

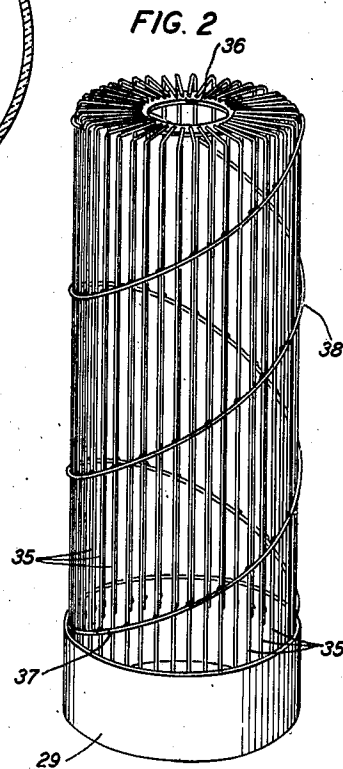
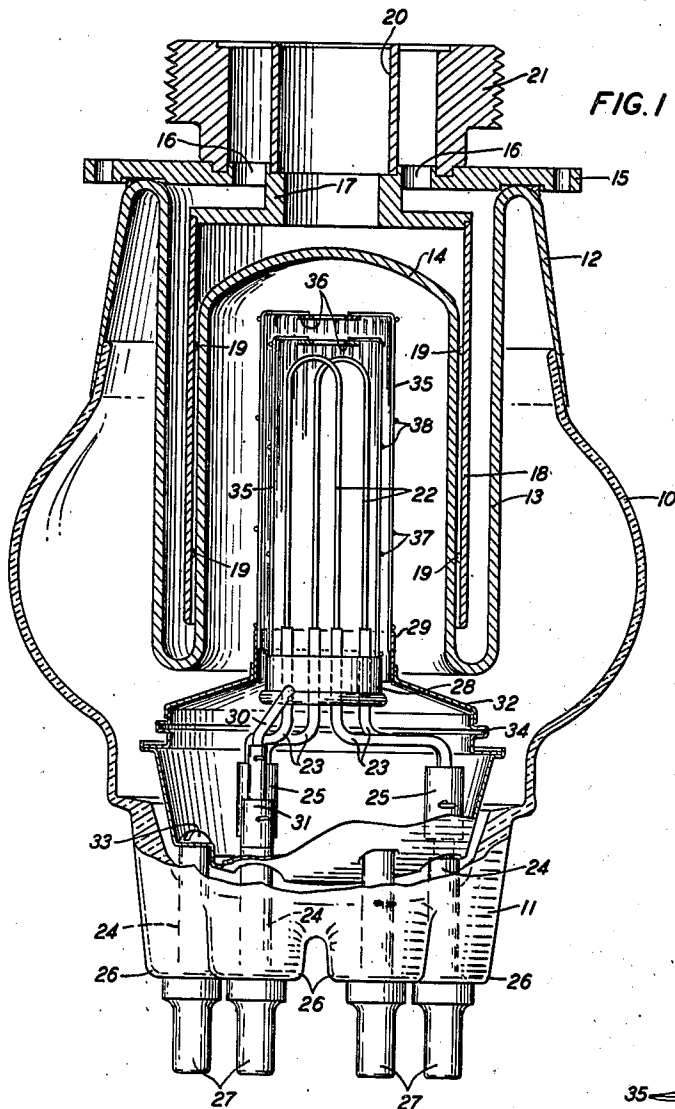
March 24, 1942.

V. L. RONCI

2,277,148

ELECTRODE FOR ELECTRON DISCHARGE DEVICES

Filed Jan. 30, 1941



INVENTOR
BY V. L. RONCI
Walter C. Kiesel
ATTORNEY

UNITED STATES PATENT OFFICE

2,277,148

ELECTRODE FOR ELECTRON DISCHARGE DEVICES

Victor L. Ronci, Brooklyn, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application January 30, 1941, Serial No. 376,564

6 Claims. (Cl. 250—27.5)

This invention relates to electrode for electron discharge devices and more particularly to grid electrodes for such devices of high power capacity and operable at ultra high frequencies.

