C. O. BASTIAN & A. E. SALISBURY.

VAPOR ELECTRIC APPARATUS.

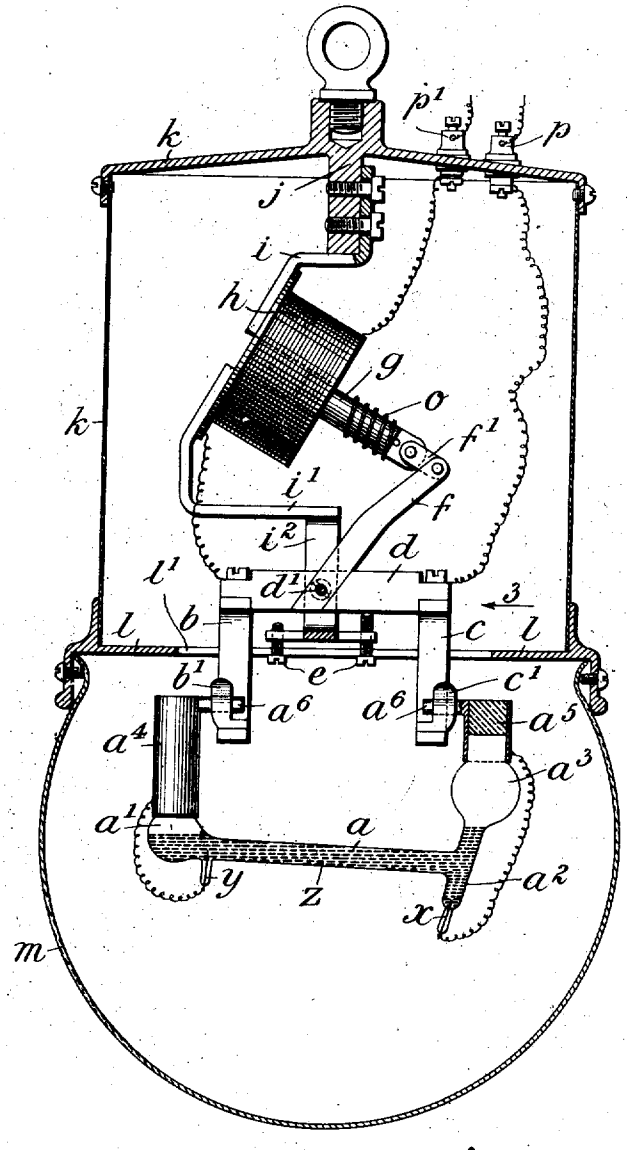
APPLICATION FILED AUG. 17, 1903.

954,407.

Patented Apr. 5, 1910.

3 SHEETS—SHEET 1.

Fig. 1.



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Inventors:
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3 SHEETS—SHEET 2.

Fig. 2.

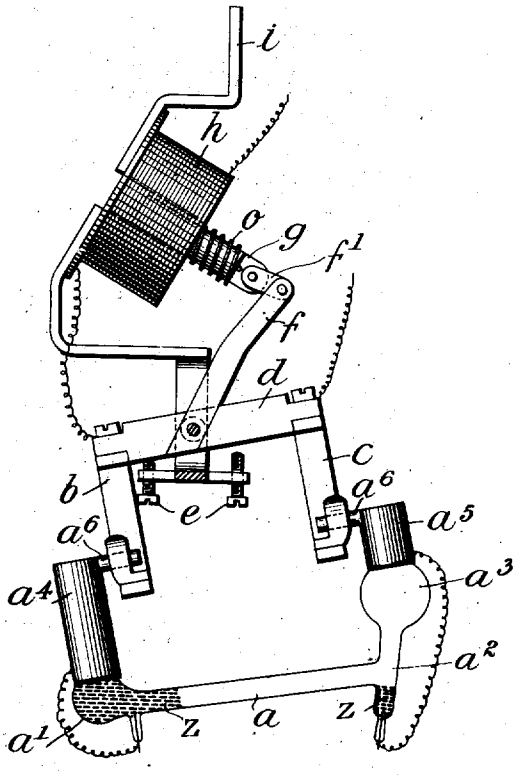
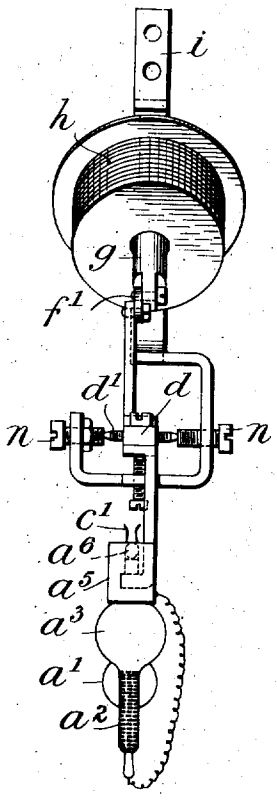


Fig. 3.



