Nov. 13, 1962 D. C. BUCK 3,064,158

MAGNETRON CAVITY RESONATOR ASSEMBLY

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Fig. 1

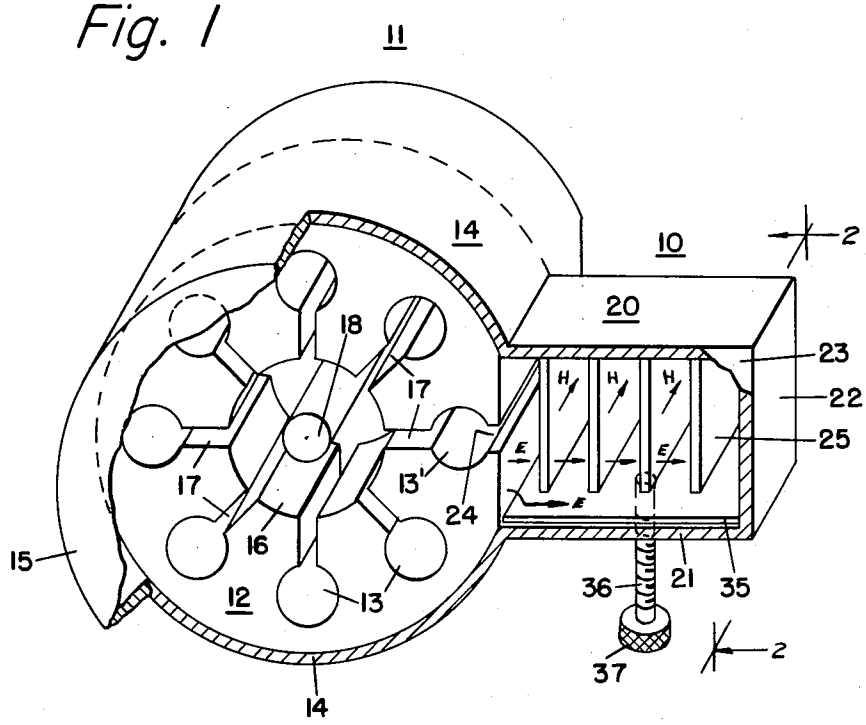
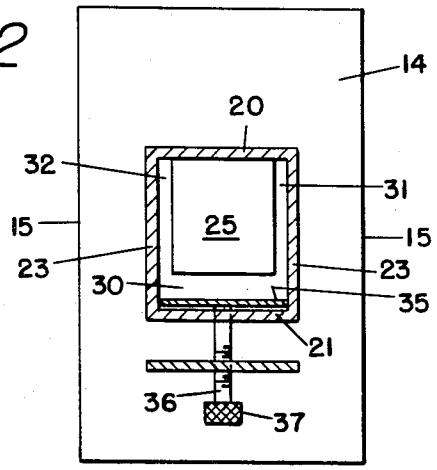


