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(54) **IGNITION AGENT COMPOSITION; AND IGNITION TOOL USING THE IGNITION AGENT COMPOSITION**

(57) There is provided: an ignition agent composition comprising a base agent containing substantially no lead component, a combustion improver, and an additive, the composition comprising, as a base agent component, one or more materials selected from the group

consisting of 5-nitroaminotetrazole and metal 5-nitroaminotetrazolate; and an igniter using the ignition agent composition.

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Description

TECHNICAL FIELD

[0001] The present invention relates to an ignition agent composition for use in an igniter and the like, and to an igniter using the ignition agent composition. More particularly, the present invention relates to an igniter suitable for gas generators used for airbag systems or seatbelt pretensioners of automobiles, and to an ignition agent composition used therein.

BACKGROUND ART

[0002] Conventionally, an electrically-energizing type igniter has been adopted for being mounted on a gas generator used for an airbag system or a seatbelt pretensioner of an automobile.

[0003] Such a type of igniter burns gas generants in a following manner.

[0004] A bridge wire provided in the igniter converts electric energy into thermal energy so as to ignite a fuse head that is disposed near the bridge wire and made of an ignition agent comprising an ignitable composition. Flames therefrom burn an enhancer and gas generants.

[0005] Ignition agents containing lead components such as lead trinitroresorcinate, which ignites with high sensitivity, have been used for a fuse head, etc., in this electrically-energizing type igniter.

[0006] In recent years, in order to improve safety for environment and in manufacturing processes, parts using no lead or lead component are desired in the automotive industry. Accordingly, it is also desired that an ignition agent used for a fuse head, etc., contains no lead.

[0007] However, there arises a problem that, when an ignition agent composition containing no lead is adopted for a fuse head, the fuse head exhibits an ignition lag behind a predetermined time upon an application of predetermined electric current. In addition, a decrease in ignitability for surely firing an enhancer may be caused, and in the worst case, ignition may not occur. Therefore, when this type of igniter is used for a gas generator in an airbag system or a seatbelt pretensioner of an automobile, a late expansion and development of an airbag may be caused.

[0008] An object of the present invention is to provide an ignition agent composition containing no lead component but nevertheless causing no delay in ignition time and no decrease in ignitability, and to provide an igniter using the ignition agent composition.

DISCLOSURE OF THE INVENTION

[0009] Wholehearted investigation by the present inventors in order to solve the aforementioned problems led to the knowledge that one or more materials selected from the group consisting of 5-nitroaminotetrazole and

metal 5-nitroaminotetrazolate are adopted as a base agent component.

[0010] An ignition agent composition having no lead component but nevertheless causing no delay in ignition time and no decrease in ignitability may be obtained by adopting, as a base agent component, one or more materials selected from the group consisting of 5-nitroaminotetrazole and metal 5-nitroaminotetrazolate.

[0011] An ignition agent composition of the present invention comprises a base agent containing substantially no lead component, a combustion improver, and an additive, the composition being characterized by comprising, as a base agent component, one or more materials selected from the group consisting of 5-nitroaminotetrazole and metal 5-nitroaminotetrazolate.

[0012] The lead component recited herein normally represents inorganic and organic compounds including a lead atom, lead simple substance, and the like (which is also applied to any of the below-described "lead component").

[0013] The base agent component preferably has a 50% average particle diameter of 30 μm or less.

[0014] A combustion improver component preferably comprises one or more materials selected from the group consisting of a metal powder and graphite. Further, the metal powder preferably comprises one or more materials selected from the group consisting of zirconium, aluminium, magnesium, magnalium, iron, tungsten, and boron.

[0015] As the additive, a binder may be mentioned.

[0016] An igniter of the present invention is characterized by using the above-mentioned ignition agent composition of the present invention. Further, the above-mentioned ignition agent composition of the present invention is preferably used for a fuse head.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a sectional view of a principal part of a gas generator using therein an igniter according to an exemplary embodiment of the present invention; and

FIG. 2 illustrates a structure of a fuse head according to an exemplary embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0018] According to an exemplary embodiment of the present invention, an ignition agent composition comprises a base agent, a combustion improver, and an additive. The base agent contains substantially no lead component. The ignition agent composition comprises, as a base agent component, one or more materials selected from the group consisting of 5-nitroaminotetrazole and metal 5-nitroaminotetrazolate.

[0019] No particular limitation is put on the metal 5-nitroaminotetrazolate that may be used as the base agent component, as long as the metal 5-nitroaminotetrazolate can exist in a stable manner. For example, there may be mentioned alkali metal 5-nitroaminotetrazolate such as potassium 5-nitroaminotetrazolate or sodium 5-nitroaminotetrazolate; and alkali earth metal 5-nitroaminotetrazolate such as strontium 5-nitroaminotetrazolate.

[0020] Moreover, since an average particle diameter of the base agent component influences an ignition time of an igniter, the base agent component preferably has a 50% average particle diameter of 30 μm or less, and more preferably, of 10 μm or less.

