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[54] ELECTRIC VARIABLE TONE PERCUSSION INSTRUMENT

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[58] **Field of Search** ..... 84/DIG. 12, DIG. 13, DIG. 8, 84/DIG. 7, 1.01, 1.24, 1.26; 331/111, 117

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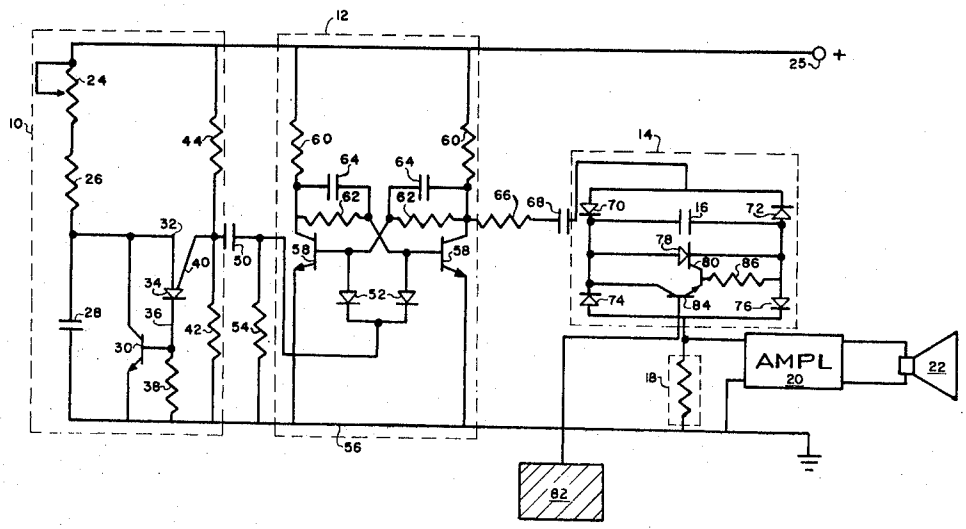
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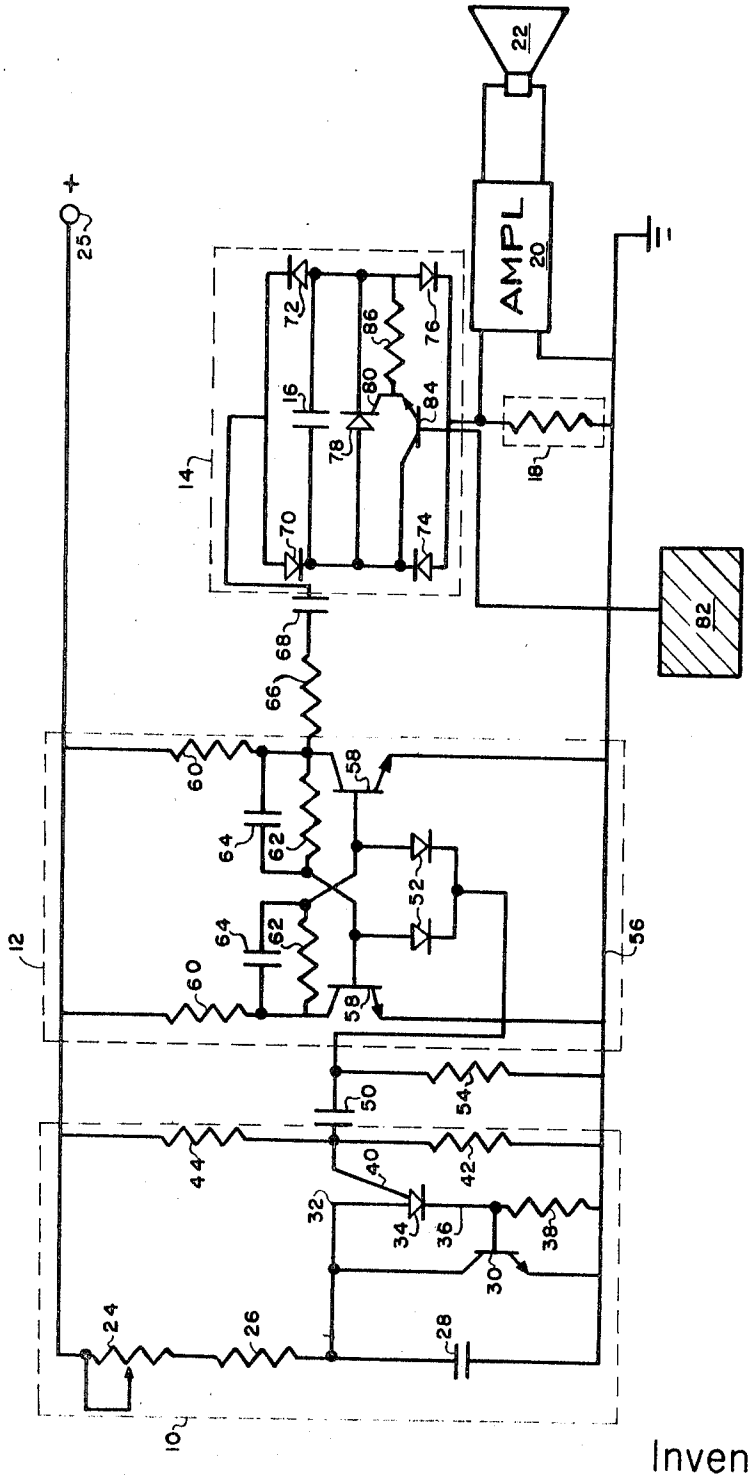
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[57] **ABSTRACT**

