

[54] **AUDIO-VISUAL SIGNAL DEVICE**
[75] Inventors: **Gerald K. Miller; Norman A. Rautiola**, both of Reed City, Mich.
[73] Assignee: **Nartron Corporation**, Reed City, Mich.
[22] Filed: **July 3, 1972**
[21] Appl. No.: **268,665**

Primary Examiner—Thomas B. Habecker
Attorney, Agent, or Firm—Lon H. Romanski

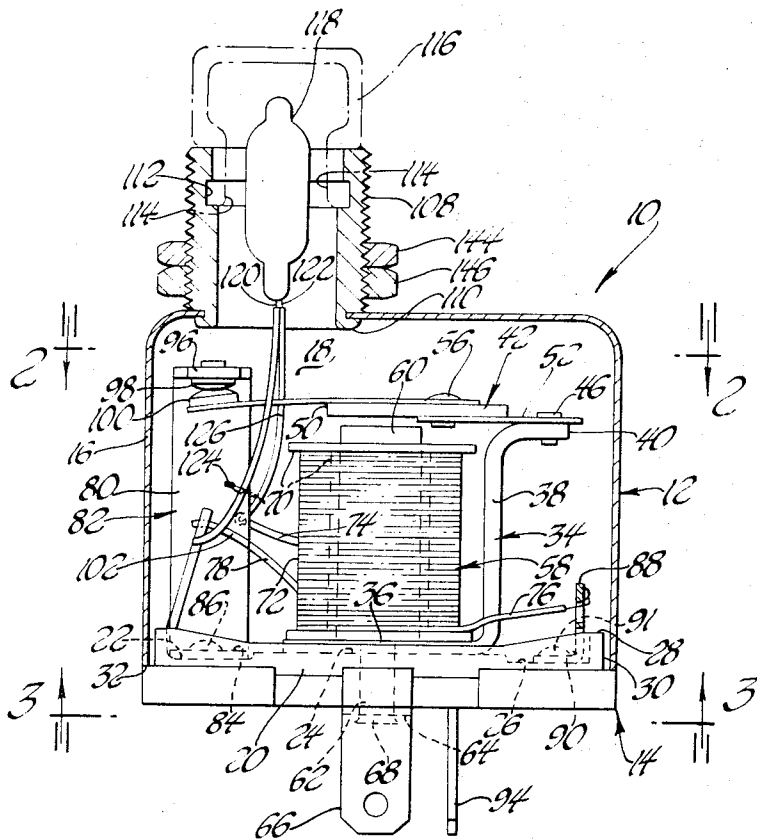
[52] U.S. Cl. **340/326, 340/331, 340/384 E, 340/400**
[51] Int. Cl. **G08b 7/00**
[58] Field of Search..... **340/326, 329, 331, 384 E, 340/400, 75, 81, 328**

[56] **References Cited**

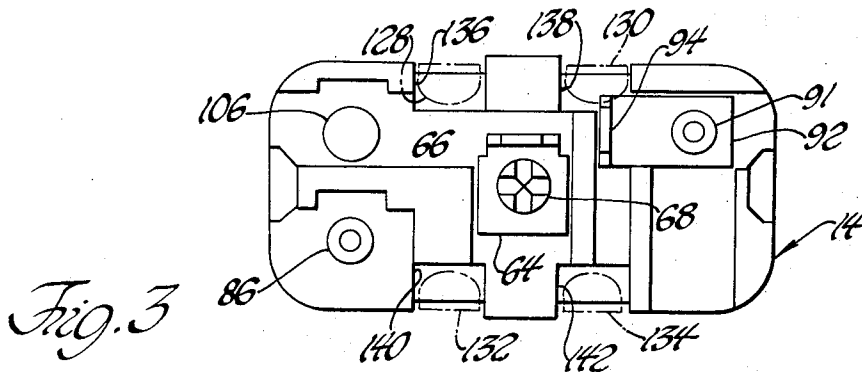
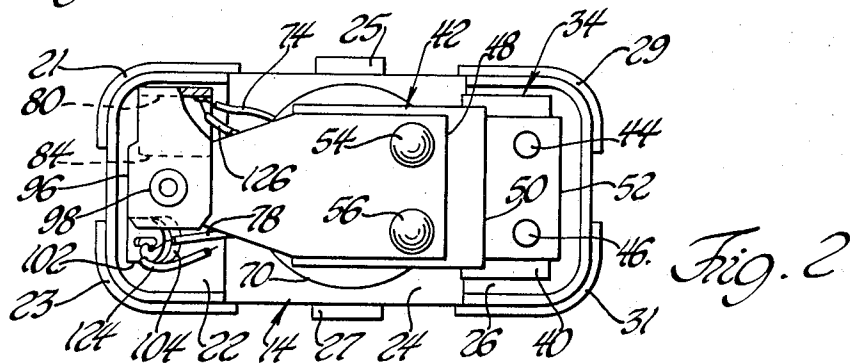
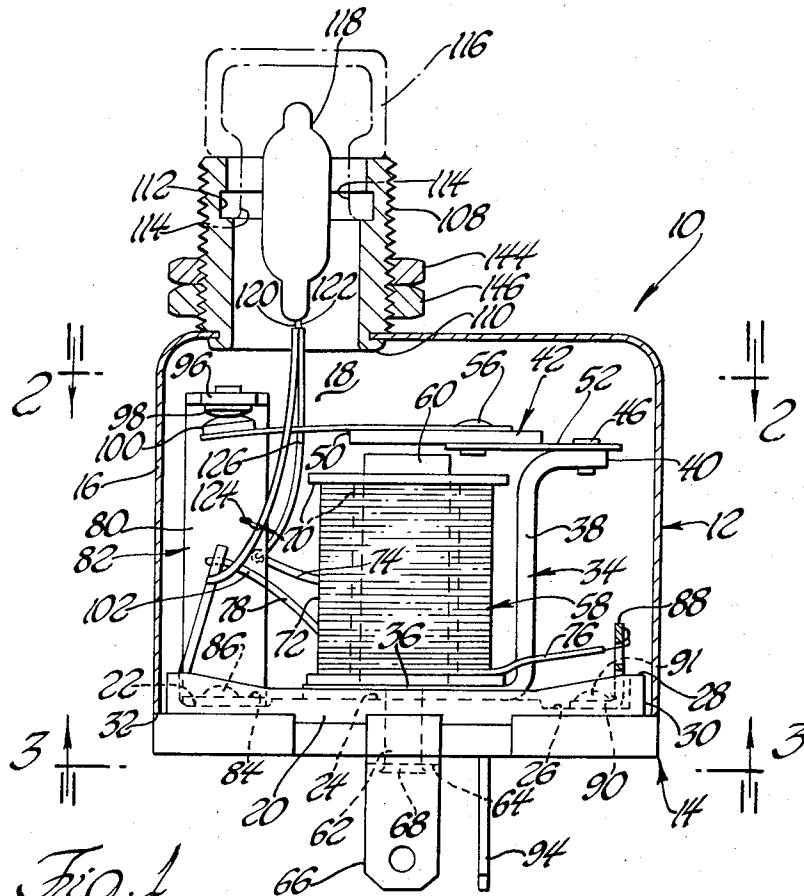
UNITED STATES PATENTS			
2,931,026	3/1960	Nelson	340/331
2,492,837	12/1949	Briggs	340/331
2,294,049	8/1942	Renshaw	340/75

