B. E. BAKER.

VACUUM REGULATOR FOR X-RAY TUBES.

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1,027,795.

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FIG. 1.

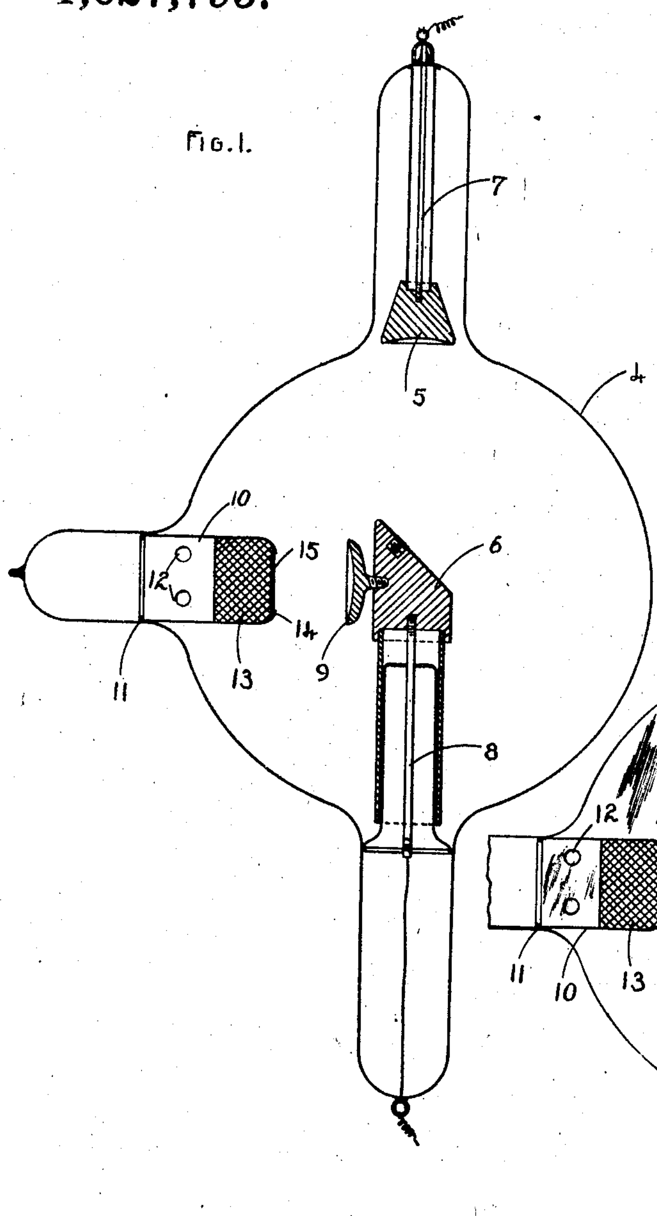
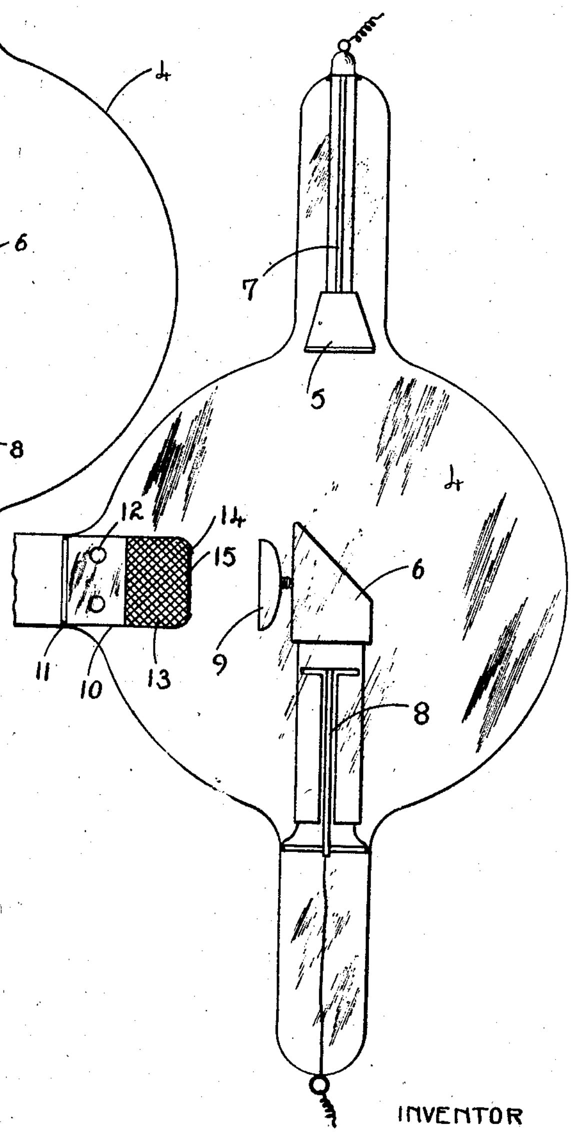


