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

(11) EP 0 902 236 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.04.2005 Bulletin 2005/15

(51) Int Cl.[7]: **F23Q 7/00**

(21) Application number: **98117067.3**

(22) Date of filing: **09.09.1998**

(54) **Glow plug**

Glühkerze

Bougie à incandescence

(84) Designated Contracting States:
DE ES FR GB

(30) Priority: **20.08.1998 JP 23336298**
11.09.1997 JP 26791797

(43) Date of publication of application:
17.03.1999 Bulletin 1999/11

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(56) References cited:
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EP 0 902 236 B1

Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to a glow plug designed to preheat a combustion chamber of a diesel engine for ensuring quick starting, and more particularly to an improved structure of a glow plug which avoids the overheat of a heating element of the glow plug to prolong the service life thereof.

BACKGROUND ART

[0002] Glow plugs are used as a preheating element serving to heat a diesel engine above a self-starting temperature during a starting mode of engine operation. For example, there are known self-temperature controlled glow plugs using a coil made of two different materials. This type of glow plug includes a heating coil and a current-controlling coil connected electrically to the heating coil in series. The current-controlling coil is made of material having a positive temperature coefficient of resistance greater than that of the heating coil and serves to avoid the overheat of the heating coil for improving the durability thereof.

[0003] DE-A-40 01 296 discloses a glow plug comprising a hollow housing of a given length having an open end, a heating coil, a current-controlling coil having a positive temperature coefficient of resistance greater than that of the heating coil, connected to an end of the heating coil and a heater casing, having disposed therein the heating coil and the current-controlling coil, inserted partially into the housing from the open end. The heater casing includes a first and a second portion. The first portion includes a large-diameter portion. The second portion includes a small-diameter portion and a connecting portion connecting between the large-diameter portion and the small-diameter portion. The small-diameter portion of the heater casing is clearly in contact with the housing so that the heater casing can not be inserted into an open end of the housing. Moreover the current-controlling coil is located in the larger diameter portion.

SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a glow plug which is capable of minimizing the heat transfer from a current-controlling coil to an engine head, thereby resulting in improved mechanical strength or durability of the engine head.

[0005] According to the invention, this object is achieved by a glow plug having the features of claim 1.

[0006] Advantageous further developments are set out in the dependent claims.

[0007] A glow plug mount structure comprising such a glow plug is defined in claim 4.

[0008] The heater casing may further include a tapered portion connecting the small-diameter portion and the large-diameter portion.

[0009] A glow plug mount hole is formed in an engine and has mounted therein the glow plug with a clearance of 0.25 mm or more between an outer wall of the small-diameter portion of the heater casing of the glow plug and an inner wall of the glow plug mount hole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present invention will be understood more fully from the detailed description given hereinbelow and from the accompanying drawings of the preferred embodiment of the invention, which, however, should not be taken to limit the invention to the specific embodiment but are for explanation and understanding only.

[0011] In the drawings:

Fig. 1 is a cross sectional view which shows a glow plug according to the first embodiment of the invention;
Fig. 2 is a partial cross sectional view which shows the glow plug of Fig. 1 installed in an engine head;
Fig. 3 is a graph which shows a temperature rise of a heating coil measured for different values of the clearance between an inner wall of a glow plug mount hole and a small-diameter portion of a heater casing;
Fig. 4 is a cross sectional view which shows a glow plug according to the second embodiment of the invention;
Fig. 5 is a partial cross sectional view which shows the glow plug of Fig. 4 installed in an engine head;
Fig. 6 is a graph which shows a temperature rise of a heating coil measured for different values of length L, as shown in Fig. 5, of a portion of a small-diameter portion of a heater casing inserted into a housing and a temperature rise of a heating coil in a conventional glow plug structure; and
Fig. 7 is a partial cross sectional view which shows a glow plug according to the third embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Referring now to the drawings, particularly to Fig. 1, there is shown a glow plug 1 according to the first embodiment of the present invention.

[0013] The glow plug 1 includes generally a heating coil 21, a current-controlling coil 22, a cylindrical heater casing 3 having disposed therein the coils 21 and 22, and a cylindrical hollow housing 5 retaining therein a base end 39 of the heater casing 3.

