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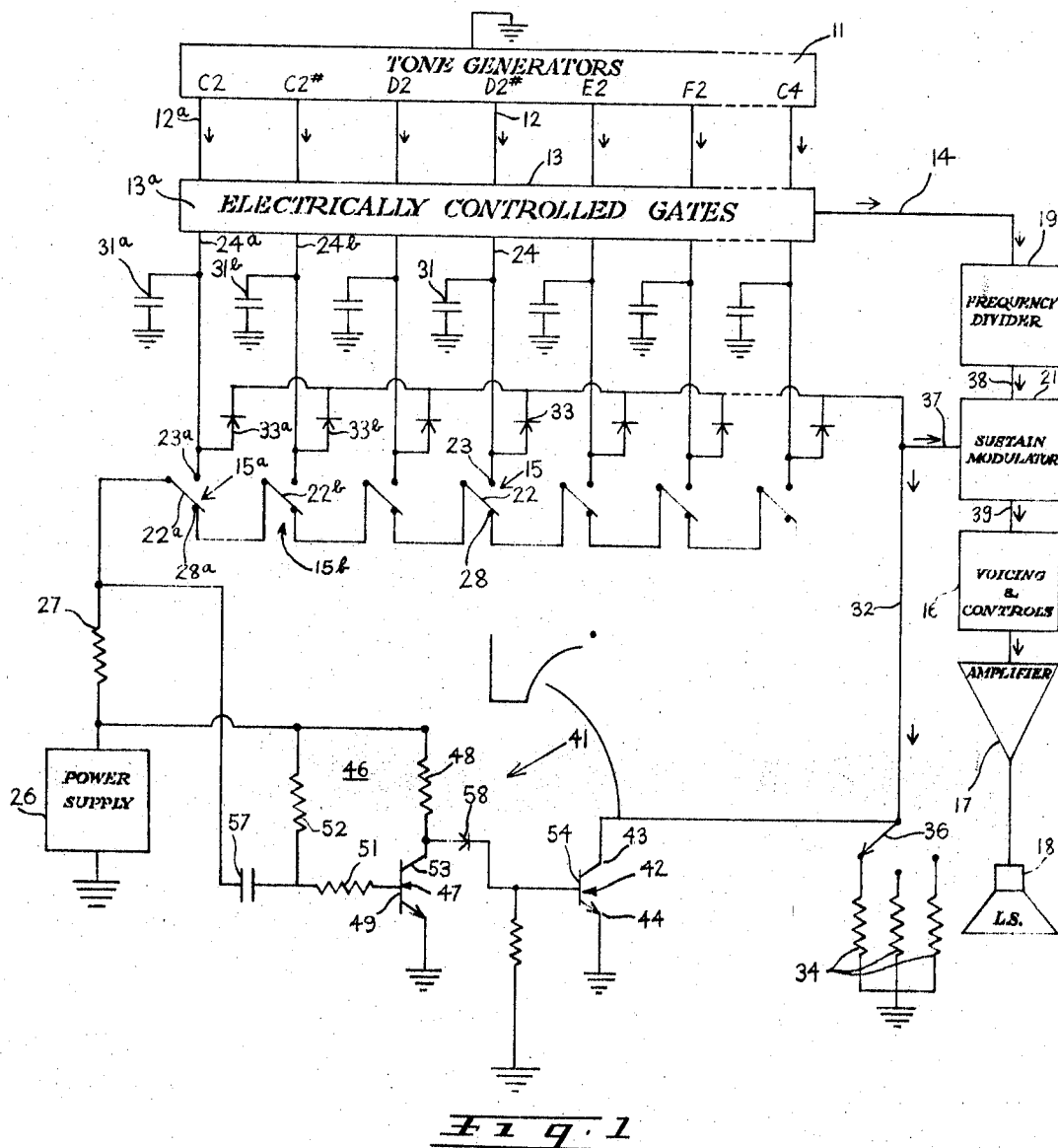
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3,446,904

