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Smith

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[54] **ELECTRONIC SIREN CIRCUIT**

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Related U.S. Patent Documents

Reissue of:

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Filed: **Dec. 7, 1971**

[52] **U.S. Cl.** .... **340/384 E;** 340/384 R
[51] **Int. Cl.²** **H04G 3/10**
[58] **Field of Search** .... 340/384 E, 384 R

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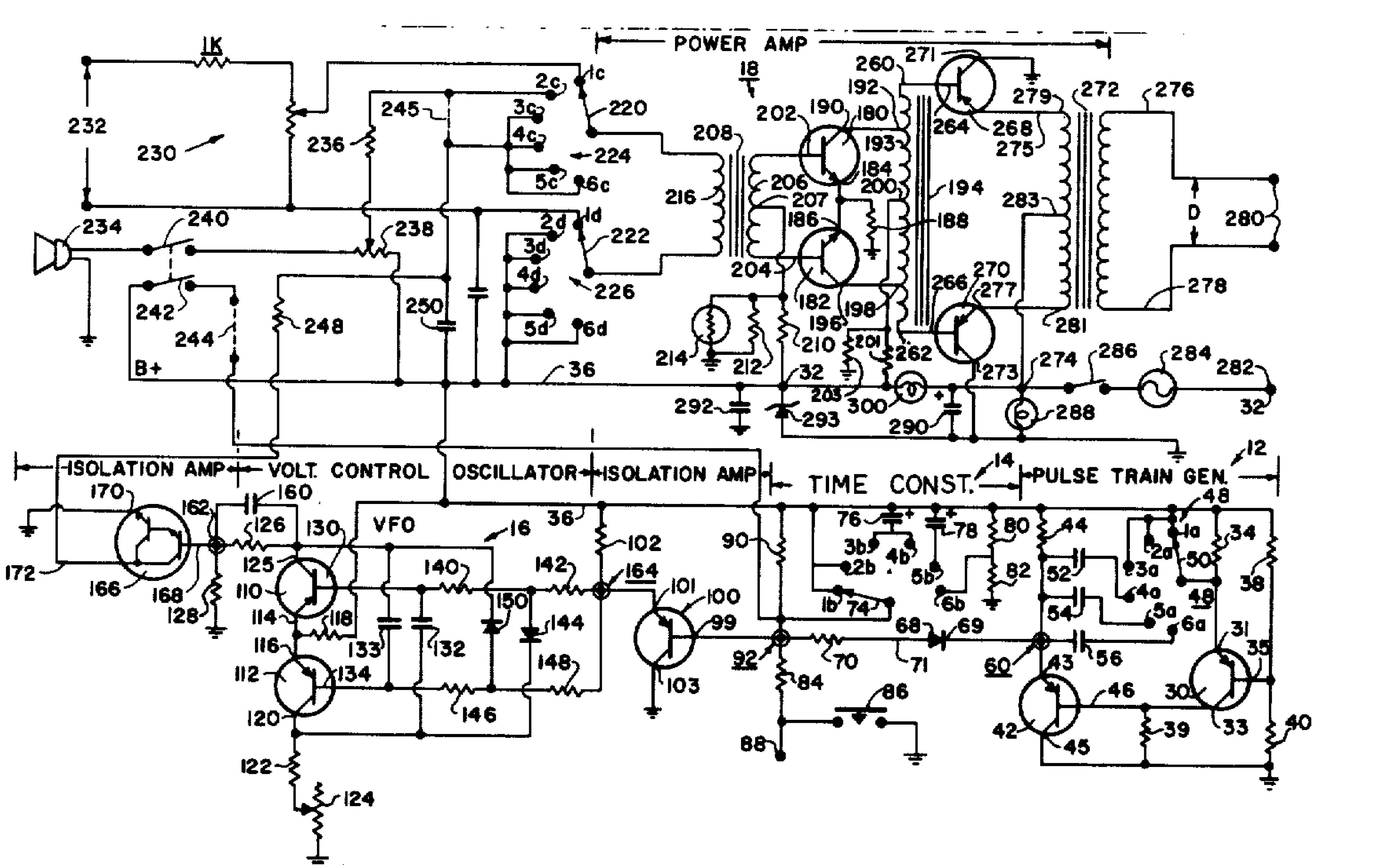
[57] **ABSTRACT**

The invention is an electronic siren comprising in combination means for generating periodically occurring charging pulses at a selected one of a plurality of predetermined repetition rates, time-constant determining means coupled to the pulse generating means for generating a repeating voltage wave form in response to the charging pulses and means coupled to the time-constant determining means for generating a square wave signal having a frequency proportional to the instantaneous voltage of the voltage wave form. Coupled to the square wave generator is an output circuit which includes a first pair of transistors and first circuit means coupling the transistors to the square wave generator for driving the first pair of transistors individually and alternately into saturation in response to the aforementioned square wave signal. There are also provided a second pair of transistors and second circuit means coupling the second pair of transistors to the first pair of transistors for driving the second pair of transistors individually and alternately into saturation in synchronism with saturation of the first pair of transistors.

