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ANODE CONSTRUCTION

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Fig. 1

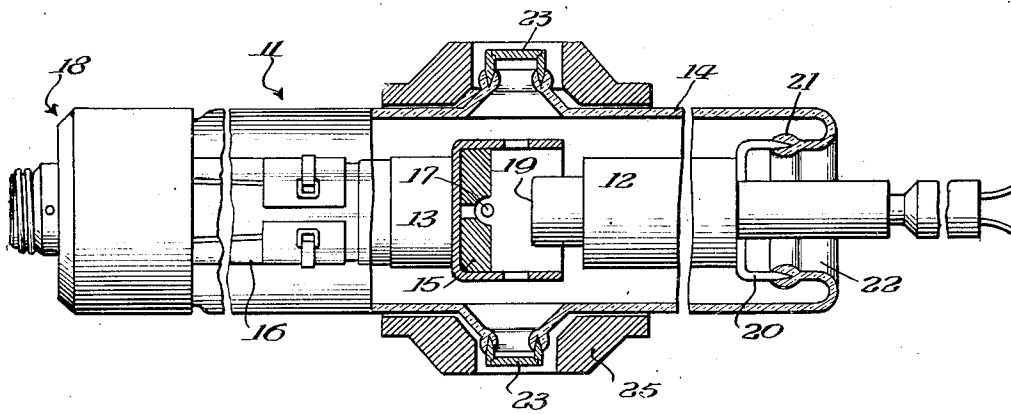
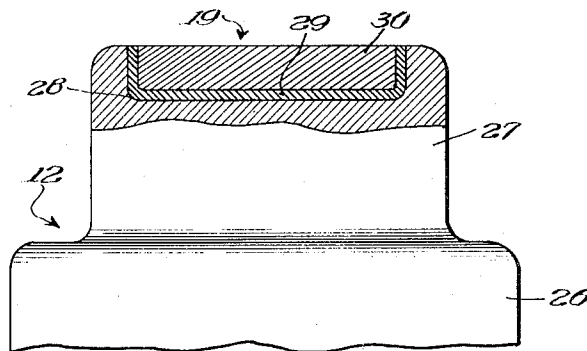


Fig. 2



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ANODE CONSTRUCTION

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1 Claim. (Cl. 250-149)

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The present invention relates in general to electronics and has more particular reference to an anode structure for X-ray generators.

An important object of the present invention resides in providing an improved anode having a target surface of metal, such as germanium, that is readily soluble with other metals and hence difficultly mountable, in substantially pure uncontaminated condition on target supporting means comprising such other materials; a further object being to mount a readily soluble metal on a support while maintaining the supported metal in substantially pure and uncontaminated condition.

Another important object is to provide an anode target of readily soluble metal, such as germanium, in substantially pure condition without contamination by other metals in solution therein, to thereby provide an X-ray generating target of pure metal for the generation of X-rays of a character particularly well suited for the analysis of other materials by X-ray diffraction.

Another important object is to provide an X-ray tube particularly adapted for the analysis of materials by diffraction, the tube having an X-ray generating target of substantially pure metallic germanium, or other readily soluble metal.

Another important object is to form a target of substantially pure metal by solidifying a mass of readily soluble metal, such as germanium, from its molten state, in place, in a formed pocket in a target support of metal, such as copper, iron, nickel and the like, readily soluble with the target material in molten condition, while maintaining the target material against contamination by such soluble metals; a further object being to apply the target material in molten condition, in a pocket lined with metal, such as molybdenum, tungsten, tantalum and the like, that is not readily soluble with the target material, whereby to maintain the same in substantially pure condition during and after solidification thereof in the pocket.

The foregoing and numerous other important objects, advantages and inherent functions of the invention will become apparent as the same is more fully understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a partially sectionalized side view of an X-ray tube embodying the present invention; and

Fig. 2 is an enlarged, partially sectionalized side view of the anode embodied in the device shown in Fig. 1.

X-ray diffraction analysis of test materials may be accomplished by exposing the material to be

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analyzed to X-rays while observing the X-ray diffraction characteristics of the material on an X-ray sensitive screen or film.

The spectral characteristics of X-rays generated by electron impingement on a suitable target depend upon the material forming the target in the X-ray generator, every target material having its own characteristic spectrum, which is independent of the operating potential of the generator above a minimum voltage, which minimum voltage is also characteristic of the target material. Any target material may, of course, be employed for X-ray diffraction analysis providing that the material of the target, and hence its spectral characteristics, be known, as otherwise spectral lines caused, by the target material, in a spectrograph of the material being examined may be mistaken for lines supposedly caused by the material under examination.

The choice of a proper target material for diffraction analysis depends upon the type of specimen being examined, the examination technically employed, and the kind of information sought. It is obvious, however, that a prerequisite for accurate analysis is accurate knowledge of the spectral characteristics of the target at which the X-rays, used for diffraction analysis, are generated. It is, therefore, desirable to provide generators having targets of pure metal, in order to insure that the spectrum of the generator will have only the known characteristics of the target material employed and to avoid the inclusion in the spectrum of unwanted lines imparted by the presence of contaminating metals.

