June 30, 1970 B. J. PLUNKETT 3,518,352

RHYTHM GENERATING CIRCUIT FOR MUSICAL INSTRUMENT

Filed June 30, 1967 3 Sheets-Sheet 1

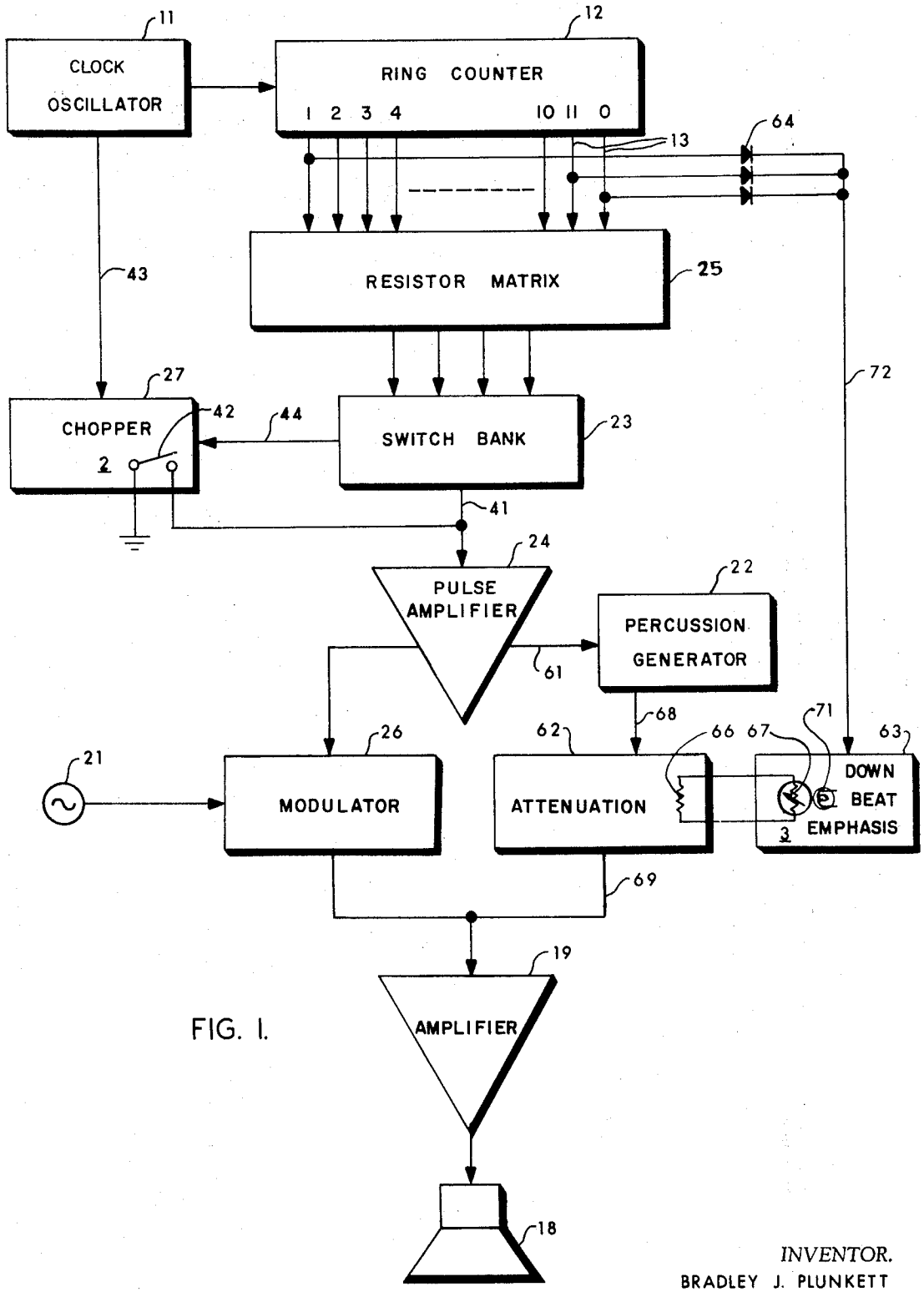


FIG. 1.

