A novel composition, used for example, as an autoignition
and/or booster composition, contains cellulose acetate
butyrate, nitroguanidine, a metal perchlorate such as potas-
sium perchlorate, a first additive that liberates molybdenum
trioxide during combustion, and a second additive selected
from well known fuels used in gas generating systems. The
novel composition is contained for example within a gas
generator. The gas generator may be contained within
a gas generating system such as an airbag inflator or seat
belt assembly, or more broadly within a vehicle occupant
protection system.
GAS GENERANT COMPOSITIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 60/875,300 filed on Dec. 15, 2006.

TECHNICAL FIELD

[0002] The present invention relates generally to gas generating systems, and to autoignition and booster compositions employed in gas generator devices for automotive restraint systems, for example.

BACKGROUND OF THE INVENTION

[0003] The present invention relates to autoignition compositions that upon ignition provide the flame front and pressure front necessary to safely ignite gas generant compositions in combustible communication therewith. As known in the art, gas generators are typically provided with an autoignition composition that in the event of a fire ignites responsive to a desired threshold temperature. As a result, the gas generant is ignited prior to melting for example, thereby safely igniting the main gas generant composition to inhibit or prevent the likelihood of an explosive event once the gas generant begins to combust.

[0004] An ongoing challenge is to simplify the manufacture of a gas generator by reducing the constituents required in the production thereof. For example, in many gas generators used in vehicle occupant protection systems, several discrete compositions are provided to serve correspondingly discrete functions. These compositions often include a primary gas generating composition that when combusted is employed to provide sufficient quantities of gaseous products to operate the associated restraint device, such as an airbag or seatbelt pretensioner. A booster composition is utilized to elevate the pressure and heat within the gas generator prior to combustion of the primary gas generant, thereby creating favorable conditions within the inflator for acceptable combustion of the primary gas generant. Of course, still another composition is the auto-ignition composition employed to provide safe combustion of the other compositions in the event of a fire. The auto-ignition composition is designed to ignite at temperatures below the melting point of the primary gas generant for example, thereby ensuring the controlled combustion of the primary gas generant, as opposed to an explosive reaction perhaps.

[0005] The use of compositions containing cellulose acetate butyrate (CAB), nitrogenanidine (NQ), and potassium perchlorate (KP) as gas generant compositions is known. These compositions provide relatively large amounts of gas and relatively small amounts of solids upon combustion. However, the ignition temperature is over 500 degrees Celsius. Seatbelt pretensioners utilizing this composition disassemble when subjected to DOT and BAM rapid heating tests. Even so, this composition is desirable given the relatively cheap costs and also because of the large amounts of gas produced. It would therefore be an improvement in the art to stabilize the ignition and combustion of a CAB composition to make it useful in smaller micro gas generators used in seatbelt devices, for example.

SUMMARY OF THE INVENTION

[0006] The above-referenced concerns and others may be resolved by gas generating systems including an autoignition/booster composition containing a first oxidizer selected from metal perchlorates, such as potassium perchlorate, at about 10-90 weight percent of the composition, and a fuel component of CAB and NQ that when taken together are provided at about 10-90 weight percent of the composition. In accordance with the present invention, a first additive of molybdenum trioxide is provided at about 0.1-3 wt % of the total composition. Alternatively, any compound that would liberate molybdenum trioxide in the same relative molar/weight amounts during combustion may also be provided as the first additive. These include molybdic acid, ammonium molybdate, sodium molybdate, phosphomolybdic acid, ammonium phosphomolybdate, and sodium phosphomolybdate. A second additive of 5-aminotetrazole is provided at about 0.1-5 wt % of the total composition. Alternatively, any azole-based fuel including metal salts of azole compounds, andazole compounds such as aminotetrazole, tetrazole, 5-nitrotetrazole, 5-nitroaminotetrazole, and bitetrazole, may be included in the same weight percent range, or in the same molar-effective amounts. Alternatively, triazole-based compounds including 1,2,4-triazole-5-one or 3-nitro-1,2,4-triazole-5-one and metal salts of these compounds may also be employed either singularly or in conjunction with the tetrazole-based compounds in the same weight percent range, or in the same molar-effective amounts. Alternatively, guanidine nitrate,aminoguanidine nitrate, trimionoguanidine nitrate, nitroguanidine, dicyandiamide, triazolone, nitrotetrazolone, and mixtures thereof may also be employed either singularly or in conjunction with tetrazole-based and/or triazole-based compounds in the same weight percent range of about 0.1-5 weight percent when taken as a whole, or in the same molar-effective amounts as the azole-based second additive.

