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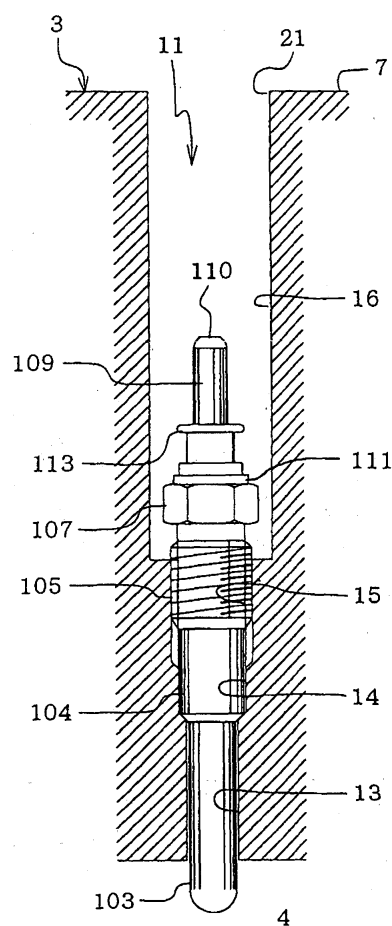
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(54) **Glow plug and structure for mounting the same onto cylinder head including plug cap and cable**

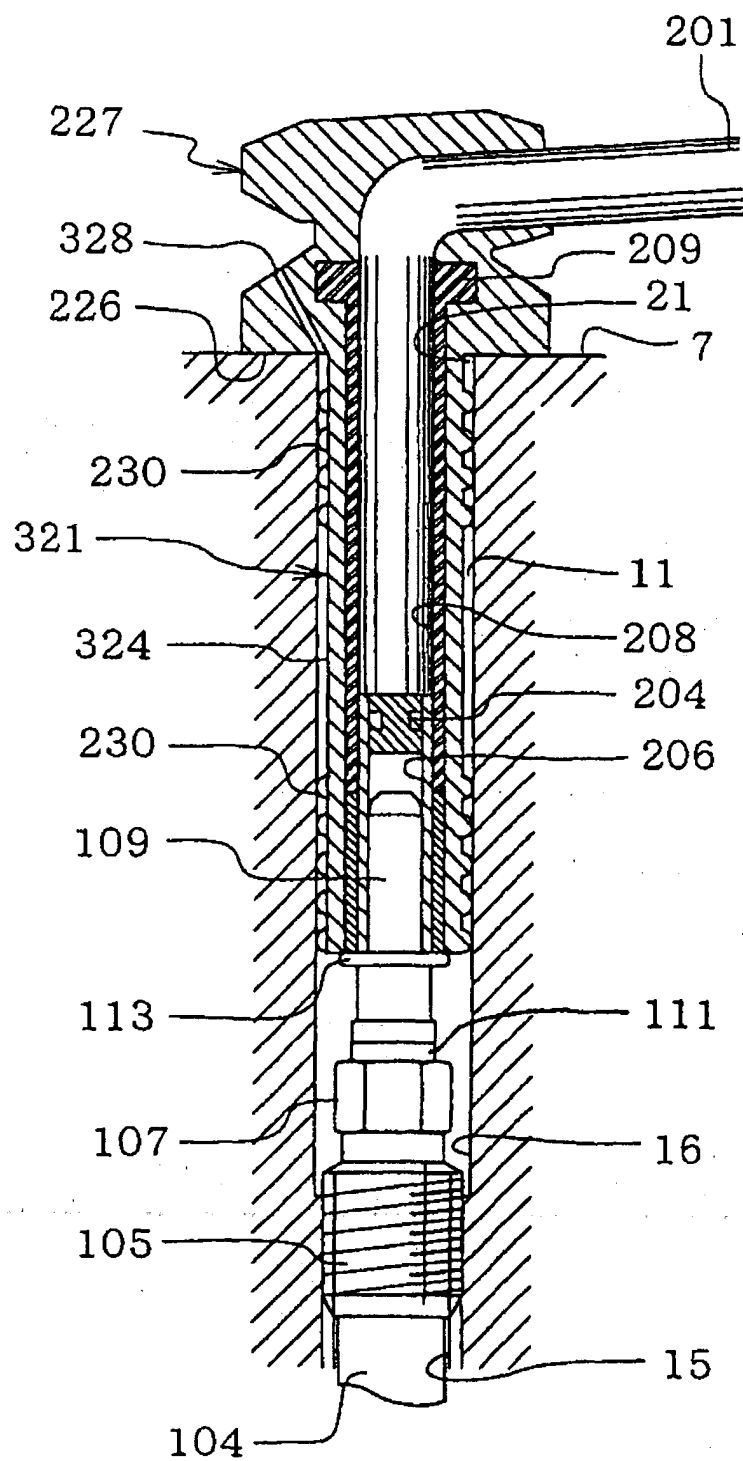
(57) A glow plug is shortened and is standardized to be used for many kinds of the engines. A structure in which a glow plug having: an externally threaded portion 105 for mounting in a glow plug-mounting hole 11 in the engine head, a hexagonal portion for screwing, and an external connection terminal, is mounted in an internally threaded portion 15 in the mounting hole 11, wherein the external connection terminal is a pin terminal 109 that extends rearward in the axial direction, and the rear end of the pin terminal 109 is positioned within the hole 11. This makes connection with a wiring cord with a socket terminal simple, with no problems. The overall length of the glow plug can be set irrespective of the distance from the combustion chamber to the outer surface of the engine head, and can be standardized.

FIG.2



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FIG.5



Description

[0001] The present invention generally relates to glow plugs and to mounting of glow plugs. In particular it relates to structures for mounting glow plugs and to wiring cords with socket terminals. More specifically, it relates to a structure for mounting a glow plug, a glow plug, to a wiring cord with a socket terminal used in the mounting structure, to glow plug - engine head assemblies, and to glow plug - engine head - wiring cord assemblies.

[0002] Fig. 10 illustrates a structure in which glow plugs 101 are mounted on a cylinder head 3 of a diesel engine of the direct injection type. In Fig. 10, the glow plug 101 is electrically connected through an internal wiring or the like from a heat-generating portion 103 at one end (lower end in the drawing) toward the rear (upper end in the drawing) in the axial direction to an external connection terminal (threaded terminal) 119, and the other electrode of the heat-generating member is electrically/mechanically connected to the glow plug body 102. By flowing a current into the heat-generating member and into the main body 102 from the external connection terminal 119, heat is generated by the heat-generating body and the combustion chamber 4 of the diesel engine is pre-heated to promote the start (ignition, combustion) of the engine (see, for example, patent reference JP-A-2001-123930).