[0021] An amount of the base agent component is normally 30 weight% to 98 weight%, and preferably 45 weight% to 97 weight%, of the ignition agent composition. An amount of the base agent component is, as a matter of course, not limited to the foregoing ones, and may properly be changed depending on an adopted combustion improver or additive.

[0022] Moreover, no particular limitation is put on a combustion improver component, insofar as the combustion improver component may easily burn with oxygen at the time of combustion of the base agent and generate flames and high heat to thereby improve a firing of an ignited agent composition such as an enhancer. It is preferable that one or more materials selected from the group consisting of graphite and a metal powder are contained as the combustion improver component.

[0023] The adopted metal powder preferably comprises one or more materials selected from the group consisting of zirconium, aluminium, magnesium, magnalium, iron, tungsten, and boron.

[0024] Among these, zirconium, magnalium, or boron is more preferable because the combustion improver influences an ignition time and a capability of igniting the enhancer.

[0025] An amount of the combustion improver is normally 0.5 weight% to 65 weight%, and preferably 1 weight% to 50 weight%, of the ignition agent composition. In a case where magnalium or boron is adopted, it is particularly preferable that the amount is 1 weight% to 45 weight%. An amount of the combustion improver is, as a matter of course, not limited to the foregoing ones, and may properly be changed depending on an adopted base agent component or additive.

[0026] Any additive may be used without any particular limitation, as long as the additive is one used in a field of ignition agents. It is particularly preferable to use a binder as the additive. As the binder, there may be mentioned nitrocellulose, carboxyl methyl cellulose, cellulose acetate, cellulose acetate butyrate, viton rubber, GAP (Glycidyl Azide Polymer), polyvinyl acetate, silicon-based binders, etc., among which nitrocellulose is preferable.

[0027] An amount of the binder is normally 1 weight%

to 20 weight%, and preferably 2 weight% to 15 weight%, of the ignition agent composition. An amount of the binder is, as a matter of course, not limited to the foregoing ones, and may properly be changed depending on an adopted base agent component or combustion improver.

[0028] A selection of a type and an amount of the binder has a large influence on a manufacturing process of a fuse head and environmental resistance required of a gas generator. The binder is not limited to a single type, and a mixture of two or more types of binder may also be used. The binder is added for the purpose of adhering and fixing a fuse head to a bridge wire and pins, and preventing the fuse head from falling away or being damaged. When a large amount of binder is added; a difficulty in a dipping of the fuse head is caused and a desired ignition performance cannot be obtained. When a small amount of binder is added, there arises a possibility that the fuse head cannot withstand harsh environmental conditions to which the gas generator comprising an igniter is exposed and the fuse head is damaged so that the gas generator cannot operate.

[0029] In the embodiment of the present invention, a preferable combination in the ignition agent composition is an adoption of potassium 5-nitroaminotetrazolate, zirconium, and a binder. An amount of the potassium 5-nitroaminotetrazolate is 48 weight% to 97 weight%, and preferably 80 weight% to 95 weight%. An amount of the zirconium is 1 weight% to 50 weight%, and preferably 5 weight% to 15 weight%. An amount of the binder is 1 weight% to 20 weight%, preferably 2 weight% to 15 weight%, and more preferably 3 weight% to 10 weight%.

[0030] In the embodiment of the present invention, further, another preferable combination in the ignition agent composition is an adoption of potassium 5-nitroaminotetrazolate, magnalium, and a binder. An amount of the potassium 5-nitroaminotetrazolate is 50 weight% to 97 weight%, and preferably 80 weight% to 95 weight%. An amount of the magnalium is 1 weight% to 45 weight%, and preferably 3 weight% to 15 weight%. An amount of the binder is 1 weight% to 20 weight%, preferably 2 weight% to 15 weight%, and more preferably 3 weight% to 10 weight%.

[0031] In the embodiment of the present invention, still another preferable combination in the ignition agent composition is an adoption of potassium 5-nitroaminotetrazolate, boron, and a binder. An amount of the potassium 5-nitroaminotetrazolate is 50 weight% to 97 weight%, and preferably 80 weight% to 95 weight%. An amount of the boron is 1 weight% to 45 weight%, and preferably 3 weight% to 15 weight%. An amount of the binder is 1 weight% to 20 weight%, preferably 2 weight% to 15 weight%, and more preferably 3 weight% to 10 weight%.

[0032] The ignition agent composition of the present invention is as described above. An ignition agent may be obtained by mixing the base agent, the combustion improver, and the additive of the ignition agent compo-

sition according to the embodiment of the present invention as described above.

[0033] An igniter according to an exemplary embodiment of the present invention is characterized by using the ignition agent composition of the aforementioned embodiment.

[0034] Further, one of the igniters according to the embodiment of the present invention is characterized by using, for the fuse head, the ignition agent composition of the aforementioned embodiment.