KEY SYSTEM FOR ELECTRICAL MUSICAL INSTRUMENT

Filed Jan. 4, 1968

Sheet 1 of 2



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Sheet 2 of 2

Fig. 2

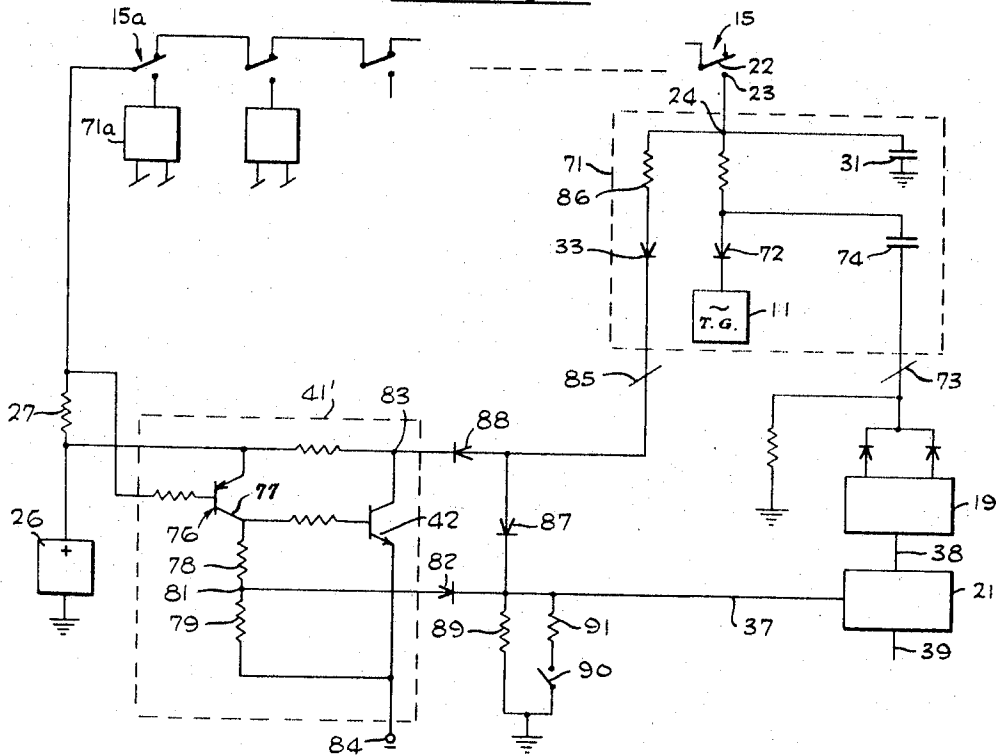
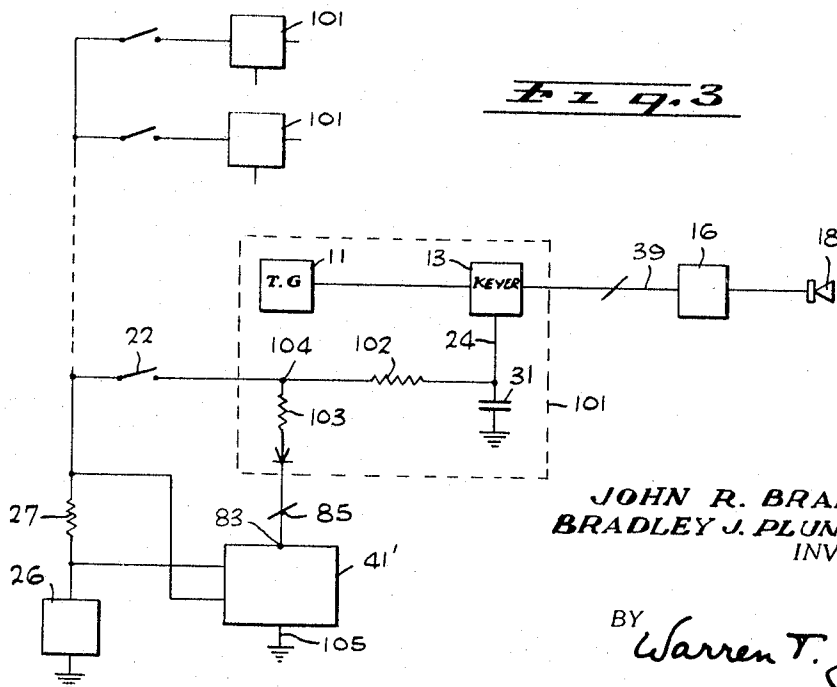


Fig. 3



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KEY SYSTEM FOR ELECTRICAL MUSICAL INSTRUMENT

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Continuation-in-part of application Ser. No. 378,117, June 26, 1964. This application Jan. 4, 1968, Ser. No. 701,032

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U.S. Cl. 84—1.13

10 Claims

ABSTRACT OF THE DISCLOSURE

Sustain circuits are provided in an electronic organ to permit the tone to persist after the organ key has been released. The tone decays gradually as a sustain capacitor discharges. If another note is played while the sustain condition of a previously played note (or notes) is in operation, means are provided to substantially instantaneously cut off all of the previously played sustain tones, so that only the last note played is sounded through the organ. This is particularly desirable in the case of a monophonic instrument using a frequency divider, where the application of two tone signals of different frequency to the single input of the frequency divider would cause a garbled sound (called a burble), because the frequency divider would not know which of the two frequencies to respond to.

