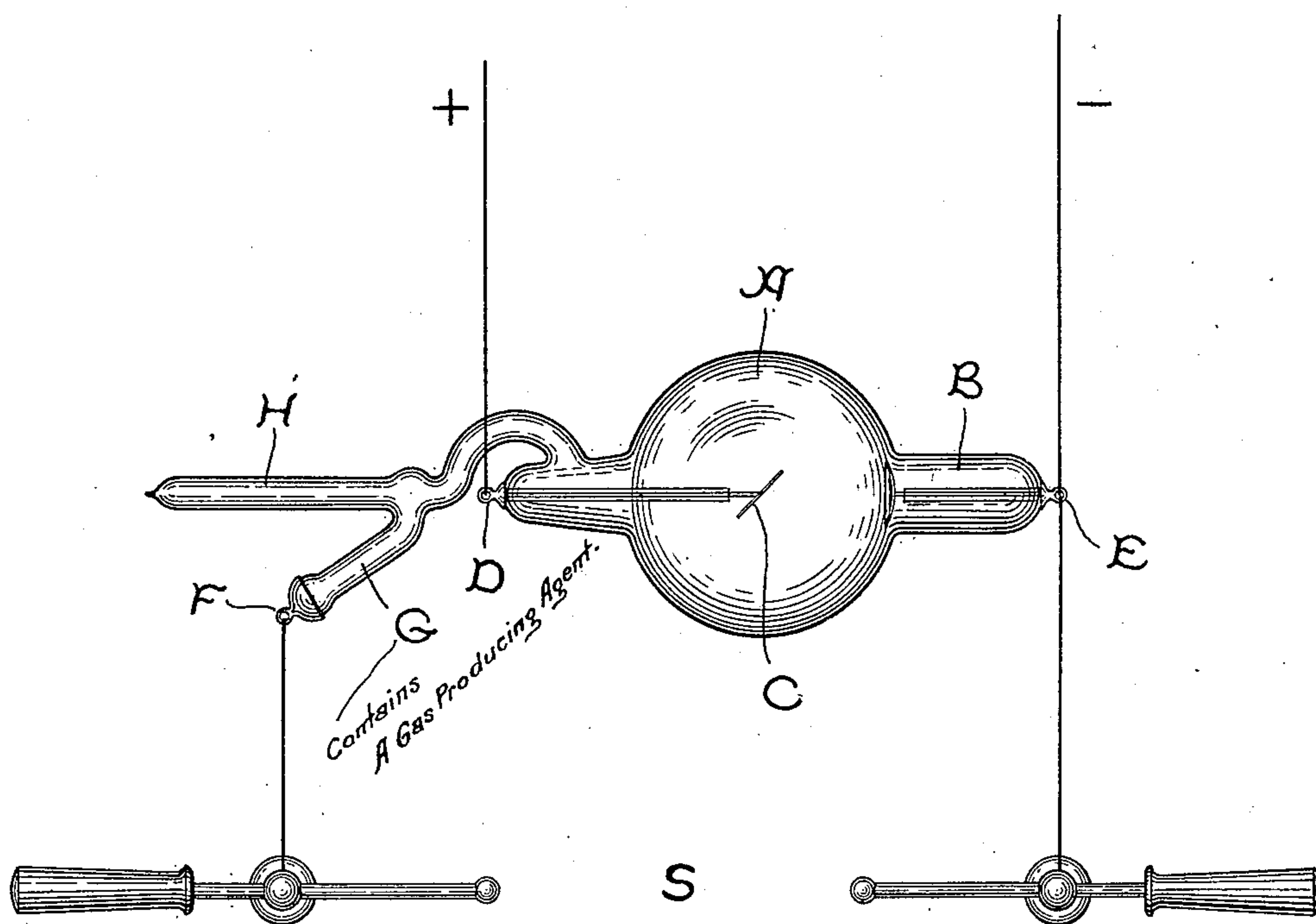


(No Model.)

I. W. HOWELL.
ROENTGEN RAY TUBE.

No. 594,156

Patented Nov. 23, 1897.



WITNESSES.

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Att'y

UNITED STATES PATENT OFFICE.

IRWIN W. HOWELL, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE
GENERAL ELECTRIC COMPANY, OF NEW YORK.

ROENTGEN-RAY TUBE.

SPECIFICATION forming part of Letters Patent No. 594,156, dated November 23, 1897.

Application filed August 26, 1897. Serial No. 649,554. (No model.)

To all whom it may concern:

Be it known that I, IRWIN W. HOWELL, a citizen of the United States, residing at Newark, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Roentgen-Ray Tubes, (Case No. 635,) of which the following is a specification.

