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Brand et al.

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[54] KEYER CIRCUIT FOR AN ELECTRONIC MUSICAL INSTRUMENT WHEREIN A SINGLE SWITCH MAY ACTUATE A SINGLE NOTE OR A CHORD

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[52] **U.S. Cl.** **84/1.01,** 84/DIG. 22

[51] **Int. Cl.** **G10h 1/00**

[58] **Field of Search** .....84/1.17, DIG. 22, DIG. 23, 84/1.01, 1.03, 1.24

[56] **References Cited**

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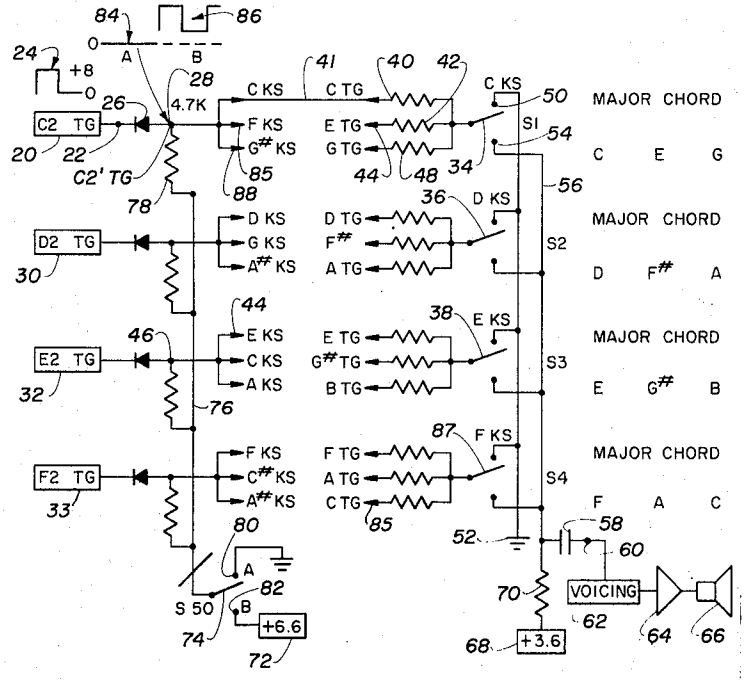
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Assistant Examiner—Stanley J. Witkowski
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[57] **ABSTRACT**

A chord circuit is provided in which, upon positioning of a tab switch, the actuation of a given key will cause the sounding of a predetermined chord. Such chord circuits may be provided for a number of different chords, so that depending upon the tab switch which is operated, the actuation of the C key, for example, may cause the sounding, selectively, of C major chord, C minor chord, C diminished chord, and so forth. In the present circuit this is done without requiring the ganging of switch poles, so that the same single-pole key switch which is conventionally used to sound a given tone, also sounds the various preselected chords.

5 Claims, 9 Drawing Figures



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4 Sheets-Sheet 1

FIG. 1.