24 Claims, 3 Drawing Figures



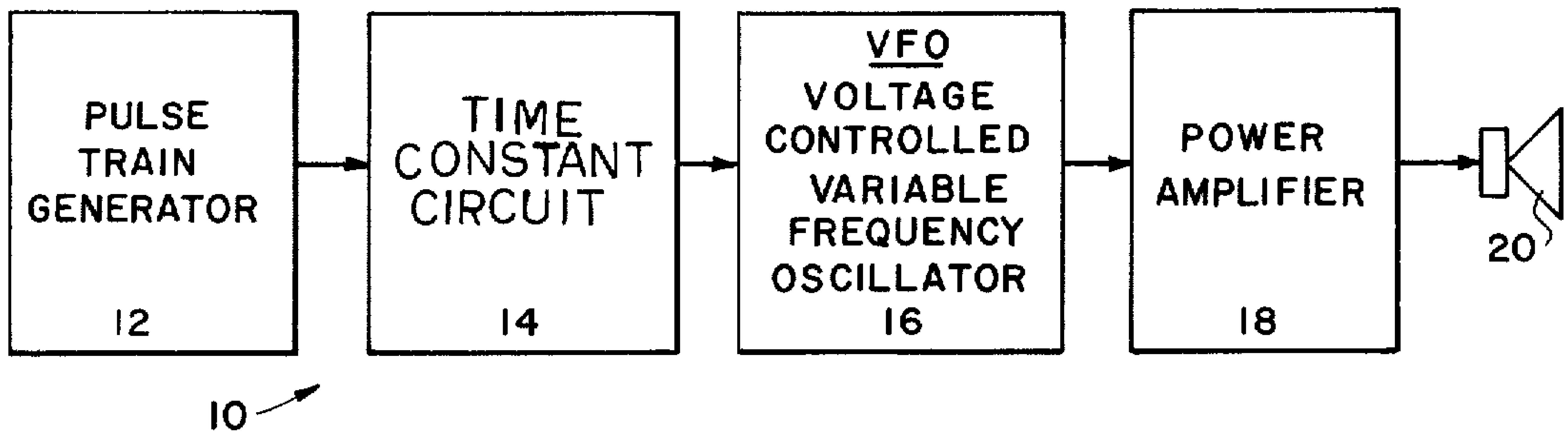


FIG-1

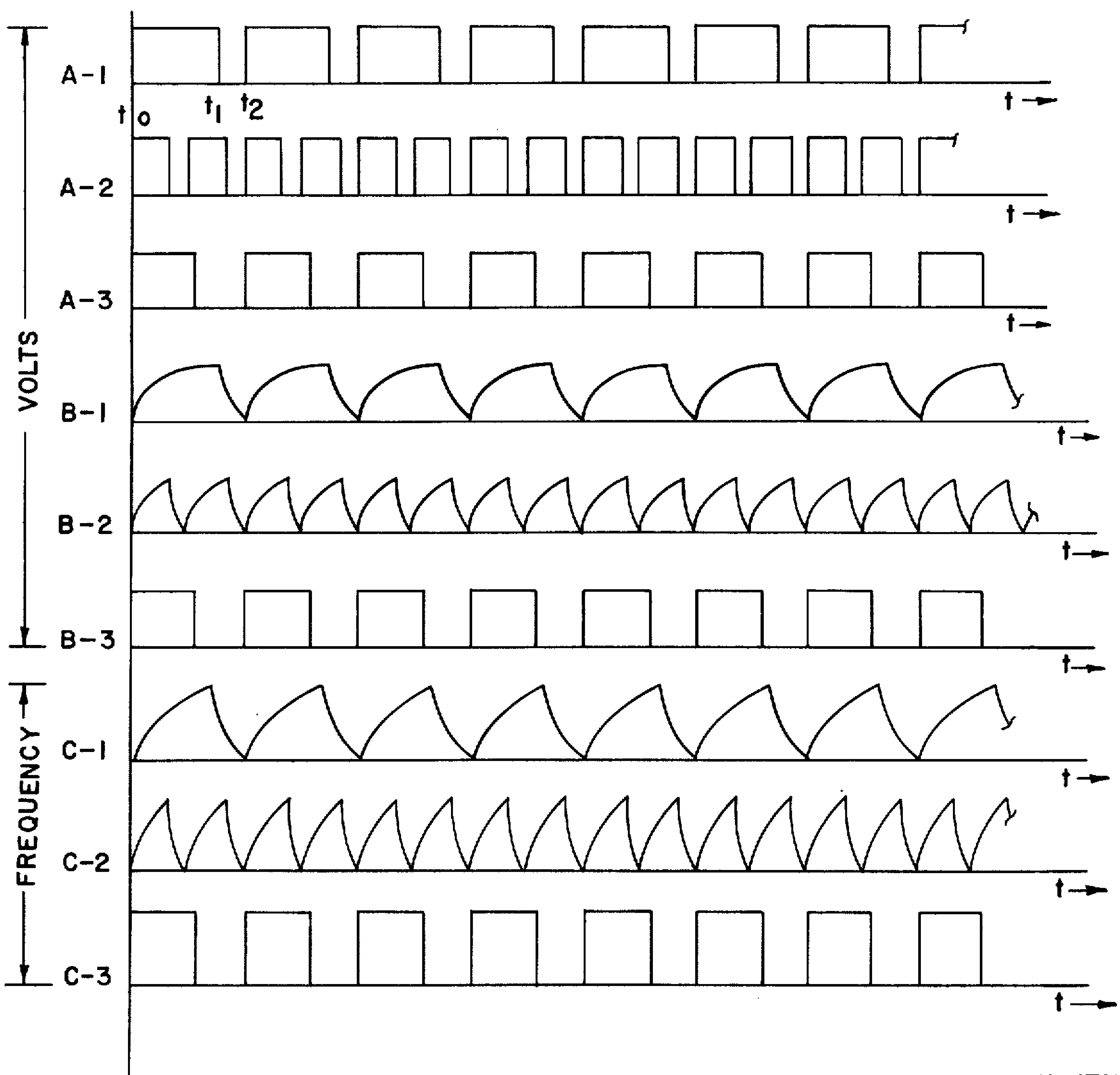


FIG-3

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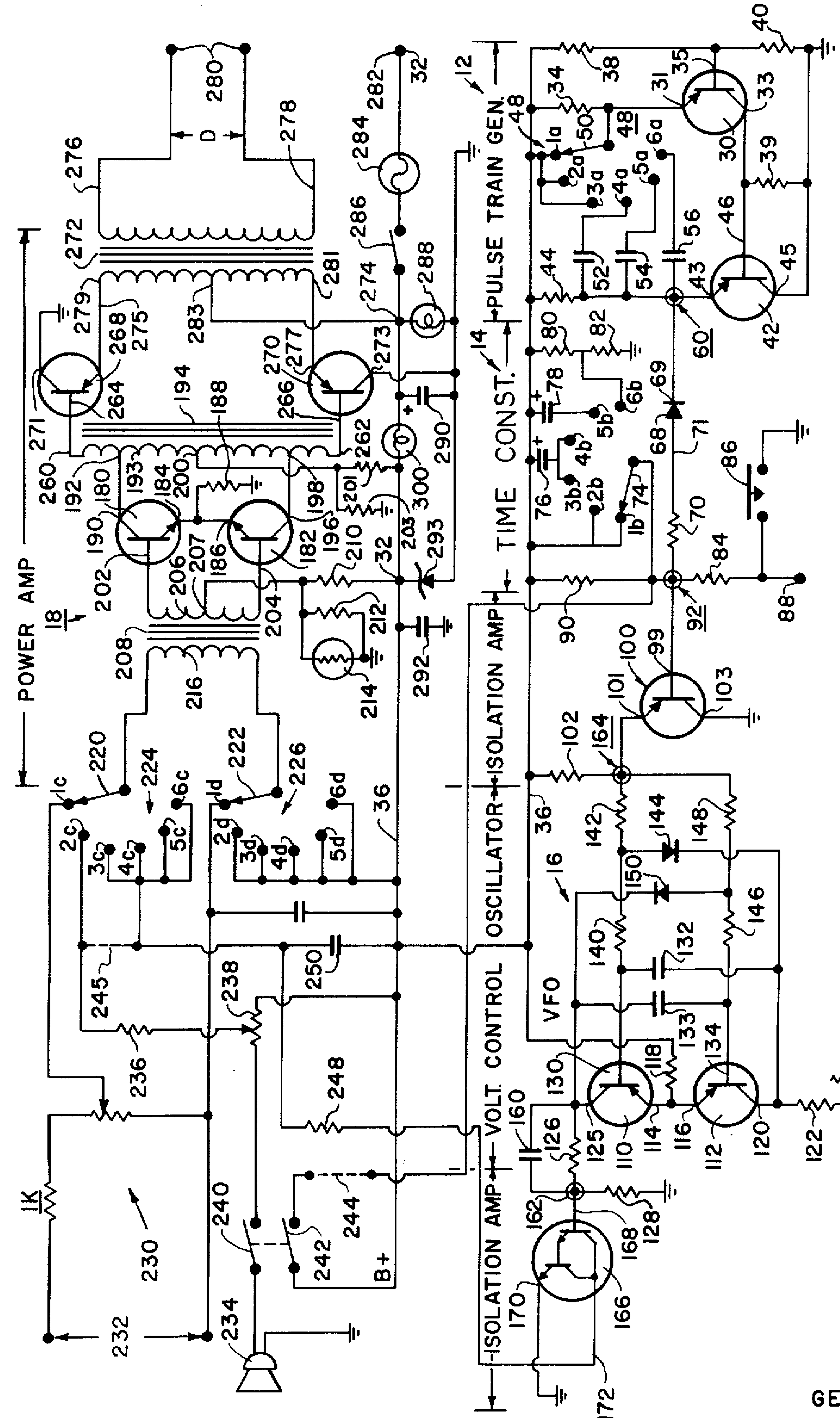

FIG-2

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ELECTRONIC SIREN CIRCUIT

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to electronic siren circuits and more particularly is an improved electronic siren circuit incorporating a square wave generator and an output circuit which utilizes diffused based transistors having a fast "rise" time and which are driven sharply between non-conducting and saturated states whereby heat and power losses within the circuit are minimized.

2. Description of the Prior Art

Prior art electronic siren circuits, such as that disclosed in U.S. Pat. No. 3,051,944 to the present Inventor, typically include a voltage controlled variable frequency oscillator which generates a square wave output signal, the square wave having a repetition rate or frequency in the audio frequency range. These circuits further include voltage signal generating circuits which apply a selected one of a plurality of different wave forms to the variable frequency oscillator to produce the desired siren signal. The output of the voltage controlled variable frequency oscillator is then applied to a speaker through a suitable power amplifier.

In the majority of applications, the electronic siren is installed in a motor vehicle or similar mobile unit. Consequently, the power and space available to operate and install the siren is limited. For this reason, and due to the need to produce a siren sound having a sufficient volume to be heard above normal ambient sound levels, it is important that the siren circuit produce the desired siren sounds with maximum efficiency. In this regard, prior art electronic siren circuits exhibit some loss of efficiency which results from rounding off of the square wave sound-generating signals produced therein.

SUMMARY OF THE INVENTION

