

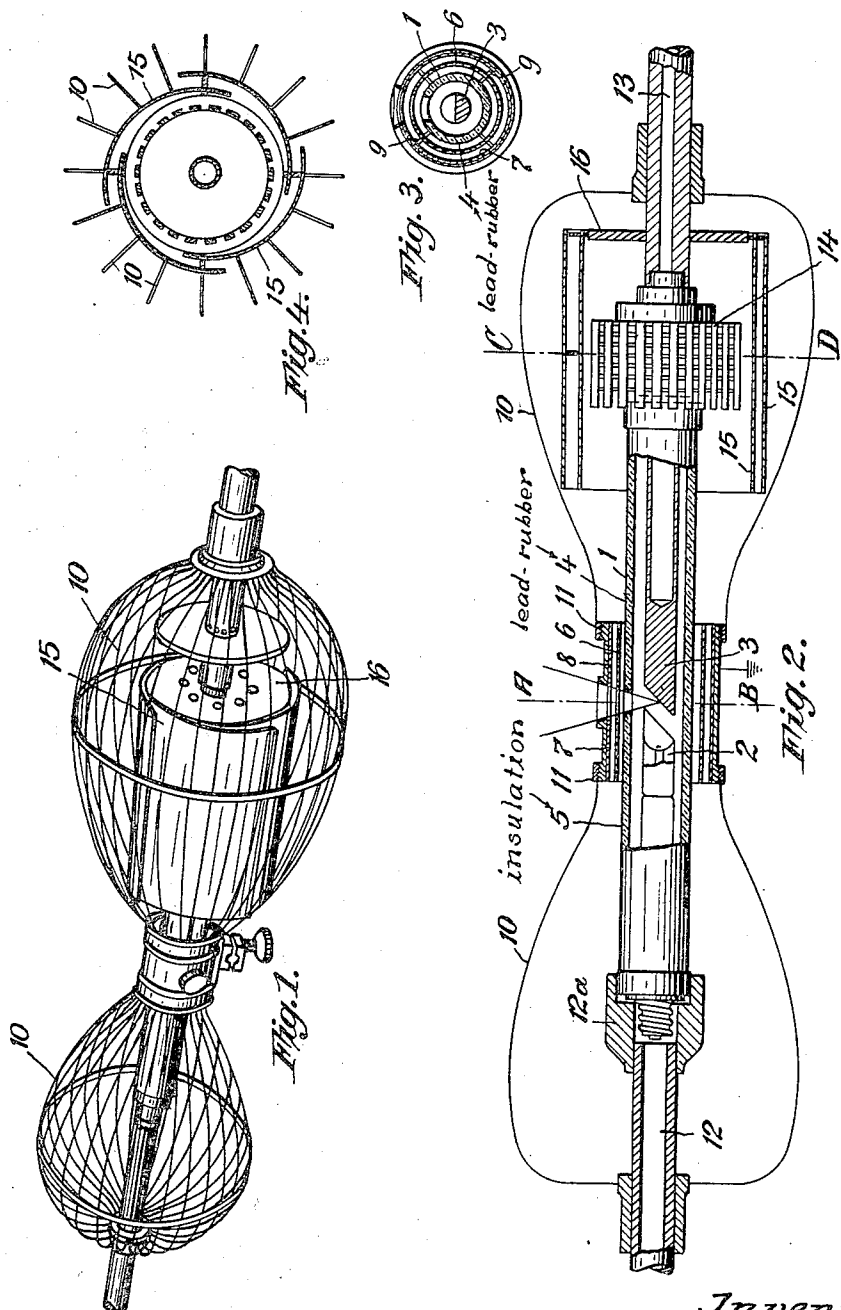
Aug. 10, 1937.

P. VIERKÖTTER

2,089,723

HIGH TENSION PROOF RÖNTGEN TUBE

Filed Sept. 15, 1934



Inventor
Paul Vierkötter
by *John H. H. H.* ATTORNEY

UNITED STATES PATENT OFFICE

2,089,723

HIGH-TENSION-PROOF RÖNTGEN-TUBE

Paul Vierkötter, Berlin-Grünwald, Germany,
assignor to the firm Radiologie Aktiengesellschaft, Berlin, Germany

Application September 15, 1934, Serial No. 744,227
In Germany September 15, 1933

5 Claims. (Cl. 250—35)

As the surface-tension of the present Röntgen-tubes is pretty high, the question as to rendering these tubes more high-tension-proof has become by far more important than hitherto. Rendering the Röntgen-tube high-tension-proof has up to now been effected by inserting the tube into a metallic hood which surrounds and encloses it completely and is insulated from it, said hood being securely earthed. The said metallic hood entails, however, several disadvantages, of which, for instance, one consists in the very great amount of space required and, furthermore, in its heavy weight whereby manipulation with the tube is rendered difficult. Besides, the hood reduces the action of the cooler as it, if this latter is an air-operated one, is detrimental to the circulation of the air, and if the cooler is a water-operated one, the hood is detrimental to the escape of the steam, in consequence whereof the loading capacity of the tube is diminished.

