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PHOTOFLASH SYSTEM

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In the normal use in indoor photography of photoflood lamps, or high amperage incandescent filament lamps, as a source of illumination, the lamps stay illuminated during the preparatory stages. This reduces the useful life of the lamp and in addition causes considerable annoyance to the subject and to the photographer.

This application is a continuation-in-part of our copending application Serial No. 18,384, filed April 1, 1948, now abandoned, for Photoflash System.

One of the aims of the present invention is to eliminate the full illumination of the lamps during the preparatory stages.

In addition, the present invention aims to employ the photoflood high amperage incandescent filament lamp in the same manner as flash bulbs.

In other words, the present invention provides a system of indoor photography employing high amperage incandescent filament lamps, known in the trade as photoflood lamps or bulbs at a supernormal illumination with the result that snapshots may be taken with great facility. The supernormal or high luminosity of the lamp is obtained by imposing upon the filament a supernormal voltage and passing through the filament a supernormal current which brings the filament to peak temperatures which approximate the melting point of the filament, the duration of this peak voltage, current and temperature, however, being so short that the useful life of the bulb is not materially shortened.

In the normal operation of the flood light at rated voltage an interval of approximately 100 milliseconds lapses between the closing of the switch and the maximum luminosity produced by the flood light. In the system of the present invention the supernormal luminosity is obtained with a time delay of only about 20 milliseconds or less. This delay corresponds to the conventional time delays in solenoid operated shutter mechanisms of cameras and the present system, therefore can be readily employed to be operated by such mechanisms and when so employed will produce the desired peak luminosity at the desired time in the operation of the shutter.

In the present invention the flood light or photoflood lamp is illuminated or operated during the preparatory stages at much reduced amperage, voltage and luminosity and is permitted to reach its supernormal luminosity peak provided for by the system for only a short time, approximately one-tenth to one-hundredth of a second. Thus, during the subnormal operation of the lamp, its illumination is useful in modeling the subject. In addition, this subnormal opera-

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tion of the lamp maintains the filament at a relatively high temperature and permits the time delay in reaching the supernormal luminosity peak to be not more than 20 milliseconds.

Another advantage of the present invention is that as compared with the normal use of such lamps in which they remained at their rated luminosity for substantial periods during each exposure lasting into many minutes, by the use of the present invention, the bulb is employed during the same period at reduced luminosity and at a supernormal luminosity for only a short time with the consequent increase of the effective life of the bulb.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

A more detailed understanding of the present invention will be had from the following specification and the accompanying drawings which illustrate the preferred embodiments of the invention, it being understood that variations thereof falling within the scope of the appended claims will be apparent to persons skilled in the art.

In the drawings, Figure 1 is a diagrammatic illustration of one form of the invention;

Figure 2 is a diagrammatic illustration of the system shown in Figure 1 associated with a solenoid operated camera shutter.

Figure 3 is a diagrammatic illustration of another form of the invention in which thyatron tubes are employed in lieu of a relay.

Figure 4 is a diagrammatic illustration of another form of the invention.

Viewed broadly, the present invention provides an impedance in series with a photoflood lamp or photoflood lamp socket. This impedance serves to reduce the voltage across the lamp during the modeling or preparatory stage. Therefore, the lamp or bulb operates at below rated voltage. When the photograph is about to be taken and the shutter is open, a supernormal voltage is then impressed upon the filament so as to produce a peak of supernormal luminosity. Because of the high peak luminosity as compared with the modeling illumination obtained from the lamps, the shutter may be set for any desired time, such as a full second, if desired, and after the shutter is opened, the closing of the operating switch of the system of the present invention will produce the supernormal luminosity for a very short time with the camera shutter open. Thereafter, the shutter may be closed. Thus, by means of the present invention an exposure of approximately

$\frac{1}{25}$ of a second is obtained with the shutter open for a much longer period as desired.

The current flowing through the lamp is sufficiently great to melt the filament or heater element of the lamp if permitted to flow continuously. For a short period of time the surface of the filament is heated to such an extent that extremely high luminosity is obtained. This characteristic is aided when alternating current is used by the skin effect, that is, the current density at the surface of the filament or conductor is greater than the density in the center thereof. The thermal capacity of the filament is such that the filament is not heated throughout the thickness thereof sufficiently to melt it within the short period of time used.

Considering the present invention more particularly, it provides an impedance coil in series with the photoflood lamps which reduces the operation of the lamp or lamps to below the rated voltage during the modeling or preparatory stages and the same impedance coil is subsequently employed to have a supernormal voltage generated therein which is imposed upon the high amperage incandescent filament so as to obtain the supernormal peak luminosity. Thus, the present invention provides a transformer in which the secondary winding is interposed in the circuit in series with the lamps, the primary winding being connected across the mains and maintained open circuited. At the proper time the primary winding is closed, thereby inducing a high voltage in the secondary which will be additive to the line voltage, thus producing the desired supernormal voltage across the filaments of the flood lamps. The present invention also provides means for maintaining the primary winding closed only for a time, permitting the filaments to reach the desired supernormal peak luminosity for the desired time. Thus, the present system may be designed to provide an exposure of about $\frac{1}{25}$ of a second or the like.

