March 3, 1970 KATSUTOSHI HOSHINO 3,499,094

MANUAL OR KNEE OPERABLE EFFECT SELECTOR SYSTEM IN ELECTRONIC MUSICAL INSTRUMENT

Filed April 11, 1967 3 Sheets-Sheet 1

FIG. 1

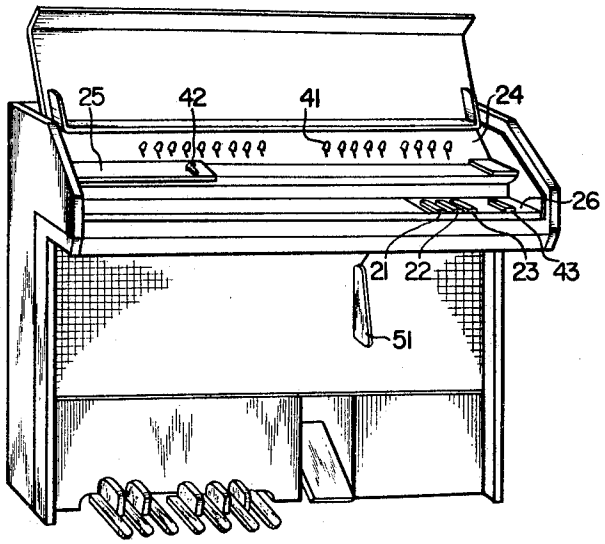


FIG. 2

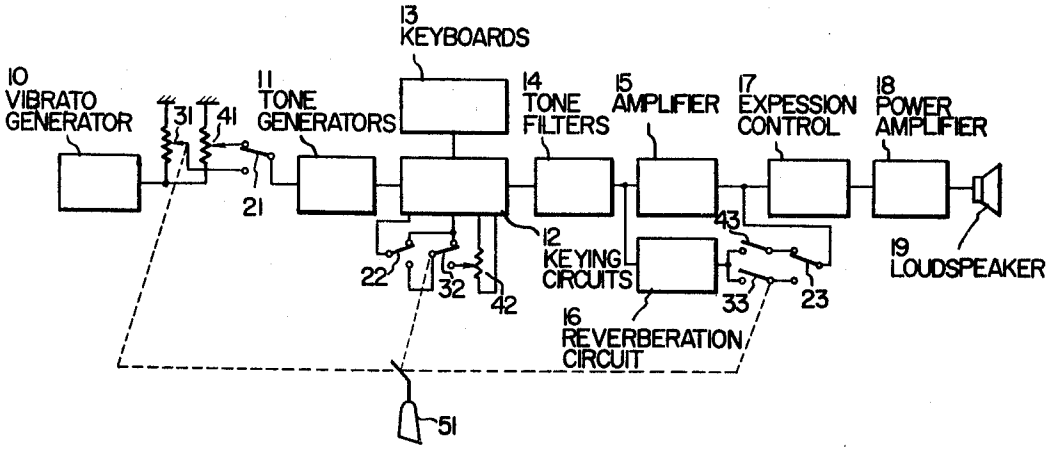


FIG. 3

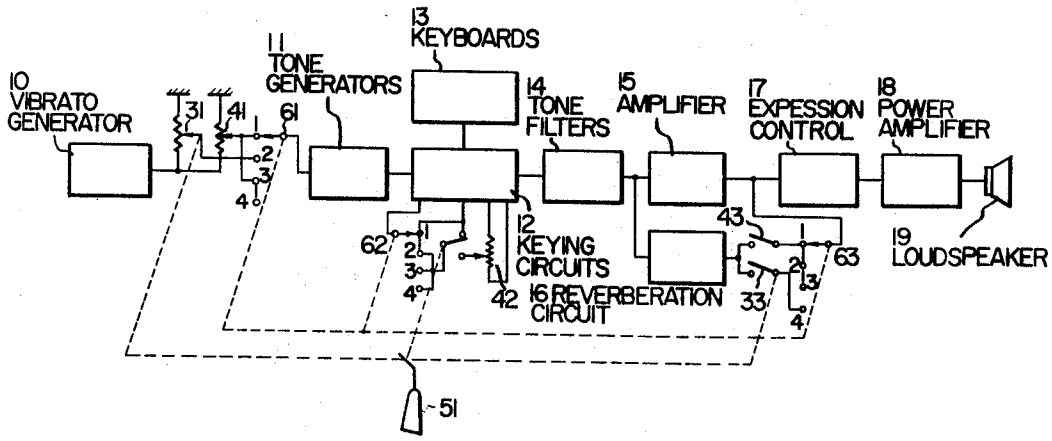

10 VIBRATO GENERATOR
31
41
61
11 TONE GENERATORS
13 KEYBOARDS
14 TONE FILTERS
15 AMPLIFIER
17 EXPESSION CONTROL
18 POWER AMPLIFIER
19 LOUDSPEAKER
12 KEYING CIRCUITS
16 REVERBERATION CIRCUIT
62
42
43
63
33
51

