

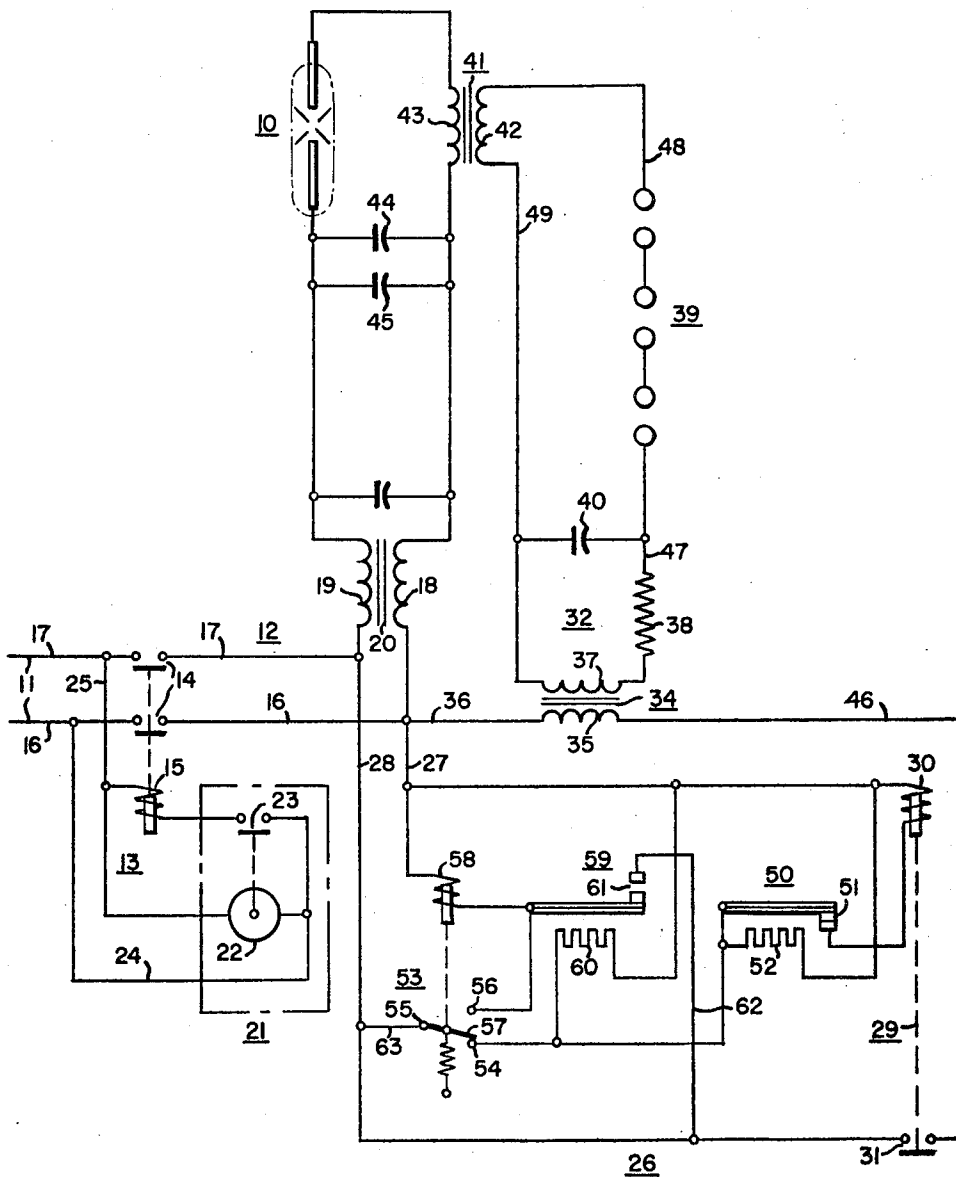
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STARTING CIRCUIT CONTROL FOR ARC LAMPS

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WITNESSES

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STARTING CIRCUIT CONTROL FOR ARC LAMPS
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This invention relates generally to a circuit system for supplying short-arc mercury lamps, and more particularly, to circuit systems for automatically delivering a supply voltage and a higher starting voltage for short-arc mercury lamps and the like when the operation of the circuit system has been initiated.

The object of the invention is to provide for the automatic starting and operation of a short-arc mercury lamp.

