

April 19, 1938.

K. F. J. KIRSTEN

2,114,536

DIRECTLY HEATED CATHODE ELECTRODE

Original Filed June 19, 1934

Fig. 1

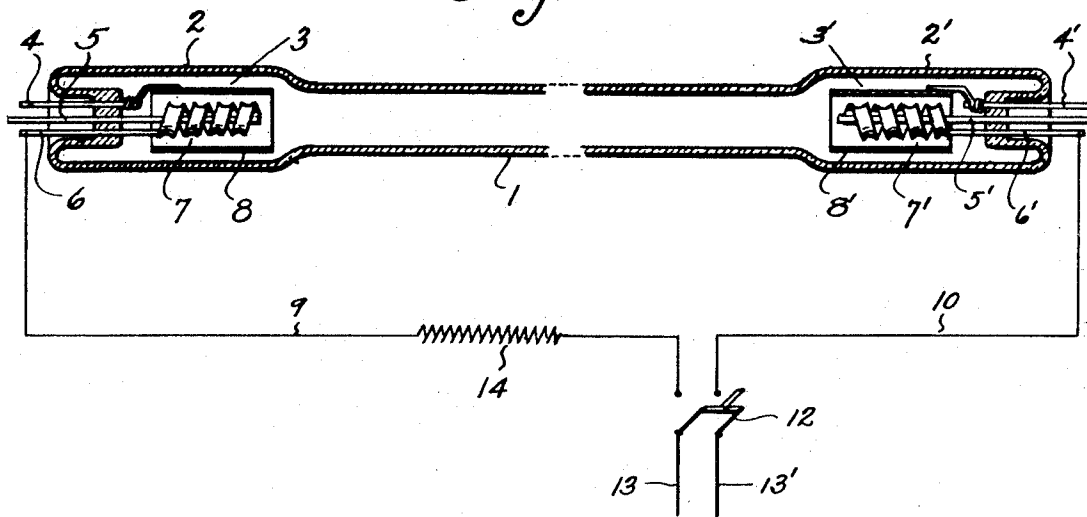


Fig. 2

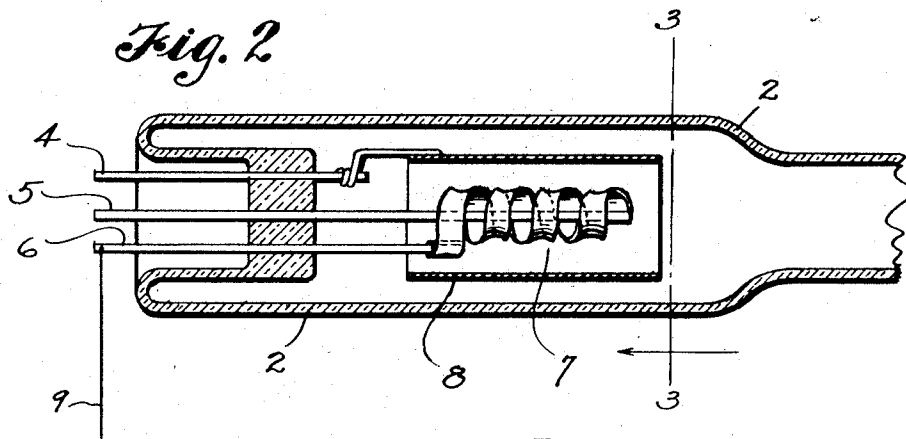


Fig. 3

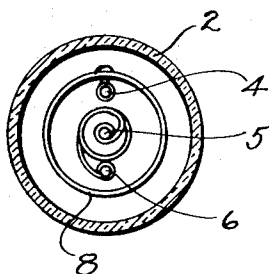
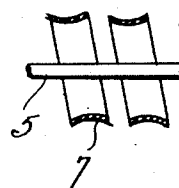


Fig. 4



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DIRECTLY HEATED CATHODE ELECTRODE

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2 Claims. (Cl. 176—126)

This invention relates to improvements in electrodes for luminous arc lamps and it has reference more particularly to directly heated cathode electrodes especially designed for use in connection with luminous arc lamps of tubular form as now extensively used for signs, displays and illumination.

It is the principal object of this invention to provide an electrode in the form of a spirally wound, metallic ribbon strip placed axially of the arc and electrically connected so that in use the maximum of the arc potential will exist at the point of the ribbon where the arc is the longest, thereby to insure uniform emission over the entire ribbon surface.

It is a further object of the invention to provide an electrode of the above stated character wherein the spiral ribbon is located coaxially within a metallic, cylindrical sleeve serving as a heat conserving means whereby the heating of the cathode electrode is greatly augmented due to the fact that a considerable amount of heat energy is prevented from radiating through the glass and is conserved for the emission space in the close vicinity of the cathode ribbon.

Other objects of the invention reside in the details of construction, the combination of parts and mode of operation, as will hereinafter be fully described.

Explanatory to the invention, it will here be stated that the present electrode is in the nature of an improvement upon a common form of directly heated cathode electrode now in use and consisting of a metallic ribbon folded in zig-zag form to lie in a plane transversely of the direction of the arc and supported at its opposite ends by metal rods or conductors sealed into the end of the glass tube which serves as the container of the rare gas, or metallic vapor in which the luminous arc flows. This ribbon, which is coated with a metallic oxide, is heated electrically from a special electrical circuit and the heat generated by the ribbon is the product of the electrical resistance of the ribbon and the square of the current carried by the ribbon. The ribbon is usually enclosed in a cylindrical, metallic reflecting shield. The luminous arc that is established between the ribbons of two electrodes placed at opposite ends of the tube is a part of another electrical circuit superimposed upon the two circuits which serve to heat the ribbons.