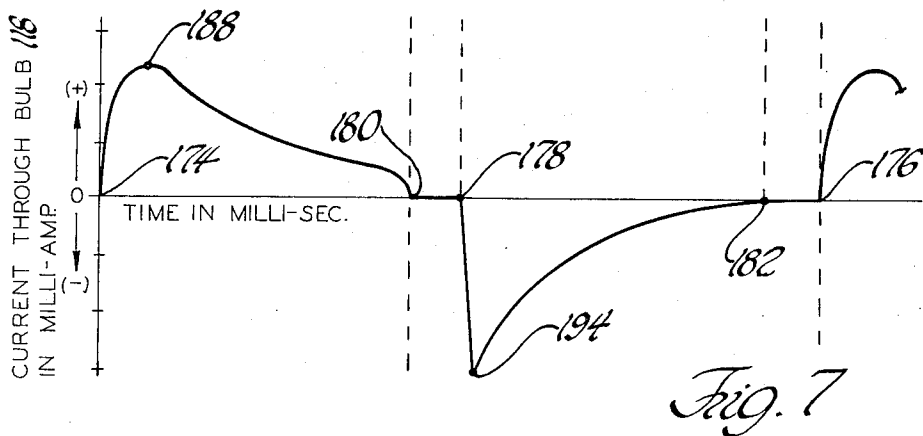
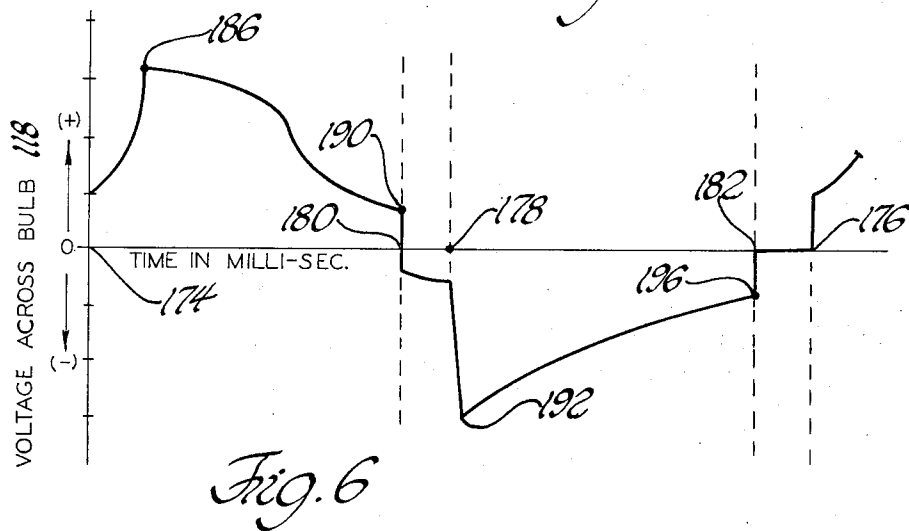
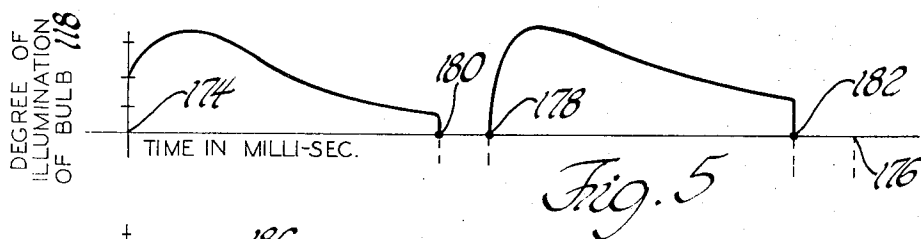
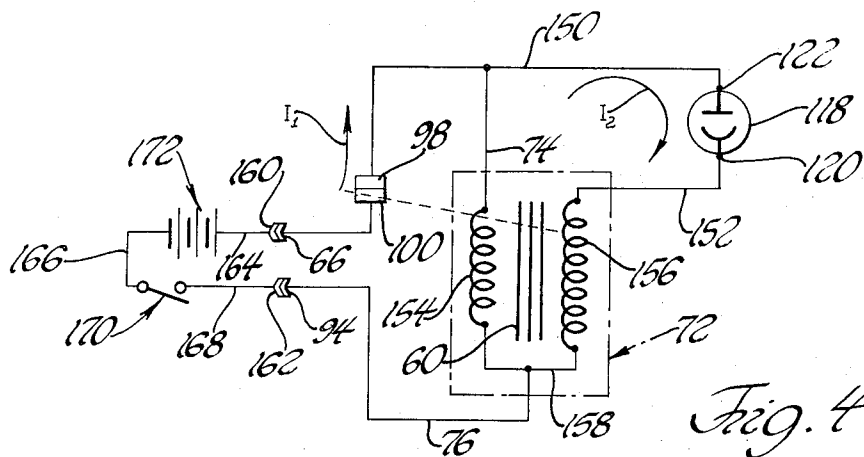
[57] **ABSTRACT**
An audio-visual signal device has a housing containing a primary winding, a secondary winding, a make and break switch assembly responsive to the magnetic field generated in the primary winding and an electrical bulb energized in response to energy transferred from the primary winding to the secondary winding; audio signals are produced in response to the making and breaking of a circuit by the switch assembly.

