

Dec. 17, 1935.

J. P. LAICO

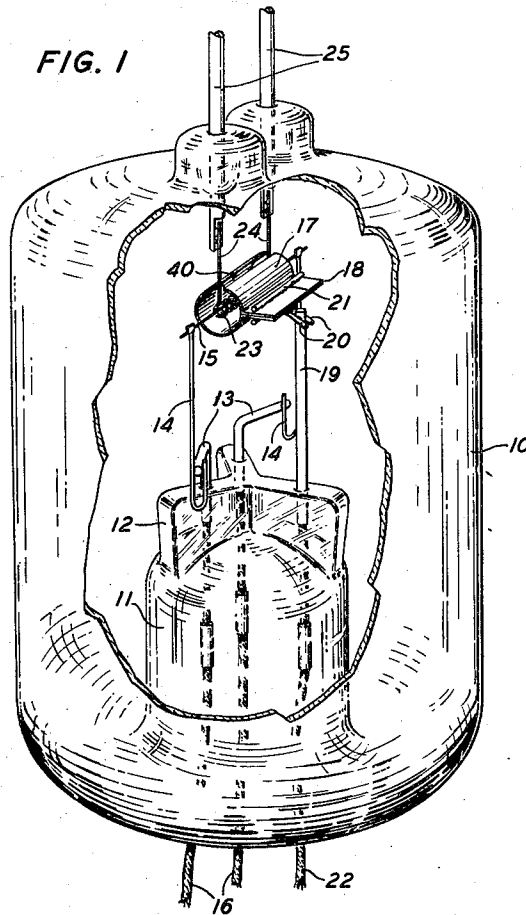
2,024,585

MANUFACTURE OF ELECTRON DISCHARGE DEVICES

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2 Sheets-Sheet 1

FIG. 1



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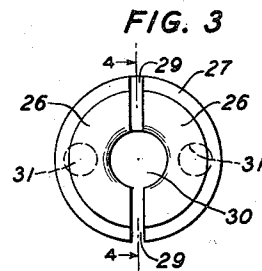
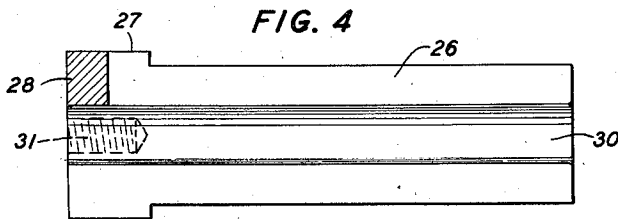
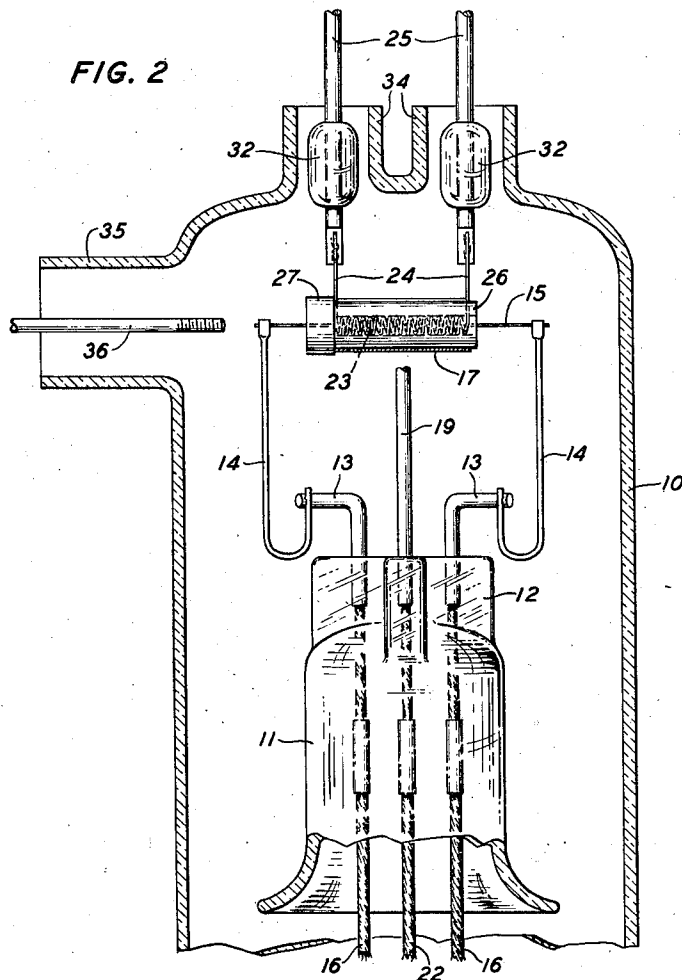
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2 Sheets-Sheet 2



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MANUFACTURE OF ELECTRON
DISCHARGE DEVICES

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6 Claims. (Cl. 250—27.5)

This invention relates to the manufacture of electron discharge devices and more particularly to the manufacture of such devices including a plurality of coaxial electrodes and particularly suitable for the generation of ultra-high frequency impulses.

