Jan. 18, 1949. G. R. SPARKS ET AL 2,459,193

CONTAINER

Filed Sept. 13, 1944

FIG. 1.

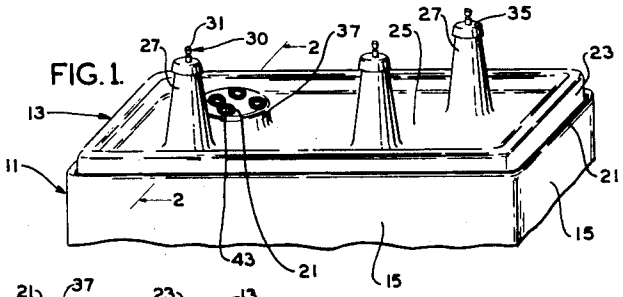


FIG. 2.

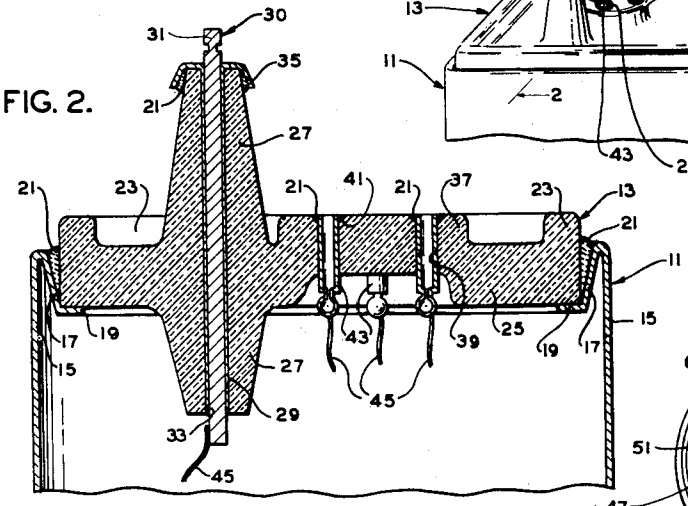


FIG. 3.

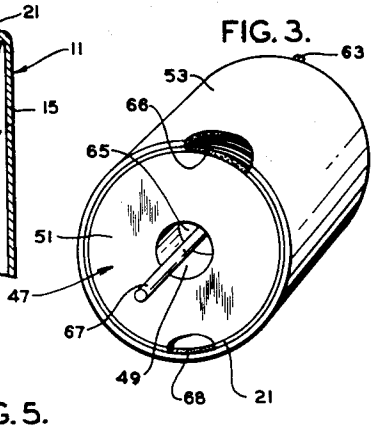


FIG. 4.

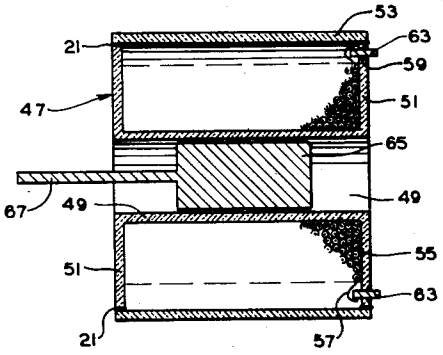


FIG. 5.

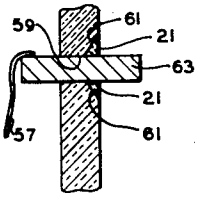


FIG. 6.

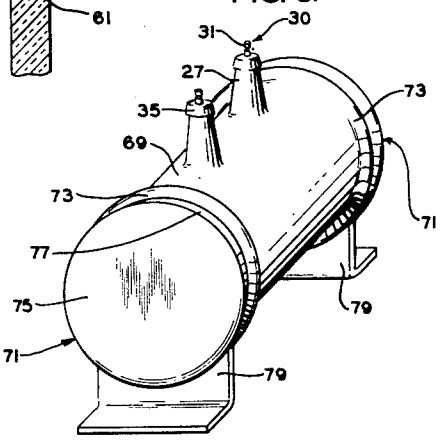
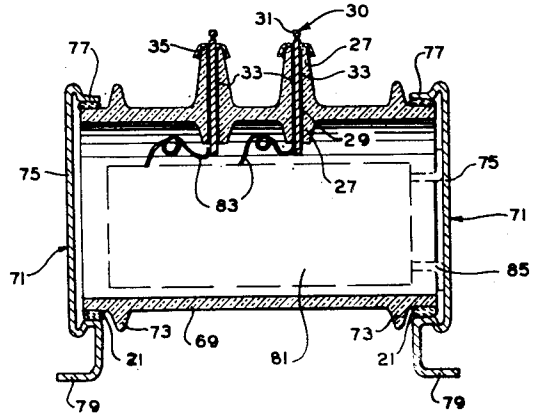


FIG. 7.



