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SOUND PRODUCER

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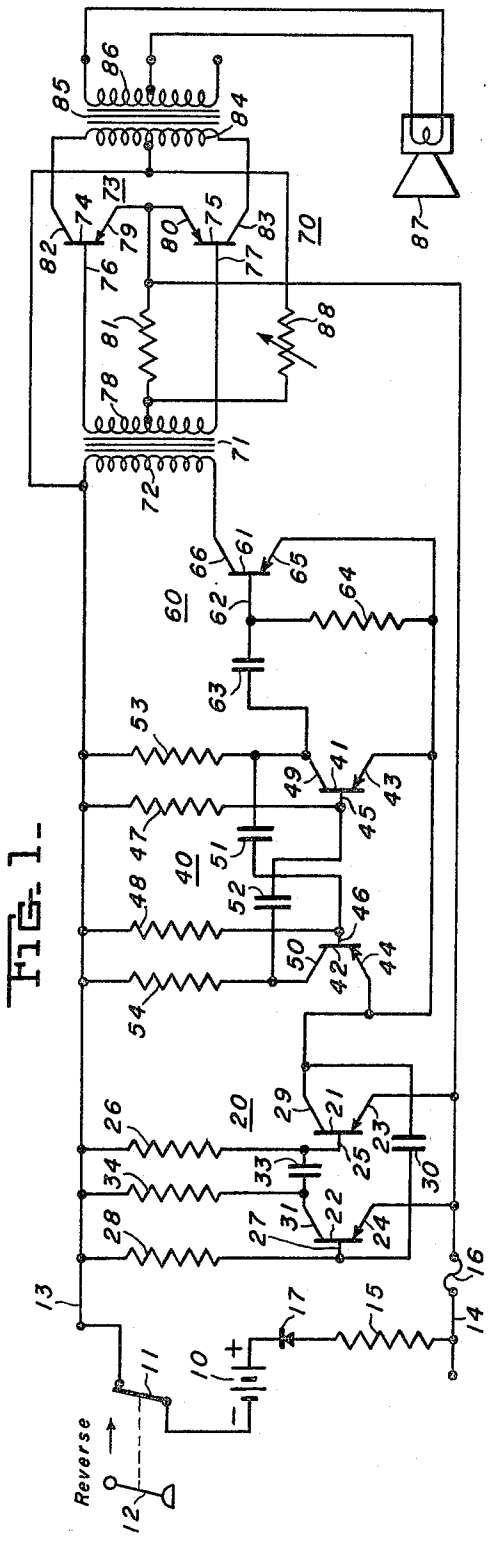


FIG. 1.

