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## EUROPEAN QUALIFYING EXAMINATION

# Paper B (MOCK)

**This paper comprises:**

| | |
|---|---|
| *** Description of the application** | **MOCK/B/EN/1-4** |
| *** Claims** | **MOCK/B/EN/5** |
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**Description of the application**

Airbag modules

**[0001]** Airbag modules consist of a control unit, a gas generator and a cushion, i.e. an inflatable bag. In a collision, the control unit activates the gas generator, which delivers a quantity of gas that fills the cushion to a certain pressure within milliseconds. The pressurized cushion expands between the occupant and an object, for example the dashboard or the steering-wheel, thereby providing a decelerating and cushioning effect that will protect the occupant upon impact.

**[0002]** During the collision, the occupant is forced against this cushion, thereby compressing it. As a result, the pressure inside the gas-filled cushion is increased. During major impacts (for example, when an occupant is not wearing a seat belt) the pressure may rise in the cushion to such an extent that the cushion becomes so hard that it can cause injuries to the occupant. The same can also occur when the gas generator produces a large amount of gases. Therefore, the presence of a pressure regulating valve is essential when large amounts of gases are generated by the gas generator.

**[0003]** The aim of the invention is to avoid impact injuries.

**[0004]** Figure 1 shows the deployment of an airbag.

**[0005]** Figures 2 (a) - (c) show a fully deployed airbag and a valve.

**[0006]** Figures 3 (a) - (c) show the airbag with a valve when the occupant strikes against it.

**[0007]** Figure 4 shows a gas generator.

**[0008]** As can be seen in Figure 1, the airbag module of the invention, which also has a control unit (not shown) to control its activation, comprises a gas generator 1 and a fabric cushion 2. Prior to being placed inside the module, the fabric cushion 2

is rolled up in such a way that when the airbag is activated, the fabric rolls out along a deployment surface, for example the windscreen 13. If the airbag is stored in this way, the windscreen 13 is covered rapidly at a very early inflation stage. The deployment time is reduced, thereby increasing occupant safety.

**[0009]** As seen in Figures 2 (a) - (c), the fabric cushion 2 always comprises a pressure regulating valve 3, i.e. a device that regulates the pressure inside the fabric cushion 2 by regulating the flow of gas exiting the fabric cushion. This adapts the hardness of the cushion 2 according to the situation. The valve comprises a strip 10 that covers at least partially a vent-hole 5 provided in the wall of the fabric cushion 2. During the expansion of the cushion the strip 10 closes the vent-hole 5, because the pressure inside the cushion chamber is not enough to deform the strip. This allows a rapid expansion of the airbag. The strip 10 may be an elastic membrane, i.e. an expandable and pliable barrier that changes shape when exposed to an outside force or pressure. The elastic membrane 10 may be made of silicone attached to the cushion 2 by a rubber-based adhesive 9, which creates a bond with strongly increased strength, as compared to other attachment means such as stitches. Rubber-based adhesives are well-known in the art. Although often used, non-elastic membranes are less suitable for as strip 10 as they tear easily.

**[0010]** As seen in Figure 3, when the occupant of a vehicle is thrown forward against the cushion 2 due to a rapid deceleration of the vehicle, the cushion 2 will be compressed by a large force, creating a rise in pressure. If, due to the magnitude of the impact, the pressure surpasses a certain threshold, the valve will allow gas to be liberated from inside the cushion, relieving the pressure in the cushion during its compression. This prevents the airbag from becoming excessively hard during high impact collisions.

**[0011]** The fabric cushion of the airbag can be made of polyester and can be coated with a polyamide resin. As compared to uncoated fabrics, a polyamide resin coating, for example Nylon, will give the fabric a better resistance to flames, which might be produced by the gas-generating composition, but does not compromise the flexibility of the fabric, since it does not make it heavy and stiff as other coatings known in the art do.

**[0012]** As seen in Figure 4, the gas generator 1 for the airbag module of the invention comprises a housing 20. This housing 20 can be made of cuzinal, a copper-zinc alloy, and filled with a gas-generating composition. An igniter 21 is located inside the housing 20 with the gas-generating composition (not shown). Upon ignition the gas-generating composition turns into gas and is expelled out of the housing and into the fabric cushion 2 through the outlets 22. The igniter 21 can be activated by induction through a magnetic field from outside the generator 1 and be not electrically connected to the outside of the generator 1. These induction igniters are more reliable, because they are less exposed to moisture from the outside and cannot be set off by static discharge as in the case of other types of electrical igniters.

