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CARRIER CURRENT CONTROL SYSTEM FOR ELECTRONIC FLASH UNITS

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Fig. 1.

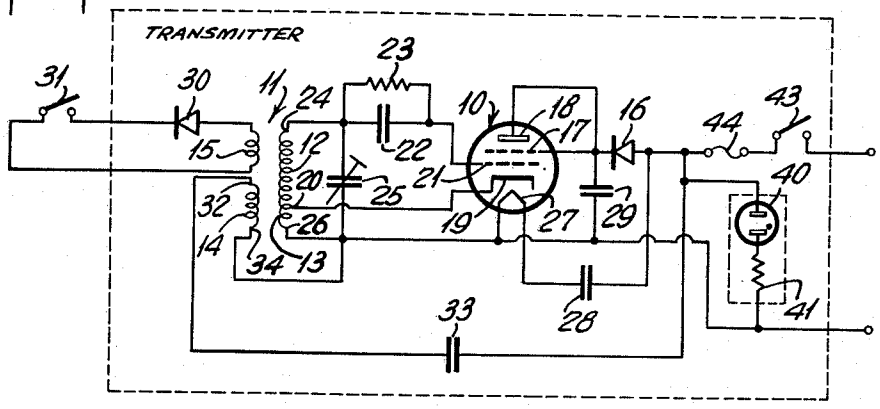
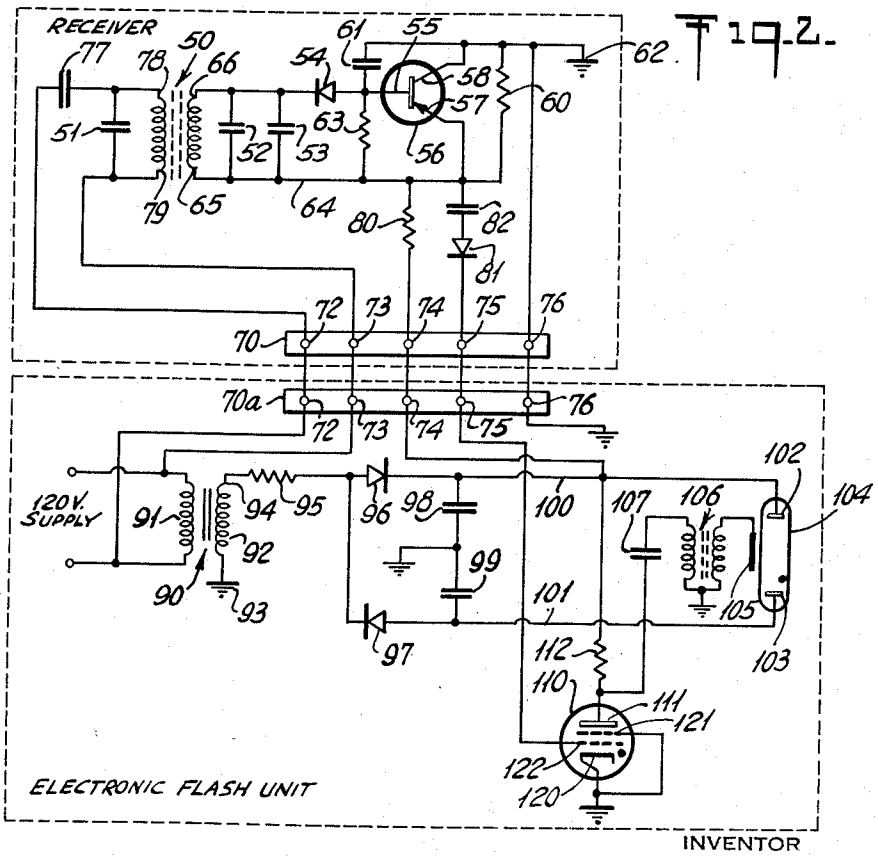


Fig. 2.



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CARRIER CURRENT CONTROL SYSTEM FOR ELECTRONIC FLASH UNITS

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The present invention relates to electric systems and more particularly to a carrier current control system for triggering electronic flash units.

