

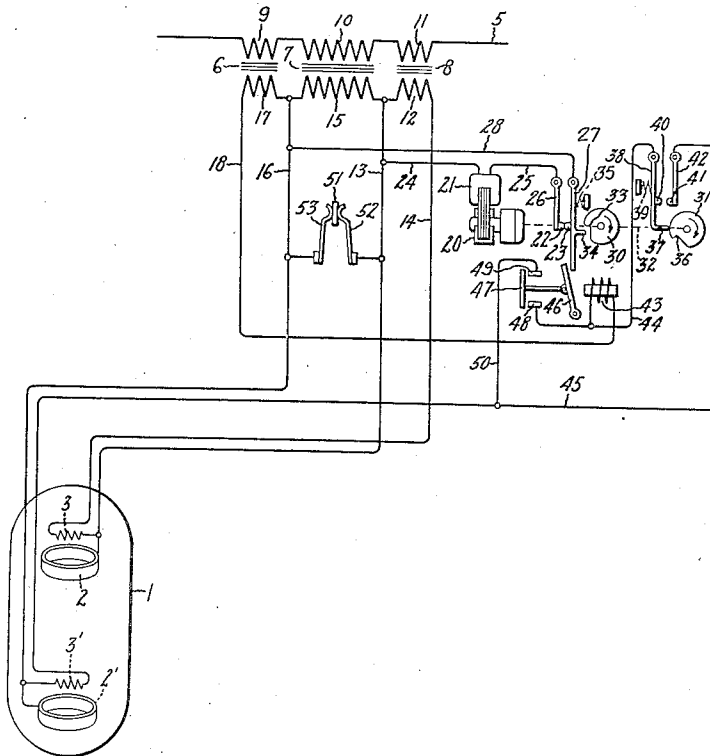
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STARTING APPARATUS FOR ELECTRIC DISCHARGE LAMPS AND THE LIKE

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## UNITED STATES PATENT OFFICE

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STARTING APPARATUS FOR ELECTRIC  
DISCHARGE LAMPS AND THE LIKEJustin Peterson, Saugus, Mass., assignor to Gen-  
eral Electric Company, a corporation of New  
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My invention relates to a starting apparatus for electric discharge lamps and the like and more particularly to an apparatus for starting the operation of sodium vapor discharge lamps.

One object of my invention is to provide an improved apparatus for applying the normal operating voltage across the discharge lamp after the thermionic cathode has been energized for a predetermined time and therefore has reached the proper operating temperature.

Another object of my invention is to provide a starting apparatus which will repeat its complete cycle of operation after each interruption of current to the discharge lamp.

For a better understanding of my invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

The accompanying drawing illustrates diagrammatically a starting mechanism built in accordance with my invention applied to a sodium vapor discharge lamp having two anodes and two cathodes. The same starting mechanism, of course, may be applied to a lamp having a single anode and a single cathode. The discharge lamp herein referred to is of a known type. It comprises a glass envelope containing a gas, such as neon, and a metal, such as sodium, which is vaporized at the operating temperature of the lamp. Electric current flowing from the cathode to the anode, which are sealed into the glass envelope, ionizes the gas and vapor and thereby generates light.

Referring to the drawing in detail, the discharge lamp 1 provided with anodes 2 and 2' and thermionic filamentary cathodes 3 and 3' is diagrammatically illustrated as being supplied with current from a series circuit 5 through transformers 6, 7 and 8. The primary windings 9, 10 and 11 of the transformers 6, 7 and 8 respectively are connected in series with each other in the series circuit 5. A secondary winding 12 of transformer 8 is connected directly to the cathode 3, which in the present embodiment comprises a metal filament, through conductors 13 and 14. A secondary winding 15 of transformer 7 is connected to the two anodes 2 and 2' through conductors 13 and 16 respectively. A secondary winding 17 of transformer 6 is connected to one end of the cathode 3' through conductors 16 and to the starting apparatus by conductor 18.

The starting apparatus comprises a synchronous motor 20 whose winding 21 is connected across the conductors 13 and 16 in series with a

pair of contacts 22 and 23 which are normally closed thereby establishing a shunt circuit across the secondary winding 15. This shunt circuit may be traced from conductor 13 to conductor 24, motor winding 21, conductor 25, contact arm 26, contacts 22 and 23, contact arm 27, conductor 28 and conductor 16. The motor 20 operates a pair of cams 30 and 31 through a shaft 32. The cam 30 is provided with a notch 33, which in the drawing is shown as being directly opposite to a projection 34 on the contact arm 27. In this position of the cam, therefore, the contact arm 27 may be moved against the pressure of a spring 35 so that the contact 23 is separated from contact 22. When the cam is moved so that the notch 33 does not register with the projection 34, the projection rides on the cam surface and the contact arm 27 cannot be moved to break the circuit through contacts 22 and 23. The shunt circuit through contacts 22 and 27 is a circuit of sufficiently low resistance to prevent a voltage rise high enough to start the lamp. The voltage rise caused by the motor winding 21 is inconsequential.

