

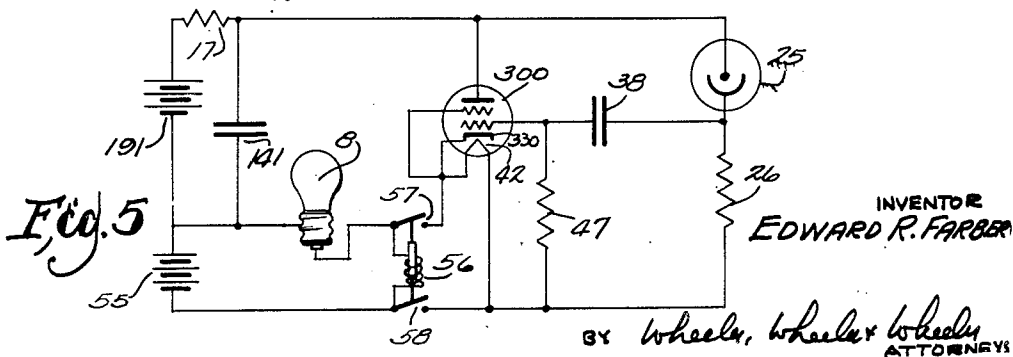
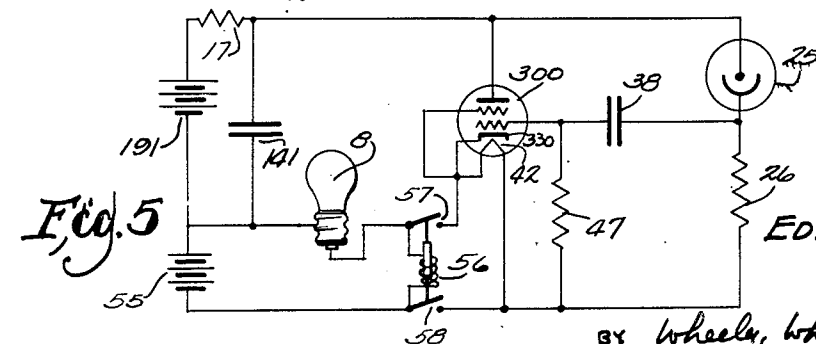
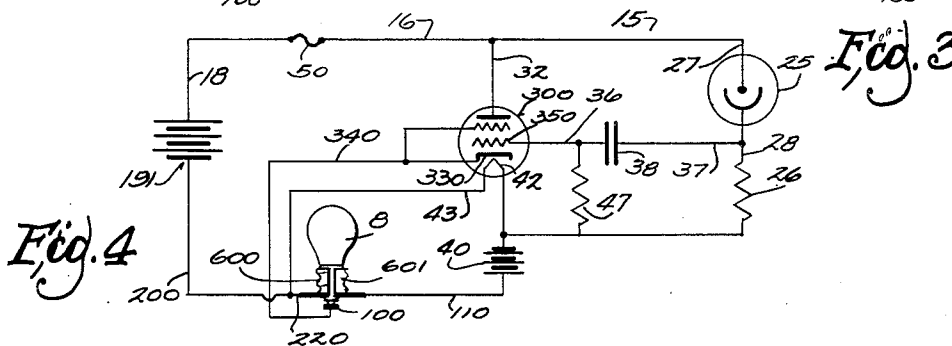
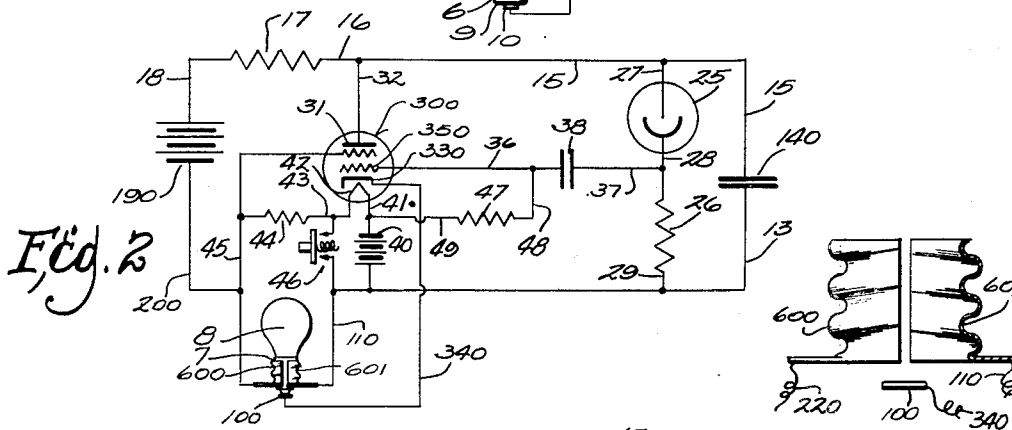
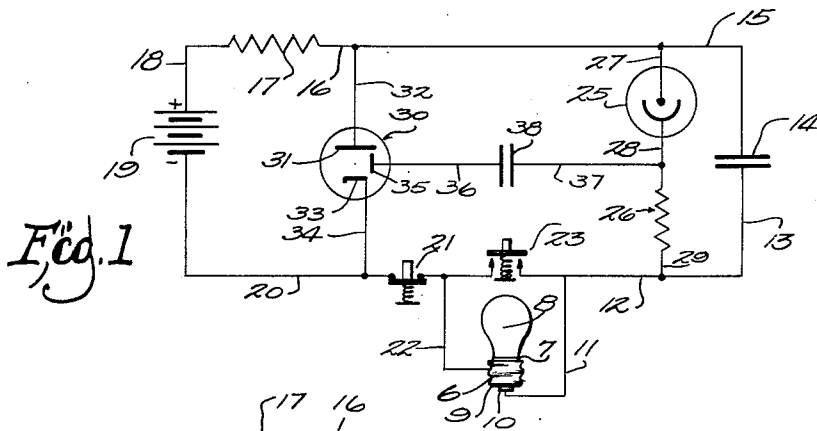
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REMOTELY CONTROLLED FLASH UNIT

