Nov. 25, 1969 H. O. SCHWARTZ ET AL 3,480,719

ELECTRONIC ORGAN PEDAL KEYING CIRCUIT WITH SUSTAIN AND CANCELLATION OF SUSTAIN UPON PLAYING OF SUBSEQUENT PEDAL

Filed June 26, 1967 2 Sheets-Sheet 1

Fig. 1.

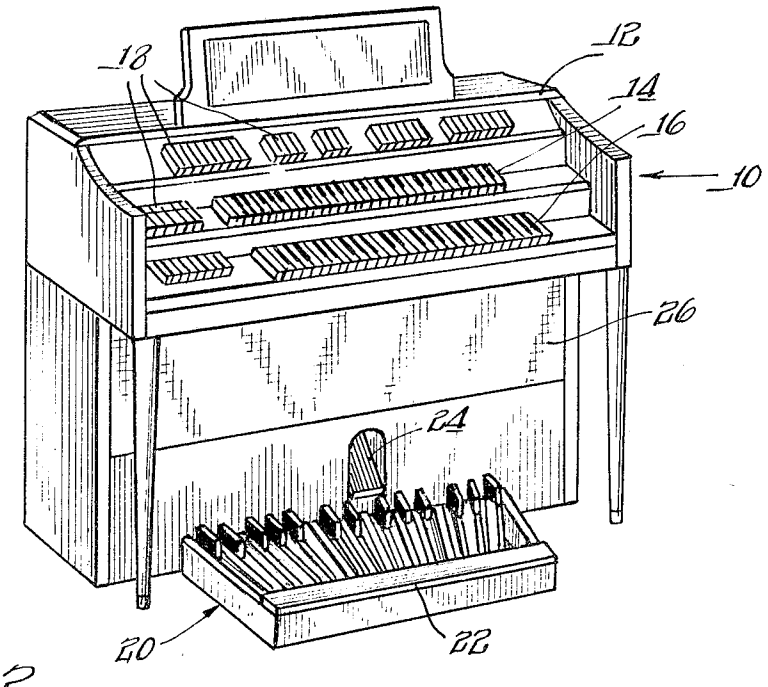
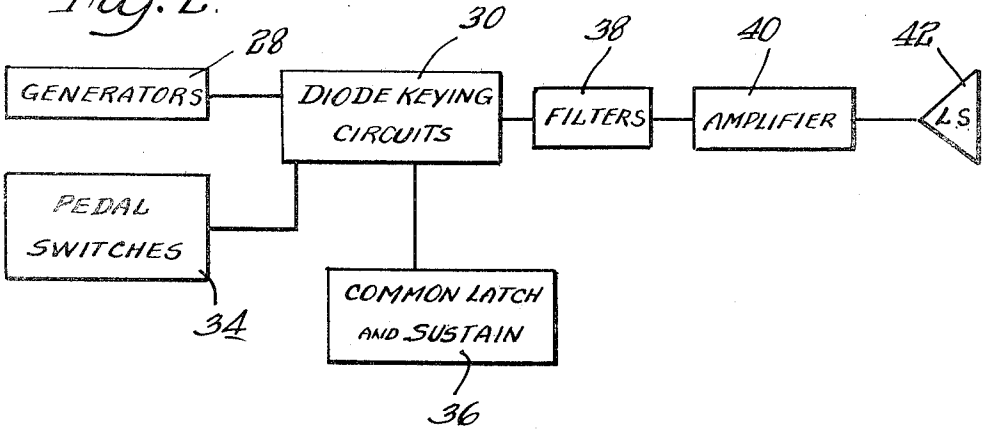


Fig. 2.