[0003] The glow plug 101 is provided for each of the cylinders of the engine. A glow plug-mounting hole (hereinafter also simply referred to as hole) 11 in which the glow plug is mounted in the engine head 3 is formed as described below in the structure of Fig. 10. Specifically, to meet the shape and size of the glow plug 101, the hole 11 includes a cavity 13 of a small diameter at the portion close to the combustion chamber 4, a cavity 14 of a slightly larger diameter on the rear side thereof (upper side in the drawing), and an internally threaded portion 15 in the cavity 14 of the large diameter on the side close to the front surface 7 of the engine head 3. The glow plug 101 is inserted in each hole 11 in the engine head 3 in a manner that the heat-generating portion 103 at the end thereof protrudes into the combustion chamber 4. A screw turning portion (hexagonal portion) 107 is turned to screw the externally threaded portion 105 into the internally threaded portion 15 in the hole 11.

[0004] In the conventional structure for mounting the glow plug 101 as described above, the screw turning portion (e.g., hexagonal portion) 107 of the glow plug and the threaded terminal forming the rear external connection terminal 119 are protruding outward on the side opposite to the combustion chamber of the engine (protruding outward beyond the surface 7 of the cylinder head 3). This is because a terminal plate (metal plate) 50 has heretofore been connected and fastened by nut 51 to each threaded terminal 119 of the glow plug 101 mounted for each of the cylinders, and the current is simultaneously supplied through the wiring cord 53 connected to the terminal plate 50 to simultaneously heat

the heat-generating members of the glow plugs 101.

[0005] In the above conventional structure for mounting the glow plugs, the external connection terminals (threaded terminals) 119 of the glow plugs 101 are connected together through the terminal plate 50. Therefore, at least the external connection terminals 119 are protruding out of the holes beyond the engine head 3. Therefore, the glow plugs used for the above mounting structure inevitably become long, and are produced requiring increased costs.

[0006] Besides, the glow plugs are used by the engines of very many kinds and of very many sizes. Therefore, the glow plugs are designed having a variety of overall lengths to suit them. With the conventional structures for mounting the glow plugs as described above, the overall lengths of the glow plugs tend to be lengthened, and cannot be made uniform or used in common.

[0007] In the above structure for mounting glow plugs, further, the external connection terminals are protruding beyond the engine head, and there is a terminal plate for connecting them together. Therefore, the structure or appearance on the surface of the engine head becomes complex. Therefore, space around the surface thereof is not effectively utilized, impairing the degree of freedom for designing the surrounding of the engine head.

[0008] The present invention intends to overcome at least some of the above problems. The object is solved by the structure for mounting a glow plug according to independent claim 1, by a glow plug according to independent claim 8, by a wiring cord with a socket terminal according to independent claims 12 and 13, by a glow plug and engine head assembly according to independent claim 15 and by a glow plug, engine head and wiring cord assembly according to independent claim 16.

[0009] Further advantages, features, aspects and details of the invention are evident from the dependent claims, the description and the drawings.

[0010] This invention as accomplished in view of various problems in the structure for mounting the glow plugs, and its object is as described below. Namely, from the standpoint of the glow plug, the overall length is shortened compared to that of the glow plugs used in the conventional glow plug-mounting structure having the glow plug-mounting hole of the same length, to accomplish the standardization and to decrease the number of kinds needed, enabling the glow plugs of a single kind to be used for many kinds of engines to decrease the cost. From the standpoint of the engine as a whole, external connection terminals of glow plugs do not protrude beyond the surface of the engine head, enabling the surface structure to be simplified, saving space or enabling space to be effectively utilized.

[0011] In order to solve the above problems, the invention described in claim 1 deals with a structure for mounting a glow plug in which a glow plug having:

an externally threaded portion for mounting in a

glow plug-mounting hole in the engine head, a turn portion for screwing said externally threaded portion, and an

external connection terminal in this order starting from the heat-generating portion, at the end that generates heat when current is applied, and progressing toward the rear end of the glow plug, is mounted in an internally threaded portion in the glow plug-mounting hole in said engine head by screwing said externally threaded portion; wherein said external connection terminal is a pin terminal that extends rearward in the axial direction, and when said glow plug is mounted, the rear end of said pin terminal enters said glow plug-mounting hole.

[0012] Unlike the prior art, the above glow plug-mounting structure does not permit the rear end of the glow plug to protrude beyond the outer surface (outward) of the engine head when the rear end of the glow plug is mounted on the engine head. Since the external connection terminal is a pin terminal, problems related to the connection of wiring are eliminated by using a wiring cord having a socket terminal. Therefore, the overall length of the glow plug can be set irrespective of the distance from the combustion chamber to the outer surface of the engine head. Therefore, the overall length of the glow plug need not be changed for each of the engines, and the glow plug of a single kind can be used in common for different kinds of engines. Further, since there is no protrusion on the outer surface of the engine head, space on the outer surface can be simplified.

[0013] The invention described in claim 2 is related to a structure for mounting a glow plug according to claim 1, wherein:

a wiring cord with a socket terminal is electrically connected to said pin terminal by inserting the pin terminal in the socket terminal;
said wiring cord has, on the outer peripheral surface thereof, a closing member at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole; and
at least a portion of said closing member is forcibly inserted in said glow plug-mounting hole in which said socket terminal has been inserted in said pin terminal.

[0014] When the electric connection is accomplished by inserting the pin terminal in the socket terminal of the wiring cord, the closing member is forcibly inserted in the glow plug-mounting hole. Therefore, water and oil are prevented from infiltrating into the hole, and the wiring cord is prevented from being separated from the pin terminal.

[0015] In the above mounting structure, the screw turning portion of the glow plug is usually formed in a polygonal shape such as square shape or hexagonal

shape. It is here desired that the contour as viewed from the axial direction of the glow plug closer to the axis (the center line of the axis) than the outer contour line of the externally threaded portion, and that the longest diagonal line linking points on the screw turning portion contour line is smaller than the diameter of the screw. If such is the case, the inner diameter of the portion of the hole close to the rear open end to the rear of the internally threaded portion of the glow plug-mounting hole can be decreased to be close to the outer diameter of the externally threaded portion, making it possible to decrease the diameter of the hole. In other words, upon decreasing the diameter of the screw turning portion (diagonal length), the diameter of the glow plug-mounting hole can be decreased and, as a result, the position of formation thereof can be selected with a high degree of freedom. It is desired that the portion at the open end at the rear of the internally threaded portion in the glow plug-mounting hole is a straight hole. However, the portion at the open end may be a stepped cavity of a large diameter or a tapered cavity of a large diameter.

