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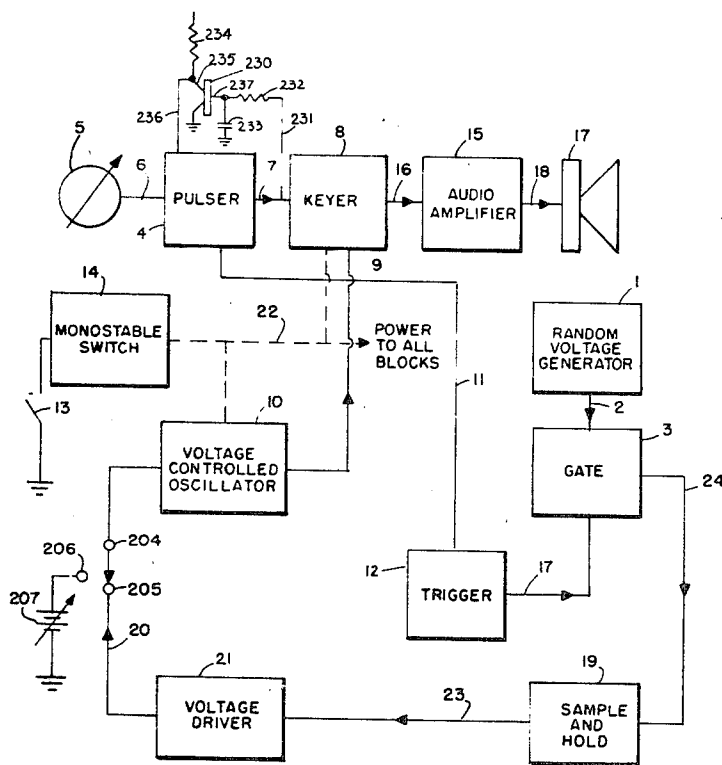
[54] **ELECTRONIC AUDIBLE SIGNALLING DEVICES**
6 Claims, 9 Drawing Figs.

[52] U.S. Cl. **340/384**
 [51] Int. Cl. **G08b 3/00**
 [50] Field of Search **340/384 E**

[56] **References Cited**

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ABSTRACT: Electronic audible signal devices such as doorbells, buzzers, beepers, telephone bells, school bells, bicycle bells, sirens, signaling bells in general and signalling devices in general are provided by novel combinations of random voltage generators, voltage controlled tone generators, pulsers, triggers, pulse shapers, keyers, audio generators, delay devices, amplifiers and loudspeakers.