In the use of electronic flash units for photographic illumination, it is often desirable to place the flash units at positions remote from the camera. Such units have been heretofore triggered by phototubes responsive to a flash at the camera, or connected by the use of sync cords. It has been found that the wiring for the sync cords has been cumbersome and time consuming to position. The phototubes have not operated satisfactorily when remotely positioned from the main flash because of the low light level. Also persons or objects have blocked the transmission of light to the phototubes. Further, the operation of the phototubes has not been wholly satisfactory as they become aged.

In order to overcome these difficulties radio frequency control has been used. However, because of static and other interference, and because of the governmental restrictions on use of radio equipment such equipment has not been used to any great extent.

The present invention aims to overcome the foregoing difficulties and disadvantages by providing a carrier current control system for the remote units and in which a carrier current signal is continuously transmitted, the transmitted signal being interrupted when the camera shutter is operated causing the receiver to generate a pulse which triggers the slave flash unit. If desired a plurality of receivers may be operated from a single transmitter.

The system in accordance with the invention is advantageous in that the receivers may be selective as to transmitted frequency so that several transmitters may be operated at the same time without causing interference with their respective receivers.

Another object of the invention is to provide a carrier current control system for triggering electronic flash units which is simple and economical in manufacture efficient in operation, rugged in use, and not subject to actuation by static or like interference.

Other objects and advantages of the invention will be apparent from the following description and from the accompanying drawing which shows, by way of example, an embodiment of the invention.

In the drawings:

FIGURE 1 is a diagrammatic view of a transmitter in accordance with the invention.

FIGURE 2 is a diagrammatic view of a receiver coupled to a flash unit in accordance with the invention.

Referring to the drawings there is shown in FIGURE 1 a carrier current transmitting system in accordance with the invention and adapted to be connected to a 120 volt alternating current supply line or the like. The transmitter includes a tube 10, a transmitter coil 11 connected in an L-C circuit with the tube 10. The transmitter coil 11 has a tank winding 12 and a tickler coil 13, an output coil 14 and a shorting winding 15. The tube 10 may be a power pentode or a triode connected as a triode oscillator. A power supply is provided by a silicon or selenium rectifier 16 connected to grid 17 and to anode 18 of the tube 10. Cathode 19 is connected to tap 20 of the coil 12. Grid 21 of the tube 10 has a grid leak bias formed by a capacitor 22 in parallel with a resistor 23 connected to end 24 of the tank winding 12. A padder condenser 25

is connected across the tank winding 12 and tickler coil 13 from terminal 24 to terminal 26. Heater filament 27 is connected across the source of supply through a capacitor 28 to drop the supply voltage, a filter capacitor 29 being connected from the filament 27 to the grid 17. The shorting winding 15 is connected through a rectifier 30 to a switch 31 which may be actuated by the shutter of the camera. Output coil 14 is coupled to the supply line by connecting its terminal 32 through a capacitor 33 while its other terminal 34 is connected to end 26 of the tickler coil. If desired a neon lamp 40 may be connected in series with a resistor 41 across the supply line after a switch 43 and fuse 44 to indicate energization of the circuit.

In the operation of the transmitter a high frequency CW signal of a frequency of about 195 kilocycles plus or minus 40 kilocycles is adjusted to the desired frequency by varying the padder condenser 25. Immediately upon energization of the circuit a carrier current is transmitted over the 120 volt power supply system. When it is desired to actuate the slave flash tube units the switch 31 is closed, shorting the winding 15 and thereby interrupting or decreasing the oscillation of the L-C circuit and discontinuing the transmission of the carrier signal or reducing it to an ineffective value. The rectifier 30 demodulates the shorted signal and also acts to prevent radio-frequency radiation and attenuation in the line going to the switch 31.

The receiver circuit is shown in FIGURE 2 and includes a series resonant circuit including a transformer 50 which may be a standard I.F. transformer tuned with powdered core slugs adapted to receive 195 kc. plus or minus 40 kc. and provided with pad capacitors 51 and 52 to tune the windings. A compensating capacitor 53 is used to adjust the circuit to receive the 195 kc. carrier signal. The carrier current signal is rectified by a highly conducting germanium diode 54 providing negative bias for base 55 of a PNP-transistor 56 having an emitter 57 and a collector 58. The negative bias received by the base 55 of the transistor causes it to conduct and effectively to short out a resistor 60 connected between the emitter 57 and the collector 58. A decoupling capacitor 61 is connected between the base 55 and the collector 58, the collector being grounded as indicated at 62. A bias resistor 63 is connected from base 55 to connecting wire 64 from end 65 of the transformer 50, the other end 66 of the transformer 50 being connected to the rectifier 54.

