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DISCHARGE LAMP CONTROL SYSTEM WITH AN ELECTROMAGNETIC
LOCK FOR THE SIMMERING SHUTTER

2,608,640

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2 SHEETS—SHEET 1

Fig. 1.

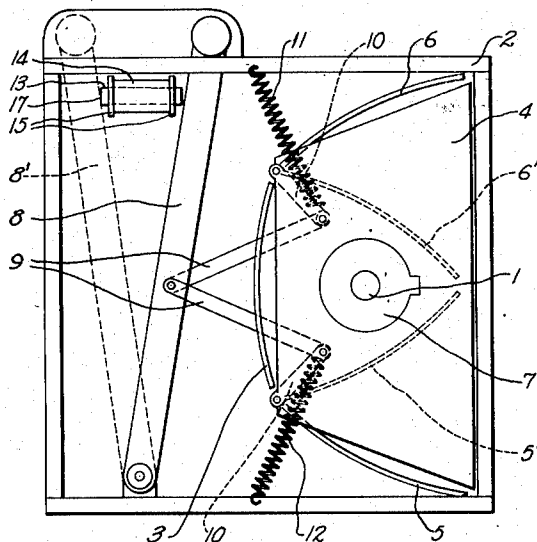
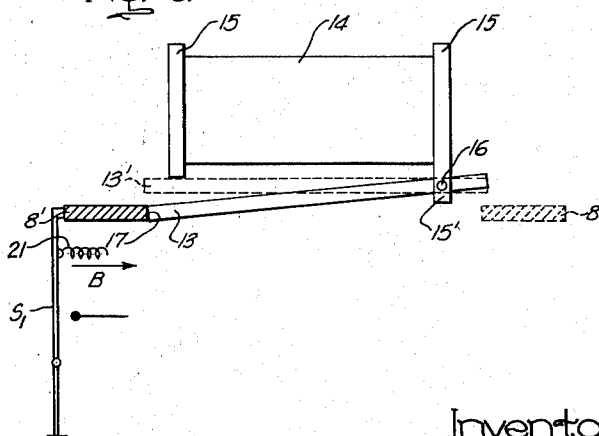


Fig. 3.



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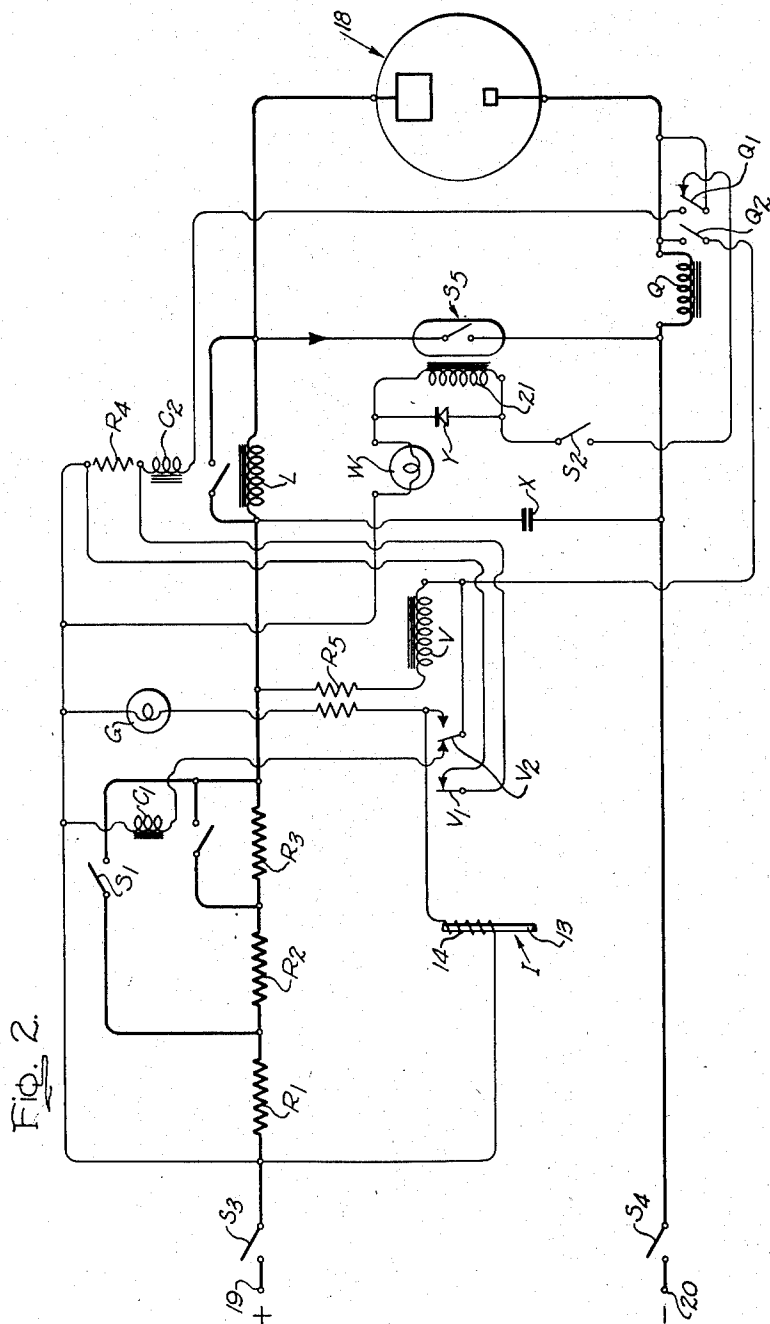
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2 SHEETS—SHEET 2