This invention relates to a key system for an electrical musical instrument and particularly to a system involving a tone sustain means in which the tone continues with steadily decreasing amplitude after release of the particular key that has been played.

RELATED APPLICATIONS

This is a continuation-in-part of Ser. No. 378,117, filed June 26, 1964, now abandoned.

BACKGROUND OF THE INVENTION

The playing of a key on an electric organ may call for the simultaneous performance of a number of functions depending upon the complexity of the organ. Foremost, of course, the key must apply, in one way or another, the predetermined pitch or tone signal to the organ speaker. Additionally, ancillary functions, such as attack, sustain or decay, percussion, and the like, may be called for. The obvious and straightforward method of filling such ancillary functions is to add other poles to the switch, so that there are a series of ganged switches all operated simultaneously by the depression of the organ key. This solution, however, inherently aggravates one of the most vexing of the problems that plague the organ industry, namely, the malfunctioning of a switch contact. Switch contacts are one of the most vulnerable wear points in an electronic organ and the one that usually requires the most servicing.

So far, no practical way has been found to avoid the basic closing of one switch contact each time a note is played. If, however, each ancillary function must be accompanied by the addition of another contact, it represents the continual multiplication of potential trouble points.

Sustain circuits are known in the organ art. These circuits, usually involving sustain charge capacitors, serve to cause the note to hold on and decay slowly even after the organ key has been released.

It is further known to provide a cutting off or killing of all sustained notes if another note is sounded before the decay of the previous note (or notes) has run its

course. While such killing is desirable in polyphonic instruments, it is virtually essential in monophonic instruments which employ a frequency divider, because the presence of the input to the divider of tone signals of two different frequencies would give the divider an ambiguous input and produce an unmusical aberration which is called burble. Heretofore, such circuits to cut off or kill previously sustained tones have required the addition of another pole and switch contact to each of the key switches with the attendant disadvantages discussed hereinbefore.

SUMMARY OF THE INVENTION

The present invention provides for the premature termination or killing of all sustained tones by the playing of any subsequent note or tone, and without the necessity of adding additional switch contacts. In other words, the circuit of the present invention, in its several forms, is arranged so that the closing of one single-pole switch, which is already in the circuit, being required to initiate the sounding of the tone itself, also serves to abruptly terminate any sustaining or decay which may still be present from previously played and released keys.

It is an object of this invention to provide a tone sustain system in which a sustained tone will be instantly cut off when another tone is sounded before the first tone has fully decayed.

It is a further object of this invention to provide such a system in which storage or maintaining means are provided for keeping open tone passage gates after the release of a playing key corresponding to a given gate, and in which all such maintaining or storage means are instantly disabled and returned to non-storage or non-maintaining condition when another key is played.

It is a further object of this invention to provide such a system which involves only one single-pole switch for each note or key of the instrument.

It is another object of this invention to provide a system in which the attack and decay of tones are controlled in a predetermined manner upon the playing of each succeeding key of the instrument.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURES 1, 2 and 3 illustrate respectively three different forms of the present invention. FIGURES 1 and 2 relate to a monophonic instrument such as might employ a frequency divider. FIGURE 3 shows the incorporation of the present invention into a polyphonic instrument. All three forms are characterized by the employment of the already existing single-pole switch to effectuate the killing of the previously played sustain.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURE 1, 11 represents in block form a plurality of tone signal generators, each individually applying to its output terminal 12 an electric signal corresponding to a musical tone. Each output 12 is applied to an individual electric gate means, all such gates being shown collectively by the block 13. The gates 13 constitute pitch selective, or pitch means which determine the pitch of the tones sounded by the instrument. All gates have a common output 14 leading to an output system, which in the specific embodiment illustrated includes, for example, voicing and controls 16, an amplifier 17, and a loudspeaker 18. Additionally interposed between the tone signal generators 11 and the output system including the loudspeaker 18 are, in sequence, a frequency divider 19, and a tone sustain modulation or envelope means 21, both of which will be described more fully hereinafter.

