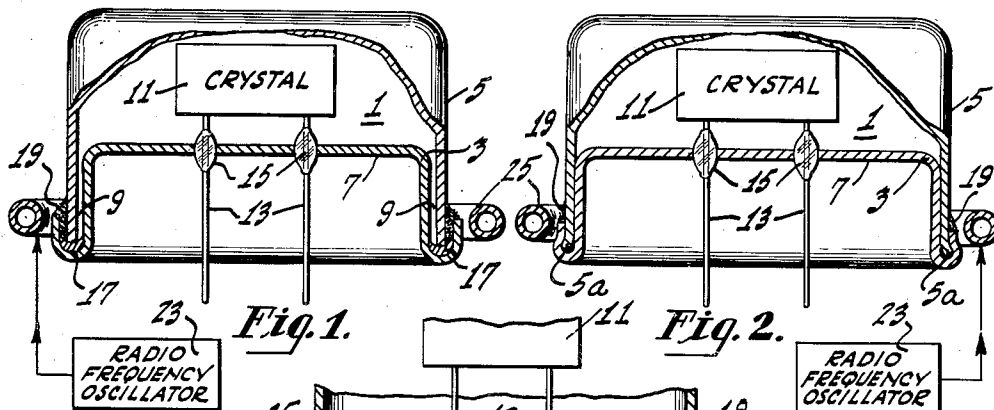
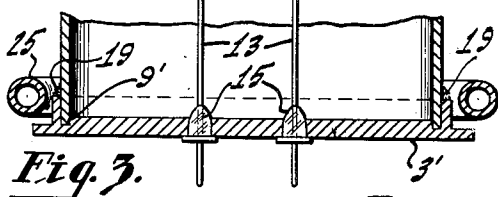
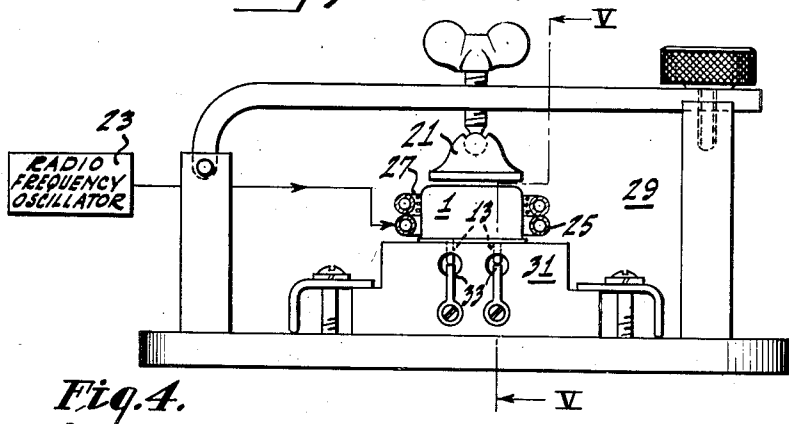
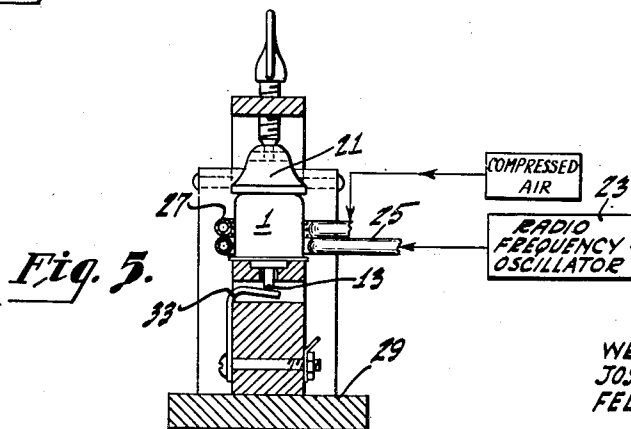


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ART OF SEALING METAL CASINGS
ENCLOSING VIBRATILE ELEMENTS
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ART OF SEALING METAL CASINGS ENCLOSING VIBRATILE ELEMENTS

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This invention relates to the art of sealing metal casings the contents of which may be adversely affected by gaseous emanations evolved during the formation of a solder or other fused-metal seal. While not limited thereto the invention will be described as applied to the sealing of a metal casing containing a piezoelectric crystal assembly.

As is well known the performance of piezoelectric crystal elements, tuning forks and other vibratile bodies, may be adversely affected by variations in barometric pressure and analogous changes which tend to alter the "load" thereon. It has therefore been proposed to mount such vibratile elements in a closed container, such for example as a glass bulb (see Tillyer 1,836,735), molded-plastic casing (see Hawke 2,228,601) or metal can (see Marrison 1,940,599). For optimum performance the container should be hermetically sealed and the ease with which glass and plastics may be rendered air-tight by fusion recommends the use of such casing materials. However, there are many installations which demand the use of a rugged metal housing and in such cases attempts to provide a truly hermetically-sealed metal casing have almost invariably resulted in undesired changes in the operating characteristics of the vibrator. This has led to the use of less satisfactory seals such, for example, as a clamped rubber or similar gasket-seals.

The present invention is predicated upon an appreciation of the fact that the change in the operating characteristics of a crystal or other vibratile element when enclosed in a metal casing is due principally to the deposition upon the element during the sealing operation, of solid matter which is present in the gaseous emanations from the rosin or other solder-flux used in forming the metal seal.

Accordingly the principal object of the present invention is to obviate the foregoing and other less apparent objections to present day metal casings and, more particularly, to provide a hermetically sealed metal casing suitable for use as a housing for a vibratile element or other body which may be adversely affected by gaseous emanations evolved during the formation of a fused-metal seal.

