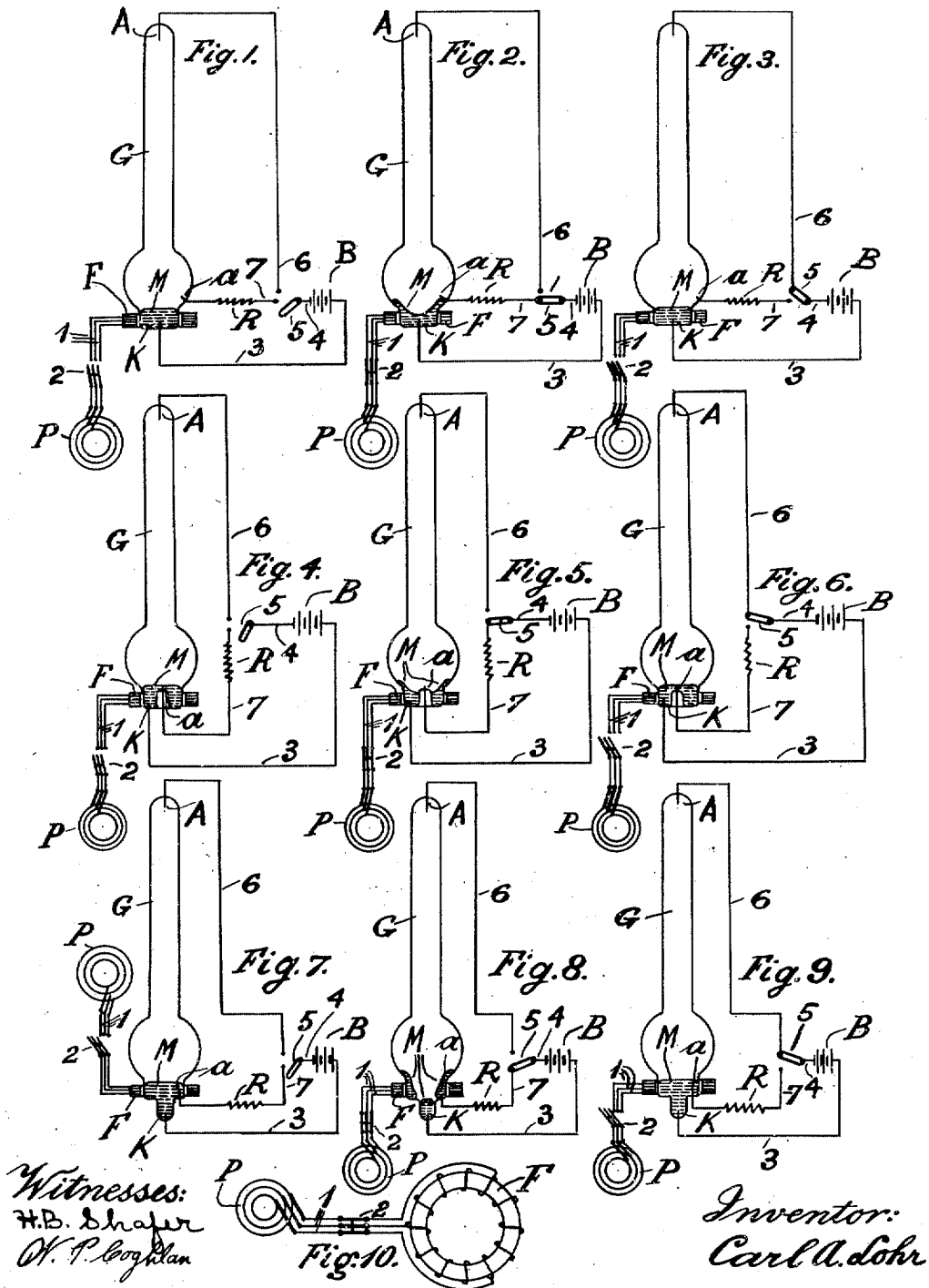


983,245.

Patented Jan. 31, 1911.

