

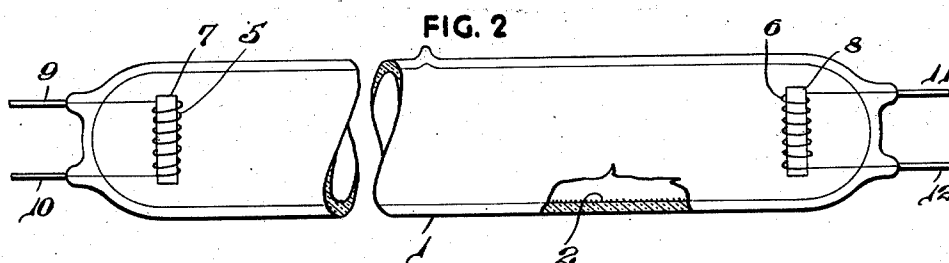
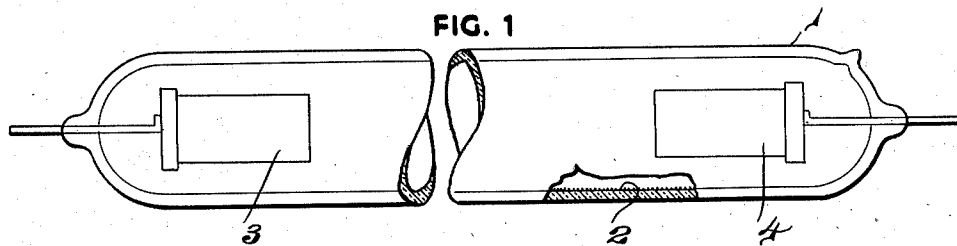
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2,216,252

COMBINATIONS OF ELECTRIC DISCHARGE DEVICES AND MATERIALS EXCITED TO
LUMINESCENCE BY THE ELECTRIC DISCHARGE

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COMBINATIONS OF ELECTRIC DISCHARGE
DEVICES AND MATERIALS EXCITED TO
LUMINESCENCE BY THE ELECTRIC DIS-
CHARGEJohn Turton Randall, Harrow Weald, England,
assignor to General Electric Company, a cor-
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12 Claims. (Cl. 176—122)

This invention relates to sources of light of the type comprising in combination an electric discharge device and material adapted to be excited to luminescence by the electric discharge through a gaseous filling in the said device. Luminescent material hereinafter will mean material adapted to be so excited.

Calcium tungstate is often used as the luminescent material in such sources. We have found that magnesium and zinc tungstates are also suitable if associated with suitable activators and suitable discharges. Magnesium and zinc tungstates are monoclinic and isomorphous with each other, whereas calcium tungstate is tetragonal; accordingly they form the class of monoclinic tungstates of metals in the second group whose atomic number is intermediate between 4 (Be) and 48 (Cd).

According to the invention, in a source of light of the light from calcium tungstate under similar discharge device is one adapted in operation to emit either the low pressure spectrum of mercury or the neon spectrum and the said material is, or contains as a main constituent, either magnesium or zinc tungstate, having a monoclinic crystalline form, and containing a suitable activator, which is preferably lead.

One method of preparing the tungstate, described by way of example, is as follows. To a mixture of pure magnesium (or zinc) oxide and pure tungstic oxide, in substantially the proportions $1\text{MgO (or ZnO)} : 1\text{WO}_3$, is added lead nitrate in amount sufficient to give 0.1% lead in the final material. These components are ground into a uniform paste with pure water, dried for one hour at $180^\circ\text{--}200^\circ\text{C.}$, reground and heated to 1000°C. for 4 (or 2) hours. The preparation is preferably removed from the furnace halfway through this heat treatment and reground; if this is not done, black specks may appear in the final product. The material is then ready for use, apart possibly from a slight grinding and sieving to obtain a suitable grain size.

The electric discharge device may have either cold electrodes and thus be adapted for operation on relatively high voltages or it may have a thermionic cathode or cathodes and thus be adapted for operation on relatively low voltages.

If the filling of the discharge device is one adapted to emit the neon spectrum, for example pure neon, the luminescent material should be in direct contact with the discharge; for the resonance line of neon at 736 A., which is mainly effective in exciting the luminescence, will not penetrate any solid of appreciable thickness. If

the filling is adapted to emit the mercury spectrum, for example the usual mixture of argon and mercury, the luminescent material may either be in direct contact with the discharge or may be separated from it by a solid partition sufficiently transparent to radiation of short wave-length.

The luminescent light from both the tungstates is bluish. If they are excited by pure neon, the proportion of primary radiation from the discharge to secondary radiation from the tungstate will usually be adjusted, by known means, so as to obtain a light as nearly as possible white in colour at a reasonably high efficiency. If magnesium tungstate is used, a close approximation to white can be obtained with an efficiency of about 20 lumen/watt. If zinc tungstate is used, a pinkish light can be obtained with an efficiency of about 15 lumen/watt.

If the excitation is by mercury, the said proportion will generally be adjusted so that the efficiency is a maximum, the colour being nearly the same as that of the secondary radiation. If zinc tungstate is used alone, the colour will then be pale blue and the efficiency may be at least 25 lumen/watt. If magnesium tungstate is used alone, the light will be bluish-white and the efficiency may be at least 30 lumen/watt. The spectrum of this light is rather broader than that of the light from calcium tungstate under similar conditions, and the efficiency can be made somewhat greater. If magnesium tungstate is mixed in suitable proportions with a material giving red light luminescence, a nearly white light is then obtained; if cadmium silicate is this material, the efficiency of the nearly white light may be as high as 25 lumen/watt; if zinc phosphate is used, the efficiency will be probably somewhat lower. When efficiency of the combined source is the main consideration, it may be desirable to leave part of the envelope bare of luminescent material, so that the light from the luminescent material may issue through this part without absorption by another part of the luminescent material.

