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MEANS FOR PREVENTING EXTERNAL COATING OF WATER-COOLED ELECTRIC LAMPS

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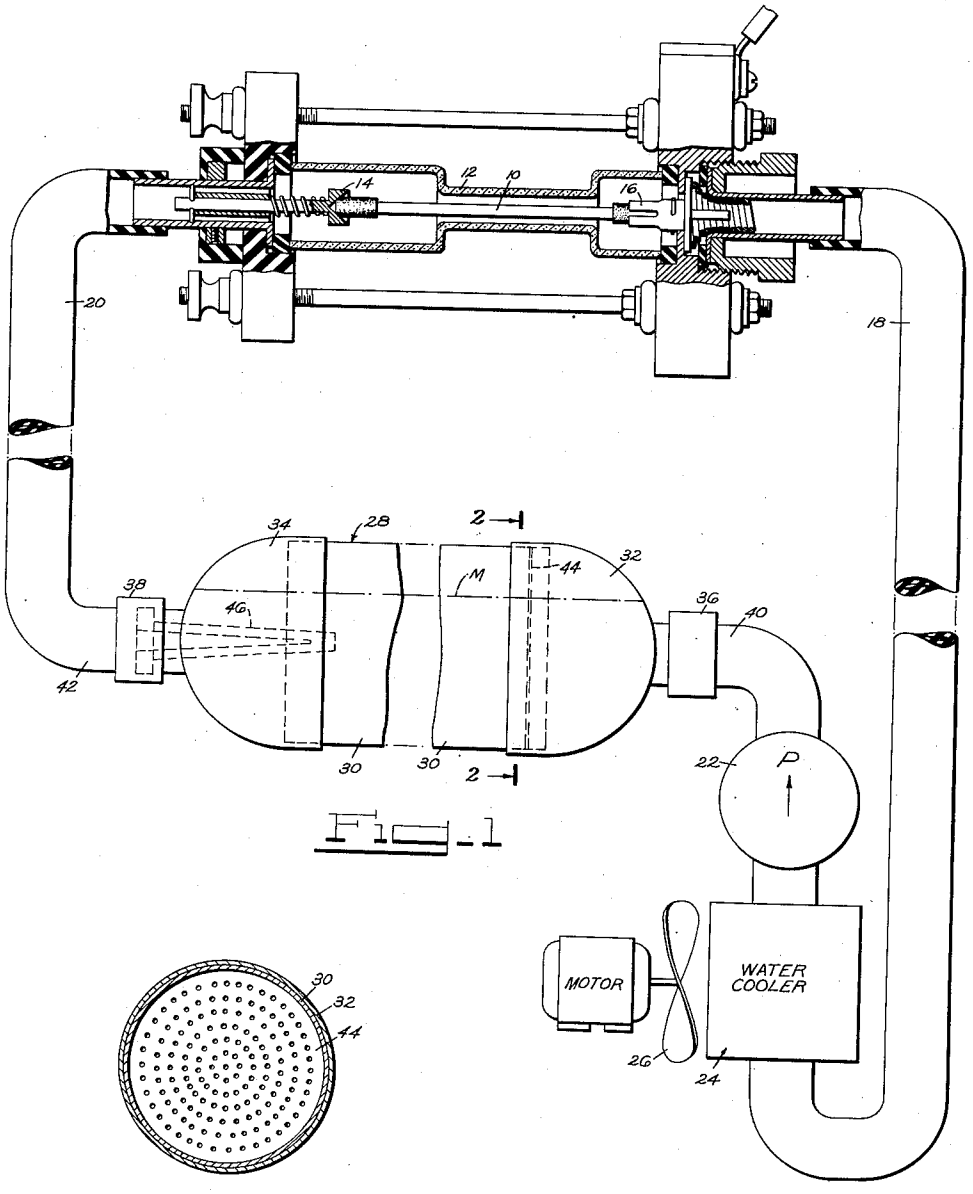

Fig. 1

Fig. 2

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MEANS FOR PREVENTING EXTERNAL COATING OF WATER-COOLED ELECTRIC LAMPS

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2 Claims. (Cl. 313—12)

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This invention relates to water-cooled electric lamps of the mercury arc type. As shown by U. S. Patents Nos. 2,435,299 and 2,435,300 such lamps are used for providing a high-intensity light source for micro-projection purposes.

