

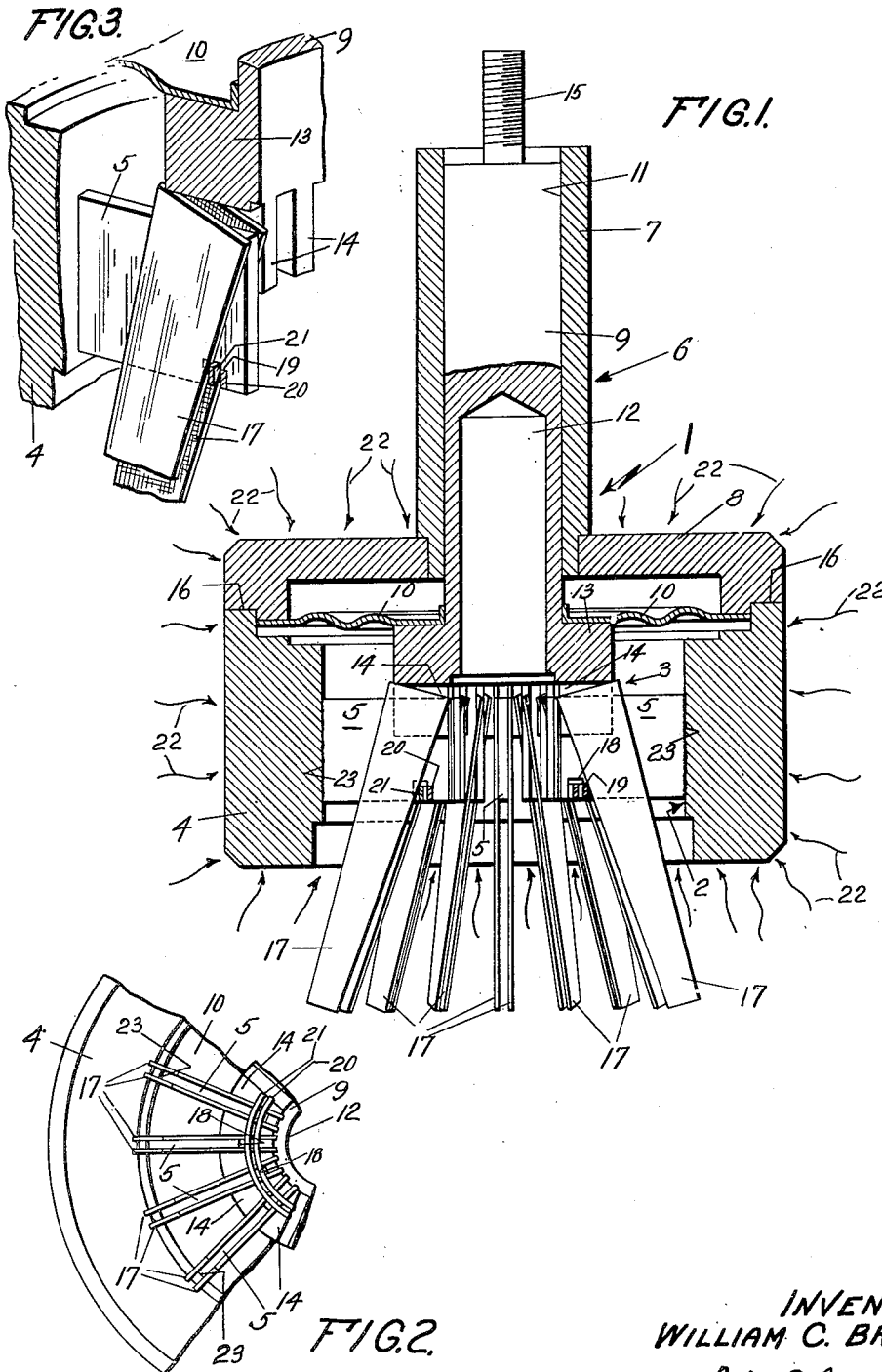
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MANUFACTURE OF ELECTRON DISCHARGE DEVICES

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MANUFACTURE OF ELECTRON-DISCHARGE DEVICES

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This invention relates to the manufacture of electron-discharge devices, and more particularly to the assembly and manufacture of tunable electron-discharge devices of the so-called multicavity magnetron type.