9 Claims, 14 Drawing Figures



SHEET 1 OF 4





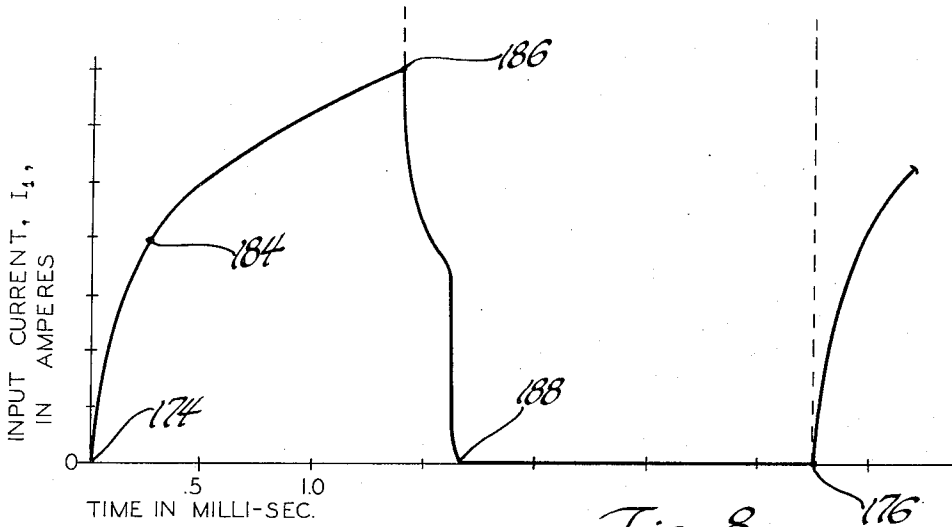


Fig. 8

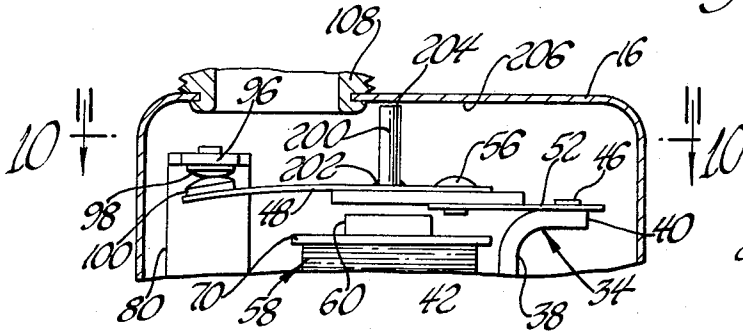


Fig. 9

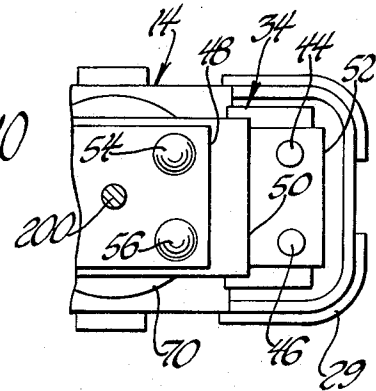


Fig. 10

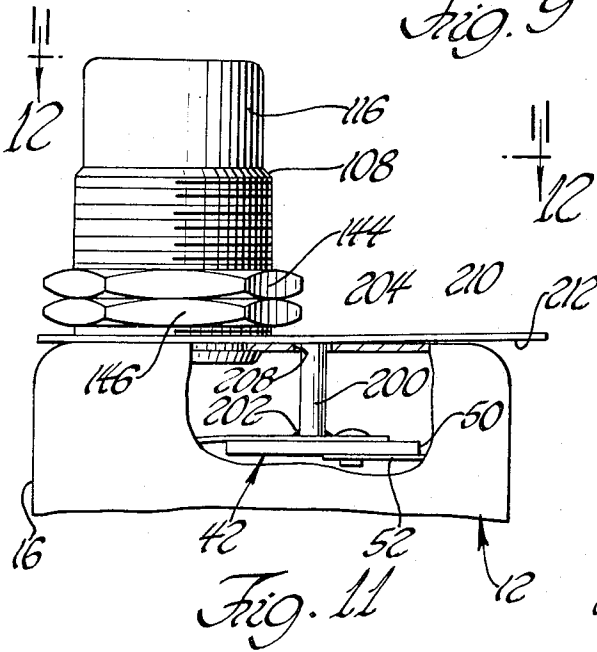


Fig. 11

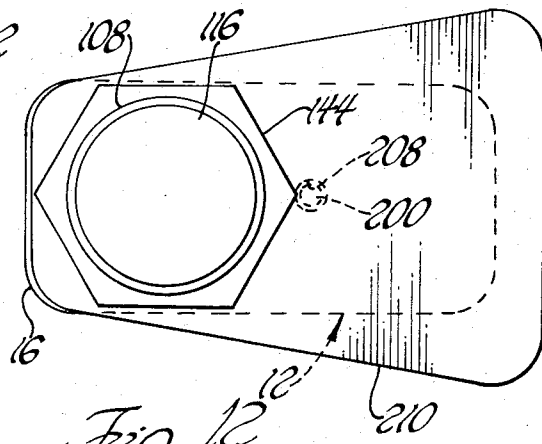
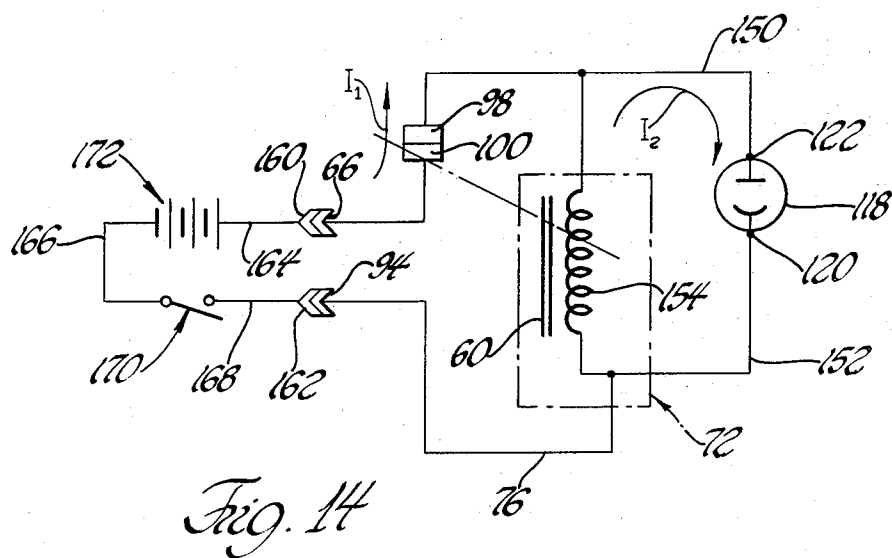
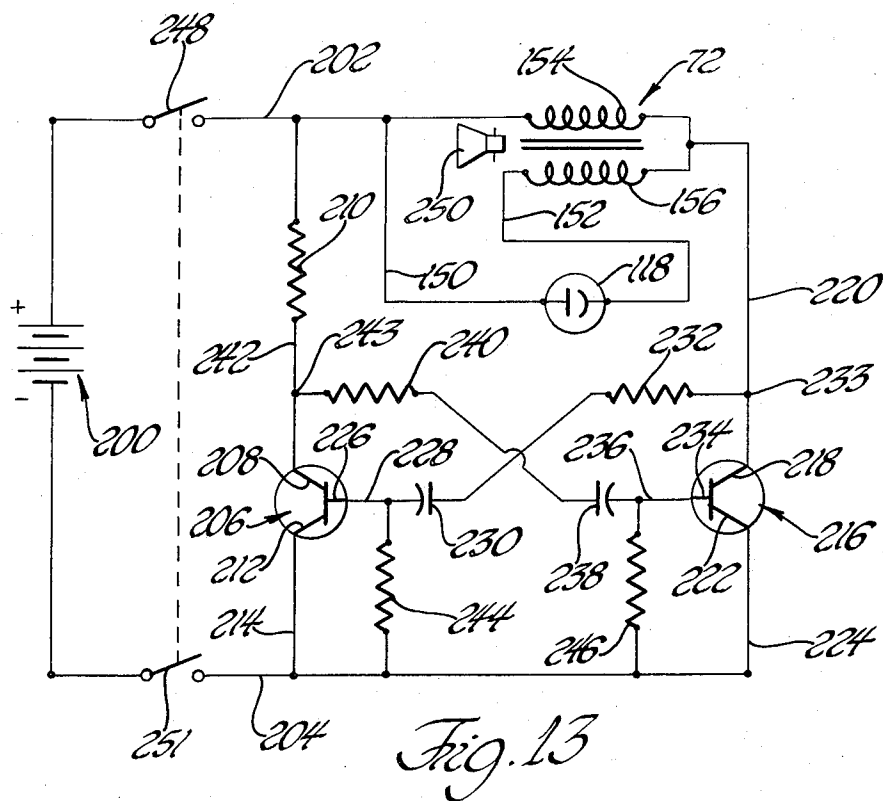


