



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.04.2014 Bulletin 2014/18

(51) Int Cl.:
F23Q 7/00 (2006.01)

(21) Application number: **12190090.6**

(22) Date of filing: **26.10.2012**

(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

• **Ratosa, Gverino**
6280 ANKARAN (SI)
• **Golob, Jure**
5242 GRAHOVO OB BACI (SI)

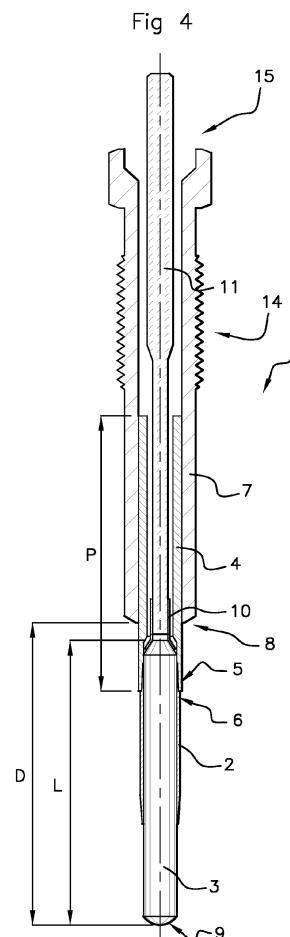
(71) Applicant: **SIEVA d.o.o., PE Spodnja Idrija**
5290 Sempeter Pri Gorici (SI)

(74) Representative: **Cabinet BARRE LAFORGUE & associés**
35, rue Lancefoc
31000 Toulouse (FR)

(72) Inventors:
• **Ramond, Alain**
31330 MERVILLE (FR)

(54) **Method of manufacturing a bi-material glow plug**

(57) The invention relates to a method of manufacturing a glow plug (1) in which a metal distal tube (2) is fitted-on around a heating rod (3) made of ceramic material, a metal proximal tube (4) is rigidly joined, by a distal end (5) of the said proximal tube (4), to a proximal end (6) of the distal tube (2), and the proximal tube (4) is joined to a plug body (7) in such a way that at least one distal portion of the proximal tube (4) projects from a distal end (8) of the plug body.



Description

[0001] The invention relates to a method of manufacturing a bi-material glow plug, especially to a method of manufacturing a plug with a bi-material heating rod made of ceramic material and metal.

[0002] Glow plugs are used to assist the starting-up of diesel engines by pre-heating a fuel gas in a combustion chamber. In direct-injection engines, the plug has to pass through a greater chamber thickness and therefore has to have a substantial length and a small diameter.

[0003] Now, glow plugs with a ceramic heating rod are particularly advantageous, especially because of their durability. But manufacturing ceramic heating rods of substantial length is particularly expensive.

[0004] At the same time, the automotive sector and the glow plug manufacturers are under substantial competitive pressure, so that reducing manufacturing costs is a major stake in the competition.

[0005] That is why plugs with a short ceramic heating rod prolonged by a metal tube have been proposed: for example, EP 1 707 883 is known in that connection.

[0006] However, the manufacture of such plugs proves to be particularly expensive. The fact is, mounting a long metal tube on a short ceramic heating rod is particularly complicated.

[0007] The object of the invention is therefore to overcome these drawbacks by proposing a new method of manufacturing bi-material glow plugs.

[0008] The object of the invention is, in particular, to propose a new method of manufacturing glow plugs with a bi-material heating rod.

[0009] The object of the invention is to propose such a method which makes it possible to reduce the cost of manufacturing such a glow plug.

[0010] The object of the invention is also to propose such a method which makes it possible to produce glow plugs on a large scale and at low cost.

[0011] In addition, the object of the invention is to propose such a method in which the length of the heating rod is easily chosen without the need for major modification of the production line.

[0012] The object of the invention is also such a method, the stages of which are simple and can be carried out by robots.

[0013] Throughout the text, the term "distal" and its derivatives designate directions, elements or parts which are situated axially towards the exposed end of the heating rod of the plug, which end is intended to extend into the combustion chamber. Likewise, the term "proximal" and its derivatives designate directions, elements or parts which are situated axially in the opposite direction, that is to say towards the base of the glow plug, or towards the connection to the outside of the cylinder head of the engine on which the glow plug is intended to be mounted.

[0014] A glow plug has an elongated shape, so that it has a longitudinal main axis along which the concepts of "proximal" and "distal" are defined. Throughout the text,

the terms "axial", "axially", "longitudinal", "longitudinally", etc. are used with reference to the said longitudinal main axis of the plug.

