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Ellin et al.

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[54] **ADAPTER APPARATUS FOR FLASH FIRING SYSTEM**

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[73] Assignee: **Polaroid Corporation,** Cambridge, Mass.

[22] Filed: **Feb. 5, 1973**

[21] Appl. No.: **329,371**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 246,706, April 24, 1972.

[52] **U.S. Cl.**..... **354/145,** 240/37.1, 315/209 SC

[51] **Int. Cl.**..... **G03b 15/02**

[58] **Field of Search**..... 240/1.3, 37.1; 315/209 SC, 315/241 P, 241 S; 354/145, 141; 95/148

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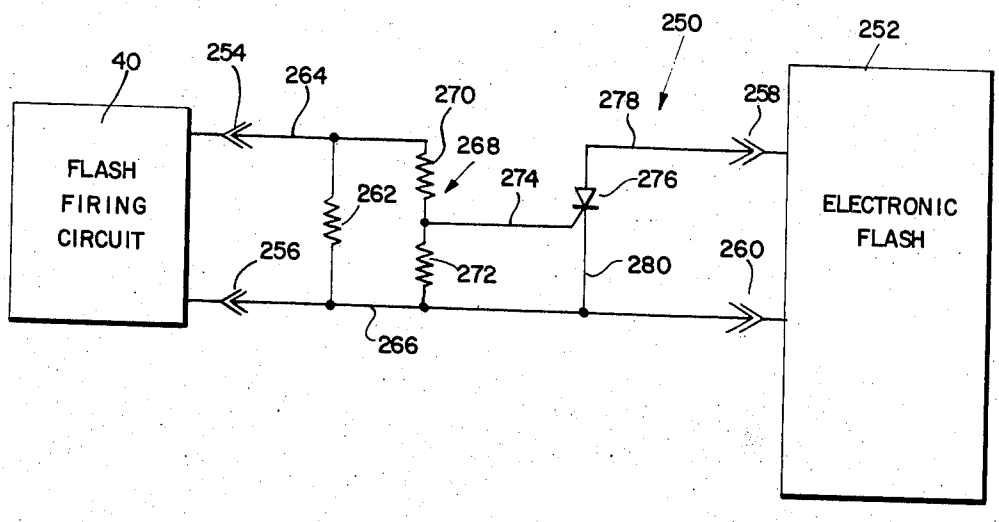
Primary Examiner—R. N. Envall, Jr.
Attorney, Agent, or Firm—Gerald L. Smith; John W. Ericson

[57] **ABSTRACT**

An adapter arrangement for use with a photographic flash firing circuit of a variety which monitors and senses the ignition of a flashlamp. Upon a successful such ignition, the firing circuit derives a unique output signal condition which is used for post exposure control purposes. The adapter arrangement permits such a circuit to be utilized for actuating an electronic flash unit or the like in place of typical flashlamps. To carry this out, an impedance having a resistance value closely related to that of an igniting flashlamp is incorporated in operational union with a switching arrangement. In one embodiment this impedance is combined with the winding of a relay. The relay serves to actuate the substitute lighting unit, while the resistive impedance serves to simulate the impedance of the igniting filament of a flashlamp. With the arrangement, therefore, the flash firing circuit is capable of developing a necessary unique output signal.

20 Claims, 7 Drawing Figures



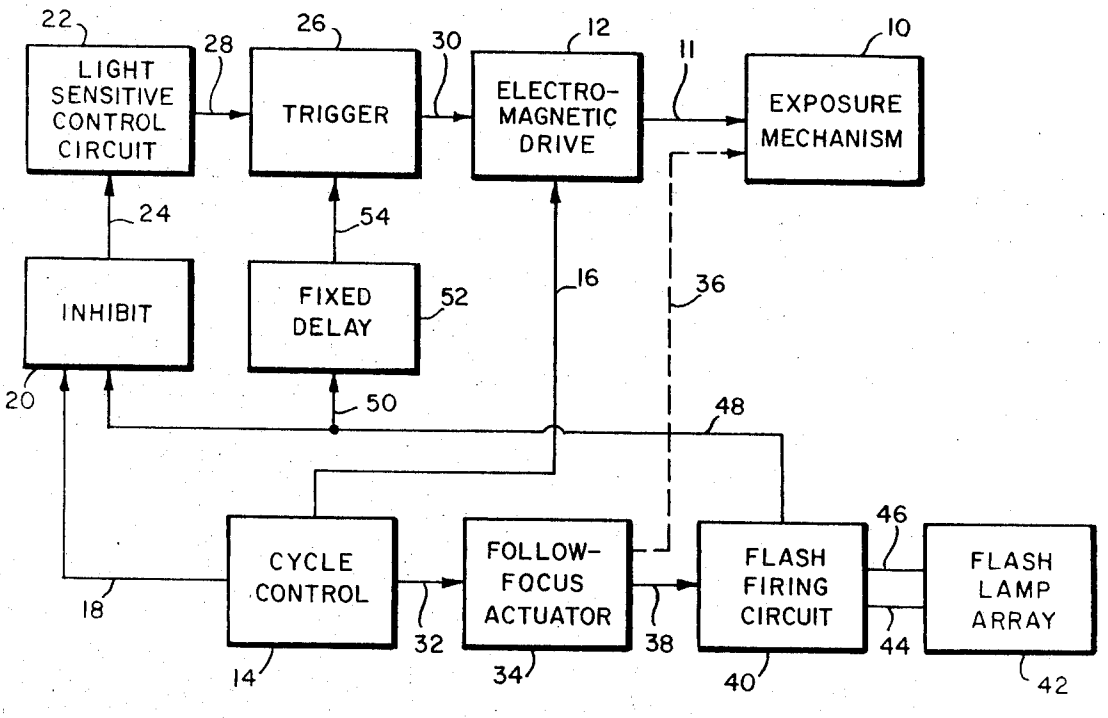

22
LIGHT SENSITIVE CONTROL CIRCUIT
28
26
TRIGGER
30
12
ELECTRO-MAGNETIC DRIVE
11
10
EXPOSURE MECHANISM
24
54
INHIBIT
FIXED DELAY
52
16
36
20
50
48
CYCLE CONTROL
FOLLOW-FOCUS ACTUATOR
FLASH FIRING CIRCUIT
46
FLASH LAMP ARRAY
18
32
38
44
14
34
40
42