INVENTOR.
BRADLEY J. PLUNKETT

BY Warren T. Jessup
ATTORNEY

RHYTHM GENERATING CIRCUIT FOR MUSICAL INSTRUMENT

Filed June 30, 1967 3 Sheets-Sheet 2

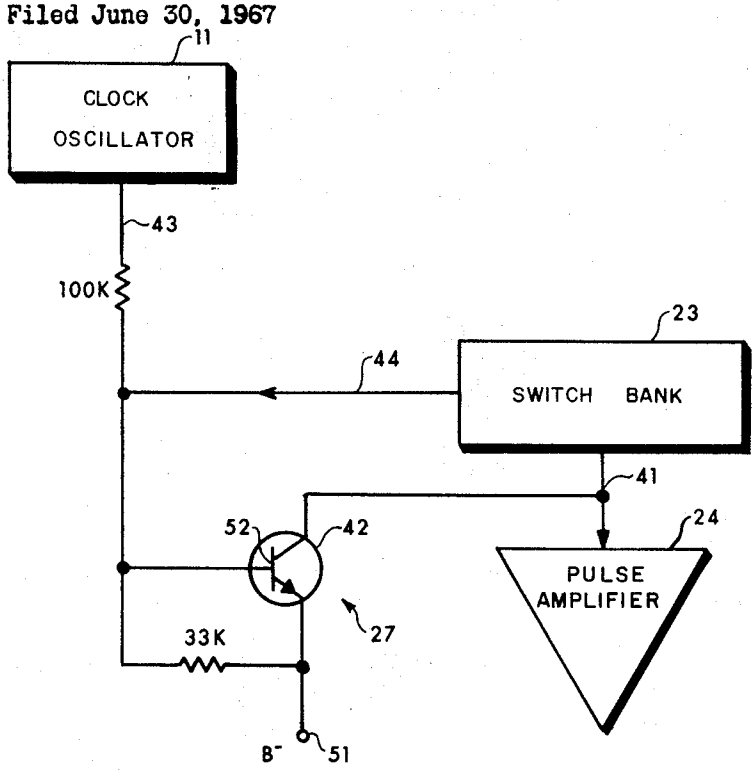


FIG. 2.