[0015] The invention therefore relates to a method of manufacturing a glow plug in which:

- a metal distal tube is fitted-on around a heating rod made of ceramic material;
- a metal proximal tube is joined, by a distal end of the said proximal tube, to a proximal end of the distal tube; and
- the proximal tube is joined to a plug body in such a way that at least one distal portion of the proximal tube projects from a distal end of said plug body.

[0016] The invention makes it possible to reduce the cost of manufacture of such a glow plug. The fact is, the joining of a long metal tube onto a ceramic heating rod is normally particularly difficult and therefore expensive, especially when the tube extends on the proximal side of the heating rod.

[0017] In the invention, this stage of the method is separated into at least two stages.

[0018] In a first stage, a metal distal tube is joined to a ceramic heating rod. Since the distal tube and the heating rod are made of different materials, the fitting of one to the other in a mechanically integral manner actually represents a delicate stage of the method of manufacture. This stage is all the easier in a method according to the invention as the shape and material of the distal tube can be chosen in order to facilitate the joining of the latter to the ceramic heating rod. In particular, the distal tube is chosen so as to be sufficiently short to permit easy access to the point at which it is joined to the heating rod.

[0019] In a second stage, a metal proximal tube is joined to the distal tube - the proximal tube is located in the distal half of the plug, but it is called proximal in relation to the most distal tube, called the distal tube. Since the proximal tube and the distal tube are both made of metal, joining them together is particularly simple.

[0020] The inventors therefore established, surprisingly, that instead of joining a single long metal tube to a ceramic heating rod in a single stage, the method of manufacture proves to be much less expensive in at least two successive stages, namely joining a relatively short distal tube onto the heating rod and then joining a relatively long proximal tube onto the distal tube.

[0021] In a method of manufacture according to the invention, it is possible to choose the length of the proximal tube in order to choose the length of projection of the glow plug into the combustion chamber. In actual fact, it is sufficient to cut a metal tube (the proximal tube) to a suitable length in order to obtain a plug having a given length of projection into the combustion chamber.

[0022] Thanks to a method of manufacture according to the invention, it is just as easy to manufacture a glow plug with a long proximal tube, and therefore with a substantial length of projection into the combustion chamber,

as a glow plug with a shorter length of projection.

[0023] The distal tube is advantageously fitted-on rigidly around a heating rod, that is to say, without any mobility between the distal tube and the heating rod. Likewise, the proximal tube is advantageously joined rigidly to the distal tube.

[0024] A method according to the invention is also advantageously **characterised in that** the distal tube is mounted on the heating rod so that the heating rod has an exposed distal end, so as to be able to be in direct contact with a gas in a combustion chamber of an engine, in order to be able to heat up the said gas.

[0025] The distance between the exposed distal end of the heating rod and the distal end of the plug body is therefore greater than the distance between the distal end of the distal tube and the distal end of the plug body. The distal end of the distal tube is therefore set back axially in relation to the distal end of the heating rod.

[0026] When the plug is mounted in an engine cylinder head, the distal end of the heating rod is therefore in direct contact with the gas contained in the combustion chamber.

[0027] Moreover, a distal tube which is axially shorter than the heating rod is chosen, advantageously and according to the invention, so that, once it is joined onto the heating rod, the distal and proximal ends of the said distal tube are set back in relation to the distal and proximal ends, respectively, of the heating rod, that is to say, the distal and proximal ends of the heating rod are exposed.

[0028] Thus, the distal tube can be easily joined to the heating rod by either of its ends. In particular, it can be easily joined onto the heating rod by its proximal end.

[0029] The proximal end of the ceramic heating rod is, advantageously and according to the invention, longitudinally beyond the distal end of the plug body.

[0030] In particular, a method according to the invention is advantageously **characterised in that** the length of the proximal tube is chosen so that the distance between the distal end of the plug body and the distal end of the heating rod is strictly greater than the length of the heating rod.

[0031] Thanks to a method according to the invention, therefore, a glow plug is obtained, the length of projection of which, that is to say the length which actually extends within the combustion chamber, can be substantial while at the same time retaining a low manufacturing cost thanks to a ceramic heating rod which is short, in particular shorter than the length of projection.

[0032] In addition, since the distal tube and proximal tube are made of metal, they are good conductors of heat, so that the gas in the combustion chamber can be heated up over the entire length of projection of the glow plug: around the proximal tube, around the distal tube and around the exposed end of the ceramic heating rod. An excess of heat can also be evacuated by the proximal tube in the plug body.

[0033] The proximal tube is, advantageously and according to the invention, joined to the distal tube in the

axial prolongation of the distal tube.

