March 29, 1960 A. W. WAINIO 2,930,919

DISCHARGE DEVICE

Filed Jan. 15, 1959

FIG. 1.

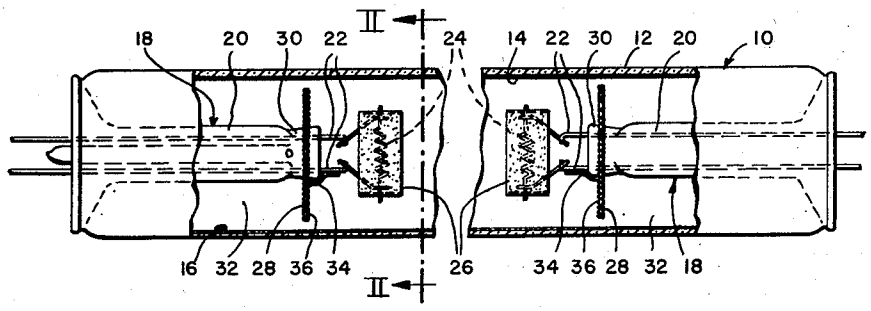


FIG. 2.

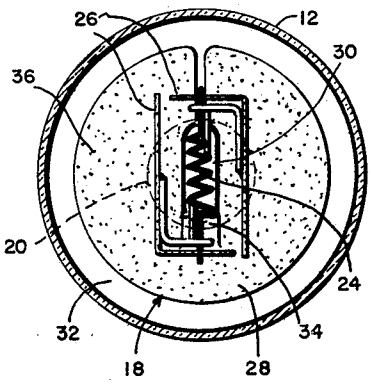
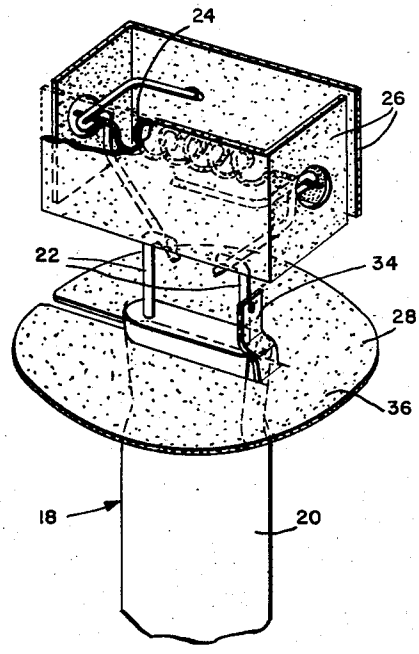


FIG. 3.



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2,930,919

DISCHARGE DEVICE

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4 Claims. (Cl. 313—109)

This invention relates to radiation-generating discharge devices and, more particularly, to low-pressure, mercury-vapor discharge devices intended to be operated under conditions of relatively high loading.

It is well known that the standard fluorescent lamp operates with the highest lumen per watt efficiency when the mercury-vapor pressure within the lamp is from about 6 to 9 microns. A mercury-vapor pressure within this range is readily obtained by having a region within the lamp where condensed mercury is at a temperature of from about 40° C. to 45° C. With the standard fluorescent lamp, this condition is readily obtained without difficulty. Where fluorescent lamps are operated with greater power input without auxiliary arrangements for controlling the mercury-vapor pressure, the higher power input per unit volume of the lamp envelope will result in increased mercury-vapor pressure, thereby decreasing the efficiency of the lamp. As an example, the usual fluorescent lamp operates with a loading of about 10 watts per foot of lamp envelope length. Higher-loaded lamps can operate with a loading of about 25 watts per foot of envelope length and the degree of increased loading can be varied considerably. In order to decrease the operating mercury vapor pressure within so-called high-loaded fluorescent lamps and thereby at least approach a maximum of efficiency in generating ultraviolet radiations, it has been proposed to use heat-deflecting shields proximate the ends of the envelope in order to form cooling chambers. The minimum temperature within the cooling chambers establishes the mercury-vapor pressure within the discharge device. The use of the higher loadings in conjunction with such heat shields has introduced additional problems, however, in that the maintenance of light emission or output is impaired. In other words, as the lamp is operated the curve of light output versus hours operation drops off faster than with a conventional fluorescent lamp.

It is the general object of this invention to avoid and overcome the foregoing and other difficulties of and objections to prior-art practices by the provision of a discharge device which is adapted to be operated with higher loadings and which has improved maintenance of light output.

It is another object to provide improved heat shields for so-called, high-loaded fluorescent lamps in order to improve the maintenance of light output for such lamps.