2 SHEETS—SHEET 1.

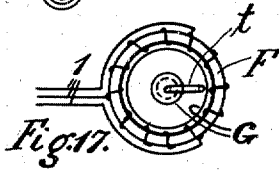
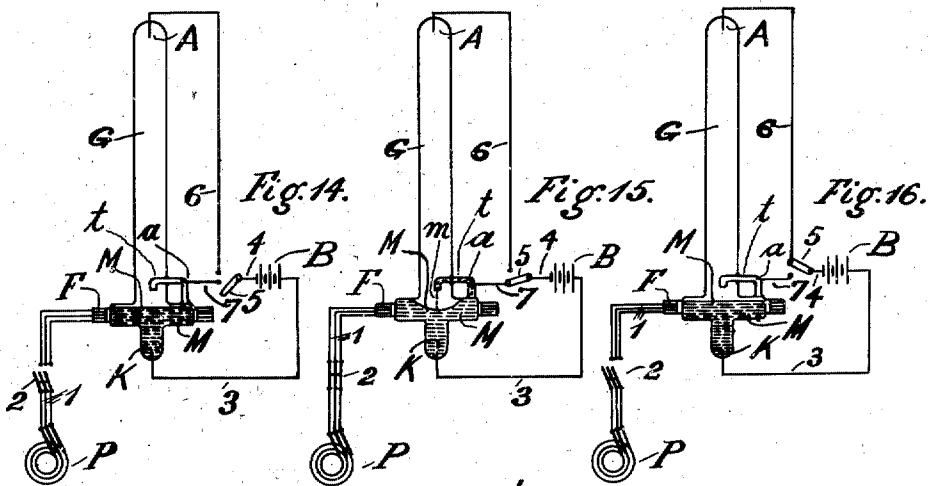
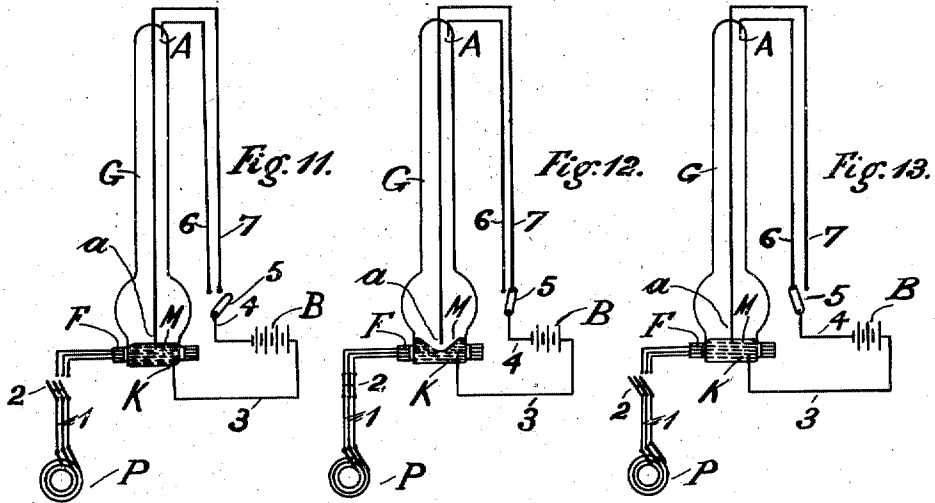


C. A. LOHR.  
ELECTRIC APPARATUS.  
APPLICATION FILED FEB. 11, 1908.

983,245.

Patented Jan. 31, 1911.

2 SHEETS-SHEET 2.



Witnesses:  
H. B. Shaper  
W. P. Cothren

Inventor:  
Carl A. Lohr.

# UNITED STATES PATENT OFFICE.

CARL A. LOHR, OF CHICAGO, ILLINOIS.

## ELECTRIC APPARATUS.

983,245.

Specification of Letters Patent. Patented Jan. 31, 1911.

Application filed February 11, 1908. Serial No. 415,452.

*To all whom it may concern:*

Be it known that I, CARL A. LOHR, a subject of the German Emperor, residing in Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Apparatus, of which the following is a specification.

My present invention relates to electric apparatus, in which for the purpose of making or breaking a contact a liquid conductor is used and more especially to such apparatus in which for a certain purpose liquid mercury participates in making or breaking a contact, such as mercury vapor lamps, mercury vapor rectifiers and the like.

