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(54) Heating device, in particular for the defrosting of freezer compartments

(57) In a heating device, in particular for the defrosting of freezer compartments, pellicular resistive elements (16a,16b) are contained in close envelopes (14) made of electrically insulating material, each envelope (14) contains one or more pellicular resistive elements (16a,16b) electrically connected therebetween and the resistive elements (16) of each envelope (14) are electrically connected with resistive elements of at least one of the other envelopes so as to mantain the resistive elements (16) contained in said envelopes (14) electrically insulated.

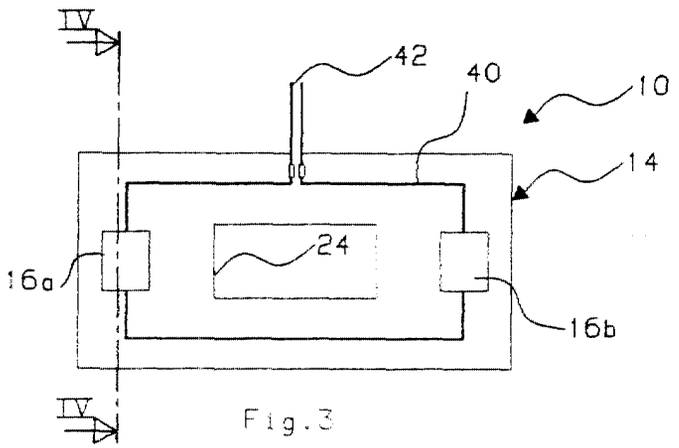

Fig.3

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Description

[0001] The present invention concerns heating devices, in particular for the quick defrosting of freezer compartments or the like which comprise resistive elements to be connected to a source of electrical supply.

[0002] The freezer compartments are recptacles substantially of parallelepipedic form inside which cooling or evaporating coil are housed, and forming part of a cooling apparatus, to lower the inside temperature to the required values.

[0003] However, during the usual operation of a freezer compartment, on the inside walls an ice layer forms, the thickness of which progressively increases so reducing, at the same time, the efficiency of the thermic exchange; then, in order to mantain the temperature inside the freezer compartment at a constant value, the refrigerating apparatus, which is controlled by a thermostat, has to work for a longer time.

[0004] Conseguently, defrosting devices have been developed to allow the ice created to melt and usually to collect it in a tray located on the bottom of the freezer compartment.

[0005] A first example of the device is comprised of armoured resistances wich consist of electrical wires wound around a suitable support of insulating material, for example polyester, inserted inside protective sheathes in PVC (polyvinyl of chloride) in its turn inserted in metallic pipes. These resistances are housed in the walls of the freezer compartments near the cooling coil of the refrigerating apparatus. By connecting the armoured resistances to an electrical supply, the heat generated melts the ice and the water formed accumulates in the collecting tray.

[0006] Nevertheless, this system has some drawbacks due to the fact that the heat generated by the resistive elements is localized and then it is badly-distributed over the entire inside surface of the freezer compartment. Consequently, the time necessary to obtain the complete melting of the ice inside of the freezer compartment increases and the electrical energy consumed increases too. In order to overcome this drawback the number of the armoured resistances or their power must be increased, unfortunately increasing the industrial costs.

[0007] It is necessary to improve the efficiency of the heat exchange instead, making the distribution of the heat as uniform as possible. In order to achieve what is required, pellicular resistive elements are utilized, that is not filiform elements but sheet-like elements, so as to cover in an optimum way the inside surface of the freezer compartment.

[0008] Pellicular resistive elements are described in the Italian utility model N. MI98U000773 filed on 27.11.1998. Each element comprises a plurality of plastic sheets or laminae between which, by means of a felt-tip pen, printing or silk-screen process, a layer of resistive ink strips are deposited, these strips are connected by means of conductive tracks also achieved by the same depositing techniques. The electrical connection between the conductive tracks of the different sheets is obtained by metallic elements which perforate the sheets.

[0009] In particular the resistive ink has the electrical characteristics of the PTC type (positive temperature coefficient) in which, as the temperature increases, the value of the electrical resistance increases, so as to self-limit the intensity of the electrical current thus avoiding possible overheating.

[0010] The sheets are arranged in the hollow walls of the freezer compartment, together with the evaporating coil, and the whole apparatus is soaked by a foam layer which, solidifying, fills the wall of the freezer compartment. Although this device allows an optimum heat distribution to be reached, there are some drawbacks.