It is also an object of the invention to provide for the application of a starting voltage to short-arc mercury lamps for a predetermined time while maintaining the normal supply voltage.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth in more detail.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, the single figure of which is a circuit diagram of a system for supplying a normal supply voltage and a starting voltage to a short-arc mercury lamp embodying the features of the invention.

Referring now to the drawing, the short-arc mercury lamp shown generally at 10 may be any of the well-known types commonly used in beacons, and other similar installations. It is well-known that these short-arc mercury lamps, as they are called in the trade, are operated from the power supply lines ordinarily found in cities and in buildings where such beacons are installed.

Further, the ordinary 115 volt lines do not deliver a high enough voltage to affect the starting of these lamps and, accordingly, in order to start or fire the lamp, a higher starting voltage has to be provided. This is usually effected by providing in the circuit system, a means for stepping up the voltage to that required for effecting the starting of the lamp. Since voltages of the order of 50,000 volts and a high frequency current are required, a circuit system is provided which is capable of stepping up the voltage from 115 volts to about 50,000 volts and providing a high frequency current.

In this particular embodiment of the invention, a power source 11 capable of supplying 115 volts and about 75 amperes is provided. The circuit system shown generally at 12 is connected to the power source 11 and the flow of current in the circuit system is controlled by the relay operated switch shown generally at 13 comprising a plurality of contact members 14 and an actuating coil 15.

The circuit for delivering the supply voltage for normal operation of the lamp extends from the power source 11 through the conductor 16 to the short-arc mercury lamp 10 back through conductor 17 to the power source. Therefore, when the relay switch 14 is closed, a circuit is established which is capable of delivering current to the lamp 10. Lamps of this type take a rather heavy current of the order of 30 or 40 amperes and the circuit for

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supplying the lamp must have corresponding current conducting capacity.

As has been pointed out, the starting voltage will be stepped up to a high value, for example, 50,000 volts and the current delivered will be of a high frequency. In order to prevent these high frequency currents from returning to the line and interfering with the local circuit system, a plurality of choke coils 18 and 19 mounted on a common core 20 are connected with the conductors 16 and 17. They function primarily as reactive current limiting ballasts for the lamp 10. Further, the choke coils 18 and 19 screen out the high frequency currents and make it possible to connect the supply circuit to the circuit systems readily available in most cities and other localities where such beacons are installed.

It is common practice in making installations of beacons to provide for manually initiating the operation of the circuit systems provided for starting and supplying the beacon. In this particular embodiment of the invention, a time clock, shown generally at 21, or some similar device is provided for initiating the operation of the circuits. The time clock 21 may be of any well-known type comprising an operating mechanism 22 and contact members 23.

The clock mechanism 22 will be set to close the contact members 23 at a predetermined time. When the contact members 23 are closed, an energizing circuit is established for the actuating coil 15 of the relay shown generally at 13. This circuit extends from the conductor 16, through the conductor 24, contact member 23, the actuating coil 15 and conductor 25, back to the conductor 17 of the supply line. The energization of the coil 15 closes the contact members 14 and the supply circuit system is established.

When the circuit for supplying a normal operating voltage to the lamp 10 is established the control circuit, shown generally at 26, is energized. As shown, the control circuit is connected through conductors 27 and 28 to the supply lines 16 and 17, respectively. The relay 29 which controls the circuit for delivering a starting voltage to the short-arc mercury lamp 10 comprises an actuating coil 30 and normally open contact members 31. When the circuit system for supplying a normal operating voltage to the lamp is connected to the power source 11 through the operation of the relay shown generally at 13, a voltage will be impressed across the actuating coil 30 of the relay 29. The contact members 31 will be closed and the circuit for supplying the starting voltage will be established.

In order to facilitate the tracing and explanation of the circuit for supplying the starting voltage, certain units connected in the starting voltage circuit will be first explained. A unit shown generally at 32 for stepping up the voltage and providing a high frequency current is connected into the circuit for supplying the starting voltage. This unit comprises a step-up transformer shown generally at 34 provided with a primary transformer winding 35 connected through a conductor 36 to the conductor 16 of the circuit provided for supplying a normal operating voltage to the lamp 10. The secondary transformer winding 37 of the transformer 34 is connected in series circuit relationship with a resistor 38. In order to supply a high frequency current to the short-arc lamp 10, a series of arc gaps 39 are connected in series circuit relationship with the resistor 38. A capacitor 40 is connected between one terminal of the sec-

ondary winding 37 of the transformer and the terminal of the resistor 38 remote from the secondary winding 37 of the transformer 34. This capacitor cooperates to provide a tuned circuit. The transformer 34 may be designed to give any desired step-up in voltage. In this embodiment of the invention, the transformer should step up the voltage at the secondary terminals to about 6000 volts, or higher, to be satisfactory.

