

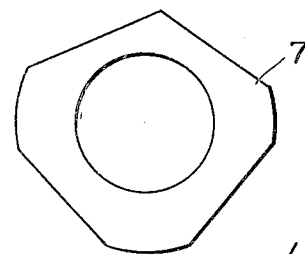
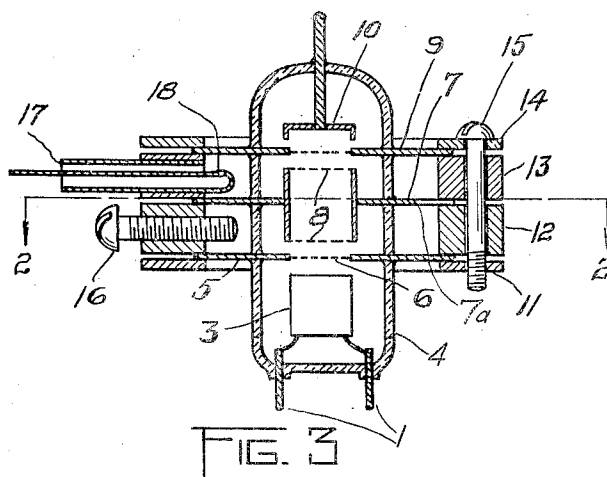
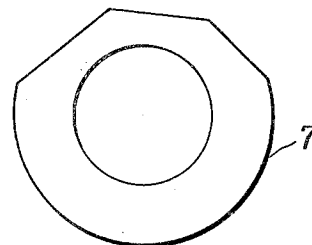
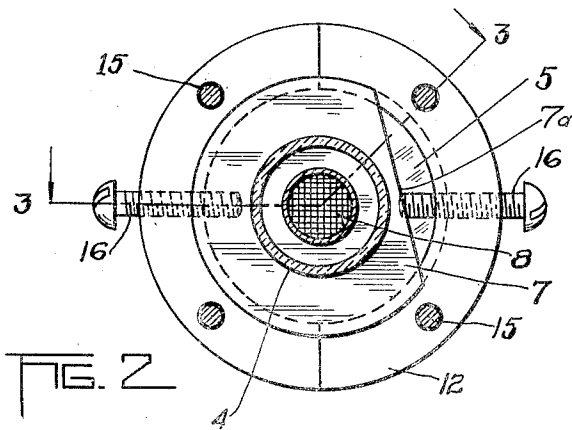
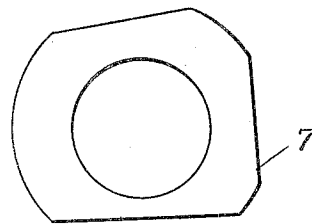
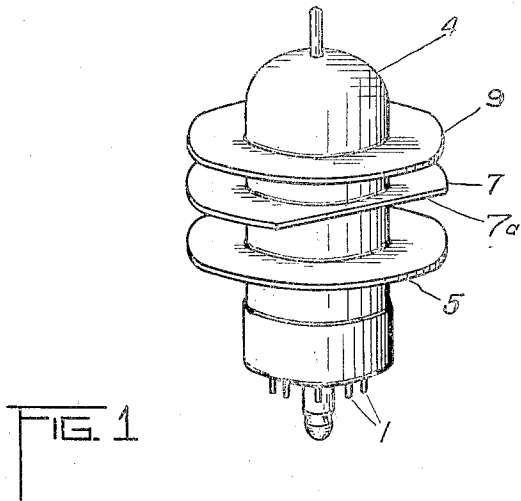
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2,492,618

ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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5 Claims. (Cl. 315-5)

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This invention refers to electron discharge tubes employing disc seals and external parts attached to cooperate with the discs in forming cavity resonators, and is more particularly directed to an improved disc and method of shaping the disc to secure the desired electrical results.

In an electron discharge tube of the type in which this invention is usable, several electrodes consisting of flat washer-like metal discs are sealed between glass sections which are part of the envelope of the tube. The washer-like disc electrode has its outer periphery external to the envelope, while its inner periphery is in the evacuated space inside the envelope. Various additional parts of the electrode structure, such as grid wires, are usually attached to the inner periphery of the disc. To the external periphery are ordinarily attached split rings and other parts which in conjunction with the discs form a set of cavity resonators in which are developed the high frequency electromagnetic fields in accordance with the variations in the electron beam inside the tube.