[0011] Above all, the laminar structure is complex because it is made of several layers. In fact, it is necessary to first arrange a plastic printing support layer which has both electrical insulating characteristics and mechanical characteristics on which a resistive ink layer has to be applied, and at last the ink layer has to be covered by a lamina of insulating material. All the phases increase the production times, as well as the final cost of the product.

[0012] A second drawback is due to the fact that the sheets or the laminae which form the pellicular resistive elements have a unique electrical insulation which might be insufficient; moreover, in order to connect more sheets therebetween, metallic elements are utilized which perforate the sheets, further reducing the electrical insulation and introducing at the same time difficulties in constructing the device.

[0013] Finally, another drawback is due to the fact that the pellicular resistive elements are not perfectly watertight; thus considering the enviroment where they are used, infiltrations of water may occur during time, damaging them.

[0014] The aim of the invention is to obtain a device in which the drawbacks cited with reference to the above-described prior art are eliminated.

[0015] The aim is achieved by a device of the initially indicated type, that is a defrosting device for freezer compartments comprising pellicular resistive elements electrically connected therebetween, characterized in that said pellicular resistive elements are contained in close envelopes of electrically insulating material, each envelope containing one or more pellicular resistive elements electrically connected therebetween, said resistive elements of each envelope are electrically connected with resistive elements of at least one of the other envelopes and the resistive elements of at least one said enevelope are connected with supply electric wires thus maintaning the resistive elements contained in said at least one envelope electrically insulated.

[0016] In such a way the resitive elements do not necessitate to be covered with layers of insulating material, but it is sufficient to arrange only one support layer on

which the resistive ink has to be depositated. The insulation is achieved after by means of the envelope in which the resistive elements are placed in, envelopes which are obtained with electrically insulating material, therefore the resistive elements are perfectly insulated.

[0017] If a high level of electrical insulating is required, it is sufficient to use resistive elements previously covered on both the surfaces by laminae of insulating material.

[0018] Each envelope comprises a covered lower and upper sheet, each of them having a perimetrical edge, said sheets being joined for at least a part of their perimetrical edge thus defining an open side, the edges of the open side being joined with the edges of the open side of other envelopes so as to seal said resistive elements inside said envelopes, thus allowing only the passage to the outside of said electrical supply wires.

[0019] It is easy to understand that by enclosing the resistive elements in said envelopes it is easy and cheap and it assures the complete and perfect insulation of the resistive elements. In addition, the envelopes are sealed making them perfectly water-tight, so that the device is waterproof thus eliminating the risk that water might infiltrate damaging the pellicular resistive elements contained in the envelopes.

[0020] These and other advantages will be more evident by the following description of an embodiment made for examplifying and not limitating the scope with reference to the subsequent enclosed drawings:

- figure 1 is a prospetic view of a freezer compartment in which the device of the present invention is mounted;
- figure 2 is a top view of a device according to the present invention;
- figure 3 is a top view of the sheet of the device of figure 2;
- figure 4 is a cross section along the line IV-IV of figure 3;
- figures 5 and 6 are top views respectively of the lower and top sheets which form each sheet of the device;
- figure 7 is a top view of the lower and top sheets joined therebetween;
- figures 8A, 8B, 8C e 8D are cross sections or top views which illustrate the joining phases of two sheets of the device.

In figure 1, a freezer compartment 11 is represented wherein a defrosting device 12 is mounted. The freezer compartment 11 comprises three side walls 11a, 11b, 11c, a bottom 11d, a cover 11e and a door 11f. The defrosting device 12 comprises, as illustrated in figure 2, five sheets 10,100,200,300,400 whose dimensions are subsantially similar in respect to those of the side walls 11a,b,c, bottom 11d and cover lie of the freezer compartment 11 in which they are housed. The sheets 10,100,200,300,400 are joined in such a way that, when they are plied at 90° one in respect to the other, they perfectly lay down on the walls of the freezer compartment 11.

[0021] From figures 3 e 4, it can be noted that the sheet 10 of the device 12 comprises an envelope 14 formed by a lower sheet 13 and an upper sheet 15 both made of electrically insulating material, as for example polyester. Inside the envelope 14 pellicular resistive elements 16a, 16b of the PTF type (polymer thick film) are contained.

