

No. 774,118.

PATENTED NOV. 1, 1904.

E. THOMSON.  
ROENTGEN RAY TUBE.  
APPLICATION FILED APR. 26, 1902.

NO MODEL.

Fig. 1.

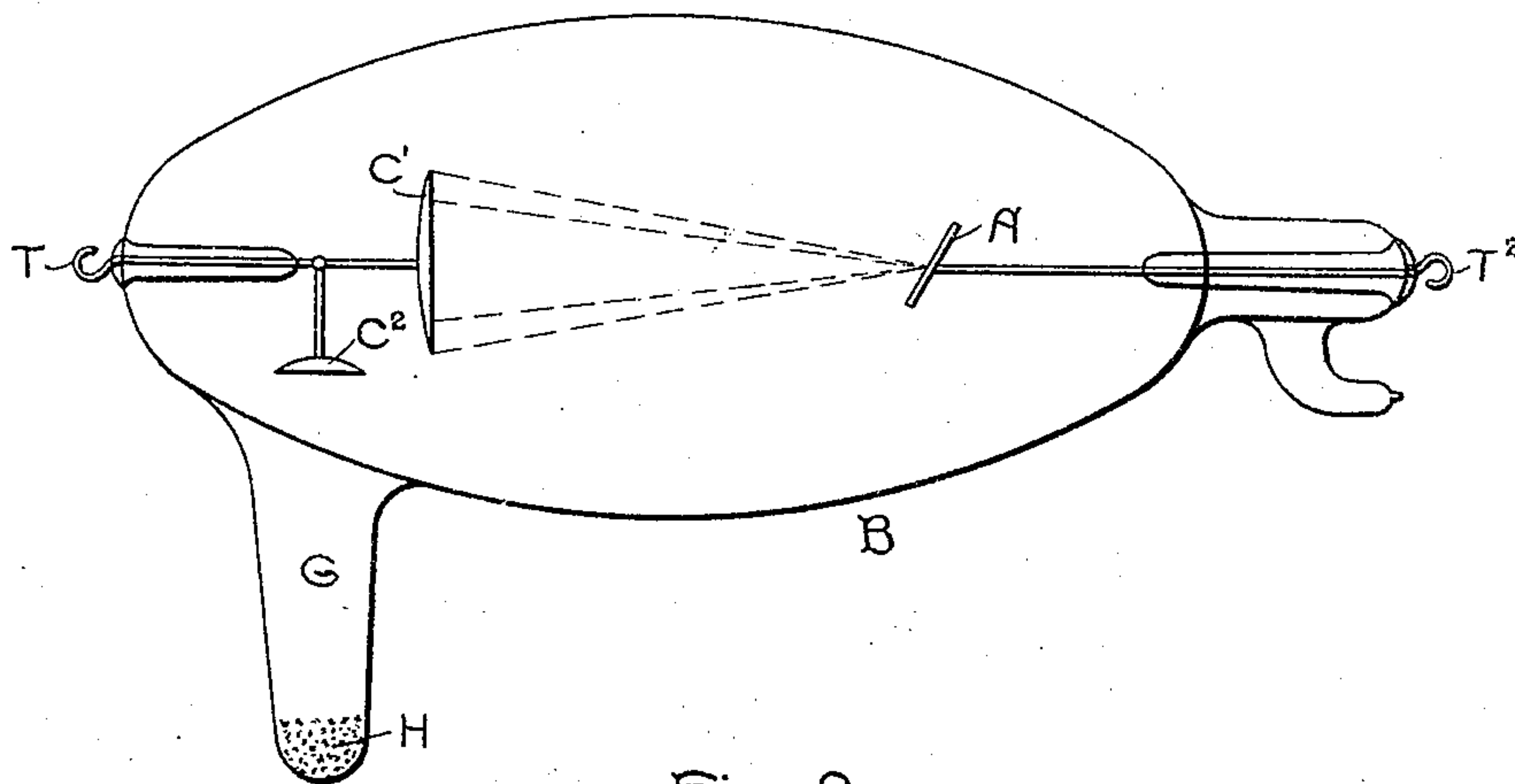


Fig. 2.