[0034] In particular, the distal end of the proximal tube and the proximal end of the distal tube have substantially the same diameter. Moreover, the distal end of the proximal tube and the proximal end of the distal tube have substantially the same thickness.

[0035] In particular, the distal end of the proximal tube is, advantageously and according to the invention, welded to the proximal end of the distal tube.

[0036] The proximal tube and the distal tube are therefore joined together in the prolongation of one another.

[0037] The distal end of the proximal tube is advantageously welded to the proximal end of the distal tube by laser welding. In actual fact, this is a reliable and rapid welding technique, and one which is therefore inexpensive in the context of large-volume mass production.

[0038] Furthermore, the distal tube is, advantageously and according to the invention, brazed around the heating rod.

[0039] Brazing is a particularly efficient technique for joining together two elements made of very different materials such as the heating rod and the distal tube. However, brazing proves to be particularly difficult to carry out if it is desired to join a long metal tube - for example a tube such as the proximal tube which is intended to increase the length of projection of the glow plug - directly onto a ceramic heating rod.

[0040] On the other hand, in the context of the invention, the distal tube is short and is therefore easily brazed around the heating rod, and especially, is easily brazed via its proximal end.

[0041] In actual fact, since the proximal end of the distal tube is axially at the level of the body of the heating rod, disposing the brazing material between the said proximal end of the distal tube and the body of the heating rod is easier than in the case of a long tube enclosing the proximal end of the heating rod.

[0042] In addition, an electrical connector can be brazed to the proximal end of the ceramic heating rod in the same operation.

[0043] Moreover, the proximal end of the distal tube is, advantageously and according to the invention, flared for the purpose of brazing the distal tube onto the heating rod.

[0044] The brazing of the distal tube onto the heating rod via the proximal end of the distal tube is therefore all the easier.

[0045] In actual fact, the distal tube is advantageously chosen so as to have an internal diameter which is adapted to be capable of being mounted on the heating rod with a radial spacing of a few microns, in order to permit the brazing of the distal tube onto the heating rod. The brazing material is then added in an annular manner at the junction between the flared proximal end of the distal tube and the surface of the heating rod.

[0046] Also, after the brazing of the distal tube onto the heating rod, the flared proximal end of the distal tube is, advantageously and according to the invention, ma-

chined in such a way that only the straight portion of the distal tube remains against the heating rod.

[0047] The flared portion of the distal tube is removed, so that all that remains of the distal tube is the straight portion around the heating rod. The proximal end of this straight portion of the distal tube is brazed against the heating rod.

[0048] The flared portion of the distal tube is advantageously machined by milling.

[0049] Advantageously and according to the invention, the proximal tube surrounds a proximal end of the heating rod, which end is equipped with at least one electrical connector for supplying said heating rod with electricity.

[0050] The proximal end of the heating rod comprises electrical connectors in order to be able to supply an electrical resistor situated within the heating rod with electric power.

[0051] The proximal tube advantageously extends on either side of the proximal end of the heating rod. In particular, the proximal tube extends beyond the proximal end of the heating rod in the direction of the plug base (that portion of the plug which is outside the cylinder head when the plug is mounted on a cylinder head). In particular, at least three quarters of the length of the proximal tube advantageously extend beyond the proximal end of the heating rod in the direction of the plug base.

[0052] Moreover, the proximal tube is, advantageously and according to the invention, connected electrically to at least one electrical connector belonging to the heating rod, on the one hand, and is connected electrically to the metal plug body on the other.

[0053] Thus the proximal tube is a conductor of current between the heating rod and the plug body. In actual fact, since the proximal tube and the plug body are made of metal, they can be used as an electrode, especially as a return electrode, between the heating rod and the plug base or the cylinder head.

[0054] The invention also relates to a method of manufacturing a glow plug, which method is characterised, in combination, by all or some of the features mentioned above or below.

[0055] The invention also extends to a glow plug obtained by a method of manufacture according to the invention.

[0056] In particular, the invention advantageously extends to a glow plug comprising:

- a metal distal tube which is fitted-on rigidly around a heating rod made of ceramic material;
- a metal proximal tube which:
 - is distinct from the said distal tube;
 - is rigidly joined, by a distal end of the said proximal tube, to a proximal end of the distal tube; and
 - is joined to a plug body in such a way that at least one distal portion of the proximal tube projects from a distal end of the plug body.

[0057] The invention also relates to a glow plug which is characterised, in combination, by all or some of the features mentioned above or below, especially by features of the method of manufacture according to the invention.