Each of the gates 13 is part of a key means which also

includes a switch means in the form of a single-pole switch 15 having a normally open contact and position 23, connected to a control terminal 24 of the corresponding gate 13. The pole 22 of each switch 15 is actuated by a musical key (not shown), as for example the key of a piano or organ type keyboard instrument. When there is no voltage on the control terminal 24, the gate 13 is nonconducting so that tone signal cannot pass from the input 12 to the output 14. When a control signal, as for example in the form of a control voltage, is applied to the control terminal 24, the gate 13 is rendered conductive, and tone signal is enabled to pass from that particular input terminal 12 to the common output terminal 14.

Such a control voltage is applied from a direct current power supply or source 26 through a resistor 27 to the switch pole 22 and thence to the control terminal 24. The embodiment illustrated is a monophonic instrument, that is, one in which only one tone can be instituted at any given time. This is effected through a sequencing arrangement of the single-pole switches 15. Each switch 15 is of the double-throw type having a back, normally closed, contact and position 28. Each contact 28 is connected in sequence to the next succeeding switch pole 22. Thus, any given switch 15 can receive control voltage from the power supply 26 only through all preceding switch contacts 28. In the embodiment shown, the switches are sequenced in ascending tone so that the lowest tones are given preference. Thus, if several tones are played so as to simultaneously actuate several switches 15 from the normal, or quiescent, position 28 illustrated, to the played position 23, only the lowest of the tones so actuated will respond, since the other corresponding switches 15 will be open circuited from the power source 26.

Associated with each control terminal 24 of the gates 13 is a respective individual maintaining means in the form of an electric storage means, shown in the present illustration as a capacitor 31. One terminal of each capacitor 31 is grounded, while the other is connected to its respective terminal 24. Each of the control terminals 24 is connected to a common line 32 through a respective individual isolating diode 33. The line 32 is selectively connected to any one of a plurality of decay resistors 34 through a manually operable selector switch 36 and thence to ground.

When any of the key switches 15 is closed, i.e., the pole 22 moved to the upper position 23, power is supplied to the corresponding control terminal 24, causing the corresponding gate 13 to become conductive and pass that particular tone signal to the output terminal 14. Simultaneously, the corresponding capacitor 31 is charged, so that when the pole 22 is released and moves back to open circuit position 28, the charge on the capacitor 31 maintains the gate 13 in conductive condition for a predetermined time, depending on the RC constant of the capacitor 31 and the particular resistor 34 which is switched into the circuit, and on other incidental circuit loading.

The aforementioned envelope or modulation means 21 serves to shape the decay or sustain envelope of the tone as it decays following release of the switch pole 22. It consists essentially of a gate which passes signals to an extent determined by the control signal or voltage on its control terminal 37 which is connected to the common line 32. In order for a tone signal to pass from the input 38 to the output 39 of the modulator 21, the voltage on the control terminal 37 must be above a certain threshold value. Above that value, the amplitude of signal passed increases in proportion to the control voltage.

The frequency divider 19 serves to lower, by an integer fraction (such as one octave), the frequency applied to its input 14, which is also the common gate output. In the embodiment shown, the tone generators 11 deliver tone signals which are essentially square waves. The frequency divider 19 is essentially an on-off voltage

switching device which is turned fully on or fully off as it is triggered by, and divides, the input pulses from the output 14. Thus, the output wave at 38 from the frequency divider 19 is of substantially uniform amplitude irrespective of the input amplitude at 14, as long as the amplitude at 14 is sufficient to trigger the divider 19. Below such a value, there is no output at all from the frequency divider 19.

The significance of the above operation of the frequency divider 19 will be understood by recognizing that as the charge on a given capacitor 31 dissipates through a resistor 34, the input signal to the modulator 21 at 38 continues unabated and endures beyond the point where the control voltage at the terminal 37 drops below the cut-off point. Thus, as long as the modulator 21 is conditioned to pass any signal at all, the frequency divider 19 is delivering a full amplitude signal. As a result, the output amplitude of the tone at the terminal 39 is determined solely by the amplitude of the control signal or voltage at the control terminal 37.

With the circuit described thus far, there would be a possibility of producing two successive overlapping tones and this would cause undesirable sounds to emanate from the speaker. That is to say, while one tone was being sustained by virtue of retained voltage on its storage capacitor 31, another key switch 15 could be operated, thereby rendering conductive the gate 13 of another tone.

