AMPLITUDE MODULATION OF MAGNETRONS

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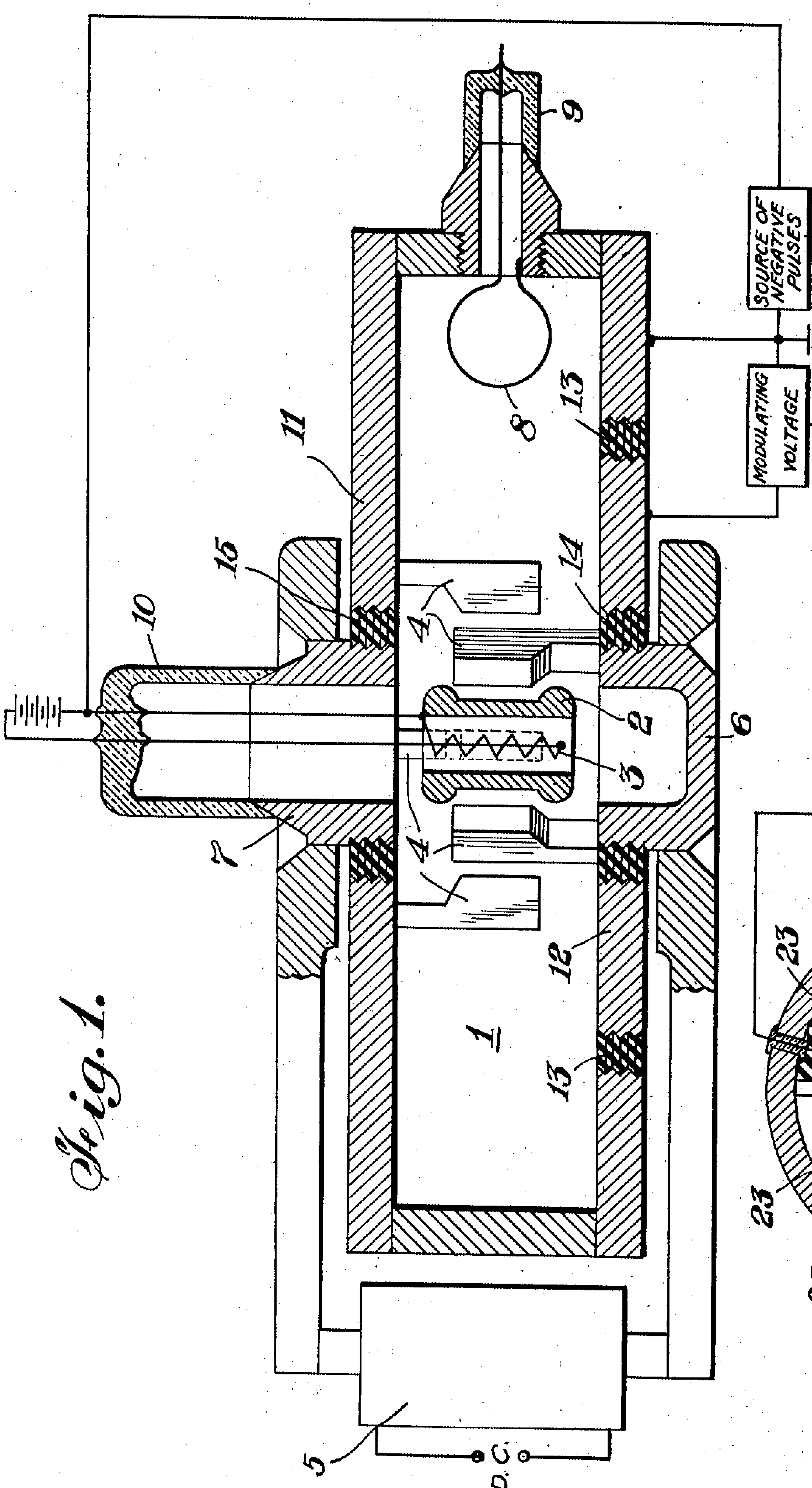

Fig. 1.