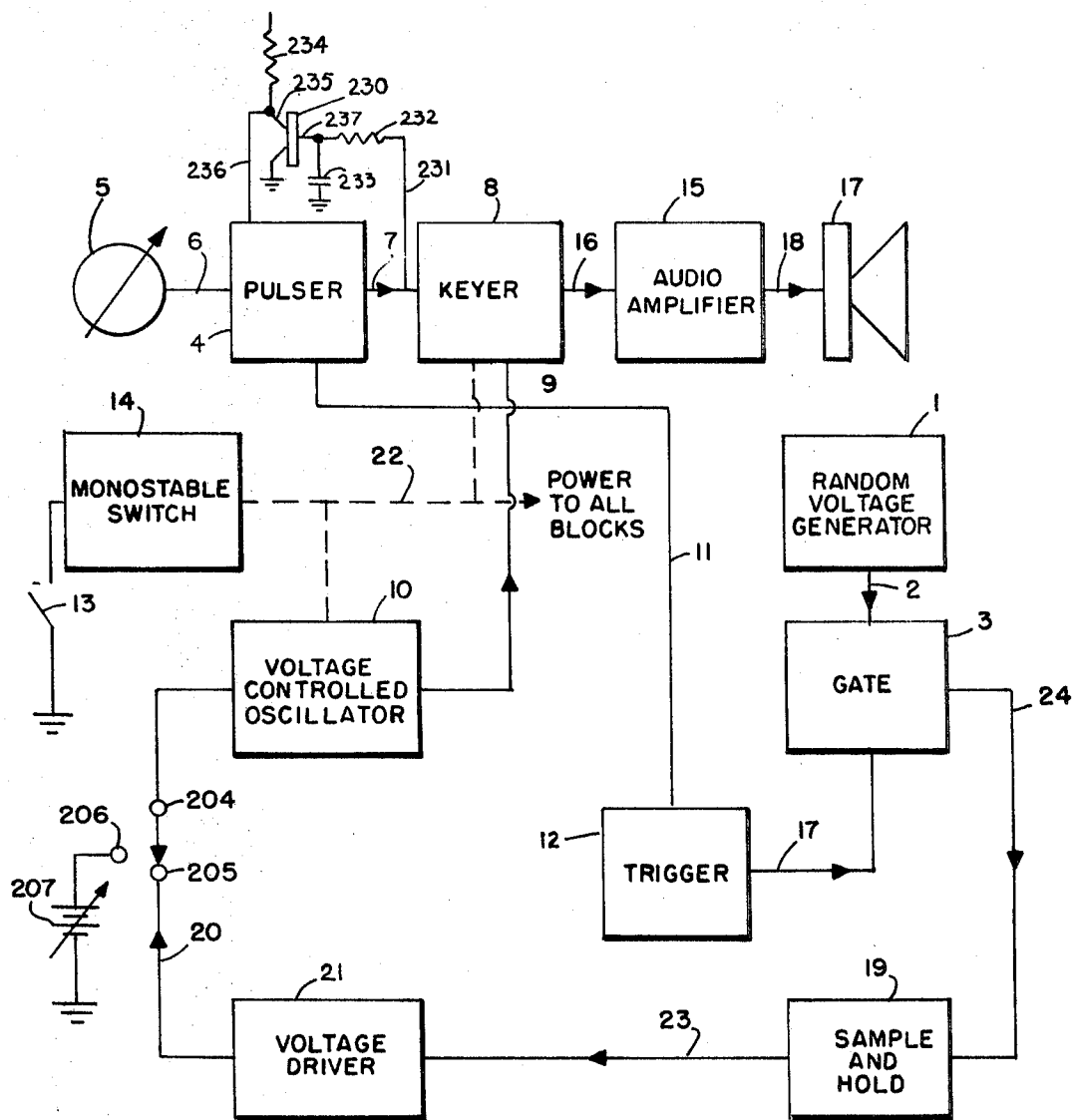


FIG 1

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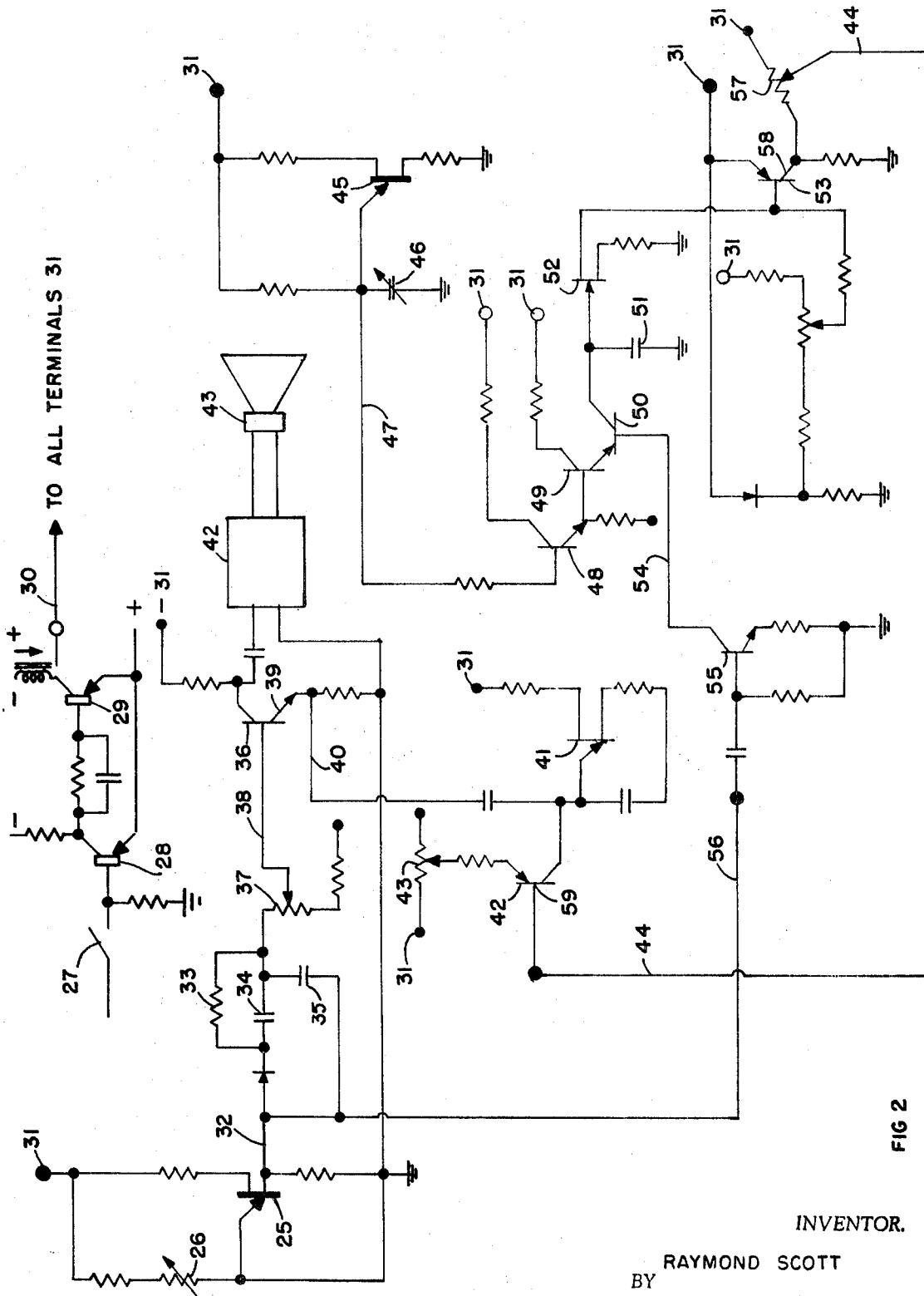


