Jan. 6, 1948. H. KERSHAW 2,434,043

HERMETICALLY SEALED CRYSTAL ASSEMBLY

Filed Dec. 8, 1944 2 Sheets-Sheet 1

FIG. 1.

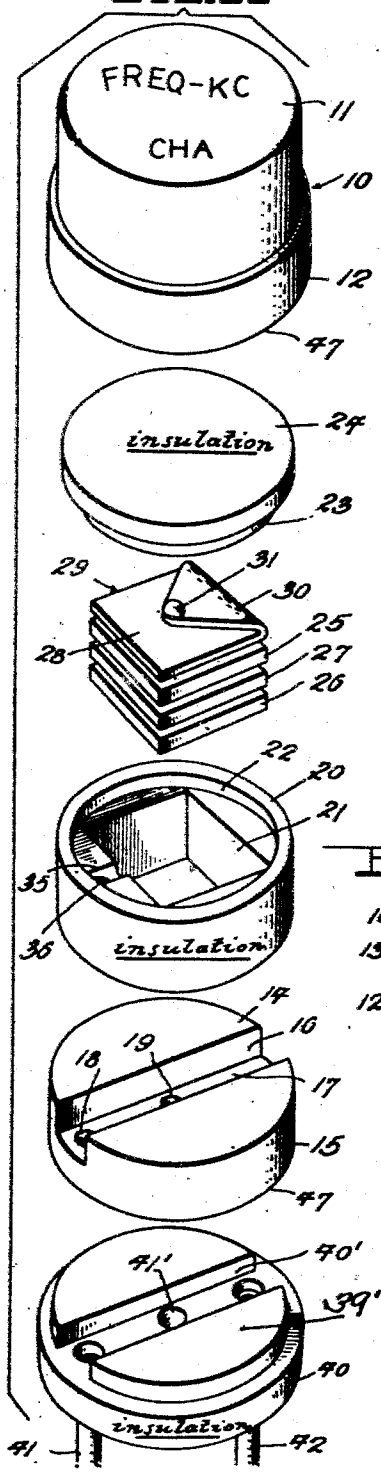


FIG. 2.

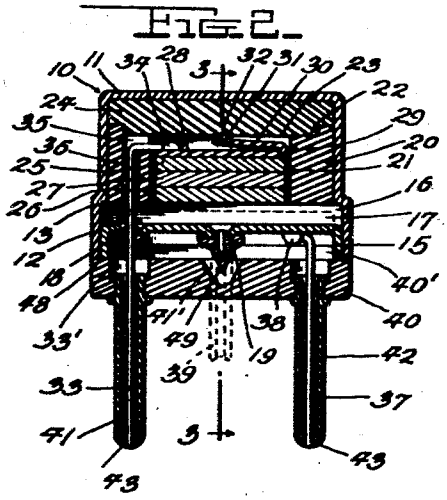


FIG. 3.

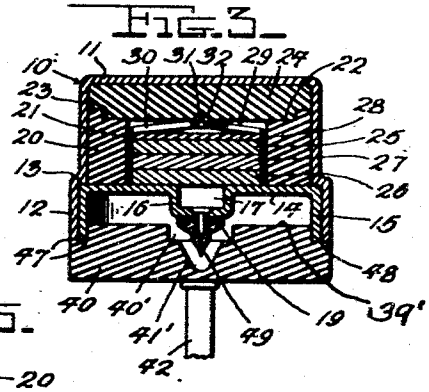


FIG. 5.

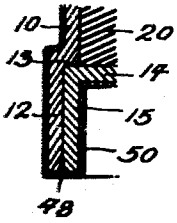
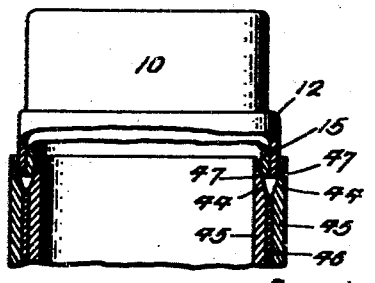


FIG. 4.