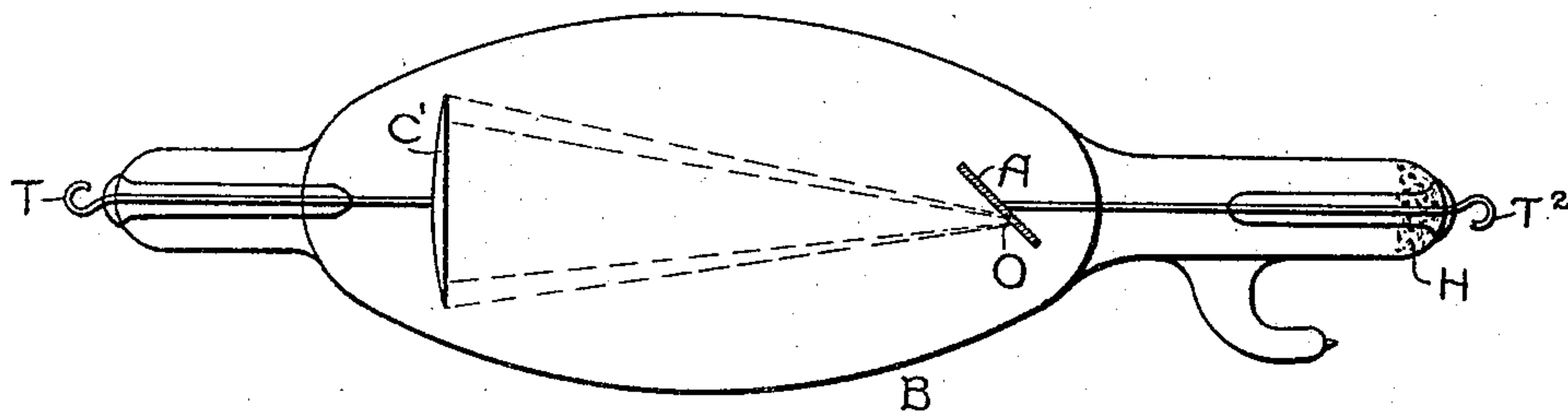
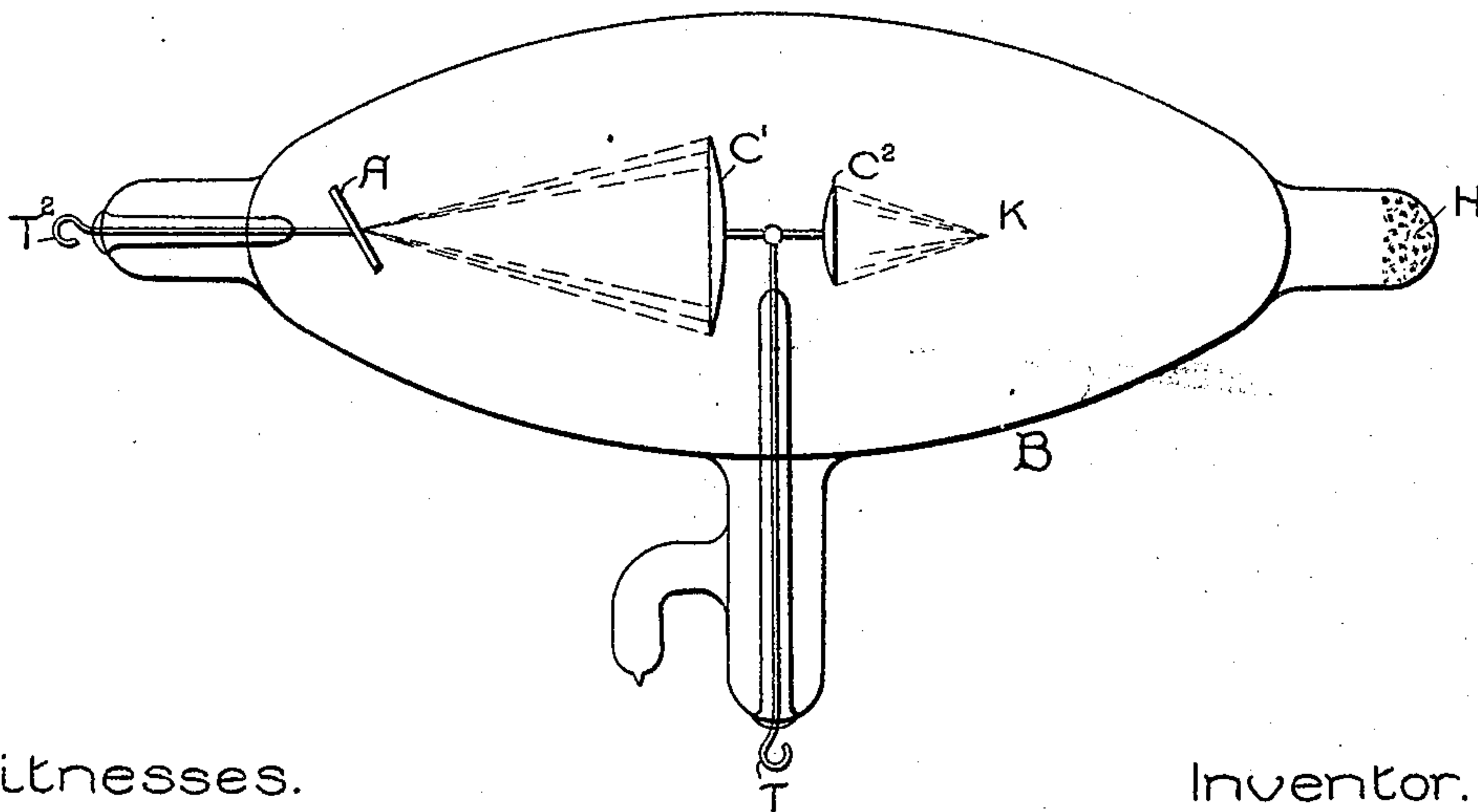


Fig. 3.



