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[11] **3,889,256**

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[54] **AUTOMATIC CONTROL FOR AUDIBLE ELECTRONIC WARNING SYSTEM**

[75] Inventors: **Richard F. Cieslak,** Algonquin; **John V. Balding,** Palatine, both of Ill.

[73] Assignee: **Industrial Electronics Service Co.,** Schaumburg, Ill.

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[21] Appl. No.: **377,644**

[52] **U.S. Cl.** ..... **340/384 E;** 340/384 R

[51] **Int. Cl.** **G08b 3/00**

[58] **Field of Search** ..... 340/384 E, 384 R; 331/47, 331/64; 84/1.24, 1.25

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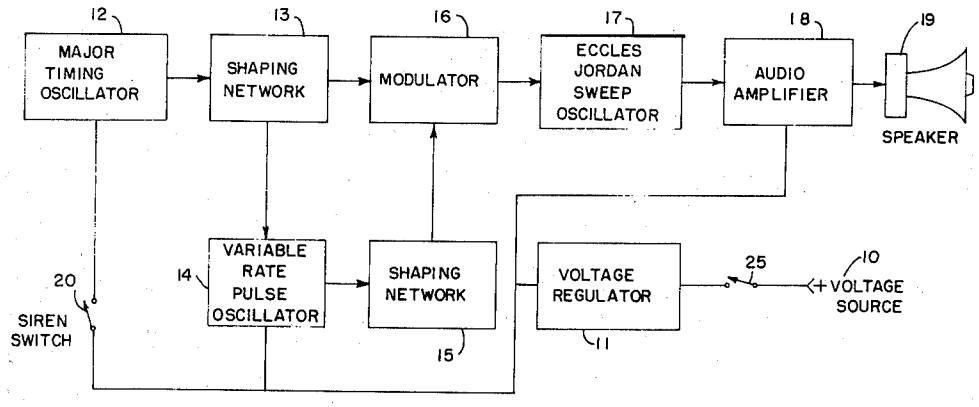
Primary Examiner—Harold I. Pitts

Attorney, Agent, or Firm—Mann, Brown, McWilliams & Bradway

[57] **ABSTRACT**

This invention is an electronic siren producing a siren sound having a sound wave produced on a slowly rising and falling frequency. A major cycle is pulsed at intervals with variations in frequency. The variations in each major cycle represent minor cycles. The invention utilizes an electronic circuit to effect such major and minor frequency cycles with existing speaker equipment to project the sound.

