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(71) Applicant *(for all designated States except US):* **AUTOLIV DEVELOPMENT AB** [SE/SE]; S-447 83 Vargarda (SE).

(72) Inventors; and
(71) Applicants *(for US only):* **WEBER, Marcus** [DE/DE]; Abt-Fuchs-Strasse 7, 9753 1 Untertheres (DE). **NIEDERNHUBER, Thomas** [DE/DE]; Gernholzweg 5a, 82205 Gilching (DE). **PEIZ, Roland** [DE/DE]; Hirschenhausenerstrasse 7, 86567 Hilgertshausen (DE).

(74) Agent: **AUTOLIV DEVELOPMENT AB;** Patent Department, Wallentinsvagen 22, S-447 83 Vargarda (SE).

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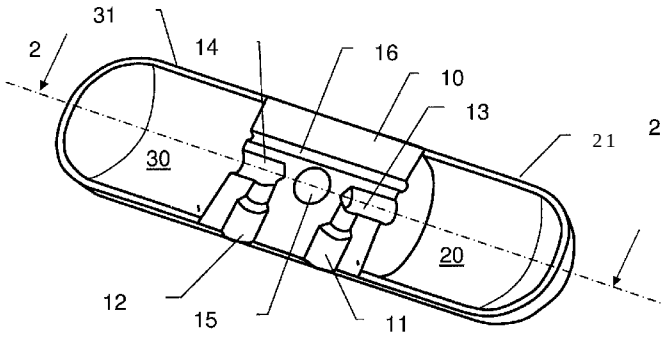
(54) **Title:** GAS GENERATOR

Fig. 1



(57) **Abstract:** A gas generator for inflating an automobile airbag, comprising -at least a first igniter suitable to be fired in order to release gases and/or particles, -at least first inflation means suitable for being released by the gases and/or the particles of the firing igniter for creating the first gases for inflating the automobile airbag, -at least a first chamber (20) containing the first inflation means, -a connecting piece (10) holding in place this first igniter and this first chamber, which connecting piece (10) comprises at least one diffusion orifice (15) toward the automobile airbag of the unit of the first inflation gases, a first direct communication between this first igniter and this first chamber(20) and a second direct communication between this first chamber(20) and this at least one diffusion orifice (15), characterized in that the first communication and the second commumcation are designed in such a manner that the first inflation gases created by the first inflation means arrive at this at least one diffusion orifice (15) before the gases and/or particles of this first igniter.

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GAS GENERATOR

The present invention relates in a general manner to a gas generator for inflating a bag or automobile airbag of an airbag module and in particular to a gas generator comprising a firing igniter and diffusion holes exclusively constructed in the vicinity of the igniter in order to obtain a compact assembly and a rapid deployment time.

Gas generators are known from the prior art that comprise a firing igniter and diffusion holes close to the igniter like those described, for example, in the documents US 7 641 230 or EP 1 424 246. The architecture of these generators is similar in that they each comprise a central piece comprising the diffusion outlet and that connects the igniter to chambers of compressed gas and connects these chambers to the diffusion outlet. The assembly in the airbag module is simple because the latter comprises a simple box in which the airbag is positioned and the generator is positioned inside the airbag. On the other hand, these systems have the particular disadvantage of requiring a bag resistant to the attacks of particles and/or gas emitted by the igniter at the very beginning of operation. In fact, the igniter, that has the goal of opening the chambers in order to permit the compressed gases to inflate the bag, produces gases and/or particles during its firing that brutally destroy the closing covers of the chambers. Now, the devices described cannot avoid that a part of these particles and/or gases emitted by the igniter exit through the diffusion orifices before the compressed gases when the bag is not yet deployed. These gases and/or particles from the igniter are more aggressive than the compressed gases of the storage chambers and reinforcements must be provided on the bag especially to avoid damage created by these gases and/or

particles from the igniter. The result is a significant increase in cost. Furthermore, these devices cannot be used with a supplementary igniter in order to offer an operation in two distinct times because the 2 chambers are opened by the same igniter. It can be noted that for the document EP 1 424 246 the covers are assembled on a piece added to the storage chamber. This implies a supplementary expense and an architecture is preferred with communication orifices of the chamber that are easy to plug, that is, the support surfaces of the covers should be plane with a space that can receive the cover.