The receiver circuit is connected to a terminal board or connecting plug 70 having connectors 72–76 thereon. Connector 72 is a supply line terminal and is connected through an isolation capacitor 77 to terminal 78 of the transformer 50. Connector 73 is another supply line terminal and is connected directly to terminal 79 of the transformer 50. Connector 74 is a high voltage supply and is connected through a high voltage isolating resistance 80 to connecting wire 64. Connector 75 is a control circuit and is connected through a zener diode 81 in series with a coupling capacitor 82 to the connecting wire 64. Connector 76 is a ground connection.

The electronic flash unit is connected to a terminal board or connecting plug 70*a* having connectors thereon engaging the connectors 72–76 and numbered the same for ease of understanding. The electronic flash unit is mainly conventional and includes a transformer 90 with a low voltage primary winding 91 and a high voltage secondary winding 92 to step up the 120 volt supply to 350 volts. End 93 of the high voltage winding 92 is grounded while end 94 is connected through a current limiting resistance 95 to a full wave voltage doubling capacitor bank including rectifiers 96 and 97 and capacitors 98 and 99. The output of the capacitor bank, 100 and 101, is connected

to electrodes 102 and 103 of a gas discharge lamp or flash tube 104.

A triggering circuit for the flash tube 104 includes a triggering electrode 105, a triggering transformer 106 and a triggering capacitor 107. The triggering circuit is controlled by a thyratron 110. Anode 111 of the thyratron 110 connected through a resistance 112 to a direct current supply and to the triggering capacitor 107. Cathode 120 of the thyratron 110 is connected to ground and to a grid 121. Control grid 122 of the thyratron 110 is connected to the connector 75 for operation from the receiver.

In the operation of the receiver the received carrier signal provides a negative bias on the collector 55 of the transistor 56 and thus effectively shorts out the resistor 60. During the period while the carrier signal is present the capacitor 82 is charged with its positive polarity connected to connecting wire 64 thus there is a negative bias on the grid 122 which prevents the thyratron from conducting and the triggering transformer 107 is charged through the resistor 112. Upon the closing of the switch 31 the carrier signal is interrupted or decreased at the receiver and the collector 55 of the transistor 55 loses its negative bias and thus the transistor ceases to short the resistance 60. Capacitor 82 then produces a positive pulse on the control grid 122 of the thyratron 110 which causes it to conduct thereby producing a pulse discharge of the capacitor 107 through the triggering electrode 105 initiating the discharge of the flash tube 104.

An electrical system manufactured commercially and found to operate satisfactorily employs constants for the various circuit components as follows:

Tube 10—32 ET5 Sylvania.
Transmitter oscillator coil 11—modified standard manufacture:
Winding 12—800 turns.
Winding 13—100 turns.
Winding 14—10 turns.
Winding 15—200 turns.
Rectifier 16—IN 1763 RCA.
Capacitor 22—150 mmfd.
Resistance 23—12K.
Padder condenser 25—300 mmfd.
Capacitor 28—2.0 mfd.
Filter capacitor 29—40 mfd.
Rectifier 30—IN 1763 RCA.
Capacitor 33—0.1 mfd.
Transformer 50—standard 455 kc. intermediate frequency.
Capacitor 53—.001 mfd.
Diode 54—IN 46A Sylvania.
Transistor 56—2N 1193 Motorola.
Resistance 60—100K.
Capacitor 61—.001 mfd.
Resistor 63—100K.
Capacitor 77—500 mmfd.
Resistance 80—1 meg.
Rectifier 81—RS–6 Hoffman.
Capacitor 82—.1 mfd.
Tube 110—2D21 GE.
Resistance 112—100K.

