UNITED STATES PATENT OFFICE.

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METHOD OF MAINTAINING THE EFFICIENCY OF METALLIC-FILAMENT LAMPS.

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To all whom it may concern:

Be it known that I, ALFRED J. LIEBMANN, a citizen of the Republic of Switzerland, and a resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Methods of Maintaining the Efficiency of Metallic-Filament Lamps, of which the following is a specification.

This invention has reference to a novel method of maintaining the efficiency of metallic filament lamps by restoring the original vacuum and candle power while burning the lamp in practice and to a certain extent during manufacture.

When a metallic filament, such as a tungsten filament happens to be a little thinner in certain portions or becomes thinner in certain places during use, said portions offer a higher resistance to the passing current. The higher resistance of such a section of a filament spontaneously results in a higher heating of this section by the passing current and more light is emitted therefrom. However, such a section is subjected to the danger of burning through. From such a portion of the filament infinitesimal particles are volatilized whereby said portion becomes thinner, the vacuum is reduced and the lamp gets hotter until at a certain critical moment the filament burns through. To prevent the loss of the lamp the tungsten filament should be restored to its normal condition, or, as I prefer to term it, healed. Likewise the vacuum should be restored to its normal height and maintained therein. It is evident that the healing of a tungsten filament is mostly required where the filament is thinnest, the heat highest and the incandescence greatest.

It is known to introduce into an incandescing lamp globe substances which are adapted to absorb traces of various kinds of vapors, so as to maintain a high vacuum. These substances generally are not purposed for healing a defective portion of a tungsten filament and sometimes do not contain elements which may effect such healing. Such substances may partially be volatilized when a lamp burns at the indicated candle power, that is, at normal voltage. Accordingly, a healing effect is not produced on the filament.

It is the special purpose of the present invention to maintain the efficiency of metallic filament lamps by placing therein, in suitable manner and location, a substance or substances which volatilize at the critical moment, that is, when either the whole filament or thin sections of the same are heated up at an abnormal voltage. Such defective sections in the filament are due to inadvertent manufacture or occur during the use of the lamp.

A substance employed for the purpose of restoring the efficiency of a filament and maintaining the surrounding vacuum must possess the properties of a contact substance or catalytic agent, because the various phases of healing the filament and maintaining the vacuum must be inaugurated and propagated by the heat of the incandescing filament without any action from the outside, which action is impossible in an all glass closed chamber. By catalytic or contact action the desired result may be obtained within the lamp globe because the catalytic agent, which reacts with the substance of which the metallic filament is composed, is not permenently changed, but simply aids in the formation of a temporary compound which is instantaneously decomposed under the existing circumstances and produces the desired effect.

The substances which I employ for the desired purpose are, for instance, fluorids, chlorids or halogen compounds, chromates or chlorates of potassium, sodium or other alkali metals or of alkali earth metals as barium, for instance, or of thallium and metals of this group. Further, double salts of two of the above compounds, for instance, barium-thallium-fluorid or mixtures of the single or double salts may be used. According to the wattage of various lamps, a suitable substance or mixture of substances may be employed. The process takes place in substantially the following manner: Assuming that, for instance, barium-fluorid, $BaFl_2$, has been placed in the lamp and that the lamp is in such condition as to require the healing of the filament then first some barium-fluorid is volatilized when the lamp is lighted and burns at an abnormal voltage in the defective sections. The volatilized particles of barium fluorid come in contact with

the hot filament and are decomposed mostly in those sections which are hottest because they are thinnest. From the thin defective sections some tungsten volatilizes and the fluor combines with the tungsten.

$$3BaFl_2+W=WFl_6+3Ba.$$

The formed tungsten fluorid, however, is not constant at the existing heat and in the presence of barium is instantaneously decomposed, the fluor uniting again with the barium while the liberated tungsten is mostly deposited on those filament portions which are thinnest and therefore hottest. These thin filament portions are thus built up until they have attained their normal thickness by a repetition of the described phases of the process. When the thin sections have been completely built up and the filament is of uniform thickness the heat and light radiated therefrom are uniform and no special building up of any section takes place any more. In this manner, a defective filament is healed during the process of exhausting it in the works or burning it in practice.