[0007] In further accordance with the present invention, a gas generator and a vehicle occupant protection system incorporating the autoignition system are also included. A seat belt device is known in the art may also contain a composition as described above may also be included.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a cross-sectional side view showing the general structure of an inflator in accordance with the present invention.

[0009] FIG. 2 is a schematic representation of an exemplary vehicle occupant restraint system containing a gas generant composition in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0010] A primary fuel component is provided containing cellulose acetate butyrate (CAB) and nitrogenanidine (NQ). The primary fuel component is provided at about 10-90 wt % of the gas generant composition. Each fuel constituent of the primary fuel component may generally be provided at about 5-95 wt % relative to the weight of the primary fuel component. A first additive selected from molybdenum trioxide, molybdic acid, ammonium molybdate, sodium molybdate, phosphomolybdic acid, ammonium phosphomolybdate, and
sodium phosphomolybdate, is provided at about 0.1-3 weight percent (wt %). Stated another way, any component that would liberate molybdenum trioxide in the same relative molar amounts may also be provided.

[0011] A second additive is selected from one or more secondary fuels including tetrazoles such as 5-aminotetrazole; metal salts of azoles such as potassium 5-aminotetrazole; nonmetal salts of azoles such as diammonium salt of 5,5'-bis-1H-tetrazole; nitrate salts of azoles such as 5-aminotetrazole; nitramine derivatives of azoles such as 5-aminotetrazole; metal salts of nitramine derivatives of azoles such as dipotassium 5-aminotetrazole; metal salts of nitramine derivatives of azoles such as dipotassium 5-aminotetrazole; nonmetal salts of nitramine derivatives of azoles such as monoammonium 5-aminotetrazole; triazole-based compounds including 1,2,4-triazole-5-one or 3-nitro-1,2,4 triazole-5-one and metal salts of these compounds; guanidines such as dicyandiamide; salts of guanidines such as guanidine nitrate; nitro derivatives of guanidines such as nitroguanidine; azoamides such as azodicarbonamide; nitrate salts of azoamides such as azodicarbonamide diminate; and mixtures thereof. The secondary fuel can be used within this system as co-fuels to the primary fuel. The second additive constitutes about 0.1-5 wt %.

[0012] An oxidizer component is selected from metal perchlorates, such as potassium perchlorate at about 10-90 wt % of the composition.

[0013] The compositions of the present invention are formed from constituents as provided by known suppliers such as Aldrich or Fisher Chemical companies. The compositions may be provided in granulated form and dry-mixed and compounded in a known manner, or otherwise mixed as known in the art. The compositions may be employed in gas generators typically found in airbag devices or occupant protection systems, or in safety belt devices, or in gas generating systems such as a vehicle occupant protection system, all manufactured as known in the art, or as appreciated by one of ordinary skill.

[0014] As shown in FIG. 1, an exemplary inflator or gas generating system 10 incorporates a dual chamber design to tailor containing a autoignition/booster composition 12 formed as described herein, may be manufactured as known in the art. U.S. Pat. Nos. 6,422,601, 6,805,377, 6,659,500, 6,749,219, and 6,752,421 exemplify typical airbag inflator designs and are each incorporated herein by reference in their entirety.

[0015] Referring now to FIG. 2, the exemplary inflator or gas generating system 10 described above may also be incorporated into an airbag system or vehicle occupant protection system 200. Airbag system 200 includes at least one airbag 202 and an inflator 10 containing a gas generate composition 12 in accordance with the present invention, coupled to airbag 202 so as to enable fluid communication with an interior of the airbag. Airbag system 200 may also include (or be in communication with) a crash event sensor 210. Crash event sensor 210 includes a known crash sensor algorithm that signals actuation of airbag system 200 via, for example, activation of airbag inflator 10 in the event of a collision.

