

**[54] ELECTRONIC MUSICAL INSTRUMENT  
WITH VARIABLE IMPEDANCE  
PLAYBOARD PROVIDING PORTAMENTO**

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abandoned.

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**[52] U.S. Cl. .... 84/1.24**

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[58] **Field of Search**..... 84/1.01, 1.24, 1.25,  
84/DIG. 7; 338/69; 331/138, 140, 141

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## [57]

## ABSTRACT

An electronic musical instrument is disclosed in which a musical scale keyboard and a portamento playboard are arranged parallel and close to each other. Associated with the portamento playboard, there is provided a continuously variable frequency oscillator covering several octaves. The portamento playboard includes a manually controllable variable impedance element which is normally open circuited to render the oscillator normally nonoperative. The variable impedance element is manually actuated so that the circuit is closed providing an impedance to control the frequency of the oscillator. The impedance element is so arranged that the position thereof actuated produces the same named note as the nearest key in the musical scale keyboard.

### 5 Claims, 6 Drawing Figures

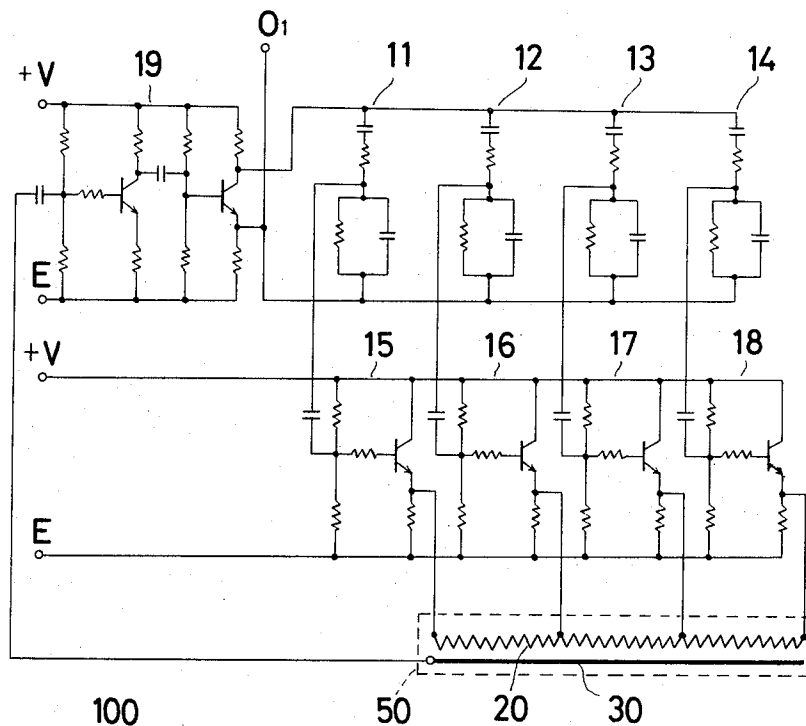




FIG. 3

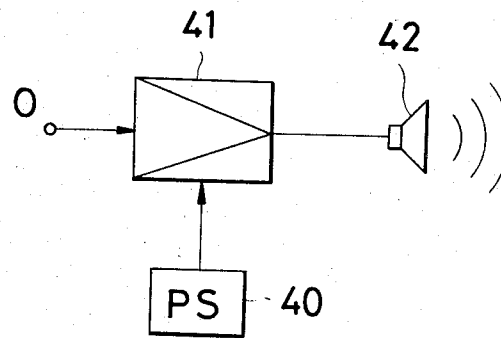


FIG. 4

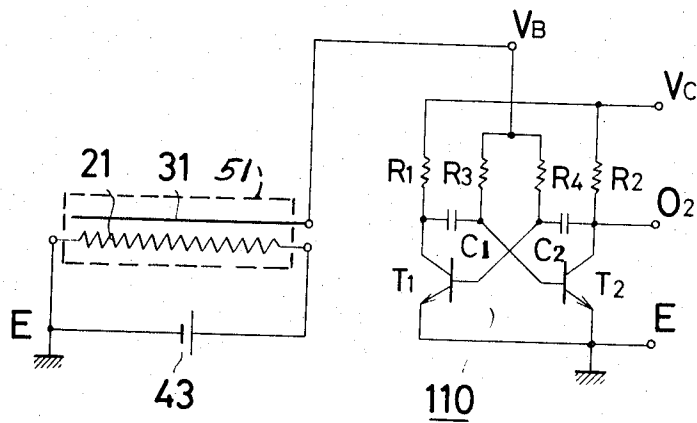


FIG. 5

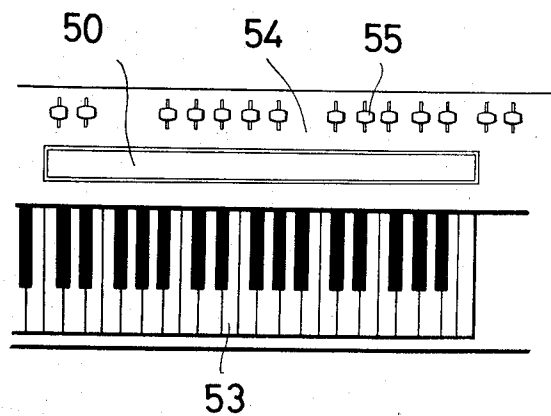
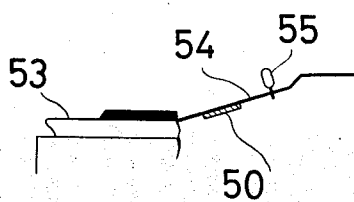


FIG. 6



# **ELECTRONIC MUSICAL INSTRUMENT WITH VARIABLE IMPEDANCE PLAYBOARD PROVIDING PORTAMENTO**

This is a continuation of my copending application Ser. No. 35,619, filed May 8, 1970, and entitled ELECTRONIC MUSICAL INSTRUMENT, now abandoned.

## **BACKGROUND OF THE INVENTION**

Portamento effect is generally obtained in an electronic musical instrument or the like by continuously varying, for instance, a resistance value in a variable resistor employed in a variable frequency oscillator so that the frequency generated thereby is increased or decreased continuously.

Heretofore, a variable resistor of a type having a slidable contact normally contacting with the resistance element has been employed for the above described purpose, and the contacting position of the slidable contact has been manually shifted to a desired direction.

However, with a portamento playing device including such a type of variable resistor, it has not been possible to start the portamento play from any desired pitch, and when such a disadvantageous feature is desired to be avoided, the knob had to be shifted to the desired position prior to the portamento play. Furthermore, since the sliding contact of the conventional variable resistor normally contacts the resistance element and the oscillator connected thereto is at its oscillating condition, separate means has been required for controlling the operation of the oscillator. For this reason, in the conventional portamento device, it has been practically impossible to carry out an ordinary tone scale performance. Moreover, the conventional portamento device has been provided on the key slip under the keys and in the front of the electronic musical instrument, thus rendering it impossible to play the device simultaneously with the playing of the keyboard and with the operation of various tone color control devices.

