

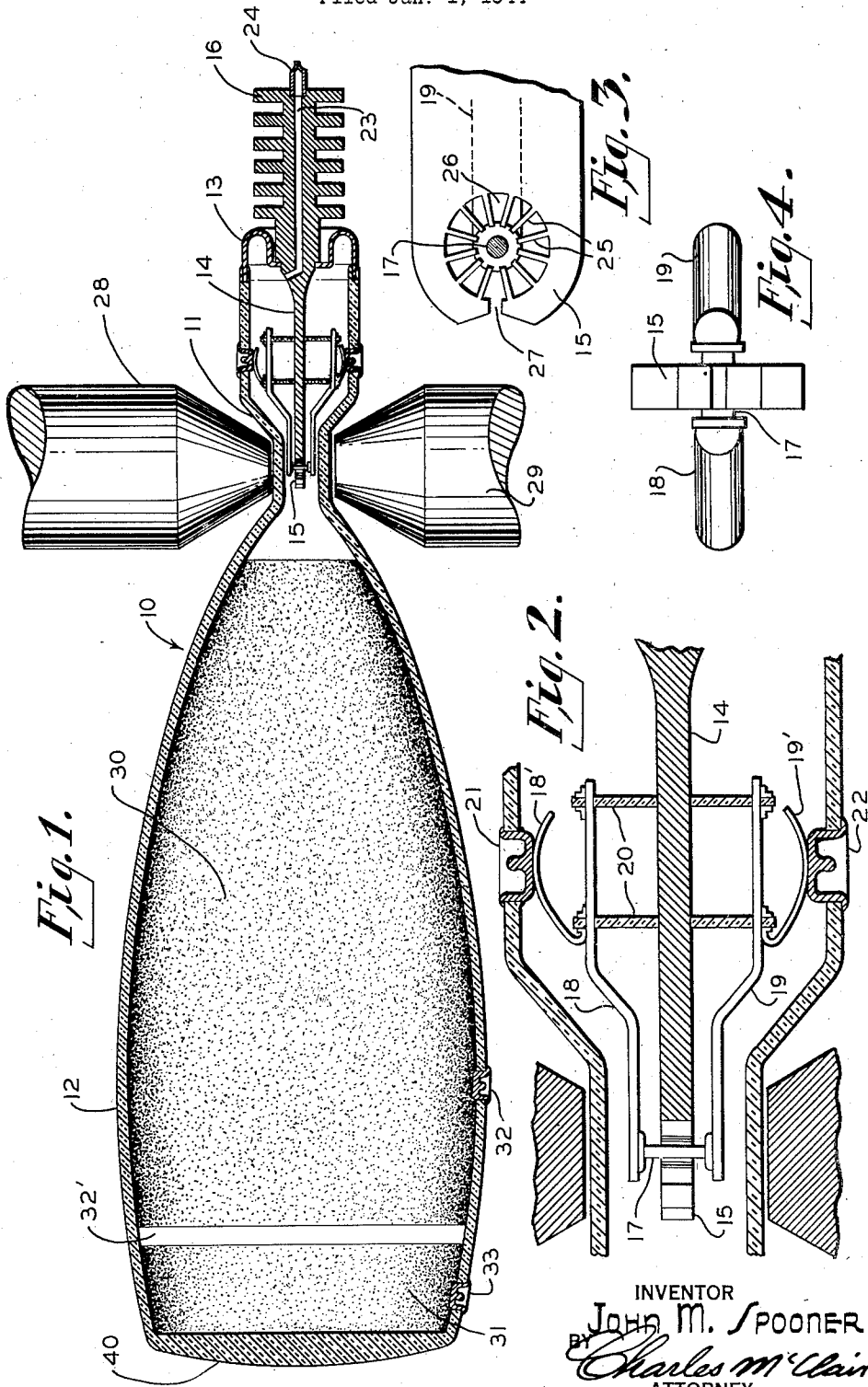
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CAVITY RESONATOR MAGNETRON DEVICE

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CAVITY RESONATOR MAGNETRON DEVICE

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11 Claims. (Cl. 315-39)

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My invention relates to electron discharge devices and more particularly to magnetrons employing cavity resonator circuits.