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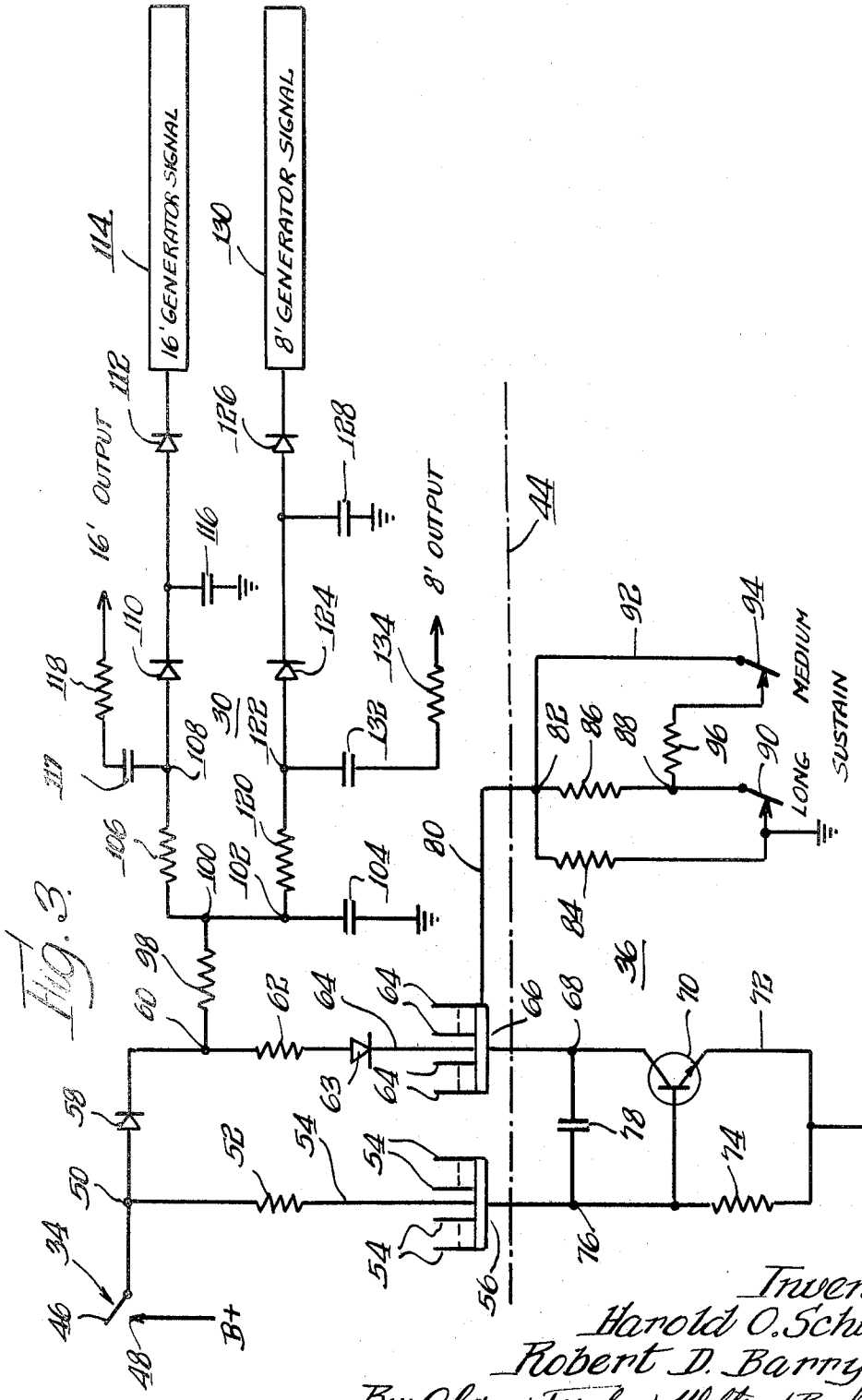

Fig. 3

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ELECTRONIC ORGAN PEDAL KEYING CIRCUIT WITH SUSTAIN AND CANCELLATION OF SUSTAIN UPON PLAYING OF SUBSEQUENT PEDAL

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U.S. Cl. 84—1.26 8 Claims

ABSTRACT OF THE DISCLOSURE

An electronic organ having a pedal keying circuit using solid state componets to maintain any note that has been played with a sustain of selectable length, with solid state means for immediately cancelling any sustained note upon the subsequent playing of another note.