## **SUMMARY OF THE INVENTION**

Therefore, the primary object of the invention is to provide a portamento device wherein all of the above described drawbacks of the conventional devices can be substantially eliminated.

Another object of the present invention is to provide a portamento device wherein the performance can be started from any desired tone pitch.

Still another object of the present invention is to provide a portamento device wherein the tone can be controlled by merely the playing portion of the portamento device and no separate control means is required.

Still another object of the present invention is to provide a portamento device whereby not only the portamento performance but also the tone scale performance can be easily undertaken.

A further object of the present invention is to provide an electronic musical instrument including a portamento device wherein portamento can be rendered simultaneously with the ordinary keyboard performance and also with the control of various tone color controlling levers.

These and other objects of the present invention can be achieved by an electronic musical instrument which comprises a keyboard capable of playing musical scale tones upon depression, a panel provided near the keyboard for including various controls such as tone color

control levers, and a portamento device provided within the area of the panel in such a manner that it is extended parallel to the keyboard and that the depression position of the portamento device for each of the musical scale tone corresponds laterally to the position of a key for the same pitched note in the keyboard, whereby a portamento performance having the tone frequency continuously changed can be attained by shifting the depressed position on the portamento device in either of directions. To be more specific, the objects of the present invention can be achieved by a provision of a portamento device in an electronic musical instrument, which device comprises a continuous, variable frequency oscillator, an amplifier for amplifying the output signal from the oscillator into a tone signal, and a playing portion acting as an oscillation control element or a frequency determining element of the variable frequency oscillator in such a manner that when a position of the playing portion is depressed, the oscillator is started to oscillate, and when the depressed position is changed, the frequency of the variable frequency oscillator is correspondingly changed, whereby a portamento performance can be attained with the position depressed on the playing portion being shifted in either of the directions along the length of the playing portion.