FIG. 4

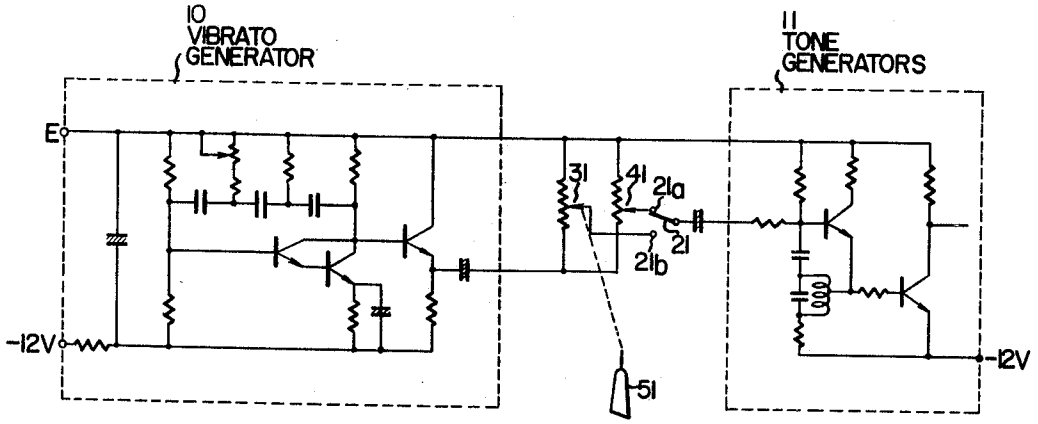

10 VIBRATO GENERATOR
11 TONE GENERATORS
E
-12V
31
41
21a
21
21b
51
-12V

FIG. 5

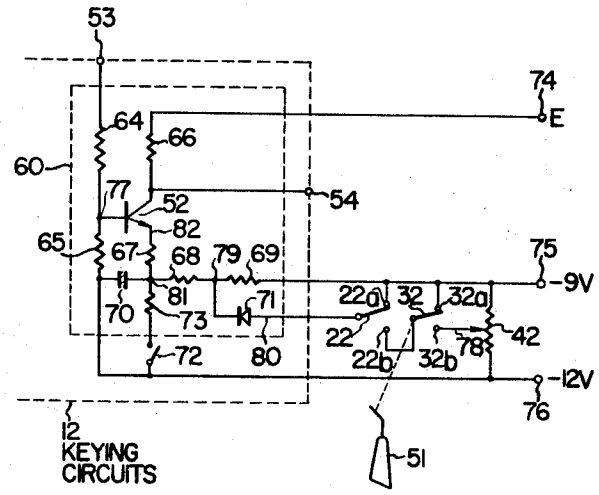
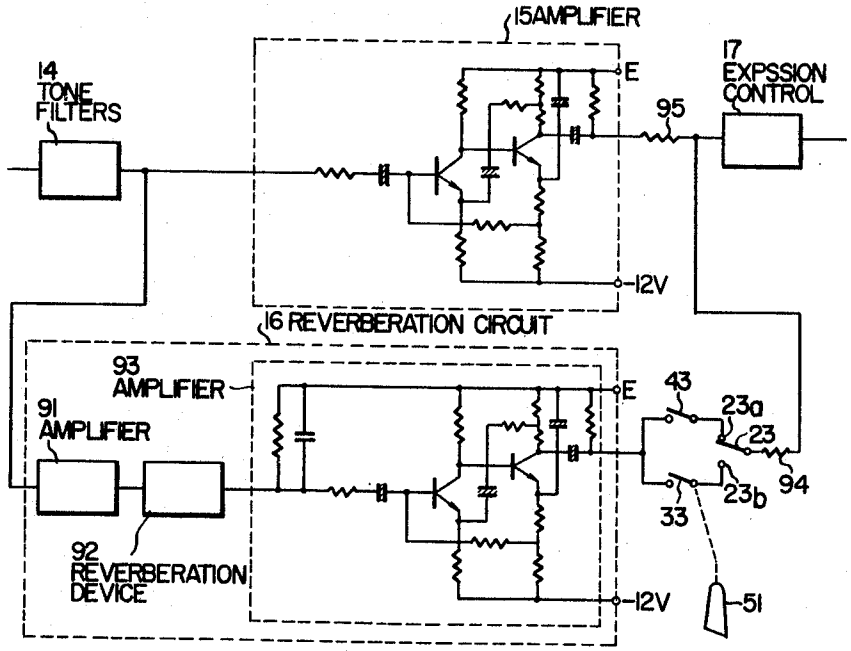

53
74
E
64
66
60
77
52
54
82
65
67
68
79
69
75
-9V
81
71
70
73
22a
32
32a
22
22b
32b
78
42
72
80
-12V
76
12
KEYING
CIRCUITS
51

FIG. 6


15AMPLIFIER
14
TONE
FILTERS
E
17
EXPSSION
CONTROL
95
-12V
16 REVERBERATION CIRCUIT
93
AMPLIFIER
E
43
23a
91
AMPLIFIER
23
94
23b
33
92
REVERBERATION
DEVICE
-12V
51

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MANUAL OR KNEE OPERABLE EFFECT SELECTOR SYSTEM IN ELECTRONIC MUSICAL INSTRUMENT

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Int. Cl. G10h *1/02, 1/04*
U.S. Cl. 84—1.25 5 Claims

ABSTRACT OF THE DISCLOSURE

An electronic musical instrument includes several effect circuits for generating respective musical effects, knob-operated control devices for respectively rendering effect circuits operative when actuated, a knee-operated control device for rendering effect circuits operative when actuated, and selector switches associated with respective effect circuits and each selecting either a semi-permanent control of the effect circuit by the knob-operated device or a momentary control of the same by the knee-operated device.

This invention relates to improvements in musical effect selector systems in electronic musical instruments.

In general, electronic musical instruments have the desirable characteristic of being rich in musical effects in addition to being capable of rendering tone colors or voices of great variety. For this very reason, however, the parts of such an instrument which must be manipulatively operated by the player are numerous, whereby the player is constantly under the pressure of intense activity.

Particularly in the case of an electronic organ, since there are ordinarily two manual keyboards and a pedal keyboard, both hands and both feet are used to play the instrument, the manual keyboards being played with the two hands, the pedal keyboard being played with left foot, and the right foot being used to operate an expression control. In addition, many musical effects as, for example, a vibrato effect, tremolo effect, sustain effect, and reverberation effect, are required, and these effects are generally controlled by respective switches mounted on a panel together with tone color stops.

The mounting of these switches on the panel, however, necessitates the removal of a hand from its keyboard each time a control switch is to be manipulated. Consequently, the player must wait for an opportunity, such as a rest or break in the succession of the music being played, which will permit him to remove a hand from the keyboard before he can manipulate a control switch, whereby the rendition of the music is subject to a restriction.