Fig. 12



AUDIO-VISUAL SIGNAL DEVICE

BACKGROUND OF THE INVENTION

There has been a need of considerable standing for a warning device capable of providing an audio signal as well as a visual signal. Some of the devices proposed by the prior art, disregarding the circuitry, employed filament type incandescent bulbs. However, such have not proven to be satisfactory because of the relatively short useful life of such bulbs resulting from filament destruction due to either or both vibrational and thermal shock.

Accordingly, the invention as herein disclosed and described is primarily directed to the solution of the problems of the prior art as well as the provision of a simple, inexpensive and yet highly reliable audio-visual signal device of long, useful life.

SUMMARY OF THE INVENTION

According to the invention, an audio-visual signal device comprises at least one electrical coil, switching means in circuit with said coil and a source of electrical potential, said switching means being effective to control the flow of electrical current through said coil for producing a varying magnetic field, means for producing an audio signal, and a light source in circuit with said coil, said means for producing an audio signal being responsive to said magnetic field for in turn creating said audio signal, and said light source being effective to go into conduction upon generation of a predetermined voltage across said light source by said magnetic field.

Various general and specific objects and advantages of the invention will become apparent when reference is made to the following detailed description considered in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings, wherein for purposes of clarity certain details and/or elements may be omitted from one or more views:

FIG. 1 is a side elevational view of an audio-visual signal device, constructed in accordance with the teachings of this invention, with portions thereof shown in generally longitudinal cross-section;

FIG. 2 is a view taken generally on the plane of line 2—2 of FIG. 1 with the bulb and cover being removed;

FIG. 3 is a view taken generally on the plane of line 3—3 of FIG. 1 and looking in the direction of the arrows;

FIG. 4 is a schematic wiring diagram of the elements of FIGS. 1, 2 and 3;

FIGS. 5, 6, 7 and 8 are respective graphs illustrating characteristic operational curves of the circuit of FIG. 4 and the device of FIGS. 1, 2 and 3;

FIG. 9 is a view similar to a fragmentary portion of FIG. 1 but illustrating a first modification thereof;

FIG. 10 is a fragmentary view taken generally on the plane of line 10—10 of FIG. 9 and looking in the direction of the arrows but with the cover removed;

FIG. 11 is a view somewhat similar to a fragmentary portion of FIG. 1 but illustrating a second modification of the invention;

FIG. 12 is generally a top plan view taken generally on the plane of line 12—12 of FIG. 11 and looking in the direction of the arrows;

FIG. 13 is a schematic wiring diagram of another embodiment of the invention; and

FIG. 14 is a schematic wiring diagram of a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in greater detail to the drawings, FIG. 1, partly in cross-section, illustrates an audio-visual signal device 10 as comprising a housing assembly 12, formed generally by a base member 14 and cooperating cover member 16 (illustrated in longitudinal cross-section), defining an interior chamber 18.

Base 14, which is formed of a suitable electrically nonconductive material such as, for example, a phenolic or nylon, includes a main body 20 having upper mounting surface 22, 24 and 26 with surface 24 being slightly elevated with respect to surfaces 22 and 26 disposed at either end. A generally upstanding wall 28 extending about the periphery of the mounting surfaces 22, 24 and 26, has an outer surface 30 of a configuration as to be relatively closely received within the open end 32 of cover 16 when the cover is assembled onto the base 14. Body 20 also has a plurality of generally radiating flange portions 21, 23, 25, 27, 29 and 31 formed integrally therewith as to thereby form abutments against which the open end 32 of cover 16 can be seated.

A first electrically conductive bracket 34 has a base portion 36, situated atop mounting surface 24, with an integrally formed pedestal portion 38 extending upwardly therefrom and terminating in a generally laterally extending arm portion 40 which, in turn, has an armature assembly 42 secured thereto as by suitable rivets 44 and 46.

Preferably, armature 42 is comprised of electrically conductive elements 48, 50 and 52, secured to each other as by rivets 54 and 56, with members 48 and 52 being formed of spring steel while intermediate member 50 is formed of a generally mild steel such as, for example, a grade 1,020 steel.

A field and energizing coil assembly 58, situated generally between base 36 of bracket 34 and armature 42, is preferably comprised of a relatively mild steel core 60 abutting at its lower end against the top surface of bracket base 36 so as to have an extension 62 of said core pass through accommodating apertures formed in bracket base 36 and body 20 as well as an aperture formed in the mounting leg 64 of an electrical blade type terminal 66. The end 68 of the extension 62 is formed over or staked against leg 54 thereby securing the core 60, bracket 34 and terminal 66 to the body 20.

An electrically non-conductive spool or bobbin 70, operatively engaged to and situated about core 60, carries what may be generally described as a field winding or coil 72. As will be better illustrated subsequently, the winding 72 is actually comprised of a primary winding and a secondary winding. It should be mentioned that in one successful embodiment of the invention the primary winding consisted of 300 turns of No. 30 AWG insulated magnet wire while the secondary winding consisted of 6,000 turns of No. 40 AWG insulated magnet wire. In any event, the coil or winding 72 has three

electrical leads 74, 76 and 78. As shown, conductor or lead 74 is electrically connected as, for example, by soldering to the upstanding pedestal portion 80 of a second electrically conductive bracket 82 which has its base 84 fixedly secured to body 20 as by means of a rivet 86 passing through both.

The second lead or conductor 76 is electrically connected as, for example, by soldering to an upstanding bracket-like terminal or tab 88 which has its base portion 90 situated on mounting surface 26, electrically connected and secured as by a rivet 91 to a mounting leg 92 of a second blade type electrical terminal 94 located on the underside of base 14.