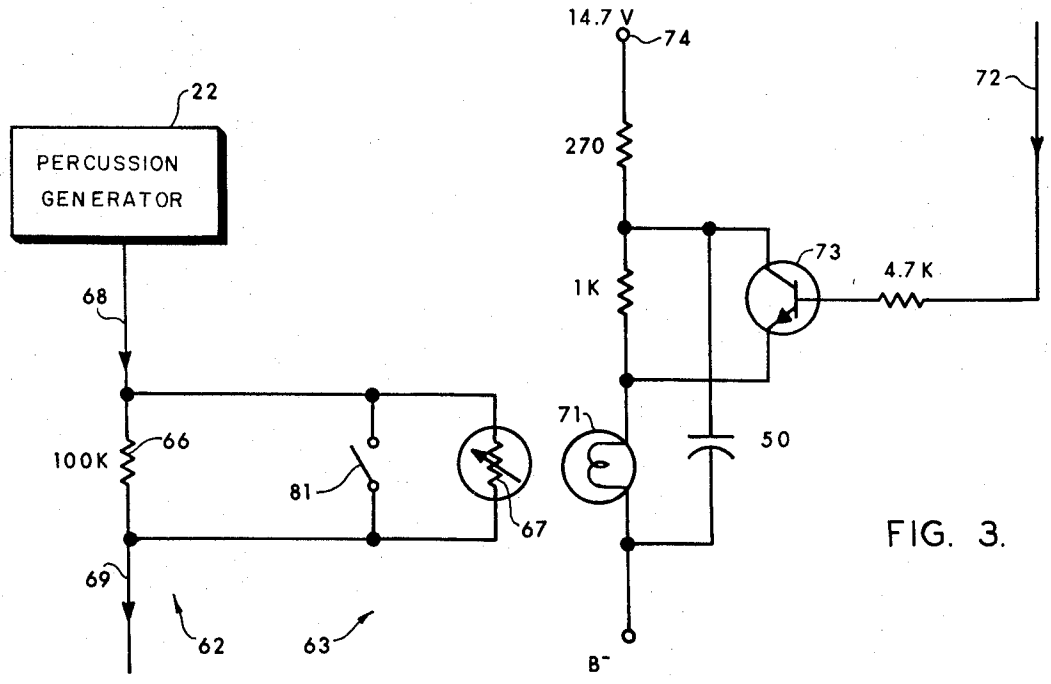


FIG. 3.

