

[54] **DISCHARGE LAMP ELECTRODE**

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3,132,409 5/1964 Freeman ..... 313/344 X  
3,170,081 2/1965 Rokosz ..... 313/344 X  
3,195,005 7/1965 Freeman ..... 313/344

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313/332, 313/344

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[58] Field of Search ..... 313/344, 310, 311,  
313/332, 346 R, 346 DC

[56] **References Cited**

**UNITED STATES PATENTS**

3,349,276 10/1967 Jacobs et al. .... 313/344 X  
2,071,973 2/1937 Francis ..... 313/344 X

[57] **ABSTRACT**

This discharge lamp electrode comprises a cylindrical tungsten rod having fitted and welded to its upper end a coil of spiral-wound wire of the same metal and two small disks, i.e. a thorium emitting disk and a titanium-emitting disk disposed above the end of the cylindrical tungsten rod; the thorium emitting disks consists of tungsten powder sintered under a relatively high pressure to constitute a skeleton, and the titanium emitting disk consists of a tungsten skeleton in which titanium is incorporated; other coils of spiral-wound tungsten wire are disposed around said disks and locked in position by weld spots.

**18 Claims, 2 Drawing Figures**

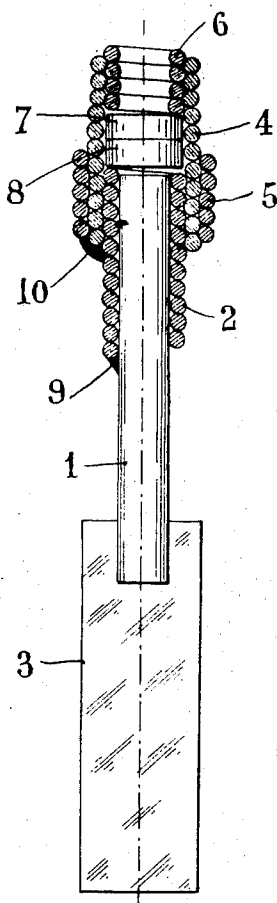


Fig.1.

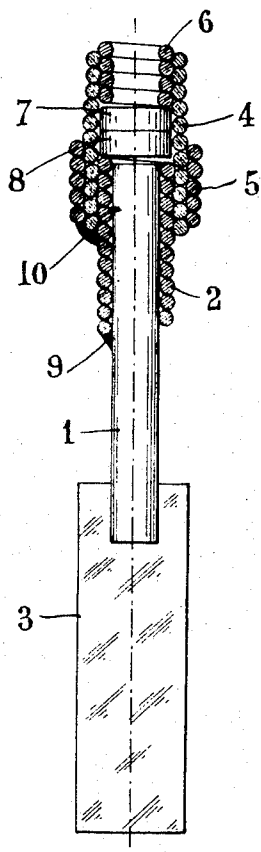
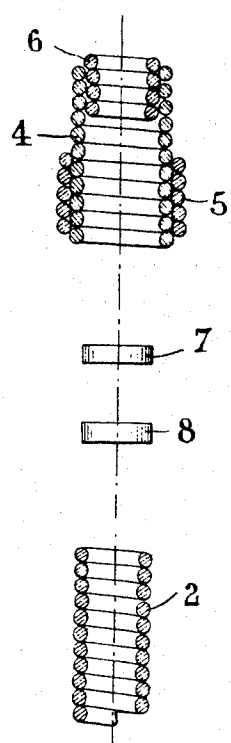


Fig.2.



**DISCHARGE LAMP ELECTRODE****BACKGROUND OF THE INVENTION**

The present invention relates in general to discharge lamps and has specific reference to a novel type of electrode therefor, notably for a high-pressure discharge lamp comprising a silica discharge tube.

In lamps of this type and notably in metal iodide lamps the electrodes consist as a rule of a cylindrical tungsten rod having fitted and welded thereto a coil of spiral-wound wire of same metal, so as to form one or a plurality of wire layers, the rod end emerging or not from the upper portion of the coil.