In some types of electronic musical instruments, there are provided control devices to be operated by the right knee for rendering the sustain effect, which among the various effects can normally be expected to be needed with the greatest frequency during musical renditions. More specifically, each of these control devices which are commonly called knee levers is pressed toward the right with the right knee to switch on the sustain effect, and when the right knee is returned to the left, the lever also

returns, and the sustain effect becomes off. In each of these types of instruments, however, the control switches for the remaining effects are also mounted on a panel and cannot be manipulated as desired at any time during a musical rendition.

As examples, of similar devices, there are control devices operated with right knee for swell control (volume control) in reed organs, but these devices are provided at the knee position for reasons of expediency and do not solve the problem of busy activity required of the player.

Thus, although electronic musical instruments known heretofore have been provided with means for generating an abundant variety of musical effects, these effects could not be fully rendered because their means could not be operated at will at any time during a musical rendition.

It is an object of the present invention to provide, in an electronic musical instrument, an effect selector system whereby any of the musical effects can be put into operation at any time and only at desired time during the playing of the instrument thereby to render and utilize fully these effects.

Another object of the invention is to provide an effect selector system of the above stated character which is of simple composition and arrangement and of simple operation.

According to the present invention, briefly summarized, there is provided a musical effect selector system in an electronic musical instrument, the system being a combination of a plurality of effect circuits for generating respective musical effects, knob-operated devices including first control elements in respective effect circuits for controlling their respective musical effects, a single knee-operated device including second control elements in respective effect circuits for controlling their respective musical effects, and a plurality of change-over switches associated with respective effect circuits and with the first and the second control elements for selecting which of the two control elements to be coupled to respective effect circuits, whereby any of the musical effects can be momentarily controlled by the knee-operated device and any other by semi-permanently controlled by the knob-operated devices respectively.

The nature, principle, and details of the invention, as well as the utility thereof, will be more clearly apparent from the following detailed description with respect to preferred embodiments of the invention when read in conjunction with the accompanying drawings, in which like parts are designated by like reference numerals.

In the drawings:

FIG. 1 is a perspective view showing the front of an example of an electronic musical instrument in which an embodiment of the invention is applied and showing an example of positional arrangement of a knee lever and switch actuating devices;

FIG. 2 is a block diagram indicating one example of the composition and arrangement of an electronic musical instrument incorporating an effect selector system embodying the invention;

FIG. 3 is a block diagram, similar to FIG. 2, showing another example of an effect selector system embodying the invention;

FIG. 4 is a circuit diagram showing one example of composition and arrangement of a vibrato control sec-

tion suitable for use in the systems illustrated in FIGS. 2 and 3;

FIG. 5 is a circuit diagram showing one example of a sustain control section suitable for use in the systems of FIGS. 2 and 3; and

FIG. 6 is a circuit diagram showing an example of a reverberation control section with related circuits suitable for use in the systems of FIGS. 2 and 3.

Referring first to FIG. 2, there is diagrammatically illustrated an electronic musical instrument having three musical effect sections, namely, vibrato, sustain, and reverberation sections, and incorporating an effect selector system according to the invention. These three effect sections may be operated by a knee lever **51** positioned to be moved left or right with the right knee of the player and intercoupled to a variable resistor **31** in the vibrato section, a switch **32** in the sustain section, and a switch **33** in the reverberation section.

Alternatively, these effect sections are operated by manual manipulation of knobs on a control panel in the ordinary manner. A variable resistor **41** and a switch **43** are provided respectively in the vibrato and reverberation sections for controlling their respective musical effects when these sections are to be operated by means of the knobs instead of the knee lever **51**. A variable resistor **42** is provided in the sustain section for controlling the decay time of the sustain effect when the knee lever is to be used. Selector switches **21**, **22**, and **23** are respectively provided in the vibrato, sustain, and reverberation sections for switching over their respective musical effects from knob operation to knee lever operaton.