FIG. 1

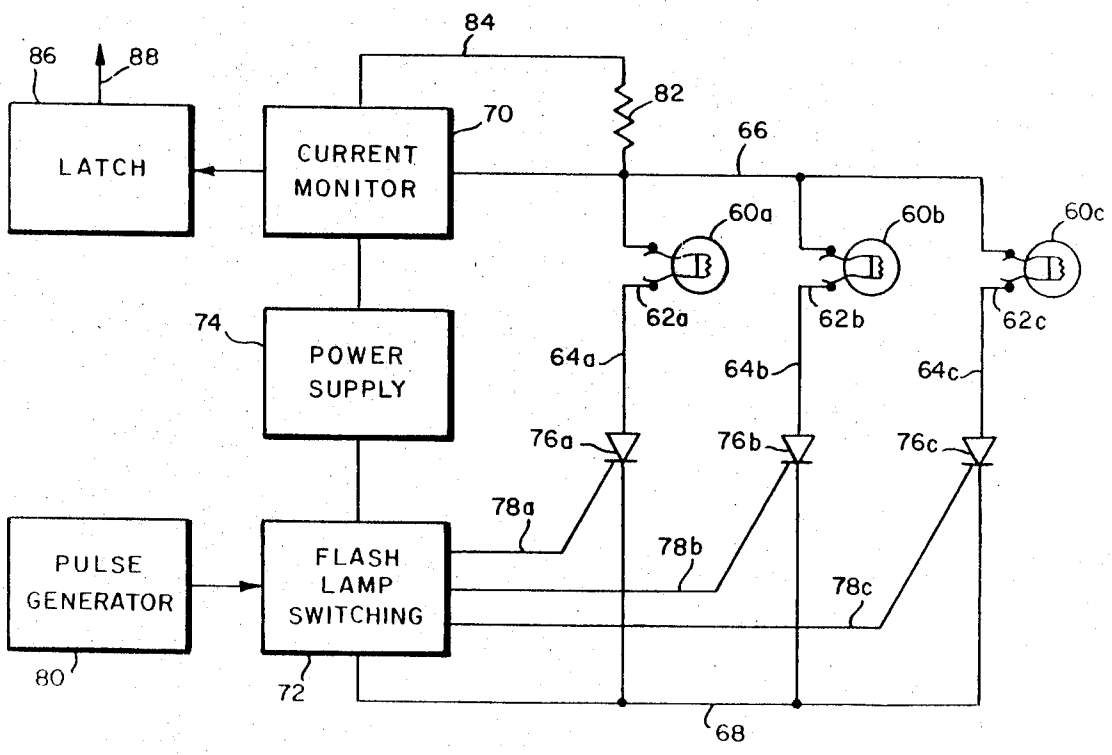

84
86
88
82
LATCH
70
CURRENT MONITOR
66
60a
60b
60c
62a
62b
62c
74
POWER SUPPLY
64a
64b
64c
76a
76b
76c
78a
78b
78c
PULSE GENERATOR
FLASH LAMP SWITCHING
80
72
68

FIG. 2

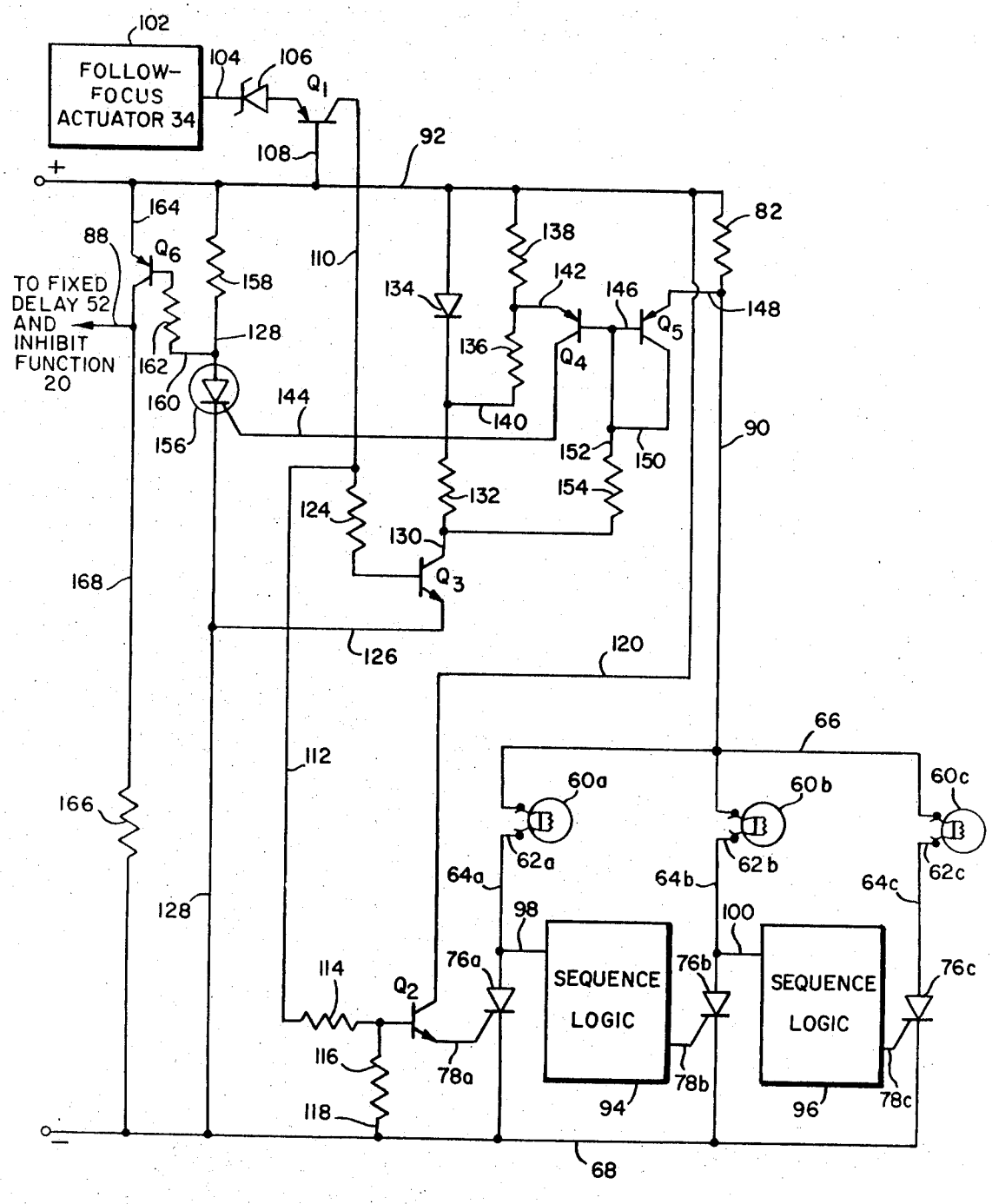

102
FOLLOW-FOCUS ACTUATOR 34
104
106
Q_1
108
92
+
164
88
Q_6
TO FIXED DELAY 52 AND INHIBIT FUNCTION 20
158
128
162
160
156
144
110
134
138
142
146
Q_5
148
82
136
Q_4
140
152
150
154
90
124
132
130
Q_3
168
126
120
66
112
166
128
60a
60b
60c
62a
62b
62c
64a
64b
64c
98
100
114
Q_2
76a
76b
76c
SEQUENCE LOGIC
SEQUENCE LOGIC
116
78a
78b
78c
118
94
96
68
−