Two embodiments of the invention will now be described by way of example with reference to Figures 1 and 2 of the accompanying drawing, each of which shows one embodiment.

In both figures, 1 is a tubular glass envelope, 2 the luminescent material, which may be any of the aforesaid materials consisting of or containing zinc or magnesium tungstate, deposited on the interior surface of the envelope.

In Figure 1 both the electrodes are cold and consist of the usual sheet metal cylinders 3, 4.

In Figure 2 both the electrodes are thermionic

and consist of tungsten helixes 5, 6 surrounding rods 7, 8 of alkaline oxide. The ends of each helix are shown connected to separate leads 9, 10, 11, 12 outside the tube so that the electrode can be heated independently of the discharge; but it is also permissible to heat the electrodes by the discharge only; then the two ends of the same helix may be connected to the same lead.

I claim:

1. An electric lamp comprising a sealed envelope containing a gaseous atmosphere which emits ultraviolet radiations when an electric gaseous discharge is produced therein, and a thin layer of luminescent material exposed to said radiations, said material consisting mainly of a tungstate of the group consisting of magnesium tungstate and zinc tungstate, together with of the order of 0.1% of lead to activate said material.
2. An electric gaseous discharge lamp comprising a sealed envelope containing mercury vapor and having electrodes sealed therein, said envelope having an internal coating thereon of a luminescent material consisting mainly of a tungstate of the group consisting of magnesium tungstate and zinc tungstate, together with of the order of 0.1% of lead to activate said material.
3. An electric gaseous discharge lamp comprising a sealed envelope containing mercury vapor and having electrodes sealed therein, said envelope having an internal coating thereon of a luminescent material consisting of magnesium tungstate activated with 0.1% of lead intermixed with cadmium silicate and zinc phosphate, whereby a substantially white light is produced by said lamp.
4. An electric gaseous discharge lamp comprising a sealed envelope containing neon and having electrodes sealed therein, said envelope having an internal coating thereon of a luminescent material consisting mainly of a tungstate of the group consisting of magnesium tungstate and zinc tungstate, together with of the order of 0.1% of lead to activate said material.
5. An electric lamp comprising in combination, a sealed envelope containing a gaseous atmosphere which emits visible and ultraviolet radiations when an electric gaseous discharge is produced therein, and a quantity of a luminescent, activated tungstate of the group consisting of magnesium tungstate and zinc tungstate exposed to said radiations the luminous efficiency of said lamp being higher than that of the lamp in the absence of the luminescent tungstate.
6. An electric lamp comprising in combination, a sealed envelope containing a gaseous atmosphere which emits ultraviolet radiations when an electric gaseous discharge is produced therein, and a quantity of luminescent, activated magnesium tungstate exposed to said radiations, said lamp being capable of operating at a luminous

efficiency upwards of about 20 lumens per watt.

7. An electric lamp comprising in combination, a sealed envelope containing a gaseous atmosphere which emits ultraviolet radiations when an electric gaseous discharge is produced therein, and a quantity of luminescent, activated zinc tungstate exposed to said radiations, said lamp being capable of operating at a luminous efficiency upwards of about 15 lumens per watt.

8. An electric lamp comprising in combination, a sealed envelope containing cooperating electrodes and a quantity of mercury the vapor of which emits ultraviolet radiations when an electric gaseous discharge is produced therein, and a quantity of a luminescent, activated tungstate of the group consisting of magnesium tungstate and zinc tungstate exposed to said radiations, said lamp being capable of operating at a luminous efficiency upwards of about 25 lumens per watt.

9. An electric lamp comprising in combination, a sealed envelope containing cooperating electrodes and neon which emits ultraviolet radiations when an electric gaseous discharge is produced therein, and a quantity of a luminescent, activated tungstate of the group consisting of magnesium tungstate and zinc tungstate in said container and exposed to said radiations, said lamp being capable of operating at a luminous efficiency upwards of about 15 lumens per watt.

10. An electric lamp comprising in combination, a sealed envelope containing cooperating electrodes, a gas and a quantity of mercury the vapor of which emits ultraviolet radiations when an electric gaseous discharge is produced in said envelope, and a thin layer of activated, luminescent magnesium tungstate on the inner surface of said envelope and in the path of said radiations, said lamp being capable of operating at a luminous efficiency upwards of about 30 lumens per watt.

11. An electric lamp comprising in combination, a sealed envelope containing cooperating electrodes, a gas and a quantity of mercury the vapor of which emits ultraviolet radiations when an electric gaseous discharge is produced in said envelope, and a quantity of activated magnesium tungstate on the inner surface of said envelope and in the path of said radiations, said lamp being capable of operating at a luminous efficiency upwards of about 25 lumens per watt.

12. An electric lamp comprising in combination, a sealed envelope containing cooperating electrodes and neon which emits ultraviolet radiations when an electric gaseous discharge is produced in said envelope, and a quantity of activated magnesium tungstate on the inner surface of said envelope and in the path of said radiations, said lamp being capable of operating at a luminous efficiency upwards of about 20 lumens per watt.

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CERTIFICATE OF CORRECTION.

3

Patent No. 2,216,252.

October 1, 1940.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 20, for the words "light from calcium tungstate under similar" read "--type specified the filling of the electric--"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of January, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)