In addition to the transformer 34, another step-up pulse transformer shown generally at 41 is provided. The primary winding 42 is connected across the secondary winding 37 of the transformer 34. The secondary winding 43 is connected across the short-arc mercury lamp 10. As shown the capacitors 44 and 45 are connected in parallel and between the secondary winding 43 of the step-up pulse transformer shown generally at 41 and one terminal of the lamp 10. These capacitors in giving a tuned circuit provide a high frequency return circuit through which the power or resulting current supplied to the lamp 10 by pulse transformer 41 flows. The capacitors also prevent high frequency currents from getting back into the primary circuit. The pulse transformer, if it has a ratio of 10 to 1 will step-up the voltage applied to the lamp 10 to 60,000 volts which is adequate for starting.

When the relay shown generally at 29 is actuated, a circuit for supplying a starting voltage which is high in comparison with the supply voltage is established. This starting circuit extends from the supply conductor 17 through conductor 28, the relay contacts 31, the conductor 46, the transformer primary winding 35 and conductor 36 back to a supply line conductor 16. The secondary winding 37 of the transformer 34 is energized and current flows from the transformer through resistor 38, conductor 47, the arc gaps shown generally at 39, converting the current into a high frequency current, conductor 48, the primary winding 42 of the pulse transformer shown generally at 41 and conductor 49 back to the secondary 37 of the transformer 34. The secondary winding 43 of the transformer shown generally at 41 will impress a starting voltage across the lamp 10.

It is well-known that a short-arc mercury lamp cannot carry a starting voltage of 50,000 to 60,000 volts for any appreciable time without greatly shortening its life. Therefore, provision is made in conjunction with relay 29 for limiting the time during which the starting voltage may be applied across the lamp 10. In this particular embodiment of the invention, a temperature sensitive time-delay relay shown generally at 50 having normally closed contact members 51 and a temperature responsive element 52 is provided. As shown, the normally closed contact members 51 are connected in series circuit relationship in the energizing circuit for the relay actuating coil 30. Relays of this type are well-known and are designed to give any predetermined operating characteristic. In a circuit system of this type, it has been found to be satisfactory to provide a temperature sensitive element which will function in five seconds when connected across a heating circuit.

It is not necessary to subject the arc lamp 10 to a starting voltage for five seconds. Ordinarily, two or three seconds is adequate. However, it has been found that lamps of this type can stand a starting voltage of 50,000 to 60,000 volts for five seconds without being seriously impaired.

In the operation of the system, when the heating element 52 is caused to open the normally closed contact members 51, the energizing circuit for the actuating coil 30 of the relay shown generally at 29 will be interrupted and the contact members 31 will open. This interrupts the circuit for supplying the starting voltage to the lamp 10. In order to assure that the energizing circuit for the actuating coil 30 will not be established as soon as the element 52 cools down, a spring operating double throw relay shown generally at 53 is provided.

The relay 53 comprises three contact members 54, 55 and 56, a contactor 51 for bridging the contact members 54 to 56, inclusive, and an actuating coil 58. The contactor 57 is normally biased to bridge the contact members 54 and 55. When the contactor 57 stands in engagement with the contact members 54 and 55, it cooperates in establishing or is a link in the energizing circuit for the relay coil 30.

A second heat responsive relay, shown generally at 59 is provided with a heat sensitive element 60 and normally open contact members 61. This relay cooperates with the relay shown generally at 53. If the relay 50 fails to function, then the relay shown generally at 59 will cooperate with the spring biased relay shown generally at 53 and effect an interruption of the circuit for applying a starting voltage to the lamp 10.

In operation, when the heat sensitive element 60 reaches a predetermined temperature, it will effect the closure of the contact members 61. When the contact members 61 stand closed, an energizing circuit for the actuating coil 58 of the relay 53 is established. The actuating circuit for the relay 53 extends from the line conductor 16 through conductor 27, the actuating coil 58 of the relay 53, the closed contact members 61 of the relay 59 and conductors 62 and 28 back to the line conductor 17.

