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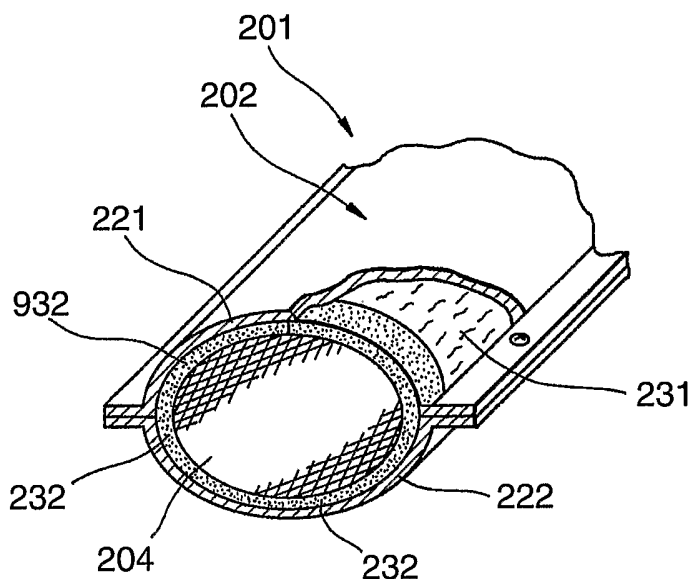
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(54) Title: POLLUTION CONTROL ELEMENT-MOUNTING MEMBER AND POLLUTION CONTROL DEVICE



(57) Abstract: A pollution control element-mounting member suitable for mounting a pollution control element within a casing of a pollution control device. The pollution control element-mounting member comprises a mat of a fiber material having a predetermined thickness, with the mat having a combination of at least two types of binders having different glass transition temperatures (T_g) impregnated therein.

POLLUTION CONTROL ELEMENT-MOUNTING MEMBER AND POLLUTION CONTROL DEVICE

Field of the Invention

5 The present invention concerns a pollution control element-retaining or mounting member, and more particularly the present invention concerns a retaining or mounting member for a pollution control element such as a catalyst carrier and a filter element. In particular, the present invention relates to a catalyst carrier-retaining or mounting member that shows good operability during inserting the catalyst carrier-mounting member in a
10 state of being wound around a catalyst carrier into a casing of the catalytic converter, that is excellent in heat resistance, an area pressure retaining property and erosion resistance, and also that in spite of reduction of the impregnation amount of the organic binder used, reduction of the aerial pressure and shedding of broken particles, fibers and others of the fibers can be simultaneously prevented. Further, the present invention concerns a
15 pollution control device provided with such a pollution control element-mounting member, more particularly, a catalytic converter having inserted therein such a catalyst carrier-mounting member and an exhaust cleaning device provided with a filter element-retaining or mounting member. The catalytic converter of the present invention can be advantageously used for treating exhaust gases of internal combustion engines of, for
20 example, power generators, automobiles and other vehicles.

Background

25 Exhaust gas-purifying systems for which ceramic catalytic converters are used have been well known as means for removing carbon monoxide (CO), hydrocarbons (HC), nitrogen oxide (NO_x) and the like contained in exhaust gases from the internal combustion engines of automobiles. A ceramic catalytic converter includes, for example, a honeycomb-shaped ceramic catalyst carrier (also termed "catalyst element") contained within a metal casing, namely, a housing.

30 As is well known, there are many types of ceramic catalytic converters. However, a ceramic catalytic converter is usually structured with a gap between the casing and the catalyst carrier accommodated therein. This gap is sufficiently filled with a mounting and heat insulating member typically formed from inorganic fibers, organic fibers and/or

generally a liquid or pasty organic binder in combination. See for example, Japanese Unexamined Patent Publications (Kokai) Nos. 57-61686; 59-10345 and 61-239100. As a result, the mounting/heat insulating member filling such gaps retains the catalyst carrier, and can prevent the catalyst carrier from accidental mechanical shocks caused by an impact, a vibration or the like. Because neither destruction nor movement of the catalyst carrier takes place in the catalytic converter having such a structure, the catalytic converter can realize the desired functions over a long period of time. Further, if it is impregnated into or coated over the inorganic fibers, the organic binder can prevent shedding or scattering of the broken particles, powders and the like (hereinafter, also referred to as "fiber pieces") of the inorganic fibers, and also it can prevent deformation of the catalyst carrier when the catalyst carrier is inserted (this operation is termed "canning") into a casing. In addition, because such a mounting/heat insulating member as mentioned above has a function of retaining a catalyst carrier, it is commonly called a catalyst carrier-retaining or mounting member.

Fig. 1 is a perspective view of the catalytic converter for exhaust gas purification described in Japanese Unexamined Patent Publication (Kokai) No. 7-269334. Using the illustrated catalytic converter 201, it becomes possible to simultaneously realize the improvement in canning of the catalyst carrier and the prevention of shedding of the fiber pieces by providing a vacuum-packed catalyst carrier using an air-tight sheet. The catalytic converter can be produced by the method in which a plate-like inorganic fibrous nonwoven fabric layer 231 and a sealing material 932 are contained in an air-tight sheet 232, a pressure in an interior section of the sheet 232 is reduced to reduce a thickness thereof, thereby adjusting a bulk density of the inorganic fibrous nonwoven fabric layer 231 to 0.10 to 0.40 g/cm³ and also a thickness thereof to approximately 1.0 to 2.5 times of the clearance between the catalyst holder 204 and the shell 202 (upper shell 221, lower shell 222) obtained upon assembling thereof, the sheet 232 is sealed, and then the inorganic fibrous nonwoven fabric layer 231 and sealing material 932 sealed under the reduce pressure are inserted to between the catalyst holder 204 and the shells 221 and 222, followed by assembling these members under application of the pressure. This catalytic converter is advantageous because it can prevent shedding of the fiber pieces without using an organic binder, however, since it is required to apply a vacuum packing system, the specified production apparatus is required to be used, along with the troublesome

production process and the increased production costs. Further, since the bonding system for the upper shell 221 and the lower shell 222 are based on use of flanges, the production operability is reduced in comparison with the pressurized insertion method in which the catalyst carrier is inserted into a cylindrical casing after a catalyst carrier-retaining member is wound around and integrated with an outer surface of the catalyst carrier.