The life of a lamp of the above designated type is comparatively short and before the lamp fails completely the light intensity decreases substantially after a comparatively short period of use. The decrease in the intensity of light emanating from the lamp is due to the deposit of a coating on the quartz tube in which the arc is formed.

The primary object of the present invention therefore is to prevent the deposit of a coating on the quartz tube of a water-cooled lamp of the above designated type and to increase the life of the lamp.

As shown by said Patent 2,435,300, the lamp terminals are disposed within the water cooling jacket, being immersed in the water which flows through the jacket and around the quartz tube for cooling the latter. The jacket tube has a constricted portion so that the conductivity of the water between the lamp terminals is sufficiently low to enable both terminals to be immersed in the cooling water.

The explanation for the deposition of a coating on the quartz tube is uncertain. It is known that this deposit of coating is not due to impurities such as those present in tap water or city water, because even when distilled water is used for cooling the tube, the deposit of a coating on the quartz tube takes place. While the invention, obviously, is not limited to any explanatory theory, it is believed that due to the high voltage at which the lamp operates, ionization of the cooling water takes place rendering this water highly reactive, so that in its flow through the circulating system various compounds are produced, including possibly metal carbonates, by reaction between (1) the water, (2) carbon, (3) oxygen, (4) carbon and oxygen containing compounds present in the water or in the walls of the cooling system and (5) the metal walls of the cooling system, which compounds are deposited on the quartz tube.

I have made the surprising and unexpected discovery that by passing the cooling water through a mixture of anion and cation exchange resins as it flows through the cooling system, the deposit of a coating on the quartz tube is minimized, if not substantially completely eliminated, with consequent maintenance of the lamp at optimum light intensity for a maximum period of time.

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The invention will now be explained in greater detail with reference to the accompanying illustrative drawing in which:

Fig. 1 shows the lamp connected to a water-cooling system having provision for subjecting the cooling water in the system to the action of ion-exchange resins; and

Fig. 2 is a sectional view on the line 2—2 of Fig. 1.

As illustrated by the drawings, the lamp assembly may be the same as that shown by Fig. 5 of Patent No. 2,435,300. Said assembly includes the quartz lamp tube 10 disposed within a water-cooling jacket 12 and mounted between terminals 14 and 16 positioned within jacket 12 and immersed in the cooling water which passes through said jacket. The opposite ends of the jacket communicate with tubes 18 and 20, respectively, in a circulatory system which includes a water pump 22 and an air-cooled radiator 24 which includes a fan 26, as described in the above mentioned Patent No. 2,435,299, and also in the application of Edwin C. Weiskopf, Ser. No. 693,292 filed August 27, 1946, issued as Patent Number 2,477,396 on July 26, 1949.

In accordance with the present invention a receptacle 28 contains a bed constituted of a mixture of anion exchange resins and cation exchange resins in which preferably the anion exchange resins predominate. This receptacle 28 is in the circulatory system through which the cooling water flows. It comprises a body portion 30 having removable end caps 32 and 34 provided with pipe fittings 36 and 38, respectively, for connection with the water inlet tube 40 and the water outlet tube 42, which is connected to tube 20. A screen 44 is removably disposed adjacent one end of receptacle 28 and a filter 46, preferably a porous metal member, is positioned at the outlet end of the receptacle 28 and is connected to fitting 38. It will be understood that screen 44 and filter 46 confine the body of ion exchange resins to receptacle 28 and that the water is filtered as it passes through filter 46, so that substantially none of the ion exchange resins flow with the circulating cooling water stream into and through the outlet tube 42.

The ion exchange resins are in the granular form readily available commercially, for example, those sold by the Rohm & Haas Company under its trade-mark "Amberlite" or those sold by American Cyanamid Company under its trade-mark "Ionac." Examples of cation exchange resins are (a) the condensation products produced by condensing a methylene body and a polyhydric phenolic body, e. g., by condensing

formaldehyde with a polyhydric phenol such as catechol, as disclosed, for instance, in United States Patent 2,104,501, (b) synthetic resins produced by the condensation of tannin with formaldehyde, which resins are sulfited to a degree such that the sulfur content of each resin is not less than 2.4% or a phenol formaldehyde type of resin also sulfited to a degree such that the sulfur content of the resin is not less than 2.4%, as disclosed, for example, in United States Patent 2,191,853, (c) modified phenol formaldehyde sulfonic acid type resins ("Amberlite IR–100"), (d) high density sulfonic acid type resins supplied in the fully regenerated sodium form ("Amberlite IR–120"), and (e) polymerized sulfonic acids containing replaceable hydrogen ("Ionac C–200" and "Ionac C–240").