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CONTAINER

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1 Claim. (Cl. 174—18)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to containers and particularly containers for electric and electronic apparatus and the like which require that the apparatus be hermetically sealed and that electrical leads pass through the container to connect the apparatus to a circuit.

The operation of sensitive electronic devices, such as meters, coils, rectifiers and the like, is adversely affected by exposure to dampness, dust, oil and the elements, and it is therefore advisable to hermetically seal them within suitable containers, frequently of metal. To do so however poses the problem of providing satisfactory means of bringing electrical leads through the containers without grounding them and without weakening the hermetic seal.

The problem has been complicated by the fact that present day use of such apparatus, as in the arctic and the tropics and in air, land and water vehicles, often subjects them to severe vibration, humidity, the corrosive effects of salt water and saline atmosphere, the ravages of tropical bacteria and extremes of, and sudden fluctuations of, pressure and temperature.

Some of said devices operate under optimum conditions if maintained at a predetermined pressure, which may be above or below normal atmospheric pressure, or if hermetically enclosed in a gas filled chamber.

Some containers presently being used have several members joined together with screws and depend upon some gasket material for hermetic sealing. These are unsatisfactory because the uneven pressure of the screws ultimately results in rupture of the seal and vibration, humidity, temperature changes, etc. loosen the gasket material.

Other containers use a separate bushing of insulating material for each lead. Such construction is usually expensive, it invites breakdown of the hermetic seal because there are a multiplicity of places where breakdown might occur, the leakage paths between conductors are usually short, and a large opening through which the apparatus may be passed for installation within the container is also necessary.

Some containers require complicated machinery or processes for hermetically sealing them. There is therefore a need for good containers which may be largely prefabricated and which

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may be easily and inexpensively sealed by the user.

It is, therefore, an object of the present invention to provide containers which are hermetically sealed throughout and which will not be adversely affected by dampness, dirt, oil, weather, temperature, vibration, bacteria, etc.

It is another object to provide means for suitably bringing leads through such containers so that there is a high electrical resistance between each lead and other conducting parts.

It is also an object to make such containers so that the apparatus to be housed therein may be easily and expeditiously mounted therein and the containers may be easily sealed by the user.

It is a further object to make a type of container where the leads through it will have good mechanical strength and wherein the electrical leakage paths between the leads and other electrical conducting parts will be extended.

Another object is to provide a container which will allow tuning or other electrical manipulation of the sealed unit.

It is another object to provide containers which are hermetically sealed so they may be evacuated, pressurized or gas impregnated.

Still another object is to provide a type of container construction wherein the hermetic seal will be maintained even though two materials, having different coefficients of expansion, such as metal and glass, are used, the construction being such as to allow some relative movement between the two materials.

Another object is to provide a container which may be largely prefabricated and which may be easily and effectively hermetically sealed when put into use. The nonmetal parts are therefore silvered or otherwise prepared for bonding in advance so that sealing may be readily effected when the container is about to be used.

Other objects will appear from the following specification and the appended drawings.

As used herein, the terminology "lead-through conductor" shall indicate a conductor which extends through a wall of nonconducting material of a container and is suitably hermetically bonded to said material, as by one of the conventional processes referred to herein.

The objects aforesaid are accomplished primarily by using insulating material, preferably glass or some similar vitreous insulating material, for one or more large surfaces of a container, and by bringing the leads through said material and bonding them to it. It is preferred to use such insulating material for at least one

entire side or wall of a container. This facilitates the positioning and mounting of apparatus within the container. A suitable number of electrical lead-through conductors are hermetically embedded or bonded into said unitary side or wall, so as to extend completely through it. Lead wires may be connected from the apparatus to the inner ends of the lead-through conductors before said side or wall is put into place. The wall of nonconducting material may then be joined to the balance of the container by any suitable hermetic bonding means, it being preferred to use a solder seal. The remainder of the container may be of any conducting or nonconducting material which can be hermetically bonded to the wall of insulating material which holds the leads. Metal or glass or other vitreous insulating material are preferred, as they may be easily bonded to a wall of insulating material, such as already described.

The insulating material should be of a type which will withstand high thermal shock and which will have sufficient mechanical strength to enable it to sustain physical shock and vibration incident to the contemplated usage of the apparatus.