Furthermore, Fig. 2 is a perspective view of the catalytic converter for exhaust gas purification described in Japanese Unexamined Patent Publication (Kokai) No. 2002-4848. The illustrated catalytic converter 300 is characterized by disposing a holding and sealing material 302 between a catalyst carrier 301 and a shell 395. The holding and sealing material 302 comprises a mat-like product of the inorganic fibers and has added thereto 0.5 to 20 wt% of a binder consisting of an organic or inorganic binder and also its packing density, determined after assembling, is adjusted to from 0.1 to 0.6 g/cm³. Further, the catalytic converter is characterized by dividing its holding and sealing material 302 into three sections (upper section 311, middle section 312 and lower section 313) in the thickness direction, the upper and lower sections each have a high solid content of the binder in comparison with the middle section. However, for this catalytic converter, since the holding and sealing material has to be divided into three sections along with control of the solid content of the binder in each of the sections, the production process is troublesome and also the production cost is increased. Moreover, while the organic binder has to be added in an amount of 0.5 to 20 wt% as described above, it is generally desired to reduce an amount of the organic binder for the purpose of satisfying the recent requirements of advanced controlling system of the automotive internal engines, because an increased amount of the organic binder can adversely affect such controlling system, especially on the function of the sensor contained therein.

Summary of the Invention

As described above, the catalyst carrier-retaining or mounting members usually used in the form of mats have been variously improved in prior catalytic converters, including those having a stuffed structure in which a catalyst carrier is inserted under the application of the pressure. However, the catalyst carrier-mounting members can still suffer from problems associated with their structures, production processes and characteristics. One important problem is to simultaneously prevent the reduction of the

area pressure or compression force of the mounting members and the shedding or scattering of the broken particles, powders and others of the fibers (fiber pieces) while reducing the amount of the organic binder used for the binding or fixing purpose.

Accordingly, an object of the present invention can be to provide a catalyst carrier-mounting member that shows good operability during inserting the catalyst carrier-mounting member in a state of being wound around a catalyst carrier into the casing of a catalytic converter, that is excellent in heat resistance, an area pressure retaining property and erosion resistance, and also that shows the reduction of the area pressure of the mounting member and the shedding of the fiber pieces in spite of the reduced impregnation amount of the organic binder used for the fixing purpose.

Further, another object of the present invention can be to provide a catalytic converter which has a simple structure, which can be easily produced, and in which the catalyst carrier-mounting member is excellent in heat resistance, an area pressure retaining property, prevention of shedding of the fiber pieces and erosion resistance.

Furthermore, other objects of the present invention can be to provide a pollution control element-mounting member for mounting pollution control elements other than the catalyst carrier such as, for example, a filter element and the like, and a pollution control device provided with such a pollution control element.

In one aspect thereof, the present invention resides in a pollution control element-mounting member for retaining a pollution control element within a casing by winding the pollution control element-mounting member around the pollution control element, wherein the pollution control element-mounting member is composed of a mat of a fiber material having a predetermined thickness, and the mat has a combination of at least two types of binders having different glass transition temperatures (T_g) impregnated therein.

Further, in another aspect thereof, the present invention resides in a pollution control device comprising a casing, a pollution control element provided within the casing and a pollution control element-mounting member arranged between the casing and the pollution control element, the pollution control element-mounting member being the above-described pollution control element-mounting member according to the present invention.

The pollution control element and the pollution control device according to the present invention each can be advantageously carried out in various embodiments. For

example, in one preferred embodiment of the present invention, the pollution control element is a catalyst carrier, and thus the pollution control device is a catalytic converter. In another preferred embodiment of the present invention, the pollution control element is a filter element (e.g., a diesel particulate filter, and thus the pollution control device is an exhaust cleaning device. The pollution control device can be used in the exhaust system of automotive and other internal combustion engines (e.g., gasoline, diesel and other organic fuel burning engines).

As will be explained hereinafter in detail, according to the present invention, it becomes possible to provide a catalyst carrier-mounting member that shows good operability when the catalyst carrier-mounting member, in a state of being wound around a catalyst carrier, is inserted into a casing of the catalytic converter, that is excellent in heat resistance, an area pressure retaining property, prevention of shedding of the fiber pieces and erosion resistance, and in addition, that an impregnation amount of the organic binder used for the fixing purpose can be reduced, while the reduction of an area pressure and the shedding of broken particles, powders and others of the fibers can be simultaneously prevented.

Further, according to the present invention, it becomes possible to provide a catalytic converter having a simple structure and capable of easily producing in which the inserted catalyst carrier-mounting member is excellent in heat insulation, an area pressure retaining property, shedding prevention of the fiber pieces and erosion resistance.

Furthermore, according to the present invention, it becomes possible to provide catalytic converters that can be advantageously used for treating exhaust gases from internal combustion engines of automobiles and other vehicles.

Moreover, according to the present invention, it also becomes possible to realize the above-described excellent effects in other pollution control devices than the catalytic converter, for example, diesel particulate filters and other exhaust cleaning devices.

The objects described above and other objects of the present invention will be easily understood from the following descriptions.

Brief Description of the Drawings

Fig. 1 is a perspective view showing one structure of prior art catalytic converters for exhaust gas purification.

Fig. 2 is a perspective view showing another structure of prior art catalytic converters for exhaust gas purification.

Fig. 3 is a side view showing one preferred structure of the catalytic converter for exhaust gas purification according to the present invention.

5 Fig. 4 is a cross-sectional view taken along the line A-A of the catalytic converter in Fig. 3.

Fig. 5 is a graph showing the results of determination of shedding of fiber pieces in the impact test with regard to the catalyst carrier-mounting member impregnated with the acrylic latex having different Tg.

10 Fig. 6 is a graph showing the results of determination of area pressure at the room temperature with regard to the catalyst carrier-mounting member impregnated with the acrylic latex having different Tg.

Fig. 7 is a graph showing the relationship between the shedding of fiber pieces and the area pressure at the room temperature with regard to the catalyst carrier-mounting member simultaneously impregnated with acrylic latex having different Tg.

Detailed Description of Modes for Carrying out the Invention

The pollution control element-mounting member and the pollution control device according to the present invention each can be advantageously practiced in various
20 embodiments. For example, the pollution control element may be a catalyst carrier (or catalyst element), a filter element (for example, exhaust cleaning filter for engines and others) or any other pollution control elements. Similarly, depending on a pollution control element applied thereto, the pollution control device may be a catalytic converter, an exhaust cleaning device such as exhaust cleaning device for engines (for example,
25 diesel particulate filter device) or any other pollution control devices. Hereinafter, the embodiments of the present invention will be described particularly referring to the catalyst carrier-mounting member and the catalytic converter, however, it should be noted that the present invention is not restricted to only the following embodiments.