[0016] Referring again to FIG. 2, the airbag system 200 may also be incorporated into a broader, more comprehensive vehicle occupant restraint system 180 including additional elements such as a safety belt assembly 150. FIG. 2 shows a schematic diagram of one exemplary embodiment of such a restraint system. Safety belt assembly 150 includes a safety belt housing 152 and a safety belt 100 extending from housing 152. A safety belt retractor mechanism 154 (for example, a spring-loaded mechanism) may be coupled to an end portion of the belt. In addition, a safety pretensioner 156 containing gas generating/auto ignition composition 12 may be coupled to belt retractor mechanism 154 to actuate the retractor mechanism in the event of a collision. Typical seat belt retractor mechanisms which may be used in conjunction with the safety belt embodiments of the present invention are described in U.S. Pat. Nos. 5,743,480, 5,553,805, 5,667,161, 5,451,008, 4,558,832 and 4,597,546, incorporated herein by reference. Illustrative examples of typical pretensioners with which the safety belt embodiments of the present invention may be combined are described in U.S. Pat. Nos. 6,505,790 and 6,419,177, incorporated herein by reference.

[0017] Safety belt assembly 150 may also include (or be in communication with) a crash event sensor 158 (for example, an inertia sensor or an accelerometer) including a known crash sensor algorithm that signals actuation of belt pretensioner 156 via, for example, activation of a pyrotechnic igniter (not shown) incorporated into the pretensioner. U.S. Pat. Nos. 6,505,790 and 6,419,177, previously incorporated herein by reference, provide illustrative examples of pretensioners actuated in such a manner.

[0018] It should be appreciated that safety belt assembly 150, airbag system 200, and more broadly, vehicle occupant protection system 180 exemplify but do not limit vehicle occupant protection systems contemplated in accordance with the present invention.

[0019] It should further be understood that the preceding is merely a detailed description of various embodiments of this invention and that numerous changes to the disclosed embodiments can be made in accordance with the disclosure herein without departing from the scope of the invention. The preceding description, therefore, is not meant to limit the scope of the invention. Rather, the scope of the invention is to be determined only by the appended claims and their equivalents.

What is claimed is:

1. A composition comprising:
a first fuel containing cellulose acetate butyrate and nitroguanidine, said first fuel provided at about 10-90 weight percent of the total composition;
an oxidizer containing one or more metal perchlorates provided at about 10-90 weight percent of the total composition;
a first additive containing at least one constituent selected from molybdenum trioxide, molybdic acid, ammonium molybdate, sodium molybdate, phosphomolybdic acid, ammonium phosphomolybdate, and sodium phosphomolybdate, is provided at about 0.1-3 weight percent of the total composition;
a second additive containing at least one additive selected from tetrazoles such as 5-aminotetrazole; metal salts of azoles such as potassium 5-aminotetrazole; nonmetal salts of azoles such as diammonium salt of 5,5'-bis-1H-tetrazole; nitrate salts of azoles such as 5-aminotetrazole; nitramine derivatives of azoles such as 5-aminotetrazole; metal salts of nitramine derivatives of azoles such as dipotassium 5-aminotetrazole; metal salts of nitramine derivatives of azoles such as dipotassium 5-aminotetrazole; nonmetal salts of nitramine derivatives of azoles such as monoammonium 5-aminotetrazole; triazole-based compounds including 1,2,4-triazole-5-one or 3-nitro-1,2,4 triazole-5-one and metal salts of these compounds; guanidines such as dicyandiamide; salts of guanidines such as guanidine nitrate; nitro derivatives of guanidines such as nitroguanidine; azoamides such as azodicarbonamide; nitrate salts of azoamides such as azodicarbonamide diminate; and mixtures thereof.