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HERMETICALLY SEALED CRYSTAL ASSEMBLY

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FIG. 6

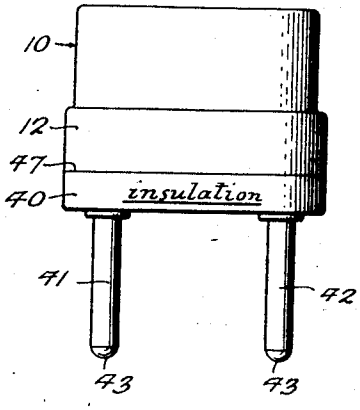


FIG. 8

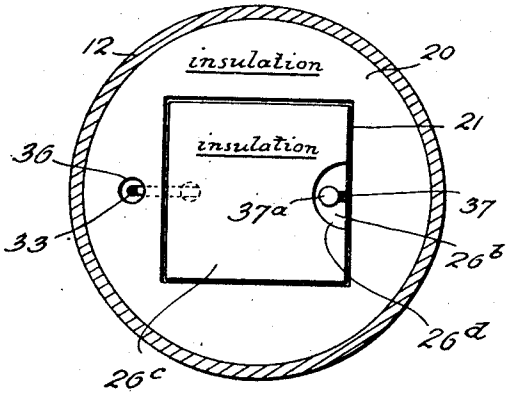


FIG. 7

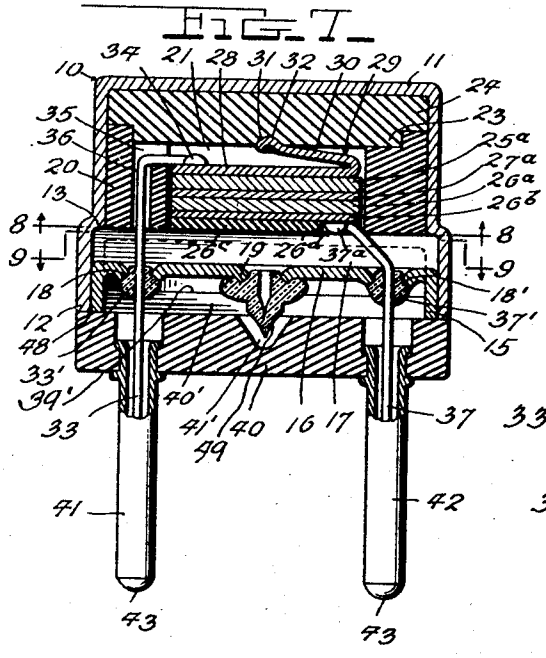
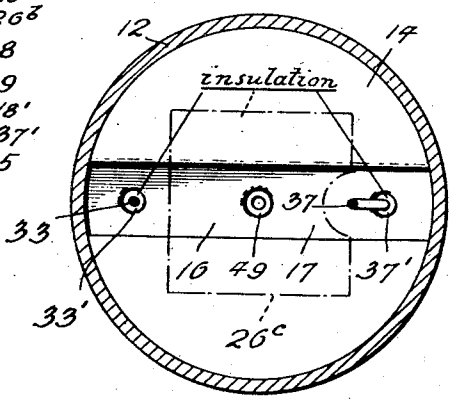


FIG. 9



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2,434,043

HERMETICALLY SEALED CRYSTAL ASSEMBLY

Henry Kershaw, Belleville, N. J.

Application December 8, 1944, Serial No. 567,259

8 Claims. (Cl. 171—327)

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My invention relates to a hermetically sealed crystal assembly for use in connection with circuits of radio transmitting or receiving sets or the like.

An important object of the invention is to provide a device of the above mentioned character which will withstand the jars or hard usage encountered when installed upon a radio set carried by an airplane or the like.

A further object of the invention is to provide a device of the above mentioned character which will retain the crystal and associated elements free from contact with the atmosphere or under vacuum.

A further object of the invention is to provide a device of the above mentioned character, so constructed that the casing may be readily evacuated after the elements are assembled therein, and the tipped vacuum tube will be covered.

A further object of the invention is to provide a vacuum tight casing having welded telescoping parts, effecting a vacuum tight joint.

A further object of the invention is to plate the casing after welding, thus reducing the porosity of the casing and the welded joint to the minimum.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings, forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is an exploded perspective view of a piezo crystal holder embodying my invention,

Figure 2 is a central longitudinal section through the assembly,

Figure 3 is a longitudinal section on line 3—3 of Figure 2,

Figure 4 is a side elevation, parts broken away, and parts in section, showing the manner of welding the telescoping parts of the casing,

Figure 5 is an enlarged fragmentary section through the casing, after welding, showing the outer surface plated,

Figure 6 is a side elevation of the completed assembly.

