

United States Patent

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[72] Inventor Norio Tomisawa
Hamamatsu-shi, Japan
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[73] Assignee Nippon Gakki Seizo Kabushiki Kaisha
Shizuoka-ken, Japan
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Primary Examiner—Milton O. Hirshfield
Assistant Examiner—R. Skudy
Attorney—Irving M. Weiner

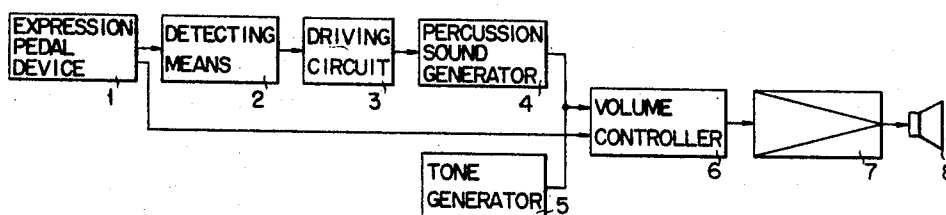
[54] ELECTRONIC MUSICAL INSTRUMENT WITH A PERCUSSION SOUND PRODUCING DEVICE 8 Claims, 6 Drawing Figs.

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[51] Int. Cl. G10k 1/02
[50] Field of Search 84/1.24,
1.26, 1.27, 1.13

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ABSTRACT: An electronic musical instrument includes an expression pedal device for controlling the tone volume of the musical tone signal. The device further operably cooperates with a detector for detecting the operation of the expression pedal and generating an electric signal. A driving pulse generator which generates a driving pulse upon receipt of the output electric signal from the detector; and a percussion sound generator which generates percussion sound signals in response to the driving pulse. Percussion sounds are produced according to the operation of the expression pedal.