Examples of the anion exchange resins are (a) those produced by condensing formaldehyde with aromatic amines, such as aniline, m-toluidine, m-ethylaminobenzene, or m-phenyllenediamine disclosed, for example, in United States Patent 2,151,833, ("Amberlite IRA–400") and (b) resinified organic bases which have the properties of removing acidic molecules, e. g. resins produced by reacting amines with aldehydes, such, for example, as the melamine-formaldehyde-guanidine resins, phenol - formaldehyde - polyamine resins and acetone-formaldehyde-polyamine resins ("Ionac A–300").

The preferred mixture is made by mixing "Amberlite IRA–400" with "Amberlite IR–120." While the proportions of the anion exchange resin and cation exchange resin may vary, the preferred mixture consists of 6 parts of anion exchange resin and 4 parts of cation exchange resin. This mixture has been found to give excellent results with the lamp and cooling system hereinbefore referred to using city water in the cooling system. As the anion and cation exchange resins are well known and commercially available products, as hereinabove pointed out, further description thereof is considered unnecessary.

As used in the cooling system of the light projector now being manufactured and constructed according to United States Patent 2,435,300 and application Serial No. 693,292, four gallons of water per minute are pumped through the jacket 12 of the lamp in order to properly cool the lamp. For this rate of flow of water through said jacket and hence through receptacle 28, a total volume of about 110 cc. of the ion exchange resins in said receptacle has been found to give excellent results, but it will be understood that the invention is not limited to this quantity of resins. Preferably, receptacle 28 is mounted in horizontal position and its internal volume is about one third greater than said volume of the resins in the wet activated state of the latter in which said resins may be obtained from the manufacturer or other source of supply ready for use.

It will be noted that the water circulatory system is a closed system, except for water which may be added from time to time to the radiator or storage tank 24 make up for losses, so that substantially the same water is circulated continuously by pump 22 through the cooling jacket 12 and the other passages of the system. Thus the water is at all times subjected to treatment by the ion-exchange material in receptacle, i. e., at all times during the operation of the lamp. It may be noted, in this connection, that the apparatus, as actually made and sold, is provided with a flow-controlled switch (not shown) so that the lamp 10 cannot be energized unless pump 22 is in operation and water flows through lamp jacket 12. Accordingly cooling water is subjected to the action of the mixture of anion and cation exchange resins in receptacle 28, which I have found prevents deposition of a coating on lamp tube 10. Hence, the high intensity of the light emanating from the lamp is maintained substantially without diminution for the full life of the lamp. Moreover, the life of the lamp is greatly increased, such increase being many hours more than the life of the lamp as rated by the manufacturer thereof.

This application is a continuation-in-part of application Serial No. 80,398 filed March 9, 1949, now abandoned.

It will be understood that various changes may be made without departing from the underlying idea or principles of the invention within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is:

1. Cooling arrangement for high intensity mercury arc lamps mounted in a jacket through which the cooling liquid passes, said lamps having terminal electrodes exposed to said liquid; comprising a closed circulatory system in which distilled water flows as the cooling liquid, said system including a storage tank for said water, said jacket, pump means for forcibly circulating said water and a container having therein an ion exchanger substance for preventing a build-up of metallic ions and thereby the formation of light absorbing deposits upon said lamp.

2. Cooling arrangement for high intensity mercury arc lamps mounted in a jacket through which the cooling liquid passes, said lamps having terminal electrodes exposed to said liquid; comprising a closed circulatory system in which water flows as the cooling liquid, said system including a storage tank for said water, said jacket, pump means for forcibly circulating said water and a container having therein an ion exchanger substance for preventing a build-up of metallic ions in said circulating water and thereby the formation of light absorbing deposits upon said lamp.

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