R. H. SMALL.

X-RAY TUBE.

APPLICATION FILED DEC. 8, 1917.

1,331,967.

Patented Feb. 24, 1920.

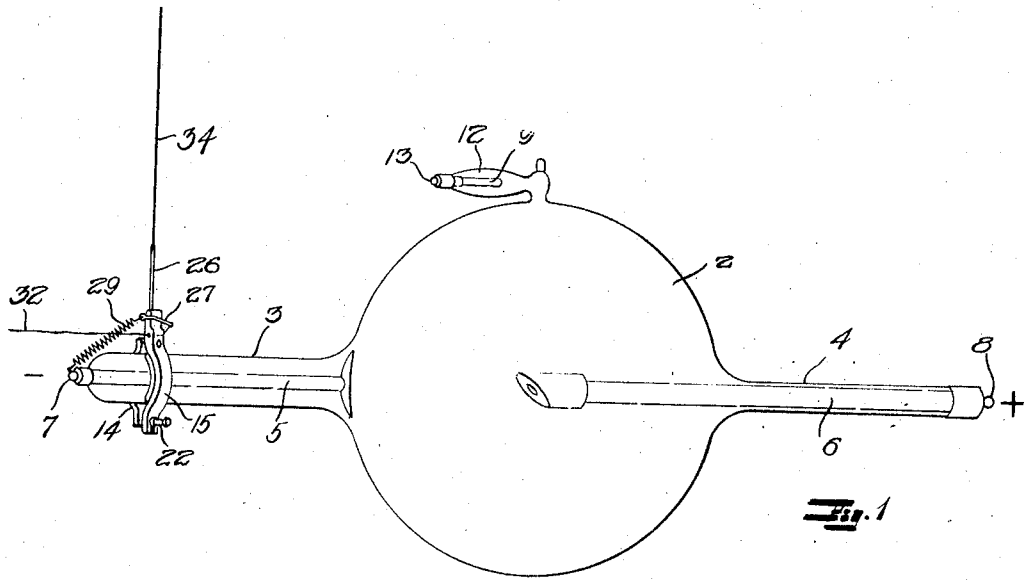

Fig. 1

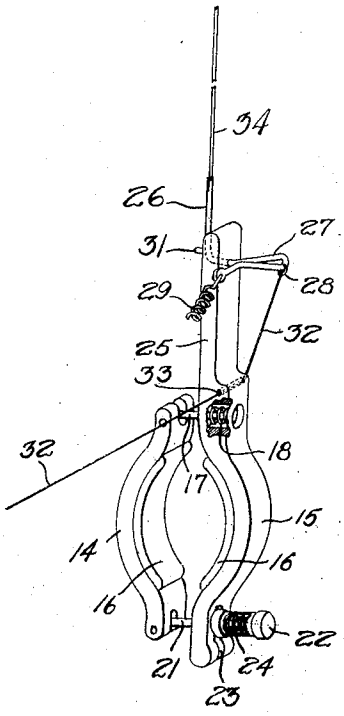

Fig. 2

WITNESS

J. B. Gardner

INVENTOR

R. H. SMALL

By White & Frost

ATTORNEYS

UNITED STATES PATENT OFFICE.

RALPH H. SMALL, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO RIEBER LABORATORIES, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

X-RAY TUBE.

1,331,967. Specification of Letters Patent. Patented Feb. 24, 1920.

Application filed December 8, 1917. Serial No. 206,152.

To all whom it may concern:

Be it known that I, RALPH H. SMALL, a citizen of the United States, and a resident of the city and county of San Francisco and State of California, have invented certain new and useful Improvements in X-Ray Tubes, of which the following is a specification.

The invention relates to X-ray tubes and particularly to means for regulating the vacuum of such tubes.

An object of the invention is to provide a simple and easily operated device, attachable to the tube, for regulating the vacuum within the tube.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description, where I shall outline in full, that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification.

Referring to said drawings:

Figure 1 is a perspective view of an X-ray tube provided with the device of my invention.

Fig. 2 is a perspective view of the device, parts thereof being broken away to disclose the construction.

A common type of X-ray tube comprises a highly evacuated glass vessel 2, having projections or necks 3—4 in which the cathode and anode 5—6 are disposed. A cathode terminal 7 is arranged at the end of the neck 3 and an anode terminal 8 is arranged at the end of neck 4. The tube is also provided with a vacuum regulator electrode 9 which is ordinarily inclosed in a small chamber 12 opening into the tube and a regulator terminal 13 is provided on the end of the chamber 12. The vacuum in the tube is regulated by connecting the regulator terminal 13 with the negative power lead, while said lead is connected to the cathode and while the positive lead is connected to the anode. This connection is of brief duration and serves to reduce the vacuum in or "soften" the tube.