INVENTOR.
BRADLEY J. PLUNKETT
BY Warren T. Jessup
ATTORNEY

June 30, 1970 B. J. PLUNKETT 3,518,352

RHYTHM GENERATING CIRCUIT FOR MUSICAL INSTRUMENT

Filed June 30, 1967 3 Sheets-Sheet 3

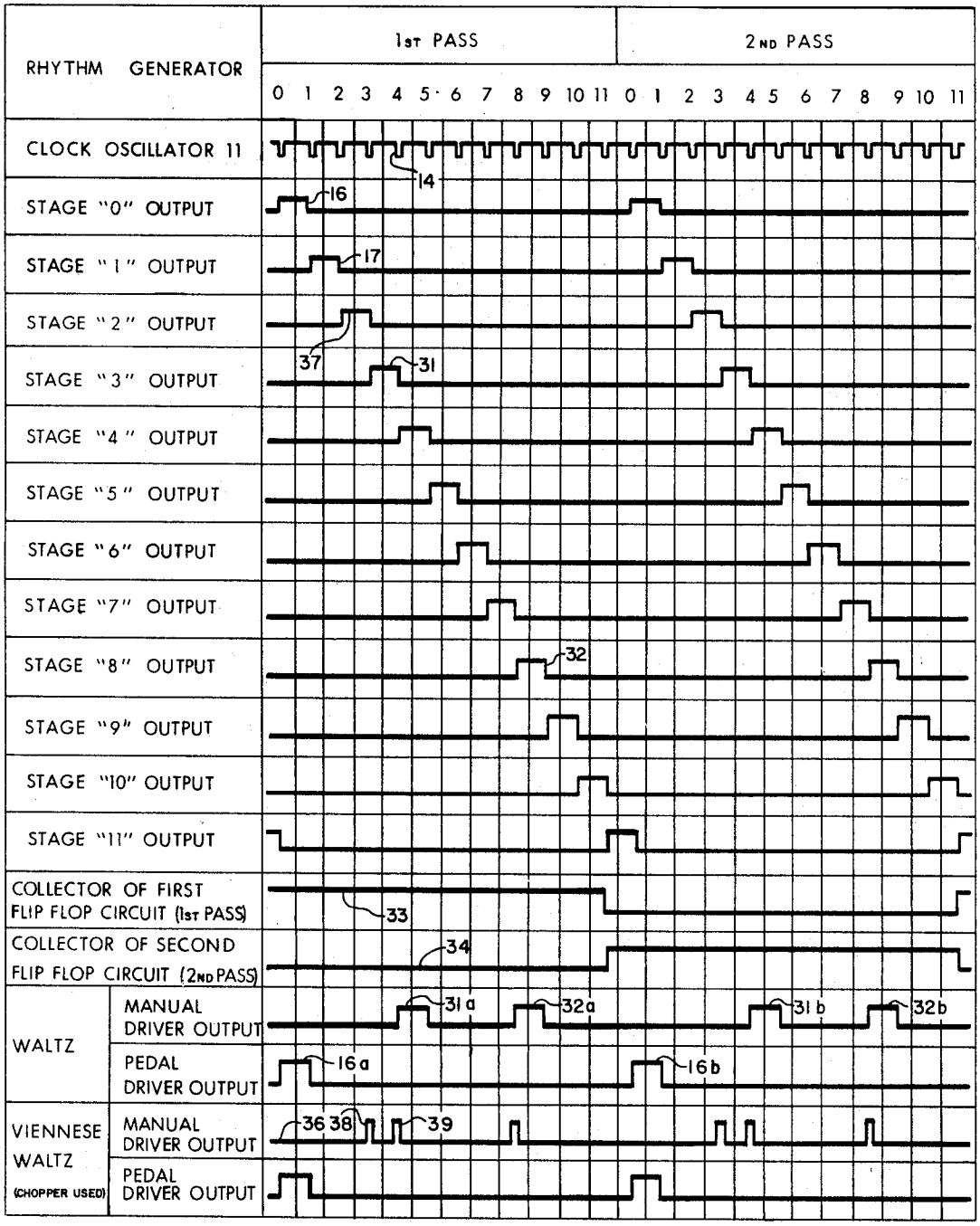


FIG. 4.

INVENTOR.
BRADLEY J. PLUNKETT
BY Warren T. Jessup
ATTORNEY

United States Patent Office 3,518,352
Patented June 30, 1970



3,518,352

# RHYTHM GENERATING CIRCUIT FOR MUSICAL INSTRUMENT

Bradley J. Plunkett, Sepulveda, Calif., assignor to Warwick Electronics Inc., Chicago, Ill., a corporation of Delaware

Filed June 30, 1967, Ser. No. 650,530
Int. Cl. G10f 1/00; G10h 1/02
U.S. Cl. 84—1.03 5 Claims

## ABSTRACT OF THE DISCLOSURE

A rhythm generating circuit comprises a clock oscillator driving a ring counter, the output of which is fed to a distribution matrix and thence to a bank of switches. The switches, individually, when operated, establish predetermined rhythm patterns, as for example preselected dance rhythms. Output from the switch bank serves to activate audio frequency sources, either through a modulator or by direct stimulation of the audio frequency. Emphasis means are provided for giving increased amplitude on each downbeat, i.e. on the first beat of each measure. Means are also provided for chopping or curtailing the beat, so that where a particular rhythm calls for rapidly recurring beats, they will be separated by an appreciable time interval.

## BACKGROUND OF THE INVENTION

It is known in the art to provide rhythm circuits having a clock oscillator which drives a ring counter, the output of which actuates various percussion tone simulators at preselected rhythm patterns. These rhythm patterns then constitute the envelopes for the percussion sounds, which are applied repetitively to the amplifier and speaker of the musical system.

## SUMMARY OF THE INVENTION

The present invention constitutes an improvement over the above described rhythm circuits, in the inclusion of certain circuits which provide emphasis of increased amplitude of the initial beat in each measure, thereby giving downbeat emphasis. Also, certain rhythms, particularly dance rhythms, call for beats which occur very close together. The beat signals generated by the ring counter normally occur one upon the other with minimal spacing between the two. Thus, if two contiguous beats are required, there is not enough separation to be distinguishable. The present invention provides a chopper or curtailing means which in effect shortens each output wave form of the ring counter, so that the beat pulses no longer run together but are separated by a measurable time interval. This makes possible the sounding of rhythms which require at certain points a very short interval between beats.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a block diagram illustrating the present invention.

FIG. 2 is a circuit diagram illustrating the circuit contents of one of the blocks constituting one of the improvements of the present invention.

FIG. 3 is a circuit diagram illustrating the contents of another block constituting a portion of the present invention.

FIG. 4 are synchronized wave forms of useful in understanding operation of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, **11** designates a clock oscillator which delivers repetitive, measured negative pulses to a



ring counter **12** having twelve output terminals **13**, numbered **1** through **11** and **0** as shown. In operation of the circuit, at any given moment there will be a signal in the form of a positive voltage on one and only one of the terminals **13**. Upon receipt of the next pulse from the clock oscillator **11** the next succeeding terminal **13** will go positive, so that a ring of positive square wave signals is constantly and successively applied around the terminals **13**. This is illustrated in FIG. 4, wherein **14** represents the clock or triggering impulses applied by the oscillator **11** to the ring counter **12**. The positive going pulse **16** represents the output at terminal or stage zero; **17** represents the output at stage **1**; and so on through and around the entire set of terminals **13**.

