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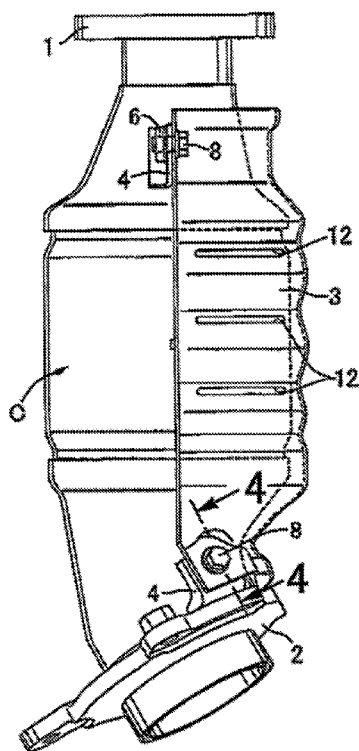
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2013-262042 19 December 2013 (19.12.2013) JP(71) Applicants: **3M INNOVATIVE PROPERTIES COMPANY** [US/US]; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US). **YUTAKA GIKEN CO., LTD.** [JP/JP]; 508-1 Yataka-Cho, Higashi-Ku, Hamamatsu-Shi, Shizuoka 413-3194 (JP).(72) Inventors: **DIETZ, Peter T.**; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).**MASHIKO, Kazutoyo**; 508-1 Yataka-Cho, Higashi-Ku, Hamamatsu-Shi, Shizuoka 413-3194 (JP). **KAGEYAMA, Yasushi**; 508-1 Yataka-Cho, Higashi-Ku, Hamamatsu-Shi, Shizuoka 413-3194 (JP).(74) Agents: **KNECHT, Harold C., III** et al.; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH,

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(54) Title: HEAT-SHIELDING COVER OF EXHAUST SYSTEM PART AND METHOD OF PRODUCTION THEREOF

**Fig. 1**

(57) Abstract: A heat-shielding cover operatively adapted for being installed adjacent to an exhaust system part (C) so as to cover the same; the heat-shielding cover including a fabric (10) provided with a prescribed shape and comprising inorganic fibers, and a mixture (11) that impregnates the fabric (10), with the mixture comprising an inorganic binder, inorganic filler particles and water. The mixture is dried so as to be rigid enough to maintain the shape of the fabric (10). The heat-shielding cover covers an exhaust system part, where the heat-shielding cover has a simple structure, is less likely to be, or is not, subject to warping in the place of installation due to thermal expansion and contraction of the heat-shielding cover, and moreover is less, or is not, susceptible to galvanic corrosion, even as a result of direct installation using an installation member.



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HEAT-SHIELDING COVER OF EXHAUST SYSTEM PART AND METHOD OF PRODUCTION THEREOF

Technical Field

The present invention relates to a heat-shielding cover of an exhaust system part. Heat-shielding covers are often installed on the exhaust system part, covering the same, using an installation member. Heat-shielding covers can be used to prevent thermal damage to the exhaust system part from high temperature of an internal combustion engine. The present invention also relates to a method of production thereof.

Background

Heat-shielding cover for an exhaust system part is already known, as is disclosed in Japanese Unexamined Patent Publication No. 2010-156372. A heat-shielding cover of an exhaust system part disclosed in Japanese Unexamined Patent Publication No. 2010-156372 includes an aluminum sheet having a comparatively large thermal expansion coefficient. Accordingly, in this sort of heat-shielding cover, a metal buffer material is interposed between the heat-shielding cover and the installation member so that warping due to thermal expansion and contraction of the heat-shielding cover does not occur in the installation member of the heat-shielding cover and impair the durability of the same; therefore, the structure surrounding the installation member becomes complex, and moreover, countermeasures for galvanic corrosion occurring due to the use of heterogeneous metals also are required surrounding the installation member.

Summary

The present invention was created, in part, in consideration of such circumstances. An object of the present invention is to provide a heat-shielding cover of an exhaust system part, that has one or any combination of the following advantages: a simple structure, is not subject to warping in the place of installation due to thermal expansion and contraction of the heat-shielding cover, and is not susceptible to galvanic corrosion, even as a result of direct installation using an installation member. Another object of the present invention is to provide a method of production thereof.

A first aspect of the present invention is a heat shield or heat-shielding cover operatively adapted (i.e., dimensioned, designed, and/or configured) for being installed adjacent to an exhaust system part so as to cover the same; the heat-shielding cover including a fabric provided with a prescribed shape and comprising inorganic fibers, and a mixture that impregnates the fabric, with the mixture including an inorganic binder, inorganic filler particles and water. The mixture is dried so as to be rigid enough to maintain the shape of the fabric. It is desirable for the fabric to be a woven or knitted fabric. One example of an exhaust system part suitable for use with the present invention is a catalytic converter.

A second aspect of the present invention is such that, in addition to the first aspect, the fabric is provided with at least a portion overlaid in multiple layers.

A third aspect of the present invention is an exhaust system that includes an exhaust system part and a heat-shielding cover, according to the first aspect, installed adjacent to the exhaust system part so as to cover the same.

A fourth aspect of the present invention is such that, during production of the heat-shielding cover according to the first aspect, the following steps are carried out: a step of molding a fabric impregnated with the mixture into the prescribed shape using at least one die, and a step of heating the die to dry the mixture so as to be rigid enough to maintain the shape of the fabric.

A fifth aspect of the present invention is such that, in addition to the fourth aspect, releasing means not easily adhered to by the mixture is interposed between each die and the impregnated fabric.

According to the first aspect of the present invention, because the heat-shielding cover includes a fabric provided with a prescribed shape, and the mixture that impregnates the fabric is dried to maintain the shape of the fabric, the heat-shielding cover is excellent in heat-insulating property, and thermal damage to various kinds of devices or objects adjacent to the heat-shielding cover can be effectively prevented or at least significantly reduced. Moreover, because the heat-shielding cover has a very small thermal expansion coefficient and has a suitable degree of flexibility, the heat-shielding cover can follow thermal expansion and contraction of the exhaust system part (e.g., a catalytic converter, exhaust manifold, exhaust pipe, muffler, diesel particulate filter or trap, etc.), and there is no occurrence of thermal warping in the place of installation on the exhaust system part. Accordingly, direct installation of the heat-shielding cover using an installation member becomes possible, the installation structure can become simple, and a contribution can be made to cost reduction. Furthermore, because the heat-shielding cover can be made without metal components, the susceptibility of galvanic corrosion in the place of installation can be eliminated or at least significantly reduced.