The invention in its broader aspects is an electronic siren circuit which comprises means for generating a selected one of a plurality of pulse trains having different predetermined repetition rates, time constant determining means coupled to the charging pulse generating means for generating a predetermined repeating voltage signal in response to the charging pulses, and a voltage controlled variable frequency oscillator coupled to the time constant determining means for generating a variable frequency square wave signal having a frequency in the audio frequency range and adapted for producing the desired siren sound. Coupled to the square wave generator is a power output circuit which includes a first pair of [diffused based] transistors coupled in a push-pull configuration and first circuit means coupling the first pair of transistors to the square wave generating means for driving the first pair of transistors alternately and individually into saturation in response to the square wave signal and a second pair of diffused based transistors and second circuit means coupling the second pair of transistors to the first pair of transistors for individually and alternately driving the second pair of transistors into saturation in synchronism with saturation of the respective ones of the first pair of transistors. The output circuit further includes impedance matching means for coupling a loudspeaker or other sound reproducing devices thereto.

In a specific embodiment, there are also provided means for selectively connecting an audio signal from a radio or microphone to the first pair of transistors and biasing the first pair of transistors to their threshold of conductivity, whereby the first pair of transistors, and the second pair of transistors which operate in synchronism therewith are rendered individually and alternately proportionately conductive in response to the audio signal.

In another specific embodiment the electronic siren circuit of the present invention further includes a first isolation amplifier coupled between the time and constant determining means and the square wave generator and a second isolation amplifier coupled between the square wave generator and the power output circuit to reduce undesirable signal feedback and to facilitate use of the circuit for driving an auxiliary siren device.

