July 23, 1957 C. V. LITTON 2,800,609

MAGNETRON TUNER DEVICE

Filed April 29, 1954

FIG. 1.

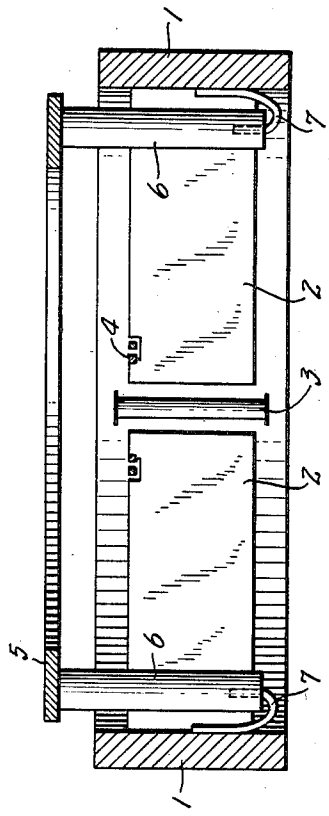


FIG. 3.

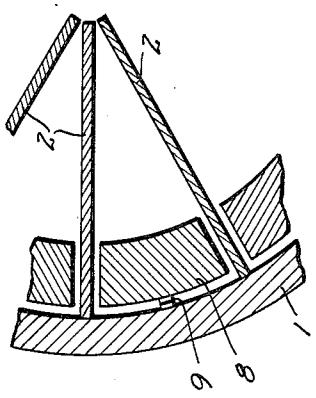
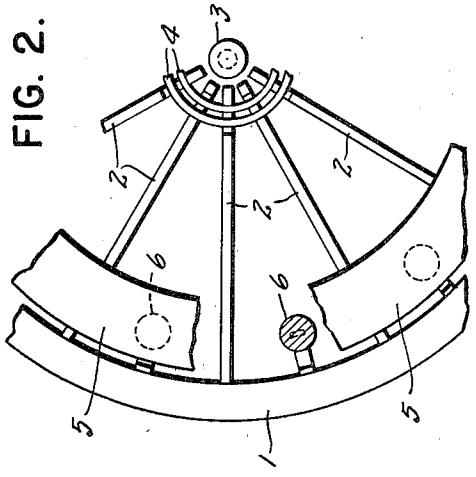


FIG. 2.



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United States Patent Office 2,800,609
Patented July 23, 1957

2,800,609

MAGNETRON TUNER DEVICE

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Application April 29, 1954, Serial No. 426,383

10 Claims. (Cl. 315—39.61)

This invention relates to tunable magnetrons and more particularly to magnetron tuning devices designed to reduce unwanted resonance effects in such tuners.

In multi-cavity resonator magnetrons, tuners have been proposed in which pins or other protrusions are mounted, to be variably inserted into the resonator cavities, as plungers, adjacent the resonator walls. These plungers may be inserted into the portion of the resonator predominantly inductive or into the portions predominantly capacitive. With this type of tuner the length of the inserted members and the spacing therebetween, together with the control mechanism, may produce circuits which will resonate at the operating frequency of the magnetron, in some positions of the tuner. If the resonance effects are close to the operating frequency difficulties arise in securing proper operational characteristics of the magnetron.

It is an object of this invention to provide a tuner for magnetron resonators which will substantially avoid the occurrence of unwanted resonance in the tuning device.

According to a feature of this invention, in a tunable magnetron having a resonator anode provided with a cavity defining wall substantially parallel with the longitudinal axis of the resonator, and having a tuning plunger with means for moving the plunger variable distances into the resonator cavity, there is provided a resilient conductive connection between the tuning plunger and the resonator wall, slidably interconnecting these parts internally of the cavity to avoid the production of unwanted resonance effects.

The resilient means may be a spring member fastened at one end of the plunger and positioned in sliding contact with the wall, so that the tuning element is connected with the magnetron anode, and the resonances that otherwise might occur are thus avoided. This device may be particularly effective in tuners adapted to affect the predominantly inductive portions of the resonator. Preferably the contact is made with the resonator wall at a point substantially coinciding with a voltage node. The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings in which:

Figure 1 is a sectional view of a portion of a magnetron anode illustrating an embodiment of my invention;

Fig. 2 is a fragmentary plan view of the magnetron illustrated in Fig. 1; and

Fig. 3 is a fragmentary view of a portion of a magnetron anode illustrating an alternative structure of the magnetron plunger.

Turning now to Figs. 1 and 2, there is shown a portion of a magnetron anode having an outer cylindrical wall 1, a plurality of vanes 2 extending radially inwardly from the wall 1 to define resonator cavities in the usual form. A cathode 3 may be provided to furnish the electron energy for the magnetron and the usual strapping rings may be provided as indicated at 4. The tuner for the magnetron may comprise a ring portion 5 having a plurality of plunger elements 6, one for each resonator, these plungers being shown as pins in the illustration of Figs. 1 and 2. Ring 5, or other means attached thereto may serve to move plunger elements 6 longitudinally of the resonators to tune these resonators simultaneously. It will be seen that two adjacent pins 6, together with the inter-connecting portions of ring 5, effectively provide a section of transmission line similar to what are known as transmission line stubs. The dimensions of these pins and the spacing therebetween, together with the capacitive effect of the magnetron anode, provide a circuit resonant at different frequencies as the plunger is inserted into the cavity. If these resonances are close to the operating frequency of the magnetron unwanted modes and resultant absorption of energy may occur, reducing the efficiency of the magnetron.