According to the second aspect of the present invention, because the fabric is provided with at least a portion overlaid in multiple layers, the heat-insulating property and/or strength of the heat-shielding cover can be increased, at least at the portion overlaid in multiple layers.

According to the third aspect of the present invention, because an exhaust system is provided that includes an exhaust system part and a heat-shielding cover installed adjacent to the exhaust system part so as to cover the same, thermal damage to the exhaust system part located adjacent to the heat-shielding cover, or thermal damage to other devices or objects by heat from the exhaust system part located adjacent to the heat-shielding cover, can be effectively prevented or at least significantly reduced.

According to the fourth aspect of the present invention, in production of the heat-shielding cover of the first aspect, because the method includes a step of molding a fabric impregnated with a mixture into a prescribed shape using one or more dies, and a step of heating

at least one die to dry the mixture so as to be rigid enough so the fabric maintains the prescribed shape, the fabric impregnated with the mixture can be provided with a shape using the one or more dies, the clay can be dried, and the heat-shielding cover can be produced efficiently.

According to the fifth aspect of the present invention, because releasing means not easily adhered to by the mixture is interposed between the dies and the impregnated fabric, the releasing means can be used to prevent the mixture from adhering to the dies. The releasing means corresponding to a releasing sheet 19, in one embodiment of the present invention, is to be described. The releasing means may also be a coating of a suitable release material applied to the surface of the dies to be in contact with the impregnated fabric.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a catalytic converter for exhaust purification having a heat-shielding cover of the present invention installed.

FIG. 2 is a perspective view of the heat-shielding cover.

FIG. 3 is a cross-sectional view along line 3-3 in FIG. 2.

FIG. 4 is a cross-sectional view along line 4-4 in FIG. 2.

FIG. 5 is a cross-sectional view illustrating the state in which a material is set in molding dies during production of the heat-shielding cover.

FIG. 6 is a cross-sectional view illustrating the state in which the material was molded into a heat shielding cover using the dies.

DETAILED DESCRIPTION

An exemplary embodiment of the present invention is described below based on the attached drawings.

First, in FIG. 1, reference numeral C indicates a catalytic converter for cleaning exhaust of an internal combustion engine of, e.g., an automobile. The catalytic converter is arranged with a length direction thereof turned vertically, between the internal combustion engine and a dashboard (not illustrated) on the body of the automobile. Respective flanges are formed on the catalytic converter, including an entrance flange 1 on an upstream upper end thereof, to which is joined a downstream end of an exhaust manifold (not illustrated) of the internal combustion engine, and an exit flange 2 on a downstream lower end thereof, to which an exhaust pipe (not illustrated) is connected. Accordingly, the catalytic converter C constitutes one part of the exhaust system of the internal combustion engine, and a heat-shielding cover 3 for covering a side surface facing a member or structure adjacent to the catalytic converter C, for example the dashboard, is installed between the entrance flange 1 and the exit flange 2 on the catalytic converter C. That is, as illustrated in FIGS. 1 and 4, cover stays 4 are fixed by welding or the like in a plurality of places on the outer surface of the catalytic converter C, each cover stay 4 is provided with a through-hole 5 and a welding nut 6, a through-hole 7 matching the

abovementioned through-hole 5 is provided at corresponding locations through the heat-shielding cover 3, and a bolt 8 is fixed by screwing into and bounding tightly to the welding nut 6 through the through-holes 5 and 7, whereby the heat-shielding cover 3 is fastened to the cover stays 4.

As illustrated in FIGS. 2 and 3, the heat-shielding cover 3 includes a woven fabric 10 of inorganic fibers provided with a prescribed shape so as to follow the outside surface of the catalytic converter C. A mixture 11 such as an aqueous mixture of an inorganic binder, inorganic filler particles and water impregnates the woven fabric 10 and is dried to maintain the shape of the woven fabric 10. The woven fabric 10 can be made using glass fiber or other heat-resistant fiber.

The fabric can comprise inorganic fibers (e.g., continuous glass fibers, silica fibers, basalt fibers, polycrystalline fibers, heat treated refractory ceramic fibers or any combination thereof,) suitable for being formed into a fabric such as, for example, one or any combination of woven, and/or knitted into a fabric. A fabric preferably refers to a woven fabric, knitted fabric or a combination of these types of fabric. Only fabrics with sufficient structural integrity are useful in the present invention. For example, it is desirable for a fabric according to the present invention to exhibit sufficient strength (e.g., tensile strength) to survive being impregnated with the mixture, formed, dried and used as a heat shield. A fabric according to the present invention can be made from the same or different types of fibers. As discussed herein, the fabric of the heat-shielding cover is saturated, soaked, coated, sprayed or otherwise impregnated throughout all, most or at least a substantial portion of its thickness with the aqueous mixture so as to be wet and pliable. The fabric can be impregnated with the aqueous mixture before or after being formed into the shape of the heat-shielding cover. After impregnation, the heat-shielding cover is pliable. It is dried so as to form a rigid heat-shielding cover. As used herein, the term "dried" refers to the pliable heat-shielding cover being heated to a temperature that is hot enough and for a time that is long enough to cause the pliable heat-shielding cover (i.e., the aqueous mixture) to harden and become a rigid heat-shielding cover (i.e., a rigid mixture).

The aqueous mixture used to impregnate the fabric of exemplary heat-shielding cover is typically a slurry comprising water, an inorganic binder and inorganic filler particles, like that disclosed in International PCT Application Publication Number WO 2013/044012 A1, which is incorporated herein by reference in its entirety. Although the weight percent of each component within the slurry may vary, typically a given slurry comprises from about 20.0 to about 54.0 percent by weight (pbw) of water, from about 1.0 to about 36.0 pbw of one or more inorganic binders, and from about 10.0 to about 70.0 pbw of inorganic filler particles, based on a total weight of the slurry. More typically, a given slurry comprises from about 22.0 to about 45.0 pbw of water, from about 5.0 to about 30.0 pbw of one or more inorganic binders, and from about 20.0 to about 55.0 pbw of inorganic filler particles, based on a total weight of the slurry.

Although the particle size of the inorganic binder material is not limited, typically, the inorganic binder comprises inorganic binder particles having a maximum particle size of about 200 nm, preferably a maximum particle size of about 100 nm. More typically, the inorganic

binder comprises inorganic binder particles having a particle size ranging from about 1.0 to about 100 nm. Even more typically, the inorganic binder comprises inorganic binder particles having a particle size ranging from about 4.0 to about 60 nm.