To preclude such undesirable sounds, there is provided a control-signal-dissipating or killer means which momentarily shorts all of the capacitors 31 and, by thus discharging them, frees or releases their maintaining action on their corresponding gates 13. This killer means is shown in general at 41 and includes a killer switch means in the form of a transistor 42 having its collector 43 connected to the common line 32 and its emitter 44 grounded. The transistor 42 is normally non-conducting, but open actuation of any of the key switches 15, it is momentarily rendered conductive to effectively ground momentarily the line 32 and thus dissipate any charge remaining on any of the storage capacitors 31.

This momentary grounding through the transistor 42 is effected through a circuit 46 triggered by a voltage change across the resistor 27, which is in the circuit between the power supply 26 and the several key switches 15. Operation of this killer means 41 will be described hereinafter in connection with a description of the overall operation of the circuit, which is as follows:

With the system energized, but none of the key switches 15 actuated, the transistor 47 is fully conducting, since it is supplied directly with power from the source 26 through the resistor 48 and its base 49 is forward or positively biased from the same source through the resistors 51 and 52. Full conduction of transistor 47 places its collector 53 substantially at ground potential and hence the base 54 of transistor 42 receives no forward bias, rendering transistor 42 non-conductive.

The musical key corresponding to the switch pole 22a is now depressed. This applies control voltage from the power supply 26 to the control terminal 24a of the gate 13a. Corresponding tone signal passes from the input 12a of the output 14, thence through the frequency divider 19 and to the input terminal 38 of the modulation means 21. The control voltage at terminal 24a is also applied through the common line 32 to the control terminal 37, causing the modulation means 21 to become fully conductive so that tone signals pass to the loudspeaker 18.

When switch pole 22a is released, the voltage on line 32 and at the control terminal 24a remains, by virtue of the charge stored in the capacitor 31a, but with steadily decreasing amplitude. The capacitor 31a discharges through the isolating diode 33a, line 32 and the selected one of the resistors 34. This decaying voltage gradually shuts down the conduction of the modulation means 21, thus creating a decaying modulation envelope on the tone signal passing therethrough. When the voltage on the

line 32 drops to a predetermined threshold value, all conduction in the modulator 21 is stopped. As noted, this occurs before any diminution in the square wave output of the frequency divider 19 has taken place.

The above example has presupposed that after release of the switch pole 22a, none of the other key switches 15 was actuated until after full decay of that particular tone had taken place. It will now be assumed that before the complete decay of the first-played tone, i.e., while it is still decaying, a second key switch 15b is actuated. Closing of switch 15b causes voltage to be applied to the control terminal 24b and initiates charging of the capacitor 31b. This charging current flowing into 31b through series-connected resistor 27 institutes a negative-going voltage on the left-hand terminal of capacitor 57, which passes to the base 49 of the transistor 47. This negative-going voltage begins to cut down conduction from the collector to emitter of the transistor 47. This action places a positive-going voltage, through diode 58, onto the base 54 of the transistor 42. This positive-going voltage institutes conduction of the transistor 42, which rapidly goes into saturation conduction, thus grounding the line 32 and consequently shorting all of the capacitors 31, and instantly dissipating any charge remaining therein.

The action described above is very rapidly regenerative. As the transistor 42 begins to go into conduction, increasing current is drawn through the series resistor 27, thus enhancing the negative-going wavefront on the left-hand terminal of the capacitor 57, and regeneratively accelerating the entire process.

When the transistor 42 reaches saturation condition, the current change through the resistor 27 ceases and the negative-going voltage on the left-hand terminal of capacitor 57 disappears. With the disappearance of the negative-going voltage, the capacitor 57 begins to discharge through the resistor 52 with a resultant positive-going voltage on the base 49. This positive-going voltage institutes conduction of the transistor 47, which reflects as a negative-going voltage on the base 54, tending to cut off conduction of the transistor 42.

The net result is that for a very brief moment, the transistor switch 42 is rendered conductive, to be rapidly followed by a resumption of its non-conductive condition. As a result, the line 32 is momentarily grounded, sufficiently long to dissipate charge on any of the capacitors 31 which might still remain during the sustain or decay action of the previously played tone.

As the transistor 42 resumes its non-conductive condition, charging current flows into the capacitor 31b through the switch pole 22b and the voltage rapidly builds up on the control terminal 24b.

With the capacitor 31b fully charged, a full modulation control voltage is applied to the control terminal 37 and another decay or sustain envelope is instituted, whenever the musician releases switch pole 22b.