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3 SHEETS—SHEET 3.

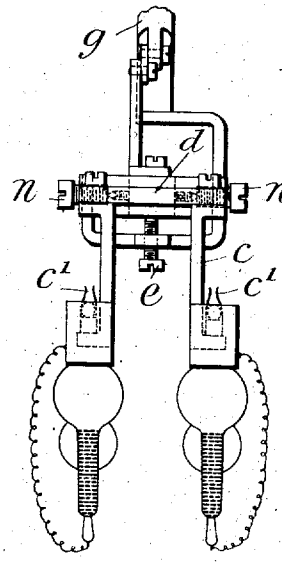

Fig. 4.

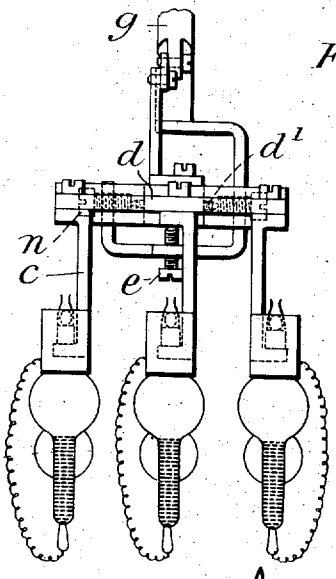

Fig. 5.

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UNITED STATES PATENT OFFICE.

CHARLES O. BASTIAN AND ALBERT E. SALISBURY, OF LONDON, ENGLAND, ASSIGNORS TO THE COOPER-HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

VAPOR ELECTRIC APPARATUS.

954,407. Specification of Letters Patent. Patented Apr. 5, 1910.

Application filed August 17, 1903. Serial No. 169,792.

To all whom it may concern:

Be it known that we, CHARLES O. BASTIAN, electrical engineer, and ALBERT E. SALISBURY, electrical engineer, both residing in London, England, and both subjects of the King of Great Britain and Ireland, have invented certain new and useful Improvements in Vapor Electric Apparatus, of which the following is a specification.

This invention relates to electric lamps of the character known as "vapor lamps" or "mercury vapor lamps" or "vapor arc lamps."

This invention comprises an exhausted or any other suitable chamber for containing mercury or other suitable volatilizable material of suitable electrical conductivity (all of which for the sake of brevity we will hereinafter refer to as "mercury") this chamber or container being provided with electrodes or contacts at the desired distance apart. The mercury in the container is in such position therein and in sufficient quantity to electrically connect the two aforesaid electrodes or contacts for starting the lamp the arrangement and operation being such that when the current is first sent through the lamp and through the mercury connecting the aforesaid electrodes or contacts thereby the mercury is automatically caused to recede or divided into separate bodies or caused to recede from one of the contacts and thereby the mercury is vaporized and the arc is struck or luminosity produced and the length of the arc or luminous space is extended or prolonged up to any length desired.

In the accompanying drawings we have illustrated practical means for carrying out our present invention such means comprising a movable exhausted container having two electrodes or contacts spaced-apart and adapted to be connected through a body of mercury, means to tilt said movable container to thereby cause the mercury to separate and strike the arc, *i. e.* effect the lighting up of the lamp hereinafter referred to as "striking the arc," electrical means operated by the main current to move or tilt said movable container to thereby strike the arc and to maintain the movable container in the tilted position until interruption of the current whereupon the movable container is returned to its normal position and the mercury flows together again or is caused to make connection through both contacts again to complete the circuit through same in readiness to strike the arc and start the lamp on resumption of the current, a condensing chamber in one part of the movable container for the mercury vapor to condense therein, a chamber to receive said mercury (or a part thereof) as it condenses, a pivoted support or cradle rocking said movable container, a lever or arm connected at one end to said movable support and adapted to be operated by the solenoid or an electro-magnet to thereby operate said pivoted support or cradle and tilt the movable container, means to adjust and limit the extent of movement of said pivoted support and cradle and thereby limit the amount of movement imparted to the movable container; and comprising other details all of which will be fully described hereinafter and the novel features finally pointed out in the claims.