Germanium is a metal well suited for use as an X-ray generating target for producing X-rays for diffraction analysis. Germanium, however, together with other suitable metals, is readily soluble with most materials, such as copper, iron, nickel and the like, which may be conveniently employed for target supporting purposes in X-ray tubes, the choice of materials for such purpose being limited mainly by cost considerations; and it is the purpose of the present invention to provide practical, yet inexpensive means for mounting germanium and other readily contaminated metals on supports of material readily soluble therewith while preventing contamination of the target material by unwanted dispersion of the material of the support in the mounted metallic target.

To illustrate the invention, the drawings show an X-ray tube 11 comprising an anode 12 and a cathode 13 in facing relationship within an hermetically sealed and evacuated envelope 14, suitable electrical connections being provided for electrically energizing the anode and cathode for X-ray generation from a suitable external power source, or sources.

The cathode 13 may comprise a head 15 sup-

ported and sealed upon a re-entrant envelope portion comprising a hollow stem 16. Conductors for energizing the electron emitting filament 17 of the cathode may extend through the stem 16. The cathode end of the tube may be fitted with a suitable base 18 for connecting the conductors with a suitable external power source for energizing the filament 17 for electron emission. The cathode comprises means for generating and directing electrons upon the facing or target end 19 of the anode, whereby to generate X-rays as a result of electron impingement on the target.

The anode, near its target remote end, may be secured to a sealing disc or washer 20 having an annular edge forming a glass-to-metal seal 21 with the re-entrant portion 22 of the envelope, the anode having an extension projecting outwardly through the disc 20 and being fitted with inlet and outlet conduits for the circulation of a cooling fluid into the anode adjacent the target end thereof for cooling the same. The envelope 14 preferably, though not essentially, comprises lead glass and is formed with conical embossments fitted with window panes 23 of beryllium, or other suitable X-ray transmitting material, the window panes being located on the envelope opposite the target end of the anode in position to project X-rays from the target outwardly of the envelope. The cathode head may be provided with a skirt 24 encircling the target end of the anode and formed with openings in line with the said window panes for the transmission of useful X-ray beams from the anode to and through the window panes. The tube is also preferably enclosed in an annular sleeve 25, which may comprise split parts suitably clamped together around the window portion of the envelope, the sleeve being provided with openings for receiving the window carrying embossments. If desired, the sleeve 25 may be formed of material opaque to X-rays for the purpose of confining therein all X-rays except the beams emanating from the anode and traveling through the openings in the cathode skirt 24 and thence through the window panes 23.

The anode 12 comprises a metallic base 26 which may be made of any suitable or preferred material, such as copper, iron, nickel and the like. The base is formed with a target carrying end 27 having a surface facing the cathode, said end portion, in accordance with the present invention, being formed with a cavity 28 which is lined with a cup-shaped insert 29 of tantalum, tungsten, molybdenum or other material difficultly soluble with germanium.

The lining 29 may be applied by casting the same in place in the base portion 27 during the formation of the base. Ordinarily the base is formed as a casting operation in a suitable die in which the preformed lining cup 29 may be mounted as an insert and the material of the base cast into the die upon and around the cup 29. The material of the base is sufficiently soluble with the material of the cup 29 to wet the same and thus secure the cup firmly in the end of the base portion 27.

After the base has thus been formed with the cup 29 in place therein, the selected anode material, such as germanium, in molten condition, may be poured into the cup and allowed to solidify to form a metallic target button 30 of metal in substantially pure condition without contamination by any metal dissolved therein. Tantalum, tungsten and molybdenum are materials relatively difficultly soluble in molten germanium

which, however, will wet the material of the cup sufficiently to result in a firm anchorage and integration of the target material with the material of the cup 29, to hold the target button 30 in place after the molten material has solidified.

After solidification of the button 30, the cathode facing target surface 19 of the anode may be ground, polished or otherwise finished to provide a smooth unbroken target surface, the central portions of which comprise the pure metal surface of the button 30.

It will be seen from the foregoing that the present invention provides a practical and relatively inexpensive means for mounting an X-ray generating target of readily soluble metal, in substantially pure condition, on a support of metal that is readily soluble with the material of the target. The invention thus teaches a commercially practical solution for the problem of providing X-ray generating targets of pure germanium and other readily soluble metals for use in generators for the production of X-rays having predetermined spectral characteristics.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the form herein disclosed being a preferred embodiment for the purpose of demonstrating the invention.

The invention is hereby claimed as follows:

1. An electron target structure comprising a base element of metal selected from the class comprising copper, iron and nickel, readily soluble with germanium, said base element having a target end surface formed with a cavity opening outwardly at said surface, a cup-shaped mounting element of metal selected from the class comprising manganese, tungsten, and tantalum, difficultly soluble with germanium, said mounting element being mounted in said cavity and integrated with said base element to form a liner for said cavity, and a target button of germanium disposed within said cup-shaped liner and metallurgically integrated therewith, whereby said button is physically integrated with and metallurgically isolated from said base element.

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