FIG 2

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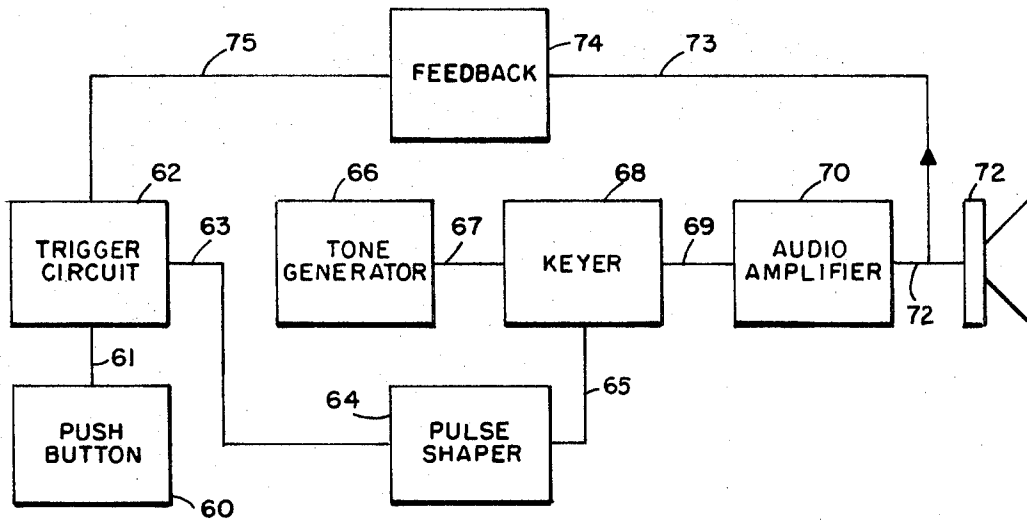


