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DISCHARGE DEVICE

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Fig. 1.

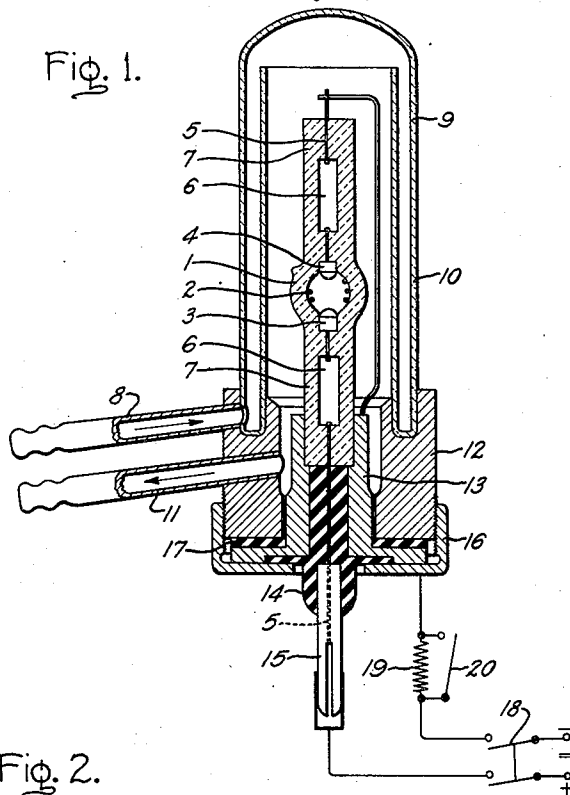
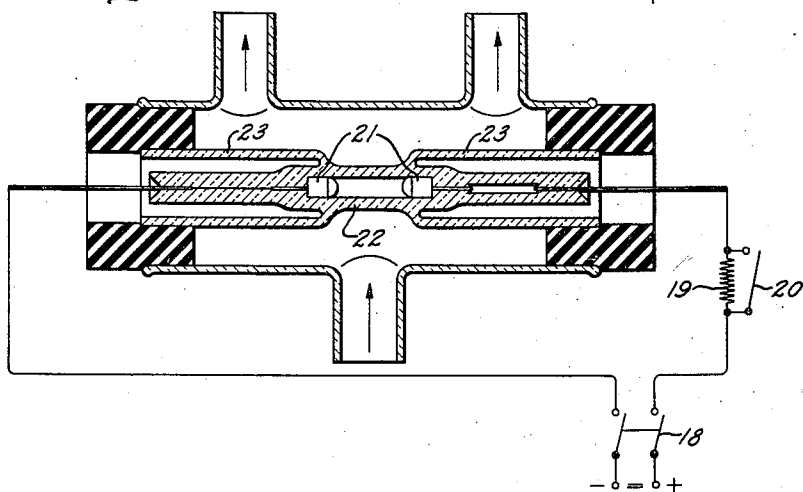


Fig. 2.



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DISCHARGE DEVICE

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10 Claims. (Cl. 176—182)

In electric excess pressure vapor discharge lamps, having a discharging vessel of quartz in which solid glow electrodes consisting mostly of tungsten sinter bodies are mounted, a series resistance has been used for limiting the discharge current for obtaining a constant operating voltage of the arc in such lamps, the quantity of the vaporizable metal, as a rule mercury, is so little that all the mercury evaporates so that the lamp operates with an overheated or super-heated mercury vapor atmosphere.

According to more recent knowledge a high pressure vapor discharging lamp with vapor filling super-heated in the service, the arc efficiency of which surpasses a certain value, shows a gradient feebly rising so that, when the voltage of the power source does not too strongly fluctuate, these lamps might be operated without any series resistance.