FIG. 2.



WITNESSES

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VACUUM-REGULATOR FOR X-RAY TUBES.

1,027,795. Specification of Letters Patent. Patented May 28, 1912.

Application filed June 9, 1911. Serial No. 632,283.

To all whom it may concern:

Be it known that I, BURTON E. BAKER, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented a new and useful Vacuum-Regulator for X-Ray Tubes, of which the following is a specification.

My invention relates to an improved regulator for Roentgen or X-ray tubes.

The objects of my invention are, first, to provide a regulator which will operate only when the user of the tube desires to change the intensity of the vacuum therein; second, to allow the user to control readily the extent of regulation as he may desire; third, to provide a regulator which is simple in operation and which will last.

Further objects and advantages of my invention will be set forth in the detailed description below.

It is well known that the rarity of the vacuum in an X-ray tube varies from time to time as the tube is used and that the tendency of the vacuum under use is to become more and more rarefied so that it becomes difficult for the electric current to pass through the tube which thus becomes unsteady and will not produce uniform results. Frequently the vacuum becomes so rarefied that it is impossible to pass current through the tube at all. At an early stage in the development of the art it was found that this trouble might be remedied by introducing gas into the tube when the vacuum became too rarefied to permit normal operation. For that purpose a small glass cell was sealed into the tube proper and into this cell was packed asbestos fiber saturated with potassium hydrate, sodium formate, or other suitable material which would throw off gas when heated. To reduce the vacuum, the operator applied heat to this glass cell and its contents by means of a flame. This method is objectionable because it is dirty and awkward to apply, because it sometimes cracks the glass, and because it is difficult to measure the amount of regulation obtained. At a later period in the history of the art, regulation was effected by running a wire through this glass cell and its inclosed gas producing mixture. The latter is heated by passing an electric current through this wire. Some tube makers have attempted automatic regulation by connecting this wire to the main electric circuit by a shunt circuit with a spark gap of such resistance that the current will pass across it and heat the regulating mixture when the resistance of the vacuum in the tube becomes greater than the resistance of the spark gap. A serious objection to this mode of regulation is that when the current has once started through the shunt circuit it tends to persist and thereby causes over-regulation. And it is difficult for the operator, usually a physician comparatively inexpert in electrical matters, to properly adjust his spark gap. Any regulator which employs a wire through the regulating mixture is necessarily short lived because the heat is unevenly distributed. The heat close to the wire is very intense and carbonizes the asbestos, forming a path which the current follows, soiling the tube by throwing carbonized particles into it, and not readily heating the gas producing mixture. This does not occur with my regulator because less heat is used and the asbestos does not become carbonized.

In the accompanying drawings, Figure 1 is a cross-sectional view of an X-ray tube containing my regulator. Fig. 2 is a perspective view of the same.

Like numerals designate similar parts throughout the several views.

In the accompanying drawings, 4 is a Roentgen or X-ray tube of the usual type. 5 and 6 are the main discharge terminals of said tube, 5 being the cathode and 6 the anode in the usual operation of the tube.

