June 6, 1950 A. R. KOCH 2,510,639

CAVITY RESONATOR SYSTEM

Filed March 2, 1948

Fig. 1.

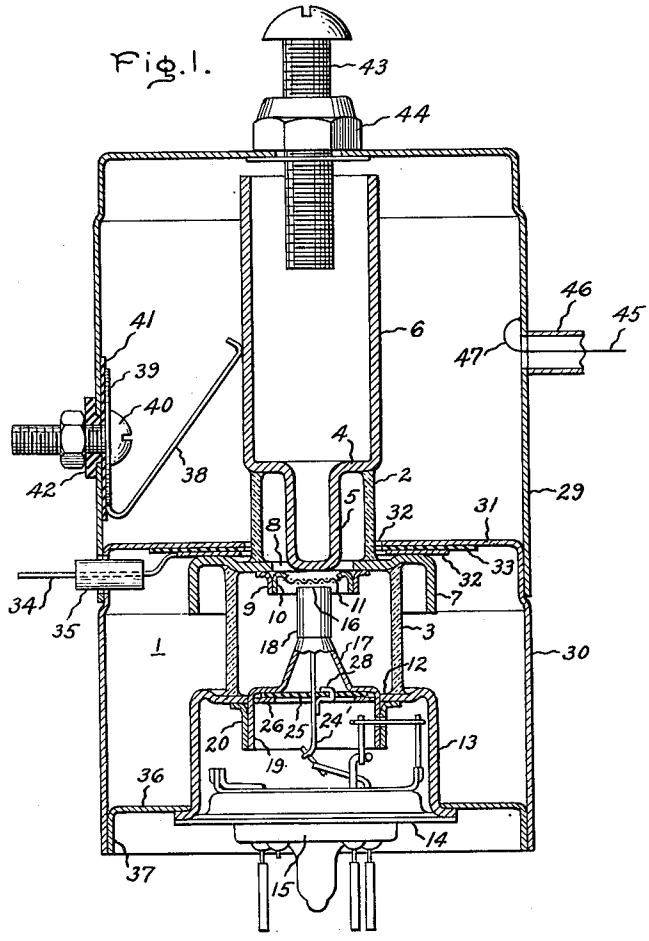


Fig. 2.

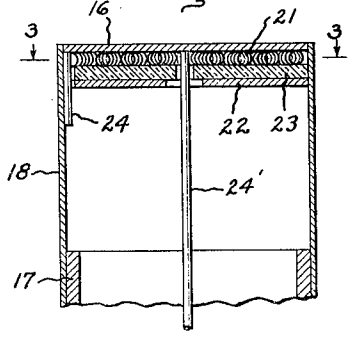
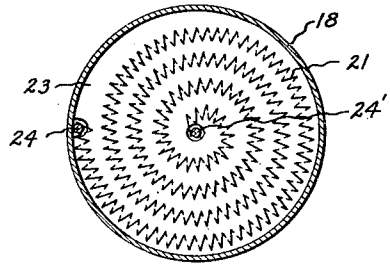


Fig. 3.



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CAVITY RESONATOR SYSTEM

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3 Claims. (Cl. 315—39)

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My invention relates to cavity resonator systems of the type adapted for generating or amplifying high frequency oscillations.

There have been provided, in accordance with the prior art, a large variety of resonator structures for producing short wave oscillations or for amplifying oscillations of this character. In accordance with an important aspect of my invention, I provide a resonant system of this character which is very simple in construction and readily manufactured at reasonable cost.

It is an object of my invention to provide a new and improved cavity resonator system.

It is another object of my invention to provide an improved and simplified resonator system including an electric discharge device.

Further objects and advantages will become apparent as the following description proceeds, reference being had to the accompanying drawing, and its scope will be pointed out in the appended claims. In the drawing, Fig. 1 is an elevational view in section of a resonator system embodying my invention; Fig. 2 is an enlarged sectional view of a portion of the cathode of the discharge device incorporated in the resonator of Fig. 1; and Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2.

Referring now to the drawing, I have shown my invention embodied in a resonator system including an electric discharge device designated generally by the numeral 1. The device is of the type which has generally been described as being of disk-seal construction and includes insulating cylinders 2 and 3 which form a portion of the envelope. The cylinder 2 is sealed at one end to an outwardly extending flange 4 of an anode member 5 which includes an integral axially extending cylindrical portion 6. As will be described in detail at a later point in the specification, the portion 6 of the anode forms the central conductor of an anode-grid resonator. The lower end of the insulating cylinder 2 is sealed to a grid disk or terminal 7 which is provided with a central aperture 8 in line with the end of the anode 5. Surrounding the opening 8 and extending downwardly from the terminal 7 to which it is secured, is a sleeve 9 within which the supporting sleeve 10 of a grid 11 is received.

The insulating cylinder 3 is sealed at its upper end to the grid terminal 7 and at its lower end to an inwardly directed flange 12 provided at the upper end of a cylindrical metal member 13. The member 13 provides a cathode terminal and also an enclosure for the lead-in conductors of the device. The envelope is completed by a header member 14 which is bonded to the lower

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end of the cylinder 13 and includes a central stem 15 of glass through which the lead-in conductors are sealed.

The cathode 16 is carried on a conical support 17 by means of an interposed cylinder 18 of thin metal foil which minimizes the transfer of heat from the active surface of the cathode to the support 17. The lower end of the cathode support terminates in a cylindrical extension 19 which is received within a sleeve 20 secured to the lower side of the flange 12 in the same manner that the grid supporting sleeve 10 is secured to the grid terminal 7.