An electric variable tone percussion instrument comprises a source of periodic signals, storage means coupled to the source of periodic signals, output means coupled to the source of periodic signals, output means coupled to the storage means and switching means coupled to the storage means, the switching means normally being in a non-conducting state, the storage means being charged to a maximum storage voltage and the output means producing an minimum output voltage while the switching means is in the non-conducting state, the storage means discharging and the output means producing a maximum output voltage when the switching means is in a conducting state, the switching means immediately returning to the non-conducting state causing the storage means to charge towards the maximum storage voltage while the output means produces an exponentially decaying output voltage signal.

11 Claims, 1 Drawing Figure





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ELECTRIC VARIABLE TONE PERCUSSION INSTRUMENT

BACKGROUND OF THE INVENTION

This invention relates to a musical instrument, and more particularly, to an electric variable tone percussion instrument.

Interest in electric musical instruments has soared in recent years. There are electrical organs, guitars and other instruments which find widespread and increasing usage and enjoy great popularity. In the field of percussion instruments, a wide variety of prior art devices exist. These devices have attendant disadvantages. They are relatively expensive and frequently are quite fragile. Additionally, the tone produced can generally be varied only within a half or, at most, a single octave range and the tone produced lacks the fullness and richness desired for such an instrument. Such prior art devices have included twin-T-RC networks used as oscillators producing sinusoidal signals where the tone produced by the percussion instrument is tunable generally over one-half an octave. This limitation on the variation of the frequency of the signal or tone produced by the instrument hampers the versatility of such instruments.

An object of my invention is to provide an improved electric variable tone percussion instrument.

Another object of this invention is to provide an electric variable tone percussion instrument utilizing solid state devices.

Another object of this invention is to provide such a device which is relatively reliable in operation and sturdy.

Still another object of my invention is to provide such a device which is capable of producing a tone with a frequency variable over the entire audible range.

Yet another object of this invention is to provide such a device which produces a rich, deep, full quality tone.

Another object of my invention is to produce such a device which is relatively inexpensive to manufacture yet reliable, attractive and compact.

Other objects, advantages and features of this invention will become more apparent from the following description.

SUMMARY OF THE INVENTION

In accordance with the principles of my invention, the above objects are accomplished by providing an electric variable tone percussion instrument comprising means to produce a periodic signal, storage means connected to the means to produce the periodic signal, output means connected to the storage means and switching means to discharge the storage means and provide an exponentially decaying signal across the output means.

In accordance with a feature of the invention, the periodic signal is produced by a sawtooth wave generator being applied to the input of a bistable multivibrator (flip-flop), the output of which is AC coupled to the input of a bridge modulator having a capacitor connected across the bridge modulator. A resistor or load is connected across the output of the bridge modulator and the capacitor will charge to a predetermined level, approximately the level of the supply voltage for the flip-flop, and remain in that state until discharged. A touch sensitive device is connected to the gate of a thyristor which when switched ON causes the capacitor to discharge, allowing a voltage to be present across the output load resistor. As the capacitor begins to charge again, the output across the resistor decays exponentially, thus providing an exponential decay signal which is amplified and supplied to a speaker.