The pulses **16**, **17** serve to activate or enable passage of audio frequency signals to a loudspeaker **18** through an output amplifier **19** from a suitable audio frequency source. This source may be either one of musical tones of predetermined pitch, represented by the tone source **21**, or may be one or more specially generated percussive sounds represented by the source **22**. For purposes of initial illustration attention will be focused on the tone sources represented by **21**. Output from the ring counter **12** is selectively coupled to the tone sources **21** to rhythmically activate the sounding of such tone sources through the speaker **18**. This coupling means consists of a resistive distribution matrix **25**, a switch bank **23**, a pulse amplifier **24** and a modulating circuit **26**. For all or certain of the rhythms, the coupling circuit may also include a chopper or curtailing means **27**, driven directly from the clock oscillator **11**.

As is known in the art, actuation of one of the switches in the switch bank **23** will select through the matrix **25**, predetermined ring counter pulses **16**, **17** and apply them through the amplifier **24** to the modulator **26**, where they serve to selectively pass tones from **21** to the speaker **18** at the rhythm determined by the switch selection in **23**.

For simplicity's sake only one form of tone source **21** has been illustrated, being for example, the tone sources representative of a manual keyboard on an electronic organ. In actual practice it is customary to provide both pedal and manual keyboard tone sources, and to provide from the output of the switch bank **23** also selected pulses which actuate a pedal tone modulator corresponding to the manual modulator **26**. It is in such a context that FIG. 4 illustrates the pulse pattern.

By way of example, when the Waltz switch is actuated in the switch bank **23**, the zero beat or pulse **16** will be applied to the pedal modulator in the form of the pulse **16***a*. The number **4** beat or pulse **31** will be applied to the manual modulator **26** in the form of pulse **31***a*. The number **8** beat or pulse **32** will also be applied to the modulator **26** in the form of the pulse **32***a*. There will thus be provided a waltz beat rhythm in which the first beat is rendered through the pedal tones while the second and third beats are rendered through the manual tones.

A similar pattern is provided on the second phase or pass of each cycle of the ring counter **12** in the form of pulses **16***b*, **31***b*, and **32***b*. Each cycle of the ring counter consists of two stages or passes, the differenttial being achieved by a flip-flop circuit (not shown) interposed at the output of the switch bank **23** and creating the two gate signals shown at **33** and **34** respectively.' These flip flops form no part of the present invention and serve simply to allow the twelve position ring counter **12** to create effectively twenty-four rather than twelve different beats. It has been found in practice that from these twenty-four different beats all desired rhythm patterns can be created, even such complicated dances as bolero and tango.

When operation of this present rhythm circuit is not desired, the moduator **26** may be turned on constantly

by suitable switching (not shown). In this case it is preferred to incorporate some attenuation, for instance 6 db down, because the steady tones from the tone sources **21** sound louder to the ear than do the intermittent rhythmic tones when the modulator **26** is pulsed from the ring counter **12**. Thus, it is desirable to increase the volume slightly when the rhythm circuit is placed in operation.

Chopper

It will be noted that the pulse **16** and **17** occur contiguously in time without substantial quiescent period between them. Thus, if a particular rhythm calls for two such contiguous signals, there is no appreciable break between the two, and hence no discernible separation between the beats. This is illustrated for example at **36** in FIG. 4, where beat No. 3 (pulse **37**) and the contiguously occurring beat No. 4 (pulse **31**) are both employed. To separate these beats, means are provided in accordance with the present invention for chopping or curtailing the outputs from the ring counter **12**, so that there is appreciable time duration between termination of one modulating pulse and the onset of the other. This is illustrated at **38** where only the first portion of the pulse **37** is allowed to pass to the modulator **26**. Thus when the Viennese Waltz switch is actuated in the switch bank **23**, all pulses are curtained as shown by the chopped duration of pulses **38** and **39**.