The catalytic converter according to the present invention can be particularly
30 advantageously used for treating exhaust gases from internal combustion engines of automobiles and others. The catalytic converter comprises at least a casing and a catalyst carrier (catalyst element) placed within the casing. The catalyst carrier-mounting member

according to the present invention that will be explained in detail hereinafter is inserted between the casing and the catalyst carrier so that the catalyst carrier-mounting member is wound around the external peripheral surface of the catalyst carrier. Further, as is carried out in the production of the prior art catalytic converters, a catalyst carrier and a catalyst carrier-mounting member may be bonded together with a bonding means such as an adhesive or a pressure-sensitive adhesive tape. However, for the catalytic converter of the invention, because the catalyst carrier-mounting member itself can manifest adequate adhesion, insertion of the bonding means that makes the structure and production complicated, and that increases the production cost is unnecessary. Further, although the catalyst carrier-mounting member is usually wound around a substantially entire surface of the catalyst carrier, if desired, it may be wound around only a part of the catalyst carrier. Furthermore, fixing means such as a wire mesh may optionally be used auxiliarily.

It is preferred that the catalyst carrier-mounting member is suitably compressed so that it can provide an appropriate bulk density when it is inserted within the casing. The compression procedures include clamshell compression, stuffing compression, Turnikit compression and others. The catalyst carrier-mounting member of the present invention can be advantageously used for the production of a catalytic converter having a so-called stuffed structure that is formed by a procedure such as stuffing compression, for example, pushing under pressure the catalyst carrier-mounting member into a cylindrical casing.

The catalytic converter of the present invention may include different types of the catalytic converters. Preferably, the catalytic converter is one equipped with a monolithically formed catalyst element, namely, a monolithic catalytic converter. Because the catalytic converter is composed of a catalyst element having small passages each having a honeycomb-shaped cross section, it is smaller in comparison with the prior art pellet type catalytic converters, and thus can suppress the exhaust gas resistance while adequately insuring a contact area with the exhaust gases, thereby enabling to treat the exhaust gases more efficiently.

The catalytic converters of the present invention can be advantageously used for treating the exhaust gases in combination with different types of internal combustion engines. In particular, the catalytic converters can adequately exhibit their excellent functions and effects when they are mounted on the exhaust systems of automobiles such as passenger cars, buses and trucks.

Fig. 3 is a side view showing a typical example of the catalytic converter according to the present invention in which the principal portion of the converter is illustrated with the cross-section for the sake of easy understanding of the structure. Moreover, Fig. 4 is a cross-sectional view of the catalytic converter in Fig. 3 taken along the line A-A. As is understood from these figures, a catalytic converter 10 is equipped with a metal casing 4, a monolithic solid catalyst carrier 1 arranged within the metal casing 4 and a catalyst carrier-mounting member 2 of the present invention arranged between the metal casing 4 and the catalyst carrier 1. As is explained in detail hereinafter, the catalyst carrier-mounting member 2 is composed of a mat of a fiber material having a predetermined thickness, and the mat is characterized by being impregnated with a combination of at least two types of binders, for example, acrylic latex, having different glass transition temperatures (T_g). An exhaust gas inlet 12 and an exhaust gas outlet 13, each having a truncated cone shape, are attached to the catalytic converter 10.

As explained above, for the catalytic converter 10 of the present invention, it is fundamentally unnecessary to use bonding means such as an adhesive agent and a pressure-sensitive adhesive sheet between the catalyst carrier 1 and the catalyst carrier-mounting member 2. However, such bonding means may be auxiliarily used if it exerts no adverse effects on the functions and effects of the invention and rather improves the adhesion between the catalyst carrier 1 and the catalyst carrier-mounting member 2, and if the effect of promoting the canning operation can be expected. Usually, the bonding means is preferably used partially. Moreover, although a protective coating is generally unnecessary, the catalyst carrier-mounting member 2 may have a protective coating for protecting the surface from damage.

Being especially explained, the solid catalyst carrier within the casing is usually composed of a ceramic catalyst carrier having a honeycomb structure with a plurality of exhaust gas passages. The catalyst carrier-mounting member of the present invention is applied by winding it around the catalyst carrier. The catalyst carrier-retaining or mounting member retains the catalyst carrier within the metal casing and seals gaps formed between the catalyst carrier and the metal casing, in addition to its functioning as a heat insulating member. As a result, the catalyst carrier-mounting member can prevent exhaust gases from bypassing the catalyst carrier, or at least it can inhibit such an undesired flow to the minimum level. Moreover, the catalyst carrier can be firmly and

elastically supported within the metal casing.

In the catalytic converter of the present invention, the metal casing can be prepared from various metal materials that are known to those skilled in the art, in any arbitrary shape in accordance with the desired functions, effects, and the like. A suitable metal casing is made of a stainless steel, and has a shape as shown in Fig. 3. Of course, a metal casing having a suitable shape can be optionally produced from metal such as iron, aluminum, titanium or an alloy of these metals.

Similarly to the production of the metal casing, the solid catalyst carrier can be produced from a material that is similar to that and in a shape similar to that used in the production of conventional catalytic converters. Suitable catalyst carriers include those known to those skilled in the art, and produced from metal, ceramics, and the like. Useful catalyst carriers are disclosed in, for example, U.S. Reissue Patent No. 27,747. Moreover, ceramic catalyst carriers are commercially available from, for example, Corning Inc. in the U.S.A. For example, a honeycomb-shaped ceramic catalyst carrier is available from Corning Inc. under the trade name "CELCOR", and another one is available from NGK Insulated Ltd. under the trade name "HONEYCERAM". Metal catalyst carriers are commercially available from, for example, Behr GmbH and Co. in Germany. Note that the detailed explanations of catalyst monoliths can be found in, for example, SAE Techn. Paper 900,500, "System Approach to Packaging Design for Automotive Catalytic Converters" by Stroom et al.; SAE Techn. Paper 800,082, "Thin Wall Ceramics as Monolithic Catalyst Support" by Howitt; and SAE Techn. Paper 740,244, "Flow Effect in Monolithic Honeycomb Automotive Catalytic Converter" by Howitt et al.

Catalysts to be supported on catalyst carriers explained above are usually metals (for example, platinum, ruthenium, osmium, rhodium, iridium nickel and palladium), and metal oxides (for example, vanadium pentoxide and titanium dioxide), and are preferably used in the form of coatings. Note that the detailed explanation of such a catalyst coating can be found in, for example, U.S. Patent No. 3,441,381.

In the practice of the present invention, the catalytic converter can be optionally produced in various structures and by various methods as long as the production does not depart from the scope of the present invention. The catalytic converter can be fundamentally produced by accommodating, for example, a honeycomb-shaped ceramic catalyst carrier in a metal casing. Moreover, it is particularly suitable that a catalyst layer

(catalyst coating) composed of a noble metal such as platinum, rhodium or palladium is supported on a honeycomb-shaped ceramic monolith to give a final catalyst carrier (catalyst element). Use of this production process can manifest effective catalytic action at relatively high temperature.