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REMOTELY CONTROLLED FLASH UNIT

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This invention relates to improvements in remotely controlled flash units. It has particular application to the so-called slave unit employed to fire one or more flash bulbs for photographic purposes subject to remote control by radiant energy. In the preferred embodiment of the invention, the radiant energy may comprise light from a master flash unit, but the art has recognized high frequency radio waves and other forms of radiation as equivalent to radiant light energy in the operation of a slave unit. Consequently, while the present invention will be described with reference to its preferred light-operated embodiment, it will be understood, without further mention herein, that the present invention resides in the slave unit irrespective of the form of energy by which it is controlled and, where reference is made to a photoelectric tube or cell, it is intended to include as an equivalent, apparatus appropriate for the reception and use of forms of radiant energy other than light.

The present invention has several important objectives:

In the first place, the slave unit to which this invention preferably pertains is one rendered highly portable by the use of batteries as a source of electrical energy for its operation. A primary object of the invention is to protect and conserve the battery both before and after the flash lamp is fired by providing means whereby, without any conscious attention on the part of the operator, the battery circuit will be open until the flash lamp is inserted in the socket and will be re-opened automatically as soon as the flash lamp fires, or at least as soon as the burned out tube is removed from its socket. The arrangement not only conserves battery energy, but also protects the apparatus, which uses a gaseous tube or thyratron as a trigger tube for releasing the energy necessary to fire the flash lamp.

The grid of a gas filled tube is able to exert control over the flow of current only up to the time when the tube fires. Thereafter, unless the circuit is broken elsewhere, current will continue to flow through the tube, this characteristic being particularly apparent where, as is the case in the preferred battery power apparatus, direct current is used. By the arrangement of the present invention, which automatically, or without special attention, opens the circuit, the thyratron, as well as the battery, is protected against damage such as might occur if uncontrolled current flow were to continue. I shall disclose a number of different species of devices for automatically opening the circuit either immediately upon the

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firing of the lamp or as a consequence of the removal of the fired lamp from its socket.

In the second place, it is an important object of the invention to provide a slave unit for the control of a flash lamp with means so regulating the firing of the trigger tube that it will be fired only by an extremely sharp radiant impulse. This feature of the invention has particular reference to the preferred embodiment where light is used as the radiant energy for controlling the unit. But for the regulating feature to which the present object pertains, the slave unit might be caused to operate if carried past a lamp or a window, or it might even be operated by the movement of a shadow with respect to its receiving photocell.