One type of magnetron referred to as a multi-segment cavity resonator type includes a cathode 45 surrounded by an anode member having a plurality of anode segments adjacent the cathode. The anode member may be a cylindrical block provided with a central chamber with a plurality of radially directed slots extending from the central chamber in which the cathode is positioned. The portions of the anode member between the slots provide the anode segments and the slots provide the cavity resonators.

In another form the anode block may be provided with a longitudinally extending central chamber having positioned therearound other chambers of cylindrical form parallel to the central chamber and connected to the central chamber by means of longitudinally extending slots. 20 The portions of the anode between the slots again provide the anode segments and the chamber the cavity resonators.

In still another form the anode may comprise a hollow cylindrical member supporting from the inner wall thereof a plurality of radially directed fins, the inner edges of which provide the anode segments surrounding the cathode space and the fins and ring providing cavity resonators. The result is a cavity resonator circuit between each adjacent pair of adjacent anode segments.

These cavity resonator circuits are electrically and electromagnetically coupled during operation of the device and energy may be extracted from one of the resonators in a number of different ways. The usual arrangement is to employ a coaxial line having a loop on the inner end of the inner conductor of the coaxial line which extends through an aperture in the wall of the anode electrode, the loop lying within one of the cavity resonators. A seal must be provided somewhere along the coaxial line to retain the vacuum within the envelope of the magnetron. The coaxial line is sometimes coupled into a wave guide into which a receiver may also be coupled. This 45 requires special equipment for blocking the transmitted signal from centering the receiver during transmission. This complicates the equipment necessary and increases the losses both in transmitting and receiving. This equipment also requires considerable space when used in the manner indicated.

It is, therefore, a principal object of my invention to provide an improved type of magnetron and associated circuit which will eliminate the

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need for coupling devices, the use of waveguides and special circuits to isolate the receiver from the transmitter when both are used together, and which will also reduce the size of the equipment necessary.

It is a further object of my invention to provide such a device where a radio wave may be generated, radiated and directed into a confined beam within a single enclosure.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection 10 with the accompanying drawing in which Figure 1 is a longitudinal section taken through an electron discharge device and associated circuit and radiating elements made according to my invention. Figure 2 is an enlarged view of details of construction of the magnetron electrodes. Figure 3 is a top view of the anode assembly and Figure 4 is an end view of Figure 3.

In accordance with my invention I provide an elongated evacuated envelope 10 which has a constricted portion 11 at one end and an elongated portion 12 gradually increasing in diameter extending toward the other end and having the shape of a cone or horn. The smaller end of the envelope is sealed by means of the re-entrant cup-shaped element 13 which supports the anode structure 15 at the inner end thereof.

In accordance with my invention the anode assembly includes a plurality of radially directed fin-like elements 25 forming between the elements cavity resonators. 26 the ends of the elements providing anode segments. One of the resonators is provided with a slot 27 parallel to the longitudinal axis of the magnetron and opening into the interior of the enlarged or flared out portion of the envelope. An indirectly heated cathode 17 is supported within the central space toward which the radially directed fin-like members extend, by means of lead and support elements 18 and 19, which are in turn insulatingly supported from the anode extension 14 by the insulating spacer members 20, contact being made to terminal elements 21 and 22 by means of spring contact members 18' and 19'. Voltage may be applied to the anode through the member 16 which serves as a radiator and is provided with a passage 23 through which the exhaust is made after which it is tipped off at 24. Electromagnets 28 and 29 provide a fixed magnetic field parallel to the cathode.

The envelope proper is flared out and has an

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elongated cone-like portion 12 which is coated on the interior with a conducting material 30. This may be solid conducting sheet or a sprayed metallic coating to which voltage may be applied through contact 32. This coating may be separated by means of a space 32' from a second coating 31 to which a different voltage may be applied through the terminal 33, if so desired. The closure member 40 may be in the form of a lens which can be utilized to further bring about a focusing effect of generated electromagnetic waves, as is well known in connection with ultra high frequency electromagnetic waves.