[0022] The pellicular resistive elements 16a,16b are formed by a lower layer of insulating material 18 which represents the support on which, by depositing techniques, resistive ink 20 is applied which optionally, as indicated in figure 4, is covered by a covered upper layer 22 of insulating material. The insulating material used in the lower layer of the support 18 and in the covered upper layer 22 is usually of plastic material, for example polyester or material containing aramidic fibers or similar to those known by the "kevlar" or "kapton" trademark.

[0023] The resistive ink layer 20 is laid down in strips and preferably has characteristics of PTC type (positive temperature coefficient) whereby as the temperature increases, the electric resistance value increases thus self-limiting the current intensity avoiding dangerous overheating. The resistive ink layer 20 is composed of a mixture of conductive solid particles and a synthetic resin dispersed in a solvent. The conductive particles are made of carbon powder of the type usually known as "carbon black" which may be combined with other conductive materials, in particular metallic elements. The synthetic resin, made of a polymer, is chosen among plastic-fluorines, polyolefines or others on the basis of acetates, metacrilati, etc. The solvent, in which the mixture of solid particles is dispersed, is chosen among the chlorinated hydrocarbon, the esters, the ethers, the esters-ethers or a mixture of the like.

[0024] The envelope 14 has a window 24, that is a cavity which is useful because, when considering that the envelope 14 is interposed between the inside walls of the freezer compartment 11 and the evaporating coil, it facilitates the heat transmission from the evaporating coil to the inside of freezer compartment 11. Inside the envelope 14, the resistive elements 16a,b are electrically connected therebetween by means of connecting electric wires 40 or conductive tracks in the case the lower support layer 18 is extented between the two resistive elements 16a,16b. The electric wires or conductive tracks 40, which are connected therebetween, come out from the envelope 14 by an electric wire or conductive track 42 (in the case the lower support layer 18 comes out form the envelope 14) in order to be connected with an electric wire or conductive track of the sheet 100, as better illustrated in the following.

[0025] More precisely, as indicated in figures 5 and 6, the lower sheet 13 and the upper sheet 15 have respectively an outside perimetrical edge composed of the lower sides 13b and 15b, the lateral sides 13a,13c and 15a,

15c and the upper sides 13d and 15d and an inside perimetrical edge 26. The sides 13a,c of the lower sheet 13 have a length lower than those of the sides 15a,c of the upper sheet 15. In order to obtain the envelope 14, the lower sheet 13 and the upper sheet 15 are overimposed on each other, with the pellicular elements 16a,16b interposed between them and the side 13b which corresponds with the side 15b, after which the sheets are joined to each other by means of welding done by radio frequency or hot welding at the sides 13a,b,c and 15a, b,c of the outside perimetrical edge, defining a soldering seam 28. The lower sheet 13 and upper sheet 15 are joined also at the inside perimetrical edge 26 thus defining the envelope 14 opened on the upper side 15d and with the window 24, as illustrated in figure 7. The soldering seam 28 may involve only the partial sides 15a,15c of the upper sheet 15 before reaching the upper side 15d, as indicated in figure 7.

[0026] Figures 8A, 8B, 8C and 8D represent the sequence by means of which the envelope 14 of the sheet 10 is joined with the envelope 114 of the sheet 100, wherein the elements of the sheet 100 corresponding to the elements of the sheet 10 are indicated with the same numeric reference plus 100. As indicated in figures 8A and 8B, the sheets 10 and 100 are overimposed so that the upper sheet 15 of the sheet 10 is in front of the upper sheet 115 of the sheet 100. Sides 15d and 115d, respectively of the sheets 10 and 110, are joined to each other by means of a soldering seam 30 and the electric wires or conductive tracks 42 and 142, respectively of the sheet 10 and the sheet 100, are electrically joined to each other, for example by means of metallic clips or bridges in the case of conductive tracks, and connected with a supply electric wire 44 to be connected to an electric energy source.

[0027] In figures 8C and 8D, it can be seen that, after, also the sides 13d and 113d of the sheet 10 and 100 respectively, are joined to each other by means of a soldering seam 32 which involves also a part of sides 13a and 113a and a part of sides 13c and 113c of sheets 10 and 100 until reaching the soldering seam 28 so as to close the envelopes 14,114 and completely seal the pellicular resistive elements 16 contained inside the envelopes 14 and 114, whereas the electric wire 44 of the electric supply comes out of the envelopes 14 and 114. In order to realize a perfect closure where the electric wire 44 comes out, the portions of the sheets 13 and 113 which cover the electric wire 44 are joined around the electric wire 44 by means of a soldering seam 34.

