

SPECIFICATION**Computer type electronic photoflash****Background of the invention**

This invention relates to electronic photoflash units used in photography as artificial light sources. More particularly, it relates to computer type electronic photoflash units having adapters which make it possible to use the photoflash units with photographic cameras for each of which an electronic photoflash of a special make and design previously had to be used to the exclusion of other electronic photoflashes.

Electronic photoflashes are becoming an almost indispensable accessory to a photographic camera. Formerly, the function of the electronic photoflash was simply to flash upon reception of a synchronization signal from the camera, and the connection between the camera and the electronic photoflash was used simply for conveying this synchronization signal. However, the functional relation between the camera and the electronic photoflash has become rather complex with the advent of electronic photoflash units as described in United States Patents 3,033,988 and 3,350,603, sometimes referred to as "computer" type electronic photoflash units. The computer type electronic photoflash is designed for automatically controlling the photoflash light quantity or volume as a function of the distance to the object being photographed. The control device is designed to terminate the light flash when the light reflected from the object as measured by a photometric circuit has attained a proper value. With the use of this computer type electronic photoflash, an optimum exposure can be obtained by simply adjusting a camera aperture to a value specified by the computer type electronic photoflash (hereafter referred to as the specified aperture). It is also proposed to provide computer type electronic photoflash units operating at a plurality of specified apertures. In this case, a change in the specified aperture requires a corresponding change in the photometric conditions of the computer type electronic photoflash. Therefore, the user is required to set the camera aperture to the prevailing photometric conditions whenever the photometric conditions are changed, a practice often forgotten by the user. It is highly desired that the photometric condition of the computer type electronic photoflash be switched automatically to an optimum one corresponding to the camera aperture setting or that, conversely, the camera aperture to be set to a proper value corresponding to the specified aperture of the computer type electronic photoflash. Moreover, since modern cameras often include photometric circuits themselves, if the photometric circuit of the camera is to be used for controlling the photoflash light volume of the computer type electronic photoflash, there is no necessity of changing the photometric conditions of the computer type electronic photoflash. To this end, the computer type electronic photoflash and the

camera must be matched with one another.

Combinations of computer type electronic photoflash units and cameras capable of automatically making the desired adjustments as described have been proposed in the art and are presently available on the market. The electronic photoflash units for use in such combinations are often referred to as "dedicated" units. However, the manners in which the cameras and the photoflash units are combined are often different for different cameras and for cameras of different manufacturers. The situation has arisen where different ones of the different major camera manufacturers have marketed cameras having different schemes for combining their cameras and photoflash units. Each different scheme results in a camera which either supplies to or requires from the photoflash unit different combinations of electrical signals representing different parameters. Thus, users who own cameras of different manufacturers making use of different combination schemes have in the past been required to purchase different flash units for each of the cameras. Moreover, photoflash manufacturers who desire to supply units useful with cameras of many different manufacturers have in the past faced the prospect of supplying different units for each scheme of combination, a practice which is rather uneconomical. Thus, it has become desirable to provide apparatus by which a single photoflash unit may be used in common with cameras making use of various different interconnection schemes between the camera and the photoflash unit.

It is thus an object of the present invention to reduce or eliminate the above inconveniences of the prior art.

It is another object of the invention to provide an electronic photoflash which can be used in common to the various versions of cameras manufactured by different manufacturers and having different schemes for combining the camera and photoflash unit.

According to a first aspect of the present invention, a computer type electronic photoflash comprises a computer type main photoflash unit having at least a discharge capacitor, a discharge tube operative to produce a light flash through discharge of electrical charges stored in said capacitor and components for controlling the photoflash light quantity from said discharge tube, and a plurality of adapters each connectible to said main photoflash unit and each capable of being mounted on a respective different type of photographic camera having a particular system for interconnecting a photoflash unit with the camera, each of said adapters having an electric circuit for transmitting electrical signals between it, the associated camera and the main photoflash unit, and each adapter having a photometric circuit operative when the light received by a photoelectric light receiving element has attained a predetermined value to actuate said components for controlling the photoflash light quantity from said discharge tube.

