Feb. 17, 1942. H. C. RENTSCHLER 2,273,450

HIGH PRESSURE METAL VAPOR LAMP

Filed March 9, 1934

Fig. 1.

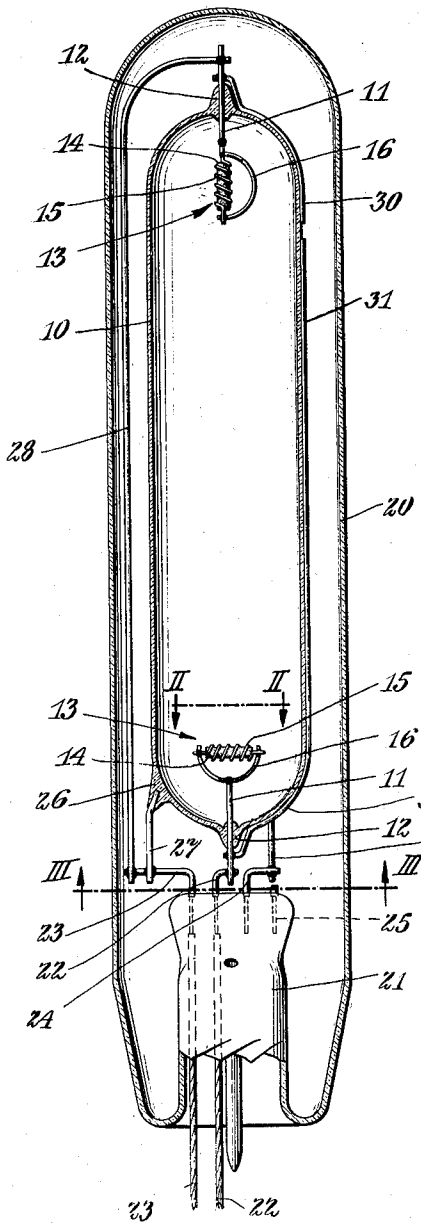


Fig. 2.

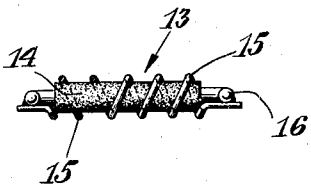
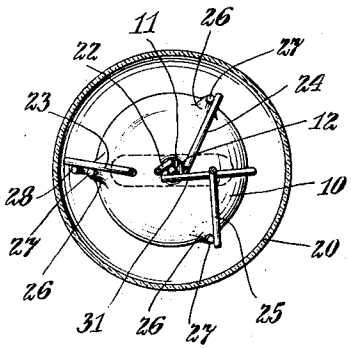


Fig. 3.



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HIGH PRESSURE METAL VAPOR LAMP

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9 Claims. (Cl. 176—122)

This invention relates to illuminating devices and more particularly to devices of this character generally termed high pressure vapor arc lamps. In its more specific aspect the invention is particularly directed to high pressure mercury arc lamps although it is not specifically limited thereto.

Heretofore high pressure mercury lamps have been proposed as an illuminating means. Lamps of this type have generally consisted of an envelope in which is located a cathode and an anode. The anode is solid and the cathode is a pool of mercury. Because of the mercury pool cathode, this type of lamp was subject to at least two major disadvantages. First, the lamp could be operated only in those positions where the mercury pool remained in its proper position and, second, means had to be provided for regulating the thermal condition of the mercury during operation of said lamp. When lamps of this character are operated, it sometimes happens that the lamps suddenly extinguish and will not restart until after a considerable period of time.

The high pressure mercury lamp is essentially an arc lamp in which a relatively high vapor pressure of the mercury is maintained during operation by the heat developed by the arc. The vapor pressure of the mercury in said lamp during operation may be hundreds of millimeters of mercury and as high as one atmosphere. When there is liquid mercury in the lamp during operation, as there always is in the prior art arc lamps, the vapor pressure of the mercury rises exponentially with the rises in temperature of the mercury pool. If for some reason the temperature of the pool is higher than that which it should be according to the lamp design, the mercury pressure rises so high that the lamp will extinguish.