The cam 31 is provided with a notch 36 which is angularly displaced from notch 33 in a counterclockwise direction, as shown in the drawing. The nose 37 of contact arm 38 is positioned to ride on the surface of this cam. When the cam 31 is moved so that the notch 36 registers with the nose 37, the contact arm 38 is moved inwardly by a spring 39, and carries its contact 40 into engagement with a contact 41 mounted on contact arm 42 and thereby establishes a circuit to the filamentary cathode 3' through a relay coil 43. This circuit may be traced from the secondary winding 17, conductor 18, relay coil 43, conductor 44, contact arm 38, contacts 40 and 41, contact arm 42 and conductor 45 to cathode 3'.

When relay coil 43 is energized it attracts its armature 46 which is pivoted at one end and engages the contact arm 27 at the other end. When the notch 33 is opposite projection 34 on the contact arm 27, the pivoted armature 46 moves the contact arm 27 and thereby separates contacts 22 and 23, thereby breaking the circuit. The armature 46 also has attached thereto a contact member 47 which is pulled into engagement with contacts 48 and 49, as soon as the relay coil 43 is energized. This engagement of the member 47 with contacts 48 and 49 continues through the subsequent movement of the armature 46 when it separates the contacts 22 and 23 until the coil 43 is deenergized. With this arrangement therefore a locking circuit for the relay coil is established by the contact member 47

as soon as the contacts 40 and 41 engage and is maintained as long as current flows in the line 5. This locking circuit is in shunt to the contacts 40 and 41 and may be traced from conductor 44 to contact 46, contact member 47, and contact 49 to conductors 50 and 45.

In operation the above-described mechanism and circuit provide for an immediate energization of cathode 3 when current is turned on in the series circuit 5. The contacts 22 and 23 being normally closed permit an operating current to flow through the motor coil 21 and cause it to turn the cams 30 and 31 clockwise. As stated above, the notch 36 is angularly displaced from the notch 33 by a few degrees, so that shortly after the motor coil is energized the notch 36 registers with nose 37 on contact arm 38 and permits this contact arm to move its contact 40 into engagement with the contact 41. A circuit is thereby established through the relay coil 43 and through the cathode 31. Simultaneously the cam 30 has moved so that the notch 33 is now out of line with the projection 34 on contact arm 27, which now rides on the cam surface, and the armature 46 cannot separate the contacts 22 and 23. The motor, therefore, keeps on turning the cams and again separates the contacts 40 and 41. This is immaterial, however, as far as the relay coil circuit is concerned, since its circuit is closed through the locking circuit including the contact member 47 and its cooperating contacts 48 and 49 which it engaged as soon as the relay coil was energized. The motor then keeps on operating until the notch 33 again registers with projection 34 and permits the armature 46 to separate the contacts 22 and 23. The time required generally for this operation is about one minute.

To insure accurate timing, I prefer to use a self-starting synchronous motor of the type shown in Warren Patent No. 1,495,936, although other types may be suitable for this purpose. This motor comprises a winding 21 for magnetizing a core and a casing which is supported by the core and contains the armature. In the type of motor shown in the patent the armature operates at a high speed and through a set of gears also contained in the motor casing operates the shaft 32 at a low rate, for example, one revolution per minute. This is approximately the time required for the cathodes to attain their proper temperature. As long as current flow continues in circuit 5, the relay coil 43 maintains the contacts 22 and 23 separated and thereby the full voltage of secondary winding 15 is applied to the discharge space between anodes 2 and 3. If, for any reason, the tube should not start operating when the contacts 22 and 23 are separated, a film cutout 51 supported by contacts 52 and 53 connected respectively to conductors 13 and 16 breaks down and cuts off this lamp from the circuit.