In electron discharge devices of the type commonly known as Barkhausen oscillators, the anode or output electrode may be a helical grid disposed between a linear cathode and a cylindrical reflecting electrode and coaxial therewith. The leading-in conductors for the output electrode, which may also serve as the supports for this electrode, preferably are sealed in the enclosing vessel at points remote from the leading-in conductors for the cathode and the reflecting electrode. In such construction, it is exceedingly difficult, without using complex supporting and spacing assemblies, to mount the output electrode in uniform space relation to the other electrodes inasmuch as it is difficult to hold the output electrode in the desired position while the supports therefor are being sealed into the enclosing vessel and to accurately gauge the clearances between the output electrode and the cathode and between the output electrode and the reflecting electrode of the device.

One object of this invention is to accurately position an electrode in an electron discharge device with reference to other electrodes of the device.

Another object of this invention is to expedite the fabrication of electron discharge devices including a plurality of electrodes disposed one within another.

In accordance with this invention, the cathode and the reflecting electrode of a Barkhausen oscillator, or other device of similar design, are mounted upon a press and the output electrode, which may be a helical grid having supporting members secured to opposite ends thereof, is mounted within a central bore of a tubular spacer member having a cylindrical surface coaxial with the helical grid and of the same diameter as the inner diameter of the cylindrical reflecting electrode. The spacer member, with the grid therein, is inserted into the reflecting electrode, and the stem and the electrodes mounted thereon are inserted into the enclosing vessel, the supports for the grid extending through apertures in the vessel. The stem and the supports for the grid are then sealed to the enclosing vessel. Subsequently, the spacer member is withdrawn through a tubular extension on the enclosing vessel and this extension is then sealed.

Inasmuch as the spacer member may be made to exact dimensions, the helical grid may be positioned accurately with respect to the reflecting electrode and the cathode. The relative positioning of the grid with respect to the other electrodes is accurately maintained during the sealing-in of the grid supports so that in the completed device the several electrodes will be in the desired space relation.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of an electron discharge device illustrative of the type comprehended by this invention, a portion of the enclosing vessel being broken away to show the internal elements more clearly;

Fig. 2 is a view partly in cross-section of the device illustrated in Fig. 1 showing the disposition of the elements prior to the sealing of the stem and the output electrode supports to the enclosing vessel;

Fig. 3 is an end view of a spacer member utilized in the fabrication of the device as shown in Fig. 2, in accordance with this invention; and Fig. 4 is a cross-sectional view of the spacer member along line 4—4 of Fig. 3.

Referring now to the drawings, the electron discharge device shown in Fig. 1 is of the type commonly known as a Barkhausen oscillator and comprises an enclosing vessel 10 having a stem 11 which terminates in a tri-armed press 12. A pair of rigid bent wires 13 are embedded in two arms of the press 12 and have secured thereto flexible J-shaped metallic members 14 which support a linear cathode 15, for example, a thoriated tungsten filament. The heating current for the cathode 15 may be supplied through conductors 16 connected to the rigid wires 13.

The cathode 15 is disposed within and coaxial with a cylindrical reflecting electrode 17 which may have a slit 18 and a longitudinal flange 19. The reflecting electrode 17 is supported from a rigid metallic support or rod 19, embedded in the remaining arm of the press 12, by L-shaped wires 20 which are suitably affixed to the support or rod 19, as by welding. The L-shaped wires 20 may be affixed to the flange 19 by welding, together with a linear wire 21 which serves to reinforce the flange 18 and also to provide a sufficiently long conductive path for the welding operation. A suitable potential may be applied to the reflecting electrode 17 through a conductor 22 connected to the rod 19.

Disposed about the cathode 15 is an output electrode, which may be a helical wire grid 23 coaxial with the cathode 15 and the reflecting electrode 17 and having integral extensions 24 secured to rigid metallic supports 25 sealed in the end of the enclosing vessel 10 remote from the stem 11.

In devices adapted for operation at ultra-high frequencies, it is essential that the electrode spacings be very small and that the electrodes be uniformly spaced. Although such uniform and small spacing might be obtained by the use of a complex supporting structure, such structure would introduce objectionable capacitative and inductive factors of appreciable magnitude in the electrode system. If such structure is not used, great difficulty is experienced in positioning the output electrode accurately with respect to the other electrodes.

In accordance with this invention, these difficulties are overcome without introducing any undesirable capacitative and inductive factors into the electrode system. To this end, the output electrode is positioned and held in accurate relation to the other electrodes during the fabrication of the device, by a spacer member which may be removed from the enclosing vessel prior to the evacuation and sealing thereof.

In one form illustrated in Figs. 3 and 4, a bifurcated spacer member, which may be machined from a single piece of metal, comprises two substantially semi-cylindrical portions 26 having an enlarged portion 27 at one end and joined by a web 28. The enlarged portion may be provided with threaded taps 31. The two semi-cylindrical portions are spaced to form an elongated slot or groove 29 and a substantially cylindrical cavity 30 of the same diameter as the outer diameter of the helical grid 23. The outer diameter of the portions 26 is equal to the inner diameter of the reflecting electrode 17.