DISCLOSURE

In the playing of a pipe organ, particularly the pedal notes thereof, a rather long time may be necessary for the notes to decay. When a pedal is released, the mechanital connections must operate to close the valve, and this takes a finite time of some length. The vibrations in the air column take some time to decay as the valve is closed, whereby the note hangs on for quite some time after the pedal has been released. For proper organ-like qualities, an electronic organ should also have some means for sustaining a note after the pedal has been released.

On the other hand, it is undesirable to have two pedal notes adjacent to one another, or even nearly adjacent, play at the same time. Adjacent notes produce beats that can be quite objectionable and very unpleasant to listen to.

Thus, in accordance with the present invention, it is an object to provide an improved sustain for electronic organ pedal notes, but with means for immediately cancelling any sustained note upon the subsequent playing of another note.

It is a further object of the present invention to provide an electronic organ pedal keying circuit, with sustain and cancel, utilizing a minimum of electromechanical contacts, whereby to promote quiet operation and long service life.

It is yet another object of this invention to provide diodes in an electronic organ pedal keying circuit for conveying the tone oscillations when biased for conduction by the closing of a pedal switch, in combination with a capacitor for holding the diodes conducting for some time after the switch has been reopened, and further in combination with a transistor for shorting out the sustain capacitor upon the subsequent playing of another note.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of an electronic organ constructed in accordance with the principles of this invention;

FIG. 2 is a block diagram illustrating the circuits of the invention; and

FIG. 3 is a schematic electrical wiring diagram showing certain of the details of the invention.

Referring now in greater particularity to the drawings, and first to FIG. 1, there will be seen an electronic organ **10** constructed in accordance with the present invention, including a case **12** having an upper keyboard **14** and a lower keyboard **16**, and a plurality of stop tablets **18** proximate thereto. A pedal board or clavier **20**, including a plurality of pedals, is provided. The number of pedals

may vary with the type of organ, but a full organ generally has 32 pedals and pedal notes. The pedals in the illustrated embodiment of the invention are pivoted from a support **22** spaced from the remainder of the case of the organ. A swell pedal **24** is pivoted in the case, and a speaker system is disposed behind grille cloth **26**, and may comprise a plurality of loudspeakers of one or more sizes.

Turning now to FIG. 2, the organ tone generators—specifically, pedal note generators—are shown at **28**. The pedal note generators **28** are connected to diode keying circuits **30**. The diode keying circuits normally will not conduct, but pedal switches **34** are connected thereto to turn on the proper diodes. A common latch and sustain network or circuit **36** is connected to the diode keying circuits to hold proper diodes on or in conducting condition, as hereinafter set forth.

The output from the diode keying circuits is connected to formant and tone filters **38** by stop switches associated therewith and operated by the stop tablets **18**, and these in turn are connected to an amplifier **40**. The amplifier is, in turn, connected to the loudspeaker system **42**, which, as heretofore noted, is mounted behind the grille cloth **26** and may comprise a plurality of speakers of different sizes or characteristics.

Turning now to FIG. 3, there will be seen a broken line disposed horizontally adjacent the center of the drawing from top to bottom, and identified by numeral **44**. It is to be understood that the circuit below this line is a common circuit, whereas the circuits above the line are duplicated, there being one such circuit for each of the pedal notes, i.e., 32 such circuits in the illustrative embodiment.

Starting at the upper left hand corner, one of the key switches **34** is shown, including a movable contact **46** normally spaced from but engageable with a fixed contact **48** connected to B+ potential. The switches may be ordinary electromechanical switches directly actuated by the respective pedals of the pedal clavier **20**, but preferably are magnetic switches as disclosed and claimed in the copending application of Thomas A. Lazzaro, Ser. No. 457,963, now Patent No. 3,408,448, entitled "Magnetic Keying for Electronic Organs." Each switch **34** is connected to a junction point **50** which leads through a resistor **52**, and from thence through a wire **54** to a common point **56**. Various of the wires **54** are shown, and there is a total of 32 such wires in the illustrative embodiment of the invention.

Each junction **50** is further connected to the anode of a diode **58**, the cathode thereof being connected to a junction **60**. The junction **60** is connected to a resistor **62**, the resistor being connected to the anode of a diode **63** and the diode cathode being connected through a wire **64** to a common junction or terminal **66**, several of the wires **64** being shown, and it being understood that there would be 32 such wires in the illustrative embodiment of the invention.