Thus, the parts necessary for flashlight emission and control of flashlight quantity comprise a main photoflash unit, and an adapter to be mounted on the photographic camera is provided for each camera type, a complete photoflash unit being provided by connecting one of the adapters to the main photoflash unit. Each such adapter has an electric circuit required to adapt the main photoflash unit to the camera intended for use with that adapter. The connection between the main photoflash unit and the adapter may be so designed that the main unit is provided with plural sockets and the adapter is provided with projecting connection terminals that may be introduced into selected sockets of the main unit. Alternatively, such connection may be made by connecting cables. In the latter case, connector means are preferably provided to at least the main unit for connecting or disconnecting the connection cables.

According to a second aspect of the present invention, there is comprised a plurality of adapters for use with a computer type electronic photoflash comprising a computer type main photoflash unit having at least a discharge capacitor, a discharge tube operative to produce a light flash through discharge of electrical charges stored in said capacitor and components for controlling the photoflash light quantity from said discharge tube, said adapters each being connectible to said main photoflash unit and to a respective different type of photographic camera having a particular system for interconnecting a photoflash unit with the camera, each of said adapters having an electric circuit for transmitting electrical signals between it, the associated camera and the main photoflash unit; and each adapter having a photometric circuit operative when the light received by a photoelectric light receiving element has attained a predetermined value to actuate said components for controlling the photoflash light quantity from said discharge tube.

Figure 1 is a front view showing a preferred embodiment of the present invention with three different cameras and their corresponding adapters two of which are of a form as contemplated by this invention;

Figure 2 is a schematic diagram of the main photoflash unit of the embodiment of Figure 1;

Figures 3, 4 and 5 are block diagrams of exemplary adapters of the embodiment of Figure 1;

Figure 6 is an exploded perspective view of a modified embodiment which is not in accordance with the present invention with three different photographic cameras and their corresponding adapters;

Figure 7 is a schematic diagram of the main photoflash unit of the embodiment of Figure 6; and

Figures 8, 9 and 10 are schematic diagrams of exemplary adapters of the embodiment of Figure 6.

Referring first to the embodiment of Figures 1

to 5, a computer type main electronic photoflash 10 has a circuit for photoflash emission and photoflash light quantity control, and connection terminals for electric connection with adapters 11, 12 and 13. The electric circuit of the main photoflash unit is shown diagrammatically in Figure 2. To a discharge capacitor 14 is connected in parallel a series circuit consisting of a discharge tube 15 and a silicon controlled rectifier (SCR) 16 as photoflash emission control element. A circuit for discharging of the discharge tube 15 is conventional per se and consists of a trigger capacitor 17, a trigger transformer 18 and another SCR 19. A synchronization signal from the camera is applied to the gate of the SCR 19 which is thereby rendered conductive for applying a high voltage pulse to the trigger electrode of the discharge tube 15 for discharging it. The SCR 16 is rendered conductive by the discharge of the tube 15 for continued discharge of the tube 15. A conventional photometric circuit 20 is so connected that its operation may be started by a voltage produced at a Zener diode during discharge of the discharge tube 15. A circuit consisting conventionally of another SCR 21 and a commutating capacitor 22 operates in response to the photometric circuit 20 to render the SCR 16 nonconductive thus stopping the discharge of the discharge tube 15. Thus, SCR's 16 and 21 and commutating capacitor 22 constitute the photoflash light quantity control elements or circuit in the embodiment described for terminating discharge of the tube 15 and of the emitted light, whereas capacitor 17, transformer 18, and SCR 19 and their associated elements constitute the photoflash emission elements or circuit for initiating discharge of the tube 15 and the emitted light. The output of the photometric circuit 20 is connected, via a change-over switch 23 (shown making this connection), to the gate of the SCR 21 for activating the SCR 21. The switch 23 is changed over from the circuit 20 when an adapter to be later described comes into use. In some embodiments of this invention where there is no need for the main photoflash unit to be independently operable without an adapter, the photometric circuit 20 and switch 23 may be omitted. The main photoflash unit 10 has four terminals J, K, L and M wherein J denotes a terminal connected to a positive voltage source for charging capacitor 14, K a ground (earth) terminal, L a terminal connected to the gate of the SCR 21 when the switch 23 is changed over, and M a synchronization terminal. A photographic camera A is manufactured by a company A' wherein the shutter speed is automatically set to a synchronization speed when the discharge capacitor is sufficiently charged when the voltage across it exceeds a predetermined level, and the aperture of the camera is automatically set by changing to the aperture specified by the computer type electronic photoflash. To this end, a shoe of the camera A has two terminals in addition to ground (earth) and synchronization terminals. Thus, as