In the fabrication of the device in accordance with this invention, the reflecting electrode 17 and the cathode 15 are mounted on the stem 11. The helical grid 23 is then inserted into the cavity 30 of the spacer member with the extensions 24 passing through the slit 29. The extensions are secured to the conductors 25, which have glass beads 32 thereon. The spacer member, with the grid therein, is then inserted into the reflecting electrode 17, the extensions 24 of the helical grid 23 passing through the slit 40 in the reflecting electrode 17 and the lower slot 29 in the spacer member permitting passage of the assembly over the support 14 of the cathode. The stem with the assembly thereon is then inserted into the enclosing vessel 10, as shown in Fig. 2, with the beads 32 positioned in tubulatures 34 on the vessel 10 and the electrodes substantially in axial alignment with another tubulature 35 on the side of the enclosing vessel. The stem 11 is sealed to the enclosing vessel 10 by fusing and the tubulatures 34 are fused to the beads 32. Subsequently, the spacer member is withdrawn through the tubulature 35, as by a rod 36 which may be threaded into the taps 31, and the tubulature 35 is sealed by fusing.

It will be noted that during the sealing of the stem 11 and the conductors 25 to the enclosing vessel, the grid 23 is maintained in proper spacial relation to the reflecting electrode 17 and the cathode 15 so that any shrinkage which may occur at the seals cannot alter the space relation of the electrodes. As a result, the desired ac-

curate spacing of the electrodes in the completed device is attained.

Although a specific design of spacer member has been shown and described and one specific illustration of practicing the method in accordance with this invention has been set forth, it is to be understood, of course, that the invention is applicable to the fabrication of devices of constructions specifically different from that shown and that modifications may be made in the spacer and the method described without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. In the manufacture of electron discharge devices including an enclosing vessel, a plurality of electrodes, a stem, and individual supporting means for said electrodes, the method which comprises positioning said electrodes relative to each other by a spacer member, inserting said electrodes into said vessel, sealing said supporting means to said vessel, withdrawing said spacer member through an opening in said vessel, and closing said opening.

2. In the manufacture of electron discharge devices including an enclosing vessel, a plurality of electrodes disposed one within another, and supporting means for said electrodes, the method which comprises mounting one of said electrodes upon a spacer member, inserting said spacer member and electrode into another of said electrodes, inserting said electrodes and said spacer member into said vessel, sealing said supporting means to said vessel, and withdrawing said spacer member from said vessel.

3. In the manufacture of electron discharge devices including an enclosing vessel having a stem, a plurality of electrodes supported from said stem, an electrode between two of said first electrodes, and supports for said second electrode, the method which comprises mounting said first electrodes on said stem, mounting said second electrode and said supports upon a spacer member, inserting said spacer member between two of said first electrodes, inserting said stem into said enclosing vessel, sealing said stem to said vessel, sealing said supports to said vessel, and withdrawing said spacer member from said vessel.

4. In the manufacture of electron discharge devices including an enclosing vessel having a stem, a cathode and a cylindrical electrode mounted on said stem, said cylindrical electrode encompassing said cathode, a helical grid between said cathode and said cylindrical electrode, and supports for said grid sealed in said vessel remote from said stem, the method which comprises mounting said cathode and cylindrical electrode upon said stem, mounting said grid and said supports upon a tubular member, inserting said tubular member within said cylindrical electrode, inserting said stem within said vessel, sealing said stem to said vessel, sealing said supports to said vessel, withdrawing said tubular member through a tubular extension of said vessel, and sealing said extension.

5. In the manufacture of electron discharge devices including an enclosing vessel having a stem, a cathode and a cylindrical electrode supported from said stem, said cathode and said cylindrical electrode being coaxial, a helical electrode between said cathode and said cylindrical electrode and coaxial therewith, and supports secured to the ends of said helical electrode and sealed in a wall of said vessel remote from said

stem, the method which comprises mounting
said cathode and said cylindrical electrode upon
said stem, inserting said helical electrode with
said supports secured thereto within a cylin-
5 drical spacer member, inserting said spacer mem-
ber into said cylindrical electrode with said heli-
cal electrode in coaxial relation with said cath-
ode and said cylindrical electrode, positioning
said stem within said vessel, sealing said stem to
10 said vessel, sealing said supports in said wall,
withdrawing said spacer member through a
tubulature on said vessel, and sealing said tubu-
lature.

6. A method of gauging the spacial relation-
ship between a plurality of electrodes in a dis-
charge device which comprises mounting an
inner and outer electrode on a stem, inserting a
tubulated electrode having terminal extensions 5
within a bifurcated spacer member, sliding said
member into said outer electrode, inserting said
stem in an enclosing vessel, sealing said stem to
one end of said vessel, sealing said extensions
10 in the opposite end of said vessel, and removing
said spacer member.

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