No. 854,104. ATENTED MAY 21, 1907.

D. McF. MOORE.

VACUUM TUBE LAMP.

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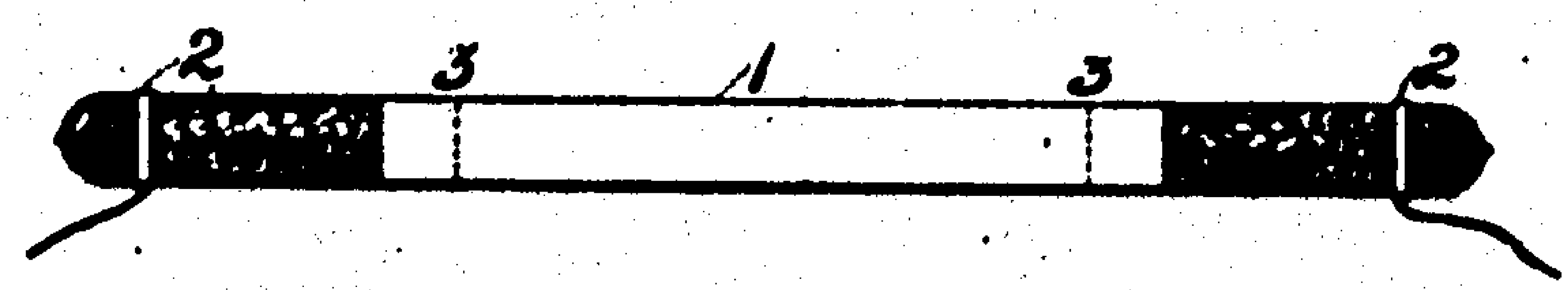

WITNESSES:

INVENTOR

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UNITED STATES PATENT OFFICE.

DANIEL McFARLAN MOORE, OF NEWARK, NEW JERSEY, ASSIGNOR TO MOORE ELECTRICAL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

VACUUM-TUBE LAMP.

No. 854,104. Specification of Letters Patent. Patented May 21, 1907.

Application filed May 25, 1904. Serial No. 209,626.

To all whom it may concern:

Be it known that I, DANIEL McFARLAN MOORE, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Vacuum-Tube Lamps, of which the following is a specification.

My present invention relates to that class of devices employed for lighting and other purposes, and comprising essentially a sealed receptacle containing a rarefied air or other gas through which electric energy is passed for the purpose of rendering the contents of the receptacle luminous, or for other purposes. In this class of devices as ordinarily constructed, the receptacle consists of a tube of translucent material, like glass, and hence when employed for lighting, such devices are ordinarily termed "vacuum tube lamps". The means for transferring energy to the gaseous contents of the tube, consist in some cases of exterior conducting caps or sleeves by which alternating or vibrating electric energy is transferred electrostatically to the contents of the tube, while in other cases, the transfer is accomplished by electric conduction from electrodes sealed in to the receptacle and located within the inclosure but suitably connected through the walls of the receptacle with the source of energy.

While for brevity, I employ in the subjoined description and in the claims, the term "vacuum tube lamp," and while I have described my invention as applied to a tube with terminals suitable for electrostatic transfer of the energy, I do not limit myself to any particular form of receptacle or of electrodes, but by the term "vacuum tube lamp", include all forms of receptacle and constructions of electrode.

Briefly stated, my invention consists in a vacuum tube lamp whose contents embrace, in addition to a tenuous gas of any character, the substance known as graphitic oxid or graphitic acid whose chemical symbol is sometimes given as $C_{11}H_4O_5$.

While I have found that the use of graphitic acid when introduced into a tube lamp secures in marked degree the advantages of length of life, steadiness of light, high efficiency and ability to operate with a comparatively low vacuum, I do not limit myself to the use of the substance known as graphitic acid, but desire it to be understood that I include under the term "graphitic acid" the resultant of the deflagration of graphitic acid which has been termed "pyro graphitic acid."

Graphitic acid or graphitic oxid as it is sometimes called, can be produced chemically by subjecting graphite to the action of the very strongest solution of nitric acid, to which chlorate of potash is added to furnish the oxygen.