When the magnetron is set into operation, the slot acts as a point or slit source of electromagnetic disturbance. The electrostatic field vector E is at right angles to the slit. Electromagnetic field vector H is parallel to the longitudinal axis of the slit. The E and H vectors form a plane which provides the wave front according to the classical theory. This wave is directed into the reflector and focusing portion of the envelope and directed out into space through the lens 40.

Thus it is unnecessary to provide any coupling devices or waveguides for directing the generated electromagnetic waves into space. At the same time the receiving equipment may be well shielded from the effects of the pulse generated by the transmitting portion of the equipment with which my device may be used. By observing a proper ratio of length-to-flare angle, it is possible to set up interference patterns which strongly reinforce a narrowly defined beam, while reducing spurious radiation lobes to a minimum. By disposing additional radiation sources within the structure in a suitable position, it should be possible to vary the direction of the central lobe of the transmitted wave by varying the phase relationship between the various sources of radiation, thus providing a means of scanning without mechanical movement of the radiating source.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is:

1. A device for use at high radio frequencies and including an elongated envelope having at one end an electron source and a cavity resonator positioned adjacent said source to be excited by electrons therefrom, said resonator having an aperture therein, said envelope having an elongated flared out portion extending from said one end and registering with the aperture in said resonator, said flared out portion having a conducting inner surface and providing a reflecting surface and waveguide for electromagnetic waves generated in said resonator, the end of said flared out portion being closed by a member permeable to electromagnetic wave energy.

2. An electron discharge device for use at ultra high frequencies and comprising an elongated envelope, one end of said envelope being provided with a constricted portion and the remainder of said envelope being formed into an elongated cone-like portion closed at the outer end by a closure member permeable to electromagnetic wave energy, a magnetron electrode assembly po-

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sitioned within the constricted portion of said envelope and including an anode member forming a cavity resonator and an electron source adjacent to said anode member for energizing the cavity resonator, said cavity resonator having an aperture opening into the cone-like portion of said envelope, said magnetron electrode assembly being supported from a closure member closing the constricted portion of said envelope, said cone-like portion of said envelope having an inner conducting surface.

3. An electron discharge device for use at ultra high frequencies and comprising an elongated envelope, one of said envelope being provided with a constricted portion and the remainder of said envelope being formed into an elongated cone-like portion closed at the outer end, a magnetron electrode assembly within the constricted portion of said envelope and including an anode assembly forming a plurality of cavity resonators and an electron source adjacent to said anode assembly for energizing said cavity resonators, one of said cavity resonators having an aperture opening into the interior of the cone-like portion of said envelope, said cone-like portion of said envelope having an inner conducting surface extending toward the closed outer end.

4. An electron discharge device for use at ultra high frequencies and comprising an elongated envelope, one end of said envelope being provided with a constricted portion and the remainder of said envelope being formed into an elongated cone-like portion closed at the outer end, a magnetron electrode assembly within the constricted portion of said envelope and including an anode member forming a cavity resonator and an electron source adjacent to said anode member for energizing said cavity resonator, said cavity resonator having an aperture opening into the interior of the cone-like portion of said envelope, said cone-like portion of said envelope having an inner conducting surface.

5. An electron discharge device having an envelope closed at one end by a cup-shaped member of conducting material, said cup-shaped member supporting an elongated flat electrode structure having a free end embracing an anode assembly, a cathode insulatingly supported from said anode assembly, terminal members extending through said envelope, leads for said cathode extending between said cathode and said terminal members for providing a circuit to said cathode, the elongated flat electrode structure extending through said envelope and having provided at the outer end thereof a radiator, said elongated flat electrode structure having a passageway extending therethrough to the exterior thereof for exhausting said envelope, and means included adjacent said anode assembly for providing a fixed magnetic field parallel to said cathode and in the space between the cathode and the anode.

6. An electron discharge device having an envelope closed at one end by a cup-shaped member of conducting material, said cup-shaped member supporting an elongated flat electrode structure having a free end embracing an anode assembly comprising an apertured portion providing a plurality of anode segments defining a central space, a cathode insulatingly supported from said anode assembly, terminal members extending through said envelope and connections extending between said cathode supports and said terminal members, the elongated flat electrode structure extending through said cup-shaped member and having provided at the outer

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end thereof a radiator, and means included adjacent said anode assembly for providing a fixed magnetic field parallel to said cathode and in the space between the cathode and the anode segments.