Although the insulating material, such as glass, may be of a uniform thickness throughout and the lead-through conductors may pass therethrough and be bonded thereto, it is preferred to thicken the material at each place where a lead-through conductor is to pass through it, said thickness being preferably accomplished by forming both upwardly and downwardly extending protuberances in the material. This thickening of the insulating material and resultant lengthening of the conductor extending through it make for greater mechanical strength of the insulating material encircling the conductor and lessens the likelihood of rupturing the bond between said material and the lead-through conductor, due to bending or other manipulation of the conductor outside the container. The protuberances also have the added advantage of causing a lengthening of the electrical leakage paths, along the surface of the insulating material, between the lead-through conductor and other electrically conducting portions of the unit, such as other lead-through conductors or parts of the container itself, if of a conducting material. For additional mechanical strength of the wall of insulating material and to further increase the leakage paths, it is found to be good practice to form ridges or beadings in the insulating material, particularly about its periphery or a short distance in therefrom.

In the drawings, Figure 1 is a perspective view of the upper portion of a container for an electronic device which is provided with several leads and a built-in socket for an electronic tube.

Figure 2 is an enlarged vertical cross sectional view, along the line 2—2, of the container of Figure 1.

Figure 3 is a perspective view of a second type of container embodying the present invention, being illustrated as enclosing the coils of a tunable transformer.

Figure 4 is a longitudinal cross sectional view of the container of Figure 3.

Figure 5 is an enlarged fragmentary view of one of the lead-through conductors of Figure 4.

Figure 6 is a perspective view of a third form of container embodying our invention, and

Figure 7 is a longitudinal cross sectional view of the container of Figure 6.

Referring now particularly to Figures 1 and 2, the container there shown comprisese a rectangular box 11 and a cover 13. The side walls 15 and the bottom (not shown) of the box 11 are made up of sheet metal, contiguous edges being welded together. The top of the box 11 is open, said opening being closed by the cover 13, when the container is put into use. The upper peripheral portions of said side walls 15 about the opening are bent inwardly and then downwardly, at a small angle to said vertical side walls, for a short distance, to form the short inner walls 17, and then inwardly again to form the horizontally disposed flanges 19. Said inner walls 17 and flanges 19 extend completely around the inside of the opening of the box 11 so as to form a supporting ledge for the cover 13.

Said cover 13 is formed of a single piece of glass and, when the container is to be sealed, its entire peripheral edge is bonded to the inner surfaces of the inner walls 17, by means of solder 21, is any conventional manner as already mentioned. The said glass cover 13 is formed with an upwardly directed beading 23, which extends completely about its periphery. At several places the glass of the central area 25 of the cover 13 is thickened to form upwardly and downwardly extending protuberances 27. At each of these thickened places the glass is pierced by a vertically disposed, circular passage 29 through which passes a lead-through conductor 30.

Each such conductor 30 is made up of a central metal rod 31, surrounded by a tubular metal sheath 33, having a hood-like metal flange 35 at its upper extremity. The sheath 33 and the rod 31 are joined by solder (not shown) or other suitable means so as to be hermetically sealed together into an integral unit. The inner surface of the hood-like flange 35 is bonded to the upper end of the upper protuberance 27 by means of solder 21 as already mentioned.

At another place, in the central area 25 of the cover 13, the glass is formed into an upwardly protruding, flat topped, cylindrical mound 37, which is pierced by several vertical bores 39. The upper end of each of said bores 39 terminates in a chamfered surface 41. Positioned in said bores 39 are metal cups 43, their upper ends being flush with the upper surface of the mound 37 and their lower ends being closed and extending below the lower surface of the glass. Said cups 43 are bonded to the chamfered surfaces 41 by solder 21 as already described, the solder also being finished flush with the upper surface of the mound 37. The cups 43 are of a size and are relatively disposed so as to be receivable to the prongs of an electronic tube (not shown), said prongs being of the type having resilient means to effect electrical contact with the cups. Cups (not shown), which are themselves fitted with resilient means, may be used in place of the cups 43 to accommodate other types of electronic tubes. Electrical leads 45 from the apparatus (not shown) in the container are soldered or otherwise connected to the lower ends of the rods 31 and the cups 43.

To use the type of container, shown in Figures 1 and 2, the metal box 11 and the glass cover 13, with the metal fittings 30 and 43 bonded therein, are prefabricated. The user need but mount the electronic or other apparatus (not shown) within the box 11, attach electrical leads 45 from said apparatus to the rods 31 and cups 43, position the cover 13 upon the flange 19 and

bond the said box and cover together as by solder 21.