[0035] A description will be given to a case where an igniter is manufactured using the ignition agent composition according to the aforementioned embodiment of the present invention. For example, the ignition agent composition is firstly made into slurry. A bridge wire is dipped into the slurry predetermined times such that the ignition agent may form a fuse head having a prescribed thickness for enveloping the bridge wire, and then the slurry is dried and caked. The resulting member is inserted into a cup containing therein an enhancer, to thereby form an igniter.

[0036] It is preferable to use a solvent when slurring the ignition agent composition. Ethyl acetate, acetone, isoamyl acetate, isobutyl acetate, etc., may be mentioned as the solvent. An amount of the solvent may be properly selected such that slurry suitable for dipping may be obtained. For example, the amount is normally 50 parts by weight to 150 parts by weight with respect to 100 parts by weight of the ignition agent composition. Preferably, the amount is 80 parts by weight to 120 parts by weight.

[0037] The ignition agent composition according to the embodiment of the present invention can be used also for a glass hermetic igniter in which a bridge wire is arranged on a glass-made plug. In this case, a fuse head can be formed by repeatedly applying slurry of the ignition agent composition to the bridge wire arranged on the glass-made plug. Moreover, the ignition agent composition according to the embodiment of the present invention can be used for an igniter, etc., disclosed in FIG. 3 of Japanese Utility Model Registration Application No. 10-8167.

[0038] An igniter according to the aforementioned embodiment of the present invention will be described with reference to drawings. FIG. 1 illustrates an exemplary embodiment of an igniter S according to the present invention.

[0039] In FIG. 1, the referential notations S, 8, 10, and 17 indicate an igniter, a case for housing gas generants (hereinafter referred to as a first cup 8), a tubular member, and a holder, respectively.

[0040] In FIG. 1, the first cup 8 for loading therein with gas generants is illustrated with an alternate long and two short dashes line. The first cup 8 is included in a gas generator for actuating a seatbelt pretensioner or an airbag system, etc., of automobiles. The first cup 8 includes a large-diameter cylindrical portion 8a, a middle-diameter cylindrical portion 8b, a non-illustrated small-

diameter cylindrical portion, and a non-illustrated bottom. The first cup 8 has a cylindrical shape that increases in diameter in two stages from the bottom side thereof. A step portion 9 is formed at an inner periphery of each border among the large, middle, and small cylindrical portions.

[0041] The igniter S is arranged inside the first cup 8 illustrated with an alternate long and two short dashes line in FIG. 1. The igniter S is used for airbag systems, etc., and preferably for seatbelt pretensioners of automobiles.

[0042] The igniter S includes an enhancer 15, a second cup 14, a plug 16, a pair of electrode pins 22, a bridge wire 5, and a fuse head 1.

[0043] The second cup 14 houses therein the enhancer 15. The plug 16 closes an opening of the second cup 14. The bridge wire 5 passes electric current through the pair of electrode pins 22. The passage of electric current through the pair of electrode pins 22 ignites the fuse head 1 to thereby fire the enhancer 15.

[0044] The holder 17 supports the igniter S in a predetermined position within the first cup 8 while serving as a plug of the first cup 8.

[0045] The holder 17 is formed with a hole 19 for mounting a plug. The hole 19 opens toward the opposite side to the plug 16. A groove 21 is formed on an outer circumferential surface of the plug 16 at a front end portion thereof. A protrusion 20 is formed on an inner circumferential surface of the second cup 14 at the opening thereof. When the protrusion 20 is fitted into the groove 21, the front end portion of the plug 16 and the opening of the second cup 14 are engaged with each other. The opening of the second cup is thereby closed.

[0046] The holder 17 and the plug 16 of the igniter S are formed in one piece to constitute a single plug member 7. Resins containing glass fibers, etc., may be cited as a material of the plug member 7. The resins include, for example, polybutylene terephthalate, polyethylene terephthalate, nylon 6, nylon 66, polyphenylene sulfide, and polyphenylene oxide, etc.

[0047] Further, the plug member 7 integrally comprises the respective electrode pins 22 and a reinforcement 26. The plug member 7 is formed by injection-molding using a non-illustrated mold. When a material such as resins is injected into the mold, the respective electrode pins 22 and the reinforcement 26 are in advance inserted into the mold, so that the plug member 7 integrates with the respective electrode pins 22 and the reinforcement 26.

[0048] The reinforcement 26 consists of a cylinder 25 and a ring-shaped plate 24 continuously extending from one end of the cylinder 25. The reinforcement 26 forms a flange protruding from the holder 17 in such a manner as to cover the holder 17 of the plug member 7. As a material of the reinforcement 26, cited are metal materials such as stainless or SPCC (Steel Plate Cold Commercial), reinforced plastics comprising thermosetting resins, etc., and the like. The ring-shaped plate 24 is

arranged perpendicularly to the respective electrode pins 22. The electrode pins 22 go through an inner-peripheral hole 27 of the ring-shaped plate 24.

[0049] Metal materials such as stainless, aluminium, etc., may be cited as a material of the tubular member 10.