Witnesses.

*Ewing R. Sumner.*  
*Helen A. Ford*

Inventor.  
Elihu Thomson.  
by *Albert G. Davis*  
Atty.

# UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## ROENTGEN-RAY TUBE.

**SPECIFICATION** forming part of Letters Patent No. 774,118, dated November 1, 1904.

Original application filed February 14, 1898, Serial No. 670,221. Divided and this application filed April 26, 1902. Serial No. 104,874.  
(No model.)

*To all whom it may concern:*

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Roentgen-Ray Tubes, (division of my prior application, Serial No. 670,221, filed February 14, 1898,) of which the following is a specification.

My invention relates to Roentgen-ray tubes or other tubes in which a high vacuum is to be maintained; and it consists in a certain apparatus designed to automatically maintain the vacuum at any desired point.

It is well known that the constant use of any vacuum-tube tends to gradually raise the vacuum to such point that current cannot readily pass through the tube. It is therefore necessary from time to time to artificially lower the vacuum in order to maintain the tube in operative condition. It has been proposed to attain this object by placing in the tube a chemical or other substance capable of giving off vapor when heated and applying heat to the said chemical when the vacuum is to be lowered. The objection to this is that the regulation is not automatic, and very delicate manipulation is required to preserve the vacuum at the proper point. Various methods of rendering this action automatic have been proposed; but they all involve the use of some extraneous regulating devices.

My invention is based upon the fact, experimentally discovered, that the cathode-rays in a low vacuum reach a focus and are rapidly dissipated on passing such focus, while in a high vacuum they are turned, as it were, into a jet beyond the focus and can pass over considerable distances with but little scattering. I therefore locate some vacuum-regulating device or substance, preferably some vaporizable material, at such a point with relation to a cathode that in a low vacuum—that is to say, a vacuum below that at which the tube is to be maintained—the focalized rays do not affect it to any material degree, but at such a point that when the vacuum rises the jet of rays beyond the focus

will reach the material or regulating device and cause the vacuum to be slightly lowered.

In the drawings attached to this specification, which represent particular embodiments of my invention, Figure 1 is a general view of a Crookes tube arranged in accordance with my invention, while Figures 2 and 3 are modified forms.

Referring more particularly to Fig. 1,  $TT^2$  are the two terminals of the tube sealed into the glass, as usual.  $C'$  is a concave cathode of any suitable material focused on an anode  $A$ .  $C^2$  is an auxiliary cathode, while  $H$  is a chemical, such as hydrate of potassium, which will give off vapor when slightly heated, placed in a recess  $G$ . The cathode  $C^2$  is so adjusted that as long as the vacuum remains at about the desired point the cathode-rays therefrom reach a focus at some point intermediate and do not greatly affect the chemical  $H$ ; but if now the vacuum rises the cathode-rays from  $C^2$  pass in a fine stream or jet to the chemical  $H$  and cause the same to liberate vapor and to reduce the vacuum.

The form shown in Fig. 2 is slightly different, in that no auxiliary cathode is used; but a small opening  $O$  is made in the anode  $A$  at such a point that when the vacuum becomes too high the cathode-rays from the cathode  $C'$  will pass through the opening  $O$  and liberate vapor from the chemical  $H$ .

The tube shown in Fig. 3 is similar to the form shown in Fig. 1, but differs slightly in the relative position of the two cathodes and the chemical  $H$ .

It will be evident that various changes in form and arrangement may be made without departing from the spirit and scope of my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a tube adapted to generate X-rays, of a gas-yielding agent within said tube, and means responsive to the current through the tube for liberating gas therefrom.

2. The combination with a tube adapted to generate X-rays, of a gas-yielding agent with-



in said tube, and means for causing rays generated in the tube to liberate gas therefrom.

3. The combination with a tube adapted to generate X-rays, of a gas-yielding agent within said tube, and means for causing rays generated in the tube to liberate gas therefrom when the vacuum rises beyond a predetermined degree.

4. The combination with a tube adapted to generate X-rays, of a gas-yielding agent within said tube, and means directing toward said agent rays having an effect varying in degree with the degree of density in the tube.

5. The combination with a tube adapted to generate X-rays, of a gas-yielding agent within said tube, and means for projecting rays in a longer path in high than in low vacua upon said agent.

6. The combination with a vacuum-tube, of

a vacuum-regulating means so located with reference to a cathode in said tube that the cathode-rays impinge upon the said means when the vacuum is too high, but impinge thereon to a less degree at lower vacua.

7. The combination with a vacuum-tube having an anode and a cathode, of a recess in said tube containing a gas-yielding substance, and an auxiliary cathode so arranged that the rays therefrom are directed toward the said substance, but reach it only when the vacuum of the tube becomes too high.

In witness whereof I have hereunto set my hand this 23d day of April, 1902.

ELIHU THOMSON.

Witnesses:

DUGALD McK. McKILLOP,  
JOHN A. McMANUS.