[0016] The invention described in claim 3 is related to a structure for mounting a glow plug according to claim 1, wherein:

a wiring cord with a socket terminal is electrically connected to said pin terminal by inserting the pin terminal in the socket terminal;
said wiring cord has, on the outer peripheral surface thereof, a straight tubular insulating layer made of a thermosetting resin, and at least part of the straight tubular insulating layer is provided with a closing member at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole; and
at least a portion of said closing member is forcibly inserted in said glow plug-mounting hole where said pin terminal is inserted in said socket terminal.

[0017] The invention described in claim 4 is related to a structure for mounting a glow plug according to claim 2 or 3, wherein said elastic member is a rubber.

[0018] The invention described in claim 5 is related to a structure for mounting a glow plug according to any one of claims 2 to 4, wherein said closing member has a flange that engages with the edge of the open end of said glow plug-mounting hole, and said flange covers said edge of the open end.

[0019] The invention described in claim 6 is related to a structure for mounting a glow plug according to claim 5, wherein said closing member slides in the axial direction of said wiring cord.

[0020] The invention described in claim 7 is related to a structure for mounting a glow plug according to any one of claims 2 to 6, wherein said closure member has a communication hole that maintains communication between the external space and the space on the side of the closing member facing toward the combustion

chamber when said closing member is forcibly inserted in said glow plug-mounting hole through said open end.

[0021] The invention described in claim 8 is related to a glow plug mounted by being screwed into an internally threaded portion in the glow plug-mounting hole in the engine head, and having an externally threaded portion for screwing into said internally threaded portion, a turn portion for screwing said externally threaded portion and an external connection terminal arranged in this order starting from the heat-generating portion at the end that generates heat when current is applied, progressing toward the rear end thereof; wherein

the whole of said screw turning portion is formed so as to be present inside the contour line of said externally threaded portion as viewed from the axial direction of thread of said externally threaded portion, and the whole of the portion to the rear of said screw turning portion including said external connection terminal is formed so as to be inside the contour line of said screw turning portion as viewed from said axial direction.

[0022] The invention described in claim 9 is related to a glow plug according to claim 8, wherein said screw turning portion is formed in a polygonal shape as viewed from the axial direction of thread of said externally threaded portion.

[0023] The invention described in claim 10 is related to a glow plug according to claim 8 or 9, wherein said external connection terminal is a pin terminal.

[0024] The invention described in claim 11 is related to a glow plug according to any one of claims 8 to 10, wherein the axes of said heat-generating portion, said screw turning portion and said external connection terminal are brought into near agreement with the axis of thread of said externally threaded portion.

[0025] The invention described in claim 12 is related to a wiring cord with a socket terminal for connection via the socket to a pin terminal of a glow plug which is the external connection terminal at the rear end of the glow plug extending rearward in the axial direction, in a state where the rear end of said pin terminal enters within a glow plug-mounting hole, wherein said wiring cord has, on the outer peripheral surface thereof, a closing member which is forcibly inserted in said glow plug-mounting hole through said open end, at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole.

[0026] The invention described in claim 13 is related to a wiring cord with a socket terminal for connection via the socket to a pin terminal of a glow plug which is the external connection terminal at the rear end of the glow plug extending rearward in the axial direction, in a state where the rear end of said pin terminal enters within a glow plug-mounting hole, wherein said wiring cord has, on the outer peripheral surface thereof, a straight tubular insulating layer made of a thermosetting resin and at least part of the straight tubular insulating layer is provided with a closing member at least the outer peripheral surface of which is made of an elastic member for sub-

stantially closing said glow plug-mounting hole.

[0027] The invention described in claim 14 is related to a wiring cord with a socket terminal according to claim 12 or 13, wherein said elastic member is rubber.

[0028] In the inventions described in claims 1 to 7 as described above, the external connection terminal at the rear end of the glow plug is a pin terminal which does not protrude outside the engine head. Therefore, there is no problem concerning the connection of the wiring cord, and the overall length of the glow plug can be shortened. Namely, unlike the conventional structure of the glow plug in which the external connection terminal protrudes beyond the surface of the cylinder head, the overall length of the glow plug is not affected by the distance from the combustion chamber to the surface of the cylinder head of the engine. Therefore, the overall length can be shortened, and the shortened size can be standardized (used in common). Accordingly, short glow plugs of a single kind can be used for many kinds of engines making it possible to greatly reduce the cost.

[0029] As for the engine as a whole, no external connection terminal of glow plug protrudes beyond the surface of the cylinder head and no terminal plate is used, either, making it possible to simplify the structure on the surface and save space which can be effectively utilized. As a result, the surroundings of the engine head can be designed more freely (with increased margin).

[0030] In the case where the glow plug-mounting structure by using the glow plugs of the invention described in claims 8 to 11 is realized, the inner diameter of the glow plug-mounting hole of the engine head need only be increased to be slightly greater than the diameter of the externally threaded portion. By doing this, the inner diameter of the portion at the open end at the rear of the internally threaded portion of the glow plug-mounting hole can be decreased to be close to the outer diameter of the externally threaded portion, contributing to decreasing the diameter of the hole and, as a result, to increasing the degree of freedom for selecting the position where holes are formed.

[0031] In the mounting structure of the invention described in claims 12 to 14, the socket terminal of the cord inserted in the open end of the hole is connected to the pin terminal of the glow plug, and the closing member around the socket terminal is forcibly inserted in the hole. As the opening is closed, therefore, the wiring cord is held in the hole, and the electric reliability is not spoiled.

[0032] The invention is also applicable for methods by which the described apparatus operates. It includes method steps for carrying out every function of the apparatus or manufacturing every part of the apparatus. The invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a sectional view illustrating a glow plug-

mounting structure according to the invention.

Fig. 2 is a sectional view illustrating the glow plug-mounting structure according to a first embodiment of the invention.

Fig. 3 is a view of the mounted wiring cord in Fig. 2.

Fig. 4 is a view illustrating, on an enlarged scale, a major portion of Fig. 3.

Fig. 5 is a sectional view illustrating the glow plug-mounting structure according to a second embodiment of the invention.

