Feb. 14, 1939. R. A. BRADEN 2,147,143

MAGNETRON DETECTOR CIRCUIT

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Fig. 1.

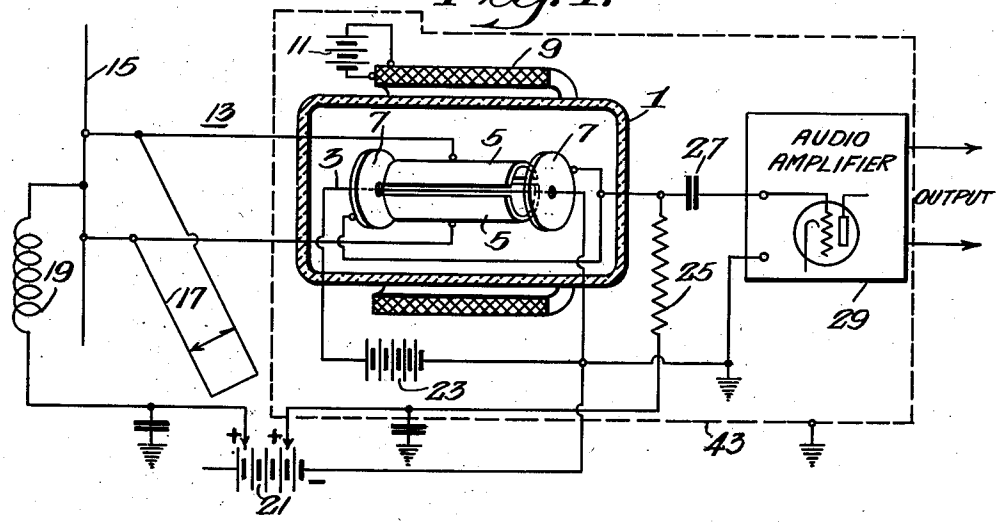
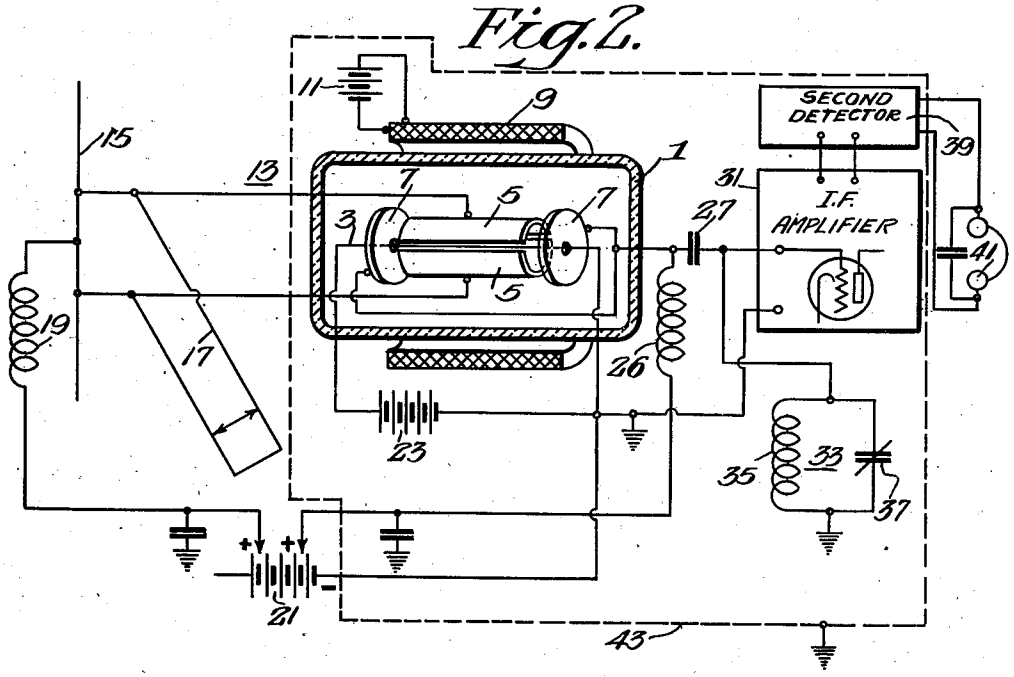


Fig. 2.



