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X-RAY TUBE WITH FOCUSING MEANS AT THE CATHODE

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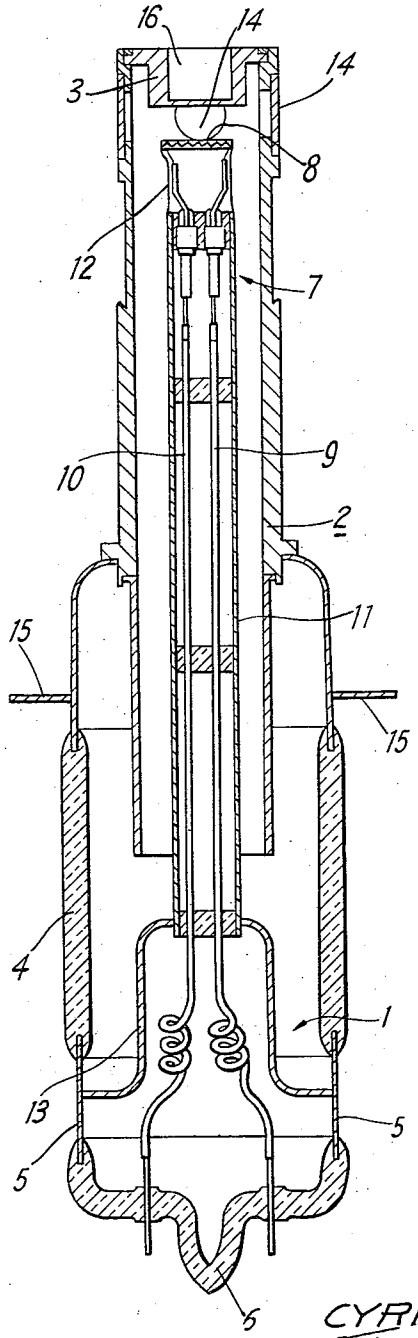

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X-RAY TUBE WITH FOCUSING MEANS AT THE CATHODE

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This invention relates to X-ray tubes and in particular to the construction of X-ray tubes capable of producing large quantities of utilisable X-radiation.

The envelope of an X-ray tube has to serve other purposes apart from the basic function of maintaining the vacuum in the tube. The electrodes are supported by the envelope, and their electrical connections passing through the wall of the envelope have to be electrically insulated from one another. Envelopes are frequently made of metal and glass, thus combining the ease and accuracy of construction of light metal containers with the insulating qualities of glass.

According to the present invention an X-ray tube constructed from co-axial tubular members in end-wise relation, has an intermediate glass sleeve joined through glass-to-metal seals to metal tubular members, one of which encloses the cathode assembly, supports the anode and provides one or more windows permeable to X-radiation, while the other member is electrically connected to and supports a focussing electrode associated with the cathode assembly, said other member being in turn sealed to a further glass member through which electrically conducting members forming part of the cathode assembly are sealed.

Part of the X-radiation produced in the tube is allowed to egress therefrom, through one or more windows each comprising a thin sheet of material permeable to X-radiation e.g. beryllium, covering an aperture in the wall of the envelope adjacent to the anode. The proportion of the radiation issued from the anode that can be utilised outside the tube is increased as the distance between the anode and the window(s) is reduced.

The arrangement of the electrodes in an X-ray tube constructed according to this invention allows the cathode assembly and the focussing electrode to be operated at high negative electrical potentials with respect to the anode and the window(s) which are kept at earth potential. This arrangement ensures that a large proportion of the X-radiation produced is utilisable and also simplifies the cooling of the anode as the cooling fluid circulated in contact with it remains at earth potential.

The invention will now be described with reference to the accompanying drawing which shows a sectional side elevation of an X-ray tube embodying this invention.

The type of tube illustrated is used in the crystallographic analysis of materials, but it must be understood that the invention is not limited to the construction of X-ray tubes performing any specialised function.