6 Claims, 3 Drawing Figures



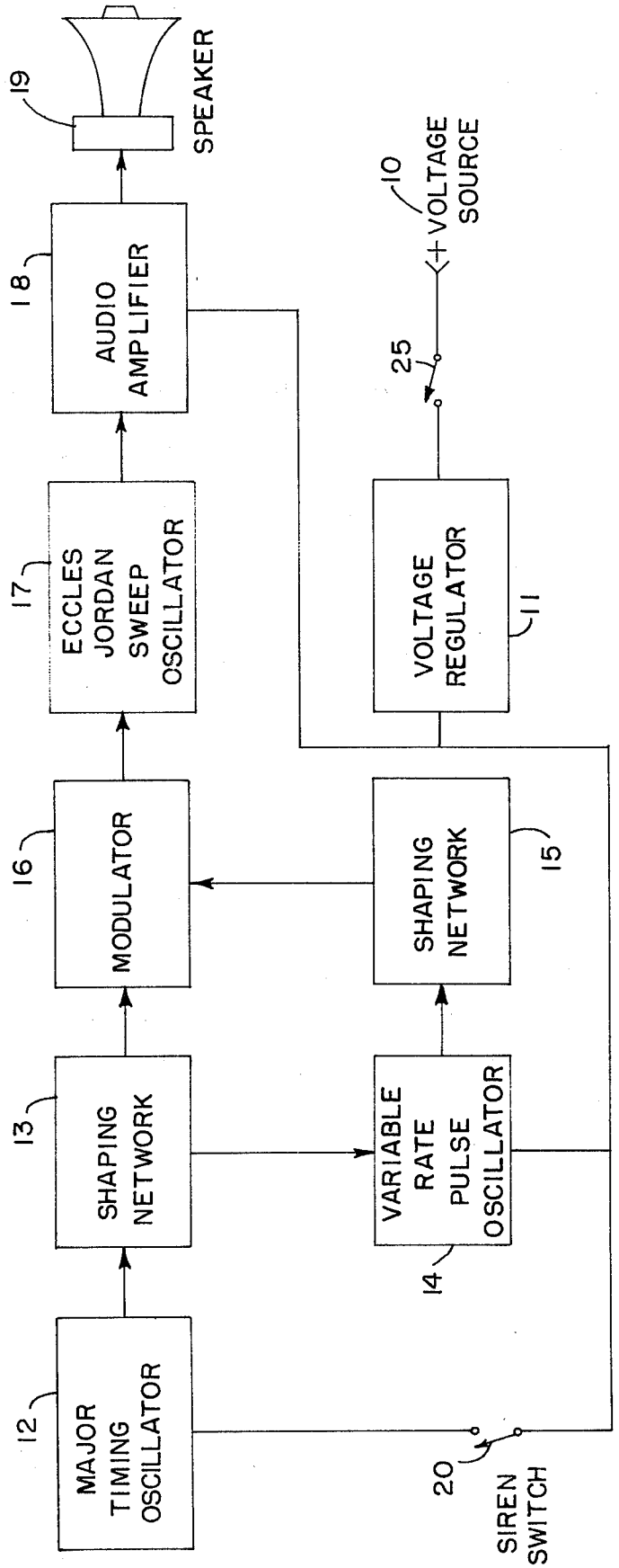

MAJOR TIMING OSCILLATOR
12
SHAPING NETWORK
13
VARIABLE RATE PULSE OSCILLATOR
14
SHAPING NETWORK
15
MODULATOR
16
ECCLES JORDAN SWEEP OSCILLATOR
17
AUDIO AMPLIFIER
18
19
SPEAKER
10
+ VOLTAGE SOURCE
25
VOLTAGE REGULATOR
11
20
SIREN SWITCH