In accordance with my invention, I provide means for readily and simply connecting the negative lead to the regulator terminal for brief periods and such means is constructed so that the connection cannot be accidentally produced or maintained. The device of my invention is mounted directly on the tube, so that it is readily movable with the tube and requires no adjustment prior to its use. Surrounding the neck 3 of the tube is a clamp formed of the two members 14—15, composed of hard-rubber, fiber, or other insulating material, and shaped to conform to the neck of the tube. The clamp members are provided on their inner surfaces with felt strips 16 which not only cushion the grip of the clamp, but also prevent contact of the material of the clamp with the tube. This direct contact has a tendency to produce minute cracks in the glass of the tube when the tube is used, thereby shortening the life of the tube. The clamping member 14 is yieldingly connected at its upper end to the clamping member 15 by the bolt 17 which is pressed by the spring 18 disposed in a seat in the member 15, the member 14 being pivoted to the bolt. Pivoted to the lower end of the clamping member is a bolt 21 having a spring-pressed sleeve 22 arranged thereon. The bolt passes through an open slot 23 in the member 15, so that by sliding the sleeve backward against the pressure of the spring 24, the bolt may be swung out of the slot and the member separated.

The member 15 is provided with an upright projection 25 which serves as a fulcrum for the metallic rod 26, which normally stands upright. Secured to and forming an extension of the rod is a flexible, resilient metallic member or ribbon 34, which is of such length that when the rod is swung the ribbon comes in contact with the regulator terminal 13. By making the member 34 light in weight, it is impossible for it to strike the regulator terminal with a heavy blow, which might damage the tube. The rod passes through the support 25 and its shorter end is bent to form a crank arm 27 to which is attached a ring 28. The end of the rod is then bent back past the pivot and a spring 29 connecting the end with the cathode terminal 7 holds the rod 26 upright against the stop 31. A string or cord 32 attached to the ring 28 and passing through the hole 33 in the member 15 serves to swing the rod to bring the member 34 into contact with the regulator terminal. The rod is electrically connected to the cathode terminal by the spring 29, so that when the rod is swung to

bring the ribbon into contact with the regulator terminal, such terminal is connected to the negative lead and the regulator electrode brought into operation. A pull on the string causes the ribbon to strike against the regulator terminal and when the string is released, the ribbon immediately swings back to its upright position.

I am aware that X-ray tubes have been heretofore constructed with a conductor attached to the regulator terminal which was adapted to be bent by hand into contact with the cathode terminal, but in that construction corona losses occurred at the conductor when the tube was in operation and the conductor was not in contact with the cathode terminal. These corona losses, which are obviated by my construction, caused a gradual softening of the tube which eventually rendered it useless.

I claim:

1. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of means mounted on the tube and connected to the cathode terminal and adapted to be swung to electrically connect said terminals.

2. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of a conductor mounted on the tube and connected to the cathode terminal, and means for swinging the conductor into contact with the regulator terminal.

3. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of a conductor pivotally mounted on said tube and adapted to be swung into contact with the regulator terminal, and a spring connecting said conductor with the cathode terminal.

4. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of a clamp engaging said tube, a conductor pivotally mounted on said clamp, a spring connecting the conductor and the cathode terminal, and means for swinging said conductor into contact with the regulator terminal.

5. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of a clamp engaging said tube, a rod pivoted to said clamp, a spring connecting the rod and the cathode terminal arranged to hold the rod upright, and means for swinging said rod into contact with the regulator terminal.

6. The combination with an X-ray tube having a cathode neck, a cathode terminal at the end of the neck and a regulator terminal, of means clamped on said neck and adapted to electrically connect said terminals.

7. The combination with an X-ray tube having a cathode neck, a cathode terminal at the end of the neck and a regulator terminal, of a clamp engaging said neck, a conductor pivoted to said clamp and adapted to be swung into contact with the regulator terminal, and a spring connecting said conductor and the cathode terminal.

8. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of a flexible resilient conductor connected to the cathode terminal and adapted to be swung into contact with the regulator terminal.

9. The combination with an X-ray tube having a cathode terminal and a regulator terminal, of a conductor pivotally mounted on the tube and connected to the cathode terminal, and a flexible resilient metallic extension on said conductor adapted to be swung into contact with the regulator terminal.

In testimony whereof, I have hereunto set my hand at San Francisco, California, this 19th day of November 1917.

RALPH H. SMALL.

In presence of—

H. G. PROST.