Aug. 5, 1969 V. M. JAMBAZIAN 3,460,136

ELECTRONIC SOUND SIGNALLING DEVICE

Filed Nov. 23, 1965

Fig. 1.

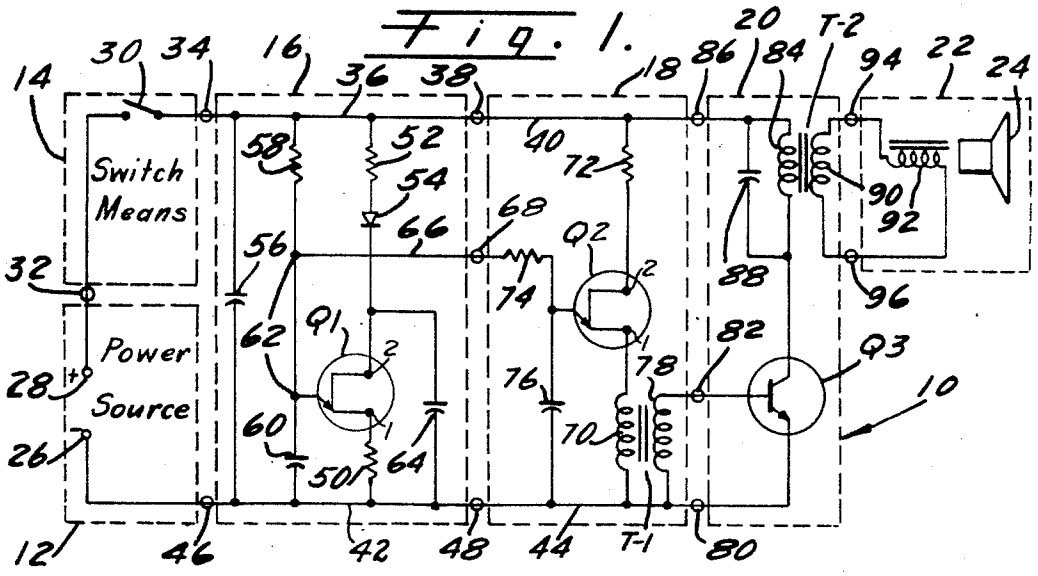


Fig. 2.

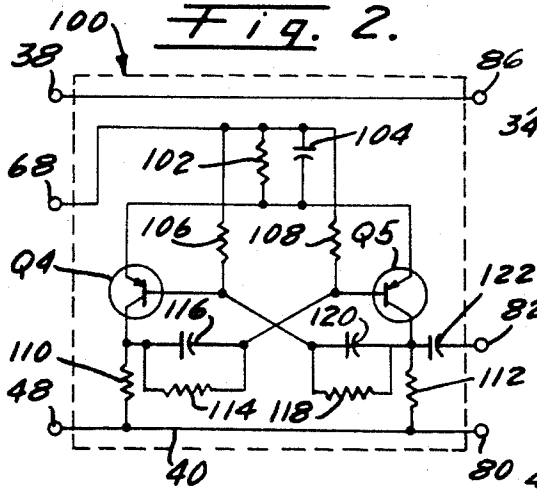


Fig. 3.

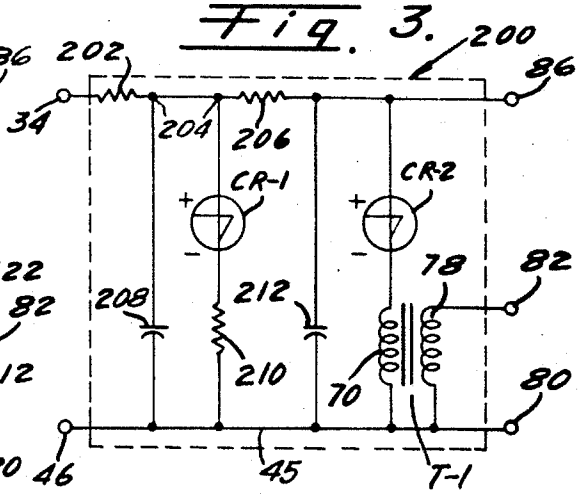
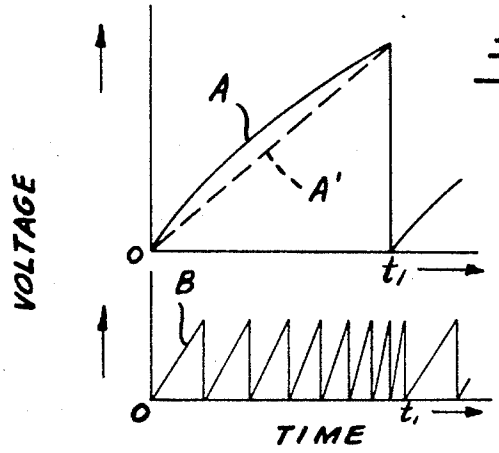


Fig. 4.