In yet another specific embodiment, the square wave generating means includes a pulse-shaping network for further reducing "rounding off" of the generated square wave signal and a balance control means for rendering the square wave signal symmetrical.

It is therefore an object of the invention to provide an improved electronic siren circuit having increased power efficiency;

It is another object of the invention to provide an electronic siren circuit which exhibits less "rounding off" of the generated square wave signal;

It is still another object of the invention to provide an electronic siren circuit which utilizes diffused based transistors operated alternately between nonconductive and fully saturated states;

It is yet another object of the invention to provide such a circuit which includes means for rendering the square wave signal symmetrical;

It is still another object of the invention to provide an electronic siren circuit having an output circuit which can selectively operate both as a high efficiency square wave amplifier and as a high power low distortion audio amplifier;

It is another object of the invention to provide such a circuit which includes means for reducing signal feedback and enable the use of the circuit with auxiliary equipment.

DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a block diagram of an electronic siren circuit in accordance with the present invention;

FIG. 2 is an electrical schematic diagram of the electronic siren circuit of the present invention; and

FIG. 3 is a diagram showing wave forms occurring in the electronic siren of the invention and useful in explaining the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is illustrated in FIG. 1 a block diagram of an electronic siren 10 comprising a pulse train generator 12, a time constant circuit 14 electrically coupled thereto, a voltage controlled variable frequency oscillator 16 (hereinafter referred to as VFO 16) which is coupled to the time constant circuit 14 and a power amplifier 18 which is driven by VFO 16. Connected to the power amplifier 18 is a conventional speaker 20. As will be explained in detail below, pulse train generator 12 generates a selected one of a plurality of pulse trains having different predetermined repetition rates. The pulses from pulse train generator 12 are applied to the time constant circuit 14 which generates a repeating voltage wave form. The voltage wave form is in turn applied to the VFO 16 which generates a square wave signal having a frequency proportional to the voltage amplitude applied thereto. The output signal from the VFO 16 is then applied to a power amplifier 18 wherein the signal is amplified and applied to the speaker 20 to produce the desired siren tones.

Referring now to FIG. 2, pulse train generator 12 is a multivibrator oscillator circuit which includes a first oscillator transistor 30 having its emitter 31 coupled to a source of regulated direct current voltage 32 through a resistor 34 and a positive voltage supply buss 36 and its collector 33 connected to ground through resistor 39. An operating bias voltage is applied to the base 35 of oscillator transistor 30 by means of a voltage divider comprising resistors 38 and 40. A second oscillator transistor 42 has its emitter 43 connected to positive buss 36 through a resistor 44 its collector 45 connected to ground, and its base 46 coupled to ground via a biasing resistor 39, respectively.

A first six position switch 48 has its armature 50 connected directly to the emitter 31 of transistor 30. Switch 48 further includes pole terminals 1a, 2a, and 3a which are connected to positive buss 36, and pole terminals 4a, 5a, and 6a which are connected to the emitter 43 of oscillator transistor 42 through capacitors 52, 54, and 56 respectively.

The output terminal 60 of pulse train generator 12 is connected to time constant circuit 14 which comprises a diode 68 having its cathode 69 connected to output terminal 60 and a resistor 70 connected electrically in series with the anode 71 of diode 68 and output terminal 92. A second six position switch 72 is ganged with switch 48 and includes an armature 74 which is connected to output terminal 92. Switch 72 further includes pole terminals 1b and 2b which are connected to positive buss 36, terminals 3b and 4b, connected to positive buss 36 through a capacitor 76, terminal 5b, connected to positive buss 36 through capacitor 78, and terminal 6b which is connected to the center of a voltage divider network comprising resistors 80 and 82, the latter having their opposite ends connected to the positive buss 36 and ground, respectively. A charging resistor 90 is connected between output terminal 92 and positive buss 36 as shown. Also connected to terminal 92 is a resistor 84, a normally open switch 86, and an auxiliary siren terminal 88, as shown, for a purpose to be explained below.

The output signal from time constant circuit 14 appears at terminal 92 and is applied to the base 99 of an isolation amplifier transistor 100. Transistor 100 has its

emitter 101 connected to positive buss 36 via load resistor 102 and its collector 103 connected to ground and functions to both amplify the signal appearing at the output terminal 92 and to provide impedance isolation between time constant circuit 14 and VFO 16.

VFO 16 is an astable multivibrator circuit which includes a pair of switching transistors 110, 112 which have their emitters 114, 116 connected in common and to supply buss 36 via resistor 118. The collector 120 of switching transistor 112 is coupled to ground via serially connected resistor 122 and variable resistor 124. The collector 125 of switching transistor 110 is coupled to ground through serially connected load resistors 126 and 128. Connected between the base 130 of switching transistor 110 and collector 120 of switching transistor 112 is a frequency determining capacitor 132 and a similar frequency determining capacitor 133 is connected between the base 134 of switching transistor 112 and the collector 125 of switching transistor 110. Resistors 140, 142 are connected electrically in series between base 130 of switching transistor 110 and the emitter 101 of isolation transistor 100 and a clamping diode 144 is connected between the common connection of resistors 140, 142 and the collector 120 of switching transistor 112 as shown. Resistors 146 and 148 and a diode 150 are similarly connected between the base 134 of switching transistor 112, the emitter 101 of isolation transistor 100, and the collector 125 of switching transistor 110.

Connected in parallel with resistor 126 is a pulse shaping capacitor 160.

The output signal from the VFO 16 appearing at output terminal 162 thereof will be a square wave signal having a frequency which is directly proportional to the voltage applied to its input terminal 164 and of essentially constant power.

Connected to output terminal 162 of VFO 16 is a second isolation amplifier 166 which includes a double transistor connected in a "Darlington" configuration. The amplifier 166 has an input terminal 168 connected to output terminal 162 of VFO 16, an output terminal 172, and a grounded terminal 170.

