Dec. 19, 1967 J. R. BRAND ET AL 3,359,358

CHORD ORGAN SWITCHING CIRCUIT FOR SELECTIVELY PLAYING EITHER CHORDS OR SINGLE NOTES BY DEPRESSING ONE KEY

Filed May 22, 1963 2 Sheets-Sheet 1

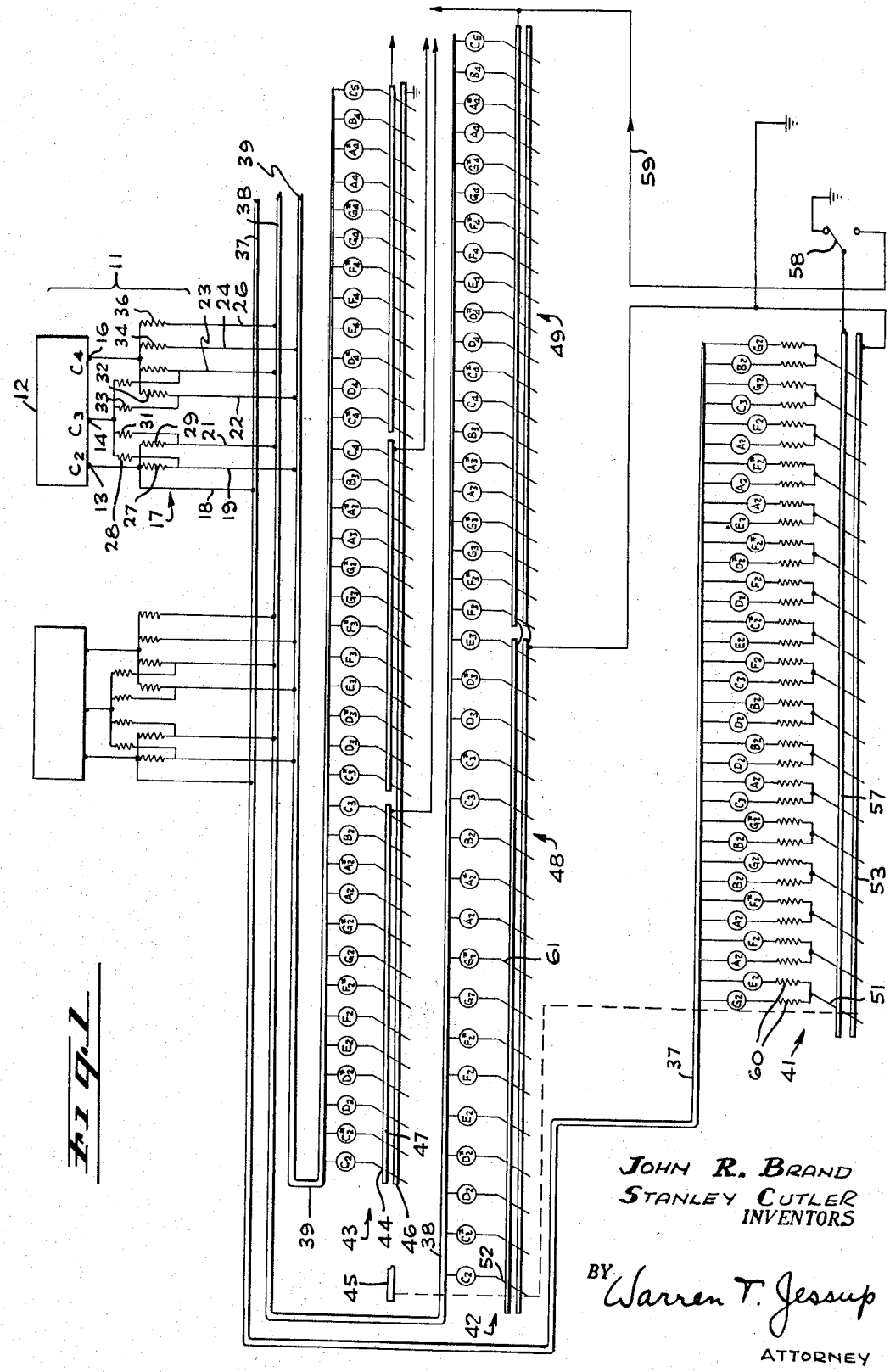

Fig. 1

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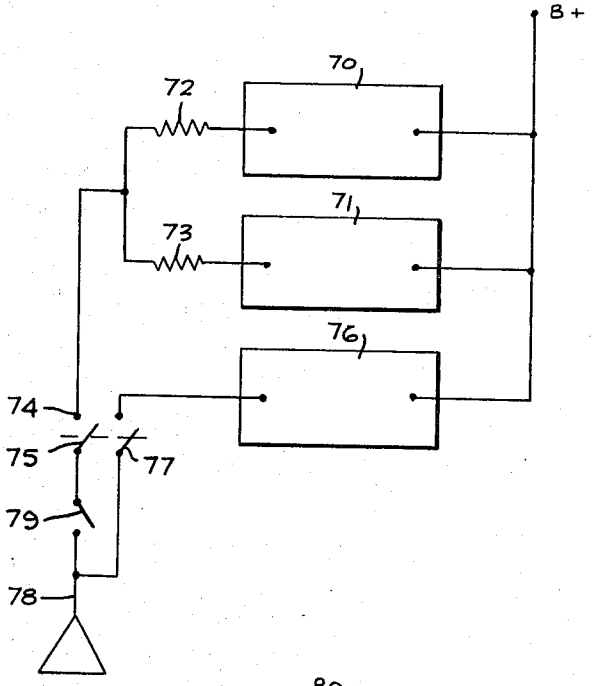
Fig. 2



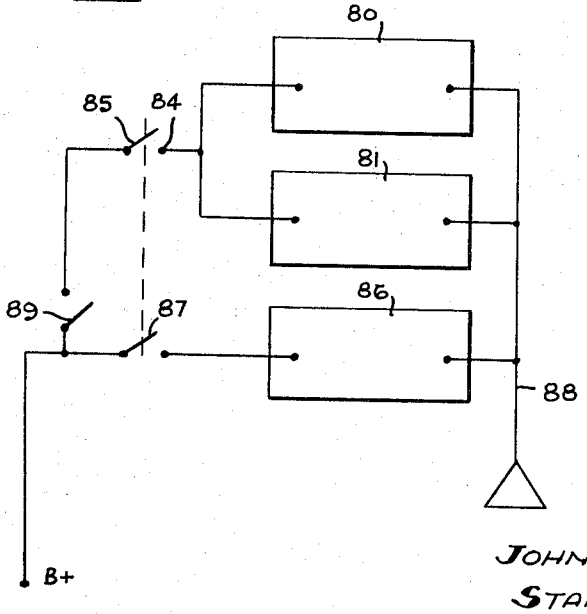


Fig. 3

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3,359,358

CHORD ORGAN SWITCHING CIRCUIT FOR SELECTIVELY PLAYING EITHER CHORDS OR SINGLE NOTES BY DEPRESSING ONE KEY

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4 Claims. (Cl. 84—1.01)

This invention relates to electronic organ circuits and more particularly to circuits in which a chord, rather than a single note or octave, is sounded when any one of a certain group of keys is pressed.

It is an object of this invention to provide an improved chord organ circuit in which a plurality of tone signals may be applied to an output bus by the closing of a single-switch contact.

It is a further object of this invention to provide an improved chord organ circuit in which playing keys of the organ keyboard may be used either to play single notes in their proper relationship to the balance of the keyboard or complete musical chords.

It is a further object of this invention to provide a chord organ circuit in which a multi-note chord may be sounded, and in which one or more notes have odd and even harmonics and the remaining notes contain substantially odd harmonics only.

A further object of this invention is to provide an organ structure and electronic circuit such that a single key of the organ may be employed to play a single note, or alternately to play a combination of notes.

In accordance with these and other objects which will become apparent hereinafter, a preferred form of the present invention is disclosed in the accompanying drawings wherein:

FIGURE 1 is a circuit diagram of the particular organ circuitry pertaining to this invention.

