No. 687,882. Patented Dec. 3, 1901.

P. C. HEWITT.

VAPOR LAMP.

(Application filed Apr. 5, 1900.

(No Model.)

Fig.1

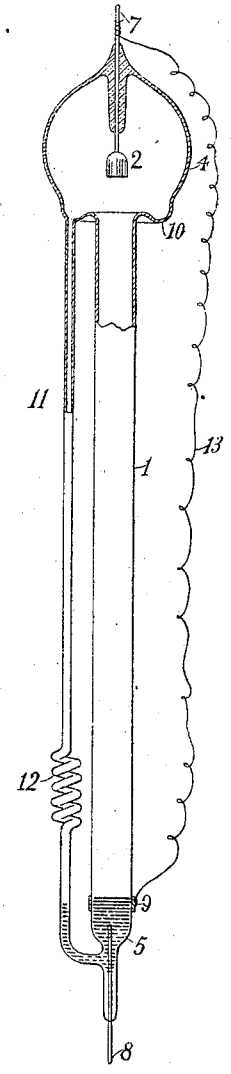


Fig.3

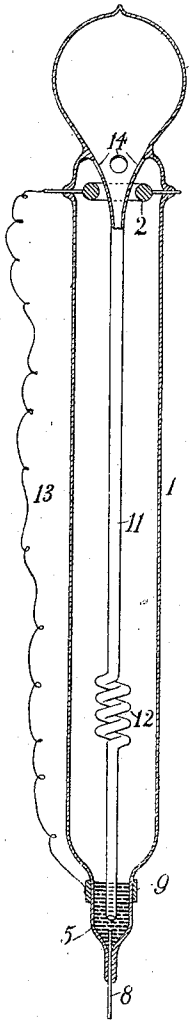
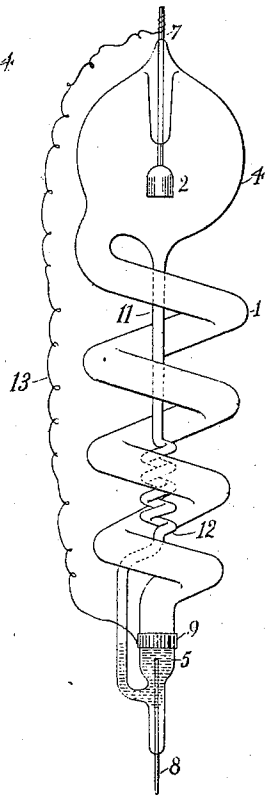


Fig.2



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UNITED STATES PATENT OFFICE.

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VAPOR-LAMP.

SPECIFICATION forming part of Letters Patent No. 687,882, dated December 3, 1901.

Application filed April 5, 1900. Serial No. 11,612. (No model.)

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Vapor-Lamps, of which the following is a specification.

My invention relates to certain improvements in apparatus for electric lighting.

The general purpose of the invention is to provide a convenient and efficient device for producing light by converting electric energy into light through the agency of vapors or gases.

In the ordinary conversion of electric energy into light a large amount of the energy is wasted in heat.

My invention aims, among other things, to produce a device adapted to convert the electric energy into light with the coincident production of as moderate amount of heat as practicable, and I have found that gases or vapors under the proper conditions have such capacity in a greater degree than matter in other states.

It has been proposed to obtain light by the passage of electric currents of very high frequency through a more or less rarefied gas contained within hermetically-closed tubes, such gas being so acted upon by a current as to become slightly luminous. This class of apparatus, commonly known as "Geissler tubes," has been found for various causes to have no commercial utility as a means of lumination. It has also been proposed in some instances to pass electric currents through two electrodes consisting of bodies of mercury contained in hermetically-closed tubes and to obtain light from the electric arc formed between the two mercury electrodes; but prior to my invention no such devices, so far as I am aware, have been produced which are suitable for general commercial use. They have not been so constructed or organized as to be capable of use upon ordinary commercial circuits and, in fact, have had little or no value except, perhaps, for special scientific or laboratory experiments. They have operated as arc-lamps in contradistinction from those in which current passing from one electrode to the other does not form an arc. The lamps which I have produced do not operate upon the arc principle but possess a characteristic form of conduction.

