(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 947 288 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.11.2015 Bulletin 2015/48

(51) Int Cl.:
F01N 3/027 *(2006.01)*

(21) Application number: **15169010.4**

(22) Date of filing: **22.05.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **23.05.2014 JP 2014107054**

(71) Applicant: **Toyota Jidosha Kabushiki Kaisha**
Toyota-shi, Aichi-ken 471-8571 (JP)

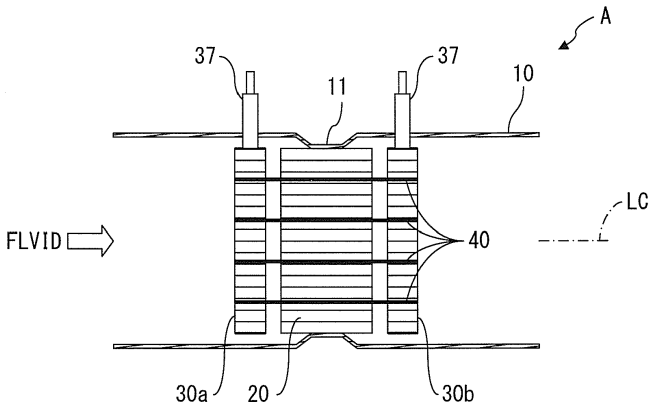
(72) Inventors:
- **IMAI, Daichi**
  TOYOTA-SHI, AICHI-KEN, 471-8571 (JP)
- **ITOU, Kazuhiro**
  TOYOTA-SHI, AICHI-KEN, 471-8571 (JP)
- **NISHIOKA, Hiromasa**
  TOYOTA-SHI, AICHI-KEN, 471-8571 (JP)

(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) ELECTRIC HEATING DEVICE AND EXHAUST PURIFICATION SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

(57) Inside a casing (10), a support member (20) is fastened, at the upstream side of the support member, a first electric type heat generating member (30a) is arranged, and at a downstream side of the support member, a second electric type heat generating member (30b) is arranged. Each heat generating member is provided with an outer tube and a strip-shaped heat generating element. Each outer tube is arranged in the casing so that its center axial line is parallel to a longitudinal axial line of the casing. Each heat generating element has two end parts which are fastened to an inner circumferential surface of the corresponding outer tube and an intermediate part which extends between the two end parts without being fastened to the corresponding outer tube. Each intermediate part is wound about a winding axial line which is parallel to the center axial line of the corresponding outer tube. Supporters are provided which run from the first heat generating member through the support member to the second heat generating member. The supporters are fastened to the intermediate part of the first heat generating member and the intermediate part of the second heat generating member, whereby the first heat generating member and the second heat generating member are supported by the support member via the supporters.

FIG. 1



EP 2 947 288 A1

Description

Technical Field

[0001] The present invention relates to an electric heating device and an exhaust purification system for an internal combustion engine.

Background Art

[0002] Known in the art is an exhaust purification system, wherein an exhaust purification device such as a particulate filter which traps particulate matter in exhaust gas is arranged inside of an engine exhaust passage, wherein an electric heating device is arranged upstream of the exhaust purification device inside of the exhaust passage, and wherein the exhaust gas from the internal combustion engine is heated by the electric heating device and the heated exhaust gas is used to heat the exhaust purification device.

[0003] Further, known in the art is an electric heating device, wherein a honeycomb-shaped support member is fastened inside a casing through in which exhaust gas flows, wherein a honeycomb-shaped electric type heat generating member is arranged upstream in the flow of exhaust gas of the support member, and wherein the heat generating member is supported by the support member through a supporter (see PTL 1).

Citations List

Patent Literature

[0004] PTL 1: Japanese Patent Publication No. 11-500205A

Summary of Invention

Technical Problem

[0005] It has been desired to shorten a time required for raising a temperature of the exhaust purification device to a target temperature. This shortening of time is achieved by strengthening a heating action of the electric heating device. Strengthening this heating action is, for example, achieved by increasing the number of heat generating members.

[0006] However, in the electric heating device of PTL 1, it is necessary to increase not only the number of heat generating members, but also increase the number of support members which support the heat generating members. As a result, a large space is required for arranging the electric heating device. If considering there is a limit to the space in which the electric heating device can be arranged, it may be said that there is also a limit to strengthening the heating action.

Solution to Problem

[0007] According to one aspect of the present invention, there is provided an electric heating device, wherein a support member is fastened inside a casing, wherein a first electric type heat generating member is arranged at one side of the support member in a longitudinal axial direction of the casing and a second electric type heat generating member is arranged at the other side of the support member, wherein each heat generating member is provided with an outer tube and a strip-shaped heat generating element, wherein each outer tube is arranged in the casing so that its center axial line is parallel to a longitudinal axial line of the casing, wherein each heat generating element has two end parts which are fastened to an inner circumferential surface of the corresponding outer tube and an intermediate part which extends between the two end parts without being fastened to the corresponding outer tube, wherein each intermediate part is wound about a winding axial line which is parallel to the center axial line of the corresponding outer tube, wherein a supporter is provided which run from the first heat generating member through the support member to the second heat generating member, wherein the supporter is fastened to the intermediate part of the first heat generating member and the intermediate part of the second heat generating member to support the first heat generating member and the second heat generating member with the support member via the supporter, and wherein the support member and the first heat generating member and second heat generating member are designed so that fluid can flow therethrough in the longitudinal axis direction of the casing, whereby the fluid which flows through the inside of the casing is heated by the first heat generating member and the second heat generating member.

