Sept. 19, 1939. J. LECORGUILLIER 2,173,208

ELECTRODE

Filed April 15, 1936

Fig. 1.

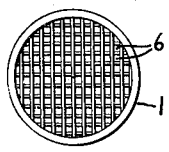


Fig. 3.

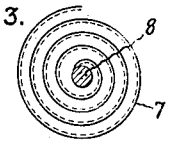


Fig. 2.

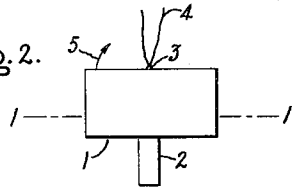


Fig. 4.

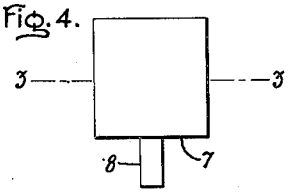


Fig. 5.

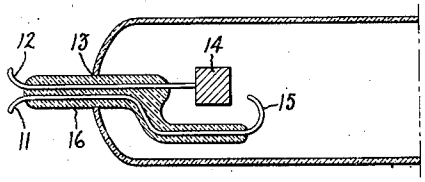


Fig. 6.

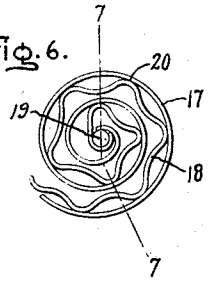
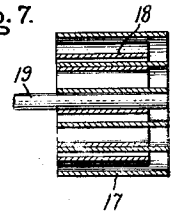


Fig. 7.



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UNITED STATES PATENT OFFICE

2,173,208

ELECTRODE

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Application April 15, 1936, Serial No. 74,586
In Great Britain May 7, 1935

3 Claims. (Cl. 176—126)

It is known that, if in a discharge tube provided with electrodes at each end, the pressure of the vapour and gas filling the tube is varied, the portion of the surface of the electrodes where the discharge starts and ends diminishes when the pressure increases, whether the tube is provided with cold electrodes or whether it is provided with thermo-emissive electrodes. For example, it is known that, with a constant current supplied, the surface of the cathode glow on a cold cathode is substantially inversely proportional to the square of the pressure.

When working pressures of the order of 5 to 10 centimetres of mercury are attained, and still more so at atmospheric pressure, the discharge starts from a point of small dimensions which possesses absolutely the appearance of a cathode spot. This spot is capable of raising a point on the electrode to a high temperature and even of melting it.

In a metallic vapour tube, however, one of the features is that ignition is effected by virtue of the presence of auxiliary gases under low pressure, generally some millimetres of mercury. The pressure then increases on account of the volatilisation of the metallic vapour and, for example, in the special case of mercury or amalgam vapour tubes, attains a pressure in the vicinity of the atmospheric pressure.

If therefore, such a tube is provided with an electrode coated with emissive oxides and not heated by an auxiliary source, and if special precautions are not taken, numerous difficulties arise. In fact, if the surface of electrode is not sufficient, there is formed at the moment of starting, that is to say, when the prevailing pressure is the pressure of filling of the auxiliary gases, a cathode spot which sweeps away the coating of emissive oxides. Then, the electrode, being heated, emits electrons but not in a sufficient quantity and this deficiency in the emission results in abundant volatilisation and a large voltage drop at the electrode.

When high pressure working condition is attained the discharge is reduced to a point, but this very hot point may deteriorate the cathode, and if the heat is not communicated to the adjacent parts, the voltage drop at the electrode will constantly vary according to the displacement of the point of arrival or departure of the discharge. The tube will flicker, and will even be extinguished if this point arrives at a cold part.

The disadvantages mentioned in the foregoing at the moment of starting will not be produced if the surface of the electrode is sufficient to support the discharge at the pressure of filling of the auxiliary gases, but in this case, the destructive effects under high pressure will be increased.

The present invention relates to an electrode device adapted for the operation under high pressure, from 500 mm. of mercury to atmospheric pressure, of metallic vapour tubes having a filling of auxiliary inert gases.

The principle of this invention is to dispose the emissive surfaces of the electrode so as to obtain the maximum emissive surface in the least volume. The result is that the calorific capacity of the electrode, which is self-heating, is very small and that its heating under the influence of the discharge is consequently rapid.

With a view to reducing the harmful effects of volatilisation, particularly the blackening of the tubes by the deposit of metallic particles on its walls, only the internal surface of the electrodes is rendered emissive. This arrangement has in addition the effect of preventing the formation of the arc at points near the walls, risking the deterioration of the latter.

It has been found that the development given to the emissive surface is preferably comprised between 5 and 10 sq. cm. per ampere. The thickness of the support of the oxide will naturally be proportional to the current to be supplied.

The accompanying drawing shows various forms of construction of the invention. They are given by way of indication, without the invention being limited thereby.

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

Fig. 2 is an elevational view of an electrode according to the present invention.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 4.

Fig. 4 is an elevational view of a modified form of electrode.

Fig. 5 is a fragmentary sectional view of a discharge tube provided with a modified form of electrode of the present invention.

Fig. 6 is an end view of another modified form of electrode.

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6.

