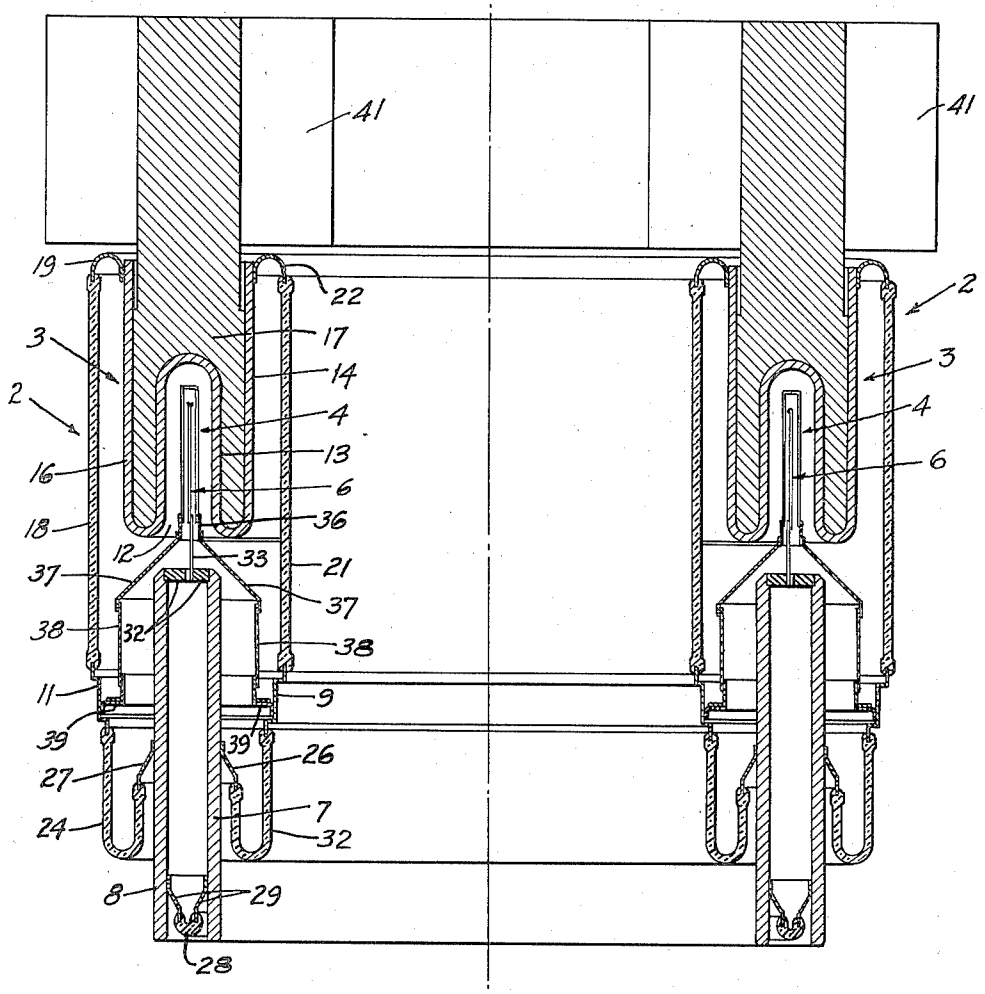
Jan. 31, 1950 H. H. EAVES 2,496,003

ELECTRON TUBE HAVING ANNULAR ELECTRODES

Filed Jan. 2, 1948

Fig. 1



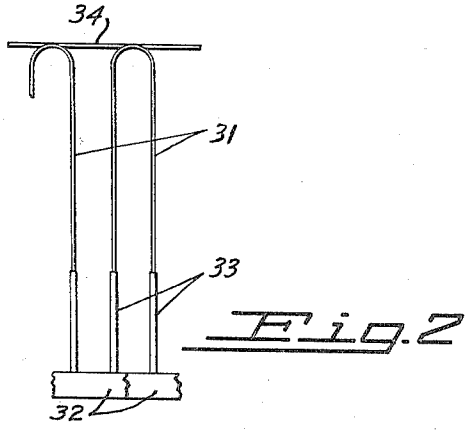


Fig. 2

INVENTOR.
Hubert H. Eaves
BY Harold E. Day
ATTORNEY

Patented Jan. 31, 1950

2,496,003

UNITED STATES PATENT OFFICE

2,496,003

ELECTRON TUBE HAVING ANNULAR ELECTRODES

Hubert H. Eaves, San Mateo, Calif., assignor to Eitel-McCullough, Inc., San Bruno, Calif., a corporation of California

Application January 2, 1948, Serial No. 63

5 Claims. (Cl. 250—27.5)

1

My invention relates to electron tubes for producing relatively large power outputs at the higher frequencies.

It is among the objects of my invention to provide a tube structure having the large electrode areas and heat dissipation capabilities required for high powers.

Another object is to provide a tube structure which takes advantage of electron emission from both sides of a cathode.

Other objects include the provision, in a tube of the character described, of an electrode arrangement suitable for establishing close electrode spacings and having an improved electrode terminal structure adaptable for use with high frequency linear circuits.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawing

Figure: 1 is an axial sectional view of a tube embodying the improvements of my invention; and

Figure 2 is a detail view of the cathode structure.

In terms of broad inclusion, my tube comprises a circular anode having an annular cavity, an annular cathode projecting into the anode cavity, and a double-wall grid projecting into the anode cavity with a wall of the grid adjacent each side of the cathode. The tube preferably has an annular envelope with the anode at one end and a cathode terminal at the other end. Grid connection is made to a terminal ring interposed in a side wall of the envelope, there being preferably two such grid terminal rings, one in each of the envelope side walls.

