Oct. 31, 1939. G. E. INMAN 2,178,423

METHOD AND APPARATUS FOR FLASHING ELECTRIC DISCHARGE DEVICES

Filed Sept. 25, 1936

Fig. 1.

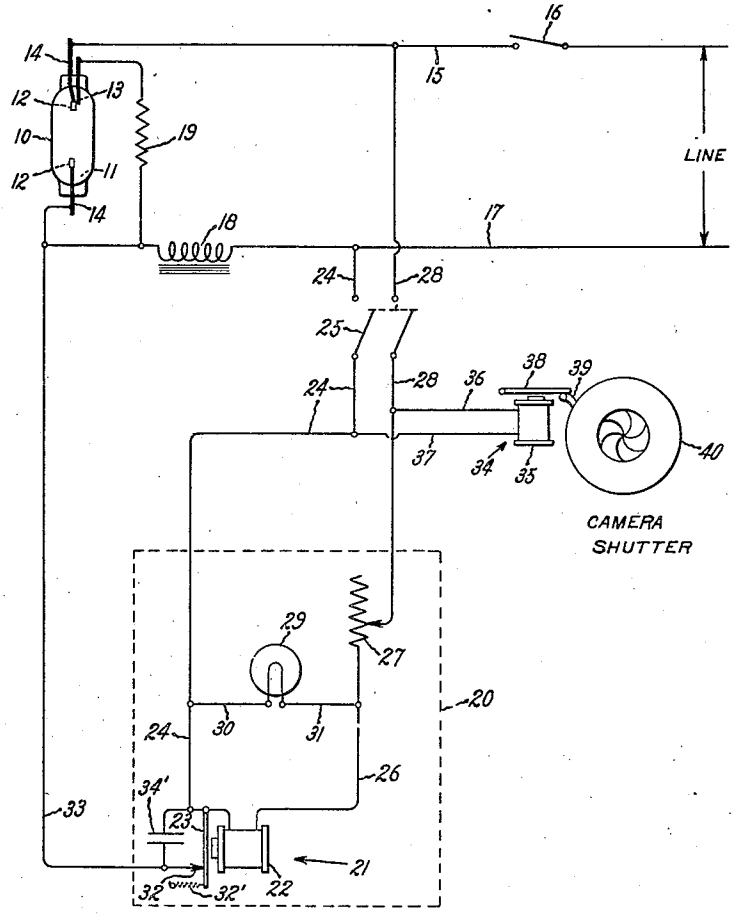
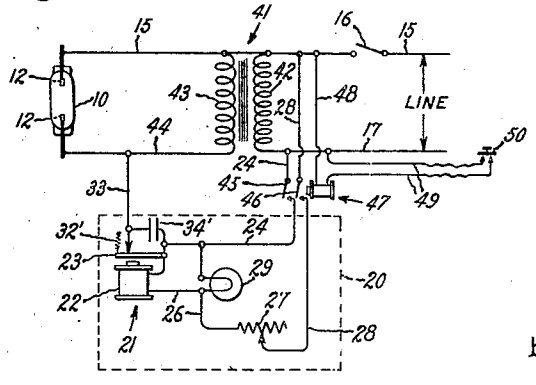



Fig. 2.




Inventor:
George E. Inman,
by Harry E. Dunham
His Attorney.

Patented Oct. 31, 1939 2,178,423

# UNITED STATES PATENT OFFICE

2,178,423

## METHOD AND APPARATUS FOR FLASHING ELECTRIC DISCHARGE DEVICES

George E. Inman, East Cleveland, Ohio, assignor to General Electric Company, a corporation of New York

Application September 25, 1936, Serial No. 102,569

1 Claim. (Cl. 240—2)

My invention relates to a method and apparatus for flashing electric discharge lamps to obtain a very intense flash of light or radiant energy which may be used, for example, for photographic or for signalling purposes.

According to my invention, a discharge lamp is operated under normal conditions with a ballast in series and the ballast, or a portion thereof, is shunted momentarily to permit an abnormal amount of current to flow through the lamp to cause it to emit a flash of light of very high intensity. A time control device is preferably included in the circuit to automatically limit the abnormal operation of the lamp to a very short period so that the time of the flash is less than about one-fifth of a second, corresponding to twelve cycles of a sixty cycle line current. The lamp may be of the high pressure positive column metal vapor type or of the low pressure gaseous discharge type in which the light is obtained from a discharge through a gas such as neon. When the lamp is used for photographic purposes, suitable means are provided in the circuit to synchronize the operation of the camera shutter with the flash of light. When the lamp is used for this purpose it may be operated under normal conditions to provide sufficient illumination for the photographer to focus his camera and adjust the position of his subject and then the lamp may be flashed to provide the high intensity illumination necessary for an instantaneous exposure. Other features and advantages of my invention will appear from the following detailed description of species thereof and from the drawing.