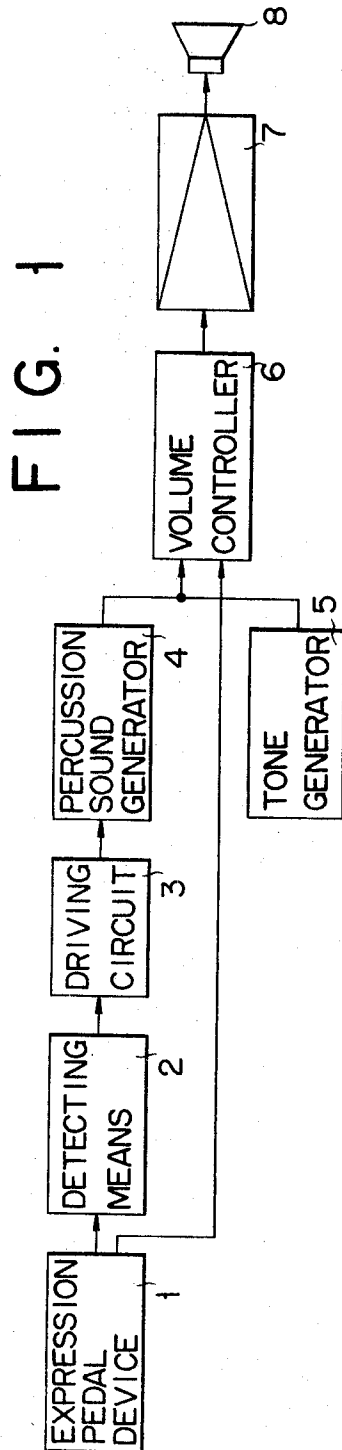


FIG. 2A

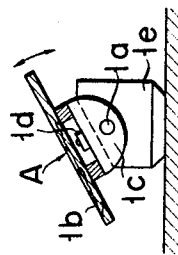


FIG. 4A

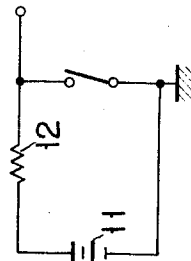


FIG. 2B

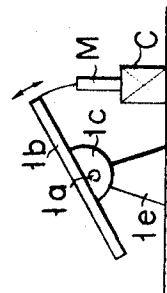
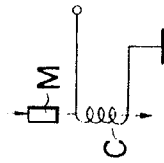
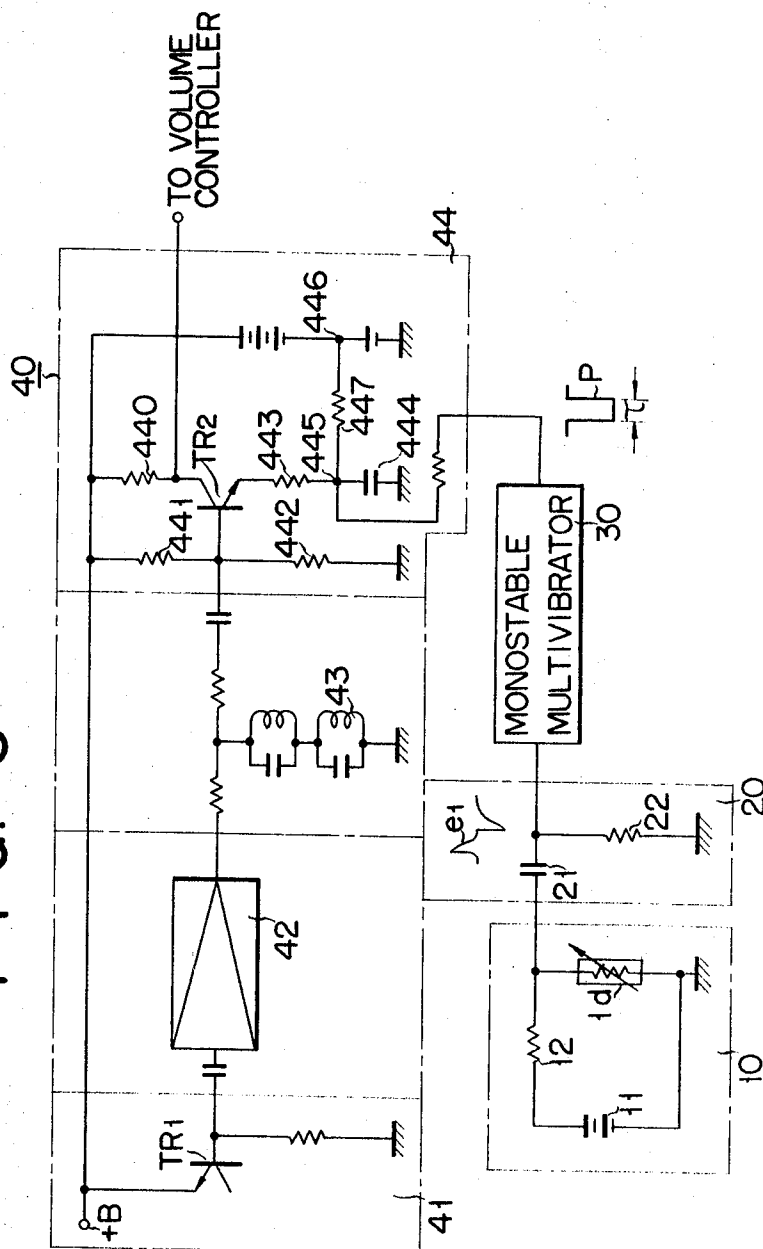


FIG. 4B



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ELECTRONIC MUSICAL INSTRUMENT WITH A PERCUSSION SOUND PRODUCING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to an electronic musical instrument with a percussion sound producing device and more particularly to such device characterized by producing percussion sounds such as of drums, cymbals, etc. in accordance with the operation of the expression pedal device.

Typical of the electronic musical instrument with a percussion sound producing device heretofore put to practical use is one in which percussion sounds are generated in accordance with the control of manual or pedal keyboards for playing normal musical scale tones.

However, with a percussion sound generator of the aforesaid arrangement, there are generated said percussion sounds along with the musical sounds given forth by selective playing of manual or pedal keys, so that it is impossible to produce at will any percussion sound independently. In the performance of a melody, therefore, it is necessary to turn off a percussion sound generator and it is extremely difficult to carry out such turnoff operation while music is being played. Accordingly, the aforementioned type of a percussion sound generator is not deemed to have a desirable arrangement for practical use.

Another type of the prior art percussion sound producing device musical instrument comprises independent manual buttons provided beside the manual keyboard to generate percussion sound by its operation. Unlike the former type, this device can indeed produce percussion sounds alone at will, but has the drawback that while the percussion button is operated the manual keys for musical scale tones cannot be played. Alternate operation of both manual keys for normal tones and buttons for percussion sounds is troublesome and requires a high degree of playing technique. Consequently, the latter type has the disadvantage like the former that it does not have a suitable arrangement for practical application.