Further, although the particle size of the inorganic filler particles is not limited, typically, the inorganic filler particles have a maximum particle size of about 100 microns (μm). More typically, the inorganic filler particles have a particle size ranging from about 0.1 μm to about 100 μm . Even more typically, the inorganic filler particles have a particle size ranging from about 0.2 μm to about 50 μm .

The woven fabric 10 can be overlaid in multiple layers that overlap partially or completely. In the illustrated example, two layers of the impregnated fabric 10 partially overlap. The use of such multiple layers of the fabric 10 may be particularly desirable in portions of the heat-shielding cover 3 such as, for example, a portion requiring higher heat-shielding properties (e.g., a portion of the heat shield 3 covering a center portion of the catalytic converter C that comes to a particularly high temperature). Other areas for multiple layers of the fabric 10 can include portions where additional strength and/or toughness is required such as, for example, a passive binding (e.g., see the washer shaped piece of fabric 10 shown in FIG. 4 that partially defines the through-hole 7).

The woven fabric 10 can be provided with a plurality of slit-shaped or round heat-discharge holes 12 as needed. Moreover, a large number of mesh holes formed by the woven fabric 10 may be left unfilled with the mixture 11 so as to remain as ventilation holes.

The operation of this embodiment is next described.

During operation of the internal combustion engine, the catalytic converter C of the exhaust system of the internal combustion engine cleans the exhaust gas and is brought to a high temperature from the reaction heat of the cleaning. However, because the side surface of the catalytic converter C is covered by the heat-shielding cover 3, the heat-shielding cover 3 shields against the radiant heat of the catalytic converter C and prevents thermal damage to various kinds of devices or objects (e.g., organic matter on the ground underneath the catalytic converter C) adjacent to the catalytic converter C.

The heat-shielding cover 3 is also excellent in acoustic shielding, and can effectively shield against exhaust noise generated by the catalytic converter C.

The hot gas produced around the catalytic converter C is dissipated to the outside through the heat-discharge holes 12 and 12 ... of the heat-shielding cover 3 or the large number of mesh holes of the woven fabric 10 configuring the heat-shielding cover 3. Therefore, overheating of the catalytic converter C can be prevented.

Moreover, as previously described, the heat-shielding cover 3 is configured with the woven fabric 10 containing a heat-resistant fiber 10, and with clay 11 that is impregnated within heat-resistant fiber 10 and dried. Therefore, the heat-shielding cover is excellent in heat-insulating property, and thermal damage to various kinds of devices adjacent thereto can be

effectively prevented.

Because the heat-shielding cover 3 has a very small thermal expansion coefficient and has a suitable degree of flexibility, the heat-shielding cover can comply with thermal expansion and contraction of the catalytic converter C and there is no occurrence of thermal warping in the part fastened using the bolt 8. Accordingly, direct binding of the heat-shielding cover 3 using the bolt 8 becomes possible and a contribution is made to cost reduction.

Moreover, because the heat-shielding cover 3 has an insulating property, there is also no susceptibility to the occurrence of galvanic corrosion in the part bound using the bolt 8.

The following Examples of material combinations have been selected merely to further illustrate potential features, advantages, and other details of the invention. It is to be expressly understood, however, that while the Examples serve this purpose, the particular ingredients and amounts used as well as other conditions and details are not to be construed in a manner that would unduly limit the scope of this invention.

EXAMPLES

The following materials as shown in Table 1 can be used in accordance with the present invention:

Table 1. Materials

<i>Fabrics</i>	<i>Description</i>	<i>Source</i>
ECG heat set knit	2" 3" or 4" wide SCOTCHCAST™ knit heat treated G yarn	3M, St. Paul MN
ECG non-heat set knit	3" wide SCOTCHCAST™ knit not heat treated G yarn	3M, St. Paul MN
ECDE heat set knit	4" wide SCOTCHCAST™ knit heat treated DE yarn	3M, St. Paul MN
silica weave	TECSIL® 3" 13-621	Intec, Anaheim CA
e-glass weave	#8817K68	McMaster-Carr, Chicago IL
<i>Inorganic Binder</i>	<i>Description</i>	<i>Source</i>
colloidal silica 4 nm	NALCO™ 1115	Nalco, Chicago IL
colloidal silica 15 nm	NALCO™ 1144	Nalco, Chicago IL
colloidal silica 20 nm	NALCO™ 2327	Nalco, Chicago IL
colloidal silica 60 nm	NALCO™ 1060	Nalco, Chicago IL
colloidal alumina 50 nm	NYACOL® AL20	Nyacol, Ashland MA
colloidal silica 8 nm	LUDOX® SM	Grace Davidson Columbia MD

Colloidal silica positively charged	Ludox CL-P	Grace Davidson Columbia MD
Colloidal silica deionized	Ludox TMA	Grace Davidson Columbia MD
Colloidal silica 20nm positive charge	NALCO 1056	Nalco, Chicago, IL
Colloidal silica sterically stabilized	Bindzil cc401	AkzoNobel, Marietta, GA
Colloidal silica positive charge wide particle size range	Bindzil CAT80	AkzoNobel, Marietta, GA
Colloidal silica neutral pH	Bindzil DP5100	AkzoNobel, Marietta, GA
sodium silicate	STIXO™ NN	PQ Corporation, Valley Forge PA

<i>Inorganic Fillers and Additives</i>	<i>Description</i>	<i>Source</i>
kaolin clay	POLYPLATE™ P	KaMin, Macon GA
calcined kaolin	2000C	KaMin, Macon GA
bentonite clay	BENTOLITE®	Southern Clay Gonzales TX
aluminum hydroxide 1	Huber ONYX ELITE®	Huber, Norcross GA
aluminum hydroxide 2	MARTINAL® OL-104 LE	Albemarle, Baton Rouge LA
fumed silica	CAB-O-SIL® M-5	Cabot, Boston MA
fumed alumina	SpectraI® grade 51	Cabot, Boston MA
alumina powder	Type A	Fisher Scientific, Fairlawn NJ
precipitated silica	ZEOTHIX® 265	Huber, Norcross, GA
ground silica 1	MIN-U-SIL™ 10	U.S. Silica, Frederick MD
ground silica 2	MIN-U-SIL™ 30	U.S. Silica, Frederick MD
aluminum powder	325 mesh #11067	Alfa/Aesar, Ward Hill MA
Talc	talc powder	J.T. Baker, Phillipsburg NJ
aluminum silicate	#14231	Alfa/Aesar, Ward Hill MA
calcium silicate	MICRO-CEL®	Celiter Corp., Lompoc CA
calcium carbonate		Sigma Aldrich, St. Louis MO
silicon carbide	800W	Electro Abrasives, Buffalo NY