**[0013]** The gas-generating composition used in the invention comprises guanidine borate and ammonium perchlorate. Within the same amount of time, this combination produces a much larger amount of gas than any other known combinations. The composition may additionally comprise another component, for instance sodium nitrate, which results in the generated gas having a lower temperature. Gas having a high temperature should be avoided if possible since it might heat up the fabric and burn the occupant.

**[0014]** The composition comprising sodium nitrate produces a flame. As an alternative to sodium nitrate, we found that potassium sulphate, a specific member of the family of sulphates, can be added to the composition. The composition with potassium sulphate not only produces large amounts of gas of a lower temperature, but also surprisingly and contrary to all other known additives, prevented the formation of flames during the gas-generating reaction in all the compositions we tested. An advantage of this lack of flames is that the fabric of the cushion cannot catch fire. This opens new dimensions in the choice of suitable fabrics as coating is no longer required.

**[0015]** The weight ratio of guanidine borate to ammonium perchlorate usually determines the speed at which gas is generated. Surprisingly, internal research, which tested weight ratios ranging from 1:1 to 10:1, showed that when a weight ratio

between 2:1 and 5:1 is used in the presence of potassium sulphate, the gas generation is much faster than the gas generation observed at any other weight ratio. Unfortunately, this effect is not observed with sodium nitrate.

Claims

1. An airbag module for protecting a vehicle occupant in a collision comprising:
- a control unit;
- a gas generator (1) comprising a housing (20) and a gas-generating composition generating gases upon ignition; and
- a fabric cushion (2) comprising a pressure regulating valve (3).

2. The airbag module according to claim 1 wherein the valve (3) comprises: an elastic membrane (10) at least partially covering a vent-hole (5) provided in the fabric cushion (2), the membrane (10) being attached to the cushion (2) by means of a rubber-based adhesive (9).

3. The airbag module according to claim 1 or 2 wherein a gas is generated by a composition comprising guanidine borate, ammonium perchlorate, and either sodium nitrate or potassium sulphate, the gas-generating composition being present inside the housing (20).