[0008] Preferably, the first heat generating member and the second heat generating member are supported by the support member in the state where a winding direction of the intermediate part of the first heat generating member and a winding direction of the intermediate part of the second heat generating member are opposite to each other.

[0009] Preferably, the first heat generating member and the second heat generating member have weak heat generating regions, respectively, and the first heat generating member and the second heat generating member are supported by the support member so that the weak heat generating region of the first heat generating member and the weak heat generating region of the second heat generating member substantially do not overlap when viewed along the longitudinal axial line of the casing.

[0010] Preferably, the electric heating device is further provided with a fastener which fastens at least part of the supporter to an inside wall surface of the casing.

[0011] According to another aspect of the present invention, there is provided an exhaust purification system

for an internal combustion engine, wherein an exhaust purification device is arranged in an engine exhaust passage, and wherein an electric heating device according to any one of claims 1 to 4 is arranged upstream of the exhaust purification device inside the exhaust passage, whereby the exhaust gas from the internal combustion engine is heated by the electric heating device and the heated exhaust gas is used to heat the exhaust purification device.

Advantageous Effects of Invention

[0012] It is possible to strengthen the heating action while reducing the size of the electric heating device.

Brief Description of Drawings

[0013]

FIG. 1 is a cross-sectional view of an electric heating device.
FIG. 2 is a front view of a heat generating member.
FIG. 3 is a partial enlarged view of a heat generating member.
FIG. 4 is a view which shows an unwound heat generating element.
FIG. 5 is a view which shows the layout of the first heat generating member and the second heat generating member.
FIG. 6 is a view which shows another embodiment of the layout of the first heat generating member and the second heat generating member.
FIG. 7 is a cross-sectional view of an electric heating device which shows another embodiment according to the present invention.
FIG. 8 is a cross-sectional view of an electric heating device which shows still another embodiment according to the present invention.
FIG. 9 is a cross-sectional view of an electric heating device which shows still another embodiment according to the present invention.
FIG. 10 is an overview of an internal combustion engine.

Description of Embodiments

[0014] Referring to FIG. 1, an electric heating device A is provided with a cylindrical casing 10. Inside the casing 10, a columnar support member 20 is fastened. In the embodiment which is shown in FIG. 1, a ring-shaped small diameter part 11 is formed at the casing 10. This small diameter part 11 presses against the support member 20 whereby the support member 20 is fastened to the casing 10. The support member 20 forms a honeycomb structure which is formed from, for example, a ceramic or metal. Therefore, the fluid which flows through the inside of the casing 10 can run through the support member 20 along a longitudinal axial line LC direction of the casing 10.

[0015] At one side of the support member 20 in the longitudinal axial line LC direction of the casing 10 or the upstream side in the flow of fluid, a first electric type heat generating member 30a is arranged, while at the other side of the support member 20 in the longitudinal axial line LC direction of the casing 10 or the downstream side in the flow of fluid, a second electric type heat generating member 30b is arranged. These heat generating members 30a, 30b are supported by the support member 20 through supporters 40. In this case, the first heat generating member 30a and the second heat generating member 30b are separated from the casing 10, that is, are supported by the support member 20 without being supported by the casing 10. Further, between the first heat generating member 30a and the support member 20 and between the second heat generating member 30b and the support member 20, slight clearances are provided.

[0016] Next, referring to FIG. 2 to FIG. 4, the first heat generating member 30a will be explained. The second heat generating member 30b is similar to the first heat generating member 30a, so the explanation will be omitted. Referring to FIG. 2, the first heat generating member 30a is provided with a cylindrical outer tube 31. Inside the outer tube 31, a strip-shaped heat generating element 32 is held in a state wound about a winding axial line LW. In the embodiment which is shown in FIG. 2, the winding axial line LW matches a center axial line LHC of the outer tube 31. In another embodiment which is not shown, the winding axial line LW does not match the center axial line LHC of the outer tube 31, however, extends in parallel with the center axial line LHC of the outer tube 31.

[0017] A heat generating element 32, as shown in FIG. 3, forms a honeycomb structure which is formed by alternately stacking flat plates 33 and corrugated plates 34. Between the flat plates 33 and the corrugated plates 34, flow paths 35 through which the fluid can flow are formed. The outer tube 31, flat plates 33, and corrugated plates 34 are formed from electroconductive materials, for example, metal plates.

[0018] FIG. 4 shows the state where the heat generating element 32 which is shown in FIG. 2 is unwound and rendered flat. Referring to FIG. 4, the heat generating element 32 has two end parts 32e, 32e in the length direction LH and an intermediate part 32i which extends between the two end parts 32e, 32e. As shown in FIG. 2, the heat generating element 32 is fastened and electrically connected to the outer tube 31 at the two end parts 32e, 32e. In this case, the intermediate part 32i is not fastened to the outer tube 31.

[0019] Further, the heat generating element 32, as shown in FIG. 2 and FIG. 3, is wound so that a clearance 36 is formed between one part of the intermediate part 32i and another part of the intermediate part 32i. This clearance 36 acts as an electrical insulating member.

