No. 745,367. PATENTED DEC. 1, 1903.

D. McF. MOORE.

ELECTRODE FOR ELECTRIC TUBE LAMPS.

APPLICATION FILED FEB. 26, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 1.

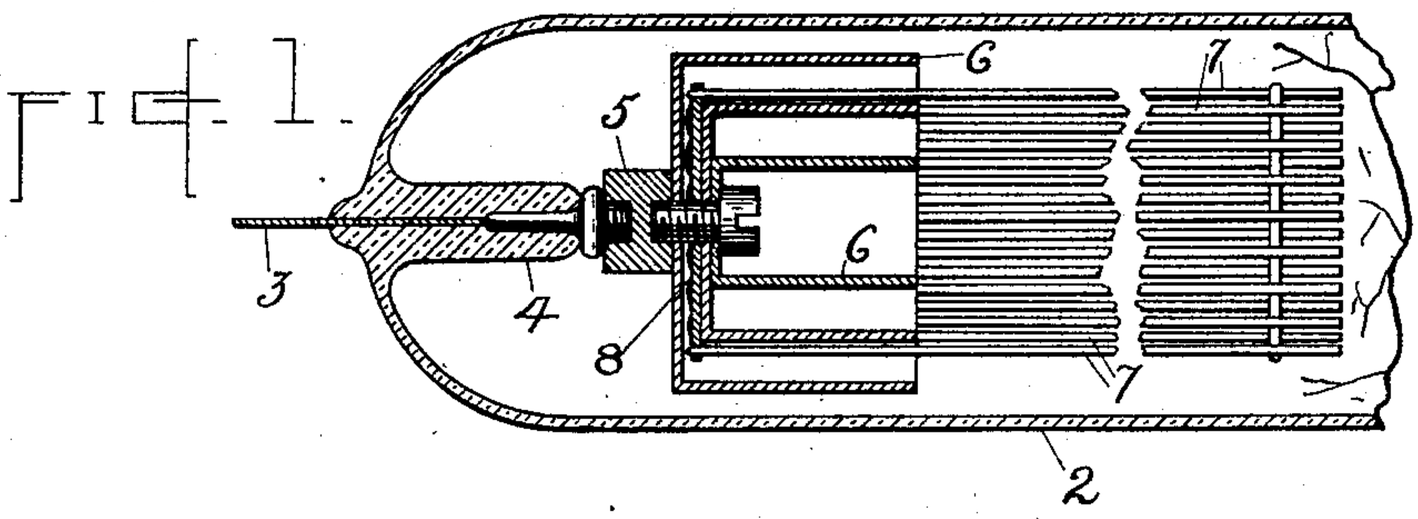


FIG. 2.