In electron discharge devices suitable for efficient operation at ultra high frequencies, the inter-electrode spacings, and particularly the spacing of the cathode and the grid or of several grids if more than one are employed, is very small and should be accurately maintained during the operation of the devices. When such devices are operated at relatively high power levels, the temperature of the grid or grids varies over a fairly wide range and, as a result, the grid undergoes expansion and contraction so that the interelectrode spacings may vary with consequent changes in the operating characteristics of the devices, and in some cases may vary so that the grid contacts with another electrode, such as the cathode, whereby the devices are rendered inoperative.

One object of this invention is to maintain the operating characteristics of an electron discharge device substantially constant. More specifically, one object of this invention is to maintain exactly the desired spacing of electrodes of an electron discharge device during operation of the device.

In one illustrative embodiment of this invention, an electron discharge device comprises a cathode, an anode, and a grid encompassing the cathode and in close space relation therewith.

In accordance with one feature of this invention, the grid comprises a plurality of parallel wires mounted in a cylindrical boundary and fixed at one end, means being provided defining a plurality of cantilever spring elements connected to alternate wires. In a specific form, this means is a relatively wide pitch flexible helix wound about the parallel wires and having its turns affixed to alternate wires.

In accordance with another feature of this invention, the grid constitutes a self-supporting structure, the end portions of the parallel wires remote from the fixed ends thereof being bent inwardly and secured to a spacing member supported by the parallel wires.

The invention and the foregoing and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is an elevational view mainly in section of an electron discharge device illustrative of one embodiment of this invention; and

Fig. 2 is an enlarged perspective view of one of the self-supporting grids included in the device illustrated in Fig. 1.

Referring now to the drawing, the electron discharge device shown in Fig. 1 comprises an evacuated enclosing vessel having a bulbous vitreous portion 10, a vitreous or ceramic dished base 11, and a metallic, e. g., copper, portion including a wall 12 hermetically sealed to the bulbous portion 10. The metallic portion includes also an inwardly extending cylindrical wall 13 and a central cup-shaped member 14 which serves as the anode of the device and is positioned coaxial with the cylindrical wall 13.

A metallic plate 15 having a plurality of apertures 16 and provided with an annular flange 17, L-shaped in section, is secured, as by soldering, to the metallic portion of the enclosing vessel adjacent the junction of the walls 12 and 13 thereof, the flange 17 having affixed thereto a cylindrical metallic member 18 coaxial with the anode member 14 and spaced therefrom by raised portions 19 on the member 17. Mounted upon the plate 15 are a pair of couplers 20 and 21 by means of which connection may be made to the inlet and outlet of a fluid circulating system for cooling the anode 14.

Disposed centrally within the anode 14 is a cathode which comprises a pair of self-supporting hairpin filaments 22, for example, of tungsten, mounted in parallel relation and connected in parallel electrically by rigid wires 23 which are joined to leading-in conductors 24 by metallic sleeves 25, the leading-in conductor 24 being hermetically sealed to protuberances 26 on the dished base 11 and terminating in terminal caps 27.

A control grid and a screen grid of a particular construction to be described hereinafter are mounted between the cathode and the anode and uniformly spaced therefrom, each of these grids including a foundation member or ring 28 and 29, respectively. The foundation ring 28 of the control grid is rigidly supported by a rigid wire 30 secured to one of the leading-in conductors 24 by a coupler or sleeve 31. The foundation ring 29 of the screen grid is mounted upon a solid walled metallic shield 32 which is secured to a number, for example, three, of the leading-in conductors 24 by screws 33, only one of which is shown, the shield being provided with an annular corrugation 34 which enables shifting of the screen grid with respect to the base 11 during the assembly of the device and thereby facilitates the mounting of the screen grid in exact

coaxiality with the other electrodes of the device. The shield 32, it will be noted, substantially encloses the leading-in conductors for the cathode and the control grid whereby these conductors are effectively screened, electrically and thermally, from the anode 14.

