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PERCUSSIVE EFFECT FOR ELECTRICAL MUSIC INSTRUMENTS

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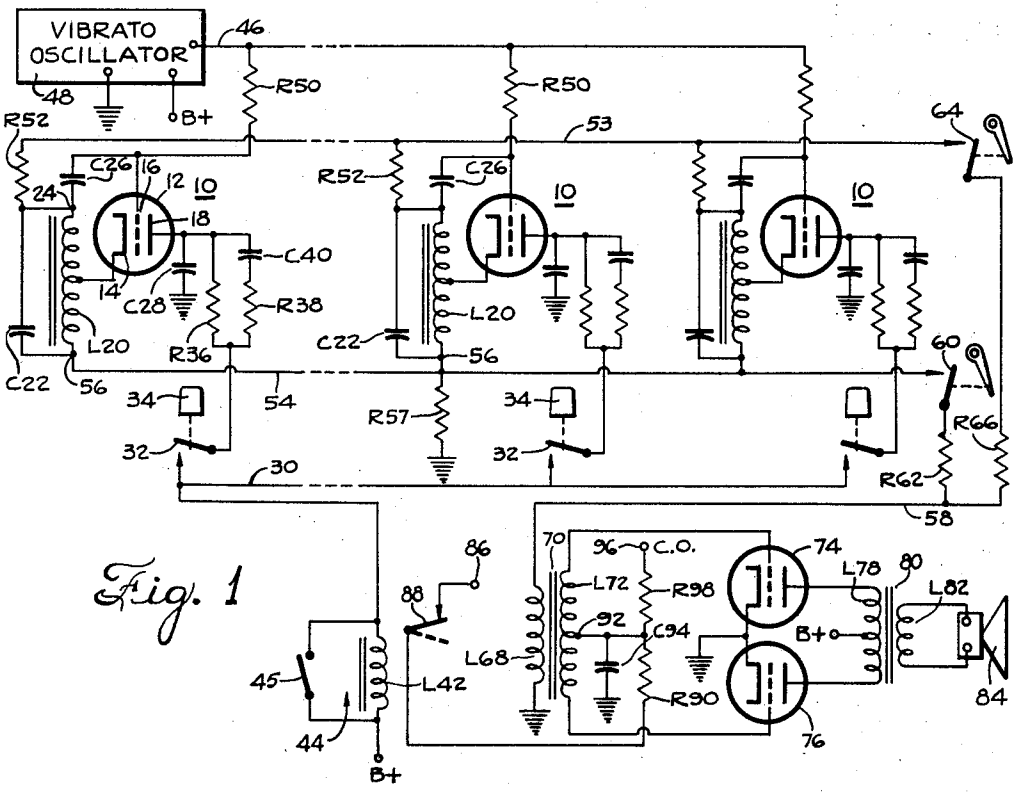
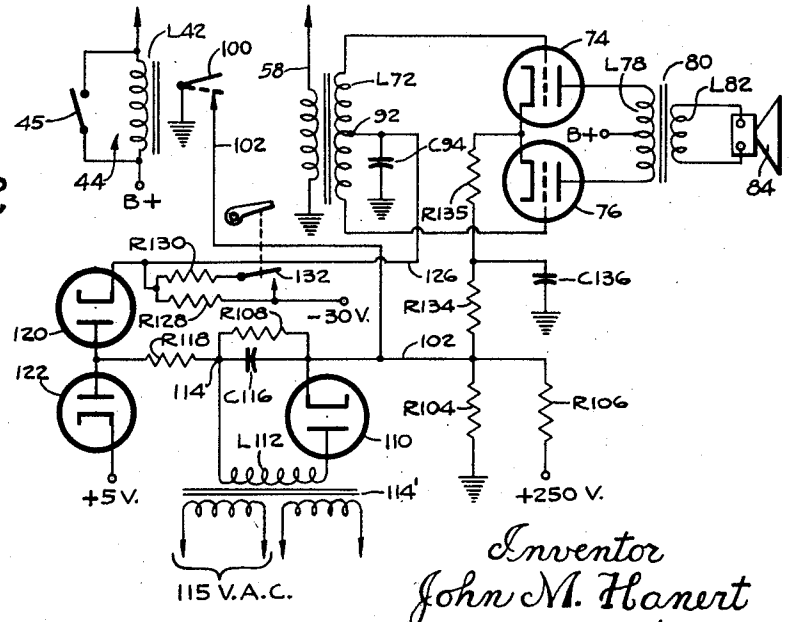


Fig. 1

Fig. 2



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PERCUSSIVE EFFECT FOR ELECTRICAL MUSIC INSTRUMENTS

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The invention relates generally to electrical musical instruments and more particularly to an instrument of the organ type in which improved means are provided for selectively obtaining a percussion effect in playing the instrument.