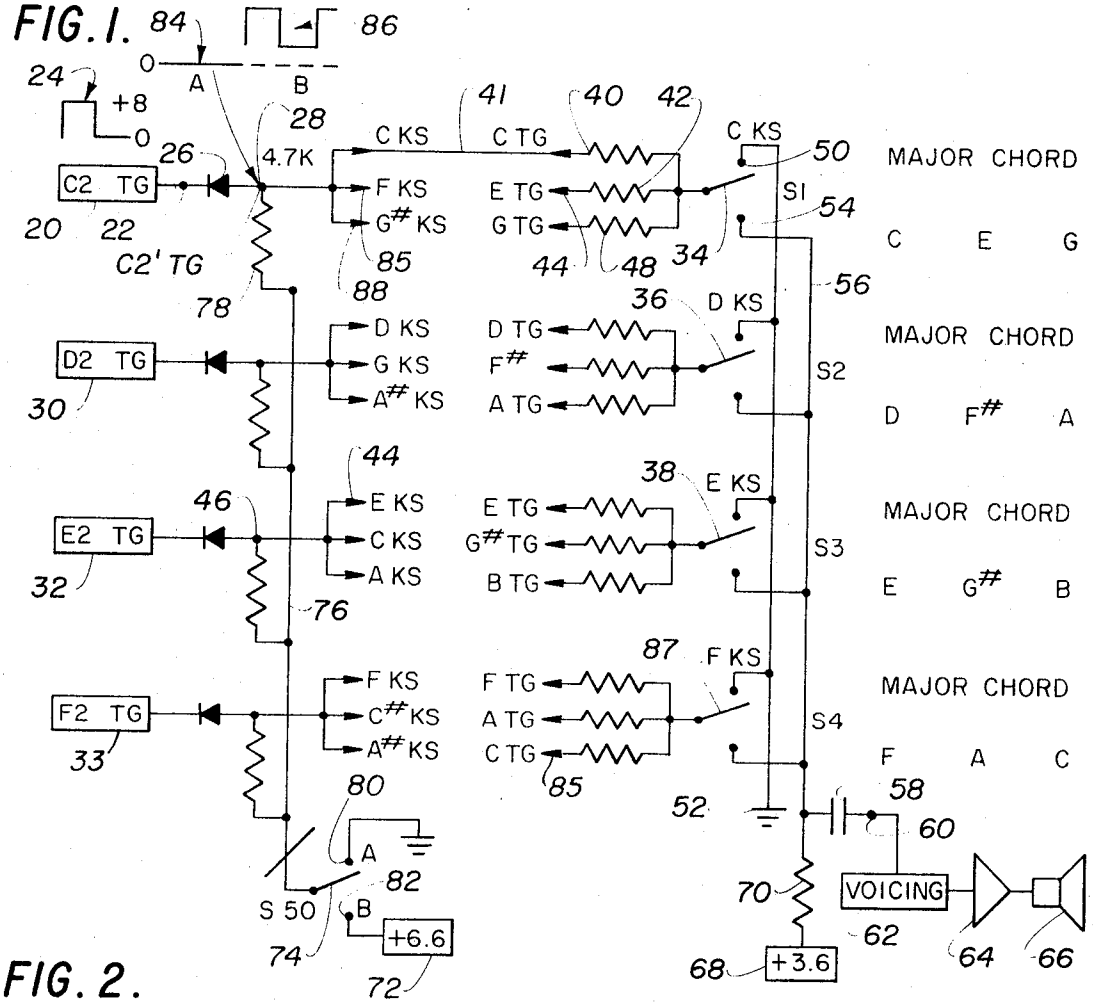
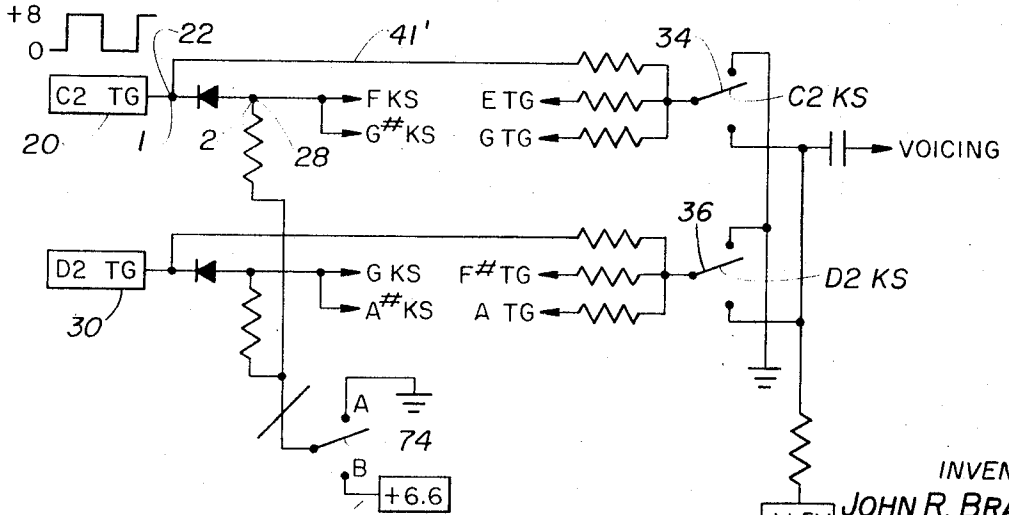