The process can be conducted as follows: Using anhydrous nitric acid and potassium chlorate that has been thoroughly dried at a temperature of about 150 degrees, about 0.5 gram of finely powdered material consisting of graphite alone, or mixed with other forms of carbon is introduced into a test-tube containing 10 cc. of nitric acid, and to this is added cautiously 4 grams of potassium chlorate. The test tube is then placed in a waterbath and kept at a temperature of 60 degrees till all action is over, that is, for about ten to twelve hours. The nitric acid is then poured off, the residue thoroughly washed with hot water by decantation and dried. By repeatedly treating the specimen in this way, all the amorphous carbon present is converted into a yellowish brown, soluble substance, while the graphite yields a yellow or brownish yellow insoluble solid which has been named graphitic acid. Where the mixture of graphite and amorphous carbon is used, the presence of the latter is readily recognized by the reddish brown color of the water used in washing the oxidized products. Both amorphous carbons and graphites vary greatly in the ease with which they are attacked by the oxidizing mixture, some carbons requiring many more treatments than others before the oxidation is complete. After the first treatment with the oxidizing mixture, a dark green substance is produced, whose color is a lighter green after the second treatment, and so on with the successive treatments, until there results a pale yellow graphitic acid. When the conversion into graphitic acid is complete, further treatment with the oxidizing mixture produces no change. Graphitic acid may be readily recognized by its peculiar property of decomposing with deflagration when heated, yield-

ing an intensely black, flocculent substance, named pyro graphitic acid. When pyro graphitic acid is treated with the oxidizing mixture, it is completely destroyed, leaving a clear solution.

Instead of using nitric acid to produce the substance, it is possible to employ other acids or mixtures of nitrogen and other acids, as practically the same results can be secured by the use of pure nitric acid or a mixture of nitric and sulfuric acids. Inasmuch as chlorate of potash performs the function of an oxidizing agent, it will be understood by chemists that it might be possible to employ other oxidizing materials.

The insoluble substance obtained by treatment with nitric acid and chlorate of potash as above described, is introduced into a vacuum tube in any desired way, and preferably the electric current is applied to the tube while being exhausted. The current may be applied during the whole period of exhaustion although it is generally desirable to partially exhaust the tube before applying the current in order to avoid any possibility of fixation of the nitrogen by the electric current, which results in the formation of amids which are liable to cause discoloration of the light-giving portion of the tube. As the exhaustion proceeds, the light gradually gets brighter and brighter in the tube, up to a certain point at which a further operation of the pump will produce no increase in its luminosity. It is necessary to pump the tube to this point, or to what I term a standstill, in order to get a tube of any considerable life. As the exhaustion proceeds, the wattage in the tube and the luminosity increases. When the desired luminosity is attained, and the increase in wattage practically ceases, the lamp is then sealed off, although it is preferable generally, in order to more thoroughly ionize the gases, to continue the application of the pump, still applying the current for a short time. The device may be then used as an electric tube lamp with high efficiency and length of life. The nature of the actions or reactions, and the exact behavior of the solid oxid of carbon employed in this manner cannot be stated in detail, but the improved results following from its use are unmistakable.

In the accompanying drawing, the figure shows a side elevation, a vacuum tube lamp in which my invention may be embodied. The terminals of the lamp consists of the usual conducting caps, preferably of graphite, which are provided with the contact ring or sleeve 2 for application of the electric current. The powdered oxid of carbon is introduced into the end sections so as to lie preferably within the conducting terminals, and said terminal sections can be sealed to the intermediate section 1, to produce a complete lamp. The sealing off is done in the usual way. The lines of junction of the end section to the middle sections are indicated at the dotted line 3.

What I claim as my invention is:

A vacuum tube lamp containing graphitic acid as and for the purpose described.

Signed at New York in the county of New York and State of New York this 23d day of May A. D. 1904.

DANIEL McFARLAN MOORE.

Witnesses:

C. F. TIECHNER, Jr.,

A. ANNA B. TALLMAN.