Referring more particularly to the drawings, the wires 10 and 11 may be connected to any suitable source of A. C. voltage, such as the customary household 110 volts. The bulbs or bulb sockets 12, two being shown in parallel, are connected on one side to line 10 through a manual switch 13 and a fuse 14, it being understood that any number of such bulbs can be employed. The winding 15 of the transformer is interposed in line 11. Thus the winding 15 serves as an impedance or choke coil to reduce the voltage across the bulbs or bulb sockets to below the rated voltage. The primary winding 16 of the transformer is connected to the wire 10 at the point 17 and to the wire 11 by means of the wire 18, the latter, however, having interposed a variable resistance 50 and a normally open switch comprising a fixed contact 19 and a movable contact 20.

Thus, when the switch 13 is closed, the flood lights will operate below normal voltage and serve to provide the desired light for modeling. When switch 19, 20 is closed, a high voltage will be induced in winding 15 which is additive to the line voltage and the incandescent filaments will reach a high supernormal peak luminosity.

The variable resistance 50 controls and may be employed to adjust the high voltage across the photoflood bulbs 12 to the desired value. The neon glow lamp 52 bridging part of the potentiometer resistor 51 serves to indicate when the voltage across the photoflood lamps 12 equals the desired predetermined value. The resistor 50 and glow lamp 52 provide a check and a means

for maintaining the apparatus in good operating condition.

The present invention provides for an automatic control of the switch 19, 20 so as to maintain the same closed only for the desired time from one-tenth to one-hundredth of a second. For this purpose the movable contact 20 is carried by the armature 21 of the relay 22. One side of the relay winding 22 is connected to the line wire 10 through a resistance 23 and rectifier 24 and wire 25. The other side of the winding 22 is connected to the other line wire 11 through the manual switch 26 and wire 27. A condenser 28 is connected as shown across the winding 22 and the switch 26.

In operation the line wires 10 and 11 are plugged with the source of line voltage and the switch 13 is closed. The winding 15 of the transformer serves as an impedance and the bulbs 12 operate at below normal voltage. At this time the condenser 28 becomes charged to its maximum voltage by a charging circuit which includes wire 25, rectifier 24, resistance 23, condenser 28 and wire 27. When the exposure is made, the switch 26 is closed and the condenser 28 discharges through the switch 26 and relay 22. This moves the armature 21 to close the switch 19, 20 thereby connecting the winding 16 across the mains. The winding 15 has a relatively high voltage induced therein, which is additive to the line voltage so as to produce a voltage of perhaps 175 volts or the like across the photoflood bulbs 12. When the condenser 28 has discharged or its voltage is reduced substantially by the discharge, the winding 22 is de-energized and the switch 19, 20 is opened. By means of this system, therefore, the switch 19, 20 is automatically opened at a predetermined time, preferably $\frac{1}{25}$ of a second, after it is closed.

Because the filaments had been maintained hot and their circuit is not interrupted it can be brought to the supernormal peak luminosity within a time delay of less than 20 milliseconds after the high voltage is applied.

It will now be seen that the present system provides for the employment of a minimum of parts. One winding of the transformer is employed both to provide the high voltage and the impedance for the bulbs. The size of the transformer is considerably reduced by the present system because a large percentage of the supernormal voltage is obtained directly from the line. In the present apparatus the initial or preliminary voltage applied to the filaments during the modeling stage may be varied by varying the reluctance in the core of the transformer, as by changing or adjusting the air gap in the core or in the core laminations. The time of energization of the relay winding 22 can be controlled by varying its resistance, or by varying the size of the condenser, or by varying the voltage to which the condenser is charged.

When the relay 22 is energized and the contacts 19, 20 are closed, the reactance of coil 15 is reduced to a low value and the voltage induced therein is built up rapidly. This voltage adds to the line voltage across the bulbs and causes them to glow at an exceedingly high intensity for the duration of time the relay is closed. By limiting the duration of the high intensity illumination to the short period of time and partially as a result of the latent heat of fusion of the filament, burn out is avoided. The present unit can be synchronized with any camera shutter which has contacts that close when the shutter is

opened. Such shutter contacts could then be used as the switch 26, to thereby obtain automatic synchronization of the flash of the photoflood lamps.