It is a further object to provide improved lead conductors and anodes for high-loaded fluorescent lamps to supplement the improved heat shields, in order further to improve the maintenance of light output for such lamps.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by providing a specific black chrome-vanadium plating on the heat shields of the lamp. In addition, the enlarged anodes and lead conductors which are used with the lamp are also desirably provided with the black chrome-vanadium plating.

For a better understanding of the invention, reference should be had to the accompanying drawing wherein:

Fig. 1 is an elevational view, partly in section, of a high-load fluorescent lamp wherein the heat shields, anodes, and lead conductors carry a specific black chrome-vanadium plating in accordance with this invention;

Fig. 2 is a sectional view taken on the line II—II in Fig. 1 in the direction of the arrows;

Fig. 3 is a perspective view of a portion of a mount for the lamp as shown in Fig. 1, further illustrating the plated heat shield, lead conductors and enlarged anodes.

With specific reference to the form of the invention illustrated in the drawing, the lamp **10** in Fig. 1 comprises a generally-tubular envelope **12** which carries a phosphor coating **14** on the interior surfaces thereof. The envelope encloses an inert, ionizable starting gas such as argon at a pressure of 4 mm. and a small charge of mercury **16**. Sealed into either end of the envelope **12** is a mount **18** which comprises an elongated, vitreous, reentrant stem **20** having lead conductors **22** sealed through the press portion thereof. A conventional Dumet wire section is used in the lead conductors to facilitate making a good hermetic seal as is customary and the inwardly extending lead conductor portions can be fabricated of nickel, iron or nickel-iron alloy for example. Oxide-coated electrodes **24** are supported between the inwardly-extending extremities of the lead conductors **22**. As is usual, the electrodes **24** are operatively disposed at either end of the envelope **12** and are adapted to support a positive-column discharge therebetween. In order to prevent overheating of the portions of the lead conductors **22** which are proximate the electrodes **24**, enlarged anodes **26** are electrically connected to each of the lead conductors **22** and in their illustrated preferred form, these enlarged anodes **26** are provided with an L configuration with the longest anode dimension paralleling the electrodes **24**.

Metallic heat shields **28** are affixed to the press portions **30** of each stem **20** proximate each end of the envelope **12** and closer to the ends of the envelope than the electrodes **24**. The size of each of the heat shields **28** is such that a gas passage is maintained between the shields **28** and the inner surface of the lamp envelope **12**. Alternatively, apertures can be provided through each of the heat shields **28** to permit the passage of gas. Cooling chambers **32** are thus formed between the ends of the enelope **12** and each of the heat shields **28**. These cooling chambers **32** establish the operating mercury-vapor pressure within the lamp **10** since the maximum mercury-vapor pressure is governed by the coolest location within the lamp envelope **12**. In the preferred embodiment as is shown more clearly in Fig. 3, the heat shields **28** snugly fit about the flattened press portions **30** of the stems **20** and a section of each shield **28** is bent so as to be maintained in electrical continuity with one of the lead conductors **22** which support each electrode **24**. In this manner, the heat shields **28** also serve as anodes to supplement the enlarged anodes **26** which are provided.

As a specific example, the lamp as shown in Fig. 1 is designed to operate with a power input of 25 watts per foot of envelope length and the envelope **12** can have an overall length of 4 feet and an outer diameter of 1½ inches. The coils which form part of the electrode **24** can be formed of coiled-coil tungsten wire, the inner coil of which is filled with a conventional mixture of alkaline-earth oxides. The phosphor coating **14** is conventional and can comprise a usual halophosphate-type phosphor or zinc-silicate, activated by manganese for example. The L-shaped enlarged anodes **26** have a long dimension of ⅝ inch, a short dimension of ⅜ inch and a width of 11/32 inch and are affixed to the lead conductors **22** with a simple spot weld. The starting gas which is contained within the envelope is argon as noted and other noble gases or

mixtures thereof at varying pressures can be substituted therefor. In the preferred form, each of the heat shields **28** is generally-circular in configuration with a maximum diameter of 1 1/16 inch. The heat shields and enlarged anodes can be formed of nickel, iron or nickel-iron alloy for example from 10 to 13 mil sheet stock. As noted hereinbefore, the heat shields **28** are desirably affixed to the press **30** of each stem **20**. This is conveniently accomplished by providing a retaining slot in the center section of each shield **28** and bending the formed tab-like center section **34** of each heat shield into electrical continuity with one of the lead conductors **22**. For the foregoing specific example, the distance from each heat shield **28** to the closest electrode **24** is approximately ¾ inch and each of the cooling chambers **32** which are formed have a maximum length of approximately 2 inches. It should be understood that the foregoing preferred design is subject to considerable variation. For example, the enlarged anodes **26** can vary in size and can be provided with other configurations such as circular or rectangular. Also, the heat shields **28** can be affixed directly to one of the lead conductors **22** rather than the press **30**, electrically insulating the shields from the other of the lead conductors, and the size of the formed cooling chambers **32** can be varied considerably.