Other objects will be more apparent from an analysis of the following disclosure of my invention. In the course of this analysis, the term "flash lamp" is used to designate any of the photoflash bulbs commonly used in photography and described, for example, in issue 28 of "The Complete Photographer," published June 20, 1942, by National Educational Alliance, Inc., Chicago, Illinois. Such a lamp comprises a bulb containing aluminum wire or leaf foil and oxygen. The lamp has a conventional base with a shell and center contact connected within the bulb by a small filament covered with a primer which will flash and ignite the foil when the filament is heated by an adequate electric current. The trigger tube or thyratron may be of the type described in the publication "Introduction to Electronics," Educational Bulletin No. 8, copyright 1945, by Allis Chalmers Manufacturing Co. It is a gas-filled electronic tube having a grid, a plate or anode and a hot or cold cathode.

In the drawings:

Fig. 1 is a circuit diagram of an embodiment of my invention.

Fig. 2 is a circuit diagram of a modified embodiment of my invention.

Fig. 3 is an enlarged fragmentary detail view in side elevation diagrammatically showing a lamp socket used in the device of Fig. 2.

Fig. 4 and Fig. 5 are circuit diagrams illustrating further modified embodiments of my invention.

Since the underlying purpose of providing a self-contained slave flash unit is to have such a unit which is small, compact and light in weight, the construction shown in Fig. 1 is often preferred because of its simplicity. There is a socket element 6 screw-threaded to receive the conventional shell 7 of the base of the flash

lamp 8. The socket is provided with the conventional insulation at 9 for the center contact 10 with which the central electrode of the lamp engages when the lamp is in place in the socket as shown.

The central contact 10 is connected by conductors 11, 12, 13 with one side of a condenser 14 which, for example, may have a capacity of 8 mfd. The other side of the condenser is connected by conductors 15, 16 through resistance 17 and conductor 18 with battery 19. The resistance 17 may have a value on the order of 50,000 ohms. The battery 19 preferably has its positive terminal connected with resistance and may be capable of supplying 90 to 135 volts. The negative side of the battery connects through conductor 20, normally closed switch 21, and conductor 22 with the socket shell 6.

Another switch, 23, normally open, may be shunted across the socket.

The photocell 25 and resistance 26 are connected in series by conductors 27, 28, 29 across the condenser 14. Likewise connected across condenser 14 is the trigger tube or thyatron 30, whose anode 31 is connected by conductor 32 to conductor 15 and whose cathode 33 is connected by conductor 34 to conductor 20. The grid 35 of the thyatron trigger tube is connected by conductor 36 and conductor 37 through a condenser 38 to conductor 28 which intervenes between the photo-electric tube 25 and the resistance 26. The condenser 38 preferably has a value of approximately .002 mfd. This value is fairly critical, whereas the values of the other elements above described are rather uncritical. I find with regard to condenser 38 that a value of .05 is too large, allowing slow variations of light intensity to trip the thyatron, and a value of .0005 is too small, although earlier photoflash lamps have steep enough curves to operate a thyatron even with a condenser as small as .0005. For the photoflash lamps currently in use, therefore, the condenser shown at 38 should preferably have a capacity between .007 mfd. and .04 mfd., a capacity of .002 mfd. being right.

It will be noted to be a feature of the embodiment above described that there are two separate circuits, both of which are connected through the socket for the flash bulb. One of these is the battery circuit to the condenser and the other is the circuit by means of which the condenser is discharged to flash the bulb.

The high resistance at 17 positively precludes any flow of battery current through the thyatron trigger tube 30. However, it would permit flow of battery current slowly through the photo-electric cell 25 but for the fact that when there is no flash bulb in the socket, the circuit through the photocell 25 from battery 19 is open.

The act of inserting the flash bulb 8 in the socket closes through the filament of the bulb a circuit between the socket shell 6 and center contact 10. This permits the battery to charge the condenser at 14. The resistance at 17 precludes any flow of current heavy enough to heat the filament of the flash bulb to the firing point, while still permitting a trickle charge into the condenser.

When the condenser is charged, any light falling on the photocell 25 will tend to establish a flow of current between the electrodes of that cell. When the light falling on the cell is sharply varied, the resulting impulse will tend to fire the thyatron trigger tube 30, but if the impulse is not too rapid, it will bleed off through the re-

sistance 26. This eliminates the danger that the flash tube 8 may be fired prematurely by the light and shadow of persons passing the photocell, or by carrying the portable slave unit past an open window. However, when the light of the flash of a master unit falls on the photocell, the energy impulse is so abrupt as to create a current incapable of bleeding off through the resistance 26 but of sufficiently high frequency to traverse readily the condenser 38 to the grid 35. This ionizes the gas of the thyatron trigger tube. The condenser 14 thereupon discharges through such tube and through the filament of flash bulb 8 to fire the flash bulb.