5 According to the present invention, the catalyst carrier-mounting member of the invention is arranged between the metal casing and the catalyst element. The catalyst carrier-mounting member is composed of a mat, blanket or the like of a fiber material having the predetermined thickness. The catalyst carrier-mounting member may be formed from one member, or it may be formed from two or more members through
10 lamination or bonding of the members. It is usually advantageous for the catalyst carrier-mounting member to have a form such as a mat or a blanket, in view of the handling property, however, the catalyst carrier-mounting member may optionally have other forms. The size of the catalyst carrier-mounting member can be varied in a wide range according to its use and the like. For example, when a mat-shaped catalyst carrier-
15 mounting member is inserted into an automotive catalytic converter, the catalyst carrier-mounting member usually has a mat thickness of from about 1.5 to 15 mm, a width of from about 200 to 500 mm, and a length of from about 100 to 1,500 mm. Such a catalyst carrier-mounting member may optionally be cut with scissors, a cutter or the like to obtain a desired shape and size.

20 The catalyst carrier-mounting member is preferably formed from an inorganic fiber material, more preferably from an inorganic fiber material containing alumina fibers. Moreover, although the inorganic fiber material may comprise a combination of two or more types of alumina fibers, another inorganic material may be used in combination with the alumina fibers to form the catalyst carrier-mounting member, if desired. Examples of
25 the usable inorganic material include silica fibers, glass fibers, bentonite, vermiculite and graphite, although the examples are not restricted to those materials mentioned above. These inorganic materials may be used alone, or at least two types of the inorganic materials may be mixed to use in combination.

30 The inorganic fibers forming the catalyst carrier-mounting member preferably comprises inorganic fibers containing alumina (Al_2O_3) and silica (SiO_2). The inorganic fibers used herein comprise two components of alumina fibers and silica fibers, and the mixing ratio of the alumina fibers to the silica fibers are preferably from about 40:60 to

96:4. When the mixing ratio of the alumina fibers to the silica fibers are outside the above range, for example, the mixing ratio is less than 40%, inconvenience such as deterioration of the heat resistance occurs.

Although there is no specific limitation on the thickness (average diameter) of the inorganic fibers, they appropriately have an average diameter of from about 2 to 7 μm . When the inorganic fibers have an average diameter less than about 2 μm , the fibers are likely to become brittle and have insufficient strength. Conversely, when the inorganic fibers have an average diameter greater than about 7 μm , the catalyst carrier-mounting member tends to be hardly formed.

Furthermore, there is no specific limitation on the length of the inorganic fibers, similarly to the thickness thereof. However, the inorganic fibers suitably have an average length of from about 0.5 to 50 mm. When the average length of the inorganic fibers is less than about 0.5 mm, the effect of forming the catalyst carrier-mounting member for which the inorganic fibers are used cannot be achieved. Conversely, when the length exceeds about 50 mm, it becomes difficult to produce the catalyst carrier-mounting member in the smooth process, because the handling property of the inorganic fibers becomes poor.

Alternatively, in the practice of the present invention, an alumina fiber mat mainly composed of a laminated sheet of alumina fibers can also be used advantageously. For such an alumina fiber mat, the average length of the alumina fibers is usually from about 20 to 200 mm, and the thickness (average diameter) of the fibers is usually from about 1 to 40 μm . Moreover, the alumina fibers preferably have a mullite composition having an $\text{Al}_2\text{O}_3/\text{SiO}_2$ weight ratio of from about 70/30 to 74/26.

The above-described alumina fiber mat can be produced from a stock spinning solution composed of a mixture of, for example, an alumina source such as aluminum oxychloride, a silica source such as silica sol, an organic binder such as poly(vinyl alcohol) and water. That is, a spun aluminum fiber precursor is laminated to form a sheet, which is then preferably needle punched. The punched sheet is usually baked at temperatures as high as from about 1,000 to 1,300°C.

Needle punching mentioned above usually has the effect of orienting part of the fibers in the direction vertical to the laminated surface. Part of the alumina fiber precursor within the sheet therefore penetrates the sheet and is oriented in the vertical direction to firmly tie the sheet. As a result, the bulk specific gravity of the sheet is increased, and

delamination and shifts among the layers are prevented. Although the needle punching density can be varied widely, it is usually from about 1 to 50 punches/cm². The thickness, bulk specific gravity and strength of the mat are adjusted by the needle punching density.

In the production of the alumina fiber mat as explained above, ceramic fibers other than the alumina fibers and inorganic expansive materials may be optionally added to the alumina fibers. In this case, although the additives may be uniformly mixed with the mat, they may also be added so that they are localized while portions to be heated are particularly being avoided. The additives can thus be added at low cost while the properties of the additives are being maintained. Examples of the ceramic fibers include silica fibers, glass fibers and the like, and examples of the inorganic expansive material include bentonite, expansive vermiculite, expansive graphite and the like.

The catalyst carrier-mounting member according to the present invention is preferably produced by a dry process. This is in contrast to the conventional catalyst carrier-mounting members which were produced by a wet process (including each of the steps of mixing inorganic fibers and organic fibers; opening inorganic fibers; preparing a slurry; shape-forming by a paper-making procedure; and pressing for forming a formed body). The dry process can be conducted fundamentally by using any of the well-known and conventional methods. Typically, the drying process utilizing needle punching etc. is advantageous as explained above.

As described above, the catalyst carrier-mounting member of the present invention is composed of a mat of a fiber material having the predetermined thickness that is inserted between a casing and a catalyst carrier inserted within the casing while the mat is wound around the external peripheral surface of the catalyst carrier. The mat-like catalyst carrier-mounting member is characterized by being impregnated with at least two types of binders having different glass transition temperatures (T_g) together in accordance with the present invention.

In the practice of the present invention, a wide variety of conventional binders can be used for binding and fixing the fiber material. Suitable examples of the binder include naturally occurring or synthetic polymeric material such as resinous material, for example, butadiene-styrene resin, polystyrene resin, polyvinyl acetate and acrylic resin, or an organic material such as polyvinyl alcohol. Preferably, an acrylic latex can be used as the binder.