Generally speaking my present invention consists in a method of making or breaking a contact by means of a liquid conductor, by setting said liquid conductor in rapid rotation preferably around a vertical axis and causing the make or break of said contact by the deformation of said liquid conductor, which the latter undergoes by action of the centrifugal force.

I deem my present invention especially adapted for the use with mercury vapor apparatus and more especially for the purpose of starting such apparatus by breaking a contact in an evacuated space between the liquid mercury (cathode) and the anode or auxiliary anode, thus causing an arc to start between the cathode and the anode or auxiliary anode, a method which is well known and practically employed in mercury vapor apparatus. With regard to the term "breaking a contact" in combination with the method of starting an arc thereby, it must be understood, that I do not mean an interruption of the electric circuit, as after the breaking of the contact for this purpose an electric circuit will yet be closed by ionic rays emanated by the cathode, but I wish to imply a breaking of a material or bodily contact between the mercury forming the cathode and another conductor forming the anode or auxiliary anode of the mercury vapor apparatus.

My invention furthermore comprises as one of its features to effect the rotation of the liquid mercury or the liquid conductor by electro-magnetic means, namely by producing a magnetic rotary field around the mercury or liquid conductor and causing therewith the said mercury or liquid conductor to act as the secondary of an induc-

tion motor and assume a rotation which will be nearly equal to that of the rotary field.

My invention furthermore comprises modifications in the manner of effecting a contact by the centrifugal force acting upon the mercury or liquid conductor. The contact may be effected by the deformation of the liquid conductor, which is caused by the rotation of the liquid conductor, or also by the more gradual deformation, which the liquid conductor undergoes, when the cause of rotation is removed, *i. e.* when the liquid conductor is rotating under its fly-wheel action and gradually assuming its natural shape, when coming to rest.

My invention will more fully be understood by reference to the accompanying drawings, in which I have illustrated my invention as being applied for the starting-process of direct-current mercury vapor lamps, whereby the starting is effected by producing an auxiliary arc between the mercury (cathode) and an auxiliary anode. With regard to the specific manner, in which I effect the contact between auxiliary anode and cathode I show five different modifications herein, which although differing from each other in their specific action, are commonly based upon the deformation which a liquid undergoes, when set in rotation, or when ceasing to rotate and assuming its shape when at rest, or in brief which are commonly effected by centrifugal force.

Referring first in a general way to the drawings, Figures 1 to 3 inclusive, Figs. 4 to 6 inclusive, Figs. 7 to 9 inclusive, Figs. 11 to 13 inclusive and Figs. 14 to 16 inclusive, the said figures forming five groups each containing three figures, show the said five modifications respectively, by which I effect the contact between cathode and auxiliary anode and more especially in which I produce the auxiliary arc and the starting of the mercury vapor lamp. The first figure of each of these five groups, namely Figs. 1, 4, 7, 11 and 14 show the mercury vapor lamp and its connections, when at rest or inoperative, the second figure of each of these five groups, namely the Figs. 2, 5, 8, 12 and 15 show the mercury vapor lamp and its connections during the starting period and the third figure of each of these five groups, namely Figs. 3, 6, 9, 13 and 16 show the mercury vapor lamp and its connections in its regular running period. All figures of

the drawings, except the Figs. 10 and 17, show in a diagrammatic view an elevation of a mercury vapor lamp and its arrangement and connections according to my present invention. Fig. 10 shows in a diagrammatic view the part F and its connections 1 by a switch 2 with a polyphase alternating current source P, the said part F being an electromagnet having windings so as to produce a magnetic rotary field thereby, when operated by the alternating current source P (switch 2 closed). Fig. 17 shows a top view of the arrangement of the mercury vapor lamp as illustrated in an elevation in the three Figs. 14, 15 and 16.

Similar letters designate similar devices in the different figures of the drawings.