In order to obviate this difficulty of controlling the temperature of the mercury pool during lamp operation, I have by my invention entirely eliminated this particular consideration. According to my invention, my high pressure mercury arc lamp operates without the presence of a mercury pool. The amount of mercury in my lamp is so limited that all of the mercury contained in the lamp is entirely in the vapor state during steady lamp operation. Since the mercury is all in the vapor state during steady lamp operation when a constricted luminous column arc lies well within the walls of the tube, any change in temperature of the mercury vapor due to external conditions will only slightly affect the pressure of the mercury because said pressure will follow the gas law that it is directly proportional to the absolute temperature of the mercury. Thus the pressure of the mercury vapor can be only slightly affected by any changes in temperature thereof due to external conditions.

An object of my invention is to provide a simplified metal vapor arc lamp which will operate over a very long period of time without extinguishing and without the employment of temperature regulating means.

Another object of my invention is to provide a simplified metal vapor arc lamp which may be operated in any desired position.

A still further object of my invention is to provide a metal vapor arc lamp that is relatively cheap and has a high luminous efficiency approaching 50 L/W.

These and other objects of my invention will be apparent from the following description and drawing wherein,

Figure 1 is a view partly in section and partly in elevation of my improved lamp.

Fig. 2 is an enlarged view of an electrode on the line II—II of Fig. 1 in the direction of the arrows.

Fig. 3 is a cross sectional view on line III—III of Fig. 1 in the direction of the arrows.

As shown in Figure 1, my lamp comprises a tubular vitreous envelope 10 composed of a glass adapted to withstand the high temperature developed in said lamp during operation. If desired, the envelope may be composed of quartz. Leading-in conductors 11 are sealed in small outwardly extending pinches 12 in the opposite ends of the envelope and extend inwardly and outwardly thereof. Each of said conductors is electrically connected to and supports an electrode 13 of the "cold-hot" type. Each of said electrodes consists of a stick 14 or rod of a compound adapted to activate a tungsten wire 15 wound therearound, and a semi-circular heavy tungsten rod 16 welded to the outer ends of the tungsten wire 15. The stick 14 may be composed of a material which will not disintegrate and pulverize during positive ion bombardment thereof. For this purpose I employ $BaCO_3$+powdered tungsten mixed and sintered. According to my invention the electrodes 13 are located rather close to the ends of the envelope 10 so that the temperature of that portion of the envelope behind the electrodes is not so low that mercury will condense thereon and also so that a uniform temperature distribution may be maintained throughout the envelope.

The envelope contains therein a charge of

starting gas, such as argon, and a limited small proportion of mercury. The pressure of the argon may be about 5 mm. of mercury. The envelope may be about 15 inches long and about one inch in diameter. The amount of mercury within said envelope may be about 300 to 400 milligrams. With this small quantity of mercury within the envelope of my mercury arc lamp, it is all completely vaporized during steady operation and the pressure and temperature characteristics thereof follow the gas laws so that small changes in temperature thereof do not greatly affect the pressure thereof. Upon steady operation, the luminous column is not a diffused glow, but is in the form of a concentrated luminous rod spaced well away from the interior wall of the envelope.

In order to further increase the efficiency of my lamp and so that it may efficiently operate with a vapor pressure of hundreds of millimeters of mercury, I surround the same by an evacuated container 20, which also supports the lamp per se. The container 20 has a reentrant stem 21 in which are sealed supporting conductors 22, 23, 24 and 25, with conductors 22 and 23 extending interiorly and exteriorly of said envelope and conductors 24 and 25 extending only into said envelope and terminating in said press. Spaced around the lower end of said bulb 10 are three other pinches 26 in which are sealed supporting rods 27 having their lower ends welded to the conductors 23, 24 and 25. The conductor 11 is welded to the conductor 22. A rod 28 of nickel or tungsten has one end welded to the upper leading-in conductor 11 and to the conductor 23. Conductors 30 and 31 are respectively welded to the upper and lower lead-ins 11 and extend along the envelope, but do not come in contact with each other, there being a small space between their ends in order that the discharge may be started within the envelope.

With my lamp I have found that the same may be readily started and after a few minutes arcing of high luminosity will take place. The operation is then steady and the lamp will not extinguish because the entire mercury charge is in a vaporous condition at this stage.

A lamp of this character is operated by placing the same between the terminals of the secondary of an appropriate transformer so that the desired current at the requisite potential may be derived therefrom in order that the lamp may operate with a highly luminous and efficient arc.

The term "cold-hot" electrodes as employed herein means electrodes which are not heated normally by means of electrical energy applied from a source external to the lamp but which are cold when the lamp is first started and become heated to an elevated temperature by the ionic bombardment thereof shortly after the lamp is operated.