Vartan Jambazian,
INVENTOR.

BY Beehler & Arant

Attorneys

United States Patent Office

3,460,136

Patented Aug. 5, 1969

3,460,136

ELECTRONIC SOUND SIGNALLING DEVICE

Vartan M. Jambazian, 2351 Warwick Ave.,
Los Angeles, Calif. 90032

Filed Nov. 23, 1965, Ser. No. 509,283
Int. Cl. G08b 3/10
U.S. Cl. 340—384 3 Claims

ABSTRACT OF THE DISCLOSURE

The invention provides an electronic signalling device in which two signals of different frequencies are operated on to produce an output having characteristics similar to the sounds produced by birds and the like.

This invention relates to electronic devices and particularly to electronic sound signalling devices such as sirens, door bells, and the like.

It is customary to provide a door bell or similar device at the entrance of a building to, for example, announce to the occupants the presence of an individual desiring admission for some reason. Many such devices are commercially available, ranging from door knockers to electric buzzers, and chimes. The sounds produced likewise vary widely, ranging from harsh, noise-like sounds to more pleasant multiple-tone sounds. But, even the latter type not infrequently becomes quite annoying and often induces a response blocking reception and disrupting communication. In such cases, the desired purpose is utterly defeated.

With the electronic sound signalling device of the invention, failures stemming from such responses can be eliminated. By using a device capable, for example, of generating sounds characteristic of those produced by birds, the irritating aspect of prior art devices is removed and greater satisfaction provided. Other benefits are also realized, some taking form in pride of ownership, some in an overall outlook on life, and some in improved relations with their fellow human beings, to name but three.

In general, the electronic signalling device of the invention comprises one or more oscillators to combine two signals of different frequencies which are amplified to drive a conventional speaker. To develop an output having characteristics similar to the sounds produced by a bird, a passive network is added in a novel manner to one of the oscillators. Many variations are possible ranging from bird-like sounds to siren effects by varying the circuit parameters. In one embodiment, two unijunction transistors are employed; in a second, only one such transistor is used together with a conventional free running multi-vibrator; and in a third, Shockley diodes are used instead. The first two embodiments may, in addition, be battery operated, and if desired, power from the local utility can be used instead.

It is therefore the primary objective and purpose of the invention to provide an improved electronic sound signalling device capable of generating a novel audio output signal.

Another object of the invention is to provide an electronic sound signalling device of the type described that is capable of generating a variety of sounds ranging from bird sounds to siren effects.

Another object of the invention is to provide an electronic sound signalling device for generating an audio signal having an increasing frequency type after-effect characteristic of sounds produced by birds.

Other objects and advantages of the invention will appear and be brought out more fully in the following specification, reference being had to the accompanying drawings wherein:

FIGURE 1 is a schematic diagram of a preferred embodiment of an electronic sound signalling device according to the invention;

FIGURE 2 is a schematic diagram of a second embodiment of the invention, only the applicable portions of FIGURE 1 being shown;

FIGURE 3 is a schematic diagram of a third embodiment of the invention again with only the applicable modified portions of FIGURE 1 being shown; and

FIGURE 4 shows certain waveforms for purposes of describing the invention.

Referring more particularly to the drawing, shown there in FIGURE 1 is a schematic diagram of a preferred embodiment of an electric sound signalling device **10** according to the invention. The device **10**, also arranged in FIGURE 1 in block diagrammatic form by dashed lines, comprises a source **12** of electrical power, a switching mechanism **14** for controlling the power to the device **10**, a first or low frequency generator means **16**, a second or high frequency generator means **18**, an amplification stage **20**, and a utilization device **22** including a speaker **24**.

For the source **12**, a conventional 6 to 12 volt bell transformer may be used or instead commercially available 9 volt batteries of, for example, Ever-Ready type #216. For descriptive purposes, the source **12** is a source of direct current voltage having a negative terminal **26** and a positive terminal **28**.

A conventional single pole, single throw switch **30** can be used for the switching mechanism **14**. One terminal of the switch **30** is connected to the positive terminal **28** of the source **12** at a junction **32**; the other terminal of the switch **30** is connected at a junction **34** as a source of B+ voltage to the first generator means **16**.