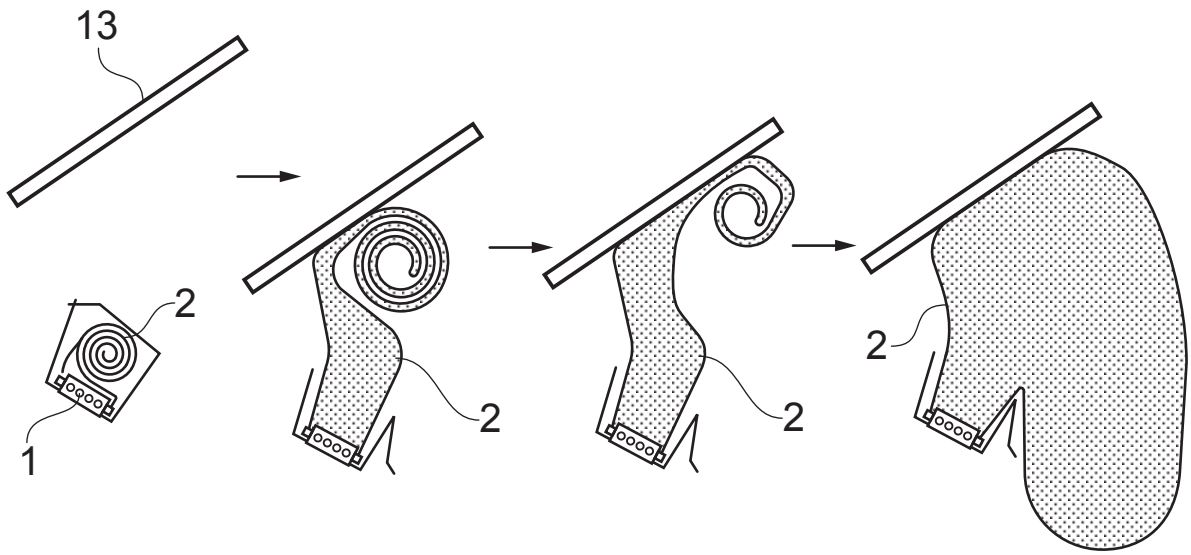


FIG. 1

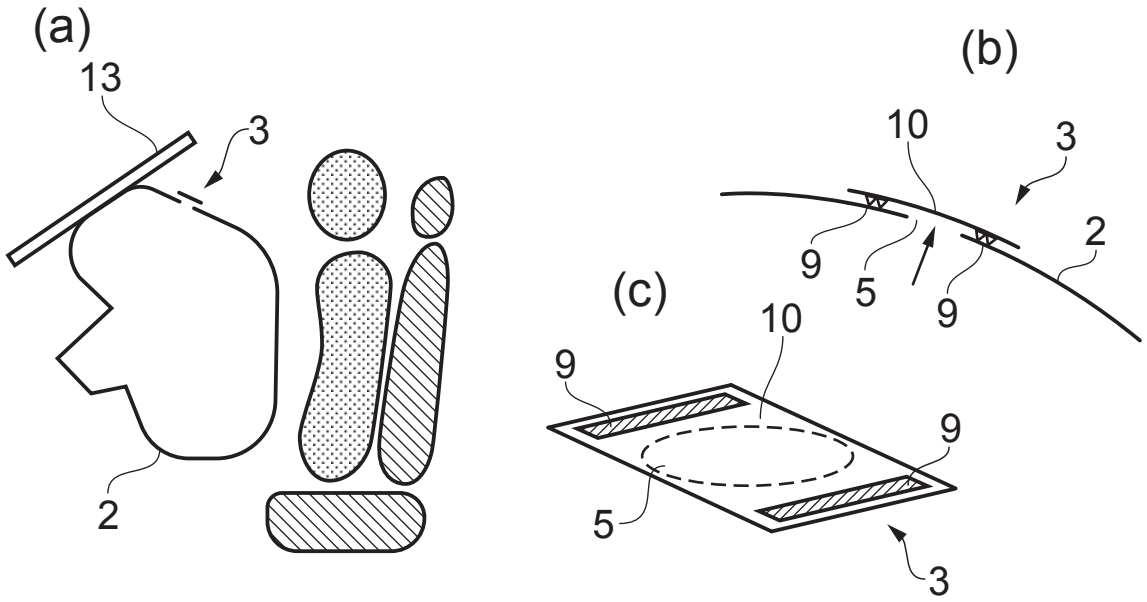


FIG. 2

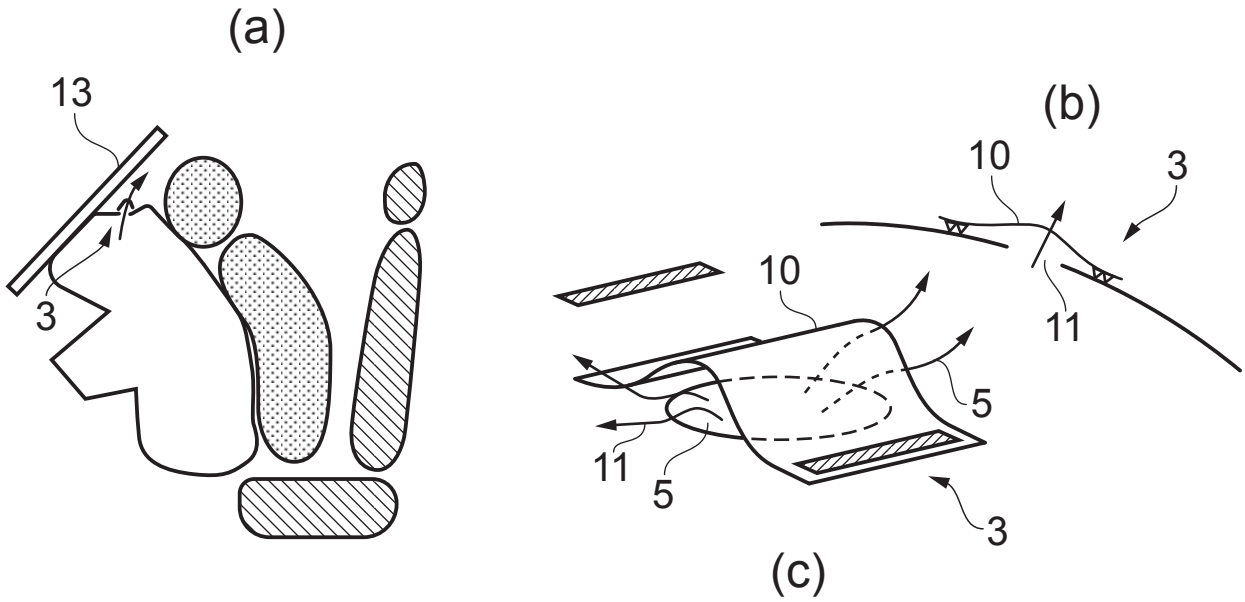


FIG. 3

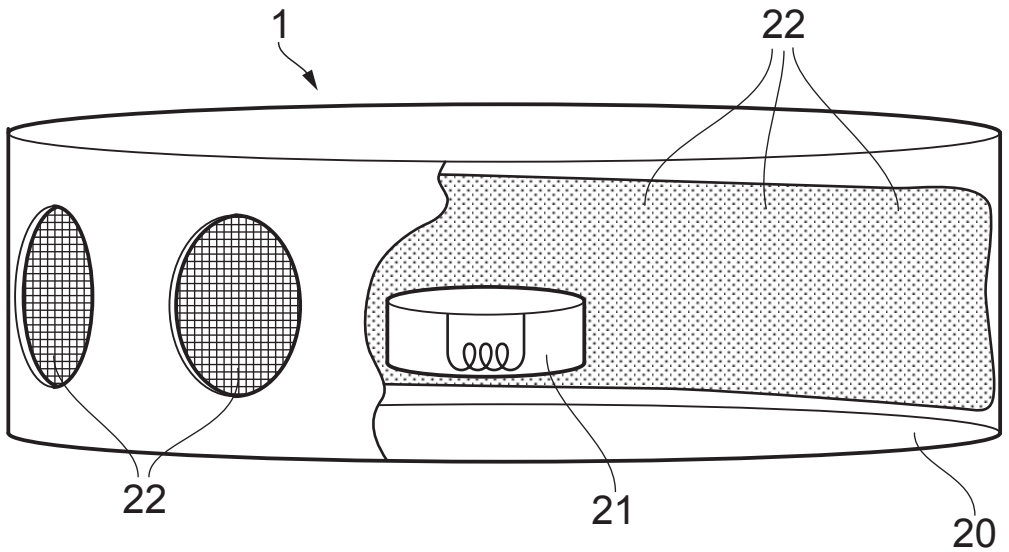


FIG. 4

**Communication under Article 94(3) EPC**

1. This communication is based on the application as originally filed. Attached documents D1 and D2 are prior art according to Article 54(2) EPC.

2. Document D1 discloses an airbag module for protecting a vehicle occupant in a collision, said airbag module comprising a control unit, a gas generator comprising a housing (see [0003] of D1) and a fabric cushion comprising a pressure regulating valve (see [0005]-[0007] of D1).
Moreover, according to D1 (see [0007]), said pressure regulating valve can be made of an elastic membrane at least partially covering the vent-hole and attached to the cushion by means of a rubber-based adhesive.
The subject-matter of claims 1 and 2 is therefore not novel in the sense of Article 54 EPC.

3. Document D2 discloses different pyrotechnical powder compositions (see [0004]-[0007] of D2) for use in airbag and specifically discloses a composition comprising guanidine borate, ammonium perchlorate and sodium nitrate.
The person skilled in the art would have readily combined the teachings of D1 and D2 as they both refer to airbags.
The subject-matter of claim 3 is therefore not inventive in the sense of Article 56 EPC.

4. The subject-matter of claims 1 and 3 is unclear. The features “generating gases upon ignition” (claim 1) and “a gas is generated by a composition” (claim 3) are process steps, whereas the claims refer to a product. This is not allowable under Article 84 EPC, because all features of an apparatus claim have to be device features if possible.

5. If the applicant wishes to maintain the application, amended claims taking the above objections into account should be filed. These amended claims would need to satisfy the EPC's requirements with respect to novelty, inventive step, clarity and, where appropriate, unity of invention. They should also not feature any amendments

which cause the subject-matter to extend beyond the content of the application as originally filed (Article 123(2) EPC).