The frequency of the sawtooth wave generator is variable and can transcend the entire audible range thus providing an improvement over prior art devices where the frequency of the tone produced was variable generally within one-half an octave. Additionally, the touch sensitive device can be used to simulate a percussion instrument such as a drum so that as the instrument is played, an electrical signal will be produced which is variable over the entire audible range.

As another feature of my invention, the sawtooth wave generator is provided with transistor means for insuring the turn-off of a programmable unijunction transistor (PUT) utilized in the generator. The use of the transistor means insures the holding current through the PUT is not maintained after the PUT is switched ON. Further, the transistor means permits a wide frequency adjustment to be achieved which is relatively insensitive to current variations, even though the PUT is utilized.

As another feature of my invention, the flip-flop is utilized to produce square wave pulses adding a wide range of frequencies in the signal produced thereby. Such a wide range of frequencies produces an extraordinary fullness and richness of tone which is not achievable with prior art devices where a sinusoidal signal is utilized.

IN THE DRAWING

The accompanying FIG. is a schematic diagram of an embodiment of my invention.

DETAILED DESCRIPTION

My invention is capable of being produced as a solid state device and is susceptible of being made on a printed circuit board or as a hybrid circuit. This provides for maximum reliability and minimum size.

The variable tone percussion instrument is provided with a sawtooth wave generator **10** supplying an output to a flip-flop **12**. The output of the flip-flop **12** is AC coupled to a diode modulator bridge **14** which includes a storage capacitor **16**. The output of the bridge **14** is connected across a load resistor **18** which provides an output signal carried through amplifier **20** and supplied to a speaker **22**. The output produced by flip-flop **12** is generally a periodic signal and, as a feature of the invention, is a square wave signal which, when AC coupled to the modulator bridge **14**, goes both positive and negative with respect to ground.

The sawtooth wave oscillator **10** is a relaxation type and is provided with a variable resistor or potentiometer **24** connected at one side to a source of positive potential and connected through a fixed resistor **26** to a capacitor **28**. Additionally, resistor **26** is connected to the collector of an NPN-type transistor **30** connected in the grounded emitter mode, and to the anode **32** of a solid state switching device, such as a PUT **34**, having its cathode **36** connected through a load resistor **38** to ground. The gate **40** of PUT **34** is connected to a voltage divider formed by resistors **42** and **44** connected between the source of positive potential **25** and ground, with the connection point between resistors **42** and **44** being connected to the gate **40** of the PUT.

The relaxation type sawtooth oscillator operates to produce periodic pulses in the following manner: the voltage divider formed by resistors **42** and **44** maintains a fixed voltage at the gate electrode **40**. Capacitor **28**, connected through resistor **26** and potentiometer **24** to the source of positive potential **25**, charges with a time constant determined by the capacitor **28** and the total resistance in the series path. This total resistance is variable because of potentiometer **24**. While the voltage at anode **32** is increasing and is less than the gate voltage, the PUT is maintained in its normally OFF state. When the voltage at the anode **32** of PUT **34** slightly exceeds the voltage at gate electrode **40**, the PUT is caused to conduct. To ensure that the PUT turns OFF after it is conducting, transistor **30** is switched ON when PUT **34** conducts since a positive voltage is developed across load resistor **38**. The switching ON of transistor **30** pulls the collector voltage down to a value of several millivolts which ensures that the voltage across the PUT is maintained low and the current is drawn through transistor **30**, thus bypassing PUT **34**. By utilizing the transistor as a current by-pass or shunt, the value at which potentiometer **24** can be set may be widely varied without affecting the operation of the PUT. This follows because the holding current level required to hold the PUT conducting

after it is switched ON is not maintained once the transistor conducts. In this manner, a wide frequency variation can be produced which is relatively insensitive to the change in current resulting from the variation in the value of the potentiometer.

When PUT **34** conducts, a voltage spike is produced at the gate electrode **40** and is coupled through a capacitor **50** to the cathodes of steering diodes **52** of flip-flop **12**. A resistor **54** is connected from the cathodes of the steering diodes **52** to a point of reference potential or ground **56**. The flip-flop **12** is conventional and is provided with NPN-type transistors **58** having their collectors connected through load resistors **60** to a source of positive potential. A parallel combination of resistor **62** and capacitor **64** connects the collector of one of the transistors **58** to the base of the other transistor coupling the collector voltage to the base of the other transistor and changing the state of the flip-flop **12** with the occurrence of each spike at gate **40**. The flip-flop **12** serves as a frequency divider, and more importantly as a means coupled with sawtooth oscillator **10** to produce a periodic signal, which is a square wave symmetrical with respect to time. The frequency at which such square waves are produced at the collector of transistor **58** is dependent upon the time constant of the sawtooth relaxation type oscillator **10**.