2. A composition comprising:
a first fuel containing cellulose acetate butyrate and nitroguanidine, said first fuel provided at about 10-90 weight percent of the total composition;
an oxidizer containing one or more metal perchlorates provided at about 10-90 weight percent of the total composition;
a first additive containing at least one constituent selected from molybdenum trioxide, molybdic acid, ammonium molybdate, sodium molybdate, phosphomolybdic acid, ammonium phosphomolybdate, and sodium phosphomolybdate, is provided at about 0.1-3 weight percent of the total composition;
a second additive containing at least one additive selected from tetrazoles such as 5-aminotetrazole; metal salts of azoles such as potassium 5-aminotetrazole; nonmetal salts of azoles such as diammonium salt of 5,5'-bis-1H-tetrazole; nitrate salts of azoles such as 5-aminotetrazole; nitramine derivatives of azoles such as 5-aminotetrazole; metal salts of nitramine derivatives of azoles such as dipotassium 5-aminotetrazole; metal salts of nitramine derivatives of azoles such as dipotassium 5-aminotetrazole; nonmetal salts of nitramine derivatives of azoles such as monoammonium 5-aminotetrazole; triazole-based compounds including 1,2,4-triazole-5-one or 3-nitro-1,2,4 triazole-5-one and metal salts of these compounds; guanidines such as dicyandiamide; salts of guanidines such as guanidine nitrate; nitro derivatives of guanidines such as nitroguanidine; azoamides such as azodicarbonamide; nitrate salts of azoamides such as azodicarbonamide diminate; and mixtures thereof.
ole-5-one or 3-nitro-1,2,4 triazole-5-one and metal salts of these compounds; guanidines such as dicyandia-
mide; salts of guanidines such as guanidine nitrate; nitro
derivatives of guanidines such as nitroguanidine; azoa-
mides such as azodicarbonamide; nitrate salts of azoa-
mides such as azodicarbonamidinate; and mix-
tures thereof; said second additive provided at about
0.1-5 weight percent of the total composition.
2. A gas generating system containing the composition of
claim 1.
3. A vehicle occupant protection system containing the
composition of 1.
4. The composition of claim 1 wherein said metal perchlo-
rate is potassium perchlorate.
5. The composition of claim 1 containing cellulose acetate
butyrate and nitroguanidine that when taken together are pro-
vided at about 10-90 weight percent, potassium perchlorate at
about 10-90 weight percent, molybdenum trioxide at about
0.1-3 weight percent, and 5-aminotetrazole at about 0.1-5
weight percent, said percentages relative to the total weight of
the composition.
6. The composition of claim 1 where the cellulose acetate
butyrate and the nitroguanidine are each provided at about
5-95 wt % of the weight of the first fuel.
7. A composition comprising:
a first fuel containing cellulose acetate butyrate and
nitroguanidine;
an oxidizer containing one or more metal perchlorates;
a first additive containing at least one constituent selected
from molybdenum trioxide, molybdic acid, ammonium
molybdate, sodium molybdate, phosphomolybdenic acid,
ammonium phosphomolydate, and sodium phospho-
molybdate; and
a second additive containing at least one additive selected
from a secondary fuel.
8. The composition of claim 7 containing potassium perchlo-
rate.
9. The composition of claim 7 wherein said first fuel is pro-
vided at about 10-90 weight percent, said oxidizer is pro-
vided at about 10-90 weight percent, said first additive is
provided at about 0.1 to 3 weight percent, and said second
additive is provided at about 0.1-5 weight percent, said
weight percentages stated relative to the total weight of the
composition.
10. The composition of claim 7 wherein said second addi-
tive is selected from the group consisting of tetrazoles such as
5-aminotetrazole; metal salts of azoles such as potassium
5-aminotetrazole; nonmetal salts of azoles such as diammon-
imium salt of 5,5'-bis-1H-tetrazole; nitrate salts of azoles such
as 5-aminotetrazole; nitramine derivatives of azoles such as
5-aminotetrazole; metal salts of nitramine derivatives
of azoles such as dipotassium 5-aminotetrazole; metal salts of
nitramine derivatives of azoles such as dipotassium 5-ami-
notetrazole; nonmetal salts of nitramine derivatives of azoles
such as monomonomium 5-aminotetrazole; triazole-based
compounds including 1,2,4-triazole-5-one or 3-nitro-1,2,4
triazole-5-one and metal salts of these compounds; guanidi-
ness such as dicyandiamide; salts of guanidines such as
guanidine nitrate; nitro derivatives of guanidines such as
nitroguanidine; azoamides such as azodicarbonamide; nitrate
salts of azoamides such as azodicarbonamidinate; and
mixtures thereof.
11. A composition comprising:
a first fuel containing cellulose acetate butyrate and
nitroguanidine;
an oxidizer containing one or more metal perchlorates;
a first additive containing a compound that liberates
molybdenum trioxide during combustion; and
a second additive containing at least one additive selected
from a secondary fuel.
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