



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <b>(21) International Application Number:</b> PCT/SE99/00854<br><b>(22) International Filing Date:</b> 19 May 1999 (19.05.99)<br><br><b>(30) Priority Data:</b><br>9801922-7                      29 May 1998 (29.05.98)                      SE<br><br><b>(71) Applicant (for all designated States except US):</b> TETRA<br>LAVAL HOLDINGS & FINANCE S.A. [CH/CH]; Avenue<br>Général-Guisan 70, CH-1009 Pully (CH).<br><br><b>(72) Inventors; and</b><br><b>(75) Inventors/Applicants (for US only):</b> DUVANDER, Patrik<br>[SE/SE]; Magnus Stenbocksgatan 4, S-222 24 Lund (SE).<br>POSTOACA, Ion [SE/SE]; Montelinvägen 19, S-237 35<br>Bjärred (SE).<br><br><b>(74) Agent:</b> SUNDELL, Håkan; AB Tetra Pak, Patent Dept., Ruben<br>Rausing's gata, S-221 86 Lund (SE).                                                                                                                                                                                                                                                                                                                                                                                                   |           | <b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG,<br>BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB,<br>GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG,<br>KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK,<br>MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI,<br>SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA,<br>ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ,<br>UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD,<br>RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK,<br>ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI<br>patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR,<br>NE, SN, TD, TG).<br><br><b>Published</b><br><i>With international search report.</i><br><i>Before the expiration of the time limit for amending the</i><br><i>claims and to be republished in the event of the receipt of</i><br><i>amendments.</i> |
| <b>(54) Title:</b> A METHOD OF PRODUCING A WELL-INTEGRATED PACKAGING LAMINATE, AS WELL AS PACKAGING<br>CONTAINERS PRODUCED FROM THE PACKAGING LAMINATE<br><br><b>(57) Abstract</b><br><p>The disclosure relates to a method of producing a well-integrated packaging laminate (10) comprising adjacent layers (13, 14, 15) of mutually incompatible plastics. The plastic layers (13, 14, 15) are extruded at the same time as a gaseous medium is applied, for adhesion-promoting purposes, between the extruded plastic layers. The gaseous medium may be one gas or a mixture of gases with an ability to modify or activate the counter-facing surfaces of the adjacent plastic layers in such a manner and to such an extent that the plastic layers (13, 14, 15) will be sufficiently compatible to be able to be permanently united to one another, without the need to employ interjacent layers of chemical bonding or adhesive agents. Preferably, the gaseous medium consists of ozone which is injected or aspirated in between the plastic layers (13, 14, 15) when these are extruded.</p> <div data-bbox="758 1288 1268 1624" style="text-align: right;"> </div> |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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# A METHOD OF PRODUCING A WELL-INTEGRATED PACKAGING LAMINATE, AS WELL AS PACKAGING CONTAINERS PRODUCED FROM THE PACKAGING LAMINATE

## 5 TECHNICAL FIELD

The present invention relates to a method of producing a well-integrated packaging laminate comprising adjacent layers of mutually incompatible plastics. The present invention also relates to a packaging container which is produced from a web or a prefabricated blank of the packaging laminate.

## BACKGROUND ART

Within the packaging technology, use has long been made of packages of a single-use disposable nature which are produced from laminated packaging material comprising layers of paper or paperboard and plastics. A well-known example of such a single-use disposable package for liquid foods, e.g. milk, is the parallelepipedic TETRA BRIK® package in which the packaging laminate includes a rigid, but foldable core layer of paperboard and outer, liquid-tight coatings of polyethylene on both sides of the core layer. Another equally well-known example is the gable-top shaped TETRA REX® package which is also produced from a packaging material including a rigid, but foldable core layer of paperboard and outer, liquid-tight coatings of polyethylene on both sides of the core layer.

The composition of the packaging material principally depends on the product which is to be packed and is, naturally to be of such a nature as to make for the production of packages affording the best possible product protection. Moreover, the package must naturally per se be sufficiently mechanically strong and configurationally stable to resist outer stresses to which the package may be subjected during normal transport and handling.