FIG. 3

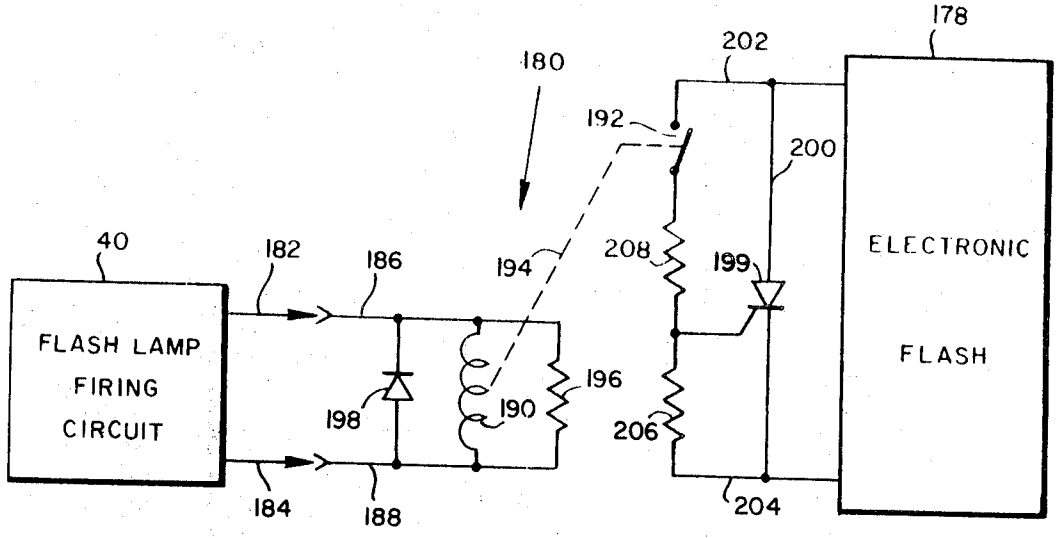

178
202
180
192
200
40
182
186
194
208
199
ELECTRONIC
FLASH
FLASH LAMP
FIRING
CIRCUIT
198
190
196
206
184
188
204

FIG. 4

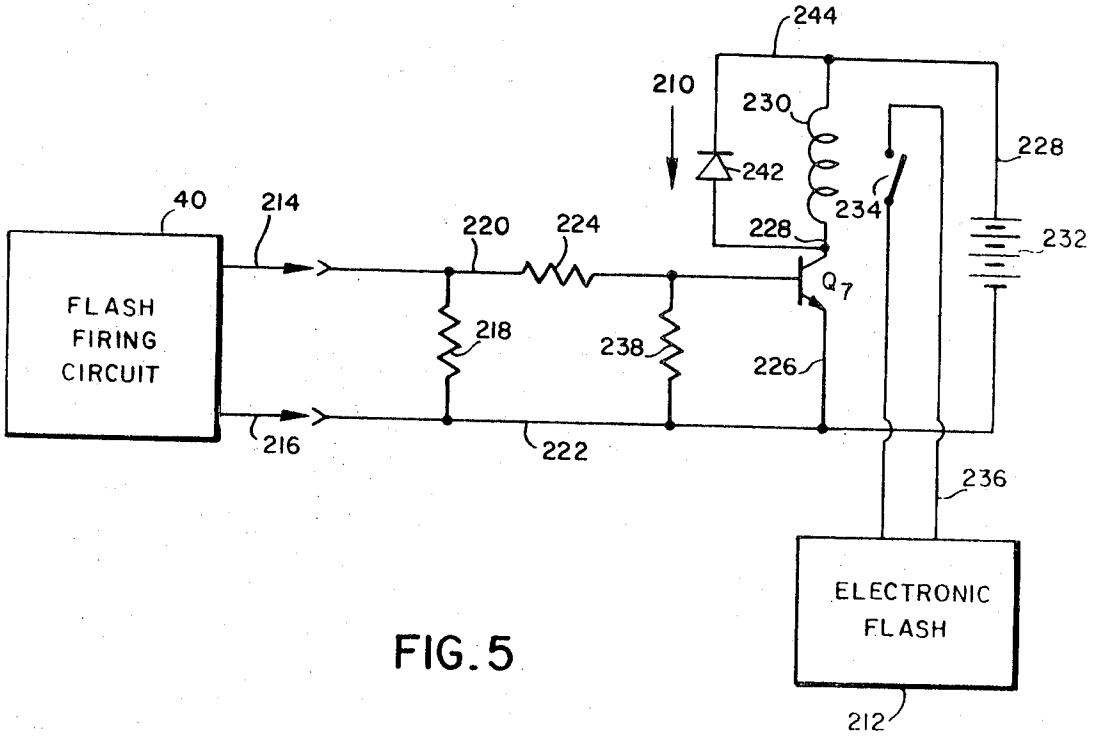

244
210
230
228
242
234
40
214
220
224
232
FLASH
FIRING
CIRCUIT
218
238
Q7
226
216
222
236
ELECTRONIC
FLASH
212

FIG. 5

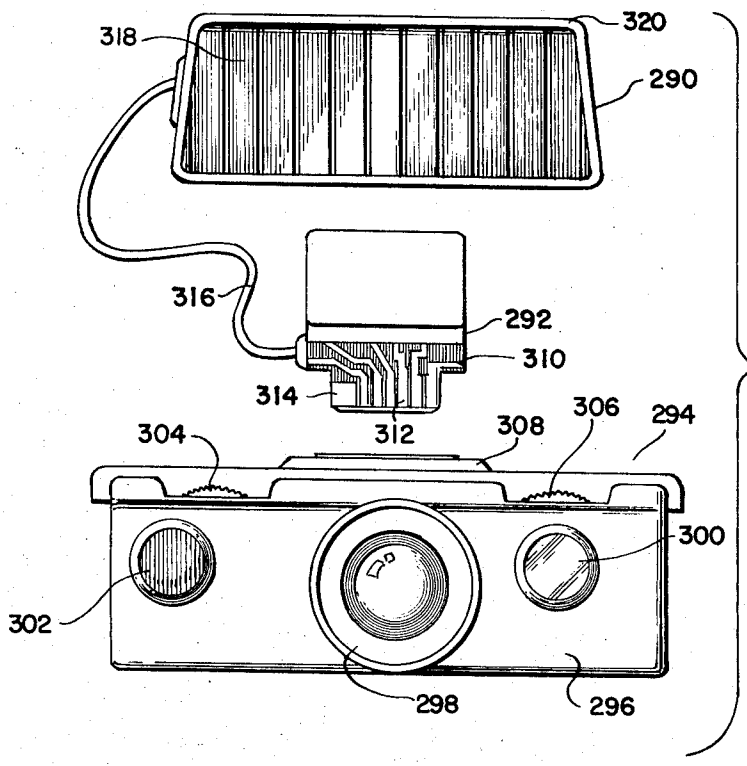

318
320
290
316
292
310
314
312
304
308
306
294
300
302
298
296

FIG. 7

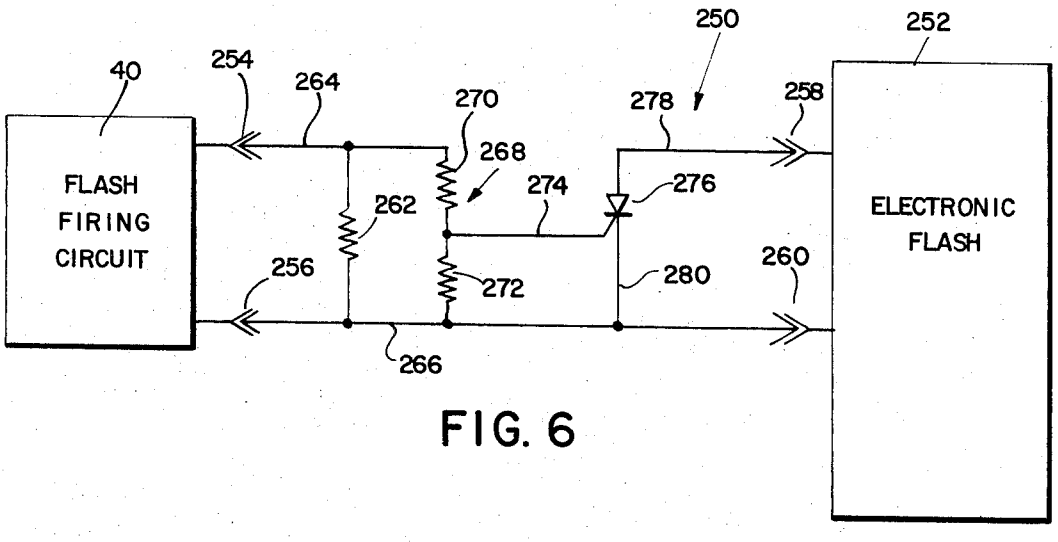

40
254
264
270
268
262
256
266
272
274
276
278
250
252
258
260
280
FLASH
FIRING
CIRCUIT
ELECTRONIC
FLASH

FIG. 6

ADAPTER APPARATUS FOR FLASH FIRING SYSTEM

RELATED APPLICATION

This is a continuation-in-part of application Ser. No. 246,706, filed Apr. 24, 1972.