Each of the control and screen grids, as shown clearly in Fig. 2, comprises a plurality of equally spaced parallel wires 35 secured to the foundation ring at one end and having the other end thereof bent inwardly and affixed to an annular metallic member, such as a plate 36. The foundation ring 28 or 29 and the plate 36, it will be noted, locate the grid verticals 35 in parallel relation and in a cylindrical boundary. During operation of the device, however, because of variations in the temperature thereof, the grid verticals 35 expand and contract and, due to differences in the temperature of the individual verticals and possible non-uniformities in the dimensions and composition thereof, certain of the verticals may expand and contract non-uniformly. The effects of such non-uniform expansion and contraction of various of the verticals are counteracted in part by the coaction of the inwardly bent end portions of the verticals and the plate 36 so that the desired uniform parallel relation is maintained to some degree. However, it has been found that, particularly in devices operated at high power levels, the differential expansion and contraction of the verticals is so great that these verticals depart from linearity, whereby the desired relation thereof to one another and to other electrodes of the device is destroyed with consequent change in the operating characteristics of the device and, in some cases, the verticals contact with another electrode, such as the cathode or another grid, whereby the device is rendered inoperative.

The deleterious effects noted above are prevented in devices constructed in accordance with the invention. As shown in Fig. 2, a pair of flexible wire helices 37 and 38 are wound about the verticals 35, the helix 37 having its turns secured, as by spot welding, to one group of alternate verticals and the helix 38 having its turns similarly secured to the other alternate verticals. The helices 37 and 38 are of a material, such as tantalum, which will retain its resilience at high temperatures. They may be of 4-mil tantalum wire or strip and the verticals 35 may be of 12-mil molybdenum.

This construction, it will be noted, provides, in effect, a multiplicity of cantilever elements each having its ends fixed to two alternate verticals of the grid. The expansion and contraction of each vertical is limited by the flexibility of these cantilever elements. The latter are relatively long and flexible and the thermal strain on the verticals, tending to bow them, is correspondingly small. Substantially linear expansion and contraction is thus realized whereby the form of each grid is preserved and the requisite spacing of each grid wire with respect to the other grid wires and to the other electrodes is accurately maintained. It will be appreciated, then, that

not only are constant operating characteristics realized but also extremely close spacing of the electrodes may be utilized.

Although a specific embodiment of the invention has been shown and described, it will be understood that it is but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electrode for electron discharge devices comprising a plurality of relatively rigid wires arranged in parallel relation, means mounting said wires to allow substantially free longitudinal expansion and contraction thereof with temperature variations and spacing said wires at one portion thereof, and means for maintaining said wires in parallel relation during expansion and contraction thereof including a plurality of cantilever spring elements each having its ends fixed to one pair of said wires, said elements being sections of a resilient wire extending obliquely with respect to said parallel wires.

2. An electrode for electron discharge devices comprising a plurality of substantially parallel wires mounted in a cylindrical boundary, means for supporting said wires, and means for maintaining said wires in parallel relation comprising a resilient helix having its turns secured to alternate wires.

3. An electrode for electron discharge devices comprising a plurality of substantially parallel wires mounted in a cylindrical boundary and having one end portion inwardly bent, a spacer member affixed to the inwardly bent portions of said wires, a support member affixed to said wires at the other end thereof, and a flexible member having at least one portion secured to certain of said wires at points intermediate the ends thereof.

4. An electrode for electron discharge devices comprising a plurality of substantially parallel wires mounted in a cylindrical boundary, means for supporting said wires, and a pair of flexible wires one of which is secured to alternate ones of said parallel wires and the other of which is secured to the other of said parallel wires.

5. An electrode for electron discharge devices comprising a plurality of substantially parallel wires mounted in a cylindrical boundary, a flexible helix having its turns secured to alternate wires, and a second flexible helix having its turns secured to the remainder of said wires.

6. An electrode for electron discharge devices comprising a plurality of substantially parallel wires mounted in a cylindrical boundary and having inwardly bent portions at one end thereof, a spacer member engaging said inwardly bent portions, a support secured to said wires at the other end thereof, a flexible wire helix encompassing said parallel wires and secured to alternate ones thereof, and a second flexible wire helix encompassing said parallel wires and secured to the remainder thereof.

VICTOR L. RONCI.