[0014] The heater casing 3 consists of a large-diameter portion 32 continuing the base end 39, a small-diameter portion 31, and a tapered portion 33. The small-diameter portion 31 has the diameter d smaller than the diameter D of the large-diameter portion 32. The large-

diameter portion 32 is press-fitted into the housing 5. The small-diameter portion 31 extends outside from an open end 51 of the housing 5 and has a closed head 36. The tapered portion connects the large-diameter portion 32 and the small-diameter portion 31 and decreases in diameter toward the small-diameter portion gradually for avoiding the concentration of stress at the junction of the large-diameter portion 32 and the small-diameter portion 31.

[0015] The heater casing 3 may alternatively be brazed to the housing 5. The tapered portion 33 is shaped by a drawing die when forming the small-diameter portion 31 by drawing such as swaging.

[0016] The current-controlling coil 22 is made of material having a positive temperature coefficient of resistance greater than that of the heating coil 21 and connects with an end 29 of the heating coil 21 to control the current flowing to the heating coil 21. The current-controlling coil 22 is disposed only within the small-diameter portion 31 of the heater casing 3 together with the heating coil 21.

[0017] The heating coil 21 is disposed within the small-diameter portion 31 of the heater casing 3 on the side of the head 36, while the current-controlling coil 22 is disposed on the side of the base end 39. The temperature coefficient of resistance of the heating coil 21 may be either positive or negative.

[0018] In use, the glow plug 9 is, as clearly shown in Fig. 2, mounted in a glow plug mount hole 81 formed in an engine head 8 with a clearance of 0.6 mm between an outer wall of the small-diameter potion 31 of the heater casing 3 and an inner wall of the glow plug mount hole 81.

[0019] The heater casing 3 is filled with a magnesia powder 38 around the heating coil 21, the current-controlling coil 22, and the central shaft 61 for electrical insulation.

[0020] A power supply terminal 62 is connected to the current-controlling coil 22 through the central shaft 61 and installed in a hexagonal base 52 of the housing 5 together with the central shaft 61 through an insulating bush 71 and a metallic nut 72.

[0021] For measurements of the glow plug 1 and the plug mount, the outer diameter d of the small-diameter portion 31 is ϕ4.3 mm. The outer diameter D of the large-diameter portion 32 is ϕ5.0 mm. The diameter of the glow plug mount hole 81 is ϕ5.5 mm. The clearance 85 is 0.6 mm. The inner diameter of the housing 5 is ϕ5.0 mm.

[0022] The large-diameter portion 32 of the heater casing 3 is, as described above, disposed within the housing 5 without projecting from the open end 51. Therefore, when the diameter of the glow plug mount hole 81 is ϕ5.5 mm equal to that of the conventional structure shown in Fig. 9, it will produce, as shown in Fig. 2, a greater clearance Q of 0.6 mm between the heater casing 3 and the inner wall of the glow plug mount hole 81, thereby reducing the heat transfer from the current-controlling coil 22 to the engine head 8.

[0023] The heating coil 21 and the current-controlling coil 22 are disposed only within the small-diameter portion 31 of the heater casing 3 which is located on the side of the head 36 from a boundary B of the large-diameter portion 32 and the tapered portion 33 and which extends outside the housing 5. Thus, even if the clearance between the housing 5 and the tapered portion 33 of the heater casing 3 is, as shown in Fig. 2, choked with carbon 89, the heat of the current-controlling coil 22 is hardly transferred to the engine head 8 through the housing 5.

[0024] Specifically, the structure of the glow plug 1 avoids the heat transfer from the current-controlling coil 22 to the outside through the housing 5 as well as the clearance 85.

[0025] The reduction in heat transfer to the outside facilitates rise in temperature of the current-controlling coil 22 up to a set value within a given period of time following energization of the current-controlling coil 22. This enables accurate control of increase in resistance of the current-controlling coil 22 or decrease in current flowing therethrough, thereby avoiding the overheat of the heating coil 21.

[0026] If the clearance Q between the heater casing 3 and the glow plug mount hole 81 is 0.25 mm equal to that in the conventional structure shown in Fig. 9, it will allow the diameter of the glow plug mount hole 81 to be decreased to ϕ4.8 mm, thereby increasing the mechanical strength of the engine head 8 which will result in greatly improved durability of the engine. This also allows air inlet and outlet ports of the engine to be increased in diameter for enhancing the engine output.