In accordance with the present invention, at least the heat shields **28** are provided with a black chrome-vanadium plating or coating **36**. A plating of this nature is disclosed in copending application S.N. 591,206, filed June 13, 1956 by Wainio and Sutter and owned by the present assignee, now U.S. Patent No. 2,885,587, dated May 5, 1959, the first-named inventor being the inventor herein. A similar plating is also disclosed in U.S. Patent No. 2,824,829, dated February 25, 1958. This black chrome-vanadium plating can be applied generally as outlined in detail in the aforementioned Patent No. 2,885,587. Briefly, this plating **36** is formed of chromium, vanadium and oxygen in which there are from 100 to 9.5 parts by weight of total chromium per part by weight of vanadium with the vanadium in the plating essentially compounded as vanadium trioxide. The chromium in the plating is partially oxidized with the ratio of total chromium atoms to total oxygen atoms combined with chromium in the plating being from 2:1 to 100:1. The thickness of the black chrome-vanadium plating is not critical although the exterior surface of the shield should be completely covered. As an example, the coating can have a thickness of about 0.05 mil. The surfaces of the plating adjacent the base metal forming the shields may tend to interact slightly with the base metal to form a complex compound, but the bulk of the plating including all exposed portions remains unreacted with the base metal. In order to realize any appreciable improvement in maintenance of light emission from such high-loaded discharge lamps, it is necessary that the heat shields **28** are provided with the foregoing plating **36** as specified. For best results, however, it is desirable that the portions of the lead conductors **22** which extend inwardly from the press and the enlarged anodes **26** also carry the foregoing black chrome-vanadium plating.

The maintenance of light output of control lamps using bare or unplated shields was compared to otherwise-identical lamps which incorporated the specified black chrome-vanadium plating. After 500 hours of operation, the control lamps displayed a light output which was approximately 83% of the light output measured at 100 hours operation. After 500 hours operation, the lamps incorporating the present black chrome-vanadium plating on the shields, lead conductors and enlarged anodes displayed a light output which was approximately 88% of the light output as measured at 100 hours operation. For a lamp as specified hereinbefore which is operated with a power input of approximately 100 watts, this represents after 500 hours operation an increase in output of about 400 lumens. It should be noted that the so-called initial output of fluorescent lamps is normally measured at 100 hours operation, at which time small variances encountered from lamp to lamp will have substantially stabilized.

The foregoing performance figures are given for highly-loaded fluorescent lamps which incorporate a black chrome-vanadium plating on the anodes and lead conductors as well as the shields. The plating may be omitted from either the anodes or lead conductors or both, if desired. Where only the shields carry this plating material, the improvement in maintenance of light output will be decreased slightly, but will still be considerably better than the control lamps. As noted hereinbefore, however, in order to realize any appreciable improvement over the control lamps, it is necessary that the shields **28** carry the specified plating **36**. The explanation for this improvement in maintenance of light output is not understood. In aforementioned Patent No. 2,885,587 it is disclosed that a similar black chrome-vanadium coating on the inwardly-extending lead conductor portions of a standard 40-watt lamp will inhibit the first appearance of end blackening. Such a coating as used on the lamp lead conductors, however, does not affect in any way the maintenance of light output for the usual fluorescent lamp, at least in any detectable amount. In addition, the heat shields **28** operate at a relatively-low temperature thereby minimizing any effects of greater thermal emissivity realized with the specified coating **36**. While the mechanism of operation by which maintenance of light output is improved is not understood, it is clear that the maintenance of light output for the high-loaded fluorescent lamps which utilize heat shields carrying this specified plating is considerably improved.

It will be recognized that the objects of the invention have been achieved by providing a discharge device which is adapted to be operated with very high loadings and which has improved maintenance. In addition, there has been provided such a discharge device which incorporates lead conductors and enlarged anodes which also carry a specified plating material.

