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(54) Propellant for airbags.

(57) The present invention relates to a novel gas-emitting substance for that type of extreme gasgenerator which is employed for inflating so-called airbags in motor vehicles, comprising one or more high-energy explosives such as hexogen (RDX) or octogen (HMX) as a major component.

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TECHNICAL FIELD

The present invention relates to a novel type of gas-emitting substance for that type of extreme gas generator which is employed for inflating so-called airbags in motor vehicles.

BACKGROUND ART

Accident protection of the airbag type has previously been the preserve of more exclusive car models, but is now becoming increasingly more common and it is to be expected that they will soon be standard components in everyday cars as well. As the product is now taking the step from the more exclusive range to everyday cars, the demand for a maintenance-free product has increased and further that the product must be expected to work throughout the entire service life of the vehicle without changing any components, in other words for at least 10-12 years. However, such has not hitherto been the case, since, in practice, safety engineers have been referred to the use, for this purpose, of substances which, on their combustion, emit gases and which are based either on sodium or potassium azide or alternatively nitrocellulose based double-base powder which, in this latter case, is a product with a clearly limited service life, while, on the other hand, the azides are extremely toxic.

By way of example of that type of azide-rich propellant for airbags which is to be found today in numerous somewhat expensive car models, reference is made to SE-A-7 314 045-1 which describes a gas-emitting substance intended for airbag units and based on sodium azide, potassium perchlorate silica dioxide and amino tetrazol, while a corresponding gas-emitting substance based on double-base powder is described in SE-A-366 695. US patent specification No. 4 931 112 proposes a novel type of gas-emitting substance for airbag units in the form of the compound 5-nitro-1,2,4-triazol-3-one (NTO), a compound which is also relatively new as an explosive.

The advantages inherent in NTO as gas-emitting substance in airbag assemblies are purportedly that it gives an azide-free propellant gas at the same time as it is combusted relatively quickly and at a relatively low temperature (of the order of 1,100-1,200 C), while at the same time emitting no other toxic gases and but limited quantities of water vapour.

However, one disadvantage in the employment of NTO as gas-emitting substance is that it is a relatively expensive explosive. It is, for example, at present between 10 and 30 times more expensive than hexogen (RDX) or cyclo-1,3,5-trimethylene-2,4,6-trinitramine. Moreover, NTO is soluble in water, for which reason it cannot be excluded that it is toxic, and since it is relatively new as an explosive, it is still relatively unknown and, among other things, its storage life under different conditions has not fully been examined.

Instead, the use is now proposed according to the present invention of one of the two well-known and well tested high-energy explosives hexogen (RDX) or octogen (HMX) as major component in a gas-generating substance intended for airbag units. Thus, according to the present invention between 50 and 95 weight per cent of the gas-emitting substance for the airbag units is to consist of fine-crystalline RDX and/or HMX. Moreover, the substance may include between 5 and 50 weight per cent of an energetically or non-energetically combustible plastic binder compatible with the other components such as polyurethane (PU), cellulose acetate butyrate (CAB), hydroxy-terminated polybutadiene (HTPB), ethyl cellulose (E.C), glycidyl acid polymers (GAP), polymers of 3-nitrateomethyl-3-methyl oxetane (polynimmo), or polymers of glycidyl nitrate (Polyglyn). In addition, up to 5 weight per cent of nitrocellulose may be included, as well as alternative per se known plasticizers and other minor additives known in powder and explosive contexts and serving other functions.

In terms of composition, the product employed according to the present invention is close to two other per se known products, namely the explosives of the PBX type, i.e. "plastic bound explosives", and the so-called LOVA powders. However, in both of these cases the fields of use are radically different at the same time as the PBX explosives include crystalline explosives of a mean particle size of 1-2 mm, while the product according to the present invention and LOVA powder (which are considered as low-sensitive alternatives to the common nitrocellulose explosive) contain crystalline explosives of a mean particle size of between 1 and 20 μm. In the employment of the substance according to the present invention, this is a basic precondition for imparting to the product suitable combustion rate.

Common to all of these three product types is that the crystalline explosive is used bonded with a binder to considerably larger particles, granulate or bodies than the individual explosive crystals. In PBX contexts, relating to explosive bodies which are to be detonated, these bodies may be very large indeed, while the LOVA powder (which is primarily used as propellant charge in artillery guns and, thus, is to be combusted under deflagration and not detonated), the powder bodies employed are generally of the same size and configuration as the nitrocellulose powder which they are intended to replace, but with that difference that the available combustion area must often be increased as compared with the nitrocellulose powder, since the LOVE powder has a generally lower combustion rate than the nitrocellulose powder. For example, a larger combustion area for an explosive powder can be achieved by giving a multi cavity charge more combustion channels.