shown in Figure 3, a foot 11X of the adapter 11 has four terminals H₁, H₂, H₃, and H₄ for mating with the corresponding four terminals on camera A and for connection to an electric circuit *a*. The terminal H₁ is the ground (earth) terminal and the terminal H₂ is the synchronization terminal. Two of the adapters 11 and 12 of the present embodiment have a photometric circuit 24 similar to the circuit 20. By virtue of this circuit 24, the combination of the present main photoflash unit 10 and the adapter may be used as computer type electronic photoflash fitted with a remote sensor i.e. other than that which may be associated with the circuit 20.

Thus, the adapter 11 has a light-receiving window 11Y through which it receives light reflected from the subject being photographed. The numeral 11Z denotes a dial for changing the specified aperture. This dial may be turned manually for changing the density of a filter arranged in front of a light receiving element positioned for receiving the light through the window 11Y and changing the photometric conditions of the photometric circuit 24, as disclosed in United States Patent Specification No. 3,769,888. The circuit 24 has terminals J', K', L' and M' for connection to the terminals J, K, L and M of the main photoflash unit 10. The electric circuit *a* has a switching circuit operative for providing an approximately ground (earth) potential at the terminal H₃ when the voltage across the discharge capacitor 14 has reached a predetermined value, and a circuit operatively associated with rotation of the dial 11Z for providing a corresponding voltage level to the terminal H₄. The terminal H₃ is used for changing the shutter speed of the camera A to the synchronization speed, while the terminal H₄ controls the aperture of the camera A, as disclosed in the Japanese Provisional Publication No. 147937/1975.

A camera B is manufactured by a company B' and has on its shoe a ground terminal, a synchronization terminal, and a further terminal for application of a series of pulses for bringing the shutter speed to a synchronization speed when the discharge capacitor is sufficiently charged, as described in the Japanese Provisional Publication No. 17331/1978. Thus, the adapter 12 as shown in Figure 4 has on its foot a third terminal H₅ and also an electric circuit *b* designed as a pulse generating circuit that operates when the voltage across the discharge capacitor 14 has reached a predetermined value. The output of the pulse generating circuit is applied to the terminal H₅. In addition, the adapter has a photometric circuit 24 and a light-receiving window 12Y for the light receiving element of the circuit 24, as in the case of the adapter 11.

A camera C is manufactured by a company C' and has on its shoe a third terminal so that a third terminal H₆ is provided on the foot of adapter 13 as shown in Figure 5. Contrary to the cameras A and B, camera C provides to the terminal H₆ an output from the photometric circuit inside the

camera, as described in the Japanese Patent Publication Nos. 28569/1977 and 28570/1977. Thus, the electric circuit *c* of the adapter 13 as shown in Figure 5 may simply be designed for applying its output to the terminal L', but when so designed would not embody the present invention. In actuality, the signal from the camera is more negative than the earth or ground potential, so the signal is converted into a positive voltage signal and applied to the terminal L'.