Fig. 6 is an enlarged view of the glow plug from the rear end prior to mounting the wiring cord in Fig. 5.

Fig. 7 is a view illustrating a modified example in which the screw turning portion of Fig. 6 is formed in a different polygonal shape.

Fig. 8 is a sectional view illustrating the glow plug-mounting structure according to a third embodiment of the invention.

Fig. 9 is a sectional view illustrating the glow plug-mounting structure according to a fourth embodiment of the invention.

Fig. 10 is a sectional view illustrating a conventional glow plug-mounting structure.

[0033] A first embodiment which is the best mode for carrying out the invention will now be described in detail with reference to Figs. 1 to 4.

[0034] In Fig. 1, reference numeral 1 denotes a cylinder block of a diesel engine. A glow plug-mounting hole 11 is formed penetrating through a suitable portion of an upper cylinder head 3 from the outer side toward a combustion chamber 4, or is formed aslant in this embodiment. In the hole 11 as shown in Fig. 2, the end of the glow plug 101 where there is a heat-generating portion 103 is mounted so as to be protruded into the combustion chamber 4. The hole 11 is constituted as described below.

[0035] Namely, as shown in Fig. 1, the hole 11 in this embodiment has a cavity 13 whose small-diameter allows the the heat-generating portion 103 of the glow plug 101 to be inserted, and a cavity 14 for positioning which allows a heat-generating portion holding portion 104 for holding the heat-generating portion 103 to be inserted. To the rear of the cavity 14 for positioning, an internally threaded portion 15 is formed into which will be screwed the externally threaded portion 105 of the glow plug 101. To the rear of that, further, there is formed a cavity 16 of a diameter larger than those screw threads. These cavities are formed to have circular sections which are concentric and have predetermined diameters. As will be described later, this cavity 16 is the one into which will be forcibly inserted the closing member that is provided for the wiring cord. On a boundary portion between the cavity 13 for the heat-generating portion and the cavity 14 for positioning, there is formed a tapered circular seat surface 18 having a circular shape as viewed from the axial direction of the hole.

[0036] Into the hole 11 the glow plug 101 is mounted

by being inserted and screwed therein. As described earlier, the glow plug 101 includes the heat-generating portion holding portion 104 for holding the heat-generating portion and having a diameter larger than the heat-generating portion 103, an internally threaded portion 105 of a diameter larger than the heat-generating portion holding portion 104, a hexagonal portion 107 forming the screw turning portion, and a shaft-like pin terminal 109 forming an external connection terminal, which are successively formed concentrically starting from the shaft-like heat-generating portion 103 at one end of the glow plug and progressing toward the rear end thereof. In this embodiment, portions from the heat-generating portion holding portion 104 up to the hexagonal portion 107 are formed on the main glow plug body 102 made of a single metal cylinder. A concentric cylindrical shape is assumed from the heat-generating portion 103 up to the externally threaded portion 105. The outer diameter of the heat-generating portion 103 is slightly smaller than the inner diameter of the heat-generating unit cavity 13 of the hole 11, and the outer diameter of the heat-generating portion holding portion 104 is slightly smaller than the inner diameter of the positioning cavity 14. The externally threaded portion 105 serves as a screw to be screwed into the internally threaded portion 15 in the glow plug-mounting hole 11. When screwed therein, the front end of the heat-generating portion holding portion (cylindrical portion) 104 is pushed onto the circular seat surface 18 to accomplish the positioning and to maintain the sealing between the combustion chamber 4 and the external unit.

[0037] In this embodiment, when viewed from the axial direction, the hexagonal portion 107 forming the screw turning portion of the glow plug 101 is the portion of the glow plug with the maximum cross section size. Here, however, the diagonal length is set to be smaller than the inner diameter of the cavity 16 which has a large diameter (also referred to as forcible-insertion cavity 16) and extends forward from the open end 21 of the hole 11. The pin terminal 109 extending rearward in the axial direction to the rear of the hexagonal portion 107 maintains electric insulation from the glow plug body 102 through an insulating member 111. The outer periphery at the end of the pin terminal 109 is chamfered, a circular flange 113 is formed on the peripheral surface of the pin terminal 109 base, protruding outward in the radial direction, and the wiring cord with socket terminal that will be described later is inserted at its socket terminal so as to serve as a stopper when connected.

[0038] The heat-generating portion 103 at the end of the glow plug 101 is inserted through the open end 21 of the hole 11, faced into the cavity 13, and the hexagonal portion 107 is turned such that the externally threaded portion 105 is screwed into the internally threaded portion 15 in the hole 11. The glow plug is thus mounted to establish a mounting structure shown in Fig. 2.

[0039] The glow plug 101 having such a mounting

structure is basically the same as that of the conventional one except that the external connection terminal is a pin terminal 109. However, the glow plug 101 of this embodiment has an overall length which is much shorter than that of the prior art. To meet the glow plug 101, the internally threaded portion 15 for mounting into which the externally threaded portion 105 will be screwed, is formed in the deep portion of the hole 11. As shown in Fig. 2, therefore, when the externally threaded portion 105 is screwed into the internally threaded portion 15 in the glow plug-mounting hole 11 of the engine 3, the hexagonal portion 107 of the glow plug 101 is positioned to the deeper part of the forcible-insertion cavity 16 in the hole 11. In the thus mounted state, the rear end 110 of the pin terminal 109 is positioned within the hole deeper than the open end 21 of the glow plug-mounting hole 11 on the surface 7 of the engine head 3. The pin terminal 109 is connected to one (not shown) electrode of the heat-generating portion 103, and the other electrode of the heat-generating member is connected to the heat-generating portion holding portion 104. By flowing a current from the pin terminal 109 to the heat-generating member, and to the externally threaded portion 105 through the heat generating member holding portion 104, heat is generated by the heat-generating portion 103 at the end of the glow plug to promote the ignition of fuel.

