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(54) Title: PYROTECHNICAL GAS GENERATOR FOR AN AIRBAG.

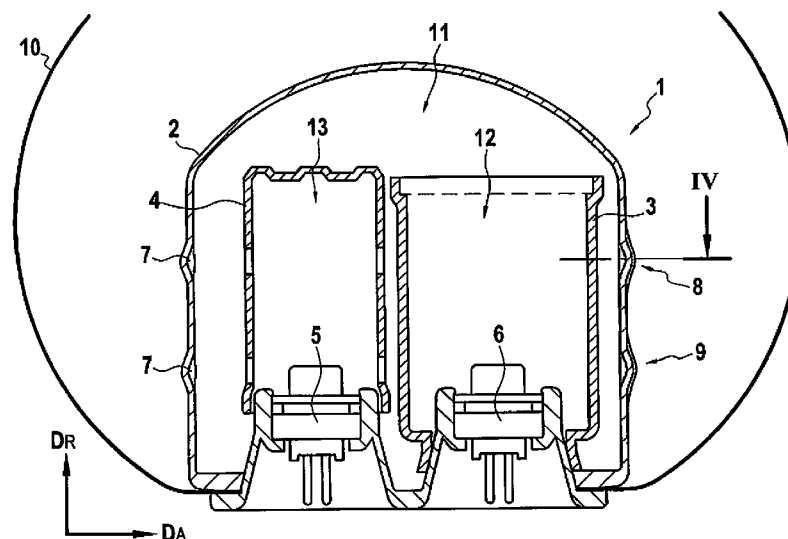


FIG.1

(57) Abstract: A pyrotechnical gas generator (1) comprising at least one pyrotechnical charge, at least one ignitor (5, 6), and a cylindrical casing (2) enclosing said at least one charge and said at least one ignitor (5, 6), said cylindrical casing (2) having an axial direction (DA) and a radial direction (DR) and comprising an annular wall (20) extending along said axial direction (DA) of said casing (2), and gas ejection holes (7) arranged on said annular wall (20). Each gas ejection hole (7) extends in a output plan (P) forming a non-zero angle (a) with a tangential plan (T) which is tangent to said annular wall (20) at said gas ejection hole (7).

MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

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— *with international search report (Art. 21(3))*

Title of the invention

Pyrotechnical gas generator for an airbag.

5 Background of the invention

The invention relates to an inflator, and in particular to a pyrotechnical gas generator designed to inflate the bag of an airbag. The present invention further relates to an airbag device having such an inflator.

10 An inflator for use in an airbag device for a passenger seat generally comprises a cylindrical casing having holes for discharging gas disposed on the peripheral surface thereof, propellant filled in the casing, booster for causing gas evolution of the propellant, an electrical igniter for igniting the booster, and auto ignition material having a lower firing
15 temperature than the firing temperature of the booster. The casing is generally made of steel or stainless steel.

The current nozzles used in the inflators to provide gas jets are generally round holes made in the steel casing, sealed by a film, and which usually have diameters between 2 mm and 4 mm for frontal disc
20 shape inflators. The number of holes is usually between 4 to 16. As gas is generated by the propellant, the film is broken by the gas pressure. The cylindrical inflator of this type is sometimes used for an airbag device for a driver seat.

In the field of devices for automotive applications, constructors
25 are always looking after new solutions which can bring weight and cost decrease. In an inflator, the filtering device represents a non-negligible part of its total weight.

The filtering device used in a pyrotechnical gas generator has currently three main functions which are:

- 30
- decreasing the gas temperature so that the exhaust gas does not damage the bag,
 - avoiding having particles emitted by the inflator which can make pin holes in the bag, and,
 - keeping slag and particles inside the inflator to meet
35 solid effluents expected level.

Some low burning temperature compositions are used in pyrotechnical gas generators to reduce their total weight as they can exhibit an exhaust gas temperature and an aggressiveness of the jets allowing a significant decrease in the size, and thus the weight, or even a
5 cancellation of the filtering device in the inflator. Indeed, the low burning temperature compositions allows decreasing the burning temperatures and improve the slagging effect with less particles.