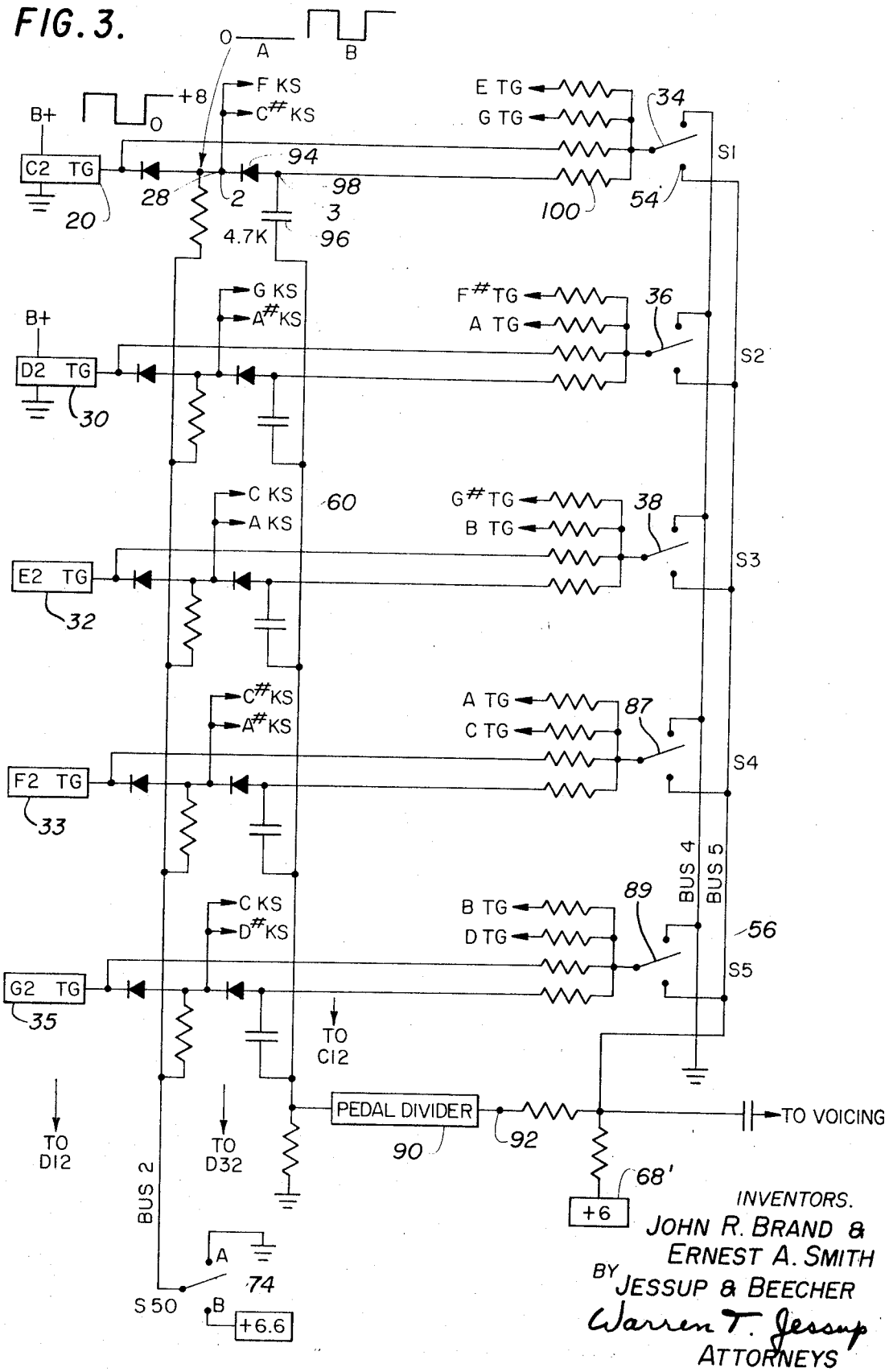


