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LIGHTING APPARATUS

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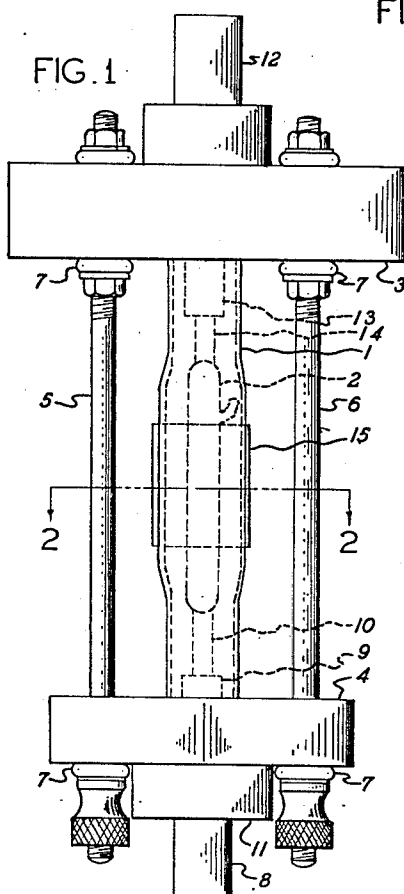
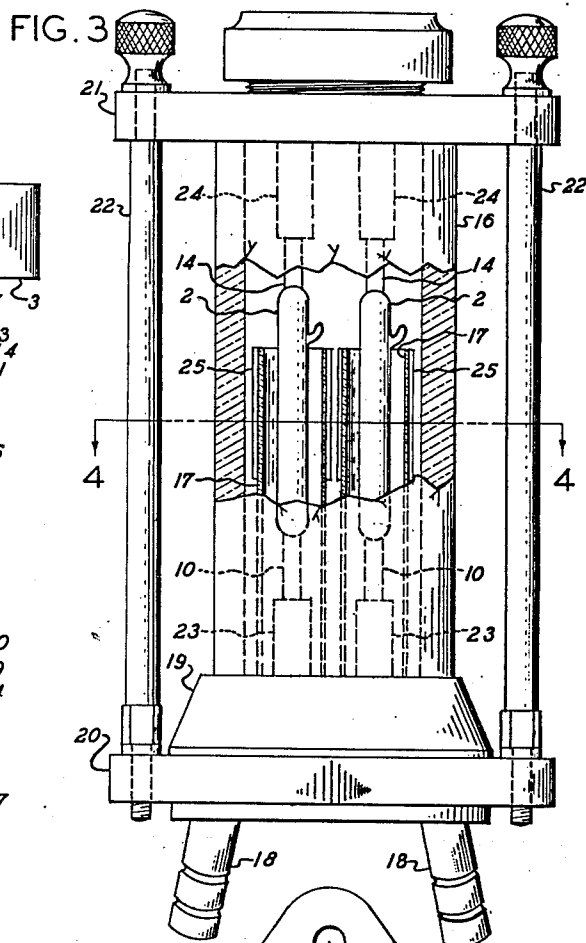
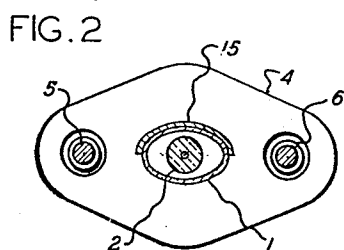
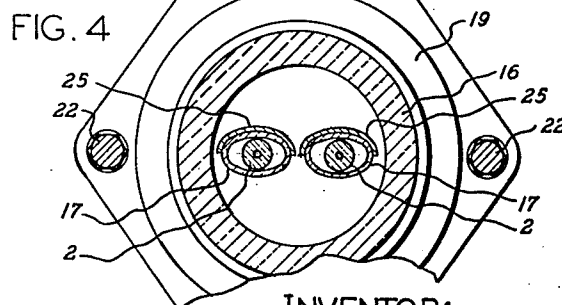
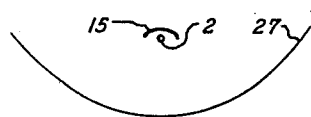


FIG. 5



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LIGHTING APPARATUS

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My invention relates to electric lamps and, more particularly to means for controlling the light emitted by elongated electric lamps, such as the high intensity mercury vapor arc lamps of the capillary type disclosed and claimed in U. S. Patent No. 2,094,694, Bol et al.

Water cooling apparatus for high pressure mercury vapor arc lamps is disclosed in U. S. Patent 2,295,046, Noel and comprises a watertight housing having a cylindrical transparent tube surrounding one or more lamps and end members through which the lamps are energized and the cooling water flows into and out of the glass tube. I have observed that when the apparatus described in the latter patent comprises two or more lamps and is mounted at the focus of the reflector of a searchlight, distinct pencil beams are projected rather than a single beam.