[0050] The tubular member 10 is in a shape of cup covering the igniter S.

[0051] The tubular member 10 includes a large-diameter portion 10a on an opening side thereof and a small-diameter portion 10b on a bottom side thereof in such a manner as to fit with shapes of the second cup 14 of the igniter S and the plug 16. Further, the tubular member 10 includes a step portion 29 formed at a joint portion between the large-diameter portion 10a and the small diameter portion 10b.

[0052] A part of an outer circumferential surface of the tubular member 10, more specifically on the opening side, has such a diameter as to contact with an inner circumferential surface of the middle-diameter cylindrical portion 8b of the first cup 8, or a diameter slightly smaller than said diameter.

[0053] The tubular member 10 is arranged on the holder 17. The tubular member 10 functions as a plug of the first cup 8 for loading therein with the gas generants. The tubular member 10 encloses the gas generants P within the first cup 8, and secludes the igniter S and the gas generants P from each other within the first cup 8.

[0054] Further, the tubular member 10 is formed, at the opening end thereof, with a flange portion 13 that protrudes to reach an inner circumferential surface of the large-diameter cylindrical portion 8a of the first cup. The flange portion 13 abuts with the step portion 9 of the first cup 8, thereby positioning the tubular member 10 within the first cup 8.

[0055] The flange portion 13 of the tubular member 10 abuts with the step portion 9 of the first cup 8, and the ring-shaped plate 24 of the reinforcement 26 abuts with the flange portion 13 with an O-ring interposed therebetween. In this state, an opening end of the first cup 8 is folded down onto the other end of the cylinder 25 of the reinforcement 26. Thereby, the flange portion 13 of the tubular member 10, the reinforcement 26, and the first cup 8 are integrally caulked.

[0056] At this time, the step portion 9 of the first cup 8 and the flange portion 13 of the tubular member 10 are pressed against the reinforcement 26 side, to deform the O-ring 28 so that inter-gaps therebetween are tightly closed. The tubular member 10 has a score 12 on the gas generants P side thereof.

[0057] The above-described structure enables the gas generator to have an amount of leakage, which leaks out of a space within the first cup 8, of 1.9×10^{-3} [Pa. m³/sec] or less. This is a gas generator excellent in environmental resistance.

[0058] The respective electrode pins 22 are arranged in parallel at an axis of the plug member 7, and penetrate

the plug member 7 to protrude from the hole 19 of the plug member 7 into the second cup 14.

[0059] The respective electrode pins 22 are shaped to curve within the plug 16. Conductive materials such as stainless, iron alloy, or nickel alloy, may be mentioned as a material of these respective electrode pins 22. The respective electrode pins 22 are electrically insulated from each other by the resin forming the plug member 7. Further, in the second cup 14, the bridge wire 5 is attached to steel portions 6 formed at front ends of the respective electrode pins 22 by welding, etc.

[0060] As illustrated in FIG. 2, the fuse head 1 includes a first and second ignition agent layers 2 and 3 for covering a surface of the bridge wire 5 made of, e. g., a nichrome wire, and further includes a coating layer 4 for coating a surface of the first and second ignition agent layers 2 and 3.

[0061] The first and second ignition agent layers 2 and 3 are obtained in a following manner. The ignition agent composition of the present invention that comprises the base agent having no lead component, the combustion improver, and the additive, is made into slurry by adding a solvent thereto. The bridge wire 5 is dipped into the slurried ignition agent composition predetermined times so as to form the first and second ignition agent layers 2 and 3 having a prescribed thickness. Thereby, the slurried ignition agent composition is applied to the surface of the bridge wire 5. Then, the slurried ignition agent composition applied to the surface of the bridge wire 5 is dried and caked.

[0062] Although FIGS. 1 and 2 illustrate that the ignition agent layers are made up of two layers, a single layer or, if necessary, three layers or more may be acceptable.

[0063] As an adoptable binder, cited are nitrocellulose, carboxyl methyl cellulose, and viton rubber, GAP, etc., among which nitrocellulose is preferable.

[0064] After the first and second ignition agent layers 2 and 3 have dried up and caked, a vinyl acetate-based resin, etc., is applied to the surface of the first and second ignition agent layers 2 and 3 by use of a solvent, to form the coating layer 4. The coating layer 4 prevents the first and second ignition agent layers 2 and 3 from peeling away from the surface of the bridge wire 5. Thus, the aforementioned ignition agent composition of the present invention is formed into the fuse head 1, which can provide an equal performance to that of a conventional fuse head using an ignition agent having lead components.

[0065] The gas generator having the above-mentioned structure is manufactured through a following process, for example.

[0066] The respective electrode pins 22 and the reinforcement 26 are in advance inserted in predetermined positions within a mold for forming the plug member. Then, a material such as resins is poured into the mold, to obtain the plug member 7 integrally comprising the respective electrode pins 22 and reinforcement 26.