Fig. 2



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Fig. 3

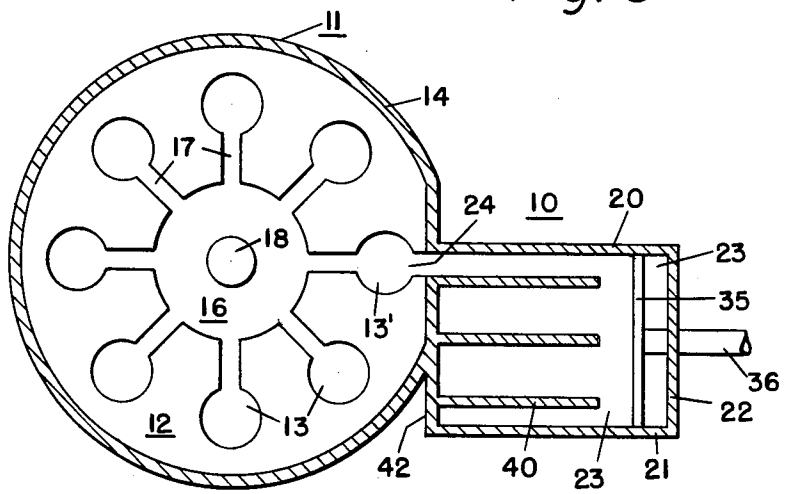
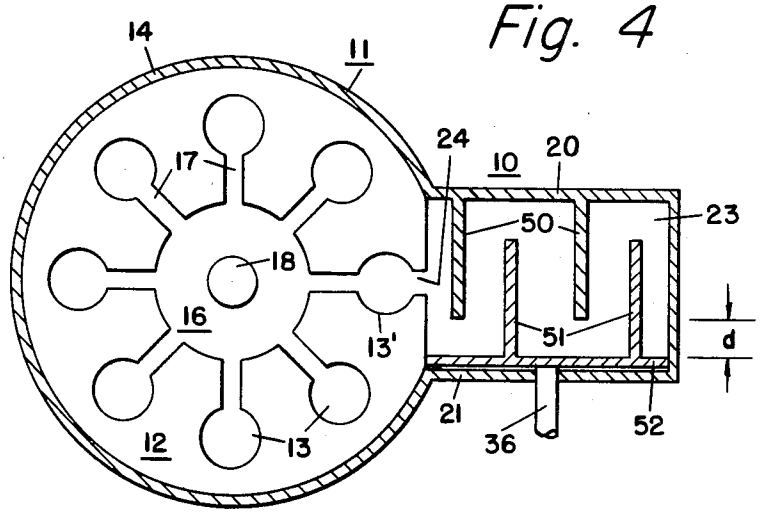


Fig. 4



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MAGNETRON CAVITY RESONATOR ASSEMBLY

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This invention relates to electronic discharge tubes of the magnetron type adapted to generate ultra-high frequency oscillations and in particular is concerned with tuning of a magnetron to convert it from a fixed-tuned oscillator to a tunable device.

The need for tuning a magnetron oscillator may arise in a situation where the oscillating system of the magnetron is predesigned to operate at a definite frequency, and it is therefore useful to be able to adjust the operating frequency or in the case of an oscillator which is off frequency, it is useful if it can be brought to operate within the frequency band by effecting a small change in the resonating properties of the oscillator.

The present invention relates to the type of tuning device which is mounted exteriorly of one or more of the resonant segments of a multi-cavity magnetron anode and utilizes a diaphragm arranged for suitable adjustment, for example, by manual, electro-mechanical, hydraulic or electronic means to vary the capacitance reactance of the magnetron.

Tuning by use of a diaphragm has been subject to some deficiencies in the past, particularly when a diaphragm is used to adjust the capacitance reactance of magnetrons of large physical dimensions, since it has been customary or necessary to use a large diaphragm for accommodating it to the iris structure of the magnetron and the large diaphragm has been subject to vibration and thermal distortions. Additionally, the large dimensioned magnetrons have required a large tuning cavity to provide effective tuning and this has presented a problem in cooling for maintaining the tuning structure at proper temperature.

Specifically, the invention is directed to a design or construction of cavity resonator which is formed with or attached to the exterior of a multi-cavity magnetron structure and is not subject to improper operation by internal vibrations or distortions. The invention is predicated on the idea of a cavity resonator of rectangular shape having a length of one-half the wave length at the frequency of operation of the magnetron with which it is used and is substantially of less width and height. Within the rectangular cavity a plurality of fins or plates are arranged to effect a periodic loading of the cavity resonator. The fins of the cavity resonator extend from one wall and have side and end edges which are disposed in spaced relation with the other walls and the resonator communicates with a selected one of the magnetron cavities through an opening in the magnetron anode.

This general design of resonator permits it to be constructed of small dimensions and yet be used with large magnetrons. Specifically, a rectangular housing 3" in length by approximately 1¼" in width by ⅔" in height has been used effectively on large magnetrons whereas a cylindrical type of resonator used with large magnetrons is of approximately 7" in diameter.

One object of the present invention is to provide a cavity resonator structure for a magnetron whereby the frequencies generated by the magnetron may be varied or controlled from a point externally of the magnetron.

Another object of the invention is to provide a rectangular cavity resonator structure which is of sectional or compartmented design providing for its periodic electrical loading of energy from the magnetron.