[0027] A temperature rise of the heating coil 21 was measured for different values of the clearance 85 between the inner wall of the glow plug mount hole 81 of the engine head 8 and the small-diameter portion 31 of the heater casing 3 when the clearance 85 is choked with carbon. The measurement of temperature of the heating coil 21 was made forty seconds after a rated voltage of 11V was applied to the glow plug 1 mounted in an engine after operating for 100 hours at 2000 rpm under full load conditions. The results are shown in Fig. 3.

[0028] As can be seen from Fig. 3, the temperature of the heating coil 21 is elevated rapidly as the clearance 85 is decreased. Particularly, when the clearance 85 is less than 0.25 mm, the temperature of the heating coil 21 exceeds 100°C, which will cause the service life of the glow plug 1 to be shortened greatly. It is, thus, advisable that the clearance 85 be greater than 0.25 mm or more.

[0029] It is also advisable that the outer diameter d of the small-diameter portion 31 of the heater casing 3 be ϕ2.5 mm to ϕ4.8 mm. In this case, decreasing the outer diameter d of the small-diameter portion 31 allows the clearance 85 to be increased or the glow plug mount hole 81 to be decreased in diameter.

[0030] If the outer diameter d of the small-diameter portion 31 is less than ϕ2.5 mm, the difficulty is encountered in machining the small-diameter portion 31. Conversely, if the outer diameter d of the small-diameter portion 31 is more than ϕ4.8 mm, the above described advantages of the invention are not obtained.

[0031] Figs. 4 and 5 show a glow plug 4 according to the second embodiment of the invention.

[0032] The glow plug 4 has the current-controlling coil 22 disposed partially inside the open end 921 of the housing 92. The central shaft 61 is, thus, shorter than that of the first embodiment by the distance L corresponding to a length of the current-controlling coil 22 disposed within the housing 92, thereby forming the pocket 87 between the housing 92 and the small-diameter portion 31 of the heater casing 3.

[0033] The pocket 87 has an inner diameter of ϕ5.3 mm and defines a clearance P of 0.5 mm between the small-diameter portion 31 and the inner wall of the housing 92 which is greater than the clearance P of 0.15 mm in the conventional structure shown in Fig. 9. This reduces the heat transfer from the current-controlling coil 22 to the engine head 8 through the pocket 87 even when the pocket 87 is choked with carbon.

[0034] Other arrangements are identical with those of the first embodiment, and explanation thereof in detail will be omitted here.

[0035] A temperature rise of the heating coil 21 was measured for different values of the length L of the current-controlling coil 22 disposed within the housing 92 when the pocket 87 is choked with carbon. The measurement of temperature of the heating coil 21 was made forty seconds after a rated voltage of 11V was applied to the glow plug 1 removed from an engine after operating for 100 hours at 2000 rpm under full load conditions without influence of carbon in the clearance 85. The results are shown in Fig. 6. A broken line indicates as a comparative example a temperature rise of the heating coil 22 in the conventional structure, as shown in Figs. 8 and 9, wherein the pocket 987 or clearance P is 0.15.

[0036] As can be seen from Fig. 6, the temperature of the heating coil 21 is elevated greatly as the length L is increased. If the length L in this embodiment is identical with that in the comparative example, the temperature rise of the heating coil 21 of this embodiment is found to be lower than that of the comparative example.

[0037] Fig. 7 shows a glow plug 11 according to the third embodiment of the invention which is different from the first embodiment only in that the rear end 228 of the current-controlling coil 22 leading to the tip of the central shaft 61 is arranged within the tapered portion 33 of the heater casing 3. Other arrangements are identical with those of the first embodiment, and explanation thereof in detail will be omitted here.

[0038] The connecting portion 229 of the current-controlling coil 22 wrapped about the tip of the central shaft 61 is, as shown in Fig. 7, disposed within the tapered portion 33, but may alternatively be arranged on the side of the large-diameter portion 32 from the boundary B of the large-diameter portion 32 and the tapered portion 32 because the connecting portion 229 does not provide the current control as compared with the other portion of the current-controlling coil 22.