FIG. 1

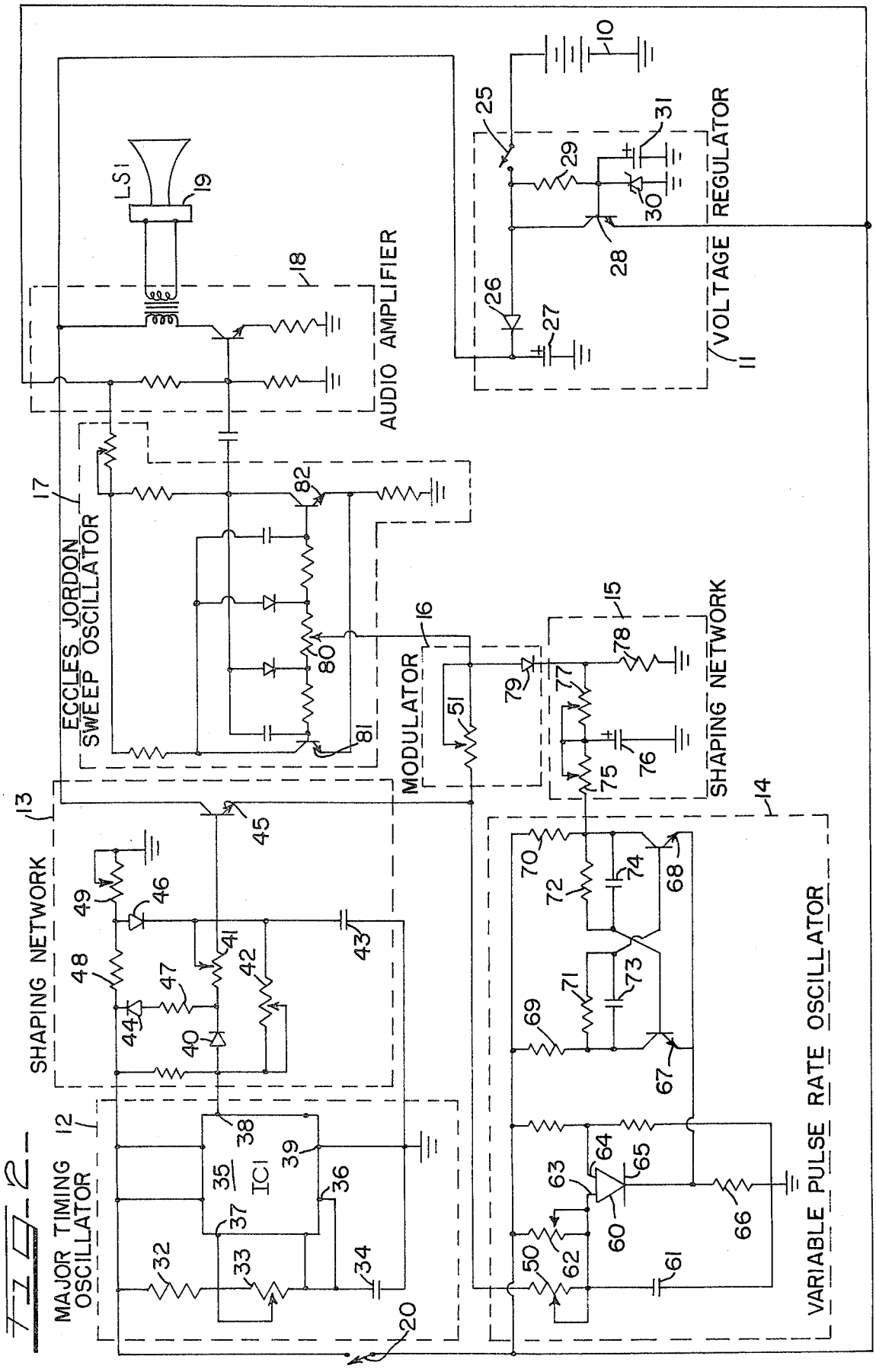

MAJOR TIMING OSCILLATOR
12
SHAPING NETWORK
13
ECCLES JORDON SWEEP OSCILLATOR
17
AUDIO AMPLIFIER
18
LS1
19
20
IC1
35
MODULATOR
16
SHAPING NETWORK
15
VARIABLE PULSE RATE OSCILLATOR
14
VOLTAGE REGULATOR
11
10
25
26
27
28
29
30
31