When the actuating coil 58 is energized, the contactor 57 is operated and opens the energizing circuit of the actuating coil 30 of the relay 29 and establishes a holding circuit for the actuating coil 58 of the relay 53. The holding circuit extends from line conductor 16 through conductor 27, the actuating coil 58 of the relay 53, contact members 56 and 55, bridged by the contactor 57 and conductors 63 and 28 back to the line conductor 17.

When the contactor 57 is actuated, it breaks the connection between the contact members 54 and 55 and bridges the contact members 55 and 56. In this manner, two relays are provided for interrupting the energizing circuit of the relay shown generally at 29. Therefore, if the relay, shown generally at 50, for some reason or other failed to operate, the functioning of the relay 59 to operate the relay, shown generally at 53 will assure the operation of the relay 29 to interrupt the circuit for supplying a starting voltage to the lamp 10.

If for any reason there is a power failure at the power source 11, the holding circuit for the relay 53 is de-energized and the spring biased contactor 57 is actuated and bridges the contact members 54 and 55. The operation of the contactor 57 into engagement with contact members 55 and 56 means that current ceases to be supplied to the heating elements 52 and 60 of the relays 50 and 59 and they cool and return to a power off position. Therefore, if there is a power failure, relays 50 and 59 are ready to function as soon as power is restored. As a result, the only thing that happens now on power failure is the operation of the spring biased relay 53. Therefore, the conditions that existed prior to the closing of the contact members 23 are reestablished and the elements 52 and 60 are connected to the power circuit. Consequently, when power is restored to the power source 11, the cycle of operation described hereinbefore would follow and a starting voltage would again be applied to the lamp 10 and when it is fired, the supply circuit will maintain it lighted.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a circuit system for an arc lamp requiring a starting voltage higher than the operating voltage, in combination, a circuit for delivering a supply voltage to the arc lamp, a control circuit responsive to predetermined con-

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ditions for closing the supply voltage circuit to the arc lamp, a circuit for delivering a starting voltage to the arc lamp, means responsive to the closing of the supply voltage circuit to the arc lamp for automatically closing the starting voltage circuit to the arc lamp, and means being energized by said supply circuit to be operable at a predetermined time after a starting voltage has been applied to the arc lamp for automatically interrupting the starting voltage circuit.

2. In a circuit system for an arc lamp requiring a starting voltage higher than the operating voltage, in combination, a circuit for delivering a supply voltage to the arc lamp, a control circuit responsive to predetermined conditions for closing the supply voltage circuit to the arc lamp, a circuit for delivering a starting voltage to the arc lamp, a relay responsive to the closing of the supply voltage circuit for automatically closing the starting voltage circuit to the arc lamp, and means being energized by said supply circuit to be operable at a predetermined time after a starting voltage has been applied to the arc lamp for automatically interrupting the starting voltage circuit.

3. In a circuit system for an arc lamp requiring a starting voltage higher than the operating voltage, in combination, a circuit for delivering a supply voltage, a control circuit responsive to predetermined conditions for closing the supply voltage circuit, a circuit for delivering a starting voltage to the arc lamp, a relay responsive to the closing of the supply voltage circuit for automatically closing the starting voltage circuit to the arc lamp, a time delay relay being energized by said supply circuit to be operable at a predetermined time after a starting voltage has been applied to the arc lamp for automatically interrupting the starting voltage circuit.

4. In a circuit system having an arc lamp requiring a starting voltage higher than the operating voltage, in combination, a circuit for delivering a supply voltage to the arc lamp, a control circuit responsive to predetermined conditions for closing the supply voltage circuit, a circuit for delivering a starting voltage to the arc lamp, a relay responsive to the closing of the supply voltage circuit for closing the starting voltage circuit to the arc lamp, a time delay relay operable at a predetermined time after the circuit starting voltage has been closed for interrupting the starting voltage circuit to the arc lamp, a double throw relay controlling the energization of the relay provided for closing the starting voltage circuit to the arc lamp, a second time delay relay which stands normally open to establish an actuating circuit for the double throw relay, the double throw relay when energized interrupting the energizing circuit for the relay which functions to apply the starting voltage to the arc lamp, and a holding circuit for the double throw relay established upon the energization of the double throw relay.

