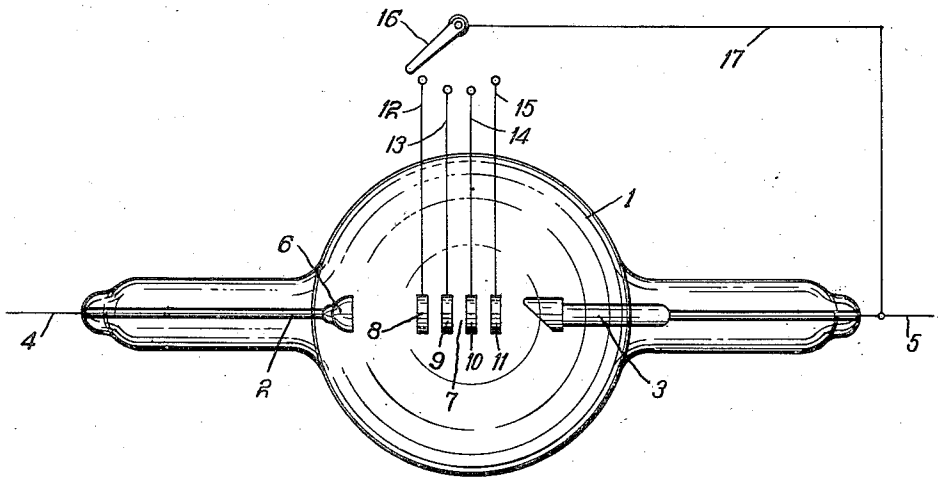
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X-RAY TUBE

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# UNITED STATES PATENT OFFICE.

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## X-RAY TUBE.

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My invention relates to electric-discharge devices and particularly to X-ray tubes.

One object of my invention is to provide a Roentgen tube having means for controlling the penetrating power of the rays produced.

Another object of my invention is to provide electric-field-producing means for disposition around the cathode rays to thereby control the hardness of the tube.

A further object of my invention is to provide a controlling device for X-ray tubes that shall be simple and inexpensive to construct and effective in its operation.

It has been found that an X-ray tube having a conducting ring disposed between the anode and the cathode for varying the area of the focal spot produces a more penetrating ray than a tube not having the ring. In view of this, I propose to use this principle to more effectively control the hardness or penetrating power of an X-ray tube.

In carrying out my invention, I provide preferably a gas-filled tube having a cathode and an anode therein and a plurality of tubular conducting members disposed around the path of the cathode rays between the anode and cathode. These conducting tubes have leading-in conductors, and a switching member is provided, external to the tube, for connecting the same selectively to the anode. With this arrangement, when the conducting tube nearest the cathode is connected to the anode, the tube will produce more penetrating rays than if the second ring is connected to the anode. In other words, the tube is rendered harder. Thus, by selectively connecting the various conducting rings to the anode, the tube may be so controlled as to permit its application to various uses. Although the conducting rings are preferably alternatively connected to the anode, it may be desired, in some instances, to connect them to the cathode, especially when using an X-ray tube of the pure electron discharge or very high vacuum type.

The single figure of the accompanying drawings is a view of an X-ray tube embodying my invention.

A simple means of carrying out my invention is illustrated in the drawing, in which an X-ray tube 1 preferably containing a rare gas, for example helium, has a cathode 2 and an anode 3 which are connected to conductors 4 and 5, respectively, that are adapted to be connected to a source of voltage (not shown). The cathode 2 may be provided with a focusing device 6, if desired, and means 7 is disposed in the tube 1 for controlling both the area of the focal spot and also the penetrating power of the X-rays provided. The means 7 comprise a plurality of tubular rings 8, 9, 10 and 11 that are connected to leading-in conductors 12, 13, 14 and 15 which may, in turn, be connected through an adjustable switch 16 and a conductor 17 to the conductor 5.

With the above arrangement, when the switch 16 is adjusted to such position that one of the rings is electrically connected to the conductor 5, it will set up an electrostatic field surrounding the cathode rays between the cathode and anode. It has been found that such a device increases the convergence of the beam of rays and thereby varies the area of the focal spot. It has also been found that, by the use of such a ring, the penetrating power of the X-rays is changed. Thus, when the conductor 12 is connected to the conductor 5, with a constant gas pressure in the tube 1, the penetrating power of the X-rays produced will be a maximum and, thus, by connecting the switch member 16 to one of the other conductors 13, 14 and 15, the penetrating power of the X-ray tube may be changed to permit it to be used under various conditions. It will be seen that this method of controlling the hardness or penetrating power of the rays is relatively simple in operation and greatly facilitates the operation of a tube under practical conditions.

It will be understood that my invention is not limited to the specific structure illustrated as it may be variously modified without departing from the spirit and scope of the invention, as set forth in the appended claims.

I claim as my invention:—

1. In an X-ray tube, the combination with a cathode and an anode, of a plurality of separate rings disposed between said cathode and anode and means for independently connecting any one of said rings to the anode to control the hardness of the tube.

2. In an X-ray tube, the combination with a cathode and an anode, of a plurality of

separate rings disposed between said cathode and anode, and means for connecting any one of the rings to the anode to control the penetrating power of the rays produced.

3. In an X-ray tube, the combination with an anode, of a plurality of separate tubular members disposed between said cathode and anode, and means for alternatively connecting said members to the anode for controlling the penetrating power of the rays produced.

4. In an X-ray tube, the combination with a receptacle, and electrodes therein, of a plurality of separate tubular members disposed between the electrodes, and means for connecting any one of the tubular members to one of the electrodes to control the operation of the tube.

5. In an X-ray tube, the combination with a gas-enclosing receptacle, a cathode and an anode therein, of a plurality of separate means disposed at intervals between said anode and cathode and means for selectively connecting only one of said separate means to said anode for controlling the penetrating power of the rays produced.

6. In an X-ray device, the combination with a sealed envelope containing a rare gas, and an anode and a cathode therein, of a plurality of separate conducting members surrounding a portion of the space between said cathode and anode and arranged so that any one of said conducting members may be independently connected to said anode for controlling the operation of the device.

7. In an X-ray device, the combination with a sealed, gas-enclosing envelope, and an anode and a cathode therein, of a plurality of separate conducting members surrounding a portion of the space between said anode and cathode, and means for selectively connecting any one of the said members to the anode to control the operation of the device.

8. In an X-ray device, the combination with a sealed envelope, and an anode and a cathode therein, of a plurality of separate conducting members surrounding a portion of the space between said anode and cathode, and means for selectively connecting any one of the said members to one of the electrodes to control the operation of the device.

9. In an X-ray device, the combination with a gas-enclosing envelope, and an anode and a cathode therein, of a plurality of spaced means for selectively producing electrostatic fields surrounding the cathode rays between the anode and the cathode for controlling the penetrating power of the X-rays produced, and means for individually connecting one of said means to the anode.

In testimony whereof, I have hereunto subscribed my name this 10th day of February, 1921.

HARVEY C. RENTSCHLER.