[0058] Other objects, features and advantages of the invention will become apparent on reading the following description which is given on a non-limitative basis and which refers to the appended drawings, in which:

- figure 1 is a diagrammatic representation of a particular mode of embodiment of a glow plug in longitudinal section (apart from the heating rod which is in side view), at a first stage of manufacture by a method in accordance with the invention;
- figure 2 is a diagrammatic representation, in accordance with figure 1, of a glow plug in longitudinal section (apart from the heating rod which is in side view), at a second stage of manufacture by a method in accordance with the invention;
- figure 3 is a diagrammatic representation, in accordance with figures 1 and 2, of a glow plug in longitudinal section (apart from the heating rod which is in side view), at a third stage of manufacture by a method in accordance with the invention;
- figure 4 is a diagrammatic representation, in accordance with figures 1, 2 and 3, of a glow plug in longitudinal section (apart from the heating rod which is in side view), at a fourth stage of manufacture by a method in accordance with the invention; and
- figure 5 is a diagrammatic representation, in accordance with figures 1, 2, 3 and 4, of a glow plug, of which half is represented in longitudinal section and the other half by a side view, the said plug having been manufactured by a method in accordance with the invention.

[0059] In a method according to the invention for manufacturing a glow plug 1 according to the invention, a metal distal tube 2 is mounted around a ceramic heating rod 3 with a radial space of a few microns, so that a brazing metal can be spread about within said space. As is represented in figure 1, the distal tube 2 has a flared proximal end 6.

[0060] The distal tube 2 is rigidly joined to the heating rod 3 by brazing. For that purpose, a ring of brazing metal 12 is introduced between the flared proximal end 6 of the distal tube 2, and the heating rod 3.

[0061] The distal tube 2 is chosen so as to have a length which is shorter than the length of the heating rod 3, and the proximal and distal ends of the distal tube are respectively disposed short of the proximal and distal ends, of the heating rod, in such a way that the distal end 9 and the proximal end 16 of the heating rod are exposed after the distal tube has been joined onto the heating rod.

[0062] Thus the distal end 9 of the heating rod is advantageously in contact with a gas which is to be heated up within a combustion chamber when the plug is mount-

ed on a cylinder head of an internal gas engine. The proximal end 16 of the heating rod advantageously has electrical connectors so as to be able to connect an electrical resistor situated within the heating rod 3 to a source for supplying electric power.

[0063] An electrically conductive piece, called the trumpet, which is especially a metal piece in the shape of a trumpet, is also disposed at the proximal end of the heating rod. Its function is to bring about an electrical connection between an electrode 11 and the ceramic heating rod 3. This piece, too, is brazed onto the heating rod, thanks to a brazing metal 12 which is introduced into the trumpet 10, at the proximal end of the heating rod.

[0064] The distal tube 2 and the trumpet 10 are therefore brazed onto the heating rod 3 simultaneously.

[0065] After the distal tube 2 has been brazed onto the heating rod 3, the flared portion of the proximal end 6 of the distal tube is machined, for example by milling, so as to remove the said flared portion.

[0066] After this machining stage, the proximal end 6 of the distal tube has a portion 13 with a reduced diameter and a shoulder, as is represented in figure 2.

[0067] In a subsequent stage of a method according to the invention, an electrode 11 is connected electrically to the trumpet 10 serving as the proximal electrical connector of the heating rod 3. The electrode 11 therefore extends longitudinally within the prolongation of the heating rod 3. The electrode 11 makes it possible to connect the heating rod electrically to an electrical connector (or tip) situated at the base 15 of the plug.

[0068] The plug base 15 is that portion of the plug 1 which is situated outside a cylinder head when the plug is fitted into said cylinder head.

[0069] A proximal tube 4 is then advantageously mounted on the proximal side of the heating rod, in such a way that the distal end 5 of the proximal tube 4 surrounds the heating rod.

[0070] The proximal tube 4 is mounted on the heating rod, via the proximal end of the distal tube, after the electrode 11 and the trumpet 10. In actual fact, said trumpet 10 is advantageously joined to the electrode 11, for example by a crimping operation with four detents, by laser welding, etc.

[0071] The proximal tube 4 has a longitudinal length which is much greater than the distance between the proximal end 6 of the distal tube and the proximal end 16 of the heating rod 3.

[0072] The distal end 5 of the proximal tube 4 has a diameter of about 4 mm which is at least substantially equal to the diameter of the proximal end 6 of the distal tube, in such a way that the distal end 5 of the proximal tube is brought into contact with the shoulder on the proximal end 6 of the distal tube.

[0073] The distal end 5 of the proximal tube and the proximal end 6 of the distal tube are welded to one another. They are, for example, welded by laser welding.