Document US 7 780 193 describes a gas generator with a central piece that supports the igniter and with diffusion holes arranged at each end of the generator. This generator has the disadvantage that it does not permit a compact assembly in the airbag module and also allows a significant time for the appearance of the first inflating gases at the beginning of operation because the complete generator must be pressurized from end to end before the first gases exit towards the bag through the diffusion holes. In a general manner it is better to avoid having intermediate filtration or diffusion chambers between the storage chamber and the diffusion orifices in order to have the shortest possible time for the appearance of the inflation gases.

A goal of the present invention is to respond to the disadvantages of the documents of the prior art mentioned above and in particular to propose at first a compact gas generator with a diffusion exclusively in the vicinity of the igniter, and of which the start of operation does not present a risk of damaging the bag by particles and/or gases emitted by the igniter.

To this end a first aspect of the invention relates to a gas generator for inflating an automobile airbag, comprising

- at least a first igniter suitable to be fired in order to release gases and/or particles,

- at least first inflation means suitable for being released by the gases and/or the particles of the firing igniter for creating the first gases for inflating the automobile airbag,

- at least a first chamber containing the first inflation means,

- a connecting piece holding in place this first igniter and this first chamber,

which connecting piece comprises at least one diffusion orifice toward the automobile airbag of the unit of the first inflation gases, a first direct communication between this first igniter and this first chamber and a second direct communication between this first chamber and this at least one diffusion orifice, characterized in that the first communication and the second communication are designed in such a manner that the first inflation gases created by the first inflation means arrive at this at least one diffusion orifice before the gases and/or particles of this first igniter.

The gas generator in accordance with the present invention offers a compact assembly in the airbag module by virtue of the diffusion exclusively arranged on the connecting piece that holds the igniter in place while guaranteeing that the gases and/or particles of the igniter do not arrive at the beginning of operation at the airbag in such a manner that it undergoes fewer attacks. In other words, the design of the communications between the igniter and the chamber on the one hand and between the chamber and the diffusion orifices on the other hand guarantees that the gases generated by the inflation means located in the chamber arrive at the diffusion before the gases and/or particles emitted by the igniter in such a manner that the still folded airbag will be forced to deploy under the effect of the first

inflation gases. Consequently, the airbag has no need of being reinforced in order to resist the gases and/or particles from the igniter. The airbag will be lighter compared to the modules equipped with generators of the prior art.

The first direct communication and the second direct communication are advantageously designed so that all the gases and/or particles from the igniter pass through this first chamber before arriving at this at least one diffusion orifice. This implementation offers an architecture in which the gases and/or particles from the igniter transit through the chamber before going to the diffusion orifice and they therefore arrive there after the first inflation gases.

A particularly interesting embodiment consists in that the first direct communication is a first direct communication conduit and that the second direct communication is a second direct communication conduit, and that the first conduit and the second conduit are separate and distinct. This implementation is economical and guarantees by its construction that the gases and/or particles from the igniter do not arrive at the diffusion before the first inflation gases created by the first inflation means contained in the chamber because the conduits do not have any part in common.

The generator comprises in a very advantageous manner:

- second inflation means suitable for being released by gases and/or particles of the first inflation means in order create second inflation gases of the automobile airbag,

- a second chamber containing the second inflation means,

the connecting piece holds in place the second chamber and comprises a third direct communication conduit between the second chamber and this at least one

diffusion orifice. This implementation in accordance with the present invention offers an increased inflation capacity by the presence of the second inflation chamber.

The gas generator comprises in an advantageous manner:

A second igniter suitable for being fired in order to release gases and particles,

- second inflation means suitable for being released by the gases and/or the particles of the second igniter in order to create second inflation gases of the automobile airbag,

- a second chamber containing the second inflation means, and

the connecting piece comprises a third direct communication conduit between the second chamber and this at least one orifice for the diffusion of the second inflation gases to the automobile airbag and a fourth direct communication conduit between the second igniter and the second chamber, and the third conduit and the fourth conduit are separate and distinct. This implementation offers an adaptive gas generator with a second igniter that can be fired independently of the first one, and the design of the third and of the fourth conduit guarantees that the gases and/or particles from the second igniter do not arrive at the diffusion before the second inflation gases created by the two inflation means contained in the second chamber because the third and the fourth conduit do not have common parts.

