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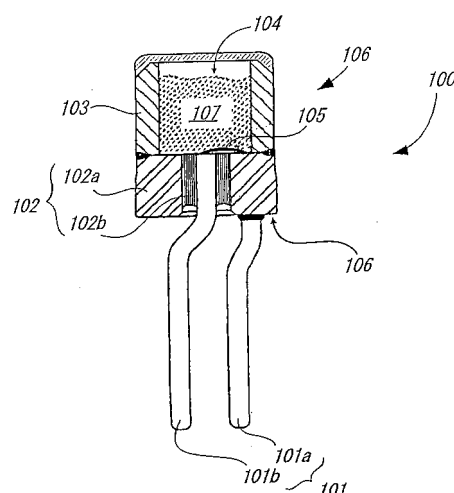
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(54) **IGNITER FOR INFLATOR AND PROCESS FOR PRODUCING THE SAME**

(57) The present invention provides an igniter for an inflator in which a heat generating body generating heat with an ignition current is not damaged, the heat generating body securely contacts a pyrotechnic material and further, a manufacturing process can be facilitated, and a method of manufacturing the same.

The method of manufacturing an igniter for an inflator including a step of producing a pyrotechnic material slurry including a fuel component and an oxidizing agent component dispersed in a solvent, a step of dropping the pyrotechnic material slurry on a heat generating body of a header portion formed in a plate shape, which generates heat with an ignition current and a step of drying the dropped pyrotechnic material slurry.

Fig. 1



Description

Technical field

[0001] The present invention relates to an igniter suitably used in an inflator for an air bag and a method of manufacturing the same.

Background Art

[0002] Conventionally, in an inflator for an air bag, an igniter is used in as a detonator. In recent years, the so-called electric type igniter is predominate, which is an igniter receiving an electric activating signal and converting the same into a thermal energy to ignite and burn a pyrotechnic material.

[0003] The electrical igniter generally includes a pair of electroconductive pins receiving an electric activating signal, an electric resistance wire electrically connected between the electroconductive pins, and a pyrotechnic material (namely, a priming) provided to come in contact with the electric resistance wire. When the electroconductive pins receive an activation signal and an electric current flows in the electric resistance wire, the resistance wire is heated to ignite the pyrotechnic material.

[0004] Since the electric type igniter functions to start activation of an inflator for an air bag, it is important that the electric igniter is activated unfaillingly, as necessary. Regarding this activation reliability, JP-A 09-210596 discloses, as important factors for a performance of an electrical detonator, a structural completeness of a bridge wire for maintaining a proper connection between a bridge wire and a pyrotechnic material (for example, contact between the both being excellent for ignition) and for maintaining an electric circuit in a closed state (for example, for reducing a risk of disconnection of the bridge wire).

[0005] And, another conventional technique relating to the present invention is US-B No. 6,009,809.

Disclosure of the Invention

[0006] The present invention relates to an igniter used suitably in an inflator for an air bag and a method of manufacturing the same, and in particular, to an igniter for an inflator characterized in a charging method of a pyrotechnic material (or a priming) which burns at activation to generate a flame and the like, and to a method of manufacturing the same.

[0007] In the method described in JP-A 09-210596, a first slurry (a pyrotechnic material slurry) charged from an opened end of a charge casing has a high viscosity of 500,000 centipoise or more, and therefore, even in case of charging the slurry into the charge casing, a projection is formed on its upper surface (that is, in the side where an ignition assembly is charged) at the time of charging, so that the upper surface becomes difficult to be horizontal. Therefore, in order to make the upper sur-

face horizontal, it is necessary to employ any means therefor at the time of charging the slurry. If no means is employed and the upper surface is not made horizontal, that is, if it dries with the projection, the bridge wire is possibly cut by the projection at the time of mounting an ignition assembly to the opened end of the charge casing.

[0008] Further, even if the upper surface of the first slurry was horizontal, the ignition assembly provided with the bridge wire is mounted to the first slurry (pyrotechnic material slurry) which is mounted to the charge casing to be dried and solidified, so that the bridge wire is pressed against the solidified material, which may causes the bridge wire damaged.

[0009] In view of the above, an object of the present invention is to provide an igniter for an inflator which solves the above-described problems in the conventional art, does not damage a heat generating body generating heat with an ignition current of a bridge wire or the like and makes the heat generating body and a pyrotechnic material securely contact with each other, and further, whose manufacturing step can be facilitated, and to provide a method of manufacturing the same.

[0010] The present invention provides, as a means for solving the above problem, an igniter for an inflator provided with a pyrotechnic material accommodating space accommodating a pyrotechnic material and a heat generating body generating heat with an ignition current and provided on a bottom surface of the pyrotechnic material accommodating space, wherein the pyrotechnic material is one obtained by charging a pyrotechnic material slurry, which includes a fuel component and an oxidizing agent component dispersed in a solvent, into the pyrotechnic material accommodating space and drying the same, and the pyrotechnic material in the pyrotechnic material accommodating space surrounds the heat generating body and closely contacts the same.

[0011] The pyrotechnic material is one obtained by charging, into the pyrotechnic material accommodating space, a pyrotechnic material slurry, which includes a fuel component and an oxidizing agent component dispersed in a solvent, and drying the same. Accordingly, the charged pyrotechnic material slurry is dried and solidified while surrounding the heat generating body, so that it is unnecessary to press the heat generating body against the solidified pyrotechnic material, thereby preventing the heat generating body from being damaged and cut and making the heat generating body and the pyrotechnic material contact more securely. In particular, when the viscosity of the pyrotechnic material slurry to be charged is low, the whole heat generating body in the pyrotechnic material accommodating space is surrounded by the pyrotechnic material, which is different from a case that a heat generating body is pressed against a solidified pyrotechnic material, so that contact of the pyrotechnic material with the heat generating body is improved. As a result, an activation reliability can be improved.