FIGURE 2 is a schematic of the embodiment.

FIGURE 3 is a schematic of an alternate embodiment.

In the electronic organ art, the tones are generated by devices which will be referred to herein as tone means. In the drawing, reference character **12** designates one of twelve tone means which together deliver all of the tones of the chromatic scale. Each tone means is capable of delivering several related tones, and the illustrated embodiment is adapted to deliver three octavely related tones. Each of the tone means, represented by reference character **12** has three output terminals **13**, **14**, and **16** at which appear octavely related tones of a given note. For the purpose of illustration, tone means **12** is assumed to be a generator for note C. Therefore, there appears at terminals **13**, **14**, and **16**, respectively, the note C2; the first octave thereabove C3; and the second octave up, C4. The tone means **12** contains a master oscillator which generates the pitch of C4 and in turn drives an Eccles-Jordan type divider which generates C3. The latter, in turn, drives another Eccles-Jordan divider which generates C2. The output wave form of both C3 and C2 (dividers) is essentially a rectangular wave which is intrinsically rich in odd-order harmonics and contains few or no even-order harmonics.

The tone means **12** is connected to a signal distribution network **17** having seven output terminals **18**, **19**, **21**, **22**, **23**, **24**, and **26**. Network **17** includes a plurality of interconnected resistors that combine the outputs from terminals **13**, **14**, and **16** in various ways to deliver the unaltered wave form from the generator, and also deliver octavely related mixtures to produce signals including both odd and even harmonics. C2 is applied directly from the terminal **13** to the treminal **18**. This same note C2 is

also applied from the terminal **13** to the terminal **19** through a resistor **27**. Also, applied to the output terminal **19**, is a portion of the output of C3 from terminal **14**, which in effect adds even-order harmonics to the signal from C2 appearing at terminal **19**.

In similar fashion, combinations containing both even and odd-order harmonics appear at terminals **19**, **21**, **22** and **23**.

Each of the output terminals of the distribution network **17** feeds to one wire of three multiple wire cables **37**, **38**, or **39**, leading to a respective switch bank **41**, **42**, or **43**. The switch bank **43**, fed by the cable **39**, consists of a row of single-pole double-throw switches which are connected to be operated by the respective keys of an upper keyboard on a two manual organ. Each switch of the bank has a connecting terminal to which the wire from cable **39** connects. Each switch arm or pole, for example pole **44**, rests in a first operable position against a grounded contact in the form of bus **46**, in the quiescent position, i.e., when the key of the keyboard is not in use. When the key is pressed, the switch arm pole **44** is raised to a second operable position into contact with an output bus **47** connected to an upper keyboard voice circuit.

The cable **38** feeds the lower keyboard bank of switches **42**. These switches **42** are connected to be operated respectively by keys **45** forming the lower keyboard of the organ. The switch bank **42** is divided into two sections, a chord key switch section **48**, and the remaining section **49**.

In accordance with the present invention, the chord key-switch section of the lower keyboard is designed to be operated either as an ordinary keyboard or as a chord keyboard at the will of the operator. When in chord operation, the third bank of switches **41**, fed by the cable **37**, is employed. When in non-chord operation, the bank **41** is isolated from the output circuit of the organ and plays no effective part in the operation.

The switch bank **41** comprises a plurality of single-pole, double-throw switches **51** each ganged to a corresponding switch **52** in the switch bank **42**, both switches being operated by the key **45**. Each switch **51** has a connecting terminal to receive connections from the feed cable **37**. In quiescent position, i.e., with the key **45** at rest, the throw arm of switch **51** rests in a first operable position against a lower contact in the form of a busbar **53** which is grounded.

The upper contact against which the switch **51** may engage is an upper busbar **57**. Bus **57** leads to the pole of a double-throw switch **58**. The switch **58** is manually accessible to the organist, and may either ground bus **57** by being thrown to its upper position, or it may be connected, by being thrown into its lower position, to an output line **59**. Line leads to the lower keyboard voicing circuits. The output bus from the switch bank **42** also connects to the output line **59**, and the other bus leads to ground.