BACKGROUND OF THE INVENTION

In a copending application for United States patent, entitled, "Flash Photographic Control System" by J. P. Burgarella, P. P. Carcia and R. C. Kee, Ser. No. 246,891, filed Apr. 24, 1972, and assigned in common herewith, a photographic camera is described which not only is fully automated, but also is thin and compact to an extent permitting it to be conveniently carried in the pocket of a garment. Full automaticity for the device is provided from such features as a dual parameter exposure control mechanism, a modified form of reflex viewing and focusing, automatic film processing following each exposure and automatic motorized conversion of components. This conversion moves the components from an initial standby viewing mode to a film unit exposure mode orientation, then returns them to the initial standby viewing mode orientation. These operational functions establish a photographic cycle which is carried out in rapid order following the simple depression of a start button located on the camera housing.

To permit more rapid sequential cycling using flash illumination, the camera is designed to operate with a multilamp array of flashlamps, the flashlamps within which are packaged in a linear fashion, all being simultaneously oriented for subject illumination. To ignite select ones of these flashlamps in a predetermined order from first to last, an electronic firing circuit is incorporated within the camera. Typical ones of such sequencing circuits are described in a U.S. Pat. No. 3,618,492 by S. Ellin. However, as described in the above-referenced application for United States patent, in one preferred embodiment of such circuits, the successful firing of a flashlamp is monitored to derive a unique circuit output signal condition. This unique signal condition then is utilized by the control system of the camera to provide post exposure interval control logic. For instance, the unique signal may be used to enable a flash-timing network having a time constant corresponding with the light generation time of a fired flashlamp. Such an arrangement provides an ideal flash-shutter synchronization technique. Additionally, the unique output signal condition may be used for selectively disabling a light-sensing network within the camera. With such an arrangement, the camera may automatically select a more desirable ambient illumination control under conditions of very high scene brightness.

Another feature of the flash control of the subject camera resides in the use of a very short electromagnetically derived pulse to actuate the firing circuit to effect the ignition of a flashlamp. With such actuation, difficulties otherwise encountered in "switch bounce" conditions and the like are obviated. Such synchronization switch instability might otherwise lead to an unwanted sequential firing of flashlamps coupled within the sequencing circuit.

For some photographic applications, it may be found desirable to operate the subject automatic camera in

conjunction with an electronic flash illumination source. When the camera incorporates a pulse actuated sequencing and firing circuit suited for flashlamps as described, such a light source substitution is not readily available. For instance, the earlier described monitoring feature of the circuit deriving the noted unique output signal condition requires that the light source assume a particular state when ignited. The normal condition of an electronic flash unit during ignition is much different than that of a flashlamp when ignited. As a consequence, this necessary condition to terminate an exposure interval may not be available. Further, sequencing circuits generally utilize solid state electronic components to carry out individual switching of lamps. Should such electronic switch be coupled through an inductive load as might be present with an electronic flash adapter, the desired pulse actuation technique may not be capable of sustaining sufficient switching current flow to effect an electronic flash firing. Further, where inductive devices are utilized for firing an electronic flash, the inductive fly-back pulse generated from said firing may injure the miniaturized circuit components of the camera.

SUMMARY

The present invention is addressed to an electronic flash arrangement and method for the use thereof with a photographic camera of a variety having a flashlamp circuit incorporating lamp ignition monitoring capabilities. Representing an adapter technique, the invention provides an impedance having an impedance characteristic corresponding with the predetermined impedance characteristic of the flashlamps otherwise fired by the flash firing circuit. Additionally, a switching arrangement is provided which serves to fire the electronic flash in response to the actuation of the switching components of the flash firing circuit. Where the control circuit of the camera in which the flash firing circuit is contained is susceptible to spurious signals or the like occasioned with the firing of the electronic flash, the switching thereof may be carried out in electrical isolation from the switching operation of the flash firing circuit. In one embodiment, the invention utilizes an electromagnetic actuator to fire an electronic flash in response to synchronizing actuation of the flashlamp firing circuit. A requisite signal output condition of the flash firing circuit is retained through the use of a select impedance in conjunction with the electromagnetic actuator. This impedance is selected having a value corresponding with the impedance values of flashlamps otherwise fired by the circuit. The use of this impedance within the circuit also permits the switching elements of an electronic flashlamp firing circuit to draw adequate current levels to permit conduction for requisite intervals of energization.

In one version of the invention, diode means are incorporated with the winding of the electromagnetic actuator in order to prevent any interference from the inductive element thereof with the control circuit of a camera. In another arrangement of the invention, a relay is utilized as the noted electromagnetic actuator. Operating as a switch, the contacts of this relay are protected through the use of a parallel coupled solid state switching device which is gated into conduction substantially simultaneously with the closure of the relay to activate an electronic flash.

Another feature and object of the invention is to provide an adapter arrangement for use in conjunction with an exposure control system for photographic apparatus of a variety incorporating a firing circuit having a switching network connectable through output terminals with flashlamps. Such flashlamps exhibit predetermined impedance values when ignited and the switching network is actuable to ignite the flashlamps from a pulse source. A monitor arrangement is incorporated with the circuit including a current detecting arrangement responsive to the exhibited impedance values of the flashlamps for deriving a select output condition used for control purposes. The adapter incorporates means connectable with the output terminals for activating another source of illumination such as an electronic flash unit. A switch arrangement is provided which is actuable to activate the other source of illumination and this switch is, in turn, actuable by electromagnetic means which may be present in the form of a relay. Additionally, an impedance is provided with the electromagnetic element of the relay and this impedance is selected having a value corresponding with the impedance values of the flashlamps utilized by the monitoring function of the firing circuit. Preferably, this impedance is present as a resistor coupled in parallel with the winding or electromagnetic portion of the noted relay. To protect the contacts of the noted switch arrangement of the electronic flash unit, an electronic switch, such as a gate controlled thyristor device may be coupled in parallel therewith and gated in response to closure of the noted switch contacts. Such an arrangement serves to preserve the contacts from undue deterioration.

Other objects of the invention will, in part, be obvious and will, in part, appear hereinafter.

The invention accordingly comprises the apparatus, method and system possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure. For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block logic diagram of the control components of a highly automated photographic camera with which the adapter arrangement of the invention may be utilized;

FIG. **2** is a schematic diagram illustrating the logic of a flash firing circuit utilized with the control arrangement described in connection with FIG. **1**;

FIG. **3** is a partial circuit diagram showing, in more detail, certain of the components of the circuit of FIG. **2**;

FIG. **4** is a schematic diagram of an adapter arrangement according to the invention;

FIG. **5** shows another adapter arrangement which may be utilized in conjunction with a solid state flash firing circuit described in connection with FIGS. **1–3**;

FIG. **6** shows still another adapter arrangement which may be utilized in conjunction with a flash firing circuit described in connection with FIGS. **1–3**; and

FIG. **7** is a front elevational view of a packaged adapter unit, the exposure housing of a camera and an electronic flash device.

DETAILED DESCRIPTION

The instant invention is particularly suited for use in conjunction with the control system of a highly automatic camera described in detail in the above-referenced application for U.S. Pat., Ser. No. 246,891. This camera is configured to operate substantially alternately in a flash illuminational mode and in an ambient illuminational mode, exposure regulation having a different technical basis for each such mode.