[0020] The first heat generating member 30a further has an electrode 37 which is electrically connected to the heat generating element 32. As will be understood from

FIG. 2 and FIG. 4, the electrode 37 is electrically insulated from the outer tube 31 while passing through the outer tube 31 and being electrically connected to the intermediate part 32i of the heat generating element 32. As shown in FIG. 1, the electrode 37 passes through the casing 10 and extends to the outside of the casing 10. Note that the outer tube 31 is grounded.

[0021] In the embodiment which is shown in FIG. 1, the first heat generating member 30a and the second heat generating member 30b are arranged inside the casing 10 so that the center axial lines LHC of the outer tubes 31 of the first heat generating member 30a and the second heat generating member 30b match with each other. In another embodiment which is not shown, the center axial lines LHC of the outer tubes 31 of the first heat generating member 30a and the second heat generating member 30b do not match with each other but extend in parallel with each other. Further, in the embodiment which is shown in FIG. 1, the first heat generating member 30a and the second heat generating member 30b are arranged in the casing 10 so that the center axial lines LHC of the outer tubes 31 of the first heat generating member 30a and the second heat generating member 30b match with the longitudinal axial line LC of the casing 10. In this case, the flow paths 35 of the above-mentioned heat generating elements 32 extend in parallel with the longitudinal axial line LC of the casing 10. In another embodiment which is not shown, the center axial lines LHC of the outer tubes 31 of the first heat generating member 30a and the second heat generating member 30b do not match with the longitudinal axial line LC of the casing 10, however, are parallel with the longitudinal axial line LC of the casing 10.

[0022] Referring again to FIG. 1, the above-mentioned supporters 40 run from the first heat generating member 30a through the support member 20 to the second heat generating member 30b. In the embodiment which is shown in FIG. 1, one ends of the supporters 40 are fastened to the first heat generating member 30a, the other ends of the supporters 40 are fastened to the second heat generating member 30b, and intermediate parts of the supporters 40 are fastened to the support member 20. In this case, as shown in FIG. 2, the supporters 40 are fastened to the intermediate parts 32i of the heat generating elements 32.

[0023] As explained above, the heat generating element 32 of the first heat generating member 30a and the heat generating element 32 of the second heat generating member 30b are held inside the outer tubes 31 in a state wound around the corresponding winding axial lines LW. In this case, due to the elasticity of the heat generating elements 32, a force acts on the heat generating elements 32 in an unwinding direction. The above-mentioned supporters 40 have the action of maintaining the positions of the heat generating elements 32 against such an unwinding force. As a result, the clearances 36 are reliably maintained and occurrence of short-circuits is obstructed.

[0024] FIG. 5 shows a layout of the first heat generating member 30a and the second heat generating member 30b in the electric heating device A which is shown in FIG. 1. In the embodiment which is shown in FIG. 5, the winding direction of the heat generating element 32 of the first heat generating member 30a and the winding direction of the heat generating element 32 of the second heat generating member 30b are opposite to each other. In this case, the direction of the force unwinding the heat generating element 32 of the first heat generating member 30a and the direction of the force unwinding the heat generating element 32 of the second heat generating member 30b are opposite to each other. As a result, the force unwinding the heat generating element 32 of the first heat generating member 30a and the force unwinding the heat generating element 32 of the second heat generating member 30b are cancelled out through the supporters 40. Therefore, the positions of the heat generating elements 32 can be reliably maintained.

[0025] When the first heat generating member 30a and the second heat generating member 30b should be operated, the electrodes 37 are electrically connected to a power source (not shown). As a result, current flows through the heat generating elements 32 whereby the heat generating elements 32 generate heat and thereby the fluid which runs through the heat generating elements 32 is heated. In this case, the fluid is heated by both the first heat generating member 30a and the second heat generating member 30b, so the fluid can be quickly heated. That is, the heating action of the electric heating device A is enhanced. Further, the two heat generating members 30a, 30b are supported by a single support member 20, so the electric heating device A can be made smaller in size. Furthermore, the heat generating members 30a, 30b are fastened to the two ends of the support member 20, so the heat generating members 30a, 30b are stably supported.

[0026] In this regard, if winding a laminate of flat plates 33 and corrugated plates 34 to thereby form the heat generating element 32, as shown in FIG. 4, incomplete regions 38, 38 are formed around the two end parts 32e, 32e. A complete region 39 is formed between these incomplete regions 38, 38. That is, if the heat generating element 32 is formed by laminating predetermined numbers of flat plates 33 and corrugated plates 34, the numbers of the flat plates 33 and corrugated plates 34 which form the complete region 39 are equal to the predetermined numbers, but the numbers of the flat plates 33 and corrugated plates 34 which form the incomplete regions 38, 38 is smaller than the predetermined numbers. This is because in the incomplete regions 38, 38, the flat plates 33 and corrugated plates 34 are offset from each other in the length direction LH. On top of this, the above-mentioned electrode 37 is electrically connected to one end 39a in the length direction LH of one side surface of the complete region 39. As a result, current flows from the electrode 37 through the complete region 39, and then reaches the outer tube 31 through the other end 39b in

the length direction LH of the other side surface of the complete region 39. Here, if making current flow substantially evenly inside the complete region 39, almost no current will flow to the incomplete regions 38, 38 and, therefore, the incomplete regions 38, 38 will not generate much heat at all. Therefore, the incomplete regions 38, 38 will be called the "weak heat generating regions". The fluid which passes through the weak heat generating regions 38, 38 is not heated much at all.