The mercury mass M surrounding the negative electrode of the apparatus forms therewith the cathode K. The main anode *i. e.* the electrode used as anode during the regular working of the apparatus is shown at A, the auxiliary anode, *i. e.* the electrode forming the anode during the starting of the apparatus is shown at  $\alpha$ , the liquid mercury surrounding the cathode K in its particular shape when at rest or when rotating is shown in cross section by the shaded surfaces M. The means for producing the rotation of the liquid mercury M is shown in cross section in all figures, except in Figs. 10 and 17, as a ring of magnetizable material F, preferably made of soft iron wire or laminated soft iron, which is magnetized so as to produce a rotary field, in which the liquid mercury M is rotated by a well known electro-mechanical principle. A direct current source B can be connected over the conductors 3, cathode K, auxiliary anode  $\alpha$ , resistance R, conductor 7 and switch 5, the latter, when thrown so as to make connection between the conductors 7 and 4 as shown in the Figs. 2, 5, 8, 12 and 15, representing the starting period of the apparatus. Also the direct current source can be connected by the conductors 3, 4 and 6 with the main anode A and the cathode K of the apparatus, when switch 5 is thrown so as to make connection between the conductors 4 and 6, as shown in the Figs. 3, 6, 9, 13 and 16, representing the regular running-period of the apparatus.

The above mentioned five modifications, in which the method of effecting the contact by the centrifugal force of the mercury is shown in the drawings are more fully described in the following.

Figs. 1, 2 and 3 show an arrangement of a mercury vapor lamp and the liquid mercury thereof, whereby for the purposes as stated, the mercury is set in rotation around a vertical axis, thereby producing a depression of the mercury surface in the neighborhood of the axis of rotation and a projection of the mercury surface on or near the circumfer-

ence of the mercury mass; a contact between the mercury surrounding the cathode K and the auxiliary anode  $\alpha$  being first made by the projected parts of the mercury, when rotating, said contact being afterward broken, by removing the cause of rotation by opening the switch 2, whereby the auxiliary arc is started by the breaking of said contact.

Figs. 4, 5, and 6 similarly show an arrangement, whereby the contact between the mercury (cathode) and the auxiliary anode  $\alpha$  is broken by the depression of the mercury surface, therewith causing the auxiliary anode  $\alpha$ , being located in an elevated part of the bottom of the glass vessel G of the apparatus to be exposed in the center of rotation of the rotating mercury mass, the center being free of mercury and the mercury mass assuming a ringlike shape, when rotating.

Figs. 7, 8 and 9 show an arrangement, whereby the mercury when rotating is compelled to also assume a ringlike shape, but in this arrangement a part of the mercury located in the axis of rotation does not participate in the rotation on account of its being located in a part of the glass vessel G which is below and substantially outside of the action of the rotary field produced by the part F. In this arrangement the contact is broken by a separation of mercury parts, one part being subject to the rotation and accordingly to centrifugal force, the other part being essentially outside of the action of the rotary field and therefor being left at rest.

In Figs. 11, 12 and 13 the mercury is arranged so as to produce a depression in the neighborhood of the axis of its rotation and thereby breaking the contact between the cathode and the auxiliary anode. This arrangement differs from the one shown in the Figs. 4, 5 and 6 therein, that the mercury does not need to assume an entire ring-shape thus producing an empty space in its center and that the said contact is broken merely by the lowering of the level of the mercury at or near its center of rotation.

In Figs. 14, 15 and 16 an arrangement of the mercury and its surrounding glass walls is shown, whereby a contact between cathode and auxiliary anode is first made and then broken, the first operation being effected by the pressure which exists at the circumference of the mercury mass, when rotating. In this case the pressure near the circumference of the rotating mercury mass is used to drive a thin stream of mercury through a small glass tube  $t$ , in which the auxiliary anode is located and cause the mercury to make a contact with the auxiliary anode, when rotating. This glass tube  $t$  is melted in the glass vessel with the lower end of its vertical part in the neighborhood of the circumference of the mercury, and is also melted in a part of the glass vessel G being somewhat above the level of the mercury.

The horizontal part of the glass tube *t* extends to a point about in the axis of rotation of the mercury but also somewhat above the level of the mercury, and may be bent somewhat downwardly at the free end of its horizontal part, all as shown at *t* in the Figs. 14, 15, 16 and 17. In the arrangement as shown, the function of the mercury stream pressed by centrifugal force through the glass tube *t* is a double one, namely to make a contact between the auxiliary anode and the cathode by means of the part of the mercury stream being inclosed by the vertical part of the glass tube *t*, as well as by means of the part of the mercury stream inclosed by the horizontal part of the glass tube *t* and the mercury stream dropping from the free end of the horizontal part of the glass tube *t* back to the mercury mass. Thus two contacts in parallel to each other are made between the mercury mass (cathode) and the auxiliary anode, therewith making the starting of the lamp more certain. Accordingly when the rotation of the mercury is ceasing (after opening switch 2) two contacts are broken between the anode and the mercury. Obviously making and breaking the contact in one or two points can be effected by a less or more rapid rotation of the mercury mass. In Fig. 15 representing the starting period the stream of mercury pressed through the glass tube *t* is shown by the dotted line *m*.