Power amplifier circuit 18 comprises a first pair of [diffused base] power transistors 180 and 182 which are connected together in a push-pull configuration wherein their emitters 184, 186 are connected in common and to ground via a resistor 188. Collector 190 of power transistor 180 is connected to one terminal 192 of the primary winding 193 of an auto transformer 194 and collector 196 of power transistor 182 is correspondingly connected to the other primary terminal 198 of auto transformer 194. The center tap 200 is connected to the center of a voltage divider circuit which includes resistors 201, 203 which are in turn connected directly to the B+ supply 32 and ground, respectively. Bases 202, 204 of power transistors 180, 182, respectively, are connected to opposite ends of the output winding 206 of a coupling transformer 208. A temperature compensated network which includes parallel connected resistor 212 and a temperature variable resistor (thermistor) 214, which has a negative temperature coefficient form a voltage divider circuit connected between B+ supply 32 and ground which applies a predetermined bias voltage to the bases of transistors [100] *180*, 182 via the center tap 207 of coupling transformer 208. The values of resistors 188, 210, 212, 201 and 203 and thermistor 214 are selected such that transistors 180, 182 are statically biased to their threshold of conductivity, that is, to a point where transistors **180, 182** are just turned "off."

The oppositely disposed terminals of the input winding **216** of transformers **208** are connected to respective ones of the armatures **220** and **222** of third and fourth six position switches **224, 226,** respectively, which are also ganged with switches **48** and **72.** A conventional volume control network **230** is connected across terminals **1c** and **1d** of switches **224, 226,** respectively. Volume control network **230** includes input terminals **232** which provide a means for connecting the power amplifier **18** to radio receiver output terminals (not shown) in conventional manner.

Similarly, a microphone **234** is connected across terminals **2c** and **2d,** there being a conventional load resistor **236** and volume control resistor **238** connected therebetween as shown. Microphone **234** includes a momentary type "on-off" switch **240** connected in series therewith. Switch **240** is also provided with a second pair of normally open, momentary contacts **242** and a jumper **244** may be connected electrically in series therewith between the supply buss **36** and the armature **74** of switch **72** in the time constant circuit **14** and a jumper **245** connected between switch **226** terminal **2c** and switch **226** terminal **2d** for reasons to be explained below.

The output terminal **172** of second isolation amplifier **166** is connected to terminals **3c** through **6c** of switch **224** via a suitable load resistor **248,** there being a capacitor **250** connected between terminals **3c** through **6c** and the supply buss **36** which removes or clips any spikes from the square wave signal generated in VFO **16** and prevents ringing. Terminals **2d** through **6d** switch **226** are connected directly to the supply buss **36.**

The output terminals **260, 262** of auto transformer **194** are connected respectively to the bases **264, 266** of a second pair of diffused base power transistors **268, 270,** respectively. Both power transistors **268** and **270** have their collectors **271, 273,** respectively, connected to ground and their emitters **275, 277,** connected to opposite ones of the input terminals **279, 281,** of impedance matching transformer **272.** Center tap **283** of output transformer **272** is connected to the B+ supply line **32** at **274** and the output terminals **276, 278** are connected to output terminals **280** of the siren circuit **10.** It will again be observed that the interconnection of the second pair of power transistors **268, 270** enables them to operate in push-pull mode in synchronism with the operation of power transistors **180, 182.**

The B+ supply **32** for the siren circuit **10** includes an input terminal **282** connected to any suitable source of positive potential such as a vehicle battery, a fuse **284** and "on-off" switch **286** connected in series therewith. An indicator light **288** is connected between "on-off" switch **286** and ground to indicate when the siren circuit has been turned "on." Also connected to "on-off" switch **286** are a pair of filter capacitors **290, 292** and a zener diode **293** having its anode connected to ground and its cathode connected to the positive buss **36.** A ballast light **300** is connected electrically in series between the cathode of zener diode **293** and "on-off" switch **286** to provide better voltage regulation and overload protection of zener diode **[243]** *293.*

The operation of the electronic siren circuit **10** is as follows. Pulse train generator **12,** as stated, is a multivibrator oscillator circuit. When armature **50** of switch **48** is in position **4a, 5a,** or **6a,** capacitors **52, 54,** and **56,** respectively, will be connected between the emitter of oscillator transistor **42** and the emitter of oscillator transistor **30.** In this mode, the oscillator will generate a plurality of trains of recurring pulses appearing at output terminal **60** and shown, respectively, as wave forms A-1, A-2, and A-3 of FIG. **3.** When switch **48** has its armature **50** in positions **1a, 2a,** or **3a,** the B+ supply voltage will be applied directly to the emitter of transistor **30** thereby biasing transistor **30** to an "on" condition. Because of the direct connection, transistor **30** will remain in this conductive state and pulse train generator **12** will produce a constant DC voltage at its output terminal **60.**

When switch **72** has its armature **74** in positions **1b** or **2b,** DC supply **32** potential will be applied directly to the base **99** of isolation transistor **100** rendering this transistor non-conductive. When armature **74** of switch **72** is in positions **3b,** or **4b,** capacitor **76** will be connected to the B+ supply via resistor **90** and to the output terminal **60** of the pulse train generator **12** via resistor **70** and diode **68.** Correspondingly, whenever the output from the pulse train generator **12** is at a high level, such as for example between time t_0 and t_1 in wave form **A-1,** or whenever oscillator transistor **42** is non-conductive as a result of transistor **30** being locked in a conducting state, a reverse bias voltage will be applied to the cathode **69** of diode **68.** Reverse biasing diode **68** in turn causes a charging current to pass through resistor **90** and into capacitor **76** thereby equalizing the voltage at the opposite terminals thereof and effectively removing any charge thereon. Conversely, whenever the wave form from pulse train generator circuit **12** is at a low level, such as for example between times t_1 and t_2 of wave form **A-1,** the capacitor **76** will begin to devolop a charge across its terminals. This charging action will correspondingly produce a negative exponential wave form having a predetermined time constant at output terminal **92.** Since, as described above, pulse train generator **12** is rendered inactive and oscillator transistor **42** statically nonconductive when switch armature **50** is in the **1a, 2a,** and **3a** positions, it will be seen that when switch **72** also has its armature **74** in the **1b, 2b,** and **3b** positions, the capacitor **76** will eventually become fully charged and the output signal appearing at output terminal **92** will be direct current voltage.

