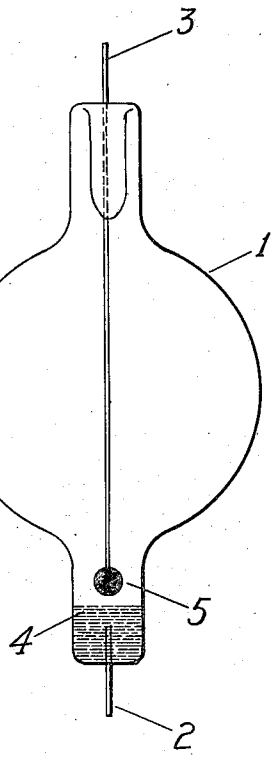
Apr. 10, 1923. 1,451,271

H. C. RENTSCHLER

VAPOR ARC LAMP

Filed Feb. 27, 1919

FIG. 1



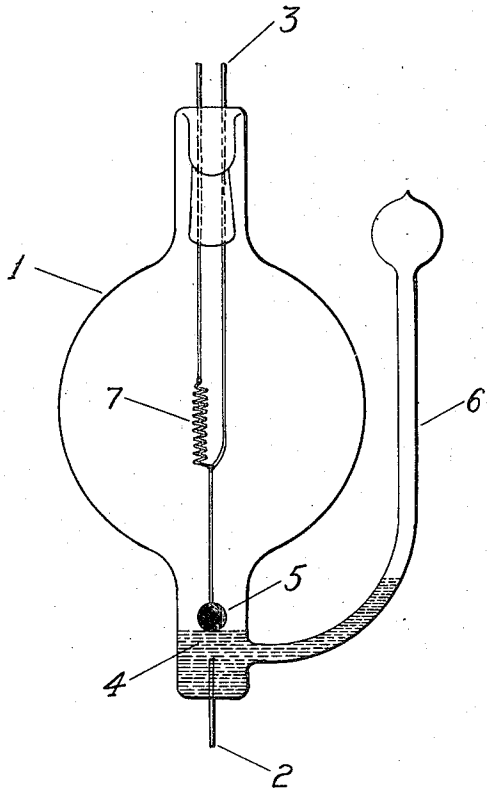


FIG. 2

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UNITED STATES PATENT OFFICE.

HARVEY C. RENTSCHLER, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA.

VAPOR ARC LAMP.

Application filed February 27, 1919. Serial No. 279,583.

To all whom it may concern:

Be it known that I, HARVEY C. RENTSCHLER, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Vapor Arc Lamps, of which the following is a specification.

This invention relates to vapor arc lamps and, more particularly, to a lamp of this type in which the light is concentrated at a point.

It has for one of its objects the provision of a light source, especially adapted for work requiring a uniform field, such as in metallographic, photographic enlarging, general projection work, etc.

Another object of the invention is the provision of an arc device having a point source of light, which will start on the same potential as the operating potential of the arc, and in which the arc may be self starting, if desired.

A further object of the invention is the production of a vapor-type lamp in which the principal light source is derived from the incandescence of a refractory body constituting the anode.

Other objects of the invention have to do with various features of construction and arrangement of parts hereinafter set forth and defined by the appended claims.

In accordance with my invention, there is provided a sealed envelope having, as the cathode thereof, a substance of low vapor pressure, such as mercury, and, as an anode, a body of some highly refractory material, such as a bead of tungsten. These electrodes may be spaced apart but a short distance or may be made to normally contact with each other, but adapted to be separated when functioning. There is placed within the envelope an inert monatomic gas, such as argon, having a substantial pressure, preferably of the order of magnitude of 5 mms. to one-half atmosphere. By the use of argon as the inert gas it is found that the arc can be made to start with the same potential across the arc as the potential required to maintain the arc and, further, that the arc has a stable characteristic, thus making it unnecessary to use a line series resistance, as ballast, to stabilize the arc.

No other gas besides argon is known to be suitable for obtaining the results contemplated by my invention. The use of other known gases, in a device of this character, gives an arc which requires ballast resistance in series therewith to stabilize it, because an arc with a falling characteristic is obtained, that is, an increase in current across the arc, results in a decrease in voltage, so that were it not for a ballast resistance the device would allow an excess of current and be destroyed. Argon, when used on direct current with mercury as the cathode, has been found to give an arc having a rising characteristic throughout its operating range, that is, one in which an increase in current through the arc results in an increase in voltage thereacross, thereby obviating the use of ballast resistance. The argon will, of course, be mixed with mercury vapor from the cathode, the proportion thereof depending on the intensity at which the device is operated. It will, therefore, be apparent that one of the features of my invention comprises the employment of argon as the gas filling and mercury as the cathode of my device.

If it is desired to make the lamp self starting, this may be accomplished by providing an exhausted auxiliary tube communicating with the mercury forming the cathode, and have the normal pressure of the argon balanced against the pressure of the column of mercury, so that the surface of the mercury in the envelope normally contacts with the tungsten bead. The initial pressure of the gas may be increased by means of a starting filament connected in the anode circuit. When the filament is heated to incandescence it causes the gas to expand, thereby slightly displacing the mercury in the container and effecting an arc between the tungsten bead and the mercury, causing the tungsten bead to be heated white hot.

