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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 December 2001 (06.12.2001)

PCT

(10) International Publication Number
WO 01/92063 A1

(51) International Patent Classification[7]: B60R 13/08, C08J 9/10

(21) International Application Number: PCT/CH01/00333

(22) International Filing Date: 29 May 2001 (29.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1100/00 2 June 2000 (02.06.2000) CH

(71) Applicant *(for all designated States except US)*: **RIETER AUTOMOTIVE (INTERNATIONAL) AG** [CH/CH]; Seestrasse 45, CH-8702 Zollikon (CH).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **DANIERE, Pierre** [FR/FR]; 461, chemin de Courbieu, F-82200 Moissac (FR). **JAMBERT, Serge** [FR/FR]; Mages Nord, F-82100 Castelsarrasin (FR). **BALEYDIER, Giles** [FR/FR]; Mages Sud, F-82100 Castelsarrasin (FR). **STIEFEL, Peter** [DE/DE]; Nettelbeckstrasse 2, 50733 Köln (DE).

(74) Agent: **SEIFERT, Hans, Ulrich**; Ritscher & Seifert, Forchstrasse 452 / Postfach, CH-8029 Zürich (CH).

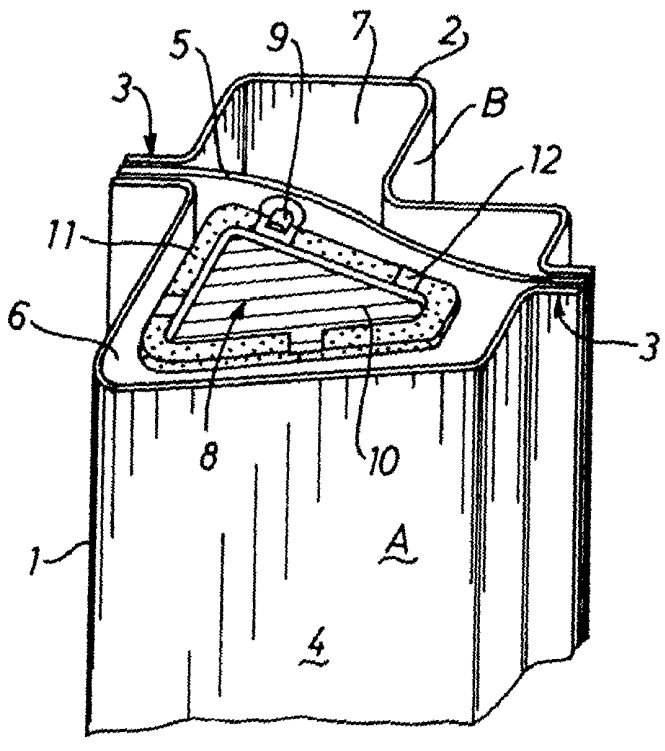
(81) Designated States *(national)*: BR, CA, CZ, JP, PL, US, ZA.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: INSERT ELEMENT FOR CAVITY SEALING



(57) Abstract: An insert element (8) for sealing cavities (6, 7) in vehicle body carriers (4) has sealing means constituted by a foamable material (11) which is secured in the cavities (6, 7) by securing means (9). The insert element (8) comprises a foamable material (11) and a support structure (10) which comprises a frame (13) and an inner part (14) for carrying the foamable material (11). The frame (13) has at least two lateral and not immediately oppositely arranged support faces (12), and carries securing means (9). With this arrangement, the foamable material can completely engulf the securing means (9) with foam during the foaming process and can flow into apertures of an intermediate metal sheet (5) foreseen for receiving the securing means (9). This ensures that these apertures are impermeably sealed against air and noise during the foaming process. The foamable material is preferably constituted of a thermoplastic polymer which can form a closed-celled foam, thus increasing the noise insulating and noise absorbing properties, whilst also acting as a moisture barrier and an airtight sealant.

WO 01/92063 A1

Insert element for cavity sealing

The present invention concerns an insert piece for sealing cavities in vehicle body carriers, in particular in vehicle body pillars, according to the preamble of claim 1.