FIG. 2.



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FIG. 3.



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FIG. 4.

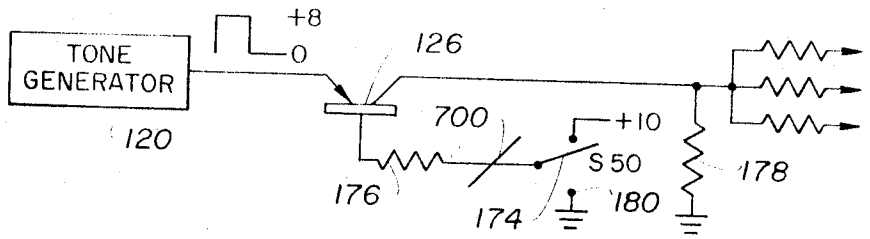


FIG. 5.

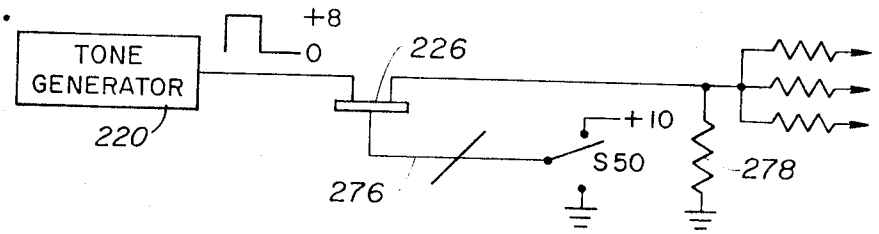


FIG. 6.

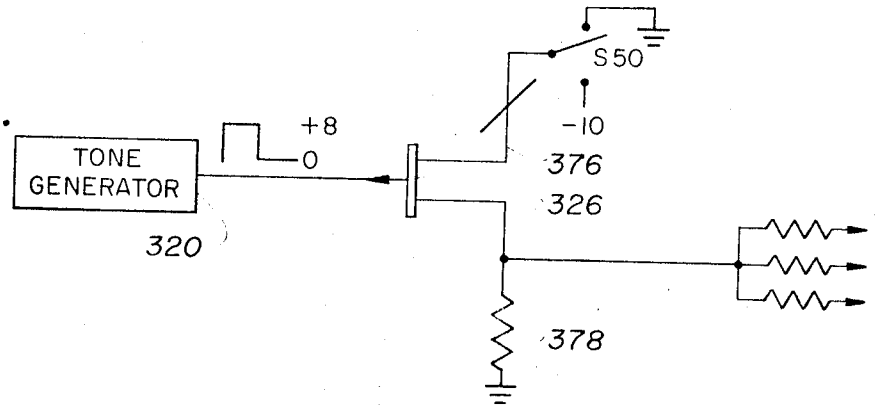
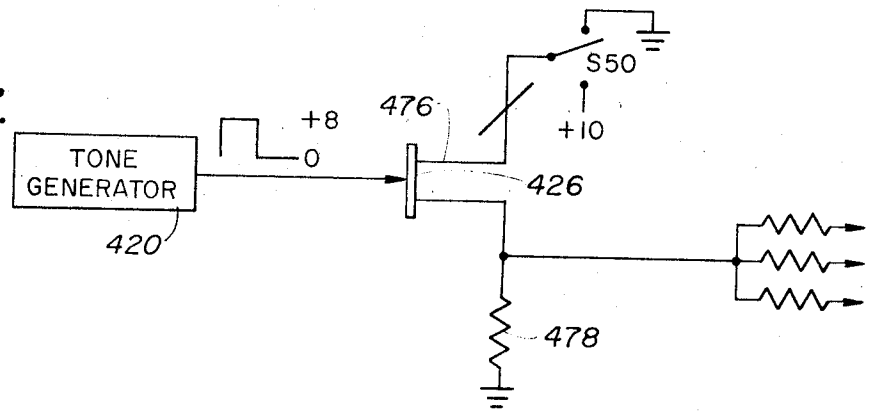


FIG. 7.



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FIG. 8.

