Aug. 22, 1939. W. BUSCHBECK 2,170,653

ELECTRON DISCHARGE TUBE FOR ULTRA HIGH FREQUENCY SYSTEMS

Filed Nov. 18, 1936

Fig. 1

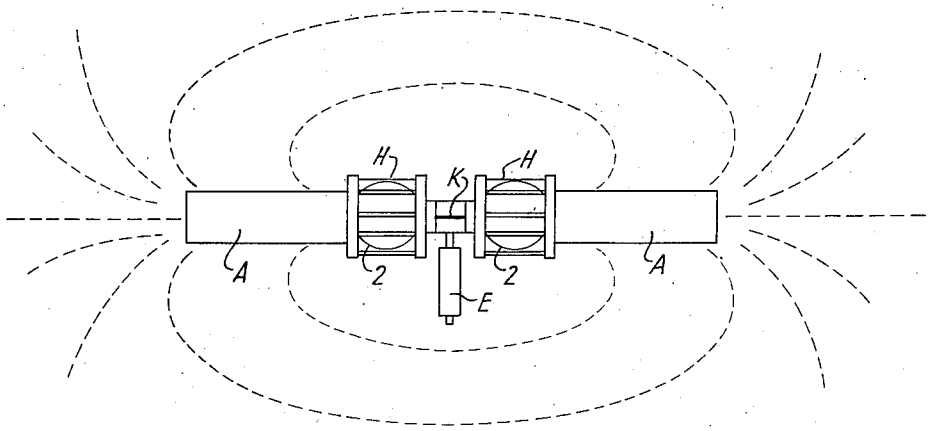


Fig. 3

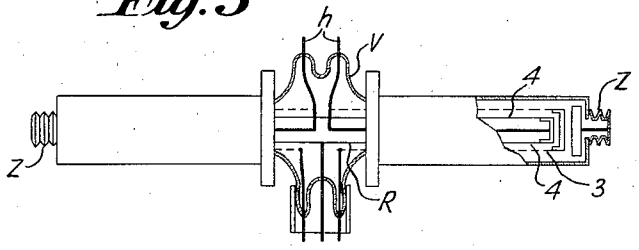


Fig. 2

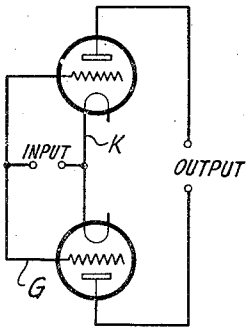
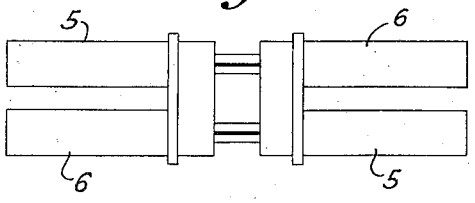


Fig. 4



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ELECTRON DISCHARGE TUBE FOR ULTRA HIGH FREQUENCY SYSTEMS

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2 Claims. (Cl. 250—27.5)

This invention relates to electron discharge tubes especially for use in ultra high frequency radio systems.

It is an object of my invention to provide an electron discharge tube of a type such that ultra high frequency oscillations may be generated. It is another object of my invention to provide a high power tube capable of generating or detecting ultra high frequency waves.

In designing electron discharge tubes suitable for high power generation of ultra short waves, difficulties have been encountered in the past, particularly because of the inherent increase in capacitances between the electrodes of the tube in relation to the reduction in the operating wave length. The difficulties of neutralizing such capacitances are very great.

It is of importance in a neutralized transmitter stage that the connection between the grid of the tube proper and the grid of its simulation in the neutral branch should be very short since in spite of the adjustment of the bridge balance to decoupling of input circuit from output circuit a back coupling or counter-coupling may occur, both very undesirable in certain cases.

A limit is set to the power increase by increasing the anode direct-current potential for the attenuation decreases greatly and a sufficient width of the band cannot be obtained. The reason lies in the fact that the external resistance must be increased with increased anode direct-current potential for obtaining a larger anode alternating potential with the same current and the load must, therefore, be coupled looser so that the attenuation decreases.

My invention will be best understood from the following description when read in view of the accompanying drawing in which Figure 1 shows more or less diagrammatically an electron discharge tube system of my invention having two symmetrical and equivalent arrangements of electrodes within a single hermetically sealed envelope;

Fig. 2 shows a circuit diagram of a short wave system in which the electron discharge tube of my invention may be employed;

Fig. 3 shows a modification of the invention; and

Fig. 4 shows a development of the basic idea of the invention as applied to a push-pull circuit.

Referring to Fig. 1, I show a transmitter tube of high power, in particular for ultra short waves, which is so constructed that the terminals of the active electrodes, and especially of the grid are disposed opposite and closely adjacent the terminals of corresponding passive electrodes. The active and passive electrodes have a common longitudinal axis. The cathode connecting line, disposed between the two systems, is made as short as possible, and the return connection is preferably shielded.

The anodes, water-cooled, if desired, are designated A. The tubular cathode K is preferably indirectly heated by a concentric filament. The filament leads are enclosed within the shield E. The glass envelope 2 may be strengthened by supporting devices H.