To prefabricate the parts of the container, the box 11 may be made of sheet metal, all of the joined edges being hermetically closed as by welding or soldering. The cover 13 is made from a single piece of glass molded to shape. The passages 29 and bores 39 may be left in the molding or may be drilled through the glass thereafter. The upper ends of the upwardly extending protuberances 27 and the chamfered surfaces 41 are then silvered for soldering by one of the conventional processes.

The rods 31 are positioned with the sheaths 33 and are hermetically sealed therein by welding, soldering or other suitable processing to form the lead-through conductors 30, or said conductors may be made up entirely of a single piece of metal. The cups 43 are then placed within the bores 39 and are bonded to the silvered chamfered surfaces 41 by means of solder 21. The conductors 30 may then be positioned in the passages 29 and, while the glass cover 13 is held in an inverted position, the silvered surfaces of the glass protuberances 27 are bonded to the hood-like metal flanges 35 by solder 21.

Should the soldering of the conductors 30 or cups 43 to the glass cover 13, or the soldering of the said glass cover 13 to the box 11 prove difficult, due to lack of room, soldering by induction heating may be advantageously utilized. The solder 21 will flow in the wedge-like channel, between the inner walls 17 and the peripheral edge of the cover 13, and will be kept from running into the interior of the box 11 by the flanges 19, and will result in an excellent, hermetic seal and a good mechanical joint.

It is to be noted that the conductors 30, which may be subjected to external bending and stresses, are elongated and pass through a relatively thick portion of the glass so as to better stand up mechanically under abuse. The tube cups 43, however, which will probably not be subjected to nearly as much physical strain, may be safely positioned in relatively thinner portions of the glass.

As the glass cover 13 comprises an entire wall of the container, the opening into which it fits is large enough to expedite positioning and mounting of apparatus within the container and to fasten electrical leads 45 from said apparatus to the rods 31 and cups 43. The fold between the walls 15 and the angulated inner walls 17 allows thermal horizontal expansion and contraction of the glass cover 13 relative to the walls, as will occur if the coefficients of expansion of the two materials used are different, it being preferred, of course, to choose materials having the same or similar coefficients whenever possible.

The undulations in the upper and lower surfaces of the glass cover 13, resulting from the beading 23, the protuberances 27 and the mound 37 increase the lengths of the possible surface leakage paths between the conductors 30, the cups 43, and the metal walls 15. This construction is intended to reduce the likelihood of electrical leakage and arcing between conductors, which has been found to occur all too often with conventional container construction. Such lengthening of the leakage paths is more important on the upper surface of the glass cover 13, where conditions may vary greatly, than on the lower hermetically sealed in surface, where conditions are subject to more control and to far less variation.

The container illustrated in Figures 3, 4 and 5 is shown as used for a type of transformer tuned by varying the longitudinal position of a "slug" (of iron filings) within the transformer coils. Such container comprises a one piece glass spool 47 and a tubular glass cover 53. The spool 47 consists of a tubular core 49 and two circular end flanges 51, disposed at right angles to said core. At several points, near the outer periphery of one or both of the end flanges 51, are apertures 59 which have chamfered surfaces 61 at their outer ends. Through each of said apertures 59 is disposed a solid metal lead-through conductor 63, bonded to the chamfered surface 61 by means of solder 21, as shown particularly in Figure 5. Transformer coils 55 are wound about the spool 47 up to about the level indicated by the broken lines and their leads 57 are connected to the inner ends of the conductors 63 by solder or in any other conventional manner. The tubular glass cover 53 is then slipped over the spool 47 and its inner peripheral surfaces 68, at both ends, are bonded respectively to the outer peripheral edges 66 of the end flanges 51, by solder 21 as already mentioned, so as to hermetically enclose the coils 55.

Slidably disposed within the tubular core 49 is a cylindrical "slug" 65 which is secured to the end of a rod 67. The transformer may be tuned by moving the "slug" 65 longitudinally by means of the rod 67 without in any way interfering with the hermetically sealed container or the coils 55 therewithin.

The container just described, and shown in Figures 3, 4, and 5, may be prefabricated in two separate parts, the tubular glass cover 53 being one, and the glass spool 47 with the lead-through conductors 63 already bonded in place being the other. The outer peripheral edges 66 of the end flanges 51 and the inner peripheral surfaces 68 at both ends of the tubular cover 53 should also be presilvered as already mentioned. The user of such a prefabricated container need then but wind the transformer coils 55 about the spool 47, connect the leads 57 from said coils to the conductors 63, move the cover 53 into place and solder it to the spool.