Referring to FIG. **1**, a block diagram showing the basic features for this two-mode control is illustrated. For instance, the exposure mechanism of the camera, as depicted at block **10**, is preferably present as a dual-bladed shutter device which is actuated from a tractive electromagnetic drive system as illustrated at block **12**. Electromagnetic drive **12** and shutter or exposure mechanism **10** are mechanically associated as depicted by dashed line **11**, such that upon energization of a solenoid, the blades of mechanism **10** are caused to close to block the optical path of the camera. During an initial such blockage in the course of a photographic cycle, the optical path of the camera is converted from a viewing and focusing operation to one permitting the exposure of a film unit. The initial closure of the exposure mechanism blades **10** through actuation of an electromagnetic drive **12** is carried out by a cycle control function **14** which is connected along input **16** to drive **12**. During the optical path conversion, cycle control function **14**, acting through line **18**, operates an inhibit function **20** in a manner temporarily disabling a light-sensitive control circuit shown at **22**. Functional connection between inhibit function **20** and circuit **22** is shown by line **24**.

When exposure mechanism **10** has fully blocked the noted optical path, cycle control **14** signals inhibit function **20** to enable light-sensitive control circuit **22** while, simultaneously, signaling electromagnetic drive **12** from line **16** in a manner de-energizing the noted solenoid. The latter de-energization permits exposure mechanism **10** to gradually unblock the optical path of the camera. Light-sensitive control circuit **22** monitors this gradual opening of the optical path as well as the levels of brightness of the scene being photographed and, when an appropriate exposure value has been derived, the system signals a trigger function **26** from along line **28** to effect the termination of this ambient mode exposure. This signal is presented along line **30** to electromagnetic drive **12**. Drive **12**, in turn, causes exposure mechanism **10** to rapidly block the optical path and terminate an exposure. Operating under the influence of cycle control **14** through line **16**, electromagnetic drive **12** retains this optical path blocking posture at exposure mechanism **10** until such time as post exposure film processing operations and the like are carried out. When these operations have been completed, control **14** de-energizes electromagnetic drive **12** and resets the entire system for a next succeeding photographic cycle. Typical of the light-sensitive control circuits which may be used at block **22** is that described in a U.S. Pat. No. 3,620,143, by J. P. Burgarella, while the operation of such a light detecting arrangement in conjunction with an exposure control system is described in a U.S. Pat. No. 3,641,891, by the same inventor. Inhibit function **20** is preferably in the form of an electronic switch which serves to activate or de-activate control circuit **22**. The inhibit function **20**

is described in a copending application for United States patent by E. K. Shenk entitled "Exposure Control System Incorporating Solid State Switching to Enable a Light-Sensitive Network" Ser. No. 213,289, filed on Dec. 29, 1971, and assigned in common herewith.

When the subject camera is operated in a flash operational mode, a packaged multiflashlamp array is attached thereto in a manner orienting the flashlamps of the array in a direction to illuminate a scene being photographed. With such mounting, cycle control function **14** is automatically adjusted to carry out a flash mode cycle. As is described in detail in the noted application for U.S. Pat., Ser. No. 246,891 during a flash operational mode, cycle control **14**, operating through line **16**, activates electromagnetic drive **12** to cause exposure mechanism **10** to block the optical path of the camera. As in the case for ambient mode operation, exposure mechanism **10** achieves and retains this optical blocking status until such time as the optical path is converted to an exposure orientation.

When exposure mechanism **10** has blocked the optical path, cycle control **14**, acting from along line **32**, also activates a follow-focus actuator **34**. As is described in a copending application for United States patent by V. K. Eloranta and E. K. Shenk, entitled "Focus Responsive Exposure Control System" Ser. No. 135,211, filed Apr. 19, 1971 and in application for U.S. Pat., Ser. No. 168,671 by L. M. Douglas, entitled "Apparatus and System for Flash Photography" filed Aug. 3, 1971, both said applications being assigned in common herewith, such follow-focus systems operate in accordance with the level of illumination from a flash source which is anticipated at a subject being photographed. To anticipate these levels, the follow-focus actuator systems utilize an approach based upon an application of the inverse square law for light energy propagation. Under this law, the light energy available from a given source is considered to vary inversely with the square of the distance from that source. The follow-focus technique utilizes the approach to automatically adjust aperture through a coupling between the exposure mechanism **10** and the focusing system of the camera. In the instant arrangement, a tractive electromagnetic device in the form of a solenoid is utilized to arrest the movement of the blades of exposure mechanism **10** as they are released by drive **12** for movement from a fully closed position toward a fully open position. The mechanical interaction between follow-focus actuator function **34** and exposure mechanism **10** is depicted by dashed line **36**. As is described in the above-noted application Ser. No. 246,891, following an appropriate delay interval to permit proper arresting and capture of the blades of exposure mechanism **10** by follow-focus actuator arrangement **34**, the solenoid within the latter is de-energized to inductively derive a flash firing pulse. This pulse is introduced through appropriate interconnection depicted by line **38** to a flash firing circuit depicted at **40**. Responding to this pulse input from line **38**, firing circuit **40** selects an appropriate flashlamp within the camera mounted flash array as at **42**, and operating through flash output terminals **44** and **46**, ignites a flashlamp to illuminate the scene being photographed.

Should flashlamp illumination be successful, the illuminating lamp will exhibit a predetermined value of resistive impedance which, in turn, is witnessed by a sensing and monitoring function within firing circuit **40**. This monitoring function then derives a unique output signal which is presented along line **48**. When thus presented on line **48**, the unique signal, acting from line **50**, activates a fixed delay function **52**, the unique signal condition at line **48** also acts upon inhibit function **20** to disable light-sensitive control circuit **22**. Following a predetermined interval of time selected in correspondence with the time required for the ignited flashlamp to generate all available light, fixed delay **52** signals trigger function **26** from line **54** to carry out an exposure terminating function. Accordingly, trigger **26**, signaling from along line **30**, activates electromagnetic drive **12** to energize the noted shutter drive solenoid and, operating through mechanical linkage **11**, causes exposure mechanism **10** to block the optical path of the camera. This optical path blocking orientation is retained until such time in film processing and optical path re-orientation procedures are carried out. As in the case of the ambient illuminational cycle, cycle control **14** then causes the system to shut down or assume a standby status in preparation for a next succeeding photographic cycle.

Looking to FIG. **2**, a schematic representation of a flash firing circuit as described at **40** is presented. In the figure, a plurality of flashlamps **60***a* – **60***c* are shown connected, respectively, to the terminals **62***a* – **62***c* of three lamp circuit lines **64***a* – **64***c*. Circuit lines **64***a* – **64***c* are connected in parallel circuit relationship to one another between power or bus leads **66** and **68**. Leads **66** and **68**, in turn, are connected, respectively, with a current monitoring as well as sensing function **70** and a flashlamp switching network **72**. Monitor function **70**, as well as network **72** are energized from a power supply depicted functionally at **74**. Each lamp circuit line **64***a* – **64***c* also includes a switching function shown, respectively, as SCR's **76***a* – **76***c*. The gate electrodes of SCR's **76***a* – **76***c*, respectively, are connected through lines **78***a* – **78***c* to switching network **72**. When actuated from a pulse generator as at **80**, flashlamp switching network **72** sequentially gates a select one of SCR's **76***a* – **76***c*. When so gated, the selected SCR is commutated to permit the passage of igniting current through the flashlamp with which it is associated. Pulse generator function **80** will be recognized as representing the solenoid feature of follow-focus actuator function **34**.