The connecting piece advantageously comprises a fifth direct communication conduit between the first and the second chamber, distinct and separate from the other communication conduits. This fifth conduit permits a communication between the chambers in order to balance pressures or create inflation functions combining the two chambers.

This first chamber advantageously comprises a first storage piece with a cylindrical form and a single opening constructed at one end and closed by the connecting piece in order to form an enclosed area, and this second chamber comprises a second storage piece with a cylindrical form and a single opening constructed at one end and closed by the connecting piece in order to form a second enclosed area. The storage pieces can be realized in a simple manner and the assembly on the connecting piece allows the chambers to be closed.

The first inflation means are advantageously guided by a first nozzle in order to create the first inflation gases in a first predetermined time and the second inflation means are guided by a second nozzle in order to create the second inflation gases in a second predetermined time and the first nozzle and the second nozzle are exclusively constructed on the connecting piece. The nozzles are constructed on the connecting piece and the storage pieces are simple pieces with a single opening without precise and expensive machining.

The gas generator advantageously comprises a first cover obturating the first conduit and the second conduit and the first conduit, the second conduit and the first cover are designed in such a manner that the gases and/or particles of the first igniter open the obturation of the second conduit when the first igniter is fired, and the gas generator comprises a second cover obturating the third conduit and the fourth conduit, and the third conduit, the fourth conduit and the second cover are designed so that the gases and/or particles of the second igniter open the obturation of the third conduit when the second igniter is fired. The construction of the covers on two conduits permits the construction of the gas generator to be simplified.

The first inflation means and the second inflation means advantageously comprise compressed gas.

The second inflation means advantageously comprise water in liquid form. This inflation means is economical and the water can be vaporized by the first inflation gases, which reduces the temperature and their aggressivity on the airbag.

The connecting piece is advantageously a metallic piece molded or deformed by beating.

The connecting piece advantageously comprises two diffusion orifices of which one is designed to be obturated when the gas generator is assembled in an airbag module.

A second aspect of the invention is an airbag module comprising a gas generator in accordance with the first aspect of the invention.

A third aspect of the invention is a vehicle comprising at least one gas generator in accordance with the first aspect of the invention.

Other characteristics and advantages of the present invention will appear more clearly upon a reading of the following detailed description of an embodiment of the invention given by way of non-limiting example and illustrated by the attached drawings in which:

- figure 1 represents a gas generator in accordance with the invention in isometric section;

- figure 2 represents the gas generator of figure 1 along section 2-2.

Figure 1 represents a gas generator comprising two storage chambers for compressed gases 20 and 30 formed essentially by storage pieces 21 and 31 connected to one another by a connecting piece 10. Chambers 20 and 30 are closed by a cover that is not shown for reasons of clarity. The connecting piece 10

hold two igniters (not shown) in place in the housings 11 and 12 for reasons of clarity. These housings 11 and 12 empty into the conduits 13 and 14. The connecting piece 10 also comprises a diffusion orifice 15 for gases to the airbag (not shown). As will be explained with figure 2, the orifice 15 communicates directly with each of the chambers 20 and 30. Finally, the connecting piece also comprises a connecting conduit 16 between the chamber 20 and the chamber 30. This conduit 16 offers several functions : the pressure between the chambers 20 and 30 can therefore be balanced. If no igniter is installed in the housing 12 the gases of the chamber 30 can flow toward the chamber 20 and the outside through this conduit 16, or a superpressure created then by the functioning in the chamber 20 can pass via the conduit 16 and bring about the opening of an outlet conduit from the chamber 30. The conduit 16 can alternatively offer a possibility of a multistage operation with the second chamber 30 that would be a buffer chamber emptying into the first chamber via its conduit 16.