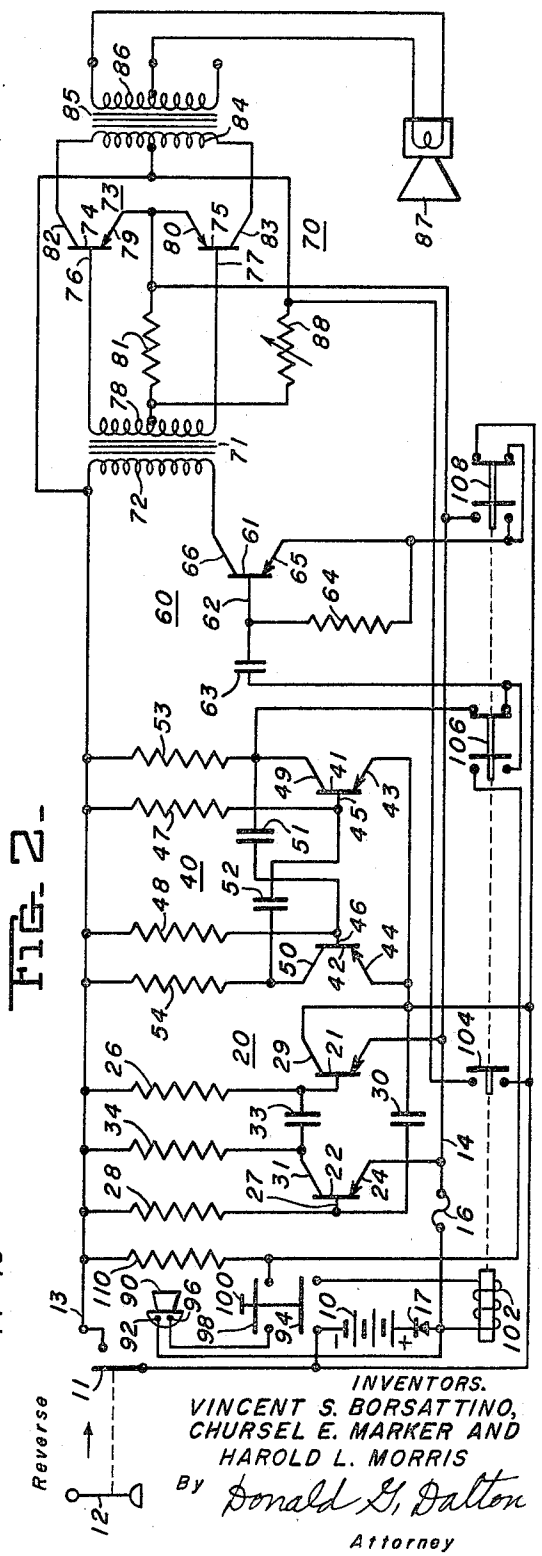


FIG. 2.

INVENTORS.
VINCENT S. BORSATTINO,
CHURSEL E. MARKER AND
HAROLD L. MORRIS
By Donald G. Dalton
Attorney

United States Patent Office

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SOUND PRODUCER

Vincent S. Borsattino, 4160 Pierce St.; Chursel E. Marker, 793 Indiana St.; and Harold L. Morris, 1338 Morton St.; all of Gary, Ind.

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This invention relates generally to electronic sound producing devices and, more particularly, to transistor operated electronic warning devices.

It is often desirable to provide a warning of dangerous or abnormal conditions. For example, when materials handling equipment is driven in reverse it is desirable to provide a warning noise to those in the immediate vicinity. Conventionally this type of warning is given by standard automobile horns operated by a relay and actuated when the vehicle is shifted into reverse. The standard horns are prone to malfunctioning and failure after a relatively short period of time. Further, the tone of an automobile horn is not an unpleasing tone and it is a steady tone during the entire time that the vehicle is operated in reverse. It is more desirable to have a very unpleasing tone for these warning devices because of the greater likelihood of causing an immediate awareness of this tone to the hearer. It is also more desirable to have an intermittent tone rather than a steady tone which will cause an immediate and continuous response in the hearer.

It is therefore a principal object of this invention to provide a fully electronically controlled and produced intermittent harsh tone.

Yet another object of this invention is to provide an electronic warning device which will produce an intermittent harsh audible sound from a steady current.

A more specialized object of this invention is to provide a transistor powered timer and tone generator which will produce an intermittent non-sinusoidal signal from steady direct current.

A feature of this invention is the provision of a multivibrator which provides a non-sinsoidal signal, which multi-vibrator is controlled by an electronic switching circuit.

Another feature of this invention is the provision of an electronic circuit for the production of harsh sounds into which can be inserted a microphone for voice communication.

Other objects and advantages of the invention will become apparent from the following description and accompanying drawings, in which:

FIGURE 1 shows the circuit of an electronic sound producing device according to this invention; and

FIGURE 2 shows the circuit of FIGURE 1 with a microphone inserted therein.

The sound producing device of this invention includes a transistor powered timer or switching circuit adapted to deliver an interrupted signal from a constant source of D.C. current. A transistor powered multivibrator tone producer is coupled to the timer circuit and adapted to produce a non-sinusoidal signal responsive to the signal delivered from the timer circuit. A transistor driver circuit is coupled to the tone producer circuit and an amplier with a speaker is coupled to the driver circuit to produce an audible harsh tone from the non-sinusoidal signal of the multivibrator.

Referring now to FIGURE 1, the sound producer is shown in a typical environment with various components of a vehicle being shown schematically. A battery is shown and designated as **10** which preferably is the battery of the vehicle upon which the sound generator is mounted. The negative side of the battery is connected

to a switch **11** which is closed by gear shift **12** when the gear shift is in the reverse position. A first conductor **13** is connected to the switch **11** and a second conductor **14** is connected to the positive side of the battery **10**. A resistor **15** is provided in the conductor **14** if the voltage of the battery is above the normal operating range of the sound producing device. A fuse **16** is provided in the conductor **14** to protect the circuit from excessive current and a diode **17** is provided to prevent damage to the circuit if reverse polarity is accidentally applied.

The sound producing device includes a switch and timer circuit **20**. The timer circuit **20** includes a first transistor **21** and a second transistor **22**. The first transistor **21** has an emitter electrode **23** connected to the conductor **14** and the transistor **22** has an emitter electrode **24** also connected to the conductor **14**. Transistor **21** has a base electrode **25** connected to the conductor **13** through resistor **26** and transistor **22** has a base electrode **27** connected to the conductor **13** through resistor **28**. The resistor **28** has a greater resistance than the resistor **26**, the reason for which will be described presently.

