

UNITED STATES PATENT OFFICE.

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WORKING OF ELECTRIC VAPOR-LAMPS.

No. 883,725.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, RICHARD KÜCH, a subject of the German Emperor, and a resident of Hanau, Germany, have invented certain new and useful Improvements in the Working of Electric Vapor-Lamps, of which the following is a specification.

When the several known manners of producing electric light are compared with regard to their efficiency, i. e. the proportion between their illuminating power and the spent energy, the gas or vapor electric lamps with mercury electrodes must be given a prominent place among the other lamps, as is well known. The statements of the efficiency of the gas or vapor electric lamp vary between .35 and .8 watts per candle power. It has been believed, that the efficiency of such lamps is the most favorable for a certain low specific weight of the vapor in the lamp. Now that an increase in the specific weight corresponds to an increase of the fall of potential in the column of light, it may be said, that the efficiency of a gas or vapor electric lamp was the most favorable for a certain fall of potential in the column of light. An increase of the specific weight of the vapor or an increase of the fall of potential in such a lamp beyond a certain point was thought to debase the efficiency. For instance in an article in the German periodical "*Centralblatt für Elektrotechnik*" 1902, number 23 von Recklinghausen says: "Beyond 5 amperes the tension rises rapidly and the useful effect very soon becomes moderate." In the lamps to which this statement refers, the fall of potential in the column of light varied from .5 to 1 volt per centimeter of the length of the column of light (*vide* O. Schott, "*Zeitschrift für angewandte Chemie*" XVIII, 1905, page 618). The fact, that with a further increase of the specific weight of the vapor the efficiency of the gas or vapor electric lamp with mercury electrodes was still further debased, has been proved by the gas or vapor electric lamps of quartz-glass for scientific purposes, which were recently placed on the market and in which the fall of potential was increased up to from 3 to 4 volts per centimeter of the length of the column of light. The efficiency was then reduced and the consumption of current was increased up to from 1 to 1.3 watts per candle power. For this

reason, it was hitherto assumed, that the consumption of electric energy would be further increased, if the specific weight of the vapor, in other words the electric potential of the lamp were to be increased, and therefore it was thought best not to go further, but to stick to the lowest possible specific weight of the vapor.

During my experiments I have discovered the startling fact, that on increasing the electric potential of the lamp far beyond the point hitherto tested an unexpected change takes place. The curve of efficiency of the lamp then changes its direction and the efficiency will quickly rise, so that its value will be far more favorable than the most favorable values hitherto attained for a low electric potential. The consumption of electric current was reduced to .17 watts per candle power and no limit appears to have been as yet reached in this reduction. The electric potential of the lamp was in this case increased up to about 25 or 30 volts per centimeter of the length of the column of light; in other words it was so much multiplied as to be about 25 to 30 times that potential, which was hitherto employed for attaining the most favorable efficiency. This entirely unexpected behavior of the gas or vapor electric lamps with mercury electrodes would seem to be explained by the following theory: For a certain potential of the lamp the light furnished by the radiation of the luminescence of the dissociated mercury vapor is supplied by a further radiation, presumably that of the temperature in consequence of the temperature increasing with the specific weight of the vapor. The radiation of the temperature produces a rapidly increasing efficiency, which compensates for the debasement of the efficiency of the radiation of the luminescence and moreover it produces a very considerable improvement in the total efficiency. The described important observations rendered it possible to produce a mercury light, in which a hitherto unknown profit is made out of the electric current. It is only necessary, to increase the electric load of the lamp and thereby to increase the specific weight of the vapor beyond that hitherto in use, until that point is attained, at which the curve of the efficiency changes its direction. The construction of the lamp

suitable for so high a load will necessarily differ from that hitherto in use. However the specific construction of the lamp required for carrying out this new method is immaterial. The essential point is, that the parts of the lamp be capable of withstanding the high temperature, which is produced at the high electric load. I may lay stress upon the fact, that the gas or vapor electric lamp can be now very much reduced in its length. For the ordinary falls of potential of from 110 to 220 volts the hitherto usual length of the column of light of from 50 to 200 centimeters can be reduced to a few centimeters, say from 6 to 15 centimeters.

In case the electric light is desired to be produced within liquids, be it for the purpose of attaining certain chemical effects, or be it for illuminating purposes, the illuminating tube of the lamp will require to be inclosed in a second tube or vessel molten on it, so as to protect the illuminating tube from contact with the liquid.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The method of working gas or vapor electric lamps having mercury electrodes to increase their efficiency which consists in applying to said electrodes an electric potential greater for unit length of column of light than that corresponding to the minimum point of its curve of efficiency, substantially as described.

2. The method of working gas or vapor electric lamps having mercury electrodes which consists in applying to said electrodes an electric potential of not less than twenty-five volts per centimeter of the length of column of light, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RICHARD KÜCH.

Witnesses:

FRANZ HASSLACHER,
MICHAEL VOLKE.