Referring to the accompanying drawings: Figure 1 is a vertical elevation with the case and inclosing globe shown in section of a mercury vapor lamp constructed according to our present invention; said lamp being shown in position ready to start, *i. e.* before the current is turned on. Fig. 2 is separate view of the mechanism of the lamp removed from the case showing the position the parts assume when the current has been turned on and the lamp is in operation. Fig. 3 is an edge view of the parts removed from the casing looking in the direction of the arrow 3 Fig. 1. Figs. 4 and 5 are end views similar to Fig. 3 showing modified arrangements namely Fig. 4 shows a double lamp and Fig. 5 a triple lamp.

The exhausted movable container or chamber for containing the mercury consists of a tube a of cylindrical or other suitable form in cross-section and either of the same or differing shape in cross-section throughout its length and made of glass or any suitable translucent material but for the sake of brevity we will hereinafter refer to "glass" only such glass tube being provided at one end with the enlargement a^1; or in place of such enlargement the glass tube a may be continued at an angle so as to allow the mercury to recede into same when the tube a is tilted into the position shown in Fig. 2. At the opposite end of said glass tube a to the enlargement a^1 we provide the cross-tube a^2 the lower part of which extends below

the bottom level of the glass tube a and has one of the electrodes connected thereto and in contact with the mercury in the bottom of said cross-tube a^2 while the upper end of the latter is in connection with a condensing chamber consisting of the glass bulb a^3 of a size to present a sufficient radiating surface on the one hand to enable the mercury vapor to condense sufficiently rapidly and on the other hand this radiation surface must be limited to prevent the mercury vapor condensing too rapidly to interfere with the proper working of the lamp; and in actual practice we have found that a glass bulb such as a^3 and cross-tube a^2 bearing to the glass tube a in or about the relative sizes shown in the drawings will give perfectly satisfactory results—or if desired the radiating chamber a^3 may be formed as a cylinder or of other suitable shape and provided with an adjustable slot or envelop by adjusting which latter more or less of said radiating surface can be covered or uncovered thus enabling the adjustment of the lamp to a nicety.

In the case illustrated the enlargement a^1 at one end of the glass tube and the condensing chamber a^3 at the other end of the glass tube a are respectively mounted and held in metal caps a^4 and a^5 which latter in turn are provided with lugs or inwardly turned arms a^6 forming contacts through and by means of which said glass tube etc. is mounted in position and the mercury therein placed in circuit in the lamp and again readily removed as for instance said arms a^6 may simply rest in the recess formed to receive same between the spring clips b^1 c^1 (see Fig. 3) on the depending arms b c, which latter are insulated from one another and to each of which one pole of the circuit is connected as shown in the drawings for instance. These depending arms b c are carried on the beam d pivoted at d^1 to a fixed part of the frame of the lamp beneath which pivoted beam or cradle d are arranged adjusting screws e by adjusting which latter thereby the extent of movement of the rock beam d can be regulated. To this rock beam d is rigidly attached the arm f which at its upper end is linked at f^1 to the core or armature g of the solenoid or electro-magnet h which latter is carried on a fixed part of the frame of the lamp. For instance as illustrated in the drawings this magnet h may be fixed to the rigid bracket i which at its upper part is attached rigidly to the lug j on the inside of the frame k of the lamp while the bracket i at its lower end is bent and turned inwardly at i^1 and downwardly at i^2 to form the support for the pivoted rock-beam d and the adjusting screws e.

l is bottom plate at the bottom of the metal hood or casing k said bottom plate l being provided with a slot at l^1 through which the depending arms b and c can freely pass without touching.

m is inclosing globe.

The rock-beam d may be pivoted at d^1 either between two adjusting screws n n as shown in Fig. 3 or same may be pivoted and mounted in any other suitable manner. A spring o may if desired be provided on the core g in order to insure said core being forced out of the coil instantly the current is interrupted.

p p' are terminals of the lamp by which same is connected up with the main circuit.

z is the mercury.

