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(71) Applicant *(for all designated States except US)*: DOC-DATA N.V. [NL/NL]; Maasschriksel 13, P.O. Box 1021, NL-5900 BA Venlo (NL).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : BEAUJEAN, Joseph, Marie, Elise [NL/NL]; Pastoorstraat 11, NL-5971 BZ Grubbenvorst (NL).

(74) Agents: VAN DER BEEK, George, Frans et al.; Nederlandsch Octrooibureau, Johan de Wittlaan 15, P.O. Box 29720, NL-2502 LS The Hague (NL).

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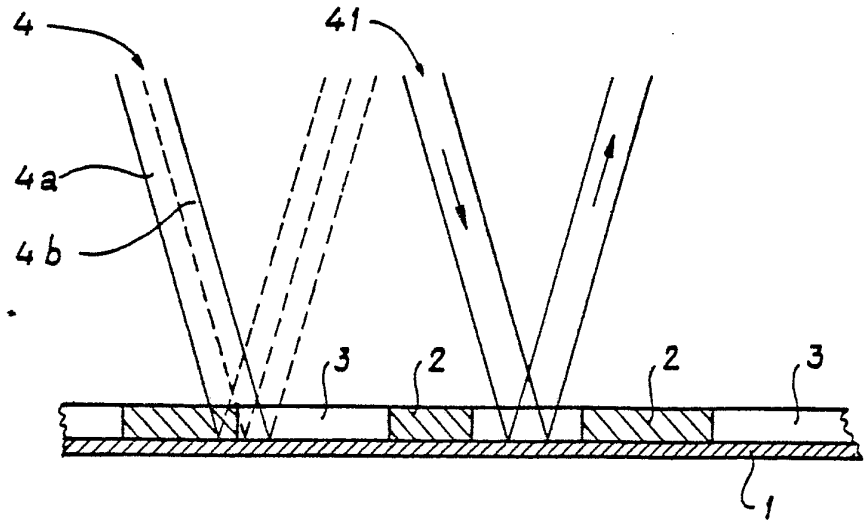

(57) Abstract

Optical information carrier comprising a substrate with an optically readable information structure, readable by means of a light beam. A flat optically transparent layer is present onto the substrate, which layer is in correspondance with the information structure divided in at least two groups of areas, whereby the areas of one group have mutually the same optical refractive index and the refractive indexes of the areas of both groups differ at least 0.2 from each other. The thickness of the optically transparent layer is selected such that dependent onto the difference in optical refractive index and dependent onto the wave length of the light of the scanning light beam an optical path length difference between the light beams scanning the areas of both groups is realized equal to or approximately equal to a half wave length or and odd multiple thereof.

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Optical information carrier with mosaic structure.

The invention relates to an optical information carrier comprising a substrate with an optically readable information structure, readable by means of a light beam, comprising adjacent areas with different properties such that they have a different influence onto the scanning light beam.

Optical information carriers of this type are known in various embodiments and for various purposes.

It is amongst others known to create in a photosensitive layer of a photographic film local differences in optical refractive index which by interference cause an intensity variation of the transmitted light beam. In this way information can be stored in the form of a hologram. Also in this way optically active elements can be created functioning as a prism or a lens.

On the other hand it is known to create interference patterns by structuring the surface of a reflector of a transparent layer at a microscopic scale. Examples thereof are grating windows and optical discs, such as the Philips compact disc which comprises a reflective layer and is read out in a reflective mode, or the video discs of Thomson-Brandt, which are read out in a transmission mode.

The fabrication of such structures appears to be not very simple in practice. Photographic films are gelatinous and are therefore mechanically vulnerable. Under the influence of moist the gelatinous layer easily becomes swollen, which rapidly will lead to a not allowable distortion of the information structure or optical structure stored within said layer. Therefore such photographical products should be handled very carefully. Also the obtainable differences in optical refractive index of the adjacent areas of the information structure are very small, in practice smaller than 0.05.

The transparent carrier of the compact disc comprises a relief structure corresponding to the information to be stored and said relief structure is covered in vacuum with a metallic layer. A lasting mechanical contact between the reflective metallic layer

and the substrate, however, appears difficult to realize.