SUMMARY OF THE INVENTION

Accordingly the object of the present invention is to eliminate the aforementioned shortcomings encountered with the prior art device and provide a novel electronic musical instrument with a percussion sound producing device which allows said sounds to be produced in accordance with the operation of an expression pedal device which is usually provided to control the sound volume of an organ, thereby giving forth percussion sounds independently or jointly with the playing of musical scale tones on the keyboards.

BRIEF EXPLANATION OF THE DRAWINGS

FIG. 1 is a schematic block diagram of an electronic musical instrument with a percussion sound producing device according to an embodiment of the present invention;

FIGS. 2A and 2B respectively present different arrangements of the main part of the expression pedal device of FIG. 1;

FIG. 3 shows the most preferable circuit arrangement of each section of the circuit network of FIG. 1; and

FIGS. 4A and 4B respectively denote equivalent circuits of the main part of the expression pedal device of FIG. 1 according to different arrangements.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

There will now be described by reference to the appended drawings an electronic musical instrument with a percussion sound producing device according to an embodiment of the present invention.

FIG. 1 is a schematic block diagram showing the arrangement of the entire device. This device is so designed that the moment the footboard 1b of the expression pedal device 1 rotates to a prescribed position by being depressed with the

foot, a pressure-sensitive element 1d (or a switching element) consisting of, for example, a recently developed semiconductor pressure-sensitive element is depressed. When the pressure-sensitive element (or a switching element) 1d is thus forced down, there is closed an electrical circuit of the later-described arrangement and instantaneous changes in current or voltage at that moment are detected by detecting means. The expression pedal device includes, of course, the tone volume control portion as in the conventional expression control.

Signals detected by the detecting means 2 are supplied to a driving circuit 3 having the later-described arrangement. This circuit 3 is previously so set as to be energized only for a specified length of time. A percussion sound generator having the later-described arrangement 4 is actuated only during the operation of the driving circuit 3. A signal from the percussion sound generator representing a desired percussion sound travels through a volume controller 6 (the main role of the expression device) and amplifier 7 in turn to be finally reproduced from a speaker 8 as a sound. Numeral 5 of FIG. 1 designates a tone generator for allowing tone signals having desired tone pitches and tone colors to be generated by selective playing of a plurality of juxtaposed manual and pedal keys (not shown). Like the aforesaid signal of the percussion sound, the tone signals issued from the tone generator 5 pass through the volume controller 6 and amplifier 7 in turn to be reproduced from the speaker 8 as a sound.

It will be apparent that in this case, the volume of tones represented by the percussion sound signals given forth by the aforesaid generator 4 and the signals issued by the aforementioned tone generator 5 can be controlled through the volume controller 6 by changes in the rotated position of the footboard 1b of the expression pedal device 1 when it is depressed with the foot.

FIG. 2A presents an arrangement of the main part of the expression pedal device 1. The footboard 1b is supported by a pivot member 1a by the medium of a rotary support 1c in a manner to rotate at about the middle point in its lengthwise direction with respect to a fixed base 1e. At a suitable point on the bottom side of said footboard 1b is positioned the aforesaid pressure-sensitive element (or a switching element) in a manner to face said bottom side at close proximity. The moment the footboard 1b is depressed with the foot in the direction of the arrow A, and rotated around the pivot member 1a to a desired position, the pressure-sensitive element (or a switching element) is also forced down substantially to close an electrical circuit having the later-described arrangement, causing current or voltage to vary widely at the instant.

Fig. 2B illustrates another arrangement of the main part of the expression pedal device 1. As in FIG. 2A, the footboard 1b is supported by the pivot member 1a by the medium of a rotary support 1c in a manner to rotate at about the middle point in its lengthwise direction with respect to the fixed base 1e. To the upper rotating end of the footboard 1b is fitted a strip of permanent magnet M in a manner to suitably move vertically with the specified range of stroke through a coil C having a prescribed number of turns.

According to the expression pedal device 1 arranged as described above, the permanent magnet strip M moves through the coil C correspondingly to the varying rotated position of the footboard 1b when it is depressed with the foot, and there take place changes in the number of magnetic fluxes from the permanent magnet strip M which are cut by said coil C. As a result there is induced in the coil C an electromotive force proportionate to changes in the angular speed resulting from the rotation of the footboard 1b. If, therefore, the pedal device of FIG. 2B is so designed as to allow varying electromotive forces induced in the coil C to be detected by the detecting means 2 of FIG. 1, it can be used interchangeably with that of FIG. 2A.