glass bubbles	SCOTCHLITE™ K37	3M, St. Paul MN
glass frit	EG02934VEG	Ferro, Cleveland OH
titanium dioxide	R900	Dupont, Wilmington DE
sodium hydroxide	Pellets	EMD, Germany
nitric acid	69% Nitric acid	J.T. Baker, Phillipsburg NJ
Kaolin clay	Dixie clay	R.T. Vanderbilt, Norwalk, CT
Wollastonite	Vansil 50	R.T. Vanderbilt, Norwalk, CT
Manganese Ferrite	FM-2400	Rockwood, Beltsville, MD
Silane	Z-6040	Dow-Corning, Midland MI

Slurries can be prepared using ingredients shown above. In each slurry, inorganic materials can be added to liquid component(s) using a high shear mixer and blended until smooth to form a given slurry as shown in Table 2 below.

5

Table 2. Slurries

Slurry	Composition
1	50 wt% 2327 colloidal silica, 50 wt% POLYPLATE™ P
2	67 wt% 2327 colloidal silica, 33 wt% calcium carbonate
3	57.1 wt% 1144 colloidal silica, 42.9 wt% calcium carbonate
4	94.4 wt% 2327 colloidal silica, 5.6 wt% M-5 fumed silica
5	87.8 wt% 1144 colloidal silica, 12.2 wt% M-5 fumed silica
6	60 wt% 2327 colloidal silica, 40 wt% talc
7	52.9 wt% 1144 colloidal silica, 47.1 wt% talc
8	60 wt% 2327 colloidal silica, 40 wt% silicon carbide
9	50 wt% 2327 colloidal silica, 40 wt% aluminum powder, 10 wt% POLYPLATE™ P
10	82.3 wt% 2327 colloidal silica, 17.7 wt% bentonite clay
11	84 wt% 2327 colloidal silica, 16 wt% fumed alumina
12	84.4 wt% 2327 colloidal silica, 15.6 wt% glass bubbles
13	50 wt% 2327 colloidal silica, 50 wt% titanium dioxide
14	66.7 wt% 2327 colloidal silica, 33.3 wt% alumina powder
15	84.2 wt% 2327 colloidal silica, 15.8 wt% precipitated silica
16	50 wt% 2327 colloidal silica, 50 wt% aluminum silicate
17	42.1 wt% 2327 colloidal silica, 57.9 wt% aluminum hydroxide-1
18	42.1 wt% 2326 colloidal silica, 57.9 wt% ground silica 1
19	42.1 wt% 2327 colloidal silica, 57.9 wt% ground silica 2
20	45.3 wt% 2327 colloidal silica, 50.0 wt% silica 1, 2.8 wt% silicon carbide,

	1.8 wt% bentonite clay
21	60 wt% 2327 colloidal silica, 40 wt% POLYPLATE™ P
22	60 wt% 2327 colloidal silica, 40 wt% 2000C calcined clay
23	44.5 wt% colloidal silica 1144, 33.3 wt% glass frit, 22.2 wt% 2000C
24	60 wt% SM colloidal silica, 40 wt% POLYPLATE™ P
25	50 wt% 2327 colloidal silica, 50 wt% POLYPLATE™ P
26	50 wt% 4 nm colloidal silica, 50 wt% POLYPLATE™ P
27	50 wt% 60 nm colloidal silica, 50 wt% POLYPLATE™ P
28	50 wt% 1144 colloidal silica, 50 wt% POLYPLATE™ P
29	60 wt% colloidal alumina, 40 wt% POLYPLATE™ P
30	100 wt% 2327 colloidal silica
31	100 wt% 4 nm colloidal silica
32	90 wt% 2327 colloidal silica, 10 wt% POLYPLATE™ P
33	80 wt% 2327 colloidal silica, 20 wt% POLYPLATE™ P
34	70 wt% 2327 colloidal silica, 30 wt% POLYPLATE™ P
35	60 wt% 2327 colloidal silica 40 wt% POLYPLATE™ P
36	100 wt% sodium silicate solution
37	80 wt% 2327 colloidal silica, 20 wt% 2000C
38	70 wt% 2327 colloidal silica, 30 wt% 2000C
39	60 wt% 2327 colloidal silica, 40 wt% 2000C
40	74.4 wt% sodium silicate, 18.6 wt% POLYPLATE™ P, 7 wt% water
41	12.5 wt% sodium silicate, 50 wt% POLYPLATE™ P, 37.5 wt% water
42	28.6 wt% sodium silicate, 42.8 wt% POLYPLATE™ P, 28.6 wt% water
43	45 wt% 2327 colloidal silica, 50 wt% POLYPLATE™ P, 5 wt% titanium dioxide
44	40 wt% sodium silicate, 30 wt% POLYPLATE™ P, 30 wt% water
45	29.4 wt% sodium silicate, 35.3 wt% POLYPLATE™ P, 35.3 wt% water
46	14.3 wt% sodium silicate, 42.8 wt% POLYPLATE™ P, 42.8 wt% water
47	60 wt% POLYPLATE™ P, 40 wt% water
48	69.5 wt% POLYPLATE™ P, 30.5 wt% water
49	15 wt% 2327 colloidal silica, 55 wt% POLYPLATE™ P, 30 wt% water
50	31 wt% 2327 colloidal silica, 49 wt% POLYPLATE™ P, 20 wt% water
51	7.7 wt% sodium silicate, 46.2 wt% POLYPLATE™ P, 46.2 wt% water
52	10 wt% sodium silicate, 90 wt% water
53	25 wt% sodium silicate, 75 wt% water
54	50 wt% sodium silicate, 50 wt% water
55	90.2 wt% 1144 colloidal silica, 9.8 wt% POLYPLATE™ P
56	50 wt% 2327 colloidal silica, 33 wt% POLYPLATE™ P, 17 wt% 2000C