The knee lever **51** and the manipulable means such as keys and knobs for actuating the switches **21**, **22**, **23**, and **43** and variable resistors **41** and **42** are respectively mounted on panels **26** and **24** of an actual electronic musical instrument as illustrated by one example of dispositional arrangement in FIG. 1.

Referring again to FIG. 2, the electronic musical instrument, generally described, comprises: a vibrato generator **10** and tone generators **11** interconnected by the combination of the variable resistors **31** and **41** and change-over switch **21** to constitute the vibrato section; keying circuits **12** connected to keyboards **13** and to the combination of the switches **22** and variable resistor **42**; tone coloring filters **14**; an amplifier **15**; an expression control **17**; a power amplifier **18**; loudspeaker **19**; and a reverberation section consisting of a reverberation circuit **16** and a combination of change-over switches **23**, **33** and **43**. The switches **21**, **22**, and **23** are selector switches respectively for vibrato, sustain, and reverberation control.

The electronic musical instrument illustrated in FIG. 3 differs from that illustrated in FIG. 2 only in the use of ganged switches **61**, **62**, and **63** substituted for independently operated switches **21**, **22**, and **23** shown in FIG. 2. In all other respects the two instruments are the same, and same parts are designated by the same reference numerals in FIGS. 2 and 3.

The invention will now be described with respect to the embodiment thereof as illustrated in FIG. 2 and, for the sake of convenience, by considering the instrument in the three sections as illustrated in FIGS. 4, 5, and 6.

In the vibrato control section illustrated in FIG. 4, the vibrato generator **10** is a vibrato signal oscillator, and the tone generators **11** are tone source oscillators (of plural number but represented in FIG. 4 by a single circuit). As mentioned hereinbefore, the variable resistor **31** is coupled to the knee lever **51**. The variable resistor **41** is for controlling vibrato depth and is actuated by a manually operated control device mounted on the panel **24** shown in FIG. 1, and the selector switch **21**, which is operated by a control device mounted on the panel **26**, which selectively changes over control of vibrato depth between knob control by means of variable resistor **41** and knee control by means of knee lever **51**.

When the movable contact of the selector switch **21** is in contact with the stationary contact **21***a*, the signal from the vibrato signal oscillator **10** is suitably controlled by the knob-operated variable resistor **41** and is then applied to the bases of transistors in the tone source oscillators **11** of Hartley type to frequency modulate the tone source oscillation signal. In this case, the depth of vibrato effect cannot be varied by operating the knee lever **51** to move the movable element of the variable resistor **31**.

On the other hand, when the movable contact of the selector switch **21** is in contact with the contact **21***b*, the vibrato signal is controlled by the variable resistor **31** coupled to the knee lever **51** and is applied similarly as above to the bases of the transistors of the tone source oscillator circuits **11** to be frequency modulated. That is, even when the instrument is being played by the player using both hands and both feet, the vibrato depth can be controlled by operating the knee lever with the right knee.

In the sustain control section shown in FIG. 5, the circuit designated by reference numeral **60** is one representative circuit of the plurality of keying circuits **12** (FIG. 2 or 3) and includes an NPN transistor **52**. This circuit is further provided with a signal input terminal **53**, a signal output terminal **54**, resistors **64** and **65** for voltage dividing the input signal from the tone source oscillator **11** (FIG. 2 or 3) and applying the resulting signal to the base side **77** of the transistor **52**, a load resistor **66** for leading out the output, a stabilizing resistor **67**, a combination of resistors **68** and **69** and a capacitor **70** for determining the envelope decay time, a diode **71** to operate cooperatively with the aforementioned variable resistor **42** to control the decay time, a key switch **72** for controlling this keying circuit **60**, and a resistor **73** for limiting the current discharged by the capacitor **70** at the instant the key switch **72** is closed.

The aforementioned selector switch **22** is actuated by a manually operably control device mounted on the panel **26** of the instrument for selectively determining whether or not the on-off switching of the sustain effect is accomplished by means for the knee lever **51**. As mentioned before, the switch **32** is coupled to the knee lever **51**.