While the invention has been described and illustrated with reference to a specific embodiment thereof, it will be understood that other embodiments may be resorted to without departing from the invention. Therefore, the form of the invention set out above should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. An electrical system for photographic flash units comprising a power supply, a transmitter oscillator including a tank winding, an output winding, and a shorting winding coupled with the tank winding, a coupling capacitor connected in series with the output winding across the power supply, a rectifier, a normally open shorting switch connected in series with the rectifier across the shorting winding operative to decrease the oscillations of the output winding, a receiver including a tuned transformer connected to the power supply, a receiver rectifier in the secondary output of the transformer to produce a negative bias, a transistor having a base, a collector and an emitter, a resistance, the base connected to the receiver rectifier to normally receive a negative bias, the resistance connected across the collector and emitter so that the resistance is effectively shorted while the base is negatively biased, a flash tube, a capacitive power supply for the flash tube, a triggering control for the flash tube including a triggering capacitor adapted to initiate discharge of the flash tube, means to charge the triggering capacitor, normally non-conducting means connected to the triggering capacitor, means to render said non-conductive means conductive operative upon the shorting of said resistor by the transistor, whereby the triggering capacitor is discharged to initiate discharge of the flash tube.

2. An electrical system for photographic flash units comprising a power supply, a transmitter oscillator including a tank winding, an output winding, and a shorting winding coupled with the tank winding, a coupling capacitor connected in series with the output winding across the power supply, a rectifier, a normally open shorting switch connected in series with the rectifier across the shorting winding operative to decrease the oscillations of the output winding, a receiver including a tuned transformer connected to the power supply, a receiver rectifier in the secondary output of the transformer to produce a negative bias, a transistor having a base, a collector and an emitter, a resistance, the base connected to the receiver rectifier to normally receive a negative bias, the resistance connected across the collector and emitter so that the resistance is effectively shorted while the base is negatively biased, a flash tube, a capacitive power supply for the flash tube, a triggering control for the flash tube including a triggering capacitor adapted to initiate discharge of the flash tube, means to charge the triggering capacitor, a thyratron including a cathode, an anode and a grid, the anode connected to the triggering transformer, and the grid connected to said resistor so that upon the shorting of the resistor the grid causes the thyratron to become conductive, whereby the triggering capacitor is discharged to initiate discharge of the flash tube.

3. An electrical system for photographic flash units comprising a power supply, a transmitter oscillator including a tank winding, an output winding, and a shorting winding coupled with the tank winding, coupling means connected in series with the output winding across the power supply, a normally open shorting switch connected across the shorting winding operative to decrease the oscillations of the output winding, a receiver including a tuned transformer connected to the power supply, a receiver rectifier in the secondary output of the transformer to produce a negative bias, a transistor having a base, a collector and an emitter, a resistance, the base connected to the receiver rectifier to normally receive a negative bias, the resistance connected across the collector and emitter so that the resistance is effectively shorted while the base is negatively biased, a flash tube, a capacitive power supply for the flash tube, a triggering control for the flash tube including a triggering capacitor adapted to intiate discharge of the flash tube, means to charge the triggering capacitor, normally non-conducting maens connected to the triggering capacitor, means to render said non-conductive means conductive operative upon the shorting of said resistor by the transistor, whereby the triggering capacitor is discharged to initiate discharge of the flash tube.

4. An electrical system for photographic flash units comprising a power supply, a transmitter oscillator including a tank winding, an output winding, and a shorting winding coupled with the tank winding, a coupling capacitor connected in series with the output winding across the power supply, a rectifier, a normally open

shorting switch connected in series with the rectifer across the shorting winding operative to decrease the oscillations of the output winding, a receiver including a tuned transformer connected to the power supply, a receiver rectifier in the secondary output of the transformer to produce a bias, an electronic switch responsive to the bias of the rectifier, the resistance connected across the electronic switch so that the resistance is effectively shorted while the electronic switch is biased, a flash tube, a capacitive power supply for the flash tube, a triggering control for the flash tube including a triggering capacitor adapted to initiate discharge of the flash tube, means to charge the triggering capacitor, normally non-conducting means connected to the triggering capacitor, means to

render said non-conductive means conductive operative upon the shorting of said resistor by the electronic switch, whereby the triggering capacitor is discharged to initiate discharge of the flash tube.

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