Thus, one who has purchased a camera A may purchase the main photoflash unit 10 and an adapter 11; one who has purchased a camera B may purchase a main photoflash unit 10 and an adapter 12; and one who has purchased a camera C may purchase a photoflash proper 10 and an adapter 13. In this way, a single main photoflash unit may be used for a variety of photographic cameras by selecting an adapter suited for the camera.

Figure 6 shows a modified arrangement wherein the main photoflash unit is connected directly to the adapter. The main photoflash unit diagrammatically illustrated at 30 has photoflash emission elements responsive to a synchronization signal from the camera for commencing a flash, and photoflash light quantity control elements for terminating the flash, as in the case of the preceding embodiment. In this embodiment which is not in accordance with the invention, all the circuits and components necessary for serving as a computer photoflash unit are incorporated in the main photoflash unit 30. This electronic photoflash can be switched between two aperture values, as desired. The outer casing of the main photoflash unit on the main photoflash unit 30 itself has a plurality of sockets or connectors 31 all of which are separately indicated in Figure 6 by lower case alphabetical letters *e-i* and *k* except reserve ones. Eleven sockets or connectors are provided in the present embodiment, including four reserve sockets.

Three adapters 32, 33 and 34 are provided for mounting to this main photoflash unit 30 and connecting it to one of the cameras A, B or C. Contrary to the preceding embodiment, no photometric circuits are provided in these adapters which operate simply for relaying of electrical signals between the main photoflash unit 30 and the cameras A, B or C although perhaps converting those electrical signals into a different form. The adapters 32, 33 and 34 are used with the cameras A, B and C, respectively. Each of these adapters has a foot 35 of the same shape for mounting to a camera accessory shoe and the lower surface of the foot 35 has terminals, not shown, but of the same form as shown in the corresponding Figures 3—5, for contacting with terminals provided at the shoe of the associated camera. The terminals on the shoes and feet serve for conveying electrical signals between each camera and each adapter associated therewith. On the mounting surface of each adapter to the main photoflash unit 30 there

are provided connection terminals 37 that may be selectively inserted into the sockets 31 on the main photoflash unit 30.

Six connection terminals 37*d*, 37*e*, 37*f*, 37*g*,

37*h* and 37*i* are provided on the adapter 32.

These terminals are introduced into the sockets 31 on the photoflash proper 30 bearing the corresponding alphabetical letters. Among these terminals *d* denotes a ground (earth) terminal, *e* a synchronization terminal, *f* a terminal connected to the positive side of an electrical source battery in the main photoflash unit, *g* a terminal for supplying a signal indicative of completion of charging of the main discharge capacitor, and *h* and *i* denote terminals for providing aperture information. The photoflash proper 30 has two specified apertures, as stated above, designed for being switched by an aperture selection switch.

This selection switch is operatively connected with the terminals *h* and *i* for producing predetermined circuit conditions at these terminals for controlling the aperture of camera A through the terminal provided on the foot 35.

The adapter 34 has three connection terminals 37*d*, 37*e* and 37*k*. The terminals 37*d* and 37*e* are used for the same purpose as indicated above for the adapter 32, while the terminal 37*k* is used for conveying a signal from a photometric circuit, not shown, inside the camera C to the control elements inside the main photoflash unit 30 through the receptacle *k* for controlling the flash quantity.

The adapter 33 has four terminals 37*d*, 37*e*, 37*f* and 37*g* that may be used for the same purpose as described with reference to the adapter 32. There is provided in this adapter 33 a circuit designed for receiving a signal indicative of completion of the main capacitor charging and supplying a series of pulses of a predetermined cycle to a circuit inside the camera B.

Thus, if the adapter 32 is mounted to the photoflash proper 30, the adapter 32 and the main photoflash unit 30 are connected to each other electrically through the sockets 31 and the terminals 37 so as to be used as a photoflash source for camera A. The adapters 33 and 34 may be used in the similar manner. An adapter provided with only connection terminals 37*d* and 37*e* may be used advantageously for cameras of the common type wherein the camera merely provides a contact closure between the synchronization terminal and ground (earth) to commence the operation of the computer photoflash unit.