The cathode is of the indirectly heated type and the cathode heater element is in the form of a flat spiral 21 which is retained in contact with the lower surface of the cathode by a nickel washer 22 and an interposed insulator 23 of aluminum oxide or similar material. One terminal 24 of the heater is bonded directly to the cathode support 18 and the other terminal 24' is brought through aligned central openings in the parts 22, 23 and supported in position by an insulating disk 25. The disk 25 is secured in position by a retaining ring 26 which is spot welded to the cathode supporting member 17. A clip 28 secured to the heater lead 24' engages the insulating member 26 to assist in supporting the heater lead. As will be readily appreciated, the connections with the heater and cathode are made through suitable lead-in conductors sealed through the stem 15.

The structure described thus far provides not only the discharge device of the resonator system but also the inner conductors of the grid-anode and grid-cathode resonators. These inner conductors are provided respectively by the anode parts 5 and 6 and by the cathode supporting structure including parts 13, 17, and 18. The outer conductors of these resonators are provided by a generally cylindrical sheet metal structure made up of two cup-shaped conducting members 29 and 30. The members 29 and 30 are assembled together with the closed end of the member 30 received within the open end of the member 25. As indicated the diameter of the upper end of the member 30 is reduced by the thickness of the material used so that the amount of telescoping of the parts is readily controlled during assembly and the outer diameter of the resonator is substantially uniform. These parts are preferably bonded together, as by soldering, before assembly on the discharge device. The end wall 31 of the member 30 is provided with a central aperture 32 of sufficient size to receive the cylinder 2 of the discharge device

envelope. When the members 29 and 30 are assembled on the discharge device, a conducting washer 32 and an insulating washer 33 are interposed in that order between the grid terminal 7 and the end portion 31 of the resonator member 30. The washer 32 is provided with a tab 34 which extends through a suitable opening in the overlapping portions of the members 29 and 30 and is insulated therefrom by a sleeve of insulating material 35. The tab 34 provides a direct current connection with the grid which is insulated from the resonator. The insulating washer 33 cooperates with the washer 32 and the end wall 31 to provide a by-pass capacitor connecting the grid terminal 7 with the resonator with respect to high frequency currents. The assembly including the members 29 and 30 is supported from the base of the discharge device by an annular member 36 which is welded or otherwise secured to the base of the member 13 of the discharge device and is provided at its outer edge with a downwardly extending flange 37 for bonding to the lower end of the resonant member 30.

A terminal for supplying direct current voltage to the anode is provided by a resilient conductor 38 positioned within the cup-shaped member 29 and having one end formed as a washer 39 which is secured against the inner wall of the member 30 by a bolt 40. The bolt and washer are retained in insulated relation with respect to the resonator member 29 by insulating washers 41 and 42.

In order to provide for some tuning of the grid-anode resonator, I provide a threaded plunger 43 in the form of a bolt which extends through the end wall of the cup-shaped member 29 and into the interior of the anode extension 6. The tuning plunger engages a nut 44 bonded to the end wall of the cup-shaped member 29. As will be readily understood, the plunger 43 is adjusted to control the capacity between the conductors 6 and 29 of the resonator.

A suitable shielded conductor for extracting energy for the grid-anode resonator is provided by a concentric transmission line including inner conductor 45 and outer conductor 46. The inner conductor terminates in a loop 47 which is coupled with the field which is produced within the grid-anode resonator during operation of the system.

It will be apparent from the foregoing detailed description that a resonator system embodying my invention is very simple and compact and may be readily manufactured at a reasonable cost. The inner conductors of the concentric resonators are provided by portions of the discharge device including the cathode and anode supports. The two cup-shaped members providing the outer conductors of the resonators are readily drawn from sheet stock and may be manufactured at low cost. The entire resonator assembly is supported from the discharge device and the over-all unitary construction is of extremely light weight. A practical embodiment of my invention has been constructed with the parts one-half the size of those illustrated in the drawing.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and it is, therefore, the aim in the appended claims to cover all such changes and modifications as

fall within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A resonator system comprising an electric discharge device including a plurality of electrodes including an anode, a cathode and a control member, a control member terminal extending outwardly from the control member, conductive structures connected respectively with said anode and cathode and extending in opposite axial directions, a pair of cup-shaped conductors each of substantially the same diameter, one of said conductors having an apertured end wall receiving said electric discharge device with said control member terminal coupled to said apertured end wall, said one cup-shaped member having said apertured end wall, received within the open end of the other of said cup-shaped members, and means joined to the other end of said one cup-shaped member and the conducting structure connected to one of the remaining electrodes to support the resonators provided by the cup-shaped members and the conductive structures connected with said electrodes.

2. A resonator system including an electric discharge device comprising an anode, a cathode and a control member terminal extending outwardly from the control member, conductive structures connected respectively with said anode and cathode and extending in opposite axial directions, a generally cylindrical member having an apertured end wall in which said electric discharge device is received with said control member terminal electrically coupled to said apertured end wall, a substantially annular metal member mechanically connected to the conductive structure connected to said cathode and to the other end of said cylindrical member, a cup-shaped conductive member enclosing the conductive structure connected with said anode and having the open end thereof engaging the apertured end of said cylindrical member.

3. A resonator system comprising an electric discharge device including an anode, a cathode and a control terminal extending outwardly from the control member, generally cylindrical conductive structures connected respectively with said anode and cathode and extending in opposite axial directions, a generally cylindrical member having an apertured end wall receiving a part of said electric discharge device and electrically coupled to said control member terminal, said cylindrical member surrounding one of the cylindrical conductive structures in spaced relationship thereto, an annular member connected between the other end of said cylindrical member and said conductive structure, a cup-shaped conductive member having an open end engaging the apertured end of said cylindrical member and extending in concentric and enclosing relation with respect to the other of said cylindrical conductive structures.

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