[0067] Then, the bridge wire 5 is welded to the steel portions 6 at front ends of the respective electrode pins 22 of the plug member 7 so as to be bridged between the steel portions. The first and second ignition agent layers 2 and 3 and the coating layer 4 are formed on the surface of the bridge wire 5 in the above-described way, to thereby form the fuse head 1.

[0068] The plug 16 of the plug member 7 having the fuse head 1 formed thereon is fitted into the second cup 14 housing therein the enhancer 15. Thus, the igniter S is formed.

[0069] Subsequently, the O-ring 28 is disposed around an outer periphery of the cylinder 25 of the reinforcement 26, and the igniter S formed on the plug member 7 is fitted into the tubular member 10. Here, the igniter S is inserted into the tubular member 10 such that a bottom of the second cup 14 may abut with the score 12 of the tubular member 10, thereby closing the score 12 of the tubular member 10. Thus, the plug 16 abuts with the step portion 29 of the tubular member 10, and the flange portion 13 of the tubular member 10 abuts with the ring-shaped plate 24 and the O-ring 28. The tubular member 10 is thereby incorporated with the plug member 7.

[0070] Subsequently, the igniter S incorporated with the tubular member 10 is fitted into the first cup 8, and the plug member 7 is inserted such that the flange portion 13 of the tubular member 10 may abut with the step portion 9 of the first cup 8. As a result, the tubular member 10 and the first cup 8 form a combustion chamber for gas generants.

[0071] The flange portion 13 of the tubular member 10 is disposed between the step portion 9 of the first cup 8 and the ring-shaped plate 24. That is, the step portion 9 of the first cup 8, the flange 13 of the tubular member 10, and the ring-shaped plate 24 abut with one another.

[0072] In this state, the opening end of the first cup 8 is folded down toward the plug member 7 side. A folded portion 30 and the step portion 9 are crimped to the cylinder 25 of the reinforcement 26. Thereby, a crimping force presses the step portion 9 and the flange 13 of the tubular member 10 against the ring-shaped plate 24, so that the O-ring 28 is also deformed to tightly closing inter-gaps among the first cup 8, the tubular member 10, and the ring-shaped plate 24. At this time, even though a force caused by crimping acts on the plug member 7 through the flange 13 of the tubular member 10, the ring-shaped plate 24 of the reinforcement 26 restrains a deformation of the plug member 7.

[0073] In this gas generator, when electric current is applied to the electrode pins 22 of the igniter S, the bridge wire 5 generates heat to ignite the first and second ignition agent layers 2 and 3 sequentially, thereby igniting the enhancer 15. Flames generated by the ignition of the igniter S spurt into the first cup 8. The flames ignite and burn the gas generants P to generate a large amount of gas. The large amount of gas is introduced into a seatbelt pretensioner or an airbag. In a case of a

seatbelt pretensioner, high pressure gas actuates the seatbelt pretensioner to tighten a seatbelt.

[0074] An application of the igniter of the present invention is not limited to gas generators for the aforementioned seatbelt pretensioner, but also whatever in a field of electric-type igniter, such as a gas generator for an airbag system of automobiles. Although the description has been given with reference to FIG. 1 in which the plug is made of resin, the igniter sealed with a glass-made plug may be acceptable. Any igniter that may have a fuse head can adopt the ignition agent composition of the present invention to manufacture the igniter of the present invention.

[Examples]

[0075] The present invention will hereinafter be described more specifically with reference to Examples. In Examples 1 to 4 and Comparative Example 1 described below, a term "part by mass" means "part by weight" and a solvent means isoamyl acetate.

Example 1

[0076] Mixed were 95 parts by mass of potassium 5-nitroaminotetrazolate, 5 parts by mass of zirconium, and 5 parts by mass of nitrocellulose dissolved in 100 parts by mass of a solvent. The ignition agent composition of the present invention was obtained. The resulting mixture was applied to a surface of a bridge wire and then dried and caked so as to form ignition agent layers on the surface of the bridge wire. A vinyl acetate-based resin (manufactured by Eastman Chemical Company) was applied to a surface of the ignition agent layers to form a coating layer, thereby forming a fuse head. A plug was fitted into a cup having therein an enhancer to thereby form an igniter.

Example 2

[0077] Mixed were 90 parts by mass of potassium 5-nitroaminotetrazolate, 10 parts by mass of zirconium, and 5 parts by mass of nitrocellulose dissolved in 100 parts by mass of a solvent. The ignition agent composition of the present invention was obtained. The resulting mixture was applied to a surface of a bridge wire and then dried and caked so as to form ignition agent layers on the surface of the bridge wire. A vinyl acetate-based resin (manufactured by Eastman Chemical Company) was applied to a surface of the ignition agent layers to form a coating layer, thereby forming a fuse head. A plug was fitted into a cup having therein an enhancer to thereby form an igniter.