It will now be observed that when switch armature **74** is in the **3b** position, manual closing of switch **86** will cause capacitor **76** to charge. Conversely, when switch **86** is opened, capacitor **76** will discharge through resistor **90.** Thus, when switch armature **74** is in the **3b** position, switch **86** provides a means for generating decreasing and increasing exponential voltage wave forms at terminal **92** each time it is closed and opened, respectively, with the time constant being determined by capacitor **76** and resistor **84.**

When switch **72** has its armature **74** in the **4b** and **5b** positions and switch **48** is in the **4a** and **5a** positions, respectively, capacitors **76** and **78** will be connected to the output terminal **60** of the pulse train generator **12** again through resistor **70** and diode **68.** Pulse train generator **12** will be oscillating thereby generating the recurring pulse train signals A-1 or A-2, respectively. In this mode, the output signal appearing at terminal **92** of the time constant circuit **14** will comprise a series of sequentially occurring increasing and decreasing exponential voltage waves having their time constant determined by capacitors **52, 54,** and **76, 78,** and resistors **44** d 90, respectively and of different frequency, these ing shown as wave forms B-1 and B-2 in FIG. 3.

When switch 72 has its armature 74 in the 6b position d switch 48 has its armature 50 in the 6a position, .lse train generator 12 will again generate a series of curring pulse signals these being shown as wave form -3 in FIG. 3. However, these signals are now applied rough terminal 6b of switch 72 to the voltage divider sistors 80, 82. Correspondingly, there will be pro- .ced a voltage wave form B-3 which is itself a square ıve.

The respective ones of the wave forms being gener- ed at output terminal 92 will be passed through and aplified by isolation transistor 100 and applied to the put terminal 164 of the VFO 16.

As stated above, the VFO 16 is a variable frequency, table multivibrator circuit. The operation of this type circuit is well known to those skilled in the art and it sufficient to state that it will generate a square wave gnal having a frequency which is directly proportional the voltage applied to its input terminal 164. The lue of the components of the VFO 16 are selected ch that its signal frequency will be within the audio nge for all values of voltage applied to its input termi- .l 164 by the time constant circuit 14.

VFO 16 also includes a balance control 124. This .lance control 124 enables adjusting the symmetry of e square wave signal generated by the VFO circuit 16 hereby the square wave signal will be rendered per- ctly symmetrical. Since the power efficiency of the ıwer amplifier 18 will be diminished if the square ıve signal generated thereby is not symmetrical, it ll now be apparent that the balance control 124 pro- des a simple yet effective means for optimizing the ıwer efficiency of the power amplifier 18.

Similarly, the addition of the capacitor 160 con- cted across load resistor 126 will reduce the switch- g time of the transistors 130, 134. This in turn re- ıces the amount of "rounding off" of the square wave oduced by the VFO 16 and again contributes to the ficiency thereof. The output signal from the VFO cuit 16 will therefore be a variable frequency, con- ınt power square wave signal having a frequency rectly proportional to the voltage applied to the input rminal 164 thereof. This output signal will be either a nstant frequency signal whenever switches 48 and 72 .ve their armatures in the 1a, 2a, and 1b, 2b positions, spectively. This signal will be a manually controlled riable frequency signal when switches 48 and 72 .ve their armatures 50 and 74 in the 3a, 3b positions switch 86 is manually operated. When switches 48 d 72 have their armatures 50 and 74 in the 4a, 5a, d 6a, and 4b, 5b, and 6b positions, respectively, the ıve form appearing in the output terminal 92 will be e wave form B-1, B-2, or B-3 thereby causing the FO circuit 16 to produce a variable frequency signal ving frequency envelopes C-1, C-2, or C-3, (FIG. 3) spectively.

The amplifier 166 will amplify the output signal from e VFO 16 and apply this signal to the input winding 6 of coupling transformer 208 whenever switches 0 and 222 have their armatures 224, 226 in the 3c, , 5c and 6c, and 3d, 4d, 5d, and 6d positions, respec- ely. The voltage of the signal generated by the VFO cuit 16 will again be of constant power, and only the quency thereof varies.

The magnitude of the signal from the VFO circuit 16 d isolation amplifier 166 is sufficient [magnitude] to drive or bias power amplifier transistors 180 and 182 individually and alternately between fully saturated and fully "off" states. Power transistors [180, 182] *268, 270* because they are diffused based transistors, will switch between their saturated and fully "off" condition with a minimum of "rounding off" of the wave fronts and thereby again adding to the efficiency of the circuit.

It will be observed that the biasing of transistors 268, 270 is effected by transistors 180, 182 by reason of their having their bases coupled directly to the output circuit of a respective one of transistors 180, 182. Consequently, transistors 268, 270 are biased to either a conductive or a non-conductive state directly by the respective one of transistors 180, 182. That is, transistors 268, 270 will be either conductive, when transistors 180, 182 are conductive, respectively, or will be non-conductive when transistors 180, 182 are nonconductive, respectively. Thus transistors 268, 270 are seen to be automatically biased or controlled by the transistors 180, 182.

When the siren 10 is operating in a siren mode, the signals applied to the bases 202, 204 of power transistors 180, 182 are of sufficient magnitude to drive the transistors 180, 182 between fully "off" and a saturated, fully "on" condition. Transistors 180, 182 will when saturated, drive transistors 268, 270 into saturation. When transistors 268, 270 are in a saturated, "on" condition they will experience a minimum of heat build up thereby enabling transistors 268 and 270 to be operated at substantially higher power levels than would be possible if they were operated in less than a saturated condition when conductive. Further, when transistors 180, 182, 268, and 270 are being operated in a saturated state, it has been found that transistors 268, 270 will produce a significant amount of power gain despite the fact that they are connected in an emitter follower configuration.

