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R. DUNSMUIR
MAGNETRON OSCILLATORS AND THEIR ASSOCIATED
OUTPUT CIRCUITS
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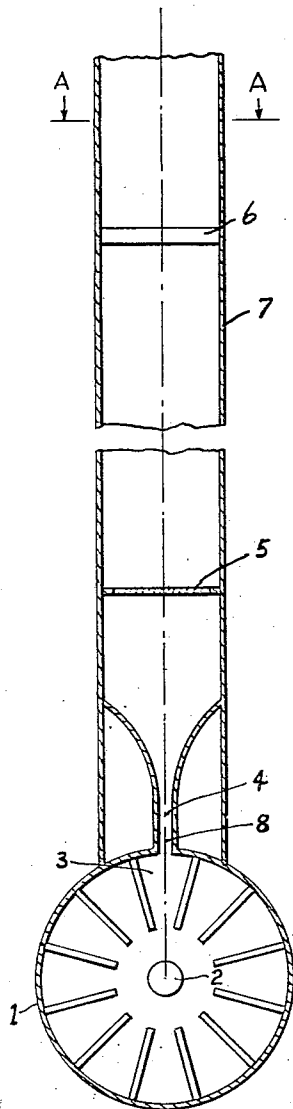


Fig. 1.

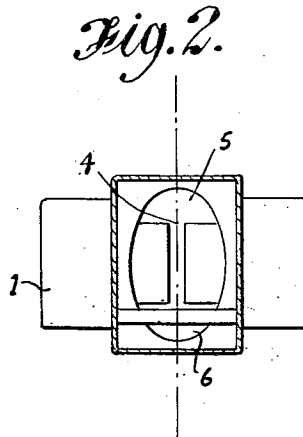


Fig. 2.

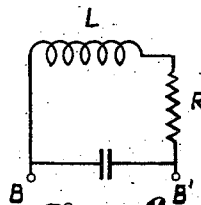


Fig. 3.

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MAGNETRON OSCILLATORS AND THEIR ASSOCIATED OUTPUT CIRCUITS

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1 Claim. (Cl. 250—36)

This invention relates to magnetron oscillators and their associated output circuits, and in particular to such oscillators utilised in the generation of very short pulses.

It is important that in magnetron oscillators required to generate very short pulses (e. g. pulses of the order of 0.1 micro-second and containing about 300 oscillatory cycles) the build-up time of the magnetron should be kept as short as possible so that it occupies a minimum number of cycles of the R. F. oscillation. The build-up time is governed by the Q factor of the loaded magnetron and will be a minimum when the Q factor is at a maximum. This unfortunately means that little power is coupled out of the magnetron. The Q factor may be defined as the ratio of resonator reactance to output resistance.

It is the object of the present invention to obtain a quick build-up combined with a high power output.

The present invention comprises the combination of a magnetron and an associated output circuit arranged so that on the commencement of a train of oscillations it presents the magnetron with a high output Q factor and thus allows a rapid build-up of R. F. oscillations in the magnetron, and wherein the output circuit has a suitably positioned reflector such that a fraction of the initial R. F. output will return to the magnetron and reduce the Q factor of the output circuit when the build-up of R. F. voltage has been substantially completed, so that substantial R. F. power may then be extracted from the magnetron.

The high external Q factor may be obtained by loosely coupling a waveguide to the magnetron. A reflector in the form of an inductive post may be mounted in the waveguide at a suitable position to achieve the desired result.

In order that the invention may be more fully understood reference will now be made to the accompanying drawing, in which:

Fig. 1 is a sectional view showing a magnetron connected to a waveguide output circuit.

Fig. 2 is a view along the line A—A of Fig. 1, and

Fig. 3 is an equivalent electrical circuit of the output of the magnetron shown in Fig. 1.

Referring now to Figs. 1 and 2, in which like parts have like references, there is shown a magnetron 1 coupled to an associated output circuit formed by a rectangular waveguide feeder 7. Magnetron 1 contains a cathode 2 and an anode consisting of a number of vane segments. The output resonator 3 of the anode is coupled by a tapered slot transformer 4 to the output waveguide 7. This transformer is so arranged as to present a small resistance in series with the self-inductance of output resonator 3 when the waveguide is matched. If the output resonator is represented by an equivalent circuit of Fig. 3 which contains inductance L and capacitance C, then the resistance looking into slot 4 from the reso-

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nator 3 will be represented by R, where R is a small resistance.

In calculating the Q factor of this circuit, i. e. the ratio of reactance to resistance, account must be taken of the inductance and capacitance of the other resonators which are effectively connected across BB' in Fig. 3. If N is the number of anode resonators in the magnetron and L is the inductance per resonator, then it can be shown that the effective Q factor of the system (that is the Q factor which takes account of the power dissipation in the load only) is approximately given by

$$\frac{N\omega L}{R}$$

where ω is 2π times the frequency.

The width of slot 4 and the coupling to resonator 3 is so adjusted as to provide a high external Q factor for the system, for example 300. Slot 4 tapers gradually so that a wave entering the narrow portion of the slot at 8 from the magnetron travels outwards along the waveguide 7 without appreciable reflection. In accordance with the invention a metal post 6 is inserted across the waveguide to reflect the outgoing wave. Post 6 is arranged as an inductive post and is positioned parallel to the shorter dimension of rectangular waveguide 7.

The wave reflected from post 6 combines with the outgoing wave from the magnetron to present a resistance at the output resonator 3 which is considerably greater than the resistance which would occur at the same point in the absence of post 6. For this condition to be satisfied the distance from resonator 3 to post 6 should correspond to an integral number (n) of half wavelengths plus an amount which is less than a quarter wavelength. The value of n may be four times the number of cycles of oscillation required for buildup. A reflectionless output window 5 may be mounted across the waveguide to provide a vacuum seal for the magnetron on whichever side of post 6 is convenient. To reduce the chance of breakdown of window 5 it is desirable to position this window at a point of minimum voltage for the standing wave pattern produced by the combination of outgoing and reflected waves.

While the invention has been described with reference to a particular embodiment employing a vane type magnetron and a waveguide output feeder it will be appreciated that other types of magnetron and other types of feeder, such as co-axial lines, can be used without departing from the invention.

What I claim is:

In combination, a magnetron, an associated output circuit arranged to present the magnetron with a high output Q factor and thus allow a rapid build-up of radio frequency oscillation in the magnetron, and a reflector positioned in said output circuit by a distance from the magnetron equal to an integral number of half wavelengths of the oscillations plus a distance which is less than an eighth wavelength so that a fraction of the initial radio frequency output will return to the magnetron and reduce the Q factor of the output circuit when the build-up of radio frequency voltage has been substantially completed, whereby substantial radio frequency power may be then extracted from the magnetron.

References Cited in the file of this patent

UNITED STATES PATENTS

2,630,533	Herlin	Mar. 3, 1953
2,765,423	Crapuchettes	Oct. 2, 1956