A conductor **36** connected to the junction **34** may be provided for supplying B+ voltage to a junction **38** to which the second generator means **18** having a similar conductor **40** is attached. The negative terminal **26** of the source **12** is similarly connected by conductors **42** and **44** to the first and second generator means, **16** and **18** respectively, at successive junctions **46** and **48**. Hereinafter, the potential on the terminal **26** is referred to as ground or ground reference potential.

The first generator means **16** in the preferred embodiment comprises a relaxation oscillator circuit utilizing a unijunction transistor Q1. A type 2N2646 unijunction transistor as manufactured by the General Electric Company may be used for the transistor Q1. Base **1** of Q1 is connected to ground at conductor **42** by a resistor **50**. Base **2** of Q1 is connected to B+ at conductor **36** through a series combination comprising a resistor **52** and a diode **54** with the cathode of the diode **54** being connected at the base **2** of Q1.

A capacitor **56** is tied between the B+ and ground at the conductors **36** and **42** respectively. A resistor **58** is serially connected to a capacitor **60** to form a junction **62**, the other ends of the resistor **58** and the capacitor **60** being respectively connected to B+ at conductor **36** and to ground at conductor **42**. A capacitor **64** is tied between the cathode of the diode **54**, which is the base **2** of the transistor Q1, and ground at conductor **42**. The emitter of the transistor Q1 is connected to the junction **62** which in turn is coupled by a lead **66** which terminates at a junction **68**.

The second generator means **18** in the preferred embodiment comprises a relaxation oscillator circuit utilizing a unijunction transistor or unijunction Q2. A type 2N2646 unijunction transistor as manufactured by the General Electric Company may be used for the transistor Q2. Base **1** of Q2 is connected to ground reference at conductor **44** through a winding **70** of a transformer T1. The other or base **2** of Q2 is connected to B+ at the conductor

40 through a resistor 72. The emitter of transistor Q2 is connected to the junction 68 through a resistor 74 and to ground at the conductor 44 through a capacitor 76. The output of the second generator means 18 is taken from the other winding 78 of the transformer T1. One end of the winding 78 is grounded at the conductor 44 which is terminated at a junction 80, and the other end of the winding 78 is coupled to the amplification stage 20 at a junction 82.

The amplification stage 20 utilizes a type NPN transistor Q3 with its emitter grounded at the junction 80 and its base connected at the junction 82. An input winding 84 of a transformer T2 is serially connected between the collector of transistor Q3 and B+ at a junction 86 to which the conductor 40 is terminated. A capacitor 88 may be connected in parallel with the winding 84. The transformer T2 includes an output winding 90 which is coupled to a voice coil 92 of the speaker 24 through junctions 94 and 96.

To operate the electronic sound signalling device 10 of FIGURE 1, the switch 30 is closed whereupon energy available at the source 12 is rapidly stored in the capacitor 56 for reasons to be described. To limit the initial current flow charging the capacitor 56, a small resistor, not shown, may be used. During the time interval when the switch 30 is closed, the voltage at all points along the conductor 36 and 40 is positive and will hereafter be referred to as B+ voltage. For all practical purposes, B+ equals the voltage available across the terminals 26 and 28 of the source 12. It should be noted that a circuit, equivalent in all respects with the embodiment of FIGURE 1 except for polarity reversals, may be devised; the particular arrangement of FIGURE 1 therefore is shown only for purposes of describing the invention.

The first generator means 16 comprising the unijunction transistor Q1 and the associated passive components which include the resistors 50, 52, and 58, the diode 54 which may be a silicon diode, and the capacitors 60 and 64 is operatively described first and followed by a similar description of the second generator means 18.

As current from the source 12 is storing charge in the capacitor 56, current from the source 12 is also charging the capacitors 60 and 64 of the generator means 16. The capacitor 60 is charged through the resistor 58 which is relatively large compared to the resistance of the resistor 52 through which current flows charging the capacitor 64. In addition, voltage divider action is achieved by the series circuit combination of resistors 50, 52, and the relatively low forward resistance of the silicon diode 54, all of which are connected in the base circuit of the transistor Q1 at bases 1 and 2, as previously pointed out. Since the resistance between the base 2 and the base 1 of Q1 is substantially large, on the order of 5K to 10K ohms as compared to the total resistance of the resistors 50 and 52 and the diode 54, the resultant voltage across the capacitor 64 and hence at the base 2 of Q1 is approximately equal to the B+ voltage. The resistor 58, which may, for example, be 50 times the resistance of the resistor 52, determines the rate at which the capacitor 60 is charged. Thus, the voltage on the emitter of Q1 builds up slowly relative to the voltage on the base 2 of Q1. When the stand-off ratio is reached, the transistor Q1 conducts and the capacitor 60 is discharged through the resistor 50. The energy stored in the capacitor 64 is available to keep the voltage on the base 2 relatively higher than that at both the emitter and the base 1 of Q1 to cut-off Q1 when the capacitor 60 is substantially discharged. Upon cut-off of Q1, the capacitor 60 is again charged through the resistor 58 and the cycle is repeated.