An object of the invention is to provide apparatus for causing tones of an electronic organ to be sounded with a percussion intensity envelope by playing the instrument in a non-legato manner.

Other objects will appear from the following description reference being had to the accompanying drawing in which:

Figure 1 is a schematic circuit diagram of representative portions of an electrical musical instrument incorporating the invention; and

Figure 2 is a similar diagram showing a modified form of output system of the instrument.

In Fig. 1 the instrument is illustrated as comprising a plurality of electronic oscillators **10**, the three oscillators shown being representative of the sixty-one tone signal generators employed in an electronic organ of conventional gamut. Each oscillator **10** comprises a triode **12** having a cathode **14**, a control grid **16**, and an anode or plate **18**. The cathode **14** is connected to a tap on an inductance L**20** which, with a capacitor C**22**, forms a resonant circuit which is mainly determinative of the frequency of oscillation of the oscillator. The values of the inductance L**20** and capacitor C**22** differ throughout the instrument and are such that the oscillators will oscillate at frequencies corresponding to the pitches of the semitone intervals of the musical scale. In other respects the oscillators may be substantially identical.

The control grid **16** is connected to an end terminal **24** of the inductance L**20** by a capacitor C**26**. The plate **18** is connected to ground through a capacitor C**28** to provide a by-pass for any unwanted high harmonic frequencies. Plate current is supplied to the plate **18** from a conductor **30** upon closure of a switch **32** operated by a playing key **34**. The switch is connected to the plate by load resistor R**36**, which is in parallel with a resistor R**38** the latter being in series with the capacitor C**40**. Plate current is supplied to the conductor **30** through the winding L**42** of a relay **44**, the winding L**42** being connected between the conductor **30** and a terminal B+ of the power supply for the instrument. The winding L**42** may be shunted by closure of a switch **45** to render the relay inoperable.

Each of the oscillators **10** has its grid **16** connected to an output conductor **46** of a vibrato apparatus **48**, the connection being through a decoupling resistor R**50**. The circuit including the resistor R**50** and vibrato oscillator **48** not only serves to vary the grid bias on the oscillator to vary its frequency of oscillation at a vibrato rate, but also provides a grid return to ground.

Signals of flute-like quality are derived from the oscillator through resistor R**52** which is connected between the end terminal **24** of the inductance L**20** and a signal collector conductor **53**. Signals of a string-like quality

are obtained through a collector conductor **54** which is connected to the other terminals **56** of the inductances L**20** and is connected to ground by a load impedance R**57**, illustrated as a resistor.

The conductor **54** is adapted to be connected to an output conductor **58** through a decoupling resistor R**62** upon closure of a manually operated switch **60**. Similarly, the flute-like tone signals appearing upon the conductor **53** are transmitted to the output conductor **58** through a decoupling resistor R**66** upon closure of a manually operable switch **64**.

The conductor **58** is connected to ground through the primary winding L**68** of an output transformer **70**. The secondary winding L**72** of this transformer has its end terminals connected respectively to the control grids of push pull triodes **74** and **76**. The cathodes of these triodes are shown as connected to ground and their plates connected to the end terminals of a primary winding L**78** of a transformer **80**. The secondary L**82** of this transformer is connected to a speaker **84**.

The triodes **74** and **76** are normally biased so that these triodes are fully conducting, such bias being provided from a terminal **86** of the power supply on which is maintained a fixed potential which when impressed upon the control grids of triodes **74** and **76** renders these triodes conductive of the signal derived from the secondary winding L**72**. The connection of terminal **86** to the control grids of triodes **74** and **76** is through a contactor **88**, forming a part of the relay **44**, which is normally in (full line) closed position, and a resistor R**90** which is connected to a center tap **92** of the secondary winding L**72**. This center tap is connected to ground through a capacitor C**94** and is connected to a terminal **96** of the power supply upon which an adjustable negative voltage is present of such value as completely or partially to cut off the triodes **74** and **76**, this connection to the terminal **96** being through a relatively high value resistor R**98**. The value of the resistor R**90** is much less than that of the resistor R**98**. The voltage division effected by these resistors is such that the triodes **74** and **76** are, when no key is depressed, in the condition to conduct the signal at the maximum desired amplitude.