FIG. 2

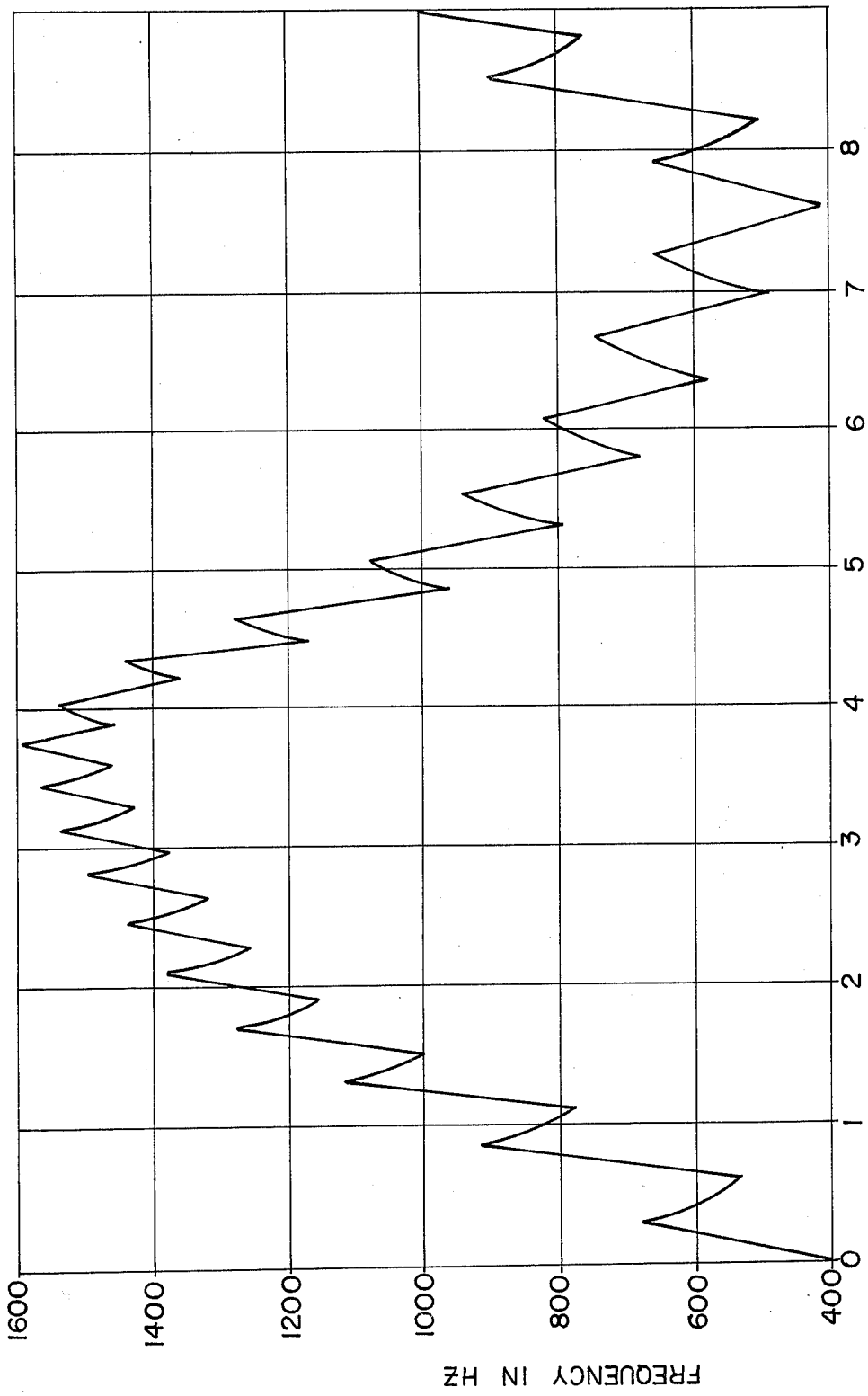

FREQUENCY IN HZ
1600
1400
1200
1000
800
600
400
0
1
2
3
4
5
6
7
8
TIME IN SECONDS

FIG. 3

AUTOMATIC CONTROL FOR AUDIBLE ELECTRONIC WARNING SYSTEM

BACKGROUND OF THE INVENTION

The present invention is directed to electrical sirens and particularly to sirens of the type which may be used with emergency vehicles.

Sirens commonly in use on emergency vehicles are of several types, i.e., as one utilizing a slowly rising and falling sound with a single or repetitive cycle, one using an alternating high and low frequency of sound or one using a slowly rising and falling sound frequency with minor sound frequency variations occurring during each cycle of the rising and falling sound. In the latter class of sirens, the sound has been produced by mechanical means. The first two types of sound producing sirens have heretofore been reproduced mechanically and electronically through use of motors or electrical amplifiers but, as far as is known, the third class has not heretofore been produced electronically. The mechanically produced siren noise has some desirable qualities not found in electronically produced siren sounds which may be attributed to purely mechanical noises resulting from the sound producing apparatus. Mechanically driven baffling is used with mechanical sirens to create a minor pulsing of the siren sound during each cycle of rising and falling frequency of the sound.

SUMMARY OF THE INVENTION

Electronically produced siren sounds have the advantages that sound emitting speakers of the siren may be located at various points in an emergency vehicle so that the sound direction may be predetermined. Electronically produced siren noises have the further advantage of utilizing combined or existing amplifying apparatus in an emergency vehicle thus reducing electrical power requirements in such vehicles. For example, the speakers used for producing a siren sound in the vehicle may also be used for a public address system.

OBJECTS OF THE INVENTION

With the foregoing in mind, the present invention has for its major purposes to provide an electronically produced siren sound which closely simulates the mechanically produced siren sound above mentioned and which produces a slowly rising and falling sound frequency with variations in the frequency during each cycle of rising and falling sound, and to enable use of such electronically produced sound with existing speaker facilities of emergency vehicles, while at the same time arranging simple and effective circuits to attain these ends at relatively low cost of manufacture and installation.

