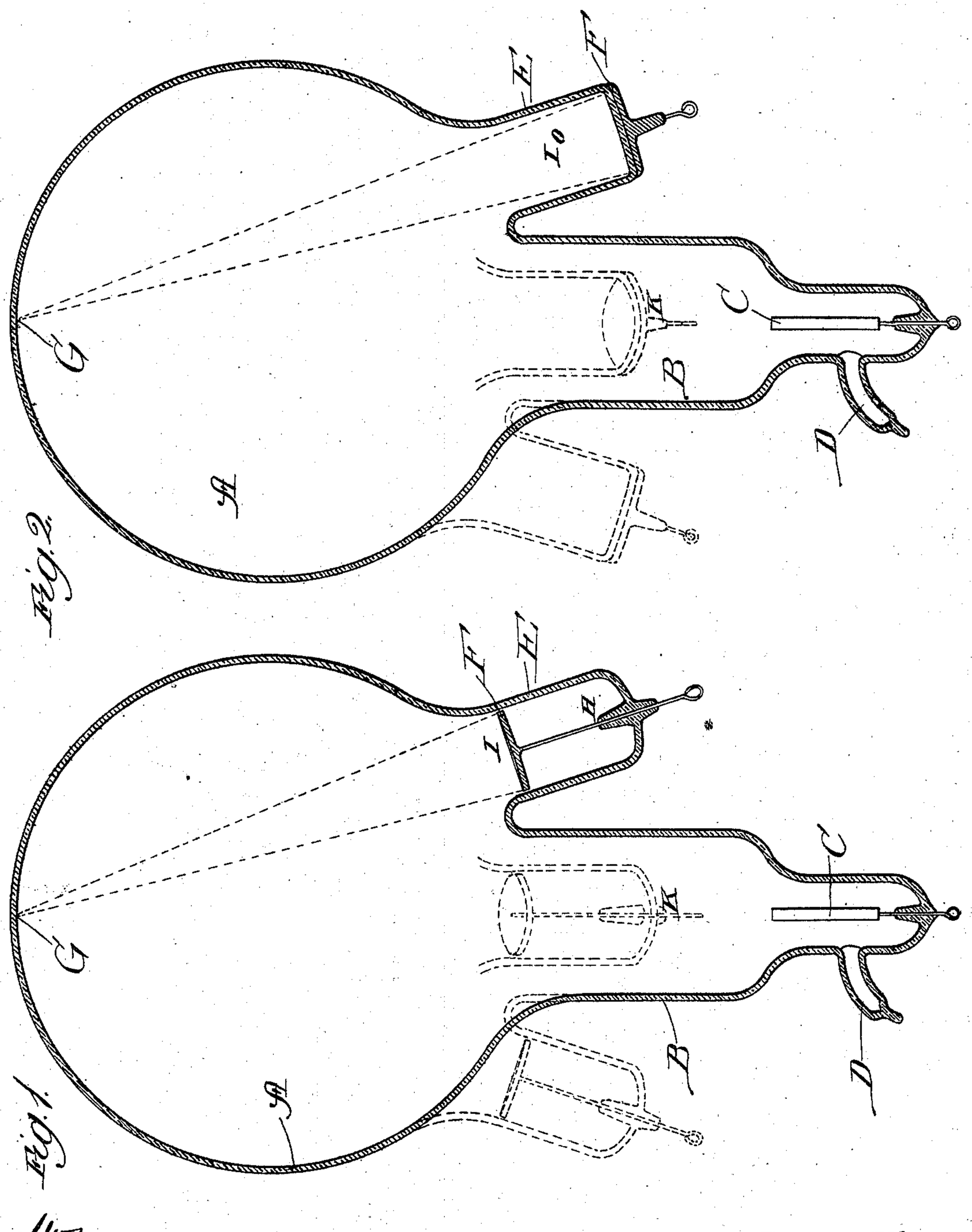
(No Model.)