The third electrical lead or conductor 78 is electrically connected as, for example, by soldering to an upstanding bracket-like terminal 102 which has its base portion 104, situated on mounting surface 22, secured to body 14 as by a rivet 106 passing therethrough.

The second bracket 82 is also provided with a generally laterally extending arm portion 96 which has an electrical contact suitably fixedly secured thereto. As shown, contact 98 is so positioned as to be adapted for engagement with a second moveable contact 100 which is suitably secured to and carried by the member 48 of armature assembly 42 so as to at times close an electrical circuit through the armature assembly 42 and bracket 82.

As best seen in FIG. 1, a generally tubular externally threaded member 108 is secured at one end 110 with an aperture formed in cover 16 as by rolling over the material forming the end of member 108. Internally, member 108 may be undercut as at 112 in order to thereby receive foot-like retaining portions 114 of a related lens 116.

Contained generally within tubular member 108 is a lamp or bulb 118 which has terminals 120, 122 respectively electrically connected to ends of electrical conductors 124 and 126 which, in turn, have their opposite ends respectively electrically connected, as by soldering, to terminal 102 and bracket pedestal 80. The stiffness of conductors 124 and 126 may, as illustrated, be sufficient to maintain bulb 118 in relatively close proximity to lens 116.

As best seen in FIG. 3, the lower open end 32 of cover 16 may be provided with a plurality of deformable tabs or ears 128, 130, 132 and 134 which may be bent over, to a position as shown in phantom lines, as to be respectively received within recesses 136, 138, 140 and 142 formed in the lower surface of body or base 14.

Nuts 144 and 146, as shown in FIG. 1, may be employed for securing the device 10 to any desired related structure.

FIG. 4 illustrates a schematic wiring diagram describing the circuitry of the device 10. All elements in FIG. 4 which are like or similar to those of FIGS. 1, 2 and 3 are identified with like reference numerals. Further, for ease of correlation, in FIG. 4; conductor 150 will be the electrical equivalent of pedestal 80 of bracket 82 along with conductor 126 of FIGS. 1 and 2; and conductor 152 will be the electrical equivalent of conductor 78, bracket 102 and conductor 124.

As previously stated, the coil assembly 72 has a primary winding 154 and a secondary winding 156 which are electrically connected to each other as by conductor means 158 which, in turn, is electrically connected to conductor 76. Terminals 66 and 94 are adapted to

be respectively electrically connected to suitable cooperating terminals 160 and 162 which, in turn, are in series circuit with conductor means 164, 166, 168, switch means 170 and a suitable course of electrical potential 172. Switch means 170, whether mechanical, magnetic or semiconductor, may be of any desired configuration, so as to be responsive to any desired sensed condition or parameter of operation. That is, when a particular condition exists, switch means 170 will become closed thereby completing the circuit from terminal 160 through source 172 to terminal 162.

It should be noted that contacts 98 and 100 are normally closed; however, the circuitry will not be in any way energized until switching means 170 becomes closed as described above.

When switching means 170 closes, current I_1 starts to flow from source 172 through closed contacts 100, 98, conductor 150 to and through conductor 74, primary winding 154, conductor means 158 to and through conductor 76, terminal 94 and back to electrical source 172. The current flow in this described circuit path increases exponentially with a time constant of L/R where; "L" represents the inductance of primary winding or coil 154 and "R" represents the effective resistance of primary winding 154 plus the resistance of that described circuit path. This building up of current flow causes electrical energy to be stored primarily in winding 154 and core 60. Also, as the current flow is thusly increasing, voltage is induced in secondary winding or coil 156 as a consequence of the time rate of change of flux from the primary winding 154 as well as the core 60. With increasing current flow and resulting flux change, the induced voltage in secondary winding 156 continues to increase until the value thereof reaches the ignition or firing voltage of bulb 118. In at least one successful embodiment of the invention the bulb 118 was a neon bulb having an ignition voltage in the order of 90.0 volts and sustained such ignition until the voltage thereacross dropped to a value in the order of 70.0 volts.

Until the neon bulb 118 fires there is no transfer of energy from the primary circuit to the secondary circuit. However, when neon bulb 118 fires current starts to flow through the secondary circuit generally described by conductor 150, neon 118, conductor 152, secondary winding 156, conductor means 158, primary winding 154 and even partly through conductor 76. At this time, secondary winding 156 acts as an energy source maintaining current flow in the secondary circuit defined above and as generally depicted by I_2 in FIG. 4. Generally, I_2 current will continue to flow until the magnetic attraction experienced by the armature (42 of FIGS. 1 and 2) becomes sufficient to open contacts 98 and 100 as by the downward movement of contact 100 as viewed in FIG. 1.

As soon as contacts 98 and 100 open, the flow of current I_1 terminates. Consequently, the flux previously existing due to the flow of current I_1 now starts to decrease causing a reversal of voltage across primary winding 154 and secondary winding 156. This, in turn, causes the secondary winding or coil 156 to start to drive a current I_3 in the same general circuit as in which current I_2 previously flowed but in a direction opposite thereto. The voltage across secondary winding 156 is sufficient to maintain neon bulb 118 in an ignited state but with opposite polarity. During this time, current I_3 flows from winding 156, through conductor 152, lamp

or bulb 118, conductors 150, 74, primary winding 154, conductor 158 and back to secondary winding 156.

Generally, current I_3 flow will continue until such time as the voltage across secondary winding 156 has decreased to a degree such as to result in a reduction in the flux sufficient to permit the contacts 98 and 100, due to the force of spring member 52, to again close. Such closure of contacts 98 and 100 may in fact occur prior to the neon 118 being extinguished. It should also be pointed out that the rate at which the reverse voltage in secondary winding 156 will decrease in magnitude is primarily dependent on the time constant determined generally by the inductance of secondary winding 156 and the effective resistance of neon 118 (the term "effective" being used because the value of resistance of neon 118 will to some degree change as the voltage is being reduced).

Such action as described above will, of course, result in the rapid opening and closing of the contacts 98 and 100 causing in turn, the generation of an audio signal while the firing and continued ignition of the neon bulb 118 creates a visual signal. Both of such signals serve to warn the operator that a particular condition of operation, in a related structure, has been attained thereby giving that operator the opportunity to affect whatever action may be necessary in response thereto.

As should be apparent in view of the preceeding, there are several time constants which affect the overall cycle time and operation of the invention. For example, there is a charging time constant determined generally by the inductance of primary coil 154 and the resistance of primary winding 154 along with its related circuitry; a second time constant which determines the rate of voltage reduction in the secondary winding when contacts 98 and 100 open; and a third time constant of the mechanical components such as armature 42 including contact 100.

That is, there will be a definite theoretical cycle time for the opening and closing of contacts 98 and 100. With all other factors being equal or constant, the mechanical time constant will be dependent on the mass of armature assembly 42, the spring rate of spring member 52, the length of the magnetic moment arm, and the rate of acceleration of the armature assembly 42 measured as from the instant that the armature assembly starts to move toward core 60 to the instant that it abuts against the core 60.

