

[54] **RIM-SHOT-SOUND-PRODUCING  
DEVICE FOR AN ELECTRONIC  
MUSICAL INSTRUMENT**

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84/1.24  
[51] Int. Cl. ....G10h 3/00  
[58] Field of Search .....84/1.01, 1.13, 1.24, 1.26

[56]

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[57]

**ABSTRACT**

The rim shot sound of a snare drum is simulated. Upon manipulation of a key switch, a percussive sine wave having a sudden buildup and a subsequent decay is obtained. The percussive sine wave signal is introduced into a clipper circuit wherein the wave peaks in the beginning portion having great amplitude are clipped. The signal is then passed through a differentiation circuit, from which is obtained a percussive signal with harmonics richer in the beginning portion and less toward end.

**5 Claims, 4 Drawing Figures**

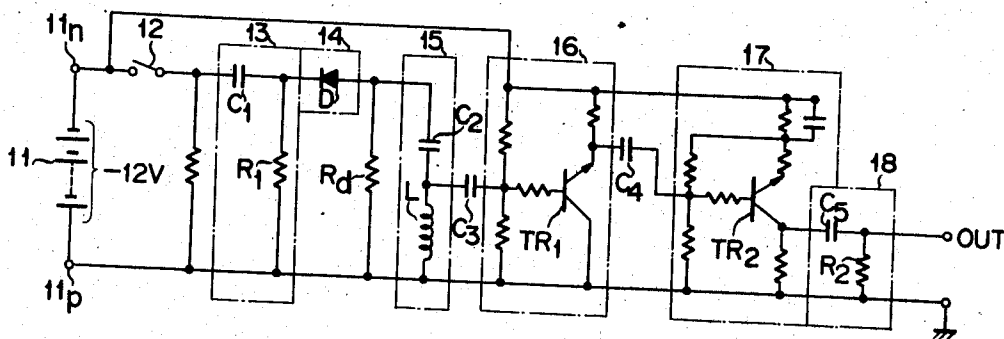


FIG. 1

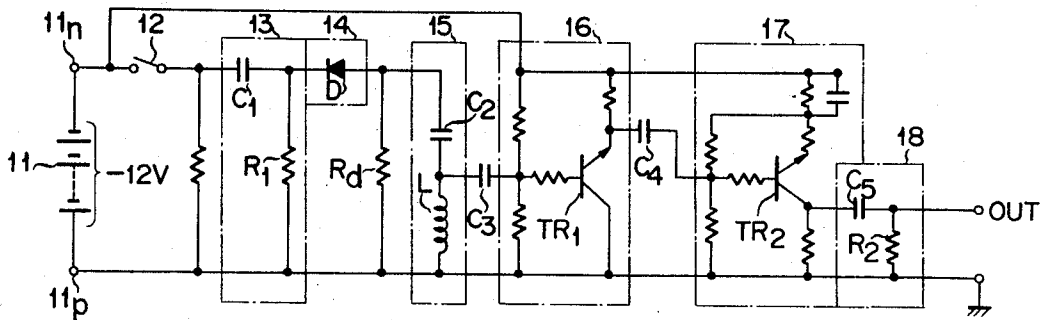


FIG. 2A

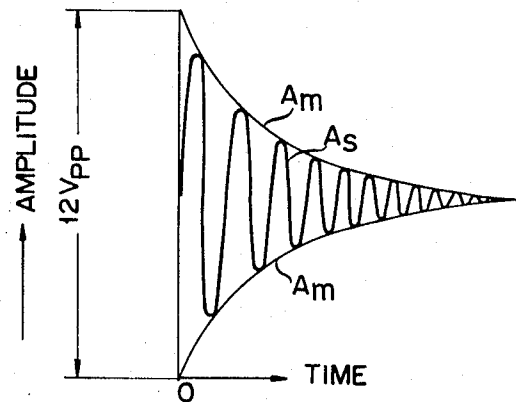


FIG. 2B

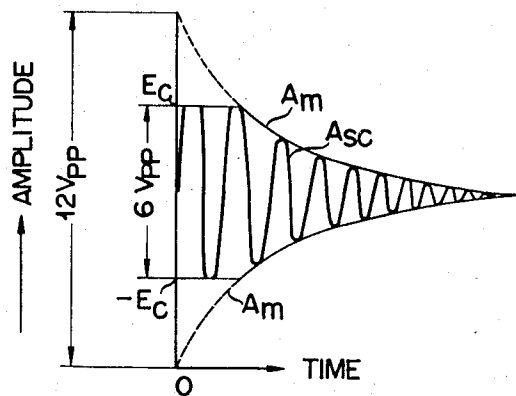
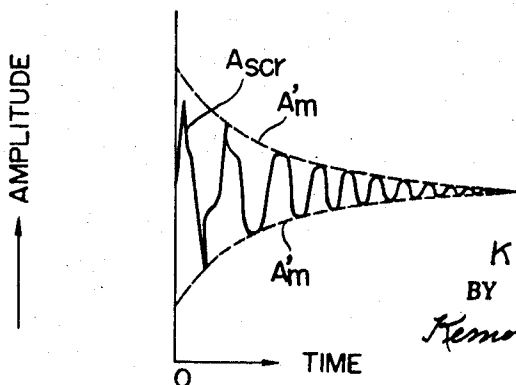