Figure 7 is a central longitudinal section through a modified form of assembly;

Figure 8 is a horizontal section taken on line 8—8 of Figure 7, and

Figure 9 is a similar view taken on line 9—9 of Figure 7.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of

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my invention, the numeral 10 designates a metal casing, which is preferably cylindrical. One end of this casing is closed by a head 11 while the opposite end of the casing is open and is provided with an annular flange or skirt 12, of larger diameter than the casing 10, affording a shoulder 13. The open end of the casing 10 is covered by a metal head 14 having an annular flange or skirt 15, to fit snugly within the annular flange or skirt 12. The head 14 is formed to provide a hollow rib 16, affording a passage 17. This rib extends axially outwardly of the flange or skirt 15 and extends diametrically of the head 14. The inner side and ends of the passage 17 are open and in communication with the interior of the casing 10, as shown. The hollow rib 16 is provided with outwardly punched apertured portions 18 and 19, as shown.

Arranged within the cylindrical casing 10 is a cylindrical insulating housing 20 having a chamber or recess 21, which is preferably square in horizontal cross section. At its top, the housing 20 has a cylindrical recess 22 for receiving the reduced extension 23 of an insulating cap or end 24. The opposite end of the insulating housing 20 rests upon the face of the head 14.

Arranged within the square chamber or recess 21 are metal electrodes 25 and 26, and arranged between these electrodes is a flat crystal 27, which may be formed of quartz and ground to a selected thinness, depending upon the frequency to be maintained in the radio set or circuit in connection with which the device is used. These elements 25, 26 and 27 are loosely mounted within the chamber 21 and may be moved axially therein within limits and there is a slight space or clearance between the edges of these elements and the walls of the chamber 21. The electrode 26 electrically contacts with the head 14 while the electrode 25 electrically contacts with the square body portion 28 of a metal leaf spring 29 having a spring arm 30, extending over the same in spaced relation. This spring arm is preferably tapered and is provided at its reduced free end with the knob 31 to enter a recess 32. The body portion 28 is loosely mounted within the chamber or recess 21 and forces the metallic electrodes 25 and 26 into engagement with the quartz crystal 27.

A lead wire 33 is welded to the body portion 28 at 34, and this lead wire extends through a recess 35 and an opening 36 formed in the insulating body portion 20. A lead wire 37 is welded to the rib 16 as shown at 38. The lead wire 33 extends through the outwardly punched apertured portion 18 and has a gas or vacuum tight joint therewith,

which is effected by means of a glass bead 33' fused thereon. A glass tube 39 is fused to the outwardly punched apertured portion 19.

The numeral 40 designates an insulating base, carrying tubular metallic terminals or plugs 41 and 42. This base 40 has a reduced extension 39', having a pressed fit in the skirt 15. The tubular terminal 41 receives the wire 33, while the tubular terminal 42 receives the wire 37. The ends of these wires extend outwardly beyond the tubular terminals and these wires are electrically connected with the tubular terminals by solder 43, the wires being subsequently severed flush with the solder. The insulating base 40 has a groove 40' and a central recess 41', leading into this groove.

In assembling the various parts of the device, the quartz crystal 27 is arranged between the electrodes 25 and 26 and these elements are introduced into the chamber 21 and the leaf spring 29 is arranged within this chamber outwardly of the electrode 25. The wire 33 which is previously welded to the leaf spring is passed through the opening 36. The insulating cap 24 may now be applied to the end of the housing 20 and the knob 31 will enter the recess 32. This knob now serves to center the leaf spring within the chamber 21, preventing any tendency for the leaf spring to bind in the chamber 21. The parts thus assembled may now be introduced into the metal casing 10 and the wire 33 will project through and beyond the flange or skirt 12. The wire 33 is now passed through the outwardly punched apertured portion 18 of the metal head 14 and this metal head and its skirt 15 are now inserted into the skirt 12, the skirts telescoping and having a snug fit. The inward movement of the head 14 is limited by its engagement with the shoulder 13. A vacuum or gas tight joint is now effected between the portion 18 and wire 13 by fusing the glass bead 38 to these parts.

With the parts thus assembled, the telescoping tubular skirts 12 and 15 are welded together for effecting a gas or vacuum tight joint. This is accomplished by bringing the telescoping skirts 12 and 15 into engagement with inclined faces 44 of tubular electrodes 45, insulated at 46. The telescoping skirts 12 and 15 are now moved axially toward the tubular electrodes 45 whereby these electrodes engage the free corners 47 of the skirts, moving the skirt 15 radially outwardly and the skirt 12 radially inwardly. The welding circuit is closed during this action and an annular weld 48 is effected between the skirts 12 and 15 and the weld is gas or vacuum tight. The method of welding the skirts 12 and 15 is fully disclosed in my copending application for Method of and apparatus for welding, filed May 2, 1944, Serial No. 533,719, which has matured into Patent 2,385,710, issued September 25, 1945.