The frequency at which the transistor Q1 is fired and cut-off is determined by the resistor 58, the capacitor 60, and the stand-off ratio of the unijunction transistor Q1. Stated differently, when the voltage across the capacitor 60 reaches that voltage, relative to the base 2, at which the stand-off ratio is reached, the transistor Q1 fires, discharging the capacitor 60. Thus, by decreasing the resistance valve of the resistor 58, the voltage build-up across the capacitor 60 is more rapid and, for the same biasing arrangement and stand-off ratio, the capacitor 60 is discharged much sooner meaning the frequency at which the first generator means 16 operates is increased accordingly. By using a variable resistance such as a potentiometer for the resistor 58, the operating frequency of the first generator means 16 can be varied accordingly as desired.

In the second generator means 18, the unijunction transistor Q2 is biased by voltage divider action caused by the resistor 72 and the resistance between the base 2 and the base 1 of Q2. The DC resistance of the winding 70, being extremely small, can therefore be ignored. If, for example, the resistance of the resistor 72 equals the internal resistance in the base circuit of Q2, the voltage at the base 2 will be equal to approximately one half the B+ voltage. The significance of biasing Q2 in this manner will subsequently become apparent.

The resistor 74 and the capacitor 76, it will be noted, are connected to the emitter of Q2 in a manner similar to the resistor 58 and the capacitor 60 of the first generator means 16, except that the resistor 74, instead of being tied to B+, is coupled directly to the junction 62, which is common with the emitter of Q1, through the lead 66 and the junction 68. In other words, the rate at which energy is stored in the capacitor 76 is determined by the current flowing through the resistor 74 from the junction 62. As the voltage across the capacitor 76, which is the voltage applied to the emitter of Q2, increases and reaches the stand-off ratio of Q2, the unijunction transistor Q2 conducts discharging the capacitor 76 through the winding 70. When the capacitor 76 is discharged, Q2 cuts-off and the capacitor 76 is again charged, repeating the cycle. Since the voltage on the base 2 of Q2 is lower than that applied to the base 2 of Q1, the transistor Q2 is alternately fired and cut-off at a faster rate or at a higher frequency than the transistor Q1.

It will be noted that during each operative cycle of the transistor Q1, the voltage at the junction 62 and hence the junction 68 is increasing. Thus, the rate of charging the capacitor 76 is successively increasing causing the transistor Q2 to be fired at successively decreasing time intervals. In other words, the frequency at which Q1 operates is substantially constant as determined by the circuit parameters supplying energy to the capacitor 60 and the stand-off ratio of Q1 and its relationship to the bias voltage approximating B+ applied to base 2 of Q1. However, the frequency at which Q2 is operating is not only higher than that of Q1 but is also changing, i.e. increasing, during each operative period of Q1. Stated differently, during each period during which Q1 is cut-off, Q2 is firing and being cut-off many times, the period of each firing and cut-off being successively less and less.

Each time Q2 is fired and the capacitor 76 discharged, current flows through the winding 70, inducing a time varying voltage in the winding 78 which is then fed to the base/emitter circuit of the common emitter type transistor amplifier Q3. The output of the second generator means 18 is amplified by Q3, and this amplified output is used to drive the output transformer T2 connected in the collector circuit of Q3. The transformer T2, which may be a Calrad type CR–85 transformer, provides the proper impedance match for maximum power transfer to the voice coil 92 of the speaker 24. If desired, a capacitor 88 may shunt the primary winding 84 of the transformer T2 to provide a low impedance bypassing path for the higher frequency components appearing in the amplified output. With respect to the transformer T1, a Calrad type CR–75 may be used with the lower 2K impedance winding being used for the winding 70.

At this point, the operation of the electronic sound signalling device 10 has been described covering that time

during which the switch **30** has been closed. In some applications, it should be pointed out, the switch **30** is closed only momentarily as, for example, in the case of a door announciator device. In others, as when siren effects are used for warning signal, for instance, the switch **30** may be closed for longer periods and either automatically opened or manually released. In either case, a hang-over or after-effect is provided so that the device **10** is not immediately turned off. In this manner, the sound generated is not abruptly terminated but rather fades away. When the device **10** is used to generate bird-like sounds, for example, the after-effect to be described serves to more accurately reproduce the sounds characteristic of birds.