There are objectionable features in the above described form of electrode since there must exist a fall of potential along the ribbon due to its electrical resistance, and the arc will tend to root

itself near the end of the ribbon where the total potential across the gas column is the highest. The result is an unequal distribution of emission and ionic bombardment of the ribbon over its surface. Furthermore, the zig-zag arrangement of the ribbon produces unequal heating thereof due to the fact that the rate of heat radiation from all parts of its surface is not uniform because the distance of any point of the ribbon surface to the reflecting shield or to adjacent points of the ribbon varies considerably. For this, and other reasons, such electrodes have a comparatively short life.

The electrode of the present application employs a ribbon and an enclosing, heat reflecting shield but is so constructed and arranged that these objectionable features of electrodes of the type just described are overcome; and there is provided a uniformity of potential gradient and uniformity of emission over the entire area of the ribbon.

In accomplishing the various objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawing, wherein—

Fig. 1 is a view of a luminous arc lamp having terminal electrodes constructed in accordance with the present invention.

Fig. 2 is an enlarged, sectional view of one of the electrodes in its longitudinal direction.

Fig. 3 is a cross section on line 3—3 in Fig. 2.

Fig. 4 is a sectional detail of the ribbon strip.

Referring more in detail to the drawing—

1 designates a sealed, transparent glass tube here shown as straight but which may be curved or angularly formed in different shapes, and in which tube a suitable gas such as neon, or a mixture of rare gases, or metallic vapors is contained. At its opposite ends the tube has the usual terminal enlargements 2—2' in which the electrodes, embodied by the present invention are located; these electrodes at opposite terminals being designated in their entirety by reference numerals 3 and 3' respectively.

At each end of the tube are three sealed in rods, or metallic conductors; those at one end being designated by numerals 4, 5 and 6 while those at the other end corresponding thereto are designated by numerals 4', 5' and 6'. The rods 5 and 5' are of the greatest extent into the tube and are centrally located. The rods 6 and 6' are shorter. The two rods 5 and 6 at one end of the tube and rods 5' and 6' at the opposite end serve to mount the metallic ribbon strips 7 and 7'.

As seen best in Fig. 2, the ribbon strip is formed in a cylindrical spiral attached at one end to the inner end of rod 5 and attached at its other end to rod 6. In the opposite end of the lamp tube, the ribbon 7' would likewise be attached to rods 5' and 6'.

Enclosing the ribbons 7 and 7', respectively, are metallic, cylindrical shields 8 and 8' supported coaxially about the ribbons and spaced therefrom by the rods 4 and 4'. These shields extend slightly beyond the ends of the ribbons and in use they retain and conserve the heat of the ribbons so as to increase the rate at which the ribbon comes to the temperature necessary for effective emission.

The lamp, as shown in Fig. 1, has circuit wires 9 and 10 leading respectively from the rods 6 and 6' to terminals of a switch 12 through which connection may be made or opened with circuit mains 13—13'. A stabilizing impedance 14 is included in the connection 9.

It is understood that if it is so desired, other circuit connections may be made with the rods 5 and 5' for an auxiliary heater circuit and also connections might be made with the rods 4 and 4' in order to use the shields 8—8' in the electrode conditioning operation that takes place prior to use of the lamp.

To give a desired stiffness to the ribbon, it is longitudinally cupped, or formed with an inwardly depressed trough, as is shown in cross section in Fig. 4. It is of prime importance in electrodes of this character employing a ribbon strip that all parts of the ribbon be equally spaced from the reflecting shield and each part thereof be also uniformly spaced from the adjacent parts so as to insure uniform heating. Unequal heating results in unequal emission, and since the tendency of the arc is to anchor to the parts of higher temperature, this results in still greater heating of these spots with the ultimate destruction of the ribbon. To insure the ribbon against warping or sagging its cylindrical form must be retained, and this is accomplished in this instance by a transverse curvature of the ribbon strip, as is best illustrated in Fig. 4. This construction gives rigidity to the ribbon both transversely and circumferentially. Thus, by this particular mechanical construction great rigidity, even under conditions of incandescence, is obtained. At the same time the heat intensity from the ribbon is

kept constant by reason of maintaining the uniform spaces of all of its elements from the reflecting shield and the practical elimination of mutual reflection between adjacent turns.

It is apparent that since the arc circuit is so connected that the maximum arc potential exists between the "far" ends of the two ribbons 7—7', and the potential drop of the heating circuit of spiral 7 is practically equal and in the same direction as the potential drop of the arc along the surface of the spiral, uniform emission of the entire spiral surface will result. This results in a much longer life of the cathode.

A further advantage of the spiral filament and its symmetrical arrangement within the heat reflecting shield resides in the fact that this filament can be brought to red heat far more rapidly than otherwise. Consequently, the cathode heating circuit and the arc circuit may be closed simultaneously without the danger of excessive cathode sputtering during the arc kindling period which is considerably shortened by the above construction.

A luminous tube properly equipped with electrodes made according to the above disclosure provides for an instant establishment of an arc upon closing the lamp circuit, thus eliminating the usually required thermostats, relays and auxiliary equipment heretofore considered necessary.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is—

1. In a lamp of the character described a cathode comprising a coil formed by a ribbon strip, connected in an electric circuit and having its convolutions uniformly spaced and edgewise to each other and the strip being inwardly troughed throughout its length for stiffness and rigidity, and a heat conserving shield of cylindrical form enclosing the spiral coaxially thereof.

2. In a lamp of the character disclosed, a cylindrical shield, a cathode formed from a flat, longitudinally troughed ribbon strip helically wound in a coil coaxially within the shield and spaced therefrom and connected at its opposite ends in an electric circuit; said coil being disposed axially in the direction of the arc path in the lamp and having its convolutions evenly spaced apart and edgewise to each other.

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