Upon depression of a playing key **34** (switch **45** being open), plate current is conducted through the relay winding L**42**, energizing the latter, and through the low value resistor R**38** and capacitor C**40** provide an initial surge of plate current to insure fast starting of the oscillator. Also, during this starting instant and thereafter plate current is supplied to the oscillator through higher value load resistor R**36**. Immediately upon the commencement of oscillation the output of the oscillator associated with the depressed key will be impressed upon the output conductor **58**, the signal being of string or flute quality, or both, depending upon the positions of the switches **60** and **64**. Thus, immediately upon depression of the key the signal is transmitted through the control triodes **74** and **76** and translated into sound by the speaker **84**. However, due to the operation of the relay **44** and the moving of its contactor **88** to open (dotted line) position, the potential on the control grids of triodes **74** and **76** commences being reduced as the capacitor C**94** is discharged through resistor R**98** which, it will be recalled, is connected to the terminal **96**, the potential on which is such as to increase the bias on triodes **74** and **76** substantially, thereby greatly to reduce the amplitude of the conducted signal, and, if the potential on terminal **96** is adjusted to cut-off value, to reduce the signal amplitude to zero. The time constant of this circuit is preferably such as to cause fairly rapid decay of the tone and may be designed so that the tone intensity envelope will simulate that of a plucked string, marimba, or may have a longer time constant to simulate the tone intensity envelopes of

bells and chimes. Upon release of the key the relay **44** is deenergized and the conductor **88** thus returned to full line position so that the control tubes **74** and **76** are again rendered conductive almost instantly due to the relatively low value of resistor **R90**.

It may be noted that the instrument must be played in a non-legato or detached manner in order to obtain the percussion effect. When this effect is not desired the switch **45** is manually closed thereby preventing operation of the relay **44**. Because the triodes **74** and **76** are, when no key is depressed, biased to conduct the signal at the maximum desired amplitude, the tones produced have a sharp rapid percussion attack and longer decay. Such tones are musically useful in accenting certain passages of a musical score being played by an orchestra, emphasizing the rhythm or solo part, and otherwise introducing variety in the rendition of the music. It will be understood that various quality, volume, and expression controls, and the like, as are customary in electrical musical instruments will be provided. Such controls are disclosed in my prior Patent 2,645,968, granted June 21, 1953.

In lieu of the output system of the instrument shown in Fig. 1, an output system such as shown in Fig. 2 may be employed. Such parts of the apparatus as correspond to those described with reference to Fig. 1 have corresponding reference characters applied thereto, and the description thereof will not be repeated. In this embodiment of the invention the relay **44** operates a normally open contactor **100** which, upon energization of the relay, connects a conductor **102** to ground.

A potential of approximately +37 volts is maintained on conductor **102** by a voltage divider comprising resistors **R104** and **R106** connected in series between a +250 v. terminal of the power supply and ground. This potential is opposed by a potential of approximately 30 volts generated across a resistor **R108** of an ungrounded power supply. This power supply comprises a diode **110** having its plate connected to one terminal of a secondary winding **L112** of the power supply transformer **114'**. The other terminal of the secondary winding **L112** is connected to terminal **144** which in turn is connected to the cathode of the diode **110** by a capacitor **C116** which is in parallel with the resistor **R108**. The terminal **114** is connected by a low value resistor **R118** to the anodes of diodes **120** and **122**. The cathode of diode **122** is connected to a +5 v. terminal of the power supply and operates as a voltage regulator to prevent the potential on the plates of these diodes from exceeding +5 volts. This voltage also appears upon the cathode of diode **120** which is connected to the center tap **92** of secondary winding **L72** by a conductor **126**. The conductor **126** is connected to a −30 v. terminal of the power supply by a resistor **R128** of relatively high value and may additionally be connected to this terminal through a resistor **R130** of relatively low value upon closure of a manually operated switch **132**. The conductor **102** is connected to the cathodes of triodes **74** and **76** through series connected resistors **R134** and **R135** the junction of these resistors being connected to ground by a capacitor **C136**. Through this circuitry the cathodes are normally maintained at a potential close to +37 volts while the grids of these triodes are maintained at a potential of approximately +5 volts. However, upon energization of the relay **44** its conductor **100** closes to connect conductor **102** to ground which potential is almost immediately impressed on the cathodes of the triodes **74** and **76** thus rendering them conductive. Lowering the potential on conductor **102** to substantially ground renders the diodes **120** and **122** non-conductive and as a result the capacitor **C94** gradually discharges through resistor **R128** until the potential on the center tap **92** approaches −30 volts which is sufficient to bias the triodes **74** and **76** beyond cutoff. The rate of discharge of the capacitor **C94**, and hence the rate of decay of a tone may be increased by closing switch **132** so that the resistance of the path through the capacitor **C94** can discharge is substantially lessened. As soon as the playing key is released and the relay **44** deenergized the potential on conductor **102** is immediately raised to approximately +37 volts and the system is thus reconditioned for operation upon depression of the next key.