When the switch **10** is opened, energy stored in the capacitor **56** is available to sustain operation of the first and second generator means, **16** and **18**, for a predetermined time dependent upon both the size of the capacitor **56** and the remaining circuit parameters. Energy available from the capacitor **56** is used to charge the capacitors **60**, **64**, and **76**, to properly bias the unijunctions Q1 and Q2 and to provide power to the amplification stage **20**.

To summarize briefly, a periodic voltage having a waveform A, reference FIGURE 4, is generated by the first generator means **16** and used to develop a periodic voltage having a waveform B for controlling the conductive state of the unijunction Q2 of the second generator means **18**. Each time the capacitor **76** is discharged through Q2 and the winding **70**, a voltage is induced in the winding **78**, is then amplified by Q3 and used to drive the speaker **24** through the output transformer T2. This operation continues for a finite time interval after the switch **30** is opened, power during this time interval being supplied from the capacitor **56**.

It should be noted that each successive sawtooth of the waveform B extends over a progressively smaller portion of the time t_1, the period of the waveform A. The peaks of each sawtooth of the waveform B are the same, being that voltage at which the stand-off ratio of Q2 is reached. This results in the slopes of successive sawtooths, reference the waveform B, being progressively greater as time passes during each period t_1 of the waveform A. In other words, FIGURE 4 graphically describes the increasing frequency characteristics of the waveform B, and hence the varying frequency output from the speaker **24**, and also the relative frequency relationship between the waveforms A and B.

As a substitute for the second generator means **18**, shown in FIGURE 2 is a conventional free-running multivibrator **100** utilizing PNP type transistors Q4 and Q5. In FIGURE 2, the same reference numerals as used in FIGURE 1 are assigned to the corresponding like input and output terminals of the multivibrator **100**.

The output of the first generator means **16**, namely, the waveform A of FIGURE 4, is applied (1) to the emitters of Q4 and Q5 through a parallel circuit combination comprising a resistor **102** and a capacitor **104** and (2) to the base of each transistor Q4 and Q5 through resistors **106** and **108** respectively. The resistors **106** and **108** may have valves ranging between 10K to 30K ohms and function to bias the transistors Q4 and Q5. The collectors of Q4 and Q5 are grounded to the conductor 40 through resistors **110** and **112** respectively. A parallel combination of a resistor **114** and a capacitor **116** is connected between the collector of Q4 and the base of Q5; similarly, a parallel combination of a resistor **118** and a capacitor **120** is connected between the collector of Q5 and the base of Q4. The output from the multivibrator **100** is taken from the collector of Q5 and coupled through a capacitor **122** to the junction **82** to be amplified by Q3 and subsequently drive the speaker **24**.

In operation, as the capacitor **60** is charged, the rising voltage of the waveform A permits the multivibrator **100** to start and run freely at a desired frequency which as is well known can be adjusted by varying the appropriate circuit parameters. When the capacitor **60** is discharged, the multivibrator **100** is cut-off and started again when the voltage at the junction **68** is sufficient to properly bias Q4 and Q5 into alternate conduction and cut-off. The alternating voltage at the collector of Q5 and appearing across the resistor **112** is passed through the capacitor **122**, which also functions as a direct-current blocking condenser, to the amplification stage **20** and hence to the utilization device **22** as previously described.

Reference is made in FIGURE 3 to a third embodiment by a reference numeral **200** which may be used as a substitute for both the first and the second generator means **16** and **18** of FIGURE 1. In this embodiment two four layer diodes, CR–1 and CR–2, known widely as Shockley diodes, are used. A type 4E50 may be used for the diode CR–1, and a type 4E20 may be used for the diode CR–2. Again, the reference numerals used to identify like junctions in FIGURE 1 are employed in FIGURE 3.

Connected to the junction **38** is a resistor **202** which in turn is connected at a junction **204** to a resistor **206** which in turn is terminated at the junction **86**. A capacitor **208** is tied between the junction **204** and to a lead **45** interconnecting the junctions **46** and **80**. The diode CR–1 having its anode or positive terminal connected to the junction **204** is further connected at the cathode or negative terminal to a resistor **210** which in turn is connected to ground at the lead **45**. One side of a capacitor **212** and the positive terminal of the diode CR–2 are connected to the junction **86**. The other side of the capacitor **212** is grounded at the lead **45**. A winding, which may be the winding **70** described in conjunction with FIGURE 1, is connected between ground at lead **45** and the negative terminal of the diode CR–2. The other winding **78** of the transformer **T1**, as described previously, is connected across the junctions **80** and **82**.

