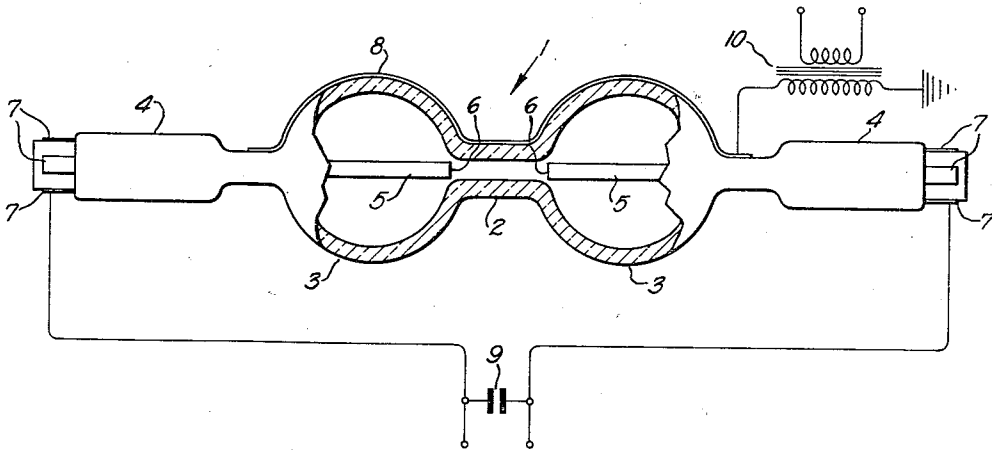


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ELECTRIC DISCHARGE LAMP
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ELECTRIC DISCHARGE LAMP

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2 Claims. (Cl. 315—241)

This invention relates to electric discharge lamps for producing intense flashes of light of very short duration. Such lamps usually have a filling comprising one or more permanent gases, and the filling may also include additives, for example metals placed in the discharge path or other gases or vapors, for modifying the spectrum of the light emitted.

In operation of such lamps, the flash is usually produced by connecting across the electrodes of the lamp a condenser charged to a high voltage, so that the flash is produced as a discharge of the condenser through the lamp; usually the condenser voltage is arranged to be somewhat less than the striking voltage of the lamp and the discharge is triggered off by the application of a suitable voltage to an auxiliary electrode associated with the lamp.

With such lamps it is often desirable that the rate of energy dissipation in each flash should be as great as possible, but in practice an upper limit to the rate of energy dissipation is usually set by one or other of two main factors. Thus during each flash the inner surface of the envelope surrounding the discharge is heated intensely by the discharge and if this heating (which of course increases with the rate of energy dissipation per flash) is too great, deterioration of the envelope results, usually by crazing of the inner surface of the envelope and possibly followed by cracking right through the wall of the envelope. It has been proposed to reduce this difficulty by using within a glass envelope a tubular quartz insert arranged to contain and constrict the discharge.

The second factor also arises from the intense heat produced by the discharge which causes rapid thermal expansion of the gas filling of the lamp in the neighborhood of the discharge, setting up a pressure wave in the filling which administers a violent shock to the envelope and may fracture it if the rate of heating produced by the discharge is too great.

It is sometimes desirable that the length of the discharge path in a lamp of the kind referred to should be small, e. g. a few centimeters, so that the lamp may co-operate efficiently with optical projection apparatus, but it is to be noted that for a given energy dissipation per flash the disadvantageous effects of the two factors aforementioned increase as the length of the discharge path decreases, since the heat produced by the discharge is more localized and the heating effect thereby intensified.

The object of this invention is to provide a novel form of lamp of the kind referred to with which a very high energy dissipation per flash can be achieved and which can be arranged to have a very short arc length so as to render it very suitable for use with optical projection apparatus.

According to one aspect of the invention, an electric discharge lamp for producing intense flashes of light of very short duration has a quartz envelope substantially of dumb-bell shape, containing a filling consisting wholly or mainly of one or more permanent gases, the axial length of the bar of the dumb-bell being greater than

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the mean internal diameter of the bar and the internal volume of each bulbous end of the dumb-bell being considerably greater than the internal volume of the bar, and each bulbous end of the dumb-bell contains an electrode, with a lead thereto sealed through that end, the discharge termination surface of which electrode lies adjacent to the corresponding end of the bar of the dumb-bell.

The bar of the dumb-bell is thus arranged to contain and constrict the discharge while the bulbous ends provide expansion chambers into which the gas filling heated by the discharge can expand for reducing the shock to the envelope. The envelope, being of quartz, is highly refractory for resisting the heating produced by the discharge and is strong mechanically for withstanding the pressure-wave shock.

Preferably the bulbous ends of the dumb-bell are both of approximately spherical shape, though other shapes, such as substantially cylindrical, may sometimes be used. The electrodes may conveniently consist of metal rods, preferably of tungsten or molybdenum, and leads to them may be brought out through the bulbous ends by the well-known quartz seal techniques.