FIG 3

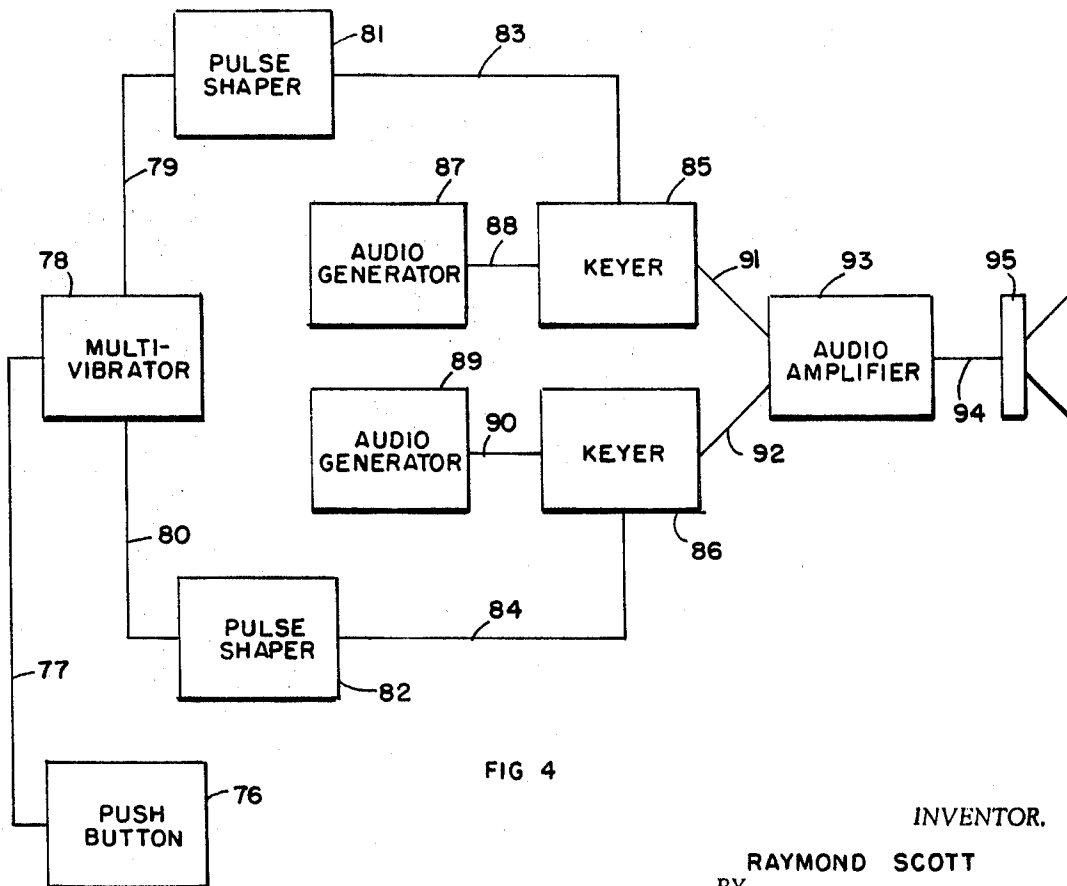
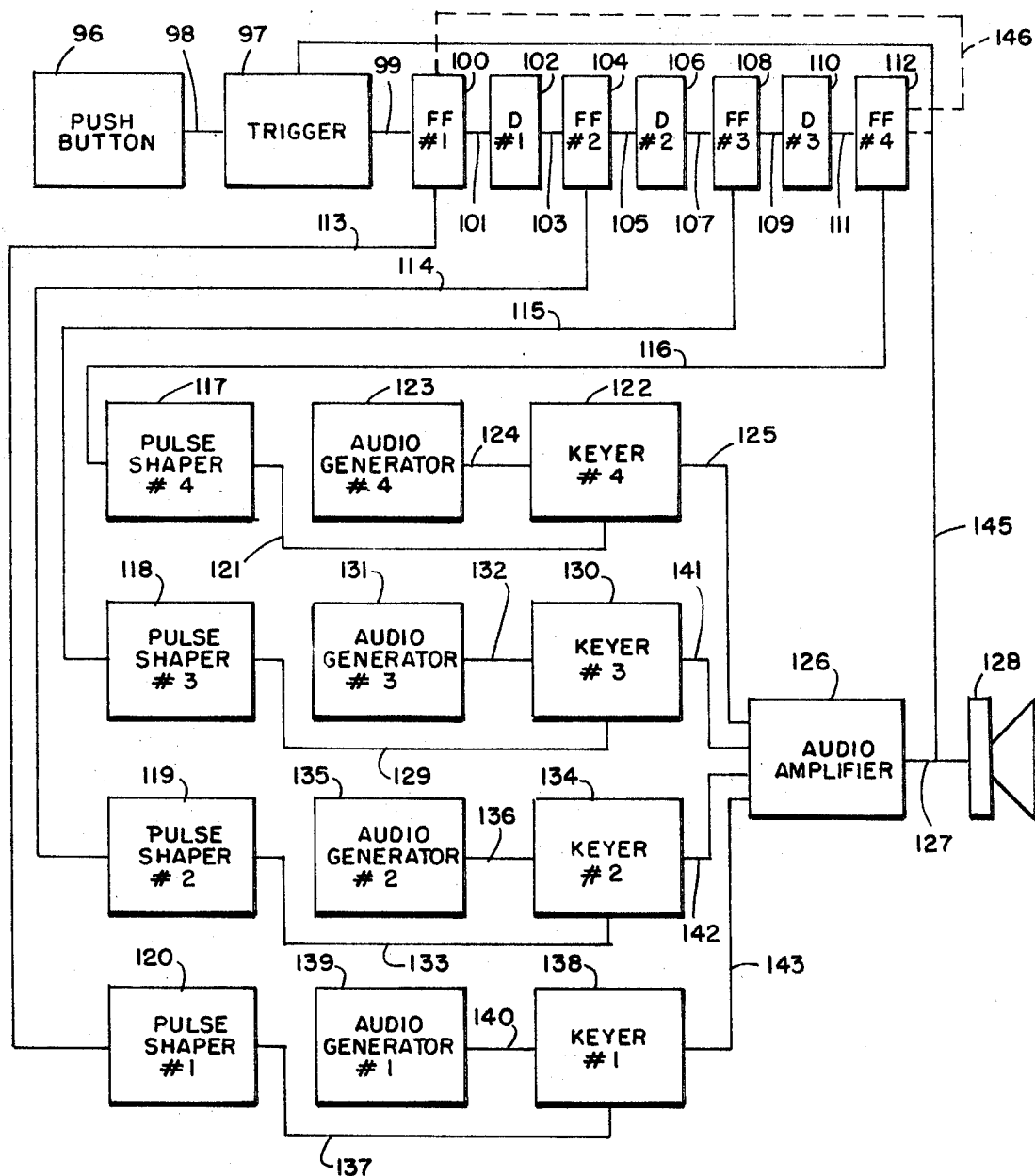


