; R03 has an initial level controlling voltage coupled to a terminal c; R04 has an attack time controlling voltage coupled to a terminal d; R05 has a first decay time controlling voltage coupled to a terminal e; R06 has a second decay time controlling voltage coupled to a terminal f; and R07 has a Q factor controlling voltage coupled to a terminal g. A voltage controlled voltage source 150 generates, in response to the attack level controlling voltage, a voltage of a magnitude corresponding to the attack level. The output voltage of the voltage source 150 is supplied through a voltage-controlled resistor 151 to a capacitor 152. Upon receipt of a trigger signal from the Schmitt trigger 9, a control sequence pulse generator generates a control output X1. The voltage-controlled resistor 151 becomes operative to cause the capacitor 152 to be charged by the output voltage of the voltage source 150 in response to the control output X1 and its resistance determining a charging time constant is determined according to the magnitude of the attack time controlling voltage. The charging voltage of the capacitor 152 is derived through a high input impedance buffer amplifier 154 and compared with the output voltage of the voltage source 150 by a comparator 155. When the magnitude of charging voltage of the capacitor 152 reaches the magnitude of output voltage of the voltage source 150, i.e., the capacitor 152 is charged up to the attack level, the comparator 155 generates an output X2. The control sequence pulse generator 153 then generates a control output X3 upon receipt of the output X2. A voltage-controlled resistor 156 becomes operative to create a discharging path of the capacitor 152 in response to the controlled output X3 and its re-

sistance determining a discharging time constant, i.e., the first decay time is determined according to the magnitude of the first decay time controlling voltage. Upon release of the key at the keyboard section the control sequence pulse generator 153 generates a control output X4. In response to the control output X4 the capacitor 152 is discharged, through a voltage-controlled resistor 157, down to the initial level, i.e., the level of output voltage of a voltage-controlled voltage source 158 which is obtained in accordance with the magnitude of the initial level controlling voltage. The discharging time constant, i.e., the second decay time is dependent upon the resistance of the voltage-controlled resistor 157 which is determined according to the magnitude of the second decay time controlling voltage. The so varying voltage of the capacitor 152 and the general level of the potentiometer R01 are added together at an output terminal 159 to form a control voltage waveform as shown in FIG. 12A. The potentiometer R07 causes a Q factor control voltage to be generated at an output terminal 160. The Q factor control voltage is coupled to a control terminal 140 of VCF of FIG. 8. The sliders of potentiometers may be provided on the control panel of an electronic musical instrument so as to be easily adjusted by a player.

FIG. 11 shows the detailed arrangement of the control voltage generator 25. The parameter controlling voltage generator 26 has potentiometers R08, R09, R010, R011 and R012 coupled to control terminals h, i, j, k and l, respectively, which generate voltage for controlling parameters such as general level, sustain level, attack time, first decay time and second decay time. Upon receipt of a trigger signal from the Schmitt trigger 9, a control sequence pulse generator 161 generates a control output X1. A voltage-controlled resistor 162 is operated in response to the control output X1. As a result, a capacitor 163 is charged up to a peak level "+" with an attack time, i.e., time constant dependent upon the resistance of the voltage-controlled resistor 162 which is determined according to the magnitude of the attack time controlling voltage. The voltage of the capacitor 163 is derived through a high input impedance amplifier 164. When the voltage of the capacitor 163 reaches the "+" level, a comparator 165 generates a control output X2. The control sequence pulse generator 161 then generates a control output X3 upon receipt of the control output X2. In response to the control output X3 the capacitor 163 is discharged, through a voltage-controlled resistor 167 down to the sustain level, i.e., the level of output voltage of a voltage-controlled voltage source 166 which is determined according to the magnitude of the sustain level controlling voltage. The resistance of the resistor 167, which determines a discharging time constant, is controlled by the magnitude of the first decay time controlling voltage. Upon release of the key, a control output X4 is obtained and the capacitor 163 is discharged through a voltage-controlled resistor 168. The resistance of this voltage-controlled resistor 168, which determines a discharge time constant, is controlled by the second decay time controlling voltage. The so varying voltage of the capacitor 163 and the general level controlling voltage from the potentiometer R08 are added together at an output terminal 169 to form the control voltage waveform as shown in FIG. 12B.

I claim:

1. An electronic musical instrument comprising:

a playing section for generating a voltage signal which is at a first voltage when said playing section is not operated and at a second voltage corresponding to a depressed position in said playing section when said playing section is operated;

delay means connected with said playing section for giving a time delay to said voltage signal;

a voltage-controlled musical tone synthesizer connected with said delay means for receiving the delayed voltage signal;

detecting means for detecting the moments when said voltage signal shifts away from and recovers said first voltage and generating keying signals upon detection, connected with said playing section and said voltage-controlled musical tone synthesizer, thereby rendering said voltage-controlled musical tone synthesizer insensitive to transient variations in said voltage signal.

2. An electronic musical instrument according to claim 1, wherein said delay means includes gate means connected to said separating means so as to be controlled by the keying signal component.

3. An electronic musical instrument according to claim 2, wherein said delay means comprises input gate means, output gate means and memory means connected between the input and output gate means.

4. An electronic musical instrument according to claim 2, further comprises another delay means connected between said separating means and said voltage-controlled musical tone synthesizer.

5. An electronic musical instrument according to claim 1, wherein said playing section determines a ground potential, said first voltage is of one polarity and said second voltage is of the other polarity, and said detecting means compares the voltage signal with the ground potential.

6. An electronic musical instrument according to claim 1, wherein said delay means comprises a timing signal generator means for generating repetitively and sequentially-changing timing signal and connected with said detecting means to start a repetitive and sequential change upon detection of said voltage signal shifting from the first voltage and to stop this repetitive and sequential change upon detection of said voltage signal recovering the first voltage, and a plurality of series connections, each including an input gate, a memory connected to said input gate, and an output gate, said input and output gates of each series connection are connected with said timing signal generator means and controlled by said timing signal so that the output gate is opened after a predetermined time delay with respect to the opening of the input gate.

7. An electronic musical instrument according to claim 6, wherein said timing signal generator means provides signals each of which opens one input gate of one of said plurality of series connections and one output gate of another of said plurality of series connections at the same timing, such opening state changing repetitively and sequentially from one to another of said plurality of series connections so long as the repetitive and sequential change of said timing signal continues, such opening state undergoing no further change with a suspension of the change of said timing signal, thus delivering out, even after the release of the depression, a voltage memorized in the series connection whose output gate is now held open.

8. An electronic musical instrument according to claim 7, further comprising another delay means connected between said separating means and said voltage-controlled musical tone synthesizer.

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