That is, in the catalyst carrier-mounting member of the present invention, it is preferred that its mat of the fiber material is especially impregnated with an acrylic latex as a binder, and also the acrylic latex used as the binder is a combination of at least one acrylic latex having a relatively low Tg and at least one acrylic latex having a higher Tg than that of the low Tg acrylic latex. According to the present invention, with the use of acrylic latex binders having different Tg, it becomes possible to obtain the remarkable actions and functions which could not be expected in the conventional catalyst carrier-mounting members impregnated with an acrylic latex. Particularly, use of the acrylic latex having a relatively low Tg enables to effectively prevent shedding of the fiber pieces, and use of the acrylic latex having a relatively high Tg enables to prevent reduction of the area pressure or compression force of the catalyst carrier-mounting member, thereby ensuring a stable maintenance of the increased area pressure. Particularly, according to the present invention, a problem of the reduction of the area pressure can be solved by using a high Tg acrylic latex in combination with the low Tg acrylic latex, while it is generally recognized in the conventional catalyst carrier-mounting members that an area pressure of the members can be reduced if the acrylic latex is deeply impregnated into about a center portion of the catalyst carrier-mounting member for the purpose of preventing shedding of the fiber pieces. More remarkably, since the low Tg and high Tg acrylic latex are used in combination to simultaneously obtain the functions originating from these acrylic latex as described above, it becomes possible to accomplish a satisfactory binding functions with a small amount of the impregnated acrylic latex, thereby avoiding adverse effect on the sensor due to use of the large amount of the acrylic latex, whereas a relatively large amount of the acrylic latex had to be impregnated to obtain a sufficient binding function in the prior art.

In the catalyst carrier-mounting member of the present invention, the acrylic latex to be impregnated in the member may include a wide variety of acrylic latex, as long as they can provide the expected functions and effects described above, and they do not adversely affect on the characteristics and others of the catalyst carrier-mounting member. If desired, the commercially available acrylic latex may be used as obtained, or it may be used after optional modification depending upon the use object of the present invention. Suitable acrylic latex includes a colloidal dispersion prepared by dispersing an acrylic latex in a water or other medium.

In the practice of the present invention, the acrylic latex used generally has a glass transition temperature (T_g) of about -50 to 50°C. Among the acrylic latex having such a wide range of T_g, the most suitable combination of the high T_g acrylic latex and the low T_g acrylic latex can be selected and determined depending upon factors such as constitution of the catalyst carrier-mounting member and the characteristics required in the catalytic converter. The present inventors have found that a combination of the first acrylic latex having a T_g of about 15 to 45°C and the second acrylic latex having a T_g of about -45 to 15°C is suitable in the present invention, while the present invention should not be restricted to this combination.

Generally, the acrylic latex is preferably used after it was substantially uniformly dispersed in the catalyst carrier-mounting member. That is, when the mat-like catalyst carrier-mounting member surrounding the catalytic carrier is observed with regard to its thickness, it is preferred that the acrylic latex is substantially uniformly dispersed in the thickness direction in the catalyst carrier-mounting member.

Further, as described above, the acrylic latex can be impregnated in the catalyst carrier-mounting member in a reduced amount in comparison with that of the conventional catalytic converters. Although the impregnation content of the acrylic latex can be variously modified within the small amount range, it is generally in the range of about 0.1 to 5% by weight, preferably in the range of about 0.1 to 3% by weight.

Impregnation of the catalyst carrier-mounting member with an acrylic latex, as explained above can be advantageously conducted with the well-known and conventional technologies, namely, dipping, spraying, coating and the like. Especially, the dipping method is simple and economical, because the catalyst carrier-mounting member can be fully dipped in a container containing an acrylic latex after preparation of such a container. In addition, according to the dipping method, there can be obtained the effect that the acrylic latex can be substantially impregnated in a whole portion of the catalyst carrier-mounting member. After impregnation, the acrylic latex may be dried naturally or dried by heating to a suitable temperature.

Examples

The present invention will be further explained with reference to the examples thereof. Note that the present invention should not be restricted to the examples.

Example 1:

Needle punched alumina fiber mat (trade name "MAFTEC", manufactured by Mitsubishi Chemical Functional Products Inc.) having a mat surface density of 0.4 g/cm³ was provided. A size of the alumina fiber mat was 260 mm long, 90 mm wide and 12.5 mm thick. Next, totally 8 types of the acrylic latex (organic binder) described in the following Table 1 each was diluted with 10 liters of water to prepare a latex dipping bath. The alumina fiber mat was dipped in each of the latex dipping bath to uniformly disperse the acrylic latex in a whole portion of the mat. An excess amount of the acrylic latex was sucked on the wire mesh, the alumina fiber mat impregnated with the acrylic latex was introduced and dried in an oven at a temperature of 180°C to obtain a water content of about 50%. Thereafter, the alumina fiber mat was dried up by using a cylindrical drier at 145°C. In each of the dried binder-impregnated alumina fiber mats, a content of the organic component indicating the impregnation amount of the acrylic latex was 0.5% by weight. The resulting binder-impregnated alumina fiber mat was stored at a room temperature.

The dried binder-impregnated alumina fiber mat was wound around the external peripheral surface of a cylindrical monolith body having a size of 78 mm in outer diameter and 100 mm long (manufactured by NGK Insulators, Ltd.) separately provided. Next, the catalyst carrier around which the alumina fiber mat was wound was stuffed within a cylindrical stainless steel casing having a size of 78 mm in inside diameter and 100 mm long with a guide corn at a rate of 40 mm/sec. In the resulting catalytic converter, no defect such as displacement or deformation of the mat which will cause a problem in the retention of the catalyst carrier was observed.

Table 1

Binder	Manufacturer	Tg (°C)	pH	Viscosity (mPa·s)	Solid Content (%)
LX816	Zeon Corporation	-10	2	30	42
LX814	Zeon Corporation	25	6	30	46
LX844	Zeon Corporation	32	7.5	70	40
LX811	Zeon Corporation	1	6.5	170	50
LX821	Zeon Corporation	-13	8.3	700	55
K-3	Rohm and Hass Company	-27	3	6000	46
HA-16	Rohm and Hass Company	35	2.9	500	45.5
ST-954	Rohm and Hass Company	-23	3.5	400	45.5

Evaluation Tests:

Different types of the organic binder-impregnated alumina fiber mats (organic content: 0.5 wt%) produced in accordance with the above-described method were tested with regard to the shedding of fiber pieces and the area pressure at a room temperature according to the following manner to obtain the results plotted in Figs. 5 and 6.

[Determination of Shedding of Fiber Pieces]

The impact test machine described in Japanese Industrial Standard (JIS K-6830) was used to conduct the impact test in accordance with the guideline described in this standard. The impact test was carried out in the following steps (1) to (4).

(1) Totally 8 types of the binder-impregnated alumina fiber mat (size: 250mm x 250mm) were produced in accordance with the method described above. Next, a test sample (size: 100mm x 100mm) was produced from each of the alumina fiber mats in a punching mold, and its weight was measured.

(2) The test sample was set in an impact test machine described in JIS K-6830, and the

impact was applied at an angle of 30 degrees.

(3) After application of Area impact, the test sample was removed from the machine, and its weight was again measured.

(4) A shedding amount of the fiber pieces was calculated from the variation of the weight of the test sample before and after testing. Shedding (wt%) of the fiber pieces plotted in Fig. 5 was thus obtained.

