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(54) **Package for vacuum or protective atmosphere preservation of food products which tend to release liquids**

(57) A vacuumized or modified atmosphere package for food products susceptible to release fluids comprising a tray and a cover is described. The tray has a bottom (3) and side walls (5) ending in a jutting edge, and includes at least two layers, one of which is facing the tray interior and is constituted by a foil (7) of an absorbent plastic material, preferably expanded polystyrene with substantially open cells, having holes (10) or slots across at least part of its upper surface, and an outward-facing or lower one is constituted by a composite plastic film (9) having gas-barrier properties. In accordance with the invention, a perimetric portion of the tray, preferably at least a portion of the edge (6) or a portion of the side walls, is sealed through pressure and radio-frequency such that the individual layers become fused along said perimetric portion causing the absorbent structure to substantially collapse into a thin gas-barrier layer having at least one intermediate region of an essentially compact material. This package effectively absorbs fluids released by the food products at the same time as it keeps the vacuum or the gaseous atmosphere established inside the tray unaltered over time.

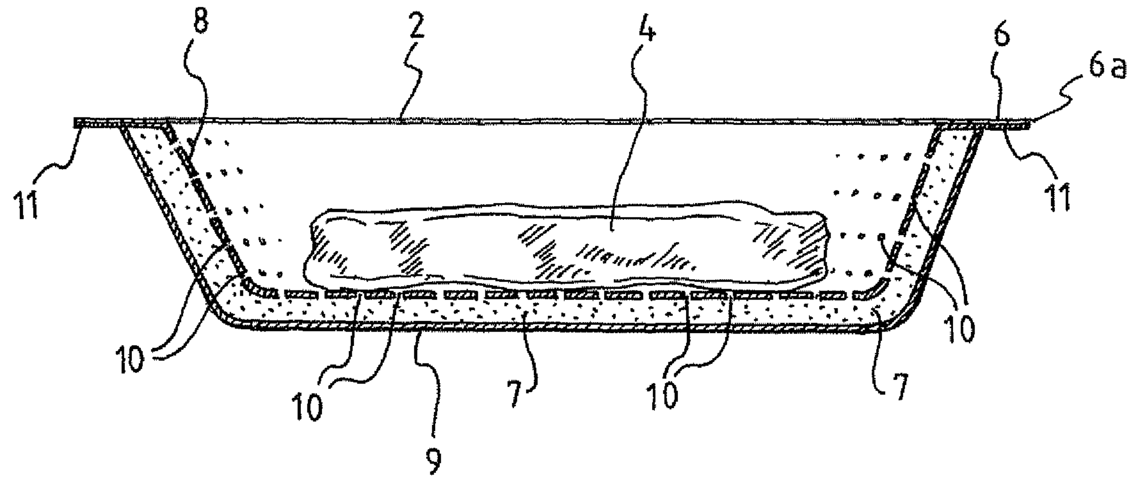

Fig. 2

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Description

Field of Application

[0001] In its broader aspect, the present invention relates to the field of modified atmosphere packaging or vacuum packaging of food products by means of packages made of plastic material.

[0002] In particular, the invention relates to a package for food products comprising a tray made of plastic material, having barrier properties with respect to the gases diffusion and having absorbing power with respect to any fluid released by the food products, and a hermetically sealed cover on said container.

[0003] Moreover, the present invention also relates to a tray to be used in the aforesaid package and a process for the preparation of such a tray and such a package.

[0004] The term "tray" is used herein to mean any container, which may have a shape other than that of an ordinary tray while still including a bottom and side walls ending in an edge.

[0005] The term "fluid" is used herein to mean any liquids (exudates) released by a food product during preservation and/or any gas contained in said package.

Prior Art

[0006] The use of containers made of plastic material for packaging food products is quite widespread, above all for the retail sale in supermarkets. In the instance of highly perishable food products that release liquids (exudates), such as fresh meat and fish products, it has been common practice to apply an absorbent material of cellulose or another fiber on the bottom of containers to avoid the presence of undesired liquids in the tray and accordingly preserve the organoleptic characteristics of the products.

[0007] In recent years, the above prior method of absorbing the exudates by applying the above absorbent materials has been supplanted by the use of containers made of an expanded thermoplastic material, in particular expanded polystyrene, which has an inherently porous, open-cells structure capable of absorbing and/or bleeding out the exudates from the food products during their preservation period and while on display at retail sale stores. This porous structure is placed in fluid communication with the food product by slits or perforations provided in its upper surface, i.e. the surface facing the interior space of the container, whereby liquids/exudates released from the food products are caused to flow into the cells and remain trapped therein.

[0008] It is also known that the need of extending, as much as possible, the shelf-life of highly perishable food products maintaining their organoleptic, nutritional and hygienic characteristics unaltered has led to the development of packaging techniques wherein a package is vacuum-conditioned, or air is removed from its interior and replaced with a suitable gas mixture (modified-atmosphere packaging).

[0009] Examples of application of such techniques of vacuum packaging or modified atmosphere packaging can be found, for example, in the patents US 3 574 642, US 5 115 624 and in the international application WO 97/36504.

[0010] In this respect, a currently very diffused technique provides the use of a tray made of expanded plastic material which is rendered gas-impermeable through the coupling of a film provided with gas-barrier properties onto the inner face of the tray. Before sealing it with a cover of gas-barrier film, the replacement of the air inside the package with a suitable gas mixture is carried out.

[0011] In the applications requiring the absorption of the exudates released by the food products, an absorbing pad can be used between the food product and the bottom of the tray, which, however negatively influences the production costs, complicates the operations of disposal and recycle of the packages after use, and can contribute to the microbiological proliferation.

[0012] Patent Application WO 00/46125 describes a tray having absorbing properties which is suitable for vacuum packaging or modified atmosphere packaging of food products which may release liquids. Such a tray consists of a structure made of open-cells plastic material enclosed between two films of which at least one is impermeable to the gases respectively applied onto its inner and outer surface. The film applied onto the inner surface is interrupted by perforations in order to allow the liquid to penetrate into a predetermined portion of the underlying open-cells structure. According to an embodiment of the above mentioned tray, said portion is sealed by welding the two films in predetermined points in order to prevent the liquid provided inside it from migrating into the remaining open-cells structure of the tray.

[0013] However, in the packages using the above tray a gas migration occurs along the open-cells plastic material over time thus reaching an equilibrium with the atmosphere outside of the tray in correspondence with the tray edgeThis phenomenon achieves the undesired effect of altering the modified atmosphere originally set inside the tray, thereby the shelf-life of the food product cannot be extended.

[0014] Further on, the realisation of an open-cell plastic material structure with two barrier films implies not negligible additional costs and the compression of the two films in order to avoid free gases diffusion through the edge limits the absorption to a limited portion of the tray.

[0015] The technical problem at the basis of the present invention is that of providing a package for modified atmosphere packaging or vacuum packaging of food products susceptible of releasing liquids which is efficient in absorbing the fluids released by the food products and which allows to maintain the gas atmosphere set inside it or the vacuum before use substantially unaltered.

Summary of the invention

[0016] The above technical problem is solved, according to one embodiment of the invention, by a vacuumized or modified-atmosphere package for food products being susceptible to release fluids, comprising:

a tray made of a plastic material, having a bottom, and having sidewalls terminating with a jutting edge, the tray comprising at least two layers, of which a layer facing inward comprises a sheet of plastic material able to absorb the fluids released by food products, having holes or slots on at least part of its upper surface, and a lower layer facing outward is made of a gas-barrier film of plastic material, ;

- a food product susceptible of releasing liquids placed onto the bottom of said tray;

a cover for said tray consisting of a gas-barrier film of plastic material which adheres onto the tray edge so as to maintain a vacuum or a protective atmosphere within the package,

said package being characterized in that at least one of the tray layers comprises at least one polar component, and in that a perimetricperimetric portion of said tray is sealed through the application of pressure and radio-frequency such that the individual layers are at least partly fused in correspondence with said perimetricperimetric portion and the absorbent structure is caused to substantially collapse into a thin gas-barrier layer having at least an intermediate region of an essentially compacted material.

[0017] The above technical problem is solved, according to another embodiment of the invention, by a vacuumized or modified-atmosphere package for food products being susceptible to release fluids, comprising:

a tray made of a plastic material, having a bottom, and having sidewalls terminating with a jutting edge, the tray comprising at least two layers, of which a layer facing inward comprises a sheet of plastic material able to absorb the fluids released by food products, having holes or slots on at least part of its upper surface, and a lower layer facing outward is made of a gas-barrier film of plastic material, ;

- a food product susceptible of releasing liquids placed onto the bottom of said tray;

a cover for said tray consisting of a gas-barrier film of plastic material sealed to at least one perimetricperimetric portion of the tray edge so as to maintain a vacuum or a protective atmosphere within the package.perimetricsaid package being characterized in that at least one of the tray layers and/or said cover comprises a polar component, and in that said cover is sealed to at least a perimetricperimetric portion of said edge through application of pressure and radio-frequency so that the individual layers of the tray and the cover are at least partially fused to at least a perimetricperimetric edge portion and the absorbing structure caused to substantially collapse into a thin gas-barrier layer having at least an intermediate region of an essentially compacted material.

[0018] The expression "plastic material having fluid absorbing properties", or its short form "absorbent plastic material", is used here to mean any plastic material having a porous or fibrous or expanded cellular structure with cells being at least partially open, preferably substantially or mostly open cells capable of taking in, as by absorption and/or draining out fluids, in particular liquids (exudates), released by the food products while stored in the package.

[0019] Preferably, the absorbent plastic material is selected from the group including expanded thermoplastic materials, specifically polystyrene, polypropylene, polyethylene, woven or non-woven fibers, fluffed plastics, and polymers of a renovable nature such as biodegradable polymers.

[0020] The term "polar component" is used herein to mean any polymer or additive exhibiting an adequately polar behavior and polar content (e.g. molecular dipoles), and a high dielectric loss factor (generally higher than 0.2 at a frequency of 27.12 MHz), such that it can be heated by application of radio-frequencies.