Figure 2 shows the generator of figure 1 in section along the axis 2-2. The connecting piece 10 comprises the conduits 17 and 18 that establish a communication between the diffusion orifice 15 and the chambers 20 and 30. The chamber 20 comprises the storage piece 21 that is closed by the connecting piece 10, and the cover 22 that covers the conduits 13 and 17 (and, if necessary, the conduit 16) renders the chamber 20 completely closed. In a similar manner the chamber 30 comprises the storage piece 31 that is closed by the connecting piece 10, and the cover 32 that covers the conduits 14 and 18 renders the chamber 30 completely closed. The functioning of the first chamber 20 of the generator is as follows: when the first igniter is fired, it produces gases and/or particles that are immediately directed by the conduit 13 toward the chamber 20. The hot gases and/or particles emitted by the first igniter into the conduit 13 increase the pressure

in such a manner that the cover 22 is broken by these gases and/or particles that can enter into the chamber 20 according to arrow A. As soon as the cover 22 is broken, the gases delivered by the chamber 20 can exit in a concomitant manner from the chamber through conduit 17 in order to go toward the diffusion orifice 15. The conduits 17 and 13 are separate and distinct and the gases and/or particles from the igniter cannot arrive at the diffusion orifice 15 before the compressed gases initially contained in the chamber 20. It is possible to envision including propellant in the chamber 20 that can be ignited by the gases and/or particles from the igniter in order to increase the inflation capacities of the gas generator. The same functioning scheme applies to the chamber 30.

It is understood that various modifications and/or improvements obvious to a person skilled in the art can be added to the different embodiments of the invention described in the present specification without leaving the scope of the invention defined by the attached claims. In particular, mention is made of chambers containing compresses gases and it can be envisioned replacing the compressed gases by propellant that would alone ensure the inflation of the airbag.

CLAIMS

1. A gas generator for inflating an automobile airbag, comprising

- at least a first igniter suitable to be fired in order to release gases and/or particles,

- at least first inflation means suitable for being released by the gases and/or the particles of the firing igniter for creating the first gases for inflating the automobile airbag,

- at least a first chamber (20) containing the first inflation means,

- a connecting piece (10) holding in place this first igniter and this first chamber,

which connecting piece (10) comprises at least one diffusion orifice (15) toward the automobile airbag of the unit of the first inflation gases, a first direct communication between this first igniter and this first chamber (20) and a second direct communication between this first chamber (20) and this at least one diffusion orifice (15), characterized in that the first communication and the second communication are designed in such a manner that the first inflation gases created by the first inflation means arrive at this at least one diffusion orifice (15) before the gases and/or particles of this first igniter.

2. The gas generator according to claim 1, characterized in that the first direct communication and the second direct communication are designed so that all the gases and/or particles from the igniter pass through this first chamber before arriving at this at least one diffusion orifice.

3. The gas generator according to one of claims 1 or 2, characterized in that the first direct communication is a first direct communication conduit (13) and that the second direct communication is a second direct communication conduit (17), and that the first conduit (13) and the second conduit (17) are separate and distinct.

4. The gas generator according to claim 3, characterized in that it comprises:

- second inflation means suitable for being released by gases and/or particles of the first inflation means in order create second inflation gases of the automobile airbag,

- a second chamber (30) containing the second inflation means,

and that the connecting piece (10) holds in place the second chamber (30) and comprises a third direct communication conduit (18) between the second chamber (30) and this at least one diffusion orifice (15).

5. The gas generator according to claim 3, characterized in that it comprises:

a second igniter suitable for being fired in order to release gases and particles,

- second inflation means suitable for being released by the gases and/or the particles of the second igniter in order to create second inflation gases of the automobile airbag,

- a second chamber (30) containing the second inflation means,

and that the connecting piece (10) comprises a third direct communication conduit (18) between the second chamber (30) and this at least one orifice (15) for the

diffusion of the second inflation gases to the automobile airbag and a fourth direct communication conduit (14) between

the second igniter and the second chamber (30), and that the third conduit (18) and the fourth conduit (14) are separate and distinct.

6. The gas generator according to one of claims 4 or 5, characterized in that the connecting piece (10) comprises a fifth direct communication conduit (16) between the first and the second chamber (20, 30) distinct and separate from the other communication conduits.