The common point, junction, or terminal **66** is connected to a junction **68** in the common latch and sustain circuit **36**, and this junction is connected to the collector of an NPN transistor **70**, the emitter of which is grounded at **72**. The base is connected to ground through a biasing resistor **74**, and the base further is connected to a junction **76**, the latter in turn being connected to the common terminal or junction **56**. A capacitor **78** is connected between the junctions **68** and **76**.

The common terminal or junction **66** has a wire **80** connected thereto which leads to a junction **82**. This junction is connected through a resistor **84** to ground. It also is connected to a resistor **86** which leads to a junction **88**. The junction is connected to a normally closed switch **90** which comprises a LONG SUSTAIN SWITCH. In

addition, the junction **82** is connected through a wire **92** to a normally closed switch **94** which comprises a MEDIUM SUSTAIN SWITCH. The other side of this switch is connected through a resistor **96** to the junction **88**.

The junction **60** is connected through a resistor **98** to the junction **100**. This junction is connected to another junction **102**, and the two have a large value shunting or sustain capacitor **104** shunted to ground.

This junction **100** is connected through a resistor **106** to the junction **108**. This junction is connected to the anode of a diode **110**, the cathode of which is connected to the anode of another diode **112**, the cathode thereof being connected to a 16-foot generator signal as indicated at **114**. This signal will be received from a generator **28**, and it will be understood that the pedal generators often are dividers connected to the generators of the keyboard. A shunting capacitor **116** is connected to ground from between the diodes **110** and **112**. These diodes normally do not conduct the generator signal, and to this end the generator signal preferably is always at a potential above ground.

The junction **108** is connected to a capacitor **117**, and this is connected to a resistor **118** leading to the 16-foot output, and on through the various stop switches to the appropriate ones of the filters **38**.

A circuit somewhat duplicative of that just described is provided for the 8-foot pedal notes. Thus, the junction **102** is connected to a resistor **120** which leads to a junction **122**. This junction is connected to the anode of a diode **124**, the cathode thereof being connected to the anode of a diode **126**, and the connection between the two being shunted to ground by a capacitor **128**. The cathode of the diode **126** is connected to the 8-foot generator signal **130**.

The junction **122** is connected through a capacitor **132** to a resistor **134** leading to the 8-foot output, and on through the stop switches to the appropriate ones of the stop switches and filters **38**.

OPERATION

In the operation of the above circuit it must be borne in mind that the diodes **110, 112,** and **124, 126** are normally nonconductive. To this end, the generator signals preferably are of a square wave configuration, and always above ground. However, it will be noted that even if the signals were to go below ground, the capacitors **116** and **128** would charge up due to any initial conduction of the diodes **112** and **126** to back bias the diodes, and thus to shut them off. The series connection of the pairs of diodes provides greatly more isolation than would be possible with but a single diode.

When any pedal switch **34** is closed, the B+ potential connected thereto is passed by the diode **58** to open or render conductive all of the diodes **110, 112** and **124, 126,** and thus to convey the respective generator signals corresponding to the note being played to the respective 16-foot output and 8-foot output. The transistor **70** is normally biased off, whereby the capacitor **104,** previously identified as a sustain capacitor and charged through the diode **58,** can discharge only through the sustain network forming the right portion of the common latch and sustain network **36.** Thus, when the pedal is released and the corresponding pedal switch **34** reopens, the charge on the capacitor **104** holds the diodes **110, 112** and **124, 126** open for some time. The capacitor discharges through resistors **98** and **62** to the common connection or junction **66,** and from thence over the wire **80** to the junction **82.** With the sustain switches closed as shown, the resistors **84, 86,** and **96** are in parallel, and there is a rather low resistance path, resulting in a rather short sustain. However, when the MEDIUM SUSTAIN switch **94** is open, the resistor **96** is removed from the circuit, and the discharge path includes resistors **84** and **86** in parallel, these being of greater resistance than the resistor **96,** whereby to effect a medium sustain. When the LONG SUSTAIN switch is open, the resistor **86** is also removed from the circuit, and only the resistor **84** (the resistor of highest resistance of the three) remains in the discharge path, whereby the capacitor **104** discharges more slowly to produce a long sustain.