57	55 wt% 2327 colloidal silica, 30 wt% POLYPLATE™ P, 15 wt% 2000C
58	52.4 wt% 2327 colloidal silica, 31.7 wt% POLYPLATE™ P, 15.8 wt% 2000C
59	7.9 wt% 4 nm colloidal silica, 68.3 wt% POLYPLATE™ P, 23.7 wt% water
60	50 wt% 2327, 50 wt% aluminum hydroxide -2
61	44.5 wt% 1144 colloidal silica, 33.3 wt% glass frit, 22.2 wt% 2000C clay
62	53.3 wt% nitric acid treated 1144 colloidal silica*, 46.7 wt% POLYPLATE™ P *Nitric acid added with stirring to 1144 colloidal silica until pH 2.3 is achieved.
63	83.7 wt% 1144 colloidal silica, 16.3 wt% calcium silicate
64	50% 1056 colloidal silica, 18% 2000C clay, 32% POLYPLATE™ P
65	50% 1056 colloidal silica, 50% Dixie clay
66	50% 1144 colloidal silica, 50% Vansil 50
67	53% Cat 80 colloidal silica, 47% POLYPLATE P
68	50% cc401 colloidal silica, 45% POLYPLATE P, 5% FM2400
69	50% DP5110 colloidal silica, 45% POLYPLATE P, 5% FM2400
70	50% 1056 colloidal silica, 45% POLYPLATE P, 5% FM2400
71	53% cat 80 colloidal silica 42% Dixie clay, 5% FM2400
72	54% Ludox CL-P colloidal silica, 46% POLYPLATE P
73	50% Ludox TMA colloidal silica, 50% POLYPLATE P
74	25% 1056 colloidal silica, 25% Cat 80 colloidal silica, 25% Polyplate P, 25% Dixie clay
75	25% 1056 colloidal silica, 25% Cat 80 colloidal silica, 25% POLYPLATE P, 25% Dixie clay + 0.33% Z-6040 silane

Each exemplary fabric can be impregnated with a given slurry to produce a given pliable heat-shielding cover, and subsequently formed and dried into a rigid heat-shielding cover via a drying/heat treatment molding procedure like that described below.

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An exemplary method of production of the heat-shielding cover 3 is next described while referring to FIG. 5.

A pair of upper and lower dies 15 and 16 for press-molding the heat-shielding cover 3 is prepared. Heaters 17 and 17 are embedded in the dies 15 and 16, and a plurality of steam escape slots 18 and 18 ... is provided on facing surfaces of the dies 15 and 16.

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When molding the heat-shielding cover 3, first, a releasing sheet 19 (e.g., made using aluminum foil) is laid on the lower die 16. A plurality of steam escape holes is provided in the releasing sheet 19 for the water in the mixture 11 to escape through when heated. A woven fabric 10 impregnated with aqueous mixture 11 is set on the releasing sheet 19. Then, as previously described, woven fabric 10 impregnated with mixture 11 is placed in multiple layers in places requiring high heat-shielding property or places requiring strength on the heat-shielding cover 3.

Moreover, a releasing sheet 19 of the same kind as mentioned above is laid on the woven fabric 10, and then, as illustrated in FIG. 6, the upper die 15 is lowered, sandwiching the impregnated woven fabric 10 against the lower die 16, the woven fabric 10 is provided with a prescribed shape as a heat-shielding cover 3. In this manner, the heat-discharging slits 12 and 12 ... are punched into the woven fabric 10 by joint operation of the two dies 15 and 16. Next, the heaters 17 and 17 are started, and the mixture 11 impregnating the woven fabric 10 is dried. The steam produced at that time is discharged through the steam escape holes of the releasing sheet 19 or the steam escape slots 18 and 18 ... of the dies 15 and 16. Thus, the dried and hardened mixture 11 maintains the shape of the woven fabric 10 provided by the dies 15 and 16, and the heat-shielding cover 3 is configured together with the woven fabric 10. After that, the upper die 15 is raised, and the heat-shielding cover 3 can be removed from between the two dies 15 and 16 together with the upper and lower releasing sheets 19 and 19. Thus, because the releasing sheets 19 and 19 prevent the mixture 11 from adhering to the dies 15 and 16 and also prevent the mixture 11 from adhering to the releasing sheets 19 and 19 themselves, the releasing sheets can be easily removed from the heat-shielding cover 3.

According to such production method, a shape can be provided to a woven fabric 10 impregnated with mixture 10, and a heat-shielding cover 3 can be produced efficiently, using a pair of upper and lower dies 15 and 16.

The present invention is not limited to the abovementioned embodiment, and all kinds of design modifications are possible within a scope that does not deviate from the main point thereof. For example, a metal mesh, porous steel sheet, or other reinforcing material may be sandwiched between woven fabrics 10 overlaid in a plurality of sheets, or the reinforcing material may be provided on the top surface. Additionally, the material of the reinforcing material is not limited to metal, and may also be a heat-resistant resin or ceramic. Moreover, the heat-shielding cover 3 can be installed on the catalytic converter C using a band, or the like, instead of one or more bolts 8. Additionally, a releasing powder can be used on the dies 15 and 16 instead of the releasing sheet 19. The releasing sheets 19 and 19 may also be replaced with a coating of conventional release material that adheres to the dies 15 and 16 but not the heat-shielding cover 3. Moreover, the shape of the heat-shielding cover can be freely selected in accordance with the type or arrangement of the exhaust system part or with the arrangement of adjacent members. Furthermore, the present invention may be useful as a heat shield for applications other than for an exhaust system part. On such other application may be, for example, as a heat shield for other heat generating structures or for protecting heat sensitive areas of a structure.

What is claimed is:

1. A heat-shielding cover operatively adapted for being installed adjacent to an exhaust system part so as to cover the same, the heat-shielding cover comprising:
 - 5 a fabric provided with a prescribed shape and comprising inorganic fibers; and
 - a mixture that impregnates the fabric, with the mixture comprising an inorganic binder, inorganic filler particles and water,
 - wherein the mixture is dried so as to be rigid enough to maintain the shape of the fabric.
- 10 2. The heat-shielding cover according to claim 1, wherein the fabric is provided with at least a portion overlaid in multiple layers.
3. The heat-shielding cover according to claim 1 or 2, wherein the inorganic filler particles comprise any particulate, when mixed with the inorganic binder in the presence of water, that
15 causes a substantial portion of the inorganic binder to be retained in the fabric.
4. The heat-shielding cover according to any one of claims 1 to 3, wherein the fabric is a woven fabric, knitted fabric or a combination of both types of fabric.
- 20 5. The heat-shielding cover according to any one of claims 1 to 4, wherein the pliable binder wrap comprises in the range of from about 1 % to about 35 % inorganic binder particles, from about 5 % to about 75 % inorganic filler particles, and from about 25 % to about 65 % of the inorganic fibers of the fabric, with each percentage being on a dry weight basis.
- 25 6. The heat-shielding cover according to any one of claims 1 to 5 further comprising at least one installation member used to install the heat-shielding cover adjacent to an exhaust system part.
7. An exhaust system comprising an exhaust system part and the heat-shielding cover
30 according to any one of claims 1 to 6 installed adjacent to the exhaust system part so as to cover the same.
8. A method of production of the heat-shielding cover according to any one of claims 1 to 6:
 - a step of molding the fabric impregnated with the mixture into the prescribed shape using
35 at least one die; and
 - a step of heating at least one die to dry the mixture so as to be rigid enough to maintain the shape of the fabric.

