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ELECTRON DISCHARGE DEVICE OF THE MAGNETRON TYPE

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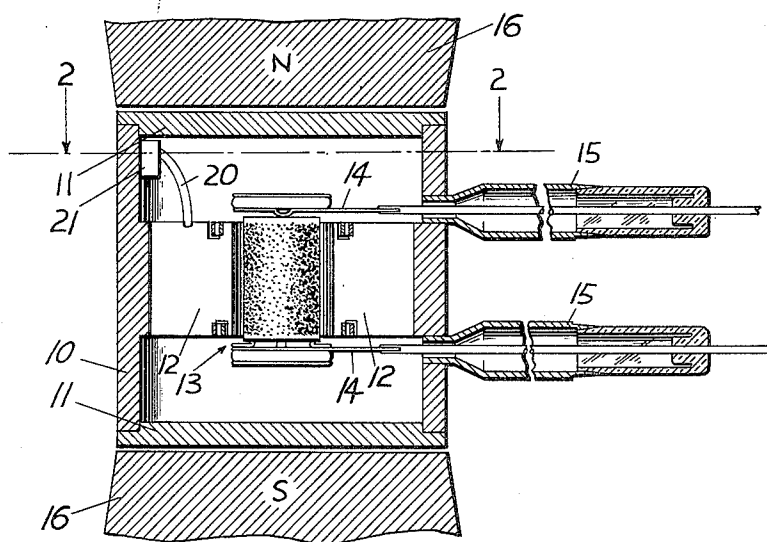


FIG. 1

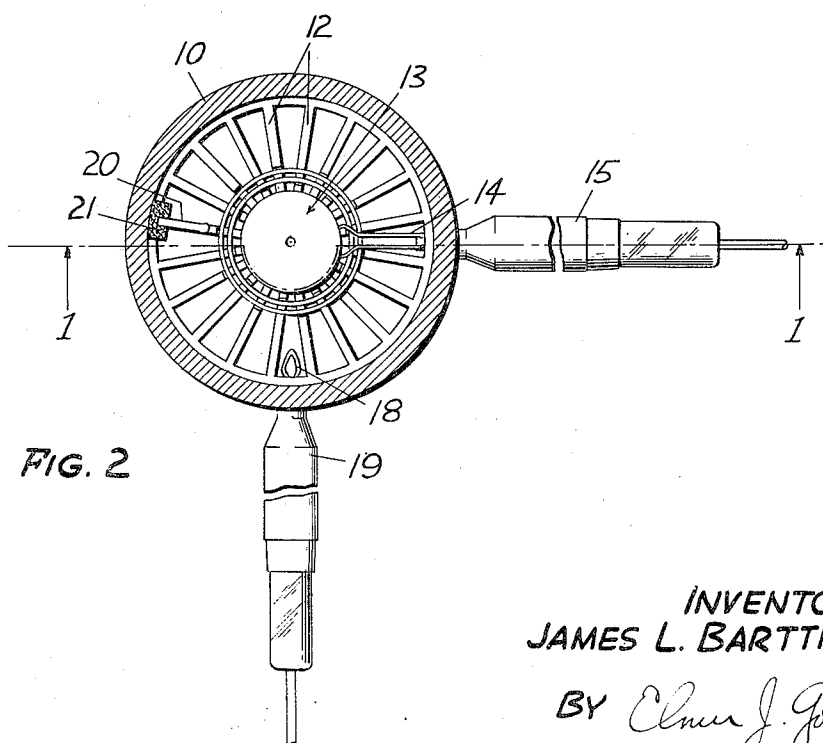


FIG. 2

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ELECTRON DISCHARGE DEVICE OF THE
MAGNETRON TYPE

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4 Claims. (Cl. 315-40)

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This application relates to electron discharge devices of the magnetron type, and more particularly to improvements therein whereby undesired frequencies of operation are suppressed.

In magnetrons of the type described herein, the desired frequency of operation is generally that, wherein the inner tips of alternating anode members are always at equal potential, known as the π mode of operation. However, due to a heavy loading of this π mode by the device being fed by the magnetron and due to variations in the magnetic field, and in the anode voltage of the device, the magnetron will sometimes begin to operate in the mode of the next higher frequency above the π mode frequency, since this mode is substantially unloaded by the apparatus to which the magnetron is coupled.

It is believed that when a magnetron is turned on the first oscillations in any mode build up due to the sporadic noise disturbances, enhanced by a major or minor, geometrically-caused, resonance occurring at the frequency of the mode.

Therefore, it is an object of this invention to damp out the noise frequencies at the undesired mode of operation thereby suppressing operation in this mode.

A further object of this invention is to load the undesired mode of operation thereby absorbing the power from this undesired mode of operation and preventing substantial building up of oscillations in the same.

Other and further objects of this invention will become apparent as the description thereof progresses, reference being had to the accompanying drawing wherein:

Fig. 1 is a vertical cross-sectional view, taken along line 1-1 of Fig. 2, of a magnetron built in accordance with this invention; and

Fig. 2 is a horizontal cross-sectional view taken along line 2-2 of Fig. 1.