It is to be understood that the organ includes the aforementioned voicing circuits, which in turn lead to suitable amplifiers, and thence to transducers in the form of loudspeakers, earphones, tone cabinets, and like output means.

To the terminal which is connected to the switch **51** of the switch bank **41**, are connected two musically related tone signals, for example G2 and E2. These signals are brought from the output terminal of the G and E tone means respectively, corresponding to the terminal **18** of the C tone generator **12** shown. Tone generators have two terminals. Normally one of these terminals is grounded and the other is the output. If the output terminals of two tone generators are connected together, there will be such severe interaction that the signals are completely

mixed and neither generator signal would be available independently. Hence, this invention employs isolating resistors **60** connected into the leads from the G and E generators, and the switch **51** is then kept at ground or connected to output depending upon the position of key **45**. Thus, a signal coming from the generator G, for example, will reach the common terminal of the switch **51**, and will follow the path of least resistance to the ground or output. It will not have a significant cross-talk effect upon the generator of the tone E. Likewise, the tone generator E will have no significant effect upon the tone generator G.

The operation of the circuit is substantially as follows:

If the organist does not wish to employ the chord organ feature, switch **58** is placed in its ground position. This grounds the bus **57**, so that even though the switch **51** is moved to its upper position every time the key **45** is played, there is no output applied to the output line **59** from the switch bank **41**. The only output appearing is that occasioned by the closing of the switch **52**, which applies the single note played, for example C2, to the output line **59**. As noted, this is a complex tone which contains a large measure of the signal C2, plus an attenuated portion of the octavely related signal C3. In this manner, the organ may be played as though the chord bank **41** did not exist.

If the organist wishes to employ the chord feature, he moves switch **58** to its lower position, thus connecting the upper bus **57** of the switch bank **41** to the output line **59**. The keys **45** of the chord key switch section **48**, in the lower keyboard, then become in effect chord keys, with depression of a key sounding a three-note chord instead of only a single note. In some cases, the note played will correspond to the name of the chord which is sounded, although in other cases, this is not so. For example, when key **45**, which plays note C2, is pressed, it operates both the arm of a switch **52** and the arm of a switch **51**. The switch **52** applies the note C2 to the output line **59** from the cable **38**. Through the cable **37** are conducted two tones, G2 and E2, thence through the resistors **60**, to the output line **59**, and through the switch **58**. There is thus sounded a C-major chord, with the C2 being predominent by virtue of its even and odd order harmonics. The G2 and E2, on the other hand, contain only odd order harmonics.

It will be noted that by grouping non-octavely musically related tone signals, for example, G2 and E2, and connecting them both fixedly to a signal terminal, i.e. the switch **51**, in the chord switch bank **41**, it is possible to sound these related tones, i.e. G2 and E2, by closing only a single contact; that is, by closing only the switch **51** to the output bus **57**. This makes possible a minimization in the number of individual switches required for chord organ operation, with the consequent saving in initial and maintenance costs.

In FIGURE 2, the circuitry of FIGURE 1 is illustrated schematically. Generators **70** and **71** operate through resistances **72** and **73** respectively, and are joined at a common terminal **74** of a switch having a pole **75**.

A third generator **76** operates through the pole of switch **77**. Switches **75** and **77** are operated in a gang by a common organ key.

The output of the organ is represented by the signal line and speaker symbol indicated by the reference character **78**. The generator **76** operates through the switch **77** directly to the output **78** of the organ. However, the output of generator **70** and **71**, in addition to passing through the switch pole **75**, must pass through the switch having a pole **79**. This switch is manually accessible to the operator and is opened whenever only a single note from generator **76** is desired. It is closed when a chord is desired.

Alternatively, as shown in FIGURE 3, generators **80** and **81** are connected to a common terminal **84** of a switch having a pole **85**.