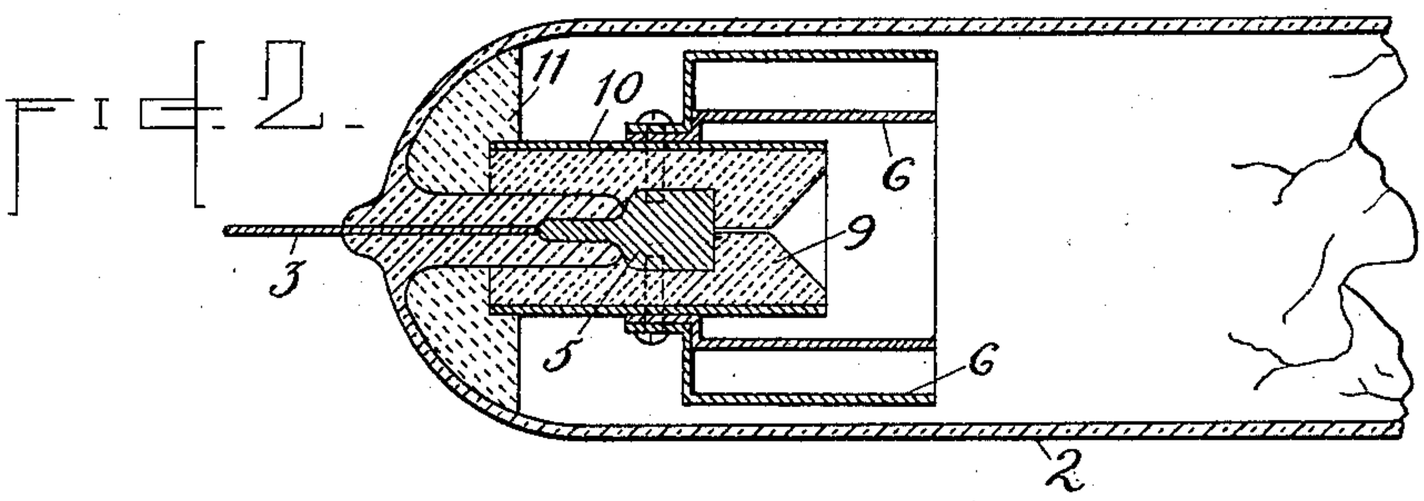
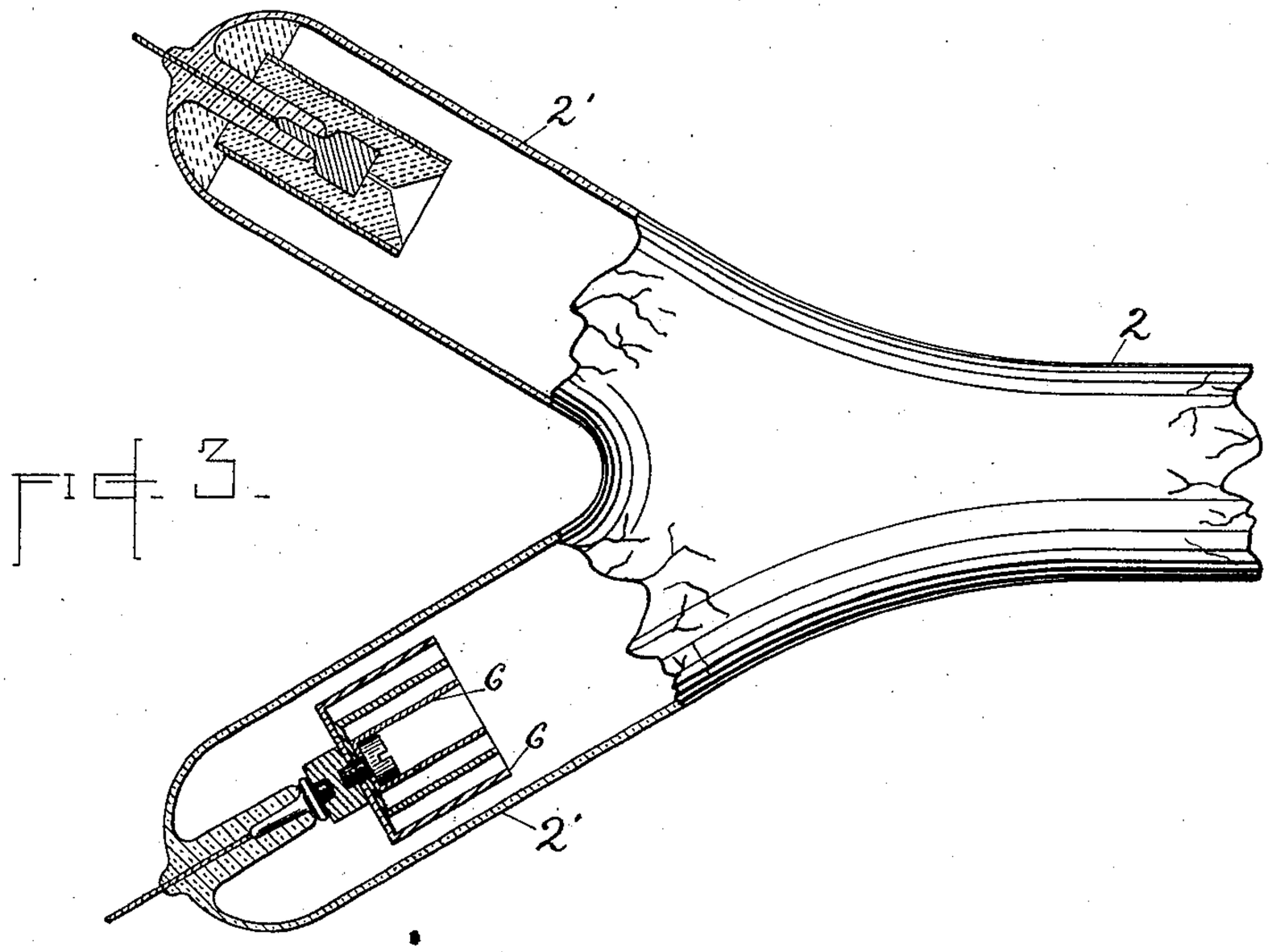