[0021] In the package of the invention, said polar component is preferably selected from the group including ethylene vinyl alcohol (EVOH), ethylene vinyl acetate (EVA), EVA and EVOH polymers and copolymers, surfactants, ethylene metacrylate (EMA), ethylene butacrylate (EBA), and ethylene ethyl acrylate (EEA).

[0022] In the package of the invention, the thickness of said thin layer is 100 to 1500 microns, preferably 300 to 600 microns.

[0023] Preferably, the perimetricperimetric portion of said tray wherein the sealing is carried out through the application of pressure and radio-frequency is at least a portion of the edge, preferably the whole edge, or a portion of the side walls.

Detailed Description

[0024] The radio-frequency sealing or welding technique has been well known since 1946 for the purpose of sealing together thermoplastic materials having polar characteristics, such as PVC (polyvinylchloride), EVA (ethylene vinyl acetate), APET (polyethylene terephtalate), and PUR (polyurethane).

[0025] Radio-frequency (RF) sealing, also called high-frequency sealing or dielectric sealing, is carried out by applying an electric field to polar thermoplastic materials such that the molecules (molecular dipoles) of these materials are forced to align themselves to the field potential. Fluctuation of the electrostatic field causes the molecules to vibrate and become heated by mutual friction. On RF sealing machines, the polar plastics materials are placed between two planes that function as capacitors and are subjected to the electric field, oscillating at a frequency of 27.12 MHz (as defined by the International Telecommunications Union (ITU) standard). The layers are fused and sealed together by pressing them between the planes. However, necessary condition to obtain the fusion and the RF sealing is the polar nature of the polymers being used, which allows the molecules to vibrate and generate heat when exposed to an electromagnetic field. Non-polar polymers that do not respond to RF are, in fact, polypropylene, polyethylene and polystyrene, whose dielectric loss factor (or dielectric dissipation factor) is lower than 0.2 at 27 MHz, and may be lower than 0.01 in certain cases. In the present invention, however, RF sealing is carried out to seal layers of the food product trays which comprise a substantial layer of a non-polar polymer unaffected by RF, as the layer of absorbent plastics material usually is, this being achieved by incorporating at least one polar component into the tray structure.

[0026] In this regard, it has unexpectedly been found not only that radio-frequency sealing can be applied to such a structure, but also, that in the sealing portion the fusion and the compaction of the layers constituting the tray can be obtained with substantial collapse of the absorbent structure until a thin layer is formed, the thin layer advantageously having efficient gas barrier properties and an adequate mechanical resistance. In particular, at least one continuous intermediate region has been recognized in said thin layer defining the sealing portion, such a region being made of a compact material acting as an effective barrier to gases or . said thin layer being completely made of a substantially compact gas-barrier material. Unexpectedly, also any uncollapsed portion of the absorbent structure has shown to have gas-barrier properties.

[0027] This enables a package incorporating said tray to effectively retain the atmosphere originally established in it over time, since gases are prevented from bleeding out through the multi-layered structure of the tray by the compact gas-barrier material provided by RF sealing.

[0028] Preferably, the tray of the package of the invention includes an additional layer, overlying said inward-facing layer, which is a film or foil of unexpanded plastics material having through holes or slots at least in correspondence with the bottom of the tray. The unexpanded film or foil may be composite (multi-layer) or non-composite (single-layer).

[0029] Alternatively, a composite film of plastic material having gas-barrier properties may be used instead of the unexpanded film or foil of plastic material.

[0030] Advantageously, said unexpanded film or foil or said composite gas-barrier film is made opaque to allow the abosorbed liquid masking. For example, the opacifying may be achieved by incorporating titanium dioxide into the plastics material.

[0031] Preferably, the film or foil of unexpanded plastics material is selected from a group including polystyrene, polypropylene, polyethylene (PE), low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE), EVA, EVA polymers and copolymers, metallocenes, and combinations thereof, in particular a mixture of polyethylene and an EVA copolymer. A composite film or composite foil comprising a layer of unexpanded polystyrene and a layer of a mixture of polyethylene and an EVA copolymer is especially preferred.

[0032] The gas-barrier films forming the outward facing layer in the tray, the optional layer overlying the inward-facing layer, and the cover, are each preferably a multi-layer film comprising at least one gas-barrier layer of plastic material, a thermoplastic material layer, and a sealing outer layer. Of course, additional layers could be provided for the purpose of conferring the desired mechanical and thickness characteristics on the film.

[0033] The material forming the gas-barrier layer may be selected from a group including polymers and copolymers of ethylene vinyl alcohol (EVOH), Nylon, polyvinylidene chloride (PVDC), poly- or copolyamides, and combinations thereof. Preferably, said material is a polymer or copolymer of ethylene vinyl alcohol and/or Nylon.

[0034] The material forming the sealing outer layer of the gas-barrier film is selected from a group including polyethylene (PE) and/or copolymers thereof, in particular ethylene vinyl acetate (EVA), polypropylene (PP) and copolymers thereof.

[0035] Multi-layer films manufactured and sold by B-PACK, being 50-60 micron thick and incorporating an EVOH gas-barrier layer, a polystyrene (PS) layer, and a sealing outer layer of polyethylene (PE), exemplify multi-layer gas-barrier films that are most preferred.

[0036] Further examples of multi-layer gas-barrier films being particularly preferred are the multi-layer barrier films LID Cryovac, which are 25-micron thick and include an EVOH barrier layer as well as additional layers comprising polyethylene mixtures of varying densities and copolimers thereof.

[0037] In the package of the invention, an expanded polystyrene foil with substantially open cells is most preferred for the absorbent plastic material.

[0038] The basic weight of the polystyrene foil with substantially open cells is within the range of 150 to 450 g/m^2.

[0039] Preferably, at least one surfactant is incorporated to said polystyrene foil with substantially open cells. This can be done conventionally in the process of making said foil.

[0040] The surfactant allows the capability to absorb acqueous liquids by the open-cells thermoplastic material foil. It is by itself a polar additive that contributes to the conversion of the RF energy into heat, thereby aiding the fusion of the open-cells thermoplastic material, and through conduction, to the fusion of the materials of the other layers of the trays and possibly of the cover material as well, which are all involved in the RF sealing of the invention.

[0041] The surfactant may be selected among conventional anionic, cationic and non-ionic surfactants, and is preferably a salt of a sulphonic acid having formula $R\text{-}SO_3H$ or a sulphuric ester having formula $R\text{-}OSO_3H$, where R is selected from a group including alkyl and arylalkyl with an alkaline metal or an alkaline-earth metal.

[0042] A specially preferred surfactant for use with the invention is an aliphatic sulphonate sold by NOVACROME under the trademark HOSTASTAT SYSTEM E 3904®.

[0043] According to another preferred embodiment of the package of this invention, the tray includes an additional layer made of an unexpanded plastic material foil and/or an expanded closed-cells plastic material foil, said additional layer extending between said inward-facing layer formed of an absorbent plastic material foil and said outward-facing layer formed of a gas-barrier film.

[0044] Preferably, the unexpanded plastic material of said additional layer is polystyrene and/or HIPS (High Impact PolyStyrene) or a butadiene styrene copolymer, the expanded closed-cell plastics material being preferably polystyrene.

[0045] The package according to this invention has an advantage in that it will retain over time the atmosphere originally established inside it, since gases are prevented from diffusing outside , and it allows to preserve highly perishable food articles, e.g. based on beef, pork, chicken and fish meat, for several days without any appreciable losing y of their organoleptic and microbiological properties, and this while absorbing and hiding the exudate from view.

[0046] It should be noted that in the inventive package, all unrestricted diffusion of gases through the porous or cellular structure, and its cut surfaces in correspondence with the edge, is prevented by the gas-barrier structure of the thin layer including at least one region of compacted material, preferably interposed between two films of which at least one is a gas barrier formed along the perimetricperimetric portion of the RF-sealed package.

[0047] In addition, the gas-barrier film constituting the cover applied to the tray edge or RF sealed to said edge allows the package to be closed tight, thus preventing any gaseous exchange with the outside environment.

[0048] Furthermore, in the package of the invention, air can be removed from, the tray interior by virtue of the absorbent material porous nature , for example of the open cell structure of the expanded plastic material layer, and possibly replaced with the gaseous atmosphere of desired composition selected to suit the particular food article being packaged.

[0049] Moreover, the absorption of the liquids released by the food products is not carried out by interposing a cellulose insert between the product and the tray bottom, but by exploiting the properties of the absorbent plastics material layer, e.g. open-cells expanded polystyrene containing a surfactant.

[0050] In this way, no materials other than the plastic material of the tray, i.e. cellulose-based materials such as paper or cardboard, are needed, which facilitates the disposal or recycling operations of the packages after use.

[0051] In addition, the upper surface of the open-cell expanded thermoplastic material foil being perforated throughout, effectively provides for the liquids to be absorbed away, even when the tray is put at an inclination angle.

[0052] Preferred methods for making a tray according to this invention are set forth in Claims 24 to 33. Preferred methods for making a package according to this invention are set forth in Claims 34 to 37.

[0053] Ways of providing foils or sheets of absorbent thermoplastic materials are known from the relevant technical literature. For open cell expanded thermoplastic materials, refer to Klempner and Frisch "Handbook of Polymeric Foams and Foam Technology", Carl Hanser Verlag, 1991. Specific methods are disclosed in EP-A-0 090 507, US-A-3 610 509, EP-A-0 642 907 and EP 0 849 309, for example.

[0054] The bonding of the foil of absorbent thermoplastic material to the gas-barrier composite film (optionally with a foil of unexpanded material therebetween) and to the unexpanded foil may be carried out through heat-lamination, the use of adhesives or any another conventional method.

[0055] Most preferred is the bonding through heat-lamination. For example, in the case of an open-cells thermoplastic material, the foil of open-cells thermoplastic material obtained by ordinary annular or flat head extrusion techniques, with expanding gases injected, may initially have been heat-laminated to an unexpanded film or foil obtained by coextrusion or post-extrusion through a technique known as "extrusion coating", to provide a first composite sheet.

[0056] This first composite sheet is perforated on one side and laminated on the other side, either in-line or off-line, with a composite gas-barrier film to produce a second perforated composite sheet. This latter lamination is preferably carried out at a temperature in the range of 185°-210°C, whilst the open-cell thermoplastic material foil is laminated with an unexpanded film or foil at a preferred temperature of 160-180°C.