5. In a circuit system for an arc lamp, requiring a starting voltage higher than the operating voltage, in combination, a circuit for delivering an operating supply voltage to the arc lamp, a control circuit controlled by a time clock for closing the circuit for delivering the operating supply voltage to the arc lamp, a circuit for delivering a starting voltage to the arc lamp, a relay responsive to the closing of the supply voltage circuit for automatically closing the starting voltage circuit to the arc lamp, and means being energized by said supply circuit to be operable at a predetermined time after a starting voltage has been applied to the arc lamp for automatically interrupting the starting voltage circuit.

6. In a circuit system for a short-arc mercury lamp requiring a higher voltage for starting than for operation, in combination, a circuit for applying a starting voltage to the short-arc mercury lamp, a relay for closing the starting voltage circuit to the short-arc mercury lamp, an energizing circuit for the relay closing the starting voltage circuit, a temperature responsive relay with normally closed contacts connected in the energizing circuit of the

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relay for closing the starting voltage circuit, a biased relay also connected in the energizing circuit of the relay for closing the starting voltage circuit of the short-arc mercury lamp, a temperature responsive relay with normally open contact members for effecting the operation of the biased relay, the temperature responsive relay with normally closed contacts and the biased relay both being disposed to control the operation of the starting voltage relay to interrupt the application of the starting voltage, and a holding circuit for the biased relay established upon the operation of the temperature responsive relay with the normally open contact members and the operation of the biased relay whereby the starting voltage circuit remains interrupted until the holding circuit is interrupted.

7. In a circuit system for a short-arc mercury lamp requiring a higher voltage for starting than for operation, in combination, a power source, a circuit for supplying an operating voltage to the short-arc mercury lamp connected to the power source, means for controlling the flow of current from the power source to the circuit for supplying an operating voltage to the short-arc mercury lamp, a circuit for supplying a starting voltage to the short-arc mercury lamp, means connected in the starting voltage circuit to the short-arc mercury lamp for stepping up the voltage and converting it to a high frequency supply, a first relay connected across the supply voltage circuit automatically to make and interrupt the starting voltage circuit, and a time delay relay standing in normally closed position being energized by said supply circuit to effect the operation of said first relay in making the starting voltage circuit and in interrupting the starting voltage circuit after a predetermined time interval.

8. In a circuit system for a short-arc mercury lamp requiring a higher voltage for starting than operation, in combination, a circuit for delivering a supply voltage to the short-arc mercury lamp, a power source, means for connecting the circuit for delivering an operating supply voltage to the power source, choke coils connected in the supply voltage circuit to the arc lamp for preventing high frequency currents from flowing in the supply voltage circuit, a circuit for delivering a starting voltage to the short-arc mercury lamp including means for providing said starting voltage with a high frequency, a relay connected across the power source for automatically closing and automatically interrupting the starting voltage circuit to the short-arc mercury lamp, a time delay relay associated with the relay for closing and interrupting the starting voltage circuit, the time delay relay being energized by said supply circuit to effect the automatic interruption of the starting voltage circuit after a predetermined interval of time.

9. In a circuit system for a short-arc mercury lamp requiring a higher voltage for starting than for operation, in combination, a power source, a circuit for delivering an operating voltage to the short-arc mercury lamp connected to the power source and means for controlling the flow of current from the power source through the circuit for delivering an operating voltage supply to the short-arc mercury lamp, a circuit for delivering a starting voltage to the short-arc mercury lamp connected across the power supply, means connected in the circuit delivering a starting voltage to the short-arc mercury lamp for stepping up the voltage and converting the current from the power supply into a high frequency supply, a relay for making and interrupting the circuit delivering the starting voltage to the short-arc mercury lamp, an energizing circuit for the relay controlling the delivery of the starting voltage, a time delay relay having normally closed contact members connected in the energizing circuit for the relay controlling the starting voltage circuit, a biased relay also connected into the energizing circuit for the relay controlling the starting voltage circuit, a second time delay relay having normally open contacts controlling the energization of the biased relay and cooper-

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ative to establish a holding circuit for the biased relay.

10. A circuit arrangement comprising a supply voltage circuit, means for automatically controlling the continuity of said supply circuit, a circuit for delivering a starting voltage across a discharge path, means responsive to said supply circuit upon a closing of said supply circuit for automatically closing said starting circuit, and means being energized by said supply circuit at a predetermined time after a starting voltage has been applied across said path for interrupting said starting circuit.

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