Granted, a packaging material consisting solely of paperboard and outer, liquid-tight coatings of plastic, normally polyethylene, makes for the production of mechanically strong and configurationally stable packages possessing superior tightness properties vis-à-vis liquid, but the packaging material is practically wholly devoid of tightness properties vis-à-vis gases such that, for example, oxygen may readily penetrate into the package. This of itself does not constitute a problem when the product which is to be

packed is a less oxygen gas sensitive product or is to be packed for just a relatively short time in its package, but the problem naturally becomes more aggravated in connection with products which are particularly sensitive to oxygen gas and lengthy storage, as is often the case when foods are concerned.

In order to impart to the package the requisite gas barrier properties such that products which are sensitive to oxygen gas and lengthy storage such as foods will also be able to transported and stored with good and/or extended shelf life, the packaging material is therefore usually supplemented with an aluminium foil - Alifoil - which in itself is practically entirely impermeable to gases.

However, an Alifoil is extremely expensive to produce, at the same time as it, because of its slight extensibility, tends to crack and thereby lose its barrier properties when it is exposed to powerful tensile stresses which may occur during the reforming of the packaging material into packages.

In recent times, so-called barrier polymers have been developed with excellent gas barrier properties, and also other properties which, unlike Alifoil, are sufficiently tensile to withstand the high tensile stresses during the packaging production, at the same time as having lower production costs than Alifoil. Examples of barrier polymers which are already employed in commercial packages are polyethylene terephthalate (PET), polyamide (PA) and copolymers of ethylene and vinyl alcohol (EVOH).

A packaging material including a core layer of paperboard and outer, liquid-tight coatings of plastic, preferably polyethylene, with a barrier polymer layer between the core layer and the one outer plastic coating is conventionally produced by an extrusion process in which a film of the barrier polymer is extruded on one side of a prefabricated web of a polyethylene coated paperboard.

Barrier polymers of the type mentioned above are in general extremely difficult to unite with polyethylene (incompatible) and therefore most generally require some type of adhesion-promoting agent in order to be able to be united permanently with the polyethylene. Examples of such adhesion-promoting agents may be paint, primer or adhesives between the barrier film and the polyethylene coating, but another measure aimed at promoting adhesion normally involves a surface treatment by means of corona discharges. Paint and primer are generally linked to less desirable

chemical solvents which must, therefore, be removed from the packaging material, while an adhesion-promoting binder such as an adhesive not only involves increased material costs but moreover renders the packaging material unnecessarily complicated by an increased number of material layers. A surface treatment by means of corona discharges in order to make for adhesion between the otherwise incompatible plastic layers requires complicated extra processing equipment, with increased capital investment and production costs as a result.

## 10 OBJECT OF THE INVENTION

The task forming the basis of the present invention is therefore to realise a method of producing a well-integrated packaging laminate of the above-described type, with adjacent layers of incompatible plastics, without the employment of interjacent chemical adhesives or complicated process equipment.

## SOLUTION

This object is simply and efficiently attained according to the present invention by means of the method as defined in appended Claim 1. Advantageous and expedient embodiments of the method according to the present invention have been given the characterising features as set forth in the appended subclaims.

The expression "gaseous medium" which is employed in the description and in the appended Claims signifies one gas or a mixture of gases capable of modifying or activating the surfaces of the adjacent plastic layers in such a manner and to such an extent that the plastic layers become sufficiently compatible with each other in order thereby, with good adhesive or bonding strength, to be able permanently (good integrity) to be united directly with one another without the employment of interjacent layers of chemical adhesives, paints, primers etc. The exact composition of the gaseous medium may vary and principally depends upon the type of plastics in each respective layer which are to be united with one another. However, for a person skilled in the art it will be easy to select the "correct" gaseous medium in each individual case with the guidance of the present description.

One example of gaseous medium which has proved to be extremely versatile in application in the reduction of the method according to the present invention into practice is ozone, with the aid of which films of the majority of hitherto known barrier polymers can be united with good integrity and adhesion to an adjacent film of polyethylene.

The gaseous medium which is employed in the method according to the present invention may be applied between the individual plastic layers in a plurality of different ways. Preferably, it is applied with the aid of a tube or the like which is provided with a nozzle and which aspirates or sprays the gas by means of pressure between the plastic layers in connection with their being extruded. Such a simple arrangement may readily be incorporated into or retrofitted to already existing extrusion equipment and requires no major extra investment or installation costs.

## **15 BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

The present invention will now be described in greater detail hereinbelow, with reference to the accompanying Drawings. In the accompanying Drawings:

Fig. 1 is a schematic cross sectional view of a packaging laminate produced using the method according to the present invention; and

Fig. 2 is a process diagram which illustrates the method of producing the packaging laminate of Fig. 1.

