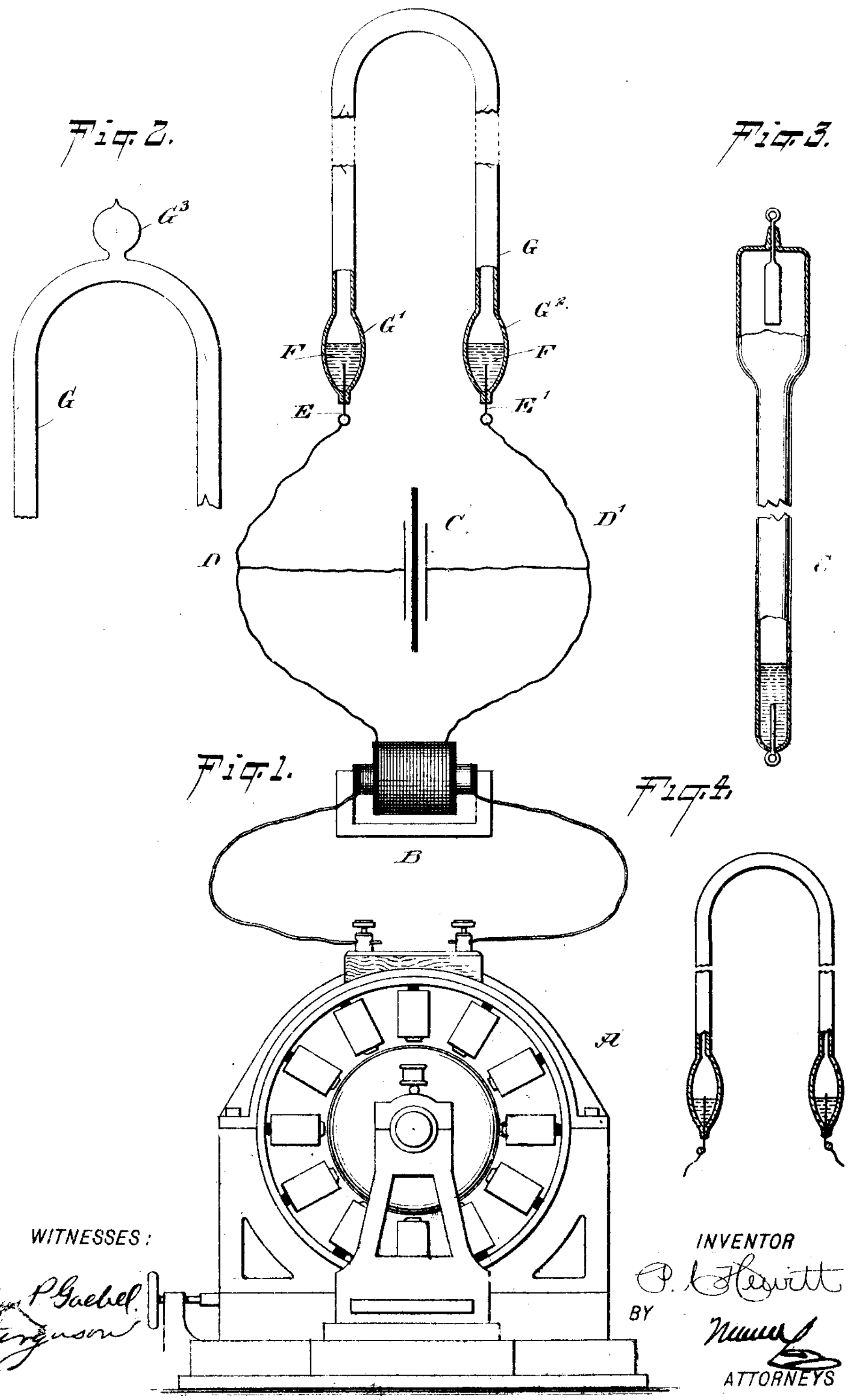
P. C. HEWITT.

METHOD FOR THE ELECTRICAL PRODUCTION OF LIGHT.

APPLICATION FILED MAR. 27, 1900.

1,091,222. Patented Mar. 24, 1914.



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METHOD FOR THE ELECTRICAL PRODUCTION OF LIGHT.

