March 8, 1938. D. S. GUSTIN 2,110,597

DISCHARGE LAMP

Filed Sept. 18, 1934 2 Sheets-Sheet 1

Fig. 1.

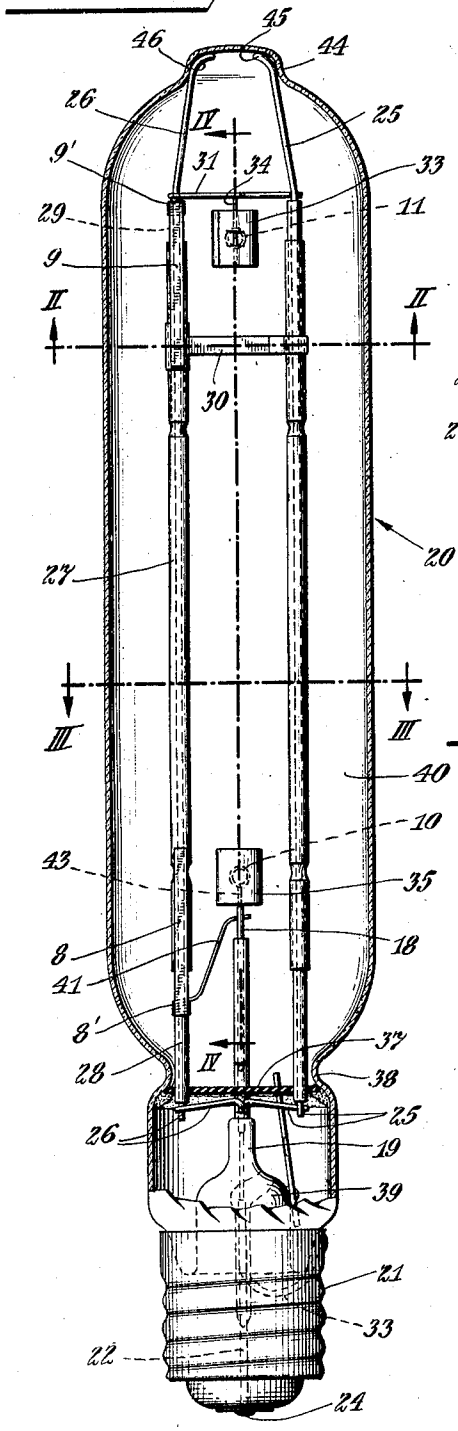


Fig. 2.

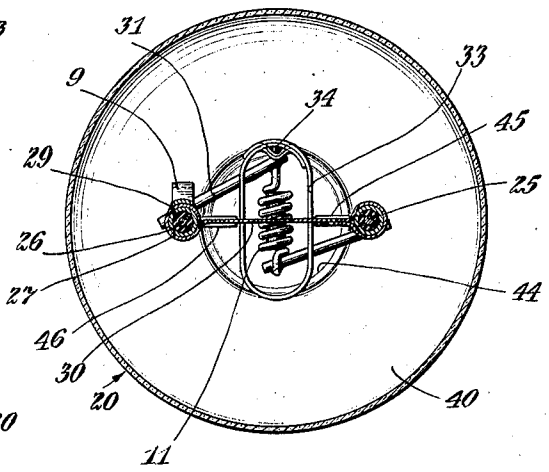
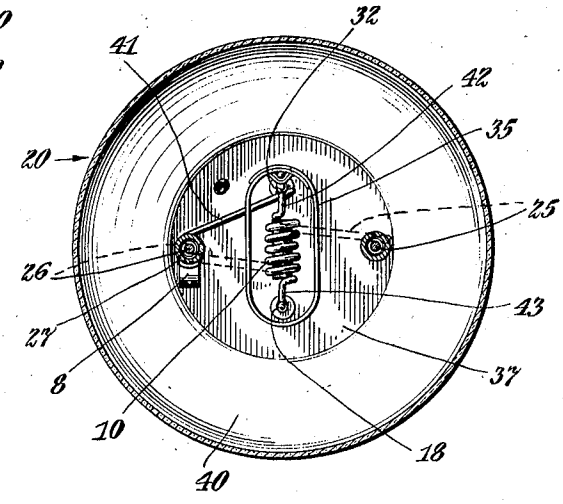


Fig. 3.



INVENTOR
D. S. GUSTIN
BY M. F. Reyes
ATTORNEY

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Fig. 4.