Under proper condition certain vapors and also certain materials normally existing in the form of gases may be caused to remain in such condition as to convey electric currents under the influence of moderate electromotive forces after a current-flow has once been established. By properly correlating the resistances between the electrodes and the vapor or gas and the resistance of the vapor or gas path itself and providing a proper heat-radiating capacity a lamp may be produced which will take considerable current at moderate electromotive forces and be self-regulating to such a degree as to permit of its use upon commercial circuits even though their electromotive forces may fluctuate through wide limits. To render lamps of this character stable and self-regulating upon the circuit, they should have the resistance between the respective electrodes and the gas or vapor path reduced as much as possible, so that these resistances relative to the resistance of the gas-path shall be small. The gas or vapor path then constitutes the principal portion of the resistance of the lamp, and as the electromotive force at its terminals increases the total opposition to the passage of current may be made to effect the required regulation.

The vapor of mercury is highly efficient as a light-yielding material and is well suited to the purposes of my invention. It readily serves under the influence of the current to transfer heat generated in the lamp to convenient points for dissipation. The selection of the material to be used for the vapor or gas must be determined by the conditions and requirements of different cases. When such a material as mercury is used, it is sometimes found convenient to provide a cooling chamber or extension at some portion of the lamp out of the path of the electric current. In such cases where condensation takes place it may be desired to return the condensed material to the lower portion of the lamp through a path outside of the path of the current.

My present invention contemplates the use of a special return-tube through which the

condensed material may be returned to that portion of the lamp from which it is driven off by the action of the current during the operation of the lamp.

In the accompanying drawings, Figure 1 illustrates one form of lamp embodying the features of this invention, and Figs. 2 and 3 illustrate modified forms.

Referring to Fig. 1, the main portion of the lamp is represented by the tube 1, having an enlargement 4, forming a cooling and impurity-containing chamber. The particular dimensions of the lamp may be varied through wide limits to change the resistance with coincident effects, the dimensions and lengths being determined by the electromotive forces and the currents and the gas or vapor to be used. This tube is provided with two electrodes, (indicated at 2 and 5, respectively.) The electrode 2 is usually the anode and the electrode 5 the cathode when the lamp is run upon a continuous-current circuit. The electrode 2 may be made of iron or other suitable material, and the electrode 5 may consist of a small quantity of mercury. A leading-in wire 7 connects with the electrode 2 and a leading-in wire 8 connects with the electrode 5.

In the operation of the lamp more or less of the mercury is volatilized, and a condensation takes place upon the walls of the cooling-chamber 4. This chamber is shown as being constructed with an annular trough 10, depressed slightly below the upper end of the tubular portion 1, so that the condensed mercury running down the walls of the chamber will collect in this trough. A return-tube 11 leads from the trough 10 to a point near the bottom of the tube 1, so that the condensed mercury may flow back to the electrode 5, thus avoiding the disturbing influence which it might otherwise have upon the vapor or gas path through tube 1. In the drawings I have shown the tube 11 as being of much smaller diameter than the tube 1 and as containing at some portion of its length several spirals 12, which serve to permit the expansion and contraction of the tube 1 without breaking the tube 11, both tubes being usually made of glass. I usually make the tube 11 either of smaller diameter or of greater total length than the tube 1 or of both smaller diameter and greater length or otherwise adjust it, so that it (the tube 11) offers a greater resistance to the passage of electric current than the tube 1 with respect to its vapor or gas path, so that in the normal operation of the lamp the current will traverse the gas or vapor path of the tube 1 to the exclusion of the tube 11. For the ready starting of the lamp I usually supply it with a special starting material, which enables the lamp to be started readily with higher potential current, and in the application of these higher potential currents I have found it advantageous to place a conductor—such, for instance, as a band of foil 9—around the tube at the upper end of the cathode and to connect this by wire 13 with the leading-in wire 7. Such band and connection is useful whether alternating or direct currents are used, particularly at starting.