Before being connected by welding to the molybdenum sheet provided for sealing the passage through the silica glass and effecting the electrical connection between the source and the discharge tube, the assembly is immersed and impregnated in a solution containing thorium oxide (thorine), colodion as a binder and butyl acetate as a dilution agent.

This assembly is then extracted from the solution, allowed to drip, dry, and then any residual trace of solution is removed by brushing its external surface. Now this procedure is time-robbing, dirty and scarcely accurate, due to the difficulty of ascertaining with precision the amount of solution left in the coil, and where this solution lies exactly.

The various elements coated with thorine and brushed are assembled with the other elements which are to constitute the lamp proper, and the lamp itself is directed to the ultimate treatments and operations required for obtaining a finished lamp.

When this lamp is energized, the free end of the electrode from which the discharge is emitted is brought to a very high temperature and thus one fraction of the tungsten is vaporized. Throughout the useful life of the lamp the thorine contained in the inner portion of the electrode is reduced into thorium. Thus, the lamp is rendered slightly emissive on its external surface, but the discharge is not definitely fixed, as it is not stabilized more at one point than at another point. Now this condition may prevail during a time variable as a function of the amount of thorine available within the electrode and also as a function of the electrode temperature.

**SUMMARY OF THE INVENTION**

It is the essential object of the present invention to provide an electrode of the type broadly set forth hereinabove, which avoids the inconvenience characterizing hitherto known discharge lamps of this type.

To this end, this electrode comprising a cylindrical tungsten rod having fitted and welded to its upper end a coil of spiral-wound wire of the same metal is characterized in that a thorium emitting element is disposed within said coil, above the end of said cylindrical rod; this thorium emitting element consists preferably of a small disk obtained by sintering, under a relatively high pressure, tungsten powder or another refractory metallic powder to constitute a skeleton, and at least another body adapted to emit thorium when heated at high temperature, which is intimately mixed with the tungsten powder or other metal before the sintering operation.

According to a specific feature characterizing this invention the electrode comprises two small disks, i.e. a thorium-emitting disk and a titanium-emitting disk; these two disks have a smooth surface condition and

are exposed during the manufacturing process to a temperature of about 2,000°C.

**BRIEF DESCRIPTION OF THE DRAWING**

A typical form of embodiment of this invention will now be described by way of example with reference to the accompanying drawing, in which:

FIG. 1 is a sectional view of the electrode;

FIG. 2 is an exploded view showing some of the component elements of the electrode.

**DESCRIPTION OF THE PREFERRED EMBODIMENT**

The electrode illustrated comprises a tungsten rod 1 having fitted and welded to one end a coil of spiral-wound tungsten wire 2; a molybdenum sheet 3, adapted on the one hand to seal the passage through the silica glass and on the other hand to provide the electrical connection between the source and the discharge tube, is welded to the lower portion of the tungsten rod 1; another coil of spiral-wound tungsten wire 4, having a lower portion adapted to be screwed to the upper portion of the first coil 2, and to be secured thereto by welding, comprises at its lower portion an external layer of spiral-wound wire 5 and at its upper position an internal layer of spiral-wound wire 6; thus, above the rod 1, between the upper portion of coil 2 and the lower portion of the inner layer 6 of the second coil 4, a chamber is formed; this chamber is adapted to receive a pair of disks 7, 8 obtained by sintering tungsten powder or another powdered metal to constitute a skeleton in admixture with other substances intimately mixed with the tungsten or other powder before the sintering operation.

The disks 7, 8 are clamped in position by screwing home the coil 2 into the coil 4, the former being locked against rotation on the tungsten rod 1 by a weld spot 9. Another weld spot 10 is made for definitely locking together all the elements of the assembly.

The electrodes, before finishing by welding the rod 1 to the molybdenum sheet 3, are heat treated to enable them to perform their function.

From these electrodes the discharge tube and then the lamp are completed in the conventional manner.

This electrode is characterized by the following properties:

- the precision with which the elements intended for imparting inter alia emissive properties to the disks are incorporated into these disks;
- the simplicity, rapidity and cleanliness with which these elements can be prepared and assembled with one another.

This invention permits of making discharge lamps that are easily started, for the iodides will not condense on the emitter disk when the lamp is put out.