This chopping is achieved at **27**, where the output appearing on terminal **41** of the switch bank **23** is killed or diverted, as shown schematically by the grounding switch **42**, except when the clock oscillator pulses **14** are applied through the line or connection **43** from the oscillator **11** directly to the chopper **27**. The chopper is placed in this condition of operation, as noted, by the closing of the Viennese Waltz switch in the switch bank **23**, which closing is sensed by a connection denominated **44** in FIG. 1. While it would be possible to curtail the pulses of all the rhythms by this placing them under the concurrent control of the switch bank output **41** and clock oscillator **11**, it is preferred to limit this operation only to those selected rhythms which require it.

The circuitry involved in the chopper **27** is shown in FIG. 2, where the grounding described hereinbefore is actually accomplished by passing the rhythm pulses from the terminal **41** to a B— connection **51** through a transistor **42**, which is rendered either substantially open circuit (high impedance) or substantially short circuit (low impedance) by the application of control voltage to its base **52**.

Referring to FIG. 2, the terminal **43** is connected to the clock oscillator **11** and has residing thereon a positive voltage, for example, +10.5 volts, except during those relatively short periods (approximately 30 milliseconds), when the pulses **14** are being delivered by the clock oscillator **11**. This positive voltage on the base **52** renders the transistor **42** conductive, so that point **41** during this condition is effectively tied to the B— terminal **51** and substantially bypasses the ring counter pulses **16**, **17** away from the pulse amplifier **24**. Under these circumstances no modulation is applied to **26**, and tone does not sound in the speaker **18** except during those regular 30 millisecond periods when the transistor **42** is in effect gated off by the receipt of clock pulses **14**. Even then of course modulation pulses pass to **24** only in accordance with the selected rhythms delivered from the switch bank **23**, for it is only then that there is output on **41** to be applied to **24**. Under these circumstances the selecter rhythm pulses pass in their rhythmic pattern to the amplifier **24**, but are shortened or curtailed from their normal duration, for example 50 to 500 milliseconds as shown at **16**, down to approximately 30 milliseconds as shown at **14**.

When the curtailing action is not desired, the terminal **44** is connected to B— through auxiliary switching in the switch bank **23**, operated in conjunction with those preselected rhythms which require curtailing. Thus, unless such a preselted rhythm switch is operated, e.g. Viennese Waltz, Tango, Bolero, the base **52** is held at B— potential, steadily gating the transistor to off or high impedance condition and creating no chopping of the normal ring counter output appearing at **41**. The selected rhythm switches may be connected in series, so that when anly one of them is actuated, the connection from terminal **44** to B— is broken, thereby rendering **42** conductive and applying B— to terminal **41**, except during those intervals when the clock pulses **14** are actually extant on the terminal **43**.



Downbeat emphasis

As noted, the present invention also contemplates a means for giving added emphasis to the down or zero beat in each measure.

Such downbeat emphasis may be applied to the musical tone sources **21**, but for purposes of illustration will be shown as being applied to the special percussion tones generated at **22**. Referring to FIG. 1 the ring counter output pulses **16**, **17** after amplification in **24** are routed to the percussion generators **22** through the channel shown at **61**, where they serve to activate the percussion tone generator. The output of the generators is then applied to the speaker **18** through an attenuating circuit **62**. The attenuating circuit is controlled by a downbeat emphasis circuit **63** which in turn is controled from terminals numbered **11**, **0** and **1** of the ring counter **12**, through "or" gates **64** represented by diodes as shown. The attenuating circuit **62** includes a resistor **66** which is paralleled by a variable resistor **67** in the circuit **63**, the magnitude of which is controlled from the ring counter **12**. When there is an output signal on terminals **11**, **0**, or **1**, the resistance of **67** is lowered appreciably, thereby lowering the series impedance interposed between the generators **22** and the loudspeaker **18**, and thus increasing the amplitude of said signals for the duration of those particular beats (**11**, **0**, and **1**).