[0012] The pyrotechnic material slurry is, before being dried, one obtained by evenly dispersing a fuel component in a solvent to form a fuel slurry and further dispersing an oxidizing agent component evenly in the fuel slurry. In particular, in case of a fuel component comprising only metal component, it is difficult to be handled because the fuel component has a high ignition sensitivity in a powdery state. But, by dispersing the fuel component in the solvent together with a binder, the fuel component is not handled in the powdery state. And in this case, in the fuel slurry, a metal component has to be maintained evenly dispersed in the solvent, and thereby, the fuel slurry needs to be stirred sufficiently. At this time, if the viscosity of the fuel slurry is put in the range of 1,000 to 500, 000 centipoise, the slurry can be stirred sufficiently and the fuel slurry in which the fuel component is evenly dispersed in the solvent can be formed.

[0013] Further, since the pyrotechnic material is formed by charging the pyrotechnic material slurry into the pyrotechnic material accommodating space and drying the same, it is necessary to evenly disperse the fuel component and the oxidizing agent component in the pyrotechnic material slurry in order to make ignition of the pyrotechnic material secure. Therefore, when the viscosity of the pyrotechnic material slurry is put in the range of 1,000 to 500,000 centipoise, stirring can be conducted sufficiently to form a pyrotechnic material slurry in which the fuel component and the oxidizing agent component are evenly dispersed in the solvent. By charging the sufficiently stirred pyrotechnic material slurry in the pyrotechnic material accommodating space of the igniter and drying the same, the igniter produced finally includes the pyrotechnic material having the fuel component and the oxidizing agent component evenly dispersed. In such an igniter, since the pyrotechnic material in which the fuel component and the oxidizing agent component are evenly dispersed contacts closely the heat generating body, the pyrotechnic material is securely ignited by heat generation of the heat generating body, so that a reliability of an ignition performance can be maintained.

[0014] Further, since the pyrotechnic material is charged in the pyrotechnic material accommodating space in a slurry state, a charge holder defining a periphery of the pyrotechnic material accommodating space can be formed with an inflammable material such as synthetic resin. At the time of charging the pyrotechnic material, if the pyrotechnic material is a dried-powdered material, it is necessary to secure contact between the heat generating body and the pyrotechnic material after charged into the pyrotechnic material accommodating space by applying a force on the charged pyrotechnic material, such as by pressing the pyrotechnic material against the heat generating body with a convex portion formed at a closed end of a cup as disclosed in, for example, US-B No. 6, 000, 809. At this time, a force is applied to the charge holder, so that the charge holder may be deformed. In the present invention, however, the

pyrotechnic material is in a slurry state, and it can be simply charged without applying a pressure on the material. Accordingly, a charge holder made of resin can be used and the thickness of the charge holder can also be made thin. Therefore, according to the igniter for an inflator of the present invention, a charge holder made of an inflammable material such as a resin or the like can be used and undesirable deformation of the charge holder can be prevented. Further, the charge holder is mounted to a portion (a header portion) where the heat generating body is provided to form the pyrotechnic material accommodating space. When the charge holder is made of an inflammable material, the charge holder can be fixed by a simple method such as adhesion to the header portion using adhesive, and the charge holder is burnt out due to combustion of the pyrotechnic material, so that the charge holder is prevented from scattering at the time of activation of the igniter even if the adhesion to the header portion is weak. Further, even if the charge holder is formed of metal, the thickness thereof can be made thin, and thereby the charge holder can be formed easily by pressing. As a result, a manufacturing cost can be reduced.

[0015] The heat generating body can be not only formed as a bridge wire comprising an electric resistance wire but also formed as the heat generating portion on a substrate at least part of which is disposed in the pyrotechnic material accommodating space. When the heat generating body is formed as the heat generating portion on the substrate, the heat generating body can be formed easily according to an example of an electric circuit formation, and variations in a resistance value can be suppressed and further, an adverse affect to the heat generating body, such as disconnection or the like can be eliminated.

[0016] An integrated circuit and a capacitor can be further provided on the substrate, and thereby, an igniter for an inflator which can be employed in a bus system can be provided. Particularly, a slurry pyrotechnic material is used in the present invention, and even when an igniter which can be employed in a bus system is formed, a capacitor or an integrated circuit is prevented from being adversely affected. That is, if powdery pyrotechnic material is used and this material is pressure-charged in the above manner, it is expected that a pressure at the pressure-charging time adversely affects a capacitor or an integrated circuit which is an electric/electronic circuit part, but such a problem can be solved in the present invention. Therefore, according to the present invention, in an igniter which can be employed in a bus system having such an integrated circuit and a capacitor, an igniter for an inflator, in which the pyrotechnic material and the heat generating body (the heat generating portion) contact each other securely and an electronic part such as an integrated circuit, a capacitor or the like is never damaged due to influence of a pressure or the like, is provided.

