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ELECTRON BEAM TUBE FOR ULTRA HIGH FREQUENCIES

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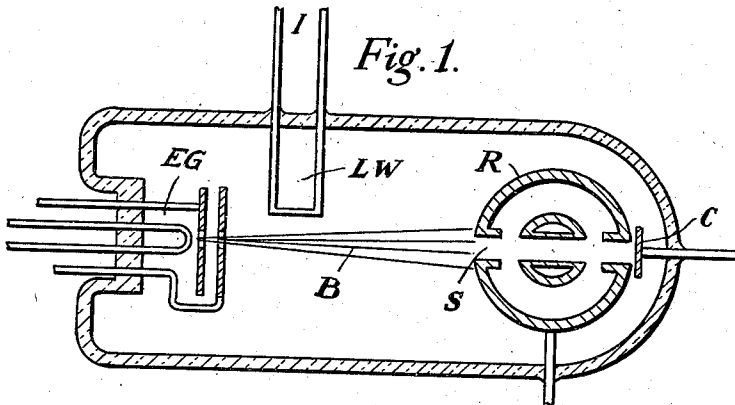


Fig. 2.

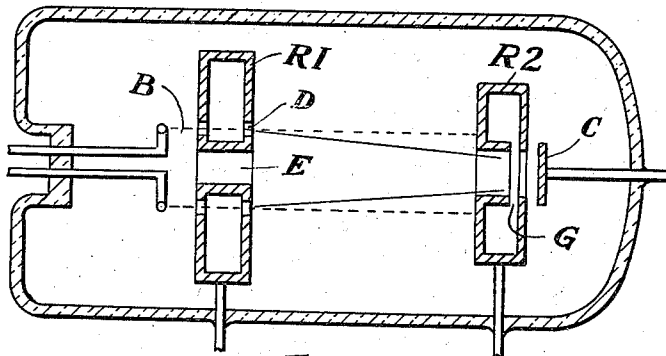
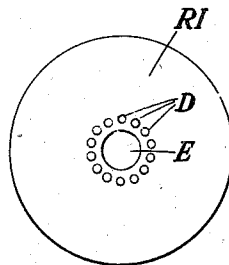


Fig. 3.



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ELECTRON BEAM TUBE FOR ULTRA HIGH FREQUENCIES

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3 Claims. (Cl. 315—6)

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The present invention relates to electron beam tube arrangements and particularly to such arrangements for use with ultra high frequencies.

Electron beam tube arrangements for use at high frequencies are usually of one of two types:

- (a) Those employing velocity modulation where the electron beam is "bunched" by means of an electric field parallel to the beam, or
- (b) Those where the electron beam is deflected by means of an electric field which is perpendicular to the initial direction of the beam.

Both of these types, or any type in which an electric field interacts with an electron beam, are characterised by the absorption of energy by the electron beam from the input circuit, or device, which affects the beam. For example, in the case of the oscillator or amplifier employing velocity modulation the electron beam absorbs energy from the input resonator, owing to the finite width of the gap across which the velocity modulating voltage is applied. Even if the gaps were ideal (i. e. of zero width), there would be a variable electric damping on the input circuit owing to spontaneous fluctuations in the electron beam current density. This electronic damping of the resonator or other input circuit lowers the magnification factor, or Q , of that circuit. If this damping could be eliminated, input circuits of higher Q could be obtained, and this would be advantageous in obtaining high frequency stability in oscillators or power amplifiers.

It is the object of this invention substantially to eliminate this damping effect.

According to one aspect of the invention an electron beam tube arrangement for use with ultra high frequencies comprises an ultra high frequency input circuit and an ultra high frequency output circuit, the input circuit being arranged to deflect magnetically the electron beam.

According to another aspect of the invention an electron beam tube arrangement for use with ultra high frequencies comprises an ultra high frequency input circuit arranged to deflect magnetically the electron beam transversely and a resonator of appropriate frequency arranged to be excited by said beam.