My invention relates to vacuum or Crookes tubes, such as are used for the generation of Roentgen rays, and has for its object to provide a tube which will readily adapt itself to the automatic regulation of the vacuum. To that end I apply to any ordinary vacuum-tube a third terminal arranged to afford an auxiliary or regulating discharge-path in shunt to the main discharge-path and in the same vacuous space with it. In practice I provide a small auxiliary tube communicating with the vacuum-bulb proper and therefore having a common vacuous space at or near one end of the bulb. The third terminal passes through this auxiliary tube, and in it is contained a volatile salt, such as hydrate of potash or other suitable gas-producing agent, through which the shunt discharge passes. Adjustable vacuum-tubes of various descriptions are now well known; but so far as I am aware there is novelty in a tube having main and shunt discharge-paths in a common vacuous space as distinguished from main and shunt discharge-paths in separate non-communicating vacuums. There are also, further, more specific features of novelty in the arrangement and construction of the tube, hereinafter particularly described, which I have found give excellent results in practice.

The accompanying drawing shows a tube in which my invention is embodied. In it, A is the main bulb or body of the tube, from which an extension B is blown, containing a concave disk of aluminium, such as is usually employed as a cathode in these devices.

C is the inclined piece of platinum-foil, which is ordinarily employed as an anode, and H is the usual sealing-off tube of greater or less length.

G is a comparatively small auxiliary tube at one end of the main tube, containing a volatile salt, such as hydrate of potash, serving as a source of vapor for lowering the vacu-

um in the tube when necessary, although many other forms suited for the practice of the invention are now well known in the art.

The bulb A and tube G communicate in a common vacuous space and are arranged so that the discharges from C direct to E and from C through the third terminal F take different distinct paths through this space.

The circuits of the apparatus are as illustrated.

D E are respectively the main positive and negative terminals of the tube, communicating with the anode and cathode.

F is the shunt or third terminal, sealed through the glass of the auxiliary tube G. In series in the shunt-circuit is an adjustable air-gap S, by which the resistance of the shunt-path may be determined.

The action of the tube, so far as understood, is as follows: In normal operation so long as the vacuum is maintained at the proper point practically no current passes through the shunt-path. It is well known that in the operation of these tubes the vacuum tends to rise. When this occurs, the resistance to the passage of current through the main discharge-path also rises, and this causes more current to pass through the shunt. This current flows through the potash or other material in the extension G and volatilizes it, liberating a gas or vapor which passes into the main portion of the tube and reduces the vacuum. As soon, however, as the vacuum is sufficiently reduced to permit the passage of current through the tube the current-flow in the shunt is reduced or ceases until upon the rising of the vacuum the current again flows through the salt. This operation is automatically carried out during the life of the tube. At starting, when the tube is cold and the vacuum is high, it is sometimes desirable to approach the terminals of the spark-gap S, so that considerable current flows in the shunt, thus lowering the vacuum in the tube; but as soon as this occurs the gap S is extended, so as to present a higher resistance.

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

1. The art of regulating the vacuum in a Roentgen-ray tube, which consists in passing a current proportioned to the resistance of

the tube through a suitable salt in the vacu-
ous inclosure, and thereby volatilizing the
salt in accordance with the degree of vacuum
desired.

5 2. A vacuum-tube having in shunt to the
main discharge-path, a second discharge-path
through a gas-producing agent in the same
vacuous space with the main discharge-path,
and serving to regulate the vacuum in the
10 main bulb, as set forth.

3. An adjustable vacuum-tube having main
discharge-terminals, a comparatively small
auxiliary tube at or near one end of the main
bulb containing a gas-producing agent, and an
15 auxiliary discharge-terminal in said tube, said
main bulb and auxiliary tube communicat-
ing in a common vacuous space, as set forth.

4. An adjustable vacuum-tube affording
20 main and shunt discharge-paths through dif-
ferent distinct courses in a common vacuous
space, and a gas-producing agent in the shunt

discharge-path which acts to lower the resist-
ance of the main discharge-path upon an in-
crease of current in the shunt.

5. An adjustable vacuum-tube having a 25
main bulb A provided with discharge-termi-
nals C and E, a tube G, communicating with
bulb A, and an auxiliary terminal F, in tube
G, as set forth.

6. A Roentgen-ray tube comprising a main 30
bulb A, provided with a concave disk elec-
trode B, and an inclined piece of foil C to be
bombarded with suitable terminals, and an
extension G for a volatile salt, with a third
terminal F sealed through the glass. 35

In witness whereof I have hereunto set my
hand this 24th day of August, 1897.

IRWIN W. HOWELL.

Witnesses:

WM. H. MEADOWCROFT,
CLARENCE T. VAN DEREN.