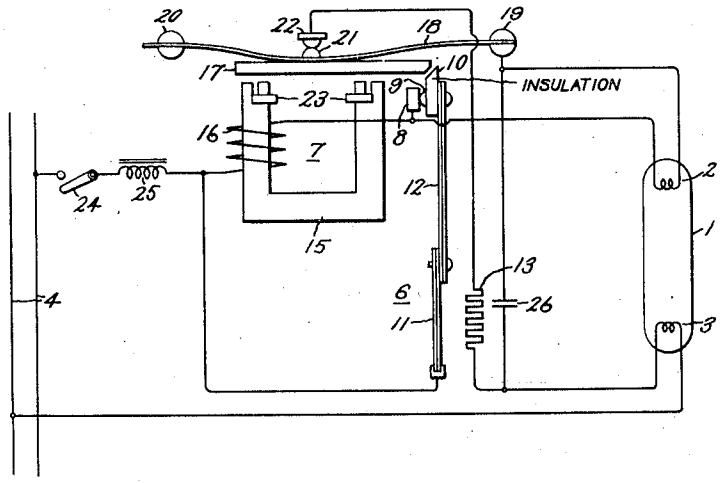
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DISCHARGE LAMP APPARATUS

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Inventor:
Robert H. Johnson,
by Harry E. Dunham
His Attorney.

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DISCHARGE LAMP APPARATUS

Robert H. Johnson, Fort Wayne, Ind., assignor to General Electric Company, a corporation of New York

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5 Claims. (Cl. 176—124)

My invention relates to gaseous electric discharge lamps of the type having thermionic electrodes and particularly to apparatus associated with such lamps for effecting the starting thereof. The object of my invention is the provision of improved apparatus for this purpose whereby the temperature of the electrodes is raised to an electron emitting point before the starting voltage is applied to the lamp and during the normal operation of the lamp there is no material loss of energy due to the starting apparatus. A further object is the provision of thermal time delay apparatus for controlling the time of application of the starting voltage which apparatus operates independently of the temperature of the ambient.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the single figure of the drawing, which is a circuit diagram illustrating one embodiment of my invention, 1 represents a gaseous electric discharge device, such for example as a fluorescent lamp, having thermionic electrodes 2 and 3 which are represented as being filamentary in form adapted to be initially heated to an electron emitting temperature by the passage of current therethrough. The lamp is connected to be energized from the source of current supply 4 which may be a 115 volt, 60 cycle commercial lighting circuit.

For controlling the starting and operation of the lamp 1, I have provided the thermal switch 6 and the electromagnetic switch 7. The thermal switch comprises the fixed contact 8, the cooperating movable contact 9, the insulating member 10 and the two part temperature responsive actuating member 11, 12. The insulating member 10 has an inclined upper edge and is shown secured between the contact 9 and the actuating member, the securing means, for example, a rivet, serving also electrically to connect the contact with the member. The two parts of this member comprise the bimetallic part 11 and the bimetallic part 12, the two parts having identical temperature-deflection constants and being connected together near their adjacent ends in good thermal and electrical relation so that the part 12 which connects with the movable contact is in effect an extension of the part 11. Arranged adjacent the part 11 and in good thermal relation therewith is the resistance heater 13, the part 11 being so constructed that when its temperature is raised it bends in a direction to separate the contacts 8 and 9. The part 12 is reversely arranged so that when its temperature is raised it bends in the opposite direction, that is, in a direction to move the contact 9 toward the contact 8. The ratio of the length of the part 12 to the part 11 for perfect ambient compensation is approximately 2.4 to 1 but I have found that a ratio smaller than that works quite satisfactorily and in certain cases may even be desirable since it serves to give the lamp electrodes a somewhat longer heating period when the temperature of the ambient is low. It will be understood that parts 11 and 12 need not necessarily have the same temperature-deflection characteristic and that should these parts be constructed of materials having different characteristics the ratio of the lengths of said parts for ideal ambient compensation would depart in an obvious manner from the ratio mentioned above. A further result of the two-part bimetallic switch construction which I have devised is, as will be seen later, that when the heater is deenergized and ceases to apply heat to the part 11 some of the heat in that part passes by conduction into the part 12 thereby preventing the contacts 8 and 9 from opening as far as they otherwise would. Thus, for the switch to be prepared to execute a complete new starting cycle with a full length electrode heating time, it is only necessary that the temperatures of the two parts 11 and 12 become equalized by conduction of heat from the one strip to the other and it is not necessary to wait until both parts are completely cooled.