Example 3

[0078] Mixed were 95 parts by mass of potassium 5-nitroaminotetrazolate, 5 parts by mass of magnalium,

and 5 parts by mass of nitrocellulose dissolved in 100 parts by mass of a solvent. The ignition agent composition of the present invention was obtained. The resulting mixture was applied to a surface of a bridge wire and then dried and caked so as to form ignition agent layers. A vinyl acetate-based resin (manufactured by Eastman Chemical Company) was applied to a surface of the ignition agent layers to form a coating layer, thereby forming a fuse head. A plug was fitted into a cup having therein an enhancer to thereby form an igniter.

Example 4

[0079] Mixed were 95 parts by mass of potassium 5-nitroaminotetrazolate, 5 parts by mass of boron, and 5 parts by mass of nitrocellulose dissolved in 100 parts by mass of a solvent. The ignition agent composition of the present invention was obtained. The resulting mixture was applied to a surface of a bridge wire and then dried and caked so as to form ignition agent layers. A vinyl acetate-based resin (manufactured by Eastman Chemical Company) was applied to a surface of the ignition agent layers to form a coating layer, thereby forming a fuse head. A plug was fitted into a cup having therein an enhancer to thereby form an igniter.

Comparative Example 1

[0080] Mixed were 50 parts by mass of lead trinitroresorcinate, 50 parts by mass of potassium perchlorate, and 10 parts by mass of viton rubber dissolved in 100 parts by mass of a solvent. The resulting mixture was applied to a surface of a bridge wire and then dried and caked so as to form ignition agent layers. A vinyl acetate-based resin (manufactured by Eastman Chemical Company) was applied to a surface of the ignition agent layers to form a coating layer, thereby forming a fuse head. A plug was fitted into a cup having therein an enhancer to thereby form an igniter.

Results

[0081] Each of the igniters in the Examples 1 to 4 and the Comparative Example 1 was set in an ignition device of an gas generator used for a seatbelt pretensioner of automobiles, and then electric current of 0.8 A was applied. After the application of the electric current, a time required for ignition (ignition time) was measured to compare respective ignitabilities. TABLE 1 shows measurement results.

TABLE 1

	Ignition Time
Example 1	1.19 msec
Example 2	1.49 msec
Example 3	1.44 msec

TABLE 1 (continued)

	Ignition Time
Example 4	1.72 msec
Comparative Example 1	1.44 msec

[0082] As clearly shown in Table 1, the Examples 1 to 4 exhibited equal ignitabilities to that of the Comparative Example in which a conventional lead component (lead trinitroresorcinate) was adopted.

[0083] Like this, since the embodiment of the present invention adopts the ignition agent composition that has potassium 5-nitroaminotetrazolate as a base agent, and zirconium, magnalium, or boron as a combustion improver, lead components in an ignition agent can be eliminated while keeping an ignitability of the ignition agent on the conventional level.

[0084] There can also be provided an igniter used for an airbag system or a seatbelt pretensioner of an automobile, which adopts the ignition agent composition containing no lead component.

[0085] Although the present invention has been described in conjunction with the specific preferred embodiment outlined above, the invention is not limited to the embodiment. It will be understood that other various embodiments may be performed without departing from the spirit and scope of the present invention.

CAPABILITIES OF EXPLOITATION IN INDUSTRY

[0086] The present invention provides an igniter of a gas generator used for an airbag system or a seatbelt pretensioner of automobiles, and an ignition agent composition used in the igniter, which contains no lead component but nevertheless causes no delay in ignition time and no decrease in ignitability.

Claims

1. An ignition agent composition comprising: a base agent containing substantially no lead component; a combustion improver; and an additive, the ignition agent composition comprising, as a base agent component, one or more materials selected from the group consisting of 5-nitroaminotetrazole and metal 5-nitroaminotetrazolate.
2. The ignition agent composition according to Claim 1, wherein the base agent component has an average particle diameter of 30 μm or less.
3. The ignition agent composition according to Claim 1, wherein a combustion improver component comprises one or more materials selected from the group consisting of a metal powder and graphite.

4. The ignition agent composition according to Claim 3, wherein the metal powder comprises one or more materials selected from the group consisting of zirconium, aluminium, magnesium, magnalium, iron, tungsten, and boron. 5

5. The ignition agent composition according to Claim 1, wherein the additive is a binder.

6. An ignition agent composition comprising: 48 10
weight% to 97 weight% of potassium 5-nitroaminotetrazolate as a base agent; 1 weight% to 50 weight% of zirconium as a combustion improver; and 1 weight% to 20 weight% of a binder. 15

7. An ignition agent composition comprising: 50 weight% to 97 weight% of potassium 5-nitroaminotetrazolate as a base agent; 1 weight% to 45 weight% of magnalium as a combustion improver; and 1 weight% to 20 weight% of a binder. 20

8. An ignition agent composition comprising: 50 weight% to 97 weight% of potassium 5-nitroaminotetrazolate as a base agent; 1 weight% to 45 weight% of boron as a combustion improver; and 1 weight% to 20 weight% of a binder. 25