## **DESCRIPTION OF PREFERRED EMBODIMENT**

In order to avoid any possible misunderstanding, or unnecessary misinterpretation of the present invention, it should be observed from the outset that the packaging laminate in Fig. 1 is, granted, shown with only five individual material layers, but that, naturally, it is not restricted solely to this simple embodiment shown purely for the sake of clarity. The packaging laminate may include both more and fewer layers than those illustrated. In its absolutely simplest embodiment, the packaging laminate could consist of but two individual material layers of plastics of the type which are incompatible with each other using conventional techniques. On the other hand, in its more complicated configurations, the packaging laminate may include considerably more individual material layers without, to that end, departing from the inventive concept as herein disclosed, provided that at

least two adjacent layers in the packaging laminate consist of mutually incompatible plastics. However, in order to illuminate and understand the present invention it is fully sufficient to describe the packaging laminate with the five material layers as shown in Fig. 1.

5 Referring to the Drawings, Fig. 1 shows a packaging laminate produced using the method according to the present invention and carrying the generic reference numeral 10. The packaging laminate 10 has a core layer 11 and outer, liquid-tight coatings 12 and 13 of plastic. The packaging laminate 10 further has a layer 14 of barrier polymer which, by the  
10 intermediary of an interjacent layer 15 of a sealing plastic, is bonded to the one side of the core layer 11 between the core layer 11 and the one 13 of the two outer plastic coatings 12 and 13.

The core layer 11 may consist of a fibre material, for example paper or paperboard of conventional packaging quality which is intended to impart  
15 to the packaging laminate 10 mechanical strength and rigidity in order to make for the production of configurationally stable packages. For the same purpose, the core layer 11 may also be a sufficiently rigid, but formable layer of plastic if desired. In the continued description, it will, however, be assumed that the core layer 11 is a rigid, but foldable layer of paperboard.

20 The two outer liquid-tight coatings 12 and 13 may consist of the same or of different plastics, but preferably consist of polyethylene which, in addition to its superior tightness properties vis-à-vis liquid, also enjoys the advantageous property of being sealable by thermosealing, which is already employed within the packaging technology. In particular, polyethylene of  
25 the low density type (LDPE) is to be preferred, with the aid of which mechanically strong and liquid-tight sealing joints or seams can be achieved at relatively low sealing temperatures by means of thermosealing technology.

The layer 14 of barrier polymer which, in the illustrated embodiment,  
30 is employed as an oxygen gas barrier for producing packages for oxygen gas-sensitive products such as liquid foods, may consist of any of the previously mentioned barrier polymers whatever, such as polyethylene terephthalate (PET), polyamide (PA) or copolymers of ethylene and vinyl alcohol (EVOH). In the continued description of the present invention, it will  
35 be assumed that the layer 14 consists of EVOH which is a known and established barrier polymer in packaging contexts. The layer 14 is bonded to

the one side of the core layer 11 by the intermediary of an interjacent sealing layer 15 between the core layer 11 and the one 13 of the two outer, liquid-tight coatings 12, 13 as shown in Fig. 1. The sealing layer 15 consists in this case of polyethylene, preferably LDPE, without, however, being restricted  
5 exclusively to this material as a person skilled in the art will be aware.

The packaging laminate 10 in Fig. 1 thus includes a paperboard layer 11 and outer, liquid-tight polyethylene coatings 12 and 13 and has, on the one side of the paperboard layer 11, an applied oxygen gas barrier layer 14 of EVOH. The oxygen gas barrier layer 14 is bonded to the paperboard layer 11  
10 by means of an interjacent sealing layer 15 of polyethylene between the paperboard layer 11 and the one 13 of the two outer, liquid-tight polyethylene coatings 12 and 13 of the packaging laminate 10. More precisely, it is the layer 14 of EVOH applied on that side of the paperboard layer 11 and serving as oxygen gas barrier which is intended to be turned to  
15 face inwards when the packaging laminate 10 is reformed into a package.