FIG 4

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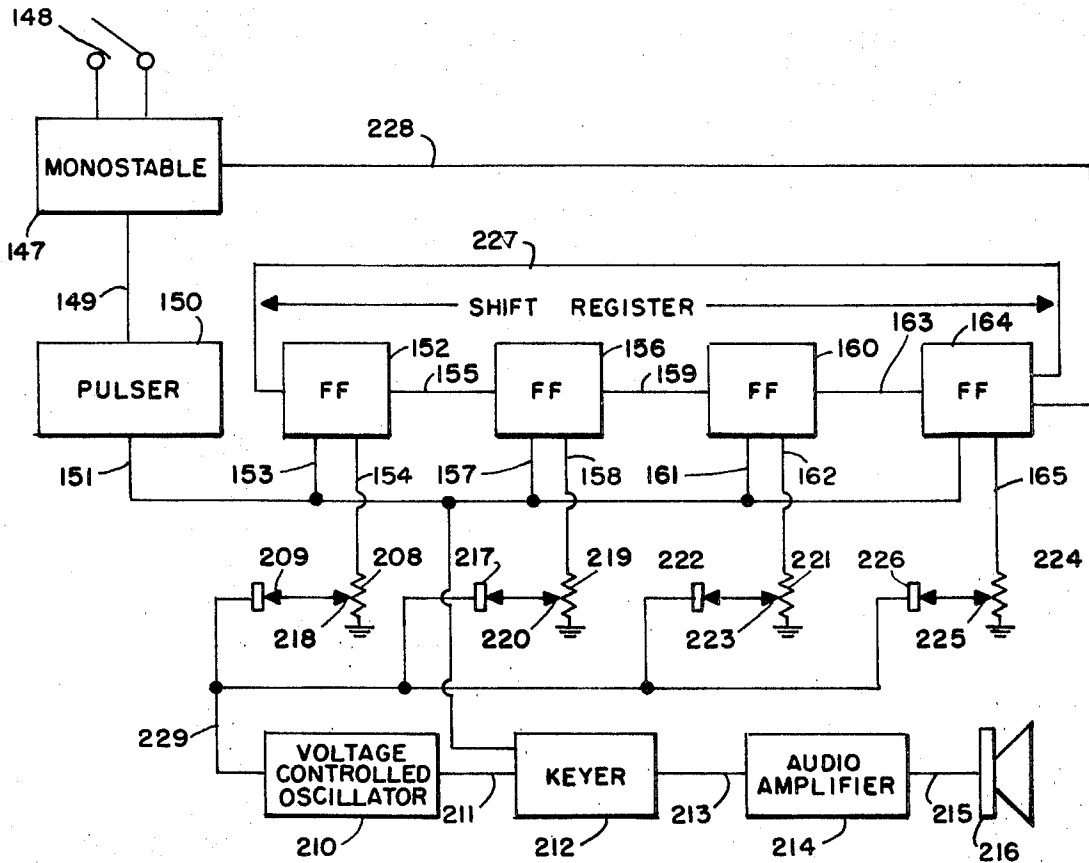


FIG 6

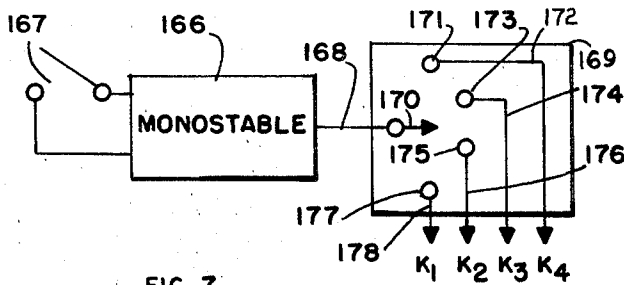


FIG 7

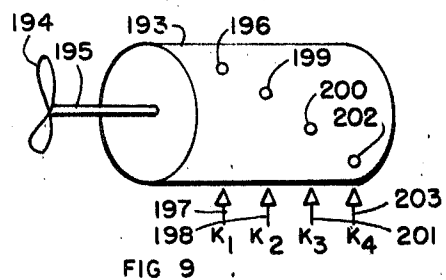


FIG 9

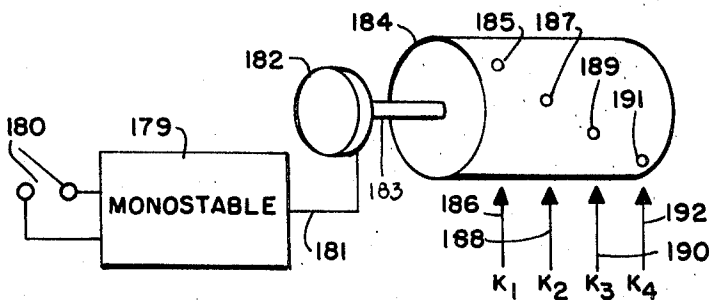


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ELECTRONIC AUDIBLE SIGNALLING DEVICES

BACKGROUND OF THE INVENTION

1. Field of the Invention

Class 340 Communications, Electrical and subclass 393 audible, combined or plural (e.g. manual and electrical, bell and buzzer).

2. Description of Prior Art

Prior art devices have included electromechanical bells generally including a metal bell stroked by an electrically driven clapper. Such bells have been programmed as by means of a punched tape or similar means for initiating or programming the stroking of the bell.

When considered in the light of the concepts in accordance with the present inventions, these prior art electromechanical devices are relatively inflexible and limited in performance. The mechanical bell, for example, emits only one tone so that for a wide range of tones a large number of bells would be required. There are many other limitations as well, such as the mechanical clapper, which has a natural period limiting the rate at which the bell may be struck. The volume is also an inherent characteristic of the bell which can be changed only slightly as by stroking more or less vigorously.