6. The letter of reply should set out the difference between the new claims and the prior art disclosed in documents D1 and D2 as well as its significance as regards inventive step. The technical problem underlying the invention compared with the closest prior art and the solution to that problem should emerge clearly from the applicant's arguments.

7. To make it easier to assess whether the amended claims comprise subject-matter which extends beyond the content of the application as filed, the applicant is urged to give an exact indication of the points in the application as filed to which the proposed amendments relate (Article 123(2) EPC).

**Document 1 (D1)**

**European Patent Application 98 249 563**

**Airbag module to be mounted in a dashboard**

**[0001]** The present invention relates to an inflatable airbag to be mounted in the dashboard of a vehicle. Such an airbag is intended to protect the passenger during a collision. According to the passenger's size and position, it is advantageous to fill the airbag with different amounts of gas in order to achieve different pressures.

**[0002]** The purpose of the invention is to provide a system to control the internal pressure of an airbag and adapt it to each passenger and situation in a simple manner, and hence to safeguard the passenger in an impact situation.

**[0003]** Figure 1 shows the airbag module of the present invention comprising a deployed fabric airbag 10 and a gas generator 2. The generator 2 comprises a housing that is made of any suitable metal for die-cast containers, for instance cuzinal.

**[0004]** When a safety processing unit 1 in the vehicle senses that impact has occurred or is imminent, it sends an electric pulse through a cable connected to an electric match 3 to activate the latter. The electric match 3 is an electrical conductor wrapped in lead azide, which is a highly combustible, fast reacting material. The activation of the electric match 3 ignites a gas-generating composition which is inside the generator 2, thus producing large quantities of gas that will be channelled into a restraint system to be activated.

**[0005]** The fabric bag 10 is made of a non-stretchable polyethylene terephthalate material (typically called "polyester" when used for fibres or fabrics, and "PET" when used for bottles and other packaging devices) and provided with a vent-hole 11 in the fabric. The vent-hole 11 is covered with a ribbon 12 made of the same fabric as the bag 10. As seen in Figure 1, the ribbon 12 is stitched to the fabric bag 10 on two opposed edges. The ribbon 12 has a loop 13 of excess fabric stitched to form a

tearable seam 14 close to one of the edges such that the vent-hole is covered by a portion of the ribbon in an air-tight manner.

**[0006]** During impact, a pressure spike is created inside the bag 10, thus generating a force towards the outside on the non-stretchable ribbon 12 through vent-hole 11. As shown in Figure 2, if this force exceeds a certain value, the seam 14 will tear and the excess fabric of the loop will be released, thereby creating an arch and uncovering the vent-hole 11. Gas is then expelled through the vent-hole 11, thus relieving the pressure and making the airbag softer.

**[0007]** In an alternative embodiment (not shown), the ribbon with the tearable seam 14 can be replaced by a ribbon made of elastic material, i.e. an expandable and pliable barrier that changes shape when exposed to an outside force or pressure. This elastic ribbon may be made of silicone attached to the fabric bag 10 by a rubber-based adhesive which is more suited than stitches when working with elastic material.

**[0008]** The generator 2 needs to generate enough gas to fill a large frontal airbag to the required pressure. Large volumes of gas are therefore necessary. Pyrotechnical powder compositions, also called pyrotechnical gas-generating systems, are preferred because they generate the maximum quantity of gas per volume of ingredients.

**[0009]** In order to avoid any small glowing particles of non-consumed pyrotechnical powder rupturing the airbag 10 or the ribbon 12, a mesh is placed at the gas outlets of the gas generator 2 to trap the particles, but allowing the generated gas to flow into the airbag 10. This mesh will also contain inside the generator 2 part of the combustion flame which is generated by the pyrotechnical powder compositions, thus preventing the fabric from igniting.

**[00010]** The ribbon 12 also has the purpose of diverting the gas to the sides. The generated gas may reach a very high temperature and may injure the occupant. Therefore, care has to be taken when choosing the location of the vent-hole 11.

**Claim:**

An occupant protecting system to be mounted in the dashboard of a vehicle, comprising a gas generator and an inflatable airbag, said airbag comprising a vent-hole and a ribbon at least partially covering said vent-hole defining an outlet flow path for the gas exiting through the vent-hole.