While I have shown and described a particular embodiment of my invention, it will be apparent to those skilled in the art that numerous modifications and variations may be made in the form and construction thereof, without departing from the more fundamental principles of the invention. I therefore desire, by the following claims, to include within the scope of my invention all such similar and modified forms of the apparatus disclosed, by which substantially the results of the invention may be obtained by substantially the same or equivalent means.

I claim:

1. In an electrical musical instrument having electron discharge device oscillators for the generation of musical tone signals, said oscillators being normally non-oscillating and being caused to oscillate by supplying current thereto, playing keys, a current supply conductor common to all the oscillators, switches operated by the keys to connect said conductor to the oscillators respectively, a source of electric energy, a relay having a winding, means connecting said winding between said conductor and the source of electrical energy, an output system coupled to the oscillators to receive the tone signals generated thereby and including amplitude control means responsive to the bias potential supplied thereto, biasing means forming part of the control means and biasing said control means to transmit tone signals at high amplitude, and means interposed in the biasing means controlled by the relay, upon energization thereof when a key operated switch is closed, to cause a gradual change in the bias on the control means in a sense to effect a reduction in the amplitude of the signals transmitted, thereby to cause the tone to be produced with a percussive intensity envelope.

2. In an electrical musical instrument having electron discharge device oscillators for the generation of electrical musical tone signals, said oscillators being normally non-oscillating and being caused to oscillate by supplying current thereto, playing keys, a current supply conductor common to all the oscillators, switches operated by the keys to connect said conductor to the oscillators respectively, a source of electric energy, a relay having a winding, means connecting said winding between said conductor and one terminal of the source of electrical energy, return conductors from the oscillators to the other terminal of the source, an output system coupled to the oscillators to receive the tone signals generated thereby and including amplitude control means responsive, to the bias potential supplied thereto, biasing means forming part of the control means and normally biasing said control means to transmit tone signals at high amplitude, and means interposed in the biasing means controlled by the relay, upon energization thereof when a key operated switch is closed, to cause a gradual change in the bias on the control means in a sense to effect a reduction in the amplitude of the signals transmitted, thereby to cause the tone to be produced with a percussive intensity envelope.

3. In an electrical musical instrument having electron discharge device oscillators for the generation of musical tone signals, said oscillators being normally non-oscillating and being caused to oscillate by supplying current thereto, playing keys, a current supply conductor common to all the oscillators, switches operated by the keys to connect said conductor to the oscillators respectively, a source of electric energy, a relay having a winding, means connecting said winding between said conductor and the source of electrical energy, an output system coupled to the oscillators to receive the tone signals generated thereby and including means responsive to the bias potential supplied thereto, and means interposed in

the amplitude control means controlled by the relay, upon energization thereof when a key operated switch is closed, to change the bias potential supplied to the control means to a value to cause high amplitude transmission of the signal through the control means to the output system, and means forming part of the control means and operable immediately after the bias on the control means has caused the transmission of the signal at high amplitude, to cause a gradual change in the bias on the control means in a sense to effect a reduction of the amplitude of the signals transmitted thereby to a low amplitude, thereby to cause the tone to be produced with a percussive intensity envelope.

References Cited in the file of this patent

UNITED STATES PATENTS

2,301,871	Hanert	Nov. 10, 1942
2,310,429	Hanert	Feb. 9, 1943