1,091,222. Specification of Letters Patent. **Patented Mar. 24, 1914.**

Original application filed April 11, 1898, Serial No. 677.199. Divided and this application filed March 27, 1900. Serial No. 10,359.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, residing in the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Methods for the Electrical Production of Light, of which the following is a full, clear, and exact description.

This application is a division of my former application, Serial Number 677,199, filed April 11th, 1898, in which former application there is claimed only the apparatus with which I practice the method herein described and claimed.

The object of my invention is to provide a new and useful method of producing light by electricity, whereby a light of high illuminating power is produced, and the intensity and color of the light may be varied.

I have discovered that certain vapors of determinable density and physical condition have the property of becoming intensely light radiant when an electric current is passed through them. Such a vapor is the vapor of mercury, sodium, iodin and other materials, each producing a light with colors peculiar to itself; and besides simple elementary vapors, other gases have this property to a certain extent. The light-giving quality depends chiefly on the density of the vapor, as well as the material. In the case of mercury, which is a fair example of a metal volatilizing at a practical temperature, the vapor is inclosed or formed in a tube, whose ends are adapted to hold a globule of mercury, into which are led wires for conducting the electrical current, which wires may be submerged in the volatilizable material, or not, as desired. In case the wire or electrode projects through the material to be volatilized, the wire becomes heated on the discharge of an electric current, which, in turn, heats the material to be volatilized and volatilizes it, filling the tube with vapor, if the tube is not already of such a temperature that it is sufficiently full of vapor. It is well known that a wire leading into an attenuated atmosphere becomes heated, although the same sized wire will conduct the current under ordinary conditions without heating. In the case where the material to be volatilized constitutes the electrode, the current heats the electrode direct, producing the same effect. A tube or other suitable container may be constructed holding an exact amount of vapor (or material for producing the vapor) necessary to produce this intense light electrically, in which case the exact degree of vapor density and physical condition can be produced which is most advantageous. The electrodes must be made of such size as not to be deteriorated by the electrical discharge, the vapor forming the sole path for the electric current between the electrodes. The light action of these tubes is intermittent and the electric current impulses or oscillations can be made with the frequency desired, and so rapid as to require a most delicate instrument to detect that the light is not continuous. A tube in the form described, one-quarter of an inch in diameter and one foot in length, will produce a light too brilliant to look at, the light being more than a hundred candle power. The quantity of light may be varied by the current used, from great brilliancy to the bare luminosity of ordinary vacuum tubes, or Geissler tubes. The best practical results require the use of a current of considerable quantity. This tube is practically indestructible, having nothing to ruin or destroy, operating at somewhere about the temperature of 300° C., if mercury is used. In the case where other materials are used, the tubes operate at a temperature a little above the vaporizing point, or thereabout, of the substance. In practice, a very agreeable light will be produced by the judicious use of two or more tubes, each containing different vapors to produce different colors.

I will describe an apparatus whereby my method may be carried out, and then point out the novel features in the appended claim.

In the drawings: Figure 1 is a side elevation of one form of a plant for producing the light. Fig. 2 is a side elevation of a modified form of tube of inverted U-shape with a condensing, equalizing, and impurity-retaining chamber at the bend of the U; and Fig. 3 is a longitudinal section of a straight tube, with a volatilizable material at one end only, shutting off that end of the tube the other electrode being free in the enlarged other end of the tube; and Fig. 4 is a detail view illustrating one of the proposed modes of construction made use of at the electrodes.

Similar reference letters denote similar parts throughout the several views.

Referring to the drawings, Fig. 1, A is an electric generator, B is a converter, C is a condenser, and D, D′ wires terminating in the electrodes E, E′ extending into the volatilizable substance F, contained in the bulbs G′, G^2, of the vacuum tube G.