The high resistance at 17 causes the thyatron to extinguish itself immediately when the current from the condenser has been discharged. The burning out of the filament of flash bulb 8 has reopened the circuit between the battery and the condenser and between the battery and the photo-electric cell. Thus, the battery is automatically protected against any further discharge whatever.

The switches shown at 21 and 23 are safety switches. Opening the switch at 21 or closing that at 23 will, in either case, prevent the accidental firing of the photo-tube while the operator still has it in his hand. Either of these switches may be used alone, but both may be present in the circuit if desired. The difference between them lies in the fact that it is sometimes desirable to set the slave unit in operation with a minimum of time lost and, on such occasions, it is desirable to use a switch located as at 23 so that the closing of the switch will not only short circuit, and thereby protect, the flash bulb, but will permit the starting of the charging of the condenser at 14.

The values of the condenser and the battery and the thyatron are related. If the trigger tube has a high voltage drop, the voltage of the battery will have to be high. The energy storage in the condenser 14 must be great enough to fire the flash lamp, but its actual size will depend on the voltage of the battery and the voltage drop of the thyatron.

In the embodiment just disclosed, the thyatron trigger tube was shown using a cold cathode. A hot cathode trigger tube may also be used and a disclosure of such a tube is made in Fig. 2. Fig. 2 further modifies the arrangement shown in Fig. 1. In Fig. 2, as in Fig. 1, the insertion of the flash bulb closes the circuit but this is done in a different manner in Fig. 2 and one result of the modified arrangement lies in the fact that the reopening of the circuit depends, not upon the firing of the flash bulb, but upon its withdrawal from the socket.

Fundamentally, the circuit of Fig. 2 is very similar to that of Fig. 1. There is a battery at 190 connected by conductor 18 with a resistance 17 which may be assumed to be identical with that of Fig. 1. Thence the same conductors 16, 15 lead to the condenser here designated 140. The photocell 25 and resistor 26 are connected across condenser 140 by conductors 27, 28, 29, 13, exactly as in Fig. 1. From a point between the photocell 25 and resistance 26, conductor 37 leads to condenser 38, which is connected by conductor 36 with the grid 350 of a hot cathode thyatron trigger tube 300. The anode 31 is connected by conductor 32 to conductor 15. The cathode 330 is connected by conductor 340 to the central contact 100 of a special split socket shown in detail in Fig. 3. The shell of the socket is divided into

component parts 600, 601 which are insulated by spacing them apart, the threads of one element being complementary to the threads of the other so that the base of the flash bulb 8 may be screwed into the socket exactly as if the elements 600, 601 were integral.

One of the socket shell elements 600 is connected by conductor 220 and conductor 200 to the battery 190. The other socket shell element 601 is connected by conductor 110 to the positive terminal of a filament heating battery 40, the negative terminal of which is connected by conductor 41 with the filament 42 which heats the cathode 330 of the thyatron trigger tube 300. The other side of the filament is connected by conductor 43 through a thyrite resistance 44 and conductor 45 to the conductor 220 and thence through the normally open socket circuit back to the filament heating battery 40. A normally open safety switch 46 is shunted between conductor 43 and conductor 110 across the resistance 44 and the normally open socket to close the filament heating circuit. In order to keep the grid 350 normally negative, I may connect the grid resistor 47 between the grid and the negative side of battery 40. This is done by conductor 36, conductor 48 and conductor 49.

The grid resistor 47 may have a value of 10 meg. The battery 190 may be 45 to 90 volts. The condenser 140 may have a capacity of 1 mfd. The filament battery 40 may be a six volt battery. The resistance 17 may be 50 000 ohms as already described. The condenser 33 is preferably .02 mfd. and must be within the approximate range already described. The resistor 26 may be 20 meg. as already described, or may be as small as 10 meg. if desired. The thyrite resistor at 44 is a type of resistance which decreases rapidly as the applied voltage rises. It is intended to bypass any voltage surge.