According to the invention the ascending of the arc gradient which exists under certain conditions in the lamps of higher efficiency and of known type can be increased quite considerably, so that a direct use of the lamp on the power source is possible even with very high fluctuations of the voltage of the source, for instance, 20% to 30% and more and with greater reliability of service. This is possible according to the invention in a water-cooled electric mercury high pressure vapor discharging lamp with a quartz vessel, vapor pressure above 5 atmospheres and solid, preferably activated glow electrodes, if a wall loading of more than 500 watt per cm.² inner surface is produced and further the quantity of the mercury is so selected that, when the lamp is in service, mercury still remains on the inner surface of the envelope or vessel.

In a water cooled excess pressure vapor discharging lamp of such type an alteration of the pressure of the vapor filling follows, owing to immediate increased evaporation or condensation, so rapidly on any alteration of the current intensity caused for instance by fluctuations of the voltage of the source that great fluctuations of the applied voltage are equalized by the immediate alteration of the operating voltage of the arc. The behaviour of the arc of such a lamp, accommodated in a smallest discharging space, can therefore be compared with the behaviour of an ohmic resistance which, owing to its positive temperature coefficient of resistance, assumes at every fluctuation of applied voltage immediately an increased or reduced resistance value. The smaller the heat capacity of the lamp vessel and the more the mercury in the discharging

vessel is approached to the arc the more inertialess will the vapor pressure follow the alterations of the arc power.

The effect according to the invention is especially pronounced in such discharging lamps, in which two electrode bodies are stopper-like inserted or fused into the ends of a narrow quartz tube forming the lamp vessel. The mercury body, located between the electrodes on the middle portion of the quartz tube, is then in direct contact with the arc. The strong cooling of the discharging vessel by cooling water is then of great importance because when the applied voltage drops a lowering of the vapor pressure must occur almost instantaneously, in order to prevent extinguishment of the lamp by the vapor pressure and the arc voltage remaining too high. For this reason it is advisable to make the wall of the discharging vessel flushed from the outer side by cooling water as thin as possible to obtain a strong cooling effect.

An outwardly directed bulge is preferably provided on the middle portion of the discharging vessel flushed on the outside by cooling water in which bulge the mercury deposits owing to the greater cooling efficiency. The same object may be obtained inversely if, by sufficient heat insulation of the wall portions enclosing the glow-electrode bodies preferably by a protecting cover keeping the cooling water away from these wall portions, care is taken that at these points during the service a wall temperature occurs which is higher than that on the middle portion of the discharging vessel more exposed to the action of the arc.

A lighting arrangement equipped with the new lamp is not only simpler and cheaper owing to the omission of the series resistance but, owing to the utilization of the full voltage of the power source, it also works with considerably better efficiency. A further advantage is that at voltage alteration of the source only comparatively little current alterations occur owing to the very rapid alteration of the vapor pressure, in any case the current alterations are substantially less than in high pressure lamps which work in the usual manner with undersaturated vapor filling and with a series resistance.

It is advisable to select the mercury quantity not much greater than is necessary, in order to just ensure a metal excess at the highest voltages of the source occurring in the service. There results then the lowest heat capacity and heat inertia of the discharging vessel and the slightest light absorption. The danger of destruction of

the lamp vessel by an extraordinarily high vapor pressure produced at high over-loading is then also avoided, because complete evaporation of the mercury which then occurs prevents a further rise in pressure. The mercury excess amounts therefore preferably to less than three times the mercury evaporated at normal service. The quantity of mercury which in a manner easy to observe by an expert depends on the desired service vapor pressure and on the lamp size is between 0.3-3 mm.³

The mercury may contain one or several evaporatable addition substances for instance to improve the color of the arc or the yield in light.

In Figures 1 and 2 of the accompanying drawing two mercury excess pressure discharging lamps constructed and working according to the invention are illustrated by way of example partly in section.

