June 9, 1936. F. HERRIGER 2,043,659

ELECTRON DISCHARGE DEVICE

Filed July 11, 1934

Fig. 1

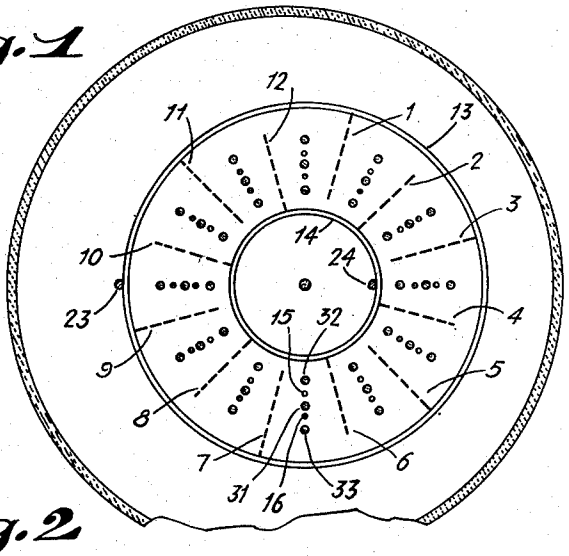


Fig. 3

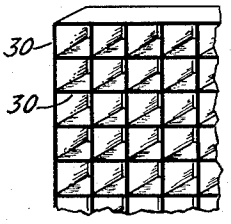
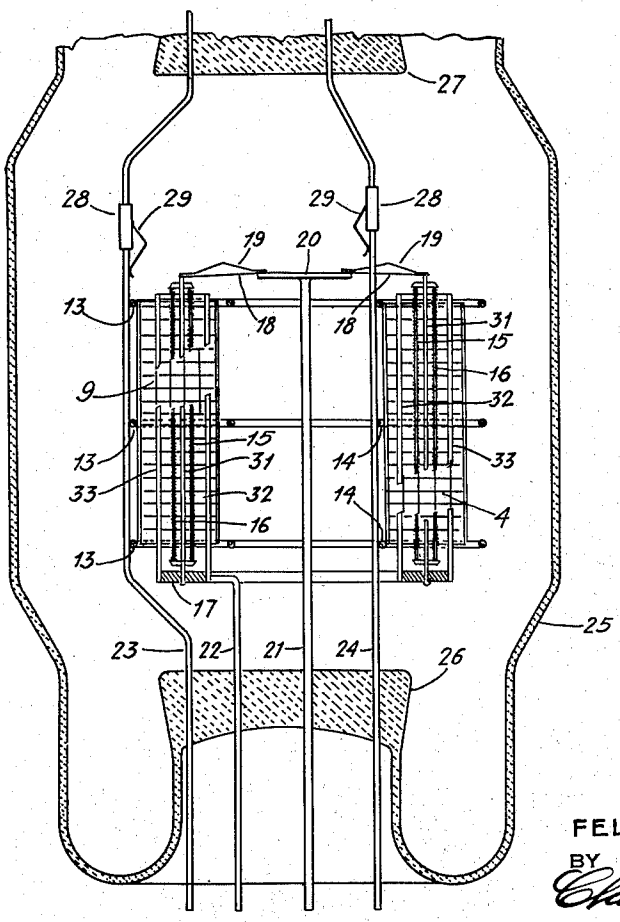


Fig. 2



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ELECTRON DISCHARGE DEVICE

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8 Claims. (Cl. 250—27.5)

My invention relates to an electron discharge tube of the thermionic type for the production of very short waves.

It is well known that for the production of extremely short continuous waves an electron discharge tube may be connected in what is known as the Barkhausen-Kurz circuit. In such an arrangement a high positive voltage is impressed upon the grid of a triode, while upon the anode (also called the retarding-field electrode) there is impressed a negative or a very small positive potential. Diodes can also be employed for the production of oscillations of this kind. In each of these examples, the periodic building up and collapse or decay of the space-charge has been found to be important for the production of the waves.

The useful energy or output that is attainable is limited by the maximum grid loss energy that may be carried off. Hence, for the generation of comparatively large outputs it is necessary to connect several tubes in parallel. One difficulty in present devices is that the connections or leads used to unite the several systems result in coupling effects of different kinds dependent upon the frequency that is generated. Another difficulty is that in the case of paralleling more than two tubes, proper balance is difficult to obtain.

The object of my invention is to provide an electron discharge device particularly suitable for ultra-short waves and having a comparatively high output in comparison to present tubes used for generating ultra-short waves. More specifically it is an object of my invention to provide an electron discharge device which is in effect a plurality of electron discharge devices which may be connected in parallel to deliver a high output at ultra-high frequencies but which is free of the difficulties usually encountered in parallel connections of electron discharge devices intended to have a large output.

According to my invention symmetric parallel conditions are obtained by connecting in parallel a plurality of diodes instead of triodes. Within the envelope of the tube I provide an even number of apertured electrodes (grids), which are radially disposed and between each pair of grids, an apertured, ribbon or filamentary emission surface is positioned. The electron emission surface in this arrangement serves at the same time as a cathode and as a retarding-field electrode for two grids, the nth grid in each case being united with the $n+2$nd grid with the result that adjacent grids oscillate in phase opposition or push-pull fashion. In this manner it is possible to shift the reversal point of electrons periodically to alternate sides of the electron-emissive surface, such shift of the reversing point being necessary to produce a periodic building-up and collapse of the space-charge.

However, it would also be conceivable to use an arrangement in which the grids are interconnected, while the cathodes oscillate in phase opposition. In this case, all of the grids would be directly connected with one another and they would have no alternating potential applied to them, whereas the nth cathode would in each instance be connected with the $n+2$nd cathode.