The herein described phenomena taking place during the healing of defective sections thus are contact or catalytic reactions. While a chemical change is effected on the defective filament portion the contact substance or catalytic agent, like the barium-fluorid in the present instance, does not undergo any permanent chemical change nor is this substance consumed, but gradually changes location and thereby becomes inactive in the course of time for the described purpose. This described process is similar to the contact reaction employed in the production of sulfuric acid by means of platinum black which transforms sulfurous acid gas, SO_2, into SO_3, leaving the platinum black, after the process, in its original state. In a similar manner the barium-fluorid, for instance, does not undergo a permanent chemical change in the present process nor is this substance consumed, but simply effects the building up of the defective filament portions. The vacuum within the lamp is maintained because the particles of tungsten thrown off from the filament react with the catalytic agent and are finally deposited mostly on the thin portions of the filament. Thus when the lamp has attained its normal condition and the filament is of usual thickness the vacuum is of normal height, because no appreciable volatilization of the contact substance then takes place, the contact substance becoming active only at the critical moment when defects in the filament occur.

I claim as my invention:

1. The method of healing metallic filaments in incandescent lamps and simultaneously restoring the vacuum to its normal height during manufacture and use which consists in spontaneously volatilizing some contact or catalytic substance within the lamp, forming temporary compounds of the substance of which the filament is composed and the said contact substance, decomposing the temporary compounds by the abnormal heat existing in the thin defective filament portions, and depositing the substance of the filament on the hottest and thinnest filament portions whereby said sections are built up and the original vacuum restored.

2. The method of maintaining the efficiency of metallic filament lamps consisting in healing metallic filaments in incandescent lamps and simultaneously restoring the vacuum to its normal height by volatilizing some contact or catalytic substance within the lamp by excessive heat produced at a critical moment when the filament or defective portions of the same burn at an abnormal voltage, building up defective filament portions by catalytic reaction and restoring the vacuum to its normal height.

3. The method of maintaining the efficiency of a tungsten lamp consisting in building up defective portions of the tungsten filament by contact or catalytic reaction which consists in vaporizing spontaneously at a critical moment during the burning of the lamp at an abnormal voltage some catalytic substance whereby temporary compounds are formed and decomposed, the hottest filament portions built up and the vacuum restored to its normal height.

4. The method of maintaining the efficiency of a tungsten lamp consisting in building up defective portions of the tungsten filament by contact or catalytic reaction when infinitesimal particles of the defective filament portions volatilize at excessive heat in said portions, volatilizing spontaneously some of the contact or catalytic substance within the lamp by such excessive heat, forming temporary compounds with the volatilized tungsten, decomposing same, depositing spontaneously the tungsten on the thinnest and hottest filament portions and restoring the vacuum to its normal height.

5. The method of maintaining the efficiency of a tungsten lamp consisting in building up defective filament portions by a contact or catalytic reaction when infinitesimal particles of the defective filament portions volatilize at excessive heat in said portions, volatilizing spontaneously some barium-fluorid within the lamp by such excessive heat, forming temporarily tungsten fluorid and barium, decomposing the temporary product, depositing the liberated tungsten on the defective filament portions and restoring the vacuum to its normal height.

6. In the method of maintaining the effi-

iency of a tungsten lamp the step or phase of building up defective thin filament portions of relative high resistance by volatilizing spontaneously some catalytic substance within the lamp, forming temporary compounds with the volatilized tungsten, decomposing same, depositing spontaneously ungsten on the thinnest and hottest filament portions and restoring the vacuum to its normal height.

7. The method of maintaining the efficiency of metallic filament lamps and restoring the vacuum therein consisting in initiating and propagating the building up of defective filament portions by evaporating some contact or catalytic substance within the lamp by the heat of the filament, forming temporary compounds of the catalytic substance and the filament material, and decomposing said temporary compounds by the abnormal heat existing near the defective thin filament portions whereby the substance of the filament is deposited on said thin portions and thus the vacuum restored.

8. The method of maintaining the efficiency of tungsten filament lamps and restoring the vacuum therein consisting in initiating and propagating the building up of defective filament portions by evaporating some contact or catalytic substance within the lamp by the heat of the filament, forming temporary compounds of the catalytic substance and the volatilized tungsten particles, and decomposing said temporary compounds by the abnormal heat existing near the defective thin filament portions whereby the tungsten particles are deposited on said thin portions and thus the vacuum restored.

Signed at New York, N. Y., this 24th day of October, 1913.

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Witnesses:
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