# J. VON DER KAMMER.

## BULB FOR X-RAYS.

No. 574,065. Patented Dec. 29, 1896.

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# UNITED STATES PATENT OFFICE.

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## BULB FOR X-RAYS.

SPECIFICATION forming part of Letters Patent No. 574,065, dated December 29, 1896.

Application filed March 17, 1896. Serial No. 583,523. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN VON DER KAMMER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Bulbs for X-Rays, of which the following is a specification.

The object of my invention is to produce an improved means for the production of so-called "X-rays," and incidentally to provide a construction of bulb or so-called "X-ray tube" by which flint-glass may be employed in its construction.

To this end my invention consists in an X-ray bulb or tube in which the anode-electrode is farther removed from the point of fluorescence than the cathode.

It consists, further, in a bulb in which the anode and cathode electrodes are presented in the same general direction, but in such manner that the focal point of each will be the same point in the glass wall of the bulb as the focal point of the other.

It consists, further, in a bulb provided with tubular projecting chambers or pockets in which are located, respectively, the anode and cathode electrodes, whereby the forward face of the electrode, particularly the cathode, is exposed to the action which takes place.

My invention consists, further, in the preferred general and specific details of construction, all as hereinafter set forth.

In the drawings, Figure 1 is a view of a bulb embodying my preferred construction, and Fig. 2 a view showing a modification.

A represents the bulb proper, which I prefer to make spherical, as shown, although I do not in any sense limit myself to this shape.

B is a tubular extension to the bulb, in which is located, by preference, the anode-electrode C. A branch D in the tube B shows a means through which exhaustion of the contained air is effected. A tubular extension or cavity E is provided in the bulb adjacent to the anode-cavity B, and in this cavity E is located the cathode-electrode F. As indicated in dotted lines, several cathode-cavities E may be supplied, so that several cathode-electrodes may be employed, it having been demonstrated that an increase in the number of cathodes producing an action at a common point in the bulb materially increases the effectiveness of the device.

The electrodes F are so arranged that the rays therefrom will be directed to a point G at the farther extremity of the bulb, which is also the focal point of the anode-rays. Whether a single cathode-electrode F be employed or several be employed, it is an important part of my invention that they shall be so disposed that the rays therefrom will be projected against a point in the bulb which is also the focal point of the anode, and while I prefer that this point shall be immediately upon the surface of the glass opposite to the anode it is entirely within my invention to have the point nearer. It is believed that the greatest effectiveness is obtained where a point of limited area on the surface of the glass affords a focal point for all the electrodes. It has been demonstrated that the cathode-rays may be deflected, as by the employment of a magnet, and it is entirely within my invention, therefore, so to arrange the electrodes that the rays therefrom shall be deflected, as by a magnet or otherwise, so as to be directed to the focal point G instead of arranging the electrodes themselves so that the focal point shall be directly in line therewith.

In the modification illustrated in Fig. 2 the parts are the same as in Fig. 1, but the cathode-electrodes in this case are in the form of a tin-foil or other layer at the outside of the cavity E. It is found that for many purposes such a cathode-terminal is entirely satisfactory.

It will be observed that the cathode-electrodes are much nearer the focal point which becomes the point of fluorescence than the anode-electrodes, and superior results are obtained thereby.

By having the cathode-electrode F set within the cavity E there is produced in this cavity two chambers H I, the chamber I, or that which is open to the bulb, being what I prefer to term the "discharge-chamber," as it is a chamber receiving repulsed molecules from the focal face of the cathode and directing them, because of the confinement of its walls, to a given point in the bulb proper, which bulb proper may be termed the "action-chamber." The rear chamber H serves as a space to allow the radiation of matter from the back of the cathode F and the leading-in wire, the limited space between the edge of the cathode and the wall of the tube serving to pre-