[0028] The same system used to join the sheet 10 to the sheet 100 is used to join therebetween all the other sheets 200,300,400 in order to finally obtain the device 12.

[0029] As already previously illustrated, it will be evident that the advantages obtained with the present invention derive from the simplicity with which the resistive elements are enclosed in envelopes of insulating material, thus obtaining a water-tight device wherein the pellicular resistive elements are not only electrically insulated but also water-tight.

[0030] It is clear that all changes or variations conceptually or functionally equivalent fall inside the scope of the invention. For example, it is possible to join the perimetrical edges of the envelopes using other welding techniques or even glues or any other adhesive substances. Furthermore, the applications may be different, and not only for the defrosting of freezer compartments, but for example also for the heating of any room or receptacle.

Claims

1. Heating device, in particular for the defrosting of freezer compartments, comprising pellicular resistive elements (16a,16b) electrically connected to each other, characterized in that said pellicular resistive elements (16a,16b) are contained in close envelopes (14) of electrically insulating material, each envelope (14) containing one or more pellicular resistive elements (16a,16b) electrically connected therebetween, said resistive elements (16) of each envelope (14) being electrically connected with resistive elements of at least one of the other envelopes so as to mantain the resistive elements (16) contained in said envelopes (14) electrically insulated and water-tight, and the resistive elements of at least one said envelope are connected with supply electric wires (44) thus maintaning the resistive elements (16) contained in said at least one envelope (14) electrically insulated.

2. Device according to the claim 1, characterized in that each envelope (14) comprises two covered lower (13) and upper (15) sheets each having a perimetrical edge, said lower and upper sheets (13,15) being joined for at least a part of their perimetrical edge (13a,b,c e 15a,b,c) thus defining an open side (13d,15d), the edges of the open side (13d,15d) being joined with the edges of open side of the other envelopes (114) so as to close said envelopes (14,114) and seal said resistive elements (16a,b) inside said envelopes (14,114), thus permitting only the passage to the outside of said supply electric wires (44).

3. Device according to claim 2, characterized in that said two lower and upper sheets (13,15) of each envelope (14) are joined along the perimetrical edge (13a,b,c,d e 15a,b,c,d) by means of hot welding.

4. Device according to claim 3, characterized in that said hot welding is a radio frequency welding.

5. Device according to claim 2, characterized in that said said two lower and upper sheets (13,15) of

each envelope (14) are joined along the perimetrical edge (13a,b,c,d e 15a,b,c,d) by means of glueing.

6. Device according to any of the previous claims, characterized in that said envelopes (14) comprise windows (24).

7. Device according to any of the previous claims, characterized in that said resistive elements (16) of said envelopes (14) are electrically connected by means of connecting electric wires (40,42).

8. Device according to any of claims from 1 to 6, characterized in that said resistive elements (16) of said envelope (14) are electrically connected therebetween by means of conductive tracks (40,42) electrically connected to each other by metallic clips or bridges.

9. Device according to any of the previous claims, characterized in that said envelopes (14) are made of thermoplastic material.

10. Device according to the claim 9, characterized in that said thermoplastic material is polyvinil of chloride (PVC).

11. Device according to any of the previous claims, characterized in that said pellicular resistive elements (16) are of the "polymer thick film" type (PTF).

12. Device according to the claim 11, characterized in that said resistive elements PTF (16) are of the "positive temperature coefficient" type (PTC).

13. Device according to any of the previous claims, characterized in that said envelopes (14) are five in quantity so that when they are plied at 90° one in respect to the other, they form a parallelepipedic structure (10,200,300,400) with five surfaces corresponding to the walls (11a,b,c,d,e,f) of the freezer compartment (11) wherein the device is mounted.

