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AMPLITUDE MODULATION OF
MAGNETRONS

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My invention relates to electron discharge de-
vices of the magnetron type and more particular-
ly to magnetrons adapted for amplitude modula-
tion.

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 volt-
age. 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 op-
erate 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 mag-
netron the power output of which is a linear
variation with respect to a modulating voltage.

A still further object of my invention is to pro-
vide 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 volt-
age to an insulated set of vanes or digits, it is
possible to amplitude modulate the magnetron
over a wide range. This scheme was tried ex-
perimentally with a Sylvania interdigitated mag-
netron operating at 4800 megacycles (SD 849B).

Therefore, according to my invention, I pro-
vide 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 modulat-
ing 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 be-
come apparent to those skilled in the art by refer-
ence to the following description and the drawing
of which:

Fig. 1 shows a vertical cross-sectional view of
a magnetron of the interdigital type incorporat-
ing 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

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hollow cathode 2 in the center of the cavity
resonator heated by an interiorly located therm-
ionic filament 3, and an anode structure consist-
ing 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.

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 cou-
pled 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 construct-
ing indirectly heated cathodes. The central out-
side 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 num-
ber of segments, preferably six or eight, and lie
in a circle around the cathode. Those portions
of these anode segments upon which the elec-
trons 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. Al-
ternate 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 in-
sulator 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 volt-
age 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 negative pulses 17
for pulse modulation is connected between ground
and the cathode 2.

In an experimental test it was found that the

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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

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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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