However, these compositions are not sufficient on their own to meet all the requirements allowing the removal of the filtering device in a
10 pyrotechnical gas generator designed to be used in an airbag.

Object and summary of the invention

The invention aims to solve the aforementioned problems, by providing a pyrotechnical gas generator for an airbag with a reduced
15 weight, and furthermore, providing a light pyrotechnical gas generator with a maximized output gas flow and a minimized jet's aggressiveness.

This goal is reached thanks to a pyrotechnical gas generator comprising at least one pyrotechnical charge, at least one ignitor, and a cylindrical casing enclosing said at least one charge and said at least one
20 ignitor, said cylindrical casing having an axial direction and a radial direction and comprising an annular wall extending along said axial direction, and gas ejection holes arranged on said annular wall for letting the inside of the casing to communicate with the outside of the casing.

According to a general feature of this pyrotechnical gas
25 generator, each gas ejection hole extends in a output plan forming a non-zero angle with a tangential plan which is tangent to said annular wall at said gas ejection hole.

Having an output section forming a non-zero angle with a tangential plan provides the gas jet with a tangential component, thus
30 reducing the aggressiveness of the gas jet on the parts of an object cooperating with the gas generator close to the gas generator.

The energy delivered in the radial direction is reduced and therefore the energy is smoothen.

In a preferred embodiment of the pyrotechnical gas generator,
35 the output plan forms an angle with the tangential plan which is strictly superior to 90°.

In a first aspect of the pyrotechnical gas generator, each gas ejection hole comprises a notch extending along said axial direction and the casing is stamped on one same side of each notch.

5 Realising the gas ejection holes with a notch and a stamping on one side simplifies to a minimum the production of the holes.

In a second aspect of the pyrotechnical gas generator, the casing comprises more than sixteen gas ejection holes arranged homogeneously around said annular wall.

10 The great number of gas ejection holes, i.e. nozzles, allows to smoothen the energy homogeneously on a higher area and increase the flow of gas delivered by the gas generator while maintaining a low radial aggression of the gas jets.

In a third aspect of the pyrotechnical gas generator, the notch of each gas ejection hole has a length less than or equal to 1 mm .

15 The small size of the notch, first, allows reducing the energy delivered by each hole, and, second, enables the gas ejection hole to act as a filter for big particles which could make pin holes in the bag of an airbag cooperating such a gas generator.

20 The casing can therefore integrate the function of a filtering device, thus reducing the total weight of the pyrotechnical gas generator as a separate filtering device is no longer needed.

In a fourth aspect of the pyrotechnical gas generator, the gas ejection holes are arranged on several rings running along the annular wall.

25 Arranging the gas ejection holes on several rings allows increasing the number of holes and thus increasing the flow of gas delivered.

30 In a fifth aspect of the pyrotechnical gas generator, the casing is made of a thin sheet of metal and each gas ejection hole comprises some least resistance lines along which the hole will preferably deform or tear itself to enlarge the opening in case of a too high pressure difference between inside and outside the casing.

35 In a sixth aspect of the pyrotechnical gas generator, the casing's resistance between two adjacent gas ejection holes along the axial direction is less than a threshold so that the casing can be slightly

torn up in case of overpressure to increase the gas ejection holes area and decrease the pressure, thus limiting the risks of explosion of the casing.

In another object of the invention, it is proposed an airbag assembly comprising a bag and a pyrotechnical gas generator as defined
5 here above and acting as an inflator, said bag being sealed around said pyrotechnical gas generator in an air tight manner.

Brief description of the drawings

The invention will be better understood by reading here after,
10 as examples and in a non-limitative way, in reference to the enclosed drawings on which:

- Figure 1 shows schematically a view in section of an airbag assembly comprising a bag and a pyrotechnical gas generator according to an embodiment of the
15 invention;
- Figure 2 shows a view in perspective of the casing of the pyrotechnical gas generator of figure 1;
- Figure 3 shows a zoomed in view of a portion III of the gas ejection hole of the casing of figure 2;
- 20 – Figure 4 represents a section view according to a plan IV of Figure 3.