The time constant built into the killer means 41 is so short that the manual closing and release of a switch pole 22 takes many times as long as the killer pulse which momentarily grounds the conductor 32. As a result, the re-institution of a sustain pulse following complete dissipation of any previous sustain voltage on the capacitor 31 takes place even though the keys may be played in extreme staccato fashion.

Employment of the transistor 42 as an on-off switch is effected by biasing it either to saturation conduction, i.e., to a low impedance, or to cut-off, i.e., to a very high impedance. The intermediate range of bias produces intermediate impedance values. When appropriate time constants for the killer means 41 are selected, the transistor 42 may be caused to experience a measurable period of finite impedance varying from virtual short circuit to virtual open circuit. This may be employed where a slow attack of the sounded tone is desired, and is brought about by the gradual increase of impedance at 42 and consequent decrease in loading on the capacitors 31.

FIGURE 2 illustrates a second embodiment of the invention, also adapted to a monophonic instrument, which, unlike the species of FIGURE 1, does not terminate or kill off the sustain of the note being played. Like FIGURE 1, however, it has the important characteristic of requiring only one single-pole switch for each note of the keyboard. In FIGURE 2, circuit elements common to those of FIGURE 1 have been designated with the same reference numerals.

Each key switch 15 is associated with a respective corresponding keying circuit 71, the input 24 of which is connected to the normally open contact 23 of the key switch 15. Until bias from the positive supply source 26 is applied to point 24 via the key switches 15, the diode 72 effectively isolates the tone generator 11 from the tone signal output terminal represented by bus 73 leading to the frequency divider 19. The bus 73 is representative of common connections where a plurality of similar circuits, such as 71, join a circuit which serves all the notes of the organ, or a given portion of the organ, such as the divider 19.

When a switch 15 is actuated or closed, its diode 72 is biased into conduction, allowing tone signal from the tone generator 11 to pass via the output capacitor 74 to the bus 73. Simultaneously the sustain capacitor 31 charges, so that when the key switch 15 is opened, discharge of the capacitor 31 maintains application of tone signal from tone generator 11 to bus 73 until the charge on 31 has been dissipated to the point where the diode 72 returns to its non-conduction or blocking condition. As noted with FIGURE 1, this signal, even though diminishing, is sufficient to fully drive the divider 19. The ultimate envelope of the decaying tone signal is determined by the input on the terminal 37 of the sustain modulator 21. In the case of normal sustain, this input is derived from terminal 24 (capacitor 31) via elements 86, 33, 85 and 87.

Unlike the killer circuit 41 of FIGURE 1, the circuit 41' of FIGURE 2 is not transient, but instead serves to render the killer transistor 42 conductive at all times that any key switch 15 is in operated or closed position. Thus, as long as switch 15 is closed, the resulting current through the resistor 27 maintains a conduction bias on the emitter/base of transistor 76, permitting the positive bias from source 26 to appear on the collector 77 of the transistor 76. The bias on point 77 is divided roughly equally between resistors 78 and 79, and the resulting bias appearing at the point 81 is sufficient, via diode 82, to bias the control terminal 37 of the sustain modulator 21 to full conduction condition. This full-on condition continues as long as a switch 15 is closed.

The bias at 77 also renders transistor 42 conductive, thus in effect connecting the point 83 to a small negative bias at 84.

Any residual sustain charge on a capacitor 31 is thus quickly dissipated by discharging through resistor 86, diode 33, diode 88, point 83, and transistor 42. This in effect kills all the notes, but the note being played is not disabled even though it, too, is connected to the negative bias now existing at point 83. This is because, in the case of the note being played, there is continuous current flow from the source 26 through resistor 27, switch 15 of the note being played and to its keyer 71. Resistors 27 and 86 form a voltage divider which permits maintenance of a substantial voltage on capacitor 31. Even though the voltage on the capacitor may lower significantly, there is still enough present to maintain the diode 72 in conduction, so that tone signal continues to pass from tone generator 11 to the output bus 73. For example, resistors 27 and 86 may be made substantially equal, e.g., 470 ohms, so that if the source 26 is 15 volts there will still be about 7½ volts present at point 24 and the circuit design is such that this voltage maintains the diode 72 conductive.

