United States Patent

[11] 3,622,824

[72] Inventor **Zed J. Atlee**
Elmhurst, Ill.

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[45] Patented **Nov. 23, 1971**
[73] Assignee **Picker Corporation**
White Plains, N.Y.

[54] **COMPOSITE X-RAY TUBE TARGET**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **313/55,**
29/198, 313/60, 313/311, 313/330, 313/352
[51] **Int. Cl.** **H01j 35/10**
[50] **Field of Search** 313/344,
330, 60, 55, 217, 218, 39, 40, 41, 45, 89, 311, 352,
355; 29/198

[56] **References Cited**

UNITED STATES PATENTS

2,521,663	9/1950	Zunick	313/60 X
2,863,083	12/1958	Schram	313/330

FOREIGN PATENTS

64,830	9/1946	Denmark	313/60

Primary Examiner—Roy Lake
Assistant Examiner—E. R. La Roche
Attorney—Buckhorn, Blore, Klarquist and Sparkman

ABSTRACT: A composite rotating X-ray tube target having a molybdenum head and an annular target face of 218 tungsten bonded to the molybdenum head, the head desirably having a unitary stem and backing portion of columbium.

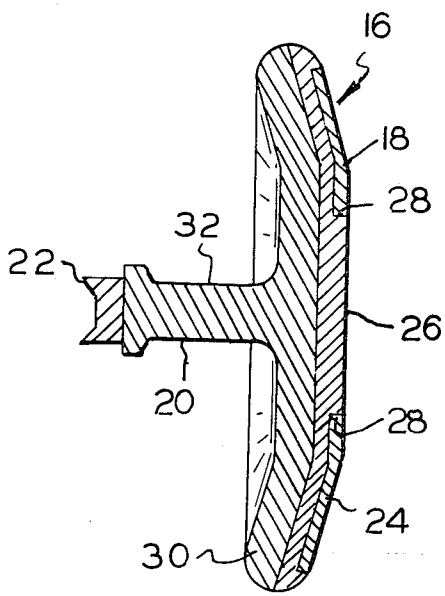


FIG. 1

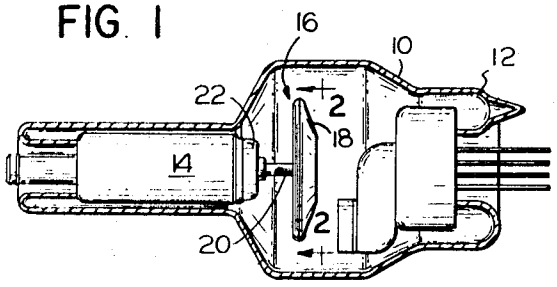


FIG. 2

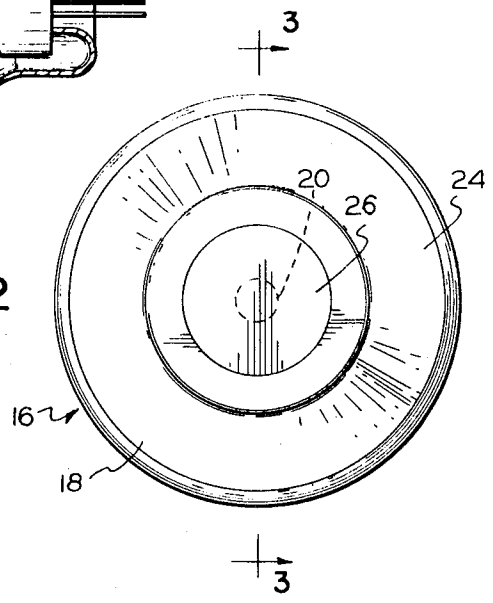


FIG. 3

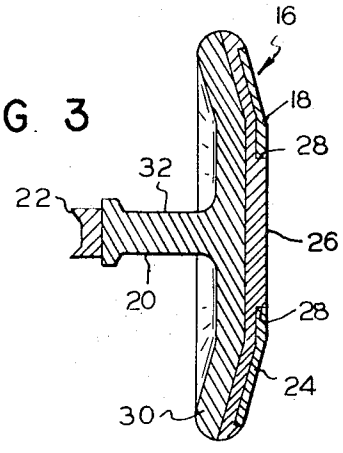
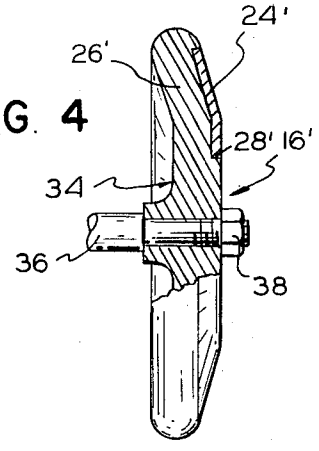


FIG. 4



ZED J. ATLEE
INVENTOR

BY
BUCKHORN, BLORE, KLARQUIST & SPARKMAN
ATTORNEYS

COMPOSITE X-RAY TUBE TARGET

BACKGROUND OF THE INVENTION

Selection of the proper materials out of which to make the rotating anode targets for X-ray tubes has posed a difficult problem. Such materials must have a good service life, maintain a smooth path and achieve good heat storage. Tungsten has desirably been used as such a material for the facing of the anode target, the head portion of which has been attached to a threaded stem or shaft by a nut. Such a form of construction, however, has not proved entirely satisfactory for massive targets which rotate at high speeds.