For the embodiment shown in FIGURE 3, when substituted for the first and second generator means **16** and **18** of FIGURE 1, a conventional half-wave rectifier power supply, not shown, is used for the source **12**.

When the switch **30** is closed, energy is stored in the capacitor **208**, the rate of charge being determined by the resistive value of the resistor **202**. For siren type effects, an 80K or more resistor may be used for the resistor **202**. Decreasing this value to, for example, one half results in more chirping because the capacitor **208** is charged and subsequently discharged at a faster rate. At the same time that the capacitor **208** is charging, current flowing through the resistor **206** charges the capacitor **212**.

Diodes having different break-down voltages are selected for the diode CR–1 and CR–2, with the latter having a break-down voltage lower than that of the former. The use of a type 4E50 for the CR–1 and a type 4E20 for CR–2 is such a suitable combination; if desired, diodes having break-down voltage characteristics other than those of the types described here may be used subject only to limitation that CR–2 has a lower relative to CR–1 break-down voltage.

When the voltage across the capacitor **212** reaches the break-down voltage of the diode CR–2, the diode CR–2 conducts discharging the capacitor **212** through the winding **70** to induce a voltage in the winding **78**. The voltage across the capacitor **212** thereupon drops rapidly and at some point, namely at that voltage at which CR–2 is cut-off, the cycle is repeated to charge the capacitor **212**. This cycle is repeated over and over again at an increasing rate during the time it takes the voltage across the capacitor **208** to reach the break-down voltage of the diode CR–1. When this happens, the diode CR–1 conducts and the capacitor **208** is discharged through the diode CR–1 and the resistor **210**. The resistance of the resistor **210** may be very small and preferably is just high enough to prevent permanent damage to the diode CR–1 as a result of high discharge currents and excessive heat dissipation.

It should be noted that the resistor **206** has a resistive value significantly larger than the combined resistance of the resistor **210** and the forward resistance of the diode

CR–1 when conductive to prevent the discharge of the capacitor 212. In addition, by changing the resistive value of the resistor 206 within the limits just mentioned, the frequency at which the diode CR–2 conducts and cuts-off may be varied to control the pitch of the sound emanating from the speaker 24. The output, available at the junctions 80 and 82, is amplified and used to drive the utilization device 22 as previously described.

When the switch 30 is opened, energy stored in the capacitor 208 is available as a source of power delivering current through the resistor 206 to charge the capacitor 212 and to supply power to the amplification stage 20. How often the capacitor 212 is charged and subsequently discharged, and the cycle repeated, is dependent upon the size of the capacitor 208 and the choice of the remaining circuit parameters as well as the type of four-layer diodes CR–1 and CR–2 that are used. By making a suitable choice, the after-effect previously described is produced and its duration to a certain extent controlled.

In FIGURE 4, the waveform A may also represent the periodic voltage which is developed across the capacitor 208 and available at the junction 204. Similarly, the voltage across the capacitor 212 varies accordingly as shown by the waveform B. As previously described in conjunction with FIGURE 1, the waveforms A and B graphically describe the frequency interrelationships of the voltages applied at the positive terminals of the diodes CR–1 and CR–2 respectively. The characteristic increasing frequency, at a decreasing rate, of the voltage across the capacitor 212 in FIGURE 4 is similar to the voltage developed across the capacitor 76 of FIGURE 1. The same applies to the output of the multivibrator 100 except that a sinusoid, not shown, rather than a sawtooth waveform is developed and available at the junctions 80 and 82. If desired, the waveform A can, by well known techniques, be made substantially linear as shown by the waveform A'; in such an event, the rate of frequency shift can be varied accordingly including zero.

Thus, there has been described an electronic sound signalling device comprising in combination first generator means including an active element for developing a first signal varying in time at a first predetermined frequency, second generator means coupled to the first generator means and including an active element, the second generator means being responsive to the first signal to develop a second signal that varies in time at a second predetermined frequency, the second frequency being higher than the first frequency, means coupled to the second generator means for amplifying the second signal, source means for supplying electrical power to the first and second generator means and to the amplifying means, switch means associated with the source means to operatively control the flow of power supplied from the source means, output means including speaker means coupled to the amplifying means for converting the amplified second signal to sound waves, first circuit means including energy storage means for storing energy therein when the switch means is disposed in an operative state and for supply energy to the first and second generator means and to the amplifying means for a preselected time interval after the switch means is disposed in an inoperative state, and second circuit means associated with the active element of the first generator means for maintaining preselected bias conditions relative to the active element associated with the second generator means.