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MAGNETRON DETECTOR CIRCUIT

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8 Claims. (Cl. 250—20)

My invention relates to magnetron detector circuits and more particularly to a magnetron detector with end plates which are connected to an audio or an intermediate frequency output circuit.

A magnetron with split anode electrodes is a desirable detector or generator of ultra high frequency currents. The addition of positively polarized end plate electrodes to a magnetron increases the stability, efficiency, output, and ease of adjustment of such magnetrons over the conventional magnetron. The effect of the positively polarized end plates is to cause the electrons which, without the influence of end plates and under the influence of a magnetic field, follow curvilinear paths from the cathode to or toward the anodes to follow spiral paths from the cathodes to and towards the anodes and the end plates.

I have found that such end plates may be included in a circuit responsive to audio or intermediate frequency currents. One of the advantages of such an end plate circuit is the convenience of adjustment. Another advantage is the substantial improvement which may be effected in the elimination or attenuation of undesirable fields which affect the operation of ultra high frequency magnetron circuits.

One of the objects of my invention is to provide means for connecting the end plates of a magnetron to a circuit which is responsive to audio frequency currents.

Another object is to provide an end plate magnetron with a circuit responsive to detected or intermediate frequency currents which flow in the end plate circuits.

A further object is to provide means whereby an end plate magnetron is operated as an oscillator and mixing tube and the end plate circuit is responsive to intermediate frequency currents created thereby.

My invention is described in detail in the following specification and accompanying drawing in which—

Figure 1 is a schematic diagram of an end plate magnetron in which the audio output is derived out of the end plate circuit, and

Figure 2 is a schematic diagram of an end plate magnetron arranged to establish intermediate frequency currents in the end plate circuit.

In referring to the drawing similar reference numerals will be used to indicate similar elements. Referring to Fig. 1, within an evacuated envelope 1 are arranged the cathode 3, split anodes 5, and end plate electrodes 7 of a magnetron. These electrodes may be supported in any suitable manner. The end plates are preferably symmetrically arranged with respect to the split anodes. A magnetic field, whose lines of force surround and are substantially parallel to the cathode 3, is established by a permanent magnet, electro-magnet or solenoid 9. The solenoid is energized by a battery 11 or the like.

The anode electrodes 5 are connected to a resonant line 13 which may be terminated in a dipole antenna 15. While the resonant line is shown as tuned by an adjustable shunt section 17, any tuning means may be employed. The mid-point of the dipole 15 is connected through a radio frequency choke 19 to the positive terminal of a battery 21. The negative terminal of the battery is connected to the cathode 3 which is energized by a battery 23 or any convenient source of power.

The end plates 7 are connected together and to a coupling impedance 25, across which detected signal voltages are developed and which is connected to a point of positive polarity on the battery 21, or to an independent battery for polarizing the end plates positive with respect to the cathode 3. The end plates are also connected, through a coupling capacitor 27, to the input of an audio amplifier 29. The output of the audio amplifier is impressed on a signal indicator. If double modulation is used in the transmitter, the audio amplifier is replaced by an amplifier responsive to the intermediate carrier frequency currents.

In the circuit of Fig. 2, the magnetron electrodes are connected similar to the above description of Fig. 1 but the connection from the end plates to an intermediate frequency amplifier 31 include a tuned circuit 33. The tuned circuit is comprised of an inductor 35 and a capacitor 37 which are resonant to the intermediate frequency currents. The output of the intermediate frequency amplifier 31 includes a second detector 39 and telephone receivers 41 or other signal indicator.