FIG. 3.



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NO MODEL. 2 SHEETS—SHEET 2.

FIG. 4.

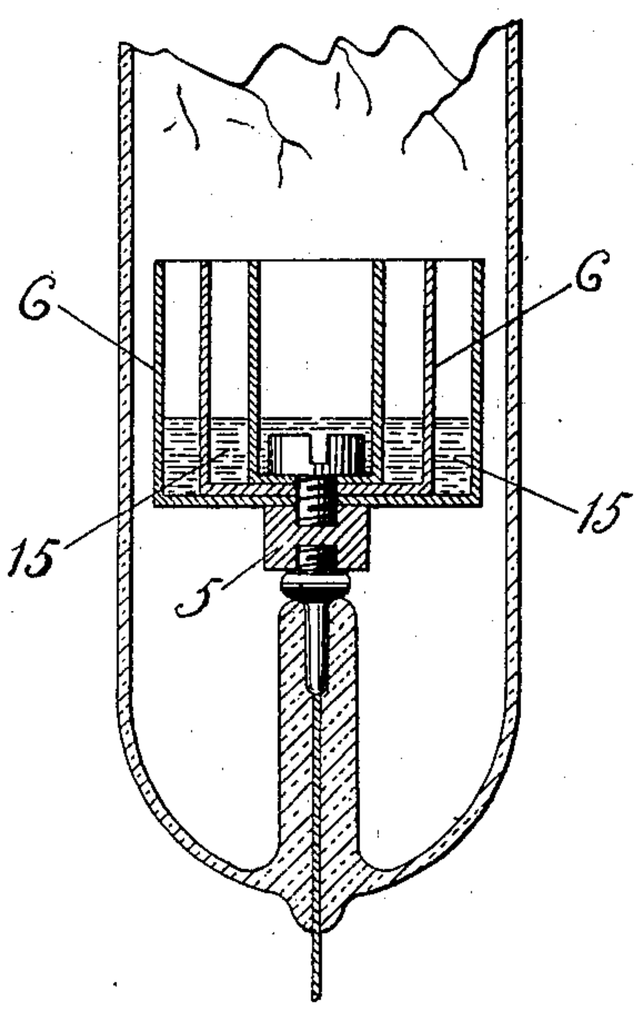
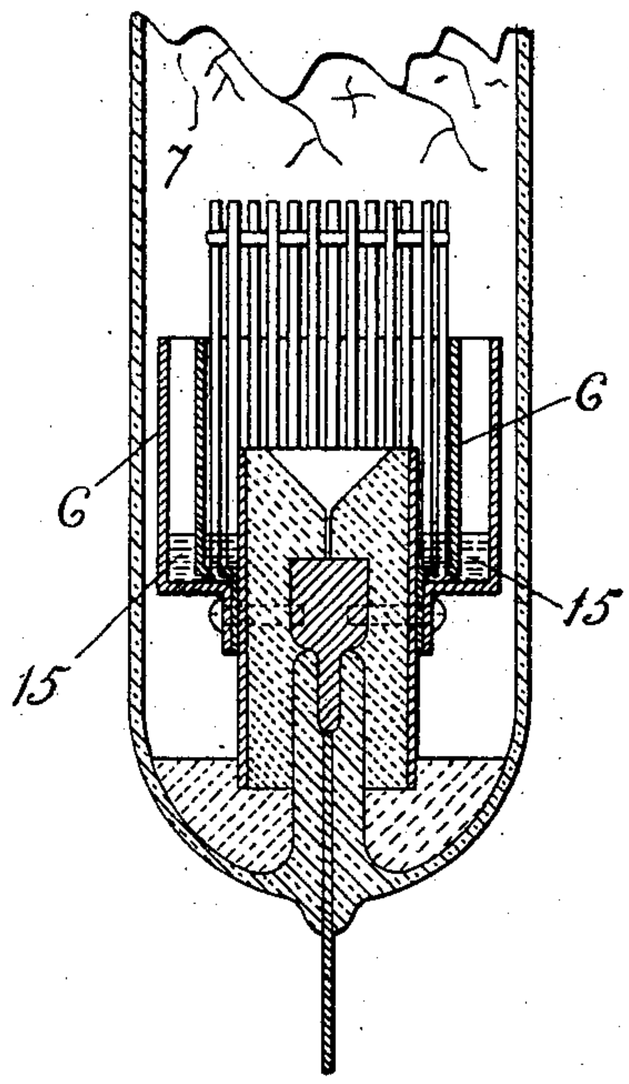