[0040] Fig. 3 illustrates a structure for mounting the glow plug 101, wherein a wiring cord 201 with a socket terminal (connector) is connected to the pin terminal 109 by inserting the socket terminal, for each of the cylinders. Here, the wiring cord 201 with socket terminal in this embodiment is constituted as described below. Specifically, the wiring cord 201 has a cylindrical metal socket terminal 206 into which the pin terminal 109 can be forcibly inserted, the socket terminal 206 having nearly the same diameter as the outer peripheral surface (insulating coating material) of the cord and secured by, for example, caulking to a fixing metal 204 secured to the core wire (not shown) at the end of the cord. The socket terminal 206 is made of a metal, has a cylindrical shape, and is so formed that a pin terminal 109 can be inserted therein when force is applied, due to the metal's resiliency. A straight tubular insulating layer (thermosetting resin tube) 208 made of a thermosetting resin (phenolic resin or polyester resin) covers the outer peripheral surface of the portion of the cord close to its end that has the socket terminal 206. Here, the straight tubular insulating layer 208 has a flange 209 at its upper end. Thus, the wiring cord 201 itself can be easily bent and deformed. The portion where the straight tubular insulating layer 208 is formed has rigidity and so will not be easily bent and deformed, and is substantially straight. In a state where the socket terminal 206 is connected to the pin terminal 109 in this embodiment, a portion including the straight tubular insulating layer 208 is positioned in the glow plug-mounting hole 11. In this embodiment, a short metal pipe 211 is interposed between the

outer peripheral surface of the portion of the socket terminal 206 close to the end and the straight tubular insulating layer 208, thereby to shore up the socket terminal 206 that fastens the pin terminal 109 in the radial direction.

[0041] On the outer peripheral surface of the portion close to the end of the cord including the straight tubular insulating layer 208, there is formed a closing member 221 made of an elastic material which, when the socket terminal 206 is connected to the pin terminal 109, is forcibly inserted from the open end 21 of the glow plug-mounting hole 11 to substantially close the open end 21 (hole 11). Though there is no particular limitation, the elastic material is preferably rubber (synthetic rubber). The closing member 221 in this embodiment is formed in a cylindrical shape which is concentric with the core wire of the cord. In a state where the pin terminal 109 is inserted in the socket terminal 206 of the wiring cord, the closing member 221 is forcibly inserted in the hole 11 to close it. However, the closing member 221 in this embodiment has an intermediate portion 222 that is slightly slimmer, and is thus divided into an upper closing member 224 and a lower closing member 225 so as to come into pressed contact with the inner peripheral surface of the hole 11 at upper and lower portions; namely, the portion close to the end of the socket terminal 206 and the portion including the rear, upper end of the straight tubular insulating layer 208. At the upper part of the upper closing member 224, there is formed an umbrella-like portion 227 protruding outward in the radial direction, the umbrella-like portion 227 having a flange surface 226 that engages with the peripheral edge (surface 7 of the cylinder head 3) of the open end 21. When the closing member 221 is forcibly inserted in the hole 11 and the pin terminal 109 is inserted in the socket terminal 206 to accomplish the connection, the flange surface (lower surface) 226 of the umbrella-like portion 227 is engaged with the peripheral edge of the open end 21 to close the open end 21.

[0042] In this embodiment, the closing member 221 is molded in a manner such that the wiring cord is inserted in the umbrella-like portion 227 being folded substantially at a right angle. Further, communication holes of a small diameter (also called air vents) 228 and 229 are formed in the upper closing member 224 and in the lower closing member 225 so as to maintain communication between the space deep in the hole and the exterior while they are forcibly inserted in the hole 11 (forcible-insertion cavity 16). Therefore, the air in space that is heated and expanded while the engine is in operation is released to the external side, and the closing member 221 is prevented from being removed. Further, a plurality of steps of ring-like lips 230 are integrally formed with the outer peripheral surfaces of the upper closing member 224 and the lower closing member 225, and the forcible insertion is accomplished as the lips 230 are in pressure contact with the inner peripheral surface of the hole 11. Upon being forcibly inserted in the hole 11, the

lower closing member 225 plays the role of a guide into the hole, and the center of the socket terminal 206 is positioned substantially at the center of the pin terminal 109.

[0043] In this embodiment, the heat-generating portion 103 end of the glow plug 101 is inserted through the hole 11, and the hexagonal portion 107 is turned by using, for example, a hexagonal wrench for deep holes to screw the externally threaded portion 105 into the internally threaded portion 15 in the hole 11, so that the glow plug 101 is mounted in the hole 11. In this case, the pin terminal 109 is not protruding beyond the outer surface 7 of the engine head 3 as in the prior art, and the rear end 110 is located away from the open end 21 of the hole 11 on the side of the surface 7 of the engine head 3 opposite to the combustion chamber, closer to the combustion chamber. Namely, in the structure for mounting the glow plug 101 of this embodiment, the external connection terminal of the glow plug 101 is not protruded outward but is the pin terminal 109. Therefore, there is no problem in the connection of the wiring cord, and the overall length can be shortened as compared to that of the glow plug mounted in the conventional mounting structure having the glow plug-mounting hole of the same length. Therefore, the overall length of the glow plug 101 can be shortened irrespective of the kind of the engine. Further, since the rear end of the glow plug 101 is not protruded beyond the outer surface 7 of the engine head 3, space outside the outer surface can be simplified and saved.

[0044] In the mounting structure of the embodiment as described above, the socket terminal 206 of the wiring cord inserted in the open end 21 of the hole 11 is connected to the pin terminal 109 of the glow plug 101 for each of the cylinders. Then, the closing member 221 is forcibly inserted in the hole 11. Therefore, the open end is not simply closed but also the socket terminal 206 connected to the pin terminal 109 is held in the hole 11. Therefore, the wiring cord is prevented from being separated despite of the application of an external force such as oscillation of the engine. The margin for forcibly inserting the closing member 221 may be suitably determined by taking into consideration the ease with which it is pushed during the connection process and the firmness by which the socket terminal 206 is held. In effecting the connection, the lower closing member 225 works as a guide in the hole. Therefore, the portion close to the socket terminal 206 of the cord may be pushed in simply. Further, since the open end 21 is closed with the flange surface 226 of the closing member 221, dust, oil and water are effectively prevented from infiltrating into the hole 11. In the mounting structure of the invention, further, the external connection terminals of a plurality of glow plugs are not wired together through the terminal plate, but the wires are connected to the glow plugs in each of the cylinders. Accordingly, the voltage can be applied to each glow plug, and the troubleshooting of problems (breakage) of the glow

plugs 101 can be done without hindrance.

[0045] The invention is not limited to the above embodiment only but can be embodied in a variety of ways without departing from the gist and scope of the invention. A second embodiment will now be described with reference to Figs. 5 and 6. This embodiment is not essentially different from the above embodiment and is the one whose structure is simplified. Therefore, the same portions are denoted by the same reference numerals, and different points only are described.