There is shown in Figure 7 a schematic diagram of the circuitry of the main photoflash unit 30 and in Figures 8—10 schematic diagrams of the adapters 32—34, respectively. The sockets *d-i* and *k* of Figure 6 are connected to the circuit of Figure 7 at the points bearing the corresponding reference letters, and the circuit points of Figures 8—10 corresponding to terminals *H₁*—*H₆* of Figures 3—5 are correspondingly indicated. The circuit of photoflash unit 30 includes many components

which are similar in description and operation to similarly numbered components of Figure 2 and the description thereof will not be repeated.

Figure 7 additionally shows a battery 50, a d.c. to d.c. converter circuit 51, and a diode 52 for developing a potential across the capacitor 14 which is much higher than the battery potential, as well as a neon glow tube 53 and an associated resistor network for developing a positive potential at terminal *g* with respect to ground (earth) terminal *d* in response to capacitor 14 becoming fully charged. The circuit of Figure 7 also includes a polarity converting circuit 41 to convert the flash termination circuit at terminal *k* to the polarity required to properly operate SCR 21 and a switch 54 for alternatively closing or opening the circuit between sockets *h* and *i* depending upon which aperture is selected, or alternatively coupling socket *i* to ground (earth). A capacitor 40 between the Zener diode and the transformer 18 is also shown.

The capacitor 40 is also connected between terminal *e* and the cathode of SCR 19 for triggering SCR 19. When the voltage across capacitor 14 reaches a predetermined value, the neon lamp 53 switches on and causes the capacitor 40 to charge. The charge on capacitor 40 discharges through terminal *e*, terminal *d*, the gate of SCR 19 and the cathode of SCR 19 when the shutter of a camera to which the unit is mounted opens. When mounted on a camera, the terminals *d* and *e* connect to the synchroswitch within the camera via terminals *H₁* and *H₂*, which synchroswitch closes when the camera shutter opens. When the SCR 19 switches on, the flash tube 15 will discharge in a manner similar to the flash tube 15 of Figure 2. The capacitor 40 is thus provided to trigger the discharge of the flash tube 15.

The circuitry of adapter 32 shown in Figure 8 includes a transistor 61 for converting the signal present at circuit point *g* to the polarity required at terminal *H₃*. An amplifier 62 is also included for developing one of two different potentials at terminal *H₄* corresponding to the aperture selected by the user through operation of switch 54 (Figure 7) in the main photoflash unit 30 to either open or close the circuit between terminals *h* and *i*. If switch 54 is operated to connect terminal *i* to terminal *d*, i.e. to earth or ground, then only a ground level potential will be present at terminal *H₄*.

The circuitry of the adapter 33 shown in Figure 9 includes transistors 63—66 and amplifier 67 to generate a pulse signal of the nature (waveform) there shown in response to a positive potential at terminal 37*g* for application through terminal *H₅* to camera B. That pulse signal is terminated when the connection between terminals *H₁* and *H₂* is closed by the synchronisation circuit of camera C at the time a photograph is taken.

The circuitry of the adapter 34 as shown in Figure 10 simply consists of direct electrical connections from each of terminals 37*d*, 37*e* and 37*k* to terminals *H₁*, *H₂* and *H₆* respectively. It

should be apparent that the circuits of Figures 8 to 10 could be used as the circuits *a-c*, respectively, of adapters 11 to 13 of Figures 3 to 5 when used with a main photoflash unit 10 having the circuitry of Figure 7.

Thus, according to the present invention, the main photoflash unit may be used with a variety of different photographic cameras by simply replacing the adapters, so that the overall cost may be lowered. The user may simply purchase a new adapter when purchasing a different photographic camera. According to the present invention a photometric circuit and a circuit for signal relaying with the camera are provided inside each adapter. Thus, only the components for photoflash emission and photoflash light quantity control need be contained inside the main photoflash unit.