An object of the invention is now to indicate in which way an optical information carrier of the above-indicated type has to be embodied to avoid the above signalled problems.

In agreement with said object the invention is characterized in that a flat optically transparent layer is present onto the substrate, which layer is in correspondence with the information structure divided in at least two groups of areas, whereby the areas of one group have mutually the same optical refractive index and the refractive indexes of the areas of both groups differ at least 0.2 from each other, whereby the thickness of the optically transparent layer is selected such that dependent onto the difference in optical refractive index and dependent onto the wave length of the light of the scanning light beam an optical path length difference between the light beams scanning the areas of both groups is realized equal to or approximately equal to a half wave length or an odd multiple thereof.

During the reading of the optical information carrier according to the invention the scanning light beam will become extinguished or at least weakened at the edges of the areas, because part of the scanning light beam is propagating through an area of the one group and another part of the same light beam is propagating through an area of the other group. Because of the optical path length difference between the light beam parts at the interface between the different areas the light beam will become extinguished because of interference between both light beam parts. That implies that the contours of the areas will become visible as dark lines during the scanning process.

The optical information carrier according to the invention therefore can be used for storing and reproducing analogue information in the form of line patterns. One can thereby think on optical gratings, Fresnel patterns and other means, which are known themselves. On the other hand one can think on drawings, regular or irregular line structures or curves, code patterns such as bar code patterns or other information containing patterns.

The practical application area of the invention is therefore not restricted to the optical devices, holograms and video carriers

or audio carriers, but comprises also labels, credit cards, micro fiches and such devices.

In a preferred embodiment the substrate of the optical information carrier is transparent. In that case the resulting product is an optical information carrier destined to be read out in a transmission mode.

The thickness of the optical transparent layer can be reduced significantly in case the substrate of the optical information carrier is reflective. In that case the information carrier has to be used of course in a reflective mode.

Irrespective of the fact if the substrate is transparent or not the optical transparent layer is preferably at the other side covered by a transparent protective layer. Such a protective layer does not have any influence onto the reading process of the information.

In an embodiment, which is relatively simple to manufacture, the areas of the one group in the optical transparent layer are made of the same material as the material of the protective layer. In that case the areas of the other group have to be applied onto the substrate by means of a suitable process, whereafter the protective layer material can be poored into the resulting structure which is sufficient to complete the optical information carrier.

With reference to the fabrication of the optical information carrier it is in many cases preferred that the areas of the one group in the optical transparent layer are made of an anorganic or organic photoresist. Such optical information carriers can be fabricated by applying a photoresist layer with a suitable thickness onto the flat substrate, illuminating said photoresist layer selectively and thereafter etching the photoresist layer selectively such that the areas of the one group remain. Thereafter a transparent material can be poored into the resulting pattern which material forms the areas of the second group and also fills the space above the information layer, thereby functioning as protective layer.

However, it is also possible to use a fluid for the areas of the second group. In that case preferably a fluid with a relatively high refractive index is used, such that the whole resulting op-

tically transparent information layer has only a very small thickness. Suitable fluids are arsenic tribromide, carbon disulfide, arsenic disulfide, thallium bromide or thallium jodide. Also fluids can be applied such as silicon oil and/or optical greases, comprising submicroscopically disperged solids with large refractive index, such as silicon, germanium or selenium/germanium to increase the refractive index of the fluid as a whole.

Preferably fluids are used which are also functioning as adhesive means between the optically transparent layer and the protective layer to be applied thereon.

The invention furthermore covers a method for fabricating an optical information carrier of the above-indicated type. Said method is according to the invention characterized in that a layer of photoresist is applied to the flat substrate, the thickness of said layer corresponding to the desired thickness of the areas of the one group, which layer thereafter is selectively illuminated and etched such that the remaining parts of the photoresist layer are forming the areas of the one group, whereafter at least the intermediate spaces between said areas are filled with a material of which the refractive index differs at least 0.2 of the refractive index of the applied photoresist.