Referring now to Figs. 1 and 2 there is shown a magnetron comprising a heavy cylindrical member 10 which may be of copper, whose ends are closed by flat, round disks 11 which are sealed thereto as by soldering. Extending radially inwardly from the inner surface of the cylindrical member 10 are a plurality of rectangular-shaped anode members 12. Each pair of adjacent anode members together with the space therebetween define a cavity which basically determines the frequency of operation of the device. The anode members 12 do not extend completely to the center of the cylindrical member 10, but rather leave a cylindrical hole in which is positioned a cathode structure 13. This cathode structure

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comprises a cylinder, the outer surface of which is coated with electron-emissive material, which is heated by a coil inside said cylinder. The details of this cathode structure are more specifically set forth in Patent No. 2,439,786, issued April 20, 1948. The cathode structure 13 is supported by a pair of leads 14 attached to the cathode structure at each end thereof and which extend out through the wall of the cylinder 10 through a pair of insulating seals 15 whereby an external heater voltage may be applied to heat the cathode, and an external potential may be applied between the cathode and anode. The magnetic pole pieces 16 of the magnetron are applied adjacent the end plates 11 to produce the required magnetic field across the inter-action spaces between the cathode 13 and the anode members 12 in a well-known manner.

In order to prevent operation of the magnetron in a mode lower than the π mode and to increase the separation of the π mode from the higher modes, a pair of straps 17 are connected to alternate anode members on the bottom edge thereof and toward the inner ends thereof and a similar pair of straps is attached to the top edges. The action of these straps is well known and more fully disclosed by Patent No. 2,417,789, issued March 18, 1947.

Power is fed to the load by means of an antenna coupling loop 18, one end of which is attached to the cylinder 10 and the other end of which passes through a seal 19 in the cylinder and thence to the load.

In order to suppress oscillations at the frequency of the next higher mode above the π mode, a wire 20 is attached to one of the vanes at a point which is substantially a voltage node for the mode above the π mode. This wire extends from the vane upwardly into a receptacle 21 of some lossy substances such as carbon or finely divided iron particles in a suitable binder such as clay. This receptacle is in turn attached to the cylinder 10. The length of the wire 20 between its point of attachment on the vane 12 and the receptacle 21 is made substantially equal to a quarter wave length of the frequency of the mode which it is desired to suppress; namely, the mode above the π mode.

Since the wire 20 is attached to a voltage node for the mode to be suppressed, the point at which the wire 20 enters the receptacle 21 will be a high current point for the frequency of the mode to be suppressed. This high current will pass through the receptacle 21 to the anode cylinder 10 which is at R. F. ground potential, thereby dis-

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sipating a large amount of power in the lossy material 21. Since this power being dissipated would normally have remained in the cavities thereby building up oscillations at the undesired frequency, the dissipation of this power in the lossy substance 21 suppresses oscillations in the undesired mode.

Obviously the Q of the dissipating circuit comprising the vane 12, the wire 20, the lossy material 21 and the anode cylinder 10 must be high enough such that it will pass substantially no power from the π mode of frequency into the lossy material 21.

In a strapped magnetron of this type having twenty anode members, the mode separation will be as much as 30% and therefore the Q of the dissipated circuit could be as low as three for this particular application without appreciably sapping power from the π mode of operation.

It is to be clearly understood that while I have shown only one wire 20 feeding undesired oscillations to the lossy material 21 from one of the vanes 12, more wires 20 may be attached to other vanes 12 to further increase the power-suppressing capacity of the lossy material 21 for the undesired frequency. Moreover, other wires 20 could be tuned to higher modes above the first mode above the π mode to prevent operation in said higher modes.

This completes the description of one modification of the invention. However, many other modifications will be apparent to those skilled in the art. For example, the wire 20 might be in the form of a probe and might be some multiple of a quarter wave length other than one, or might be fed from a current node rather than a voltage node. Also, it is not necessary that the straps 17 be used on the vanes and indeed other configurations of the anode structure may be used without departing from the spirit and scope of the invention. Therefore, applicant desires a broad interpretation of the appended claims commensurate with the scope of the invention within the art.

What is claimed is:

1. An electron discharge device comprising an evacuated envelope containing a cathode and a plurality of anode members radially spaced from said cathode, adjacent anode members together with the space therebetween defining resonant cavities, and means for suppressing oscillations at frequencies, other than that at which each of said cavities is primarily resonant, comprising a wire whose electrical wave length is a multiple of a quarter wave length of the frequency to be suppressed coupled to said cavities and to a power dissipation means.

2. An electron discharge device comprising an evacuated envelope containing a cathode and a

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plurality of anode members, adjacent anode members together with the space therebetween defining resonant cavities, means for producing a magnetic field perpendicular to the electron path between said cathode and said anode, and means for suppressing oscillations at frequencies, other than that at which each of said cavities is primarily resonant, comprising a wire whose electrical wave length is a multiple of a quarter wave length of the frequency to be suppressed coupled to said cavities and to a power dissipation means, said wire being attached to a voltage node, of the frequency to be suppressed, on one of said anode members.

3. An electron discharge device comprising an evacuated envelope containing a cathode and a plurality of anode members, adjacent anode members together with the space therebetween defining resonant cavities, means for directing electrons from said cathode to said anode along modified circular paths, and means for suppressing oscillations at frequencies, other than that at which each of said cavities is primarily resonant, comprising a wire whose electrical wave length is a multiple of a quarter wave length of the frequency to be suppressed coupled to said cavities and to a power dissipation means, said power dissipation means comprising a mass of carbon.

4. An electron discharge device comprising an evacuated envelope containing a cathode and a plurality of anode members, adjacent anode members together with the space therebetween defining resonant cavities, means for controlling the flow of electrons from said cathode to said anode comprising means for producing a magnetic field, and means for suppressing oscillations at frequencies, other than that at which each of said cavities is primarily resonant, comprising a wire whose electrical wave length is a multiple of a quarter wave length of the frequency to be suppressed coupled to said cavities and to a power dissipation means, said wire being attached to a voltage node of the frequency to be suppressed on one of said anode members and said power dissipation means comprising a mass of carbon.

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