9. The igniter using the ignition agent composition according to Claim 1. 30

10. The igniter using the ignition agent composition according to Claim 2.

11. The igniter using the ignition agent composition according to Claim 3. 35

12. The igniter using the ignition agent composition according to Claim 5.

13. The igniter using the ignition agent composition according to Claim 1 for a fuse head thereof. 40

14. The igniter using the ignition agent composition according to Claim 2 for a fuse head thereof. 45

15. The igniter using the ignition agent composition according to Claim 3 for a fuse head thereof.

16. The igniter using the ignition agent composition according to Claim 5 for a fuse head thereof 50

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FIG. 1

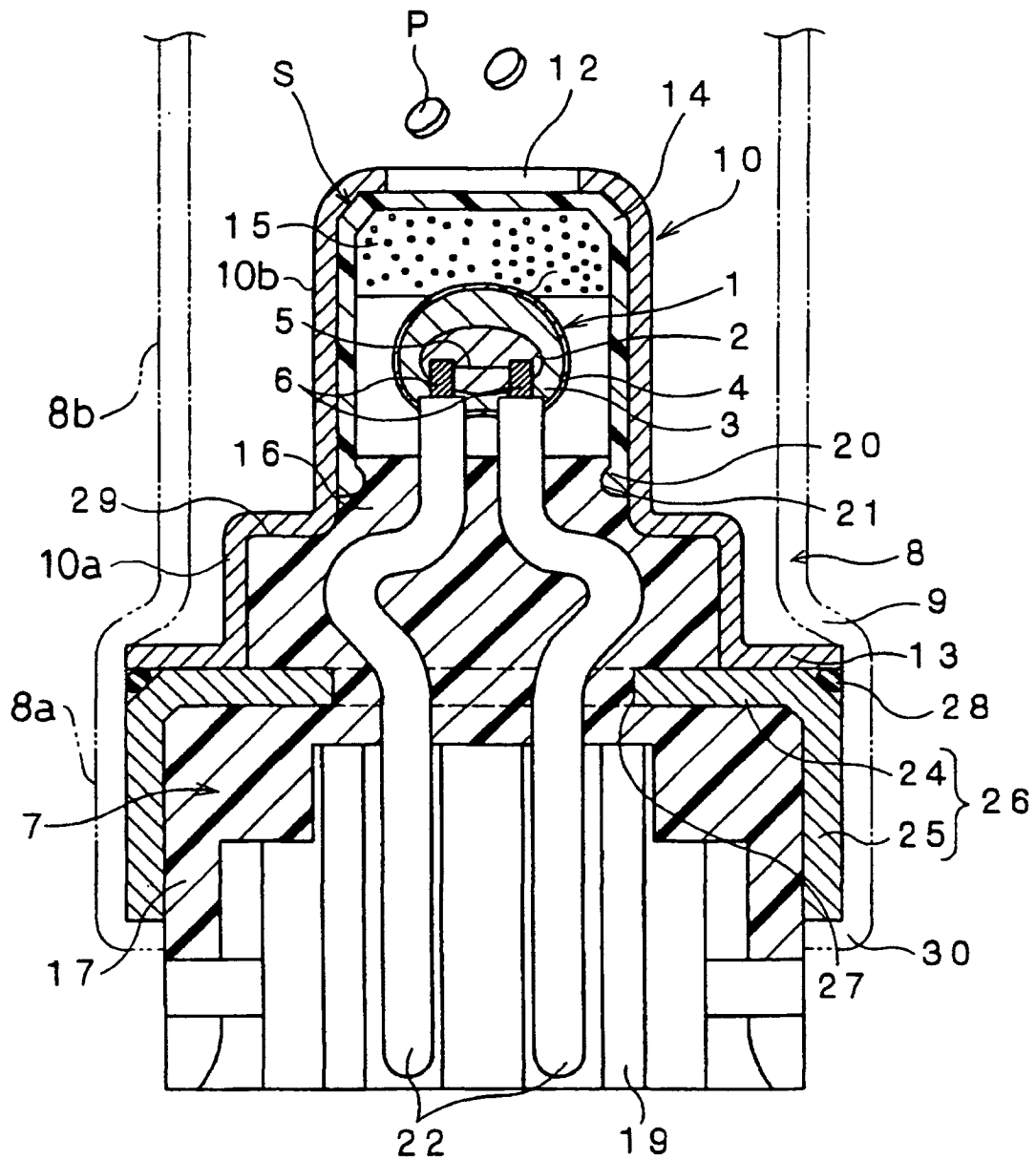
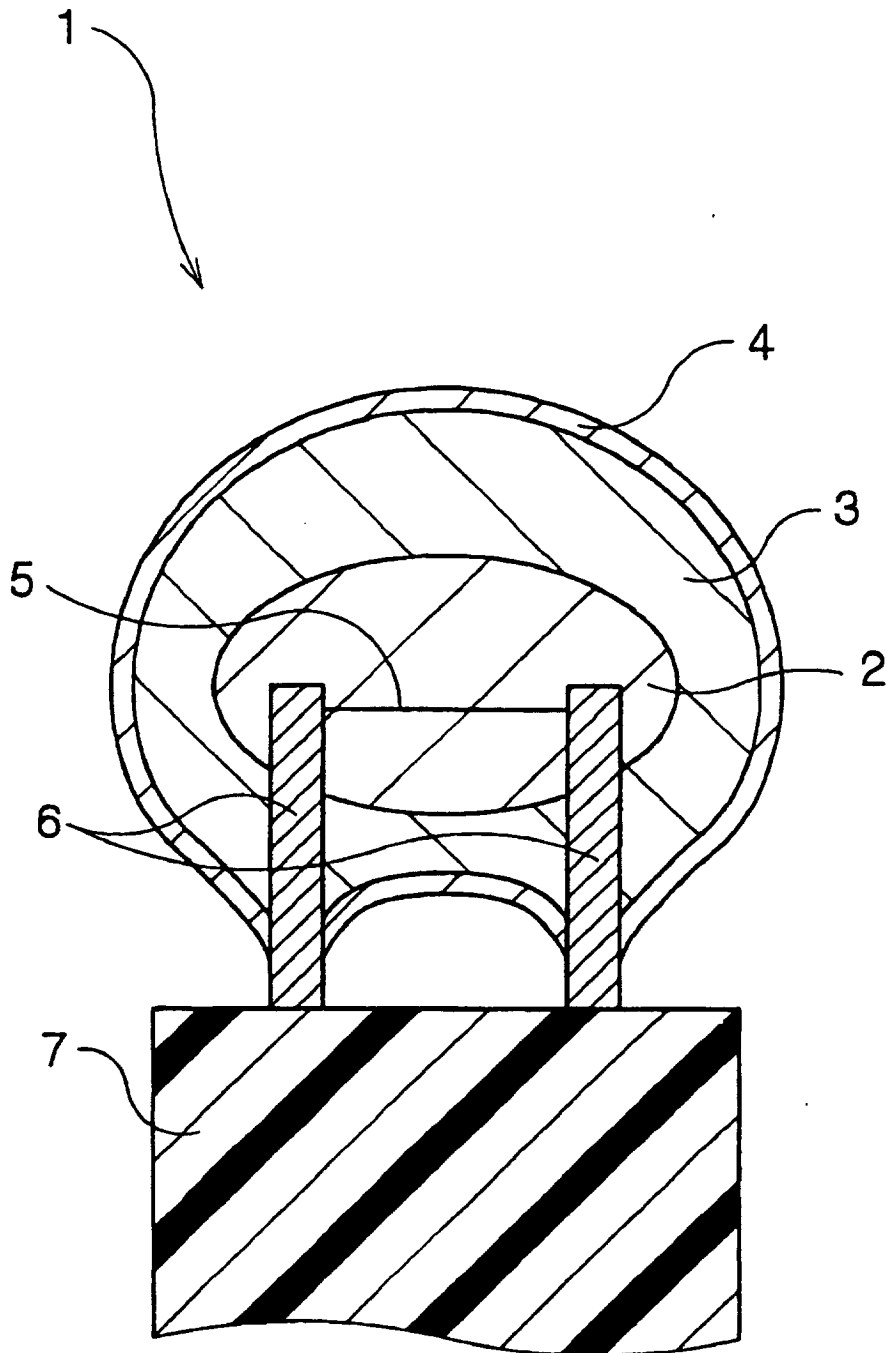