[0046] In this embodiment, the diagonal size T1 of the polygonal portion (hexagonal portion 107) which is an externally threaded portion 105 turn portion of the glow plug 101 is larger than the outer diameter D9 of the pin terminal 109 and larger than the outer diameter D13 of the flange 113 at the base end portion, but is smaller than the thread diameter of the externally threaded portion 105. That is, referring to Fig. 6 viewing the glow plug 101 from the rear end side thereof, the hexagonal portion 107 as a whole is so formed as to exist on the inside of the contour line of the externally threaded portion 105 (on the side of the axis of the screw). Besides, the whole portion at the back of the hexagonal portion 107 that includes the pin terminal 109 which is the external connection terminal, is formed to be on the inside of the contour line of the hexagonal portion 107.

[0047] In this embodiment, the inner diameter of the cavity 16 in which the closing member 321 is forcibly inserted need only be slightly larger than the screw diameter of the externally threaded portion 105, and, in this embodiment, may be smaller than the inner diameter of the forcible-insertion cavity 16 of the previous embodiment. Namely, in this embodiment, the inner diameter of the portion close to the open end to the rear of the internally threaded portion 15 in the glow plug-mounting hole 11 can be decreased to be close to the outer diameter of the externally threaded portion 105, making it possible to decrease the diameter of the hole 11 and, as a result, to increase the degree of freedom for selecting the position of formation.

[0048] In this embodiment, the screw turning portion of the externally threaded portion 105 is formed in substantially a hexagonal shape as viewed from the side of the axis. As described earlier, however, this can be formed in any polygonal shape. Fig. 7 illustrates an example modified from Fig. 6. The screw turning portion of the externally threaded portion 105 is formed in a regular polygonal shape 107b comprising angles smaller than two right angles and angles larger than two right angles as viewed from the direction of the axial line as shown in Fig. 7. Referring to Fig. 7, this example is different from that of Fig. 6 with respect to the polygonal portion 107b only. Therefore, the same portions are denoted by the same reference numerals but are not described in detail. Thus, the screw turning portion may be formed in a suitable shape depending upon the shape and kind of the socket of the tool, such as socket wrench, used for screwing the glow plug. The screw turning por-

tion can be set in any polygonal shape as viewed in the direction of the axis not only when it fits inside of the contour line of the externally threaded portion but also when it extends to the outer side thereof.

[0049] On the other hand, the straight tubular insulating layer 208 formed on the outer peripheral surface of the cord has its upper end positioned on the outer side of the open end 21 in a state where the socket terminal 206 is connected to the pin terminal 109. The closing member 321 includes an umbrella-like portion 227 in which is inserted the flange 209 of the upper end of the straight tubular insulating layer 208, and a cylindrical portion 324 formed covering the outer peripheral surface of the straight tubular insulating layer 208 maintaining a substantially predetermined thickness and extending downward from the central portion of the lower surface (flange surface 226) of the umbrella-like portion 227, concentric with the cord. Namely, in this embodiment, the closing member forcibly inserted in the hole 11 is a cylindrical portion 324 having nearly the same diameter which is small. In this embodiment, too, lips 230 same as those of the above-mentioned embodiments are formed in a plurality of states at predetermined positions in the lower portion and in the upper portion on the outer peripheral surface of the closing member 321. The lips 230 are brought into pressure contact with the inner peripheral surface of the hole 11. In this embodiment, too, an air vent 328 is formed. Here, vertical grooves are engraved in the lips 230 on the outer peripheral surface of the closing member 321, and a through hole is formed in the umbrella-like portion 227 so as to be communicated with the grooves.

[0050] In this embodiment, the inner diameter of the forcible-insertion cavity 16 in the hole 11 is decreased by the amount by which the diagonal size of the polygonal portion (hexagonal portion 107) that forms the screw turning portion of the glow plug 101 is decreased, offering an advantage of an increased degree of freedom for selecting the position of forming the hole 11 in the engine head 3.

[0051] Next, a third embodiment will be described with reference to Fig. 8. This embodiment is basically the same as the above first embodiment. Therefore, the same portions are denoted by the same reference numerals, and different points only are described. Namely, in this embodiment, the closing member is divided into upper and lower two portions, i.e., upper closing member 224 and lower closing member 225 separated at an intermediate portion of the straight tubular insulating layer 208.

[0052] In this embodiment, the closing member is divided as described above. Therefore, the closing member can be made of a material having heat resistance; i.e., the closing member 225 deep in the hole 11 where the temperature becomes high can be made of a rubber having a high heat resistance. In this embodiment as shown, the wiring cord is not bent at 90 degrees when inserted in the upper closing member 224. Therefore,

the closing member 221 can have a small size. As compared with the first embodiment, further, the straight tubular insulating layer 208 is thickly formed. This is done so that the end portion of the cord including the socket terminal 206 is held straight by the straight tubular insulating layer 208. In any embodiment, the straight tubular insulating layer need not be employed provided the end portion of the cord including the socket terminal 206 inserted in the hole 11 is not impaired in its connection to the pin terminal thereby.

[0053] Fig. 9 illustrates a fourth embodiment which is an improvement of the above third embodiment, and is basically the same. Therefore, the same portions are denoted by the same reference numerals and different points only will be described. In this embodiment, the straight tubular insulating layer 208 of the above embodiment is further extended outward beyond the outer surface 7 of the cylinder head 3, and the end of the straight tubular insulating layer 208 opens sideways, being bent by 90 degrees. The wiring cord is positioned inside the straight tubular insulating layer 208, and the upper closing member 224 that is separated is permitted to slide relative to the straight tubular insulating layer 208.

[0054] In this embodiment, even when the size S from the position of the pin terminal 109 to the surface 7 of the cylinder head 3 in a state where the glow plug 101 is mounted on the hole 11 is not the same, the flange surface 226 at the lower surface of the umbrella-like portion 227 can be brought into contact with the peripheral edge of the open end 21 by sliding the upper closing member 224 relative to the straight tubular insulating layer 208, to the extent that the upper closing member 224 can be slid. Namely, with the wiring cords with socket terminal used in the above embodiments, the distance from the end surface of the socket terminal 206 to the flange surface 226 on the lower surface of the umbrella-like portion 227 must be varied to match the size (depth of the pin terminal 109) S from the open end 21 of the hole 11 to the pin terminal 109. In this embodiment, however, the same wiring cord can be used over the range in which the upper closing member 224 can be slid. In this embodiment, the closing member is permitted to slide relative to the straight tubular insulating layer. However, the closing member may be provided to directly slide relative to the wiring cord. Here, however, it is desired that the closing member in its free state restrains the movement of the surface of the straight tube insulating layer or the surface of the wiring cord (surface of the covering member) in the radial direction due to its resiliency.