[0027] In this regard, in the embodiment which is shown in FIG. 5, the first heat generating member 30a and the second heat generating member 30b are supported by the support member 20 so that the weak heat generating regions 38 of the first heat generating member 30a and the weak heat generating regions 38 of the second heat generating member 30b substantially do not overlap when viewed along the longitudinal axial line LC of the casing 10. In other words, the angular positions of the first heat generating member 30a and the second heat generating member 30b about the longitudinal axial line LC of the casing 10 are set so that the weak heat generating regions 38 of the first heat generating member 30a and the weak heat generating regions 38 of the second heat generating member 30b substantially do not overlap. As a result, the fluid which passed through the weak heat generating regions 38 of the first heat generating member 30a and was not heated much at all is blocked from passing through the weak heat generating regions 38 of the second heat generating member 30b, that is, passes through a region which generates heat well. Therefore, a deviation in temperature of the fluid in the radial direction or circumferential direction of the casing 10 is reduced.

[0028] FIG. 6 shows another embodiment of the layout of the first heat generating member 30a and the second heat generating member 30b. In the embodiment which is shown in FIG. 6, the winding direction of the heat generating element 32 of the first heat generating member 30a and the winding direction of the heat generating element 32 of the second heat generating member 30b is the same directions as each other. Further, the angular positions of the first heat generating member 30a and the second heat generating member 30b about the longitudinal axial line LC of the casing 10 are set so that the weak heat generating regions 38 of the first heat generating member 30a and the weak heat generating regions 38 of the second heat generating member 30b substantially do not overlap each other when viewed along the longitudinal axial line LC of the casing 10. As a result, the variation in temperature of the fluid in the radial direction or circumferential direction of the casing 10 is reduced.

[0029] FIG. 7 shows another embodiment according to the present invention. In the example which is shown in FIG. 7, compared with the embodiment which is shown in FIG. 1, the thickness of the support member 20 is made smaller. That is, the plurality of heat generating members 30a, 30b are stably held through the supporters 40, so the support member 20 can be made smaller in size. Therefore, the electric heating device A is made further smaller in size.

[0030] FIG. 8 shows still another embodiment according to the present invention. In the embodiment which is shown in FIG. 8, fasteners 41 are provided which fasten at least part of the supporters 40 to an inside wall surface of the casing 10. That is, the supporters 40 which adjoin the casing 10 extend running through the first heat generating member 30a and the second heat generating member 30b. At the two ends of these supporters 40, the fasteners 41 which extend outward in the radial direction are connected. As a result, the supporters 40 are fastened through the fasteners 41 to the inside wall surface of the casing 10. As a result, the first heat generating member 30a and the second heat generating member 30b are more stably supported. In another embodiment which is not shown, the fasteners 41 are connected to only one of the upstream side end parts and the downstream side end part of the supporters 40. In a still other embodiment which is not shown, all of the supporters 40 are fastened by fasteners 41 to the inside wall surface of the casing 10.

[0031] FIG. 9 shows still another embodiment according to the present invention. In the embodiment which is shown in FIG. 9, inside the casing 10, a first support member 20a and a second support member 20b are arranged separated from each other in the long direction LC and are fastened to the casing 10 at a first small diameter part 11a and a second small diameter part 11b, respectively. Upstream of the first support member 20a, a first heat generating member 30a is arranged, between the first support member 20a and the second support member 20b, a second heat generating member 30b is arranged, while downstream of the second support member 20b, a third heat generating member 30c is arranged. These heat generating members 30a, 30b, and 30c are supported by the support members 20a, 20b via supporters 40 which run from the first heat generating member 30a through the first support member 20a and the second support member 20b and reach the third heat generating member 30c.

[0032] FIG. 10 shows the case of application of the above-mentioned electric heating device A to an exhaust purification system for an internal combustion engine. Referring to FIG. 10, an internal combustion engine body B is connected through an exhaust pipe C1 to the electric heating device A, while the electric heating device A is connected through an exhaust pipe C2 to the exhaust purification device D. The exhaust purification device D is formed from a particulate filter which traps particulate matter which is contained in the exhaust gas or an exhaust purification catalyst which oxidizes or reduces ingredients in the exhaust gas. When the temperature of the exhaust purification device D should be made to rise, the electric heating device A is operated. As a result, the exhaust gas is heated by the electric heating device A, and the heated exhaust gas is used to heat the exhaust

purification device D. In another embodiment which is not shown, the casing 10 of the electric heating device A is formed from an exhaust pipe of an internal combustion engine.

Reference Signs List

[0033]

A: electric heating device
10: casing
20: support member
30a: first heat generating member
30b: second heat generating member
31: outer tube
32: heat generating element
32e: two end parts
32i: intermediate part
40: supporter