In the drawing, Fig. 1 is a diagram of a circuit for operating a discharge lamp according to my invention including means for operating a camera shutter, and Fig. 2 is a diagram of a modified circuit.

Referring to Fig. 1, the lamp 10 may be of the high pressure positive column metal vapor type disclosed in the United States patent application Serial No. 102,554, Eugene Lemmers, filed September 25, 1936 now Patent No. 2,130,304. This particular lamp contains a filling of argon at a pressure of about 6 mm. of mercury and a quantity of vaporizable metal 11, preferably mercury. A pair of main electrodes 12—12 are located at opposite ends of the bulb and a starting electrode 13 is preferably provided adjacent to the upper electrode 12. The said main electrodes preferably consist of highly porous slugs or blocks of refractory metal, preferably tungsten, impregnated with an electron emissive material such as barium oxide, as disclosed and claimed in the United States patent application Serial No. 16,614, Eugene Lemmers et al., filed April 16, 1935 now Patent No. 2,121,637. Such electrodes contain a very high amount of electron emissive material and are therefore particularly well suited to withstand the effects of a high overload for short periods of time. The electrodes 12—12 are mounted on leads 14—14 which are made large enough to safely carry the momentary high current.

The circuit for normal operation of the lamp 10 includes a conductor 15 which connects the lead 14 of the upper electrode 12 to one side of the line through a switch 16, and a conductor 17 which connects the lead 14 of the lower electrode 12 to the other side of the line through a ballast, shown here as a choke coil 18. The starting electrode 13 is connected through a high resistance 19 to the lower electrode 12. When the switch 16 is closed, a discharge is initiated between the upper electrode 12 and the starting electrode 13 and the gas in the bulb is ionized, thereby causing the arc to start between the two main electrodes 12—12. This lamp operates with a concentrated arc at a pressure of about two atmospheres.

The lamp is caused to flash at a very high intensity by a time control means, shown within the dotted lines 20, which momentarily shunts the choke coil 18 so that, in this case, the full line voltage is applied across the lamp 10. The time control means 20 comprises a relay 21, the coil 22 and armature 23 of which are connected on one side through a conductor 24 and one side of a double pole switch 25 to the conductor 17, and on the other side through a conductor 26, variable resistance 27, conductor 28, and the other side of said switch 25, to the conductor 15. A resistance, preferably in the form of an incandescent lamp 29 having a tungsten filament, which has a positive temperature coefficient of resistance, is connected across the coil 22 of the relay 21 by conductors 30 and 31 which are connected to the conductors 24 and 26 respectively. The armature 23 of the relay 21 is normally held against the stationary contact 32 of the relay by a spring 32'. Said contact 32 is connected by a conductor 33 to the lead 14 of the lower electrode 12 of the lamp. A condenser 34' may be connected across the armature 23 and contact 32 to prevent arcing therebetween.

For photographic purposes, the circuit may also include a solenoid 34 having its coil 35 connected by conductors 36 and 37 to the conductors 28 and 24 respectively. The armature 38 of the solenoid

is arranged to actuate the control lever 39 of a camera shutter 40 so as to open said shutter when the lamp 10 is flashed.

To operate the device, the switch 16 is first closed to cause the lamp 10 to operate normally, as explained above, with the choke coil in series to lower the line voltage and limit the current. To flash the lamp and operate the camera shutter 40, the switch 25 is closed. This action shunts out the ballasting choke coil 18, the circuit then being from one side of the line through conductor 15, upper electrode 12 of lamp 10, lower electrode 12, conductor 33, contact 32, armature 23, conductor 24, and conductor 17, to the other side of the line. Since the full line voltage is then applied to the lamp, an abnormal current flows therethrough and the lamp emits light of extremely high intensity. The closing of the switch 25 also connects the coil 35 of the solenoid 34 across the line, thereby attracting the armature 38 and tripping the shutter control lever 39. The abnormal flow of current through the lamp 10 is permitted by the time control means 20 to continue for but an extremely short time (one-twentieth of a second, for example, with a shutter speed of one-fiftieth of a second).