During the lamp operation, the emitter disk fixes the discharge in the central portion of the electrode.

The emission is such that the electrode temperature remains relatively low, so that the rate of tungsten volatilization is extremely moderate.

The building up of thorium, necessary for a proper operation of the lamp, is obtained by slow extraction from within the disk 7, through the tungsten skeleton, this disk being adapted to be heated to temperatures of the order of, say, 2,100°C.

If desired, the disk 8 may have an operating temperature differing somewhat from that of disk 7, for exam-

ple of the order of 1,500°C. It may be also adapted to perform a function other than that of disk 7, for example a getter function; in this case the disk 8 may consist of a tungsten skeleton in which titanium, for example, or any other suitable substance, is incorporated. Due to the particular flexibility of manufacture of these electrodes, from the dual standpoint of the types of substances that can be used in the disk composition and of the temperatures to which these disks may be brought, they facilitate the development of delicate lamps and subsequently permit the commercial manufacture of the same lamp under satisfactory economical conditions with a high degree of reproducibility.

The titanium-containing disk 8 is disposed on the current input side and the thorium-oxide containing disk 7 is disposed on the arc side; both disks are strongly clamped against each other by screwing home the tungsten coil 2 into the other tungsten body 4.

Besides, the two disks 7, 8 may be rigidly assembled with each other by a weld spot before introducing them into the tungsten coil 4. The assembly is then locked in position by another weld spot 10.

Before welding the molybdenum sheet the assembly illustrated in FIG. 1 is heated in a vacuum oven at a temperature of about 2,000°C; thus, a certain amount of thorine is converted into thorium and will facilitate the first firing of the lamp.

With these two disks, the thorium and titanium are extracted slowly from a tungsten skeleton during the useful life of the lamp.

The thorium emitting disk facilitates the striking of the lamp arc and ensures a high degree of flux with drops of only a few units percent for lamps having a useful life of the order of 5,000 hours; the manufacturing process contemplated according to this invention permits of proportioning with a high degree of precision the thorine contained in the disk; therefore, the useful life of the lamp can be improved very considerably.

The titanium containing disk (of the disk containing a substance of the same order) imparts to the lamp a spectrum having a considerable continuous background; it improves the color sustaining and the ignition facility.

The surface condition of these two sintered disks avoids, during the first few ignitions, the well-known deterioration resulting therefrom and, therefore, the blackening by atomization on the inner wall of the burner.

The use of these two disks imparts a high degree of arc stability to the lamp.

By way of illustration, in the case of a 2 kW lamp, the thorium emitter may consist of a disk having a diameter of 2.5 mm, a thickness of 0.65 mm and weighing about 50 m/g, the disk composition comprising about 45 m/g of tungsten having a granulometry of a few microns, 5 m/g of thorium oxide and 0.5 m/g of finely ground silicon.

These component elements are mixed beforehand and introduced into the body of a die in which the mixture is subsequently compressed by applying thereto a pressure of the order of 15 to 20 tons per square centimeter.

Still by way of example and for the same type of 2 kW lamp, the titanium containing element consists of a disk similar to the above-described one, as far as its mechanical properties are concerned. Its composition is

obtained by mixing about 45 m/g of tungsten with 10 to 50 percent of titanium powder having a granulometry of a few microns. The use of titanium should not be construed as limiting the scope of the invention; thus, substances of the same group, such as zirconium, hafnium, tantalum, vanadium and niobium are capable of yielding very satisfactory results.

The tungsten and titanium mixture is prepared for making a relatively great quantity of disks and introduced into the body of a die in which the disk is shaped under the same pressure of about 15 to 20 tons per sq.cm. as used for making the thorium emitting disks.

These two types of disks are heated in an oven in which a neutral gas, for example argon, is circulated, to a temperature of the order of 1,500°C. This second sintering step imparts a certain mechanical strength to the disks.

The thus sintered disks have a very smooth surface condition, without any unevenness. By performing the sintering operation in the above-described fashion the use of a binder, generally a carbon-releasing collodion, may be dispensed with.

