March 25, 1958 M. W. WALLACE 2,828,444

CAVITY MAGNETRON

Filed April 10, 1948

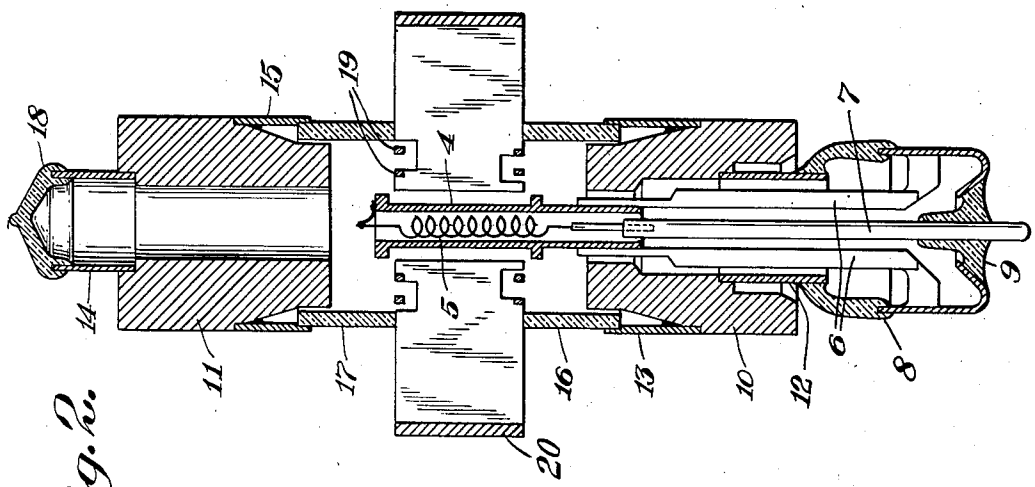


Fig. 2.

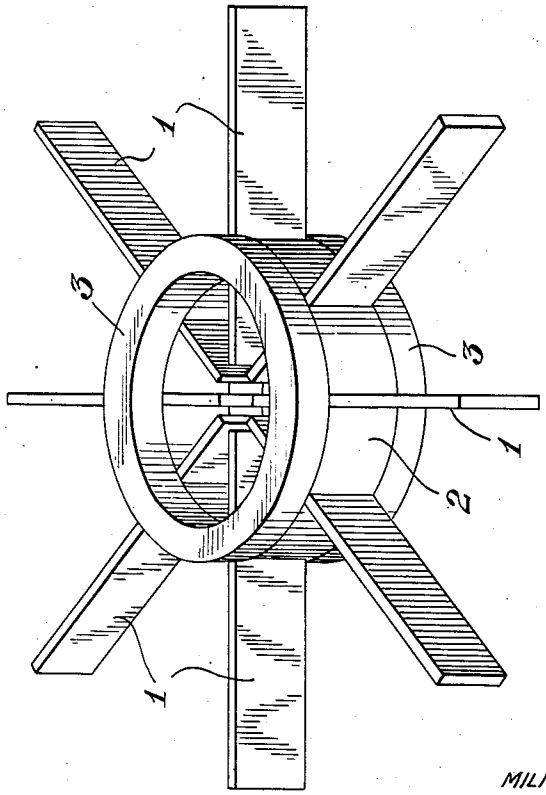


Fig. 1.

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CAVITY MAGNETRON

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1 Claim. (Cl. 315—39.75)

My invention relates to magnetrons and is particularly directed to improvements in the resonate anode structure of the magnetron.

A large proportion of the cost of manufacture of the conventional magnetron may be attributed to the fact that the resonant cavities of the anode structure are included within the evacuated portion of the envelope, although the only portion of the magnetron that requires evacuation is the cathode and the electron interaction space between the cathode and the inner ends of the cavity slots. Pickup circuits for removing high frequency energy and tuning means are also included inside the usual magnetron envelope.

The object of my invention is a novel magnetron structure that will reduce the envelope size and cost.

A further object of my invention is to provide a magnetron whose cavities are formed by vanes with a novel envelope structure sealed to the vanes about the ends thereof adjacent the cathode of the magnetron.

In one embodiment the magnetron comprises vanes arranged in radial planes evenly spaced about the cathode. The envelope structure therefore comprises impervious insulating material sealed about the ends of the vanes adjacent the cathode and flat insulating discs sealed directly to the ends of the envelope structure.

As will be apparent to those skilled in the art, my novel envelope structure may also be used in a magnetron of the so-called rising sun type, as illustrated in the Bell System Technical Journal of April 1946, vol. XXV, No. 2 pages 227–232. In this case the envelope of impervious insulating material would be in the form of windows sealed to the vanes and tight covers brazed directly to the top and bottom of the vanes and to the windows of insulating material.