[0039] While the present invention has been disclosed in terms of the preferred embodiment in order to facilitate a better understanding thereof, it should be appreciated that the invention can be embodied in various ways without departing from the scope of the invention as set forth in the appended claims.

[0040] A glow plug used in diesel engines is provided which includes a plug housing, a heater casing, and a heating element. The heating element consists of a heating coil and a current-controlling coil connected in series with the heating coil to control the current flowing to the heating coil. The heater casing has disposed therein the heating coil and the current-controlling coil and is inserted partially into the housing from an open end thereof. The heater casing includes a small-diameter portion and a large-diameter portion connected in series with the small-diameter portion. The whole of the large-diameter portion is disposed within the housing in tight engagement therewith, while the whole of the small-diameter portion projects from the open end of the housing for producing a clearance with an inner wall of a glow plug mount hole formed in an engine head to minimize the heat transfer from the heating element to the engine head.

Claims

1. A glow plug comprising:

a hollow housing (5; 92) of a given length having an open end;

a heating coil (21);

a current-controlling coil (22) having a positive temperature coefficient of resistance greater than that of said heating coil (21), connected to an end of said heating coil, and

a heater casing (3), having disposed therein said heating coil (21) and said current-controlling coil (22), inserted partially into said housing (5; 92) from the open end, said heater casing (3) including a first and a second portion, the first portion including a large-diameter portion (32), the second portion including a small-diameter portion (31) and a connecting portion (33) connecting between the large-diameter portion and the small-diameter portion in series, the whole of the large-diameter portion (32) being disposed within said housing (5) in engagement therewith, the small-diameter portion (31) projecting from the open end of said housing (5; 92), wherein

the whole of the heating coil (21) and said current-controlling coil (22) are disposed within the second portion of said heater casing (3), and

wherein an inner diameter of the open end of said housing (5; 92) from which the heater casing (3) is inserted is greater than or equal to a diameter of the large-diameter portion (32) of the heater casing (3).

2. A glow plug as set forth in claim 1, wherein the connecting portion (33) of said heater casing (3) is tapered.

3. A glow plug according to claim 1 or 2, wherein a pocket (87) is formed between the hollow housing (92) and the small-diameter portion (31).

4. A glow plug mount structure comprising a glow plug according to one of the preceding claims, and a glow plug mount hole (81) formed in an engine, having mounted therein said glow plug with a clearance of 0.25 mm or more between an outer wall of the small-diameter portion (31) of the heater casing (3) of said glow plug and an inner wall of said glow plug mount hole (81).

Patentansprüche

1. Eine Glühkerze aufweisend:

ein Hohlgehäuse (5; 92) einer gegebenen Länge, das ein offenes Ende hat;
eine Heizspirale (21);
eine Stromsteuerspirale (22), die einen positiven Temperaturbeständigkeitskoeffizient hat, der größer ist als der der Heizspirale (21), und mit einem Ende der Heizspirale verbunden ist, und
ein Heizgerätgehäuse (3), das darin die Heizspirale (21) und die Stromsteuerspirale (22) angeordnet hat, und teilweise in das Gehäuse (5; 92) von dem offenen Ende aus eingesetzt ist, wobei das Heizgerätgehäuse (3) einen ersten und einen zweiten Abschnitt hat, wobei der erste Abschnitt einen großdurchmessrigen Abschnitt (32) hat und der zweite Abschnitt einen kleindurchmessrigen Abschnitt (31) und einen Verbindungsabschnitt (33) hat, der den großdurchmessrigen Abschnitt mit dem kleindurchmessrigen Abschnitt reihenweise miteinander verbindet, wobei der ganze großdurchmessrige Abschnitt (32) innerhalb des Gehäuses (5) in Eingriff mit diesem befindlich angeordnet ist, und der kleindurchmessrige Abschnitt (31) von dem offenen Ende des Gehäuses (5; 92) hervorsteht, wobei

die ganze Heizspirale (21) und die Stromsteuerspirale (22) innerhalb des zweiten Abschnitts des Heizgerätgehäuses (3) angeordnet sind, und

wobei ein Innendurchmesser des offenen Endes des Gehäuses (5; 92), von welchem das Heizgerätgehäuse (3) aus eingesetzt wird, größer oder gleich ist als ein Durchmesser des großdurchmessrigen Abschnitts (32) des Heizgerätgehäuses (3).