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DISCHARGE LAMP CONTROL SYSTEM WITH
AN ELECTROMAGNETIC LOCK FOR THE
SIMMERING SHUTTERAnthony H. Willoughby, Rickmansworth, Eng-
land, assignor to General Electric Company, a
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2 Claims. (Cl. 240—11.4)

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This invention relates to improvements in a lighting arrangement comprising a circuit for operating a high pressure metal vapor electric discharge lamp and a housing for the lamp which is adapted to enclose the lamp and is provided with at least one shutter which can be opened for permitting light from the lamp to emerge.

Arrangements of this type are often employed in floodlighting units used for the illumination of subjects to be photographed, for example in film studios and photographic studios. In such arrangements, if the shutters are opened too soon after the lamp is switched on, and before the lamp has fully run up, the light obtained at first may not be of sufficient brightness or may not be of the required color; variations in the lighting which might be thus produced are highly undesirable in photographic operations and correct color of the light is, of course, essential for color photography.

An object of my invention is to provide a new and improved lighting arrangement of the above type. Another object of my invention is to provide a new and improved starting and operating circuit for electric discharge lamps which will control the opening and closing of shutters mounted on a housing for the lamp thus regulating the light emerging from the housing. A further object of my invention is to provide a new and improved circuit and device for locking shutters on a lamp housing in the closed position and for unlocking the shutters only when the lamp has attained approximately its normal operating pressure. Further features and advantages of my invention will appear from the following detailed description of species thereof.

According to my present invention, a lighting arrangement comprises a circuit for operating a high pressure metal vapor electric discharge lamp, a housing for the lamp adapted to enclose the lamp and provided with at least one shutter which can be opened for permitting light from the lamp to emerge, means for locking each said shutter in the closed position and means for unlocking said shutter or shutters adapted to be operated from the said circuit in a manner such that each said shutter is unlocked, so that it can then be opened only when the lamp has attained approximately its normal operating pressure.

Preferably the said means for unlocking the shutters comprises a relay adapted to be operated by the voltage across the lamp when the voltage has risen to a value corresponding to the normal operating pressure of the lamp.

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In a preferred method of carrying out the invention, the coil of an interlock relay is connected in series with contacts actuated by the voltage-operating relay, which operates the said contacts to close the energizing circuit of the said coil when the voltage across the lamp electrodes has risen to a specified minimum value, corresponding to the minimum operating pressure at which the lamp is usable, and the interlock relay is adapted to effect the actual locking and unlocking of the shutter or shutters.

In the drawings accompanying and forming part of this specification one form of the invention is shown by way of example, in which Fig. 1 is a diagrammatic plan view of the arrangements within a lamp housing according to the invention; Fig. 2 is a wiring diagram of the associated circuit arrangement, and Fig. 3 is a side-elevational view showing the mechanical details of the operation of the interlock relay.

Referring to Fig. 1, a lamp holder 1, adapted to support a high pressure metal vapor lamp, is mounted in a housing 2 comprising metal reflectors in sections situated above, below, behind and at the sides of the lamp. Only the reflector section 3, 4, 5 and 6, situated respectively behind, above and at the sides of the lamp, are shown in the drawing; the side sections, which form shutters adapted to close over the lamp, are shown in the open positions at 5, 6, and their closed positions are indicated by broken lines at 5', 6'. The top reflector section 4 is provided with an aperture 7 for permitting the passage of leads to the lamp. The side sections 5 and 6 are arranged to be simultaneously closed over the lamp or opened by means of a manually operated lever 8 located at the back of the housing, the lever operating the shutters through link members 9, 10 biased by springs 11, 12. The lever 8 is shown by full lines in the shutters-open position, and by broken lines at 8' in the shutters-closed position. The lever 8 is locked, with the shutters closed, by means of an interlock relay which comprises an electromagnet consisting of a soft iron bar 13 and an operating coil 14.