A multicavity magnetron of the type to which this invention relates includes at least one electrode, for example, the anode thereof, in the form of a cylindrical structure, made of highly conductive material, such as copper, and provided with a plurality of interiorly-extending, radially-disposed anode members, each pair of adjacent anode members, together with that portion of said anode structure lying therebetween, defining a cavity resonator. In the copending application of Erich Nevin Kather, Ser. No. 668,847, filed May 10, 1946, now Patent No. 2,529,950, granted November 14, 1950, there is disclosed and claimed a structure for mechanically tuning such a multicavity magnetron over a rather wide frequency range. Generally, this structure consists of a plurality of conducting elements, each of which is positioned intermediate a pair of adjacent anode members but spaced therefrom, so that each such element is positioned in a separate one of the cavity resonators; these elements are movable with respect to the adjacent anode members to alter the capacitance between said members, and thereby also the resonant frequency of the magnetron. The conducting elements are integrally joined to a movable common support, so that they are all movable as a unit.

By moving a conducting element intermediate each pair of adjacent anode members, preferably, in the high-capacitance regions thereof, at the inner ends of said members, adjacent the cathode of the device, considerable additional capacitance may be added in parallel with that already existing. In order to obtain a high additional capacitance, so as to achieve as wide a tuning range as possible, it is necessary to have very small clearances between the tuning conducting elements and the anode members or vanes, while at the same time not permitting any contact between said elements and the vanes or paddles. When the tuning structure and the anode structure are made up as separate subassemblies, normal cumulative tolerances in the anode subassembly and the tuner subassembly make a close fitting final assembly between these two subassemblies impossible.

Therefore, an object of this invention is to devise a method for enabling the desired small clearances between the tuning elements and the vanes of a tunable multicavity magnetron to be

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accurately achieved, resulting in magnetrons of wider tuning range, while at the same time reducing the number of rejects, thus cutting down the amount of scrap.

5 This, and other objects of the present invention, which will become more apparent as the detailed description thereof progresses, are attained, briefly, in the following manner.

While not absolutely necessary, it has been found advisable, in order to suppress spurious oscillations in devices of the type to which the present invention relates, to provide the anode structure thereof with at least one pair of conducting straps alternately contacting successive anode members.

10 As above described, the anode of such a device includes a cylindrical structure or envelope provided with a plurality of anode members or vanes.

The magnetron tuner subassembly, which includes a plurality of conducting elements integrally joined to a common support, as described above, each such element being intended to be positioned between a pair of adjacent anode vanes, is used as a jig for the straps and vanes of the anode subassembly. The exact optimum small separation between the tuning elements and the vanes is assured through the use of removable shims which hold or maintain the said elements and the vanes in the correct relative positions while the vanes and the tuner subassembly are both being soldered or brazed to the outer metallic envelope of the magnetron. Thus, the anode vanes are correctly located and uniformly and properly spaced, with respect to the tuning elements, for proper operation with those particular tuning elements.

Furthermore, the shims or spacing members are made of a non-solderable material, such as stainless steel, for example, and, since they are placed on each side of the tuning elements, between such elements and the anode vanes, function to prevent accidental soldering of the elements to the anode vanes, which soldering would cause the device to be rejected.

15 In the accompanying specification there shall be described, and in the annexed drawing shown, an illustrative embodiment of the method of the present invention. It is, however, to be clearly understood that the present invention is not to be limited to the details herein shown and described for purposes of illustration only, inasmuch as changes therein may be made without the exercise of invention, and within the true spirit and scope of the claims hereto appended. For example, tuning devices having various shapes of

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tuning fingers, different from that shown, may be utilized in the invention.

In said drawing:

Fig. 1 is a longitudinal sectional view taken through the center of a tunable multicavity magnetron, illustrating one step in the manufacture thereof, according to the present invention;

Fig. 2 is a partial bottom view of Fig. 1; and

Fig. 3 is an enlarged partial cut-away perspective view of the magnetron of Fig. 1.