[0074] The result obtained after these stages involving the connection of an electrode 11 and a proximal tube 4

is represented in figure 3. A bi-material heating tube is thus obtained, the distal end 9 of which is made of ceramic material and a proximal portion of which (the distal tube 2 and proximal tube 4) is made of metal.

[0075] The total length of the bi-material heating rod is greater than the length L of the ceramic heating rod 3.

[0076] The cost of manufacturing such a bi-material heating rod is low in relation to the cost of a heating rod of the same length which is made entirely of ceramic material.

[0077] This bi-material heating rod and the electrode 11 are then introduced into a hollow plug body 7, the internal diameter of which is substantially equal to the external diameter of the proximal portion of the proximal tube 4. The result of this stage of the method of manufacture is represented in figure 4.

[0078] In particular, the proximal tube 4 is joined to the plug body, for example by crimping or by laser welding.

[0079] The zone in which the proximal tube 4 is welded into the plug body 7, and the length P of the proximal tube 4, are chosen in such a way that the distance D between the distal end 8 of the plug body 7 and the distal end 9 of the ceramic heating rod 3, called the length of projection D, is greater than the length L of the heating rod 3.

[0080] Thus, for example, in one particular mode of embodiment which is represented in figures 4 and 5, the length P of the proximal tube 4 is about 3 cm, the length of projection D is between 20 mm and 35 mm, especially about 28 mm, while the length L of the heating rod 3 is about 25 mm.

[0081] The addition of the proximal tube 4 therefore makes it possible to obtain a substantial length of projection D in spite of a relatively short heating rod 3.

[0082] In this way a plug 1 is obtained in which the length of projection D of the heating rod into the combustion chamber is greater than the length of the ceramic part of the heating rod, thus greatly reducing the costs of manufacturing such a plug 1.

[0083] The plug body 7 has means for fixing the plug in an engine cylinder head, for example a thread 14. The current for supplying the resistor belonging to the heating rod 3 is returned via the proximal tube 4 and then via the plug body 7, and is thus connected to the vehicle's earth as a result of the screwing of the plug body 7 into a metal cylinder head of an engine.

[0084] The plug body 7 also has a clamping nut.

[0085] The electrode 11 extends proximally, along the longitudinal axis, beyond the proximal end of the plug body 7, and is then introduced into a plug base 15. The plug base 15 brings about sealing of the plug by closing the hollow body 7 of the plug at its proximal end, and also brings about an electrical connection between the electrode 11 and an external connector which is adapted to be capable of connecting a cable for supplying the plug with electricity to said electrode.

[0086] The invention may form the subject of numerous other variants of embodiment which are not represented.

[0087] Thus, the lengths of the distal tube 2, the proximal tube 4 and the heating rod 3 - and consequently the length of projection D - may vary. Cutting the proximal tube to a different length makes it possible, advantageously, to rapidly modify the length of projection D of the plugs which have been manufactured, and without modifying the production line.

[0088] Moreover, the proximal tube 4 could be joined to the distal tube 2 by methods other than laser welding, for example by conventional welding.

[0089] Likewise, the proximal tube 4 could, for example, be fitted-on around the distal tube 2 and not end-to-end longitudinally.

[0090] In addition, the distal tube can be fitted tight onto the heating rod instead of being brazed.

Claims

1. Method of manufacturing a glow plug (1) in which:

- a metal distal tube (2) is fitted-on around a heating rod (3) made of ceramic material;
- a metal proximal tube (4) is joined, by a distal end (5) of the said proximal tube (4), to a proximal end (6) of the distal tube (2); and
- the proximal tube (4) is joined to a plug body (7) in such a way that at least one distal portion of the proximal tube (4) projects from a distal end (8) of the plug body (7).

2. Method according to claim 1, **characterised in that** the distal tube (2) is mounted on the heating rod (3) so that the heating rod has an exposed distal end (9), so as to be able to be in direct contact with a gas in a combustion chamber of an engine, in order to be able to heat up the said gas.

3. Method according to either of claims 1 or 2, **characterised in that** the length (P) of the proximal tube (4) is chosen so that the distance (D) between the distal end (8) of the plug body and the distal end (9) of the heating rod (3) is strictly greater than the length (L) of said heating rod.

4. Method according to one of claims 1 to 3, **characterised in that** the distal end (5) of the proximal tube (4) is welded to the proximal end (6) of the distal tube (2).

5. Method according to one of claims 1 to 4, **characterised in that** the distal tube (2) is brazed around the heating rod (3).

6. Method according to claim 5, **characterised in that** the proximal end (6) of the distal tube is flared for the purpose of brazing the distal tube (2) onto the heating rod (3).