It will be noted in the FIGURE 2 circuit that, unlike the circuit of FIGURE 1, the sustain modulator 21 is not killed off with the playing of each note, but instead

remains conductive at all times that any key switch 15 is in closed condition. As in FIGURE 1, the modulator 21 of FIGURE 2 continues to conduct in diminishing amplitude, even after the opening or release of all key switches 15 by virtue of the charge draining off the sustain capacitor 31 through the resistor 86, diode 33, diode 87 and thence to the control terminal 37. The discharge of capacitor 31 also proceeds through a relatively high-valued, grounded resistor 89. If no sustain is desired, resistor 89 is simply by-passed by the closing of a switch 90, which rapidly discharges the capacitor 31 through a relatively low-valued resistance 91.

The circuits of FIGURES 1 and 2 both involve essentially a monophonic instrument, and include the series-connected, double-throw, single-pole key switches 15 and the frequency divider 19. The present invention is also applicable to a polyphonic instrument as shown in FIGURE 3. In FIGURE 3 there is shown a plurality of generally similar keying circuits 101, each of which includes a tone generator 11, feeding a common output circuit 39 through a keyer 13. 16 represents common formant or voicing circuits, amplifiers, controls and the like. The ultimate output is fed through the speaker system 18.

Each circuit 101 is controlled or energized by a single-pole, single-throw key switch 22, the closing of which applies positive bias from the source 26 through resistor 27 and a resistor 102 to the control terminal 24 of the keyer 13. As in FIGURES 1 and 2, each control terminal 24 has an associated sustain capacitor 31, which quickly charges up and holds the keyer 13 in conducting condition, for a predetermined time after release of the key. In the case of FIGURE 3, the keyer 13 also serves as a sustain modulator, forming the decay envelope of the tone in accordance with the diminishing amplitude of the voltage on its terminal 24.

FIGURE 2 elements 88, 87, 89, 90 and 91 are eliminated in the FIGURE 3 form, as is line 37 and its diode 82.

Closing of the key switch 22 also renders the killer circuit 41' conductive, by virtue of the flow of current through resistor 27, in the same way as was described in connection with FIGURE 2. This places the bus 85 substantially at ground, shown at 105. The resistor 103 is substantially larger (e.g., may be 1000 ohms) than resistor 27, so that the division of voltage from source 26 still leaves a substantial bias on the point 104, which maintains sufficient charge on the capacitor 31 to render the keyer 13 fully conductive.

When all key switches 22 are in open condition, the killer circuit 41' is inoperative by virtue of absence of voltage drop across resistor 27. Thus, any charge on sustain capacitors 31 will discharge normally through keyer 13. Under this condition, if any note is played during the decay or sustain of previous notes, i.e., if another key switch 22 is closed, it will immediately actuate the killer circuit 41', quickly discharging all residual charge in previously charged sustain capacitors 31, while at the same time charging up the particular capacitor 31 associated with the switch 22 which has just been closed.

The presence of the 1000 ohm resistor 103 causes the discharge of the capacitors 31 through the killer transistor 42 to be somewhat longer than the corresponding discharge in FIGURES 1 and 2, but the difference in discharge time is not discernible to the ear. Furthermore, any slight delay in fully killing off the sustained note is not noticeable or objectionable, because FIGURE 3 relates to a polyphonic instrument and does not include the frequency divider 19 of FIGURES 1 and 2. When the frequency divider 19 is used, it is necessary to kill off all sustain capacitors very rapidly in order to preclude any danger of burble.

While the present invention has been shown and described herein in what is conceived to be the most practical and preferred embodiments, it is recognized that

departures may be made therefrom within the scope of the invention which is, therefore, not to be limited to the details disclosed herein, but is to be afforded the full scope of the invention as hereinafter claimed.

What is claimed is:

1. A musical instrument comprising:

a plurality of tone signal generators,
an output system,
a plurality of single-pole switches,
a corresponding plurality of musical keys for actuating said switches,

circuit means connected to, and responsive to actuation of, said switches for selectively applying corresponding tone signals to said output system,
maintaining means for maintaining application of said tone signals to said output system after de-actuation of the corresponding said switch,
electrical sensing means for sensing the flow of current through any of said switches, when such switch is actuated, and

disabling means responsive to said sensing means for disabling at least certain of said maintaining means.

2. Instrument in accordance with claim 1, wherein: said sensing means includes an impedance connected in series with said switch for sensing actuation thereof by sensing flow of current through said impedance.

3. Instrument in accordance with claim 2, wherein: said maintaining means comprises a plurality of capacitors corresponding respectively to said switches, and

said disabling means comprises means for connecting a discharge circuit to said capacitors.

