

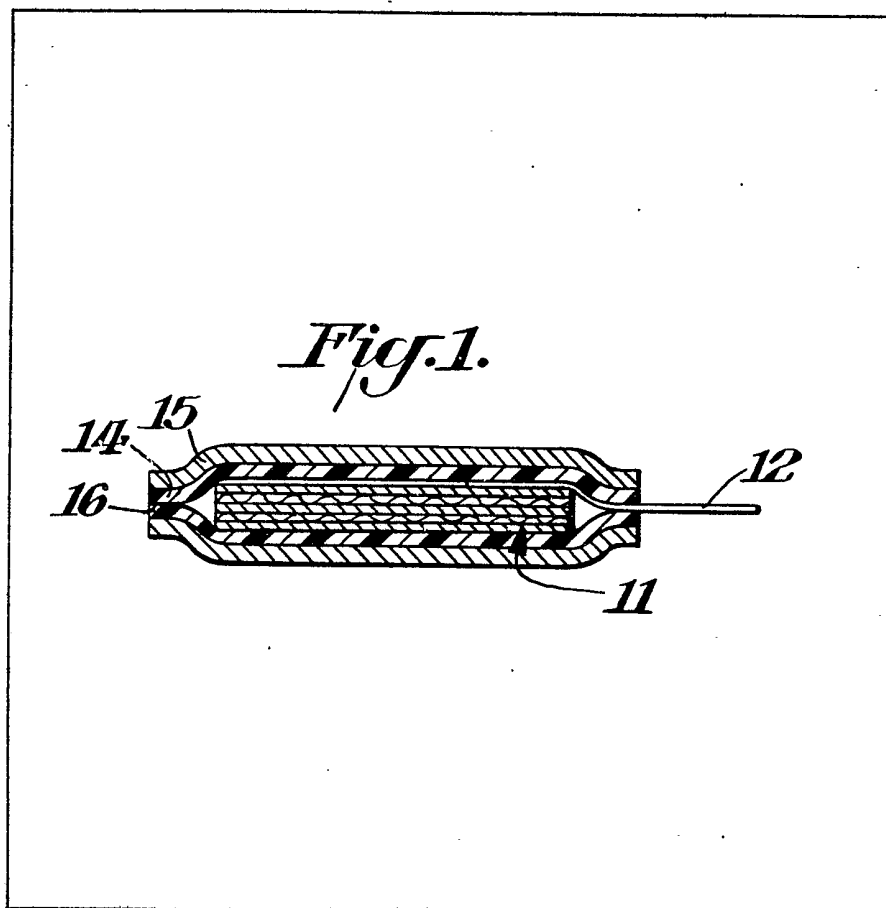
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(71) Applicants
Sprague Electric Company, North Adams, Massachusetts 01247, United States of America
(72) Inventors
Henry Francis Puppolo, Mark Markarian
(74) Agents
A. A. Thornton & Co.

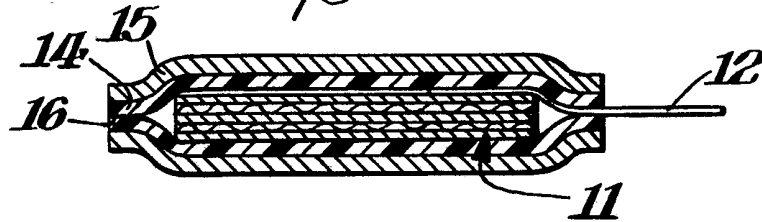
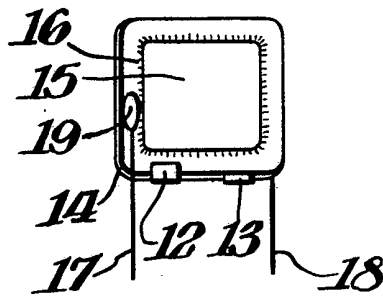
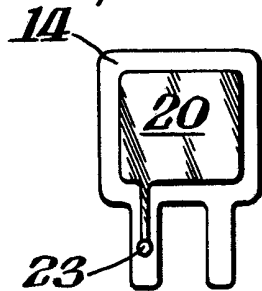
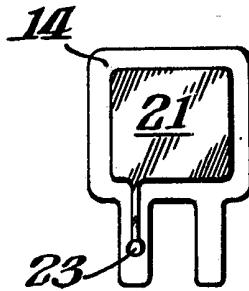
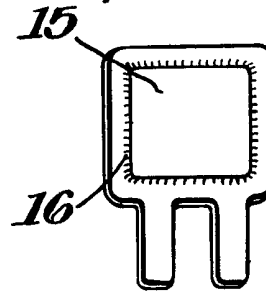
(54) **Sealed flat electrolytic capacitor and production thereof**

(57) A copper-encased flat electrolytic capacitor is produced by sealing a flat capacitor section (11) between heat-sealable polymer-copper laminates (14, 15). The polymer surface (14) of

each laminate is adjacent the capacitor section (11), and the copper surface (15) forms the exterior of the sealed capacitor. Leads (17, 18) may be attached to the opposite copper surfaces of the capacitor, or electrical connection may be made to leg-like extensions of the laminates serving as leads.