7. Method according to claim 6, **characterised in that**, after the brazing of the distal tube (2) onto the heating rod (3), the flared proximal end (6) of the distal tube is machined in such a way that only the straight portion of the distal tube remains against the heating rod.

8. Method according to one of claims 1 to 7, **characterised in that** the proximal tube (4) surrounds a proximal end of the heating rod (3), which end is equipped with at least one electrical connector for supplying the heating rod with electricity.

9. Method according to claim 8, **characterised in that** the proximal tube (4) is connected electrically to at least one electrical connector of the heating rod (3), and is connected electrically to the metal plug body (7), the plug body being made of metal.

10. Glow plug (1) comprising:

- a metal distal tube (2) which is fitted-on around a heating rod (3) made of ceramic material;
- a metal proximal tube (4) which:
 - is distinct from the said distal tube (2);
 - is joined, by a distal end (5) of the said proximal tube (4), to a proximal end (6) of the distal tube (2); and
 - is joined to a plug body (7) in such a way that at least one distal portion of the proximal tube (4) projects from a distal end (8) of the plug body (7).

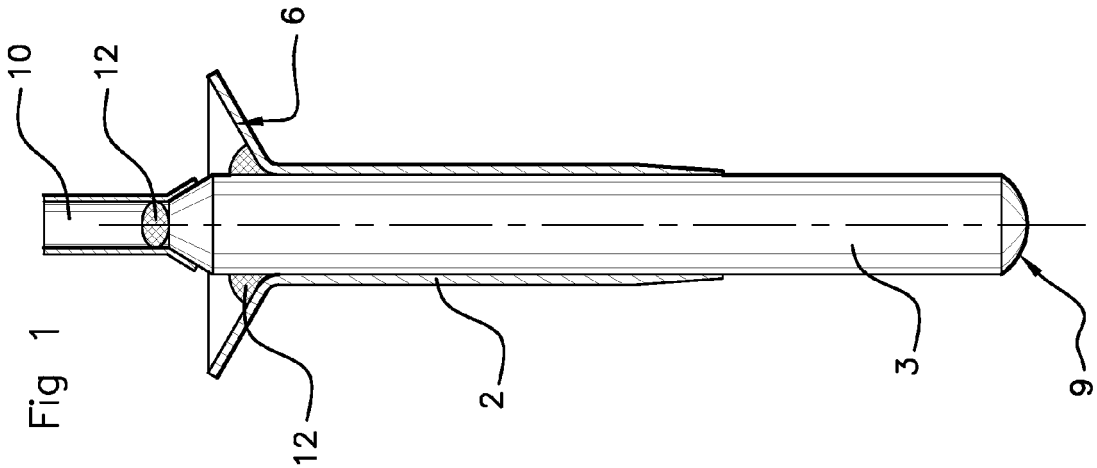
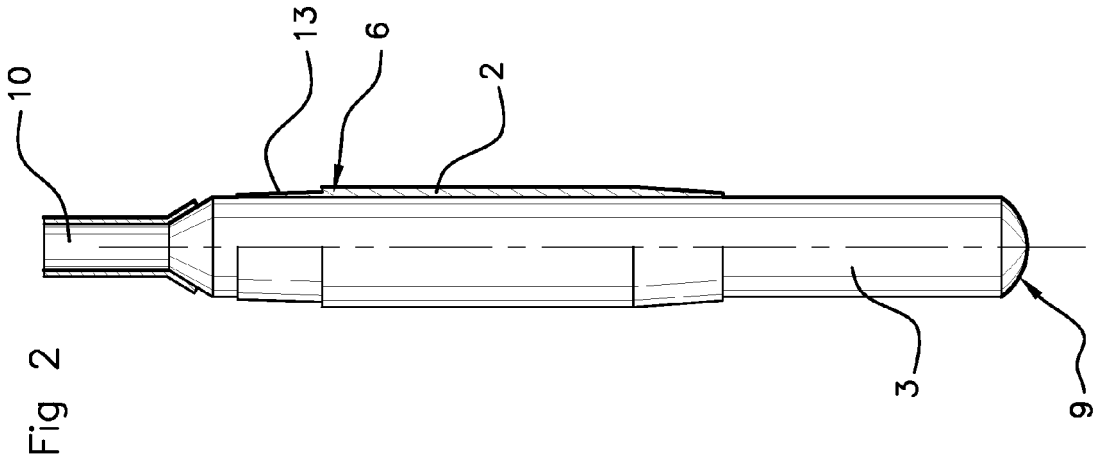