Generator **86** operates through a switch having a pole **87**. However, rather than leading to a speaker output system, these switches having poles **85** and **87** are in a common gang operated by the key of the organ to connect a source of power to the generators **80**, **81** and **86**. An output, including a speaker, indicated by reference character **88**, is permanently connected to the output of the generators. A manual selecting switch **89** determines whether the generators **80** and **81** will be employed with the generator **86** in the production of a chord.

Thus, it will be seen that in FIGURE 2, the generators are in constant operation, and the switches determine which of the outputs will be employed to produce the audible signal. On the other hand, as in FIGURE 3, the switches determine which of the generators will be energized to product the audible signal.

It will also be seen that in an electronic musical instrument having a plurality of tone means for generating signals corresponding to notes of a musical scale, and in which instrument there is a key of a keyboard for expressing tones from the tone means, the invention comprises the combination of a circuit means including only one single-pole switch connecting a tone generator and a non-octavely related tone generator together, to the output circuit of the system. This invention thereby permits operation by a single-pole switch to unite two musically related notes into a system whereby they may be employed as a combined output note with or without another note to produce a chord.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, 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 following claims.

What is claimed is:

1. In an electronic musical instrument having a plurality of tone means for generating signals corresponding to notes in a musical scale, and a keyboard for expressing tones from said tone means, the combination of;

a single pole switch means having a plurality of terminals and operable by a key of the keyboard;

impedance means connecting a first of said tone means to a first terminal of said switch means and connecting at least another non-octavely related tone means to said first terminal;

said switch means having a pole operable between a first station interconnecting said first terminal and a second terminal, and a second station interconnecting said first terminal with a third terminal, said second terminal connected to ground, and a circuit means for connecting the third terminal to the output of the electronic musical instrument, operation of any said key causing its corresponding switch means to swing said pole from said first station at ground to said second station connected to said output;

whereby there is applied to said output a plurality of tone signals.

2. In an electronic musical instrument having a plurality of tone means for generating signals corresponding to notes in a musical scale, and a keyboard for expressing tones from said tone means, the combination of;

a single pole first switch means having a plurality of terminals and operable by a key of the keyboard;

impedance means connecting a first of said tone means to a first terminal of said first switch means and connecting at least another non-octavely related tone means to said first terminal;

said first switch means having a pole operable between a first station interconnecting said first terminal and a second terminal, and a second station interconnecting said first terminal with a third terminal, said second terminal connected to ground, and circuit

means for connecting the third terminal to the output of the electronic musical instrument, operation of any said key causing its corresponding said first switch means to swing said pole from said first station at ground to said second station connected to said output;

a second switch means operable in gang with the first switch means; and

means connecting a third tone means to the first terminal of said second switch means and connecting the second terminal of said second switch means to said output of the musical instrument, pressing of said key causing its corresponding gang of switches to connect to said output of the musical instrument;

whereby, there is applied to said output musically related tone forming a chord.

3. In an electronic musical instrument having a plurality of tone means for generating signals corresponding to notes in a musical scale, the output wave form of said tone means being comprised substantially of a fundamental and odd harmonics thereof, and a keyboard for expressing tones from said tone means, the combination of:

a single pole switch having a first terminal with a pole, a second terminal connected to ground, and a third terminal;

impedance means connecting a first of said tone means to said first terminal of said switch, and connecting at least another non-octavely related tone means to said first terminal, said pole of the switch operable between said second terminal and said third terminal;

circuit means for connecting said third terminal of said switch to the output of the electronic musical instrument;

a second single pole switch having a first terminal with a pole, a second terminal connected to ground, and a third terminal;

means connecting still another non-octavely related tone means to the first terminal of said second switch and connecting a portion of the output of the octave higher tone means to said first terminal;

circuit means for connecting said third terminal of said second switch to the output of the electronic musical instrument;

a mechanical gang apparatus providing interconnection of a key of said keyboard with said first and second switch, pressing said key thereby causing both switches to move from the ground positions to the output of the musical instrument;

whereby, there is applied to said output a plurality of tone signals.

4. In the musical instrument defined in claim 3, said tone means being related so as to produce a musical chord.

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