The interlock relay 13, 14 is shown in greater detail in Fig. 3, which comprises a side elevation of the relay and shows that the coil 14 has magnetic end pieces 15, and that the soft iron bar 13 is pivoted on the downward extension 15' of one of the end pieces by means of a pin 16. The lever is shown in section in the shutters-closed position at 8', and its shutters-open position is indicated in broken lines at 8. The bar 13 is arranged so that the free end, 17, abuts against

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the lever in the position 8, as shown in Figs. 1 and 3, thus preventing it from being moved into the position 8 to open the shutters 5 and 6, until the coil 14 is energized by means of a relay operated by the voltage across the lamp, as will be described later. When the said voltage attains the required minimum value, current flows through the coil 14 and the soft iron bar 13 is then attracted towards the coil and moves upwards into the position 13' indicated by broken lines in Fig. 3, thus releasing the lever 8 which is then free to move, in a direction indicated by the arrow B (Fig. 3), at right angles to the direction of movement of the bar 13, from the position 8' to the position 8, thus opening the shutters 5 and 6.

In Fig. 2, which shows diagrammatically the circuit arrangements associated with the lamp housing shown in Fig. 1, the lamp 18, which in this example is a high pressure mercury vapor discharge lamp operated on direct current and adapted to dissipate $2\frac{1}{2}$ kw., is connected to supply-terminals 19, 20 adapted to be connected to a D. C. mains supply, for example 115 volts, in the polarity indicated, and the lamp has in series with it three resistances R_1 , R_2 , R_3 and a choke L; a starter switch S_1 is connected in parallel with the lamp 18. The starter switch S_1 may be an electro-magnetically operated vacuum switch, and the operating coil 21 thereof may be connected in series with a control switch S_2 and the contacts Q_1 of a current-operated relay Q which is arranged in series with the lamp 18 so as to be operated by the current through the lamp, so that when the lamp starts the said contacts Q_1 operate to open-circuit the operating coil 21 of the vacuum switch S_1 , whereby accidental operation of the switch S_1 is prevented. Also the operating coil 21 of the vacuum switch may be shunted by a rectifier Y and connected in series with a voltage-dropping resistance W, suitably the filament of an indicator lamp, for protecting the lamp 18 against wrong polarity of connection to the D. C. supply. A condenser X may be connected across the lamp 18 and the choke L, to prevent the inductive pulse produced across the choke for starting of the lamp from being fed back into the mains circuit.

The current-operated relay also operates, via the contacts Q_1 , which are changeover contacts, a contactor C_2 which short circuits the choke L when the lamp has started; a resistance R_4 shunted by contacts V_1 , to be referred to later, is connected in series with the contactor C_2 and the mains supply, in order to reduce the current flowing through the contactor when the interlock relay is in operation, as will be explained below.

The coil of the voltage-operated relay V provided in accordance with this invention is arranged to be connected across the lamp in series with a current-limiting resistance R_5 by closing of the contacts Q_2 of the current-operated relay Q when the lamp starts. This voltage-operated relay V is adapted to operate only when the voltage across the lamp attains a given value, for example 50 volts, and it then actuates the interlock relay I via contacts V_2 to enable the lamp shutters to be opened. The coil 14 of the interlock relay is connected across the mains supply in series with the contacts V_2 , which are changeover contacts, operated by the voltage-operated relay V to close the energizing circuit of the coil 14. When a current flows through the coil 14 the end 17 of the soft iron bar 13 abutting against the lever 8 (Figure 1 and 3) is attracted to the

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magnet, thus releasing the lever, which may then be manually operated to open the shutters 5 and 6, as described above with reference to Figs. 1 and 3.

Preferably the circuit also includes an arrangement whereby, after the lamp 18 has attained its operating pressure, it can be "simmered," that is, run at a low current and therefore at a power dissipation considerably below its operating dissipation, as long as the shutters 5 and 6 are closed, but automatically attains its full operating dissipation when the shutters are opened. The lamp 18 can thus be maintained ready for immediate use while it is not required. To that end the arm of switch S_1 in its open position is spring pressed against the lever 8 in the shutters-closed position 8' of the relay (Fig. 3). As the lever is moved toward its open-shutter position 8 the arm of switch S_1 is moved by the spring 21 to its closed position. Two of the resistances in series with the lamp, viz R_2 and R_3 , thus are short circuited, so that the full operating circuit then flows through the lamp 18, which thus automatically dissipates its full power simultaneously with the opening of the shutters 5 and 6.