9. The method of production according to claim 8, wherein releasing means not easily adhered to by the mixture is interposed between each die and the impregnated fabric.

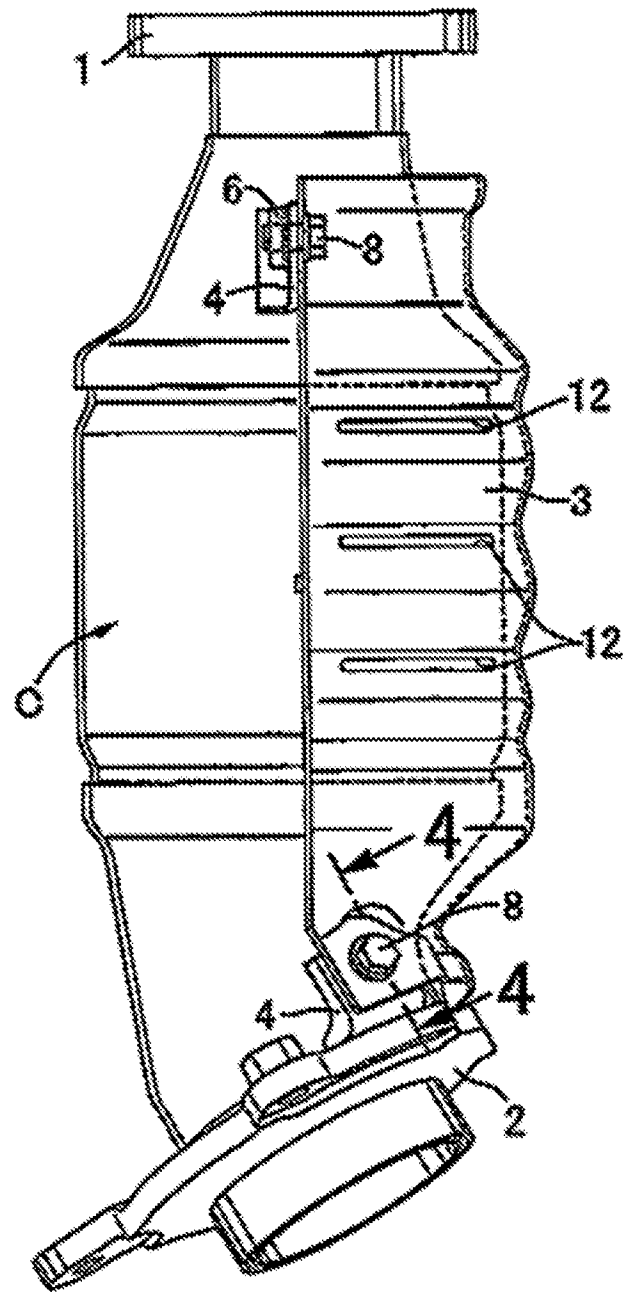


Fig. 1

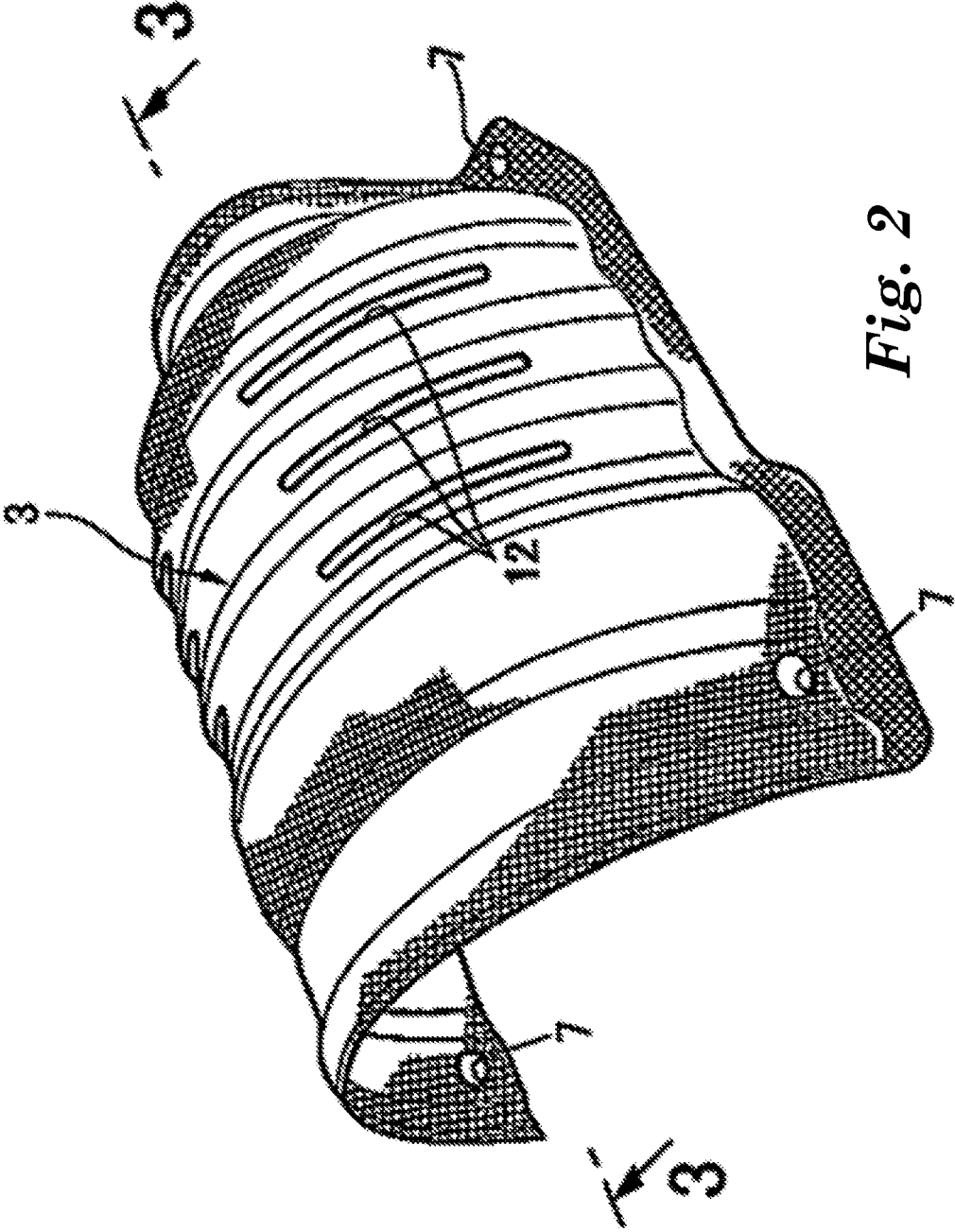


Fig. 2

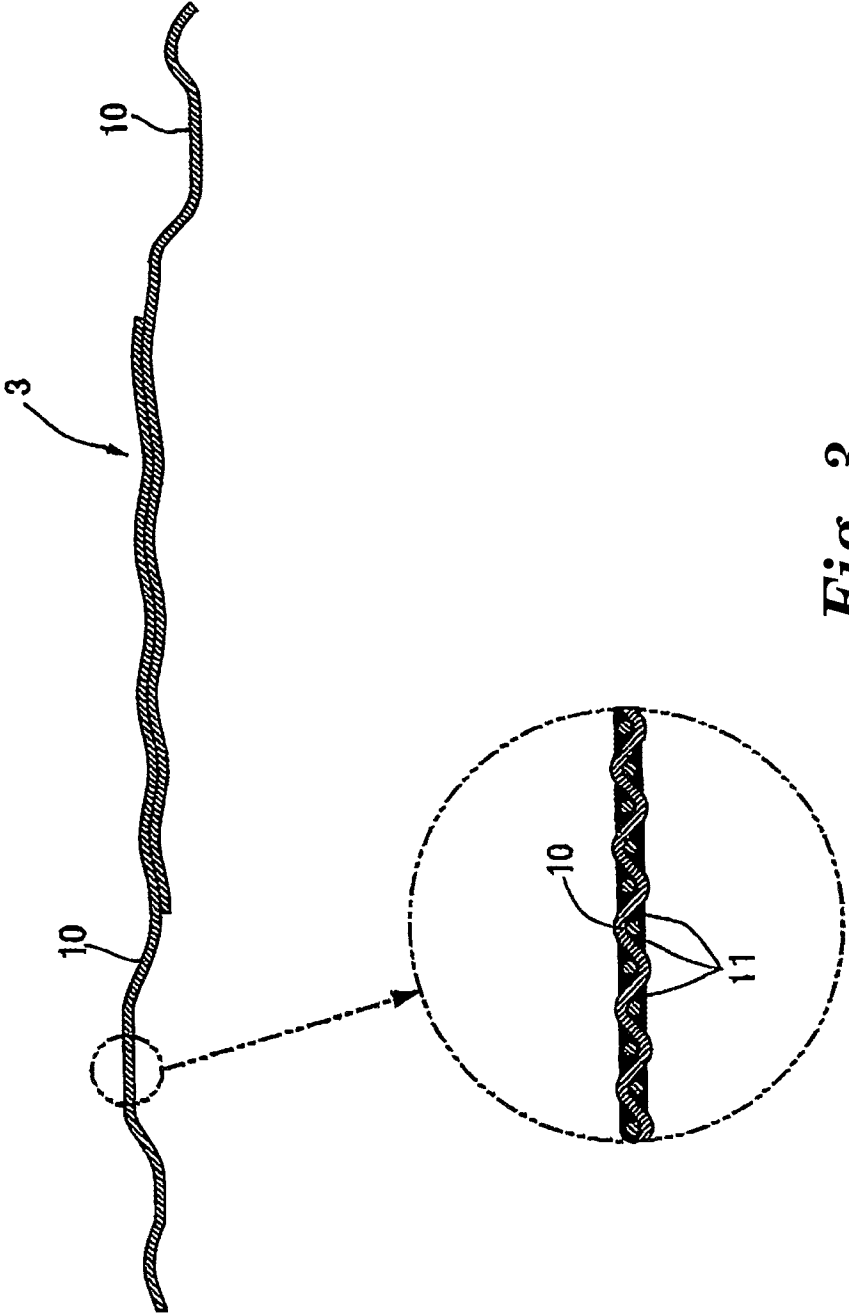


Fig. 3