DESCRIPTION OF THE DRAWINGS

These and other purposes will appear from time to time in the course of the ensuing specification and claims when taken with the accompanying drawings, in which:

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

FIG. 2 is a schematic wiring diagram of the siren system showing the electrical relationship of all of the elements indicated in FIG. 1; and

FIG. 3 is a sound wave diagram.

DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in the drawings, the several elements of the siren system include a voltage source **10**, a voltage regulator **11**, a major timing oscillator **12**, a shaping network **13**, which supplies a variable pulse rate oscillator **14**. A second shaping network **15** takes the frequency supplied by the oscillator **14** and supplies it to a modulator **16**, which mixes the output from the shaping network **15** with the output from the shaping network **13** and supplies this mixed frequency to a sweep oscillator **17**. Oscillator **17** supplies audio amplifier **18** for a speaker **19**. A switch **20** controls the siren. The sweep oscillator **17** is powered from the voltage source **11** and is controlled by a bias voltage from modulator **16**.

The sound generated by this electronic system is on a rising and falling frequency ranging from a peak frequency to a low frequency, requiring a time interval to reach the peak frequency and approximately the same interval to fall back to the low frequency. This varying frequency comprises a major cycle but is pulsed at a continuously varying rate and at peak frequency the pulse rate is at a maximum. Each pulse varies in frequency depending upon whether the major cycle is near the high or the low end and each pulse comprises a minor cycle. This variably pulsed sound, as generated by this system, is obtained through the circuitry illustrated in more detail in FIG. **2**. This sound is shown diagrammatically in FIG. **3**. As an example, the basic sound may be a rising and falling frequency ranging from 400 hertz to 1600 hertz. The sound takes approximately 3 to 5 seconds to reach the peak of 1600 hertz and the same time to fall back to the minimum. This is referred to herein as a major cycle. This varying frequency is then "pulsed" at a continuously varying rate. Near or at peak frequency, the pulse rate is at a maximum (approximately **200** cpm). These pulses shall be referred to as minor cycles. Each minor pulse varies in frequency approximately 100 to 200HZ and in length approximately 0.3 to 0.6 seconds, depending on whether the major cycle is near the high or low end.

The sweep oscillator varies in output frequency with the bias voltage from modulator **16** so that as the bias voltage increases the output frequency of the oscillator also increases and when the bias voltage decreases the output frequency also decreases. The major timing oscillator **12** operates essentially like a switch, alternately turning on for a certain time period, as for example 3 to 5 seconds and then off for substantially the same period of time. The shaping network **13** functions to change the voltage switched on and off by the oscillator **12** to a slowly rising and falling voltage wave form similar to a sine wave. It converts the square wave form of approximately 3 – 5 seconds duration from oscillator **12** to a repetitive approximate sine wave of approximately 6 to 10 seconds duration. This voltage wave form provides a variable bias voltage for the sweep oscillator so that the output of the oscillator is a cyclically varying frequency of the same duration, i.e., approximately 6 to 10 seconds. This, in turn, provides a cyclically varying sound in the audio speaker of the same duration as illustrated in FIG. **3**. The variable pulse rate oscillator **14** is supplied with the alternately rising and falling voltage from the shaping network **13** and varies its pulse rate proportionately, so that, as the voltage increases, the pulse rate also increases and when the voltage decreases the pulse rate also decreases. This vary-

ing pulse is then shaped and applied to the sine wave voltage form from shaping network **13** and the resultant mixed voltage wave form is applied to the sweep oscillator **17** in the form of the bias voltage so that the output of this circuitry provides the variable pulsing frequency which results in the particular sound of this siren system.

The schematic wiring diagram of FIG. **2** illustrates the details of the several elements which together function to operate the system and obtain the sound generated and controlled by this total circuit. The voltage regulator circuit **11** includes a switch **25** and, when this switch is closed, positive voltage is applied from battery **10** to the voltage regulator circuit. The diode **26**, with the condenser **27** function as a filter while the transistor **28**, resistor **29**, diode **30** and condenser **31** function as a series regulator. Two D.C. supply voltages are made available from this voltage regulator circuit. A filtered voltage supplies the amplifier **18** and a transistor amplifier supply in shaping network **13** for modulator **16** and variable pulse rate oscillator **14**. The regulated voltage provides power for oscillator **12**, variable rate oscillator **14** and sweep oscillator **17**.