7 is a wire sealed into the tube, electrically connected with the cathode 5, and extending outside the tube to be connected with the source of electric current. 8 is a similar wire connecting the anode 6 with the source of electric current.

9 is a small cathode or metal disk with its surface preferably concaved, attached to the anode 6 at or near the point shown in the drawings by screwing it into the anode or by other suitable means.

10 is a glass cell open at its inner end and sealed into the glass of the tube proper at the point 11. In the cell 10 there are a number of orifices 12 inside the main tube.

13 is a mass of asbestos fiber or other suitable material saturated with a volatile salt

or other chemical which will produce gas when heated. The shoulder 14 prevents the mixture 13 from passing into the main tube.

15 is a small metal disk resting against the shoulder 14.

The operation of my device is as follows: When the tube is used for the production of X-rays in the ordinary way, the wire 7 is connected with the negative pole of the electric coil or other source of current and the wire 8 with the positive pole. As the cathode stream runs only from the negative pole toward the positive, there is no cathode stream from the small cathode 9 and no regulation occurs. When the operator wishes to regulate the tube, he reverses the current, connecting the wire 7 with the positive current and the wire 8 with the negative current. This reversal of the current may be accomplished by manually changing the connections of the wires 7 and 8. Usually, however, the operator uses an electric coil or other device provided with a switch which enables him to run the current in either direction at will. When the current is reversed and the discharge terminal 6 becomes the negative pole of the tube, a cathode stream is discharged from the small cathode 9. As the open end of the cell 10 is placed within the focal field of the cathode 9, this cathode stream impinges upon the disk 15, heating the disk 15 and the gas producing mixture 13 behind it. The gas thus produced passes through the orifices 12 into the tube proper and thus reduces the rarity of the vacuum. It has been found in practice that a momentary reversal of the current will usually effect sufficient regulation.

The disk 15 may be omitted and the cathode stream from the small cathode 9 allowed to strike directly into the gas producing mixture 13. Good practical results may be obtained in this manner. When this is done, the orifices 12 may be omitted if preferred.

While the parts shown and described are well adapted to serve the purposes set forth, it is to be understood that my invention is not limited thereto, for changes may be made in the details of my device without departure therefrom.

Having described my invention, what I claim is:

1. In an X-ray tube, the combination of electric discharge terminals housed therein and operative under normal conditions of current flow as an anode and a cathode respectively, a gas producing medium housed within said tube, and means for concentrating cathode rays on said medium upon the reversal of the direction of said current flow.

2. In an X-ray tube, the combination of electric discharge terminals housed therein and operative under normal conditions of current flow as an anode and a cathode respectively, an auxiliary discharge terminal electrically connected with said terminal normally operative as an anode, a gas producing medium housed within said tube within the focal field of said auxiliary terminal, and means for causing the reversal of the direction of said current flow.

3. In an X-ray tube, the combination of electric discharge terminals housed therein and operative under normal conditions of current flow as an anode and a cathode respectively, an auxiliary discharge terminal electrically connected with said terminal normally operative as an anode, a cell in the focal field of said auxiliary terminal, a gas producing element within said cell, and means for causing the reversal of the direction of said current flow.

4. In an X-ray tube, the combination of a principal cathode and a principal anode, an auxiliary cathode mounted upon said principal anode, a cell in the focal field of said auxiliary cathode, and a gas producing element within said cell.

5. In an X-ray tube, the combination of a principal cathode and a principal anode, an auxiliary cathode mounted upon said principal anode, a cell in the focal field of said auxiliary cathode, a gas producing element within said cell, and means for causing an electric current to flow through said tube in either direction.

6. In an X-ray tube, the combination of a principal cathode and a principal anode, an auxiliary cathode electrically connected with said principal anode, a cell in the focal field of said auxiliary cathode, and a gas producing element within said cell.

7. In an X-ray tube, the combination of a principal cathode and a principal anode, an auxiliary cathode electrically connected with said principal anode, a cell in the focal field of said auxiliary cathode, a gas producing element within said cell, and means for causing an electric current to flow through said tube in either direction.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

BURTON E. BAKER.

Witnesses:

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