From another aspect an electron beam tube arrangement for use with ultra high frequencies according to the invention comprises an ultra high frequency resonator excited by the input currents and arranged to deflect magnetically the electron beam transversely and an ultra high frequency resonator excited by the electron beam and included in an output circuit.

By means of the magnetic deflection of the beam there is no absorption of energy by the beam from the input resonator or other circuit.

The principle of a system in accordance with the invention is illustrated in Fig. 1 of the accompanying drawings whilst Fig. 2 illustrates a practical arrangement. Figure 3 is a view of R1 of Fig. 2 as seen from the left or right of Figure 2.

Referring to Figure 1 the current through the closed end of a Lecher wire LW comprising the input circuit 1 sets up a magnetic field which deflects the electron beam B generated by the electron gun EG backwards and forwards across the slot S in a resonator R which comprises a coaxial line section resonator or any other kind of hollow resonator. A collector electrode C is provided at the output side of the slot S. The resonator R may be placed so that the electron beam crosses the slot once or twice during each period of the oscillation applied to the input circuit. In the former case the system may be used as an oscillator by coupling the resonator to the input circuit, or as a power amplifier. If the resonator receives two pulses of current in each period of the input frequency, the system acts as a frequency doubler.

In the preferred arrangement shown in Fig. 2, an annular electron beam B passes through a first disc resonator R1 at a current antinode, and through a second disc resonator R2 at a voltage antinode. The end walls or flat sides of the resonator R1 each have a circular arrangement of apertures D concentric with a central aperture E Fig. 3. The apertures D are to enable the annular beam B to pass through the resonator. The inner cylindrical wall of R2 is provided with a peripheral gap G at one end as shown in Figure 2. The effective electrical field appears across this gap G, there being a voltage antinode at this location. Pulses of current pass through the second resonator once in every cycle. These pulses are caused by the electromagnetic deflections of the individual electron beams which make up the annular beam, each of these individual beams being deflected radially so that it passes intermittently through the resonator. The aligned apertures D in the resonator R1 form electron paths parallel to the flow of current on the inner cylindrical wall of the resonator R1, and thus these paths cut the electromagnetic lines of force in the proper direction to cause the radial deflection of the beams. By coupling the second resonator to the first, the system will work as an oscillator. Alternatively it can be used as a power amplifier in which case the first resonator

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is driven by a separate low power oscillator, or it may be used as a small signal amplifier, the signal being applied to the first resonator. Any known arrangement may be used for producing the annular electron beam B and a collecting electrode C is provided in the usual manner.

The method of deflecting an electron beam by means of magnetic fields leads to all the advantages to be derived from an input system which is not damped by the electron beam with which it interacts.

While two arrangements embodying the invention have been described others will be apparent to those skilled in the art and all of which will fall within the scope of the appended claims.

What is claimed is:

1. An electron beam tube for use with ultra high frequencies comprising a hollow tuned output resonator having aligned apertures in the walls thereof, means for generating and directing a beam of electrons through said apertures, and a tuned input circuit having a current path positioned adjacent the path of the said beam between said generating and directing means and said output resonator, said current path being located with a component parallel to said beam path whereby the magnetic field developed about said current path deflects said electron beam and periodically directs it through said apertures and said output resonator.

2. An electron beam tube as claimed in claim 1 wherein the said electron beam generating means

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comprises means for producing a pencil of electrons and said input circuit comprises a Lecher wire having a crossbar parallel to the longitudinal axis of the beam and the said output resonator comprises a section of coaxial transmission line having diametrical aligned slots through which the beam passes.

3. An electron beam tube as claimed in claim 1 wherein said electron beam generating means comprises means for producing an annular beam of electrons and wherein the said input circuit comprises an apertured annular input resonator providing a path for the electron beam at a current antinode of the said input resonator and the said output resonator comprises an apertured annular resonator providing a path for the electron beam at a voltage antinode of the said output resonator.

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