In greater detail and referring to the drawing, a triode type of tube embodying my invention comprises an annular evacuated envelope 2 and annular of ring-shaped electrodes including an anode 3, grid 4 and cathode 6. A pair of coaxial metallic cathode terminal rings 7 and 8 are preferably located at the envelope and opposite the anode, and a pair of coaxial metallic grid terminal rings 9 and 11 are preferably interposed in the inner and outer side walls of the envelope. In my tube the metal anode is of the external or conduction-cooled type forming part of the envelope wall, and in my preferred structure the circular

2

anode has an annular internal cavity 12 into which the other annular electrodes project. This anode has a body 13 of inverted U-shape cross section and preferably has upturned flanges 14 and 16 to provide a reentrant recess into which the core 17 of a cooler may project.

The vacuum-tight envelope is completed by several sections of insulating or vitreous material such as glass. An outer cylindrical side wall section 18 is sealed along its upper edge to a sealing flange 19 carried by the anode flange 16, and is sealed along its lower edge to the outer grid terminal ring 11. Similarly an inner cylindrical side wall section 21 is sealed between an anode sealing flange 22 and the inner grid terminal ring 9. The lower end of the tube is formed by a pair of U-shaped circular sections 23 and 24 sealed between the grid terminal rings and suitable sealing flanges 26 and 27 on the cathode terminals 7 and 8. A glass ring 28 sealed to flanges 29 between the cathode terminal rings completes the envelope.

In my preferred tube the cathode is of the filamentary or directly heated type comprising spaced vertical bars of thoriated tungsten wire arranged in annular formation. As shown in Figure 2 the bars are conveniently formed by hairpin filaments 31 connected at the lower ends to conductor rings 32 by rods 33. By this arrangement the hairpin filaments are connected in parallel across the cathode terminals, and form a multiplicity of parallel filament bars lying in the cylindrical surfaces defined by the annular cathode structure. A tie wire 34 connected to the upper bights of the filaments serves to reinforce the structure. The annular grid 4 is of double-wall construction, preferably of inverted U-shape, so that a wall of the grid lies adacent each side of the cathode. The grid may be of foraminated or any other suitable open-work structure and preferably has terminal bands 36 along the lower edges of the two walls. Conductive supports of sheet metal are connected between the grid bands 36 and the terminal rings 9 and 11, which supports are preferably formed by annular skirts 37 extending from cylindrical uprights 38 mounted on flanges 39 of the terminal rings. Since these grid supports extend from the base of the grid to the side walls of the tube a complete electrostatic shield is provided between the anode and cathode. This shielding is desirable in grounded grid triode operation.

While I have shown a triode it is understood that additional grids may be included and sup-

ported from additional terminal rings provided in the side walls. The shielding afforded by the grid mounting structure in my tube is ideal when connected to a screen grid of a tetrode combination.

For air cooled operation suitable fins 41 are provided on the cooler core 17. These fins preferably extend both outwardly and inwardly since the annular envelope structure enables air to be directed centrally through the tube as well as along the outer surfaces. Effective cooling of the anode as well as other parts of the tube is thus assured.

By the use of annular electrodes it becomes apparent that large electrode areas are provided in a relatively compact structure. Not only is a large cathode or emitter surface made available by the annular cathode described, but my improved tube structure further takes advantage of electron emission from both sides of the cathode. This is a decided improvement over conventional tube designs which usually make use of electron emission from only one side of a cathode.

Another feature of my tube is that the electrode terminals are all coaxial with the tube axis, thus making the tube well adapted for use with high frequency linear circuits.

I claim:

1. An electron tube comprising an annular envelope, a ring-shaped anode adjacent one end of the envelope and having an annular cavity, a cathode terminal ring adjacent the other end of the envelope, an annular cathode projecting into the anode cavity and connected to said cathode terminal, a grid terminal ring interposed in a side wall of the envelope, an annular double-wall grid projecting into the anode cavity with a wall of the grid adjacent each side of the cathode, and a conductive support connected between a wall of the grid and said grid terminal ring.

2. An electron tube comprising an annular envelope, a ring-shaped anode adjacent one end of the envelope and having an annular cavity, a cathode terminal ring adjacent the other end of the envelope, an annular cathode projecting into the anode cavity and connected to said cathode terminal, a grid terminal ring interposed in each side wall of the envelope, an annular double-wall grid projecting into the anode with a wall of the grid adjacent each side of the cathode, and conductive supports connected between the walls of the grid and said grid terminal rings.

3. An electron tube comprising an annular envelope, a ring-shaped anode adjacent one end of the envelope and having an annular cavity, a cathode terminal ring adjacent the other end of the envelope, an annular cathode projecting into the anode cavity and connected to said cathode terminal, a grid terminal ring interposed in each side wall of the envelope, an annular double-wall grid projecting into the anode with a wall of the grid adjacent each side of the cathode, and a pair of annular conductive supporting shields connected between the walls of the grid and said grid terminal rings.

4. An electron tube comprising an annular envelope, a ring-shaped anode adjacent one end of the envelope and having an annular cavity, a pair of cathode terminal rings sealed to the envelope adjacent the other end thereof, and an annular filamentary cathode projecting into the anode cavity and supported by said terminal rings.

5. An electron tube comprising a circular anode having an annular cavity with vertical cylindrical inner wall surfaces, an annular cathode projecting into the anode cavity and having vertical cylindrical sides coaxial with said inner surfaces of the anode, and an annular double-wall grid projecting into the anode cavity with a vertical cylindrical wall of the grid adjacent each side of the cathode.

HUBERT H. EAVES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,390,683	Beldi	Dec. 11, 1945
2,402,602	Chevigny	June 25, 1946
2,424,685	Eitel et al.	July 29, 1947
2,436,649	Kane	Feb. 24, 1948