[0057] Alternatively, said first perforated composite sheet may be laminated, on its non-perforated side, with a foil of an unexpanded composite material such as polystyrene, and the resulting laminate be subjected to successive lamination with a composite gas-barrier film over the free surface of the unexpanded material foil, thereby obtaining a third perforated composite sheet.

[0058] The perforations or slots in the unexpanded film or foil and the open-cell thermoplastic material foil may be formed conventionally by means of perforating machines, for example. They are useful to allow the liquid released by the food product contained in the tray to pass into the foil of open-cell thermoplastic material.

[0059] The tray is molded conventionally, preferably through thermoforming of the second perforated composite sheet or the third perforated composite sheet in a specially provided die at a temperature in the range of 160°-220°C. In particular, the above thermoforming operations may be carried out sequentially in one die or several dies with conventional methods, e.g. by vacuuming, injecting compressed air, mechanical methods, etc.

[0060] The tray is sealed along a perimetricperimetric portion thereof, preferably an edge portion or the whole edge or a portion of the sidewalls by applying pressure and radio-frequency. In this process, the tray is first housed in a cavity of a suitable mould, then pressed against the portion to be sealed while in contact with a suitably shaped electrode which has been pre-heated at an appropriate temperature for sealing, and then exposed to RF energy. The right combination of electric field application time, energy and pressure will set the polar components (polymers and/or additives) into vibration, to generate and propagate heat through the thickness of the perimetricperimetric sealing portion of the tray, thus inducing fusion of the layers and substantial collapse of the absorbent structure of the thermoplastic material foil (e.g. an open-cells thermoplastic material) into a thin layer comprised of an essentially compact material or provided with at least a definite region of essentially compact material.

[0061] Preferably, during the RF sealing process of the invention, frequencies within the range of 1 to 300 MHz, preferably of 27,12 MHz, are applied for about 0.5-2 seconds, and the pressure applied to the sealed portion is of 10 to 1000 kg/cm^2, with the electrode being pre-heated at a temperature in the range of 30° to 90°C.

[0062] The package may be made by using known processes in the art, e.g. from US Patent No. 5,744,181.

[0063] In these known processes, a food product to be packaged is laid on the tray bottom after the RF sealing step, and the tray is sealed under a vacuum or protective atmosphere. Thereafter, a film of a gas-barrier-forming plastic material composite is bonded to the tray edge, preferably heat-sealed thereto.

[0064] In another embodiment, the RF sealing step may also affect the barrier film from which the tray cover is formed, the sealing being here carried out as part of the package-making process. In this way, production costs can be appreciably reduced and the package according to the invention completed in less time.

[0065] In this connection, a food product to be packaged is laid onto the tray bottom before of the perimetric RF sealing step, and the tray is sealed perimetricmetrically at the edge, under a vacuum or a protective atmosphere, with a gas-barrier film constituting the cover by a radio-frequency process.

[0066] The package of the invention may be a vacuum or a modified-atmosphere package. The modified atmosphere is achieved by vacuumizing, followed by an injection of inert gases such as nitrogen and carbon dioxide, or of oxygen-containing mixtures, as required for the type of food product that is being packaged for long-term preservation.

[0067] The features and advantages of the invention will become more clearly understood upon reading the following description of preferred embodiments of this package for food products, and of examples of packaging of food products that release liquids, the description and the examples being both illustrative and in no way limitative, and making reference to the accompanying drawings.

Brief Description of the Drawings

[0068] In the drawings:

Figure 1 is a perspective view of a package according to the invention;

Figure 2 is a sectional view of the package shown in Figure 1, taken along line II-II;

Figure 3 is an enlarged detail view of the tray shown in Figure 2;

Figure 4 is a sectional view of a package according to another embodiment of the invention;

Figure 5 is an enlarged detail view of the tray shown in Figure 2;

Figures 6 to 9 are fragmentary sectional views of a package according to another embodiment of the invention;

Figure 10 is a plot of the rate of change in composition of the modified atmosphere established inside a prior art package over time;

Figure 11 is a plot of the rate of change in composition of a modified atmosphere established inside a package according to the invention over time, where the tray has been RF sealed substantially all around its edge; and

Figures 12 and 13 are electronic micrographs at 100X enlargement of sections taken through the sealed regions of packages according to the invention.

Detailed Description

[0069] With reference to Figures 1 to 3, a package according to the invention is shown to include a tray 1 and a covering 2.

[0070] The tray 1 has a bottom 3 adapted to receive a food product 4 beforepackaging , and has sidewalls 5 ending in a jutting edge 6, the edge 6 having an end surface 6a.

[0071] The tray structure comprises a foil 7 of expanded polystyrene with substantially open cells, whose upper surface is covered with an unexpanded multi-layer film 8 (comprising a polystyrene layer and a sealing layer consisting of a mixture of polyethylene and an EVA copolimer) and whose lower surface is covered with a multi-layer film 9 incorporating a gas-barrier layer 9 of EVOH or Nylon.

[0072] The film 8 is formed with a plurality of holes 10 having a predetermined diameter and reaching down to a predetermined depth in the thickness of the underlying expanded polystyrene foil 7, thereby to allow liquid matter relased from the food product, in this case beef, pork, chicken cuttings, to enter into the substantially open cells of the foil 7 via said holes 10.

[0073] In particular, the open cells structure of the foil 7 has a thick network of canalized capillary ducts which intercommunicate the individual cells and allow the latter to receive and hold the liquid entered through said holes 10.

[0074] Thus, the liquid is trapped in a sponge-like fashion, and by virtue of the strong capillary effect of the canalizations on the liquid, the liquid is prevented from flowing back to the upper surface of the bottom 3 of the tray 1 through the holes 10, even when the tray is tilted or turned over.

[0075] This penetration of the liquid is also helped by the presence of a surfactant in the bulk of foil 7, the surfactant significantly reduces the water repellence of the plastic material, thereby enhancing the adhesive forces between the liquid and the solid (plastic material), to the point that the cohesive forces of the molecules in the liquid are overcome and the liquid can enter the substantially open-cells structure of the foil 7 through the holes 10.

[0076] In accordance with this invention, the package is sealed perimetricmetrically by an application of radio-frequency and pressure all around the edge 6 of the tray 1 before the covering 2 is attached. Therefore, the edge 6 will be in the form of a thin gas-barrier layer 11 having at least one region with a substantially compacted structure that extends all around the edge perimeter, the compact structure being the result of the materials of the foil 7 and the upper and lower films 8, 9 becoming fused under the heat generated by the vibratory motion of the molecules of the polar components exposed to the radio-frequency.

[0077] By providing said thin layer according to the invention, gases permeating through the open-cells porous structure of the tray 1 are prevented from diffusing outwards.

[0078] The cover 2 consists of a multi-layer barrier film, and is bonded to the tray by heat-sealing it to form a permanent bond to the material of the edge 6 of the tray 1.

[0079] This cover 2 is installed at the end of the packaging process, after a vacuum is drawn and/or the atmosphere inside the tray 1 containing the food product 4 is modified.

[0080] Figures 4 to 10 show further embodiments of the package according to the invention. Throughout these Figures, structural elements common or being functionally equivalent to elements of the package shown in Figures 1-3 carry the same reference numerals.

[0081] In particular, the package of the invention shown in Figures 4 and 5 differs from that shown in Figures 1-3 in that the tray 1 additionally includes a foil 7a of a closed-cells expanded plastic material, preferably polystyrene, disposed between the open-cell polystyrene foil 7 and the gas-barrier film 9. The edge 6 is in the form of a thin gas-barrier layer 12, wherein at least one region having a substantially compact structure extends all around the edge perimeter, this compact structure originating from the fusion of the materials that comprise the open-cells polystyrene foil 7, closed-cells expanded plastic foil 7a, and upper and lower films 8 and 9, under the heat generated by vibration of molecules in the polar components exposed to radio-frequency.

[0082] The package partially shown in Figure 6 differs from that shown in Figures 1-3 in that the radio-frequency sealing is performed along a perimetricperimeter portion 13 of the side walls 5 of tray 1. In this embodiment, it is formed along the perimetricperimeter portion 13 of sidewalls 5 is a thin gas-barrier layer 14 which includes at least one perimetric region having a substantially compact structure, this compact structure resulting from the fusion of the materials comprising the foil 7 and upper and lower films 8 and 9 induced by the heat generated by molecular vibration in the polar components exposed to radio-frequency.

[0083] Both packages partially shown in Figures 7 and 8 differ from that shown in Figures 1-3 in that the radio-frequency sealing is performed along a perimetricmeter portion of the of the tray edge 6 rather than all around the entire edge 6. In particular, on the package shown in Figure 7, RF sealing is performed perimetricperimetrically at an inner end portion of the edge 6 to form a thin gas-barrier layer 15, whereas on the package shown in Figure 8, the sealing is performed perimetricperimetrically along a substantially central portion of the edge 6 to form a thin gas-barrier layer 16.

[0084] In this case, the barrier film constituting the cover 2 bonded to the tray 1 by heat sealing is permanently bonded to the edge 6 in the correspondence with the upper film 8 of the tray, and optionally along the sealing portions as well (as shown in Figures 7 and 8).

[0085] The package partially shown in Figure 9 differs from that shown in Figures 1-3 in that the radio-frequency sealing performed along the edge 6 of tray 1 also affects a perimetricmetric portion of the gas-barrier film constituting the cover 2. In this embodiment, the edge 6 is a thin gas-barrier layer 18 which has at least one region with a substantially compact structure, this compact structure resulting from the fusion of the materials constituting the tray 1 (open-cell polystyrene foil 7, and upper and lower films 8 and 9), and of the barrier film constituting the cover 2, under the heat generated by the vibratory motion of the molecules of the polar components exposed to radio-frequency.

[0086] Additionally to the aforementioned advantages, the package of this invention has an advantage in that the liquid realized from the food products can be absorbed across the entire inner surface of the tray, by virtue of the latter featuring a structure wherein an intermediate absorbent layer comprises preferably a foil of a thermoplastic material with substantially open cells.