When the power amplifier circuit 18 is being used to amplify a signal from a radio receiver means (not shown), or from microphone 234, it will be apparent that transistors 180, 182 and transistors 268, 270 must operate as relatively low distortion amplifier devices. Accordingly, when it is desired to use a power amplifier 18 as an audio amplifier for the radio or microphone signal, it is not possible to drive the transistors 180, 182, 268 and 270 between fully "off" and fully "on," saturated states. Rather, transistors 180, 182 still operate to automatically bias the second pair of transistors 270, 272, but to a degree of conductivity less than or below their saturation levels. Specifically, an audio signal applied to the transistors 180, 182 from either the radio input terminals 232 or from the microphone 234 is maintained at a level substantially below that required to drive the first pair of transistors 180, 182 into saturation. Because transistors 180, 182 are biased to their threshold of conductivity as described above, and by reason of their connection in a push-pull configuration, they will be alternately and individually rendered conductive by alternately phased portions of the input signals from the radio input terminals 232 or microphone 234. Transistors 180, 182 will in turn render transistors 268, 270 alternately and individually conductive, respectively, but not saturated. Operating in this manner, it will be observed that each of the transistors 268, 270 will be operated for a 50 percent or less duty cycle and, simultaneously, will operate with relatively low distortion. Correspondingly, these latter two transistors can be operated as audio amplifier components and at substantially higher power levels than would be possible were transistors **268, 270** statically biased in a conventional manner.

It should further be noted that diffused based transistors are primarily adapted for use as high power switching transistors which, as stated, are capable of switching between their fully saturated and fully "off" conditions with great speed and exhibit low heat build up when conducting in a saturated state. It is this characteristic of the diffused base transistor which renders it desirable for use in a high power, square wave amplifier. However, these same characteristics normally render a diffused based transistor unsuitable for use as an audio amplifier component since the load impedances used therewith to enable the highest power output from the transistor would cause the transistors to overheat and burn out in a very short period of time should the transistors be statically biased for operation in a linear region as is normally done when the device is used in an audio amplifier. However, in the present circuit, the interconnection of the two pairs of power transistors **180, 182** and **268, 270,** whereby the second pair of transistors **268, 270** are automatically biased by the first pair of transistors and whereby the second pair of transistors **268, 270** are rendered non-conductive for at least half of the time, enables the use of these transistors as audio amplifier components at high power levels and without the danger of transistors **268, 270** being over driven and burned out.

It should be noted that when jumpers **244** and **245** are installed in the circuit, the VFO circuit **16** will continue to operate and thereby produce a siren signal at the output terminal **280** of the power amplifier **18** even when switches **220, 222** have their armatures in the **2c** and **2d** positions, respectively. However, when the microphone switch **240** is closed, and correspondingly microphone terminals **242** are closed, the B+ potential will be applied directly to the base of isolation transistor **100** rendering it non-conductive. This in turn will cause full B+ potential to be applied to the bases **130, 134** of the VFO circuit **16** rendering it inactive. It can thus be seen that utilization of the jumpers **244, 245** will cause automatic turning "off" of the siren whenever the microphone switch **240** is depressed thereby permitting simultaneous use of both devices.

When an auxiliary siren circuit (not shown) is connected to auxiliary siren terminal **88,** the interconnecting wires will generally possess a significant amount of reactance. This reactance would, in turn, normally result in degradation of the operation of VFO circuit **16** and possibly cause it to "run away." However, isolation amplifier **100** prevents this reactance from affecting the VFO circuit parameter.

It can thus be seen that the electronic siren circuit of the present invention, by providing means for rendering the square wave signal generated within the VFO circuit **16** perfectly symmetrical, by reason of the minimization of the "rounding off" of the square wave generated thereby, and the utilization of diffused base transistors in the power amplifier circuit produces an electronic siren circuit having a maximum power efficiency.

In a working model of an electronic siren circuit in accordance with the present invention, the following component values were used with resistors followed by an (*) having a 5 percent tolerance.

RESISTORS

34	10 K *	126	1.8 K *
38	8.2 K	128	560
39	22 K	122	1.8 K
40	32 K	124 Pot.3	
44	7.5 K *	140	22 K *
70	3.3 K	142	22 K *
80	18 K *	146	22 K *
82	10 K *	148	22 K *
84	2.2 K	188	1
90	47 K	212	47
102	4.7 K	230	1 K
118	390 *	236	560
		248	1.8 K

POTENTIOMETERS

124	500 ohms.
230	100
238	350 (linear)

CAPACITORS

52	200 mfd, 10 volt	133	0.022 mfd
54	100 mfd, 10 volt	160	0.047 mfd
56	39 mfd, 10 volt	250	0.1 mfd
76	150 mfd, 10 volt	290	200 mfd, 15 volt
78	4.7 mfd, 10 volt	292	200 mfd, 15 volt
132	0.022 mfd		

TRANSISTORS

30, 42, 100, 112	2N4402
180, 182	TIP41
268, 270	CP2357
Amplifier 166	2N5307

DIODES

69, 144, 150	IN 457
293	IN 2030B (Zener)

While there have been described above the principles of this invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of the invention.

What is claimed is:

1. In an electronic siren the combination comprising:

a. means for selectively generating periodically occurring charging pulses at one of a plurality of predetermined repetition rates,

b. time constant determining means coupled to said pulse generating means for generating a corresponding plurality of repeating voltage wave forms in response to said charging pulses,

c. means coupled to said wave form generating means for generating a square wave signal having a frequency proportional to the instantaneous voltage of said voltage wave form,

d. a power output amplifier circuit including

1. a first pair of **[** diffused base **]** transistors connected in a push-pull circuit configuration,
2. first circuit means selectively coupling said first pair of transistors to said square wave generator for driving said first transistors individually and alternately into saturation in response to said square wave signal,
3. a second pair of **[** diffused base **]** transistors connected in a push-pull emitter follower configuration, *said second pair of transistors being diffused base transistors,*
4. second circuit means coupling said second pair of transistors to said first pair of transistors for driving said second pair of transistors individually and alternately into saturation in synchro-

nism with saturation of respective ones of said first pair of transistors, and

e. impedance matching means for coupling said second pair of transistors to a sound reproducing device.