FIG. 5.



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UNITED STATES PATENT OFFICE.

DANIEL McFARLAN MOORE, OF NEWARK, NEW JERSEY.

ELECTRODE FOR ELECTRIC-TUBE LAMPS.

SPECIFICATION forming part of Letters Patent No. 745,367, dated December 1, 1903.

Application filed February 26, 1903. Serial No. 145,184. (No model.)

To all whom it may concern:

Be it known that I, DANIEL MCFARLAN MOORE, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Electrodes for Electric-Tube Lamps, of which the following is a specification.

My invention relates to that class of devices in which an electric current or discharge is caused to pass through a space containing air or other gas or vapor rarefied to any desired extent by means of electrodes sealed within the gas-containing receptacle or holder and to which electrodes energy from any desired exterior source and of any desired potential is supplied.

My invention relates more particularly to apparatus wherein the gas or its degree of tenuity and the energy applied are of such character as to render the gas or vapor luminous, and thus permit the apparatus to be employed as a source of light.

The special object of my invention is to permit apparatus of the kind described to be more readily operated by alternating currents.

In the construction of apparatus of this kind it has heretofore been proposed by me to employ electrodes of different kinds at the terminals of the gas column or body of gas or vapor through which the electric discharge takes place, one of said electrodes being made with special reference to the fact that when the device is on a continuous-current circuit said electrode, if it be the positive electrode, should be especially constructed or organized with reference to that fact, while the other should be especially constructed or be of special character to best adapt it to use as the negative electrode or cathode of the apparatus. Such a device is not adapted for use on alternating-current circuits, because the cathode must at times be an anode, and at such instants of time there will be by reason of the character of such electrode a great opposition to the flow of current, so that practically one-half of the semicycles of alternating current will be stopped off. In a similar manner the anode when best adapted for operation as an anode with a continuous current is not well adapted for use as a cathode, and hence is unsuitable for performing its function at every reversal of the alternating current.

My present invention consists, substantially, in providing at either or both ends of the gas column or body through which the electric discharge takes place two electrodes, one adapted to operate as an anode and the other adapted to operate as a cathode. In carrying out my invention I may mount said electrodes independently of one another, or the two may be combined in what I term a "composite" electrode. When this device is employed for a lamp of the kind in which a rarefied gas or vapor rendered luminous by an electric discharge is employed as the light-giving source, said lamp becomes especially well adapted for operation by alternating current.

In the accompanying drawings, Figure 1 is a longitudinal section through one end of the tube or receptacle and one form of composite electrode suited for use in carrying out my invention. It will be understood that when the device is employed upon an alternating-current circuit the opposite end of the tube or receptacle would have the same or a similar electrode or a combination of electrodes suitable for the transference of alternating energy to the contents of the tube. Fig. 2 is a similar longitudinal section through another form of composite electrode suited to the purposes of my invention. Fig. 3 illustrates a modification of my invention wherein the two electrodes at one end of the gaseous column are separately mounted each upon its own leading-in wire or stem. Figs. 4 and 5 illustrate other modifications.