While only one embodiment of this invention has been disclosed, it is to be understood that this invention is not limited thereto but further includes that which falls fairly within the following claims.

Claims

1. A computer type electronic photoflash comprising a computer type main photoflash unit having at least a discharge capacitor, a discharge tube operative to produce a light flash through discharge of electrical charges stored in said capacitor and components for controlling the photoflash light quantity from said discharge tube, and a plurality of adapters each connectible to said main photoflash unit and each capable of being mounted on a respective different type of photographic camera having a particular system for interconnecting a photoflash unit with the camera, each of said adapters having an electric circuit for transmitting electrical signals between it the associated camera, and the main photoflash unit; and each adapter having a photometric circuit operative when the light received by a photoelectric light receiving element has attained a predetermined value to actuate said components for controlling the photoflash light quantity from said discharge tube.

2. A computer type electronic photoflash as claimed in claim 1, wherein the computer type main photoflash unit and an adapter are connectible to each other by connecting means whereby they may be connected both mechanically and electrically.

3. An electronic photoflash as claimed in claim 2, wherein the connecting means comprise a plurality of sockets provided on the main photoflash unit and connection terminals provided on each adapter and capable of being introduced into selected ones of said sockets.

4. An electronic photoflash as claimed in claim 1, wherein the computer type main photoflash unit and a said adapter are connectible by means of electrical cords (leads).

5. A plurality of adapters for use with a computer type electronic photoflash comprising a computer type main photoflash unit having at least a discharge capacitor, a discharge tube operative to produce a light flash through discharge of electrical charges stored in said capacitor and components for controlling the photoflash light quantity from said discharge tube, said adapters each being connectible to said main photoflash unit and to a respective different type of photographic camera having a particular system for interconnecting a photoflash unit with the camera, each of said adapters having an electric circuit for transmitting electrical signals between it, the associated camera, and the main photoflash unit; and each adapter having a photometric circuit operative when the light received by a photoelectric light receiving element has attained a predetermined value to actuate said components for controlling the photoflash light quantity from said discharge tube.

6. A photoflash according to claim 1, substantially as herein described with reference to and as shown in the Figures 1 to 4 or Figure 7.

7. A plurality of adapters according to claim 5, wherein one of the adapters is substantially as herein described with reference to and as shown in Figure 3 or 4.

should be apparent that the circuits of Figures 8 to 10 could be used as the circuits a-c, respectively, of adapters 11 to 13 of Figures 3 to 5 when used with a main photoflash unit 10 having the circuitry of Figure 7.

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2. A computer type electronic photoflash as claimed in claim 1, wherein the computer type main photoflash unit and an adapter are connectible to each other by connecting means whereby they may be connected both mechanically and electrically.

3. An electronic photoflash as claimed in claim 2, wherein the connecting means comprise a plurality of sockets provided on the main photoflash unit and connection terminals provided on each adapter and capable of being introduced into selected ones of said sockets.

4. An electronic photoflash as claimed in claim 1, wherein the computer type main photoflash unit and a said adapter are connectible by means of electrical cords (leads).

5. A plurality of adapters for use with a computer type electronic photoflash comprising a computer type main photoflash unit having at least a discharge capacitor, a discharge tube operative to produce a light flash through discharge of electrical charges stored in said capacitor and components for controlling the photoflash light quantity from said discharge tube, said adapters each being connectible to said main photoflash unit and to a respective different type of photographic camera having a particular system for interconnecting a photoflash unit with the camera, each of said adapters having an electric circuit for transmitting electrical signals between it, the associated camera, and the main photoflash unit; and each adapter having a photometric circuit operative when the light received by a photoelectric light receiving element has attained a predetermined value to actuate said components for controlling the photoflash light quantity from said discharge tube.

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