2. The combination of claim [2] *1* wherein said first circuit means includes means for applying said square wave signal to the bases of said first pair of transistors, said second circuit means is coupled to the bases of said second pair of transistors, said second circuit means includes an auto transformer having a pair of input terminals and a pair of output terminals, said first pair of transistors each having a similar one of their collector and emitter connected in common, and the other of their collector and emitter connected to said input terminals, respectively, said second pair of transistors having their bases connected individually to different ones of said output terminals.

3. The combination of claim 1 further comprising means for generating a first audio signal, said first circuit means further including first switch means for selectively connecting said power output circuit to one of said square wave generators and said audio signal means, means for electrically biasing the transistors of said first pair of transistors to their threshold of conductivity whereby said first circuit means renders said first pair of transistors individually and alternately conductive in proportion to said first audio signal.

[4. The combination of claim 3 further comprising means for electrically biasing the transistors of said first pair of transistors to their threshold of conductivity, said first circuit means rendering said first pair of transistors individually and alternately conductive in proportion to said first and said second audio signals in response thereto.]

5. The combination of claim 3 wherein said second circuit means includes means for rendering said transistors of said second pair of transistors individually and alternately conductive in proportion to the degree of conductivity of said first pair of transistors when said output circuit is selectively connected to said audio signal means.

6. The combination of claim 1 wherein said square wave generating means comprises an astable multivibrator circuit which includes a pair of switching transistors, said switching transistors each having a similar one of their collector and emitter connected in common, their bases coupled to said time constant determining means, and a pair of capacitors connecting the other of said collector and emitter of each said switching transistor to the base of the mutually opposite one of said switching transistors, the switching frequency of said multivibrator being proportional to the voltage applied to said bases.

7. The combination of claim 6 wherein said multivibrator circuit includes an output circuit having a pulse-shaping means for increasing the switching speed of said switching transistors.

8. The combination of claim 7 wherein said multivibrator further includes balancing means for rendering said square wave symmetrical.

9. The combination of claim 8 wherein said balancing means includes a resistor and a potentiometer connected electrically in series with the collector-emitter circuit of one of said switching transistors.

10. The combination of claim 9 wherein said pulse-shaping means is a capacitor connected electrically in

series with the collector-emitter circuit of the other of said switching transistors.

11. The combination of claim 1 wherein said first circuit means includes means for electrically isolating said power output circuit and said multivibrator circuit.

12. The combination of claim 11 wherein said isolating means comprises a Darlington amplifier circuit which includes an input terminal coupled to said output circuit.

13. The combination of claim [18] *11* further comprising second isolating means for electrically isolating said square wave generating means from said time constant determining means.

14. The combination of claim 13 wherein said second isolating means includes an isolation transistor having a base, and a collector-emitter circuit, said base being connected to said wave form generating means, said collector-emitter circuit being coupled to said square wave generating means.

15. The combination of claim 1 wherein said pulse generating means is a [second] multivibrator oscillator.

16. The combination of claim 15 wherein said [second] multivibrator oscillator includes a plurality of frequency determining elements and [second] switch means for selectively connecting a predetermined one of said frequency determining elements into said oscillator circuit thereby determining the switching frequency of said multivibrator.

17. The combination of claim 16 wherein said selecting means includes a multiple pole switch.

18. The combination of claim 16 wherein said frequency determining elements are capacitors.

19. The combination of claim 1 further comprising means for selectively disabling said pulse generating means and means coupled to said time constant determining means for manually generating a plurality of charging pulses, said time constant determing means being responsive to said manually generated pulses to generate one of said wave forms.

20. The combination of claim 14 further comprising means for coupling an auxiliary siren circuit to said time constant determining means.

21. The combination of claim 20 wherein said auxiliary siren connecting means is connected to said time constant determining means, said second isolating means being connected between said auxiliary siren connecting means and said square wave generator.

22. For use in an electronic siren capable of producing selectively, audio and siren signals, a power output amplifier circuit including

a. a first pair of [diffused base] transistors connected in a push-pull amplifier circuit configuration having input and output circuits, means for selectively biasing said transistors to the threshold of conductivity whereby audio signals coupled to said input circuit renders said transistors alternately conductive in proportion to the amplitude thereof,

b. a second pair of [diffused base] transistors connected in a push-pull emitter-follower amplifier configuration having input and output circuits, *said second pair of transistors being diffused base transistors,* means coupling the first-mentioned output circuit to the second-mentioned input circuit for driving said second pair of transistors alternately into saturation in synchronism with saturation of respective ones of said first pair of transistors,

c. impedance-matching means for coupling said second pair of transistors to a sound producing device, said impedance matching means having input and output circuits the input circuit of which being connected across the emitters of said second transistors, the last-mentioned input circuit having an impedance appearing across said emitters.

23. The circuitry of claim **22** wherein said coupling means includes an auto transformer having a pair of input terminals and a pair of output terminals, said first pair of transistors each having a similar one of the collectors and emitters connected in common and the other connected to said input terminals, respectively, said second pair of transistors having the bases thereof connected respectively individually to different ones of said output terminals.

24. The circuitry of claim **23** in which the emitters of said first transistors are connected in common and the collectors thereof are connected, respectively, to said input terminals, said impedance-matching means including a transformer having primary and secondary windings, the primary winding being connected between the emitters of the second transistors, a source of voltage connected between the center of said primary winding and the collectors of said second transistors.

25. The circuitry of claim **24** including a square-wave generator and a source of audio signals selectively coupled to said input circuit of the first-mentioned amplifier and switch means for selecting which of said generator or source is applied to said first mentioned input circuit.

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