The invention will be more clearly understood from the following description with reference made to the accompanying drawings.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

In the drawings:

FIG. 1 is a fragmented perspective view showing one part of a portamento playing portion included in an electronic musical instrument according to the present invention;

FIG. 2 is a circuit diagram showing an example of a variable frequency oscillator wherein a variable impedance element is employed for the playing portion;

FIG. 3 is a block diagram showing an example of an amplifier which receives a signal from the output terminal 01 in FIG. 2 or from the output terminal 02 in FIG. 4 and produces a tone corresponding to the input signal;

FIG. 4 is a circuit diagram showing an example of a variable frequency oscillator wherein a variable d.c. voltage generating device is employed as its playing portion;

FIG. 5 is a partial top plan view showing an example of an electronic musical instrument according to the present invention; and

FIG. 6 is a schematic side view of an electronic musical instrument of FIG. 5.

## **DETAILED DESCRIPTION OF THE INVENTION**

Referring now to FIG. 1 showing an example of a portamento playing portion employed in an electronic musical instrument according to the present invention, there are indicated a base plate 1 consisting of an insulating material such as wood, plastic, or the like and the upper surface thereof being recessed along its central axis, an elongated resistance element 2 extended in the recessed portion of the base plate 1 and consisting of a piece of phenolic resin plate deposited by a carbon resistance material, said resistance element 2 being further provided with a plurality of lead-out taps (not shown) spaced apart each other by a suitable distance

along the lengthwise direction, an electrically conductive body 3 consisting of an electrically conductive thin plate such as German silver provided with a number of fine slits cut therethrough and placed on the base plate 1 opposingly to and normally spaced apart from the resistance element 2, and a flexible sheet 4 consisting of a resilient material such as hair-inplanted cloth and extended over the conductive body 3 to be fixed at both sides of the base plate 1.

The portamento playing portion 50 is composed of the above described base plate 1, resistance element 2, electrically conductive body 3, and the flexible sheet 4, and, when the upper surface of the flexible sheet 4 is depressed, for instance, by a finger 6, the conductive body 3 is brought to contact the resistance element 2 at the position so that the resistance value used for the circuit can be changed depending on the depressed position on the flexible sheet 4.

Furthermore, the resistance element 2 and the electrically conductive body 3 constitute a variable impedance element which shows an infinitely large impedance value when it is not depressed and which shows an impedance value variable in accordance with the depressed position when it is depressed, and therefore when the variable impedance element is connected to a continuous variable frequency oscillator 100, it acts as an oscillation start-and-stop control element as well as a frequency determining element.

FIG. 2 shows an example of a continuous variable frequency oscillator 100 wherein the above described portamento playing portion 50 is employed. In the example, a modified CR Wien bridge type oscillator is utilized which comprises a plurality of frequency determining circuits 11, 12, 13 and 14, the frequencies thereby determined being spaced apart by a suitable frequency difference of, for instance, one octave, and the circuits 11, 12, 13, and 14 being connected to the taps of a resistance element 20 (corresponding to the resistance element 2 in FIG. 1) consecutively through impedance conversion circuits (emitter followers) 15, 16, 17, and 18. An electrically conductive body 30 (corresponding to the conductive body 3 in FIG. 1) of the portamento playing portion 50 is connected to an input terminal of an amplifier circuit 19. Impedance conversion circuits 15-18 and amplifier 19 are biased by voltages of +V and E (ground).

With the above described arrangement of the circuit, at the normal condition, that is, when the conductive body 30 is not contacting with the resistance element 20, the variable frequency oscillator 100 does not oscillate. However, when the conductive body 30 is depressed so that the conductive body 30 contacts the resistance element 20 at a position, the oscillator 100 starts to oscillate, and the oscillation frequency is determined to a value intermediate of two frequencies inherent to two frequency determining circuits nearest to the contacting point. When the contacting point between the conductive body 30 and the resistance element 20 is shifted in either of the directions, the frequency generated from the variable frequency oscillator 100 can be varied continuously.