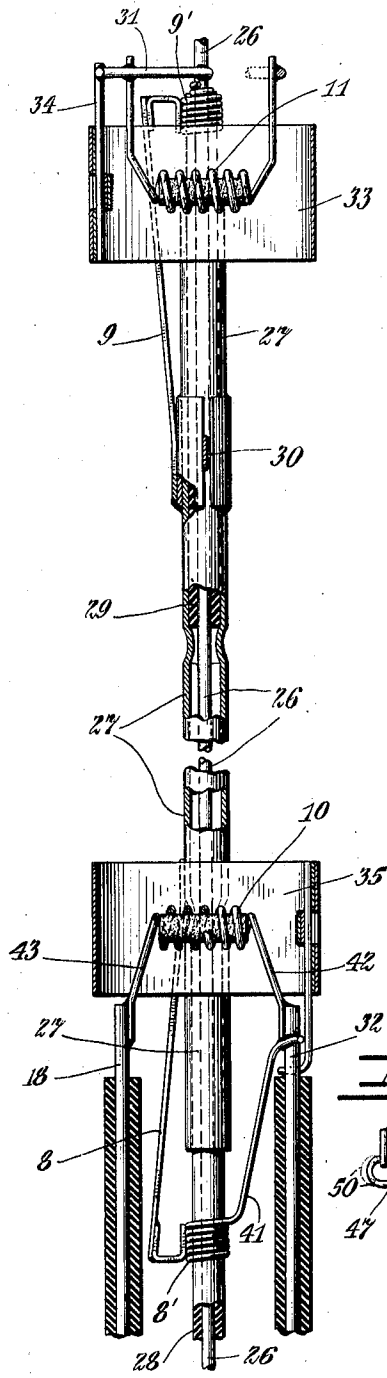


Fig. 5.

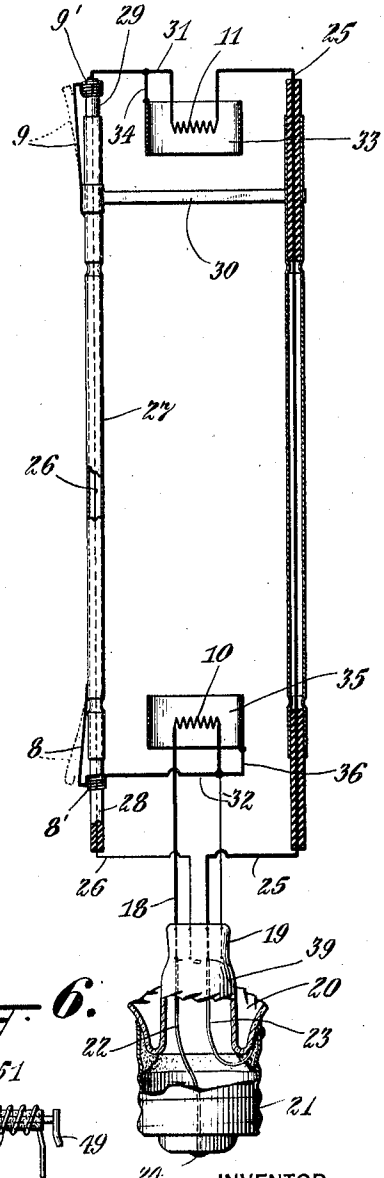
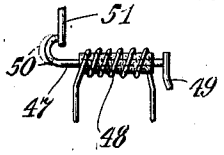


Fig. 6.



INVENTOR
D. S. GUSTIN.
BY M. F. Reynolds
ATTORNEY

Patented Mar. 8, 1938 2,110,597

UNITED STATES PATENT OFFICE

2,110,597

DISCHARGE LAMP

Daniel S. Gustin, Bloomfield, N. J., assignor, by mesne assignments, to Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 18, 1934, Serial No. 744,485

9 Claims. (Cl. 176—124)

This invention relates to discharge devices of the type employing an incandescent cathode and solid electrodes operating in an ionizable medium, and it is an object of the invention to provide a device of the above character capable of starting by means of an initial discharge between electrodes with relatively close spacing and subsequently operable by discharge between electrodes of relatively wide spacing.

A further object of the invention is to so construct and arrange the electrodes and their cooperative elements as to provide a relatively short initial discharge gap.

Another object of the invention is to provide a discharge lamp with internal means for diverting current from one electrode to another.

Another object of the invention is to provide a discharge lamp with a starting electrode and means responsive to temperature for cutting out said electrode.