2. Eine Glühkerze gemäß Anspruch 1, wobei der Verbindungsabschnitt (33) des Heizgerätgehäuses (3) verjüngt ist.

3. Eine Glühkerze gemäß Anspruch 1 oder 2, wobei eine Tasche (87) zwischen dem Hohlgehäuse (92) und dem kleindurchmessrigen Abschnitt (31) ausgebildet ist.

4. Eine Glühkerzenbefestigungsanordnung, die eine Glühkerze gemäß einem der vorangehenden Ansprüche aufweist, und eine Glühkerzenbefestigungsbohrung (81) hat, die in einem Motor ausgebildet ist, der die Glühkerze mit einem Zwischenraum von 0.25 mm oder mehr zwischen einer Außenwand des kleindurchmessrigen Abschnitts (31) des Heizgerätgehäuses (3) der Glühkerze und einer Innenwand der Glühkerzenbefestigungsbohrung (81) befestigt hat.

Revendications

1. Bougie à incandescence comprenant :

un logement creux (5 ; 92) d'une longueur donnée comportant une extrémité ouverte,
une bobine de chauffage (21),
une bobine de régulation de courant (22) présentant un coefficient de température de résistance positif supérieur à celui de ladite bobine de chauffage (21) reliée à une extrémité de ladite bobine de chauffage, et
un boîtier d'élément chauffant (3) ayant, disposées dans celui-ci, ladite bobine de chauffage (21) et ladite bobine de régulation de courant (22), insérée partiellement dans ledit logement (5 ; 92) depuis l'extrémité ouverte, ledit boîtier d'élément chauffant (3) comprenant une première et une seconde parties, la première partie comprenant une partie de grand diamètre (32), la seconde partie comprenant une partie de petit diamètre (31) et une partie de liaison (33) reliant la partie de grand diamètre et la partie de petit diamètre en série, la totalité de la partie de grand diamètre (32) étant disposée à l'intérieur dudit logement (5) en contact avec

celui-ci, la partie de petit diamètre (31) dépassant de l'extrémité ouverte dudit logement (5 ; 92), dans laquelle la totalité de la bobine de chauffage (21) et de ladite bobine de régulation de courant (22) sont disposées à l'intérieur de la seconde partie dudit boîtier d'élément chauffant (3), et

dans laquelle un diamètre intérieur de l'extrémité ouverte dudit logement (5 ; 92) par laquelle le boîtier d'élément chauffant (3) est inséré est supérieur ou égal au diamètre de la partie de grand diamètre (32) du boîtier d'élément chauffant (3).

2. Bougie à incandescence selon la revendication 1, dans laquelle la partie de liaison (33) dudit boîtier d'élément chauffant (3) est conique.

3. Bougie à incandescence selon la revendication 1 ou 2, dans laquelle une poche (87) est formée entre le logement creux (92) et la partie de petit diamètre (31).

4. Structure de montage de bougie à incandescence comprenant une bougie à incandescence selon l'une des revendications précédentes, et un trou de montage de bougie à incandescence (81) formé dans un moteur ayant, montée dans celui-ci, ladite bougie à incandescence avec un espacement de 0,25 mm ou plus entre une paroi extérieure de la partie de petit diamètre (31) du boîtier d'élément chauffant (3) de ladite bougie à incandescence et une paroi intérieure dudit trou de montage de bougie à incandescence (81).