In the lamp shown in Fig. 1 the discharging vessel 1 consists of a small quartz glass ball flushed by cooling water and with an internal diameter of about 9 mm. The discharging vessel 1 is filled with rare gas, preferably with neon to which some argon is added, and further a small quantity of mercury 2 of a thickness of approximately 1 mm.³ is deposited on the wall of the vessel between the electrodes. The mercury quantity is such that, even at the greatest potential occurring in the service, some not evaporated mercury remains on the wall of the discharging vessel, so that the lamp works always in the range of saturated vapor. The two electrode bodies 3, 4 spaced at about 5 mm. are stopper-like embedded in the wall of quartz glass, so that only their conical end faces are exposed. The electrode body 3, which in this instance acts in the service as anode of a direct current discharge, is somewhat larger than the electrode body 4 acting as cathode, as the heat development on the anode is greater than that on the cathode, as is generally known. When feeding with alternating current electrode bodies of similar size and known means reducing the re-ignition voltage are employed, preferably a continually maintained auxiliary discharge bridging the intervals of darkness.

The current leads 5 are fused vacuum tight into the quartz nipples 7 by means of bands 6 of molybdenum. The enveloping vessel 9 enclosing the discharge vessel 1 and equipped with a water supplying socket 8 comprises an intermediate cylinder 10 which is equipped with an outflow socket 11 for the cooling water. The enveloping vessel 9 and the intermediate cylinder 10 are fixed in a metal jacket 12 having external screw threads. The current lead 5 of the cathode 4 is connected with the lamp base 13 inserted in the metal jacket 12 and extends through the intermediate cylinder 10. The current lead for the anode 3 enclosed by an insulating body 14 is connected with the axial plug 15. A cap nut 16 is screwed on to the metal jacket 12 with interposition of a rubber packing 17. The cooling water flows in the outer space between the enveloping vessel 9 and the intermediate cylinder 10 to the upper closed end of the enveloping vessel 9 and thence in the intermediate cylinder 10 along the ball-shaped discharge vessel 1 back to the base.

The plug 15 is connected directly with one of the poles of the switch 18 and the cap nut 16 through the intermediary of a starting resistance 19 with the other pole of this switch 18. The starting resistance 19 is bridged by a switch 20

which after the lighting up of the lamp short-circuits the starting resistance, so that the lamp is connected directly to the power source having a voltage of about 220-250 volts. The intensity of the service current amounts in the present instance to about 8 amperes at a service vapor pressure of about 120 atmospheres. The electric power taken up by the lamp is about 1900 watts and the special wall loading of the ball-shaped discharge vessel is about 750 watts per sq. cm. inner surface.

In the mercury excess pressure discharge lamp of about 50 atmospheres service vapor pressure shown in Fig. 2, two electrode bodies 21 of similar size are fused stopper-like into the ends of a narrow quartz tube 22 of about 4 mm. inner diameter. Quartz sleeves 23 are fused on to the two end parts of the quartz tube 22 approximately at the height of the points of the electrode bodies and serve to keep away the cooling water from the wall portions of the quartz tube valve 22 surrounding the electrode bodies 21, in order that on these wall portions increased service temperature occurs and the mercury cannot deposit behind the electrode bodies. The mercury quantity is in this instance so great that all the mercury is not evaporated when the lamp is in service. The short-circuiting of the starting resistance 19 after the burning of the lamp may be effected by hand or automatically, for instance by a bi-metal switch. A so-called hot conductor, such as a short oxide rod, is preferably employed as starting resistance, the electric resistance value of which great at the beginning becomes almost 0 during the starting procedure of the lamp owing to the heating. Such a hot conductor can be united without difficulty with the enveloping vessel of the lamp or with the socket of the same.

We claim:

1. In combination, a current source, a high pressure arc discharge device capable of operation without a series ballast and means connected in series with said device across the terminals of said current source to ballast the discharge only during starting, said means having a negative temperature coefficient of electrical resistance.

2. In combination, a current source, a high pressure arc discharge device capable of operation without a series ballast and means connected in series with said device across the terminals of said current source to ballast the discharge only during starting, said means having a negative temperature coefficient of electrical resistance and being mounted in heat receiving relation to said device.