[0017] Further, the present invention provides, as an-

other means for solving the above-described problem, a method of manufacturing an igniter for an inflator comprising a step of producing a pyrotechnic material slurry including a fuel component and an oxidizing agent component dispersed in a solvent, a step of dropping the pyrotechnic material slurry on a heat generating body, which generate heat by an ignition current, of a header member formed in a plate shape and a step of drying the dropped pyrotechnic material slurry.

[0018] In the manufacturing method of the present invention, the pyrotechnic material slurry is dropped on the heat generating body provided on the header portion and it is dried. Thereby, a close contact between the pyrotechnic material and the heat generating body is made secure, so that an operation security can be ensured. Further, since it is unnecessary to press the heat generating body against the dried and solidified slurry, the heat generating body is prevented from being damaged and disconnected.

[0019] In the igniter for an inflator and the method of manufacturing the same of the present invention, a step of producing the pyrotechnic material slurry desirably includes a stage of forming a fuel slurry obtained by dispersing a fuel component and a binder component into a solvent and a stage of forming a pyrotechnic material slurry by adding the oxidizing agent component to the fuel slurry. In particular, in case of the fuel component comprising only metal component which is difficult to be handled in a powdery state because of a high ignition sensitivity, by dispersing the fuel component a binder in the solvent together with a binder not to be handled in the powdery state, safety at manufacturing, that is a danger a danger of ignition of the fuel component can be eliminated. For example, when zirconium described below is used as the fuel component, its powder has a very high sensitivity to get ignited easily, but safety during manufacture can be elevated by handling zirconium in such a state that it is dispersed in a solvent.

[0020] By adding a binder in the pyrotechnic material slurry, preferably in the fuel slurry, the heat generating body and the dried slurry can be contacted to each other securely without applying a physical force such a pressure-charging or applying a force with a structural feature or the like.

[0021] The fuel slurry or the pyrotechnic material slurry has a viscosity of 1,000 to 500,00 centipoise, preferably a viscosity of 5,000 to 300,000 centipoise, further preferably a viscosity of 10,000 to 100,000 centipoise, and it is desirable to stir this slurry. By setting the viscosity in this range, a stirring work becomes easy and respective components can be evenly mixed. When the viscosity of the slurry to be stirred is higher than 500,000 centipoise, it becomes difficult to mix respective components, and when the slurry drops on the heat generating body, a projection is formed easily as described below. On the contrary, when the viscosity is lower than 1,000 centipoise, a drying time of the pyrotechnic material after the slurry dropped on the heat generating body be-

comes excessively long, which results in inconvenience in manufacture. The viscosity can be set in this range not only by adjusting the temperature, the surrounding temperature or the like of the fuel slurry or the pyrotechnic material slurry but also by adjusting the amount of addition of the solvent.

[0022] In the step of dropping the pyrotechnic material slurry on the heat generating body, it is desirable that the step is conducted while the slurry is being stirred. Since the metal component included in the pyrotechnic material slurry has a large specific gravity, it gravitates according to time elapse. In view of this, it is desirable that the slurry is dropped, while it is being stirred, so that respective components are evenly dispersed without gravitation of the fuel component. In particular, when the viscosity of the slurry is kept low in order to have respective components evenly dispersed or the like, the metal material becomes especially easy to gravitate. Consequently, the importance of dropping the pyrotechnic material slurry on the heat generating body while it is being stirred is great.

[0023] When the pyrotechnic material slurry is dropped on the heat generating body, desirably, a charge holder provided with a peripheral surface surrounding the heat generating body is mounted, before the dropping, in the side of the header member formed in a plate shape where the heat generating body generating heat with an ignition current exists. If the charge holder is mounted in advance, at the time of dropping the pyrotechnic material slurry on the heat generating body, the pyrotechnic material slurry can be dropped into a space defined by the header member and the charge holder.

[0024] The charge holder is maintained as it is even after dropping of the pyrotechnic material slurry, and it can be used for forming a space accommodating the pyrotechnic material in the igniter. The charge holder is usually made of the same material as that of the header. For example, when the header is made of stainless steel, the charge holder can also be made of stainless steel. Incidentally, the charge holder and the header can also be made of different materials. The charge holder is cylindrical and it is mounted to the header by welding its one end portion to the header. At this time, in order to prevent the charge holder from scattering at the time of activation of the igniter, the charge holder and the header have to be welded to each other securely. However, alternatively, the charge holder can be formed of inflammable material such as synthetic resin or the like, so that it can be formed to be broken or burnt at activation of the igniter. If it is formed in this way, the charge holder is prevented from scattering because it is burnt out at activation of the igniter. When the charge holder is formed of inflammable material such as synthetic resin or the like, a material which does not change due to a drying temperature in a step of drying the slurry described latter is used as the inflammable material. The material depends on a drying temperature, but it is pref-

erable to use, for example, epoxy or the like as such a material, taking into consideration fixing to the header easily using adhesive or the like. The charge holder formed of an inflammable material only serves as a kind of a mold when the pyrotechnic material slurry is dropped on the header. Once the slurry is solidified, the role as the charge holder is terminated. When the pyrotechnic material is ignited, the charge holder is also burnt out and it is not scattered.

[0025] As the fuel component, powdery material is used, and powder selected from the group consisting of zirconium, iron, tin, manganese, cobalt, nickel, tungsten, titanium, magnesium, aluminum, niobium and a mixture thereof can be used, and, among them, powder consisting of zirconium is preferable.

[0026] As the oxidizing agent component, powder material is used, and powder selected from the group consisting of a perchloric acid salt such as potassium perchlorate, lithium perchlorate, sodium perchlorate or the like and nitric acid salt such as potassium nitrate, and a mixture thereof can be used, and, among them, powder consisting of potassium perchlorate is preferable.