In Fig. 2 I have shown a modification in which the tube 1 is spiral in form and the return-tube 11 is passed down from the lower end of the condensing-chamber inside the coils of the spiral.

In Fig. 3 a modification is illustrated in which the electrode 2 is annular in form and the return-tube 11 passes down through the annular electrode and the axis of the tube 1. The cooling-chamber 4 opens into the tube 1 through passages 14. The lower end of the return-tube 11 opens into the tube 1 near the bottom. The spiral 12 serves also to break the fall of the mercury and relieves the tube of the concussion which might otherwise result in breaking it. The convolutions or bends are therefore usually located near the lower ends of the return-tubes.

The invention claimed is—

1. The combination with an electric lamp, comprising a vapor or gas chamber and a vapor or gas within the same constituting a conducting-path which is of considerable length as compared with its diameter, of electrodes at the respective ends of the chamber, and a return-tube connecting different portions of the chamber.

2. A vapor or gas lamp consisting of the combination of an electrode, a vapor-containing chamber having considerable length as compared with its diameter, a cooling-chamber, a second electrode at or near the opposite end of the vapor-containing chamber, and a return-tube leading from the cooling-chamber to the lower end of the vapor-containing chamber.

3. A vapor or gas lamp consisting of the combination of a vapor-containing chamber, a cooling-chamber, an electrode at or near the vapor-containing chamber, and a return-tube leading from the cooling-chamber to the lower end of the vapor-containing chamber and having one or more convolutions in its length.

4. The combination of the chamber for containing the gas or vapor path, the cooling-chamber having a condensed-vapor-receiving portion, or its equivalent, and a return-tube leading therefrom to another portion of the gas or vapor containing chamber.

5. An electric lamp of the character described comprising a vapor-containing chamber, a solid electrode in one portion of the chamber, a mercury electrode at another portion of the chamber, and a return-tube for receiving the condensed mercury leading from a point in the vicinity of the solid electrode to a point in the vicinity of the mercury electrode.

6. In an electric lamp, the combination of a vapor-containing tube of considerable length as compared with its diameter, two electrodes, one of solid and the other of volatile material, a cooling-chamber out of the path of the

electric current, and a return-tube leading from the cooling-chamber to the volatile electrode.

7. In an electric lamp, the combination of a vapor-containing tube, two electrodes, a cooling-chamber out of the path of the electric current, and a return-tube leading from the cooling-chamber to a point near one of the electrodes, said return-tube having bends in its length near its lower end.

8. In an electric lamp having a vapor consisting wholly or in part of a condensable material and forming a path of considerable length as compared with its diameter, two electrodes, one of solid and the other of volatile material, and a return-tube for the condensed material leading from a point in the lamp near that at which condensation takes place to a point in the lamp at or near where vaporization takes place.

9. The combination with a vapor or gas electric lamp, of a cooling-chamber connected with the upper portion of the lamp, and a return-tube for the condensed material leading from the cooling-chamber through the lamp to the lower portion thereof.

10. In a gas or vapor lamp, two widely-separated electrodes, a condensable current carrying vapor between the electrodes, and a condensed-vapor-return tube not traversed by the current.

11. In a gas or vapor lamp, two widely-separated electrodes, a condensable current carrying vapor between the electrodes, and a condensed-vapor-return tube not traversed by the current leading from the condensing to the vaporizing portion of the lamp.

12. An electric lamp consisting of an inclosing chamber, two widely-separated electrodes and a condensable vapor through which current passes between the electrodes, and a return-tube connecting a cooler portion of the chamber with the portion of the chamber at or near which vaporization takes place and through which return-tube current does not pass.

13. In a light-producing device, a container, mercury-vapor in the container, a mercury electrode in the container, a second electrode in the container, the container having two independent communications or tubes between the electrodes, the mercury-vapor in one tube forming the path between the electrodes for an electric current and determining the quantity of current consumed by the lamp, and the second tube providing a separate communication between the electrodes, but not carrying current, substantially as described.

Signed at New York, in the county of New York and State of New York, this 27th day of March, A. D. 1900.

PETER COOPER HEWITT.

Witnesses:
WM. H. CAPEL,
CHARLES B. HILL.