The output of flip-flop **12** is connected through an AC coupler comprising a resistor **66**, having one end connected to the collector of one of the transistors **58** while the other end is connected through a capacitor **68** to one end of a diode bridge modulator **14**. The diode bridge modulator is provided with diodes **70**, **72**, **74** and **76**. The anode of diode **70** is connected to the cathode of diode **72** and to capacitor **68**. The cathode of diode **70** is connected to the cathode of diode **74** while the anode of diode **72** is connected to the anode of diode **76**. The cathode of diode **76** is connected to the anode of diode **74** and through load resistor **18** to the source of reference potential or ground **56**. A storage means or device, such as capacitor **16**, is connected across the diode bridge and is connected between the cathode of diode **70** and the anode of diode **72**. The diodes are connected in the conventional manner so that current can flow through capacitor **16** in only one direction, and since the AC coupling, including resistor **66** and capacitor **68**, couples the output of flip-flop **12** to the input of bridge modulator **14**, the capacitor **16** will charge to a predetermined value with a time constant determined by the value of capacitors **16** and **68**, resistors **66**, **60** and **18**, and the nominal resistance values of the diodes when conducting. Resistor **66** also serves as a decoupler to minimize the loading down of the output of flip-flop **12**. The capacitor **16** will charge to the predetermined value and maintain that charge, and therefore, zero current flows through the bridge and across output resistor **18** providing a zero voltage level across the resistor.

In accordance with a feature of my invention, a switch means, such as a gated silicon control rectifier (SCR) **78** is utilized to discharge capacitor **16**. The gated SCR serves as a conventional switching device and its anode and cathode are connected across capacitor **16**. The SCR operates in the following manner: it is in a non-conducting state until a triggering pulse is applied to the gate **80** of the SCR **78** which causes the SCR to conduct. It will conduct as long as the current flowing therethrough is greater than a holding current level. When a person's finger or hand touches a touch sensitive contact **82**, the capacity of the contact changes slightly and stray RF or AC signals which are induced in the body become amplified by an NPN-transistor **84**. The collector of transistor **84** is connected to the anode of SCR **78** while the emitter of transistor **74** is connected to the gate electrode **80** and through a gate load resistor **86** to the anode of diode **72**.

The bridge modulator operates in the following manner: the capacitor **16** charges to the predetermined level and will maintain that charge as long as SCR **78** is non-conducting. When the finger or hand touches touch sensitive contact **82**, SCR **78** is triggered, capacitor **16** discharges completely through the SCR thus causing a DC current to flow through the bridge and load resistor **18**, thereby providing a maximum voltage signal across the resistor. The holding current level required to keep the SCR **78** in its conducting state is not maintained and thus SCR **78** immediately turns OFF, thereby allowing capacitor **16** to recharge. The recharging of capacitor **16** causes an exponentially decaying signal to appear at the output of the device, that is across resistor **18**. It must be remembered that the signal supplied to the input of the bridge modulator **14** is a square wave produced by the flip-flop **12** having a frequency determined by the value of potentiometer **24**. Therefore, the exponentially decaying signal appearing across resistor **18** is a square wave signal which is exponentially decaying in amplitude. It is well known that square wave signals contain a multitude of harmonics, and the signal provided across resistor **18** which is carried through amplifier **20** and supplied to speaker **22** is a rich, deep, full tone which is capable of being varied over the entire audible range. The exponential decay across resistor **18** is responsible for the percussive sound, and it has been found that the sound produced is extremely attractive and interesting and not available with prior art devices.

In accordance with a feature of my invention, the gate load resistor **86** ensures that SCR **78** will not conduct inadvertently. The gate load resistor also increases the holding current level of the SCR which prevents the conducting state being maintained after it initially is switched ON.

It may be understood that my invention provides a signal which is rich in harmonic content and when amplified by amplifier **20** and supplied to speaker **22**, will produce an unusual, interesting and attractive sound or tone.