In the preferred embodiment, the active elements comprise unijunction transistors Q1 and Q2 each biased differently to develop the sawtooth waveform A, the voltage of which is used to periodically charge the capacitor 76 at an increasing rate to fire the second unijunction transistor Q2 and in so doing induce a voltage, reference to the waveform B, having a frequency higher than that of the sawtooth waveform A, the center of this higher frequency being the average of the frequencies at the beginning and at the end of the time interval t_1 during which the first unijunction transistor Q1 is cut-off. In addition, to assure cut-off of the first unijunction transistor Q1 when the capacitor 60 supplying voltage to its emitter is discharged, a capacitor 64 inhibited from discharging through the first unijunction transistor Q1 during conduction by the diode 54, is provided and connected in the base circuit of the first unijunction transistor Q1 at base 2. The capacitor 56 stores energy whenever the switch 30 is closed and supplies power after the switch 30 is opened to the device 10 to produce the desired after-effect.

In the second embodiment of FIGURE 2, a free-running multivibrator 100 is used in place of the second unijunction transistor Q2. With this arrangement, a sinusoidal output signal having an increasing frequency which may be at a varying rate, is produced.

In the third embodiment, four-layer diodes CR–1 and CR–2, are used for the active elements of the first and second generator means 16 and 18. The capacitor 208 functions in a manner similar to the capacitor 60 and the capacitor 212 like the capacitor 76. Since the resistor 206 is significantly large relative to the resistance through the branch comprising the diode CR–1 and the small resistor 210 when the diode CR–1 is conducting, the capacitor 212 cannot be discharged when the diode CR–1 is conducting which means the resistor functions in a manner similar to the diode 54 of FIGURE 1. At the same time, current flowing through the resistor 206 from the junction 204 causes a voltage drop which decreases as the current flowing to charge the capacitor 212 decreases as charge accumulates in the capacitor 212, thus the voltage at the positive terminal of the diode CR–2 slowly rises until conduction takes place at which time the capacitor 212 is discharged to that voltage at which the diode CR–2 cuts off. The voltage induced in the winding 78 has a frequency characteristic as described in conjunction with the output voltages of the embodiments of FIGURES 1 and 2. Upon opening the switch 30, the capacitor 208 functions in a manner similar to the capacitor 56 of FIGURE 1 to produce the desired after-effect.

I claim:

1. An electronic sound signalling device comprising in combination

source means for supplying electrical power including a source of direct current voltage;

switch means associated with said source means to operatively control the flow of power supplied from said source means;

first generator means including an active element for developing a first signal varying in time at a first predetermined frequency;

second generator means coupled to said first generator means and including an active element, said second generator means being responsive to said first signal to develop a second signal that varies in time at a second predetermined frequency, said second frequency being higher than said first frequency;

said first and second generator means further comprising relaxation oscillators including first and second unijunction transistors, first and second series circuit combinations each comprising a resistor and a capacitor, and first and second leads for connecting the junction of said resistor and capacitor of said first and second series circuit combinations respectively to the emitters of said first and second unijunction transistors, the other end of the resistor of said first series circuit combination being connected to said source of direct current voltage through said switch means and the other end of the resistor of said second series circuit combination being connected to the emitter of said first unijunction transistor, said first unijunction transistor being disposed in a conductive state when the voltage at the emitter thereof reaches the stand-off ratio;

means coupled to said second generator means for amplifying said second signal;

output means including speaker means coupled to said amplifying means for converting said amplified second signal to sound waves;

first circuit means including energy storage means for storing energy therein when said switch means is disposed in an operative state and for supply energy to said first and second generator means and to said amplifying means for a preselected time interval after said switch means is disposed in an inoperative state, said energy storage means further comprising a capacitor connected in parallel circuit relationship across said first series circuit combination and across said second circuit means and in series circuit relationship with said source of direct current voltage when said switch means is disposed in an operative state;

second circuit means associated with the active element of said first generator means for maintaining preselected bias conditions relative to the active element associated with said second generator means, said second circuit means further comprising a resistor, a diode and a capacitor connected in series circuit relationship with one of the bases of said first unijunction transistor being connected at the junction of said capacitor and said diode to cut-off said first unijunction transistor when the capacitor of said first series circuit combination is discharged; and

said second generator means further including resistance circuit means for biasing said second unijunction transistor into a conductive state periodically at an increasing rate when said first unijunction transistor is disposed in a non-conductive state to produce said second signal, said second frequency being the average of the frequencies at the beginning and at the end of the time during which said first unijunction transistor is cut-off.