4. Musical instrument in accordance with claim 3, wherein:

said disabling means is common to said capacitors and connects the same to a common discharge circuit.

5. Musical instrument in accordance with claim 4, including:

a sustain modulator in said output circuit, and
circuit means connecting said capacitors to said modulator for controlling passage of said tone signals through said output circuit.

6. A musical instrument comprising:

a plurality of tone signal generators,
an output system,
a plurality of single-pole switches,
a corresponding plurality of musical keys for actuating said switches,

circuit means connected to, and responsive to actuation of, said switches for selectively applying corresponding tone signals to said output system,

a plurality of capacitive means corresponding to said switches for maintaining application of said tone signals to said output system after de-actuation of the corresponding said switch, and

a single killer circuit means connected and common to said plurality of capacitive means for abruptly changing the charge on said capacitive means, thereby to disable the maintenance of application of tone signals from at least certain of said generators.

7. Instrument in accordance with claim 6, including: electrical sensing means for sensing the flow of current through any of said switches when said switch is actuated, for operating said killer circuit means in response to said sensing.

8. In a musical instrument having a plurality of tone generators, an output system, a tone decay envelope means interposed between the tone generators and the output system, and having a decay control terminal and a plurality of playing keys selectively operable to sound selected tones, the combination comprising:

a plurality of electric gates each having an input, output, and gate control terminal and effective to pass or block tone signals in accordance with the electrical condition of its control terminal,

means for connecting the outputs of said gates to said decay envelope means,
 a plurality of key switches operable by the respective playing keys,
 means for applying a control signal to a respective given gate control terminal in response to actuation of its corresponding key switch thereby to cause the gate to pass tone signal,
 storage means for continuing the control signal on said gate control terminal and on the decay control terminal, after release of the key and its respective key switch, and
 control signal dissipating means common to, and responsive to the actuation of, at least certain of said key switches for removing any continuing control signal applied to a control terminal, said dissipating means including sensing means for sensing flow of current resulting from actuation of said certain key switches and effecting operation of said dissipating means in response to said sensed current.

9. In an electrical musical instrument having a plurality of tone generators, a corresponding plurality of single-pole key switches and keys for operating same, an output system, and tone decay modulator means interposed between the tone generators and the output system for causing sustained passage of tone signals after release of a key, the combination comprising:
 a plurality of gating means each having input, output and control terminals,
 circuit means for applying the tone signals of each tone generator to the input of its respective gating means,
 circuit means for connecting the output of each of said gates to the input of said modulator means, said modulator means including a control terminal adapted to receive a control signal for controlling the passage of tone signals through said modulator means,
 storage capacity means connected to the respective control terminals of said gates,
 circuit means including unidirectional current means for connecting said capacity means to the control terminal of said modulator means,
 each of said switches being connected to the control terminal of a respective said gate,
 power means,
 circuit means for applying power to the control terminals of said gates in response to actuation of a key switch corresponding to a respective gate,
 means for sensing the initiation of charging current to a capacity means, and
 killer switch means responsive to said sensing means for removing charge from said capacity means.

10. In a monophonic instrument the combination of:

a plurality of tone signal generators,
 a corresponding plurality of gates having inputs connected respectively to the outputs of said generators, each of said gates having a control terminal, said gates having a common output,
 modulation means having an input connected to said common output of said gates and an output connected to output system of the musical instrument, said modulation means having a control terminal, the voltage on which determines the conductive condition of the modulation means,
 a plurality of single-pole switches each having a normally open contact connected to the control terminal of a respective gate,
 a plurality of storage capacitors connected respectively to the control terminals of respective gates,
 power means for supplying charging current to said storage capacitors, said power means being connected to the pole of a first of said single-pole switches in sequence,
 each of said switches except for the last in said sequence having a normally closed back contact, each back contact being connected to the switch pole of succeeding switch in sequence,
 diodes connected respectively to said control terminals of respective gates,
 the other terminals of said diodes each being connected to said control terminal of said modulation means,
 killer switch means connected to said control terminal of said modulation means, said killer switch means being normally non-conductive,
 current sensing means for sensing flow of current from said power supply means to said storage capacitors,
 differentiating means responsive to said current sensing means for applying a momentary pulse to momentarily render conductive said killer switch means thereby to discharge any residual charge on said storage capacitors, and
 impedance means connected to said control terminal of said modulation means for normally discharging said storage capacitors in accordance with an RC time constant to determine the decay time of the envelope applied by said modulation means to tone signals passing through said modulation means.

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