The main object of the present invention is to obviate the large and heavy hood into which the Röntgen-tube is to be inserted and to present instead a conveniently manipulable tube which does not require any type of protective hood or the like, but is high-tension-proof in and by itself. Another object of this invention is to design the means provided for the purpose in view in such a manner that the action of the cooler is not reduced and, thus, also the loading capacity of the tube is not diminished. According to this invention, a certain portion of the tube which consists of metal and has the aperture or window through which the rays escape, or are emitted respectively, is itself earthed by the intermediary of a condenser inserted between the tube and the earth. Inserting the condenser into the conductive connection is necessary in order to prevent the flow of a current from the cathode to the earth across the wall of the tube, because such a current would cause a detrimental heating of the tube wall. Another characteristic feature is that upon the above-mentioned portion of the tube which is earthed metallic hoods consisting of network of a suitable kind of grating or of perforated sheet-metal or the like are arranged, said hoods surrounding the ends of the tube. The various means stated render the tube perfectly high-tension-proof without any material increase of the amount of space required and without the provision of a separate hood, as necessary up to now.

I am aware of the fact that it has already been proposed to arrange a condenser above the middle portion of a Röntgen-tube, but with that

known arrangement the condenser is not earthed and the object of that arrangement is not to render the tube high-tension-proof, but to render the distribution of the tension upon the tube wall more uniform. It is likewise known to provide the middle portion of a Röntgen-tube with an earthed envelopment serving for conducting off loads from that middle portion. This arrangement is likewise not intended to render the tube high-tension-proof as the load and, therefore, the tension is transmitted onto it. Finally, it is known to enclose the tube as a whole into a sort of basket consisting of a kind of grating, but such a basket requires much space and renders the manipulation of the tube difficult.

Now, according to this invention, the above-mentioned condenser is formed directly upon the Röntgen-tube itself. The number of the condenser foils and the state or condition of the dielectric depend upon the surface tension. It is suited to the purpose in view to use air as dielectric because it is in this case possible to combine carrying off of the heat with the circulation of the air.

In order to render it possible to make the hoods enclosing the tube ends as small as possible without entailing the danger of sparks getting over between the cooler and the hoods, I have also designed a constructional form in which the cooler is enclosed in an envelope consisting of a substance, the insulating capacity of which is greater than that of the air. This envelope consists preferably of a plurality of members arranged in the manner of turbine vanes and permitting a good circulation of the air. Also the frontal side of the cooler is provided with a disk consisting of a well insulating material and having apertures for the air circulation.

The invention is illustrated diagrammatically and by way of example on the accompanying drawing on which Figure 1 is a perspective representation of a Röntgen-tube designed according to this invention; Figure 2 is an axial section through this tube; and the Figures 3 and 4 are transverse sections in the planes A—B and C—D of Fig. 2.

On the drawing, 1 denotes a glass cylinder in which is enclosed the cathode 2 and the anticathode 3. The glass cylinder is surrounded with a shell or jacket 4 made of a material (for instance lead-rubber) through which rays cannot pass, and above said shell or jacket 4 is provided another shell or jacket 5 consisting of an insulating material, for instance the compound known in commerce under the name

Pertinax, which material is hard paper impregnated with an insulating material such as "bakelite". The middle portion of the tube is, in a certain distance from the shell or jacket 5, surrounded with another insulating shell or jacket 6, above which, again in a certain distance therefrom, the usual metallic portion of the tube is located which portion may consist of a shell or jacket 7 of lead and of an outer shell or jacket 8 of another metal. The shells or jackets 4, 5, 6, 7, and 8 have perforations for the passage of the Röntgen-rays. The distances between said shells or jackets are maintained by ledges 9 consisting of an insulating material, for instance the above-mentioned Pertinax.

While, with the known Röntgen-tubes, the middle portion 7, 8 of the tube is located either directly at the high-vacuum space or at least directly above the glass wall or above the ray-protective layer surrounding this wall, the metallic envelope 7, 8 is, with the present improved Röntgen-tube separated from the tube by an intermediate space containing air so that in this way a very effective condenser is obtained which at the same time renders possible a good circulation of, and cooling by, that air. The tube-portion 7, 8 may be earthed without there arising any danger that a current flows from the cathode to the tube portion 7, 8 and, therefore, to the earth. There is, thus, also no risk that the middle portion of the tube can be heated by such a current.

The condenser provided according to this invention need not necessarily operate with air, but another condenser type may be used. In tubes of small output sometimes a sufficient condenser effect will be obtained by providing only the glass wall, the grounded metal shell, and an insulating layer between the glass wall and the shell.