Example 1

[0087] Using a procedure as described in the application EP 0849309, a specially prepared mixture was extruded to provide an expanded polystyrene foil having substantially open cells (above 80%), weight (grams for square meter) of 350 g/m^2, thickness of 4.5 mm, and density of 60 g/l.

[0088] The above foil was immediately transferred to a heat-laminating station, where a film of opacified unexpanded material composed of two layers, namely, a polystyrene layer and a sealing layer formed of a mixture of polyethylene and an EVA copolymer, and being 50-micron thick, was bonded to a bonding surface of the foil by laminating at a temperature of 160°C. In particular, the bonding step by heat-lamination was carried out with the sealing layer facing the bonding surface of the open-cell expanded polystyrene foil. The resulting composite sheet was perforated across the free surface of the unexpanded film using a set of metal needles, down part of the thickness of the open-cells expanded polystyrene foil.

[0089] A white-opacified multi-layer barrier film, of the PE//EVOH//PS type manufactured by B-Pack and being 60-micron thick, was then bonded to the free surface of the foil to produce a perforated expanded composite sheet. The last-mentioned laminating step was carried out at a temperature of 170°C and a feed rate of 15 m/min.

[0090] Finally, the perforated expanded composite sheet was transferred to a hot molding machine, where it was pre-heated at a mean temperature of 200°C for subsequent transfer into the thermoforming mold whence a semi-finished tray wasobtained.

[0091] The semi-finished tray was taken to an RF edge sealing arrangement, which included a lower die having an insulative dielectric foil of Mylar where the tray was correctly positioned on its inside, and an upper die formed of a brass electrode that was maintained at a temperature of 60°C and having a suitable geometry for edge sealing. The RF edge sealing step was then carried out using a pressure of 55 kg/cm^2, as measured at the tray edge, and radio-frequency at 27,12 MHz applied to the edge of the semi-finished tray for 2 seconds, whereafter the tray blank edge was allowed to cool for 3 seconds. The sealing operation was performed at 5 cycles/min, and the edge thickness showed to have shrunk down to 300 microns upon after sealing.

[0092] The resulting edge-sealed tray was then shaken out and transferred to a packaging machine which is equipped with a chamber, the chamber being provided with a suitable die and apertured for drawing air out and/or letting a gas mixture in.

[0093] After laying the food product to be packaged inside the tray, the tray was placed in said chamber along with a coverheld over it. The coverconsisted of a multi-layer barrier film of the PET/EVOH/PE type with a thickness of 45 microns.

[0094] The chamber was then closed and its internal air drawn out by the application of a reduced pressure of 1-4 millibars. A gas mixture comprising 70% oxygen and 30% carbon dioxide was then injected into the chamber.

[0095] On completion of the step of injecting said gas into the chamber, the cover was heat sealed to the tray edge to produce a package according to the invention.

[0096] The gas permeability properties of the tray of the package according to the invention were evaluated by monitoring the behavior over time of the gaseous composition originally introduced into the package. These properties have also been compared with those of a tray of a conventional gas-barrier absorbent package.

[0097] In particular, the conventional package comprised a tray having a porous structure directed to absorb liquids, and a covering made of a gas-barrier film. In particular, the tray structure included an open-cell expanded polystyrene layer bonded at the top and the bottom to corresponding inner and outer gas-barrier films. In addition, the tray was sealed perimetricmetrically of its bottom by a combination of pressure and ultrasonics to form a fluid-tight space, between the outer and inner gas-barrier films, adapted to absorb and hold liquids released from the food products. Each barrier film of this prior art package was a multi-layer barrier film of the PE//EVOH//PStype. The conventional package was injected with the same gas composition as was used with the package according to the invention.

[0098] The gas composition was measured at predetermined time intervals on each package by means of an oxygen and carbon dioxide percent meter of the Check Mate 9900 Dansensor model type.

[0099] The results are, for the conventional package tray, shown in Table 1 below and illustrated by the graph of Figure 10, the results for the package tray of this invention being shown in Table 2 below and illustrated by the graph of Figure 11.

Table 1

Gas permeability of conventional package tray		
Time(days)	O_2(%)	CO_2(%)
0	66.3	28.7
1	55.3	22.1
3	49.5	19.2
5	35.2	12.7
7	30.8	8.6
10	27.3	6.4

Table 2

Gas permeability of the package tray according to the invention		
Time(days)	O_2(%)	CO_2(%)
0	65.8	30.8
1	63.1	26.2
3	63.0	26.5
5	62.9	26.1
7	64.5	25.1
10	63.6	24.9

[0100] It can be seen from the Tables above that both packages typically show a first change in the mixture composition after the first few hours from packaging, which is due to the mixture being diluted by residual air in the open-cells porous structure. Subsequently, the composition of the atmosphere inside the package according to the invention advantageously remains unaltered over time, to confirm the effectiveness of the edge sealing operation in the trayaccording to the invention.

[0101] By contrast, the conventional package shows a progressive alteration and loss of the gas atmosphere originally established on its interior, so suggesting the occurrence of a near-constant effusion of gases from the interior of the porous tray structure to the outside, despite of the presence of the perimetric sealing on the tray bottom.

[0102] Figure 12 shows an electronic micrograph enlarged at 100X of a section of the tray edge in the above package of the invention. It can be seen that the edge structure forms a continuous of compact material into which the original open-cells structure shows to have substantially collapsed. Accordingly, gases diffusing into the porous structure of the tray meet a compact structure along the edge that will stop them from passing to the tray outside.

[0103] Figure 13 shows an electronic micrograph enlarged at 100X of a section of the tray edge in another package of the invention. It can be seen in this section of the edge that the structure includes two regions A and B between the inner and outer films which are constituted by closed cells, and a core region C intermediate said regions A and B, which is formed of compact material. Surprisingly, also the closed cells of regions A and B are impermeable to gas diffusion, as the gas permeability properties of the tray in this package are fully comparable with those reported in Table 2 and Figure 11. This shows that a partially-fusion of the open-cells structure (in this example, its core region) can be adequate to produce the desired gas-barrier effect to the diffusion of the gas outside the trayand the retaining of the modified atmosphere therein.

Example 2

[0104] A semi-finished tray has been provided using the same procedure as in Example 1. The semi-finished tray was transferred to a packaging machine whose chamber is equipped with a lower die, in which the semi-finished tray was correctly positioned in it, lower die being provided with an insulative dielectric foil of Mylar, an upper die, consisting of a brass electrode pre-heated at a temperature of 50°C and having a suitable geometry to permit sealing of the tray edge, and ports for drawing air out and/or letting a gas mixture in.

[0105] After laying the food product to be packaged inside said semi-finished tray, the semi-finished tray was transferred into said chamber along with a cover held over it. The cover consisted of a multi-layer barrier film of the PET/EVOH/PE type with a thickness of 45 microns.

[0106] The chamber was then closed and its internal air drawn out by the application of a reduced pressure of 1-4 millibars. Thereafter, a gas mixture comprising 70% oxygen and 30% carbon dioxide was injected into the chamber.

[0107] Upon completion of the step of injecting said gas into the chamber, said covering was RF sealed to the tray edge obtaining a package according to the invention.

[0108] In particular, the RF sealing process for the tray edge and the coverwas carried out under a pressure of 55 kg/cm^2, as measured at the sealing edge, such that the edge of the tray and the film of the cover over the edge were held and pressed together, while radio-frequency energy was delivered at 27.12 MHz for 2 seconds, whereafter the package of the invention was allowed to cool for 3 seconds. The sealing operation was performed at 7 cycles/min, and the combined thickness of the tray edge and the covering showed to have been shrunk down to 320 microns after sealing.

[0109] A package of this invention, constructed as above, has excellent retention capabilities in the respect of the modified atmosphere originally established therein, such capabilities being fully comparable with those of the package according to the invention discussed in Example 1.

Claims

1. A vacuumized or modified atmosphere package for food products susceptible to release fluids, the package comprising:

a tray made of plasticmaterial including a bottom and side walls ending in an edge, the tray having at least two layers of which a inward-facing layer comprises a foil of a plastic material effective to absorb fluids released from said food products and having slits or holes on at least part of its upper surface, and a outward-facing layer is of a plastic material film with gas-barrier properties;
a food product susceptible to release fluids placed onto the bottom of said tray;
a cover for said tray consisting of a gas-barrier film of a plastic material which adheres onto the tray edge so as to maintain a vacuum or protective atmosphere inside the package;
said package being **characterized in that** at least one of the tray layers comprises at least one polar component, and **in that** a perimetricperimetric portion of said tray is sealed through the application of pressure and radio-frequency such that the individual layers are at least partly fused in correspondence with said perimetricmetric portion and the absorbent structure caused to collapse substantially into a thin gas-barrier layer having at least an intermediate region of an essentially compacted material.

2. A vacuumized or modified atmosphere package for food products susceptible to release fluids, the package comprising:

a tray made of plastic material including a bottom and side walls ending in an edge, the tray comprising at least two layers of which a inward-facing layer comprises a foil of plastic material effective to absorb fluids released from the food products and having slots or holes on at least part of its upper surface, and a outward-facing layer is made of a plasticmaterial film with gas-barrier properties;
a food product susceptible to release fluids placed onto the bottom of said tray;
a cover for said tray h consisting of a gas-barrier film of plasticmaterial sealed to at least a perimetricperimetric portion of the tray edge so as to maintain a vacuum or protective atmosphere inside the package;
said package being **characterized in that** at least one of the tray layers and/or said cover comprises a polar component, and **in that** said cover is sealed to at least a perimetricperimetric portion of said tray edge through application of pressure and radio-frequency so that the individual layers of the tray and the covering are at least

partly fused to at least a perimetric edge portion and the absorbent structure is caused to collapse substantially into a thin gas-barrier layer having at least an intermediate region of an essentially compacted material.

3. A package according to either Claim 1 or 2, **characterized in that** the thickness of said thin gas-barrier layer is 100 to 1500 microns, preferably 300 to 600 microns.

4. A package according to either Claim 1 or 3, **characterized in that** said perimetricperimetric portion of the tray, in which the sealing is performed by application of radio-frequency and pressure, is constituted by at least one edge portion, preferably the whole tray edge, or a portion of the side walls.