vent the entrance of these molecules into the action-chamber A. By entirely withdrawing the electrodes from the bulb proper, that is, from the action-chamber in which the electrical action on the residual matter takes place and in which the focal point of the electrodes lies and from which the X-rays proceed, a construction is produced by which marked improvement is obtained. I have found that when the electrodes are located within the action-chamber and the residual matter is therefore allowed to radiate from both surfaces of the electrodes within this chamber the free path of the molecules in motion, which are expelled from the face-focal surface of the cathode, is obstructed by the molecules in motion expelled from the other surface parts of the cathode, with the result that the former molecules lose their velocity and the production of weak and disappearing X-rays is the effect. By withdrawing the cathode and anode electrode entirely from the chamber in which the action takes place this obstruction of the molecules is prevented, and to this I ascribe largely the superior intensity and force of the action which is effected by my construction.

The tube B, leading into the action-chamber A, has a further function, not heretofore referred to, which leads me to term the chamber therein (lettered K) the "reception-chamber." I have found that whenever too much residual matter prevails in the tube it is indicated by a cloudy luminosity which assembles on the anode but not on the cathode. By the construction which I have described, employing the reception-chamber K, this cloudy luminosity is entirely collected into a branch leading out of the action-chamber, so that the action-chamber itself is entirely clear and interference with the free path of the molecules from the face-focal surface of the cathode and with their velocity is prevented. This is believed to be a new departure in the construction of X-ray bulbs.

It will be understood that the drawings illustrate the preferred construction, and among other features the location of the anode at a point farther distant from the focal point than the cathode is important. The electrical action which takes place in a bulb of this character is of an oscillating nature with a preference toward the cathode. To increase this preference, I increase the distance between the anode and focal point.

It has generally been believed that flint-glass cannot be successfully employed in the production of bulbs for X-rays; but I have found that with the construction here shown a perfect result is obtained with a bulb made of flint-glass. It is of course to be understood that in the case of this bulb, as in all bulbs of the same nature, the air is to be extracted until nearly a perfect vacuum is obtained.

I do not undertake to theorize upon this invention, nor do I limit myself in any sense to any theory as to the cause or the action of the so-called "X-rays."

What I claim as new, and desire to secure by Letters Patent, is—

1. A bulb for the production of so-called "X-rays," provided with cavities containing respectively the anode and cathode electrodes, the electrodes in said cavities being so arranged that they are presented in substantially the same direction, substantially as described.

2. A bulb for the production of so-called "X-rays" provided with a cavity E, and a cathode-electrode located at said cavity and substantially filling the same laterally and presenting one face only to the action within the bulb, substantially as described.

3. A bulb for the production of so-called "X-rays" comprising a spherical body having on one side cavities for the electrodes, and electrodes in said cavities for the anode and cathode respectively, said electrodes being so disposed that their rays shall have a common focal point, substantially as described.

4. An X-ray bulb, comprising an action-chamber A, a receiving-chamber K leading into the action-chamber, and a discharge-chamber I leading into the action-chamber, an anode-electrode in the receiving-chamber, and a cathode-electrode in the discharge-chamber, substantially as described.

5. An X-ray bulb, comprising an action-chamber A, a receiving-chamber K leading out of the action-chamber, a discharge-chamber I leading out of the action-chamber, an anode-electrode in the receiving-chamber, and a cathode-electrode in the discharge-chamber, said electrodes being presented to have a common focal point in the opposite wall of the action-chamber, substantially as described.

6. An X-ray bulb comprising an action-chamber, a receiving-chamber in the form of a cavity, open to the action-chamber, and a discharge-chamber in the form of a cavity, open to the action-chamber, in combination with a cathode-electrode located within and substantially filling the discharge-chamber diametrically and arranged to present its face at right angles to the side walls of the discharge chamber or cavity, substantially as described.

7. A bulb for the production of so-called "X-rays," comprising an action-chamber and cavities opening into said action-chamber, said cavities containing respectively the anode and cathode terminals, the anode-cavity being deeper than the cathode-cavity, as set forth.

JOHN VON DER KAMMER.

In presence of—
J. H. LEE,
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