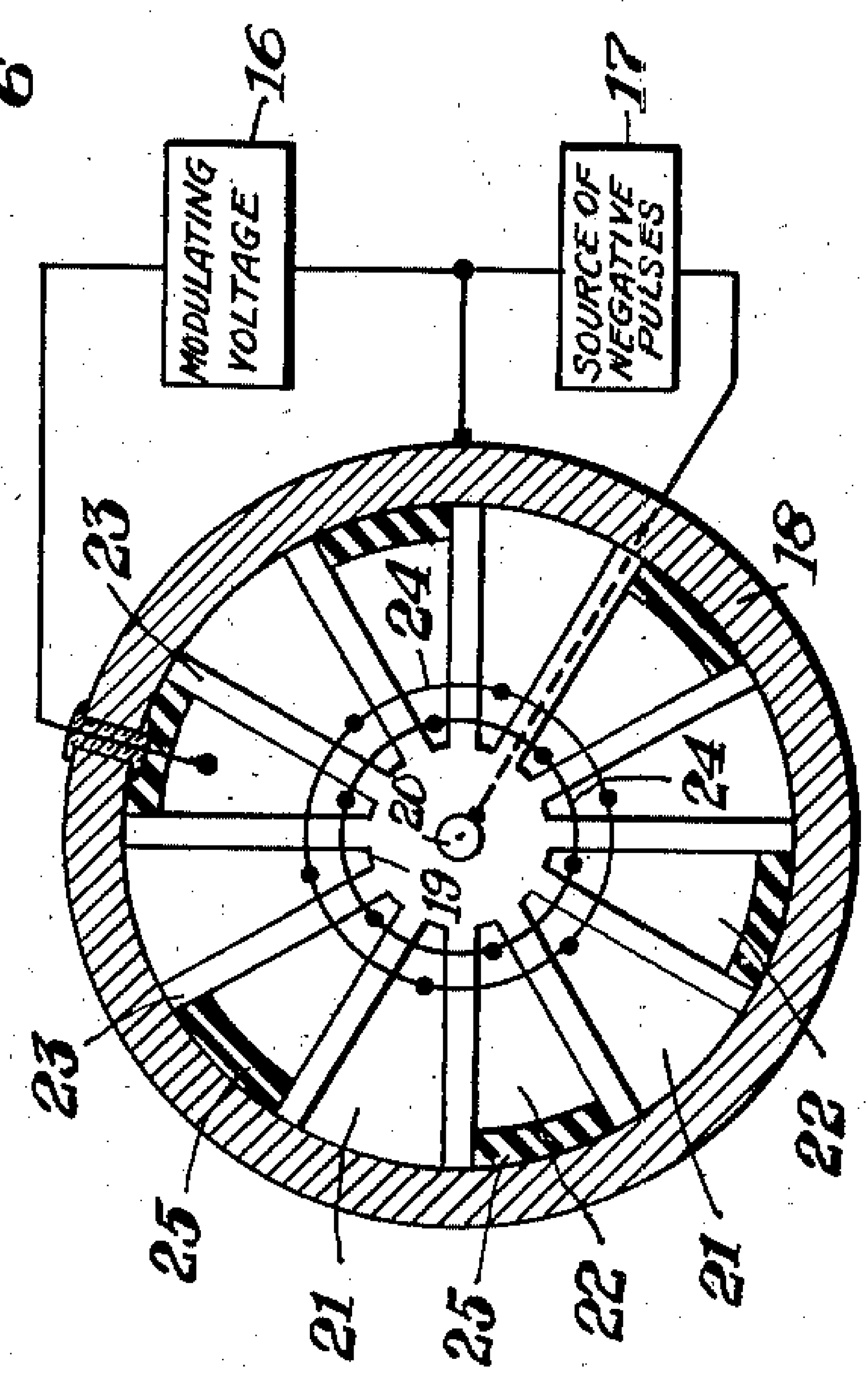

Fig. 2.