The circuit of the downbeat emphasis **63** is shown in FIG. 3 where output from the tone generators **22** is applied through conductor **68**, through the fixed resistor **66**, and thence to the line **69** and to the output circuit **19**, **18**. The resistor **66**, as noted hereinbefore, is paralleled by a variable resistor **67**, in this case a light dependent resistor or LDR, the amplitude of which varies greatly depending upon the amount of light falling thereon from an incandescent light source **71**. When the light **71** is dark, the resistance **67** is relatively high. When the light source **71** is energized, the light therefrom renders **67** relatively low. Signal from the selected ring counter terminals is applied through the line **72** to the base of a transistor **73**, rendering it conductive, and causing the light **71** to be energized from a power source **74**. When there is no signal on **72**, transistor **73** is non-conductive, cutting current in **71** down to a bare minimum and in effect darkening the LDR **67**.

The light source, **71** being incandescent, does not respond instantaneously. Therefore it has been found desirable to turn its energizing circuit on, one beat ahead of the downbeat, i.e. terminal No. **11**, and to keep it on for one beat after the downbeat, i.e. terminal No. **1**. This gives the actual downbeat pulse **16** its added emphasis through the circuit **62** for its entire duration and precludes shading it at either end.

When the downbeat emphasis is not desired, the LDR **67** is simply shorted by the closing of switch **81** located at any convenient point on the organ console.

Whereas the present invention has been shown and described herein in what is conceived to be the best mode contemplated 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 invention as hereinafter claimed.

What is claimed is:

1. A rhythm generating circuit for a musical instrument comprising:

counter means having a plurality of terminals for successively producing on said terminals a repetitive succession of activating signals,

at least one audio frequency source,

speaker means,

coupling means for selectively coupling said terminals to said source for effecting the sounding of said source through said speaker, at selected rhythms,

characterized by:

emphasis means coupled to at least one given said terminal for increasing the sounding amplitude through said speaker during the time when activating signal resides on said given terminal.

2. Circuit in accordance with claim 1, wherein:

said emphasis means includes,

variable impedance means interposed between said source and said speaker, and

means for lowering the impedance of said impedance means during said time.

3. A rhythm generating circuit for a musical instrument comprising:

counter means having a plurality of terminals for successively producing on said terminals a repetitive succession of activating signals,

at least one audio frequency source,

speaker means,

coupling means for selectively coupling said terminals to said source for effecting the sounding of said source through said speaker, at selected rhythms,

characterized by:

curtailing means for shortening the duration of certain of said signals in response to certain predetermined selections in said coupling means.

4. Circuit in accordance with claim 3 wherein:

said curtailing means comprise by-pass means for by-passing audio frequency sound signals away from said speaker means and including variable impedance means capable of being varied from a very high impedance to a relatively low impedance, said impedance means being in its relatively low impedance condition, except when influenced by external control means,

first control means for intermittently placing said impedance means at its high impedance condition, for the said shortened durations,

second control means for continuously placing said impedance means in its high impedance condition,

and means for disabling said second control means in response to said predetermined selections.

5. A rhythm generating circuit for a musical instrument comprising:

counter means having a plurality of terminals for successively producing on said terminals a repetitive succession of activating signals,

at least one audio frequency source,

speaker means,

coupling means for selectively coupling said terminals to said source for effecting the sounding of said source through said speaker, at selected rhythms,

characterized by:

clock means for triggering said counter means to produce the successive said actuating signals,

curtailing means in said coupling means for shortening the duration of signals applied to said speaker, in response to direct activation from said clock means.



**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,247,307 | 4/1966 | Campbell | 84—1.03 |
| 3,255,292 | 6/1966 | Park | 84—1.03 |
| 3,286,013 | 11/1966 | Brand et al. | 84—1.25 |
| 3,358,068 | 12/1967 | Campbell | 84—1.01 |

WARREN E. RAY, Primary Examiner

U.S. Cl. X.R.

84—1.18, 1.24