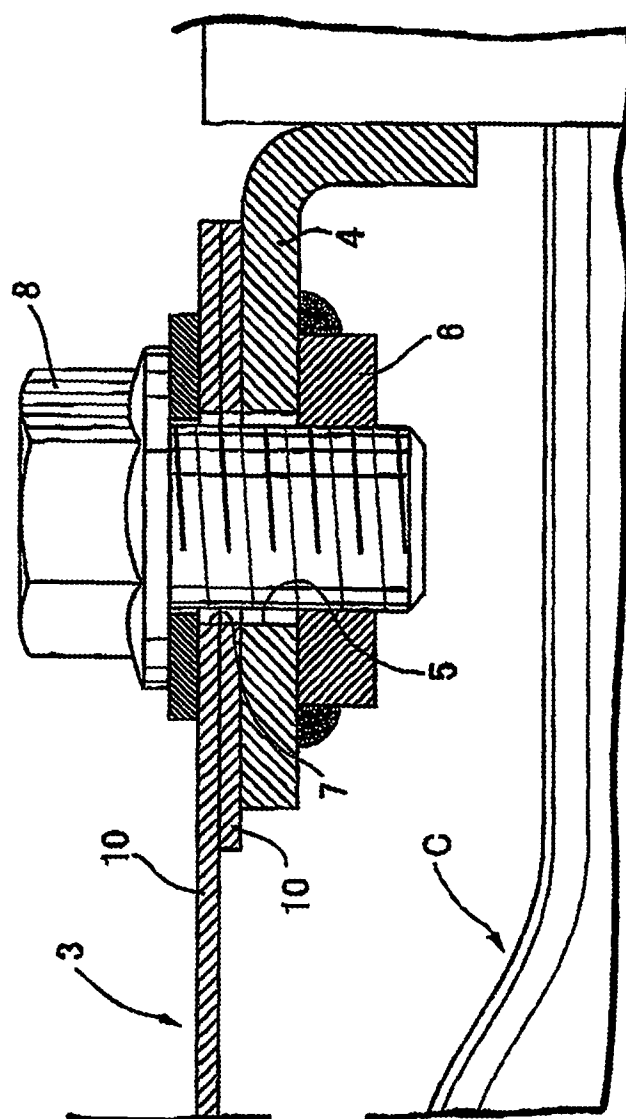


Fig. 4

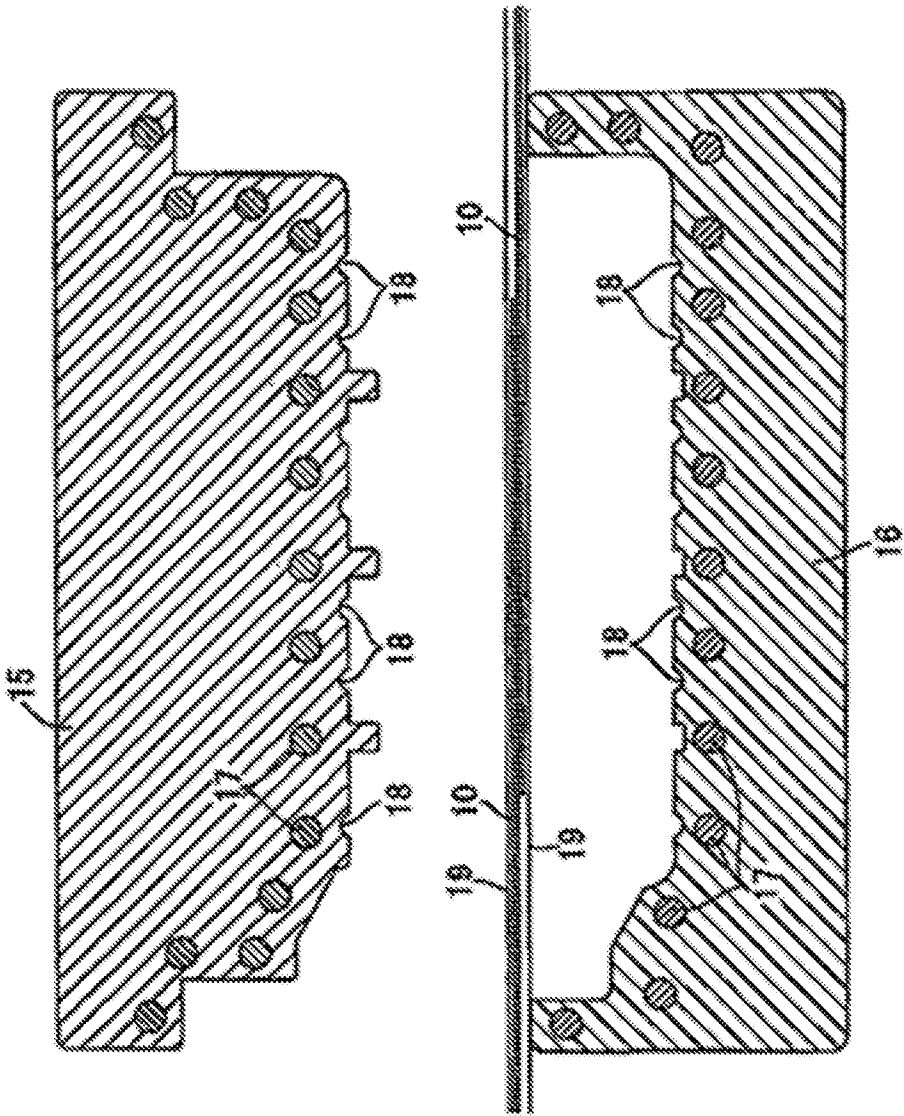


Fig. 5

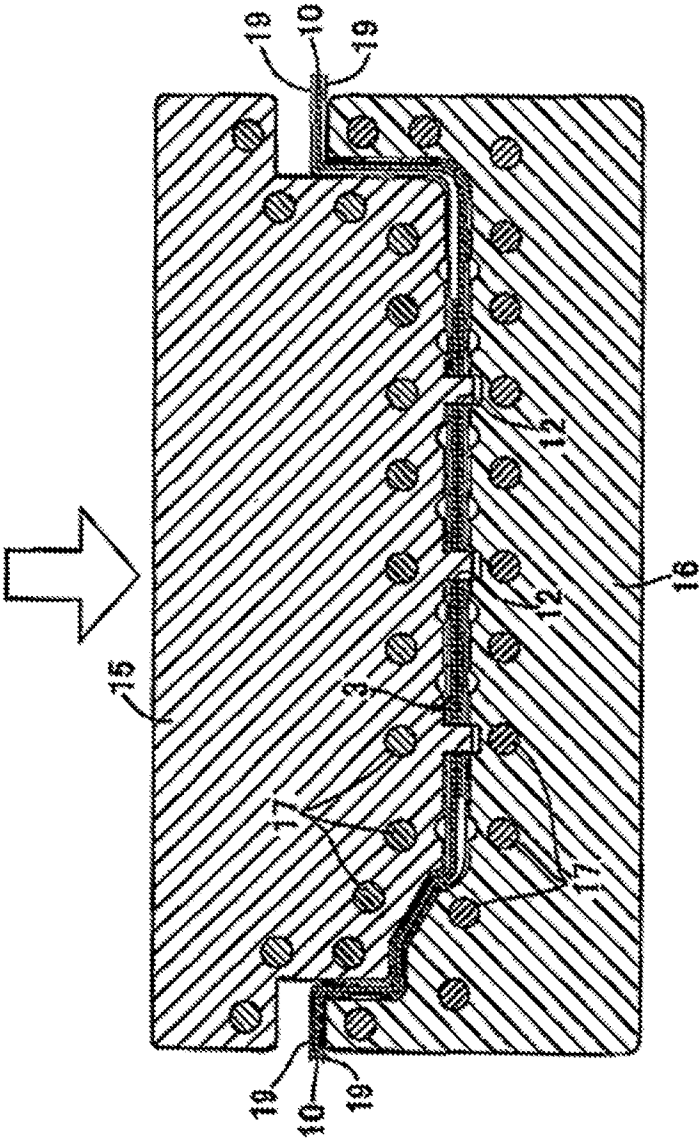


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2014/070700

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01N13/14
ADD.

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)
F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

10 March 2015

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Harf, Julien

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/070700

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No

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