Detailed description of the embodiments

The present invention will be described with respect to
25 particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. Where the term "comprising" is used in the
30 present description and claims, it does not exclude other elements or steps. Where an indefinite or definite article is used when referring to a singular noun e.g. "a" or "an", "the", this includes a plural of that noun unless something else is specifically stated.

The term "comprising", used in the claims, should not be
35 interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. Thus, the scope of the expression "a

device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

5 Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the
10 invention described herein are capable of operation in other sequences than described or illustrated herein.

In figure 1 is schematically presented a view in section of an airbag assembly comprising a bag 10 and a pyrotechnical gas generator 1
15 according to an embodiment of the invention.

The bag 10 is attached to the pyrotechnical gas generator 1 in an airtight manner.

The pyrotechnical gas generator 1, or inflator, has a cylindrical casing 2 made of metal such as steel or stainless steel. The inside of the
20 casing 2 defines a first chamber 11.

The pyrotechnical gas generator 1 further comprises a first cylindrical partition 3 and a second cylindrical partition 4. The inside of the first cylindrical partition 3 defines a second chamber 12 and the inside of the second cylindrical partition 4 defines an ignition chamber 13. The first
25 chamber 11 is thus defined by the space left inside the casing 2 once the two cylindrical partitions 3 and 4 have been inserted in the casing 2. The second partition wall 4 defining the ignition chamber 13 is perforated in order to communicate with the first chamber 11.

Filled in the first and second chambers 11 and 12 are gas
30 generant for generating gases, respectively, and filled in the ignition chamber 13 is an ignition load. The second chamber 12 and the ignition chamber 13 are both provided with ignitors 5, 6. The electrical ignitors 5 and 6 have a wire generating heat by electricity and explosive. When the wire is turned on an electric current, the ignitor is fired and thereby the
35 generant or the ignition load is ignited so that the generant initiates the gas evolution.

As illustrated on Figure 2 which shows a view in perspective of the casing 2 of the pyrotechnical gas generator 1 of figure 1, the casing 2 is cylindrical with an annular surface 20 extending along the axial direction D_A and defining a tube. The annular surface 20 extends along the axial direction D_A from a top wall 25 extending in the radial direction D_R .

The annular surface 20 comprises a plurality of gas ejection openings, or nozzles, 7 for allowing gas to spout from the first chamber 11 of the casing 2 and inflate the bag 10.

As illustrated on figure 2 and on figure 3 which is a zoom of part III of figure 2, each nozzle 7 is made by, first, cutting a notch 70 into the annular surface, the notch 70 extending along said axial direction D_A , and, second, stamping the casing 2 on one side of the notch 70, the stamping 75 being made from the inside of the casing 2 to deform the casing 2 towards the outside, i.e. away from the axial centre of the casing 2. The stamping 75 is made on the same side of each notch 70 for every nozzle 7.

As illustrated on figure 4 which represents a section view according to a plan IV comprising the radial direction D_R and perpendicular to the axial direction D_A of the casing 2, the notch 70 and the stamping 75 cooperate to define an output section of the nozzle 7 extending in a first plan P comprising the axial direction D_A , the first plan P forming a non-zero angle α with a second plan T which is tangent to the annular wall 20 at the notch 70 and comprises the axial direction D_A . In other words, the first plan P and the second plan T both comprise the axial direction D_A but are distinct from each other, thus forming an angle α which cannot have a value equal to zero or 180° . The non-zero angle α formed by the first and second plans P and T ensures that the gas jet ejected from the nozzle is not purely radial, i.e. is not directed only along the radial direction D_R , but comprises a tangential component, i.e. comprises a radial component and a tangential component, thus reducing the aggressiveness of the jet on the bag.

In a preferred embodiment, the angle α formed by the first and the second plans P and T is strictly superior to 90° , and in particular slightly superior to 90° , for example between 92° and 100° .