The evacuated envelope, which encloses a chamber **1**, comprises a tubular metallic member **2** which supports the anode **3**, a glass sleeve **4** and a further tubular metallic member **5**. The metallic members are secured to the glass sleeve in co-axial endwise relation through glass-to-metal seals. The cross section of the tubular member **2** changes from circular at the end adjacent to sleeve **4** to rectangular at the end supporting the anode and the remote end of member **5** is sealed by a glass member **6**.

The metal used for the manufacture of the members is one having similar expansion characteristics to the glass in order to avoid any stress which would otherwise be set up in the glass due to unequal expansion of the glass and the adjoining metal.

The cathode assembly **7** consists of two electrically conducting members **9** and **10** which pass through and are supported by a metallic tube **11** and are connected electrically to a filament **8** of tungsten or other electron emitting material. A focussing device **12** for the cathode comprises a metal cylindrical block in axial alignment with and electrically connected to the tube **11**, having a cavity formed in it in which the filament **8** is positioned but from which it is electrically insulated. The cathode structure is held rigidly along the axis of the envelope with the filament spaced apart from the anode by means of a conducting housing **13** electrically connected to the metallic tubular member **5**. The conducting members **9** and **10** through which the filament **8** is supplied with current, pass through glass-to-metal seals in the member **6** to terminals located exterior to the tube.

A plurality of windows **14** each formed by a thin sheet of material permeable to X-radiation covering an aperture in the envelope are spaced around the end of tubular member **2** adjacent the anode **3**. The close proximity of the anode to these windows ensures that a large proportion of the X-radiation produced within the tube can egress as useful radiation.

On supplying the filament by means of conducting members **9** and **10** from a suitable source of electrical potential, the temperature of the filament **8** is raised sufficiently for electrons to be emitted. The cathode structure is as previously stated, given a high negative electrical potential and the anode is kept at earth potential. The electrons emitted from the filament bombard the anode and cause X-radiation to be produced. This bombardment inevitably raises the temperature of the anode and it is cooled by allowing a stream of water or other suitable cooling fluid to flow through a cavity **16** formed behind the target surface of the anode.

The focussing device **12** is supplied from a source of potential connected to the metal sleeve **5** and it is maintained at a potential slightly negative with respect to the cathode. By means of this focussing device the size of the electron beam bombarding the anode may be varied.

A flange **15** forming a part of the tubular member **2** allows the end of the tube from which the high potential connections emerge to be mounted with an associated high potential terminal socket in an electrically insulating gas filled container.

What I claim is:

1. An X-ray tube comprising an evacuated envelope consisting of first and second tubular metallic members located in co-axial endwise relation, a tubular glass sleeve separating said metallic members, glass-to-metal seals securing said sleeve to said metallic members, a glass member which seals the end of said first metallic member remote from said glass sleeve, an anode providing a target surface, carried by said second member at the end thereof remote from said glass sleeve, at least one window permeable to X-radiation on said second member adjacent said anode, a cathode assembly comprising an electron emitting filament and a focussing device for the electrons emitted from said filament, said cathode assembly being supported within said second member with said filament adjacent said anode, said focussing device being formed in part by a metallic sleeve supported at one end by, and in electrical contact with, said first tubular member and electrically conducting members forming part of said cathode assembly extending in insulated relation axially of said metallic sleeve and sealingly through said glass member to the exterior of said envelope.

2. An X-ray tube comprising an evacuated envelope consisting of first and second tubular metallic members located in co-axial endwise relation, a tubular glass sleeve separating said metallic members, glass-to-metal seals securing said sleeve to said metallic members, a glass mem-

ber which seals the end of said first metallic member remote from said glass sleeve, an anode providing a target surface closing the end of said second member remote from said glass sleeve, at least one window permeable to X-radiation in said second member adjacent said anode, a cathode assembly comprising an electron emitting filament and a focussing device for the electrons emitted from said filament, said cathode assembly being supported axially within said second member with said filament adjacent said anode, said focussing device being formed in part by a metallic sleeve supported at one end by a conducting housing electrically connected to said

first tubular member, and electrically conducting members forming the lead-in wires to said filament extending in insulated relation axially of said metallic sleeve and sealingly through said glass member to the exterior of said envelope.

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