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Fig. 1.*Fig. 2.**Fig. 3A.**Fig. 3B.**Fig. 3C.*

SPECIFICATION

Flat electrolytic capacitor and production thereof

5 This invention relates to flat electrolytic capacitors and to the manufacture thereof.

10 It is known in the art to produce capacitors which are heat-sealed in various plastics, polymers, and laminates. However, the bending and flexing of the leads of such capacitors during testing and soldering or attachment to circuit boards frequently weakens or breaks the bond between the encasement and the leads, leading to failure of the capacitor because of ingress of contaminants or leakage of electrolyte.

15 We have now developed a sealed flat capacitor in which the exterior surface can serve as the leads or provide a conductive surface for attachment of leads thereto, by soldering or welding, for example.

20 According to one aspect of the invention, there is provided a process of manufacturing a sealed flat electrolytic capacitor comprising placing a flat impregnated capacitor section with associated spacers and electrode tabs between two layers of insulating polymer-copper laminate, with said section being adjacent the polymer surface of both of said layers, contacting each electrode tab with the respective copper surface of said layers, and heat-sealing around the periphery of said layers to provide a sealed capacitor.

25 According to another aspect of the invention, there is provided a sealed flat capacitor comprising a flat impregnated capacitor section with associated spacers and electrode tabs between two layers of insulating polymer-copper laminate, said layers being heat-sealed together around the periphery thereof, the polymer surface of both said layers being adjacent said section, one of said electrode tabs contacting the copper surface of one of said layers and the other of said electrode tabs contacting the copper surface of the other of said layers.

30 The copper surface of each layer of polymer-copper laminate forms the exterior surface of the capacitor. The polymer-copper laminate provides an internal insulating layer and a vapour barrier.

35 The laminate may be a heat-sealable lamina of polyester, polyolefin, perfluoroethylene, or cellophane combined with a copper-clad aluminium or electroplated copper foil. Alternatively, a polymer-aluminium foil-polymer-copper laminate or a polymer-polyester-polymer-copper may be used.

40 In order that the present invention may be more fully understood, preferred embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

45 Figure 1 is a cross-section of a heat-sealed capacitor according to the invention, taken through one of the electrode tabs;

Figure 2 is a top view of the heat-sealed capacitor of Figure 1 with external leads; and

Figures 3A, 3B and 3C show a sequence of

65 making another embodiment of capacitor in which the case forms the leads.

Figure 1 shows a capacitor section 11 consisting of an anode and a cathode separated by an electrolyte. Section 11 is sealed between layers of an insulating polymer-copper laminate 14, 15 with the polymer surfaces 14 next to the capacitor section and the copper surfaces 15 forming the exterior of the capacitor. Electrode tab 12 extends beyond the laminate which is heat-sealed at least around the periphery as indicated by 16.

70 Figure 2 shows a top view of the sealed capacitor of Figure 1 with leads 17, 18 attached. Extending electrode tabs 12 and 13 are bent into contact with respective copper surfaces 15 of the two laminate layers after the unit has been heat-sealed around the periphery 16. The polymer surfaces 14 of the two laminates insulate the top from the bottom of the capacitor. Leads 17 and 18 are attached to surfaces 15 by soldering or welding 19.

80 Instead of attaching leads, the upper and bottom copper surfaces 15 of the case may be used instead. It is preferable in this embodiment to clip or notch the case so that it will only fit one-way in its intended receiver, instead of simply marking the case as to anode and cathode surfaces.

85 Figures 3A, 3B and 3C show a sequence in the manufacture of sealed units in which the leads are integral extensions of the exterior surface. A polymer-copper laminate 14, 15 is cut larger than anode foil 20 and cathode foil 21 and is provided with at least one leg-like extension. Anode foil 20 is placed on the polymer surface 14 of one laminate, and cathode foil 21 is similarly placed on the polymer surface 14 of another congruent piece. A portion of polymer is removed from a leg of each laminate, and electrode tabs are attached at 23 to the underside of the copper surfaces 15, preferably by welding. After addition of electrolyte (not shown), the layers are superimposed, with the copper surfaces 15 outward, and are heat-sealed at least around the periphery 16 and completely on the leg-like extensions which then serve as plug-in leads for the capacitor.