In the embodiment illustrated on figures 2 and 3, the casing 2 comprises forty-four nozzles 7 arranged on two rings 8 and 9 running

around the annular wall 20 at two different positions along the axial direction D_A . Each notch 70 of each nozzle 7 has a length of 0.5 mm.

The nozzles 7 thus integrate the gas ejection function together with the filtering function for big particles which could make pin holes in the bag of an airbag cooperating such a gas generator 1.

In this embodiment, the casing's resistance between two adjacent nozzles 7 along the axial direction D_A is less than a threshold so that the casing can be slightly torn up in case of overpressure to increase the nozzles area and decrease the pressure, thus limiting the risks of explosion of the casing 2.

The casing 2 is an external casing configured to be directly in contact with the external environment of the pyrotechnical gas generator 1, i.e. the most external casing of the pyrotechnical gas generator 1. In the airbag assembly of figure 1, the casing 2 is thus the most external casing of the gas generator 1, and is regarding the bag 10 of the airbag assembly, no other element, such as another casing or a filter for example, being positioned between the casing 2 and the bag 10.

The invention provides thus a pyrotechnical gas generator for airbag, and an airbag, with a reduced weight and a maximized output gas flow and a minimized jet's aggressiveness.

CLAIMS

1. A pyrotechnical gas generator (1) comprising at least one pyrotechnical charge, at least one ignitor (5, 6), and a cylindrical casing (2) enclosing said at least one charge and said at least one ignitor (5, 6), said cylindrical casing (2) having an axial direction (D_A) and a radial direction (D_R) and comprising an annular wall (20) extending along said axial direction (D_A) of said casing (2), and gas ejection holes (7) arranged on said annular wall (20),
- 10 characterized in that said cylindrical casing (2) defines a chamber (11) comprising a cylindrical partition (4) defining an ignition chamber (13) enclosing an ignition load and an ignitor (5), and
- each gas ejection hole (7) extends in a output plan (P) forming a non-zero angle (α) with a tangential plan (T) which is tangent to said annular wall (20) at said gas ejection hole (7).
- 15
2. The pyrotechnical gas generator (1) according to claim 1, the output plan (P) forms an angle (α) with the tangential plan (T) which is strictly superior to 90° .
- 20
3. The pyrotechnical gas generator (1) according to any of claims 1 or 2, wherein each gas ejection hole (7) comprises a notch (70) extending along said axial direction (D_A) and the casing (2) is stamped on one same side of each notch (70).
- 25
4. The pyrotechnical gas generator (1) according to any of claims 1 to 3, wherein the casing (2) comprises more than sixteen gas ejection holes (7) arranged homogeneously around said annular wall (20).
- 30
5. The pyrotechnical gas generator (1) according to any of claims 1 to 4, wherein the notch (70) of each gas ejection hole (7) has a length less than or equal to 1 mm.
- 35
6. The pyrotechnical gas generator (1) according to any of claims 1 to 5, wherein the gas ejection holes (7) are arranged on several rings (8, 9) running along the annular wall (20).

7. The pyrotechnical gas generator (1) according to any of claims 1 to 6, wherein the casing (2) is made of a thin sheet of metal and each gas ejection hole (7) comprises some least resistance lines along which the hole (7) will preferably deform or tear itself to enlarge the opening in case of a high pressure difference between inside and outside the casing (2).

8. The pyrotechnical gas generator (1) according to claim 3 in combination with any of claims 2 and 4 to 7, wherein the casing's resistance between two adjacent gas ejection holes (7) along the axial direction (D_A) is less than a threshold.

9. The pyrotechnical gas generator according to any of claims 1 to 8, wherein said cylindrical casing (2) is an external casing configured to be directly in contact with the external environment of the pyrotechnical gas generator (1).

10. An airbag assembly comprising a bag (10) and a pyrotechnical gas generator (1) according to any of claims 1 to 9 acting as an inflator, said bag (10) being sealed around said pyrotechnical gas generator (10) in an air tight manner.