The major timing oscillator circuit **12** is controlled by the on-off siren switch **20**. When this switch is closed the regulated positive voltage from the regulator **11** is continuously applied to the timing oscillator. The resistors **32** and **33** and the condenser **34** form a timing circuit in conjunction with the timer **35**. Timer **35** is a known form of timer for periodically discharging condenser **34**. The condenser **34** is charged through the resistors **32** and **33** until the regulated voltage is reached at the connection **36** on the timer, whereupon the condenser **34** discharges through the resistor **33** into the timer at connection **37** until the voltage at the connection **36** drops to approximately one-third of the regulated voltage and at this point the condenser **34** again starts to charge and this cycle repeats continuously so long as the siren control switch **20** is closed. The output of the timer **35** at the connection **38** represents a square wave form, as indicated, which switches from the high voltage to the low voltage, i.e., from the regulated voltage to ground, through the connection **39**. The square wave is of approximately 3 to 5 seconds duration.

The shaping network **13** includes a diode **40**, resistances **41** and **42** and the condenser **43**. When the output of the timer **35** through the connection **38** is at the high, or regulated voltage, the diode **40** is biased on and the condenser **43** charges through the parallel resistors **41** and **42**. When the timer output through connection **38** is at the low voltage, diode **44** is biased off so that the condenser **43** discharges through the resistor **42**. Thus, there is provided at the base of transistor **45** a slowly rising and falling wave form wherein the duration is determined by the R-C time constant of the variable resistance **33** and the condenser **34** in the major timing oscillator circuit **12**. Diodes **44** and **46**, and resistors **47**, **48** and **49**, are used to provide smooth starting and termination of the rising and falling voltage. The collector of transistor **45** receives power from the filtered source of the regulator **11**. The transistor **45** amplifies the current of the rising and falling wave form and applies it to the resistor **50** of the variable pulse rate oscillator circuit **14** and to the resistor **51** of the modulator circuit **16**.

In the variable pulse rate oscillator circuit **14** a programmable unijunction transistor **60** is used. Condenser **61** is charged through the resistances **50** and **62**. When charged, the voltage at the anode **63** of transistor **60** increases until it reaches approximately **70%** of the voltage at the gate **64** of the transistor. At this point transistor **60** turns on and discharges the condenser **61** through the cathode **65** of transistor **60** and resistor **66**. As the voltage applied to the resistor **50** rises and falls, the charge time of the condenser **61** accelerates and slows down, respectively, so that the transistor **60** pulses at a varying rate. Each time the transistor pulses, a bistable multivibrator, comprised of transistors **67** and **68**, resistors **69**, **70**, **71** and **72**, and condensers **73** and **74**, is energized. This provides a square wave of varying rate or duration at the collector of transistor **68**. This wave is cyclic in nature and of a much shorter time duration than the wave form from network **13**. Also, the range of the variation in voltage occurring during the wave is much smaller than the range of voltage variation produced in the major wave.

The shaping network **15** shapes the varying minor square wave from the transistor **68** of the variable pulse rate oscillator circuit **14**, into a wave form which is similar to a triangular wave, at the junction on the resistor **75** and condenser **76** and then reduces it in amplitude through a voltage divider formed by resistors **77** and **78**.

The shaped wave from the major timing oscillator circuit **12** and the shaping network **13** is applied to the resistor **51** of the modulator circuit **16** while the varying shaped wave from the variable pulse rate oscillator circuit **14** and shaping network **15** is applied to the cathode of the diode **79** of the modulator circuit. The resultant wave form at the junction of the resistor **51** and the diode **79** comprises essentially the minor varying wave from shaping network **15** imposed on the major timing wave from shaping network **13**.

The mixed voltage wave form from the modulator circuit **16** is applied to the center tap of a resistor **80** in the sweep oscillator circuit **17**, where it functions as a bias voltage for the transistors **81** and **82**. The output of the sweep oscillator at the collector of the transistor **82** increases in frequency as the bias voltage increases so that, as the slowly rising and falling variable pulsing wave form is applied to the sweep oscillator, the output frequency slowly rises and falls in synchronism with the rising and falling wave form from network **13** in synchronism with the minor wave form from shaping network **15** while continuously pulsing at a varying rate. The pulses occur most rapidly at the highest frequency and occur most slowly at the lowest frequency.