The next step is to evacuate the casing 10, which is effected by connecting the tube 39 with a source of vacuum. After the desired degree of vacuum is obtained, a small amount of an inert gas, such as argon, is introduced into the casing through the tube 39. This introduced argon does not ordinarily materially reduce the degree of vacuum within the casing 10. Attention is called to the fact that since the glass tube 39 communicates with the passage 17, the tube 39 will have communication with the interior of the casing 10 due to the clearance between the edges of elements 25, 26, 27 and 29 and the walls of the chamber 21. After the introduction of the inert gas, the casing 10 is sealed by heating the glass tube in the usual manner whereby it is tipped, as shown at 49. The inert gas may be supplied to the casing in any desired amount, prior to tipping of the vacuum tube.

All metal is porous to some extent and to reduce the porosity of the casing 10, head 14 and the welded joint 48 to the minimum porosity, after the welding is effected, I plate the outer surface of the casing 10, head 14 and annular weld 48 with a metal plating 50, Figure 5.

The casing 10 and head 14 may be formed of any suitable metal and the head 14 or parts thereof to which the glass is to be fused should be formed of a metal having the same coefficient of expansion as glass.

After the welding and plating, the insulating base 48 is applied to the skirts 12 and 15 and the wires 33 and 37 pass through the tubular terminals 41 and 42 and attached thereto by the solder 43. The tip 49 may now project into the recess 41'.

The terminals 41 and 42 are usually plugged into the radio circuit so that the quartz crystal 27 is connected across the filament and grid of the vacuum tube. The use of these devices is well known as indicated by Patents 2,289,950; 2,295,990; and 2,339,198.

In Figures 7 to 9 inclusive I have shown a modification of the invention. In these figures, 25^a and 26^a designate the electrodes and 27^a is the quartz crystal arranged between the electrodes. The electrode 25^a contacts with the body portion 28 of the spring 29, while the electrode 26^a engages a metallic contact 26^b arranged beneath it and being of the same shape and size. The metallic contact 26^b rests upon an insulating strip 26^c, which is also square. This insulating strip is supported upon the upper end of the head 14. The insulating strip 26^c has an opening 26^d cut therein, for the passage of the wire 37. This wire is soldered or welded to the contact 26^b as shown at 37^a. The wire 37 is not electrically connected with the head 14 but passes thru an outwardly punched apertured portion 18' and is soldered or welded to the contact 26^b, as stated, and is insulated from the head 14 by a glass bead 37' fused or welded to these parts, to form a vacuum tight joint.

All other parts of the device remain identical with those shown and described in connection with the first form of the invention.

It is to be understood that the forms of my invention herewith shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, what I claim is:

1. A hermetically sealed crystal assembly comprising a metallic casing having one end closed and the other end open, an insulating housing mounted within the casing, electrodes mounted within the housing to receive a crystal between them, means to move the electrodes together, a metallic head arranged within the open end of the casing and having a gas tight joint therewith, the head having apertures, means to evacuate the metallic casing through one aperture of the head, a wire electrically connected with one electrode and extending thru the other aperture, an insulating bead to seal the wire within its aperture, a second wire electrically connected

to the head, an insulating base arranged upon the open end of the casing and covering the metallic head, and terminals carried by the base and electrically connected with the wires.

2. A hermetically sealed crystal assembly comprising a metallic casing having one end closed and its opposite end open, an insulating housing within the casing, electrodes within the housing to receive a crystal between them, means to move the electrodes together, a metallic head for insertion within the open end of the casing, said metallic head having a hollow rib providing a passage upon its inner side, said head having an evacuating aperture leading into the passage and having a second aperture, the head having a gas tight joint with the casing, means to move the electrodes together, means to close the evacuating aperture, a wire electrically connected with one electrode and passing through the second aperture and having a sealed joint therein, a second wire connected with the head, the head being electrically connected with the other electrode, an insulating base mounted upon the open end of the casing and covering the metallic head, and terminals carried by the base and having electrical connection with the wires.