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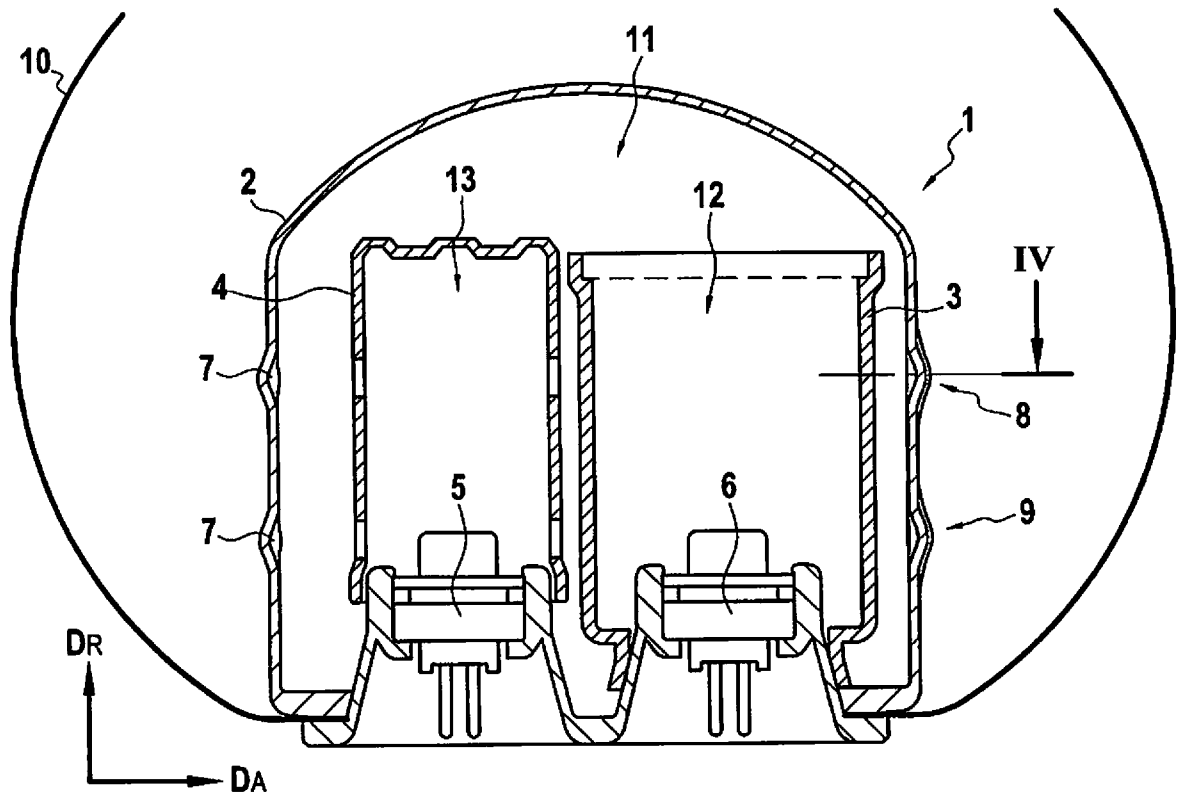