Other objects and advantages of the invention will be more clearly understood by reference to the following description together with the accompanying drawings in which

Fig. 1 is a side elevational view of a device constructed in accordance with the present invention, partly in section to more clearly show structural features;

Fig. 2 is a view taken on line II—II in Fig. 1;

Fig. 3 is a view taken on line III—III in Fig. 1;

Fig. 4 is an enlarged detail view of the cathodes and anodes and shows thermic members mounted adjacent thereto;

Fig. 5 is a diagrammatic view of the circuit employed in the present device and

Fig. 6 is a detail view of a modified form of a thermic member.

It has become the practice to use discharge lamps for general illumination and one such type of lamp employing a metallic vapor as for example sodium, or the like, and a rare gas such as argon or neon, is clearly shown and described in copending application Serial No. 668,506 filed April 29, 1933 and assigned to the present assignee.

In lamps of the above character the useful life of the lamps is to a great extent dependent on the life of the cathode and in cases where the cathode and anode electrodes are a relatively great distance apart and the voltage drop is high, the cathode is caused to sputter. When the voltage is applied before the cathode reaches a temperature to freely emit electrons it often happens that the discharge is concentrated at one or more spots on the cathode. These spots, obviously, reach a relatively high temperature which is caused by ion bombardment at the relatively high voltage impressed between the cathode and the cooperating electrode.

Various constructions have been used to prevent full voltage from being applied before the cathode has reached the proper electron emitting temperature; as, for example, time relays have been employed but certain disadvantages attend their use since special adjustments must be made for each type of tube. It has also been proposed to provide built-in thermionic relays directly influenced by the heat of the cathode. Devices as heretofore proposed have, however, utilized an internal cut-out to operate means external of the lamp to make or break the circuit and such lamps operated with a separate means for heating the filament.

In accordance with the present invention a lamp may be constructed comprising a bulb in which are mounted two hot cathodes or filaments arranged in series and a starting or auxiliary electrode, means being provided to cut out the starting electrode when the main discharge occurs. Two lead wires may be employed whereas in lamps as heretofore proposed it was necessary to provide auxiliary equipment in the form of transformers, etc., requiring the use of more than two lead wires and it is possible, therefore, by reason of the present invention, to equip the lamp with a standard screw thread or other suitable type of base to be inserted directly into a standard socket.

Although the invention is applied to various types of discharge lamps including metal vapor lamps, mercury high pressure lamps or the like, it is shown and described for use for street lighting in which constant current is provided and in which the lamps are connected in series. Constant current could, obviously, be provided by means of a transformer in which case the devices may be operated in parallel.

When in operation, on alternating current the discharge alternates between anodes and cathodes at opposite ends of the bulb. In a lamp constructed as shown, the electrodes may be about 5¾ inches apart in a bulb of about 2½ inches in diameter. The lamp may contain a deposit of sodium and a rare gas such as neon or argon to promote starting. The voltage for initiating a discharge in such a lamp would be about 35 volts, the current being constant at about 6.6 amperes and the operating voltage being about 25 to 27 volts.

In devices as heretofore employed the initial discharge was produced by what were termed

starting tips in which case the starting voltage was about 60 volts and current limiting was necessary. In the present device the use of a starting electrode arranged and connected as hereinafter described, makes it possible to carry the full-line current without the need of any limiting resistance and thus the low starting voltage is attained.

When devices as heretofore employed were started the high voltage was applied and before the cathode had time to reach full electron emitting temperature, the tendency was for the discharge to concentrate on any hot spots that might occur on the filament with detrimental results. Therefore, it is an advantage for practical reasons to be able to start the device at relatively low voltage and the present invention makes starting at low voltage practical.

In accordance with the present invention the device, as clearly shown in the diagrammatic view in Fig. 5, may be provided with a thermic element 8 in the form of a bimetallic strip disposed in position to be operated by heat radiated from a cathode 10. Another thermic member 9 is disposed adjacent to a cathode 11. The bimetallic elements 8 and 9 are arranged to normally engage with contact portions 8' and 9' respectively, to close the circuit within the device.

As illustrated, one end of the cathode 10 is connected with a conductor 18 which is sealed in a press 19 forming part of the structure of a bulb 20. The bulb may be provided with a standard screw thread base 21 since, by reason of the present invention, only two leads 22 and 23 are employed. The lead 22 connects the conductor 18 with the center contact 24 on the base and the lead 23 has one end electrically connected to the side of the base. The other end of the lead 23 connects with a conductor 25 connected to one terminal of the cathode 11. The conductor 25 is enclosed in a tube insulated from the conductor or may be enclosed in a sheath of insulative material.