Still another object of the invention is to provide a cavity resonator structure utilizing a diaphragm for adjusting the volume of the resonator to provide for large or small tuning rates.

The above and other objects and features of the invention will be fully set forth in the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective of a magnetron and an external cavity resonator assembly of the present invention with portions of the assembly removed to show details.

FIG. 2 is a sectional view on the line 2—2 of FIG. 1 looking in the direction of the arrows.

FIGS. 3 and 4 are longitudinal sections through magnetron and external cavity resonator assemblies showing modifications of details of the resonator of FIG. 1.

Referring to FIG. 1, one type of cavity resonator of the invention is shown at 10 and assembled with a magnetron indicated at 11 which is of the type having an anode block 12 formed with a plurality of generally cylindrical shaped cavities 13. The anode block 12 is cylindrical and is enclosed within a housing having a cylindrical side wall 14 and similar end walls 15—15. At 16 is shown the central cylindrical reaction space of the magnetron which communicates with the cavities 13 through coupling channels or slots 17 and has disposed centrally thereof a cathode 18 which is in the form of a cylindrical rod and supported in position by suitable means, as shown, for example, by patent No. 2,466,765 to P. L. Hartman. The anode block 12 will preferably be constructed of a conductive or dielectric material in order that the surfaces of the cavities 13 will be sufficiently conductive to function as reflectors of the electro-magnetic waves of the frequencies which are generated by the magnetron.

The resonator 10 is in the form of a rectangular housing which has substantially greater length than width or height and is secured to the cylindrical wall 14 of the magnetron in sealed relation therewith. As shown in FIG. 1, the upper and lower walls 20 and 21, respectively, of the resonator 10 are in the form of extensions of the annular sidewall 14 of the magnetron and the resonator has a closed outer end 22 and sidewalls 23—23 as in FIG. 2. The inner end wall of the resonator 10 is formed by a portion of the anode 12 and is in communication with a selected cavity identified at 13' through a resonant aperture 24 formed in the end wall portion of anode 12 providing an arrangement for communication between the resonator 10 and the reaction space 16 of the magnetron 11. A group of rectangular fins or plates 25 have their upper edges fixed to upper wall 20 of the resonator and extend therefrom in parallel relation with end wall 22 toward the bottom wall 21 providing a space 30 therewith which is defined by the plane of the lower edges of the fins 25. The fins, which extend transversely of the resonator, terminate short of the sidewalls 23—23 and provide other spaces 31 and 32 with the sidewalls and which communicate with the space 30, the spaces 31 and 32 being defined by the planes of the respective side edges of the fins 25.

The principal electric and magnetic fields of the resonator 10 of the assembly are indicated respectively by the arrows at E and H. The capacitance between the edges of adjacent fins may be adjusted by the provision of a diaphragm 35, disposed as shown in FIG. 1, adjacent the lower wall 21, and having its peripheral edges in tight fitting but movable relation with the side walls and arranged to be adjusted by any suitable means or the lower wall 21 could be formed of flexible diaphragm material. For adjustment of the diaphragm, a shaft 36 is arranged to adjust the volume of the cavity resonator and as shown is screw-threadedly mounted in the lower wall 21 for manipulation by its knurled end 37.

In FIGS. 3 and 4, the resonators are modified over the

construction shown and described in connection with FIG. 1. In FIG. 3, the fins are identified at **40** and extend from the portion of the anode **12** which forms the inner end wall of the resonator in parallel relation with the upper and lower walls **20** and **21** toward the end wall **22** of the resonator in spaced relation therewith and the side edges of the fins will be understood, although not shown, to be disposed in spaced relation with the side walls **23—23** of the resonator. The diaphragm in the modification is mounted in a manner to be moved toward or away from the fins by means of the adjusting shaft **36**.

In FIG. 4, the fins are divided in sets, the fins of one set being indicated at **50** while the fins of the other set are indicated at **51**, one set of fins as **50** are secured to the top wall **20** and extend toward the bottom wall **21** while the fins **51** of the other set are secured to a diaphragm **52** which is disposed adjacent the bottom wall **21**. Adjustment is made by means of the adjusting shaft **36** in the manner of FIGS. 1 and 2.