The transistor **21** has a collector electrode **29** which delivers an output signal when the transistor **21** is conducting. A capacitor **30** is coupled across the collector electrode **29** of transistor **21** and the base electrode **27** of transistor **22**. Transistor **22** has a collector electrode **31** which is coupled to the base electrode **25** of the transistor **21** through capacitor **33**. The collector electrode **31** of transistor **22** is connected to conductor **13** through resistor **34**.

When the gear shift **12** is shifted into the reverse position, switch **11** will be closed and steady E.M.F. will be applied to conductors **13** and **14**. Current will flow and a positive condition will exist between the emitter electrode **23** and the collector electrode **29** of the transistor **21**. This will cause transistor **21** to be conductive and a signal will be produced at collector electrode **29** of transistor **21**. Since the value of resistor **28** is greater than the value of resistor **26**, the transistor **22** will be inoperative. Current from the collector electrode **29** will charge capacitor **30**. The charge on capacitor **30** will build up until it reaches a point where it counterbalances the negative stress on transistor **22** caused by resistor **28** at which point transistor **22** will begin to conduct. Current from the collector electrode **31** of the transistor **22** will charge capacitor **33**. The charge on capacitor **33** will build up until it reaches a point where it overcomes the bias on transistor **21** caused by resistor **26** at which point the transistor **21** becomes non-conductive. Current will then cease to flow from the collector electrode **29**. When current ceases to flow from the collector electrode **29**, the capacitor **30** will lose its charge through resistor **28** and through the components of multivibrator circuit **40**, as will become apparent, and transistor **22** will become nonconductive. Current will then cease to flow from the collector electrode **31** and the capacitor **33** will lose its charge through resistors **26** and **34**. As the charge drains from capacitor **33** a point will be reached when the transistor **21** again becomes conductive and the cycle will repeat itself. Thus it can be seen that the timer circuit **20** causes an intermittent positive signal in collector electrode **29**.

The multivibrator circuit **40** is coupled to the timer circuit **20** and includes a pair of transistors **41, 42** having respectively emitter electrodes **43, 44**, each connected to collector electrode **29** of transistor **21**. The transistors **41, 42** have base electrodes **45, 46** connected to conductor **13** through resistors **47, 48** respectively. Transistors **41, 42** have respectively collector electrodes **49, 50** each adapted to deliver an output signal. A capacitor **51** is

coupled between collector electrode **49** of transistor **41** and base electrode **46** of transistor **42**. A capacitor **52** is similarly coupled between the collector electrode **50** of transistor **42** and the base electrode **45** of transistor **41**. Collector electrodes **49**, **50** are connected to the conductor **13** through resistors **53**, **54** respectively.

When a signal is produced in collector electrode **29** the signal is applied simultaneously to emitter electrodes **43**, **44**. Due to inherent differences in the components of the multivibrator circuit, one or the other of the transistors **41**, **42** will first become conductive and the other will remain non-conductive. Assuming that transistor **41** first becomes conductive a signal will be produced at the collector electrode **49**, which at the first instant will charge capacitor **51**. The charge on capacitor **51** will bias transistor **42** into a nonconductive state. Capacitor **51** will begin to lose its charge through resistors **48** and **53** until base electrode **46** of transistor **42** is negative enough to cause transistor **42** to conduct. A signal will then be produced in collector electrode **50** of transistor **42** which will cause capacitor **52** to charge biasing transistor **41** into a nonconductive state. Capacitor **52** will then lose its charge through resistors **54** and **47** and transistor **41** will again reach its conductive point. This type of multivibrator action is well known in the art. Thus, an oscillating circuit is provided with a non-sinusoidal signal produced at collector electrode **49**. The signal produced at collector electrode **49** is an audiofrequency tone. The timer circuit **20** and multivibrator circuit **40** together constitute a repetition rate generator.

A driver circuit **60** is coupled to the multivibrator circuit **40**. The driver circuit **60** includes a transistor **61** having a base electrode **62** connected to collector electrode **49** of transistor **41** through a capacitor **63**. The base electrode **62** of transistor **61** is also connected to collector electrode **29** of transistor **21** through a resistor **64**. The transistor **61** includes an emitter electrode **65** connected to collector electrode **29** of transistor **21**. During the time that a signal is produced at collector electrode **29** a bias is applied to transistor **61** and hence transistor **61** is synchronous with transistor **21**. The signal produced at collector electrode **29** produces an audio frequency tone signal in the multivibrator circuit **40** and this tone passes through capacitor **63** which causes transistor **61** to operate as a class B amplifier. Capacitor **63** also blocks D.C. current from passing to base electrode **62**. Hence, the driver circuit **60** amplifies the signal from the multivibrator **40** and delivers the amplified signal at collector electrode **66** of transistor **61**.