In order to avoid these unwanted resonances a series of conductive spring members 7 are provided interconnecting the pins 6 and the wall 1 of the magnetron. As illustrated, these springs 7 are fastened into the ends of the pins 6 and are slidably in contact with the inner surface of wall 1. Thus, the effective transmission line formed by the pins is short circuited at both ends and, therefore, the resonance frequency will be altered to such an extent that they will not approach that of the magnetron in any position of the tuner.

In Fig. 3 is shown an alternative structure in which the magnetron anode wall 1 and 2 are shown substantially the same as in the embodiment of Figs. 1 and 2. The plunger 8 is formed substantially as a portion of a sector of the resonator cavity. This plunger pin is connected by means of a spring member indicated at 9 similar to spring members 7 to the wall 1 of the resonator. The examples illustrated are purposely simplified in order clearly to illustrate the invention without the complications of other magnetron structural elements. It will be understood that other types of spring members could be provided to interconnect the plungers and magnetron walls if desired. Also it will be understood that the connection need not be made at substantially the voltage nodal point as illustrated but should be made to other portions of the magnetron anode. Preferably, however, it is made to the outer wall, as connections to the magnetron vanes would generally not be satisfactory. The vanes are usually narrow in axial extent and are often very thin so that pressure of this kind would not be desirable. In most cases it is desirable that the connections be made to the tuners arranged in the portion of the resonator predominantly inductive since this part is generally adjacent to the outer walls of the magnetron resonator.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. A tunable magnetron having an anode provided with a cavity resonator, said anode defining a wall of the resonator extending substantially parallel to an axis of said resonator, a tuner having a plunger, and means for moving said plunger into said resonator cavity substantially parallel with said wall, characterized by a spring fastened to one end of said plunger 4 slidably interconnecting said plunger and said wall internally of said cavity, to avoid unwanted resonances in said tuner.

2. In a tunable magnetron having a resonator anode,

with a predominantly inductive reactive portion including an outer wall of said resonator, and a tuner comprising a metal member having one end insertable into said resonator substantially parallel to said outer wall portion and adjacent thereto, characterized by means to reduce unwanted resonances in said tuning element comprising a spring fastened to one end of said metal member and positioned in sliding contact with said wall portion.

3. A magnetron according to claim 2, wherein said spring is in contact with said wall at substantially a voltage node of said resonator.

4. In a tunable magnetron having a resonator anode, with a predominantly inductive reactive portion including an outer wall of said resonator, and a tuner comprising a conductive tuning element movable substantially parallel to said outer wall portion and adjacent thereto, characterized by means to reduce unwanted resonances in said tuning element comprising a conductive resilient means fastened to said tuning element and positioned in sliding contact with said wall portion.

5. In a tunable magnetron having a resonator anode with a predominantly inductive reactive portion, including an outer wall of said resonator, and a tuner comprising a metal member having one end insertable in the said resonator substantially parallel to the outer wall portion and adjacent thereto, characterised by means to reduce unwanted resonances in said tuning element comprising a spring fixed to one end of said metal member and positioned in sliding contact with said wall portion.

6. In a tunable magnetron having a plurality of resonators forming an anode, each of said resonators having a predominantly inductive reactive portion including an outer wall of the corresponding resonator, and a tuner having tuner elements movable in each of said resonators substantially parallel to the respective outer wall portions and adjacent thereto, characterised by means to reduce unwanted resonances in said tuning element comprising conductive resilient means fastened to each of the tuning elements and in sliding contact with the respective wall portions of the associated resonators.

7. In a tunable magnetron, an anode provided with a cavity resonator, said anode defining a wall of the resonator, a tuning plunger, means for moving said plunger into said resonator in a direction substantially parallel with said wall, and conductive means slidably interconnecting said plunger and said wall internally of said cavity.

8. In a tunable magnetron, an anode provided with a cavity resonator, said anode defining a wall of the resonator, a tuning plunger positioned in said cavity resonator and grounded to said wall internally of said cavity resonator, and means for moving said plunger relative to said cavity resonator to vary the resonant frequency of said cavity resonator.

9. In a multi-cavity tunable magnetron, the combination comprising a cathode, an anode surrounding said cathode and having at least one cavity resonator therein, said cavity resonator extending radially from said cathode and having a closed end remote from said cathode, a tuning plunger positioned in said cavity resonator adjacent said closed end, means in said resonator conductively interconnecting said plunger and said closed end, and means for moving said plunger relative to said cavity resonator to vary the resonant frequency of said cavity resonator.

10. In a multi-cavity tunable magnetron, the combination comprising a cathode, an anode surrounding said cathode and having at least one cavity resonator therein, said cavity resonator extending radially from said cathode and having a closed end remote from said cathode, a tuning plunger positioned in said cavity resonator adjacent said closed end, said plunger being grounded to said closed end within said cavity resonator, and means for moving said plunger relative to said cavity resonator to vary the resonant frequency of said cavity resonator.

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