Accordingly, if the output terminal  $o_1$  of the oscillator 100 is connected to an amplifying apparatus consisting of an amplifier 41 power thereof being supplied from a power source 40 and of a speaker 42 or the like, as shown in the block diagram in FIG. 3, and when a position on the portamento playing portion consisting

of the conductive body and the resistance element is depressed by, for instance, a finger and the position depressed is shifted along the extended direction of the playing portion, a desired performance of portamento can be obtained.

Of course, it would be more advantageous if a frequency divider circuit, tone color circuit, and various effect circuits be disposed between the circuits besides of the above described amplifying apparatus.

In another aspect of the present invention, the portamento playing portion may also be constructed in the form of a variable voltage generating device which generates a d.c. voltage corresponding to the depressed position along the length of the portion when a part of the playing portion is depressed, and generates no voltage when the playing portion is not depressed.

Accordingly, the portamento device may be constructed from; the playing portion in the form of a variable voltage generating device; a continuous variable frequency oscillator connected with the playing portion and generates a signal of a frequency corresponding to the d.c. voltage generated from the variable voltage generating device when the voltage is applied to the oscillator, and the oscillation is not started when no voltage is applied to the oscillator; and an amplifying apparatus which amplifies the output signal from the variable frequency oscillator and converts it to a sound; whereby a portamento performance can be attained by depressing and shifting the depressed position on the playing portion along the length thereof.

In this case, there is employed a portamento playing portion 51 (the actual construction is not shown) having no lead-out taps as in the case of the playing portion 50 shown in FIG. 1, and the portion 51 is connected to an astable multivibrator wherein transistors are employed as shown in FIG. 4, so that the voltage generated from the playing portion 51 is applied to the base of the multi-vibrator transistors.

In FIG. 4, there are indicated a playing portion 51 of the portamento device, constructed in the form of a variable voltage generating device, comprising a resistance element 21 (corresponding to the resistance elements 2 in FIG. 1), a d.c. power source 43 connected across the ends of the resistance element 21, and a conductive body 31 (corresponding to the conductive body 3 in FIG. 1) which is connected to a base terminal  $V_B$  of the astable multi-vibrator 110 comprising transistors T1 and T2, resistors R1, R2, R3, and R4, and capacitors C1 and C2.

In the ordinary condition in which the conductive body 31 does not contact the resistance element 21, no voltage is applied to the base terminal  $V_B$  and the multi-vibrator will not be started to the oscillating state. However, if the conductive body 31 is depressed to contact with the resistance element 21, a voltage corresponding to the depressed position is applied to the base terminal  $V_B$  of the variable frequency multi-vibrator 110, and the multi-vibrator 110 will be started to oscillate at a frequency corresponding to the depressed position of the conductive body 31. Moreover, if the depressed position on the conductive body 31 is shifted in either of the directions along the length of the playing portion 51, the generated voltage from the portamento playing portion 51 can be varied continuously, and the oscillation frequency of the variable frequency multi-vibrator 110 can be continuously varied.

Because the output terminal 02 of the variable frequency oscillator consisting of the astable multivibrator 110 is connected to the amplifying apparatus shown in FIG. 3, a portamento sound can be generated from the speaker of the amplifier apparatus if the playing portion 51 consisting of the conductive body 31 and the resistance element 21 is depressed at a position and the depressed position is shifted along its length in either of the directions. Of course, it will be apparent that more advantageous results can be obtained if a frequency divider circuit, tone color circuit, and effect sounds circuits are provided besides of the amplifying apparatus.

As is apparent from the above description, since the oscillator starts its oscillation whenever the playing portion of the portamento device is depressed and the frequency of the oscillation is determined by the depressed position along the playing portion, the performance can be started or stopped without requiring other separate devices and the control of the oscillation frequency can be carried out by mere an operation of the playing portion.

Furthermore, when it is desired to play music of scale tones on the portamento device according to this invention, the playing portion of the device is intermittently depressed at positions corresponding to the note-keys on the keyboard.

With all of the above described advantageous features of the portamento playing device according to the present invention, it will be apparent that the function and effect and the ability of expression of the electronic musical instrument employing the portamento device can be remarkably improved in comparison with the conventional electronic musical instruments.