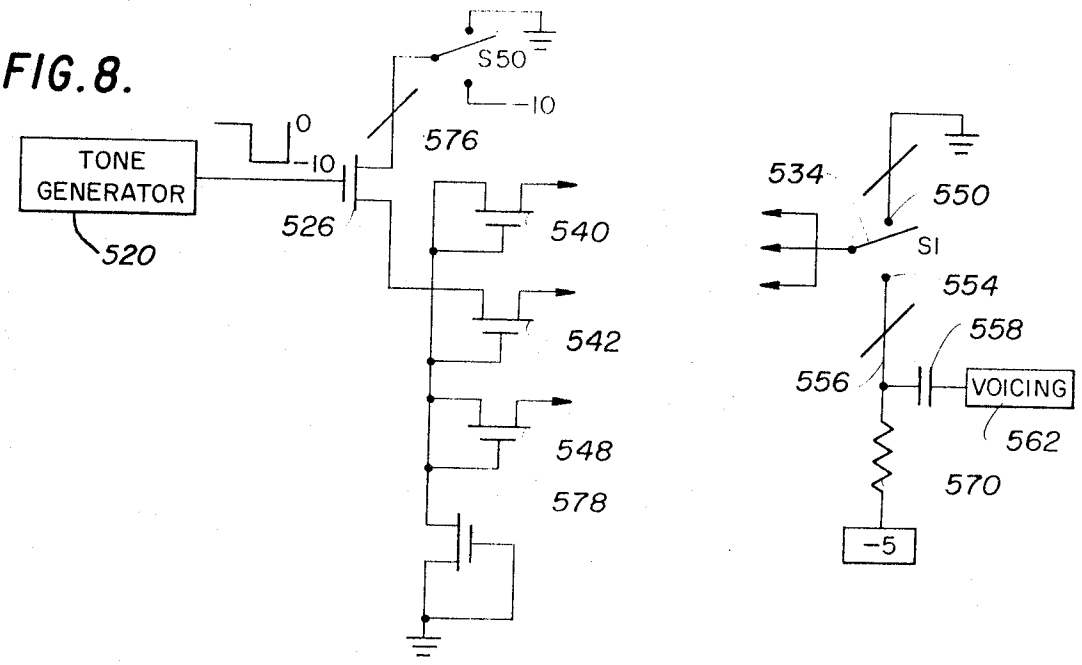
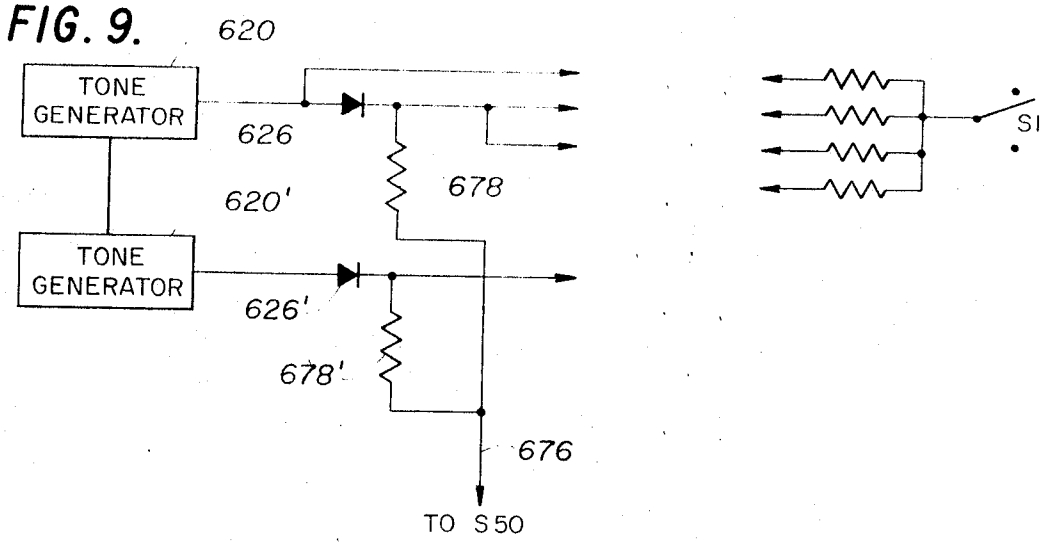


FIG. 9.