A support member 26 disposed parallel to the conductor 25 is provided. A metallic sleeve 27 encloses the major portion of the support 26 and is insulated therefrom by bushings 28 and 29. The ends of the thermic members 8 and 9 are electrically connected to opposite ends of the sleeve 27. A starting electrode 30 is electrically connected with the sleeve 27 and disposed in relatively close relation to the cathode 11. The other terminal 31 of the cathode 11 is electrically connected to contact portion 9' which electrically connects with the sleeve 27 by means of the thermic member 9. The other terminal 32 of the cathode 10 connects with contact portion 8' which electrically connects with the sleeve 27 by means of the thermic member 8. Adjacent to cathode 11 is an anode 33 electrically connected to the said cathode by a conductor 34 and cathode 10 is provided with anode 35 electrically connected to the said cathode by a conductor 36.

When the device is connected to receive electrical energy the filaments heat up and the radiated heat causes a thermic member to move and the voltage is then impressed between cathode 11 and the starting anode 30. The rare gas is ionized at a relatively low voltage and a discharge produced. Devices as heretofore constructed required a starting voltage of about 60 to 100 volts, the present device, as above mentioned, being operable for starting at about 35 volts. The initial discharge is produced primarily by the ionization of the rare gas and as the heat from the discharge causes the vaporizable metal to vaporize, a discharge occurs by reason of such vapor, the other member 9 is heated and moves to cut out the auxiliary electrode and the cathodes. Current then flows through ionized vapor and a device constructed along the lines of one herein disclosed will operate at about 27 volts with 6.6 amperes of current.

A lamp may be constructed in any suitable manner to operate as above described and in the selected embodiment of the invention illustrated in the structural drawings the cathodes 10 and 11 may each comprise a coil of tungsten or other refractory wire having a core of barium silicate or other compound capable of high electron emission at the operating temperature of the device.

Each tungsten coil may consist of about twelve turns on a 120 mil. mandrel with a pitch of about thirty-five turns per inch. A core of barium silicate is slipped into the coil to serve, when heated, as a copious source of electrons.

Referring to Figs. 1 to 4 showing a practical embodiment of one form of the device, the cathode 11, as shown, has one terminal connected to conductor 25 which conductor is in the form of a support member extending through a mica disk 37 sealed in a constricted portion 38 in the bulb neck. The disk divides the lower portion of the bulb, which includes a stem 39 having press 19, from the discharge chamber 40 and prevents the vapor from reaching the stem and condensing by reason of its relatively lower temperature. The conductor 25 connects with the lead wire 23. The other terminal 31 of the cathode 11 is connected with contact portion 9' which is engaged by the thermic member 9 on the sleeve 27.

The thermic member 9 is connected to a cross piece 30 which may be a metallic strip and constitutes the auxiliary or starting electrode. This electrode is electrically connected at one end to the sleeve 27. The other end of the electrode is secured to, but is insulated from the conductor 25. The electrode or cross piece 30 thus also serves as a strengthening element to give rigidity to the structure.

The thermic member 8 is electrically connected to the other end of the sleeve 27 and engages contact portion 8' mounted on but insulated from the support 26. This contact portion is connected by a member 41 to terminal or conductor 42 at one end of the cathode 10. The other end 43 of the cathode 10 connects with conductor 18 which in turn is connected to center lead wire 22. It will thus be evident that the cathodes are in series when the thermic members are in their closed or normal positions.

When electrical energy is applied the temperature of the cathode is raised and the heat radiated causes the thermic members to move. It will be noted that the thermic member 9 is so positioned with respect to the cathode 11 as to be more quickly affected than member 8. When the cathodes heat up the member 9 is the first to move and break the cathode circuit. The voltage is then impressed between cathode 11 and the starting electrode 30. By reason of the rare gas content of the bulb a discharge occurs and the heat generated vaporizes the vaporizable material, as for example, the sodium, and as the discharge becomes stronger the cathode 10 heats the thermic member 8 which then moves to break the circuit including the electrode 30. The discharge then continues between anodes 33 and 35 and cathodes 10 and 11 and the cathodes are

maintained at electron emitting temperature by ionic bombardment, and by current which flows through a cathode from an anode during each half cycle of the alternating current employed, the discharge serving as a conductor when the thermic elements break the circuit through the sleeve **27**.

The present showing includes heat responsive elements for cutting out the cathodes as well as the starting electrode. If desirable, however, the cathodes may be heated by a circuit independent of the discharge circuit and an auxiliary electrode may be employed in conjunction with thermic means which serves to cut out the auxiliary electrode.