In an embodiment a resin is used as filling material which resin is applied with such a thickness that on the one hand the areas of the second group are formed whereas on the other hand simultaneously the protective layer is formed both above the areas of the first group as well as above the areas of the second group.

To prevent with certainty the development of air enclosures or gas enclosures in the areas of the second group a fluid can be used for filling said intermediate spaces, whereafter onto said fluid a solid protective layer is applied in vacuum.

The etching of the layer can be carried out according to various known methods. Relatively sharp bounded steep extending side walls of the areas of the one group and therewith sharply delimited contours in the information carrying structure are obtained in case the etching process is carried out in a plasma.

The illumination of the layer is preferably carried out by means of a controlled electron beam.

Hereinafter the invention will be explained in more detail with reference to some embodiments thereof.

Figure 1 illustrates a first embodiment of an optical information carrier according to the invention destined to be read out in a reflective mode.

Figure 2 illustrates a second embodiment of an information carrier according to the invention destined to be read out in a transmission mode.

Figure 3 illustrates a third embodiment of an optical information carrier according to the invention.

Figure 1 illustrates a first embodiment of an optical information carrier according to the invention. The information carrier comprises a reflective substrate onto which an optically transparent informatiopn carrying layer is present, which in this case contains on the one hand the areas 2 and on the other hand the areas 3. The areas 2 are for instance made of a photoresist material. The areas 3 form together with the areas 2 an integral layer onto the substrate 1.

As an example the optical information carrier of Figure 1 can be fabricated starting with a polished aluminium substrate 1. A layer of photoresist material is applied to said substrate 1 for instance by evaporating a layer of selenium/germanium or arsenic trisulfide. During the application of said layer the desired thickness of the areas 2 to be obtained is taken into accound.

After applying the layer of photoresist said layer is selectively illuminated. For that purpose use can be made of a controlled electron beam in a known illuminating apparatus. Also illumination by means of ultraviolet light through a mask is possible. The illuminating wave length is dependent onto the sensitivity of the applied photoresist.

After illumination the photoresist is etched, whereby the not illuminated parts of the photoresist layer are removed. For this etching process use can be made of etching fluids which are themselves known. It is, however, preferred to use an etching plasma. During the etching process in a plasma the resulting shape of the side walls of the areas 2, in other words the under etching rate, etc., can be controlled with high accuracy.

The result of the etching process is a polished aluminium carrier 1 with thereon a pattern of areas 2. In the embodiment of Figure 1 said intermediate product is filled with a polyester resin 3, whereby care is taken that preferably the upper surface of the resulting resin layer is coexistent with the upper surface of the areas 2.

In case an organic photoresist is applied instead of an anorganic photoresist then preferably submicroscopically disperged silicon, germanium or selenium/germanium is introduced in the polyester resin to increase the refractive index difference between those areas.

At the left side of Figure 1 the situation during the reading of the information carrying structure is indicated. The impingeing light beam 4, generated by a not illustrated light source, propagates through the transparent information carrying layer 2, 3 and is reflected by the substrate 1 to a not illustrated light receiver. If, as is illustrated, the light beam impinges onto the transistion between two areas 2 and 3 then the part 4a of the light beam will propagate along an optical path which as a result of the selected materials for the areas 2 and 3 differs a half wave length or an odd multiple thereof from the path through which the part 4b of the light beam is propagating. The result thereof is that the parts 4a and 4b of the light beam will cause extinction of each other so that in fact no light is reaching the light receiver.

If, however, the light beam is impingeing onto one of the areas 2 or 3, as is indicated at the right side of the Figure by means of the light beam 4', then the receiver will receive the reflected light beam.

Figure 2 illustrates a further embodiment of an optical information carrier according to the invention. Said optical information carrier comprises a transparent substrate 11, for instance a substrate of polyester terephthalate. Said polyester therephthalate can be supplied in the form of a plate or in the form of a foil. Onto said substrate a layer of a suitable photoresist is applied. Because the optical information carrier illustrated in Figure 2 is destined to be read out in a transmission mode in general a somewhat thicker layer of photoresist have to be applied because the

areas 12 to be realized must have a somewhat larger thickness. Said thickness is of course dependent onto the difference in the optical refractive index between the material of the areas 12 and the index of the intermediate parts 13a of the optical information carrier.