[0055] The above embodiments all use cylindrical pin terminals. However, the invention is in no way limited to the cylindrical pin terminal only, and any pin terminal can be employed provided it has a shape specified under ISO 6550-3:1996(E). In particular, flat terminals specified as B1 and B2 make it possible to further decrease the cost of production.

Claims

1. A structure for mounting a glow plug in which a glow plug having:

an externally threaded portion (105) for mounting in a glow plug-mounting hole (11) in the engine head, a turn portion (107) for screwing said externally threaded portion, and an external connection terminal (109) in this order starting from the heat-generating portion at the end that generates heat when current is applied, and progressing toward the rear end thereof along the axle,

is mounted in an internally threaded portion (15) in the glow plug-mounting hole in said engine head by screwing said externally threaded portion therein; **characterized in that:**

said external connection terminal is a pin terminal (109) that extends rearward in the axial direction, and when said glow plug is mounted, the rear end (110) of said pin terminal enters said glow plug-mounting hole (11).

2. The structure for mounting a glow plug claimed in claim 1, wherein:

a wiring cord (201) with a socket terminal is electrically connected to said pin terminal by inserting the socket terminal therein; said wiring cord has, on the outer peripheral surface thereof, a closing member (221) at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole (11); and at least a portion of said closing member is forcibly inserted in said glow plug-mounting hole in a state where said socket terminal is inserted in said pin terminal (109).

3. The structure for mounting a glow plug claimed in any of claims 1 to 2, wherein:

a wiring cord (201) with a socket terminal is electrically connected to said pin terminal by inserting the socket terminal therein; said wiring cord has, on the outer peripheral surface thereof, a straight tubular insulating layer made of a thermosetting resin and at least part of the straight tubular insulating layer is provided with a closing member (221) at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole; and at least a portion of said closing member is forcibly inserted in said glow plug-mounting hole

(11) in a state where said socket terminal is inserted in said pin terminal (109).

4. The structure for mounting a glow plug claimed in claim 2 or 3, wherein said elastic member is rubber.

5. The structure for mounting a glow plug claimed in any one of claims 2 to 4, wherein said closing member has a flange (226) that engages with the edge of the open end (21) of said glow plug-mounting hole, and said flange covers said edge of the open end.

6. The structure for mounting a glow plug claimed in any of claims 2 to 5, wherein said closing member slides in the axial direction of said wiring cord.

7. The structure for mounting a glow plug claimed in any one of claims 2 to 6, wherein said closure member has a communication hole that maintains communication between the external space and the space on the side of the closing member (221) facing toward the combustion chamber, in the state where said closing member is forcibly inserted in said glow plug-mounting hole (11) through said open end.

8. A glow plug mounted by being screwed into an internally threaded portion in the glow plug-mounting hole in the engine head, and having an externally threaded portion (105) for being screwed into said internally threaded portion (15), a turn portion (107) for screwing said externally threaded portion and an external connection terminal arranged in this order starting from the heat-generating portion (103) at the end that generates heat when current is applied, and progressing toward the rear end thereof; wherein

the whole of said screw turning portion (107) is so formed as to be present inside the contour line of said externally threaded portion as viewed from the axial direction of thread of said externally threaded portion, and the whole of the portion existing to the rear of said screw turning portion including said external connection terminal (109) is so formed as to be present inside the contour line of said screw turning portion as viewed from said axial direction.

9. The glow plug claimed in claim 8, wherein said screw turning portion is formed in a polygonal shape as viewed from the axial direction of thread of said externally threaded portion.

10. The glow plug claimed in claim 8 or 9, wherein said external connection terminal (109) is a pin terminal (109).

11. The glow plug claimed in any one of claims 8 to 10, wherein the axes of said heat-generating portion, said screw turning portion and said external connection terminal are brought into near agreement with the axis of thread of said externally threaded portion (105). 5
12. A wiring cord with a socket terminal for connection via the socket to a pin terminal of a glow plug (101) which is the external connection terminal (109) at the rear end of the glow plug extending rearward in the axial direction, in a state where the rear end of said pin terminal enters within a glow plug-mounting hole (11), wherein said wiring cord has, on the outer peripheral surface thereof, a closing member (221) which is forcibly inserted in said glow plug-mounting hole through said open end (21), at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole. 10 15 20
13. A wiring cord with a socket terminal for connection via the socket to a pin terminal of a glow plug (101) which is the external connection terminal (109) at the rear end of the glow plug extending rearward in the axial direction, in a state where the rear end of said pin terminal enters within a glow plug-mounting hole (11), wherein said wiring cord has, on the outer peripheral surface thereof, a straight tubular insulating layer made of a thermosetting resin and at least part of the straight tubular insulating layer is provided with a closing member (221) at least the outer peripheral surface of which is made of an elastic member for substantially closing said glow plug-mounting hole (11). 25 30 35
14. The wiring cord with a socket terminal claimed in claim 12 or 13, wherein said elastic member is rubber. 40
15. A glow plug and engine head assembly comprising:

a glow plug (101) having a heat-generating portion (103), an externally threaded portion (105), a turn portion (107) for screwing said externally threaded portion, and an external connection terminal (109) composing an rear end of the glow plug; 45

an engine head having a glow plug-mounting hole (11) with an internally threaded portion (15) thereon; 50

wherein the glow plug is mounted in the internally threaded portion in the glow plug-mounting hole in said engine head by screwing said externally threaded portion therein; wherein the rear end (110) of said pin terminal is located in said glow plug-mounting hole (11). 55

16. A glow plug, engine head and wiring cord assembly comprising:

a glow plug having a heat-generating portion (103), an externally threaded portion (105), a turn portion (107) for screwing said externally threaded portion, and an external connection terminal (109) composing an rear end of the glow plug;

an engine head having a glow plug-mounting hole (11) with an internally threaded portion (15) thereon;

an wiring cord (201) having a socket terminal into which the external connection terminal of the glow plug is inserted;

wherein the glow plug is mounted in the internally threaded portion in the glow plug-mounting hole in said engine head by screwing said externally threaded portion therein; wherein the rear end (110) of said pin terminal is located in said glow plug-mounting hole (11);

wherein the socket terminal is connected with the external terminal of the glow plug in said glow plug-mounting hole.