One feature of the invention consists in providing a very short connection between the active grid and a corresponding passive grid used for purposes of neutralization.

The construction of the connecting lines between the active and passive grids, also between the two cathodes is in the form of concentric conductors, which offer the further particular advantage that the wattless currents flowing in grid line G, Fig. 2, produce not only in this line but also in line K connected therewith a potential drop of exactly equal amount with the result that the output alternating potential cannot produce a back-coupling or a counter-coupling alternating potential between grid and cathode. When viewed from the output side, the grid and cathode are equi-potential points for the high frequency.

As a further advantage may be cited the small mutual stray capacity existing between the two anodes.

Since the active anode and the passive anode act like the two halves of a dipole antenna they may be employed as such. The anode elements A when activated produce radiations, the field intensity characteristics of which are represented by the dotted lines surrounding and extending away from the envelope of the tube.

The adaptation of a radiator of this type for maximum power output is obtained by use of separate adjustments of the D. C. resistance and the high frequency impedances respectively. The radiation resistance in the point of symmetry is actually solely a function of the radiator length in its relation to the wave length, while the reactance of the radiator at the point of symmetry depends further on the wave resistance. An adaption is, of course, feasible by inductive or capacitative reactances connected in parallel with the radiator input (the two anodes). It will also be suitable in arrangements of this type to move the second cathode return to the center of the tube arrangement as shown at *h* in Fig. 3. Other-

wise the filament leads would need to be provided with radio frequency chokes.

A dipole de-attenuated in itself in this manner has, compared to the usual arrangements (feeding of the dipole or dipoles through energy lines) the considerable advantage that the energy line losses are eliminated. Such losses as do occur are attributable solely to the direct current control energy which must be furnished through the concentric cable, the outer conductor of which is constituted by the shield E. The opportunity is thus given to develop directional antennas or to increase the power considerably by a plurality of dipoles, controlled synchronously and in phase and individually de-attenuated. Under certain circumstances these dipoles may be modulated.

The lowest obtainable limiting wave length is dependent in first place (beside the unavoidable internal capacities) on the inductance of that part of the conductor disposed between the active grid starting point and the corresponding counter-point in the passive grid. Hence, the active and passive tube electrodes are all contained within a common high vacuum vessel. The previously mentioned conductor may then be reduced to not more than half the length that would otherwise be necessary.

In Fig. 3, I show a modification having a common glass vessel V. To the right may be seen in section the grid **3** and heating filament **4** which latter consists of an interior lead of thick wire and several returns of exterior thin wires which run into a pipe R in the center of the tube arrangement. The hot filament connections are at *h*. In order to provide a neutralizing adjustment the grid-anode capacity of the tube or of the neutralizer or of both is suitably made somewhat variable by means of flexible members Z, which are preferably corrugated or made like bellows, and of metal, glass or other material adapted to form a vacuum-tight seal.

In a further modification of the invention, the ultra high frequency energy (decimeter waves) may be withdrawn capacitively through the glass wall of the tube envelope.

A further step may be taken, building the passive portion the same as the operative portion of the tube. In this case the life of the filament can practically be doubled by the alternate heating on the respective sides of the tube.

The oscillator tube of my invention is capable of use in systems which do not employ ultra short waves, but, say, waves of slightly greater length. In this case neutralization may be effected by external capacitances and the two sides of the tube may both be activated in parallel. The output is thus doubled. The heating filament may at the same time be series operated for further economy of power.

Fig. 4 shows another modification of my invention in which four sets of electrodes are provided, each set including a cathode, an anode and a control grid. The arrangement is intended for push-pull operation. The sections **5** may be considered active sections, whereas their complementary sections **6** will then be made passive and would be utilized solely for purposes of neutralization.

Other modifications of my invention will readily occur to those skilled in the art, but nevertheless they would be comprehended within the scope of the claims.

I claim:

1. An electron discharge device comprising two cylindrically formed and coaxially arranged anodes hermetically closed at their outer extremities, tubular insulating means sealed to the inner extremities of said anodes and forming in combination therewith a vacuum-tight envelope, cathodes and control grids concentrically disposed within and in juxtaposition to the anodes and forming therewith two electrode groups, concentric terminal leads connected to said cathodes and to said control grids, said leads being admitted through the envelope at points adjacent the transverse plane of symmetry of said discharge device, capacity means for excitation of the cathode and grid within one group, means for causing the cathode and grid within the other group to remain temporarily passive, and means constituted by the relative arrangement of the electrodes and of their leads for causing the interelectrode capacitances to be neutralized.

2. An electron discharge device comprising a plurality of cylindrically formed anodes each hermetically closed at one end, tubular insulating means sealed to the other ends of said anodes and forming in combination therewith a single vacuum-tight envelope, cathodes and control grids concentrically disposed within and in juxtaposition to each of said anodes, concentrically disposed terminal leads connected to said cathodes and control grids; capacity means for excitation of the cathode and grid within one anode while the cathode and grid within another anode remain passive, and means constituted by the relative arrangement of the electrodes and of their leads for effectively neutralizing the capacitances of said device.

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