5. A package according to either Claim 2 or 3, **characterized in that** said at least one perimetricperimetric portion of the tray edge in which sealing with a coveris performed by application of radio-frequency and pressure, is constituted by the whole tray edge.

6. A package according to any of the preceding claims, **characterized in that** said polar component is selected from a group including ethylene vinyl alcohol (EVOH), ethylene vinyl acetate (EVA), EVA and EVOH polymers and copolymers, surfactants, EMA, EBA, and EEA.

7. A package according to any of the preceding claims, wherein said plasticmaterial with absorbing properties for fluids is selected from a group including expanded thermoplastic materials, in particular polystyrene, polypropylene, polyethylene, woven or non-woven fibers, plastic fluff materials, and polymers of renovable nature or biodegradable polymers.

8. A package according to Claim 7, wherein said plastic material with absorbing properties for fluids is polystyrene with substantially open cells.

9. A package according to any of the preceding claims, wherein said inward-facing layer incorporates at least one surfactant.

10. A package according to any of the preceding claims, further comprising a layer, overlying said inward facing layer of the tray and being constituted by a film or unexpanded foil of either a single-component or a composite plastic material or a composite film with gas-barrier properties having slots or holes at least across said bottom.

11. A package according to Claim 10, wherein said film or unexpanded foil or composite film with gas-barrier properties, forming the layer overlying the inward-facing layer, ismade opaque.

12. A package according to either Claim 10 or 11, wherein the film or expanded foil may be composite or non-composite, and the plastic material of said film or unexpanded foil is selected from a group including polystyrene, polyethylene (PE), polypropylene (PP), metallocenes, low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE), EVA, EVA polymers and copolymers, metallocenes, and combinations thereof.

13. A package according to any of the preceding claims, wherein said composite gas-barrier films are each constituted by a multi-layer film comprising at least one gas-barrier layer of a plasticmaterial and at least one layer of a thermoplastic material.

14. A package according to Claim 13, wherein the plastic material of said gas-barrier layer is selected from a group including polymers and copolymers of ethylene vinyl alcohol (EVOH), Nylon, polyvinylidene chloride (PVDC), poly- or copolyamides, and combinations thereof.

15. A package according to Claim 14, wherein said plastics material is a polymer or copolymer of ethylene vinyl alcohol, or is Nylon.

16. A package according to any of preceding Claims 13 to 15, wherein said composite gas-barrier films are formed from the same plastic material.

17. A package according to any of the preceding claims, wherein said tray comprises an additional layer consisting of a foil of unexpanded plastic material and/or a foil of closed-cells expanded plastic material, said additional layer being placed between said inward-facing layer constituted by a foil of absorbent plastic material and said outward-facing layer constituted by a gas-barrier film.

18. A package according to Claim 17, wherein said expanded plastic material is polystyrene.

19. A tray for use with the package for food products according to any of Claims 1, 3, 4 and 6 to 18, the tray having a bottom and side walls ending in an edge and comprising at least two layers of which an inward-facing layer comprises a plastic material foil with a capability to absorb fluids released by said food products, having holes or slots on at least part of its upper surface, and an outward-facing layer constituted by a plastic material film with gas-barrier properties; **characterized in that** at least one of said tray layers incorporates at least one polar component, and that a perimetric portion of said tray is sealed by application of radio-frequency and pressure such that the individual layers are at least partly fused to said perimetric portion and the absorbent structure is caused to collapse into a thin gas-barrier layer having at least one intermediate region formed of an essentially compacted material.

20. A tray according to Claim 19, **characterized in that** the thickness of said thin gas-barrier layer is in the range of 100 to 1500 microns, preferably 300 to 600 microns.

21. A tray according to Claim 19 or 20, **characterized in that** said perimetric portion of the tray where the sealing is performed by applying radio-frequency and pressure is constituted by at least one edge portion, preferably the whole edge or a portion of the side walls.

22. A tray according to any Claims 19 to 21, further comprising a layer arranged on said inward facing layer and constituted by a film or unexpanded foil of either a single-component or a composite plastics material or a composite film with gas-barrier properties, having holes or slots at least in correspondence with said bottom.

23. A tray according to any Claims 19 to 22, comprising an additional layer constituted by a foil of unexpanded plastic material and/or a foil of closed-cell expanded plastic material, said additional layer extended between said inward-facing layer constituted by a foil of absorbent plastic material and said outward-facing layer constituted by a gas-barrier film.

24. A method of making a tray according to any claims 19 to 21, comprising the following steps:

providing a perforated composite sheet comprising a foil of an absorbent plastics material bonded on one surface to a composite gas-barrier film, said foil of absorbent plastic material having holes or slots extending from its non-bonding surface down at least part of its thickness;
forming the perforated composite foil into a semi-finished tray having a bottom and side walls ending in a jutting edge, said composite gas-barrier film defining the lower layer of said semi-finished tray;
sealing a perimetric portion of said semi-finished tray by applying of radio-frequency and pressure for a predetermined time, thereby forming, along said perimetric portion, a thin gas-barrier layer having at least one intermediate region of an essentially compact material, and obtaining said tray.

25. A method of making a tray of plastic material according to Claim 22, comprising the steps of;

providing a perforated composite sheet having a foil of an absorbent plastics material bonded on one surface to a film or foil of an unexpanded plastic material and on the opposite surface to a composite gas-barrier film, said unexpanded film or foil being having holes or slots extending for at least part of the thickness of the underlying foil of absorbent plastic material;
forming the perforated composite foil into a semi-finished tray having a bottom and side walls ending in a jutting edge and wherein said composite gas-barrier film defines the lower layer of said tray;
sealing a perimetric portion of said semi-finished tray by applying radio-frequency and pressure for a predetermined time, so as to obtain, along said perimetric portion, a thin gas-barrier layer having at least one intermediate region of an essentially compact material, and obtaining said tray.

26. A method of making a tray of plastic material according to Claim 23, comprising the steps of:

providing a perforated composite sheet having a foil of an absorbent plastic material bonded on its opposed surfaces to a first film or foil of an unexpanded plastic material and to a second foil of unexpanded plastic material and/or a foil of a closed-cell expanded plastic material, respectively, and a composite gas-barrier film bonded to said second foil of unexpanded plastic material and/or a foil of closed-cell expanded plastic material,

said first unexpanded film or foil being having holes or slots extending down at least part of the thickness of the underlying foil of absorbent plastic material;
forming the perforated composite foil into a semi-finished tray having a bottom and side walls ending in a jutting edge and wherein said composite gas-barrier film defines the lower layer of said semi-finished tray;
sealing a perimetric portion of said semi-finished tray by applying radio-frequency and pressure for a predetermined time, so as to obtain, along said perimetric portion, a thin gas-barrier layer having at least one intermediate region of an essentially compact material, obtaining said tray.

27. A method according to any Claims 24 to 26, wherein, during the sealing step, the radio-frequency is comprised within the range 1 to 300 MHz, preferably 27.12 MHz, the pressure is comprised between 10 and 1000 kg/cm^2 measured on the sealing edge and the pressure and radio-frequency are applied for a duration of 0.5 to 2 seconds.

28. A method according to Claim 27, wherein the application of the pressure and radio-frequency during the sealing step is performed by placing said semi-finished tray in a die constituting a lower electrode, by pressing said perimetric portion between said lower electrode and an upper electrode having a predetermined shape and being pre-heated at a temperature of 30° to 90°C, and by applying a radio-frequency across said electrodes.

29. A method according to any Claims 24 to 28, wherein said perimetric portion constituted by at least one edge portion, preferably the whole edge of said semi-finished tray or a portion of the side walls of said semi-finished tray.

30. A method according to any Claims 24 to 27, wherein said foil of absorbent plastic material is constituted by a foil of expanded polystyrene with substantially open cells optionally incorporating at least one surfactant.

31. A method according to Claim 24, wherein said perforated composite sheet is obtained through the following steps:

providing a sheet of an absorbent plastic material;
bonding, preferably through heat-lamination, a composite film with gas-barrier properties to a surface of said foil of absorbent plastic material;
making a series of holes or slots in said foil of absorbent plastic material across at least part of its non-bonded surface, said holes or slots extending down at least part of the thickness of said foil of expanded thermoplastic material, obtaining said perforated composite sheet.

32. A method according to Claim 25, wherein said perforated composite sheet is obtained through the following steps:

providing a sheet of an absorbent plastic material;
bonding, preferably through heat-lamination, a film or foil of an unexpanded plastic material on a surface of said foil of expanded thermoplastic material, obtaining a semi-finished composite foil;
making a series of holes or slots in the semi-finished composite foil blank at least part of the non-bonded surface of said unexpanded film or foil, said holes extending down at least part of the thickness of said foil of absorbent plastic material, obtaining a perforated composite semi-finished sheet;
bonding, preferably through heat-lamination, a composite film of a plastic material with gas-barrier properties on the free surface of said foil of absorbent plastic material, obtaining said perforated composite sheet.

33. A method according to Claim 26, wherein said perforated composite sheet is prepared through the steps of:

providing a sheet of an absorbent plastic material;
bonding, preferably through heat lamination process, a first film or foil of an unexpanded plastics material on a surface of said foil of expanded thermoplastic material, obtaining a composite sheet blank;
making holes or slots in the semi-finished sheet across at least part of the non-bonded surface of said unexpanded film or foil, said holes extending down at least part of the thickness of said foil of absorbent plastic material, obtaining a first perforated composite semi-finished sheet;
bonding, preferably through heat-lamination, a second film or foil of an unexpanded plastic material and/or a foil of a closed-cell expanded plastic material on the first semi-finished perforated composite sheet across the free surface of said foil of absorbent plastics material, obtaining a second perforated composite semi-finished sheet;
bonding, preferably through heat-lamination, a composite film of a plastic material with gas-barrier properties on the second perforated composite semi-finished sheet across the free surface of said second foil of unexpanded plastics material and/or said foil of closed-cell expanded plastics material, obtaining said perforated composite

sheet.

34. A method of making a package for preserving food products suceptible to release fluids under a vacuum or protective atmosphere, comprising the steps of:

providing a tray according to any Claims 19 to 24;
laying the food product to be packaged onto the bottom of said tray;
sealing the tray containing the food product under a vacuum or protective atmosphere by bonding a cover constituted by a gas-barrier composite film of a plastic material on the edge of the tray, preferably through heat-sealing.