In the operation of the device illustrated in Fig. 1, the magnetron is adjusted to operate as an ultra high frequency detector. The tuned circuit 13, 15, 17 is made responsive to the incoming signal currents. The magnetic field, and anode and end plate potentials are adjusted to give optimum signal response. The tendency of the magnetron detector to be influenced by stray

fields can be greatly reduced by the use of the end plate circuit which can be readily shielded from the disturbing currents.

In the arrangements shown in Figs. 1 and 2, the shielding **43** prevents direct pick up. The capacity between the end plates and the anodes is very low. This low capacity will make the transfer of disturbing currents, picked up by the transmission line, very small. Finally, the antenna and the transmission line are at ground potential for all currents whose frequency is below the ultra high frequency band within which the magnetron detector operates. Hence, practically no disturbing potentials will be picked up within the frequency range to which the detector output circuit is responsive.

In the operation of the circuit of Fig. 2, I have found that the magnetron input circuit and the magnetron operating parameters may be adjusted so that the magnetron generates oscillatory currents of a frequency equal to the incoming signal frequency plus or minus the intermediate frequency. The incoming signal frequency currents and the currents generated by the oscillations within the magnetron combine to form beat or intermediate frequency currents which are impressed on the intermediate frequency amplifier and rectified by the detector **39**. As in the case of the circuit of Fig. 1, the intermediate frequency circuits may be shielded to reduce the pickup from disturbing fields.

Thus, I have described an end plate magnetron in which the end plates are connected to a circuit or amplifier responsive to intermediate or audio frequency currents. The end plate circuits may be shielded from undesired fields to attenuate its response to said fields, and thereby improve the signal to noise ratio over conventional magnetron circuits.

I claim as my invention:

1. An ultra high frequency magnetron having cathode, anode and end plate electrodes, means connected to said anode electrodes for impressing incoming signal frequency currents thereon, means across which detected signal voltages are developed, and connections from said last named means to said end plate electrodes.

2. An ultra high frequency magnetron having cathode, anode and end plate electrodes, means for biasing said anode and end plate electrodes positively with respect to said cathode, means connected to said anode electrodes for impressing incoming signal frequency currents thereon, means across which detected signal voltages are developed, and connections from said last named means to said end plate electrodes.

3. An ultra high frequency magnetron having cathode, anode, and end plate electrodes, means connected to said anode electrodes for impressing incoming signal frequency currents on said anode electrodes, means for adjusting the operating parameters of said magnetron to thereby generate beat frequency currents, a circuit responsive to said beat frequency currents, and connections from said end plate electrodes to said circuit.

4. An ultra high frequency magnetron having cathode, anode, and end plate electrodes, means for biasing said anode and end plate electrodes positively with respect to said cathode, means connected to said anode electrodes for impressing incoming signal frequency currents on said anode electrodes, means for adjusting the operating parameters of said magnetron to thereby generate beat frequency currents, a circuit responsive to said beat frequency currents, and connections from said end plate electrodes to said circuit.

5. A magnetron for receiving and detecting ultra high frequency oscillations including cathode, split anode, and end plate electrodes, means for establishing a magnetic field whose lines of force are substantially parallel to and surround said cathode, a resonant line connected to said split anode electrodes, means for tuning said resonant line to incoming currents, a circuit responsive to detected components of said currents and connected to said end plate electrodes, and means for polarizing said split anodes and said end plates positive with respect to said cathode.

6. A device of the character of claim 1 in which the end plate electrodes are symmetrically arranged with respect to the anode electrodes.

7. A device of the character of claim 5 in which the end plate electrodes are symmetrically arranged with respect to the split anodes.

8. An ultra high frequency magnetron including cathode, split anodes, and end plates symmetrically arranged with respect to said split anodes, a resonant line including a dipole antenna connected to said split anodes, a shunt section connected to said resonant line for tuning said line to incoming signal frequency currents, means responsive to detected components of said incoming signal frequency currents, connections from said end plates to said means, and a source of polarizing voltage for biasing said split anodes and said end plates positively with respect to said cathode.

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