[0027] As the solvent for dispersing the fuel component and the oxidizing agent component, an organic solvent such as isopropyl alcohol, methyl ethyl ketone, hexane and the like can be used.

[0028] The binder mixed in the pyrotechnic material slurry can be cellulose resin, urethane resin, fluorine-contained rubber composition. Further, in the pyrotechnic material slurry, an additive selected from the group consisting of glass powder, glass fiber, ceramic fiber, steel wool, bentonite, kaolinite and a mixture thereof can be used. In particular, when potassium perchlorate is used as the oxidizing agent component, it is desirable that the binder is selected from the group consisting of hydroxypropyl cellulose, nitrocellulose and urethane. This is because potassium perchlorate is prevented from being dissolved in the binder.

[0029] As the heat generating body which generates heat with an ignition current, one comprising a printed circuit or one including an integrated circuit and a capacitor can also be used besides a bridge wire of an electric resistance wire.

[0030] Further, by forming an inflator for an air bag using the igniter for an inflator, an inflator for an air bag which can be activated unfailingly is provided.

[0031] That is, the present invention provides an inflator for an air bag used in an inflatable safety system, comprising, in a housing having a gas discharging port, an igniter which activates an inflator and a gas generating means which is actuated by activation of the igniter, wherein the igniter of this invention is used as an igniter.

[0032] As described above, in the igniter for an inflator according to the present invention, the pyrotechnic material securely contacts the heat generating body while any damage or cut of the heat generating body is not caused. Therefore, an igniter is unfailingly activated up-

on receiving an activating signal to activate the gas generating means, and consequently, such an inflator for an air bag that can be unfailingly activated at need is provided.

[0033] Therefore, the igniter for an inflator according to the present invention can be used in varieties of inflators such as a hybrid type inflator, an inflator used for inflating a curtain-like air bag, a pyrotechnic inflator, an inflator used in a seatbelt pretensioner, a knee bolster or the like, and others, for varieties of purposes such as for activating a gas generating means, for rupturing a member sealing a gas for inflating an air bag or the like.

[0034] The method of manufacturing an igniter for an inflator of the present invention is a method of manufacturing an igniter for an inflator in which a bridge wire or other heat generating body generating heat with an ignition current is not damaged, the heat generating body securely contacts a pyrotechnic material, and the manufacturing process is facilitated. And the igniter for an inflator according to the present invention is a igniter for an inflator in which the heat generating body is never damaged and the heat generating body securely contacts the pyrotechnic material, and that unfailingly activates at need.

Brief Description of the Drawings

[0035]

Fig. 1 is a vertical sectional view showing an igniter for an inflator.

Fig. 2 is a process diagram showing a method of manufacturing an igniter for an inflator.

Fig. 3 is a vertical sectional view showing another igniter for an inflator.

Description of Numerals

[0036]

100, 200	igniter for inflator
101, 201	electroconductive pin
102	header portion
103	charge holder
104, 204	pyrotechnic material accommodating space
105	bridge wire
106	igniter sub-assembly
107	pyrotechnic material
107s	pyrotechnic material slurry
205c	integrated circuit
205	printed circuit board

Preferred Embodiment of the Invention

[0037] The present invention will be explained below in detail with reference to the drawings showing embodiments of the present invention. Fig. 1 is an axial sec-

tional view showing an embodiment of an igniter 100 for an inflator, Fig. 2 is a flow diagram showing a method of manufacturing the igniter 100 for an inflator shown in Fig. 1, and Fig. 3 is an axial sectional view showing an embodiment of another igniter 200 for an inflator.

[0038] In the igniter 100 for an inflator shown in Fig. 1, a pair of electroconductive pins 101a and 101b receiving an electric activating signal are held by a plate-like header member 102 in an insulated state and a cylindrical charge holder 103 is provided along an edge of the header member 102 in a standing manner, a bridge wire 105 of a heat generating body which converts electric energy into thermal energy is provided on a bottom surface in a space (namely, a pyrotechnic material accommodating space 104) formed by the charge holder 103 and the header member 102, in other words, on an upper surface of the header member 102, thereby forming an igniter sub-assembly 106. By accommodating a pyrotechnic material 107 in the pyrotechnic material accommodating space 104 in the igniter sub-assembly 106, the igniter 100 for an inflator is constituted.

[0039] In the igniter sub-assembly 106 in this embodiment, one electroconductive pin 101a is joined to an annular portion 102a comprising an electroconductive body in the header portion 102 to allow electrical conduction thereto. And, in an electric insulating body 102b, such as glass or the like, filled in a hole portion existing at the center of the annular portion 102a in the header portion 102, the other electroconductive pin 101b is provided to expose its end surface on an upper surface of the header portion 102. An upper surface of the annular portion 102a, an upper surface of the electric insulating body 102b and an end surface of the electroconductive pin 101 existing in the central hole portion of the annular portion 102a become flush with one another, and a heat generating body which generates heat with an ignition current, namely, the bridge wire 105 is spanned between the upper surface of the annular portion 102a and the end surface of the electroconductive pin 101b held by the electric insulating body 102b.