In many applications, such as a positive or negative regenerative amplifier, and more particularly an oscillator, it is desired to secure electromagnetic coupling between two of these cavity resonators. In the case when this coupling is desired between two adjacent cavity resonators which are separated by one of the disc electrodes sealed into the envelope, the coupling has been obtained by providing an arc-like slot, with appreciable radial extension, in the separating disc, providing a direct opening between the cavity resonators through which the electromagnetic fields in one resonator can influence the fields in the other resonator.

The fabrication of the arc-like slot in the disc is an integral part of the manufacture of the tube; that is, the slot must be made before the tube is assembled, and relatively complex tools are required to cut it to the exact shape and size required to secure the proper amount of electromagnetic coupling which is necessary for the tube and its cavity resonators to operate in the intended manner. Further, after the tube has been assembled, it is not practical to alter the dimensions of the slot with this prior construction so as to adjust the electromagnetic coupling and make the tube and cavity resonator system operate in the desired manner.

In order that the electromagnetic coupling between two adjacent cavity resonators separated by a disc sealed into the envelope of an electron discharge tube may be obtained in a simple, effi-

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cient, and convenient manner, it is the object of my invention to provide a disc electrode with a particular external peripheral shape which may be easily fabricated with relatively simple tools and which may be readily altered at any time during the assembly of the tube or after it is exhausted and in use. My invention thus enables the user of the tube to adjust the electromagnetic coupling between the cavity resonators with greater precision to the desired value, to alter this coupling whenever required to secure slight changes in the operating conditions in the system, or even to change completely the application for which the tube was originally intended.

I therefore provide a simple, efficient, and convenient method for obtaining a path through which electromagnetic coupling is secured between the two cavities by cutting a segment from the external circular periphery of the disc. This segment may be cut or it may be enlarged at any time during or after construction of the tube, or additional segments may be cut whenever necessary.

Further objects and advantages of my invention will be pointed out, or will be apparent to those skilled in the art, in the course of the following description made in reference to the accompanying drawing. The features of novelty which characterize my invention will be particularly set forth in the appended claims.

In the drawing, Fig. 1 is a perspective view of a three-disc electron discharge tube provided with an embodiment of my invention. Fig. 2 is a sectional end view of the tube shown in Fig. 1, taken along the line 2-2 of Fig. 3, and with the addition of the external rings which cooperate with the disc to complete the cavity resonators. Fig. 3 is a sectional side elevation taken along the line 3-3 of Fig. 2. Figures 4, 5, and 6 show various forms of disc electrodes fabricated or altered in accordance with the invention to obtain the desired electromagnetic coupling in the finished structure.

In Fig. 1 I have illustrated a tube with three disc seals of the type described. The tube is designed to have additional external parts attached to cooperate with the discs 5, 7, and 9 in forming a pair of adjacent cavity resonators separated by the disc 7. The particular embodiment which my invention shows in this figure includes the straight section 7a of the disc 7 obtained by cutting in one or more pieces a section from the internal circular periphery of the disc 7. When the external parts are attached to complete the cavity resonators an opening along the line 7a will

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exist between them to allow electromagnetic coupling of the fields in the two resonators.

The operation of the tube, which is well known to those skilled in the art, may be best described in connection with Fig. 3. The lead-in wires 1 are sealed into the envelope 4 and are connected to a heater (not shown) inserted in cathode 3, which is connected at some convenient point to one of the lead-in wires. Positive voltage is applied to the collector electrode 10 supported by a pin or wire sealed through the upper end of the envelope and to the grids 8 and 6 or by connection to screw 15. The beam of electrons leaves the cathode 3, passes through the four grids (indicated by dash lines, as at 6 and 8), and is collected by the positive electrode 10. The grids are supported by the discs 5, 7, and 9 which are sealed into the envelope 4 and axially spaced along the envelope. To the interior periphery of the disc 7 is fastened a tubular member which carries the grids 8.

The cavity resonators are externally completed by the addition of split rings 12 and 13 which are attached to the discs with the aid of clamping rings 11 and 14 and screws 15.