In U.S. Pat. No. 1,410,499, May 21, 1922, Pacz disclosed a tungsten composition designated as 218 tungsten. This particular composition is made by reducing in a hydrogen atmosphere a tungsten oxide intimately associated with commercial grade chemicals such as sodium carbonate, potassium carbonate, sodium nitrate, and silicic acid. The mixture is thereafter pressed in powder form into ingots which are sintered and then mechanically worked into the form desired. I have discovered that such 218 tungsten is a desirable material out of which to make the facing for rotating anode targets, and that such targets, when bonded to molybdenum, may be provided with a unitary stem and backing portion of columbium which makes it possible to obviate the usual shaft and nut arrangement.

SUMMARY OF THE INVENTION

The anode target which I have invented is a composite target having a face of 218 tungsten bonded to molybdenum. The molybdenum portion of the target may desirably have a backing of columbium which backing may in turn be a unitary part of a columbium stem for the target. Columbium is a desirable material for the stem and backing because it can be worked cold and because it has a very high specific heat, which results in poor thermal conductivity and good heat storage. Thus it is an ideal shaft material, maintaining the shaft bearing as cool as possible. Its high thermal expansion, however, requires the "sandwich" type of construction above disclosed, in which a molybdenum portion is disposed in contact with the 218 tungsten to avoid bonding problems.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a side elevation of an X-ray tube constructed in accordance with the invention;

FIG. 2 is a view taken on line 2—2 of FIG. 1 and illustrates to an enlarged scale an anode target made in accordance with the present invention;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2; and

FIG. 4 is a sectional view similar to FIG. 3 illustrating a different embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings and in particular to FIGS. 1–2, the illustrated tube comprises an envelope **10** having a cathode structure **12** mounted in one end thereof and an anode **14** in the opposite end thereof. The anode **14** is of the rotating type

having a rotating target element or head **16** provided with a frustoconical target surface **18**. The head **16** has a stem **20** extending from a rotor **22** suitably supported in the envelope in a conventional manner. The rotor **22** is adapted to be driven by a magnetic field generated by coils (not shown) positioned exteriorly of the envelope **10**.

As can be clearly seen in FIGS. **2** and **3**, the target element or head **16** is a composite structure having an annular target face **24** of 218 tungsten bonded to a molybdenum portion **26** having an annular recess **28** adapted to accommodate the 218 tungsten face **24**. The molybdenum portion **26** is itself backed by a portion **30** of columbium bonded thereto. The molybdenum portion **26** is thus disposed between the 218 tungsten face **24** and the backing portion **30** of columbium. In the preferred construction this columbium backing **30** is, in turn, a unitary part of a columbium stem **32**.

Columbium is a desirable material for the stem **32** and the backing portion **30** because it can be worked cold and because it has a very high specific heat, 0.065 cal./g./° C. at 20° C. Columbium is also an ideal shaft material because its very poor thermal conductivity, 0.13 cal./cm.²/cm./° C./sec., helps to maintain the shaft bearing as cool as possible.

The high coefficient of thermal expansion of columbium, however, 7.2×10^{-6} per ° C., makes the sandwich type of construction above described desirable. Such avoids the bonding problems which would occur were the columbium backing **30** bonded directly to the 218 tungsten face **24**. A further advantage of the one piece columbium stem and backing is that such achieves additional heat storage over the conventional two-piece shaft and head construction.

FIG. **4** illustrates a modification of the invention in which the target element or head **16'** comprises an annular target face **24'** of 218 tungsten bonded to a molybdenum portion **26'** having an annular recess **28'** adapted to accommodate the 218 tungsten face. In this embodiment, however, the molybdenum portion **26'** constitutes the entire backing **34** for the 218 tungsten face, the composite structure being mounted on a conventional shaft **36** and being retained in position by a nut **38**.

I claim:

1. In an X-ray tube having cathode means in one end thereof, anode means in the opposite end thereof and a rotor to rotate said anode means about the longitudinal axis thereof,
   an anode target comprising
   a stem extending from said rotor and adapted to rotate therewith;
   a head on said stem comprising a portion of molybdenum;
   an annular face target of 218 tungsten bonded to said molybdenum portion of said head,
   and a backing portion of columbium on said head, said molybdenum portion being disposed between said 218 tungsten face and said backing portion of columbium and being bonded to said columbium backing portion.

2. The X-ray tube of claim 1 in which said stem comprises a columbium stem.

3. The X-ray tube of claim 2 in which said columbium stem and said backing portion of columbium comprise a unitary stem and backing portion of columbium.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,622,824 Dated Jan. 21, 1972

Inventor(s) Zed J. Atlee

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 24 "7.2x10'7E'6" should be --7.2×10^{-6}--.

Signed and sealed this 25th day of April 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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