As shown in Figs. 1 and 2, the electrode body 1 is mounted on a supporting member 2. The electrode body 1 comprises a large number of cells 6, the walls of which are coated with emissive oxides, the supporting metal being of the nickel or platinum group. The external surface of the electrode is pickled or scoured, so that the discharge cannot start therefrom.

When the circuit is closed, some cathode spots are certainly produced, but since the electrode is of small volume, it heats up rapidly, and the successive spaces acting as thermal insulators relatively to each other, the discharge then starts uniformly from the whole of the internal surface, and the ionised gas permits the electrons to issue from small orifices, in a manner similar to Hull's cathodes.

When the tube is working, the discharge 4 is concentrated in a point 3 but the drop in potential in the vicinity of this point attracts the electrons from the whole of the surface of the electrode, which being of small volume and of slight calorific mass, is raised to a cherry red heat. The said electrons, following for example the path of the arrow 5, contribute to the principal current and to that extent diminish the destructive action of the spot 3.

There is thus obtained a simple electrode having 9 to 10 volts drop at low and high pressure and functioning perfectly.

Figs. 3 and 4 shows another form of construction of the electrode according to the invention. The electrode in this case is produced by coiling a metal ribbon 7 in a spiral having a small spacing between the turns, the said metal ribbon being coated, except on the external face of the first turn of the winding, with emissive oxides, more particularly barium dioxide. The central rod 8 serves as a support. The diameter of the electrode is made substantially equal to the axial dimension thereof so as to have the maximum surface in the minimum volume.

For tubes of high intensity of 10 to 20 amperes, the "spot" may still retain a certain destructive effect during what is called the "formation" operation of the tube. Such electrodes are then effectively constituted by a ribbon of refractory metal, such as molybdenum, coated with a metal of the nickel group for example, either directly or indirectly by metallisation or electro-deposition. This ribbon is then coated with emissive oxides. In order to increase the surface, the ribbon may be corrugated or crimped.

Notwithstanding the excellent results obtained with the spiral shaped electrodes above mentioned, applicant has found however that the life of the tube is limited by the disintegration of the emissive oxide.

In order to obviate this defect, the present invention contemplates forming a reserve of emissive oxide which automatically feeds the zone of emission. This improvement likewise ensures the protection of the zones of emission against the destructive action of the discharge spot.

Figs. 6 and 7 illustrate an electrode so constructed, comprising two ribbons made of different metals disposed one within the other. One of the ribbons, preferably 17, is made of a refractory metal, tantalum for example, and the other ribbon 18 is made of a metal of the platinum or nickel group, nickel for example. The two ribbons fixed to the current lead-in 19 may be wound freely into a spiral. The ribbons may also be secured together in places by small spots of solder which affords the advantage, when the spiral is being made, of producing a crimping, thereby providing a large number of small cavities which imprison the emissive oxide, the latter under these conditions adhering very well to the nickel ribbon. The ribbon of refractory metal should stand higher than the ribbon of metal of the platinum or nickel group and should be external thereof.

The deposition of oxide on this electrode is effected by known processes.

The so constructed electrode, of large emissive surface of small volume, small calorific capacity, and comprising a reserve of oxide which feeds the refractory metal by diffusion during operation enables a long working life to be attained, even with considerable pressures of mercury vapour.

The electrodes according to the present invention may of course be employed in the known manner with an auxiliary electrode. The object of this arrangement is to produce, with a view to ignition, a glow discharge between the auxiliary electrode shown at 15 in Fig. 5 and the principal electrode 14.

Considerable difficulties have been encountered in constructing with ordinary commercial glass, such as borosilicate glass, the auxiliary current lead-in for the ignition electrodes, due to the phenomenon of the electrolysis of the glass when hot. A practical and efficacious device has been found, and this consists in enveloping in one and the same bead of borosilicate or the like glass the two wires: the wire 11 for supplying current to the auxiliary electrode and the wire 12 for supplying current to the principal electrode 14, the said bead being joined at 13 to the glass of the tube. The resistance of the glass at this point is not weakened, because this rear part of the tube is coolest and is remote from the arc.

I claim:

1. An electrode for gaseous discharge devices which comprises two ribbons, one of refractory metal and the other of a metal of the group consisting of platinum and nickel groups, said ribbons comprising alternate layers of a compact spiral and being separated from each other by a layer of emissive material, the ribbon of refractory metal standing higher than and surrounding the other ribbon.

2. An electrode for gaseous discharge devices comprising two ribbons, one of tantalum and the other of a metal of the group consisting of platinum and nickel groups, said ribbons comprising alternate layers of a compact spiral and being separated from each other by an emissive material coating said last-mentioned ribbon, the ribbon of tantalum standing higher and surrounding the other ribbon.

3. An electrode for gaseous discharge devices comprising two ribbons, one of refractory metal and the other of a metal of the group consisting of platinum and nickel groups, said ribbons comprising alternate layers of a compact spiral and being separated from each other by an emissive material coating said last-mentioned ribbon, the ribbon of refractory metal standing higher than and surrounding the other ribbon, said two ribbons being fixed to a current lead-in and secured together at spaced points.

JEAN LECORGUILLIER.