The audio frequency output of the sweep oscillator **17** is then amplified by means of one or more audio amplifiers **18**, the circuitry of which, as shown, is generally typical of amplifiers of this type, and used to drive one or more speakers **19** whereby to project a slowly rising and falling variably pulsing sound continuously while turned on. The frequency range of the output from oscillator **17** corresponds in extent to the frequency range of the sound produced.

This electronic siren system has particular application to vehicles where the voltage source may be on the order of twelve volts, as provided in the usual automotive electrical system, but the principles of the system may be utilized with other voltages and in other instal-

lations where the location may be fixed, as distinguished from a moving vehicle.

It should be understood that voltage regulator circuits, timing oscillator circuits, wave shaping circuits, variable pulse rate oscillator circuits, sweep oscillator circuits, and audio amplifier circuits are known individually to the art but not in the combination or for the purpose herein described.

FINAL SUMMARY

From the foregoing, it will be seen that an electronic siren system has been provided wherein an audio section of the electronic circuitry produces a slowly rising and falling variably pulsed sound level in accordance with frequencies developed in a basic electronic circuit. As the major sound frequency increases during the cycle of sound, minor variations in pitch occur. The occurrence of these minor variations becomes more rapid as the major sound frequency increase and less rapid as the major sound frequency decreases. This provides a simulation of the pulsing of the mechanically driven sirens where the pulsing is produced by mechanically driven baffling, the actuation of which reoccurs at a rate corresponding to the variable rotating speed of the siren drive.

I claim:

1. An electronic siren including an audio speaker and an amplifier for producing sound at continual maximum audio output from said speaker in response to frequency variations transmitted to said amplifier, including frequency responsive amplifying means for an audio speaker, a voltage controlled sweep oscillator circuit for supplying a variable frequency to said amplifying means to provide frequencies distinguished from ambient sounds, modulating means for supplying a variable control voltage to said oscillator circuit, a timing oscillator circuit, said timing oscillator circuit including variable and settable means for supplying a pulsating voltage, a shaping network for changing the pulsating voltage of said oscillator circuit into a slowly rising and falling voltage which repeats in a cyclic manner, a variable rate pulse oscillator controlled by the output of said shaping network, a second shaping network for shaping the output of said variable rate pulse oscillator circuit means for imposing a varying cyclic voltage from said second shaping network on the voltage wave form supplied by said first shaping network in said modulating means to thereby produce a number of periodically rising and falling minor voltage variation on the main voltage wave supplied to said sweep oscillator circuit to thereby produce an amplifier control frequency having the characteristic of a cyclically recurring, slowly rising and falling main frequency of sound occurring over a preselected interval of time and a number of rising and falling minor frequencies occurring within said major frequency variation during each cycle of said main frequency while it is at maximum continual level.

2. An electronic siren system having an audio section projecting a square form sound wave at continual maximum audio output, electronic means for generating said sound wave of square form and slowly rising and falling frequency on a major cycle different from that of predominant ambient sound, and electronic means to pulse said major cycle and generate minor cycles to produce variable frequencies in said sound wave, said audio output being varied in rate and direction of frequency change represented by said minor cycles to change the frequency rate while it is at maximum continual level whereby to simulate a changing audio level.

3. An electronic siren system as set forth in claim **2** wherein said means for generating said sound wave includes an electronic circuit, and said means to pulse said major cycle includes a variable rate pulse oscillator in said circuit.

4. An electronic siren system as set forth in claim **3** wherein said electronic circuit includes a shaping network imposed on said major cycle, and a shaping network imposed on said minor cycles.

5. An electronic siren system as set forth in claim **3** wherein said electronic circuit includes a timing oscillator for applying a variable frequency to said sound wave.

6. An electronic siren system as set forth in claim **5** wherein said electronic circuit includes a shaping network imposed on said major cycle, and a shaping network imposed on said minor cycles.

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