Referring to FIGS. 5 and 6, respectively showing a plan view and a side view of an example of the electronic musical instrument according to the present invention schematically, the portamento playing portion 50 is provided on the surface of a panel 54, wherein various operational levers 55 such as tone color control levers are provided, so that the playing portion is disposed in parallel with the keyboard 53 in the proximity of the latter. Furthermore, the portamento playing portion 50 are positioned on the surface of the panel 54 in such a manner that any depressed position along the playing portion 50 for rendering a desired pitch tone corresponds to the location of a key on the keyboard so that the note name of the tone produced from the portamento device by depressing said position is equal to the note name (in the same or different octave) of the tone to be rendered by depressing a position-corresponding key on the keyboard.

It is also found out that the performance of the portamento and the ordinary performance on the keyboard can both be carried out most conveniently when the surface of the panel 54, namely the surface of the portamento playing portion 50, is inclined to the surface of the keyboard 53 by an angle in a range of from 10° to 30° or more preferably about 15°, as is best seen from FIG. 6.

In the electronic musical instrument according to the present invention, since the portamento device is so constructed that the oscillator starts to oscillate each time when the playing portion thereof is depressed and the oscillation frequency is also determined by the position depressed along the playing portion, the performance can be started from any desired musical pitch

without requiring any other control device, and the control of the oscillator can be attained merely by operating the playing portion. Because the portamento playing portion is placed on the surface of the panel near the keyboard together with the various control levers such as tone color control levers, both of the portamento portion and the keyboard, or the portamento portion and the tone control levers can be handled by one hand, whereby another hand can be utilized to other required playing operations such as manipulation of other tone control levers or playing on other part of the keyboard. Thus it is apparent that the ability of expression of the musical instrument can be remarkably improved by putting the invention into practice.

Furthermore, the portamento playing portion and the keyboard are arranged in such a manner that the positions thereof for rendering the tones of the same note name are in good correspondence between each other, and, when these two are played in the substantially similar manner, a chorus effect can be obtained because of the beat sounds created by a slight difference in their frequencies. Likewise, when only the portamento playing portion is played, positions to be depressed along the playing portion for obtaining tones of the desired note names can be easily found from the keys on the keyboard, because the positions correspond each other in the note names.

With all of the advantageous feature of the present invention, it is apparent that the function and ability of an electronic musical instrument can be improved remarkably.

What is claimed is:

1. An electronic musical instrument comprising:

a musical scale keyboard including keys for musical performance; and

a continuously variable frequency oscillator; said continuously variable frequency oscillator including:

an amplifier having an input and an output;

a portamento playboard for controlling said oscillator over plurality of octaves;

said portamento playboard being arranged parallel and adjacent to said keyboard, said portamento playboard including a positionally actuatable variable impedance element mounted therein and extending therewith; said positionally actuatable variable impedance element having a first end and a second end; said positionally actuatable variable impedance element having a plurality of taps disposed at predetermined positions thereon;

a plurality of frequency responsive networks each connected to one of said plurality of taps to form a frequency determining network having first and second terminals; said first terminal connected to said input of said amplifier and said second terminal connected to said output of said amplifier thereby forming a feedback loop around said amplifier responsive to the position of said positionally actuatable variable impedance element actuated for providing a frequency responsive impedance value related thereto; said variable impedance element normally exhibiting an infinitely large impedance value to render said oscillator nonoperative and, when actuated, said frequency responsive impedance value representing the position actuated to render said oscillator operative to oscillate a fre-

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quency determined by said frequency determining network; and  
said portamento playboard being located with respect to said keyboard to provide frequencies from said oscillator when actuated at particular positions corresponding to notes or keys on said keyboard adjacent to said particular position.

2. The electronic musical instrument as defined in claim 1 in which each of said frequency responsive networks are characterized by a nominal operating frequency and said nominal operating frequency of each of said frequency responsive networks is different.

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3. The electronic musical instrument as defined in claim 2 in which said nominal operating frequencies of said frequency responsive networks are separated each from the other by octave relationships.

4. The electronic musical instrument as defined in claim 3 in which said continuous variable frequency oscillator is a Wein Bridge Oscillator.

5. The electronic musical instrument as defined in claim 4 in which said frequency responsive networks are resistor capacitor networks.

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