While PBX products are intended to be detonated and, in such instance, be employed in completely different configurations and contain crystalline explosives of a completely different crystal size than LOVA powder and the product employed according to the present invention, the difference between the LOVA powder and the product employed according to the present invention primarily resides in their different respective fields of use, the LOVA powder being thus employed as a propellant primarily in artillery guns while the invention relates to a more unusual field of application for crystalline high-energy explosives, namely as a substance which, on its combustion, emits gases in an airbag unit.

In purely general terms, the present invention is thus based on the concept of employing one of two specific, well-known crystalline high-energy explosives as the major gas generator in accident safety units of the airbag type for private cars.

The advantages inherent in this somewhat unusual choice will be clearly apparent when the seemingly daring concept is considered of finally incorporating high-energy explosives in everyday vehicles. The reason for this is that it has long been a well-known fact in the field of explosives that both of the high-energy explosives RDX and HMX relevant here age but slightly even at high temperatures. The above-proposed plastic binders enjoy, in addition, a high degree of compatibility with the pertinent high-energy explosives.

By utilizing the knowledge from more or less normal use of these high energy explosives and the already-mentioned explosives containing so-called LOVA powder, there is, moreover, every possibility of tailoring the combustion properties in the desired manner for pyrocharges designed according to the present invention to be gas-emitting on their combustion. Hence, the product according to the present invention may contain minor quantities of nitrocellulose. However, these have not proved to be capable of affecting the superior storage life of the product.

As always, the combustion rates of the products according to the present invention will depend, on the one hand, of those components included and in what quantities, and, on the other hand, the combustion area available on combustion and the particle size of the RDX or HMX crystals, respectively, and under what pressure the combustion takes place.

However, for determining these criteria an expert testing is first required in respect of the volume and hydrodynamic design of each respective gas generator, as well as the desired gas volume per unit of time, gas pressure and so on. Consequently, these details will not be described in greater detail in this context.

For reducing carbon monoxide generated in the combustion, it is possible to add an oxygen-emitting substance such as potassium nitrate or other oxidation agent, which has proved to give a marked reduction of the carbon monoxide content. Above all in such airbag units as are ventilated within the vehicle interior, it may be motivated to add quite high contents of oxidation agent - of the order of 30 per cent and more.

The present invention has been defined in the appended claims and examples are presented below of a number of compositions suitable for use in accordance with the present invention.

Example 1

76 weight per cent RDX
12 weight per cent CAB
7.6 weight per cent TBC (tributyl citrate)
4 weight per cent Nitrocellulose
0.4 weight per cent centralite

Example 2

78 weight per cent RDX
15 weight per cent CAB
7 weight per cent TBC'

Example 3

80 weight per cent RDX
20 weight per cent HTPB hydroxy terminated polybutadiene

In the above-disclosed examples, RDX has been generally disclosed as a crystalline explosive. However, this may readily (but of course with a slightly modified combustion rate) be replaced by one or more of the crystalline high-energy explosives disclosed by way of introduction.

In all of the above-indicated substances usable in the method according to the present invention, the crystalline explosive must have a main particle size of between 1 and 20 μm and, preferably, about 5 μm.

The present invention should not be considered as restricted to that described above and shown on the drawings, many modifications being conceivable without departing from the spirit and scope of the appended claims.

Claims

1. A gas-emitting substance for inflating an accident safety arrangement of the so-called airbag type, comprising one or more high-energy explosives as major gas-emitting substance, **characterized in that,** the substance includes between 50 and 95 per cent of hexogen (RDX) and/or octogen (HMX) of a mean particle size of between 1 and 20 μm, up to 5 weight per cent of nitrocellulose and between 5 and 50 weight per cent of a combustible, energetic or non-energetic binder.

2. The gas-emitting substance as claimed in Claim 1, **characterized in that** use is made, as energetic binder, of one or more of the substances selected from a group comprising polyurethanes (PU), cellulose acetate butyrate (CAD), hydroxy terminated polybutadiene (HTPB), ethyl cellulose (EC), glycidylacid polymers (GAP), and polymers of either 3-nitratemethyl-3-methyl oxymethane (polynimmo) or glydicyl nitrate (Polyglyn).

3. The gas-emitting substance as claimed in any one of Claims 1 or 2, **characterized in that** it consists of
   76 weight per cent RDX
   12 weight per cent CAB
   7.6 weight per cent TBC
   4 weight per cent Nitrocellulose
   0.4 weight per cent ethyl centralite
   including normal calculated impurities.

4. The gas-emitting substance as claimed in Claim 3, **characterized in that** it has been designed as a powder of a thickness of 0.15-1.0 mm.

5. The gas-emitting substance as claimed in any one or more of Claims 1-4, **characterized in that** it also includes an oxidation agent in the form of an oxygen-emitting substance such as potassium nitrate (KNO_3) or the like.