It is to be understood that in this type of container the glass may be thickened to accommodate the lead-through conductors and the glass may also have various undulations for strength and increased leakage paths as already shown and described in connection with Figures 1 and 2. This type of container, wherein the two members are of the same material, need not have means to equalize differences in thermal expansion.

Referring now to Figures 6 and 7, there is shown a hermetically sealed container for a selenium rectifier 81 or the like. The container comprises a hollow glass cylinder 69 and two metal end caps 71. The glass cylinder 69 is provided with two outwardly extending integral beadings 73, which respectively are set in a short distance from the ends of the cylinder, and a suitable number of lead-through conductors 30 (two being shown) positioned intermediate said beadings 73. The conductors 30 shown are of the same type as those already described in connection with Figures 1 and 2. Each comprises a rod 31 and a tubular sheath 33, with a hood-like flange 35, which rod and sheath pass through a passageway 29 extending through upwardly and downwardly directed protuberances 27 in the glass cylinder 69.

Each end cap 71 is made up of sheet metal and

comprises a circular disk 75, the perimetric portion of which if folded over and inwardly and then in a direction normal to the plane of the disk, so as to form a cylindrical rim 77, which rim is of a size to telescope over one end of the glass cylinder 69. A mounting bracket 79 of suitable type may be attached to the rim 77 of each of the end caps 71. Said rims 77 are bonded to the glass cylinder 69 by means of solder 21 so as to hermetically seal the two end caps 71 to the glass cylinder and thereby seal the apparatus 81 within the container.

The two end caps 71, with the mounting brackets integral therewith or attached thereto, and the cylinder 69 with the lead-through conductors 30 bonded in place and the outer peripheral portions silvered, may be prefabricated.

In use, the apparatus 81 to be housed is secured to one of the end caps 71, as by legs 85 spot welded to the inner surface of said end cap. Electrical leads 83 from the apparatus 81 are then joined to the inner ends of the lead-through conductors 30 in the glass cylinder 69, said apparatus being held partly within one end of the glass cylinder during said operation so as to keep the leads as short as possible. The end cap 71, to which the apparatus 81 is secured, is then bonded to the cylinder 69 by solder 21 between the inner surface of the rim 77 and the outer peripheral surface of one end of the glass cylinder. The second end cap 71 is then similarly bonded to the other end of the cylinder 69. The construction of the container shown in Figures 6 and 7 is such as to allow materials of slightly different expansion coefficients to be used, as the folded over peripheral edges of the end caps 71 will absorb differences in expansion between the two materials.

If desired, this type of container may have one of the end caps 71 bonded to one end of the cylinder 69 during prefabrication. Then the connecting of the leads 83 and the inserting of the apparatus 81 are both accomplished through the other end of the cylinder 69, resulting usually in slightly longer leads.

The invention herein may also be applied to containers for coils or other apparatus, which are provided with a plurality of parallel prongs for insertion into a standard socket. In such application at least one end of the container may be made of a single piece of glass or other insulating material having a plurality of suitably positioned lead-through conductor prongs hermetically bonded therein. Said piece of insulating material is hermetically bonded to the balance of the container as already described.

It will be understood that, although glass or similar vitreous materials are largely referred to herein, other insulating materials may be used in utilizing the invention here set forth. For instance, it is understood that certain plastics and pressed materials have been developed which may be processed so that they may be readily and simply bonded to metal or other materials as by soldering. Containers, made according to the present invention, may use some of these materials for the insulating wall or panel housing the terminals and also for the balance of the container.

If it is desired to evacuate or pressurize any of the containers described in this specification, or introduce gas therein, a suitable opening or nipple for this purpose, according to conventional practice, may be left in the insulating material, said opening to be hermetically sealed when it has served its purpose.

While several illustrative embodiments of the present invention have been described, it will be obvious that various modifications may be made without departing from the spirit of the invention.

We claim:

A container for an apparatus comprising a metal box open substantially throughout one entire side, the peripheral edges of the box about said open side being folded over to form an inner wall extending entirely around said open side, said inner wall being spaced slightly from the outer wall of said box and being slightly angulated thereto, a flange extending inwardly from said inner wall and completely around said open side so as to form a supporting ledge, a glass cover adapted to fit and close said open side and have its periphery abut said inner wall and have its inner surface rest against said supporting ledge, a hermetic seal of solder between the periphery of the glass cover and the inner wall to completely close and hermetically seal the open side of the box aforesaid so as to form a hermetically sealed container about said apparatus.

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