Claims

1. An electric heating device (A), wherein a support member (20) is fastened inside a casing (10), wherein a first electric type heat generating member (30a) is arranged at one side of the support member (20) in a longitudinal axial direction (LC) of the casing (10) and a second electric type heat generating member (30b) is arranged at the other side of the support member (20), wherein each heat generating member (30a, 30b) is provided with an outer tube (31) and a strip-shaped heat generating element (32), wherein each outer tube (31) is arranged in the casing (10) so that its center axial line (LHC) is parallel to a longitudinal axial line (LC) of the casing, wherein each heat generating element (32) has two end parts (32e) which are fastened to an inner circumferential surface of the corresponding outer tube (31) and an intermediate part (32i) which extends between the two end parts (32e) without being fastened to the corresponding outer tube (31), wherein each intermediate part (32i) is wound about a winding axial line (LW) which is parallel to the center axial line (LHC) of the corresponding outer tube (31), wherein a supporter (40) is provided which runs from the first heat generating member (30a) through the support member (20) to the second heat generating member (30b), wherein the supporter (40) is fastened to the intermediate part (32i) of the first heat generating member (30a) and the intermediate part (32i) of the second heat generating member (30b) to support the first heat generating member (30a) and the second heat generating member (30b) with the support member (20) via the supporter (40), and wherein the support member (20) and the first heat generating member (30a) and second heat generating member (30b) are designed so that fluid can flow therethrough in the longitudinal axis direction (LC) of the casing (10), whereby the fluid which flows through the inside of the casing (10) is heated by the first heat generating member (30a) and the second heat generating member (30b).

2. The electric heating device (A) according to claim 1 wherein said first heat generating member (30a) and said second heat generating member (30b) are supported by said support member (20) in the state where a winding direction of said intermediate part (32i) of said first heat generating member (30a) and a winding direction of said intermediate part (32i) of said second heat generating member (30b) are opposite to each other.

3. The electric heating device (A) according to claim 1 or 2 wherein said first heat generating member (30a) and said second heat generating member (30b) have weak heat generating regions, respectively, and wherein said first heat generating member (30a) and said second heat generating member (30b) are supported by said support member so that the weak heat generating region of said first heat generating member (30a) and the weak heat generating region of said second heat generating member (30b) substantially do not overlap when viewed along the longitudinal axial line of said casing.

4. The electric heating device (A) according to any one of claims 1 to 3 which is further provided with a fastener which fastens at least part of said supporter (40) to an inside wall surface of said casing (10).

5. An exhaust purification system for an internal combustion engine, wherein an exhaust purification device (D) is arranged in an engine exhaust passage, and wherein an electric heating device (A) according to any one of claims 1 to 4 is arranged upstream of the exhaust purification device (D) inside the exhaust passage, so as to heat the exhaust gas from the internal combustion engine is heated by said electric heating device (A) and the heated exhaust gas is used to heat said exhaust purification device (D).