Vehicles of all types have carrier or support parts in the form of hollow structural members. These carrier parts usually consist of two formed or pressed metal sheets which are arranged in the vehicle in such a manner, that an inner surface and an outer surface are defined. In order to stiffen these two pillar-like hollow structural members it is common to arrange an additional, third metal sheet inside these hollow structural members. Thus, different cavities are formed inside the hollow structural members. These carrier parts and cavities cause vibrations and noise to be transported throughout the vehicle, which is detrimental to the comfort of passengers, i.e. results in vibrations and noise in the vehicle interior.

It is therefore known in the art to insert partitioning walls in these hollow structural members in order to prevent the transportation of sound and to dampen vibrations. Such insert parts are known to the man skilled in the art, for example from EP 0 730 999 or US 5,642,914. The insert parts described in these publications essentially comprise a support structure which is secured inside the hollow structural members, and is edged with a foamable material which is heated and thereby foams during manufacture of the vehicle. In this way a partitioning wall is formed inside the hollow structural member. These partitioning walls serve to dampen the vibrations of the carrier elements, and also have a noise insulating effect,

i.e. they reflect the noise transported by the carrier elements. The securing of these insert parts makes it necessary to provide apertures in the carrier elements, through which suitable retaining means, in particular screws or clips, can be guided. Experience shows that these apertures cannot be completely sealed off by the foaming process during vehicle manufacture, which negatively effects the noise insulation and moisture barrier properties of the partitioning walls.

It is therefore the object of the present invention to provide an insert element which overcomes the deficiencies of the prior known insert parts. In particular, it is the object of the present invention to provide an insert element for sealing cavities which improves the acoustic properties of these parts. Furthermore, an insert element is to be provided which can be cost-efficiently manufactured and which is simple to insert.

This is achieved by an insert element for sealing cavities having the features of claim 1, and in particular by an insert element on whose frame at least two lateral and not immediately adjacently arranged support faces are provided. This arrangement allows the unhindered foaming of the insert element at its peripheral regions and thus leads to a complete insulation, in particular in the region of the retaining or securing elements. Furthermore, with this arrangement the foam-covered surface portion of the carrier cross-section to be sealed is increased.

In a preferred embodiment of the invention, at least one of the support faces is formed as a clip. This allows the clip to be totally engulfed by foam during the foaming process,

thus completely sealing the aperture for securing the carrier elements.

In a further preferred embodiment of the invention, the material filling the frame of the carrier element is in the form of a lattice and is covered with a foamable material. This lattice can be made of a metallic material, in particular of steel sheet or aluminium, or can be made of a thermoplastic polymer, for example a polyamide or a polypropylene, which can be compounded with polybutadien to controllably determine the stiffness. In this way, the relatively expensive filler material can be replaced by a more cost-effective foaming material. This embodiment can be carried out in such a manner, that a compact filling is produced during the foaming process, the skin of which is geometrically irregular and closed-celled, thus leading to a further improvement in the sound insulation properties.

As a foamable material, thermoplastic polymers are suitable, in particular a copolymer of ethylene and vinyl-acetate (PEVA), to which is added a foaming agent, in particular azodicarbonamide and a cross-linking agent, in particular dicumylperoxide. During foaming, this material forms a closed-cell foam which is not only noise insulating and noise absorbing but is also particularly suitable as a moisture barrier and air-tight sealant.

Other preferred embodiments have the features of the dependent claims.

In a further embodiment, the inventive insert element is made of a single piece of foamable material and comprises at least one retaining element which is integrated into this insert element. This retaining element protrudes from

the edge region of the insert element and can be either engaged or locked into an aperture provided for this purpose, or can be inserted into a double-clip as a counterpart.

The advantages of the insert element according to the present invention are immediately obvious to the person skilled in the art and are to be seen, in particular, in the effective sealing, the significant increase in sound absorption and thus in the improvement of the acoustic efficiency, as well as in a cost-effective manufacture and assembly.