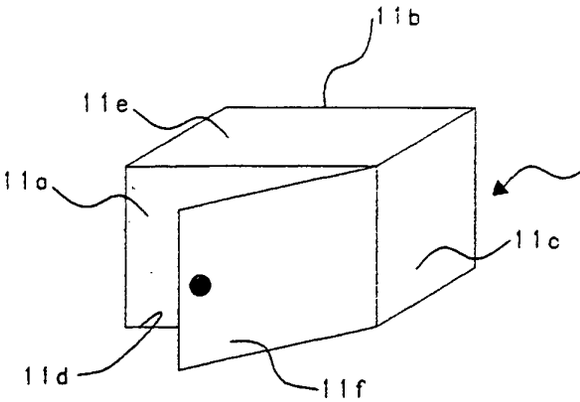

Fig.1

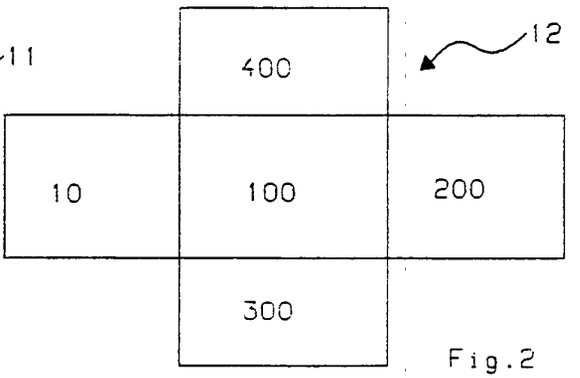

Fig.2

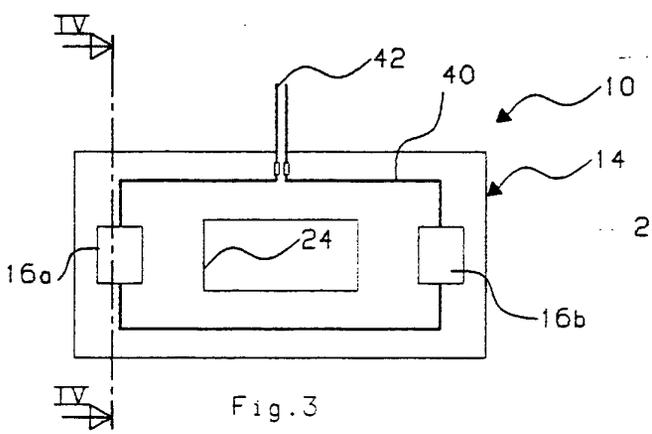

Fig.3

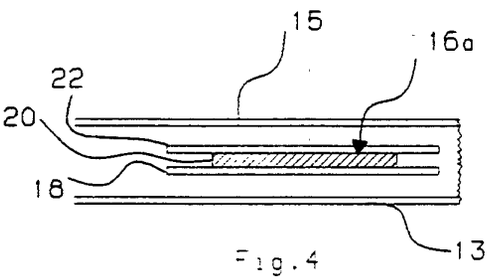

Fig.4

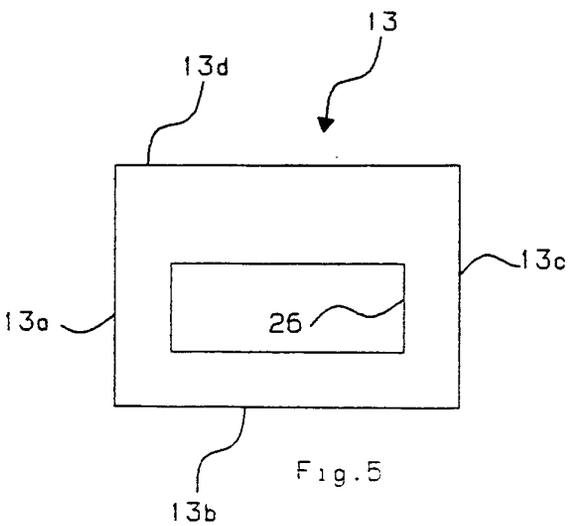

Fig.5

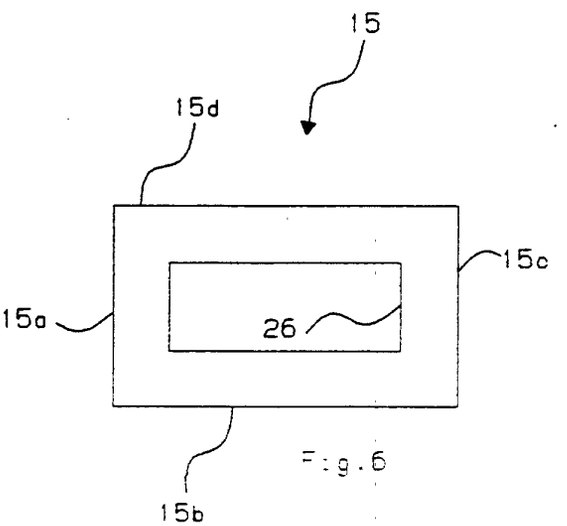

