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ULTRA HIGH FREQUENCY TUBE

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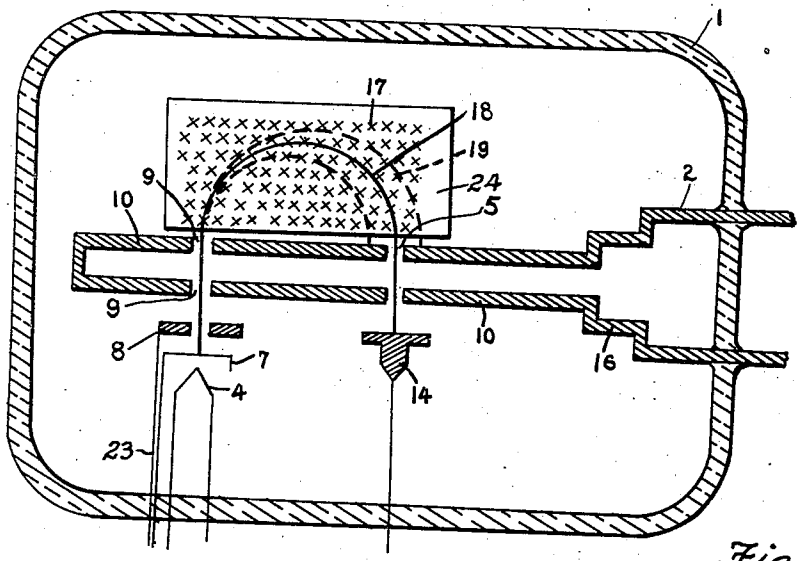


Fig. 1

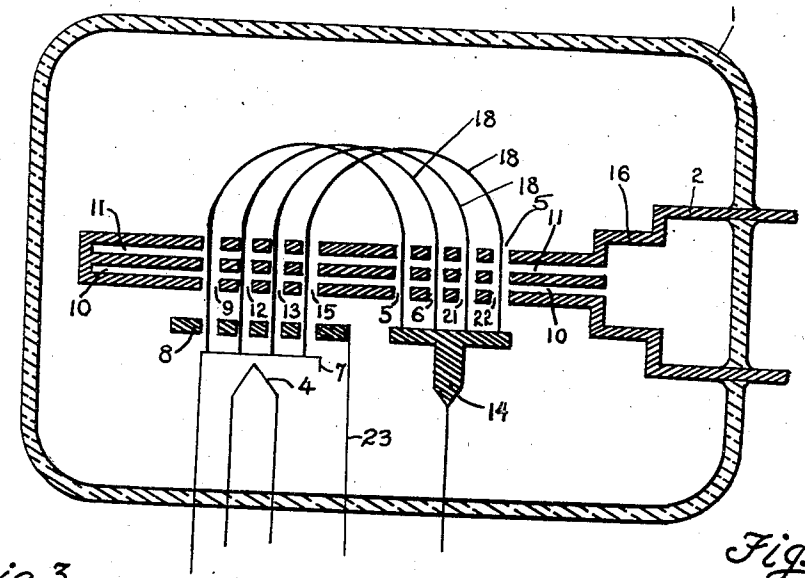
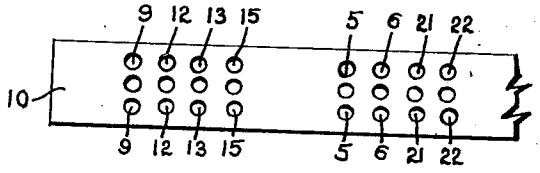


Fig. 2

Fig. 3



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ULTRA HIGH FREQUENCY TUBE

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1 Claim. (Cl. 315—5)

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This invention relates to tubes for ultra high frequency, and in particular to oscillators and amplifiers for the microwave region.

An object of the invention is to produce a tube of the velocity modulated type for microwaves and particularly to produce such a tube for use as a beating oscillator in a heterodyne receiving set.

Figure 1 is a sectional profile view of a tube according to the invention;

Figure 2 is a sectional profile view of another tube according to the invention; and

Figure 3 is a plan view of a portion of the waveguide in the tube of Figure 2.

My invention is also useful as a transmitter tube for communications, and for other purposes.

A feature of the invention is the use of a magnetic field to analyze a velocity modulated beam of electrons in order to obtain an amplitude modulated beam of electrons.

Other objects, advantages, and features of the invention will be apparent in the following specification taken in connection with the accompanying drawings in which:

In Figure 1 the glass envelope 1 has a waveguide 2 sealed through it at one end and is electrically coupled to a waveguide resonator chamber 10, by means of another piece 16 of waveguide whose dimensions are such as to give the proper electrical coupling. The tube also contains a cathode 7 which is heated by some suitable means, such as the filament 4 shown in the figure. The cathode is made negative with respect to the resonator 10, so electrons which are emitted by the cathode 7 are accelerated toward the resonator 10. These electrons are formed into a beam in the usual manner by means of the focussing ring 8, so that they pass through the first set of holes 9, in the resonator 10. An oscillating electric field exists in the resonator. Consequently the electron beam is velocity modulated during its first passage through the resonator 10. After pasing through the resonator, the electron beam enters a magnetic field represented in the usual manner by the crosses 17, which represent lines of form extending from a conventional magnetic poll 24. This magnetic field causes the electron beam 18 to follow a roughly semicircular path, back to the second set of holes 5 in the resonator. The faster electrons will travel in a larger circle 19 than the slower electrons, so when the electron beam again reaches the resonator, only the faster, or only the slower, depending on the adjustment of the magnetic field, electrons pass through the second set of holes 5. Therefore, the beam which passes through the resonator will be amplitude modulated and so deliver energy to the resonator 10. The exact phasing of the velocity modulation with the reentering beam is accomplished by a fine adjustment of the magnetic field which does not appreciably affect the focussing action. Part of the energy which is delivered to the oscillating field maintains the field in the resonator, and part passes through the coupling 16, into the output waveguide 2, and out of the tube to be used. A collector electrode 14 is provided to remove the spent electrons. Lead-in wire 23 extends from focusing ring 8 through glass envelope 1.

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In order to allow more current in the electron beam, it may be convenient to use several holes 9, 12, 13, 15 in parallel, and also 5, 6, 21, 22 at the other end, as shown in Figures 2 and 3. One advantage of using a large current is that more energy is delivered to the resonator and hence the power output can be larger. In order to obtain a still further increase in the power output, it may be convenient to have more resonator chambers 10, 11 as shown in Figure 2. One advantage of a larger number of resonators 10 is that there would be an increase in the available power output.

In either case, the coupling 16 should be loose enough so that the resonant frequency will be determined by resonator 10, and 11 if so used.

For best results, the velocity of the electrons passing through the waveguide 10 and the distance of their path through the waveguide 10 at this point should be chosen so that this distance is equal to an odd number of half-periods at the desired wavelength. The tuning will be better if the odd number is small.

What I claim is:

An ultra-high frequency oscillator comprising: a longitudinal waveguide closed at one end and open at the other for transmission of power therefrom and having two spaced apart sets of openings therein for the passage of electron beams laterally therethrough at two separated places therein, a cathode in register with one set of openings, means on the opposite side of said waveguide from said cathode for producing a magnetic field on said opposite side of said waveguide from said cathode and transverse to the path of the electron beam through said sets of openings and a collector electrode on the same side of the waveguide as the cathode and in register with the second set of openings in the waveguide.

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