It is important in this connection to have an electron emitting surface that is as uniformly apertured as possible. According to my invention, this condition is satisfied by providing a number of hot cathodes of grid- or network-construction and connecting them either in parallel or in series, or by using a plate-shaped emitting surface. Where only a few heated cathodes are employed, a homogeneous retarding-field potential is produced by providing between pairs of heated cathodes, an electrode preferably kept at cathode potential. This auxiliary electrode may be apertured or solid.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure 1 is a horizontal cross-section of a tube embodying my invention, Figure 2 is a longitudinal section of the tube shown in Figure 1 with parts removed to make the figure more easily understood. Figure 3 is an enlarged perspective view of a portion of the grid structure.

The cold electrodes 1 to 12 inclusive, which are grid-like or apertured as best shown in Figure 3, are disposed radially, and consist of parallel strips of sheet material 30 forming a screen, which for the purpose of preventing a large primary grid current, are so arranged that their wide sides are positioned in the direction of flow of the electrons. The grids 1, 3, 5, 7, 9, 11 are externally welded to wire rings or loops 13, while the grids numbered 2, 4, 6, 8, 10, 12 are secured to three rings 14.

As shown in Figure 2, in which, for the sake of clarity of illustration, only the grids 4 and 9 are indicated, between each pair of the grids are interposed two parallel thermionic or heated cathodes 15 and 16. Between the two cathodes

is mounted a rod 31 maintained at cathode potential, adjacent cathode 15 a similar rod 32, and adjacent cathode 16 a rod 33. These rods serve for improving the distribution of the potential, and are secured to the supporting and distributing ring 17. Attached to the distributor ring are all of the cathodes. This ring is supported by the heater supply lead 22. Upon the opposite end of the cathodes is a fine wire spring 18 to which is fastened the molybdenum wire 19 for carrying the current. The fine wire springs are arranged on the distributor disc 20, which, in turn, is secured on the heavy heater-supply lead 21. The grid supporter rings 13 are welded onto the supply lead 23, and the grid supporter rings 14 onto the supply lead 24. At one end of the glass body 25 are sealed in the press 26 both the cathode leads 21 and 22 as well as the grid leads 23 and 24. The grid leads only are brought out thru the press 27 at the opposite end of the envelope. This press, when mounting and assembling the tube, is mounted by the aid of the bushings 28 over the grid leads 23 and 24, the slip springs 29 being further provided for the purpose of insuring proper electrical contact.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is,—

1. An electron discharge tube for ultra-short waves having an envelope, a plurality of apertured cold electrodes disposed within said envelope, a set of rings supporting alternate cold electrodes radially and outwardly from said rings, and a second set of rings larger in diameter than the first set and coaxial with the first set and supporting the remaining cold electrodes radially and inwardly from said second set of rings, and a thermionic cathode interposed between each pair of juxtaposed cold electrodes and consisting of filamentary elements lying in a radial plane.

2. An electron discharge tube for ultra-short waves having an envelope, a plurality of apertured cold electrodes disposed radially within said envelope and a thermionic cathode interposed between each pair of juxtaposed cold electrodes and consisting of filamentary elements lying in a plane and alternate cold electrodes being electrically interconnected, said cold electrodes consisting of a plurality of parallel sheet strips forming a screen lying in a radial plane, said strips lying in planes perpendicular to the radial plane of the cold electrodes.

3. An electron discharge tube for ultra-short waves having an envelope, a plurality of apertured cold electrodes disposed radially within said envelope, and a thermionic cathode interposed between each pair of juxtaposed cold electrodes and consisting of filamentary elements lying in a plane, auxiliary electrodes positioned between the filamentary elements comprising said cathode and co-planar therewith, said cathodes being electrically connected and alternate cold electrodes being electrically connected in parallel.

4. An electron discharge tube for ultra-short waves having an envelope, a plurality of electrodes in said envelope, and comprising alternate cold electrodes and cathodes, each of said cathodes comprising filamentary elements lying in a plane, and rods mounted adjacent and in the plane of the filamentary elements of said cathodes for providing a uniform distribution of the potential in the plane of the cathode containing the filamentary elements.

5. An electron discharge tube for ultra-short waves having an envelope, a plurality of electrodes in said envelope, and comprising alternate cold electrodes and electron emitting cathodes, each of said cathodes comprising filamentary elements lying in a plane and auxiliary electrodes mounted between the filamentary elements comprising said cathodes and co-planar therewith.

6. An electron discharge tube for ultra-short waves having an envelope, a plurality of electrodes in said envelope, comprising alternate cold electrodes and electron emitting cathodes, each of said cathodes comprising filamentary elements lying in a plane and auxiliary electrodes mounted between the filamentary elements comprising each of said cathodes and co-planar therewith.

7. An electron discharge tube for ultra-short waves having an envelope, a plurality of electrodes in said envelope, and comprising electron emitting electrodes disposed in a radial plane and a cold electrode positioned in each space between adjacent electron emitting electrodes and consisting of a plurality of parallel sheet strips forming a screen lying in a radial plane, said strips lying in planes perpendicular to the radial plane of said cold electrode whereby the planes of said strips lie parallel to the direction of travel of electrons from said electron emitting electrodes.

8. An electron discharge tube for ultra-short waves having an envelope, an inner support and an annular outer support coaxial with and surrounding said inner support within said envelope, and a plurality of perforated cold electrodes projecting radially from each of said supports toward the other and with the projecting electrodes on each support interleaved with the projecting electrodes on the other support and an electron emitting electrode disposed in a radial plane between each pair of juxtaposed cold electrodes.

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