SUMMARY

The present invention comprises a completely electronic bell system except for the initiation pushbutton and the loudspeaker output transducer. The clapper is simulated by pulsers and triggers; the bell tone and characteristic by tone generators and pulse shapers; and the acoustical output by loudspeaker transducers. However, the electronic bells and buzzers in accordance with the present invention are far more flexible and versatile than the former electromechanical devices. The characteristics which were inherent in the rigid bell are not only widely variable but are under complete electronic control or are completely random as the operator or user chooses. Mechanical limitations of speed tone, loudness, pitch and other characteristics are completely eliminated and overcome in accordance with the present invention. Thus, new concepts applications and capabilities are provided, many not considered previously.

A wide range of signaling devices are provided with tone, pitch, attack, decay and other characteristics variable in practically unlimited variety. The extent of variation and character of various signaling devices in accordance with the present invention will be clearly understood from the detailed description of the invention given below in connection with the various figures of the drawing.

In the Drawing:

FIG. 1 is a block diagram of one form of the present invention.

FIG. 2 is a detailed schematic circuit diagram of the form of the invention shown in FIG. 1.

FIG. 3 is a block diagram of a modified form of the present invention.

FIG. 4 is a block diagram of another form of the present invention.

FIG. 5 is a block diagram of still another form of the present invention.

FIG. 6 is a block diagram of a modified form of a portion of the form of the invention shown in FIG. 5.

FIGS. 7, 8 and 9 are still further modified forms of a portion of the form of the invention shown in FIG. 5.

FIG. 1 is a block diagram of one form of the present invention. Operation of the device is initiated by closing a switch such as momentary contact pushbutton 13 is connected to trigger monostable switch 14 which applies, for a predetermined period of time (depending on the constants of the monostable switch), energizing voltage to the system rendering all of the other blocks operative for this period of time. When the system has thus been energized, the sequence of operations described below is started.

FIG. 1 then operates with a voltage controlled oscillator 10 producing a tone which is applied to keyer 8 over line 9. Pulser 4 rate controlled by a suitable rate control device 5 connected over line 6 turns keyer 8 on and off over line 7. Keyer 8 in going on passes tone signals from oscillator 10 over line 16 to audio amplifier 15 and the amplified tones are applied over line 18 to a suitable transducer such as loudspeaker 17. At the same time random voltage generator 1 is activated and starts generating a varying voltage such as, for example, a series of ramp voltages. These varying voltages are applied over line 2 to gate 3. Gate 3 when opened by a pulse from trigger 12 over line 17 applies a momentary voltage to sample and hold 19 over line 24. Trigger 12 is activated by pulses from pulser 4 over line 11. Sample and hold 19 receives a voltage from gate 3 which depends on the point in the cycle of random generator 1 at which gate 3 is opened by trigger pulses from trigger 12. This received voltage is held until the next sample is taken through gate 3. This held voltage is applied to voltage driver 21 over line 23 where a corresponding driver voltage is produced suitable for controlling voltage controlled oscillator 10 over line 20. This voltage applied from driver 21 causes the frequency or tone of oscillator 10 to assume a new value which in turn is emitted over loudspeaker 17. Thus, at each pulse from pulser 4, a new tone is produced and emitted and this new tone is randomly determined by the instantaneous voltage gate by gate 3 from random voltage generator 1. The rate at which the tones are changed and emitted is determined by the pulse rate of pulser 4 which in turn is determined by the setting of pulse rate control 5. The number of pulses of tone emitted or the length of time during which they are emitted for each closure of pushbutton switch 13 depends on the time constants of monostable switch 22 since when switch 22 opens, the system stops all activity.

In order to operate the device with a steady pitch (but adjustable) a switch 204, 205, 206 is provided for switching the frequency control of voltage controlled oscillator 10 from the random voltage generator to an adjustable voltage source 207.

An interesting and unusual effect can be provided if the power to pulser 4 is supplied through transistor 230 operated as a level detector or pulse counting switch. Pulses from line 7 over line 231 and through integrating resistor 232 serve to charge capacitor 233. Power to pulser 4 is supplied from line 33 through resistor 234 connected to collector 235 and over line 236. When capacitor 233 has been charged to the conduction point of base 237, collector 235 conducts dropping voltage through resistor 234 and lowering the voltage over line 236 to pulser 4 causing it to stop pulsing. As capacitor 233 discharges, the collector drops, the voltage rises and pulser 4 starts to generate pulses again. The object is to prevent a monotonous sound being produced from steady closure of pushbutton 13.

FIG. 2 is a schematic circuit diagram of a circuit suitable for use in the system shown in FIG. 1 and described above. The corresponding FIG. 1 numerals are shown in parentheses. The pulser (4) is shown as a unijunction oscillator employing unijunction transistor 25 and having a frequency controlled by variable resistor 26 (5). Pulses are applied to the keyer, transistor 36 (8) through a pulse shaping network including resistor 33 and capacitors 34 and 35 and a gain control 37 over lead 38. The voltage controlled oscillator employing unijunction transistor 41 (10) and a frequency control dynamic resistor supplied by transistor 42 and controlled by the setting of potentiometer 43 and the voltage supplied over line 44. The tone or signal from oscillator 41—42 is applied to keyer 36 over lead 40 to emitter 39. The keyed tone is applied to amplifier 42 (15) and in turn to loudspeaker 43 (17). The random generator is a unijunction oscillator employing unijunction transistor 45 (1) and having suitable frequency control means such as variable capacitor 46. The ramp voltages generated by this oscillator are applied over lead 47 (2) and through emitter follower transistors 48 and 49 to gate transistor 50 (3). Gate 50 is closed by a signal over line 54 (17) which in turn is derived from pulser 25 over lead 56 (11)