The operation of the time control means 20 is as follows: When the switch 25 is closed, the coil 22 of relay 21 and the incandescent lamp 29 are also connected across the line, the circuit being from one side of the line through conductor 17, conductor 24, relay coil 22 and lamp 29 in multiple, conductor 26, resistance 27, conductor 28, and conductor 15 to the other side of the line. The time of the flash is controlled by the lamp 29, the tungsten filament of which increases in resistance as it is heated. When the switch 25 is first closed, the resistance of the cold filament of lamp 29 is comparatively low so that insufficient current flows through the coil 22 of relay 21 to cause it to attract the armature 23. However, the filament in lamp 29 heats up very rapidly, thereby increasing in resistance so that sufficient current flows through the coil 22 to cause it to attract the armature 23 and draw it away from the contact 32, thereby breaking the shunt circuit around the choke coil 18. The coil 22 holds the armature away from contact 32 until the switch 25 is opened, whereupon the spring 32' pulls the armature back against said contact 32 and the circuit is set to again flash the lamp 10. The variable resistance 27 may be used to adjust the period of the flash between, for example, one-sixtieth and one-fifth seconds.

The following characteristics were obtained with a lamp 10 of the high pressure mercury type described above: The lamp was rated at 100 watts and was connected through a reactor having an inductance of .157 henry to a 115 volt, 60 cycle line. The lamp operated normally at 65 volts and 1.65 amperes and produced a light intensity of 3,000 lumens. With the reactor shorted out, the lamp operated at 100 volts and 60 amperes and produced 400,000 lumens. The lamp was also operated from a 220 volt, 60 cycle line, a portion only of the ballast being shorted out in this case rather than the whole reactor. Under these conditions the lamp produced 3,100,000 lumens of light during the flash period.

The circuit shown in Fig. 2 is similar to that shown in Fig. 1 except that the ballast in this case consists of a high reactance auto-transformer 41 and means are provided for flashing the lamp 10 from a distance. The primary 42 of the transformer is connected across the line conductors 15 and 17. The secondary 43 is connected at one side to the conductor 15 and at the other side to a conductor 44, said conductors 15 and 44 being connected to the upper and lower electrodes 12—12 respectively of the lamp 10. The time control circuit 20 is connected in the same manner as in Fig. 1 except that armature switches 45 and 46 of a relay 47 have been substituted for the double pole switch 25. The coil of relay 47 is connected across the line leads 15 and 17 by conductors 48 and 49. When a push button 50 in conductor 49 is closed, the relay 47 is energized to close switches 45, 46, the transformer 41 being shunted momentarily to cause the lamp 10 to flash at a high intensity.

In order to operate properly, the lamp 10 must be of sufficient size and so constructed that the discharge therein is not extinguished by the increase in temperature and pressure therein during the period of the flash. The leads 14 must be larger than in a lamp operated only under normal conditions so that they are not heated to such an extent as to crack the bulb of the lamp at the seal. The electrodes 12—12 must also be sufficiently large to withstand the abnormal current flow without damaging their activating properties. Furthermore, in some cases, as when operating on a 220 volt line, it is desirable to shunt only a portion of the ballasting device for the lamp 10 so that the lamp is not excessively overloaded. When using the device as a signalling means, the push button 50 in Fig. 2 may be replaced by a periodic circuit closing means, such as a drum type switch or a cam switch, to cause the lamp to flash periodically. The lamp may also be electrically modulated, without the use of the time control means 20, to cause it to be flashed, for example, thirty times per second. The lamp must of course be suitably designed to withstand the frequent overloading.

What I claim as new and desire to secure by Letters Patent of the United States is:

The combination of an electric discharge lamp having a pair of electrodes, a ballasting device, said electrodes being connected through said ballasting device to a source of electrical energy for normal operation of the lamp, means for shunting out at least a portion of said ballasting device to permit an abnormal amount of current to flow through said lamp and produce a flash of light of high intensity, and time control means for automatically cutting out the said shunting means after a very brief interval of time to cause the said lamp to again operate under normal conditions, said time control means comprising a circuit including a relay and resistance element whose resistance varies rapidly with change in temperature, the change in resistance of said resistance element due to current passing therethrough causing said relay to be actuated to interrupt said shunting means.

GEORGE E. INMAN.