

# UNITED STATES PATENT OFFICE.

ANTON LEDERER, OF VIENNA, AUSTRIA-HUNGARY.

INCANDESCENT BODY FOR ELECTRIC LAMPS.

1,180,264.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, ANTON LEDERER, a subject of the Emperor of Austria-Hungary, residing at IV/1 Gusshausstrasse No. 3, Vienna, Austria-Hungary, have invented a new and useful Improvement in Incandescent Bodies for Electric Lamps, of which the following is a specification.

My invention relates to certain improvements in filaments for incandescent electric lamps, in particular such filaments as are essentially composed of metals that tend to alter internally under the influence of electric currents and to the process of manufacturing the same.

It consists generally in the production of more durable and efficient incandescent filaments, containing an intimate mixture of such a metal with another metal or metallic compound which causes the filaments to resist internal alterations during their use.

In the manufacture of filaments for incandescent lamps, and especially of filaments consisting of pure tungsten metal, it has been observed that, after burning for some time, an alteration in the structure of such filaments takes place. This alteration, which manifests itself in a displacement of sections of a filament with respect to its longitudinal axis, is usually designated by the terms "off-setting" or "faulting", and is probably due to the crystallization of the metal. The appearance of this crystalline structure has the deleterious effect that it renders the filaments considerably more brittle than they were before and it thus increases very greatly the liability of the filaments breaking when the lamp is in service or is subjected to shocks. I have discovered that by the addition of small percentages of suitable substances to the tungsten this crystallization and consequent deterioration of the filament can be largely obviated or entirely prevented. In one of the ordinary processes of manufacturing tungsten filaments it is usual to bring the tungsten metal, or an appropriate tungsten compound, into the shape of a plastic paste by means of an addition of a suitable binding material. I have found that when a small amount of oxygen or oxygen containing compounds of rare earth metals and like materials, such as thorium, zirconium, erbium, cerium, lanthanum, etc., is added to a paste of such a character, or to the materials used in making metallic filaments according to

other processes, the resulting filament is structurally different from a filament consisting only of tungsten and that the change-over of the filament into the crystalline structure is considerably delayed or altogether prevented. The presence of a binding material, is, of course, immaterial, nor does it matter at what time during the process of manufacturing these additions are made to the tungsten metal or tungsten compound, as long as they produce the desired result in the finished filament.

In order not to affect the efficiency of the filament or to deleteriously affect its mechanical qualities, it is necessary that the quantities of the above substances, which are to be added to the tungsten, be comparatively small, so that, after the finished filament is obtained, the tungsten is the largely predominating element in it.

Only such combinations of the auxiliary ingredients should be added to the tungsten as will have no harmful effect on the original constituents of the filament or on the resultant filamentary material. Especially suitable for the purpose are oxygen containing compounds of the rare earth metals, such as the nitrates, ammonium nitrates, oxalates, citrates, tartrates, etc., as these can be easily and expeditiously incorporated with the tungsten paste. The quantities of such additions should be such that the tungsten element of the resultant filament still largely predominates, but within this range the quantity may be varied within reasonable limits. Thus, for instance, I have found that satisfactory results are obtained by adding to the ordinary tungsten paste a quantity of thorium oxid up to about 7-10%. In case of zirconium oxid it is possible to add up to about 10% without producing a deleterious effect upon the mechanical qualities of the resultant filament or the life of the lamp made up with such filaments. When a mixture of thorium and zirconium oxid is employed it is possible to increase the amount of the addition up to 15%. While these maximum percentages are satisfactory in some cases it is, of course, preferable, as stated above, that the quantities added be considerably smaller.

I have observed that when raw filaments are squirted from a paste made up in conformity with the procedure outlined above and are then subjected to the customary process of forming the tungsten filament,

that is, heating it to a high temperature in a reducing atmosphere, there appears to be a partial, if not complete, reduction of the auxiliary metallic oxygen compounds in the raw filament. It is believed that during this forming process such oxids are reduced to sub-oxids which latter give to the filament the required qualities and moreover are conductors of the first class. This is indicated by the fact that the resistance of such filaments and their temperature coefficients are distinctly altered.

The appearance of a filament containing offset-resisting additions is closely similar to the appearance of a filament composed of tungsten only. During the burning of lamps provided with my filaments, however, the delay of the time when the crystallization of the filament becomes harmful can be distinctly observed.