90 In manufacturing capacitors according to the invention on a production line, it is preferable to use anodized foil as the anode, to which electrode tabs are attached at regular intervals, and cathode foil with spaced electrode tabs attached. A preferred manufacturing process will now be described. Soft paper spacer material is folded in half lengthwise, and the anode foil inserted in the fold. Cathode foil with electrode tabs extending half its width is similarly folded, and the anode-spacer assembly is fed into it. This assembly is fed into folded spacer material to produce a continuum of sections. The sections may then be fed onto the polymer-copper laminate, with polymer surface 14 adjacent the sections, which are then impregnated by injecting electrolyte onto the paper, and covered with another laminate 14, 15. The units are cut apart and heat-sealed. The

electrode tabs 12 and 13, as shown in Figure 2, are folded and welded to their respective copper surfaces 15, and leads 17, 18 are attached to the copper surfaces 15, or the capacitor is registered, e.g. by clipping one corner, to permit use in only one spatial arrangement with the case serving as the leads.

In the embodiment of Figures 3A, 3B and 3C, the anode foil is encased in paper spacer material as above and cut adjacent an electrode tab into individual anodes with attached tab. The individual anodes are placed on the polymer surface 14 of a heat-sealable insulating polymer-copper laminate 14, 15 in the shape of but slightly larger than the final capacitor and with leg-like extensions corresponding to the spacing of the electrode tabs. The anode tab extends part-way down one of these legs. A portion of the polymer surface 14 adjacent the end of the tab either has been removed or is removed, and the tab is electrically connected, preferably by welding to the copper surface 15 through the hole in the polymer. The cathode is assembled similarly to the opposite leg of the other laminate 14, 15. Electrolyte is dropped onto the paper saturating it, and the layers are placed one over the other, polymer surfaces 14 together. The capacitor is then heat-sealed completely through the legs and at least around the periphery 16 to form the finished capacitor with plug-in integral leads.

The polymer lamina of the laminate may be, for example, heat-sealable polyester, polyolefin, perfluoroethylene, or cellophane and preferably is a heat-sealable polyethylene.

The copper lamina may be copper foil, electroplated copper, or copper-clad aluminium. The laminate may also contain an aluminium foil layer, e.g., be a polyethylene-aluminium foil-polyethylene-copper clad aluminium laminate, when a redundant vapour barrier layer and extra safety from copper ion contamination of the electrolyte is required. If this laminate is used in the embodiment of Figure 3, a portion of the aluminium layer must be removed as well as polymer for electrode tab attachment to the outer copper legs. Alternatively, a polyethylene-Mylar-aluminium-polyethylene-copper laminate may be used, where the Mylar acts to prevent ion migration and short-circuiting.

CLAIMS

1. A process of manufacturing a sealed flat electrolytic capacitor comprising placing a flat impregnated capacitor section with associated spacers and electrode tabs between two layers of insulating polymer-copper laminate, with said

section being adjacent the polymer surface of both of said layers, contacting each electrode tab with the respective copper surface of said layers, and heat-sealing around the periphery of said layers to provide a sealed capacitor.

2. A process according to Claim 1, in which each electrode tab extends through the sealed periphery and the tabs are bent away from one another into contact with the respective copper surface.

3. A process according to claim 2, which further comprises attaching leads to the respective copper surfaces.

4. A process according to claim 1, in which each layer of said laminate has a leg-like extension to which the respective electrode tab is connected, said extensions being heat-sealed with the rest of the assembly forming integral terminals for the capacitor.

5. A sealed flat capacitor comprising a flat impregnated capacitor section with associated spacers and electrode tabs between two layers of insulating polymer-copper laminate, said layers being heat-sealed together around the periphery thereof, the polymer surface of both said layers being adjacent said section, one of said electrode tabs contacting the copper surface of one of said layers and the other of said electrode tabs contacting the copper surface of the other of said layers.

6. A capacitor according to claim 5, in which the section comprises an anodized anode foil located within a fold of spacer located within a folded cathode foil.

7. A capacitor according to claim 5, in which each of the electrode tabs extends through the sealed periphery and is bent opposite to the other into contact with the respective copper surface of said layers.

8. A capacitor according to claim 7, in which leads are attached to respective copper surfaces.

9. A capacitor according to claim 5, in which each layer of said laminate has a leg-like extension to which the respective electrode tab is electrically connected, said extensions being heat-sealed with the rest of the capacitor forming integral terminals thereon.

10. A process of manufacturing a sealed flat electrolytic capacitor, substantially as described herein with the reference to Figures 1 and 2 or Figures 3A, 3B and 3C of the accompanying drawings.

11. A sealed flat capacitor, substantially as herein described with reference to Figure 1 and 2 or Figures 3A, 3B and 3C of the accompanying drawings.