The invention is described in the following with the aid of the drawings and the subsequent description of a preferred embodiment.

Fig. 1 shows a cross section through a vehicle body carrier with an inserted insert element;

Fig. 2 shows a detailed view of an insert element according to the invention;

Fig. 3 shows a diagram of sound absorption curves.

Figure 1 is a cross section through a vehicle body carrier 4. This carrier 4 comprises a first formed sheet metal part 1, constituting an outer surface A and a second formed sheet metal part 2, constituting an inner surface B. These two sheet metal parts 1, 2 are welded together at their edges 3. For further stiffening the carrier 4 in this embodiment, an intermediate metal sheet 5 is welded, which divides the inner space of the carrier 4 into an outer cavity 6 and an inner cavity 7. In order to seal the outer

cavity 6, an insert element 8 is secured to the intermediate metal sheet 5. For this purpose, the insert element 8 comprises securing means 9, and in particular a clip, which grasps into an aperture in the intermediate metal sheet 5. The insert element 8 comprises a support structure 10, on to which there is applied foamable sealing material 11. In order to retain the foamable sealing material 11 in place, the support structure 10 comprises at least two, not immediately adjacently arranged support faces 12. It is essential for the purpose of the present invention that these support faces are not immediately adjacent to each other, because otherwise the foamable sealing material could not foam freely and pervious or leaky areas could result. Furthermore, the inventive arrangement results in a considerable increase in the surface areas of the cavity cross-sectional areas which are covered with foam, which substantially improves the acoustical efficiency.

In a further development of this inventive insert element, the securing means are formed in such a manner that a further insert element can be fastened thereto from the opposite side.

Figure 2 clarifies the inventive design of the insert element 8. The support structure 10 essentially comprises a frame 13 and an inner part 14. At the lateral part of the frame, and not exactly opposite each other, are arranged support faces 12. One of these support faces is formed as a securing means and in the embodiment of Figure 2, has the shape of a clip 9. This Figure shows a portion of the intermediate metal sheet 5 in order to distinctly show the functioning of the clip 9. Above or over the frame 13 of the support structure 10 there is arranged a strip bearing

foamable sealing material 11, which is held in place by the support faces 12. With this arrangement, the sealing material can completely engulf the clip 9 with foam during the foaming process and can flow into the aperture of the intermediate metal sheet 5 foreseen for receiving the securing means 9. This ensures that these apertures are impermeably sealed against air and noise with the foaming process. In a further development of the inventive insert element the inner part 14 is replaced by a lattice, which again serves as a support for a foamable sealing material. The foaming process results in a further increase in the surface area of the cavity cross-sectional area which is covered with foam, which considerably improves the acoustic efficiency and in particular the noise absorption capability. Further, it is understood that the foamed material has an airproof skin which serves as a moisture barrier. The person skilled in the art of acoustics will be in a position to design the insert element in such a way as to optimize the acoustic insulation and absorption properties for the specific requirements. In the present embodiment, where the support structure 10 has a lattice-type inner part 14, the amount of filling material required - usually polyamide - can be substantially reduced, thus allowing the entire insert element to be produced relatively inexpensively, because the foamable material used according to the present invention is substantially more cost-efficient than polyamide. Furthermore, a lattice-type inner part of the support structure 10 also permits this inner part to be made of inexpensive polypropylene instead of the usually used polyamide. Even though polypropylene has a lower melting point than polyamide and is therefore not suitable for use as support structure material, it can be applied as a lattice-type inner part, because the temperature of 160°C to 200°C required for the

foaming process is in turn decreased by the foaming material 11.