3. A vapor arc discharge device comprising a sealed envelope and designed for operation under artificial cooling conditions with an electrical energy input in excess of 500 watts per square centimeter of the inner surface of said envelope, said envelope being provided with spaced electrodes and having therein a sufficient quantity of vaporizable metal to produce a vapor pressure in excess of 5 atmospheres when partially vaporized, the heat dissipating capacity of said envelope being such that when the device is operated under the designed conditions the vapor pressure in the envelope is in excess of 5 atmospheres and a drop in the applied voltage is immediately followed by a drop of such magnitude in the vapor pressure and in the arc voltage that the device successfully operates without a series ballast on a fluctuating voltage.

4. A vapor arc discharge device comprising a sealed envelope and designed for operation under artificial cooling conditions with an electrical energy input in excess of 500 watts per square centimeter of the inner surface of said envelope, said envelope being provided with spaced electrodes and having therein a sufficient quantity of mercury to produce a mercury vapor pressure in excess of 5 atmospheres when partially vaporized, the heat dissipating capacity of said envelope being such that when the device is operated under the designed conditions the vapor pressure in the envelope is in excess of 5 atmospheres and a drop in the applied voltage is immediately followed by a drop of such magnitude in the vapor pressure and in the arc voltage that the device successfully operates without a series ballast on a fluctuating voltage.

5. A vapor arc discharge device as in claim 3 wherein the part of the envelope intermediate the electrodes has a higher heat dissipating capacity than other parts thereof.

6. A vapor arc discharge device as in claim 3 wherein the quantity of metal remaining unvaporized during operation under the designed conditions is less than three times the amount vaporized during such operation whereby the danger of destruction of the device by an increasing vapor pressure caused by temporary overloading of the device is eliminated.

7. A vapor arc discharge device as in claim 3 wherein the envelope is tubular in shape and has an internal diameter of the order of 4 millimeters.

8. In combination, a source of electrical energy, a vapor arc discharge device connected across the terminals of said source and means for artificially cooling said device, said device comprising a spherical, sealed envelope having an internal diameter of the order of 9 millimeters, said envelope having therein a gaseous atmosphere, spaced, solid, thermionic electrodes and a sufficient quantity of mercury to produce a mercury vapor pressure of the order of 120 atmospheres when partially vaporized, the heat dissipating capacity of said envelope being such that when the energy input of said device from said source is about 750 watts per square centimeter of the inner surface of said envelope the mercury vapor pressure is of the order of 120 atmospheres and a drop in the voltage of the

source is immediately followed by a drop of such magnitude in the vapor pressure and in the arc voltage that the device successfully operates without a series ballast on a fluctuating voltage.

9. In combination, a source of electrical energy, a vapor arc discharge device comprising a sealed envelope having spaced electrodes and a quantity of vaporizable metal therein sufficient to produce a vapor pressure in excess of 5 atmospheres when partially vaporized, means having a negative temperature coefficient of electrical resistance connected in series with said device across the terminals of said source and serving as a series ballast only during starting of the device and means to artificially cool said envelope, the heat dissipating capacity of said envelope being such that when the energy input of said device from said source is in excess of 500 watts per square centimeter of the inner surface of said envelope the vapor pressure in said envelope is higher than 5 atmospheres and a drop in the voltage of the current source is immediately followed by a drop of such magnitude in the vapor pressure and in the arc voltage that the device successfully operates without a series ballast on a fluctuating voltage.

10. In combination, a source of electrical energy, a vapor arc discharge device comprising a sealed envelope having spaced electrodes and a quantity of vaporizable metal therein sufficient to produce a vapor pressure in excess of 5 atmospheres when partially vaporized, means having a negative temperature coefficient of electrical resistance mounted in heat receiving relation to and connected in series with said device across the terminals of said source and serving as a series ballast only during starting of the device and means to artificially cool said envelope, the heat dissipating capacity of said envelope being such that when the energy input of said device from said source is in excess of 500 watts per square centimeter of the inner surface of said envelope the vapor pressure in said envelope is higher than 5 atmospheres and a drop in the voltage of the current source is immediately followed by a drop of such magnitude in the vapor pressure and in the arc voltage that the device successfully operates without a series ballast on a fluctuating voltage.

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