In order to render also the tube ends high-tension-proof, grating-like hoods 10 are arranged upon the middle portion 7, 8 of the tube. For fastening said hoods threaded rings 11 may, for instance, be employed. These hoods enclose the tube ends, but, by reason of their grating-like design, they do not impede in any way the cooling action of the cooler, and as the hoods are metallically connected with the middle portion 7, 8 of the tube, they are also earthed by the intermediary of the earthing of said middle portion. The high-tension-proof supplying and withdrawing members 12 and 13 extend through the frontal ends of the hoods 10. Connecting the conducting member 12 with the tube is effected by means of a sleeve-like member 12a of an insulating material.

In order to render it possible to make that hood 10 which encloses the cooler 14 as small as possible without entailing the danger of sparks getting over between the cooler and the hood, the cooler is provided with an envelope, the electric resistance of which is greater than that of the air and does not impede the circulation of the air. This envelope consists of curved blades 15 of an insulating material which blades overlap one another similar to turbine blades; the insulating material is also in this case the preferred Pertinax; also a perforated flat frontal disk 16 constitutes a member of said envelope. The air can circulate through the spaces between the blades 15 and the perforations of the disk 16. Angularly bent small tubes of an insulating material may be inserted into the perforations of the disk 16 for the purpose of con-

ducting rectangularly away the air that arrives coaxially with the axis of the tube.

As appears from the above description and the drawing the invention presents a completely high-tension-proof Röntgen-tube which is at the same time easily manipulable and able to render an excellent performance.

I also point to the feature that the directly earthed portion of the tube in which the ray-passage window is provided need not indispensably be the middle portion of the tube. With tubes from which the rays escape axially, the member having the ray-escape window which, according to this invention should be earthed constitutes an end portion of the tube. In this case merely a grating-like hood would be requisite for enclosing the other portion of the tube.

I wish it to be understood that the invention is applicable not only in connection with Röntgen-tubes, but also with valve tubes and the like.

I claim:

1. A high-voltage X-ray tube having a wall, an insulating shell arranged at a distance from and surrounding at least a portion of said wall, a metallic shell arranged at a distance from and surrounding said insulating shell, ray-exit windows provided in alignment in said wall and said shells, means for directly earthing said metallic shell, grating-like protective hoods connected to said metallic shell and enclosing portions of the tube not surrounded by said metallic shell, an anode cooling device arranged at one edge of said wall within one of said hoods, and an insulating shell arranged in said last mentioned hood to surround said cooling device, said last mentioned shell consisting of a material having a higher dielectric strength than air and being formed with ports for the circulation of air.

2. A high-voltage X-ray tube having a wall, a shell of insulating material arranged at a distance from and surrounding at least a portion of said wall, a metallic shell arranged at a distance from and surrounding said insulating shell, ray-exit windows provided in alignment in said wall and said shells, means for directly earthing said metallic shell, grating-like protective hoods connected to said metallic shell and enclosing the portions of the tube not surrounded by said metallic shell, an anode cooling device arranged at one end of said wall within one of said hoods, and an insulating shell arranged in said last mentioned hood, said last mentioned shell surrounding the cooling device consisting of a material having a higher dielectric strength than air and comprising a perforated end wall and overlapping curved blades forming the side wall.

3. A high-voltage X-ray tube having a wall of glass, a jacket of an X-ray absorbing material enclosing said wall, a shell of insulating material arranged at a distance from and surrounding at least a portion of said jacket, a metallic shell arranged at a distance from and surrounding said insulating shell, said shell of insulating material and said metallic shell enclosing at least that part of the X-ray tube from which the X-rays exit, said jacket and said shells constituting a condenser surrounding said X-ray exit of the tube, the exterior metallic shell of which is grounded, the jacket and shells being formed with aligned openings to provide an X-ray window.

4. A high-voltage X-ray tube having a wall of glass, a jacket of an X-ray absorbing material enclosing said wall, an insulating shell arranged at a distance from and surrounding at least a

portion of said jacket, a metallic shell arranged at a distance from and surrounding said insulating shell, said shell of insulating material and said metallic shell enclosing at least that part of the X-ray tube from which the X-rays exit, said jacket and said shells constituting a condenser around said X-ray exit of the tube, the exterior metallic shell being grounded and the jacket and said shells being respectively formed with ray-exit windows in aligned relation and grating-like protective hoods connected to said metallic shell and enclosing the portions of the tube not surrounded by said metallic shell.

5. A high-voltage X-ray tube having a wall of glass, a jacket of an X-ray absorbing material enclosing said wall, an insulating shell arranged at a distance from and surrounding at

least a portion of said jacket, a metallic shell arranged at a distance from and surrounding said insulating shell, said shell of insulating material and said metallic shell enclosing at least that part of the X-ray tube from which the X-rays exit, said jacket and said shells constituting a condenser around said X-ray exit of the tube, the exterior metallic shell being grounded and the jacket and said shells being respectively formed with ray-exit windows in aligned relation and grating-like protective hoods connected to said metallic shell and enclosing the portions of the tube not surrounded by said metallic shell, and an anode-cooling device arranged at one edge of said wall within one of said hoods.

PAUL VIERKÖTTER.