[0040] In the igniter sub-assembly 106 in this embodiment, a cylindrical charge holder 103 extending along a peripheral edge of the header portion 102 is provided on a face of the header portion 102 on which the bridge wire 105 is provided, and the both are joined to each other. Incidentally, the charge holder 103 may also be formed integrally with the header portion 102. Such a constitution may be employed that the header member 102 and the charge holder 103 are formed of the same material and one end portion of the charge holder 103 is mounted to the header member 102 by welding, or such a constitution may be employed that the header member 102 and the charge holder 103 are formed of different materials (for example, the header member 102 is formed of stainless steel while the charge holder 103 is formed of an inflammable material) and the both are fixed to each other by adhesive. Further, such a constitution may be employed that the header member 102

is formed of an insulating material such as resin and the end surfaces of respective electroconductive pins 101 are exposed on the upper surface of the header member 102, and the bridge wire 105 is spanned between the end surfaces of the electroconductive pins 101.

[0041] In this embodiment, the pyrotechnic material 107 accommodated in the space 104 formed by the header portion 102 and the charge holder 103 is one obtained in such a manner that a pyrotechnic material slurry 107s which includes a fuel component 107a and an oxidizing agent component 107b and is dispersed in a solvent is filled into the pyrotechnic material accommodating space 104 and dried. In this connection, one example of a method of manufacturing the igniter 100 for an inflator will be explained with reference to Fig. 2.

[0042] First, a fuel slurry 107s' is prepared by dispersing a fuel component 107a comprising zirconium powder and a binder 107c selected from the group consisting of hydroxypropyl cellulose, nitrocellulose and urethane in a solvent 107d selected from the group consisting of isopropyl alcohol, methyl ethyl ketone, hexane and the like, and this slurry is stirred with a viscosity of 1,000 to 500,000 centipoise (Fig. 2(a)).

[0043] Next, potassium perchlorate is mixed in the fuel slurry 107s' as the oxidizing agent component 107b to form a pyrotechnic material 107 slurry, and the slurry is stirred with a viscosity of 1,000 to 500,000 centipoise (Fig. 2(b)).

[0044] Since the fuel slurry 107s' and the pyrotechnic material slurry 107s are set to have the viscosity of 1,000 to 500,000 centipoise, respective components 107a to 107c can be dispersed at a high level. Then, zirconium powder which is the fuel component 107a together with the binder 107c is dispersed in the solvent 107d to be used, an unintentional firing can be prevented during manufacture.

[0045] After the pyrotechnic material slurry 107s is sufficiently stirred so that respective components are dispersed sufficiently, it is charged in the space formed by the header member 102 and the charge holder 103 in the ignition sub-assembly 106, namely, the pyrotechnic material accommodating space 104 while it is being stirred (Fig. 2(c)). By charging the pyrotechnic material slurry 107s while stirring the same, unevenness of composition due to sinking of the fuel component during charging can be prevented.

[0046] After the pyrotechnic material slurry 107s charged in the pyrotechnic material accommodating space 104 is dried, the space 104 is closed (Fig. 2(d)). Regarding the closing, as shown in Fig. 2 (d), an opening portion of an opened end portion (an upper end) of the charge holder 103 may be closed by a lid member 120 covering only the opening portion, or the opening portion can be closed by covering the opening portion with a lid member with a peripheral edge, which has a peripheral wall portion extending to the charge holder, and welding (laser-welding or the like) an lower end portion of the peripheral wall portion to an outer peripheral

portion of the header. When the lid member 120 is fixed by welding, the latter case is more preferable even in view of suppressing thermal influence to the pyrotechnic material 107. In particular, as described above, the pyrotechnic material slurry 107s charged into the space 104 is adjusted to have a viscosity of 1,000 to 500,00 centipoise, so that the drying time is not prolonged excessively.

[0047] Since, in the above manufacturing method, the pyrotechnic material 107 is formed in a slurry state (107s) to be charged (Fig. 2(c)), it is unnecessary to pressure-charge the pyrotechnic material to press the same against the bridge wire 105, or press the bridge wire 105 against the dried and solidified pyrotechnic material, and the bridge wire 105 is therefore prevented from being damaged. Further, since charged pyrotechnic material slurry 107s is dried as it is, the bridge wire 105 and the pyrotechnic material 107 are securely brought in close contact with each other.

[0048] Fig. 3 shows another embodiment of an igniter 200 for an inflator constituted to use an integrated circuit 205c as the heat generating body for converting an electric energy into a thermal energy. The igniter 200 shown in this figure is an igniter 200 which can correspond to a bus system provided in a vehicle and it can be constituted to include an integrated circuit 205c, a capacitor or the like.

[0049] The igniter 200 is provided on its substrate with the integrated circuit 205c and a heat generating portion 206, and it is an igniter having such a structure that a resin 210 surrounds the above members except for the heat generating portion 206 and the heat generating portion projects into the pyrotechnic material accommodating space 204. And a pair of electroconductive pins 201 are connected to the circuit. With this structure, when an electroconductive pin 201 receives an activation signal, the integrated circuit 201 determines whether or not to activate, and if it is necessary to activate, a heat is generated to ignite and burn the pyrotechnic material 107.

[0050] Even in the igniter 200, since slurry-like material (107s) is charged into the pyrotechnic material accommodating space 204 as the pyrotechnic material 107, the heat generating portion 206 and the pyrotechnic material 107 can be securely brought into close contact with each other without damaging the substrate 205 (substantially, the integrated circuit 205c, the capacitor or the like).