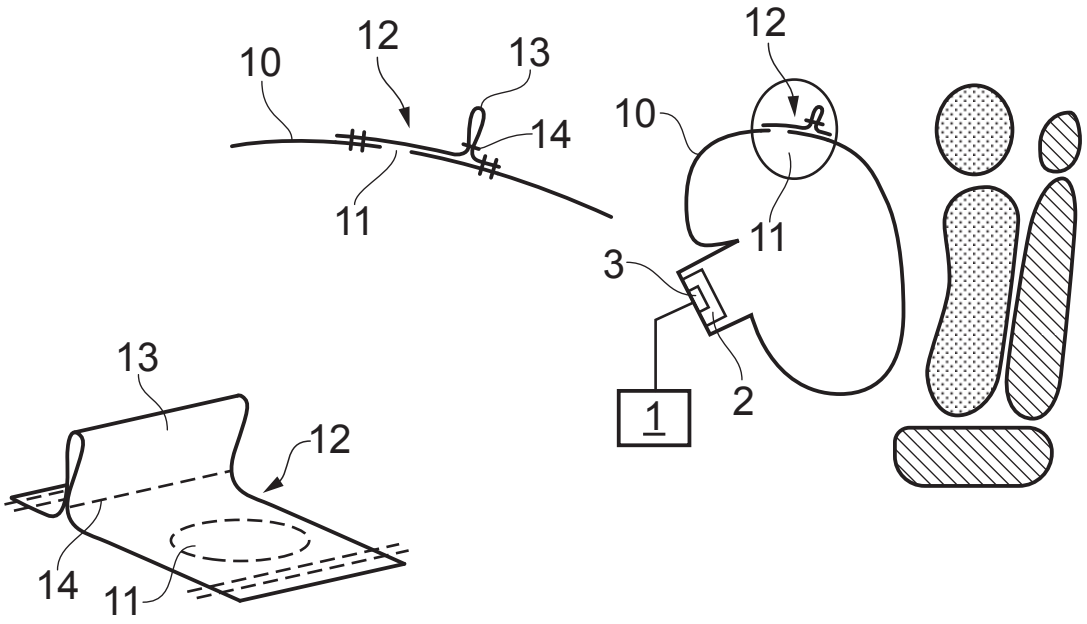


FIG. 1

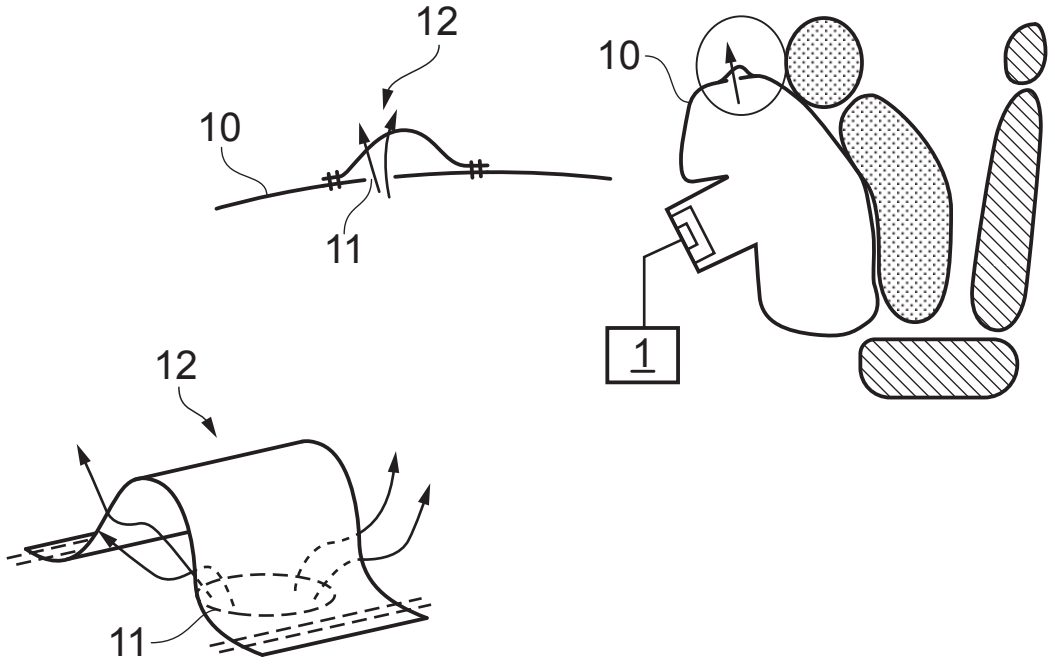


FIG. 2

**Document 2 (D2)**

**"Pyrotechnical gas-generating systems" (*"Automotive Safety"; 1997*)**

**[0001]** Passive restraint systems such as airbags and seatbelts make use of gas-generating means to activate their security systems. Pyrotechnical systems, which rapidly create large quantities of gas, have had great success.

**[0002]** Pyrotechnical systems usually comprise a gas generator housing, which can be made as a die cast container of stainless steel, nickel-plated steel, carbon steel, aluminium or cuzinal. The container may comprise exhaust openings to channel the gas into another component of the restraint system, such as an inflatable fabric cushion bag or a cylinder-piston system.

**[0003]** The container contains a powder composition for generating gas, and an initiator. The powder composition can be ignited by the initiator. The initiator comprises a coil and highly combustible material, which may be lit by an induced current in the coil to initiate the ignition of the powder composition. These initiators, which are now becoming well established in the art, have the advantage that they are placed inside the container and can be activated at a distance without being wired to the outside. The isolation from the outside protects the initiator from humidity, and the absence of an electrical connection removes the danger of static electricity discharges or short circuits which could accidentally trigger the initiator.

**[0004]** The choice of the materials which form the powder composition is of major importance. A large amount of gas has to be generated within a few milliseconds. This gas cannot be toxic since it is going to be released into the passenger compartment. When used to inflate airbags the generated gas should also not be too hot. Airbags are made of fabric which may be damaged by high temperatures. Also, if the heat is passed to the vehicle occupant when coming into contact with the airbag, it could cause injuries.

**[0005]** Pyrotechnical powder compositions comprising a fuel agent, an oxidizer to accelerate combustion and at least one additive are considered the most effective.

Often, the combination of guanidine borate and ammonium perchlorate, together with an additive, for instance sodium nitrate, is used.