The above described circuit is provided with a ground terminal **74** and power source terminals **75** and **76** to which are applied potentials which are negative relative to the potential of the ground terminal **74**. The potential of the terminal **76** is negatively higher than that of the terminal **75**, and the potential of the terminal **75** is slightly positive relative to the maximum instantaneous (positive side peak) voltage of the base **77** of the transistor **52**.

With the key switch **72** in the closed state, the potential of the junction **79** between the resistors **68** and **69** is lower (more negative) than the potential of the anode side **80** of the diode **71** when any of the following three states exists:

(1) When the selector switch **22** is closed on the side of its contact **22***a*;

(2) When the selector switch **22** is closed on the side of its contact **22***b*, and the switch **32** is closed on the side of its contact **32***a*; and

(3) When the selector switch **22** is closed on the side of its contact **22***b*, the switch **32** is closed on the side of its contact **32***b*, and the movable element **78** of the variable resistor **42** is positioned on the side of the terminal **75**.

With the circuit in the above described state wherein the potential of the junction **79** is lower (more negative) than the potential of the anode side **80** of the diode **71**, voltage is applied in the forward direction to the diode **71**, which is thereby in the conductive state.

When, with the circuit in this state, the key switch **72** is opened, the potential of the capacitor **70** is abruptly raised (positively) for the most part through the forward direction resistance of the resistor **68** and diode **71**, and the charging of the capacitor **70** is then com-

pleted. Accordingly, the potential of junction **81** between capacitor **70** and resistor **68** changes from the potential of terminal **76** to that of terminal **75**. With the circuit in this state, the maximum instantaneous voltage of the base **77** of the transistor **52** becomes lower than the potential of the junction **81**, that is, lower than the potential of the emitter **82** of the transistor **52**, which is then in the cut-off or non-conducting state, and no signal appears at the output terminal **54**.

When the selector switch is closed on the side of its contact **22***b*, the switch **32** is closed on the side of its contact **32***b*, and the movable element **78** of the variable resistor **42** is placed on the side of terminal **76**, the potentials of the junction **79** and the movable element **78** become such that voltage is applied in the reverse direction to the diode **71** to bias non-conductive. The charge in the capacitor is gradually raised (positively) for the most part through resistors **66** and **67**, transistor **52**, and resistors **68** and **69**, whereby the signal at output terminal **54** gradually attenuates, the resistor **69** having substantially high resistance value such as, for example, 500 kiloohms.

When, in the case when the switches **22** and **23** are respectively on the sides of contacts **22***b* and **23***b*, and the movable element **78** of the variable resistor **42** is in the vicinity of the middle part of the resistor, the key switch **72** is opened (switched from ON to OFF), a voltage is applied in the forward direction to the diode **71** during the initial period. However, as the potential of the capacitor **70** is raised, the potential of the junction **79** is increased until it exceeds the potential of the anode side **80** of the diode **71**. From this instant the diode **71** is subjected to a voltage in the reverse direction to be substantially non-conducting. The total charging time of the capacitor **70** becomes intermediate between those mentioned above, and the decay time of the output signal also becomes intermediate.

Thus, it will be apparent from the operation as described above that, by placing the selector switch **22** on the side of contact **22***b* and presetting the movable element **78** of the variable resistor **42** so as to produce a suitable decay time before hand, a desired sustain effect can be obtained at any time by actuating the knee lever **51** with the right knee while the instrument is being played. When the selector switch **22** is placed on the side of contact **22***a*, the sustain effect is switched off irrespective of the operation of the switch **32** and variable resistor **42**.

In the reverberation control section as shown in FIG. 6, a reverberation device **92** such as of the coil spring type is driven by an amplifier **91** to produce its reverberated output signal which is amplified by an amplifier **93**. The aforementioned tone filters **14** are connected on their output side to the amplifier **15** and amplifier **91** to send tone signals thereto.