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AMPLITUDE MODULATION OF MAGNETRONS

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My invention relates to electron discharge devices of the magnetron type and more particularly to magnetrons adapted for amplitude modulation.

Many attempts have been made to amplitude modulate a magnetron with the result that the power output is discontinuous rather than a linear variation with respect to modulating voltage. This is certainly true when it is attempted to apply the modulating voltage in series with the anode voltage, or for that matter, to use the familiar scheme of current modulation whereby the current through the magnetron is varied. In both of these schemes, the magnetron will not operate successfully over wide variations in current or voltage, since certain fundamental parameters which were used in designing the magnetron, will be violated.

An object of my invention is to provide a magnetron the power output of which is a linear variation with respect to a modulating voltage.

A still further object of my invention is to provide a magnetron of the interdigital type, the power output of which is a linear variation with respect to a modulating voltage.

I have found by operating the magnetron in the usual fashion, that is, optimum voltage and current, and then applying the modulation voltage to an insulated set of vanes or digits, it is possible to amplitude modulate the magnetron over a wide range. This scheme was tried experimentally with a Sylvania interdigitated magnetron operating at 4800 megacycles (SD 849B).

Therefore, according to my invention, I provide a magnetron of the cavity resonator type or the interdigital type in which a plurality of anode vanes or digits are mounted in a circle about the cathode, adjacent one of said vanes or segments are insulated from one another for low frequencies and means are provided for applying a modulating voltage between adjacent ones of said vanes or segments of the resonator.

The above mentioned objects and features will be more clearly understood and others will become apparent to those skilled in the art by reference to the following description and the drawing of which:

Fig. 1 shows a vertical cross-sectional view of a magnetron of the interdigital type incorporating a feature of my invention and

Fig. 2 shows a horizontal cross-sectional view of a modified magnetron of the cavity resonator type incorporating features of my invention.

In the drawing there is shown a magnetron comprising an evacuated cavity resonator 1, a hollow cathode 2 in the center of the cavity resonator heated by an interiorly located thermionic filament 3, and an anode structure consisting of an even number of short length identical anode segments 4. A coil 5 associated with iron pole pieces 6 and 7 produces a magnetic field whose flux lines extend parallel to the cathode.

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Ultra high frequency oscillations are taken out of the magnetron by means of an output coupling loop 8 which is coupled to utilization apparatus, such as a transmission line leading to an antenna, not shown. One end of the loop 8 is shown coupled to one wall of the cavity resonator while the other end extends externally through a glass seal 9. The cathode heater leads and the cathode lead extends out from the magnetron through glass seal 10. The heater 3 may be embedded in high temperature insulating material inside hollow cathode 2 after the usual manner of constructing indirectly heated cathodes. The central outside surface of cathode 2 may be oxide coated according to common practice. The ends of the cathode 2 are provided with flanges which act as shields to help confine electrons to the central portion of the device.

The anode segments 4 may be any even number of segments, preferably six or eight, and lie in a circle around the cathode. Those portions of these anode segments upon which the electrons impinge are thicker than the short stubs which connect these segments to the oppositely disposed faces of the resonator, as shown.

The anode segments 4 are mounted on opposite walls 11 and 12 of the cavity resonator 1. Alternate ones of said segments are mounted on one wall and adjacent ones of said segments are mounted on opposite walls. Walls 11 and 12 are insulated from one another by an annular insulator lug 13 forming a bi-pass condenser with the sections of the wall. The magnetic pole pieces are also separated from the walls of the resonator 1 by annular rings of insulation 14 and 15 in order that the magnetic circuit does not short circuit the by-pass condenser 13.

In the preferred embodiment, one part of the resonator 1 is grounded and the modulating voltage source 16 coupled between ground and the part of wall 12 which is insulated from the rest of the resonator by insulating ring 13 and which carries one set of the anode segments 4.

If it is desired to operate the magnetron under pulse conditions a source of negativ e pulses 17 for pulse modulation is connected between ground and the cathode 2.