FIG. 1

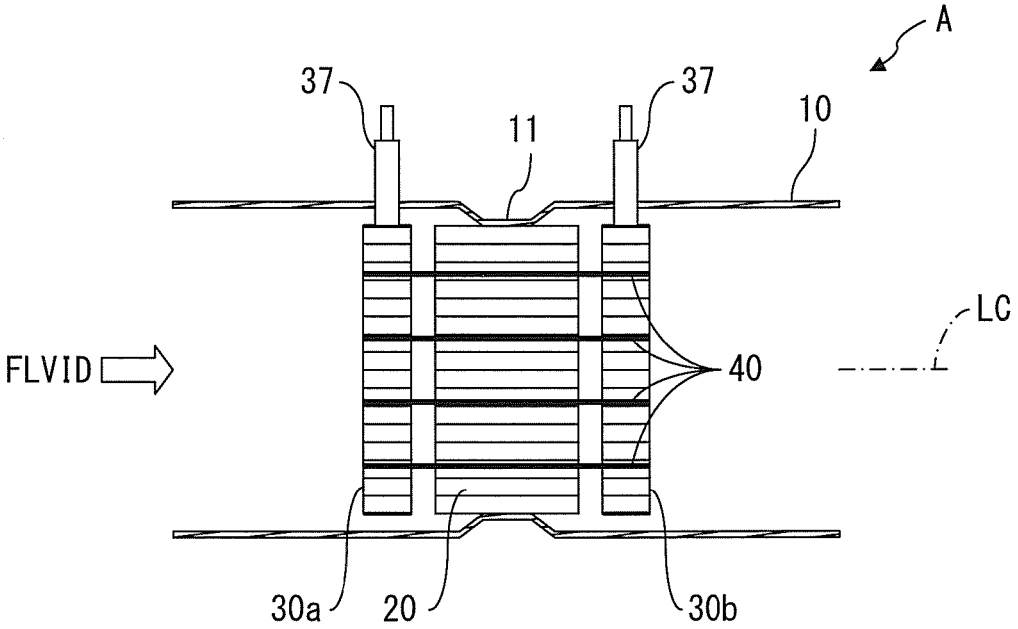

A
37
37
10
11
LC
FLVID
40
30a
20
30b

FIG. 2

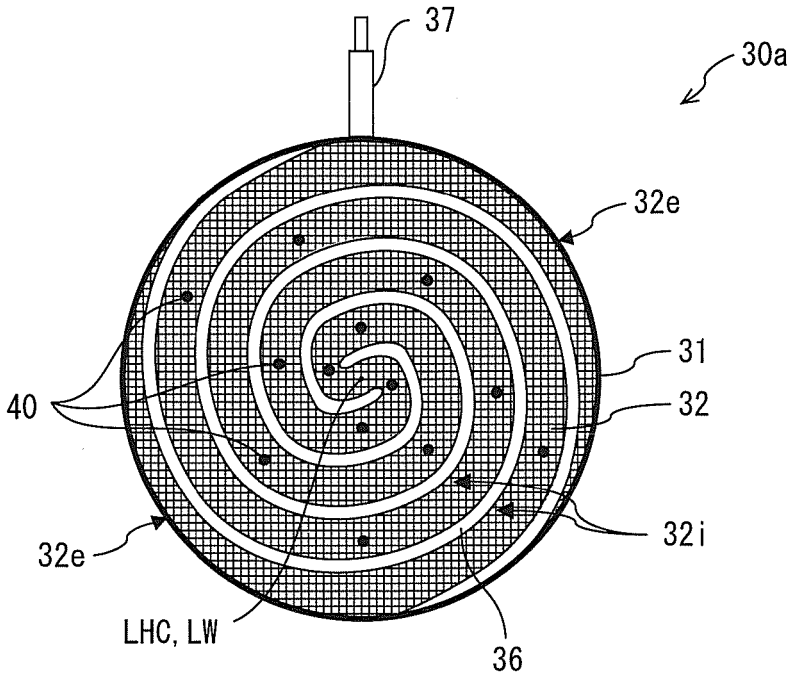

37
30a
32e
31
40
32
32i
32e
LHC, LW
36

FIG. 3

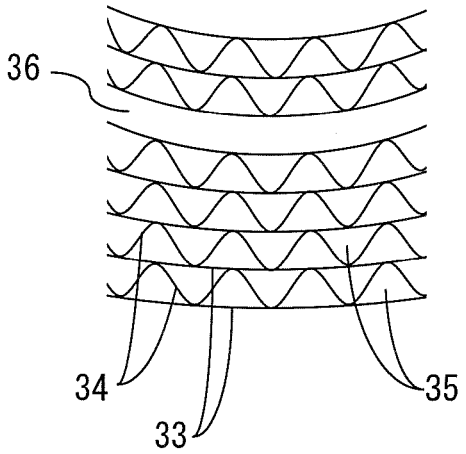


FIG. 4

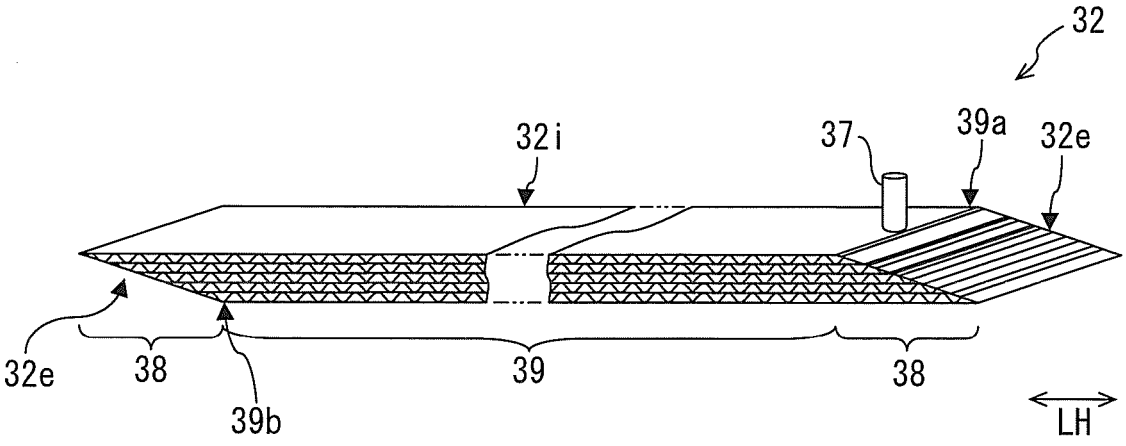


FIG. 5

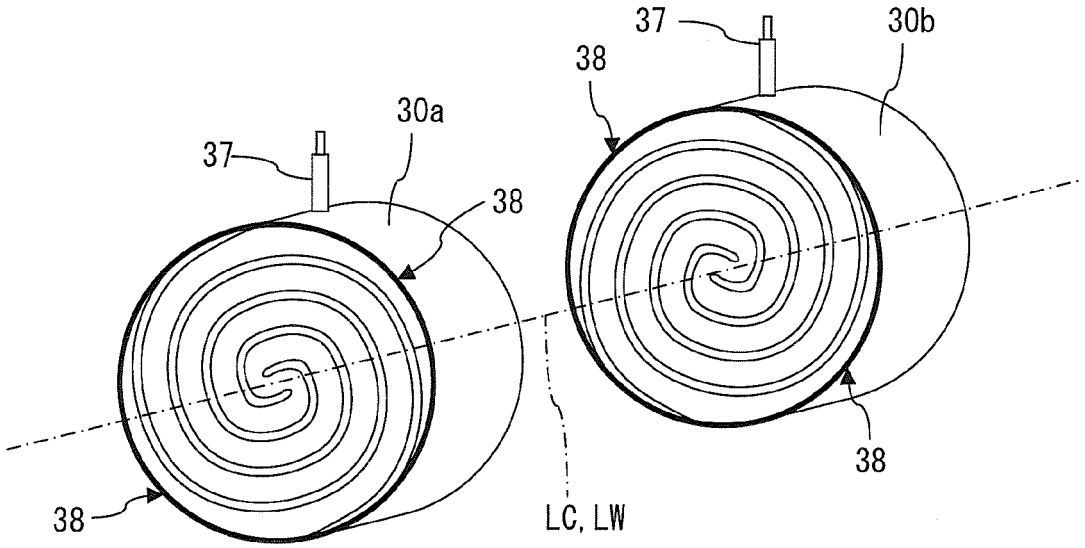


FIG. 6

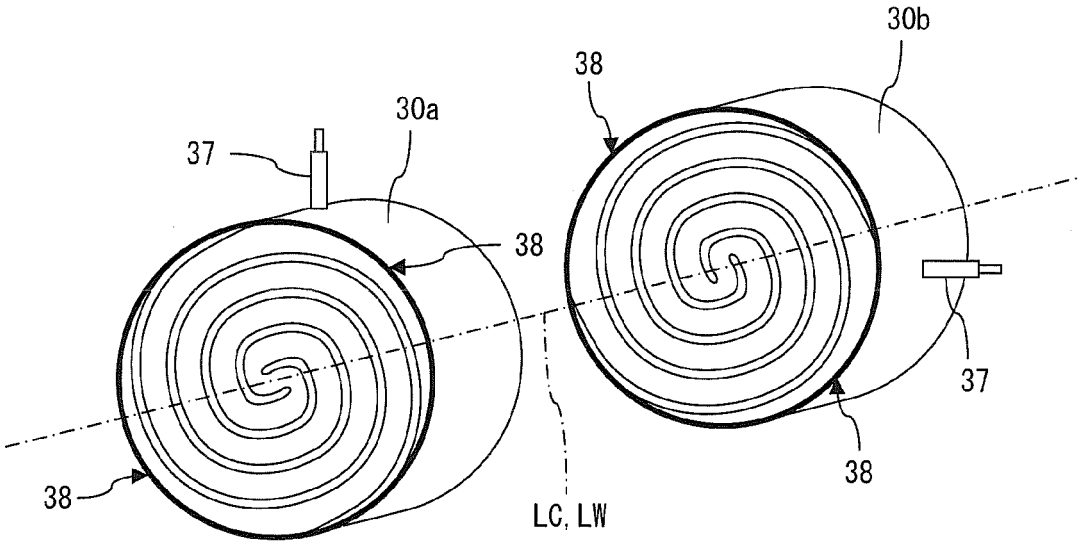


FIG. 7

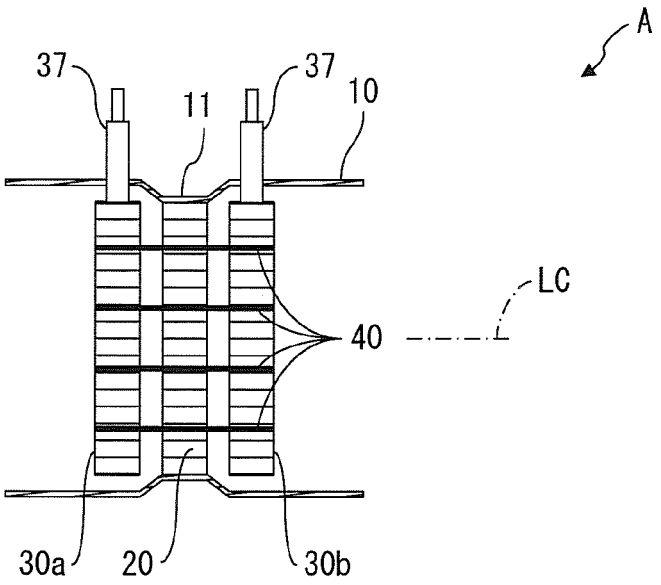


FIG. 8

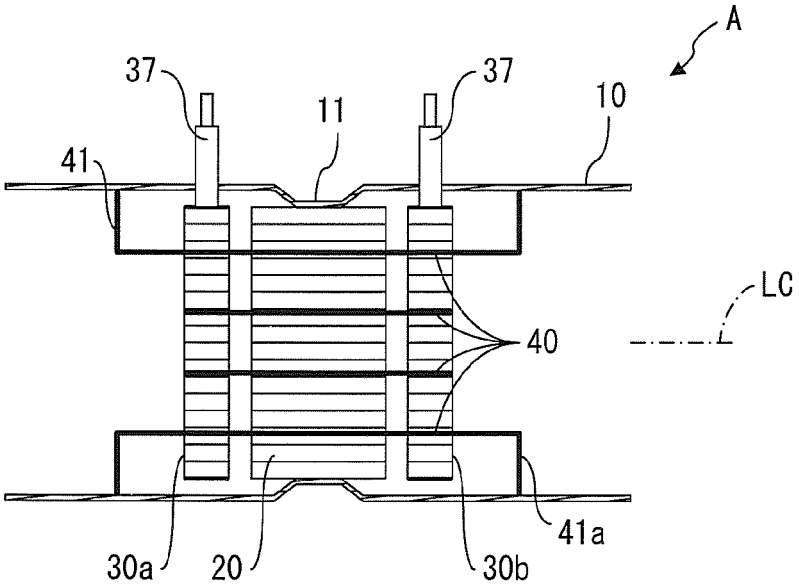


FIG. 9

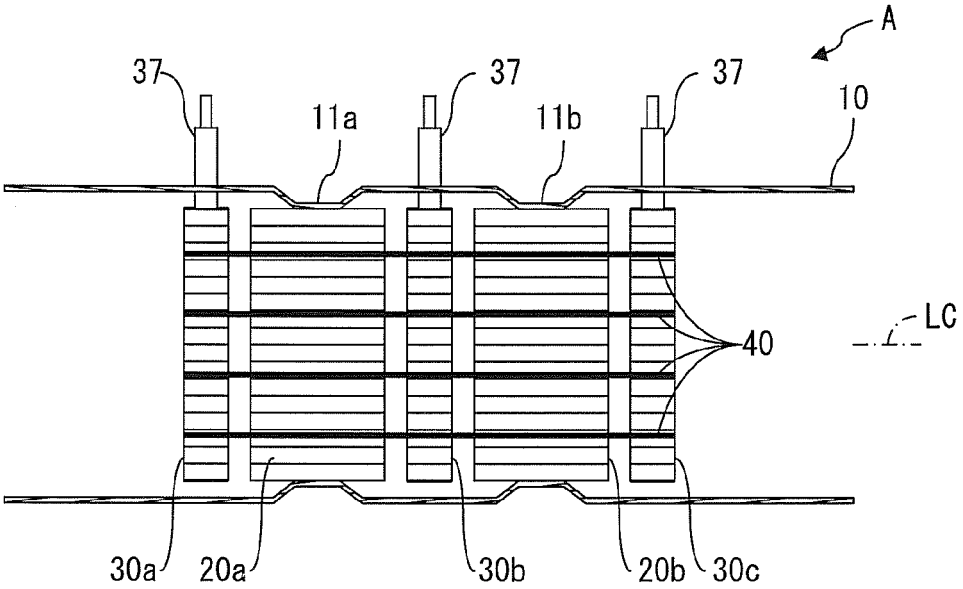
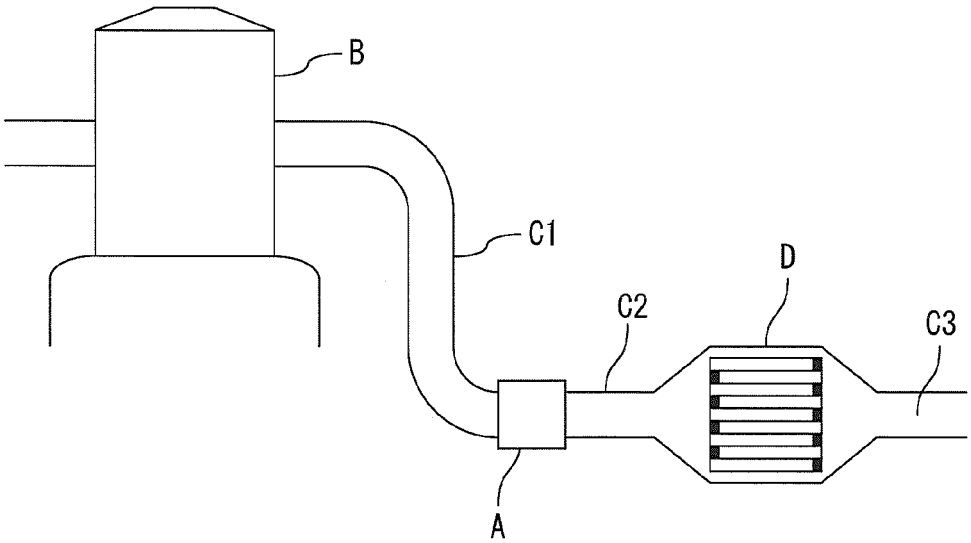


FIG. 10



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 16 9010

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2007 025417 A1 (EMITEC EMISSIONSTECHNOLOGIE [DE]) 4 December 2008 (2008-12-04)	1,5	INV. F01N3/027