7. The gas generator according to one of claims 4 to 6, characterized in that this first chamber (20) comprises a first storage piece (21) with a cylindrical form and a single opening constructed at one end and closed by the connecting piece (10) in order to form an enclosed area, and that this second chamber (30) comprises a second storage piece (31) with a cylindrical form and a single opening constructed at one end and closed by the connecting piece (10) in order to form a second enclosed area.

8. The gas generator according to one of claims 4 to 7, characterized in that The first inflation means are guided by a first nozzle in order to create the first inflation gases in a first predetermined time, and that the second inflation means are guided by a second nozzle in order to create the second inflation gases in a second predetermined time, and that the first nozzle and the second nozzle are exclusively constructed on the connecting piece (10).

9. The gas generator according to one of claims 5 to 8, that are dependent on claim 4, characterized in that it comprises a first cover (22) obturating the first conduit (13) and the second conduit (17), that the first conduit (13), the second

conduit (17) and the first cover (22) are designed in such a manner that the gases and/or particles of the first igniter open the obturation of the second conduit (17) when the first igniter is fired, that the gas generator comprises a second cover (32) obturating the third conduit (18) and the fourth conduit (14), and that the third conduit (18), the fourth conduit (14) and the second cover (32) are designed so that the gases and/or particles of the second igniter open the obturation of the third conduit (18) when the second igniter is fired.

10. The gas generator according to one of claims 4 to 9, characterized in that the first inflation means and the second inflation means comprise compressed gas.

11. The gas generator according to one of claims 5 to 8, characterized in that The second inflation means comprise water in liquid form.

12. The gas generator according to one of claims 1 to 11, characterized in that the connecting piece is a metallic piece molded or deformed by beating.

13. The gas generator according to one of claims 1 to 12, characterized in that the connecting piece comprises two diffusion orifices of which one is designed to be obturated when the gas generator is assembled in an airbag module.