[Determination of Area Pressure at Ordinary Temperature]

(1) Totally 8 types of the binder-impregnated alumina fiber mat (size: 250mm x 250mm) were produced in accordance with the method described above. Next, a circular test sample (diameter: 45mm) was produced from each of the alumina fiber mats in a punching mold, and its weight was measured.

(2) A thickness of the mat necessary to obtain a filling density of 0.3 g/cc was calculated from the measured weight.

(3) The test sample was set in a center portion of the compression plate of the compression test machine(Model "976.29-32", produced by MTS Co.), and the test sample was compressed at a speed of 20 mm/minutes until the mat thickness is changed to the predetermined thickness calculated by the above procedure. A compression force or pressure (area pressure) at the peak was determined at a room temperature in the X-Y recorder. The area pressure (KPa) at the room temperature plotted in Fig. 6 was thus obtained.

It is appreciated from the graph of the shedding of the fiber pieces plotted in Fig. 5 and the graph of the area pressure at the room temperature plotted in Fig. 6 that when the acrylic latex having a relatively low Tg is used as a binder, shedding of the fiber pieces can be prevented, but a reduction of the area pressure cannot be avoided. Contrary to this, when the acrylic latex having a relatively high Tg is used as a binder, an area pressure can be increased, but at the same time, shedding of the fiber pieces are increased. In other words, it is appreciated that when the acrylic latex having a relatively low Tg is used in combination with the acrylic latex having a relatively high Tg, an area pressure can be highly maintained, while inhibiting shedding of the fiber pieces.

Example 2:

Totally 8 types of the binder-impregnated alumina fiber mats were produced in accordance with the method described in Example 1, and the shedding of the fiber pieces and the area pressure at the room temperature were determined in each of the alumina fiber mats in the manner described in Example 1. Note in this example that to simultaneously evaluate an effect of the impregnation amount of the acrylic latex on the shedding of the fiber pieces and the area pressure at the ordinary temperature, a content of the organic component in the alumina fiber mat was changed to 0.5 and 3.5 wt%. The results are summarized in the following Table 2.

Table 2

Binder	Tg (°C)	Fiber Shedding (wt%)		Area Pressure at Room Temp. (KPa)	
		Organic Content 0.5%	Organic Content 3.5%	Organic Content 0.5%	Organic Content 3.5%
K-3	-27	0.032	0.000	142.7	132.4
ST-954	-23	0.022	0.011	156.9	143.2
LX821	-13	0.048	0.011	158.0	152.7
LX816	-10	0.028	0.002	145.8	120.4
LX811	1	0.047	0.004	149.3	151.8
LX814	25	0.129	0.089	144.3	222.8
LX844	32	0.118	0.084	170.1	269.5
HA-16	35	0.128	0.062	141.0	231.9

It is appreciated from the results described in Table 2 that when an impregnation amount of the acrylic latex as a binder was increased, shedding of the fiber pieces can be prevented as is well-known in the art. Further, it is appreciated that when the acrylic latex used as a binder has a Tg of not higher than the room temperature (20°C), the resulting

effect of preventing shedding of the fiber pieces is remarkably high. Furthermore, it is appreciated that when the acrylic latex used as a binder has a Tg of the low temperature range (probably, the temperature of not higher than 10°C), the area pressure at the room temperature can be reduced. On the contrary, it is appreciated that when the acrylic latex
5 used as a binder has a Tg of about the room temperature or more, the area pressure at the room temperature can be increased.

Example 3:

The binder-impregnated alumina fiber mats were produced in accordance with the
10 method described in Example 1, and the shedding of the fiber pieces and the area pressure at the room temperature were determined in each of the alumina fiber mats in the manner described in Example 1. Note in this example that to evaluate an effect of the combined use of two acrylic latex on the shedding of the fiber pieces and the area pressure at the room temperature, the acrylic latex (LX816 and LX844 described in Table 1) were used
15 alone or in combination (mixing ratio: 1:1, 1:4 and 1:7) as described in Fig. 7. Further, a content of the organic component in the alumina fiber mat was 3 wt% in each test sample. The measurement results concerning the shedding of the fiber pieces and the area pressure at the room temperature were summarized to obtain a graph plotted in Fig. 7.

20 It is appreciated from the graph showing the relation between the shedding of the fiber pieces and the area pressure at the room temperature that when two types of the acrylic latex having different Tg are used in combination as a binder, an increased area pressure and a low level of the shedding of the fiber pieces can be simultaneously realized as is evidenced in the dotted line area of Fig. 7, contrary to the sole use of the acrylic latex
25 according to which it was impossible to attain such remarkable effects.

Example 4:

The binder-impregnated alumina fiber mats were produced in accordance with the method described in Example 1, and the shedding of the fiber pieces and the area pressure
30 at the room temperature were determined in each of the alumina fiber mats in the manner described in Example 1. Note in this example that to evaluate an effect of the combined use of two acrylic latex on the shedding of the fiber pieces and the area pressure at the

room temperature, the acrylic latex (LX816, LX814, LX844 and K-3 described in Table 1) were used as a mixture of two acrylic latex (mixing ratio: 1:1) as described in the following Table 3. Further, in this example, to evaluate an effect of the impregnation amount of the acrylic latex on the shedding of the fiber pieces and the area pressure at the room temperature, a content of the organic component in the alumina fiber mat was changed to 0.5 and 3.5 wt%. The measurement results concerning the shedding of the fiber pieces and the area pressure at the room temperature were summarized to obtain Table 3 described below.

Table 3

1st Binder	2nd Binder	Fiber Shedding (wt%)		Area Pressure at Room Temp. (KPa)	
		Organic Content	Organic Content	Organic Content	Organic Content
		0.5%	3.5%	0.5%	3.5%
LX816	LX814	0.058	154.2	0.013	180.1
LX816	LX844	0.047	156.7	0.026	201.2
K-3	LX844	0.020	165.1	0.028	171.2

It is appreciated from the measurement results described in Table 3 that when the acrylic latex capable of contributing an increase of the area pressure and the acrylic latex capable of contributing prevention of shedding of the fiber pieces are used in combination, it becomes possible to simultaneously accomplish an increase of the area pressure and an inhibition of the shedding of the fiber pieces.

What is claimed is:

1. A pollution control element-mounting member suitable for mounting a pollution control element within a casing of a pollution control device, said pollution control element-mounting member comprising a mat of a fiber material having a predetermined thickness, with the mat having a combination of at least two types of binders having different glass transition temperatures (Tg) impregnated therein.

2. The pollution control element-mounting member according to claim 1, wherein said binder is acrylic latex.

3. The pollution control element-mounting member according to claim 2, wherein the acrylic latex is a combination of the first acrylic latex having a Tg of 15 to 45°C and the second acrylic latex having a Tg of -45 to 15°C.