After applying the photoresist layer said layer is selectively illuminated by means of a controlled laser beam or through a mask by means of a suitable light source. Thereafter the illuminated areas are of the photoresist layer or etched away so that again an intermediate product is obtained comprising the transparent carrier 11 with thereon the separate areas 12.

In this example thereafter the intermediate product is filled with a polyester resin which is doped with submicroscopically disperged germanium, silicon or selenium/germanium. In the illustrated example the resin layer extends above the actual optical information carrying layer such that said resin forms on the one hand the areas 13a belonging to the information carrying structure and functions on the other hand in the section 13b as protective layer for the information carrying structure.

It is remarked that also the carrier in Figure 1 can be covered by a protective layer, which protective layer does not have any influence onto the reading light beam.

Figure 3 illustrates a further embodiment of an optical information carrier according to the invention. Said embodiment comprises the substrate 21, for instance consisting of a polycarbonate foil. In the above already discussed manner the areas 22 are formed onto said foil, said areas belong to the optical information carrying transparent layer.

After the formation of the areas 22 the obtained intermediate product is wetted with a fluid such as arsenic tribromide with a refractive index of 1.82, carbon disulfide with a refractive index of 1.85, arsenic disulfide with a refractive index of 2.00, thallium bromide with a refractive index of 2.4 or thallium jodide with a refractive index of 2.8, or for instance silicon oil with therein disperged submicroscopical silicon, germanium or selenium/germanium. In case for the photoresist material of the areas 22 a material with low refractive index is selected then certainly the requirement, that the difference between the refractive index of

the material of the areas 22 on the one hand and 24a on the other hand has to be larger than 0.2, is fulfilled. The wetting fluid therefore forms a layer 24 and onto said layer 24 a protective layer is applied, for instance in the form of a polycarbonate foil 23. Preferably said layer 23 is applied onto the fluid layer 24 in vacuum to prevent the development of eventual air bubbles between layers 23 and 24 and furthermore to enhance the adhesion between the layers.

Preferably a fluid with adhesive properties is used in the fluid layer 24. As ultimate step finally the complete structure is sealed at the edges, which is in the drawing not illustrated, to guarantee a long life of the product.

Claims

1. Optical information carrier comprising a substrate with an optically readable information structure, readable by means of a light beam, comprising adjacent areas with different properties such that they have a different influence onto the scanning light beam, characterized in that a flat optically transparent layer is present onto the substrate, which layer is in correspondence with the information structure divided in at least two groups of areas, whereby the areas of one group have mutually the same optical refractive index and the refractive indexes of the areas of both groups differ at least 0.2 from each other, whereby the thickness of the optically transparent layer is selected such that dependent onto the difference in optical refractive index and dependent onto the wave length of the light of the scanning light beam an optical path length difference between the light beams scanning the areas of both groups is realized equal to or approximately equal to a half wave length or an odd multiple thereof.

2. Optical information carrier according to claim 1, characterized in that the substrate is transparent.

3. Optical information carrier according to claim 1, characterized in that the substrate is reflective.

4. Optical information carrier according to one of the preceding claims, characterized in that the optically transparent layer is at the other side covered by a transparent protecting layer.

5. Optical information carrier according to claim 4, characterized in that the areas of one group in the optically transparent layer are made of the same material as the protecting layer material.

6. Optical information carrier according to one of the preceding claims, c h a r a c t e r i z e d i n that the areas of one group are made of an organic or anorganic photoresist.

7. Optical information carrier according to claim 6, c h a r a c t e r i z e d i n that the photoresist comprises selenium/germanium or arsenic trisulfide.

8. Optical information carrier according to one of the preceding claims, c h a r a c t e r i z e d i n that the areas of one group are formed by a transparent curing mouldable fluid with therein submicroscopically disperged silicon, germanium or selenium/germanium.

9. Optical information carrier according to one of the preceding claims, c h a r a c t e r i z e d i n that the areas of one group are formed by a fluid.

10. Optical information carrier according to claim 9, c h a r a c t e r i z e d i n that the applied fluid is a silicon oil.