14. A module airbag comprising a gas generator in accordance with one of claims 1 to 13.

15. An automobile vehicle comprising at least one gas generator in accordance with one of claims 1 to 13.

Fig. 1

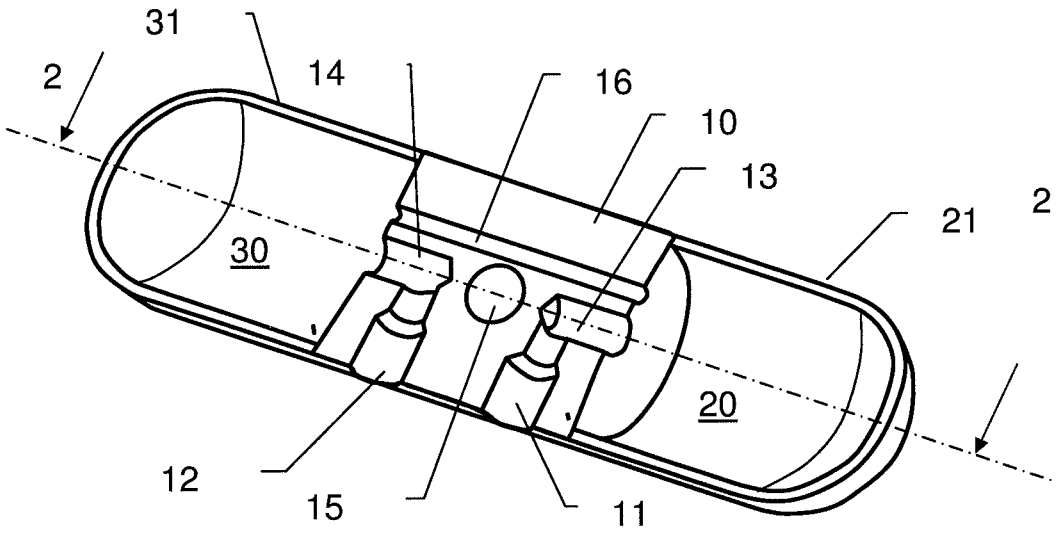
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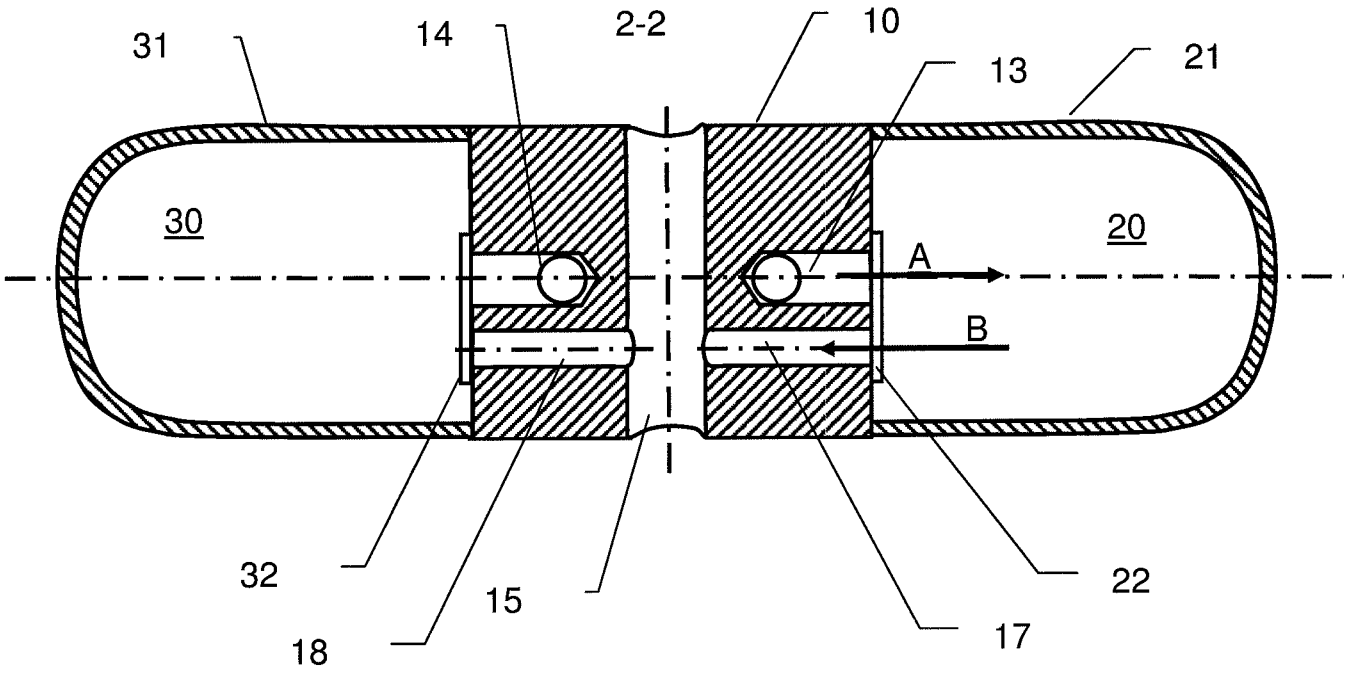
Fig. 2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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE201 2/051 346

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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: B60R

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 200501 461 2 1 A 1 (CAMPBELL DOUGLAS P ET AL), 7 July 2005 (2005-07-07); whole document --	1-3, 12-1 5
A	US 5651 563 A (CUEVAS JESS A), 29 July 1997 (1997-07-29); column 4, line 28 - column 4, line 56; figures 1-2 --	1-15
A	US 200401 9581 2 A 1 (CANTERBERRY JB ET AL), 7 October 2004 (2004-1 0-07); paragraph [0024]; figures 1, 4 --	1-15
A	US 20050062273 A 1 (MATSUDA NAOKI ET AL), 24 March 2005 (2005-03-24); paragraphs [0073]-[0076]; figure 1 -- --------	4

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

* Special categories of cited documents:

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13-03-201 3	14-03-201 3

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-1 02 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Annelie Persson Telephone No. +46 8 782 25 00

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Continuation of: second sheet

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US	200501 461 2 1 A 1	07/07/2005	DE	2001 0 176	U 1	23/1 1/2000
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			EP	1602536	B 1	03/1 2/2008
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			US	7 13 1663	B 1	07/1 1/2006
			US	7 12 1582	B2	17/1 0/2006
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