The operation of the lamp is as follows:—Before the circuit is completed the parts of the lamp occupy the normal position shown in Fig. 1. When current is switched on through the lamp it flows between the electrodes x and y located at opposite ends of the glass tube a through the mercury located in said glass tube a in the position shown in Fig. 1 and at same time the coils or solenoid h are energized and the core g thereby drawn up into said coils and thus the beam d is rocked and consequently the glass tube a tilted or moved into the position shown in Fig. 2 so that the mercury is separated (at or near the point of junction of the glass tube a with the cross-tube a^2) thus leaving some of the mercury in the lower part of the cross-tube a^2 while the rest of the mercury recedes in the glass tube a (into the enlargement a^1) to about the position of the mercury z shown in Fig. 2 and thereby the arc is struck and mercury vapor formed and the lamp continues burning and the solenoid or electro-magnet h continues to hold the glass tube a in the tilted position shown in Fig. 2 as long as the current continues to flow. The mercury vapor meantime continuously condensing in the chamber a^3 and the condensed mercury falls from said condensing chamber a^3 toward the bottom of the cross-tube a^2 and any excess of mercury rising in the cross-tube a^2 above the level of the bottom of the tube a (at its junction with the cross-tube a^2) will consequently run down the said tube a and chamber a^2 toward the chamber a^3 and join the body of mercury at this end a^1 of the glass tube a. Should the current be interrupted either momentarily or otherwise immediately the current ceases the electro-magnet releases the core the beam d is rocked and the glass tube a and connecting parts restored to the position shown in Fig. 1 whereupon instantly the current flows again through the mercury z between the electrodes x and y. Thereupon the lamp will be automatically started and so on.

By our foregoing invention we are enabled to produce a lamp very simple and economical in its construction and of great efficiency and economy with regard to cur-

rent consumption as it is well known that mercury vapor lamps will produce a very high efficiency, but the difficulty in such lamps heretofore has been to start them whereas this difficulty of starting is overcome by the present invention.

While we have shown as the means for moving the mercury container, the electro-magnet, we do not wish to limit ourselves to this specific means since we may employ any suitable electrically operated means for accomplishing the same result.

We find in practice that mercury vapor lamps constructed according to our present invention require considerably more current to start them than is necessary to keep them lighted when once the mercury has been warmed up and vaporized. For example a lamp of about the actual dimensions shown in the drawings strikes up readily with about two amperes but after about 15 seconds the current may be reduced to about 0.6 ampere when the lamp will continue burning steadily with the latter current. This reduction in current after starting may be effected in any well known or suitable way.

We may if desired suspend two or more of our mercury vapor lamps on the rock beam d as shown in Figs. 4 and 5 and we may connect these lamps in series with one another or in parallel, the winding on the electro-magnet being varied accordingly.

In constructing these lamps we find that lead glass is very suitable for the purpose and that pure mercury in the container exhausted to a high degree of vacuum gives excellent results and under these conditions there is no tendency for the lead glass to melt or crack when the lamp is working with a current just sufficient to maintain the mercury vapor in a state of incandescence. We do not wish to bind ourselves however to pure mercury or lead glass or other details as for example impurities might with advantage be introduced or other qualities of glass used without departing from the spirit of our present invention.

The contacts or leading-in wires or both are advantageously made of platinum and such wires or the contacts within the container should always be completely covered with mercury except in certain cases one such contact may be exposed. For example one of the contacts or electrodes might be of iron or other metal but we prefer both to be of platinum.

From our observations of the working of these lamps apparently during the operation of the lamp, a transference of metal (mercury) takes place from one electrode to the other (probably an electrolytic action with metallic vapor as the electrolyte) but the loss of mercury at the one electrode and the gain at the other is compensated for by condensation or the overflowing of the mercury z from the cup at the bottom of the cross-tube a^2 or both.

The enlargement a^1 in or on or at or toward the end of the container a is of an internal capacity or size such that it will not quite receive all the mercury out of the container and consequently it serves to limit the extent to which the mercury can be moved back or divided and thus governs the length of the arc or luminous space, and this limitation of the size of this chamber has the further result that it also prevents the possibility of the contact in the mercury in said chamber ever becoming uncovered which is a desideratum.

In a divisional application filed by us on December 14th, 1906, Serial Number 347,751, claims are made upon certain features described herein.