Claims

1. An igniter for an inflator provided with a pyrotechnic material accommodating space accommodating a pyrotechnic material, a heat generating body, generating heat with an ignition current, provided on a bottom surface in the pyrotechnic material accommodating space, wherein

the pyrotechnic material is obtained by charging, in the pyrotechnic material accommodating space, a pyrotechnic material slurry including a fuel component and an oxidizing agent component dispersed in a solvent and drying the same, and

the pyrotechnic material existing in the pyrotechnic material accommodating space surrounds the heat generating body to closely contact the same.

2. An igniter for an inflator according to claim 1, wherein the pyrotechnic material slurry is formed by adding the oxidizing agent component into a fuel slurry obtained by dispersing the fuel component into the solvent, and the fuel slurry has a viscosity of 1,000 to 500,000 centipoise.

3. An igniter for an inflator according to claim 1, wherein the pyrotechnic material slurry is formed by adding the oxidizing agent component into a fuel slurry obtained by dispersing the fuel component into the solvent, and the pyrotechnic material slurry has a viscosity of 1,000 to 500,000 centipoise.

4. An igniter for an inflator according to any one of claims 1 to 3, wherein the solvent is selected from the group consisting of alcohols, ketones, acetates, alkanes, and a mixture thereof.

5. An igniter for an inflator according to any one of claims 1 to 4, wherein the pyrotechnic material slurry further includes a binder selected from the group consisting of cellulose derivatives, urethanes, rubbers, and a mixture thereof.

6. An igniter for an inflator according to claim 5, wherein the cellulose derivatives includes hydroxypropyl cellulose.

7. An igniter for an inflator according to any one of claims 1 to 6, wherein the pyrotechnic material slurry is further mixed with one selected from the group consisting of glass powder, glass fiber, ceramic fiber, steel wool, bentonite, kaolinite and a mixture thereof.

8. An igniter for an inflator according to claim 5, wherein the oxidizing agent component is potassium perchlorate, and the binder is selected from the group consisting of hydroxypropyl cellulose, nitrocellulose and urethane.

9. An igniter for an inflator according to any one of claims 1 to 8, wherein a periphery of the pyrotechnic material accommodating space is defined by a cylindrical charge holder formed of a synthetic resin.

10. An igniter for an inflator according to any one of

claims 1 to 9, wherein the heat generating body is formed on a substrate as a heat generating portion, at least part of the substrate is disposed in the pyrotechnic material accommodating space, and the heat generating portion is disposed to contact the pyrotechnic material.

11. An igniter for an inflator according to claim 10, wherein the substrate is further provided with an integrated circuit and a capacitor.

12. A method of manufacturing an igniter for an inflator comprising:

a step of producing a pyrotechnic material slurry including a fuel component and an oxidizing agent component dispersed in a solvent;
a step of dropping the pyrotechnic material slurry on a heat generating body of a header portion formed in a plate shape, which generates heat with an ignition current; and
a step of drying the dropped pyrotechnic material slurry.

13. A manufacturing method according to claim 12, wherein the step of producing a pyrotechnic material slurry includes a stage of stirring a fuel slurry obtained by dispersing the fuel component and a binder component in the solvent with a viscosity of 1,000 to 500,000 centipoise.

14. A manufacturing method according to claim 12 or 13, wherein the step of producing a pyrotechnic material slurry includes a stage of stirring a pyrotechnic material slurry obtained by further adding the oxidizing agent component into a fuel slurry with a viscosity of 1,000 to 500,000 centipoise.

15. A manufacturing method according to any one of claims 12 to 14, wherein the pyrotechnic material slurry further includes a binder selected from the group consisting of cellulose derivatives, urethanes, rubbers, and a mixture thereof.

16. A manufacturing method according to claim 15, wherein the cellulose derivatives include hydroxypropyl cellulose.

17. A manufacturing method according to any one of claims 12 to 16, wherein the pyrotechnic material slurry is further mixed with one selected from the group consisting of glass powder, glass fiber, ceramic fiber, steel wool, bentonite, kaolinite and a mixture thereof.

18. A manufacturing method according to any one of claims 12 to 17, wherein

the fuel component is powder selected from the group consisting of zirconium, iron, tin, manganese, cobalt, nickel, tungsten, titanium, magnesium, aluminum, niobium and a mixture thereof; and

the oxidizing agent component is powder selected from the group consisting of potassium perchlorate, lithium perchlorate, sodium perchlorate and a mixture thereof.

19. A manufacturing method according to any one of claims 12 to 18, wherein the oxidizing agent component is potassium perchlorate, and the pyrotechnic material slurry further includes a binder selected from the group consisting of hydroxypropyl cellulose, nitrocellulose and urethane.

20. A manufacturing method according to any one of claims 12 to 19, wherein the step of dropping the pyrotechnic material slurry is conducted while being stirred.

21. A manufacturing method according to any one of claims 12 to 20, wherein a charge holder provided with a peripheral wall surface surrounding the heat generating body is mounted in the side of the header member formed in a plate shape where the heat generating body generating heat with an ignition current exists, and

in the step of dropping the pyrotechnic material slurry, the pyrotechnic material slurry is dropped in a space defined by the header member and the charge holder.