Referring to Fig. 1, 2 is the wall of a tube or receptacle preferably of glass and also preferably translucent to permit the glowing gaseous contents of the tube to be employed as a source of illumination, as now well understood in the art. 3 is the leading-in wire of the device, suitably sealed in the end of said receptacle and passing inwardly through the usual glass stem 4 and having within the lamp a terminal consisting, if desired, of a block or piece of metal 5, which may be secured to the end of said leading-in wire or conductor in any desired way.

The anode or positive portion of the electrode is suitably secured to the block or piece of metal 5 in any desired manner. The anode or positive portion in this instance is shown as composed of a number of concentric cups or small cylinders of iron or other metal 6, set within one another and fastened at the bottom by a screw or other device to the block 5. Other metal, such as chemically-pure iron, may be used. Aluminium will also serve the purpose. This construction of the anode portion of the device affords large superficial area for the passage of the current from the electrode into the gas and is further adapted to maintain itself at a comparatively low temperature, so that the apparatus may be operated by comparatively heavy currents.

The diameter of the anode portion should be substantially the same as that of the discharge-column and as an anode for a continuous current is adapted to maintain a discharge of greater stability. This form of anode I have described in my prior application for electric-tube lamps filed May 6, 1902, Serial No. 106,134, and is not therefore herein claimed as an improvement *per se* in anodes.

The other portion of the composite electrode—namely, the cathode portion thereof—is in Fig. 1 shown as consisting of a structure adapted to provide a large number of points for the reception of the electric discharge. This character of structure may be obtained by employing a number of wires 7 projecting with their points into the gas-space and suitably fastened to the block 5 or to the anode portion of the structure.

In the present instance the cathode portion is made up of a number of wires looped through holes in a disk 8, which is inserted into the bottom of the outer cup 6 and is fastened between the same and the next cup of the series by the screw which holds the parts to the block 5. By thus providing large surfaces in combination with a large number of points in the electrode it acquires a composite character which adapts it for use with an alternating current, since it will behave well either as a positive or as a negative electrode. When iron is employed for the parts of the electrode illustrated in Fig. 1, it is preferable to employ pure Norway iron, treated previously to its insertion in the lamp by burning it at a white heat in a Bunsen flame, then boiling it for several hours in hot water, previously to which it is scoured with a suitable alkali to clear it of oil, then baking in an asbestos oven to dry it, and finally dipping in alcohol and firing in a flame to burn off any remaining oil.

In Fig. 2 another form of composite electrode adapted to perform the dual function of anode and cathode is shown. The cathode portion is constructed in this instance substantially on the principle of the cathode described in my prior application, Serial No. 106,134, filed May 6, 1902. In this instance the cathode portion consists of a mass 9 of lime or other oxid, such as oxid of magnesium or a mixture of any such oxids in intimate union with the conducting block or piece of metal 5 in which the leading-in wire 3 terminates. The piece of lime is preferably provided with one or more narrow or constricted passages leading from the forward end or portion toward the middle block and which opening receives the electric discharge that causes the walls or portions of the block of lime immediately around said passage or opening to become highly heated. These parts being maintained at a high degree of temperature are especially adapted to operate as a cathode to receive the electric discharge. The mass of lime may be made by compressing the powdered oxid into form and then boring it out, so that it may fit closely upon the metal block 5, or it may be formed by compressing it upon said electrode in the process of forming up the plastic mass of powdered oxid and some suitable softening liquid. In place of the material specified oxids of any of the rare earths, such as oxid of thorium or serium, may be used in place of the lime. Surrounding the block of lime there may be a metal casing 10 to reinforce the same and to serve also as a part of or for the attachment of the parts which constitute the cathode portion of the electrode.

Around the base of the parts described may be applied a mass 11 of soft lime, which protects the stem and leading-in wire from the electric discharge that is liable to seek the leading-in wire at or near its point of entrance and may without such protection disintegrate and melt down the seal, so as to destroy the seal of the lamp.