If the capacitor **104** is still charged, whereby the note is still sustaining, when a subsequent note is played, then the B+ potential will be transmitted through others of the wires **54** and **64** to the common connections **56** and **66.** The biasing on the transistor **70** thus is changed to render the transistor conductive. This effectively short circuits the connection **66** to ground, and discharges the previously charged capacitor **104** in very short order, thereby cancelling the note that was sustaining.

Various circuit values will be immediately apparent to those skilled in the art. However, to insure completeness of disclosure, the following values are set forth as exemplary, the B+ potential being 23 volts

Resistor:

52	ohms	220K
62	do	2.2K
74	do	47K
84	do	270K
86	do	100K
96	do	22K
98	do	5.6K
106	do	390K
120	do	390K

Capacitor:

78	microfarads	.022
104	do	2.2
116		Vary with frequency
117		
128		
132		

The specific example of the invention as herein shown and described is for illustrative purposes only. Various changes in structure will no doubt occur to those skilled in the art and will be understood as forming a part of the present invention insofar as they fall within the spirit and scope of the appended claims.

The invention is claimed as follows:

1. An electronic organ comprising means providing a source of electric oscillations corresponding to the pedal notes of said organ, output means, means connecting said source to said output means and including a plurality of diode means respectively corresponding to said pedal notes and connected so as normally not to conduct said oscillations, a voltage source of predetermined polarity, a plurality of pedal switches respectively corresponding to said pedal notes and connected to said voltage source and respectively connected to said diode means, said diode means individually being rendered conductive by application of voltage of said predetermined polarity upon operation of a respective pedal switch, a plurality of voltage storage means respectively connected to said diode means and each storing voltage upon conduction of a corresponding diode means to continue that diode means conducting after cessation of operation of the corresponding pedal switch, discharging means connected to said voltage storage means for discharging voltage therefrom at a controlled rate, and solid state means connected to said voltage storage means and normally non-conducting, said solid state means also being connected to said pedal switches and biased for conduction upon operation of any of said pedal switches rapidly to discharge voltage stored by any of said voltage storage means.

2. An electronic organ as set forth in claim **1** wherein said solid state means is a common solid state means, being connected to all of said voltage storage means and all of said key switches.

3. An electronic organ as set forth in claim **2** wherein said solid state means is a transistor.

4. An electronic organ as set forth in claim 3 wherein the collector of said transistor is connected to said voltage storage means and the base is connected to said pedal switches.

5. An electronic organ as set forth in claim 1 and further including diode means connecting said voltage storage means to said solid state means.

6. An electronic organ as set forth in claim 2 and further including a plurality of diodes respectively connecting said voltage storage means to said common solid state means.

7. An electronic organ comprising means providing a source of electric oscillations corresponding to the pedal notes of said organ, output means, means connecting said source to said output means and including a plurality of diode means respectively corresponding to said pedal notes and connected so as normally not to conduct said oscillations, a voltage source of predetermined polarity, a plurality of pedal switches respectively corresponding to said pedal notes and connected to said voltage source, a plurality of diodes respectively connecting said pedal switches to said diode means and normally non-conducting, said diodes and said diode means selectively being rendered conductive by application of voltage of said predetermined polarity upon operation of a respective pedal switch, a plurality of voltage storage means respectively connected to said diode means and each storing voltage upon conduction of a corresponding diode means to continue that diode means conducting after cessation of operation of the corresponding pedal switch, discharging means connected to said voltage storage means for discharging voltage therefrom at a controlled rate, and a common cancel circuit comprising a normally non-conducting transistor, said transistor having a collector connected in common to all of said voltage storage means, said transistor having a base connected in common independent of said plurality of diodes to all of said pedal switches, said transistor being biased for conduction by operation of any of said pedal switches rapidly to discharge voltage stored by any of said voltage storage means.

8. An electronic organ as set forth in claim 7 and further including a second plurality of diodes respectively connecting said diode means to said transistor collector.

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U.S. Cl. X.R.

84—1.01