While there has been described what is at present considered to be the preferred embodiments of this invention, it will be obvious that various changes may be made therein without departing from the scope of the invention.

I claim:

1. A tunable magnetron oscillator of the type comprising an annular anode ring having a group of circumferentially spaced oscillator cavities disposed inwardly of its outer peripheral wall, a slot communicating through the peripheral wall with one of said cavities, a cavity resonator formed of pairs of opposed walls providing a boxlike construction integral with the anode ring and extending outwardly thereof, one wall of said resonator being formed of a portion of the anode ring bounding said slot, a plurality of rectangular fins arranged in spaced parallel relation with each other and with one pair of opposed walls, each fin having a first and second pair of opposed edges, said fins having one edge of the first pair of edges secured to one wall of a second pair of opposed walls and the other edge of said first pair of edges providing a space with the other wall of said second pair of opposed walls and said fins also having one edge of the second pair of edges providing a space with one wall of a third pair of opposed walls and the other edge providing a space with the other wall of the third pair of opposed walls and means in the cavity resonator adjacent said other wall of said second pair of opposed walls for varying the volume of the resonator.

2. A tunable magnetron oscillator of the type comprising an annular anode ring having a group of circumferentially spaced oscillator cavities disposed inwardly of its outer peripheral wall, a slot communicating through the peripheral wall with one of said cavities, a cavity resonator formed of pairs of opposed walls providing a boxlike construction integral with the anode ring and extending outwardly thereof, one wall of said resonator being formed of a portion of the anode ring bounding said slot, a plurality of rectangular fins arranged in spaced parallel relation with each other and with the walls of one pair of opposed walls, said fins having one edge secured to one wall of a second pair of opposed walls and its other edges spaced from the other wall of said second pair of opposed walls and from both the walls of a third pair of opposed walls and diaphragm means in the cavity resonator adjacent said other wall of said second opposed pair of walls for varying the volume of the resonator.

3. A tunable magnetron oscillator of the type comprising an annular anode ring having a group of circumferentially spaced oscillator cavities disposed inwardly of its outer peripheral wall, a slot communicating through the peripheral wall with one of said cavities, a cavity resonator formed of pairs of opposed walls providing a boxlike construction integral with the anode ring and extending outwardly thereof, one wall of said resonator being formed of a portion of the anode ring bounding said slot, a plurality of rectangular fins arranged in spaced parallel relation with each other and with said inner wall of the resonator, said fins having one edge secured to one side wall of the resonator and its other edges spaced from the other side walls of the resonator and diaphragm means in the cavity resonator adjacent the side wall opposite said one side wall for varying the volume of the resonator.

4. A tunable magnetron oscillator of the type comprising an annular anode ring having a group of circumferentially spaced oscillator cavities disposed inwardly of its outer peripheral wall, a slot communicating through the peripheral wall with one of said cavities, a cavity resonator formed of pairs of opposed walls providing a boxlike construction integral with the anode ring and extending outwardly thereof, one wall of said resonator being formed of a portion of the anode ring bounding said slot, a plurality of rectangular fins arranged in spaced parallel relation with each other and with said inner wall of the resonator, said fins having one edge secured to one side wall of the resonator and its other edges spaced from the other side walls of the resonator, diaphragm means in the cavity resonator adjacent the opposite side wall from said one side wall and means carried by said opposite side wall for adjusting the diaphragm to vary the volume of the resonator.

5. A tunable magnetron oscillator of the type comprising an annular anode ring having a group of circumferentially spaced oscillator cavities disposed inwardly of its outer peripheral wall, a slot communicating through the peripheral wall with one of said cavities, a cavity resonator formed of pairs of opposed walls providing a boxlike construction integral with the anode ring and extending outwardly thereof, one wall of said resonator being formed of a portion of the anode ring bounding said slot, a plurality of rectangular fins arranged in spaced parallel relation with each other and with one pair of opposed side walls of the resonator, said fins having one edge secured to said inner wall of the resonator and its other edges spaced from the other end wall and the other pair of opposed side walls of the resonator and diaphragm means in the cavity resonator adjacent said other end wall for varying the volume of the resonator.

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