11. Optical information carrier according to claim 9 or 10, c h a r a c t e r i z e d i n that the applied fluid comprises submicroscopically disperged silicon, germanium or selenium/germanium.

12. Optical information carrier according to claim 9, c h a r a c t e r i z e d i n that the applied fluid is selected of the group arsenic tribromide, carbon disulfide, arsenic disulfide, thallium bromide or thallium jodide.

13. Optical information carrier according to one of the claims 9 until 12 inclusive, comprising a protective layer, c h a r a c t e r i z e d i n that the fluid plays the role of adhesive means between the optically transparent layer and the protective layer.

14. Method for fabricating an optical information carrier according to one of the preceding claims, c h a r a c t e r i z e d i n that a layer of photoresist is applied to the flat substrate, the thickness of said layer corresponding to the desired thickness of the areas of the one group, which layer thereafter is selectively illuminated and etched such that the remaining parts of the photoresist layer are forming the areas of the one group, whereafter at least the intermediate space between said areas are filled with a material of which the refractive index differs at least 0.2 of the refractive index of the applied photoresist.

15. Method according to claim 14, c h a r a c t e r i z e d i n that the filling material consists of a resin which is applied with such a thickness that on the one hand the areas of the second group are formed whereas on the other hand simultaneously the protective layer above the areas of the one group as well as above the areas of the second group is formed.

16. Method according to claim 14, c h a r a c t e r i z e d i n that a fluid is used for filling said intermediate spaces, whereafter onto said fluid a protective layer is applied in vacuum.

17. Method according to one of the claims 14 until 16 inclusive, c h a r a c t e r i z e d i n that said layer is etched in a plasma.

18. Method according to one of the preceding claims 14 until 17 inclusive, c h a r a c t e r i z e d i n that the layer is illuminated by means of a controlled electron beam.