A	* abstract; figures 1, 2, 5 * * paragraphs [0008], [0009], [0044] *	2-4	

X	GB 2 313 559 A (EMITEC EMISSIONSTECHNOLOGIE [DE]) 3 December 1997 (1997-12-03)	1,5	
A	* abstract; figures 1, 2 * * page 3, line 13 - page 6, line 28 *	2-4	
X,D	& JP H11 500205 A 6 January 1999 (1999-01-06)	1,5	
A	* figure 1 *	2-4	

A	WO 2008/062916 A1 (IL JIN ELECTRIC CO LTD [KR]; HWANG JAE-WON [KR]; KIM WON-TAE [KR]; YAN) 29 May 2008 (2008-05-29) * abstract; figure 5 * * page 2, paragraph 10 - page 5, paragraph 46 *	1-5	
	-----		TECHNICAL FIELDS SEARCHED (IPC) F01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 October 2015	Steinberger, Yvonne

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 16 9010

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-10-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102007025417 A1	04-12-2008	DE 102007025417 A1	04-12-2008
		DK 2150689 T3	19-11-2012
		EP 2150689 A1	10-02-2010
		ES 2391917 T3	03-12-2012
		JP 5189643 B2	24-04-2013
		JP 5735470 B2	17-06-2015
		JP 2010528219 A	19-08-2010
		JP 2013036468 A	21-02-2013
		US 2010126984 A1	27-05-2010
		WO 2008145556 A1	04-12-2008
GB 2313559 A	03-12-1997	AU 4831096 A	11-09-1996
		CN 1175992 A	11-03-1998
		DE 19505727 A1	22-08-1996
		DE 19680093 D2	07-05-1998
		GB 2313559 A	03-12-1997
		IN 186369 B	18-08-2001
		JP 3636471 B2	06-04-2005
		JP H11500205 A	06-01-1999
		KR 100374079 B1	18-06-2003
		MY 121220 A	28-01-2006
		RU 2153083 C2	20-07-2000
		US 5865864 A	02-02-1999
		WO 9626354 A1	29-08-1996
WO 2008062916 A1	29-05-2008	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 11500205 A **[0004]**