Although I have shown and described my invention I do not desire to be specifically limited thereto as various other modifications of the same may be made without departing from the spirit and scope of the appended claims.

What is claimed:

1. A lamp comprising a hermetically sealed container, having a press, a plurality of leading-in conductors sealed in said press and extending exteriorly and interiorly thereof, a plurality of supports also sealed in said press, an envelope located in said container, a plurality of cold-hot electrodes in said envelope, said conductors being electrically connected to said electrodes, a plurality of rods sealed in said envelope, said rods cooperating with said supports to maintain said envelope in proper position.

2. An electrical discharge device comprising sealed inner and outer envelopes, said outer envelope having a supporting press, an ionizable medium and a pair of electrodes in said inner envelope, means for causing a flow of electrical energy through said inner envelope producing a discharge between said electrodes, said means including lead-in conductors extending from said press, one of said conductors being continued from said press between the walls of said inner and outer envelopes, the full length of said inner envelope, so as to connect with the electrode remote from said press, the other conductor connecting directly with the near electrode, and means for supporting said inner envelope from said press, comprising a plurality of support wires embedded in said press, supporting wires embedded in said inner envelope, the outer ends of said supporting wires being secured to said press-embedded wires and the lead-in conductor to the remote electrode.

3. An electrical discharge device comprising sealed inner and outer envelopes, a pair of electrodes in said inner envelope, said inner envelope also containing a filling of discharge-conducting gas and a vaporizable metal in sufficiently small quantity that it can be completely vaporized in the operation of the device, means to supply sufficient electrical energy to said device to completely vaporize said vaporizable metal, said outer envelope having a press extending toward said inner envelope, and means extending from said press to the adjacent end portion of said inner envelope and supporting the latter therefrom.

4. An electrical discharge device comprising a sealed container having a press, a plurality of leading-in conductors sealed in said press and extending exteriorly and interiorly thereof, a plurality of supports also sealed in said press, an envelope enclosed in said container, a plurality of electrodes in said envelope, one disposed adjacent said press and one remote therefrom, said envelope also containing a filling of conducting gas and a vaporizable metal in sufficiently small quantity that it can be completely vaporized during operation of the device, said conductors extending one to each electrode, and means sealed to the press-adjacent end of said envelope and respectively united to said press-sealed supports and conductor which connects with the electrode remote from said press.

5. An electrical discharge device comprising an envelope having an electrode disposed in each end thereof, each electrode comprising a rod of electron-emission material, a coil of tungsten wire surrounding said rod, and a heavy curved tungsten rod the ends of which are secured to said coil, lead-in conductors extending through said envelope and connected to said tungsten rods, a filling of discharge-conducting gas in said envelope, and a vaporizable metal also in said envelope and in sufficiently small quantity that it can be completely vaporized in the operation of the device, and means to supply sufficient electrical energy to said lead-in conductors to completely vaporize said metal.

6. An electrical discharge device comprising an inner cylindrical envelope with substantially semi-spherical ends provided with a discharge-

conductive filling including a metal vapor and operating with a high pressure discharge, activated electrodes disposed one in each end portion of said envelope and each comprising a rod of electron-emitting material surrounded by a coil of refractory metal, an outer enclosing envelope having a press, and supports extending from said press to the adjacent end portion of said inner envelope for maintaining the desired relationship therebetween.

7. An electrical discharge lamp comprising a light-transmitting envelope of high melting point vitreous material, a plurality of electrodes disposed therein and each consisting of a rod of electron-emitting material surrounded by a tungsten coil, a filling of inert gas in said envelope at a pressure of less than one atmosphere, and such a quantity of mercury in said envelope that at the operating temperature of the lamp said mercury is completely vaporized and the combined pressure of the gas and vapor exceeds one atmosphere.

8. An electrode for a discharge device comprising a rod of conductive electron-emission material, a refractory metal wire wound therearound, and a curved refractory metal rod with its ends welded to the outer ends of said wire for connecting said coil with a leading-in conductor.

9. An electrode for a discharge device comprising a sintered rod of a mixture of barium carbonate and powdered tungsten, a tungsten wire wound therearound, and a semi-circular heavy tungsten rod with its ends welded to the outer ends of said tungsten wire for connecting said coil with a leading-in conductor.

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