What is claimed as new is:

1. A discharge lamp electrode comprising:

- a. a cylindrical tungsten rod,
- b. a coil of spiral-wound tungsten wire fitted and welded to the upper end of the rod, the coil defining a chamber above the rod, and
- c. at least two disks disposed in the chamber wherein at least one of the disks is a thorium emitting disk.

2. Electrode according to claim 1, characterized in that the coil of spiral-wound wire consists of a first coil section fitted to the upper end of the tungsten rod and of a second coil section having its lower portion screwed to the upper portion of the first coil section, said second coil section comprising at its upper portion an internal layer of spiral-wound wire in order to constitute the chamber in which the thorium emitting disk is disposed and retained.

3. Electrode according to claim 1, characterized in that said thorium emitting disk consists of comprises a sintered homogeneous mixture of a powder refractory metal and a substance which is thorium emitting at high temperature.

4. Electrode for discharge lamp, according to claim 3 wherein there are two disks and the second disk is a getter disk comprising a sintered homogeneous mixture of a powder refractory metal and a element selected from the group consisting of titanium, zirconium, hafnium, tantalum, vanadium and niobium.

5. Electrode for discharge lamp according to claim 4, characterized in that the lamp is a 2 kW lamp and the thorium emitting disk has a diameter of 2.5 mm, a thickness of 0.65 mm and weighs about 50 m/g, the composition of said disk consisting essentially of about 45 m/g of tungsten powder having a granulometry of a few microns, 5 m/g of thorium oxide and 0.5 m/g of very finely ground thorium.

6. Electrode for discharge lamp according to claim 5, characterized in that the second disk is a sintered mixture of powder refractory metal and titanium which consists essentially of about 45 m/g of tungsten and 10 to 50 percent of titanium powder having a granulometry of a few microns.

7. Electrode for discharge lamp according to claim 4, characterized in that the element is titanium.

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8. Discharge lamp electrode according to claim 4, characterized in that said disks are fastened to each other by weld spots.

9. The electrode of claim 3 wherein the refractory metal is tungsten and the thorium emitting substance is selected from the group consisting of thorine, thorium and mixtures thereof.

10. The electrode of claim 4 wherein the refractory metal of the second disk is tungsten.

11. A discharge lamp electrode comprising a cylindrical tungsten rod, a first tungsten coil section fitted and welded to the upper end of said tungsten rod, a second tungsten coil section having its lower portion screwed around the upper section of the first coil section, a third tungsten coil section having at least its lower portion screwed in the upper portion of the second coil section in order to constitute a chamber, a thorium emitting element disposed and retained in said chamber, said thorium emitting element consisting of a small disk obtained by sintering under a very high pressure a mixture of a powder of a suitable refractory metal such as tungsten to constitute a kind of skeleton, and of at least another substance adapted to emit thorium when heated at a relatively high temperature.

12. A discharge lamp electrode according to claim 11, in which said first two coil sections of tungsten are welded together.

13. A discharge lamp electrode according to claim

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11, in which a second small disk of titanium emitting material is disposed and retained in said chamber under the disk of the thorium emitting element.

14. A discharge lamp electrode according to claim 13, in which said third tungsten coil section is screwed in the second tungsten coil section so that the two disks are strongly pressed against each other.

15. Electrode for discharge lamp according to claim 11 characterized in that in the case of a 2 kW lamp the thorium emitting element consists of a small disk having a diameter of 2.5mm, a thickness of 0.65 mm and weighing about 50 m/g, the composition of said disk including about 45 m/g of tungsten powder having a granulometry of a few microns, 5 m/g of thorium oxide and 0.5 m/g of very finely ground thorium.

16. Electrode for discharge lamp according to claim 13, characterized in that in the case of a 2 kW lamp, the titanium containing element consists of about 45 m/g of tungsten and 10 to 50 percent of titanium powder having a granulometry of a few microns.

17. Discharge lamp electrode according to claim 13, characterized in that the titanium is replaced by a material of the same group, such as zirconium, hafnium, tantalum, vanadium and niobium.

18. Discharge lamp electrode according to claim 13, characterized in that said disks are fastened to each other by weld spots.

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