Fig.6

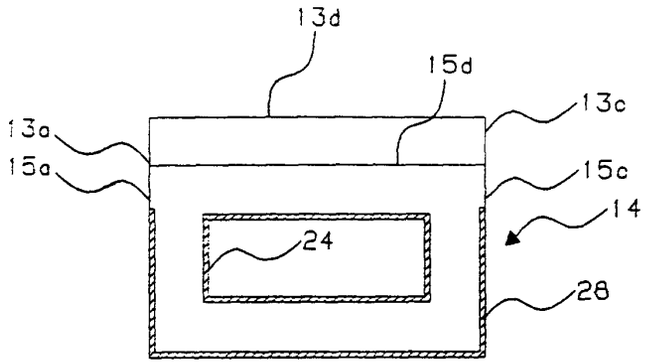

Fig.7

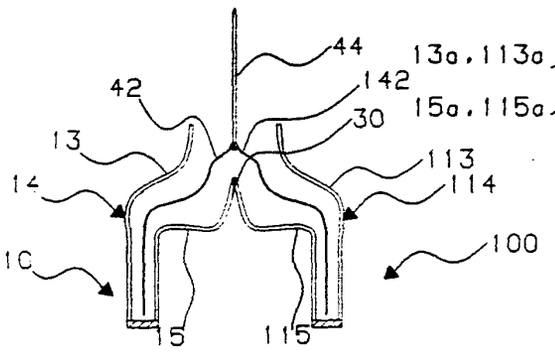

Fig.8A

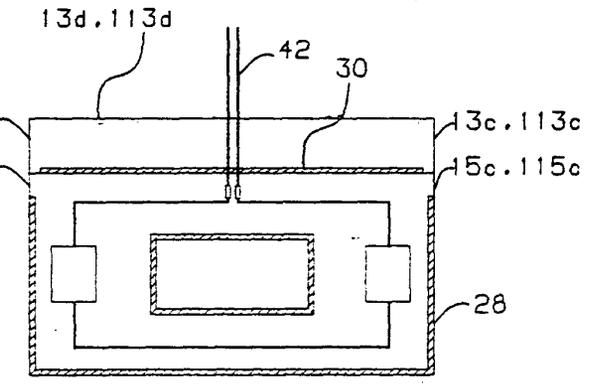

Fig.8B

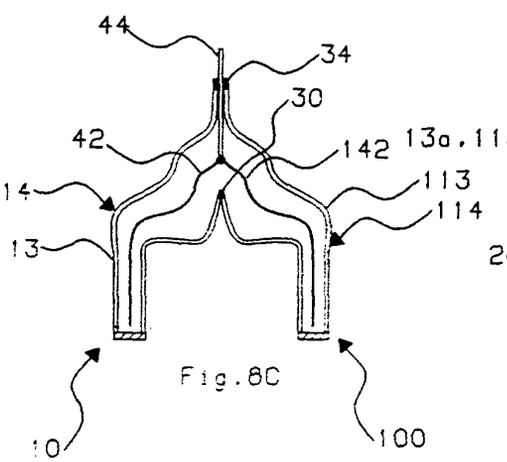

Fig.8C

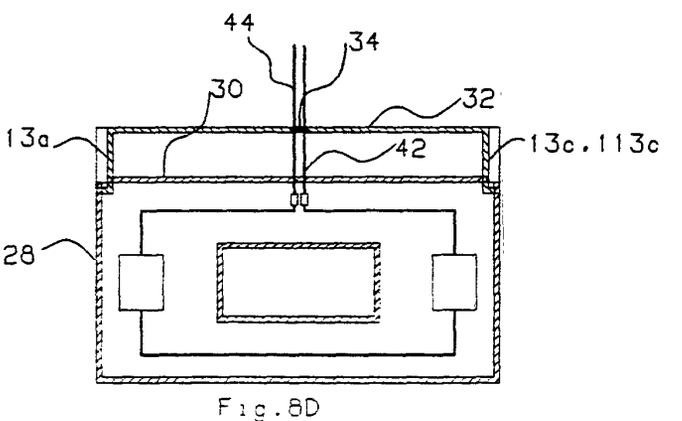

Fig.8D