Another object of the invention is to provide an improved method of sealing a metal container, and one which lends itself readily to the mass production of encased piezoelectric crystals and other labile elements, substances or materials.

The foregoing and other objects are achieved in accordance with the invention by first provid-

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ing the casing with a temporary or auxiliary seal which is formed, without the application of heat, to prevent the ingress of gas into the casing. Thereafter, a fused metal seal such, for example, as a soldered joint is formed on the exterior of the casing. The heat necessary to the formation of the latter seal is applied for such a short period of time and is quenched so rapidly that neither the mechanical nor chemical properties of the auxiliary seal, nor of the contents of the casing, are adversely affected.

The invention may also be said to reside in the details of construction and procedure which are hereinafter described in connection with the accompanying drawing, wherein:

Fig. 1 is an elevational view, partly in section, of a piezoelectric crystal assembly including a hermetically sealed metal casing constructed in accordance with the principle of the invention,

Fig. 2 is a similar view of an alternative embodiment of the invention,

Fig. 3 is a fragmentary sectional view showing another embodiment of the invention,

Fig. 4 is a side elevational view of a mounting jig including an induction heating unit for making a fused-metal seal in accordance with the invention and

Fig. 5 is a sectional view taken on the line V—V of Fig. 4.

In the embodiment of the invention shown in Fig. 1, 1 designates generally a container comprising a metal base 3 and a metal hood or cover 5. The base is provided with a central re-entrant portion 7 and with a circumferential rim or well 9 within which the open end of the cover is adapted to be received. When, as is the instant case, the container 1 comprises a casing for a piezoelectric crystal 11 the necessary electrode leads 13 extend through a pair of glass or other suitable insulating beads 15 in the re-entrant portion of the casing and provide a support for the crystal. In this embodiment of the invention the interior of the rim 9 is provided with a partial filling, layer or gasket 17 of a yieldable material which is immune to temperatures employed in the formation of a fused-metal seal 19 on the exterior of the casing. The temperature employed in the formation of the outer fused-metal or solder seal 19 need be no higher than 180° C.; thus, the yieldable layer may conveniently be constituted of lead, or it may comprise a suitable synthetic material such, for example as silicone rubber. The purpose of the yieldable layer 17 is to compensate for any irregularities in the edge of the cover 5 and thus to permit the

formation of an air-tight seal thereabout when a temporary clamping force is applied to the assembly as by means of thumbcrew 21 (Fig. 4) or the like. This temporary or auxiliary seal adjacent to the yieldable material 17 prevents the admission into the casing of the gaseous emanations evolved during the formation of the solder seal 19.

If the temperature within the casing 1 exceeds 90° C. for any appreciable period of time the performance of the crystal 11 may be adversely affected. Accordingly, the fused-metal seal must be made very rapidly, as by use of induction heat supplied by a radio frequency oscillator 23 and applicator coil 25. In one successful embodiment of the invention wherein the casing 1 was formed of brass, about 10 mils thick, the fused-metal seal 19 was formed by wrapping four turns of 60-40 solder wire (about 15 mils thick) about the casing immediately above the sealing line and subjecting it to the energy from a 2 kilowatt oscillator for about five seconds, then after an interval of about two seconds, to permit the solder to flow, the joint was subjected to a cooling blast of air for a period of about 3 to 5 seconds. As indicated in Figs. 4 and 5 of the drawing the air was directed upon the seal through a conduit 27 which was mounted on the r. f. applicator 25.

It is not always necessary to employ a yieldable insert (17 Fig. 1) in forming the seal which keeps the solder fumes from entering the container during the soldering operation. Thus, as indicated in Fig. 2 a substantially airtight seal can be achieved by crimping the rim portion 9 of the base tightly over the edge of the hood 5, in which case the said edge is preferably first provided with an outward flare, as indicated at 5a.

Referring now to Fig. 3, it is possible to achieve a satisfactory inner seal without the use of the liner 17 (of Fig. 1), or the crimping operation (described in connection with Fig. 2), by forming an accurately machined groove 8' in the base for receiving the edge of the cover or hood. In this case the base, which is here designated 3' is made of solid metal (instead of flexible sheet stock) and the edge of the cover may be lapped, if necessary, to ensure an air-tight fit when it is pressed down (by the clamp 21, Fig. 4) in the groove 8'.

In sealing a piezoelectric crystal assembly in accordance with the invention it is preferable to energize the crystal during the sealing operation and, to this end, the jig 29 (Fig. 4) upon which the assembly is mounted is provided with a socket base 31 having a pair of contacts 33 through which electrical connections are made to the crystal through the pins or leads 11.

What is claimed is:

1. In combination a vibratile element, a metal casing within which said element is mounted, said casing comprising a bi-part container having the parts united by an outer fused-metal seal and by an inner seal which is immune to temperatures employed in the formation of said fused-metal seal.

2. The invention as set forth in claim 1 and wherein said inner seal comprises a yieldable metal gasket.

3. The invention as set forth in claim 1 and wherein said inner seal comprises silicone rubber.

4. The invention as set forth in claim 1 and wherein said inner seal consists of crimped together portions of said metal parts of said casing.

5. Method of encasing a vibratile element in a metal casing which comprises, mounting said element upon the base of said casing, providing said base with an outwardly turned rim, seating the cover of said casing within said rim, forming a cold gas-tight seal between the overlapping portions of said rim and cover and forming a fluxed solder seal between the edge of said rim and the abutting external surface of said cover; the fluxing operation incident to the formation of said solder seal being performed subsequent to the formation of said gas-tight seal, whereby the gaseous emanations from the flux are prevented from entering said casing and affecting the vibratile characteristics of said element.

6. The invention as set forth in claim 5 and including the step of energizing said vibratile element during the formation of said fluxed solder seal.

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