FIG.1

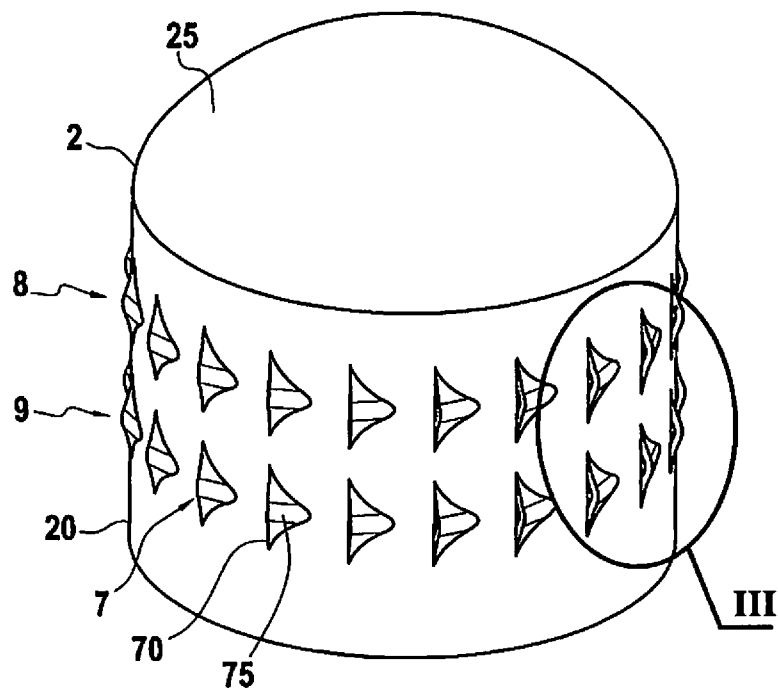


FIG.2

2/2

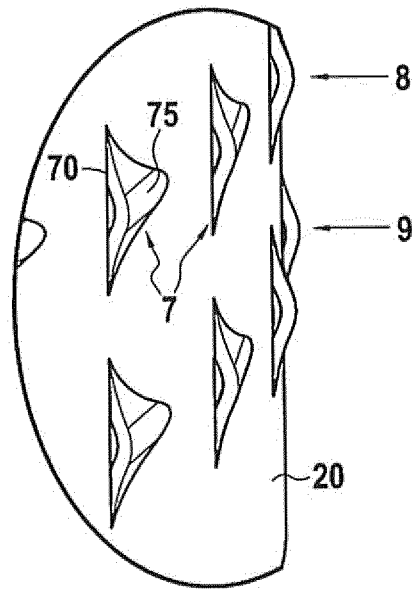


FIG.3

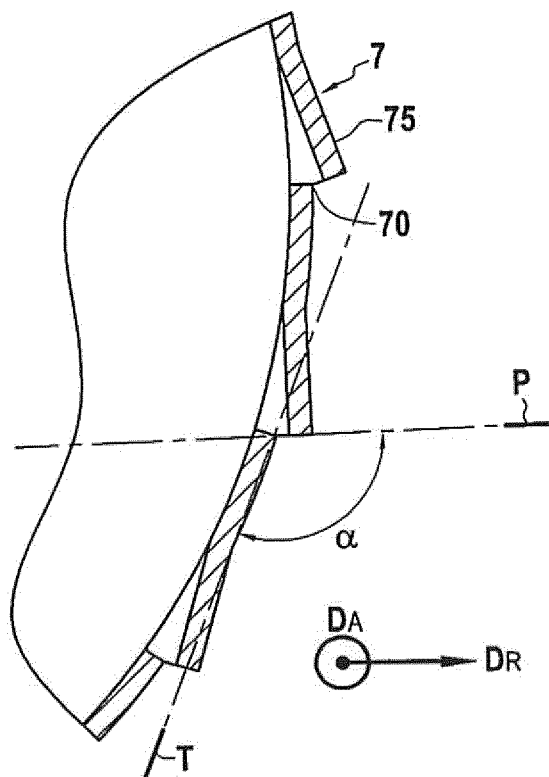


FIG.4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/065609

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R21/264
ADD.

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)
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 practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2015/128799 A1 (LAUBACHER BRIAN A [US] ET AL) 14 May 2015 (2015-05-14) paragraphs [0036], [0042], [0046], [0047], [0050]; figures 1-3 -----	1-4
A	DE 197 16 652 A1 (BIEMOLD WILHELM [BE]) 22 October 1998 (1998-10-22) column 3, lines 55-65; figure 3 -----	1-3
A	DE 195 05 580 A1 (DYNAMIT NOBEL AG [DE]) 22 August 1996 (1996-08-22) column 3, lines 26-40; figures 1,2 -----	1
A	WO 2015/042126 A1 (KEY SAFETY SYSTEMS INC [US]) 26 March 2015 (2015-03-26) paragraphs [0009], [0040]; figures 1,1A,4 -----	6,7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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