3. A hermetically sealed crystal assembly comprising a metallic casing having one end closed and the other end open, an insulating housing mounted within the casing, electrodes mounted within the housing to receive a crystal between them, a spring to move the electrodes together and including a contact engaging one electrode, a metallic head arranged within the open end of the casing and having a gas tight joint therewith, the head having apertures, means for evacuating the metallic casing wire electrically connected with the contact and extending thru one aperture, a glass bead to seal the wire within the aperture, a second contact engaging the other electrode, an insulating strip arranged between the second contact and metallic head, a second wire passing thru the other aperture and attached to the second contact, a glass bead sealing the second wire within the last named aperture, an insulating base mounted upon the open end of the casing, and terminals carried by the base and electrically connected with the wires.

4. A hermetically sealed crystal assembly comprising a metallic casing having one end closed and its opposite end open, an insulating housing within the casing and having one end closed and its opposite end open, the closed end of the housing being arranged next to the closed end of the casing, overlapping electrodes arranged within the housing and arranged generally parallel with the closed end of the housing, a crystal disposed between the electrodes, a metallic head inserted within the open end of the casing and having a hollow rib providing a passage which is open upon its inner side, the head having a gas tight joint with the casing, means tending to move the electrodes together, the head having means whereby the casing may be evacuated through the passage, a wire electrically connected with one electrode, a second wire having electrical connection with the other electrode, an insulating base mounted upon the open end of the casing and covering the head, and terminals carried by the base and having electrical connection with the wires.

5. A hermetically sealed crystal assembly, comprising a metallic casing having one end closed and its opposite end open, an insulating housing within the casing and having one end closed

and its opposite end open, the closed end of the housing being arranged next to the closed end of the casing, a metallic head inserted within the open end of the casing and having an interior passage and also having means whereby the casing may be evacuated through the passage, the head having a gas tight joint with the casing, overlapping electrodes arranged within the housing and arranged generally parallel with the closed end of the housing, a crystal disposed between the electrodes, a metallic element contacting with one electrode and having a resilient part acting against the closed end of the housing, a wire electrically connected with the metallic element, a second wire having electrical connection with the other electrode, an insulating base mounted upon the open end of the casing and covering the head, and terminals carried by the base and having electrical connection with the wires.

6. A hermetically sealed crystal assembly, comprising a metallic casing having one end closed and its opposite end open, an insulating housing within the casing and having one end closed and its opposite end open, the closed end of the housing being arranged next to the closed end of the casing, a metallic head covering the open end of the casing and having a gas tight joint with the casing, overlapping electrodes arranged within the housing and arranged generally parallel with the closed end of the housing, a crystal disposed between the electrodes, a spring acting upon one electrode and acting against the closed end of the housing, a wire electrically connected with one electrode, a second wire having electrical connection with the other electrode, an insulating base mounted upon the open end of the casing, and terminals carried by the base and having electrical connection with the wires.

7. A hermetically sealed crystal assembly, comprising a metallic casing having one end closed and its opposite end open, an insulating housing within the casing and having one end closed and its opposite end open, the closed end of the housing being arranged next to the closed end of the casing, a metallic head covering the open end of the casing and having a gas tight joint with the casing, overlapping electrodes arranged within the housing and disposed generally parallel with the closed end of the housing, a crystal disposed between the electrodes, means to move the electrodes together, a wire electrically connected with one electrode, a second wire having electrical connection with the outer electrode, an insulating base mounted upon the open end of the casing, and terminals carried by the base and having electrical connection with the wires.

8. A hermetically sealed crystal assembly, comprising a metallic casing having one end closed and its opposite end open, an insulating housing within the casing and having one end closed and its opposite end open, the closed end of the housing being arranged adjacent to the closed end of the casing, overlapping electrodes arranged within the housing and arranged generally parallel with the closed end of the housing, a crystal disposed between the electrodes, means to move the electrodes together, a metal head inserted within the open end of the metal casing and having a marginal skirt extending axially of the casing, the skirt and casing being welded together adjacent to the outer end of the skirt, a metallic plating applied to the outer face of the casing and head and covering the welded joint, an insulating base arranged near the open

end of the casing, terminals carried by the base, means electrically connecting one terminal with one electrode, and means electrically connecting the other terminal with the other electrode.

HENRY KERSHAW.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
861,242	Edison	July 23, 1907
2,228,087	Rose	Jan. 7, 1941
2,203,486	Bone	June 4, 1940
2,203,545	Peterson	June 4, 1940
2,260,707	Fair	Oct. 28, 1941
2,277,871	Mitchell et al.	Mar. 31, 1942