Having now described our invention what we claim as new and desire to secure by Letters Patent of the United States is:—

1. A mercury vapor apparatus, comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the said container and mercury and thereby strike the arc.

2. A mercury vapor apparatus, comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move said container and to thereby separate the mercury between said electrodes or contacts.

3. A mercury vapor apparatus, comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move said container whereby the mercury is caused to recede from one of said electrodes or contacts.

4. A mercury vapor apparatus, comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move said container whereby the mercury is caused to recede from both of said electrodes or contacts.

5. A mercury vapor apparatus, comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means operated by the main current adapted to move the said container and thereby cause a separation of the mercury between the electrodes.

6. In a mercury vapor apparatus, the combination with an exhausted container for mercury having electrodes or contacts spaced-apart therein and adapted to be connected through the said body of mercury in said container, of electrical means automatically operated by the flow of current

through the apparatus adapted to move said container to cause a division of the mercury therein and thereby strike the arc and to maintain such separation until interruption of the current takes place, substantially as and for the purposes hereinbefore described.

7. In a mercury vapor apparatus, the combination with an exhausted container for mercury, having electrodes or contacts spaced-apart therein and adapted to be connected through the said body of mercury in said container, of a rock-beam supporting said container, an electro-magnet adapted to be energized by the flow of current through the apparatus, means adapted to be operated by said electromagnet to rock said beam to move the mercury and thus strike the arc and maintain the parts in this position until interruption of the current, substantially as and for the purposes hereinbefore described.

8. In a mercury vapor apparatus, the combination with an exhausted container for mercury, having electrodes or contacts spaced-apart therein and adapted to be connected through the said body of mercury in said container, of a rock-beam supporting said container, an electro-magnet adapted to be energized by the flow of current through the apparatus, means adapted to be operated by said electro-magnet to rock said beam and thereby tilt the container and cause separation of the mercury and thus strike the arc and maintain the parts in this position until interruption of the current, substantially as and for the purposes hereinbefore described.

9. In a mercury vapor apparatus the combination with an exhausted glass tube for containing mercury and disposed horizontally or thereabout, of a receptacle at one end adapted to receive the mercury from said glass tube when the latter is tilted in one direction, a condensing chamber at the opposite end of said glass tube, electrodes or contacts adapted to be connected by the mercury in said horizontal glass tube, movable means to support said glass tube and its connections, means to rock or tilt said glass tube so as to move the mercury in the glass tube and thereby strike the arc, and electrical means to retain said glass tube in the rocked or tilted position after the arc has been struck until interruption of the current, substantially as and for the purposes hereinbefore described.

10. In a mercury vapor apparatus, the combination with an exhausted glass tube for containing mercury and disposed horizontally or thereabout, of a receptacle at one end adapted to receive the mercury from said glass tube, when the latter is tilted in one direction, a condensing chamber at the opposite end of said glass tube, electrodes or contacts adapted to be connected by the mercury in said horizontal glass tube, movable means to support said glass tube and its connections, means to rock or tilt said glass tube so as to cause separation of the mercury in the glass tube and thereby strike the arc, and electrical means to retain said glass tube in the rocked or tilted position after the arc has been struck until interruption of the current, substantially as and for the purposes hereinbefore described.

11. In a mercury vapor apparatus, the combination with an exhausted glass tube for containing mercury and disposed horizontally or thereabout, of a receptacle at one end adapted to receive the mercury from said glass tube when the latter is tilted in one direction, a condensing chamber at the opposite end of said glass tube, electrodes or contacts adapted to be connected by the mercury in said horizontal glass tube, movable means to support said glass tube and its connections forming the container for mercury, an electro-magnet energized by the main current flowing through the apparatus, mechanism operated by said electro-magnet and connected with said container to tilt the latter and move the mercury when current flows through the apparatus and thereby strike the arc and maintain said container in such tilted position until interruption of the current, substantially as and for the purposes hereinbefore described.

12. In a mercury vapor apparatus comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the container and mercury therein and thereby strike the arc, the combination therewith of a mercury receptacle in communication with said container, said receptacle being of a size just sufficient to receive that amount of mercury which is removed from the said container upon the lighting up of the apparatus.