The scope of my invention is specifically defined in the appended claim and preferred embodiments thereof are described in the following specification and shown in the accompanying drawing in which Fig. 1 is a view in perspective and partly in section of one vane-and-envelope assembly of my invention, and Fig. 2 is a longitudinal sectional view of one complete magnetron of my invention.

The number, spacing and dimensions of the metal vanes of Fig. 1 are selected to meet the requirements of frequency and power of a desired magnetron. The vanes are rectangular flattened metal plates and are evenly spaced in angularly disposed planes each vane extending along a radius from the center point of a circle. The inner ends of the vanes terminate a distance from the center of said circle dictated by the diameter of the cathode, not shown in Fig. 1, and the desired radial depth of the electron interaction space. The vanes are assembled and rigidly held in place by cylindrical segments 2 of gas-impervious insulating material such as vacuum glass or glazed tight ceramic. The segments are preferably curved and spaced a uniform distance from the center of the assembly to form a continuous cylindrical wall,

and are hermetically sealed to opposed faces of the metal vanes. In manufacture, any one of several techniques may be chosen. For example, the glass or ceramic parts may be preformed and metalized along the edges to be sealed, whereupon hermetic junctions are made by brazing or soldering the metalized surfaces to the vanes. Alternatively, the ceramic edges may be sealed directly to the metal by various low temperature glass fluxes or enamels. If porcelain type bodies are preferred, unfired or "green" ceramic parts may be held in place with the metal parts and the whole fired to the sintering temperature of the ceramic. The ceramic is composed of fused parts to make the ceramic gas impervious. If copper vanes are used they are made thin in order to match coefficients of expansion. Refractory metal jigs may be used to prevent movement of the metal parts during the shrinkage of the ceramics in firing. The ceramics employed here would of course be chosen for their good high-frequency properties including low losses.

By making uniform the width of the vanes 1 and the length of the insulating segments 2 so that the ends of the structure are even, the ends may be closed by flat insulating discs not shown sealed directly to the ends of the structure. As mentioned above if my invention is used in a magnetron of the rising-sun-type, the ends may be closed by flat metal covers brazed directly to the ends of the vanes and the insulating segments therebetween. Clear spaces at the ends are, however, easily provided by sealing insulating rings 3 to, and in registry with, the circle of segments 2. Alternatively, the segments 2 and rings 3 may be cast in one integral ceramic piece with windows to receive the metal vanes. Metalized edges in the window will permit the solder sealing to the metal vane, or an enamel glaze on the vanes will effectively join and seal the parts when properly heated.

The sectional view of the complete magnetron of Fig. 2 shows the indirectly heated cathode sleeve 4 and heating electrode 5 centered in the vane assembly. The support straps 6 for the sleeve and one conductor 7 for the heater are held in coaxial relation by the concentric lead-in seals 8 and 9 at the lower end. Heavy tubular magnetic pole pieces 10 and 11 are sealed into opposite ends of the vane assembly by thin metal sleeves 12, 13, 14 and 15 and rings 16 and 17 of glass or ceramic corresponding to rings 3 of Fig. 1. An exhaust tubulation 18 is joined to the upper end of the upper pole piece. Means for "strapping" the vanes as in conventional magnetrons are shown, rings 19 being connected to alternate vanes for fixing the mode of oscillation. An outer ring 20 is preferably fastened to the outer ends of the vanes to complete the resonators.

The diameter of the envelope may be as small as practical to bring the seal region near the inner ends of the vanes, sufficient clearance only being provided in the embodiment shown to provide for the straps. However, where absorption of energy in the insulating portions of the envelope between the vanes may become appreciable, the diameter of the envelope may be adjusted to place the seals at a node on the vanes of standing voltage waves. The location of such nodes will of course be determined by the geometry of the vanes, the operating frequency, and whether or not the outer ends of the vanes are short circuited. Such determinations may be made empirically or by known tapered transmission line formulae.

In addition to reducing the volumetric size of the envelope of a magnetron of any given capacity, with the obviously improved exhausting conditions, my novel structure permits easy cooling of the parts, easy tuning, and external coupling to the oscillator.

I claim:

In a magnetron, a cathode, a plurality of vanes uniformly spaced about and extending radially from said cathode, the inner ends of the vanes terminating a predetermined distance from said cathode, the vanes and resonator construction being resonant at a predetermined frequency, an envelope of insulating material enclosing said cathode and the inner ends of said vanes, said envelope being sealed to each vane at a point approximately at a node of standing voltage wave of said predetermined frequency.

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