The pressure of the permanent gas filling may vary according to the length of the discharge path, i. e., the length of the bar of the dumb-bell, but for efficient operation the pressure is preferably never less than 400 mms. of mercury, and with very short discharge path lengths, i. e. of about three centimeters or less, is preferably about one atmosphere. The statement that the filling may consist "mainly" of permanent gas is used to imply the possible presence of one or more additives, as aforementioned, for modifying the spectrum of the light emitted. The permanent gas used is preferably krypton or a mixture of krypton and xenon.

For triggering off the discharge, a lamp in accordance with the invention may be fitted with an auxiliary electrode, which may conveniently take the form of a length of wire outside the envelope, attached at each end to the envelope and closely following the outer contour of the envelope along the direction of the axis of the lamp.

A lamp in accordance with the invention designed with dimensions within the following limits is very suitable for use as a small light source in optical projection apparatus:

Length of bar of dumb-bell, less than 2 cms.

Mean internal diameter of bar, less than 1 cm.

Length of discharge path between electrodes, not more than 2 cms.

Mean internal diameter of bulbous ends (approximately spherical), not less than 2 cms.

Pressure of permanent gas filling, not less than 500 mm. of mercury.

One lamp in accordance with the invention will now be described by way of example in connection with the drawing which is an elevation, partly in section, of such a lamp.

The lamp has a quartz envelope 1 of dumb-bell shape with walls about 3 mm. thick; the bar 2 of the dumb-bell is of about 15 mm. axial length and 4 mm. in internal diameter. Each of the bulbous end portions 3 is approximately spherical and 30 mm. in internal diameter and each at the side diametrically opposite and projecting away from the bar of the dumb-bell is continued by a quartz extension tube 4 in which is set, and which is collapsed onto, a stout cylindrical tungsten rod electrode 5 (wrapped in molybdenum foil where the quartz is collapsed onto it) of 3 mm. diameter, which rod projects diametrically for 28 mm. within the envelope so that its end face 6, which is plane, lies adjacent to the corresponding end of the bar 2 of the dumb-bell and so that there

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is a gap of 19 mm. between the opposed ends 6—6 of the rods 5—5.

The quartz side-stems 4 in which the rods 5 are set are continued by molybdenum foil strip-seals of known kind, of large current-handling capacity, the rod electrodes 5 being connected to the foils at one end of the seals and metal connecting clamps (not shown) being fixed around the exposed parts of the foil 7 at the other end of the seals.

A starting electrode consisting of a length of bent wire 8 following closely the outer contour of the dumb-bell envelope 1 is attached at each end to one of the quartz side-stems 4.

The envelope 1 of the lamp is filled with krypton or a krypton-xenon mixture at a pressure of 700 mm. of mercury.

A condenser 9 is connected across the electrodes 5—5 of the lamp and is charged to a high voltage from a suitable source. The condenser voltage is ordinarily somewhat less than the striking or ignition voltage of the lamp and the discharge is triggered by the application of a suitable voltage from a transformer 10 to the auxiliary electrode 8.

With the lamp as described with a purely krypton filling I have succeeded in obtaining flashes of one millisecond duration with an energy dissipation of 2000 watt-seconds per flash.

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

1. A gaseous electric discharge lamp for producing intense flashes of light of very short duration and comprising a quartz envelope substantially of dumb-bell shape and containing a filling of ionizable gas at a pressure not less than about 500 millimeters, the axial length of the bar portion of said dumb-bell shaped envelope being less than 2 cms., the mean internal diameter of said bar portion being less than 1 cm. and less than the length thereof, the bulbous ends of said envelope having a mean internal diameter not less than 2 cms. and a volume considerably greater than the volume of said bar portion, and an electrode in each said bulbous end of the envelope having its discharge termination surface adjacent to the corresponding end of the said bar portion of the envelope

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to define a discharge path therebetween not more than 2 cms. long, and means including a source of electrical energy for impressing between the electrodes a brief voltage pulse of magnitude sufficient to produce an intense flash of light through the gas in said bar portion with concomitant creation of a high pressure shock wave, said bulbous ends providing expansion chambers for reducing shock to the envelope due to heating and expansion of the gas filling.

2. A gaseous electric discharge lamp for producing intense flashes of light of very short duration and comprising a quartz envelope substantially of dumb-bell shape and containing a filling of ionizable gas at a pressure of several hundred millimeters, the bar portion of the dumb-bell shaped envelope having an axial length of about 15 mm. and a mean internal diameter of about 4 mm., each bulbous end of the dumb-bell shaped envelope being approximately spherical and having an internal diameter of about 30 mm., and an electrode in each said bulbous end of the envelope having its discharge termination surface adjacent to the corresponding end of the said bar portion of the envelope to define a discharge path therebetween about 19 mm. long, and means including a source of electrical energy for impressing between the electrodes a brief voltage pulse of magnitude sufficient to produce an intense flash of light through the gas in said bar portion with concomitant creation of a high pressure shock wave, said bulbous ends providing expansion chambers for reducing shock to the envelope due to heating and expansion of the gas filling.

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