13. In a mercury vapor apparatus comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move said container to cause a separation of the mercury and thereby strike the arc, the combination therewith of a mercury receptacle in communication with said container, said receptacle being of a size just sufficient to receive that amount of mercury which is removed from the said container upon the lighting up of the apparatus.

14. In a mercury vapor apparatus comprising an exhausted container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the said container and the mercury and thereby strike the arc, the combination therewith of a mer-

cury receptacle in communication with said container, said receptacle being of a size just sufficient to receive that amount of mercury which is removed from the said container upon the lighting up of the apparatus.

15. In a mercury vapor apparatus comprising an exhausted container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the container to cause a separation of the mercury and thereby strike the arc, the combination therewith of a mercury receptacle in communication with said container, such receptacle being of a size just sufficient to receive that amount of mercury which is removed from the said container upon the lighting up of the apparatus.

16. In a mercury vapor apparatus comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the mercury by the movement of the said container and thereby strike the arc, the combination therewith of an enlargement at one end of said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus, substantially as set forth.

17. In a mercury vapor apparatus comprising a container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the said container to cause a separation of the mercury and thereby strike the arc, the combination therewith of an enlargement at one end of said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus, substantially as set forth.

18. In a mercury vapor apparatus comprising an exhausted container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move the said container and the mercury therein and thereby strike the arc, the combination therewith of an enlargement at one end of said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus, substantially as set forth.

19. In a mercury vapor apparatus comprising an exhausted container for mercury, electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move said container to cause a separation of the mercury and thereby strike the arc, the combination therewith of an enlargement at one end of said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus, substantially as set forth.

20. In a mercury vapor apparatus comprising a container for mercury electrodes or contacts in said container normally connected by the mercury in said container and means adapted to move the said container and the mercury therein and thereby strike the arc, the combination therewith of an enlargement at one end in said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus said receptacle being of a size limited in suchwise as to prevent the mercury being separated beyond a desired point according to the space to be rendered luminous and also to prevent the possibility of the contact which is in said receptacle becoming uncovered, substantially as set forth.

21. In a mercury vapor apparatus comprising a container for mercury electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to move said container to cause a separation of the mercury and thereby strike the arc, the combination therewith of an enlargement at one end in said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus said receptacle being of a size limited in suchwise as to prevent the mercury being separated beyond a desired point according to the space to be rendered luminous and also to prevent the possibility of the contact which is in said receptacle becoming uncovered, substantially as set forth.

22. In a mercury vapor apparatus comprising an exhausted container for mercury electrodes or contacts in said container normally connected by the mercury in said container, and means to move the said container and the mercury therein and thereby strike the arc, the combination therewith of an enlargement at one end in said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus said receptacle being of a size limited in suchwise as to prevent the mercury being separated beyond a desired point according to the space to be rendered luminous and also to prevent the possibility of the contact which is in said receptacle becoming uncovered, substantially as set forth.

23. In a mercury vapor apparatus comprising an exhausted container for mercury electrodes or contacts in said container normally connected by the mercury in said container, and means adapted to tilt said container to cause a separation of the mercury and thereby strike the arc, the combination therewith of an enlargement at one end in

said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus said receptacle being of a size limited in suchwise as to prevent the mercury being separated beyond a desired point according to the space to be rendered luminous and also to prevent the possibility of the contact which is in said receptacle becoming uncovered, substantially as set forth.

24. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and electro-magnetic means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

25. A mercury vapor apparatus comprising a container for mercury, electrodes therein normally connected within the container by good conducting material, and means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

26. In a mercury vapor apparatus, the combination with an exhausted container for mercury, having separated electrodes therein normally connected within the container by a good conducting material of electro-magnetic means automatically operated by the flow of current through the apparatus for moving said container and initiating a flow of current through the vapor of mercury.

27. In a mercury vapor arc lamp, the combination with an exhausted container for mercury, having electrodes or contacts spaced apart therein and adapted to be connected through the said body of mercury in said container, of electrical means automatically operated by the flow of current through the lamp to move said container and the mercury therein and thereby start the arc, and to maintain such separation until interruption of the current takes place, substantially as and for the purposes hereinbefore described.

28. A mercury vapor lamp comprising a movable container for mercury, the said lamp being adapted to operate in an inclined position, and automatic means for tilting the lamp so as to make metallic connection between the electrodes.