and through trigger transistor 55 (12). When gate 50 is closed the instantaneous voltage from random generator 45 is applied to a sample and hold device such as capacitor 51 connected to field effect transistor 52 (19). This voltage sample is applied through a voltage driver transistor 53 (21) over collector 58 and potentiometer 57 to line 44 (20) back to base 59 of the frequency control transistor 42 of voltage controlled oscillator 41 (10). Each time pulser 25 generates a pulse a new frequency is thus generated in a randomly determined manner.

The sequence described above is initiated by actuating a monostable switch comprising transistors 28 and 29 (14) by closing a suitable switch such as pushbutton 27 (13) and applying energizing voltage over lead 30 (22) to the bias terminals 31 of the pulser, keyer and so on forming the complete circuit as described above.

Details of the operation of the individual circuits pulser, keyer and so on have not been supplied since these are all well-known devices individually operating in a conventional manner. The invention resides rather in the novel combination and interconnection of these devices to provide new, useful and unobvious results.

To review briefly, the operator presses button 27 (13) energizing the system and initiating the sequence of operation. Bursts of tone are produced, each pulse producing a new random pitch until the monostable switch resets and shuts the system off. The next time the button is pressed another sequence of entirely different tones is produced and so on indefinitely. The average pitch of the tones can be changed by adjusting potentiometer 43, the tonal increments can be changed by controls 46 and 57 and the rate of production of tone bursts can be changed by adjusting variable resistors 26.

FIG. 3 is a modified form of the present invention shown in block diagram form. When pushbutton 60 is pressed, a circuit is closed over line 61 actuating trigger circuit 62 which in turn emits a pulse over line 63 to pulse shaper 64. Pulse shaper 64 shapes the received pulse into the desired shape for keyer purposes and passes it over line 65 to keyer 68. Keyer 68 further shapes the received pulse and gate line from tone generator 66 received over line 67 into audio amplifier 70 over line 69 providing desired attack and decay characteristics. Speaker 72 receiving the amplified signals over line 71 reproduces the gated and shaped sounds from amplifier 70. The resultant sound may be likened to striking a bell or gong once with a mallet, hammer or other suitable device. The attack can be infinitely varied by variations in the trigger, pulse shaper and keyer circuits. It can be long or short also with infinite variations. The pitch of the sound can be high or low or anything in between. The harmonic spectrum can be shaped as desired in the audio generator. Volume can be loud or soft as required by adjustment of the gain of the audio amplifier. The analogy with conventional bells will be evident since the mallet is represented by the shaped pulse from the trigger and the gong or bell is replaced by the audio or tone generator, audio amplifier and speaker. Feedback over line 73, through feedback device 74 and over line 75 to the trigger circuit provides means for disabling the trigger, so that the pushbutton is inoperative until the signal on line 71 has decayed to a chosen point in order to achieve a one stroke effect.

FIG. 4 is another form of the present invention shown in block diagram form. This is a two-bell form in which pushbutton 76 closes a circuit over line 77 to activate multivibrator 78. Multivibrator 78 alternately sends pulses over lines 79 and 80 to pulse shapers 81 and 82. These pulse shapers in turn send pulses over lines 83 and 84 to keyers 85 and 86 which gate signals from audio generators 87 and 89 over lines 88 and 90 with the desired attack and decay characteristics for each. The gated signals are fed over lines 91 and 92 to combine in audio amplifier 93. The amplified bell-tone signals are fed over line 94 to speaker 95 for audible reproduction. This system is analogous to two bells with a single clapper. The bell tones are determined by the frequencies to which the audio generators 87 and 89 are adjusted. The attack and decay

characteristics are determined by the pulse shapers and keyer characteristics. The rate of striking is determined by the period of multivibrator 78.

FIG. 5 is still another form of the present invention shown in block diagram form. This form provides for sequential operation of a simulated series of bell like or other audible signaling sounds, each tone or sound being held and/or decayed individually and by independently adjustable hold and decay means. Thus, pitch, tonal spectrum, attack and decay are individually adjustable. Pressing pushbutton 96 closes a circuit over line 98 turning on trigger 97 sending a pulse over line 99 to flip-flop 100. Flip-flop 100 sends a pulse out over line 113 to pulse shaper 120 which passes a shaped pulse to keyer 138 over line 137 where it is processed even further and passes tone signals from audio generator 139 over line 140 to provide tone signals with chosen attack and decay characteristics over line 143 to audio amplifier 126 and from there over line 127 to speaker 128.