Fig 3

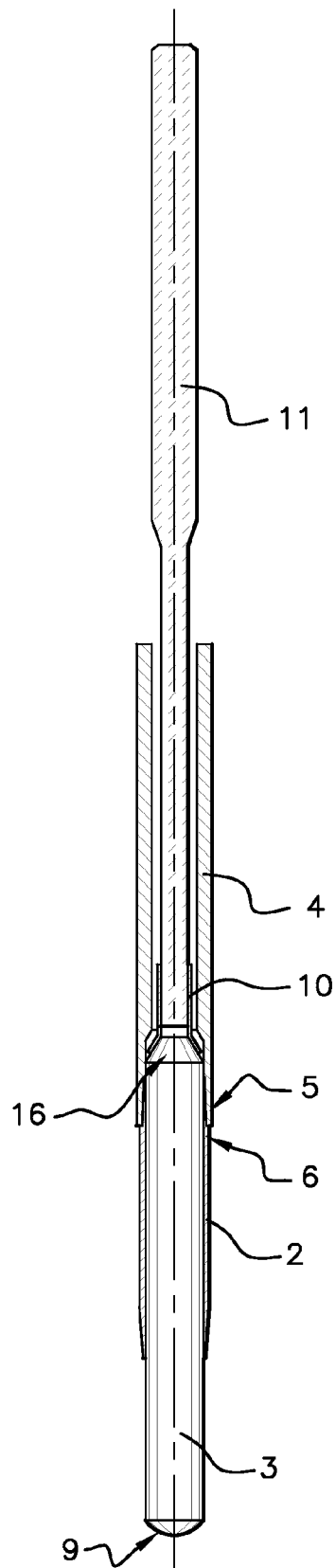


Fig 4

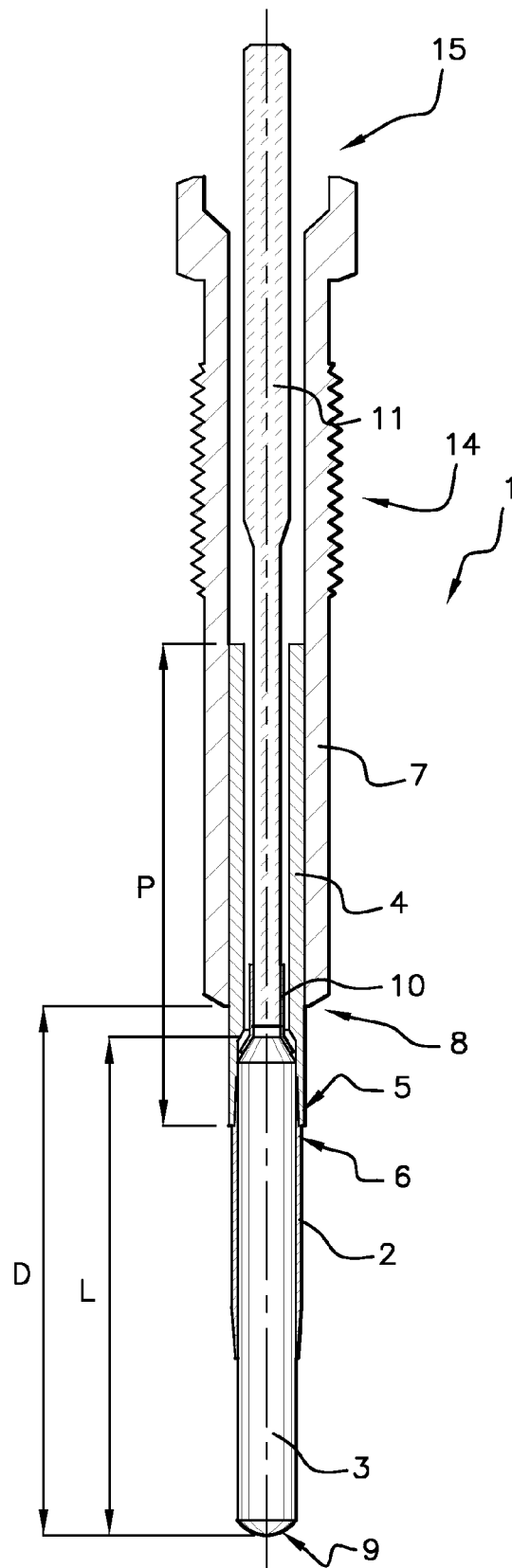
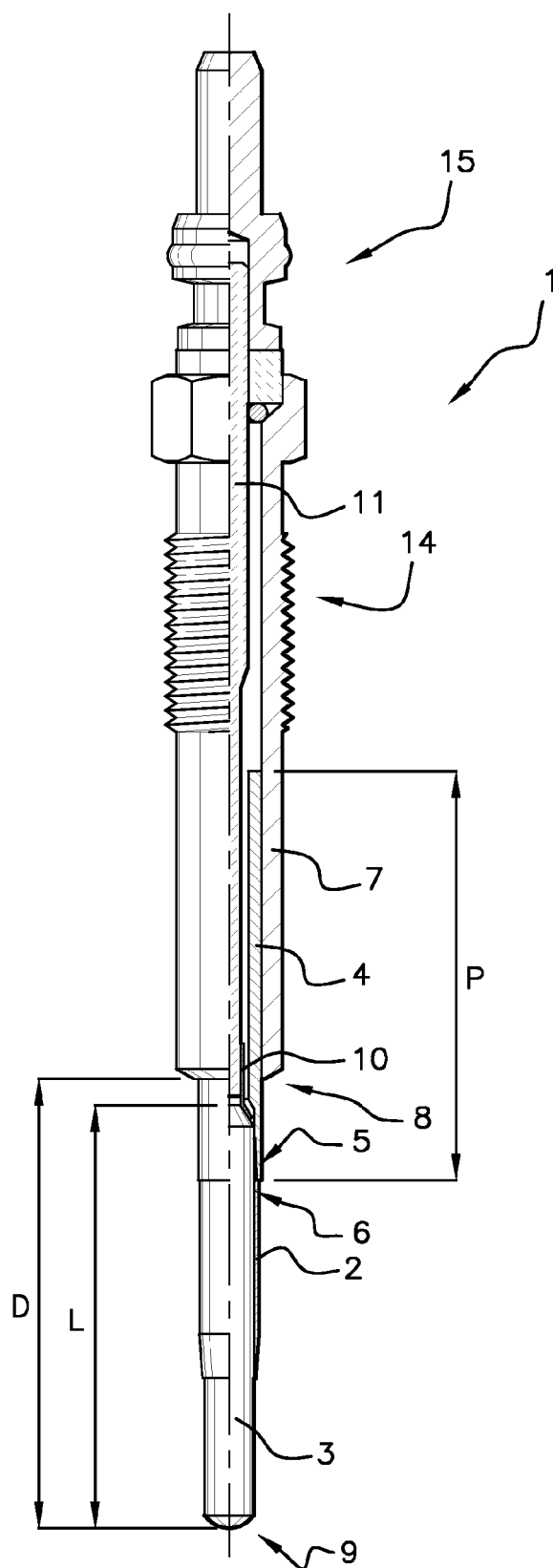