While best-known embodiments have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. A mercury-vapor discharge device adapted to be operated under such conditions as would normally cause the operating mercury-vapor pressure within the device to exceed the pressure desired, said device comprising an elongated envelope, a phosphor coating on the interior surface of said envelope, an inert ionizable starting gas and a small charge of mercury contained within said envelope, lead-in conductors sealed through either end of and extending within said envelope, operatively-disposed electrodes electrically connecting to and supported by said lead conductors a short distance from either end of said envelope, enlarged anodes positioned proximate said electrodes and electrically connecting to said lead conductors, metallic heat-deflecting shields proximate each end of said envelope and positioned closer to the ends of said envelope than said electrodes to form cooling chambers, each of said shields electrically connecting to one of the lead conductors supporting each of said electrodes, and a black chromium-vanadium plating on said heat shields, said plating principally comprising from 100 to 9.5 parts by weight of total chromium per part by weight of vanadium, the vanadium in said plating essentially compounded as V_2O_3, and the chromium in said plating partially oxidized with the ratio of total chromium atoms to total oxygen atoms combined with chromium in said plating being from 2:1 to 100:1.

2. A mercury-vapor discharge device adapted to be operated under such conditions as would normally cause the operating mercury-vapor pressure within the device to exceed the pressure desired, said device comprising an elongated envelope, a phosphor coating on the interior

surface of said envelope, an inert ionizable starting gas and a small charge of mercury contained within said envelope, lead-in conductors sealed through either end of and extending within said envelope, operatively-disposed electrodes electrically connecting to and supported by said lead conductors a short distance from either end of said envelope, enlarged anodes positioned proximate said electrodes and electrically connecting to said lead conductors, metallic heat-deflecting shields proximate each end of said envelope and positioned closer to the ends of said envelope than said electrodes to form cooling chambers, each of said shields electrically connecting to one of the lead conductors supporting each of said electrodes, and a black chromium-vanadium plating on said heat shields and the portions of said lead conductors extending within said envelope, said plating principally comprising from 100 to 9.5 parts by weight of total chromium per part by weight of vanadium, the vanadium in said plating esesntially compounded as V_2O_3, and the chromium in said plating partially oxidizing with the ratio of total chromium atoms to total oxygen atoms combined with chromium in said plating being from 2:1 to 100:1.

3. A mercury-vapor discharge device adapted to be operated under such conditions as would normally cause the operating mercury vapor pressure within the device to exceed the pressure desired, said device comprising an elongated envelope, a phosphor coating on the interior surface of said envelope, an inert ionizable starting gas and a small charge of mercury contained within said envelope, lead-in conductors sealed through either end of said envelope, operatively-disposed electrodes electrically connecting to and supported by said lead conductors a short distance from either end of said envelope, enlarged anodes positioned proximate said electrodes and electrically connecting to said lead conductors, metallic heat-deflecting shields proximate each end of said envelope and positioned closer to the ends of said envelope than said electrodes to form cooling chambers, each of said shields electrically connecting to one of the lead conductors supporting each of said electrodes, and a black chromium-vanadium plating on said heat shields and said enlarged anodes, said plating principally comprising from 100 to 9.5 parts by weight of total chromium per part by weight of vanadium, the vanadium in said plating essentially compounded as V_2O_3, and the chromium in said plating partially oxidized with the ratio of total chromium atoms to total oxygen atoms combined with chromium in said plating being from 2:1 to 100:1.

4. A mercury-vapor discharge device adapted to be operated under such conditions as would normally cause the operating mercury vapor pressure within the device to exceed the pressure desired, said device comprising an elongated envelope, a phosphor coating on the interior surface of said envelope, an inert ionizable starting gas and a small charge of mercury contained within said envelope, lead-in conductors sealed through either end of and extending within said envelope, operatively-disposed electrodes electrically connecting to and supported by said lead conductors a short distance from either end of said envelope, enlarged anodes positioned proximate said electrodes and electrically connecting to said lead conductors, metallic heat-deflecting shields proximate each end of said envelope and positioned closer to the ends of said envelope than said electrodes to form cooling chambers, each of said shields electrically connecting to one of the lead conductors supporting each of said electrodes, and a black chromium-vanadium plating on said heat shields, the portions of said lead conductors extending within said envelope and said enlarged anodes, said plating principally comprising from 100 to 9.5 parts by weight of total chromium per part by weight of vanadium, the vanadium in said plating essentially compounded as V_2O_3, and the chromium in said plating partially oxidized with the ratio of total chromium atoms to total oxygen atoms combined with chromium in said plating being from 2:1 to 100:1.

References Cited in the file of this patent

UNITED STATES PATENTS

2,182,732	Meyer	Dec. 5, 1939
2,433,404	Smith	Dec. 30, 1947
2,692,350	Arnott	Oct. 19, 1954