7. An electron discharge device having an envelope closed at one end by a cup-shaped member of conducting material, said cup-shaped member supporting an elongated flat electrode structure having a free end embracing an anode assembly comprising an apertured portion having a plurality of radially directed anode segments, a cathode insulantly supported from said anode assembly, the elongated flat electrode structure extending through said cup-shaped member and having provided at the outer end thereof a radiator, and means included adjacent said anode assembly for providing a fixed magnetic field parallel to said cathode and in the space between the cathode and the anode segments.

8. An electron discharge device having an envelope provided with a restricted portion and closed by a cup-shaped member of conducting material, said cup-shaped member supporting an elongated flat electrode structure having a free end embracing an anode assembly comprising an apertured portion including a plurality of radially extending fin-like members defining a plurality of cavity resonators the inner ends of which provide anode segments connected by said cavity resonators, a cathode insulantly supported from said anode assembly, the elongated flat electrode structure extending through said cup-shaped member and having at the outer end thereof an electro-magnetic wave radiator, the elongated flat electrode structure having a passageway extending therethrough for exhausting said envelope, one of said cavity resonators being provided with a slot extending through said anode assembly, said slot opening into the space in the interior of said envelope.

9. An electron discharge device having an envelope provided with a restricted portion and closed by a cup-shaped member of conducting material, said cup-shaped member supporting an elongated flat electrode structure having a free end embracing an anode assembly comprising an apertured portion including a plurality of radially extending fin-like members, the inner ends of which provide anode segments connected by cavity resonators, a cathode having cathode leads and insulantly supported from said anode assembly, terminal members extending through said envelope and spring connections extending between said cathode leads and said terminal members, the elongated flat electrode structure extending through said cup-shaped member and having at the outer end thereof an electromagnetic wave radiator, and having a passageway extending therethrough for exhausting said en-

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velope, and means included adjacent said anode assembly providing a fixed magnetic field parallel to said cathode and in the space between the cathode and the anode segments, one of said cavity resonators being provided with a slot extending through said anode assembly and opening into the space in the interior of said envelope.

10. An electron discharge device having an elongated envelope closed at one end by a cup-shaped member of conductive material, said cup-shaped member supporting an electrode structure within said envelope, said electrode structure including a cathode, terminal members extending through said envelope and spring-like conductors having one end connected to said cathode and the other end free and extending between said cathode and the terminal members in said envelope, the free ends of said spring like conductors frictionally engaging said terminal members whereby contact is made between said spring-like conductors and said terminal members when said cup-shaped member is sealed to the end of said envelope.

11. An electron discharge device having an elongated envelope having at one end a restricted portion and an electrode assembly mounted in said restricted portion and comprising a magnetron electrode assembly, said assembly including an anode member provided with a cavity resonator and an electron source associated with said anode member for supplying electrons for energizing the cavity resonator, said envelope having an elongated cone-like portion extending from said restricted portion, said cavity resonator having an aperture opening into said cone-like portion of said envelope, said magnetron electrode assembly being supported from a closure member closing the restricted portion of the envelope, the axis of said electrode assembly being transverse to the longitudinal axis of said envelope, said cone-like portion of said envelope having an inner conductive surface.

JOHN M. SPOONER.

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Certificate of Correction

Patent No. 2,435,804

February 10, 1948

JOHN M. SPOONER

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 14, after the word "one" insert *end*;
and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.
Signed and sealed this 11th day of July, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

Disclaimer

2,435,804.—*John M. Spooner*, Manheim Township, Lancaster County, Pa. CAVITY
RESONATOR MAGNETRON DEVICE. Patent dated Feb. 10, 1948. Dis-
claimer filed Apr. 12, 1950, by the assignee, *Radio Corporation of America*.

Hereby enters this disclaimer to claims 1 and 4 of said patent.

[*Official Gazette May 16, 1950.*]