In carrying out my method I use an electric current of varying voltage, which may depend upon the length of the tube G which it is desired to operate and the quantity of light to be produced, and also upon the material used. I place across the wires D, D′, leading to the tube G, the condenser C, which is of suitable capacity. This condenser C, being in resonance with the tube G and current, will adjust the voltage of the current in some degree to any varying resistance that may occur in the tube. The tube G is constructed with the volatile electrodes G′, G^2, and is proportioned in size to the current to be used. The resistance of the vapor in a high degree of attenuation is greater than it is when it becomes a little more dense; then becoming still more dense, the electrical resistance increases so that if the electrodes overheat, the vapor generated will shut off the electrical current until they are again sufficiently cooled; but with a properly constructed tube, this only happens through accident. The material condensing on the sides of the tube G or in the enlarged portions thereof, Figs. 2 and 3, may return automatically to the volatilizable electrode or electrodes. An electrode being of a volatile material will never attain a temperature higher than its vaporizing temperature, and the pressure and density of the vapor in the tube are controllable by the space in the tube not carrying current and forming part of the inclosure contained in the tube. The temperature of the electrodes is thus under control and governable, the vapor, as produced, absorbing the heat.

In order to produce one of my tubes, I first exhaust it to a high vacuum, hot, then turn on the electric current, and, while the current is on, cause the vapor to flow through the tube, or generate in the tube and flow into the pump until it has carried away with it all the impurities existing in the tube. These vapor impurities develop in a tube apparently perfectly exhausted, on the passage of the electrical current, and their absolute removal and prevention from reappearance is most easily effected in this manner. The quantity of light is approximately proportional to the vapor density; a density of low resistance makes it possible to employ a current of low voltage in producing the light. The quantity of light is under absolute control by varying the quantity of the current, the density of the vapor, or the nature of the vapor. As the vapor in the tube may be very attenuated in some cases, it may become necessary in the economical use of some vapors to use a starting device to acquire the proper vapor density on starting. Such a starting device may consist of applied or external heat, or increased electrical potential for the time being. The apparatus of Fig. 1 is an example of the latter form of starting device. A condenser in resonance with a transformer will raise the voltage of the transformer to a very much higer degree than the ratio of the windings of the transformer would call for, and therefore will overcome the resistance at starting.

I have shown the tubes substantially in the form of an inverted **U** in Figs. 1 and 2, but the tubes may be in almost any shape from spiral to straight tubes; but in the case of a **U**-shaped tube used for volatile materials, I prefer to use a tube with a partition in the bottom consisting of the material to be volatilized, or two tubes joined together. In Fig. 3, the straight tube contains a volatilized substance at the lower end, and a solid piece of iron, or the like, suspended in the upper enlarged end, and electric wires leading to the substance and the piece of iron. As above stated, the enlarged portions of the tube G afford increased surface for the condensation of vapor. These enlarged portions are seen in Fig. 2 at the bulb G^3, and in Fig. 3 at the bulb around the electrode in the upper end of the tube. A second function of such a bulb is that of a pressure equalizer. The vapor in the bulb is not affected by the current, nor rendered luminous, as the current does not pass through it, and hence the vapor contained therein can act as an equalizer to give the light a uniform brilliancy and steadiness. As the vapor rises from the volatilizable substance at the electrode any gaseous impurities existing in the tube are driven by such vapor into these bulbs out of the path of the current. The bulbs therefore serve also the purpose of chambers for retaining impurities.

In Fig. 4 I have shown the leading-in wires E and E′ as projecting beyond the surface of the mercury of the electrodes. It is well understood that such an arrangement lowers the resistance of either electrode when functioning as a cathode and thereby serves a useful purpose.

The electrical resistance of different saturated vapors varies in a very great degree for the same density, mercury vapor being of comparatively low resistance and iodin vapor of high resistance. I prefer to use vapors of low resistance as more economical and more convenient.

In producing my tube containing mercury, I have found that a very small amount of oxygen, or oxid of mercury, in the tube increases in a marked degree the electrical resistance and impairs the light radiant quality. I have also found that the combination of two or more tubes, each giving rays of light of different color, is advantageous.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent:—

In a mercury vapor apparatus, the combination with a translating device comprising an exhausted container and mercury electrodes therein separated by a vapor path, said device having a relatively high cathode starting resistance and relatively low operating resistance and means for operating the electrodes alternately as cathodes, of a solid conducting projection above the surface of each electrode whereby its cathode resistance is lowered.

In testimony whereof, I have set my hand in the presence of two witnesses.

PETER COOPER HEWITT.

Witnesses:

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