According to my invention, in brief, the operation of the mercury vapor apparatus is as follows: At rest, when the apparatus is inoperative, switches 2 and 5 are open as shown in the Figs. 1, 4, 7, 11 and 14. At starting, switch 2 is closed, producing the rotary field in the part F and therewith causing the mercury M to assume its particular shape as shown in the Figs. 2, 5, 8, 12 and 15. Also at starting the switch 5 must be thrown so as to make contact with the conductor 7 leading to the auxiliary anode *a*. In every case, as shown, in the Figs. 2, 5, 8, 12 and 15 the switch 2 producing the rotary field in the part F should be closed after the switch 5 is in its proper position, namely making contact with the conductor 7. In Figs. 2 and 15, where the contact between the cathode and the auxiliary anode is first made by the shape of the mercury when rotating, and then broken, when the latter assumes its natural shape, the switch 5 must be first closed and after the mercury has assumed its shape due to the rotation, therewith making a contact between cathode and auxiliary anode, switch 5 must be opened again, before the switch 5 can be thrown so as to make contact with the conductor 6 leading to the main anode A. In the other figures, namely Figs. 5, 8 and 12, where the contact between cathode and auxiliary anode is broken by the shape of the mercury caused by its rotation, switch 5

should be thrown so as to make contact with the conductor 6 leading to the main anode A before switch 2 is opened again, as can be easily seen by mere inspection of the drawings. During the regular running period of the apparatus switch 2 is open and switch 5 is in contact with conductor 6 and the main anode A, as shown in the Figs. 3, 6, 9, 13 and 16. It may be noted, that the switch 5 should be broad enough so as to not interrupt the contact with the auxiliary anode before the contact over conductor 6 with the main anode is made.

While I have shown in the accompanying drawings and described in this specification some embodiments of my invention, I do not wish to limit myself to the particular constructions as shown and described, since modifications can be made by those skilled in the art, without departing from the spirit of my invention.

What I claim is—

1. In combination with an electric apparatus, a liquid conductor placed in an evacuated space, means for setting the said liquid conductor in rotation so as to cause a deformation of the said liquid conductor by action of centrifugal force, and an electric circuit being arranged so as to be interrupted in the said evacuated space by the said deformation and so as to start thereby an electric arc at the point of interruption.

2. In combination with an electric apparatus, a liquid conductor placed in an evacuated space, means for producing a rotating magnetic field around the said liquid conductor, so as to cause a rotation and therewith a deformation of the said liquid conductor by action of centrifugal force, and an electric circuit being arranged so as to be interrupted in the said evacuated space by the said deformation and so as to start thereby an electric arc at or near the point of interruption.

3. In combination with an electric mercury vapor apparatus, containing liquid mercury in an evacuated space, means for producing a rotating magnetic field around the said liquid mercury or a part thereof, so as to cause a rotation and therewith a deformation of the said liquid mercury by centrifugal force, and an electric circuit being arranged so as to be interrupted in the said evacuated space by the said deformation and so as to produce an electric arc thereby, substantially as and for the purposes set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CARL A. LOHR.

Witnesses:

H. B. SHAFER,  
W. P. COGHILAN.

It is hereby certified that in Letters Patent No. 983,245, granted January 31, 1911, upon the application of Carl A. Lohr, of Chicago, Illinois, for an improvement in "Electric Apparatus," errors appear in the printed specification requiring correction as follows: Page 1, line 59, the word "effecting" should read *affecting*; same page, line 62, the word "effected" should read *affected*; lines 80 and 95, the word "effect" should read *affect*; page 2, line 54, the word "effecting" should read *affecting*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of February, A. D., 1911.

[SEAL.]

C. C. BILLINGS,  
*Acting Commissioner of Patents.*