FIG. 2C



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## RIM-SHOT-SOUND-PRODUCING DEVICE FOR AN ELECTRONIC MUSICAL INSTRUMENT

### BACKGROUND OF THE INVENTION

This invention relates to a rim shot sound producing device and more particularly to a rim shot sound producing device for an electronic musical instrument which is capable of simulating such sounds as would be produced on a snare drum when its rim is struck by the body of a stick with its tip end being in contact with the beating membrane of the drum.

In the field of electronic musical instruments, for example, an electronic organ, there has recently been more favorably accepted a type capable of playing not only ordinary melody tones and those of accompaniment by selective depression of a plurality of keys arranged in the order of musical notes but also various percussion sounds as derived from a snare drum, bass drum, cymbals, conga and bongos.

With respect to, for example, the snare drum included in the aforesaid percussion instruments, there are sometimes played during actual performance not only the ordinary drum percussion sounds by striking the surface of a drum membrane with the tip end of a stick but also special percussion sounds by knocking the drum rim with the body of the same stick.

To date, however, there has not been made available an electronic musical instrument capable of playing such rim shot like sounds. This is, so to speak, a disgrace to an electronic musical instrument which is generally deemed and strongly demanded to be essentially capable of producing sounds or tones as much resembling as possible those of all natural musical instruments.

It is, therefore, the object of this invention to provide a rim shot sound producing device for an electronic musical instrument thereby to enable said instrument more truthfully to approach the tones or sounds produced by all natural instruments.

### SUMMARY OF THE INVENTION

According to an aspect of this invention, there is provided a rim shot sound producing device for an electronic musical instrument comprising: a key switch, circuit means for producing a percussive sine wave signal having a sudden buildup and a subsequent decay upon manipulation of the key switch, a clipper circuit connected to the above-mentioned circuit means to clip the wave peaks of the percussive sine wave signal in the beginning portion thereof having great amplitudes, and a differentiation circuit to pass the clipped signal from the clipper, thus producing a rim shot sound.

### BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 represents a concrete circuit arrangement of a rim shot sound producing device according to an embodiment of this invention; and

FIGS. 2A to 2C illustrate concrete output waveforms from the main section of the circuit arrangement of FIG. 1.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

It will be noted that the rim shot sound obtained by striking the rim of a snare drum with the body of a stick is characterized by the waveform which tends to rise sharply at the time of striking, gradually (but rather fast) decay with time, contain the largest amount of harmonics (mainly including odd order harmonics) at the rise time and lose the harmonics progressively toward the end of the decay into the form of a substantially pure tone only consisting of the fundamental sine wave.

FIG. 1 shows a concrete circuit arrangement of a rim shot sound producing device according to an embodiment of this invention which is capable of playing sounds closely resembling actual rim shots. A DC source 11 (-12 volts) has one of its paired terminals, for example, a positive terminal 11<sub>a</sub>, grounded. To the other negative terminal 11<sub>b</sub>, of the source 11 is connected a series resonance circuit 15 including a capacitor C<sub>2</sub> and an inductor L connected in series successively, through a normally open key switch 12, a differentiation cir-

cuit 13 consisting of a capacitor C<sub>1</sub> and a resistor R<sub>1</sub>, and a rectifier 14 having a diode D connected in the forward direction.

Under the aforementioned arrangement, when the switch 12 is closed by the manipulation of the associated key, the differentiation circuit 13 is impressed with the negative source voltage (-12 volts). In this case, there is obtained differentiated output voltage which sharply rises through the differentiation circuit 13 at the moment of said voltage impression, that is, only when the switch 12 is closed, and then rapidly falls with time representing a percussive pulse envelope. Thereafter, the negative source voltage is blocked by the charged capacitor C<sub>1</sub> and is not conducted to the output side of the differentiation circuit 13.

The differentiated output voltage thus obtained from the circuit 13 is rectified while passing through the rectifier 14 and supplied to the series resonance circuit 15. From the series resonance circuit 15, therefore, is generated a sine wave signal A<sub>s</sub> of a predetermined frequency having a percussive envelope characteristic whose maximum amplitude section A<sub>m</sub> sharply (suddenly) rises at the moment the switch 12 is closed and subsequently decays with time. In this case, the frequency of the sine wave signal A<sub>s</sub> is determined by the capacitance of the capacitor C<sub>2</sub> and the inductance of the inductor L. The envelope characteristics of the maximum amplitude section A<sub>m</sub> are determined by the damping period of the series resonance circuit 15, that is, the magnitude of Q thereof as well as by the time constant derived from the product of the capacitance of the capacitor C<sub>1</sub> and the resistance of the resistor R<sub>1</sub> constituting the differential circuit 13. Needless to say, the above-explained circuit producing a percussive sine wave signal may be constructed otherwise according to the known circuit technique. The resonance circuit 15 may be a parallel resonance circuit, too.