Referring now more in detail to the aforesaid illustrative embodiment of the present invention, with particular reference to the drawing illustrating the same, the numeral 1 generally designates an electron-discharge device of the so-called tunable multicavity magnetron type, said device including an anode structure 2 and tuning means 3.

In the device shown, the anode structure includes a hollow cylindrical body or envelope 4, made of highly conductive material, such as copper, having assembled therein a plurality of radially-disposed, interiorly-extending copper anode members in the form of vanes 5, these vanes being assembled in such a position as to have their outer end faces suitably fastened, as by silver soldering or brazing, to the inner cylindrical wall of envelope 4.

In the manufacture or assembly of the device, a tuning subassembly 6 is made up. Said subassembly 6 comprises a pole piece 7, an end plate 8, a plunger 9, and a diaphragm 10. The tubular pole piece 7 is hermetically sealed, as by soldering, for example, into the shallow cup-like end plate 8, said end plate having a diameter equal to the outer diameter of envelope 4. Plunger 9 is slidably mounted in a bore 11 formed in the pole piece 7, the inner end of said plunger being recessed, as at 12, to accommodate the upper end of a cathode structure (not shown) in the completed device, and the lower end of said plunger being formed into a cup-shaped portion 13 which is integral with the previously-mentioned tuning member generally designated by the reference numeral 3.

The tuning member 3, which may be substantially cylindrical, comprises a plurality of integral spaced elements or fingers 14 which are adapted to straddle the anode members 5 and thereby extend into the cavity resonators formed in the anode structure 2. Each finger 14 is more or less rectangular or plate-like in shape, and is adapted to be moved intermediate a pair of adjacent anode members 5, preferably, in the high-capacitance region near the inner ends thereof.

A flexible annular diaphragm 10 is secured, at its outer edge, to a portion of the lower surface of end plate 8 and, at its inner edge, to the plunger 9.

In order to provide for an external physical connection to plunger 9 for moving the same vertically, a threaded stud 15 is formed on the upper end of plunger 9 and integral therewith. Any suitable control mechanism (not shown), for example, the mechanism disclosed in the aforesaid Kather application, may be coupled to stud 15 in order to move plunger 9 and fingers 14 vertically to thereby vary the tuning of the completed device. The fingers 14 are all integral with plunger 9, so that they are all movable as a unit by movement of said plunger.

The end plate 8 is adapted to be hermetically sealed, as by soldering at 16, for example, to envelope 4, to close the upper end thereof, the

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diaphragm 10 helping to complete this closure when the device is assembled.

According to this invention, in assembling or manufacturing the device, the tuning subassembly 6, consisting of elements 7-10 and 13-15 as above described, is built and assembled as a unit. The tuning subassembly is then used as a jig, in order to locate and properly space the anode members or vanes with respect to the fingers or tuning elements 14, and to maintain the anode members in position while they are being soldered or brazed to envelope 4 and while end plate 8 is being soldered or brazed to said envelope.

The tuning subassembly 6 is placed in position on envelope 4, with end plate 8 thereof contacting the upper end of said envelope, and said subassembly 6 is then firmly held in such position while further assembling takes place. The separate anode members or vanes 5 are then assembled in position with respect to fingers 14 of the tuning subassembly, in such a way that there is a vane on each side of each of the integrally-connected but spaced fingers 14. Thus, the anode members 5 are properly located with respect to said fingers. In order to achieve and insure the exact optimum (very small) desired separation between the vanes 5 and the fingers 14, a removable spacing member or shim 17 is placed on each side of each of the elements 14, or in other words is inserted between each element and the adjacent anode member 5, so that there is a pair of such shims between each of said elements 14 and the pair of corresponding anode members 5 between which it intervenes. The shims 17 are quite thin, being on the order of five mils in thickness, for example, and are made of a non-solderable material, such as stainless steel, to prevent accidental soldering of the fingers 14 to the vanes 5, which soldering cannot be tolerated since the fingers must be able to move freely with respect to the vanes for tuning purposes.