As a select one of the flashlamps **60***a* – **60***c* is ignited, a voltage drop will be witnessed across a resistor as at **82**. Resistor **82** is connected within line **84** between lead **66** and current monitor **70**. When such voltage drop is so witnessed or sensed, monitor function **70** signals a latch network **86** to establish a unique signal condition such as that described at line **48** in FIG. **1**. This output from flash **86** is represented in FIG. **2** at **88**. Should a flashlamp **62***a* – **62***c* fail to ignite, monitor **70** will not witness a voltage drop at resistor **82** and no signal will be passed to latching network **86**. Accordingly, output **88** will not evidence its requisite unique output signal condition. Under such circumstance, neither the fixed delay described at **52** nor light-sensitive control circuit inhibition as at **20** will take place and the camera progesses through a form of ambient mode photographic cycle.

Referring to FIG. **3**, a more detailed representation for current monitor and sensing function **70**, switching network **72** and latch **86** is provided. In the figure, where appropriate, identical numeration is retained for

components heretofore described. Accordingly, flashlamps **60***a* – **60***c* are shown coupled within flash circuit lines **64***a* – **64***c*, which in turn, are connected between power leads **68** and **66.** Lead **66,** in turn is connected through line **90** to a main power lead **92.** Also present within lamp circuit lines **64***a* – **64***c* are SCR's **76***a* – **76***c* which, in turn, are interconnected with sequence logic networks **94** and **96.** Network **94** is connected through line **98** to line **64***a* at the anode side of SCR **76***a* and, additionally, is coupled to gating line **78***b* of SCR **76***b*. Similarly, logic network **96** is connected through line **100** to lamp circuit line **64***b* at the anode side of SCR **76***b* and to gating line **78***c* of SCR **76***c*. Functions **94** and **96** serve to detect the previous firing of a flashlamp, for instance, at **60***a* and cause the circuit to select a next flashlamp, i.e., **60***b* by relaying a firing or gating pulse to the appropriate SCR thereof, i.e., **76***b*. Typical sequence logic techniques as provided by functions **94** and **96** are described in the noted U.S. Pat. No. 3,618,492.

The firing circuit being energized from lines **68** and **92,** a pulse of short duration, for instance about **10** microseconds is generated from follow-focus actuator **34** as depicted at function block **102.** This pulse is directed along line **104** and through a level detecting zener diode **106** to the emitter terminal of a PNP transistor Q_1. The base of transistor Q_1 is connected through line **108** to power line **92,** while its collector electrode is coupled with line **110.** Line **110,** in turn, is connected through line **112** and a limiting resistor **114** to the base of an NPN transistor Q_2. Bypass resistor **116** is connected within line **118** between ground or power lead **68** and line **112** intermediate resistor **114** and the base of transistor Q_2. The collector of transistor Q_2 is connected through line **120** to power lead **92,** while its emmitter is connected with gate line **78***a* of SCR **76***a*. With the arrangement shown, in the presence of a short duration pulse at line **104,** transistor Q_1 is forward biased into conduction for a correspondingly short interval to energize lines **110** and **112** and, in consequence, forward bias the base-emitter junction of transistor Q_2. Transistor Q_2 simultaneously activates line **120** from power lead **92** to impose a short duration gating current into gate line **78***a* of SCR **76***a*. Thus gated, SCR **76***a* is turned "on" to ignite the filament of flashlamp **60***a*. SCR **76***a* will remain "on" until commutated off due to decay occurring in line **64***a* occasioned with the destruction of the igniting filament within flashlamp **60***a*. With the next succeeding actuation of the firing circuit, SCR **76***a* will be gated on, however, sustaining current will be derived from line **98** of sequence logic network **94.** Network **94,** in turn, will supply gating current through line **78***b* to SCR **76***b*. Accordingly, for this actuation of the firing circuit flashlamp **60***b* will be ignited. The next succeeding flash cycle will activate sequence logic circuit **96** through line **100** in identical fashion to effect the ignition of the final flashlamp **60***c* of the series. Of course, several additional flashlamps may be arranged within this form of firing circuit.

With the forward biasing of transistor Q_1 for the brief interval occasioned from the pulse at line **104,** an NPN transistor Q_3 also is forward biased. The base of transistor Q_3 is connected through limiting resistor **124** to line **110,** its emitter is connected through line **126** to lead **68** through line **128,** and the collector thereof is connected to line **130.** Line **130** is connected through a resistor **132** and diode **134** to power line **92.** With the forward biasing of transistor Q_3, line **130** is energized and a basic reference voltage is established through diode **134.** This reference voltage is further refined by a voltage dividing network including resistors **136** and **138** connected within line **140** between the cathode side of diode **134** and power line **92.** The refined reference voltage level is tapped by a line **142** connected intermediate resistors **136** and **138** and extending to the emitter terminal of a PNP transistor Q_4. The collector of transistor Q_4 is connected to a gate lead **144,** while its base is connected to a common line **146.** The voltage level witnessed at line **146** is insufficient to effect a forward biasing of the base-emitter junction of transistor Q_4. Line **146** is also connected to the base of another PNP transistor Q_5, the emitter of which is connected through line **148** to one side of resistor **82** within line **90.** The collector of transistor Q_5 is connected through line **150,** line **152** and resistor **154** to line **130.** Note, in view of a forward biasing of transistor Q_5, the voltage at line **146** follows the voltage variation at resistor **82.** With the arrangement, a form of comparison network is provided. For instance, assuming that a selected flashlamp **60***a* – **60***c* has been successfully ignited, current passage through sensing resistor **82** will derive a voltage drop which is witnessed at common line **146** inasmuch as transistors Q_4 and Q_5 are selected to remain conductive throughout the duration of the actuating pulse introduced from line **104.** This witnessed voltage drop at line **146** serves to enhance the biasing of transistor Q_4 and, as a consequence, transistor Q_4 commences to conduct and, thereby activate gate line **144.** Line **144,** in turn, gates "on" an SCR **156** connected within line **128.** Thus gated, SCR **156** commences to conduct through resistor **158** and will remain conducting until sustaining current from power lines **92** and **68** is abated. Line **128** also is connected from the anode side of SCR **156** through line **160** and resistor **162** to the base of PNP transistor Q_6. The emitter of transistor Q_6 is connected through line **164** to power line **92,** while its collector is connected through resistor **166** and line **168** to line **68.** As SCR **156** continues to conduct, transistor Q_6 is forward biased. The resultant energized state of line **168** and the voltage level in evidence thereat is introduced to output line **88** which, in turn, provides the unique signal condition required to operate fixed delay **52** as well as inhibit function **20.**

Should a selected flashlamp **622***a* – **62***c* fail to ignite, no appreciable igniting current will pass through sensing resistor **82,** and no voltage drop will be witnessed at common line **146.** As a consequence, transistor Q_4 is not forward biased and no gating signal is applied through gate line **144** to turn on SCR **156.** Inasmuch as SCR **156** does not conduct, transistor Q_6 is not forward biased and the unique signal condition described earlier will not be in evidence at output **88.**

The operational description of the circuit of FIG. **3** reveals that the very short pulse supplied from follow-focus actuator function **102,** for instance, **10** microseconds requires that the current to maintain conduction through all of the noted SCRs must reach a sustaining level within the period of the pulse itself. While such sustaining levels are readily achieved with the resistive igniting filament arrangement of typical flashlamps, such is not the case where inductive loads or the like are substituted for these igniting filaments. Where such inductive load is substituted, the current buildup characteristic at the firing SCR's as at **76***a* – **76***c* would be

so slow as to fail to commutate them into continuous conduction. As a consequence, a selected flashlamp **60***a* – **60***c* would not be ignited. Additionally, sufficient current would fail to be drawn through sensing resistor **82** so as to forward bias transistor Q_4 and, in consequence, gate latching SCR **156.** As a result, the requisite unique signal condition at line **88** would fail to appear to permit the camera to complete its photographic cycle.