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KEYER CIRCUIT FOR AN ELECTRONIC MUSICAL INSTRUMENT WHEREIN A SINGLE SWITCH MAY ACTUATE A SINGLE NOTE OR A CHORD

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the circuit of the present invention in its basic form, wherein actuation of a given single-pole key switch may cause the sounding of a given chord, shown in this example as the major chord.

FIG. 2 shows a modification in which the preselected note is sounded, even though the chord tab switch is not actuated.

FIG. 3 shows a refinement in which the pedal tone corresponding to the actuated key switch is also sounded.

FIG. 4 is a fragmentary circuit diagram, showing the manner in which PNP transistors may be employed instead of diodes.

FIG. 5 corresponds to FIG. 4 employing instead P channel J field effect transistors instead of diodes.

FIG. 6 is similar to FIG. 4 employing P channel J field effect transistors with no loading on the tone generator.

FIG. 7 is similar to FIG. 4 employing N channel J field effect transistors instead of diodes.

FIG. 8 illustrates the employment of an MOS integrated circuit in place of both the diodes and the resistors.

FIG. 9 illustrates a modification in which integrated circuits are employed.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, **20** represents a tone signal generator at the output **22** of which appears a square wave, shown at **24**. In this example it will be assumed that the negative excursion is at zero volts (ground) and the positive excursion at plus 8 volts.

The tone signal **24** is coupled via a diode gate **26** to point **28**, which serves as the output terminal of the gate **26** and also its control terminal.

It is to be understood that the circuit includes tone generators for all desired tones. For example, tone generator **20** will be assumed to generate the C tone; tone generator **30** the D tone; tone generator **32** the E tone; tone generator **33** the F note; tone generator **35** (FIG. 3) the G note; and similar tone generators (not shown) generating the A, A0, B, C0, D0, F0, G, G0 notes, and so on.

Each tone generator has a corresponding key switch actuated customarily by the finger keys of an organ keyboard. Moreover, each of the tone generators supplies its tone to other key switches, as will be described, when its tone is included in the chord represented by the particular key switches. Each key switch consists of a single-pole, double-throw switch represented by the switch **34** for the note C. In similar fashion, the D tone generator **30** has a key switch **36**; the E tone generator **32** has a key switch **38** the F tone generator **33** has a key switch **87**; the G tone generator **35** has a key switch **89** (FIG. 3), and so on.

The key switch **34** is coupled to a number of different tone generators. In the example shown, these are the tone generators for the C major chord, namely C, E and G. Thus the switch **34** is coupled via resistor **40** and conductor **41** to the output terminal **28** of the C gate **26**. Switch **34**, and more specifically the pole of switch **34**, is also coupled via resistor **42** and conductor **44** to the gated output **46** of the E tone generator **32**. The major chord is completed by coupling the switch **34** via resistor **48** to the output of the G gate (not shown).

The normally closed contact **50** of the key switch **34** is grounded at **52**. The normally open contact **54** is connected via conductor **56** and coupling capacitor **58** to an output circuit terminal **60**. The output circuit may be of any form, simple or complicated, and is here shown by way of example as consisting of a voicing circuit **62**, an amplifier **64**, and an electro-acoustic transducer in the form of a speaker **66**. The conductor **56** is biased by a voltage source **68** through resistor **70**.

As noted hereinbefore, terminal **28**, in addition to constituting the output terminal of the diode gate **26**, also constitutes

the control terminal for the gate. This control is effected through the selective application or removal of bias from a source **72** applied through a double-throw switch **74** to a chord control line **76**, and thence through an isolating resistor **78** to the terminal **28**. When the switch **74** is in its upper position, or A position, it engages contact **80** and is grounded. When in its lower or B position, it engages contact **82** and places the line **76** at the bias of **72**. In the example shown, this bias will be assumed to be plus 6.6 volts.