A conventional amplifying circuit **70** is coupled to the driver circuit **60**. The amplifying circuit **70** includes a transformer **71** having a primary coil **72** coupled between collector electrode **66** and conductor **13**. The amplifier circuit **70** includes a push-pull circuit **73** having a pair of transistors **74**, **75**. The transistors **74**, **75** have base electrodes **76**, **77** respectively connected to opposite ends of secondary coil **78** of the transformer **71**. Emitter electrodes **79**, **80** of the transistors **74**, **75** are connected to the center of the secondary coil **78** of transformer **71** through resistor **81**. Resistor **81** is a low value resistor or thermistor to prevent thermal run away of transistors **74**, **75**. Collector electrodes **82**, **83** of the transistors **74**, **75** are connected to opposite ends of primary coil **84** of a transformer **85**. Secondary coil **86** of the transformer **85** is connected to a speaker **87**. Also, the center of the secondary coil **78** of transformer **71** is connected to the center of primary coil **84** of transformer **85** through resistor **88**. The amplified signals from collector electrode **66** of transistor **61** are further amplified by the amplifier circuit **70** in a well known manner and are broadcast intermittently as harsh audible tones by speaker **87**.

Typical values of the components of the circuit are given below in Table I. These values are illustrative only and are in no way limitations on the invention.

TABLE I

Transistors **21**, **22**, **41**, **42**, **61**, **74** and **75**	PNP Junction.
Resistor **26**	1,500 ohms.
Resistors **34**, **53**, **54** and **88**	1,000 ohms.
Resistors **47** and **48**	100,000 ohms.
Resistor **28**	22,000 ohms.
Resistor **64**	100 ohms.
Resistor **81**	4 ohms.
Capacitors **30** and **33**	100 ufd.
Capacitors **51** and **52**	.1 ufd.
Capacitor **63**	5 ufd.
Transformer **71**	100 ohms 50 ma. D.C. to 15 ohms CT 200 to 2000 CRS.
Transformer **85**	48 ohms 550 ma. D.C. to 16 ohms CT.

With the values given in Table I the timer circuit **20** will provide alternately a "positive on" signal and a "zero off" condition at collector electrode **29** at a rate of about 60 times per minute. This means that there is a signal at collector electrode **29** for about half a second and no signal for about half a second. During the half a second that there is a signal the multivibrator circuit **40** will produce a substantially square wave signal with many harmonics at a frequency of about 1500 cycles per second. This signal amplified by driver circuit **60** and amplifier **70** will produce a harsh sounding tone at speaker **87** for the half second of the signal at collector electrode **29** and the speaker will produce no sound during the half second that there is no signal. Thus, the sound generator of this invention produces an intermittent harsh tone during the entire period that the gear shift **12** is in the reverse position. This intermittent harsh tone is produced from a steady supply of D.C. current with no mechanical switching required. As long as a steady current is applied to the conductors **13** and **14** an intermittent sound will be produced. This intermittent sound is produced with no moving parts in the circuits and with all switching being done electronically through transistors. The sound producer of this invention is relatively free of maintenance since there are no moving mechanical parts and various tones and rates of tone production can be selected by varying the values of the components of the circuit. A circuit with the values given in Table I has been successfully operated continuously for 24 hours at temperatures as low as −40° F. and as high as 145° F.

Referring now to FIGURE 2, a microphone **90** is shown in the circuit. The microphone **90** has a first terminal **92** connected to the positive side of battery **10** through diode **17** and a second terminal **96** connected to a normally open contact **98**. A contact **94** is provided which when closed energizes solenoid **102**. Contacts **94**, **98** are closable by button **100**. Solenoid **102** operates contacts **104**, **106** and **108**. Each of the contacts has a first position and a second position, each normally being in its first position and movable to the second position when solenoid **102** is energized.

In its first position contact **104** is open and in its second position connects the negative side of the battery to the center of primary coil **84** or transformer **85**, and to primary coil **72** of transformer **71**. Contact **106** in its first position connects collector electrode **49** of transistor **41** to the base electrode **62** of transistor **61** through capacitor **63**. In its second position contact **106** disconnects collector electrode **49** from base electrode **62** and connects the base electrode **62** to terminal **96** through contact **98**. In its first position contact **108** connects collector electrode **29** of transistor **21** to emitter electrode **65** of transistor **61**. In its second position contact **108** disconnects collector electrode **29** from emitter electrode **65** and connects emitter electrode **65** to conductor **14**. A microphone load resistor **110** is provided between con-

tact **98** and conductor **13** for current control. This resistor has a value of about 1000 ohms.