The selective change over to determine whether the ON-OFF operation of the reverberation effect is to be carried out with the knee lever **51** or with the manual switch **43** is accomplished by the selector switch **23**. When this switch is closed on the side of its contact **23***a*, the reverberation signal amplified by amplifier **93** is controlled by the ON-OFF operation of the manual switch **43** mounted on the panel **26**.

On the other hand, when the selector switch **23** is closed on the side of contact **23***b*, the reverberation signal is controlled by the ON-OFF operation of the switch **33** coupled to the knee lever **51** and is mixed by resistors **94** and **95** with the signal which has been amplified by the amplifier **15** and has not passed through the reverberation circuit, the resulting mixed signal being then introduced into the expression control **17**.

While the individual operations of the three musical effect sections have been described above, the simultaneous operation thereof also is possible. When two switches (for example, **21** and **22**) of the selector switches **21**, **22**, and **23** are simultaneously closed to the knee-operation sides, two effects (i.e., vibrato and sustain) are subjected to the momentary control by the knee lever, the rest effect (i.e., reverberation) being left subjected to the semi-permanent control by the knob and free from (not being interrupted by) the knee control.

Then, if the selector switches **21**, **22**, and **23** are replaced by ganged switches **61**, **62**, and **63** of successive changeover type such as rotary switches as indicated in FIG. 3, only one musical effect is controlled at one time by the knee lever **51**, the rest being controlled by the knobs in the panel. More specifically, when the ganged switches **61**, **62**, and **63** are at position **1**, the knee lever **51** is not related to any of the musical effects, and when these ganged switches are at positions **2**, **3**, and **4**, the knee lever **51** is made ready to control, respectively, only the vibrato effect, only the sustain effect, and only the reverberation effect.

As described above, the present invention provides, in an electronic musical instrument having means for respectively generating a plurality of musical effects, an effect selector system wherein the respective musical effects are controlled either by the knee lever or by the knob according to the selection of the player. When a musical effect is selected to be under the knee control, the effect can be rendered momentarily operative or non-operative at will at any time in the very midst of the music performance, even though both hands and both feet are occupied. In addition, when a musical effect is selected to be under the knob control in the panel, the effect is rendered semi-permanently operative or non-operative irrespective of the control of the knee lever for other effects. By selecting either of the two controlling ways, the various musical effects of the electronic musical instrument can be fully rendered and utilized.

While the present invention has been described with respect to embodiments thereof having means to generate three musical effects, it will be apparent to those skilled in the art that the present invention can be applied with equal facility and effectiveness to the selective control of any plural number of musical effects in electronic musical instruments.

It should be understood, therefore, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention as set forth in the appended claims.

What I claim is:

1. In an electronic musical instrument, a musical effect selector system comprising, in combination, a plurality of effect circuits for generating respective musical effects, knob-operated control devices for respectively rendering effect circuits operative when actuated, a single knee-operated device capable of controlling the effect circuits, and a plurality of switches for establishing and terminating the control relationship between the knee-operated device and each of the effect circuits thereby to select at least one musical effect to be controllably rendered by the operation of the knee-operated device, and selector switches associated with respective effect circuits and each selecting either a semi-permanent control of the effect by said knob-operated control devices or a momentary control of the same by said knee-operated device.

2. The musical effect selector system as claimed in claim **1** in which the switches are controllably operated by manipulable mechanical devices mounted on at least one panel of the electronic musical instrument.

3. The musical effect selector system as claimed in claim **1** in which the switches are of the changeover type associated with respective effect circuits and with said knob-operated control devices and said knee-operated device for selecting the respective type of con-

trol desired, whereby each musical effect can be rendered at one time by the knee-operated device.

4. The musical effect selector system as claimed in claim 1 in which the effect circuits include those for generating at least a vibrato effect, a sustain effect, and a reverberation effect.

5. The musical effect selector system as claimed in claim 3 in which the effect circuits include those for generating at least a vibrato effect, a sustain effect, and a reverberation effect.

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U.S. Cl. X.R.

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