The electromagnetic switch comprises the core 15 having thereon the coil 16 and the armature 17 which is secured to the spring 18. The latter is supported at both ends, one end being fixed to the post 19 and the other end arranged to slide in a slot in the post 20. The switch has the cooperating movable and fixed contacts 21 and 22 and is shown having its polepieces provided with the shading coils 23 to assist the magnet in holding its armature without chatter or vibration. The adjacent ends of the armature 17 and the member 10 are provided with inclined faces and are so arranged that when the electromagnet is not energized and the armature is held by the spring 18 in its upper or contact closing position, the member 10 of the thermal switch is free to move into a position in which the contact 9 engages the contact 8. However, when the electromagnet is energized and the armature is drawn against it, the member 10 is pushed to the right and contacts 8 and 9 are separated, or if

they are already separated, they are retained in a contact open position as long as the electromagnet is energized.

One side of the source of supply 4 connects directly with one end of the electrode 3 and the other side of the source connects with one end of the other electrode 2 through the control switch 24, the ballast reactor 25 and by a divided circuit including the winding 16 in one branch and the thermal switch 6 in the other branch. The other ends of the electrodes are connected together through the heater 13 and the contacts of the electromagnetic switch. The small capacitor 26 is bridged across the contacts 21 and 22 and the heater 13 for the purpose of reducing the spark at the contacts 21, 22 and to reduce radio interference from the lamp.

With the parts in the position illustrated, the closing of the control switch 24 closes an electrode heating circuit including the reactor 25, the thermal switch 6, the electrode 2, the contacts of the electromagnetic switch, the heater 13 and the electrode 3 in series. By the time that the electrodes have reached an electron emitting temperature as a result of the current passing therethrough, the part 11 of the thermal switch will have been heated sufficiently by the heater 13 to open the contacts 8 and 9, thus energizing the winding 16 of the electromagnet which previously was substantially short circuited by the thermal switch. The actuation of the armature 17 gives a quick break to the heating circuit whereby the voltage impulse due to the reactor 25 causes the lamp 1 to break down in the well understood manner. The operation of the electromagnetic switch opens the circuit of the heater 13 and as the part 11 of the thermal switch cools, the contacts of that switch approach each other but are prevented from actual contact by the armature 17 which remains in its lower position as long as the lamp is in operation. Upon opening the control switch 24, however, or if the source of supply is interrupted, the resulting deenergization of the electromagnet permits the contacts of the thermal switch to close in readiness for a restarting of the lamp. In the event that the contacts of the electromagnetic switch separate at or near the zero value of the current wave and an insufficient voltage is supplied to the lamp to cause it to start, the armature of the electromagnet is immediately retracted to its closed contact position when it is again energized to repeat the lamp starting effort. Should the voltage of the source of supply be interrupted for a short time and before the thermal switch has cooled sufficiently to reclose, the armature will vibrate making successive attempts to start the lamp while at the same time the lamp electrodes are having their temperature raised by the intermittent passage of current therethrough.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

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

1. In combination, an electric discharge lamp having thermionic electrodes, means including a time delay switch and a ballast for connecting said lamp with a source of current supply, a heating circuit for said electrodes connected therebetween and including a second switch and control means for said time delay switch, operating means for said second switch connected across said time delay switch and means responsive to said second switch for controlling said time delay switch.

2. In combination, an electric discharge lamp having thermionic electrodes, means including a thermal switch and a ballast for connecting said electrodes with a source of current supply, a heater for said thermal switch and an electromagnetic switch connected in series between said electrodes and forming a path for heating current for the electrodes, the winding of said electromagnetic switch being connected across said thermal switch and means controlled by said electromagnetic switch for preventing the closing of said thermal switch.

3. In combination, an electric discharge lamp having thermionic electrodes, means including a thermal switch and a ballast for connecting one end of each of said electrodes with a source of current supply, a heater for said thermal switch and an electromagnetic switch connected in series between the other ends of said electrodes the winding of the latter switch being connected across said former switch, and means operative when said electromagnetic switch is open for preventing the closing of said thermal switch.

4. In apparatus including an electric discharge lamp having thermionic electrodes and a circuit for supplying heating current to said electrodes in series, means including a thermal switch for opening said circuit between said electrodes, said switch having a two part contact moving member one part being carried by and extending beyond the other, said parts being constructed to warp in opposite directions in response to an increase in temperature and means for heating one of said parts.

5. In apparatus including an electric discharge lamp having thermionic electrodes and a circuit for supplying heating current to said electrodes in series, means including a thermal switch for opening said circuit between said electrodes, said switch having a two part bimetallic contact moving member one part forming a continuation of the other and the two parts being arranged to bend in opposite directions in response to an increase in temperature, and a resistance heater adjacent to one of said parts.

ROBERT H. JOHNSON.