FIG. 3 shows the most preferable concrete circuit arrangements for the respective sections of FIG. 1. Where the expres-

sion pedal device 1 is arranged as shown in FIG. 2A, the equivalent circuit 10 is prepared by connecting the aforesaid pressure-sensitive element (or a switching element) 1d (FIG. 3 presents a pressure-sensitive element) between both electrodes of an operating power source 11 through a serially connected current control resistor 12 which is provided, if necessary, when the footboard 1b is not depressed with the foot, the resistance of the pressure-sensitive element 1d has an infinite resistance value, so that the aforesaid equivalent circuit 10 receives little current and remains substantially open. However, the moment the footboard 1b is depressed with the foot and rotated to a prescribed position around the pivot member 1a thereby to force down the pressure-sensitive element 1d, there occurs a sharp decrease in the resistance value of said element 1d. At that moment, the equivalent circuit 10 is closed to receive widely varying currents from the operating power source 11. It will be readily appreciated from the foregoing description that substitution of the pressure-sensitive element 1d with an ordinary switching element having a bistable property with respect to both release and shortening as indicated by the equivalent circuit of FIG. 4A or another switching element involving an electromagnetically coupled mechanism of FIG. 2B as further illustrated by the equivalent circuit of FIG. 4B will result in substantially the same operating effect. Current variations occurring when the pressure-sensitive element 1d is forced down by the footboard 1b are detected most preferably by the aforementioned means 2 consisting of a differentiation circuit 20 using a condenser 21 and resistor 22 to form signals e_1 having a differentiated waveform as shown in FIG. 3. The signals e_1 differentiated by the differentiation circuit 20 and having said differentiated waveform is supplied to the aforementioned driving means preferably consisting of a monostable multivibrator 30. This vibrator 30 is, as is well known, so set as to give forth outputs only during a prescribed length of time. At the output terminal of said vibrator 30 is generated an output pulse P having a time width τ corresponding to the operating time thereof.

On the other hand, the percussion sound generator 4 comprises a white noise signal generator 41 for producing white noise signals by the breakdown property of a transistor TR₁ which is impressed with an inverse bias voltage, as illustrated, between the emitter and base terminals, an amplifier 42, provided, if required, suitably to amplify the white noise signals from said generator 41, a tone coloring filter 43 consisting of more than one LC resonators (FIG. 3 indicates two) to form desired percussion sounds such as those of drums or cymbals from the white noise signals obtained through the amplifier 42, and a switching circuit 44 having the undermentioned arrangement to turn on or off the percussion sound signals passing through the tone coloring filter 43 in interlocking relationship with the movement of the footboard 1b of the expression pedal device 1.

The switching circuit 44 consists of, for example, an NPN-type transistor TR₂ as shown, the base input terminal of which is connected to the juncture of two base bias resistors 441 and 442 serially connected between the +B source terminal and grounding point. The emitter terminal of said transistor TR₂ is grounded through serially connected resistor 443 and condenser 444, and the collector terminal thereof is connected to the +B source terminal through a load resistor 440, thus forming an emitter-grounded-type transistor circuit. The juncture of the resistor 443 and condenser 444 is used as a keying terminal 445 to turn on or off interlockingly with the rotation of said footboard 1b the percussion sounds having a desired tone color obtained from the white noise signal generator 41 through the tone coloring filter 43. To the keying terminal 445 is connected the output terminal of the monostable multivibrator 30, and there is further connected a resistor 447 across said keying terminal 445 and a suitable DC potential point 446 lying between the +B source potential point and grounding potential point. In the switching circuit 44 having the aforesaid arrangement, the emitter terminal of the transistor TR₂ is generally connected to the DC potential point

446 through the serially arranged resistors 443 and 447, as far as a direct current is concerned. When, under such condition, the pressure-sensitive element 1d is depressed by the rotation of the footboard 1b, the aforesaid monostable multivibrator 30 issues outputs only during the prescribed length of time, and there is conducted to the output terminal an output pulse P having a time width τ corresponding to said operating time. The output pulse P is impressed on the keying terminal 445 to short the condenser 444, so that the emitter terminal of the transistor TR₂ is grounded only through the resistor 443.