22. A manufacturing method according to claim 21, wherein the charge holder is formed of a synthetic resin.

Fig. 1

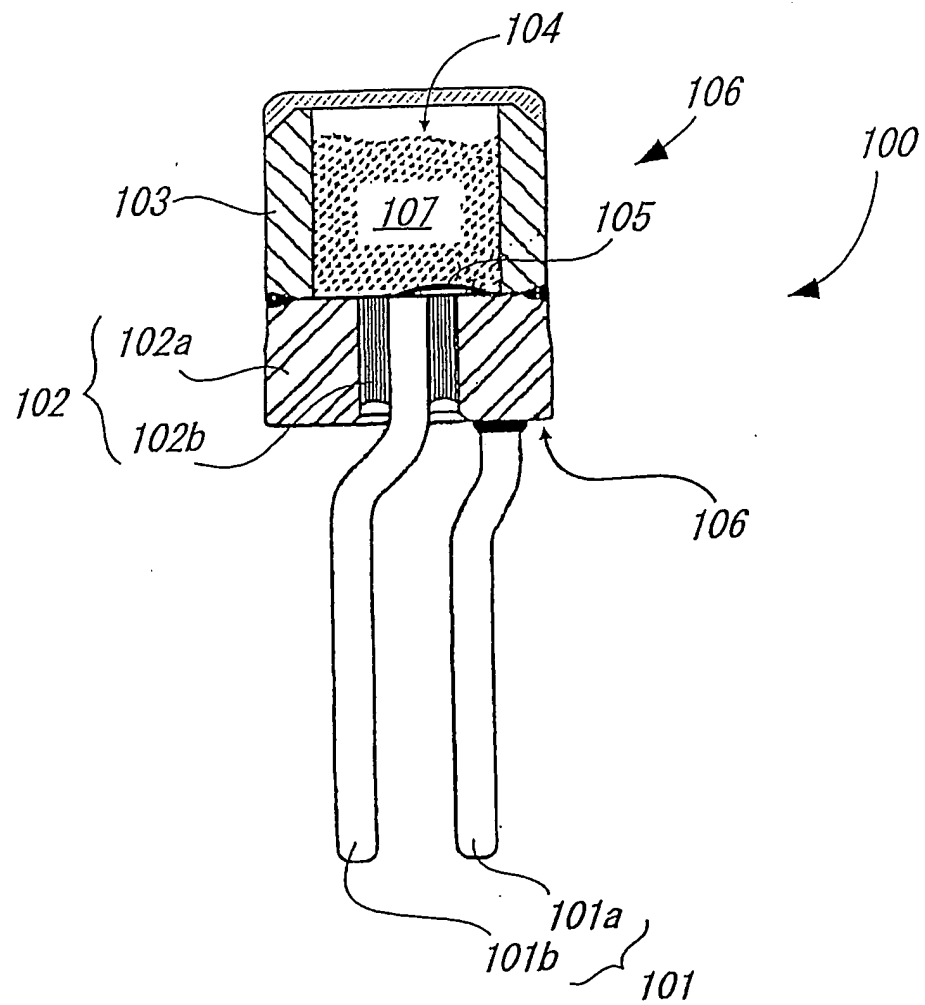


Fig. 2

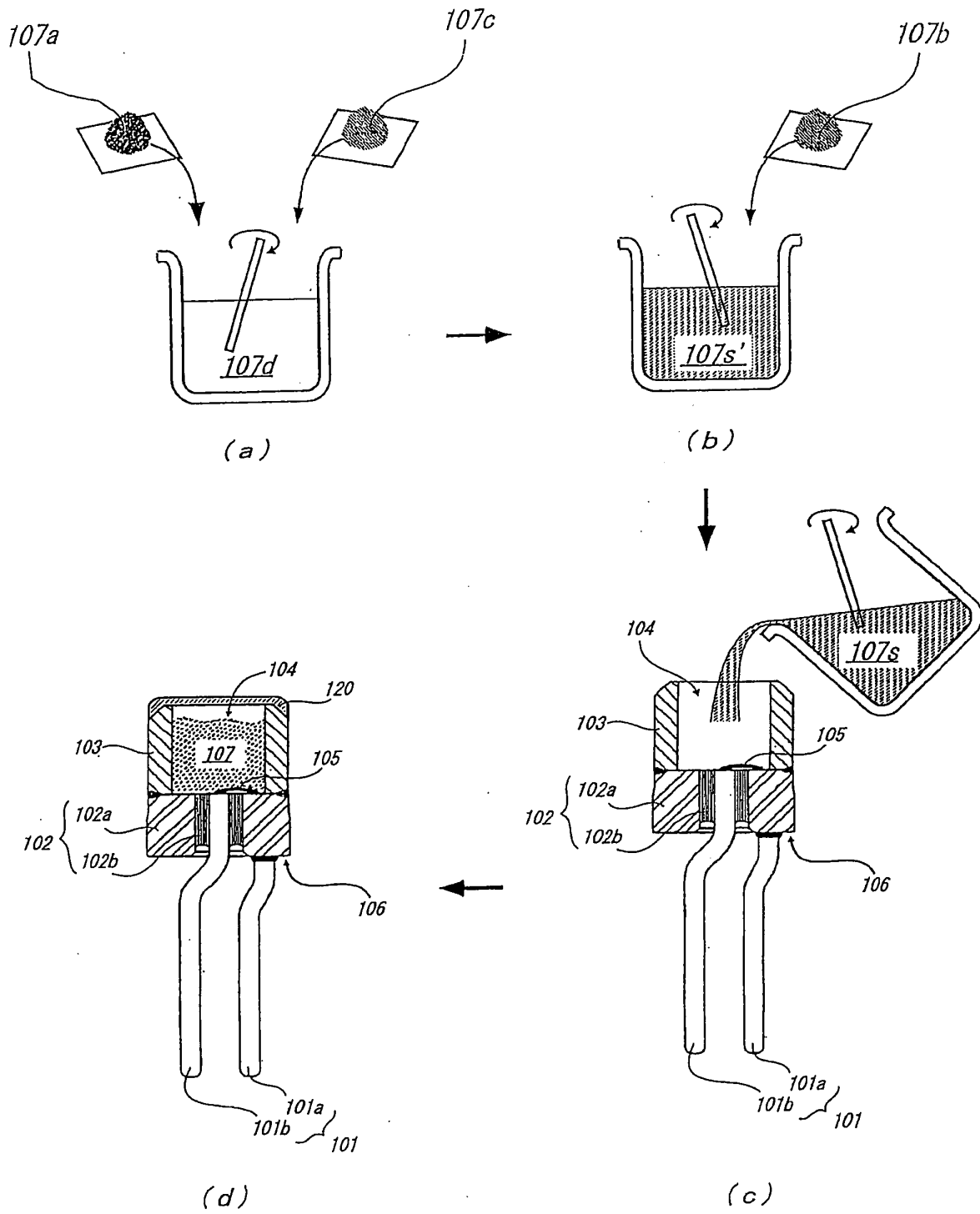
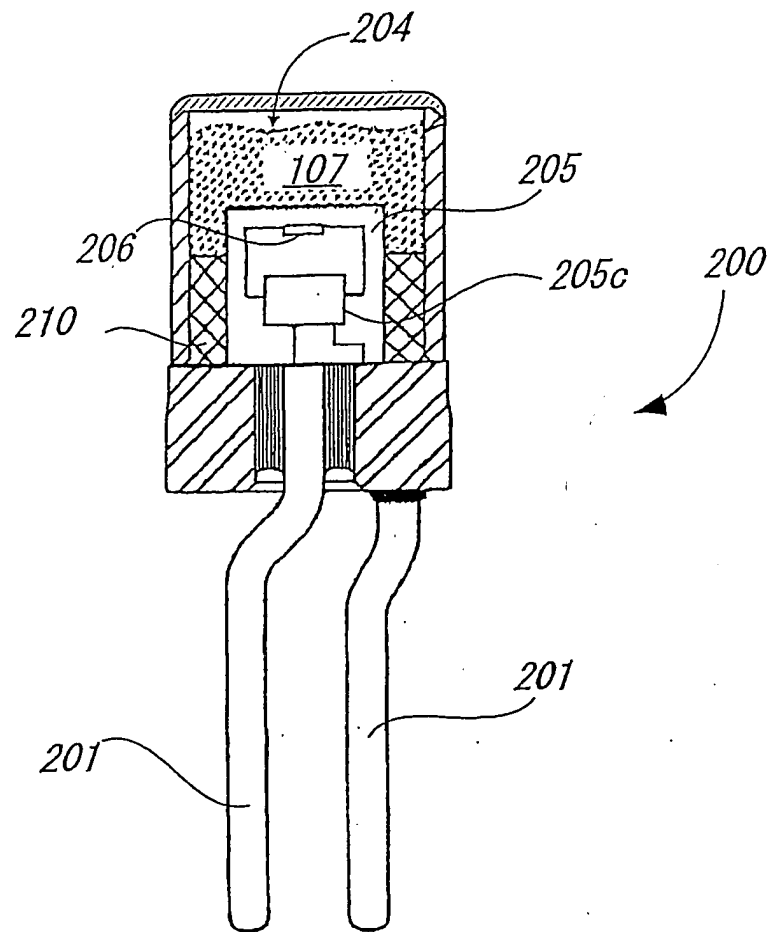


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/11079

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ F42B3/12, B60R21/26, B01J7/00, C06C7/00, F23Q13/00 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 F42B3/12, B60R21/26, B01J7/00, C06C7/00, F23Q13/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Jitsuyo Shinan Toroku Koho 1996-2003 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X <u>Y</u>	US 5686691 A1 (OEA, Inc.), 11 November, 1997 (11.11.97), Full text; all drawings & JP 9-210596 A & EP 780659 A2	1 <u>2-22</u>
X <u>Y</u>	JP 3064725 U (Kokubobu Nakayama Kagaku Kenkyuin), 29 September, 1999 (29.09.99), Par. No. [0006]; Fig. 1 (Family: none)	1, 9-12, 20-22 <u>2-8, 13-19</u>
☒ 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 27 November, 2003 (27.11.03)		Date of mailing of the international search report 09 December, 2003 (09.12.03)
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/JP03/11079

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X <u>Y</u>	JP 2000-292100 A (Showa Kinzoku Kogyo Kabushiki Kaisha), 20 October, 2000 (20.10.00), Par. No. [0025] (Family: none)	1,10-12 <u>2-9,13-22</u>
X <u>Y</u>	JP 2001-116495 A (Showa Kinzoku Kogyo Kabushiki Kaisha), 27 April, 2001 (27.04.01), Par. No. [0025] & EP 1092938 A2 & US 6354217 B1	1,10-12 <u>2-9,13-22</u>
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 129106/1980 (Laid-open No. 52543/1982) (NOF Corp.), 26 March, 1982 (26.03.82), Page 6, lines 1 to 7 (Family: none)	1-22
Y	JP 10-325699 A (Nichiyu Giken Kogyo Co., Ltd.), 08 December, 1998 (08.12.98), Par. Nos. [0014], [0030] (Family: none)	1-22

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