In an experimental test it was found that the power output from an interdigital magnetron operating at 4000 megacycles, amplitude modulated according to this disclosure, was a linear function of the modulating voltage.

The same arrangement is applicable to cavity magnetrons in which the cavities are formed by vanes arranged radially about the cathode. Alternate vanes about said cathode are insulated from the other vanes and electrically connected and the modulating voltage is applied thereto. The one set of vanes should be insulated from the other by a built in mica or similar condenser which will by-pass the radio frequency.

As illustrated in Fig. 2, an envelope 18 which is made of a block of conductive material is provided with a central bore 19 within which is mounted a cathode 20 axially with the outer cylindrical part of the anode block. The part of the anode block between the outer cylindrical wall and the central bore 19 is cut to form wedge-shaped sections 21, 22, the slots 23 between said sections being radial. In accordance with the practice in the art alternate ones of said segments are strapped together by connectors 24.

In accordance with this invention, alternate one of said segments 22 are isolated by built-in pieces of mica 25 from the cylindrical part of the envelope 18. A modulating voltage source 16 is then connected between adjacent segments and it has been found that the output from the magnetron is modulated in amplitude linearly with respect to said modulating voltage.

The invention is not intended to be limited to the specific embodiments described in detail above and other applications will be apparent to those skilled in the art.

I claim:

1. A magnetron adapted for amplitude modulation comprising a cavity resonator, a cathode mounted inside said resonator, an even number of anode segments greater than two mounted in a circle about said cathode, means insulating adjacent segments from one another, means connecting alternate segments together, and means for applying a modulating signal between adjacent ones of said segments.

2. A magnetron according to claim 1 wherein said insulating means comprises a high-frequency by-pass condenser.

3. A magnetron adapted for amplitude modulation comprising a conducting envelope, a cathode mounted inside said envelope, an even number of vanes mounted to extend from said envelope radially towards said cathode, insulating means separating alternate ones of said vanes from said envelope, means electrically inter-connecting said alternate ones of said vanes, the others of said vanes being conductively connected to said envelope, and means for applying a modulating voltage between adjacent ones of said vanes.

4. A magnetron according to claim 3 wherein said insulating means comprises a high-frequency by-pass condenser.

5. A magnetron adapted for amplitude modulation comprising a cavity resonator having two parallel surfaces, a cathode mounted inside said

resonator at right angles to said surfaces, an anode structure surrounding said cathode and composed of an even number of anode segments greater than two located between said surfaces and mounted with alternate segments on the same surface, adjacent segments being mounted on opposite ones of said two surfaces of said resonator, means adjacent said resonator for producing a magnetic field having flux lines extending in a direction substantially parallel to said cathode, and means for applying a potential signal between said parallel surfaces for amplitude modulating the oscillations in said resonator.

6. A magnetron adapted for amplitude modulation comprising a cavity resonator composed of a substantially closed metal wall having two parallel surfaces for maintaining radio frequency oscillations, a cathode mounted inside said resonator at right angles to said surfaces, a cylindrical anode structure surrounding said cathode and composed of a multiplicity of equal length anode segments greater than two located between said surfaces and mounted with alternate segments on the same surface and adjacent segments on opposite ones of said two surfaces and electrically connected thereto, means adjacent said resonator for producing a magnetic field having flux lines extending in a direction substantially parallel to said cathode, and a radio frequency by-pass condenser separating said two surfaces from one another for low frequencies, and means electrically coupled between said two surfaces for applying a potential signal therebetween for amplitude modulating the oscillation in said resonator.

7. A magnetron according to claim 1 wherein the cavity resonator is defined at least in part by two opposed wall portions, one group of alternate anode segments being supported on one wall portion and the other group of alternate anode segments being supported on the other wall portion, and the means for insulating adjacent segments include insulation disposed between said wall portions.

8. A magnetron according to claim 1 wherein the cavity resonator is defined at least in part by a circular wall, the anode segments being disposed radially inwardly of said wall, and the means for insulating adjacent segments includes insulation disposed between alternate segments and said wall.

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