The relative and primarily controlling time constants are of significance because it is a general compromise therebetween which results in optimum performance of the invention. That is, for example, such constants can be selected in order to provide a maximum audio signal, however, in so doing the energization of the bulb 118 occurs for only such a slight moment, relatively speaking, that it is difficult to determine that the bulb 118 is or was energized. It is also possible to select such constants in order to provide a maximum visual signal; however, in so doing the opening and closing of the contacts 98 and 100 becomes so rapid as to nullify any sound which the contacts would otherwise create thereby destroying any effective audio signal.

Accordingly, it has been discovered that best results are obtained for both the audio signal and the visual signal when the time constant for the mechanical elements, armature 42, is generally in the order of magnitude of the charging time constant of the primary wind-

ing or coil 154. This, of course, does not mean that both time constants must be equal or even substantially equal in order to achieve satisfactory operation of the invention. All that is required is that the mechanical time constant be more like than not the magnitude of the charging time constant of the primary winding 154.

For example, the graphs of FIGS. 5, 6, 7 and 8 characteristically illustrate the operation of one successful embodiment of the invention.

If in FIG. 5 it is assumed that the distance from point 174 to point 176 represents one complete cycle of operation (from the instant that contacts 98 and 100 close then the time that contacts 98 and 100 are open and finally back to the instant of closure of contacts 98 and 100) and that the distance from point 174 to 178 is the one half of the cycle time, it can be seen that bulb 118 actually became extinguished as at the time represented at point 180. It remained extinguished from time point 180 to the start of the second half cycle as at point 178 and subsequently again extinguished at time point 182. (Reference numerals 174, 176, 178, 180 and 182 are employed on related graphs since such numbers merely designate specific points in time.)

In comparing the graphs of FIGS. 6, 7 and 8, it can be seen that as current I_1 starts to flow the rate of current increase is described generally by a first slope or portion of the curve from point 174 to a first value as at point 184 at which time a transfer of energy from the primary circuit to the secondary circuit starts to occur generally in accordance with the curve segment depicted between point 184 and 186 at which time the contacts 98 and 100 open (this time of opening would correspond to time point 180). The input current I_1 then drops to zero as at point 188 and remains at that value until the start of the second cycle as at point 176.

In FIG. 6 it can be seen that the voltage across the bulb 118 increases quickly to a firing voltage value as at 186 with accompanying maximum current flow through the bulb 118 occurring as at 188 in FIG. 7. Once bulb 118 fires, it remains ignited until the voltage drops to a value less than the sustaining voltage of the bulb 118 as at point 190. Because of the contacts 98 and 100 being opened, the flux change in the secondary winding 156 causes a reverse polarity voltage across bulb 118 to again attain a firing or ignition voltage to occur as at point 192 with an accompanying maximum current flow as at 194 of FIG. 7. Such reverse voltage undergoes a reduction until point 196 is reached which is at a value less than the ignition sustaining voltage of the bulb 118.

From the above, it can be seen that the bulb 118 need not be in a continuously ignited state, but that it may in fact be extinguished for a portion of the overall cycle. However, it is important to note that bulb 118 is in an ignited state for a major portion of the overall cycle time of device 10. It should be apparent, of course, that the time constants may be so selected as to result in bulb 118 actually being in a continuously ignited state if such is desired.

FIGS. 9 and 10 fragmentarily illustrate a modified form of the invention. All elements which are like or similar to those of FIGS. 1, 2 and 3 are identified with like reference numbers.

In the modified form of FIGS. 9 and 10, the armature assembly 42 is provided with a generally upstanding pin

or rod 200 which has its lower end suitably secured as at 202 to the armature assembly 42 as by cementing thereto or any other suitable means. The upper end 204 of rod 200 is preferably in close juxtaposition to the inner surface 206 of cover 16. Accordingly, when the armature assembly 42 moves from its open-contact position to its closed-contact position not only will contacts 98 and 100 strike each other causing an audio signal, but end 204 of rod 200 will strike the inner surface of cover 16 and thereby create an additional audio signal generally augmenting that audio signal created by the contacts 98 and 100.

FIGS. 11 and 12 fragmentarily illustrate a second modified form of the invention. All elements which are like or similar to any of FIGS. 1, 2, 3, 9 or 10 are identified with like reference numerals.

In the second modified form of FIG. 11, a clearance aperture 208 is formed in the top of cover 16 as to thereby permit the free passage therethrough of a portion of rod 200 so as to enable rod 200 to have its upper end 204 juxtaposed to the under-surface 212 of a clapper-like member or plate 210. As can also be seen in FIG. 12, plate 210 is generally trapezoidal having its small end situated generally about and suitably fixedly secured to the tubular extension 108, leaving the remaining portion to be flexed away and toward the outer surface of cover 16. Accordingly, when armature assembly 42 moves from its open-contact position to its closed-contact position not only will contacts 98 and 100 strike each other causing a first audio signal, but end 204 of rod 200 will strike the under surface of plate 210 causing the plate to first move away from and then return and strike the outer surface of cover 16 thereby creating an additional audio signal generally augmenting the first audio signal created by contacts 98 and 100.

FIG. 13, a schematic wiring diagram, illustrates the fact that the invention may be practiced without the use of movable mechanical electrical contacts but instead solid state switching means. In FIG. 13, elements which are like or similar to those of preceding Figures are identified with like reference numbers.

Referring in greater detail to FIG. 13, a suitable source of electrical potential 200 is in circuit with conductor means 202 and 204. The primary winding 154 of coil means 72 has one end electrically connected to conductor means 202 while its other end is electrically connected to a first end of secondary winding 156. Lamp means 118 is electrically connected to the other end of winding 156 by means of conductor 152 and electrically connected to conductor means 202 as by conductor 150.

A first transistor 206 has its collector 208 connected to conductor 202 as through a resistor 210 while the emitter 212 thereof is electrically connected to conductor 204 via means 214. A second transistor 216 has its collector 218 electrically connected, as by conductor means 220, to the electrical juncture of primary and secondary windings 154 and 156 while the emitter 222 thereof is electrically connected via means 224 to conductor means 204.

The base terminal 226 of transistor 206 is in series circuit with conductor means 228, capacitor means 230 and resistor means 232 which, in turn, is electrically connected to conductor means 220. Similarly, base terminal 234 of transistor 216 is in series circuit with conductor means 236, capacitor means 238 and

resistor means 240 which, in turn, is electrically connected to conductor means 242 generally at a point between resistor 210 and collector 208.

Further, resistance means 244 is connected at one end with conductor means 228 and at its other end with conductor means 204; similarly, resistance means 246 has its opposite ends respectively connected to conductor means 236 and 204. Suitable switching means 248 and 251 may be provided in circuit with source 200 so as to, for example, become closed in response to a related sensed condition as previously described with reference to 170 of FIG. 4.