Figures 1 and 2 of the accompanying drawings illustrate two forms of devices suitable for carrying out my invention.

Referring first to Fig. 1, I have shown an exhausted transparent container 1 having leading-in conductors 2 and 3 sealed in the ends thereof and connecting with a cathode 4 and an anode 5, respectively. The cathode may consist of a vaporizable substance, such as mercury, and the anode may comprise a tungsten bead. Although any of the

inert monatomic gases may be introduced within the container 1, I prefer the use of argon to obtain an arc having a rising characteristic. A sufficient quantity of this gas is placed within the container so as to afford a substantial pressure. This form of device is started by tilting, as is customary with mercury vapor devices, so that an arc is formed between the tungsten bead and the pool of mercury. By spacing or causing the two electrodes to function at a short distance apart, the arc is confined to a limited region, which is due to the pressure of the argon. By having the arc thus confined and the tungsten bead as the anode, the incandescence of the bead supplies the principal source of light, especially as more heat is developed at the anode, as will be understood. In order to avoid condensation of the mercury on the part of the envelope through which the light passes, the cathode and anode should be located within one of the constricted end portions thereof, as illustrated. Such a construction causes the portion of the container 1 adjacent the electrodes to be maintained at a temperature above the condensation point of mercury with the result that the light from the lamp is readily transmitted at a region where most desired. However, this construction, although preferred, is not necessary to the successful operation of a device embodying my invention, and the electrodes may be relatively positioned in the enlarged portion of the envelope 1, if desired. The arc is stabilized by the argon, which will cause an accompanying rise in the current with an increase in the voltage across the arc, and, vice versa, a drop in the voltage will be followed by a decrease in the current. This stabilizing influence of the argon makes it possible to omit the series resistance necessary, as ballast, in the operation of ordinary arc devices.

Referring to Fig. 2, I have shown one form of a self-starting arc lamp. An exhausted auxiliary tube or container 6 is provided which communicates with the pool of mercury comprising the cathode 4. The pressure of the mercury and the argon is such that the surface of the mercury adjacent to the anode 5 normally contacts with the tungsten bead. A starting filament 7, connected in the anode circuit, functions, when heated to incandescence, to expand the argon, thereby effecting the formation of an arc between the mercury and the tungsten bead. The length of this arc may be predetermined by controlling such variable factors as the design of the container, the quantity of argon introduced therein, the quantity of mercury used, etc., since it is obvious that the ultimate state of equilibrium between the mercury and the argon determines the distance or length of the arc formed.

From the above description, it will be apparent that a vapor lamp embodying features of my invention is especially adaptable where a concentrated source of light is desired, together with a uniform field, the latter being made possible by virtue of the fact that the arc is caused to play within a limited region, and by the use of a reconstructible cathode. The use of the usual undesirable ballast resistance is obviated by using argon in combination with a mercury cathode and a refractory anode.

What I claim as my invention is:

1. An arc device comprising an evacuated envelope containing argon and including a mercury cathode and a refractory anode, whereby an arc is obtained having a rising characteristic.

2. An arc device comprising a container, a refractory metal anode and a mercury cathode located therein in an atmosphere of argon, whereby said device may be used without a ballast resistance.

3. A low-tension arc device comprising an evacuated envelope containing argon gas, a mercury cathode and a refractory metal anode placed closely thereto, whereby an arc is obtained having a rising characteristic, and emitting the major portion of its light from the refractory metal anode.

4. An arc device comprising a transparent gas-filled envelope with a restricted lower portion, a mercury cathode in said portion, and a refractory metal anode closely spaced thereto, whereby an arc is developed therebetween and mercury is prevented from condensing on said restricted portion by virtue of the heat developed in the closely adjacent arc.

5. A vapor arc device comprising an evacuated envelope containing argon and mercury vapor and including a reconstructible cathode and a refractory metal anode whereby an arc is obtained having a rising characteristic throughout its operating range.

6. A vapor arc device comprising an evacuated envelope, a refractory metal anode and a reconstructible cathode located therein in an atmosphere of argon and mercury vapor whereby said device may be used without a ballast resistance.

7. A low-tension vapor arc device comprising an evacuated envelope containing argon gas and mercury vapor, a reconstructible cathode and a refractory metal anode placed closely thereto, whereby an arc is obtained which will start on the same voltage at which it operates.

8. A low-tension vapor arc device comprising an evacuated envelope containing argon gas and mercury vapor, a reconstructible cathode and a refractory metal anode placed closely thereto, whereby an arc is obtained which will start on the same voltage

at which it operates and which will emit a major portion of its light from the anode thereof.

9. A vapor arc device comprising a transparent envelope with a restricted lower portion and containing argon, a mercury cathode in said restricted portion and a tungsten anode closely spaced therefrom, whereby an arc is developed therebetween and mercury is prevented from condensing on said restricted portion during operation, by virtue of the nearness of the arc to the walls of the restricted portion.

In testimony whereof, I have hereunto subscribed my name this 24th day of Feb., 1919.

HARVEY C. RENTSCHLER.