The shims 17 have a width at their inner ends which is somewhat greater than the radial length of fingers 14, and a length such that, when they are pushed upwardly to the upper ends of fingers 14, or to the upper ends of the slots defining such fingers, the lower ends thereof will extend a substantial distance below the bottom of envelope 4, so that, when they are in the angular position shown in Fig. 1, extending at an acute angle to the longitudinal axis of plunger 9 (the reason for this angular position will be explained hereinafter), the inner ends of each shim will cover substantially all of the side face of the corresponding finger 14, as shown in Fig. 1. Thus, non-soldering of the fingers 14 to the vanes 5, and also exact separation between the said fingers and the said vanes, are assured.

By using the tuning subassembly as a jig for the vanes, each set of vanes is matched to the set of tuning fingers with which it will cooperate during the life of the magnetron, thus eliminating the adverse effect of the cumulative tolerances which would come into play if the anode subassembly were assembled and soldered together independently of the tuner subassembly.

In order to eliminate spurious oscillations, each anode member 5 may be provided, in its lower edge, with a slot 18, the opposite side edges of the slots in adjacent anode members being provided with shoulders 19 upon which there may be seated concentrically-disposed, circular conducting straps 20 and 21, said straps alternately con-

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tacting successive anode members and thereby assuring that alternate anode members will always be at the same instantaneous potential.

It should now be apparent that the shims 17 must extend at an acute angle to the longitudinal axis of plunger 9, in order to pass outside of the straps 20 and 21 in the downward extension of said shims below the lower end of envelope 4.

The device is assembled in the manner described above, with the tuning subassembly 6 serving as a jig for the assembly of the vanes 5, and with the shims 17 insuring the proper separation between the fingers 14 and said vanes. Since the tuning subassembly is used as a jig for vanes 5, it is also, in effect, a jig for straps 20 and 21, because these straps are in turn located by the vanes. The jig 6, due to the close frictional fit between the shims, vanes, and fingers, helps to maintain the anode members 5 in position while the soldering operation is performed. The vanes 5 are forced radially outwardly and held firmly against the inner cylindrical wall of envelope 4 by any suitable means (not shown), after which heat is applied to the entire assembly, as indicated by the arrows 22, in order to silver solder or braze the vanes 5 to the envelope at 23, and to similarly fasten end plate 8 to the envelope at 16, as well as to fasten straps 20 and 21 securely in position by soldering. Preferably, the assembly is inverted from the position shown in Fig. 1 while the soldering is being done, in order to maintain straps 20 and 21 in position by gravity.

After the assembly 1 has cooled, the shims 17 may be removed and the device subjected to additional processes to complete the magnetron. Since the shims 17 hold the fingers 14 and vanes 5 in position during the soldering operation, exact separation between the fingers and the vanes is assured, and, since this separation is very small, magnetrons of wide tuning range are produced, while at the same time reducing the number of rejects.

Other objects and advantages of the present invention will readily occur to those skilled in the art to which the same relates.

What is claimed is:

1. In the art of manufacturing a tunable multi-cavity magnetron having a plurality of separate anode members to be fastened to a common support to which is also to be fastened a tuning assembly, said assembly including a plurality of integral elements each of which is adapted to be

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positioned intermediate a pair of adjacent anode members, the steps of utilizing said assembly as a jig to locate and maintain said anode members in position with nonsolderable spacers, and thereafter soldering said anode members and said assembly to said support whereby said anode members are maintained a constant predetermined distance from said tuning means during tuning.

2. In the art of manufacturing a tunable multi-cavity magnetron having a plurality of separate anode members to be soldered to a common support to which is also to be soldered a tuning assembly, said assembly including a plurality of integral elements each of which is adapted to be positioned intermediate a pair of adjacent anode members, the steps of utilizing said assembly as a jig to locate and maintain said anode members in position with stainless steel spacers, and thereafter soldering said anode members and said assembly to said support while said anode members are so maintained in position.

3. In the art of manufacturing a tunable multi-cavity magnetron having a plurality of separate anode members to be soldered to a common support to which is also to be soldered a tuning assembly, said assembly including a plurality of integral elements each of which is adapted to be positioned intermediate a pair of adjacent anode members but spaced therefrom, the steps of utilizing said assembly as a jig to locate and maintain said anode members in position, inserting a non-solderable spacing member on each side of each of said elements to properly space said anode members from said elements and to prevent soldering of said anode members to said elements, and thereafter soldering said anode members and said assembly to said support while said anode members are so maintained in position.

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