The operation of the circuitry of FIG. 13 is generally as follows. Let it be assumed that transistor 206 has just switched to a non-conducting state (turned "off"); at this precise moment capacitor 230, which was charged so as to be negative (−) on the left and positive (+) on the right, starts discharging through resistor 232, conductor 220, collector 218, emitter 222, conductor means 224, 204 and resistor 244. The discharging of capacitor 230 through the collector-emitter diode of transistor 216 is made possible by transistor 216 now being in a conducting state (turned "on").

That is, when transistor 206 turned "off" capacitor 238 was at that time discharged. Therefore, when capacitor 238 turned "off" point 243 became positive (+) potential and capacitor 238 started charging through resistors 240 and 246. During the charging of capacitor 238, base 234 of transistor (because of resistance 246) becomes positive with respect to the emitter 222 thereby causing transistor 216 to turn "on." When capacitor 238 becomes sufficiently charged, base 234 again attains a negative (−) potential of conductor means 204 thereby causing transistor 216 to turn "off" with the result that conduction through the collector 218 — emitter 222 terminates placing point 233 at positive (+) potential.

When point 233 is placed at positive (+) potential, current starts to flow through resistor 232, discharged condenser 230 (causing it to start charging), and resistor 244 to conductor 204. Such current flow causes base terminal 226 to become more positive (+) with respect to the emitter 212 resulting in transistor 206 being turned "on" and permitting current flow through the collector-emitter diode thereof. With transistor 206 being turned "On" point 243 again drops to negative (−) potential permitting capacitor 238 to discharge through resistor 240, collector 208-emitter 212, conductor 204 and resistor 246.

Transistor 206 continues to be held "on" until capacitor 230 becomes sufficiently charged resulting in base 226 being at negative (−) potential causing transistor 206 to again be turned "off" with the cycle being repeated.

In the embodiment disclosed, the respective charging time for capacitors 230 and 238 will be shorter than the corresponding discharge times because on discharge, resistors 244 or 246, as the case may be, are to some degree shunted by the emitter-base diode of the "on" transistor. That is, the charging time of, for example, capacitor 230 would be dependent on the RC of resistor 232 and capacitor 230 whereas the discharge time would be determined by $(R_1 + R_2)(C)$ of resistor 232 plus resistor 244 and capacitor 230.

Of course, every time that transistor 216 is turned "on" current flows from source 200 through primary winding 154 of coil assembly 72 and whenever transis-

tor 216 is turned "off" such current flow through winding 154 is terminated. As described in relation to FIG. 4, the resulting generation and collapse of the associated magnetic field causes energization of the related auditory warning means 250 and the visual signaling means or lamp 118. Means 250, of course, can be any suitable arrangement for auditory sound generation whether, for example, in the form of a speaker-like diaphragm or a moveable armature striking a sounding board.

It should also be apparent that if desired, resistors 240 and/or 232 may be variable resistors such as rheostats which can be adjusted to obtain a correspondingly variably determined frequency of oscillation of the free running or astable multivibrator comprised of transistors 206, 216 and related circuitry.

FIG. 14, a schematic diagram, illustrates a manner in which both the embodiments of FIGS. 4 and 13 may be modified; that is, the elimination of the secondary winding 156. All elements in FIG. 14 which are like or similar to FIGS. 4 or 13 are identified with like reference numbers. The functional operation of the circuit in FIG. 14 is like that of FIG. 4.

Although only a select number of preferred embodiments and modifications of the invention have been disclosed and described, it is apparent that other embodiments and modifications of the invention are possible within the scope of the appended claims. For example, it should be apparent that the invention as herein disclosed is not limited to the use of only a single light bulb or source (in that a plurality of such could obviously be employed in the arrangement generally disclosed) nor is the practice of the invention limited to the use of light source means carried by support structure means directly related to the audio means. Obviously, such light source means, whether singular or plural, may be located at positions substantially remote to the audio means.

We claim:

1. An audio-visual signal device, comprising first electrical coil means, second electrical coil means, a core, said first and second coil means being wound generally concentrically about said core, a switch assembly having a first stationary and second movable contact means, said first and second contact means being in series circuit with said first electrical coil means and effective for at times completing a first electrical circuit from said first electrical coil means to an associated source of electrical potential, armature means operatively carrying said second movable contact means and responsive to a magnetic field created by said first coil means and said core in response to current flow through said first electrical coil means, said armature means being effective whenever said magnetic field attains a predetermined force for moving said second movable contact means away from said first stationary contact means in order to thereby open said first electrical circuit, a bulb having a first terminal thereof electrically connected in series circuit with one end of said second electrical coil means, said bulb having a second terminal thereof electrically connected to one end of said first coil means, an other end of said second coil means being electrically connected to an other end of said first coil means as well as adapted for electrical connection to said associated source of electrical potential whereby said bulb is made to experience ignition and energization thereof during a major portion of the

time that said contact means are closed as well as experience ignition and energization during a major portion of the time that said contact means are opened, and said armature means and said contact means being effective to create an audio signal in response to the opening and closing movement of said contact means.

2. An audio-visual signal device according to claim 1, wherein said bulb comprises a neon bulb, and wherein said predetermined voltage is the firing or ignition voltage of said neon bulb.

3. An audio-visual signal device according to claim 1 wherein said armature means is resiliently deflectable, and wherein said second movable contact means and said armature means collectively have a mechanical time constant which is in the order of magnitude of the charging time constant of said first coil means.

4. An audio-visual signal device, comprising a housing assembly, said housing assembly comprising first and second housing sections, a first bracket member situated within said housing assembly and secured to said first housing section, said first bracket member having a generally upwardly disposed first bracket portion, a field generating coil assembly having a primary coil and a secondary coil wound generally about a medially disposed core, said coil assembly and said core being situated within said housing assembly and secured to said first housing section in a manner having one end of said core directed upwardly, a second bracket member situated in said housing assembly and secured to said first housing section in a manner as to be disposed generally on a side of said coil assembly opposite to said first bracket member, said second bracket member having a generally laterally extending second bracket portion carrying a first electrical contact in an operationally fixed position, a resiliently deflectable armature secured at one end to said first bracket portion in a manner so as to be disposed generally above and in relatively close proximity to said one end of said core, a second electrical contact member carried by said armature as to be movable therewith and disposed generally below said first electrical contact, said armature including resilient means normally resiliently urging said second electrical contact into engagement with said first electrical contact, a neon bulb, first conductor means electrically connecting a first electrical lead of said primary coil of said coil assembly to a first terminal of said neon bulb and to said first electrical contact, second conductor means electrically connecting a second electrical lead of said secondary coil of said coil assembly to a second terminal of said neon bulb, first and second input terminals adapted for connection to an associated source of electrical potential, said first and second input terminals being spaced from each other and secured to said first housing section externally of said housing assembly, said first input terminal being electrically connected to said second electrical contact through said first bracket member and said second input terminal being electrically connected to a third electrical lead common to both of said first and second primary coils of said coil assembly, and aperture means formed in one of said housing sections for permitting the viewing of light emanating from said neon bulb.