The present inventors' experiments show that the rim shot sound generated from, for example, a snare drum has a waveform which, mainly at the time of rise, contains large amounts of odd order harmonics with respect to the fundamental frequency component of about 600 Hz. and subsequently decays in about 20 ms. in the form of a sound approaching a pure tone having a substantial sine wave. The inventors' experiments have also found that where it is desired to produce sounds resembling the rim shots of a snare drum using the aforesaid circuit arrangement, it is preferred to set the frequency of the series resonance circuit 15 at about 600 Hz. in advance and set the decaying period thereof to about 20 ms. (said experiments further show that, to this end, the time constant of the differentiation circuit 13 should preferably be set at about 40μs.). Referring to FIG. 1, a resistor R<sub>4</sub> connected in parallel with the series resonance circuit 15 is a damping resistor provided, if required, for proper control of the decaying period of the resonance circuit 15, that is, the magnitude of Q value thereof.

However, the output signal A<sub>s</sub> of FIG. 2A obtained from the series resonance circuit 15 only consists of a substantial sine wave of about 600 Hz. little containing harmonics from the time of rise to the extinction. Accordingly, said signal, as it is, will only produce sounds considerably different from the rim shots of the snare drum whose waveform should have the aforementioned characteristics.

Accordingly, this invention consists in conducting output signal A<sub>s</sub> from the series resonance circuit 15 having the waveform of FIG. 2A successively through a coupling capacitor C<sub>3</sub> and a transistor TR<sub>1</sub> constituting an amplifier 16 for proper amplification and passing the signal thus amplified successively through a coupling capacitor C<sub>4</sub> and, for example, a transistor TR<sub>2</sub> included in a saturation amplifier acting as a clipper 17 so as to clip the relatively high-amplitude peaks of the beginning portion at a proper amplitude level E<sub>c</sub>, for example, a level (about 6 volts from peak to peak as indicated) equal to about half an initial maximum amplitude (about 12 volts from peak to peak as indicated) and drawing out the clipped signal A<sub>sc</sub> through another differentiation circuit 18

consisting of a capacitor  $C_3$  and resistor  $R_2$  and cascade connected to the clipper 17.

The above-mentioned circuit arrangement of this invention causes the maximum amplitude peaks of the beginning portion of output signal  $A_r$  from the resonance circuit 15 to be clipped by the clipper 17 as shown in FIG. 2B after proper amplification by the amplifier 16, so that the clipped signal is substantially flattened at the peak section to be converted from a sine to a rectangular waveform. When the clipped signal  $A_{sc}$  from the clipper 17 having a waveform shown in FIG. 2B is conducted through the differentiation circuit 18, then the beginning portion whose peak point has a maximum amplitude as described above is subjected to ordinary differentiation. Only this differentiated section of the clipped signal  $A_{sc}$  is made to contain proper amounts of harmonics with respect to the fundamental wave of 600 Hz. (depending on the time constant of the differentiation circuit 18, there may be additionally performed modulation). The nonclipped portion of the output signal  $A_r$  does not substantially undergo the aforementioned differentiation but is drawn out approximately in the form of a sine wave containing few harmonics, but in a smaller amplitude.

FIG. 2C shows an output waveform  $A_{scr}$  from the differentiation circuit 18. As apparent from the foregoing description, said output waveform  $A_{scr}$  can practically produce sounds closely resembling the rim shots of the snare drum.

The transistor  $TR_1$  included in the amplifier 16 of FIG. 1 is an emitter follower type so as to have a sufficiently high input impedance which would not give a loading effect to the series resonance circuit 15.

It will be apparent that generation of sounds resembling the rim shots of not only a snare but also a tenor or a bass drum can be easily effected by properly adjusting the time constant of the differentiation circuits 13 and 18 and the resonance frequency and the decaying characteristics or the magnitude of a Q value of the series resonance circuit 15.

What I claim is:

1. A rim shot sound producing device for an electronic musical instrument comprising: a key switch, circuit means for producing a percussive sine wave signal having a sudden build-up and a subsequent decay upon manipulation of said key switch, a clipper circuit connected to said circuit means to clip the wave peaks of said percussive sine wave signal in the beginning portion thereof having great amplitudes, and a differentiation circuit to pass the clipped signal from said clipper circuit.
2. The rim shot sound producing device according to claim 1 wherein said circuit means for producing a percussive sine wave signal comprises a circuit producing a percussive pulse and a resonance circuit triggered by said percussive pulse.
3. The rim shot sound producing device according to claim 1 wherein said resonance circuit consists of a capacitor and an inductor.
4. The rim shot sound producing device according to claim 3 wherein said resonance circuit further includes a damping resistor connected therein.
5. The rim shot sound producing device according to claim 1 wherein said clipper circuit consists of a saturation amplifier so designed as to clip at a substantially half voltage level of the maximum amplitude envelope portions.

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