29. A mercury vapor device comprising a movable container for mercury, electrodes therein, said container being adapted to occupy either of two positions in one of which positions it is held by gravity, and automatic means brought into action by current flow for tilting the device into the other position, whereby metallic connection between the electrodes is alternately made and broken.

30. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and automatic means adapted to move said container and thereby initiate a flow of current through the mercury vapor.

In witness whereof we have hereunto set our hands in presence of two witnesses.

CHAS. O. BASTIAN.
ALBERT E. SALISBURY.

Witnesses:
HENRY BIRKBECK,
FRED L. RANDS.

Disclaimer in Letters Patent No. 954,407.

DISCLAIMER.

954,407.—*Charles O. Bastian* and *Albert E. Salisbury*, London, England. VAPOR ELECTRIC APPARATUS. Patent dated April 5, 1910. Disclaimer filed October 17, 1913, by the assignee, *Cooper Hewitt Electric Company*.

Enters this disclaimer—

"To those parts of the claims in said specification which are in the following words, to wit:

"24. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and electro-magnetic means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

"29. A mercury vapor device comprising a movable container for mercury, electrodes therein, said container being adapted to occupy either of two positions in one of which positions it is held by gravity, and automatic means brought into action by current flow for tilting the device into the other position, whereby metallic connection between the electrodes is alternately made and broken.

"30. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and automatic means adapted to move said container and thereby initiate a flow of current through the mercury vapor."

[OFFICIAL GAZETTE, *October 28, 1913.*]

said container to form a receptacle adapted to receive the mercury which is removed from the container upon the lighting up of the apparatus said receptacle being of a size limited in suchwise as to prevent the mercury being separated beyond a desired point according to the space to be rendered luminous and also to prevent the possibility of the contact which is in said receptacle becoming uncovered, substantially as set forth.

24. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and electro-magnetic means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

25. A mercury vapor apparatus comprising a container for mercury, electrodes therein normally connected within the container by good conducting material, and means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

26. In a mercury vapor apparatus, the combination with an exhausted container for mercury, having separated electrodes therein normally connected within the container by a good conducting material of electro-magnetic means automatically operated by the flow of current through the apparatus for moving said container and initiating a flow of current through the vapor of mercury.

27. In a mercury vapor arc lamp, the combination with an exhausted container for mercury, having electrodes or contacts spaced apart therein and adapted to be connected through the said body of mercury in said container, of electrical means automatically operated by the flow of current through the lamp to move said container and the mercury therein and thereby start the arc, and to maintain such separation until interruption of the current takes place, substantially as and for the purposes hereinbefore described.

28. A mercury vapor lamp comprising a movable container for mercury, the said lamp being adapted to operate in an inclined position, and automatic means for tilting the lamp so as to make metallic connection between the electrodes.

29. A mercury vapor device comprising a movable container for mercury, electrodes therein, said container being adapted to occupy either of two positions in one of which positions it is held by gravity, and automatic means brought into action by current flow for tilting the device into the other position, whereby metallic connection between the electrodes is alternately made and broken.

30. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and automatic means adapted to move said container and thereby initiate a flow of current through the mercury vapor.

In witness whereof we have hereunto set our hands in presence of two witnesses.

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ALBERT E. SALISBURY.

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"24. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and electro-magnetic means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

"29. A mercury vapor device comprising a movable container for mercury, electrodes therein, said container being adapted to occupy either of two positions in one of which positions it is held by gravity, and automatic means brought into action by current flow for tilting the device into the other position, whereby metallic connection between the electrodes is alternately made and broken.

"30. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and automatic means adapted to move said container and thereby initiate a flow of current through the mercury vapor."

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Enters this disclaimer—

"To those parts of the claims in said specification which are in the following words, to wit:

"24. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and electro-magnetic means adapted to move the said container and thereby initiate a flow of current through the mercury vapor.

"29. A mercury vapor device comprising a movable container for mercury, electrodes therein, said container being adapted to occupy either of two positions in one of which positions it is held by gravity, and automatic means brought into action by current flow for tilting the device into the other position, whereby metallic connection between the electrodes is alternately made and broken.

"30. A mercury vapor apparatus comprising an exhausted container, electrodes therein adapted to be alternately connected and disconnected within the container by good conducting material, and automatic means adapted to move said container and thereby initiate a flow of current through the mercury vapor."

[OFFICIAL GAZETTE, *October 28, 1913.*]