From the foregoing description it will be evident that as soon as the current flow in circuit 5 is interrupted the coil 43 will be deenergized and will permit the spring 35 to push the contact arm 27 forward and thereby close the circuit through the contacts 22 and 23. At the same time, the contact arm 47 is moved away from the contacts 48 and 49, thereby opening the locking circuit for coil 43. Upon resumption of current flow, therefore, the coil 43 will not be immediately reenergized and the motor 20 will operate until the cam notch 36 reaches the projection 37. At this instant the spring 39 will urge

the contact arm 38 forward so that the contact 40 will engage contact 41 and thereby close the circuit through cathode 3' and the coil 43. The armature 46 will then tend to separate the contacts 22 and 23 but can not do so until the notch 33 is opposite projection 34. In this manner the motor cam 31 controls the energization of the cathode 3' and the cam 30 controls the energization of the discharge path between the electrodes a predetermined period of time subsequent to the energization of the cathode.

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

1. In a starting apparatus for an electric discharge lamp provided with an anode and a thermionic cathode, means for energizing said cathode and the discharge path between said anode and cathode, and means for delaying the energization of said discharge path a predetermined interval of time subsequent to each energization of said cathode comprising a normally closed switch for establishing a shunt circuit across said discharge path, means tending to open said switch when said cathode is energized, timing means operated in series with said normally closed switch for preventing the opening of said switch until said cathode is energized for a predetermined time and resetting means responsive to current interruptions to said cathode for instantly resetting said timing means whereby a full timing period is obtained after each current interruption.

2. In a starting apparatus for an electric discharge lamp provided with a pair of electrodes including a thermionic cathode and an anode, means for energizing said cathode and the discharge path between said electrodes respectively, a pair of normally closed contacts and a timing motor connected in series across said discharge path, a relay connected in series with said cathode, and means including said motor and said relay for separating said contacts to energize said discharge path a predetermined interval of time subsequent to each energization of the filamentary cathode.

3. In a starting apparatus for an electric discharge lamp provided with an anode and a thermionic cathode, means for energizing said cathode and the discharge space between said anode and cathode and means for controlling the energization of said discharge space including a normally closed switch for maintaining a low resistance circuit across said discharge space, a timing motor connected in series with said switch, a relay tending to open said switch energized simultaneously with said cathode, and a cam driven by said motor for preventing the opening of said switch until a predetermined interval of time subsequent to the energization of said cathode.

4. In a starting apparatus for an electric discharge device provided with an anode and a thermionic cathode, means for energizing said cathode and the discharge space between said anode and cathode and means for controlling the energization of said discharge space including a normally closed switch for maintaining a low resistance circuit across said discharge space, a timing motor connected in series with said switch, a relay tending to open said switch energized simultaneously with said cathode, and means operated by said motor for preventing the opening of said switch until a predetermined interval of time subsequent to the energization of said cathode.

5. In an apparatus of the character described, comprising a plurality of elements one of which is energized a predetermined time interval prior to a second one of said elements, the combination  
5 of a switch connected across said second element, a relay energized simultaneously with said first element tending to open said switch, a motor connected in series with said switch, and means operated by said motor for preventing the opening  
10 of said switch until a predetermined time interval subsequent to the energization of said first element.

6. In an apparatus of the character described, comprising a plurality of elements, one of which  
15 is energized a predetermined time interval prior to a second one of said elements, the combination of a switch connected across said second element, a relay energized simultaneously with  
20 said first element tending to open said switch, a synchronous motor connected in series with said switch, and a cam operated by said motor for preventing the opening of said switch and thereby  
25 preventing the energization of said second element until a predetermined time interval subsequent to the energization of said first element.

7. In a starting apparatus for an electric discharge lamp provided with an anode and a thermionic cathode, means for energizing said cathode and the discharge space between said anode  
30 and cathode respectively, timing means for delaying the energization of said discharge path for a predetermined time subsequent to each energization of said cathodes, and means responsive

to each current interruption for instantly resetting said timing means whereby a full time period is obtained after each current interruption independent of its length.

8. In a starting apparatus for an electric discharge lamp provided with an anode and a thermionic cathode, means for energizing said cathode and the discharge space between said anode and cathode respectively, motor operated means  
5 for timing the energization of said discharge path subsequent to each energization of said cathode, and means responsive to an interruption of current to said cathodes for instantly resetting said  
10 timing means whereby a full time period is obtained after each current interruption.

9. In a starting apparatus for an electric discharge lamp provided with an anode and a thermionic cathode, means for energizing said cathode and the discharge space between said anode and cathode respectively, means for controlling  
20 the energization of said discharge space including a normally closed switch for maintaining a low resistance circuit about said discharge path, a motor connected in series with said switch, a relay tending to open said switch energized  
25 simultaneously with said cathode and a pair of cams operated by said motor, one of said cams controlling the energization of said relay and said cathode and the other of said cams preventing  
30 the opening of said switch until a predetermined period subsequent to the energization of said cathode.

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