As was mentioned previously, the packaging laminate 10 includes adjacent layers of mutually incompatible plastics which, in the current example, consist of the three layers 13, 14 and 15 of polyethylene, EVOH and polyethylene, respectively, applied on the inside of the packaging laminate  
20 10. Since polyethylene and EVOH are polymers possessing different and, in sealing contexts incompatible, surface properties (polarity), it has proved extremely difficult or impossible to unite, with good integrity and adhesion, such layers directly to one another without employing interjacent adhesion-promoting agents of the type described above. According to the present  
25 invention, it has however proved that this difficulty may effectively be overcome and that the layers 13, 14 and 15 very readily and using but simple means, may be made compatible and permanently united directly to one another, without either interjacent chemical bonding or adhesive agents or complicated surface treatments as required in prior art technology.  
30 According to the present invention, the packaging laminate 10 in Fig. 1 is produced in the manner schematically illustrated in Fig. 2 and as will be described in greater detail hereinbelow, with reference to this Figure.

From a magazine reel (not shown) to the left in Fig. 2, a prefabricated web 16 is unwound, consisting of a prefabricated semi-manufacture  
35 comprising a core layer 11 of paperboard and an outer, liquid-tight coating 12 of polyethylene, as shown schematically in the encircled area A. The web

16 is led up to and through the nip between two rotating rollers 17 and 18 at the same time as a triple-layer film comprising two films 15 and 13 of polyethylene and an interjacent film 14 of EVOH is extruded on the one side of the web 16 with the aid of an extruder device 19 disposed above the roller nip.

The extruder device 19 may be any conventional type of device whatever which is employed for extruding a triple layer film and, therefore, need not be described in greater detail here, since such devices are already well-known to a person skilled in the art.

In the present case, the illustrated extruder device 19 is provided with a nozzle head 20 with three gap apertures which are disposed in parallel and spaced apart approx. 20 mm from one another and which direct the extruded films into the roller nip. Further, the films are extruded at mutually different extrusion temperatures which, in this example, may be approx. 325°C for the film 15 of polyethylene, approx. 230°C for the interjacent film 14 of EVOH and approx. 280°C for the film 13 of polyethylene.

As was mentioned previously, polyethylene and EVOH are incompatible polymers which, as a result, cannot be united directly to one another without implementing specific measures. For this purpose, a gaseous medium is injected or aspirated according to the present invention, the medium being capable of modifying or activating the polymer surfaces in such a manner and to such an extent that each respective polymer surface becomes compatible and can thereafter be united with each other during the passage through the nip between the rollers 17 and 18, at the same time as the extruded polyethylene film 15 serving as the sealing layer bonds with good adhesive strength the EVOH film 14 to the paperboard layer 11 of the 16.

With the aid of, for example, a tube 21 provided with a nozzle, the gaseous medium is injected or aspirated into the region between the extruded films 15 and 14, and 14 and 13, respectively, immediately above the roller nip. Such a tube may readily be incorporated in or mounted at the extruder device 19 and requires no extensive modification or alteration of the device 19.

As was previously pointed out, the gaseous activation medium may, according to the present invention, consist of one gas or a mixture of several gases, and the pertinent composition depends upon the nature and type of

the plastics in the adjacent films which are to be united with one another. However, with the knowledge of the present invention, it will be easy for a person skilled in the art to select a suitable medium in each individual case.

5 A gaseous medium which has proved to be efficient in the method according to the present invention consists of ozone which has the ability to realise the sought-for surface modification in connection with the majority of combinations of plastic films which occur in packaging contexts. Ozone functions particularly efficiently in this purpose in connection with the pertinent films of polyethylene 13 and 15 and EVOH 14. In this case, Ozone  
10 makes for the production of a well-integrated packaging laminate 10 also at extremely high production (web) speeds.

After the passage through the nip between the rollers 17 and 18, the web is led further a distance around the periphery of the one roller 18 before being removed from the roller 18 by the intermediary of a stripping roller 22  
15 and rolled up on a magazine reel (not shown) to the right in Fig. 2.