As can be seen in FIGURE 2 when contacts **94** and **98** are in their normally open position the solenoid **102** is not energized and contacts **104**, **106** and **108** will be in the normal first positions. When the vehicle is shifted in reverse, the circuit will function identically as the circuit of FIGURE 1. However, if button **100** is pushed it will close contacts **94** and **98**. When contact **94** is closed it will energize solenoid **102** which will shift contacts **104**, **106** and **108** into their second positions. This will disconnect the transistor **61** from timer circuit and from the multivibrator circuit and connect the microphone to the transistor **61** and also provide a constant supply of power to its emitter electrode **65** and the amplifier circuit **70**. Hence, sound delivered to the microphone is amplified by the driver circuit **60** and amplifier circuit **70** and broadcast from speaker **87**. When button **100** is released contacts **94** and **98** return to their normally open position which will deenergize solenoid **102** and contacts **104**, **106** and **108** will return to their first positions. It can be seen that whether or not the gear shift **12** is in reverse when button **100** is pushed the microphone will be operably connected into the circuit and if the gear shift **13** is in reverse the microphone circuit will override the repetition rate generator.

While several embodiments of our invention have been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. An intermittent sound generator comprising in combination, a transistor switching circuit having means adapted to receive a constant direct current from a power source and provide an intermittent signal, said switching circuit including a first transistor normally conductive and a second transistor normally nonconductive, first capacitor means responsive to the first transistor and adapted to urge the second transistor into conductivity after a predetermined amount of time of conductivity of the first transistor, second capacitor means responsive to the second transistor and adapted to urge the first transistor into nonconductivity after a predetermined amount of time of conductivity of the second transistor, and resistor means positioned to return each of said transistors to their normal state after a predetermined amount of time, whereby said first transistor is alternately conducting and nonconducting, a tone generator coupled to said switching circuit having means adapted to generate an audio frequency tone when a signal is received by the tone generator from the switching circuit, driver means operably connected to said tone generator to amplify the tone generated, a microphone selectably connectable to said driver means, and means to disconnect the tone generator from the driver means when the microphone is connected thereto, power amplifying means operably connected to said driver means, and sound producing means adapted to broadcast the amplified tone operably connected to said amplifying means, whereby interrupted sound is produced from a constant direct current.

2. An intermittent sound generator comprising in combination, a transistor powered switching circuit having means adapted to receive a constant direct current from a power source and provide an intermittent signal, a transistor multivibrator coupled to said switching circuit, said multivibrator including electrically operated means to produce audio frequency signals responsive to a signal received from said switching circuit, driver means including a driver transistor coupled to said multivibrator adapted to amplify a signal received therefrom, means to energize said driver transistor from the signal delivered by the switching circuit, a microphone selectably connectable to said driver means and means to disconnect the switching circuit and the multivibrator from said driver means when the microphone is connected thereto, power amplifying means coupled to said driver means, and sound producing means adapted to broadcast the amplified tone coupled to said amplifying means, whereby interrupted sound is produced from a steady direct current.

3. An intermittent sound generator comprising in combination, a switching circuit adapted to receive a constant direct current from a power source and provide an intermittent signal, said switching circuit including a first normally conductive transistor and a second normally nonconductive transistor, a first capacitor responsive to said first transistor and adapted to urge said second transistor into conductivity after a predetermined amount of time of conductivity of the first transistor, a second capacitor responsive to said second transistor and adapted to urge the first transistor into nonconductivity after a predetermined time of conductivity of the second transistor, resistor means positioned to return each of said transistors to their normal condition after a predetermined amount of time, a transistor powered multivibrator coupled to said switching circuit, said multivibrator including electrically operated means to produce audio frequency signals responsive to a signal received from said switching circuit, driver means including a driver transistor coupled to said multivibrator adapted to amplify a signal received therefrom, said driver transistor being connected to said switching circuit and energized by a signal therefrom, a microphone selectably connectable to said driver means and means to disconnect the switching circuit and the multivibrator from said driver means when the microphone is connected thereto, a power amplifier means coupled to said driver means, and speaker means coupled to said power amplifier means, whereby interrupted sound is produced from a steady direct current.

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NEIL C. READ, *Primary Examiner.*

BENNETT G. MILLER, *Examiner.*

W. C. GLEICHMAN, T. A. ROBINSON,
Assistant Examiners.