Although in the present construction one of the thermic members is arranged to open before the other, the lamp will operate no matter which one of the thermic members is actuated since, as soon as the filament circuit is broken, the discharge will occur between the sleeve and the nearest cathode.

The present invention not only gives a practical and desirable device from an operating standpoint, but furnishes a rigid and practical construction. The disk **37** serves to hold the lower portion of the internal structure and the upper end of the bulb **20** is provided with a dome **44** to receive ends **45** and **46** of supports **25** and **26** respectively.

In Fig. 6 a modified form of thermic member is shown in which an expansible member in the form of a rod **47** is disposed within a cathode coil **48**. The rod may be held in the barium silicate core and may be arranged to butt against a stop **49**. One end **50** of the rod may be disposed to contact with a conductor **51** constituting part of the lamp circuit, the cathode being electrically connected to a conductive member moved by the rod. Thus, when the lamp is cold the rod keeps the circuit closed. When the cathode heats up, however, the longitudinal expansion of the rod causes it to break the circuit. It is obvious that various forms of thermic members may be employed and that the structure shown may be varied. It is, therefore, to be understood that the present invention contemplates other variations in structure and arrangement as falling within the scope of the present invention defined by the appended claims.

What is claimed is:

1. A device comprising a bulb, a pair of cathodes, an anode electrically connected to each cathode, a conductor connected to a terminal of one of said cathodes, another conductor connected to a terminal of the other cathode, a starting electrode adjacent one of said cathodes, and a heat responsive member within said bulb connecting the other terminal of said cathodes.

2. A device comprising a bulb, a pair of cathodes, an anode electrically connected to each cathode, a conductor connected to a terminal of one of said cathodes, another conductor connected to a terminal of the other cathode, a starting electrode adjacent one of said cathodes, and a pair of heat responsive members connecting the other terminals of said cathodes, one heat responsive member being positioned to operate in response to heat from one cathode and the other member in response to heat radiated from the other cathode.

3. A device comprising a bulb, a pair of cathodes, an anode electrically connected to each cathode, a conductor connected to a terminal of one of said cathodes, another conductor connected to a terminal of the other cathode, a conductive member between the terminals of said cathodes, a starting electrode electrically connected to said member, a heat responsive element normally connecting said member to the other terminal of one of said cathodes, another heat responsive element normally connecting said member to the other terminal of the other cathode, said heat responsive members operating when heated by said cathodes to break the flow of current through said cathodes and said electrode.

4. A device comprising a bulb, an ionizable medium in said bulb, a pair of cathodes, an anode electrically connected to each cathode, a starting electrode within said bulb adjacent one of said cathodes, an electrical circuit within said bulb for the flow of electrical energy to heat said cathodes and ionize said medium and a member within said bulb responsive to heat radiated from a cathode to break said circuit and cause said ionized medium to conduct current between a cathode and an anode in the form of a glow discharge.

5. An electrical device comprising a sealed envelope containing an ionizable medium, a plurality of cathodes, an electrical circuit including said cathodes, an anode electrically connected to each cathode, means within said envelope sensitive to temperature disposed to be heated by a cathode to open said circuit when said cathode reaches an electron emitting temperature, a starting electrode to initiate a discharge and means sensitive to temperature disposed in effective relation to a cathode for cutting out said starting electrode when the discharge heats said cathode.

6. An electrical device comprising a sealed envelope containing an ionizable medium, a cathode, a starting electrode and operating electrodes and means positioned within said envelope sensitive to heat radiated from said cathode for cutting out said starting electrode.

7. An electrical device comprising a sealed envelope containing an ionizable medium, a plurality of cathodes connected in series, anodes, a starting electrode electrically connected to said cathodes, means for breaking the series connection between said cathodes and means for breaking the electrical connection between said starting electrode and said cathodes.

8. An electrical discharge device comprising a sealed envelope containing an ionizable medium, a plurality of cathodes electrically connected in series, an anode electrically connected to each cathode, a starting electrode within said device adjacent one of said cathodes, means for causing a flow of electrical energy to heat said cathodes to ionize said medium and means responsive to heat radiated from at least one of said cathodes for terminating the flow of said energy when a cathode reaches a predetermined temperature.

9. An electrical discharge device comprising a sealed envelope containing an ionizable medium, a cathode, an anode, a starting electrode normally operating in conjunction with the cathode to produce a discharge and means within said envelope responsive to temperature variations in said cathode for cutting out said electrode.

DANIEL S. GUSTIN.