The measurement curves shown in Figure 3 are the results of a comparative measurement. A conventional insert element having a closed inner part 14 and a groove-shaped support structure arrangement was measured in an impedance tube according to the norm D45 5430. The resulting measurement curve C shows that the value of the absorption coefficient for frequencies lower than 3150 Hz is less than 0.1, and that the value for frequencies in the range between 3150 Hz to 5000 Hz reaches a maximum of 0.23. On the other hand, for an insert element according to the present invention measurement curve D shows a substantially improved absorption behaviour at frequencies above 1250 Hz, i.e. in this range shows an absorption coefficient of around 0.58. By increasing the proportion of the area covered with foam the absorption coefficient can be further improved to a value of around 0.8. These comparative measurements clearly show that by using specific configuration of the support structure 10 and thereby increasing the proportion of the sealed cross-sectional area covered with foamable material, the acoustic absorption is substantially increased without decreasing the acoustic insulation.

In a preferred embodiment, a thermoplastic polymer is used as a foamable material, in particular a copolymer of ethylene and vinyl acetate (PEVA), to which copolymer a foaming agent, in particular azodicarbonamide, and a cross-linking agent, in particular dicumylperoxide, are added. This results in a closed-cell foam during the foaming process which is especially suitable as a moisture barrier and an airtight sealant.

Patent Claims

1. Insert element (8) for sealing of cavities (6, 7) in vehicle body carriers, in particular vehicle body pillars (4), having sealing means comprising a foamable material (11) and means (9) for securing the same in the hollow cavities (6, 7), whereby the insert element (8) comprises a support structure (10) for the foamable material (11), said support structure (10) having a frame (13) and an inner part (14), wherein the frame (13) has at least two lateral and not immediately oppositely arranged support faces (12).

2. Insert element according to claim 1, whwerein at least one of the support faces (12) is formed as a securing means (9), in particular as a clip.

3. Insert element according to claim 2, wherein the clip (9) is formed as a double clip.

4. Insert element according to one of claims 1 to 3, wherein the inner part (14) of the support structure (10) is in the form of a lattice.

5. Insert element according to claim 4, wherein at least the inner part (14) of the support structure (10) is made of a metallic material or of polypropylene.

6. Insert element according to one of claims 4 or 5, wherein the inner part (14) is covered with a foamable material which, after a foaming process, completely seals the inner part (14).

7. Insert element according to one of claims 1 to 5, wherein the foamable material (11) is constituted of a thermoplastic polymer, for example a copolymer of ethylene and vinyl acetate (PEVA), to which copolymer a foaming agent, for example azodicarbonamide, and a cross-linking agent, for example dicumylperoxide, are added.

8. Insert element (8) for sealing hollow cavities (6, 7) in vehicle body carriers, in particular in vehicle body pillars (4), having means for sealing constituted of a foamable material (11) and having means (9) for securing the same in the cavities (6, 7), wherein the insert element (8) is composed of a single piece of foamable material (11), of which the securing means (9) are a part.

9. Insert element according to claim 8, wherein the foamable material (11) is constituted of a thermoplastic polymer, for example a copolymer of ethylene and vinyl acetate (PEVA), to which copolymer a foaming agent, for example azodicarbondamide, and a cross-linking agent, for example dicumylperoxide, are added.