2. An electronic sound signalling device comprising in combination

source means for supplying electrical power including a source of direct current voltage;

switch means associated with said source means to operatively control the flow of power supplied from said source means;

first generator means including an active element for developing a first signal varying in time at a first predetermined frequency;

second generator means coupled to said first generator means and including an active element, said second generator means being responsive to said first signal to develop a second signal that varies in time at a second predetermined frequency, said second frequency being higher than said first frequency;

said first generator means further comprising a relaxation oscillator including a unijunction transistor and a first series circuit combination comprising a resistor and a capacitor connected at the junction thereof to the emitter of said unijunction transistor, said unijunction transistor being disposed in a conductive state to discharge the capacitor of said first series circuit combination when the voltage at the emitter of said unijunction transistor reaches the stand-off ratio;

said second generator means further comprising a free running multivibrator, the active elements of which comprise two transistors each biased to conduct alternately when the other is cut-off to generate said second signal, the frequency of said second signal increasing at a variable rate, the power for driving said multivibrator being supplied from the junction of the resistor and the capacitor of said first series circuit combination;

means coupled to said second generator means for amplifying said second signal;

output means including speaker means coupled to said amplifying means for converting said amplified second signal to sound waves;

first circuit means including energy storage means for storing energy therein when said switch means is disposed in an operative state and for supply energy to said first and second generator means and to said amplifying means for a preselected time interval after said switch means is disposed in an inoperative state, said energy storage means further comprising a capacitor connected in parallel circuit relationship across said first series circuit combination and across said second circuit means and in series circuit relationship with said source of direct current voltage when said switch means is disposed in an operative state;

second circuit means associated with the active element of said first generator means for maintaining preselected bias conditions relative to the active element associated with said second generator means; and

said second circuit means further including a second series circuit combination comprising a resistor, a diode and a capacitor connected at the junction of said diode and said capacitor to one of the base terminals of said unijunction transistor, said diode preventing the capacitor of said second series circuit combination from discharging through the resistor of said first series circuit combination and said unijunction transistor when disposed in said conductive state, said capacitor of said second series circuit combination providing a voltage in the base circuit of said unijunction transistor to terminate said conductive state when the capacitor of said first series circuit combination is discharged.

3. An electronic sound signalling device comprising in combination

source means for supplying electrical power to said device including a half-wave voltage rectifier for supplying the positive portions of an alternating current voltage;

switch means associated with said source means to operatively control the flow of power supplied from said source means;

first generator means including an active element for developing a first signal varying in time at a first predetermined frequency;

second generator means coupled to said first generator means and including an active element, said second generator means being responsive to said first signal to develop a second signal that varies in time at a second predetermined frequency, said second frequency being higher than said first frequency;

said first and second generator means further including first and second four layer diodes, the former having a higher break-down voltage than that of the latter;

means coupled to said second generator means for amplifying said second signal;

output means including speaker means coupled to said amplifying means for converting said amplified second signal to sound waves;

first circuit means including energy storage means for storing energy therein when said switch means is disposed in an operative state and for supply energy to said first and second generator means and to said amplifying means for a preselected time interval after said switch means is disposed in an inoperative state, said first circuit means further including a first series circuit combination comprising a first resistor and a first capacitor connected at the junction thereof to the positive terminal of said first four layer diode, said first series circuit combination being connected across said source means through said switch means, said first four layer diode being disposed in a conductive state to discharge said first capacitor when the voltage at the positive terminal of said first four layer

diode substantially equals the break-down voltage thereof;

second circuit means associated with the active element of said first generator means for maintaining preselected bias conditions relative to the active element associated with said second generator means, said second circuit means further including a second series circuit combination comprising a second resistor and a second capacitor, said second series circuit combination being connected in parallel with said first capacitor, the positive terminal of said second four layer diode being connected to the junction of said second resistor and said second capacitor, said second four layer being disposed in a conductive state to discharge said second capacitor when the voltage at the positive terminal of said second four layer diode substantially equals the break-down voltage thereof; and

said energy storage means further comprising said first capacitor whereby energy is supplied to charge said

second capacitor to periodically fire said second four layer diode for a predetermined time interval after said switch means is disposed in a non-operative state to produce a fading after-effect at the end of said second signal.

References Cited

UNITED STATES PATENTS

3,051,944	8/1962	Smith.	
3,137,846	6/1964	Keeling	340—384
3,214,708	10/1965	Chamberlain	331—111 X
3,300,733	1/1967	Price	331—111 X

THOMAS P. HABECKER, Primary Examiner

CHARLES M. MARMELSTEIN, Assistant Examiner

U.S. Cl. X.R.

46—180; 331—47, 52, 107, 111, 113