Fig 5





EUROPEAN SEARCH REPORT

Application Number
EP 12 19 0090

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 2008 009429 A1 (BOSCH GMBH ROBERT [DE]) 18 September 2008 (2008-09-18) * paragraphs [0022], [0023], [0033], [0043]; figures 1,3 *	1-5,8-10	INV. F23Q7/00
A	US 2007/227487 A1 (LAST BERND [DE] ET AL) 4 October 2007 (2007-10-04) * the whole document *	1	
A	DE 10 2004 063750 A1 (BOSCH GMBH ROBERT [DE]) 13 July 2006 (2006-07-13) * the whole document *	1	
A	JP 2009 243710 A (NGK SPARK PLUG CO) 22 October 2009 (2009-10-22) * abstract *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			F23Q
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 March 2013	Examiner Rodriguez, Alexander
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 19 0090

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.

08-03-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102008009429 A1	18-09-2008	DE 102008009429 A1	18-09-2008
		EP 2135008 A1	23-12-2009
		JP 5119274 B2	16-01-2013
		JP 2010521645 A	24-06-2010
		US 2009321408 A1	31-12-2009
		WO 2008110496 A1	18-09-2008

US 2007227487 A1	04-10-2007	CN 1954179 A	25-04-2007
		EP 1747406 A1	31-01-2007
		FR 2869391 A1	28-10-2005
		JP 4662981 B2	30-03-2011
		JP 2007534918 A	29-11-2007
		KR 20070043931 A	26-04-2007
		US 2007227487 A1	04-10-2007
		WO 2005111501 A1	24-11-2005

DE 102004063750 A1	13-07-2006	DE 102004063750 A1	13-07-2006
		EP 1834132 A1	19-09-2007
		JP 4594396 B2	08-12-2010
		JP 2008525758 A	17-07-2008
		US 2008302323 A1	11-12-2008
		WO 2006072510 A1	13-07-2006

JP 2009243710 A	22-10-2009	NONE	

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

- EP 1707883 A [0005]