In general, this circuit operates in much the same manner as that shown in Fig. 1. Specifically, the control circuit does not need to be completed through the filament of flash bulb 8, but is completed circumferentially of the base of the bulb between the component socket shell parts 600, 601, when the bulb is inserted in the socket. Insertion of the bulb closes the filament heating circuit and enables the current from the filament battery 40 to heat the filament 42. Insertion of the bulb also closes the circuit which enables the battery 190 to charge the condenser 140. Both of these circuits are completed through the shell portions of the bulb base without involving any interior circuit through the flash bulb itself. Additionally, as will be obvious, the insertion of the bulb in the socket further completes the firing circuit between the central electrode of the bulb base and the central contact 130 of the socket, this circuit including the anode and cathode of the trigger tube and the storage condenser 140.

The actual firing of the trigger tube and flash bulb occurs as already described, when energy radiation is received in such intensity that it cannot leak off through resistor 26 and will pass condenser 33 to affect the grid 350.

The firing of the flash bulb still leaves the filament heating circuit closed circumferentially of the bulb base, but the removal of the bulb from the socket reopens all circuits.

Fig. 4 shows a simplified version of the embodiment of Fig. 2, requiring no storage condenser. The battery 191 is relied upon to supply all energy required to fire the trigger tube 300. To protect the thyatron from continued high

current flow in the case of defective or shorted lamps, a fuse 50 is used. The circuit demonstrates that the resistor 17 and various other components may be eliminated.

The embodiment shown in the circuit of Fig. 5 is similar to that at Fig. 1 in that the current which affects the control of the apparatus flows through the filament of the flash bulb 8. In this instance, the insertion of the bulb closes a circuit between a relay battery 55 and a relay winding 56 to close relay switches 57, 58. The closing of switch 58 enables the battery 55 to energize the filament 42 for heating the hot cathode 330. The closing of switch 57 is also essential to complete the filament circuit, but it is also essential to connect the flash bulb 8 operatively across the condenser 141. In this instance, the condenser is so disposed as to be permanently charged by the battery 191 at the moment following discharge through the flash bulb. The condenser portion is interchangeable as between the arrangement shown in Figs. 1 and 5, that shown in Fig. 1 being preferred for reasons already described and that shown in Fig. 5 being merely illustrative of a possibility within the scope of the invention. So far as the relay is concerned, it will be obvious to those skilled in the art that this circuit is fully equivalent to that shown in Fig. 1, inasmuch as it merely does through a relay what Fig. 1 accomplishes by direct connection. In both instances, the battery circuit for possible discharge through the photo-electric cell is opened automatically by the firing of the bulb. The circuit remains open until a new bulb is inserted, thereby energizing the filament of the thyatron and completing the battery circuit through the photo-cell.

While, as above stated, the invention preferably finds its embodiment in a slave unit for photo-flash purposes, it will be apparent that many of the features of my invention are of general application in other slave units, wherever any actuated device requiring a predetermined value for its operation may, merely by being connected into the circuit, pass sufficient current through a secondary circuit for control purposes.

I claim:

1. In a flash-bulb firing system, a capacitance, a charging circuit comprising a voltage source in series with the capacitance, a discharging circuit, comprising a firing switch means and at least two terminals in series with the capacitance, the terminals being adapted for connection to the igniting element of a flash-bulb, a control circuit for controlling the firing switch means comprising a radiant energy responsive means in series with the voltage source, and circuit closing means in the said control circuit, the circuit closing means comprising means to complete the control circuit only when a flash-bulb is connected with at least one of the said terminals, whereby current drain through the control circuit is prevented when no flash-bulb is connected to the said one terminal.

2. In a flash-bulb firing system, a capacitance, a charging circuit comprising a voltage source and at least two terminals in series with the capacitance, a discharging circuit comprising a firing switch means and the said terminals in series with the capacitance, the terminals being adapted for connection to the igniting element of a flash-bulb, a control circuit for controlling the firing switch means comprising a radiant energy responsive means in series with the volt-

age source, and circuit closing means in the control circuit, the circuit closing means comprising means to complete the control circuit only when a flash-bulb is connected with at least one of the said terminals, whereby current drain through the control circuit is prevented when no flash-bulb is connected to the said one terminal.

3. In a flash-bulb firing system, a capacitance, a charging circuit comprising a voltage source and at least two terminals in series with the capacitance, a discharging circuit comprising a firing switch means and the said terminals in series with the capacitance, the terminals being adapted for connection to the igniting element of a flash-bulb, a control circuit for controlling the firing switch means comprising a radiant energy responsive means in series with the voltage source, and circuit closing means in the con-

trol circuit, the circuit closing means comprising the said two terminals, whereby all current drain is prevented when no circuit exists between the said terminals.

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