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fig-1

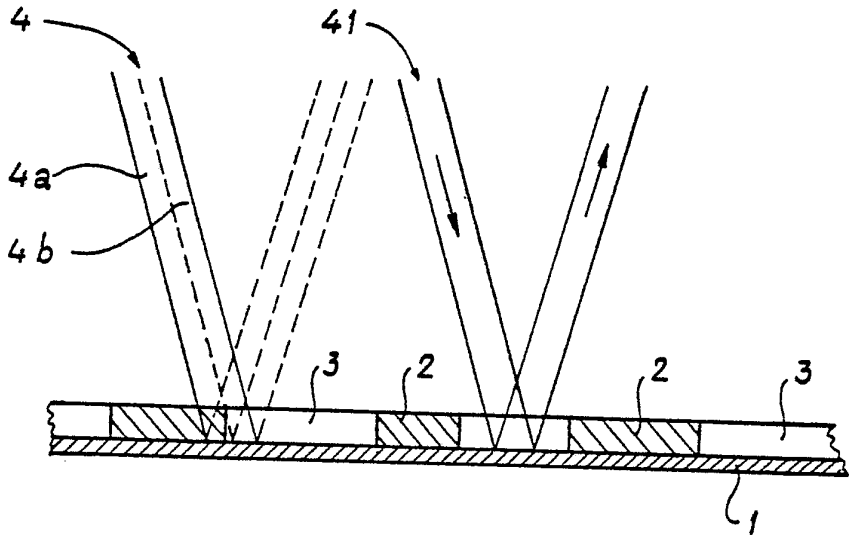


fig-2

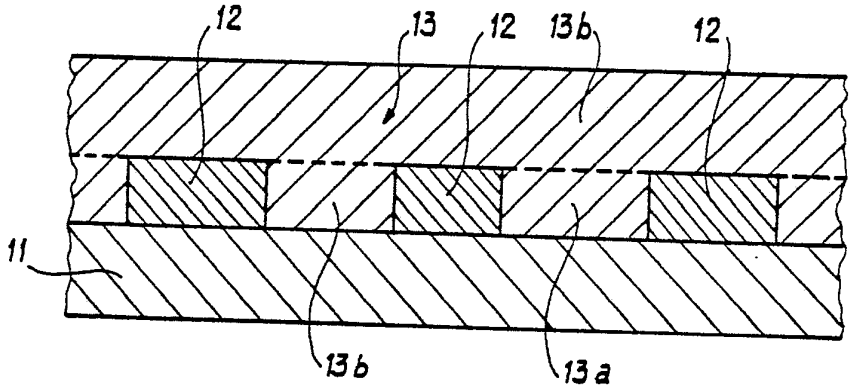
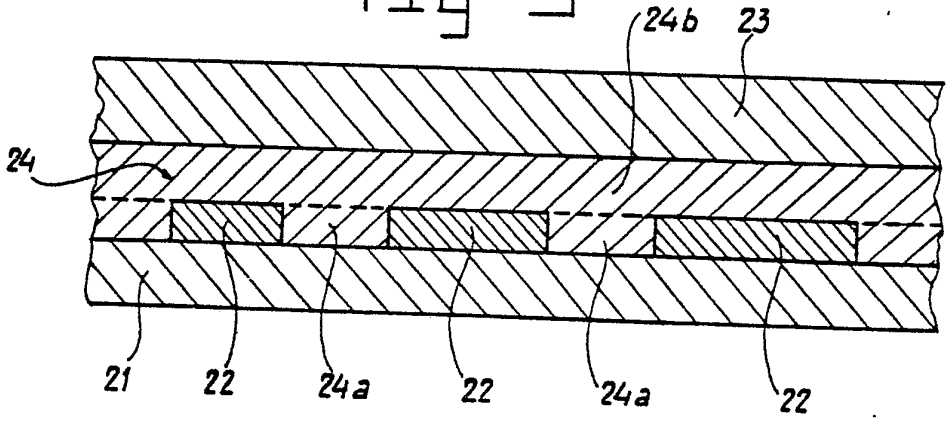


fig-3



INTERNATIONAL SEARCH REPORT

International Application No PCT/NL 85/00023

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [4]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: G 11 B 7/24; G 11 B 7/26

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	G 11 B 7/24 G 11 B 7/26

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4422159 (H.G. CRAIGHEAD et al.) 20 December 1983, see column 2, line 50 - column 3, line 16; column 5, lines 28-52; examples 2,4; column 6, lines 41-55	1-7,14-15, 17-18
A	EP, A,0107379 (P.A. MANAGEMENT CONSULTANTS) 2 May 1984, see page 6, line 31 - page 8, line 1; claims 1,31,35	17-18
A	Patents Abstracts of Japan, volume 6, nr. 190 (M-159)(1068), 29 September 1982 & JP, A, 5798394 (NIPPON DENSHIN DENWA KOSHA) 18 June 1982, see the entire abstract	12
A	Patents Abstracts of Japan, volume 6, nr. 249 (M-177) (1127) 8 December 1982 & JP, A, 57146691 (NIPPON DENSHIN DENWA KOSHA) 10 September 1982, see the entire abstract	7
A	GB, A, 2084786 (RCA) 15 April 1982	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16th September 1985	28 OCT. 1985
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

Form PCT/ISA/210 (second sheet) (January 1985)

International Application No. PCT/NL 85/00023

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	Patents Abstracts of Japan, volume 6, nr. 129 (P-128) (1007), 15 July 1982 & JP, A, 5753843 (OKI DENKI KOGYO) 31 March 1982 --	
A	Patents Abstracts of Japan, volume 6, nr. 221 (P-153) (1099) 5 November 1982 & JP, A, 57123540 (TOKYO SHIBAURA DENKI K.K.) 2 August 1982	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/NL 85/00023 (SA 9908)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 17/10/85

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 4422159	20/12/83	WO-A-	8300943	17/03/83
		GB-A-	2109610	02/06/83
		EP-A-	0087460	07/09/83
		CA-A-	1193007	03/09/85
EP-A- 0107379	02/05/84	JP-A-	59135643	03/08/84
GB-A- 2084786	15/04/82	FR-A-	2490858	26/03/82
		NL-A-	8104409	16/04/82
		JP-A-	57086139	29/05/82
		DE-A-	3137528	01/07/82