4. The pollution control element-mounting member according to claim 2 or 3, wherein the total content of the acrylic latex in the mat of the fiber material is in the range of 0.1 to 5% by weight.

5. The pollution control element-mounting member according to any one of claims 1 to 4, wherein the fiber material is an inorganic fiber material comprising alumina containing fibers.

6. The pollution control element-mounting member according to claim 5, wherein the inorganic fiber material further comprises silica fibers and/or glass fibers in combination with the alumina containing fibers.

7. The pollution control element-mounting member according to any one of claims 1 to 6, wherein the mat of the fiber material is formed by a dry process.

8. The pollution control element-mounting member according to any one of claims 1 to 7, wherein said pollution control element is a catalyst carrier.

9. The pollution control element-mounting member according to any one of claims 1 to 7, wherein said pollution control element is a filter element.

5 10. A pollution control device comprising a casing, a pollution control element provided within the casing and a pollution control element-mounting member arranged between the casing and the pollution control element, the pollution control element-mounting member being the pollution control element-mounting member described in any one of claims 1 to 7.

10 11. The pollution control device according to claim 10, wherein said pollution control element is a catalyst carrier, and said pollution control device is a catalytic converter.

12. The pollution control device according to claim 10, wherein said pollution control
15 element is a filter element, and said pollution control device is an exhaust cleaning device.

13. An exhaust system for an internal combustion engine, said exhaust system comprising said pollution control device according to any one of claims 10 to 12.

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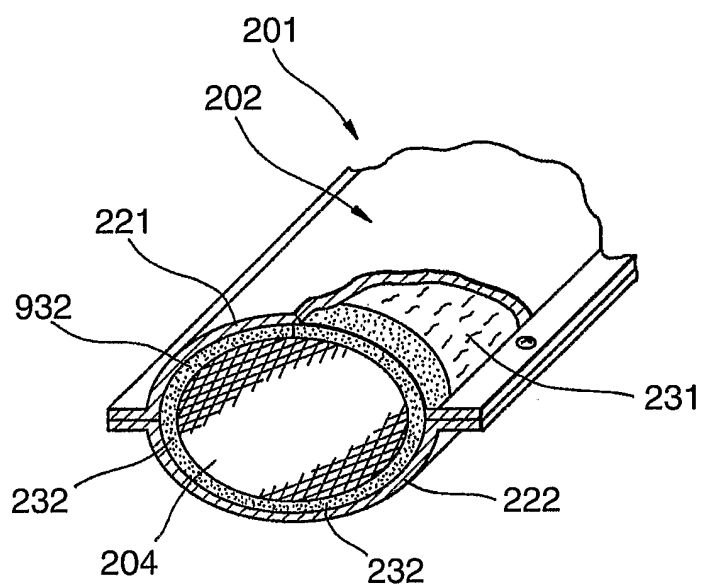


FIG. 1

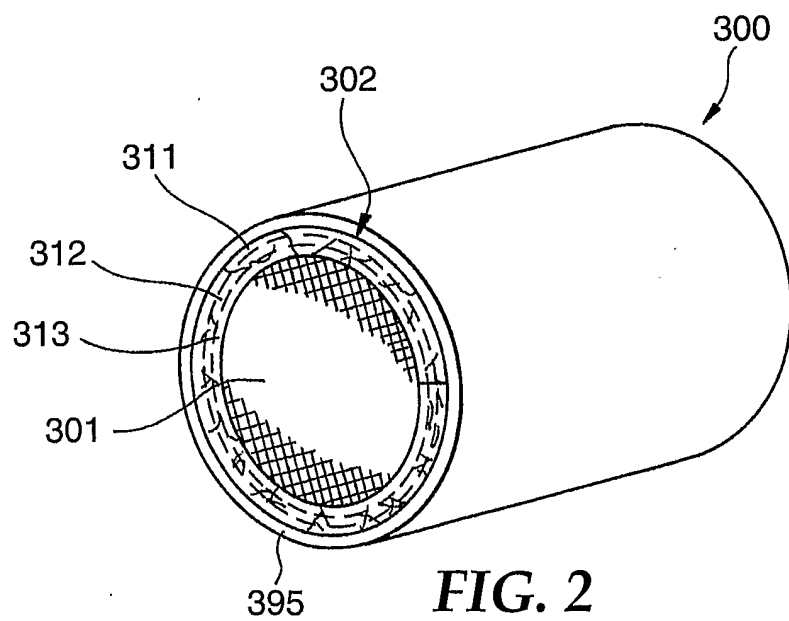


FIG. 2

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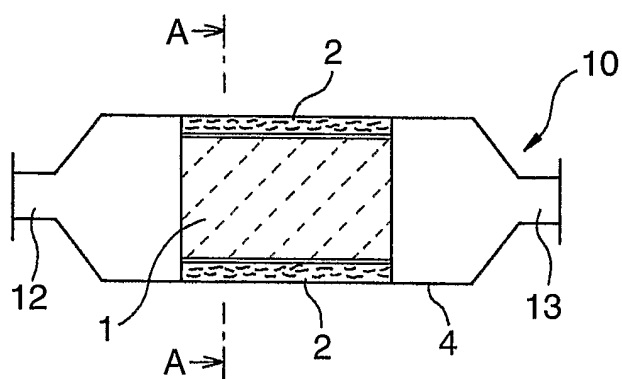