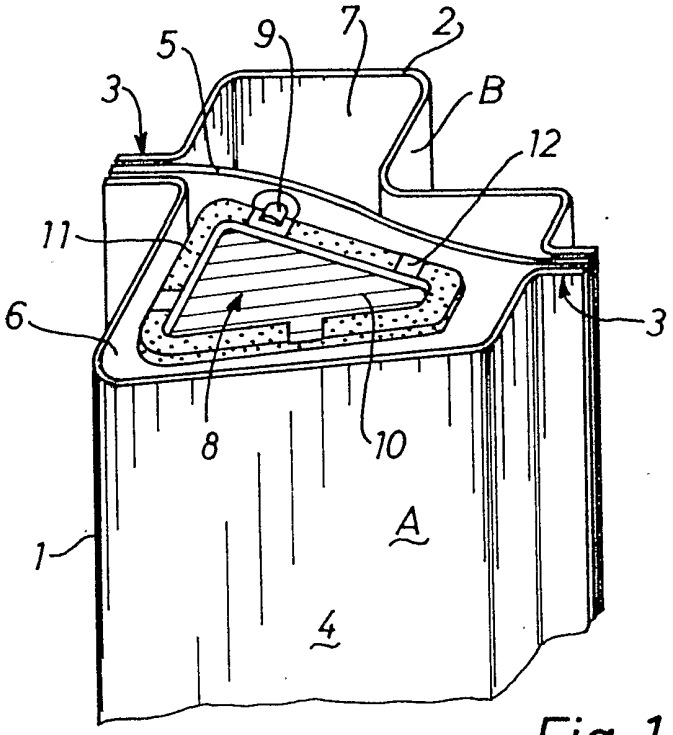


Fig. 1

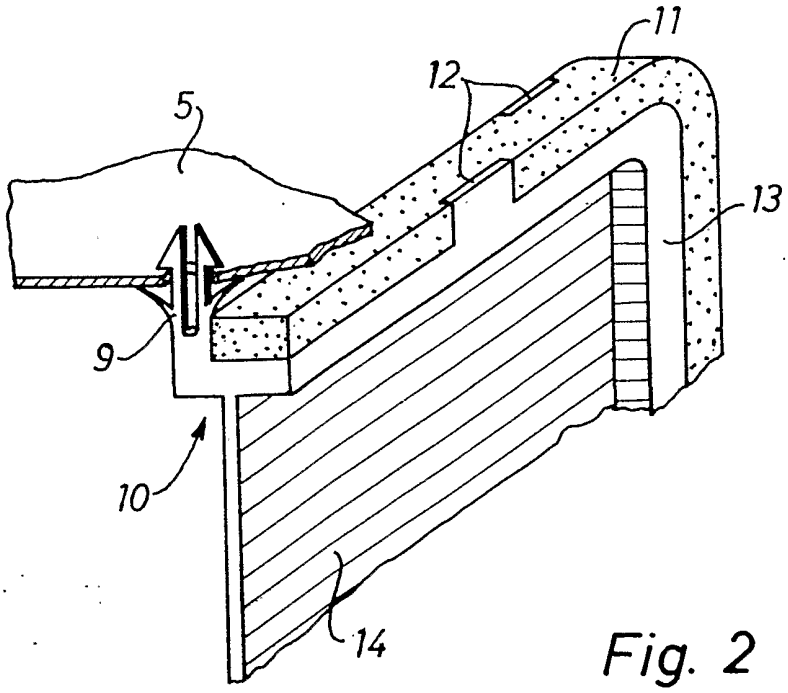


Fig. 2

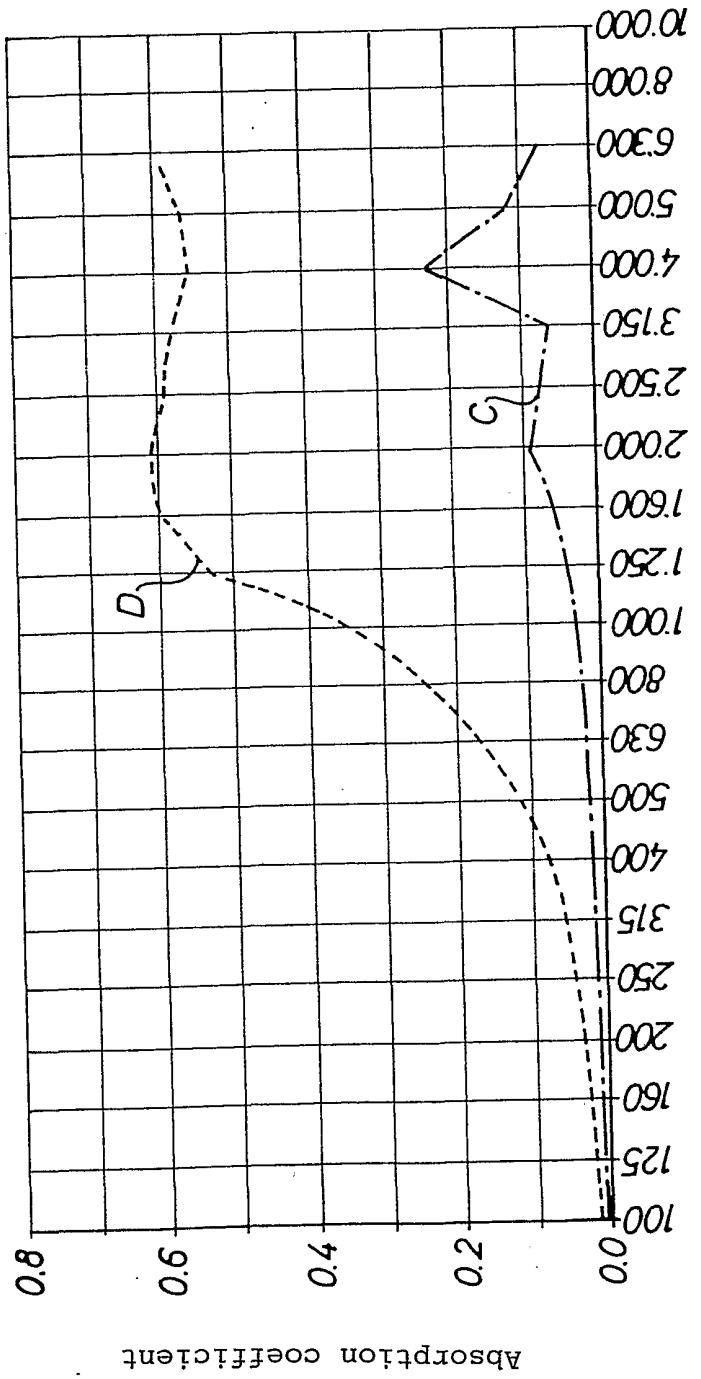

Absorption coefficient
0.0
0.2
0.4
0.6
0.8
Frequency (Hz)
100
125
160
200
250
315
400
500
630
800
1.000
1.250
1.600
2.000
2.500
3.150
4.000
5.000
6.300
8.000
10.000
C
D

Fig. 3

INTERNATIONAL SEARCH REPORT

Intern | Application No
PCT/CH 01/00333

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60R13/08 C08J9/10

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)
IPC 7 C08J B60R

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 642 914 A (TAKABATAKE YOSHIHIRO) 1 July 1997 (1997-07-01) cited in the application column 4, line 39 - line 52	1,2,7
P,X	WO 01 30906 A (TKACZ PETER ;DUFFIN GARY RAYMOND (US); ORBSEAL LLC (US); TAYLOR DO) 3 May 2001 (2001-05-03) page 11, line 8 -page 12, line 4	8,9
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 14, 22 December 1999 (1999-12-22) & JP 11 254462 A (NEOEX LAB INC), 21 September 1999 (1999-09-21) abstract	1,7

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 September 2001	12/09/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Standring, M

INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/CH 01/00333

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 37506 A (RAYCHEM CORP) 29 July 1999 (1999-07-29) page 6, line 3 - line 13	1
A	EP 0 730 999 A (NEO EX LAB INC) 11 September 1996 (1996-09-11) cited in the application page 5, line 27 - line 36	1,7
A	page 2, line 9 - line 14	8,9

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern al Application No
PCT/CH 01/00333

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5642914 A	01-07-1997	JP 2954499 B	27-09-1999
		JP 8258047 A	08-10-1996
		JP 2746856 B	06-05-1998
		JP 8282396 A	29-10-1996
WO 0130906 A	03-05-2001	NONE	
JP 11254462 A	21-09-1999	NONE	
WO 9937506 A	29-07-1999	US 6114004 A	05-09-2000
		CN 1296451 T	23-05-2001
		EP 1053126 A	22-11-2000
EP 0730999 A	11-09-1996	JP 2721327 B	04-03-1998
		JP 8276448 A	22-10-1996
		DE 69600357 D	23-07-1998
		DE 69600357 T	17-12-1998
		US 5806915 A	15-09-1998