Where the camera shutter does not have contacts, but instead is operated by a solenoid, the optional wiring arrangement of the control circuit shown in Figure 2 may be employed. In this figure the box 30 corresponds to that part of the system shown in Figure 1 which is included within the dotted line box 30. The elements of the control shown in Figure 1 and which also appear in Figure 2 bear the same reference characters.

In the wiring diagram shown in Figure 2 when the switch 32, a double pole single throw switch, is closed to operate the shutter and to create a flash, the condenser 28 is discharged through the relay 22, through wire 33, switch 32 and wire 34. The closing of the switch 32 also energizes the shutter operating solenoid 35 through the circuit which includes wire 37, rectifier 24 solenoid 35 and voltage dropping resistor 36. The solenoid thus acts essentially in synchronization with the relay 22. The voltage dropping resistor 36 reduces the voltage across the solenoid coil to the desired value. The by-pass resistor 38 is desirable in the event that the solenoid coil is not plugged in, in which case it provides a current path to charge the condenser. The resistance of 38 is very high compared to the resistance of solenoid coil 35.

Figure 3 shows a system which is analogous to the system shown in Figure 1 except that instead of a relay 22 and contacts 19, 20 operated thereby, one or two thyratrons 40 are employed, as shown. In this system the thyratrons are normally biased to cut off. When the switch 26 is closed, condenser 28 discharges through the primary winding 41 of the transformer which is provided with two secondaries 42 and 43, one of these two secondaries 42, 43, connected in the grid circuit of each thyatron 40. The oscillations generated in the circuit which includes the condenser 28 and the primary winding 41 are thereby transferred to the grids of the thyratrons and cause the same to fire, thus effectually connecting the winding 16 to the line. The thyratrons continue firing until the oscillations dampen out to below the firing potential of the thyratrons. The time of firing is controlled by the characteristics of the transformer 41, 42, 43.

The use of a transformer for illuminating a flash bulb is not always essential. For example, a flash bulb that would flash in a period of $\frac{1}{25}$ of a second, or thereabouts, when connected across the terminals of a normal line voltage, say 110 volts, could be used, as clearly illustrated in Figure 4. For example, two 32 volt flash lamps 112 may be used to produce a flash when connected across 110 volt circuit. The voltage supplied to the lamps 112 may be reduced to 20 volts or some other subnormal voltage by means of any suitable impedance, such as a choke coil 150 connected in series with the lamps. A condenser 38 energized through the leakage circuit including the resistance 23 and the rectifier 24 is charged by the rectified current. By closing the switch 26, the condenser 28 energizes the relay 22 so as to close the switch 19 for $\frac{1}{25}$ of a second, or thereabouts, at which time 110 volts is applied directly to the terminals of the lamps 112, this 110 volt voltage being derived directly from the lines.

the electromagnet 22, the switch 19 will again be opened, in that the current flowing through the leakage circuit including the rectifier 24 and the resistance 23 is insufficient to hold the electromagnet 22.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described our invention, we claim:

1. In an illuminating apparatus for photographic purposes employing high luminosity incandescent filament lamps, the combination of a receptacle for said lamp, a transformer having two windings, one winding being connected in series with said receptacle and serving to reduce the voltage impressed upon said receptacle to substantially below the rated voltage of the lamp, the second winding being normally open circuited, and electric control means operable in response to the closing of its circuit to close the circuit of the second winding and to open the same after the lapse of a predetermined small fraction of a second.

2. The apparatus set forth in claim 1 in which the last named means comprise a condenser and circuit means receiving a discharge from said condenser, said circuit means including a switch for opening and closing the second winding, the discharge serve to actuate said circuit to close and open the second winding circuit.

3. In an illuminating apparatus for photographic purposes employing a high luminosity incandescent filament lamp, the combination of an electrical receptacle for said lamp, a transformer having a primary winding connected in parallel with said receptacle and normally open circuited and a secondary winding connected in series with said receptacle and serving to reduce the voltage at the receptacle, and electric control means for closing and opening said primary winding.

4. The apparatus set forth in claim 3 in which the control means include a three electrode gaseous discharge device and a condenser whose discharge renders said device conductive for a predetermined small fraction of a second.

5. In an illuminating apparatus for photographic purposes employing a high luminosity incandescent filament lamp, the combination of a receptacle for said lamp, a transformer having two windings, one winding connected in series with the receptacle, means for connecting said receptacle and second winding to a voltage source, the second winding connected in parallel with the receptacle, the circuit of said second winding being normally open, and electric control means for closing the circuit of said second winding thereby generating in the one winding a voltage in a manner to add the same to the voltage of the source, so as to cause the filament lamps to flash momentarily then said electric control means opening the circuit through the second winding.