In operating the lamp by the arrangement described, the shutters should be closed before closing the mains switch S_3 , S_4 and a conventional mechanical interlock (not shown) may be arranged to prevent the mains switch being closed if the shutters are open. During the starting period, that is, after the discharge has struck but before the operating pressure has been attained, two of the three resistances arranged in series with the lamp, viz. R_1 and R_2 , are operative, the third, R_3 , being cut out by means of a contactor C_1 which is automatically closed during the starting period as described below. To start the lamp, the control switch S_2 for the vacuum switch S_1 is closed and then opened, so closing and opening the vacuum switch. Whilst the vacuum switch S_1 is closed, the inductor L as well as the resistances R_1 and R_2 , is in series with it, and this inductor is wound with high resistance wire so as to limit to a safe value the current flowing through the switch. When the vacuum switch opens, an inductive pulse, for example of about 1000 volts, is produced across the choke L and causes the lamp to strike. The passage of current through the lamp then operates the relay Q which is in series with the lamp and causes the relay to change over the contacts Q_1 and close the contacts Q_2 so as to close contactor C_1 short-circuit the choke L (via Q_1 and C_2), open-circuit the cooperating coil of the vacuum switch (via Q_1) and connect the voltage-operated relay V across the lamp (via Q_2). At this stage the resistance R_4 in series with the choke contactor C_2 is short-circuited by means of contacts V_1 subsequently to be opened by the voltage-operated relay V.

When the lamp starts, the voltage across it is very low, for example only about 15 to 20 volts; when this voltage has risen to, say, 50 volts, the lamp is dissipating sufficient power for use, but the voltage may continue to rise and may ultimately reach a steady value of, for example, 70 to 80 volts. When the voltage attains the required value, say 50 volts, the voltage-operated relay V is actuated to operate the interlock relay I to release the shutter lever as already described, and to connect an indicator G, such as a green lamp, across the mains via V_2 to indicate that the discharge lamp 18 is ready for use. The voltage-operated relay V also opens the contactor C_1

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(via V_2) which was short circuiting the third resistance R_3 , so that all three resistances R_1 , R_2 , and R_3 are now in series with the lamp 18, which under these conditions dissipates considerably less than its full power, for example 1 kw. Another function of the voltage-operated relay is to open the contacts V_1 which were short-circuiting the resistance R_4 in series with choke contactor C_2 .

When the lamp is required to be used, the shutters 5 and 6 are opened by manually operating the lever 3 (Figs. 1 and 3) which is now free to move, and the opening of the shutters automatically short circuits the resistances R_2 and R_3 as described (via S_1), so that the lamp immediately dissipates its full operating power.

This application is a continuation in part of my application Serial No. 42,231, filed August 3, 1948, and owned by the General Electric Company the assignee of the present application and abandoned after the filing of this application.

While I have shown and described my invention as applied to particular systems of connections and as embodying various devices diagrammatically shown, it will be obvious to those skilled in the art that changes and modifications may be made without departing from my invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. In combination, a high pressure metal vapor discharge lamp, a circuit for operating said lamp, a housing enclosing said lamp and provided with a manually operable shutter, electromagnetic means positioned to lock said shutter in its closed position before said lamp has attained a predetermined minimum operating voltage and to unlock said shutter after said lamp has attained said voltage, and electric relay means having its coil electrically connected across said lamp so that the operation of said relay means is controlled by the operating voltage of the lamp and having a pair of contacts connected with the coil of said

electromagnet means, said relay means being operable to energize said electromagnet means and unlock said shutter when said lamp has attained said minimum operating voltage.

2. In combination, a high pressure metal vapor discharge lamp, a circuit for operating said lamp including series ballast resistance means, a housing enclosing said lamp and provided with a manually operable shutter, electromagnetic means positioned to lock said shutter in its closed position before said lamp has attained a predetermined minimum operating voltage and to unlock said shutter after said lamp has attained said voltage, and electric relay means having its coil electrically connected across said lamp so that the operation of said relay means is controlled by the operating voltage of the lamp and having a pair of contacts connected with the coil of said electromagnet means, said relay means being operable to energize said electromagnet means and unlock said shutter when said lamp has attained said minimum operating voltage, and switch means mechanically linked with said shutter so as to move to a closed circuit position on opening of said shutter and electrically connected in shunt with a portion of said ballast resistance means whereby the lamp operates at full power and brilliance on the opening of said shutter.

ANTHONY H. WILLOUGHBY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,405,286	Bourne	Aug. 6, 1946
2,412,292	Schneider	Dec. 10, 1946

FOREIGN PATENTS

Number	Country	Date
579,034	England	July 22, 1946
579,920	England	Aug. 21, 1946