An object of my invention is to provide water cooling apparatus of the above type in which this disadvantage is avoided. Another object of my invention is to provide such apparatus comprising a reflector for controlling the distribution of the light emitted by the lamp. Another object of my invention is to increase the spread of the beam and the uniformity of candlepower throughout the spread of the beam projected by a searchlight including such apparatus. Further objects and advantages of the invention will appear from the following detailed description of species thereof, from the appended claims and from the drawing accompanying and forming part of this specification in which, Fig. 1 is a front elevational view of a lighting apparatus embodying my invention; Fig. 2 is a sectional view along the line 2-2 of Fig. 1; Fig. 3 is a front elevational view of another species of my invention; Fig. 4 is a sectional view along the line 4-4 of Fig. 3 and Fig. 5 is a diagrammatic illustration of the apparatus at the focus of a searchlight reflector.

The lighting apparatus shown in Fig. 1 of the drawing comprises a glass tube 1 surrounding a tubular lamp 2 and clamped between two end members the upper one 3 of which comprises a brass plate and the lower one 4 an electrically insulating plate. The plates 3 and 4 are held together by retaining bolts 5 and 6 which are insulated from the metal plate 3 and spaced from the plate 4 by rubber bushings 7. Rubber gaskets (not shown) are inserted between the ends of the glass tube 1 and the end members 3 and 4 to provide a watertight seal therebetween.

A water intake tube 8 of metal is mounted on and extends through the lower plate 4 and communicates with the interior of the glass tube 1. A spring contact 9 is mounted in the intake tube 8 and extends into the glass tube 1 to accommodate and engage a terminal 10 of the lamp 2. The electrical contact 9 is electrically connected to the intake tube 8 which is provided

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with a current lead (not shown) passing through an electrically insulating cap 11. The electrical connections have not been shown for simplicity of illustration. The exposed portion of the intake tube 8 may be enclosed and electrically insulated by a rubber water-inlet tube (not shown) during operation of the lamp 1 so that all electrically conducting parts at the intake end of the apparatus are insulated to protect the user from electrical shock.

The metal plate 3 at the outlet end of the apparatus is provided with an outlet tube 12 communicating with the interior of the glass tube 1. A stationary contact 13 which engages the lamp terminal 14 is mounted in the passage through the metal plate 3 and electrically engages the metal plate. Electrical connections to the terminal 15 of the lamp may be made through the metal plate 3.

The lamp 2 comprises a sealed, tubular, quartz envelope about 40 mm. in length with an outside diameter of about 6 mm. and a bore of about 2 mm. Two metal sleeves which constitute the lamp terminals 10 and 14 are attached to the ends of the envelope. A current leading-in wire extends from each sleeve, through the wall of the quartz envelope and terminates in the small bore of the envelope. The inner ends of the leading-in wires which are spaced a substantial distance apart are surrounded by a quantity of mercury and serve as electrodes for the elongated, luminous, high pressure mercury vapor arc discharge which occurs in the central portion of the envelope.

The apparatus described above is well known and the description thereof is included in order that my invention may be readily understood.

The glass tube 1 surrounding the lamp 2 is circular in cross-section at its ends which have an outside diameter of about 14 mm. and elliptical at its central portion surrounding the luminous arc in the lamp. The major axis of the ellipse measured on the outer surface of the tube 1 is about 17 mm. and is in a plane with the bolts 5 and 6. The minor axis of the ellipse is about 10 mm. A reflector 15 constituted by a film of reflecting metal, such as aluminum, is applied to the outer surface of the glass tube 1 and covers the segment of the ellipse limited by the said major axis. The thickness of the film has been greatly exaggerated in the drawing for clarity of illustration. The trough-shaped reflector 15 is as long as the discharge gap in the lamp and the longitudinal axis of the lamp coincides with the center of the generating ellipse. The light emitted by the lamp 2 is projected by the lamp unit within a 180 degree angle measured from the center of the arc. The reflected light passes through the plane including the minor axis of the generating ellipse and the longitudinal axis of the lamp and the angle of reflection

increases as the vertices of the ellipse are approached.