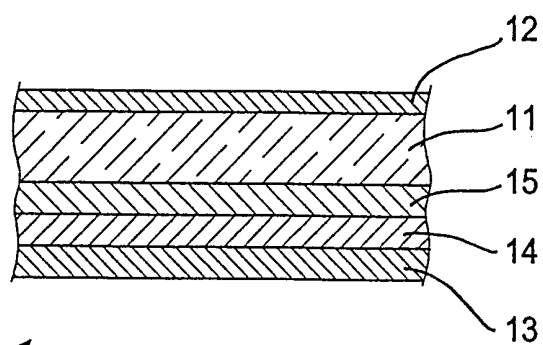
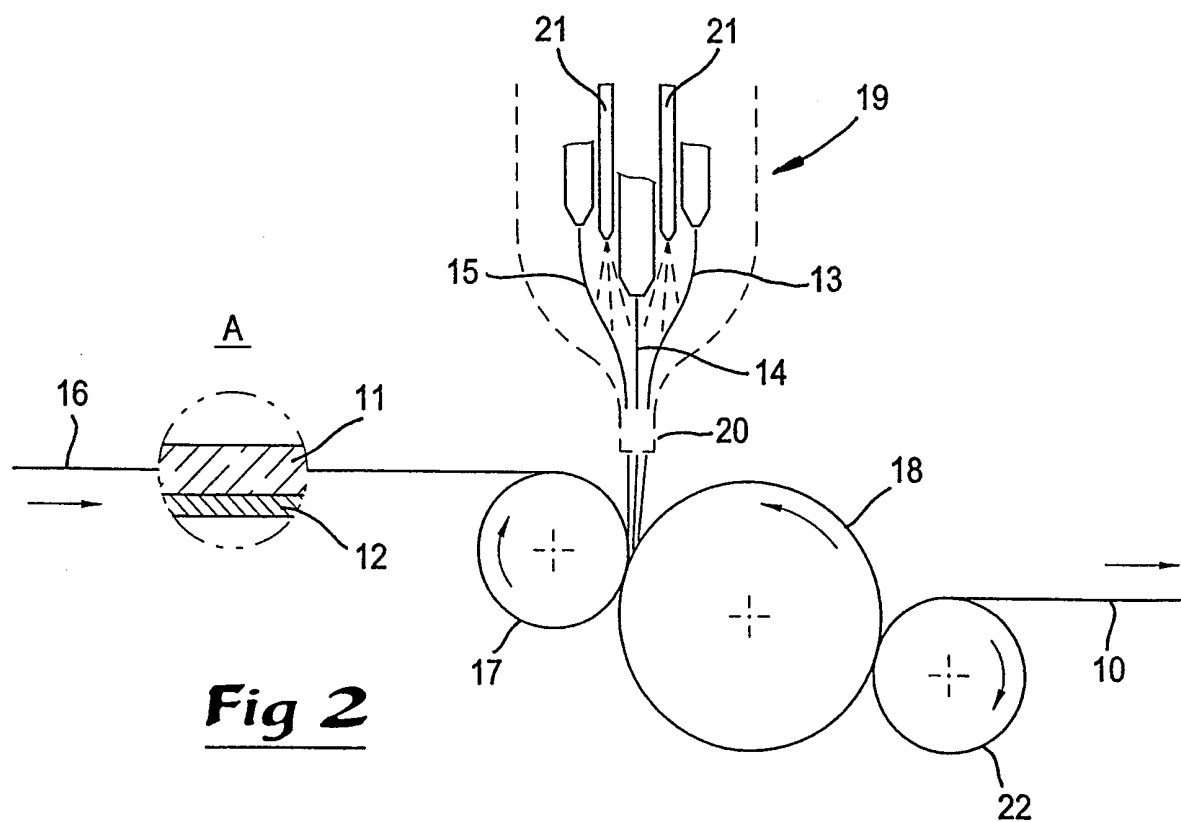
It will thus have been apparent from the foregoing description that the present invention provides a method which, with very simple means and with but minor modification of existing equipment, makes for the production of a packaging laminate of the type described by way of  
20 introduction without the need to employ chemical bonding or adhesive agents or complicated process equipment. Furthermore, using the method according to the present invention, more or less customised packaging laminates may be produced for specific packaging purposes with but a minimum of individual material layers in the laminate structure.

25 While the present invention has been described with the aid of a specifically preferred embodiment, it is not restricted exclusively to this example. A plurality of alterations and modifications will be obvious to a person skilled in the art without departing from the inventive concept as this is defined in the appended Claims.