FIG. 3

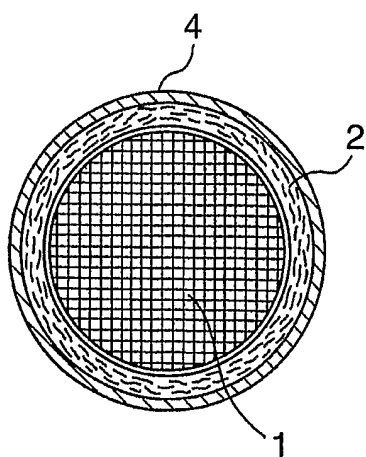
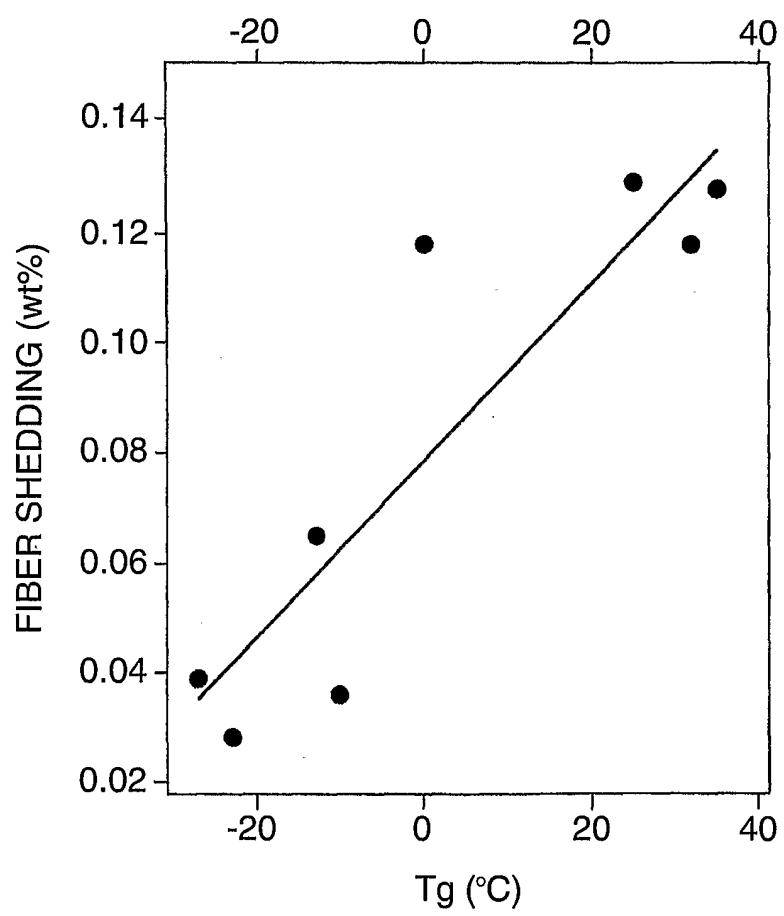
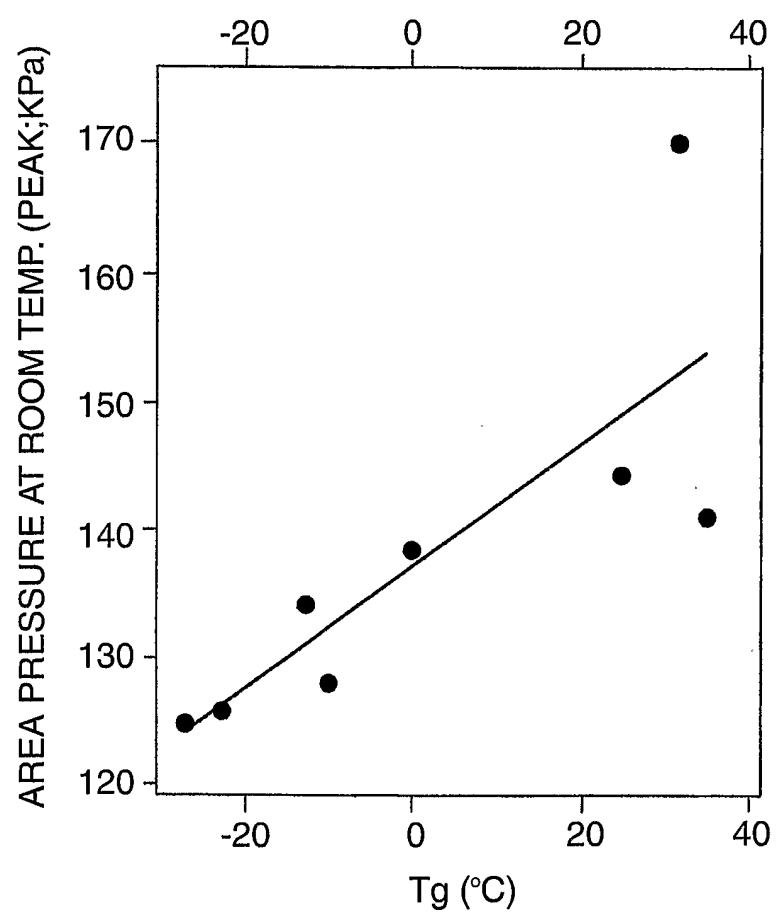


FIG. 4

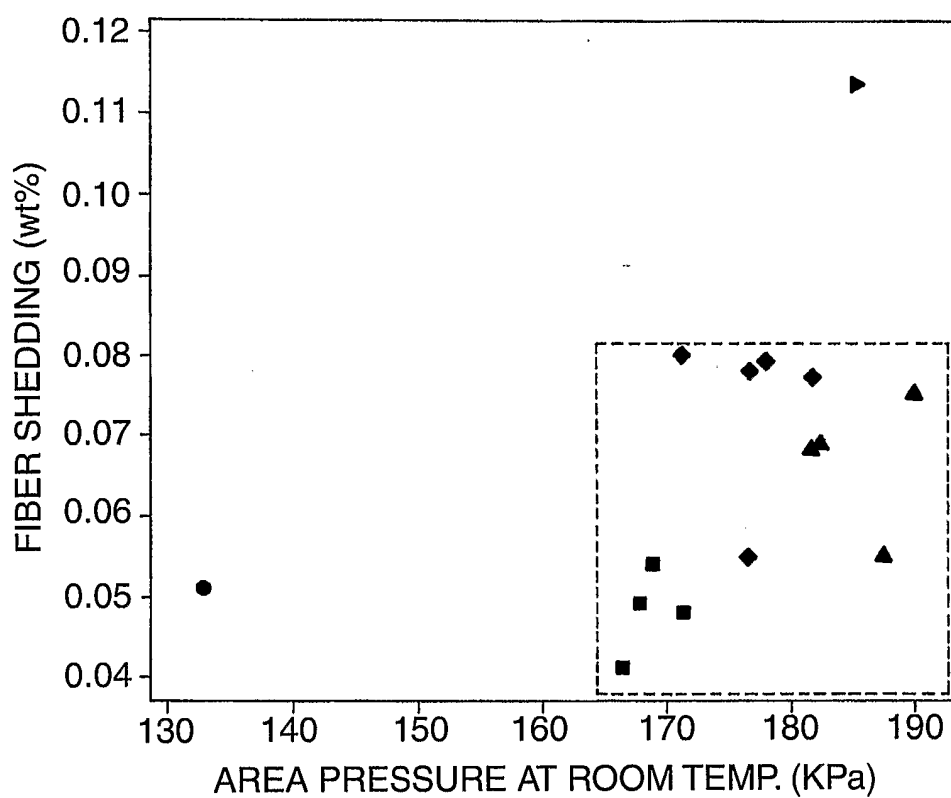
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**FIG. 5**

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**FIG. 6**

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**FIG. 7**

- LX816
- LX816 : LX844=1 : 1
- ◆ LX816 : LX844=1 : 4
- ▲ LX816 : LX844=1 : 7
- LX844