35. A method of making a package for preserving food products suceptible to release fluids under a vacuum or protective atmosphere, comprising the steps of:

providing a perforated composite sheet having a foil of absorbent plastic material bonded on one of its surfaces to a composite film with gas-barrier properties, said foil of absorbent plastic material having holes or slots extending from its non-bonded surface at least partly down its thickness;
forming the perforated composite sheet into a tray having a bottom and side walls ending in a jutting edge, wherein said composite gas-barrier film defines the lower layer of said tray;
laying the food product to be packaged onto the bottom of said tray;
sealing the tray containing the food product under a vacuum or protective atmosphere by placing a cover constituted by a gas-barrier composite film of a plastic material onto said tray and by applying pressure and radio-frequency onto at least one perimetric portion of the tray edge and the gas-barrier film of the covering overlying said at least one perimetric portion of the tray edge, so as to obtain a thin gas-barrier layer having at least one intermediate region of an essentially compact material.

36. A method of making a package for preserving food products suceptible to release fluids, under a vacuum or protective atmosphere, comprising the steps of:

providing a perforated composite sheet having a foil of absorbent plastic material bonded on one of its surfaces to a film or foil of unexpanded plastic material, and on the other surface to a composite film having gas-barrier properties, said unexpanded film or foil being having holes or slots extending down at least part of the thickness of the absorbent plastic foil thereunder;
forming the perforated composite sheet into a tray having a bottom and side walls ending in a jutting edge, wherein said composite gas-barrier film defines the lower layer of said tray;
laying the food product to be packaged onto the bottom of said tray;
sealing the tray containing the food product under a vacuum or modified atmosphere by placing a cover constituted by a composite plastic film with gas-barrier properties onto said tray and by applying a pressure and radio-frequency to at least one perimetric portion of the tray edge and to the gas-barrier film of the cover overlying said at least one perimetric portion of the tray edge, so as to obtain a thin gas-barrier layer having at least one intermediate region of an essentially compact material.

37. A method of making a package for preserving food products suceptible to release fluids, under a vacuum or protective atmosphere, comprising the steps of:

providing a perforated composite sheet having a foil of absorbent plastic material bonded on its opposed surfaces to a first film or foil of an unexpanded plastic material as well as to a second foil of unexpanded plastic material and/or a foil of a closed-cell expanded plastic material, respectively, and a composite film with gas-barrier properties bonded to said unexpanded plastic film or foil, said first unexpanded film or foil having holes or slots extending down at least part of the thickness of the foil of absorbent plastic material thereunder;
forming the perforated composite sheet into a tray having a bottom and side walls that end in a jutting edge, wherein said composite gas-barrier film defines the lower layer of said tray;
laying the food product to be packaged onto the bottom of said tray;
sealing the tray containing the food product under a vacuum or modified atmosphere by placing a cover formed from a composite gas-barrier film of plastic material over said tray and by applying pressure and radio-frequency to at least one perimetric portion of the tray edge and to the gas-barrier film of the cover overlying said at least one perimetric portion of the tray edge, so as to obtain a thin gas-barrier layer having at least one intermediate region of an essentially compact material.