It can be appreciated that any signal source providing a specific or finite number of periodic signal may be applied to the input of modulator **14**, and the flip-flop utilized in my invention provides the additional advantage of producing a signal rich in harmonic content at the output. The exponential decay rate may also be varied by changing the RC time constant in the path including capacitors **16** and **68** and resistors **66**, **60** and **18**. This variation may be conveniently achieved by making resistor **66** a potentiometer.

Touch sensitive contact **82** is also illustrative of a device which is sensitive to the signals carried in a person's body, but any device sensitive to the movement of hands could be utilized to trigger the SCR to produce the exponentially decaying output signal produced by my invention. For instance, a photocell could be used and the degree of shading obtained in a light field as sensed by the photocell would determine whether or not the SCR were to be switched ON and could simultaneously be used to adjust or vary the frequency of the relaxation type oscillator. As an alternative, the photocell arrangement could be used solely for determining the frequency output of the variable tone device with the frequency continuously variable as the amount of light within the field of the photocell is varied.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above apparatus without departing from the scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. An electric variable tone percussion instrument comprising a source of a finite number of periodic signals, means connected to said source for continuously varying the frequency of said periodic signals, bridge modulator means coupled to said source, said bridge modulator means contains a storage means output means coupled to said bridge modulator means, and switch means coupled to said storage means, said switch means normally being in a non-conducting state, said storage means being charged to a maximum voltage and said output means producing a minimum output voltage while said switch means is in said non-conducting state, said storage means discharging and said output means producing a maximum output voltage when said switch means is in a conducting state,

said switch means immediately returning to said non-conducting state causing said storage means to charge towards said maximum storage voltage while said output means produces an exponentially decaying output voltage signal.

2. An electric variable tone percussion instrument as set forth in claim 1, wherein said periodic signals are square waves.

3. An electric variable tone percussion instrument as set forth in claim 2, wherein said storage means is a capacitor.

4. An electric variable tone percussion instrument as set forth in claim 1, wherein said means for varying the frequency of said periodic signals comprises means for varying said frequency continuously through the audio range.

5. An electric variable tone percussion instrument as set forth in claim 4, wherein said means for adjusting the frequency is a potentiometer, and said source of periodic signals includes a solid state switching device, said potentiometer being coupled to said switching device, and means for returning said switching device to a non-conducting state after said switching device conducts by maintaining the amount of current flowing through said switching device at less than a holding current level independently of the setting of said potentiometer.

6. An electric variable tone percussion instrument as set forth in claim 5, wherein said means for returning includes a transistor being caused to conduct when said switching device conducts.

7. An electric variable tone percussion instrument as set forth in claim 4, wherein said source comprises a relaxation type oscillator coupled to a bistable multivibrator, said oscillator including a programmable unijunction transistor having an anode, cathode and gate electrodes, said programmable unijunction transistor being non-conducting when the voltage at said anode is less than the voltage at said gate electrode, a capacitor and a potentiometer connected between a source of positive potential and ground, said capacitor being coupled to said anode and charging in accordance with a time constant determined by said capacitor and said potentiometer, said programmable unijunction transistor conducting when said capacitor charges to a voltage greater than the voltage at said gate electrode, a transistor having base, emitter and collector electrodes, said base electrode being connected to said cathode electrode, said collector electrode being connected to said anode electrode and said emitter electrode being connected to ground, said transistor conducting when said programmable unijunction transistor conducts ensuring that said programmable unijunction transistor becomes non-conducting after becoming conducting.

8. An electric variable tone percussion instrument as set forth in claim 1, including a touch sensitive contact, said switch means being triggered into said conducting state when said touch sensitive contact is manually touched.

9. An electric variable tone percussion instrument as set forth in claim 3, said bridge modulator means including diode means connected to said capacitor for allowing current to flow through said capacitor in only one direction enabling said capacitor to charge to said maximum storage voltage.

10. An electric variable tone percussion instrument as set forth in claim 9, wherein said bridge modulator means having an output, said output means being connected across said output of said bridge modulator.

11. An electric variable tone percussion instrument as set forth in claim 10, wherein said switch means is connected across said capacitor, said switch means being provided with a gate electrode connected to a touch sensitive contact, said touch sensitive contact producing a triggering signal when manually touched causing said switch means to be in a conducting state discharging said capacitor.

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