The percussion sound generator of the present invention is so designed that under the normal condition in which the emitter terminal of the transistor TR₂ is connected as described above to the DC potential point 446 through the serially arranged resistors 443 and 447, the transistor is brought to an open state, because the diode between the base and emitter thereof is supplied with an inverse bias voltage and that when the emitter terminal is grounded only through the resistor 443, the transistor is closed, because the diode between the base and emitter thereof is impressed with a forward bias voltage.

An electronic musical instrument arranged as described above according to the present invention allows percussion sounds to be given forth by the white noise signal generator 41 only when the pressure-sensitive element 1d is depressed by the rotation of the footboard 1b, so formed as to have a desired tone color by passing through the tone-coloring filter 43, led out through the switching circuit 44 and finally reproduced from the speaker 8 after passing through the volume controller 6 and amplifier 7 in turn. The percussion sound generator 4 in FIG. 1 or 40 in FIG. 3 is of other types as conventionally used.

Accordingly, the present invention permits percussion sounds to be produced interlockingly with the movement of the footboard of an expression pedal device independently of manual and pedal keys, thus eliminating the necessity of providing any separate mechanism. Further, the apparatus of the present invention is not only of so simple arrangement that it can be handled easily, but also produces percussion sounds independently or jointly with the playing of manual and pedal keys and additionally permits a performance only consisting of rhythms to be played. Accordingly, the invention has very advantageous practical effects.

What I claim is:

1. An electronic musical instrument comprising: means for generating musical tone signals, an expression pedal device for controlling the tone volume of said musical tone signals, detecting means associated with said expression pedal device for detecting the operation thereof and for generating an electric signal when said expression pedal device is operated, a driving pulse generator for generating a driving pulse upon receipt of said electric signal from said detecting means, and a percussion sound generator for generating percussion sound signals in response to said driving pulse.

2. An electronic musical instrument according to claim 1 the percussion sound generator consists of a white noise signal generator for producing white noise signals, a tone coloring filter for forming percussion sound signals having desired tone colors from the white noise signals generated by said white noise signal generator and a switching circuit for drawing out the percussion sound signals passing through the tone coloring filter.

3. An electronic musical instrument according to claim 1 wherein said detecting means comprises a pressure-sensitive switching element.

4. An electronic musical instrument according to claim 1 wherein said detecting means comprises an electromagnetically coupled system.

5. An electronic musical instrument according to claim 1 wherein said pulse generator includes a monostable multivibrator.

6. An electronic musical instrument comprising; means for generating musical tone signals; an expression pedal device for

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controlling the tone volume of said musical tone signals; detecting means associated with said expression pedal device for detecting the operation thereof and for generating an electric signal when said expression pedal device is operated; a driving pulse generator for generating a driving pulse upon receipt of said electric signal from said detecting means; and a percussion sound generator for generating percussion sound signals in response to said driving pulse, wherein said percussion sound generator includes a switching circuit consisting of a circuit associated with an emitter-grounded type transistor whose base is supplied with said percussion sound signals, and in said circuit there are connected at least two serially arranged resistors across the emitter terminal of said transistor and a suitable DC potential point lying between the operating source potential points, the contact of said two serially arranged resistors being used as a keying terminal for switching, and there is connected a condenser between the keying terminal and grounding point.

7. In an electronic musical instrument having a pedal controlled signal output element and having a white noise generating transistor electrically connected to a tone coloring filter, a switching device for operatively connecting the pedal controlled signal output element to the white noise generating

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transistor comprising an emitter grounded transistor, a direct current source, a pair of serially connected resistors connected across the emitter terminal of said transistor and a direct current potential point lying between operating source potential points, a keying terminal between said pair of resistors for switching, and a condenser connected between and to the keying terminal and grounding point of said transmitter.

8. In an electronic musical instrument;

a white noise generating transistor connected to a source of direct current and normally biased to a conductive state;

a switching transistor having a grounded emitter electrically connected in circuit to said white noise generating transistor and to the source of direct current; said switching transistor being biased to a nonconductive state;

a tone-coloring filter connected to and between said white noise generating transistor and said switching transistor to effect a desired percussion sound;

means operable to apply pulses to the bias of said switching transistor to render this latter conductive; and

a pedal-actuated switch operatively connected to and controlling said means.

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