FIG. 1

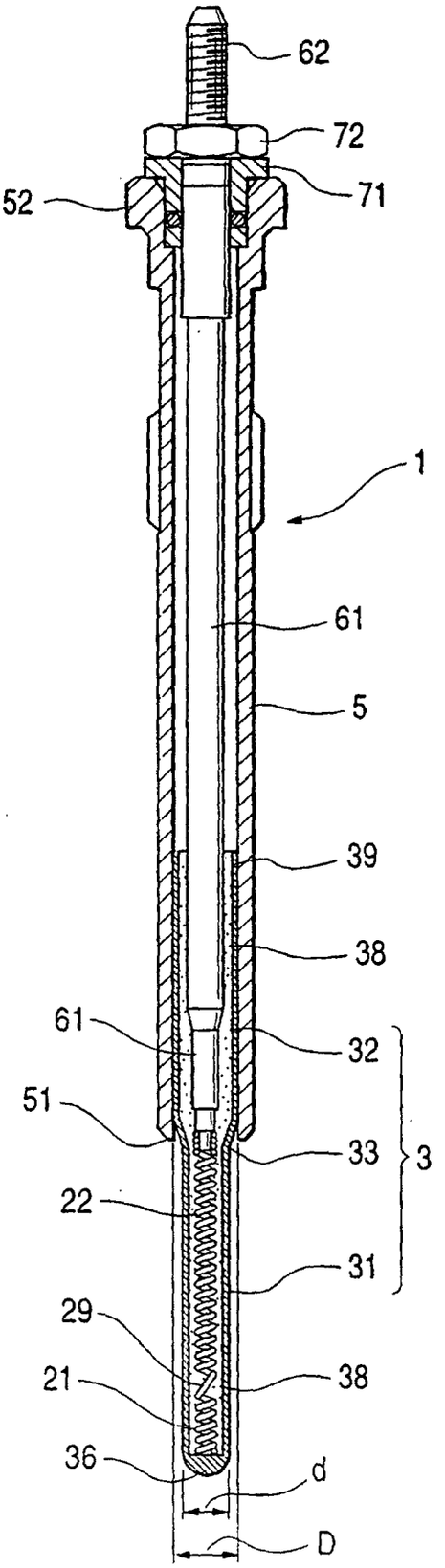


FIG. 2

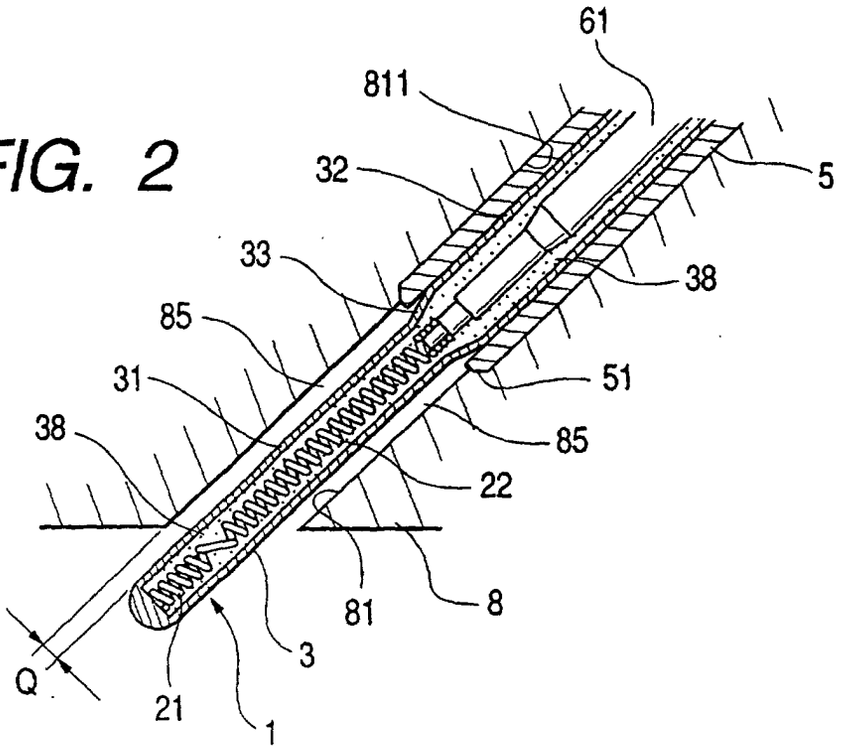

61
811
32
5
33
38
85
31
51
38
85
22
81
8
3
Q
21
1

FIG. 3

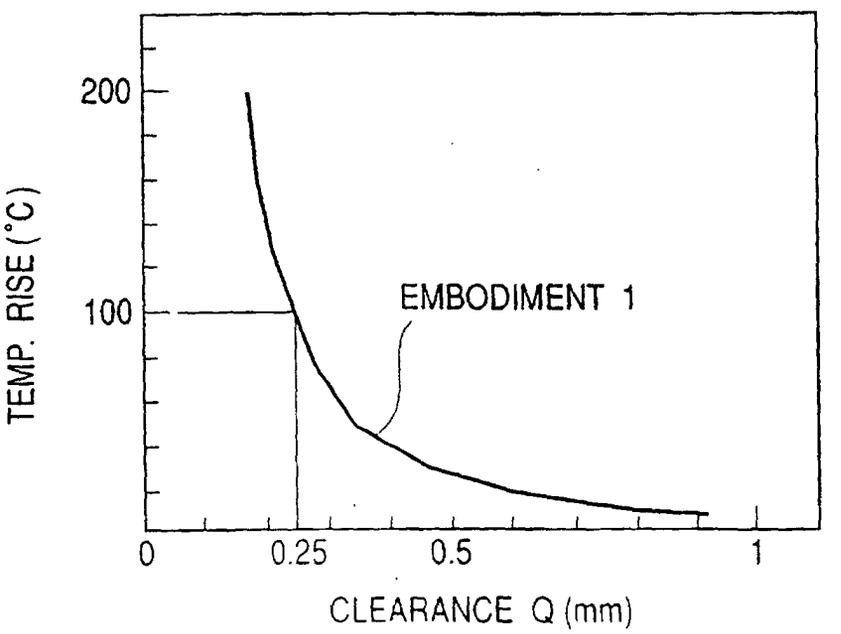

200
100
TEMP. RISE (°C)
EMBODIMENT 1
0
0.25
0.5
1
CLEARANCE Q (mm)