The lower cavity resonator is thus bounded by the grid 6, carried by the disc 5, the split rings 12, and the lower grid 8 with its supporting tube mounted on the disc 7. The upper cavity resonator is similarly enclosed by the upper grid 8, its supporting tube, the disc 7, the split ring 13, the upper disc 9 and its grid. Tuning screws 16 are inserted in threaded holes in the split ring 12 to adjust the frequency of the lower cavity. A similar set of screws might be used in conjunction with the upper cavity, although they are not shown in this drawing. A coupling loop 18, connected to a coaxial line 17, is shown inserted in the upper cavity. The high frequency electromagnetic fields in this cavity supply power to this loop. In the case of an amplifier tube, a similar input loop should be inserted in the lower cavity resonator, ordinarily in place of one of the screws 16.

With the particular tube shown, high frequency electrical oscillations are generated and transferred to the coaxial line 17 by cooperation in the wellknown manner between the variations in the electron beam passing from cathode 3 to collector 10 and the electromagnetic fields in the cavity resonators. For this purpose it is necessary to have some means provided for electromagnetic coupling between the two cavity resonators. According to this invention, this coupling is provided for this particular tube by providing disc 7 which separates the cavity resonators with a straight section 7a formed by cutting a segment from the original circular external periphery, thus permitting a direct opening between the cavity resonators through which interaction of the fields may take place. The method in which the disc is cut is clearly shown in Fig. 2, which is a sectional view through the tube directly over the disc.

It is now apparent that a disc of this shape offers many advantages in simplicity of the initial construction, and that more especial benefits result from the fact that it may be easily altered to increase the electromagnetic coupling at any time during or after the assembly of the tube. The tube may be used in conjunction with a particular set of cavity resonators and tested for frequency of operation, output power, and so on. If it is deemed to be not operating properly because of insufficient coupling, it may be removed from the

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equipment and the cut segment enlarged. In some cases it may be advisable to make one or more additional cuts as shown in Figures 4, 5, and 6. These cuts may be all distinct, having sections of the original circular periphery between them, or the ends of the cuts may overlap.

It is thus shown that in the construction of an experimental tube this method of adjustment should be of particular value to the designer who might test the tube through a series of conditions over a very wide range of coupling between the cavities. In the case of tubes manufactured on a large scale, the invention could be used to prevent rejects: the cut section can be made intentionally smaller, initially, than required, and enlarged to the desired point after the tube has been completed and while it is being tested.

If it is desired to operate the tube as a regenerative amplifier, regeneration in any desired amount may be obtained by cutting off a segment of the proper size. Degeneration may be provided in the same way if beam voltages are adjusted so that the oscillations in the input and output resonators are out of phase. It is possible, in addition, to use the same tube, subsequently, as an oscillator by enlarging a segment or by cutting off one or more additional segments so that the regeneration is sufficient to cause oscillation.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim is:

1. The combination of an electron discharge tube and a pair of cavity resonators, said electron discharge tube comprising an envelope and a disc electrode terminal sealed through said envelope and forming a barrier between said resonators, said disc terminal having an external portion removed to provide coupling between said resonators.

2. An electron discharge tube having three disc seals and two external cavity resonators, the discs forming part of the boundaries of the cavity resonators, the center disc in particular being part of the separating wall between the two resonators and being of a different shape from the other two discs providing an opening between the cavity resonators, the outer periphery of the middle disc being not entirely circular but running in part along a chord of a circle.

3. An electron discharge tube having an envelope containing electrodes for providing an electron stream, pairs of grids mounted in the path of the electron stream, and a disc sealed through the envelope and connected to the adjacent grids of said pairs of grids, and a pair of resonators secured to said pairs of grids with said disc forming the dividing boundary between the resonators, said disc having a peripheral portion removed providing coupling between said resonators.

4. An electron discharge device comprising an envelope, electrodes within said envelope for providing an electron stream, pairs of grids interposed in the path of the electron stream, and a disc sealed through said envelope and connected to adjacent grids of said pairs of grids, said disc being generally circular with peripheral portions lacking.

5. An electron discharge device including an envelope, electrodes within said envelope for providing an electron stream, several grids interposed in the path of the electron stream, and a disc

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sealed through said envelope and connected to an intermediate grid, said disc being generally circular with peripheral segments lacking.

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