5. An audio-visual signal device according to claim 6 and further comprising audible sound increasing means, said sound increasing means comprising striker

means operatively carried by said armature assembly, said striker means being adapted to intermittently strike said second housing section as said armature assembly cyclically moves toward and away from said core.

6. An audio-visual signal device according to claim 6 and further comprising audible-sound increasing means, said sound increasing means comprising striker means operatively carried by said armature assembly, second aperture means formed through said second housing section, and a vibratory member operatively carried by said housing assembly externally thereof, said striker means being adapted to intermittently strike said vibratory member through said second aperture means as said armature assembly cyclically moves toward and away from said core thereby causing said vibratory member to in turn strike the outer surface of said housing assembly.

7. An audio-visual signal device effective for creating an apparent continuous and non-intermittent light signal as well as an auditory signal to indicate the attainment of a predetermined condition by associated means, said device comprising first electrical coil means having first and second electrical terminal means, second electrical coil means having third and fourth electrical terminal means, a core having said first and second electrical coil means wound generally cylindrically thereabout, said first and third electrical terminal means being electrically connected to each other and to first electrical conductor means leading to an associated source of electrical potential, a bulb, second electrical conductor means electrically connecting said fourth electrical terminal means to a first terminal of said bulb, a fixed first electrical contact, resiliently deflectable armature means positioned in relatively close proximity to said core and said first and second electrical coil means as to be directly acted upon and responsive to the magnetic flux density generated thereby, a movable second electrical contact carried by said armature means for intermittent engagement with said fixed first contact, third electrical conductor means for electrically connecting said movable second contact to said associated source of electrical potential, fourth electrical conductor means electrically connecting a second terminal of said bulb to said fixed first electrical contact, and fifth electrical conductor means electrically connecting said second electrical terminal means of said first electrical coil means to said fourth electrical conductor means, said first and second contacts being effective when closed against each other and when in closed circuit with said associated source of electrical potential for causing a primary current flow through said first coil means and said first electrical conductor means, said primary current flow having a first magnitude of varying value so as to initially have a relatively low value and to thereafter increase to a relatively high value, said second coil means and said core being continuously acted upon by a magnetic field developed by said primary current flowing through said first coil means so as to thereby develop a voltage potential across said second coil means, said bulb remaining in an unenergized state while said first and second contacts are closed and until said voltage potential across said second coil means attains a first predetermined magnitude sufficient to ignite and energize said bulb into illumination, the resilience of said armature means being of such magnitude as to prevent move-

ment of said armature means toward said core and thereby prevent the opening of said first and second contacts until after said voltage potential attains said first predetermined magnitude, said first and second contacts being effective when opened to terminate further supply of primary current to said first coil means and thereby initiate collapse of said magnetic field in turn developing a second voltage potential across said second coil means of a magnitude to again ignite and energize said bulb with a second current flow through said bulb and said second coil means in a direction opposite to the current flow through said bulb when said bulb was first fired and energized when said first and second contacts were closed against each other, said fifth electrical conductor means being effective to provide a path for said second current flow passing through said bulb said second coil means and said first coil means.

8. An audio-visual signal device, comprising first electrical conductor means, first coil means having first and second ends, second coil means having third and fourth ends, a core, said first and second coil means being formed about said core, said first end of said first coil means being electrically connected to said first electrical conductor means, said second end of said first coil means being electrically connected to said fourth end of said second coil means, a bulb having first and second electrical terminals, said first electrical terminal being electrically connected to said third end of said second coil means, said second electrical terminal being electrically connected to said first electrical conductor means thereby defining a closed loop sub-circuit comprised of said bulb and said first and second coil means, second conductor means electrically connecting said second and fourth ends of said first and second coil means to a first emitter-collector circuit of a first transistor, third electrical conductor means electrically connected to said emitter-collector circuit, said second and third electrical conductor means each having other ends adapted for connection to an associated source of electrical potential through associated switch means, a second transistor having a second emitter-collector circuit, one side of said second emitter-collector circuit being electrically connected to said third conductor means, the other side of said second emitter-collector circuit being electrically connected through selected first resistance means to said first electrical conductor means, a first R-C circuit electrically connected to a base terminal of said first transistor, and a second R-C circuit electrically connected to a base terminal of said second transistor, said first and second R-C circuits being effective to control and determine the respective times during which said first and second emitter-collector circuits are "on" or conductive as well as the respective times during which said first and second emitter-collector circuits are "off" or non-conductive, said first and second R-C circuits also being effective to control the respective conductivities of said first and second emitter-collector circuits so that said first emitter-collector circuit is conductive only when said second emitter-collector circuit is non-conductive and said second emitter-collector circuit is conductive only when said first emitter-collector circuit is non-conductive, said first emitter-collector circuit being effective when made conductive to cause a primary current flow through said first coil means and said first coil means and said first electrical conductor means,

13

said primary current flow having a first magnitude of varying value so as to initially have a relatively low value and to thereafter increase to a relatively high value, said second coil means and said core being continuously acted upon by a magnetic field developed by said primary current flowing through said first coil means so as to thereby develop a voltage potential across said second coil means, said bulb remaining in an unenergized state while said first emitter-collector circuit is conductive and until said voltage potential across said second coil means attains a first predetermined magnitude sufficient to ignite and energize said bulb into visible illumination, the said R-C circuits having time constants such as to maintain said first emitter-collector circuit conductive for some time after said first predetermined magnitude of said voltage potential has been achieved and said bulb has been ignited and energized due to the discharging of said first predetermined magnitude of said voltage potential, said R-C circuits being effective after said bulb has been ignited and energized to cause said first emitter-collector cir-

14

cuit to become non-conductive and said second emitter-collector circuit to become conductive thereby causing said magnetic field to collapse and induce a second voltage potential in said second coil means, said second voltage potential being effective to ignite and energize said bulb by a second current flow through said bulb in a direction opposite to the current flow through said bulb which caused energization of said bulb during the time that said first emitter-collector circuit was conductive, and said armature means being effective whenever said magnetic field attains a predetermined magnetic force for moving associated auditory sound generating means in order to thereby create an auditory signal.

9. An audio-visual signal device according to claim 8 wherein said bulb comprises a neon bulb, and wherein said first predetermined magnitude of the first mentioned voltage potential is the firing or ignition voltage of said neon bulb.

* * * * *

25

30

35

40

45

50

55

60

65

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,810,149 Dated May 7, 1974

Inventor(s) Gerald K. MILLER and Norman A. RAUTIOLA

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 54, change "54" to --64--. Column 6, line 35, change "rmains" to --remains--. Column 8, line 38, after "When" insert --such--. Column 11, line 3, change "housingsection" to --housing section--.

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents