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(54) METHOD OF MANUFACTURING A BI-MATERIAL GLOW PLUG

VERFAHREN ZUR HERSTELLUNG EINER ZÜNDKERZE AUS ZWEI MATERIALIEN

PROCÉDÉ DE FABRICATION D'UNE BOUGIE DE PRÉCHAUFFAGE À BIMATÉRIAU

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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 and DE102004061872 are known in that connection. JP S58-66720 discloses a glow plug comprising a heating rod joined to the plug body by a metal tube, a heat resistant sprayed metal layer covering the cylindrical insulating sintered body and the distal tip of the ceramic heating rod. This layer is thermal sprayed on the outer circumference of the sintered body and of the tip.

[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 according to claim 1.

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

[0023] In particular, in a method according to the invention 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. 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.

[0024] Thanks to a method of manufacturing 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] The proximal tube is, advantageously and according to the invention, joined to the distal tube in the axial prolongation of the distal tube.

[0033] 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 prox-

imal tube and the proximal end of the distal tube have substantially the same thickness.

[0034] 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.

[0035] The proximal tube and the distal tube are therefore joined together in the prolongation of one another.

[0036] 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.

[0037] Furthermore, the distal tube is, advantageously and according to the invention, brazed around the heating rod.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] In addition, an electrical connector can be brazed to the proximal end of the ceramic heating rod in the same operation.

[0042] 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.

[0043] The brazing of the distal tube onto the heating rod via the proximal end of the distal tube is therefore all the easier.

[0044] 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.

[0045] 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, machined in such a way that only the straight portion of the distal tube remains against the heating rod.

[0046] 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.

[0047] The flared portion of the distal tube is advantageously machined by milling.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] The invention also extends to a glow plug obtained by a method of manufacture according to the invention.

[0054] In particular, the invention advantageously extends to a glow plug according to claim 11.

[0055] Other objects, features and advantages of the invention will become apparent on reading the following description 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.

[0056] 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.

[0057] 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.

[0058] 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.

[0059] 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 mounted 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.

[0060] 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.

[0061] The distal tube 2 and the trumpet 10 are therefore brazed onto the heating rod 3 simultaneously.

[0062] 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.

[0063] 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.

[0064] 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.

[0065] 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.

[0066] 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 3.

[0067] 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.

[0068] 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.

[0069] 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.

[0070] 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.

[0071] 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.

[0072] The total length of the bi-material heating rod is greater than the length L of the ceramic heating rod 3.

[0073] 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.

[0074] 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.

[0075] In particular, the proximal tube 4 is joined to the plug body, for example by crimping or by laser welding.

[0076] 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.

[0077] 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.

[0078] 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.

[0079] 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.

[0080] 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.

[0081] The plug body 7 also has a clamping nut.

[0082] 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.

[0083] 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.

[0084] Moreover, the proximal tube 4 could be joined to the distal tube 2 by methods other than laser welding, for example by conventional welding. According to the invention, the proximal tube 4 is brazed around the distal tube 2 and not end-to-end longitudinally.

Claims

1. Method of manufacturing a glow plug (1) comprising at least the steps of:

- fitting-on a first metal tube, named distal tube (2), around a heating rod (3) made of ceramic material;
- joining a second metal tube, named proximal tube (4), by a distal end (5) of the said proximal tube (4) welded to a proximal end (6) of the distal tube (2); and
- joining the proximal tube (4) to a plug body (7)
- the distance (D) between the distal end (8) of the plug body and the distal end (9) of the heating rod (3) being strictly greater than the length (L) of said heating rod,

characterized in that:

- the proximal tube (4) is joined to the 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),
 - 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,
 - the distal tube is fitted-on around the heating rod by the following steps:
 - flaring the proximal end (6) of the distal tube for the purpose of brazing the distal tube (2) onto the heating rod (3),
 - brazing the distal tube (2) around the heating rod (3),
 - after brazing the distal tube (2) onto the heating rod (3), machining the flared proximal end (6) of the distal tube in such a way that only a straight portion of the distal tube remains against the heating rod.
2. Method according to claim 1, further comprising mounting the distal tube (2) 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 any of claims 1 or 2, further comprising:
- the internal diameter of the distal tube (2) is chosen so that the distal tube (2) is mounted on the heating rod with a radial spacing permitting the brazing of the distal tube (2) onto the heating rod (3),
 - brazing material is then added in an annular manner at the junction between a flared proximal end of the distal tube (2) and the surface of the heating rod.
4. Method according to claim 3, further comprising:
- the flared portion of the distal tube (2) is then removed, so that all that remains of the distal tube (2) is the straight portion around the heating rod (3),
 - the proximal end of this straight portion of the distal tube (2) being brazed against the heating rod (3).
5. Method according to any of claims 1 to 4, further comprising disposing the proximal tube (4) so as to surround a proximal end of the heating rod (3), which
- end being equipped with at least one electrical connector for supplying the heating rod with electricity.
6. Method according to claim 5, further comprising connecting electrically the proximal tube (4) to at least one electrical connector of the heating rod (3), and connecting electrically the proximal tube (4) to the plug body (7), the plug body being made of metal.
7. Method according to any of claims 1 to 6, further comprising the internal diameter of the plug body (7) is chosen substantially equal to the external diameter of a proximal portion of the proximal tube (4).
8. Method according to any of claims 1 to 7, further comprising the zone in which the proximal tube (4) is joined into the plug body (7) and the length (P) of the proximal tube (4) are 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.
9. Method according to any of claims 1 to 8, further comprising joining the proximal tube (4) to the plug body by crimping or by laser welding.
10. Method according to any of claims 1 to 9, further comprising choosing the distal tube (2) so as to have a length which is shorter than the length of the heating rod (3), and disposing the proximal and distal ends of the distal tube respectively 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.
11. Glow plug (1) manufactured according to the method of claim 1, comprising :
- a first metal tube, named distal tube (2), which is fitted-on around a heating rod (3) made of ceramic material;
 - a second metal tube, named 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) welded to a proximal end (6) of the distal tube (2); and
 - is joined to a plug body (7),
 - the distance (D) between the distal end (8) of the plug body and the distal end (9) of the heating rod (3) being strictly greater than the length (L) of said heating rod,

characterized in that:

- the proximal tube (4) is joined to the 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),
 - the length (P) of the proximal tube (4) is such 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,
 - the distal tube (2) is brazed around the heating rod (3),
 - only a straight portion of the distal tube (2) is brazed against the heating rod (3).
12. Glow plug according to claim 11 **characterized in that** a proximal end of the straight portion of the distal tube (2) is brazed against the heating rod (3).
13. Glow plug according to either ones of claim 11 and of claim 12 **characterized 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.
14. Glow plug according to any of claims 11 to 13 **characterized in that** the internal diameter of the plug body (7) is substantially equal to the external diameter of a proximal portion of the proximal tube (4).
15. Glow plug according to any of claims 11 to 14 **characterized in that** the zone in which the proximal tube (4) is joined into the plug body (7) and the length (P) of the proximal tube (4) are such 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.
16. Glow plug according to any of claims 11 to 15 **characterized in that** the proximal tube (4) is joined to the plug body by crimping or by laser welding.
17. Glow plug according to any of claims 11 to 16 **characterized in that** the distal tube (2) has a length shorter than the length of the heating rod (3), and the proximal and distal ends of the distal tube (2) are respectively disposed short of the proximal and distal ends, of the heating rod (3), in such a way that the distal end (9) and the proximal end (16) of the heating rod (3) are exposed after the distal tube (2) has been joined onto the heating rod (3).

Patentansprüche

1. Verfahren zur Herstellung einer Glühkerze (1), umfassend wenigstens die folgenden Schritte:

- Anbringen eines ersten Metallrohrs, d.h. eines distalen Rohrs (2), um einen ersten Heizstab (3) herum, der aus Keramikmaterial besteht;
- Verbinden eines zweiten Metallrohrs, d.h. eines proximalen Rohrs (4), durch ein distales Ende (5) des proximalen Rohrs (4), das an einem proximalen Ende (6) des distalen Rohrs (2) aufgeschweißt ist; und
- Verbinden des proximalen Rohrs (4) mit einem Kerzenkörper (7)
- wobei die Distanz (D) zwischen dem distalen Ende (8) des Kerzenkörpers und dem distalen Ende (9) des Heizstabs (3) grundsätzlich größer ist, als die Länge (L) des Heizstabs,

dadurch gekennzeichnet, dass:

- das proximale Rohr (4) auf eine Weise mit dem Kerzenkörper (7) verbunden wird, sodass wenigstens ein distaler Abschnitt des proximalen Rohrs (4) aus einem distalen Ende (8) des Kerzenkörpers (7) hervorsteht,
 - die Länge (P) des proximalen Rohrs (4) derart ausgewählt ist, dass die Distanz (D) zwischen dem distalen Ende (8) des Kerzenkörpers und dem distalen Ende (9) des Heizstabs (3) grundsätzlich größer ist, als die Länge (L) des Heizstabs,
 - das distale Rohr durch die nachfolgenden Schritte um den Heizstab angebracht ist:
 - Aufweiten des proximalen Endes (6) des distalen Rohrs zu dem Zweck des Lötens des distalen Rohrs (2) auf den Heizstab (3),
 - Lötens des distalen Rohrs (2) um den Heizstab (3),
 - nach dem Lötens des distalen Rohrs (2) auf den Heizstab (3), maschinelle Bearbeitung des aufgeweiteten proximalen Endes (6) des distalen Rohrs auf eine Weise, sodass nur der gerade Abschnitt des distalen Rohrs gegen den Heizstab verbleibt.
2. Verfahren nach Anspruch 1, ferner umfassend das Befestigen des distalen Rohrs (2) an dem Heizstab (3), sodass der Heizstab ein freigelegtes distales Ende (9) aufweist, um in der Lage zu sein, in direktem Kontakt mit einem Gas in einer Verbrennungskammer eines Motors zu stehen, um in der Lage zu sein, das Gas zu erwärmen.
3. Verfahren nach einem der Ansprüche 1 oder 2, ferner umfassend:
- dass der Innendurchmesser des distalen Rohrs (2) derart ausgewählt ist, dass das distale Rohr (2) an dem Heizstab mit einem radialen Zwischenraum befestigt ist, der das Lötens des distalen Rohrs (2) auf den Heizstab (3) erlaubt,

- dass dann Lötmaterial in einer ringförmigen Weise am Gelenk zwischen einem aufgeweiteten proximalen Ende des distalen Rohrs (2) und der Oberfläche des Heizstabs zugegeben wird.
4. Verfahren nach Anspruch 3, ferner umfassend:
- dass der aufgeweitete Abschnitt des distalen Rohrs (2) dann entfernt wird, sodass von dem distalen Rohr (2) nur der gerade Abschnitt um den Heizstab (3) verbleibt,
 - wobei das proximale Ende dieses geraden Abschnitts des distalen Rohrs (2) gegen den Heizstab (3) gelötet wird.
5. Verfahren nach einem der Ansprüche 1 bis 4, ferner umfassend das Anordnen des proximalen Rohrs (4) derart, um ein proximales Ende des Heizstabs (3) zu umgeben, welches Ende mit wenigstens einem elektrischen Anschluss zur Bereitstellung des Heizstabs mit Strom ausgerüstet ist.
6. Verfahren nach Anspruch 5, ferner umfassend das elektrische Anschließen des proximalen Rohrs (4) an wenigstens einen elektrischen Anschluss des Heizstabs (3) und das elektrische Anschließen des proximalen Rohrs (4) an den Kerzenkörper (7), wobei der Kerzenkörper aus Metall besteht.
7. Verfahren nach einem der Ansprüche 1 bis 6, ferner umfassend dass der Innendurchmesser des Kerzenkörpers (7) im Wesentlichen gleich dem Außendurchmesser eines proximalen Abschnitts des proximalen Rohrs (4) ausgewählt wird.
8. Verfahren nach einem der Ansprüche 1 bis 7, ferner umfassend dass die Zone, in der das proximale Rohr (4) in dem Kerzenkörper (7) verbunden wird und die Länge (P) des proximalen Rohrs (4) derart ausgewählt werden, dass die Distanz (D) zwischen dem distalen Ende (8) des Kerzenkörpers und dem distalen Ende (9) des Heizstabs (3) grundsätzlich größer ist, als die Länge (L) des Heizstabs.
9. Verfahren nach einem der Ansprüche 1 bis 8, ferner umfassend das Verbinden des proximalen Rohrs (4) mit dem Kerzenkörper durch Umfalzen oder Laserschweißen.
10. Verfahren nach einem der Ansprüche 1 bis 9, ferner umfassend die Auswahl des distalen Rohrs (2) derart, dass dieses eine Länge aufweist, die kürzer ist, als die Länge des Heizstabs (3) und die Anordnung der proximalen und distalen Enden des distalen Rohrs, sodass diese jeweils von den proximalen und distalen Enden des Heizstabs beabstandet sind, auf eine Weise, sodass das distale Ende (9) und das proximale Ende (16) des Heizstabs jeweils freigelegt

ist, nachdem das distale Rohr mit dem Heizstab verbunden worden ist.

11. Glühkerze (1), die gemäß dem Verfahren nach Anspruch 1 hergestellt ist, umfassend:

- ein erstes Metallrohr, d.h. ein distales Rohr (2), das um einen Heizstab (3) herum angebracht ist, der aus Keramikmaterial besteht;
- ein zweites Metallrohr, d.h. ein proximales Rohr (4), das:

- sich von dem distalen Rohr (2) unterscheidet;
- durch ein distales Ende (5) des proximalen Rohrs (4), das an ein proximales Ende (6) des distalen Rohrs (2) geschweißt ist, verbunden ist; und
- mit einem Kerzenkörper (7) verbunden ist,

- wobei die Distanz (D) zwischen dem distalen Ende (8) des Kerzenkörpers und dem distalen Ende (9) des Heizstabs (3) grundsätzlich größer ist, als die Länge (L) des Heizstabs,

dadurch gekennzeichnet, dass:

- das proximale Rohr (4) mit einem Kerzenkörper (7) auf eine Weise verbunden ist, sodass wenigstens ein distaler Abschnitt des proximalen Rohrs (4) von einem distalen Ende (8) des Kerzenkörpers (7) hervorsticht,
- die Länge (P) des proximalen Rohrs (4) derart ist, dass die Distanz (D) zwischen dem distalen Ende (8) des Kerzenkörpers und dem distalen Ende (9) des Heizstabs (3) grundsätzlich größer ist, als die Länge (L) des Heizstabs,
- das distale Rohr (2) um den Heizstab (3) gelötet ist,
- nur ein gerader Abschnitt des distalen Rohrs (2) gegen den Heizstab (3) gelötet ist.

12. Glühkerze nach Anspruch 11, **dadurch gekennzeichnet, dass** ein proximales Ende des geraden Abschnitts des distalen Rohrs (2) gegen den Heizstab (3) gelötet ist.

13. Glühkerze nach entweder einem von Anspruch 11 und Anspruch 12, **dadurch gekennzeichnet, dass** das distale Rohr (2) an dem Heizstab (3) derart befestigt ist, dass der Heizstab ein freigelegtes distales Ende (9) aufweist, um in der Lage zu sein, in direktem Kontakt mit einem Gas in einer Verbrennungskammer eines Motors zu stehen, um in der Lage zu sein, das Gas zu erwärmen.

14. Glühkerze nach einem der Ansprüche 11 bis 13, **dadurch gekennzeichnet, dass** der Innendurchmes-

ser des Kerzenkörpers (7) im Wesentlichen gleich dem Außendurchmesser eines proximalen Abschnitts des proximalen Rohrs (4) ist.

15. Glühkerze nach einem der Ansprüche 11 bis 14, **dadurch gekennzeichnet, dass** die Zone, in der das proximale Rohr (4) in dem Kerzenkörper (7) verbunden wird und die Länge (P) des proximalen Rohrs (4) derart sind, dass die Distanz (D) zwischen dem distalen Ende (8) des Kerzenkörpers und dem distalen Ende (9) des Heizstabs (3) grundsätzlich größer ist, als die Länge (L) des Heizstabs.
16. Glühkerze nach einem der Ansprüche 11 bis 15, **dadurch gekennzeichnet, dass** das proximale Rohr (4) mit dem Kerzenkörper durch Umfalzen oder Laserschweißen verbunden ist.
17. Glühkerze nach einem der Ansprüche 11 bis 16, **dadurch gekennzeichnet, dass** das distale Rohr (2) eine Länge aufweist, die kürzer ist, als die Länge des Heizstabs (3) und die proximalen und distalen Enden des distalen Rohrs (2) jeweils von den proximalen und distalen Enden des Heizstabs (3) beabstandet angeordnet sind, auf eine Weise, sodass das distale Ende (9) und das proximale Ende (16) des Heizstabs (3) jeweils freigelegt sind, nachdem das distale Rohr (2) mit dem Heizstab (3) verbunden worden ist.

Revendications

1. Procédé de fabrication d'une bougie de préchauffage (1) comprenant au moins les étapes consistant à :
- installer un premier tube métallique, appelé tube distal (2), autour d'une tige chauffante (3) composée d'un matériau céramique ;
 - raccorder un second tube métallique, appelé tube proximal (4), par une extrémité distale (5) dudit tube proximal (4) soudé à une extrémité proximale (6) du tube distal (2) ; et
 - raccorder le tube proximal (4) à un corps de bougie (7),
 - la distance (D) entre l'extrémité distale (8) du corps de bougie et l'extrémité distale (9) de la tige chauffante (3) étant strictement supérieure à la longueur (L) de ladite tige chauffante,
- caractérisé en ce que :
- le tube proximal (4) est raccordé au corps de bougie (7) de telle manière qu'au moins une partie distale du tube proximal (4) fasse saillie depuis une extrémité distale (8) du corps de bougie (7),
 - la longueur (P) du tube proximal (4) est choisie

de sorte que la distance (D) entre l'extrémité distale (8) du corps de bougie et l'extrémité distale (9) de la tige chauffante (3) soit strictement supérieure à la longueur (L) de ladite tige chauffante,

- le tube distal est installé autour de la tige chauffante par les étapes suivantes :

- évasement de l'extrémité proximale (6) du tube distal aux fins du brasage du tube distal (2) sur la tige chauffante (3),

- brasage du tube distal (2) autour de la tige chauffante (3),

- après le brasage du tube distal (2) sur la tige chauffante (3), usinage de l'extrémité proximale (6) évasée du tube distal de telle manière que seule la partie droite du tube distal reste contre la tige chauffante.

2. Procédé selon la revendication 1, comprenant en outre le montage du tube distal (2) sur la tige chauffante (3) de sorte que la tige chauffante ait une extrémité distale (9) exposée, de façon à pouvoir être en contact direct avec un gaz dans une chambre de combustion d'un moteur, afin de pouvoir chauffer ledit gaz.

3. Procédé selon l'une quelconque des revendications 1 ou 2, comprenant en outre :

- le diamètre interne du tube distal (2) est choisi de telle sorte que le tube distal (2) est monté sur la tige chauffante avec un espacement radial permettant le brasage du tube distal (2) sur la tige chauffante (3),

- du matériau de brasage est ensuite ajouté de manière annulaire à la jonction entre une extrémité proximale évasée du tube distal (2) et la surface de la tige chauffante.

4. Procédé selon la revendication 3, comprenant en outre :

- la partie évasée du tube distal (2) est ensuite retirée, de telle sorte que tout ce qui reste du tube distal (2) est la partie droite autour de la tige chauffante (3),

- l'extrémité proximale de cette partie droite du tube distal (2) étant brasée contre la tige chauffante (3).

5. Procédé selon l'une quelconque des revendications 1 à 4, comprenant en outre la disposition du tube proximal (4) de façon à entourer une extrémité proximale de la tige chauffante (3), laquelle extrémité étant équipée d'au moins un connecteur électrique afin d'alimenter la tige chauffante en électricité.

6. Procédé selon la revendication 5, comprenant en

autre le raccordement électrique du tube proximal (4) à au moins un connecteur électrique de la tige chauffante (3), et le raccordement électrique du tube proximal (4) au corps de bougie (7), le corps de bougie étant composé de métal.

7. Procédé selon l'une quelconque des revendications 1 à 6, comprenant en outre le diamètre intérieur du corps de bougie (7) est choisi de manière sensiblement égale au diamètre extérieur d'une partie proximale du tube proximal (4).

8. Procédé selon l'une quelconque des revendications 1 à 7, comprenant en outre la zone dans laquelle le tube proximal (4) est raccordé dans le corps de bougie (7) et la longueur (P) du tube proximal (4) sont choisies de sorte que la distance (D) entre l'extrémité distale (8) du corps de bougie et l'extrémité distale (9) de la tige chauffante (3) est strictement supérieure à la longueur (L) de ladite tige chauffante.

9. Procédé selon l'une quelconque des revendications 1 à 8, comprenant en outre le raccordement du tube proximal (4) au corps de bougie par sertissage ou par soudage au laser.

10. Procédé selon l'une quelconque des revendications 1 à 9, comprenant en outre le choix du tube distal (2) de façon à avoir une longueur qui est inférieure à la longueur de la tige chauffante (3), et la disposition des extrémités proximale et distale du tube distal respectivement à distance des extrémités proximale et distale de la tige chauffante, de telle manière que l'extrémité distale (9) et l'extrémité proximale (16) de la tige chauffante soient exposées après que le tube distal a été raccordé sur la tige chauffante.

11. Bougie de préchauffage (1) fabriquée selon le procédé selon la revendication 1, comprenant :

- un premier tube métallique, appelé tube distal (2), qui est installé autour d'une tige chauffante (3) composée d'un matériau céramique ;
- un second tube métallique, appelé tube proximal (4) qui :

- est distinct dudit tube distal (2) ;
- est raccordé, par une extrémité distale (5) dudit tube proximal (4) soudé à une extrémité proximale (6) du tube distal (2) ; et
- est raccordé à un corps de bougie (7),

- la distance (D) entre l'extrémité distale (8) du corps de bougie et l'extrémité distale (9) de la tige chauffante (3) étant strictement supérieure à la longueur (L) de ladite tige chauffante,

caractérisée en ce que :

- le tube proximal (4) est raccordé au corps de bougie (7) de telle manière qu'au moins une partie distale du tube proximal (4) fasse saillie depuis une extrémité distale (8) du corps de bougie (7),

- la longueur (P) du tube proximal (4) est telle que la distance (D) entre l'extrémité distale (8) du corps de bougie et l'extrémité distale (9) de la tige chauffante (3) est strictement supérieure à la longueur (L) de ladite tige chauffante,
- le tube distal (2) est brasé autour de la tige chauffante (3),
- seule une partie droite du tube distal (2) est brasée contre la tige chauffante (3).

12. Bougie de préchauffage selon la revendication 11 **caractérisée en ce qu'**une extrémité proximale de la partie droite du tube distal (2) est brasée contre la tige chauffante (3).

13. Bougie de préchauffage selon l'une ou l'autre des revendications 11 et 12, **caractérisée en ce que** le tube distal (2) est monté sur la tige chauffante (3) de sorte que la tige chauffante ait une extrémité distale (9) exposée, de façon à pouvoir être en contact direct avec un gaz dans une chambre de combustion d'un moteur, afin de pouvoir chauffer ledit gaz.

14. Bougie de préchauffage selon l'une quelconque des revendications 11 à 13, **caractérisée en ce que** le diamètre intérieur du corps de bougie (7) est sensiblement égal au diamètre extérieur d'une partie proximale du tube proximal (4).

15. Bougie de préchauffage selon l'une quelconque des revendications 11 à 14, **caractérisée en ce que** la zone dans laquelle le tube proximal (4) est raccordé dans le corps de bougie (7) et la longueur (P) du tube proximal (4) sont telles que la distance (D) entre l'extrémité distale (8) du corps de bougie et l'extrémité distale (9) de la tige chauffante (3) est strictement supérieure à la longueur (L) de ladite tige chauffante.

16. Bougie de préchauffage selon l'une quelconque des revendications 11 à 15, **caractérisée en ce que** le tube proximal (4) est raccordé au corps de bougie par sertissage ou par soudage au laser.

17. Bougie de préchauffage selon l'une quelconque des revendications 11 à 16, **caractérisée en ce que** le tube distal (2) a une longueur inférieure à la longueur de la tige chauffante (3), et les extrémités proximale et distale du tube distal (2) sont respectivement disposées à distance des extrémités proximale et distale de la tige chauffante (3), de telle manière que l'extrémité distale (9) et l'extrémité proximale (16) de la tige chauffante (3) soient exposées après que le

tube distal (2) a été raccordé sur la tige chauffante
(3) .

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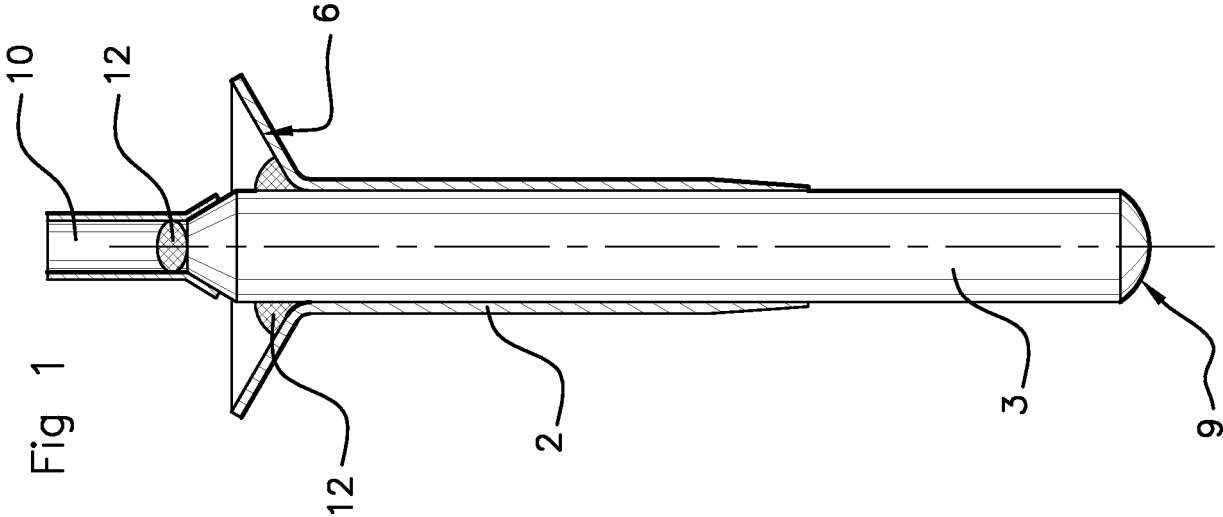
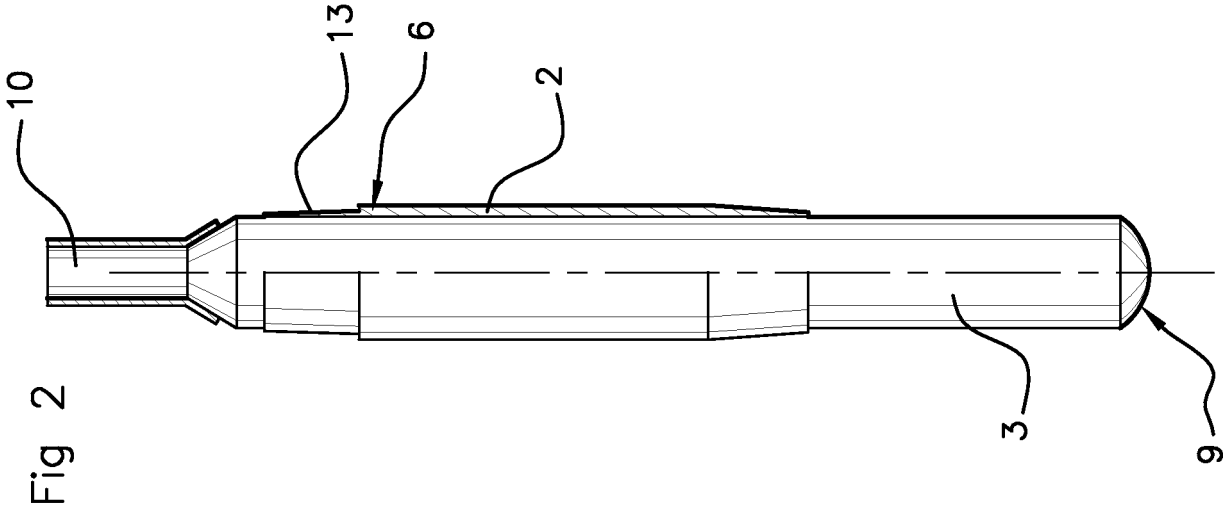