**[0006]** The following substances have been found to give the best results at the ratios of fuel agents to oxidizers we tested (1:1 and 6:1 for each of combination, whereas it is assumed that the results observed can be extrapolated to the entire range 1:1-6:1). It has been suggested that, in addition to the ones we tested, other additives such as sulphates can also be used.

| Fuel agent | Oxidizer | Additives |
|---|---|---|
| Cellulose | Potassium chlorate | Magnesium carbonate |
| Starch | Potassium perchlorate | Zinc carbonate |
| Sucrose | Sodium chlorate | Potassium bicarbonate |
| Cellulose acetate | Sodium perchlorate | Sodium nitrate |
| Guanidine borate | Lithium nitrate | Barium carbonate |
| | Lithium perchlorate | Potassium nitrate |
| | Ammonium perchlorate | Lithium carbonate |

**[0007]** Generation of a flame during the combustion process is very advantageous. The flame ensures that no residual glowing particles of powder composition are left and that the powder composition is completely converted into gas as quickly as possible. The use of a flame-producing powder composition is therefore highly recommended. In order to allow the use of flame-producing powder compositions in airbag systems, airbag cushions made of fabric, for instance polyester, have to be coated with nylon resin, which ensures good fire resistance. Nylon-coated fabrics also maintains a high degree of flexibility, so that the time needed for deploying the airbag cushion is not adversely affected by the presence of a coating. This is crucial in airbags having a large volume or placed close to the passenger such as in the dashboard. In addition to the above results, our extensive experiments have also surprisingly shown that rubber-based adhesive, which are sometimes used in airbags, can easily melt in the presence of a flame. Based on this finding, we expect that airbags comprising rubber-based adhesive will be soon forbidden by the authorities.

**Letter from the applicant**

Dear Dr. Lauda,

You have informed us that documents prejudicial to novelty and inventive step have been found by the EPO Examining Division for our application entitled "Airbag modules". The airbag market is rapidly growing, we would like you to make sure that we are granted a patent quickly.

We have thoroughly analysed the arguments raised in the European Patent Office's communication and in response have drafted an amended set of claims, which we enclose (marked and clean versions).

We limited the subject-matter of claim 1 to the subject-matter of former claim 3, with the further restriction that the composition has to have a weight ratio of guanidine borate to ammonium perchlorate between 2:1 and 5:1. This range is not specifically disclosed in the prior art documents and is linked to a special technical effect.
We also deleted the reference to a valve from independent claim 1 as this is not an essential feature for the compositions having the above weight ratio.
In addition, we deleted former dependent claim 2 which was characterising said valve in a way which, according to D2, might soon be forbidden.
Please do not hesitate to draft a dependent claim reintroducing any of these elements if you think that such a claim would be useful.

Our newest internal results have shown that the weight ratio of 3:1 of guanidine borate to ammonium perchlorate produces a surprisingly clean combustion, i.e. it is totally free of toxic residual gas. We added a new dependent claim to specifically cover this embodiment.

Finally, we have included a new dependent claim relating to polyamide resin-coated fabrics, e.g. Nylon-coated polyester, which are used by all of our competitors.
Note that we are also seriously considering the use of fabrics without coating in some of our newest airbags. Please add a further dependent claim to cover these

newest airbags, i.e. claims directed to airbag modules using fabrics without coating, if possible

Last but not least, we do not exactly understand the examiner’s objection under Article 84 EPC. We think that the claim is clear as it is, isn’t it? Please amend it if you think it has to be.

We hope our new set of claims has essentially overcome the EPO's objections, but we leave it to you to make further amendments as necessary and add one or two dependent claim if deemed providing an useful exclusivity for our business purposes.

Yours truly,
J. Hunt

P.S: One of our chemist just drew my attention on the fact that it might somehow be possible to claim a chemical composition, as opposed to a claim to an airbag module comprising said composition. Not being a chemist myself, I am not in a position to give you more information. Suffice to say that our company sells airbag modules and we are not interested in any other independent claims.

**Letter from the applicant**

**Attachment: New set of claims** (marked)

1. An airbag module for protecting a vehicle occupant in a collision comprising:
- a control unit;
- a gas generator (1) comprising a housing (20); and a gas-generating composition generating gases upon ignition; and
- a fabric cushion (2) ~~comprising a pressure regulating valve (3),~~
characterised in that
a gas is generated by a composition comprising guanidine borate, ammonium perchlorate, and either sodium nitrate or potassium sulphate, the gas-generating composition being present inside the housing (20),
and in that said gas-generating composition comprises a weight ratio of guanidine borate to ammonium perchlorate between 2:1 and 5:1.

2. The airbag module according to claim 1, wherein the gas-generating composition comprises a weight ratio of guanidine borate to ammonium perchlorate of 3:1.

3. The airbag module according to any of claims 1-2, wherein the fabric cushion (2) is made of fabric coated with a polyamide resin.

~~2. The airbag module according to claim 1 wherein the valve (3) comprises: an elastic membrane (10) at least partially covering a vent-hole (5) provided in the fabric cushion (2), the membrane (10) being attached to the cushion (2) by means of a rubber-based adhesive (9).~~

~~3. The airbag module according to claim 1 or 2 wherein a gas-generating composition comprising guanidine borate, ammonium perchlorate, and either sodium nitrate or potassium sulphate is present inside the housing (20).~~

**Letter from the applicant**

**Attachment: New set of claims** (Clean)

1. An airbag module for protecting a vehicle occupant in a collision comprising:
- a control unit;
- a gas generator (1) comprising a housing (20) and a gas-generating composition generating gases upon ignition; and
- a fabric cushion (2),
characterised in that
a gas is generated by a composition comprising guanidine borate, ammonium perchlorate, and either sodium nitrate or potassium sulphate, the gas-generating composition being present inside the housing (20),
and in that said gas-generating composition comprises a weight ratio of guanidine borate to ammonium perchlorate between 2:1 and 5:1.

2. The airbag module according to claim 1, wherein the gas-generating composition comprises a weight ratio of guanidine borate to ammonium perchlorate of 3:1.

3. The airbag module according to any of claims 1-2, wherein the fabric cushion (2) is made of fabric coated with a polyamide resin.