Referring to FIG. **4,** an adapter arrangement for actuating an electronic flash **178** or the like from a flashlamp firing circuit as at **40** is disclosed generally at **180.** Any one of the contact terminals as earlier described at **62***a* – **62***c* may be tapped for interconnecting circuit **40** with adapter **180.** For instance, terminals identified at **182** and **184** are shown. Corresponding leads **186** and **188** are provided in adapter **180** for purposes of interconnecting the winding **190** of a reed-type relay or the like across contacts **182** and **184.** Winding **190** of the relay serves to cause a closing of the contacts of a switch designated **192** when energized. The electrically isolated association between winding **190** and switch **192** is depicted by dashed line **194.** As discussed earlier, winding **190** represents an inductive load to the flashlamp firing circuit **40.** Without more, this load would hinder current build-up through lamp circuit **64***a* – **64***c* to an extent preventing SCR's **76***a* – **76***c* from conducting at a sustaining current level prior to the removal of gating current at line **78***a* – **78***c* occasioned with the end of the actuating pulse. To correct for this inductive characteristic, an impedance in the form of a fixed resistor **196** is coupled between lines **186** and **188** in parallel circuit relationship with winding **190.** Additionally, a diode as at **198** is similarly connected in parallel with winding **190.** With the arrangement shown, when a brief igniting signal energizes contacts **182** and **184,** winding **190** commences to be energized to close switch **192.** To permit the flash firing circuit **40** to operate properly, resistor **196** is selected having an impedance characteristic closely proximate that of flashlamps **60***a* – **60***c.* Accordingly, circuit **40** "sees" a successful ignition of flashlamp, transistor Q_4 conducts and latching SCR **156** is commutated into conduction (FIG. **3**). As a consequence, the requisite unique signal condition is present at output line **88.** Inasmuch as during the energization of winding **190** a fly-back pulse may be generated, diode **198** is connected between lines **186** and **188** in parallel circuit relationship therewith. Thus positioned, diode **198** serves to dissipate any fly-back pulses or the like which may be generated.

Inasmuch as switch **192** may be of somewhat delicate structure, it is desirable that it not be called upon to operate under the relatively high current conditions that may be encountered with electronic flash units as at **178.** To protect the contacts at switch **192,** therefore, a switching SCR **199** is connected within line **200** between input lines **202** and **204** and in parallel with switch **192.** The gate **206** of SCR **199** is connected intermediate a pair of voltage dividing resistors **206** and **208** connected, in turn, with switch **192** in line **210.** With the arrangement shown, as relay contacts or the contacts of a switch **192** are closed upon energization of winding **190,** gate **206** of SCR **199** is activated to commutate it "on" substantially simultaneously with the closure of switch **192.** As a result, SCR **199** assumes substantially all of the current load occasioned with the firing of electronic flash unit **178.**

Referring to FIG. **5,** another adapter arrangement for use with flash firing circuit **40** is shown generally at **210.** As in the case of FIG. **4,** any pair of the terminals **62***a* – **62***c* of firing circuit **40** may be utilized or tapped for purposes of electrical connection with an electronic flash **212** or the like. Such contacts are depicted at **214** and **216.** Adapter arrangement **210** includes a load resistor **218** having an impedance value selected for simulating the impedance value of the igniting filament of a flashlamp **60***a* – **60***c.* Accordingly, resistor **218** operates in identical fashion as resistor **196** described in connection with FIG. **4.** More particularly, the resistor permits sustaining current to flow through the appropriate switching SCR **76***a* – **76***b* as well permitting a latching function to be carried out by SCR **156.** Resistor **218** is connected between leads **220** and **222** which, respectively, are coupled with terminals **214** and **216.** A drain limiting resistor **224** is connected in line **220** and serves the function of limiting a drain from firing circuit **40.** Line **220** also is connected to the base of an NPN transistor Q_7. The emitter of transistor Q_7 is connected along line **226** to line **222** while its collector is connected through line **228** to a winding **230** of a relay, for instance, of a "reed" variety. Winding **230,** in turn, is connected to a separate power supply present as a battery **232.** As is apparent, upon energization of adapter arrangement **210** from contacts **214** and **216,** transistor Q_7 is forward biased to energize winding **230** from battery **232.** As a consequence, relay contacts **234** are closed to fire electronic flash **212.** Note that contacts **234** are present in an actuating output line **236** extending from electronic flash **212.** A resistor **238** is positioned between lines **214** and **216** to assure that transistor Q_7 is biased "off" until utilized for switching purposes. A diode **242** present within line **244** is connected across winding **228.** As in the embodiment of FIG. **4,** this diode serves to suppress excessive transients and the like which may be generated with the deenergization of winding **228.** With the self-powered arrangement shown in FIG. **5,** no undue power drains are occasioned in operating the additional circuitry provided within the adapter arrangement. Where the general power supply of the camera utilizing the control system is limited, such additional power supply may be of some value.

Referring to FIG. **6,** another adapter arrangement for use with flash firing circuit **40** is shown generally at **250.** As in the embodiments of FIGS. **4** and **5,** any pair of terminals **62***a* – **62***c* of firing circuit **40** may be utilized or tapped for the purposes of electrical connection with an electronic flash **252.** Such contacts are depicted at **254** and **256.** The embodiment of FIG. **6** differs from that of the earlier described embodiments inasmuch as electronic flash device **252** is switched or fired without the electrical isolation feature of those embodiments. Where the integrated circuitry of a camera is sufficiently immune from damage due to voltage excursions or the like which might have been generated from an electronic flash device, such an arrangement is available. Accordingly, the actuating switch output of electronic flash device **252** is coupled to adapter arrangement **250** at contacts **258** and **260.**

As in the earlier embodiments, adapter arrangement **250** includes a load resistor **262** having an impedance value or characteristic selected for simulating the impedance values or characteristics of the igniting filament of a flashlamp **60***a* – **60***c.* Accordingly, resistor

262 operates in identical fashion as resistors 218 and 196 in the embodiments of FIGS. 4 and 5. More particularly, the resistor permits sustaining current to flow through the appropriate switching SCR's 76*a* – 76*b* as well as permitting a latching function to be carried out by SCR 156 (FIG. 3). Resistor 262 is connected between leads 264 and 266 which, respectively, are coupled with terminals 254 and 256. Coupled in parallel with resistor 262 is a divider network 268 formed of resistors 270 and 272. The function of network 268 is to develop a signal of appropriate level at line 274 for gating a high voltage SCR 276 to an "on" condition. The anode side of SCR 276 is connected through line 278 to contact 258, while its cathode is connected along line 280 to line 266. Line 266 may represent connection with a common contact terminal of flash firing circuit 40.

With the arrangement shown, upon energization of adapter arrangement 250 from contacts 254 and 256, SCR 276 is gated from line 274 to close the circuit across contacts 258 and 260. Electronic flash device 252 is fired or switched on and resistor 262 serves the function of causing flash firing circuit 40 to "see" a successful ignition of a flashlamp.