## WHAT IS CLAIMED IS:

1. A method of producing a well-integrated packaging laminate (10) comprising adjacent layers (13, 14, 15) of mutually incompatible plastics, characterized in that said plastic layers are extruded at the same time as a gaseous medium is applied, with an adhesion-promoting purpose, between the extruded plastic layers (13, 14, 15).
2. The method as claimed in Claim 1, characterized in that the gaseous medium is injected or aspirated in between the extruded plastic layers (13, 14, 15).
3. The method as claimed in Claim 1 or 2, characterized in that said plastic layers (13, 14, 15) are extruded on one side of a web (16) of paper or paperboard.
4. The method as claimed in any of the preceding Claims for producing a well-integrated packaging laminate (10) comprising adjacent layers of polyethylene (13, 15) and ethyl vinyl alcohol copolymer (14), respectively, characterized in that the gaseous medium consists of ozone.
5. The method as claimed in any of Claims 1 to 3 for producing a well-integrated packaging laminate (10) comprising adjacent layers of polyethylene terephthalate and ethyl vinyl alcohol copolymer, respectively, characterized in that the gaseous medium consists of ozone.
6. A packaging container, characterized in that it is produced from a packaging laminate (10) produced by the method according to any one of the preceding Claims.

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**Fig 1****Fig 2**

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/00854

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B32B 27/08, B32B 27/16, B32B 31/12

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                             | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | File WPI, Derwent accession no. 81-24508D,<br>Mitsubishi Plastics Ind. Ltd: "Heat shrinking<br>laminated film prepn. - by co-extruding mixed<br>resin layer and sealing thermoplastic<br>resin layer treating with ozone and laminating";<br>& JP,A,56015326, 810214, DW8114<br><br>--                                                         | 1-5                   |
| X         | File WPI, Derwent accession no. 93-047611,<br>Mitsubishi Petrochemical Co Ltd: "Prepn. of<br>laminate for packing material - by treating<br>copolymer sheet of ethylene), unsatd. polybasic<br>acid and (meth)acrylate) or, vinyl) ester) with<br>ozone and pressing against substrate;" &<br>JP,A,4368845, 921221, DW9306, Abstract<br><br>-- | 1-6                   |

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                             | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 4370187 A (MIKIO KATAGIRI ET AL),<br>25 January 1983 (25.01.83), column 10,<br>line 21 - line 30, abstract, claim<br><br>--                                                                                                                                                                                                 | 1-6                   |
| X         | File WPI, Derwent accession no. 93-277821,<br>Idemitsu Petrochem Co: "Film laminate prodn.<br>useful for packaging - by extrusion-<br>laminating polyolefin type resin to base<br>material, and ozone-treated in its melted<br>state;" & JP,A,5193018, 930803, DW9335,<br>abstract<br><br>--                                   | 1-6                   |
| A         | File WPI, Derwent accession no. 96-094325,<br>Kaupakku KK et al: "Device for blowing ozone<br>used for extrusion-laminating device - consisting<br>of ozone-supplying pipe and piston to regulate<br>blowing width of ozone;" & JP,A,8003348,<br>960109, DW9610<br><br>--                                                      | 1-6                   |
| A         | File WPI, Derwent accession no. 95-190548,<br>Mitsubishi Plastics Ind Ltd: "Composite<br>sheet for moulding of e.g. food and medicine<br>containers - comprises laminate of moulding<br>base sheet and laminate co-extrusion film,<br>obtd. by corona-treatment without adhesive;"<br>& JP,A,7108611, 950425, DW9525<br><br>-- | 1-6                   |
| A         | US 4481289 A (SHIGEO HONMA), 6 November 1984<br>(06.11.84)<br><br>--                                                                                                                                                                                                                                                           | 1-6                   |
| A         | EP 0781653 A2 (SUMITOMO CHEMICAL COMPANY LIMITED),<br>2 July 1997 (02.07.97)<br><br>--<br>-----                                                                                                                                                                                                                                | 1-6                   |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                       | Publication<br>date                          |
|-------------------------------------------|---------------------|------------------------------------------------------------------|----------------------------------------------|
| US 4370187 A                              | 25/01/83            | JP 1403302 C<br>JP 56089515 A<br>JP 60051438 B                   | 09/10/87<br>20/07/81<br>13/11/85             |
| US 4481289 A                              | 06/11/84            | DE 3210434 A,C<br>GB 2099363 A<br>JP 57157239 A<br>JP 61042254 B | 21/10/82<br>08/12/82<br>28/09/82<br>19/09/86 |
| EP 0781653 A2                             | 02/07/97            | JP 9234845 A                                                     | 09/09/97                                     |