When the tab control switch **74**, which controls the selection of the chord, is in the upper or A position, the voltage at **28** remains at zero volts, as shown at **84**. When the chord tab switch **74** is in its lower or B position, the signal is as shown at **86**, being a square wave going between 6.6 and 0.6 volts. That is, when the tone signal **24** is at plus 8 volts, the diode **26** can, of course, not conduct, since it is reverse biased. During this interval then, the full voltage from **72** is felt at **28** and accounts for the 6.6-volt level of the signal **86**. When the tone signal **24** drops to zero volts, then current flows through the diode **26** and the resulting voltage drop across resistor **78** is felt at **28**. The forward voltage drop across the diode **26** is approximately 0.6 volts, so that the minimum voltage excursion at **86** is thus 0.6 volts; thus, with the chord tab switch **74** in the B position, there resides on the terminal **28** a square wave tone signal having a peak-to-peak excursion of approximately 6 volts.

This tone signal is applied via the conductor **41** and resistor **40** to the pole of switch **34**.

Thus, whenever the switch **74** is in its lower or B position, there resides on the pole of the C key switch **34** tone signals corresponding to the notes C,E and G, i.e., a C major chord. The actuation of the C key switch **34**, i.e., the closing at contact **54**, thus places a C major chord on the conductor **56** and thence via the capacitor **58** to the loudspeaker **66**.

The C tone signal from **20** is also fed to the other key switches whose major chord incorporates the note C. Thus, the terminal **28** is coupled via the conductor **85** to the key switch **87** representing the note F on the keyboard. The C note from terminal **28** is coupled also via conductor **88** to the key switch for G sharp (not shown), since a G sharp major chord also contains the note C. In like manner, each of the tone generators, as exemplified by the C tone signal tone generator **20**, is coupled through its associated diode gate, to respective key switches which represent chords in which the particular note from that tone generator appear.

In the fashion above described, each of the key switches exemplified by **34** is coupled to the gated output of the three tones making up the major chord for that key. Reciprocally, and as explained above, each of the tone generators has its output applied to each of the key switches which needs that tone in its major chord. When the chord tab switch **74** is moved to its lower or B position, the actuation of any key switch will thus cause the sounding of a major chord of that key. When the chord tab switch is in its upper or A position, no tones will sound upon the actuation of a key switch, because all of the gates exemplified by diode gate **26**, are disabled by the removal of enabling bias from the source **72**.

It is usually desirable to always allow the actuation of a given key switch to sound that particular note. To that end the circuit of FIG. 2 is provided, in which the conductor **41'** instead of being connected to the gated output **28** from the tone generator **20**, is connected directly to the output terminal **22**. Thus, in FIG. 2, actuation of the key switch **34** causes a sounding of the note C, irrespective of the position of the chord tab switch **74**. In FIG. 2, with the switch **74** in the A position, the actuation of a given key switch, e.g., **34**, will sound only that particular note. With switch **74** in the B position, the actuation of a given key switch will sound the major chord of that key.

It will be obvious that similar matrixes can be provided, each with its individual chord tab switch **74**, to provide other chords of a given note, for example, the minor chord, the diminished 7th etc.

In FIG. 3 the circuit is shown expanded to include a pedal divider **90**, whose output **92** is applied to the output conductor

56. The pedal divider 90 is known in the art and is simply a frequency divider which delivers to its output a signal of one-half of the input frequency. This frequency then becomes the pedal tone corresponding to the note of the actuated key switch 34.

The input to the divider 90 is taken from the diode output terminal 28 via another diode gate 94 and coupling capacitor 96. The terminal 98 constitutes both the output terminal for the second diode gate 94 and the control terminal which serves to selectively enable and disable the gate 94.

The diode gate 94 is enabled by the closing of key switch 34, which applies enabling bias from a 6-volt bias source 68' to the lower, normally open, contact 54 of the key switch 34.