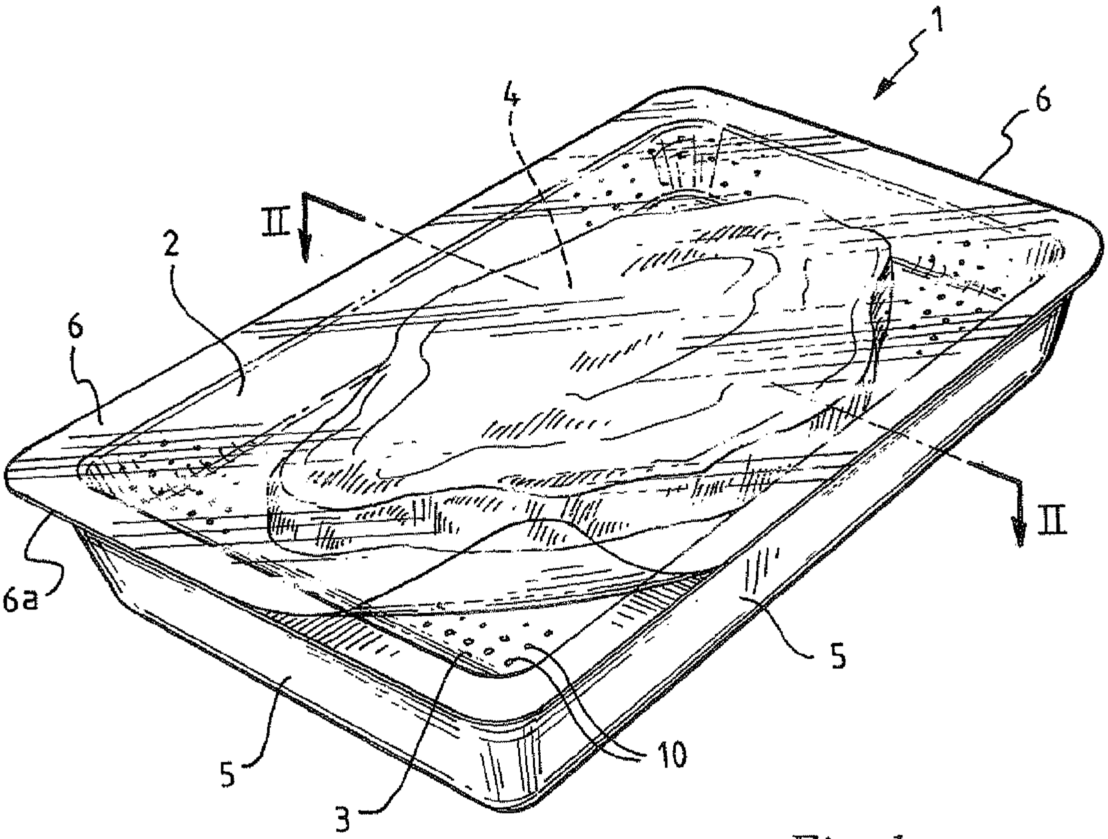


Fig. 1

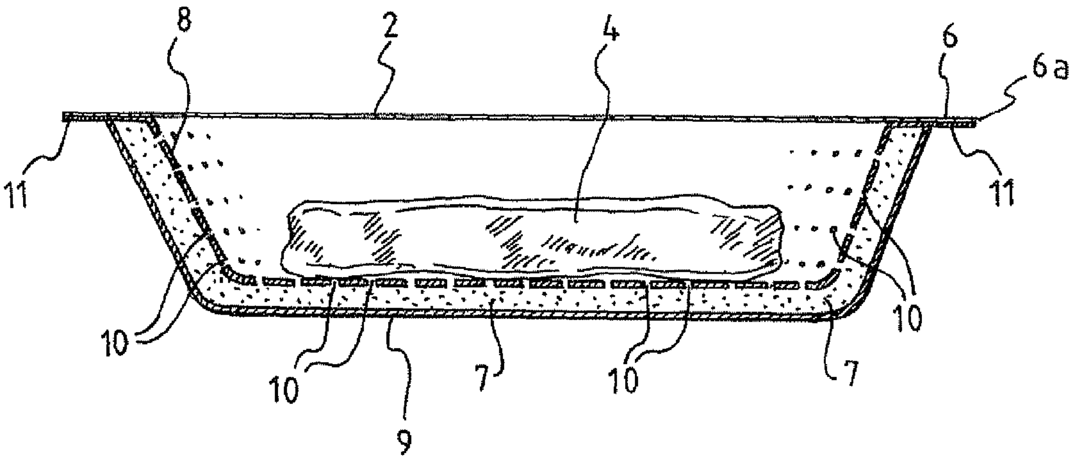


Fig. 2

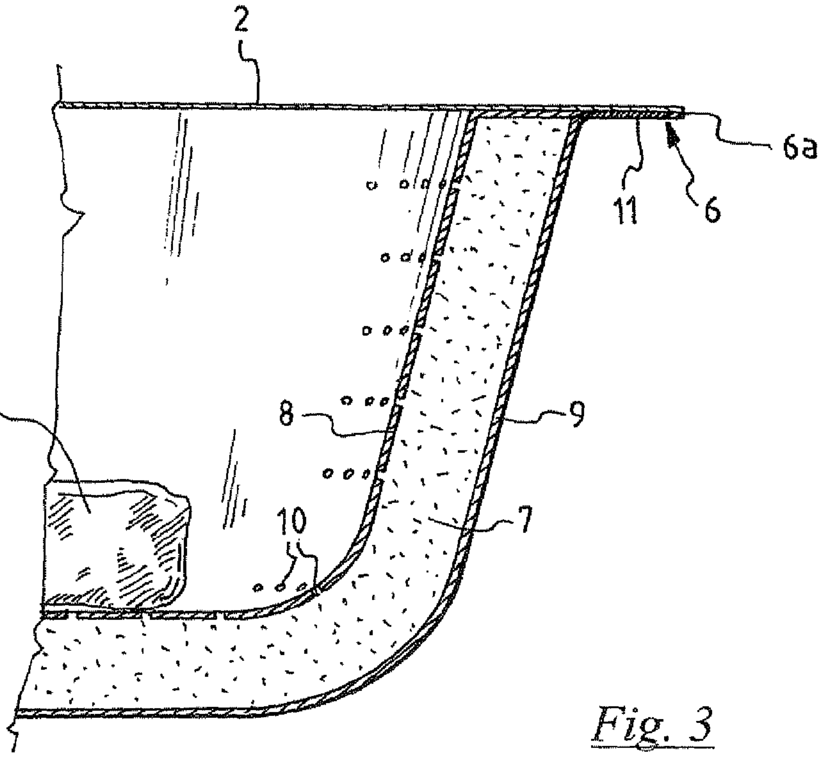


Fig. 3

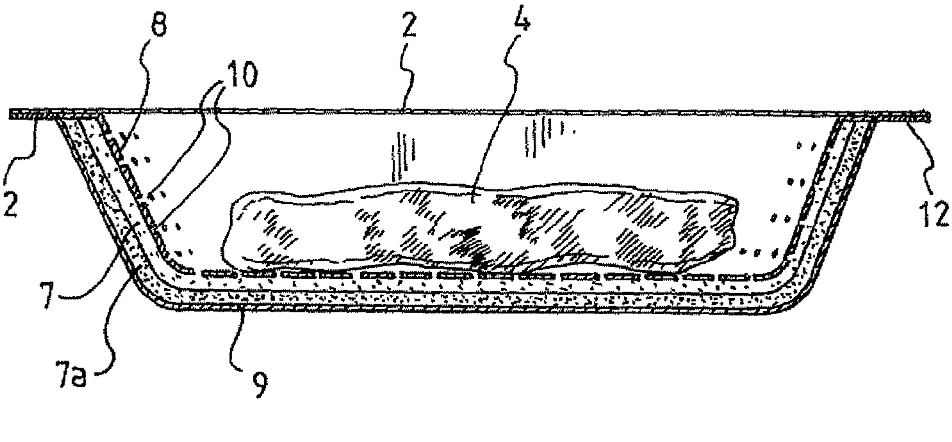


Fig. 4

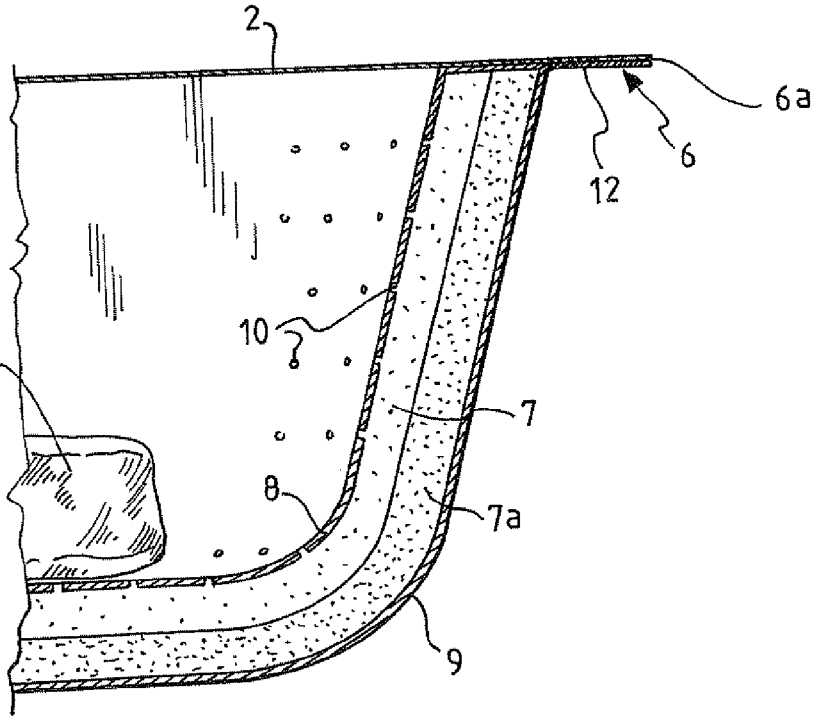


Fig. 5

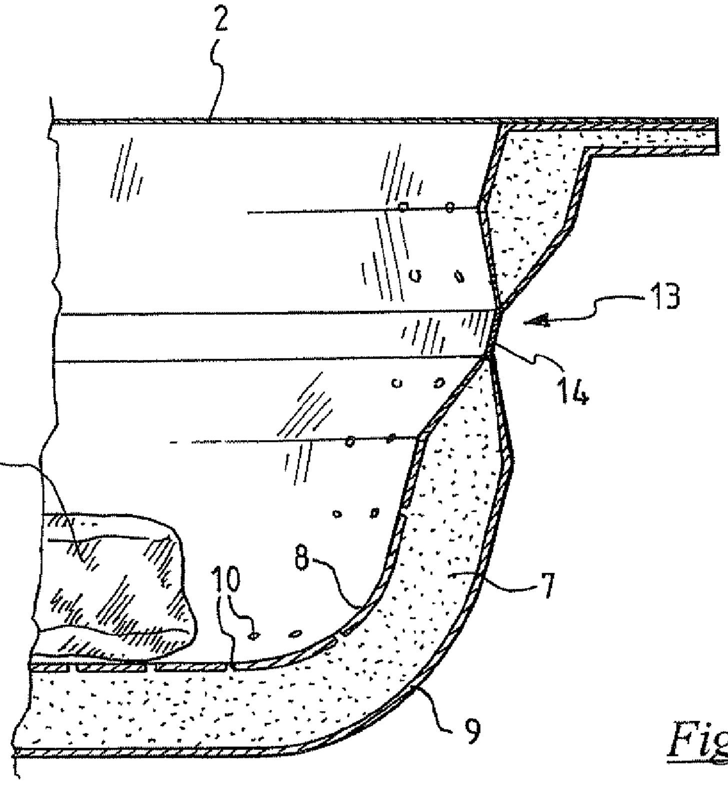


Fig. 6

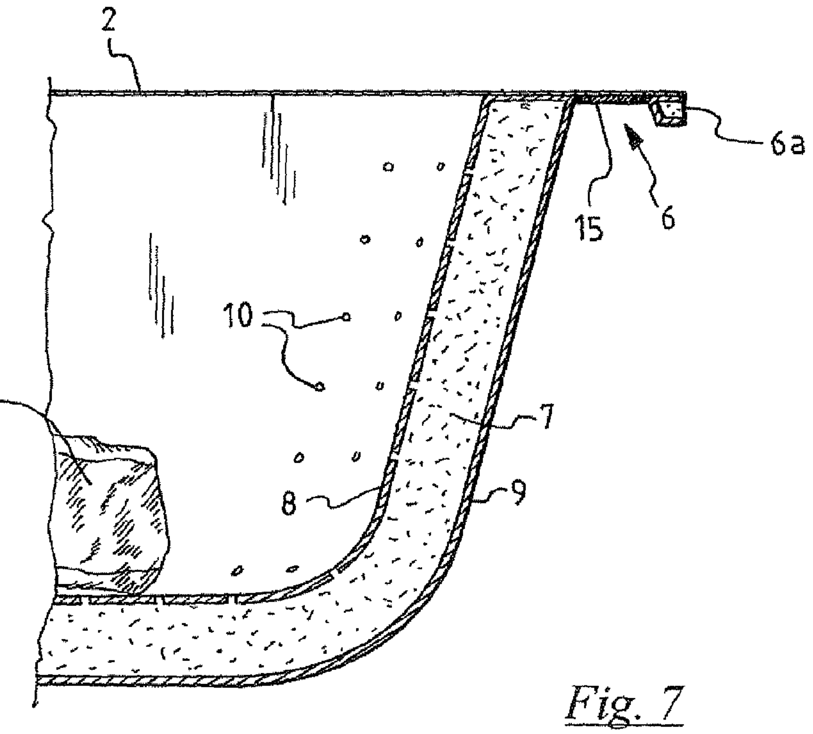


Fig. 7

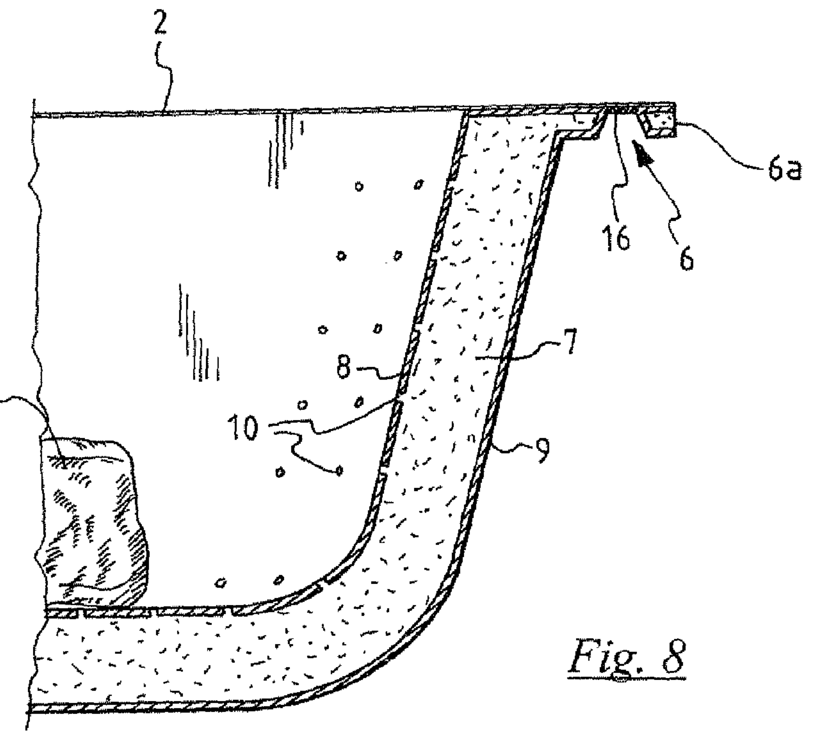


Fig. 8

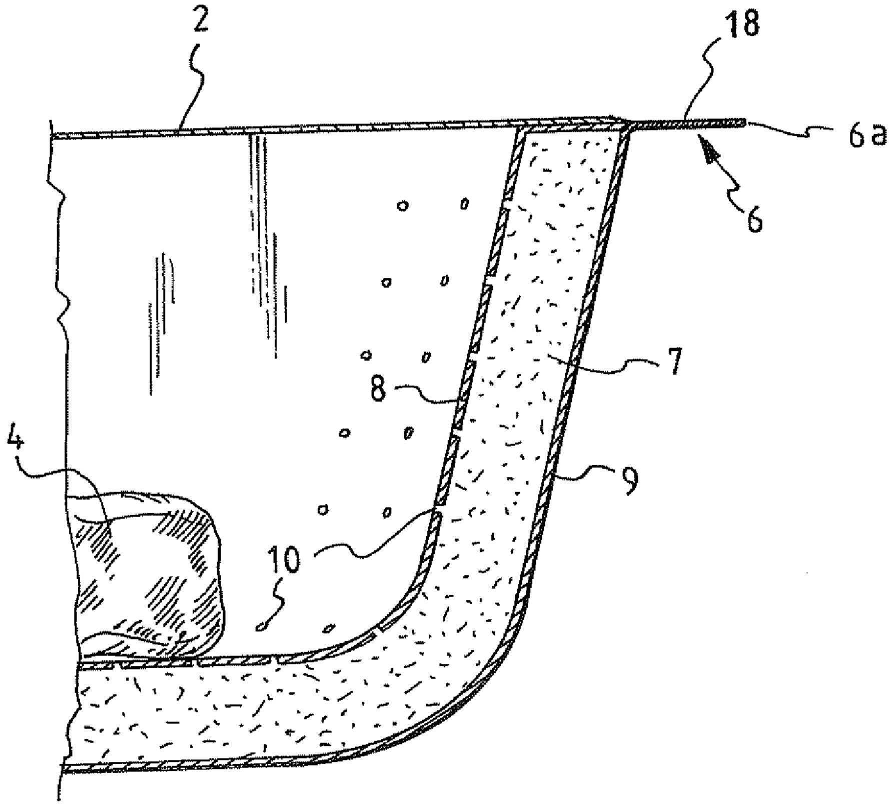


Fig. 9

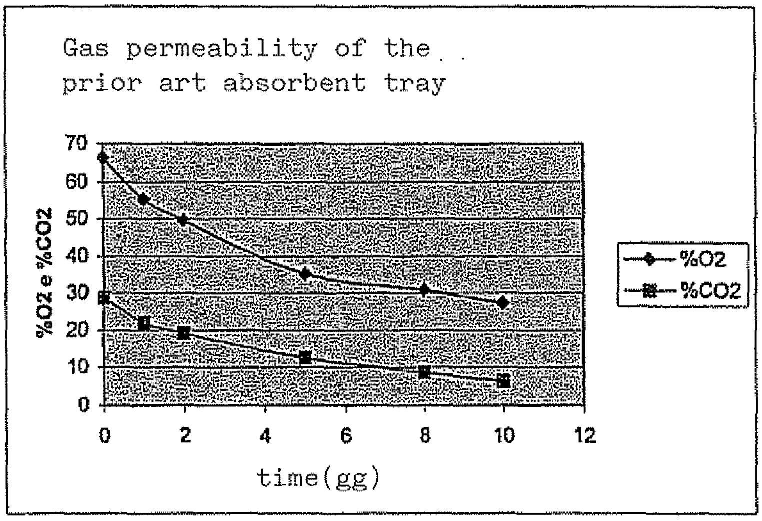

Gas permeability of the
prior art absorbent tray
70
60
50
40
30
20
10
0
%O2 e %CO2
0
2
4
6
8
10
12
time(gg)
%O2
%CO2

Fig. 10

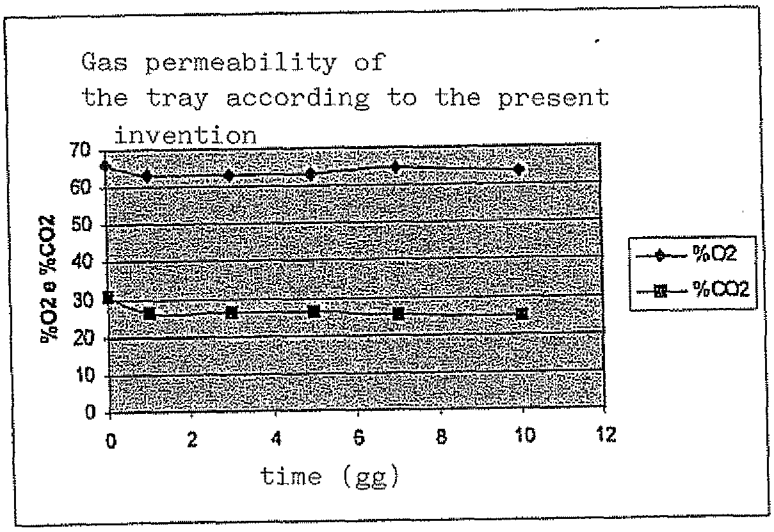