Fig 3

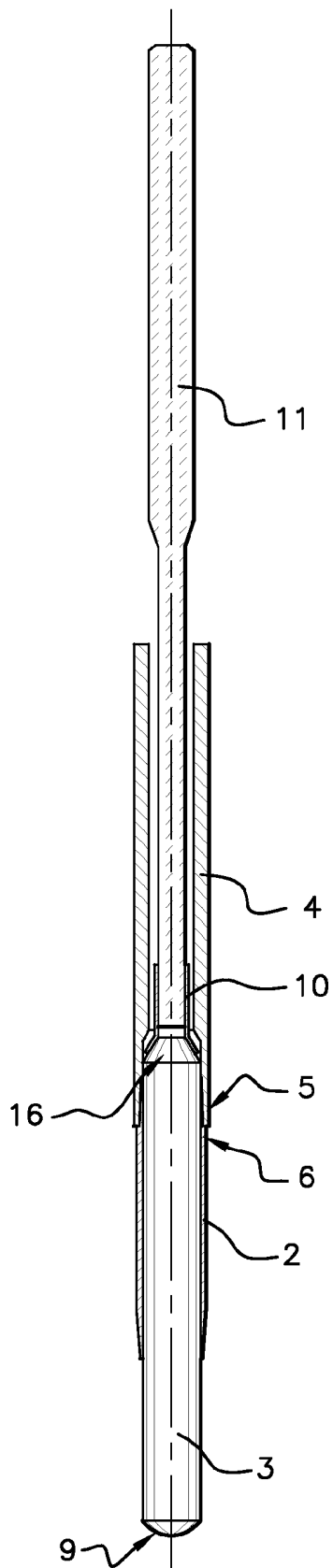


Fig 4

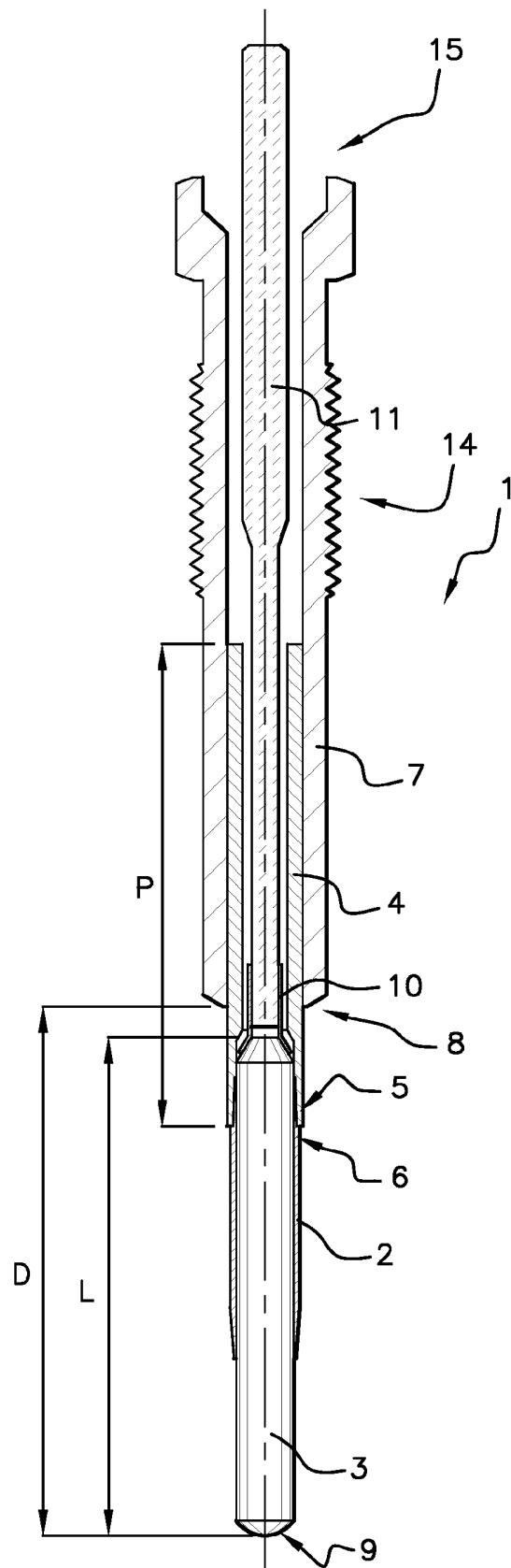
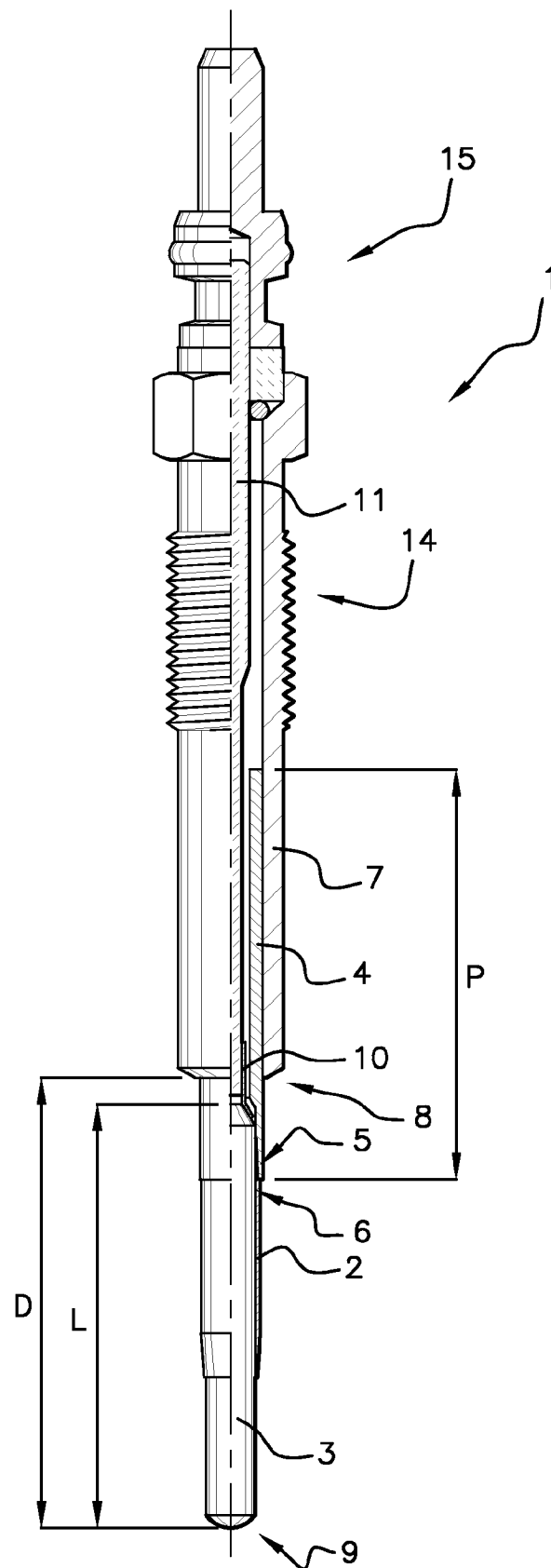


Fig 5



REFERENCES CITED IN THE DESCRIPTION

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