The anode portion of the composite electrode shown in Fig. 2 may consist of the same form of metal body employed in the composite electrodes shown in Fig. 1 for the anode portion of the lamp. The metal tubes constituting the anode portion of the device shown in Fig. 2 may be suitably secured to the metal jacket 10, and being thereby in electrical union with the part which operates as the cathode will afford a proper medium for the passage of currents from the leading-in wire to the gas or vapor within the receptacle. If desired, the screws or devices which fasten these tubes to the jacket 10 may pass through the lime and into union with the block 5.

In the modification of my invention shown in Fig. 3 the anode and cathode portions of the apparatus at one end of the gaseous column or body are separately mounted and supported. This may be accomplished by branching the tube 2 into the branches 2′, the end of each of which is provided with a suitable leading-in wire terminating in the case of the anode in parts 6, substantially the same as those already described, or in any other form or construction that may be chosen as best suited for use as an anode, while the other leading-in wire terminates in a cathode of the

form illustrated in Fig. 2 or in any other desired form or construction found best suited for use as a cathode under the particular conditions of use of the apparatus.

Fig. 4 illustrates a further modification of my invention. In this instance the electrode which constitutes the cathode portion of the compound electrode or pair of electrodes consists of a body 15 of vaporizable liquid, such as mercury, which is contained in a suitable holder or receptacle, here shown as consisting of the cup-shaped metallic body or bodies 6, which form the anode portion of the pair of electrodes. The liquid 15, which is the cathode, is in electrical connection with the leading-in wire through contact with the anode portion. In the further modification shown in Fig. 5 the portion of the pair of electrodes which constitutes the cathode portion of said path consists of three elements, all of character such that they will conspire in giving to the parts the character of a cathode. The central portion or element of said cathode portion is substantially the same as in Fig. 2; but combined therewith are the projecting wires 7, already described, which wires may be secured, as shown, to the metallic part 6, constituting in this instance the anode, or may be otherwise fastened or mounted in suitable relation, as shown, to the central portion. In addition a body of mercury or other suitable liquid 15 may be employed as a part of the cathode portion of the pair of electrodes constituting, respectively, the anode and cathode at one end of the gas column. The body of mercury 15 may be held in the anode part, as shown, or be otherwise contained, as will be obvious to those skilled in the art. Similarly, as will be apparent, the anode part might be itself compound or composite in character.

It should be understood that I do not limit myself to the particular forms or kinds of anodes and cathodes described and shown, since the form or character of the anode part is limited solely by the consideration of the function which it is called upon to fulfil in the combination and similarly as to the cathode or elements forming such cathode.

What I claim as my invention is—

1. The combination with a sealed holder or receptacle containing a rarefied gas or vapor through which electric energy is passed, of two pairs of electrodes contained within said receptacle one pair at each terminal of the space through which the electric discharge takes place and each said pair comprising an anode and a cathode.

2. The combination with a sealed holder or receptacle containing a rarefied gas or vapor, of two electrodes at one terminal of the space through which the electric discharge takes place one of said electrodes operating as an anode and the other as a cathode.

3. An electric lamp comprising a translucent tube or receptacle containing a rarefied gas or vapor, and provided at each end with an anode and a cathode.

4. In an apparatus comprising a sealed receptacle containing a rarefied gas or vapor and internal electrodes for the application of electric energy to the gas or vapor, a composite electrode one portion of which is an anode and the other a cathode.

5. In an electric lamp comprising a receptacle containing a rarefied gas or vapor adapted to be rendered luminous by an electric discharge, an internal composite electrode one element or portion of which is an anode and the other a cathode.

6. The combination with a sealed holder or receptacle containing a rarefied gas or vapor, of a compound electrode one part of which is an anode while the other part consists of a body of vaporizable liquid held in said anode.

7. The combination with a sealed holder or receptacle containing a rarefied gas or vapor, of a composite electrode consisting of a cup-shaped piece or pieces of metal containing a vaporizable liquid.

Signed at New York city, in the county of New York and State of New York, this 20th day of February, A. D. 1903.

DANIEL McFARLAN MOORE.

Witnesses:

J. GALLWITZ,

E. L. LAWLER.