Output pulses from flip-flop 100 are also applied over line 101 to delay device 102, which may be any suitable time delay device, such as a unijunction transistor ramp generator, the output of which is applied over line 103 to the second flip-flop 104 causing it to generate a pulse. The output pulse from this second flip-flop 104 is similarly conveyed over line 114 to a second pulse shaper 119, and from there over line 133 to keyer 134 controlling tones from audio generator 135 over line 136 to audio amplifier 126 over line 142. The characteristics of this second tone burst is determined in pitch by audio generator 135 and in timing by delay device 102 and in attack and decay characteristics by pulse shaper 119 and keyer 134.

Similarly, any desired number of additionally delayed pitch and shape determined tone bursts or bell-like tones can be provided. Two additional are provided as shown in FIG. 5, one after delay in delay device 106 over lines 105 and 107, flip-flop 108 over line 115, pulse shaper 118 over line 129 to keyer 130, controlling tones from audio generator 131 over lines 132 and 141 to audio amplifier 126 and speaker 128; and another after further delay in delay device 110 over lines 109 and 111 to flip-flop 112 and over line 116 to pulse shaper 117, line 121 to keyer 122 controlling tones from audio generator 123 over lines 124 and 125 to amplifier 126 and speaker 128. Feedback over line 145 from audio amplifier output line 127 (or the last flip-flop in the chain 112) may be used to prevent retriggering trigger 97 until the sequence has been completed. An additional feedback over line 146 can be used to produce a ring counter effect in which the sequence is automatically repeated.

FIG. 6 shows in block diagram form a modified means for providing the switching sequence used in the multiple tone device of FIG. 5. Only the portion of the system is shown for generating the sequence of pulses to be applied to the keyers, either directly or through pulse shapers. In this modification monostable trigger 147 is activated by switch (pushbutton) 148 and over line 149 turns on pulser 150. The output of pulser 150 is applied to line 151 and distributed to a shift register comprising flip-flops 152, 156, 160 and 164 over lines 151, 153, 157 and 161. Interconnections 155, 159 and 163 are provided so that the flip-flops will trigger in sequence producing pulses successively over lines 154, 158, 162 and 165 to potentiometers 208, 219, 221 and 224 respectively. Predetermined portions of the output pulses appearing across these potentiometers are selected by adjustable arms 218, 220, 223, and 225 and in turn applied through isolating diodes 209, 217, 222 and 226 and line 229 to voltage controlled oscillator 210. Thus, predetermined but adjustable tones in a repeated pattern are produced and applied over line 211 to keyer 212. Keyer 212 is keyed from pulser 150 over common line 151 and feeds the sequence of tones in sequence over line 213 to amplifier 214 and in turn over line 215 to speaker 216.

FIG. 7 is a further modification of the pulse sequence generator in which the monostable 166 actuated by pushbutton 167 energizes a stepping switch 169 over line 168 and pro-

vides a sequence of switch closures between movable common contact 170 and a sequence of fixed contacts 171, 173, 175 and 177 providing circuits to a series of keyers (or interposed pulse shapers) over leads 172, 174, 176 and 178 respectively.

FIG. 8 is a still further modification with monostable 179 actuated by switch 180 and starting a suitable means for driving contact drum 184 such as motor 182 connected over line 181 and driving drum shaft 183. Drum 184 carries a series of contacts 185, 187, 189 and 191 providing sequenced circuit closure to keyer lines 186, 188, 190 and 192 respectively.

FIG. 9 is still another modification in which a series of contacts 196, 199, 200 and 202 are carried by drum 193 and providing a sequence of keyer circuit closures over lines 197, 198, 201 and 203 respectively. Drum 193 may be turned to provide the keyer circuit closure sequence by hand as by means of a hand key 194 connected to drum 193 by shaft 195.

While the forms of the invention shown in FIG. 5 through 9 provide a sequence of four, any desired number may be used, four having been chosen merely for purposes of illustration. A number of ways have been shown for generating the sequence of pulses but many other ways will be apparent to those skilled in the art and in keeping with the spirit and scope of the invention.

While various forms of the present invention have been shown and described, many modifications will be apparent to those skilled in the art and within the spirit and scope of the invention as set forth, in particular, in the appended claims.

I claim:

1. In a signalling device the combination of:
a plurality of tone generators;
an audio amplifier;
a speaker coupled to said audio amplifier;
a plurality of keyers for applying tones from said tone generators to said amplifier;
a switch operated pulse generator for generating a series of pulses to actuate said keyers;
and time delay means coupled between said pulse generator and said keyers for supplying actuating signals to said keyers in sequence at predetermined intervals of time.
2. A signalling device as set forth in claim 1;
wherein said time delay means is adapted to provide different time intervals between said keyer actuating signals.
3. A signalling device as set forth in claim 1;
wherein said time delay means include unijunction transistor oscillator means.
4. A signalling device as set forth in claim 1;
wherein said time delay means includes a shift register for providing a plurality of timed output pulses to said keyers.
5. A signalling device as set forth in claim 1;
and means for modifying said pulse generating means in response to continued closure of said switch.
6. A signalling device as set forth in claim 1 and including;
a low frequency random voltage generator coupled to said tone generators for controlling the frequencies of said tone generators.