It will, of course, be understood that my invention is not limited in its application to use in connection with any particular process of producing the filaments, but that, if desired, it may be employed in connection with any other process than that specifically set forth. It is also to be understood that my invention is not alone applicable to tungsten filaments but that it is also applicable to all filaments suitable for incandescent lamps and subject to offsetting or faulting in use.

In the subjoined claims, the expression "refractory metal of the tungsten type" is to be understood as comprising all metals which can be substituted for tungsten in the manufacture of incandescent electric lamp filaments.

I am aware that it has been proposed to make lamp filaments consisting of a mixture of a metal and an oxid, but, in such cases, the oxid forms a large part of the finished filament, whereas, in my process, the oxid or other metallic compound is added only in sufficient quantity to accomplish the desired result. This result is essentially the prevention of harmful internal alteration or "offsetting," and the fact that the addition of other substances than the filament metal will produce this result has never, so far as I am aware, been suggested prior to my present invention.

I claim as my invention:

1. A filament composed mainly of a metal that tends to offset, when utilized as a conductor of electricity, and containing an offset resisting material.
2. An essentially metallic filament for incandescent electric lamps which consists mainly of a metal that tends to offset, but which resists offsetting.
3. A filament for incandescent electric lamps which consists mainly of tungsten and which resists offsetting.
4. A filament for incandescent electric lamps consisting mainly of a material that

tends to develop structural alterations when utilized as a conductor of electricity and containing an additional material for resisting such development.

5. A filament for incandescent lamps composed mainly of a material that tends to crystallize when utilized as a conductor of electricity and containing an additional material for delaying such crystallization.

6. A filament composed of an intimate mixture of a refractory metal of the tungsten type and such a quantity of an offset resisting material as will resist deleterious alteration within the said filament when the said filament is utilized as a conductor of electricity.

7. A filament composed mainly of a metal that tends to offset when utilized as a conductor of electricity and containing a plurality of offset-resisting materials.

8. A filament composed mainly of a metal that tends to offset, when utilized as a conductor of electricity, and containing thoria and another offset-resisting material.

9. A filament for incandescent electric lamps composed of an intimate mixture of a refractory metal of the tungsten group and an additional material which comprises at least one of a group of substances including thorium, zirconium, erbium, cerium, and lanthanum, and the oxygen compounds of the said metals, the said additional material being present in substantially sufficient quantity to prevent deleterious alteration within the said filament during use.

10. The process of making essentially metallic filaments for incandescent electric lamps comprising the steps of adding to the material composing such filaments an offset-resisting material in only substantially sufficient quantity to resist deleterious alteration within the said filaments during their use, and thereafter shaping the mixture into filamentary form with application of heat.

11. The process of making tungsten filaments for incandescent electric lamps comprising the steps of adding thoria to the tungsten in sufficient quantity to resist deleterious structural alteration of such filaments during their use, and thereafter shaping the mixture into filamentary form with application of heat.

12. The process of making essentially metallic filaments for incandescent lamps comprising the steps of adding to the material composing such filaments a plurality of offset-resisting substances and thereafter shaping the mixture into filamentary form with application of heat.

13. The process of manufacturing filaments for incandescent lamps which consists in making a plastic paste composed of a refractory metal of the tungsten group, an oxygen compound of metal of the rare earth group

which is a conductor of the second class and a suitable agglutinant, forming such paste into filaments and subjecting the same to a high temperature in a suitable atmosphere, thereby transforming said conductor of the second class into a conductor of the first class.

14. A filament for incandescent electric lamps, consisting of an intimate mixture of a refractory metal of the tungsten group and another conductor of the first class, which other conductor consists of a metal of a rare earth and the suboxid thereof, and has been transformed during the manufacture of the filament from a conductor of the second class into one of the first class.

15. A filament for incandescent electric lamps consisting of an intimate mixture of

a refractory metal of the tungsten group with a compound of a metal of the rare earth group, which compound is a conductor of the first class.

16. A filament for incandescent electric lamps, consisting of an intimate mixture of a refractory metal of the tungsten group and less than 15% of another conductor of the first class which comprises a mixture of at least one metal of the rare earth group and the suboxid thereof.

In testimony whereof, I have hereunto subscribed my name this 28th day of November, 1906.

ANTON LEDERER.

Witnesses:

ALVESTO S. HOGUE,  
AUGUST FUGGER.