FIG. 4

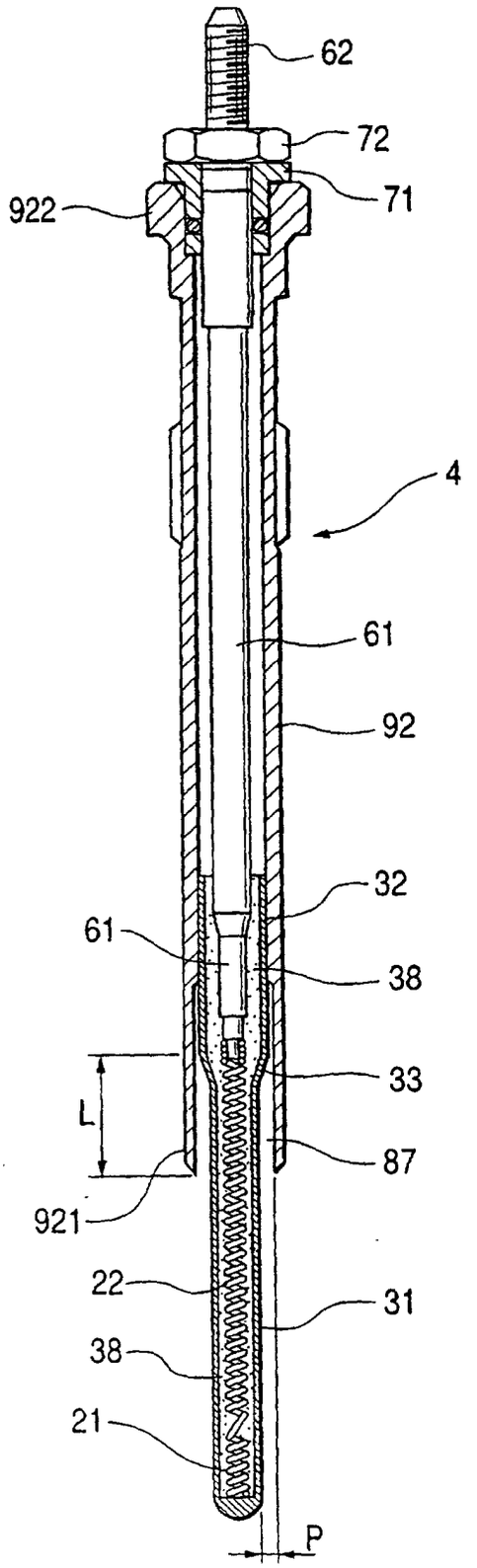


FIG. 5

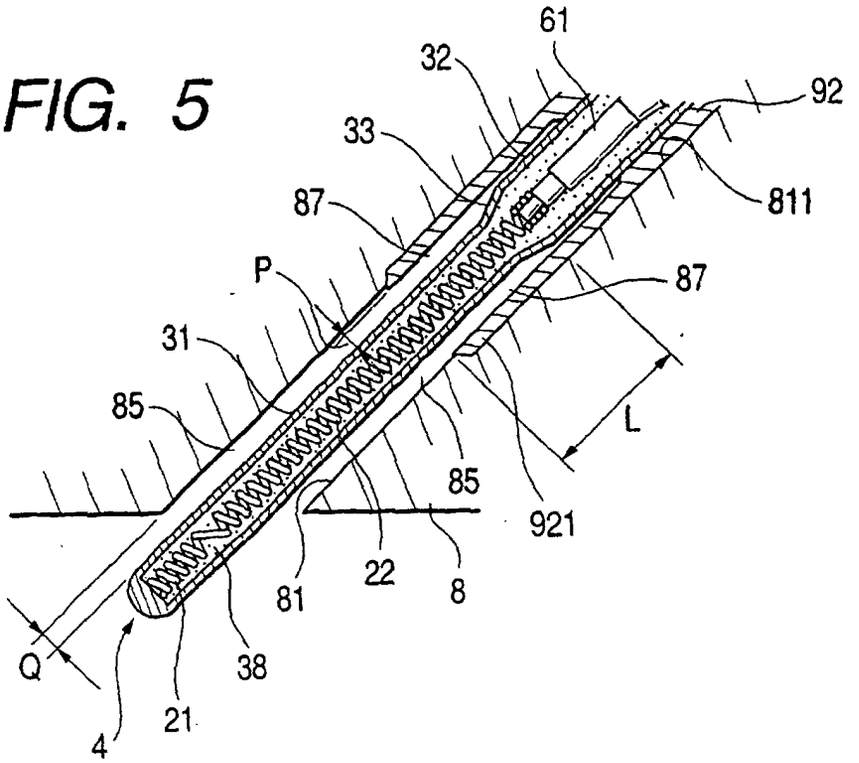
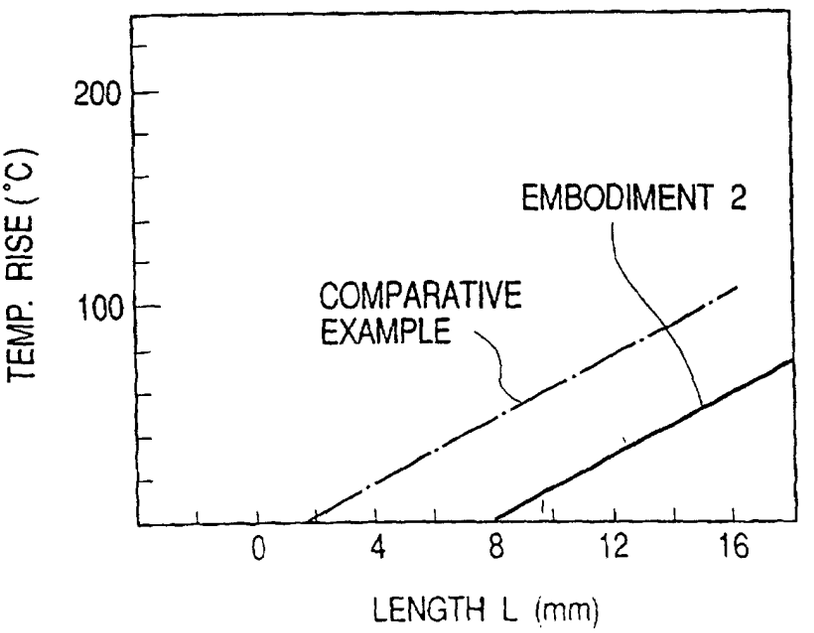

61
32
92
33
811
87
87
P
31
85
L
85
921
22
8
81
38
Q
21
4

FIG. 6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100
TEMP. RISE (°C)
EMBODIMENT 2
COMPARATIVE
EXAMPLE
0
4
8
12
16
LENGTH L (mm)

FIG. 7