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/05596

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ C06B41/00, 33/00, C06C7/00, B01J7/00, B60R21/26, 22/46		
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) Int.Cl ⁷ C06B41/00, 33/00, C06C7/00, B01J7/00, B60R21/26, 22/46		
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) PATENT FILE (PATOLIS), JICST FILE (JOIS), CA (STN), REGISTRY (STN)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-302769 A (Nippon Kuatsu System Kabushiki Kaisha), 31 October, 2000 (31.10.00), Par. No. [0002] (Family: none)	1-16
Y	JP 11-199361 A (Nippon Kuatsu System Kabushiki Kaisha), 27 July, 1999 (27.07.99), Claims (Family: none)	1-16
Y	US 5516377 A (Thiokol Corp.), 14 May, 1996 (14.05.96), Claims; examples & WO 95/18765 A1	1-16
☒ 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 "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 09 August, 2002 (09.08.02)		Date of mailing of the international search report 20 August, 2002 (20.08.02)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/05596

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5962808 A (Automotive Systems Laboratory, Inc.), 05 October, 1999 (05.10.99), Claims 9, 17 & WO 98/39274 A1 & EP 964842 A1 & JP 2001-514611 A	1-16
Y	JP 2001-80986 A (Nippon Kayaku Co., Ltd.), 27 March, 2001 (27.03.01), Claims & WO 01/4074 A1 & EP 1205458 A1	1-16

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