6. In an illuminating apparatus for photographic purposes employing high luminosity incandescent filament lamps, the combination of a receptacle for said lamp, a transformer having two windings, one winding being connected in series with said receptacle and serving to reduce

When the condenser 28 is discharged through

the voltage impressed upon said receptacle to substantially below the rated voltage of the lamp, the second winding being normally open circuited, and control means to close and open the circuit of the second winding, said control means closing the circuit of the second winding to cause the filament lamps to flash momentarily then open circuiting the second winding.

7. The method of illuminating objects for photographic purposes by the employment of an incandescent filament lamp having a normal voltage substantially equal to normal line voltage, the steps of impressing upon the lamp a voltage substantially below its rated voltage, charging a condenser, discharging the condenser through a relay, said relay altering the circuit through the lamp so as to impress upon the terminals of the lamp a voltage sufficiently high to cause a current to flow through the filament of the lamp, generating sufficient heat to melt the filament if permitted to continue, the condenser upon being discharged permitting the relay to open the circuit through the lamp before sufficient heat has been generated in the filament to melt the same.

8. In an illuminating apparatus for photographic purposes employing a high luminosity incandescent filament lamp, the normal voltage of the filament lamp being substantially equal to the normal line voltage, the combination of a receptacle for said lamp, a transformer having a primary winding and a secondary winding, the primary winding being connected in series with said receptacle and serving to reduce the voltage impressed upon said receptacle to a voltage substantially below the rated voltage of the lamp, the secondary winding being normally open circuited, and electric control means including a condenser and a rectifier connected in series across the terminals of the line and in parallel with the primary winding of the transformer and the filament of the lamp, a relay and a switch connected in series across the terminals of the condenser so that as the switch is closed the condenser discharges through the relay, said relay actuating a switch for connecting the secondary windings of the transformer across the terminals of a filament so as to increase the voltage impressed upon the terminals of the filament to cause a current of sufficient magnitude to melt the filament if permitted to continue to flow, the relay open circuiting the secondary winding upon the condenser being discharged so as to have a voltage across the terminals less than the voltage required to hold the relay switch closed.

9. In a photoflash illuminating apparatus employing an incandescent lamp or lamps, means for applying a subnormal voltage to said lamp or lamps, and means for applying a supernormal voltage for a predetermined interval of time to said lamp or lamps, said last mentioned means including a relay, a condenser, a switch for connecting the condenser across the terminals of the relay, and a leakage circuit for charging the condenser, the closing of the switch causing the condenser to energize the relay so as to supply a supernormal voltage to the lamp or lamps, the current through the leakage circuit being insufficient to hold the relay so that the relay interrupts the supernormal voltage upon the condenser being discharged.

10. In an illuminating apparatus employing an incandescent lamp or lamps, means for applying a predetermined voltage to said lamp or lamps, means for varying said voltage, and means for automatically limiting the time of application thereof to obtain a change in luminosity for said lamp or lamps for a predetermined interval of time, said last mentioned means including a relay for actuating a switch to vary the voltage, a condenser, a leakage circuit for charging the condenser, and a switch for connecting the condenser across the terminals of the relay, the current through the leakage circuit being insufficient to actuate the relay, the charge on the condenser upon the last mentioned switch being closed energizing the relay to vary the voltage supplied to the lamp or lamps until the condenser has been discharged at which time only the predetermined voltage is applied to the lamp or lamps.

11. In a photoflash illuminating apparatus employing an incandescent lamp or lamps, means for applying a predetermined voltage to said lamp or lamps, and means for adding a supernormal voltage to said lamp or lamps to produce a flash, said last mentioned means automatically limiting the time of application thereof for a predetermined interval of time, said last mentioned means including a condenser, a leakage circuit for charging the condenser, a relay, and a switch for connecting the condenser across the terminals of the relay, the current required to hold the relay being greater than the current normally flowing through the leakage circuit so that as the switch is closed causing the condenser to discharge through the relay the relay causes a supernormal voltage to be applied to the lamp or lamps only until the condenser has been discharged.

12. In a photoflash illuminating apparatus including an incandescent lamp or lamps, an electric circuit connected to the source of energy having a voltage input substantially higher than the voltage required to illuminate the lamp or lamps under normal operating conditions, said circuit including an impedance connected in series with the lamp or lamps so as to reduce the voltage supplied to the lamp or lamps to a subnormal voltage, and circuit means for applying the line voltage directly to said lamp or lamps for a predetermined interval of time so as to cause a flash thereof, said last mentioned means including a relay, a condenser, a switch for connecting the condenser across the terminals of the relay, and a leakage circuit for charging the condenser, the leakage circuit including a rectifier and an impedance for reducing the current flow so that the current flowing through the leakage circuit is insufficient to energize the relay but sufficient to charge the condenser, the closing of the switch causing the condenser to energize the relay so as to apply the line voltage to the lamp or lamps until the condenser is substantially discharged through the relay at which time the relay interrupts the flow of line voltage to the lamp or lamps thereby interrupting the flash thereof.

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