When the chord tab switch 74 is in the B position, tone signal resides on the terminal 28. Since this signal, however, varies between plus 0.6 and plus 6.6 volts, it is not felt at the terminal 98, because of the polarization of the diode 94. With closing of the key switch 34, the 6-volt, bias from 68' appears on terminal 98 via resistor 100, so that a 4.8 volt, peak-to-peak square wave now resides on the output terminal 98, i.e., a square wave varying from 6 volts to 1.2 volts.

This square wave is differentiated in the capacitor 96 and the resulting negative spikes on the conductor 60 are used to drive the pedal divider 90 to produce a square wave output at 92 having one-half the frequency of the tone generator 20.

FIGS. 4, 5, 6 and 7 illustrate respective modifications of the present invention, in which the diode 26 has been replaced by various three-terminal devices. In these figures the reference numeral for a given component has been given a distinctive number in the hundreds position. The last two digits indicate the correspondence between the modification and the component shown in FIG. 1. Thus, in FIG. 4 the numeral 126 denotes a transistor (three-terminal device) which replaces the diode 26 (two-terminal device) of FIG. 1. Essentially the difference is that in the FIG. 1 modification the control terminal for the gate represented by the diode 26 is the same as one of the two signal terminals. In the three terminal components of FIGS. 4–7, the gate terminal is separate from the two signal terminals.

In FIG. 4, the diode 26 has been replaced by a PNP transistor 126. In FIG. 5, the diode has been replaced by a P channel J–FET. In FIG. 6 the diode has been replaced by a P channel J – FET with no loading on the tone generator 320. In FIG. 7 the diode has been replaced by an N channel J – FET.

FIG. 8 illustrates the integration of diode and resistors into an MOS integrated circuit. Keeping in mind the numerical format explained above, it is believed that the substitution of components from FIG. 1 to FIG. 8 will be obvious.

The tone generators 20 et al may also be included within a single IC chip. In this case the production of the monophonic bass note is done in a slightly different way when IC chips are used. This is shown in FIG. 9, where an extra divider per note is included within the IC and a second equivalent of diode 26 is used to produce a polyphonic bass system that does not produce burble. These two diodes are shown at 626 and 626' in FIG. 9. While FIG. 9 illustrates the tone generator 620' as being one octave lower than 620, it will be readily understood that it could just as well be more than one octave lower by the incorporation or multiple dividers.

It will be readily understood by those skilled in the art that the oblique line exemplified at 700 in FIG. 4 represents the common bussing of all notes of the circuit. That is to say, referring to FIG. 4 by way of example, the conductors 176 leading from their respective tone circuits are all connected to a common buss at 700 and thus employ a common switch 174.

What is claimed is:

1. Keying circuit for keyboard musical instrument having a plurality of tone signal generators for generating electrical signals respectively corresponding to different musical notes, electroacoustic transducing means for sounding said notes, a plurality of key switches coupled to said transducing means and to said tone signal generators for applying respective electrical signals to said transducing means, characterized by:

circuit means, including gate means respectively connected to said generators, for coupling a plurality of said generators corresponding to notes of a chord to a given one of said key switches, to be applied to said transducing means upon actuation of said one of said key switches corresponding to one of said chord notes, and

control means connected to said gate means for selectively enabling and disabling said gate means to selectively effect sounding of a chord upon actuation of said corresponding switch.

2. Circuit in accordance with claim 1, including:

bypass circuit means for bypassing the gate means for said corresponding switch to the generator corresponding to said one note,

whereby said one note is sounded upon actuation of said corresponding switch, irrespective of the enabling or disabling of said gate means.

3. Circuit in accordance with claim 1, wherein:

said gate means comprises non-linear conducting means,

said generators generate essentially rectangular waves, and

said control means comprises means for selectively biasing said gate means to non-conductive and conductive condition.

4. Circuit in accordance with claim 1, including:

frequency divider means having input and output,

means for coupling said output to said transducing means, and

second circuit means coupling tone signals from said circuit means to said input, for sounding a pedal tone whenever the key switch corresponding to the pedal tone is actuated.

5. Circuit in accordance with claim 4, wherein said second circuit means includes:

second gate means coupled to said first-named gate means and wherein

actuation of said corresponding key switch enables said second gate means, thereby to effect sounding of said pedal tone.

* * * * *