Looking to FIG. 7, an exploded view showing a typical electronic flash device at 290, an adapter arrangement in packaged form at 292 and the exposure housing portion 294 of a photographic camera as described in the noted application for U.S. Pat., Ser. No. 246,891 is revealed. Exposure housing 294 generally incorporates a cover portion 296, a lens mounting 298, an entrance window 300 for providing light responsive exposure control, a start button 302, a focusing knob 304 and a trim wheel 306. A flash array mounting structure 308 is positioned upon the top of housing 296 and is designed to receive and support a blade-type support and electrical contact device of a linear flash array. This blade support is shown at 310 extending downwardly from adapter unit 292. The terminals for a typical flash array are formed by printed circuitry technique upon support 310 and include a common terminal 312 as well as a switch actuating surface 314. As discussed earlier, surface 314 serves to cause the control system of a camera to carry out a flash photographic cycle. Of course, such switching or other adjustment of the control system is carried out in conjunction with each of the disclosed embodiments, dependent upon the camera structure or design involved. The remaining terminals upon the support 310 would otherwise lead to individual flashlamps but are connected in common with a lead as at 264 in FIG. 6, lead 220 in FIG. 5 or lead 186 in FIG. 4. Common terminal 312, of course, corresponds with lead 266 in FIG. 6 and its counterpart in FIGS. 4 and 5. The switching output of adapter 292 is provided at a coaxial contact member configured to couple with a mating end of a switching cable 316 of electronic flash unit 290. This connection may be represented by contacts 258 and 260 in FIG. 6 or their equivalent in FIGS. 4 and 5.

Electronic flash device 290 is formed incorporating the usual elements of such devices including a power supply and a gas discharge type illuminating arrangement. The light exit window of the device is shown at 318 as being mounted within a housing 230.

It should be apparent that the components of the adapter 292 can be formed integrally within electronic flash unit 290, a supporting blade as at 310 merely extending from the bottom of housing 320.

Since certain changes may be made in the above-described system and apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the description thereof as shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. Apparatus for use with a camera having a photographic exposure control system of a variety operative when selectively activated to ignite a replaceable flashlamp exhibiting a predetermined impedance characteristic when so ignited, said system including means responsive to said exhibited impedance characteristic for performing an operational function, comprising:
   - a support;
   - electrical input terminal means on said support;
   - electrical output terminal means on said support;
   - means connected to said support for attaching said apparatus to the camera with its said electrical input terminal means in electrical communication with the camera's photographic exposure control system;
   - means formed on said support for mounting another source of artificial illumination, not exhibiting said predetermined impedance characteristic when ignited, in electrical communication with said output terminal means;
   - switching means connected between said electrical input and output terminal means and responsive to said selective activation for effecting the energization of the other source of artificial illumination; and
   - impedance means connected to said electrical input terminal means, said impedance means being selected so that said apparatus exhibits said predetermined impedance characteristic to said electrical input terminal means when the other source of illumination is energized responsive to said selective activation.

2. The apparatus of claim 1 in which said impedance means is present as a resistor having a resistivity value substantially equivalent to the value of resistivity exhibited by said flashlamp when ignited.

3. The apparatus of claim 1 in which said switching means is present in solid state configuration and is gatable to effect said energization of said source of artificial illumination not exhibiting said predetermined impedance characteristic.

4. In an exposure control system of a variety incorporating a flashlamp firing circuit having switching network means connectable with flashlamps exhibiting predetermined impedance characteristics when ignited in response to actuation of said switching network means and including monitor means responsive to said exhibited impedance characteristic for deriving a select output condition, apparatus comprising:
   - impedance means selectively connectable with said switching network means and exhibiting said predetermined impedance characteristic in the presence of said actuation thereof; and
   - switching means which includes said impedance means and is responsive to said switching network means actuation for effecting the energization of a source of artificial illumination other than said flashlamps.

5. The invention defined in claim 4 in which said impedance means is present as a resistor having a resistivity value substantially equivalent to the value of resistivity exhibited by said flashlamp when ignited.

6. The invention defined in claim 4 in which said switching means is present in solid state configuration and is gatable to effect said energization of said source of artificial illumination other than said flashlamps.

7. The invention defined in claim 4 in which said switching means is present in solid state configuration and includes a gating input responsive to said switching network actuation for effecting the energization of a source of artificial illumination other than said flashlamps.

8. Apparatus for firing an electronic flash device with an exposure control system of the variety incorporating a flashlamp firing circuit having switching network means connectable with flashlamps exhibiting predetermined impedance characteristics when ignited in response to the application of a voltage by said switching network means and including monitor means responsive to said exhibited impedance characteristic for deriving a select output condition, said apparatus comprising:

an impedance having said predetermined impedance characteristic, means for connecting said impedance to said switching network means; and

circuit means operatively connected to said impedance for firing said electronic flash device in response to voltage applied by said switching network means.

9. The apparatus of claim 8 in which said circuit means are electrically isolated from said switching network means.

10. An adapter for interconnecting a photographic control system, of the type having first terminals adapted to be electrically energized to ignite a flashlamp and operative in a cycle conditioned by the presence or absence of a first impedance across said terminals when said terminals are excited, with a source of illumination having second terminals and exhibiting a second impedance, said source being responsive to a predetermined signal applied to said second terminals to produce a flash of light; said adapter comprising: circuit means having input terminals adapted to be connected to said first terminals, output terminals adapted to be connected to said second terminals, an input impedance between said input terminals equal to said first impedance, and means responsive to the electrical energization of said input terminals including said impedance for applying said predetermined signal to said output terminals.

11. A strobe adapter for interconnecting a flash camera having output terminals for producing a flashlamp igniting signal to a strobe unit having control terminals adapted to receive a trigger signal; comprising a pair of input terminals adapted to be connected to the flashlamp igniting terminals of the camera, output terminals adapted to be connected to the control terminals of the strobe unit, impedance means simulating a flashlamp connected between said input terminals, switching means connected to said output terminals and responsive to an applied signal to produce a trigger signal across said output terminals, and means responsive to a flashlamp igniting signal applied to said input terminals including said impedance for applying a signal to said switching means.

12. An electronic flash assembly for use with a photographic exposure control system of a variety having terminals energizable to ignite a flashlamp exhibiting a predetermined impedance characteristic when so ignited, comprising:

illumination generating means operative by switching actuation to generate, by gas discharge technique, an illuminational output;

impedance means having an impedance characteristic corresponding with said predetermined impedance characteristic and connectable in series circuit relationship with said exposure control system terminals; and

switching means operatively connected to said impedance means and responsive to said terminal energization when said impedance means is connected with said terminals for effecting said switching actuation of said illumination generating means.

13. The electronic flash assembly of claim 12 in which said switching means is present in solid state configuration and is gatable to effect said switching actuation of said illumination generating means.

14. The electronic flash assembly of claim 12 in which said switching means is present in solid state configuration and includes a gating input selectively connectable with said terminals, said switching means being gatable from said input upon the occurrence of said energization of said terminals.

15. The electronic flash assembly of claim 12 in which said switching means includes:

a switch actuable to carry out said generating means switching actuation; and

electromagnetic actuator means energizable in response to said terminal energization for actuating said switch.

16. An electronic flash unit for use with a flash camera having output terminals for producing a flashlamp igniting signal, comprising electronic flash discharge means having control terminals adapted to receive a trigger signal and discharge circuit means coupled to said control terminals for producing a flash of light in response to a trigger signal applied to said terminals, a pair of input terminals adapted to be connected to the flashlamp igniting terminals of the camera, impedance means simulating a flashlamp connected between said input terminals, and trigger signal producing means responsive to a flashlamp igniting signal applied to said input terminals for applying a trigger signal to said control terminals.

17. The apparatus of claim 16, in which said impedance means comprises a resistor, and in which said trigger signal producing means comprises an electronic switch having actuating terminals connected to said input terminals and load terminals connected to said control terminals.

18. The apparatus of claim 17, in which said electronic switch is a controlled rectifier.

19. The apparatus of claim 17, in which said electronic switch is a transistor.

20. The apparatus of claim 16, in which said trigger signal producing means is a relay having a winding connected to said input terminals and contacts connected to said control terminals.

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