I have demonstrated that a searchlight comprising a 24 inch parabolic reflector having the apparatus described above mounted vertically thereon with the longitudinal axis of the lamp 2 transverse to the axis and at the focus of the parabolic reflector and with the elliptical reflector 15 facing the parabolic reflector projects a narrow beam of light. Such an arrangement is shown diagrammatically in Fig. 5 in which the parabolic reflector is indicated at 27 and the plane of the paper is normal to the longitudinal axis of the lamp 2. I have demonstrated further that the projected beam is of greater angular spread and of higher candlepower at the higher angles than the beam projected by the same searchlight except for the use of an uncoated, cylindrical glass tube in place of the tube 1 described above. Specifically, when an uncoated cylindrical tube approximately 14 mm. in diameter was used the candlepower at the axis of the beam was 10,500 in a horizontal plane including the beam axis and at $\frac{1}{2}$ degree on either side of the said axis it averaged 3,300; at $\frac{3}{4}$ degree 900; at 1 degree 400, and at $1\frac{1}{4}$ degrees 100. When the coated elliptical tube 1 described above was substituted for the cylindrical tube in the same searchlight and the same measurements made in the same plane and in the same manner the candlepower at the beam axis was 11,000; at $\frac{1}{2}$ degree it averaged 4,300; at $\frac{3}{4}$ degree and 1 degree 2,350; at $1\frac{1}{4}$ degrees 1,650; at $1\frac{1}{2}$ degrees 1,800, and at 2 degrees 400.

The candlepower distribution of the searchlight in a vertical plane with the uncoated cylindrical tube was 10,500 at the beam axis; averaged 9,550 at 1 degree from the beam axis; 6,200 at 2 degrees, and 450 at 3 degrees. With the coated elliptical tube the candlepower at the beam axis was 11,000; at 1 degree it averaged 9,000; at 2 degrees 6,000, and at 3 degrees 1,250 in the same vertical plane.

Thus, the reflector 15 on the tube 1 is effective for increasing the spread of the beam and the candlepower at the higher angles of spread of the beam projected by the searchlight.

The apparatus shown in Figs. 3 and 4 of the drawing is similar to that shown in Fig. 1 except that in this embodiment two mercury vapor arc lamps 2 are mounted side by side in a jacket comprising a heavy, cylindrical outer glass tube 16 and each lamp 2 is surrounded by an elliptical glass tube 17 terminating short of one end of the lamp. The major and minor axes of tubes 17 are of the same length as those of tube 1 of Figs. 1 and 2. Cooling water may flow into and out of the jacket through the nipples 18 which are connected to the interior of the glass tubes 17 by passages in the electrically insulating plate 19 which is engaged by a metal holder 20. The glass tubes 17 are mounted on the plate 19 with the joints watertight and the outer glass tube 16 is recessed into an annular groove in the plate 19 and a similar groove in the metal upper plate 21. The joints between the ends of the outer tube 16 and the plates 19 and 21 are made watertight by soft rubber gaskets. Retaining bolts 22 engage holder 20 and plate 21 and clamp the assembly together. Electrical connections to the lamp terminals 10 and 14 of the lamps 2 are made through the stationary contacts 23 in the elliptical tubes 17 which contacts 23 extend through the insulator plate 19 for connection to terminals of an electric power source for the

lamps 2, and through spring contacts 24 mounted on and electrically connected to the metal plate 21 which may be connected to a suitable terminal of the power source.

Each tube 17 has a metal film constituting a reflector 25 alongside of the light emitting portions of the lamps 2 as in the embodiment of the invention shown in Figs. 1 and 2 and each reflector 25 directs the light emitted by the lamp 2 it surrounds in the same manner as the reflector 15 of Figs. 1 and 2. Thus, when the apparatus shown in Figs. 3 and 4 is mounted at the focus of a parabolic reflector in a searchlight a single beam of high candlepower is projected rather than distinct pencil beams which was obtained with similar apparatus in which the glass tubes 17 were cylindrical and free from a reflecting coating.

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

1. A liquid-cooled mount for an elongated high pressure mercury vapor discharge lamp having its end terminals exposed to the cooling liquid comprising a light transmitting tube having a portion elliptical in cross section closely surrounding the light emitting portion of the lamp and a coating of reflecting metal on said tube portion and completely covering one-half of said portion symmetrical with its minor axis.

2. A liquid-cooled mount for an elongated high pressure mercury vapor discharge lamp having its end terminals exposed to the cooling liquid comprising a jacket through which cooling liquid may circulate and at least a portion of which is light transmitting, means to support the lamp within said jacket portion and a light transmitting tube within said jacket having a portion elliptical in cross section closely surrounding the light emitting portion of the lamp and a coating of reflecting metal on said tube portion and completely covering one-half of said portion symmetrical with its minor axis.

3. A liquid-cooled mount for a plurality of elongated high pressure mercury vapor discharge lamps having its end terminals exposed to the cooling liquid comprising a jacket through which cooling liquid may circulate and at least a portion of which is light transmitting, means to support the said lamps in parallel juxtaposed positions within said jacket portion, a plurality of light transmitting tubes one for each of said lamps within said jacket each having a portion elliptical in cross section closely surrounding the light emitting portion of its respective lamp and a coating of reflecting metal on said tube portion and completely covering one-half of said portion symmetrical with its minor axis.

GEORGE R. BAUMGARTNER.

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