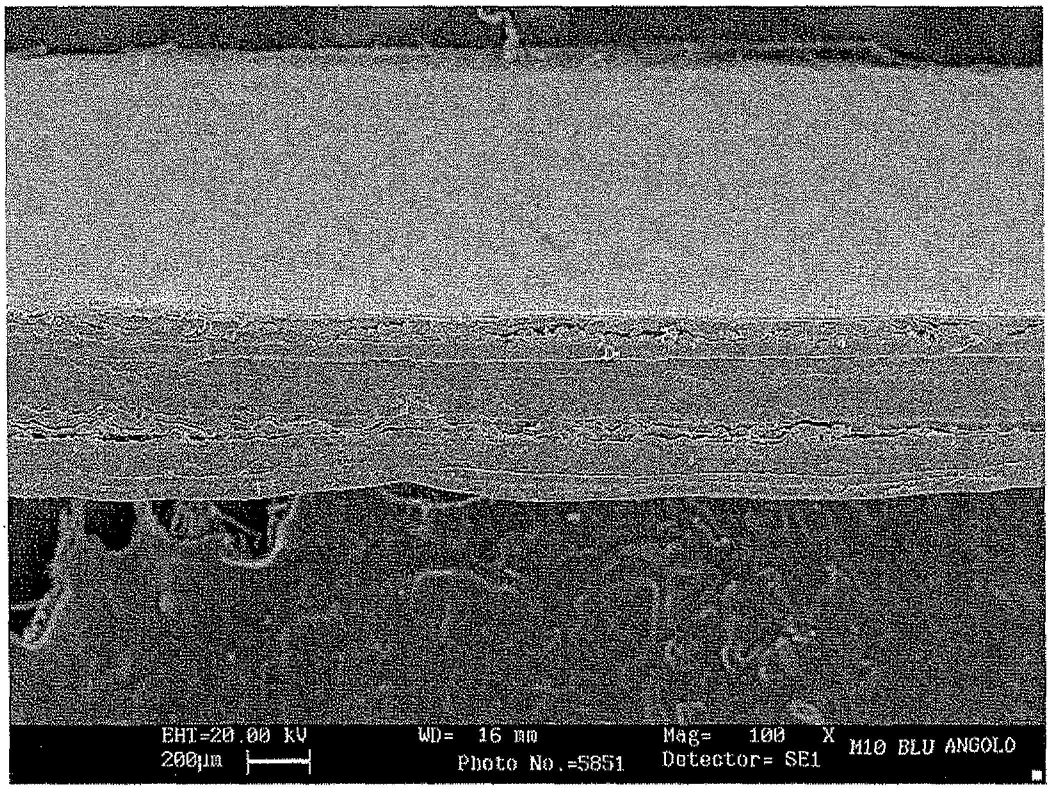

Gas permeability of
the tray according to the present
invention
70
60
50
40
30
20
10
0
%O2 e %CO2
0
2
4
6
8
10
12
time (gg)
%O2
%CO2

Fig. 11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200μm
WD= 16 mm
Photo No.=5851
Mag= 100 X
Detector= SE1
M10 BLU ANGOLO

Fig. 12

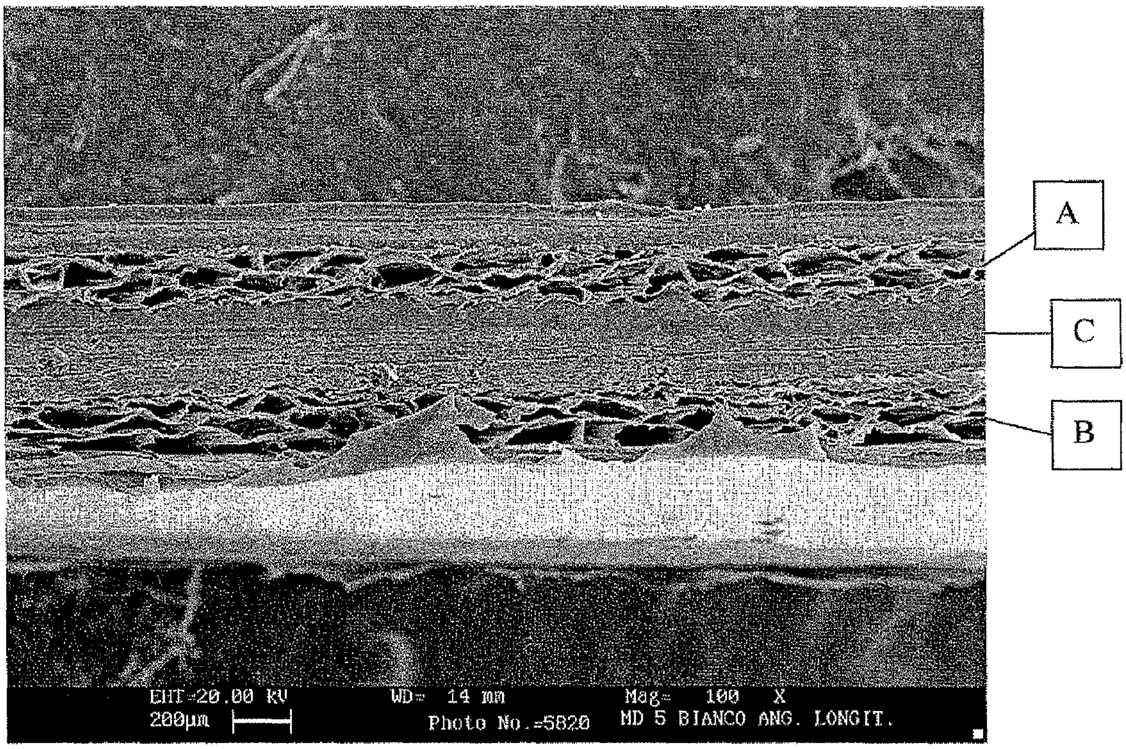
A
C
B
EHT=20.00 kV
WD= 14 mm
Mag= 100 X
200µm
Photo No.=5820
MD 5 BIANCO ANG. LONGIT.

Fig. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5887

DOCUMENTS CONSIDERED TO BE RELEVANT

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X : particularly relevant if taken alone
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