FIG.1

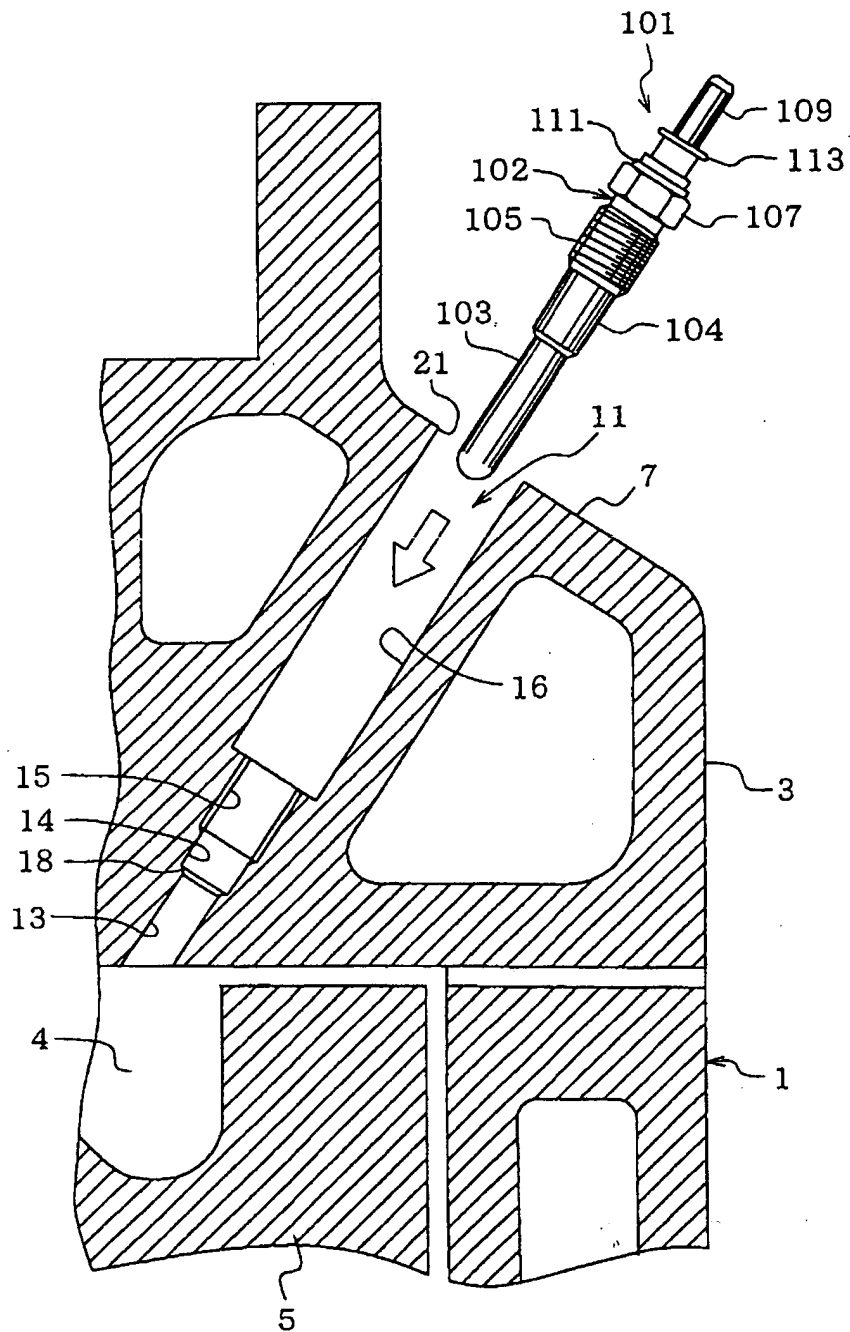


FIG.2

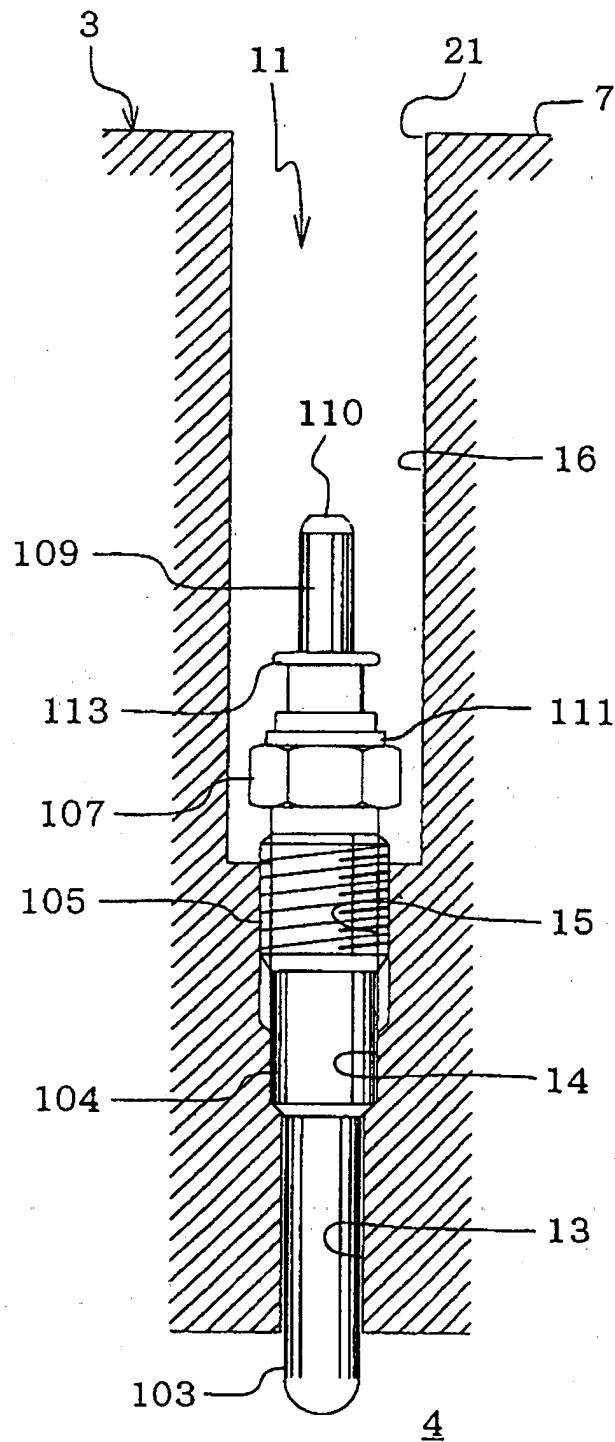


FIG.3

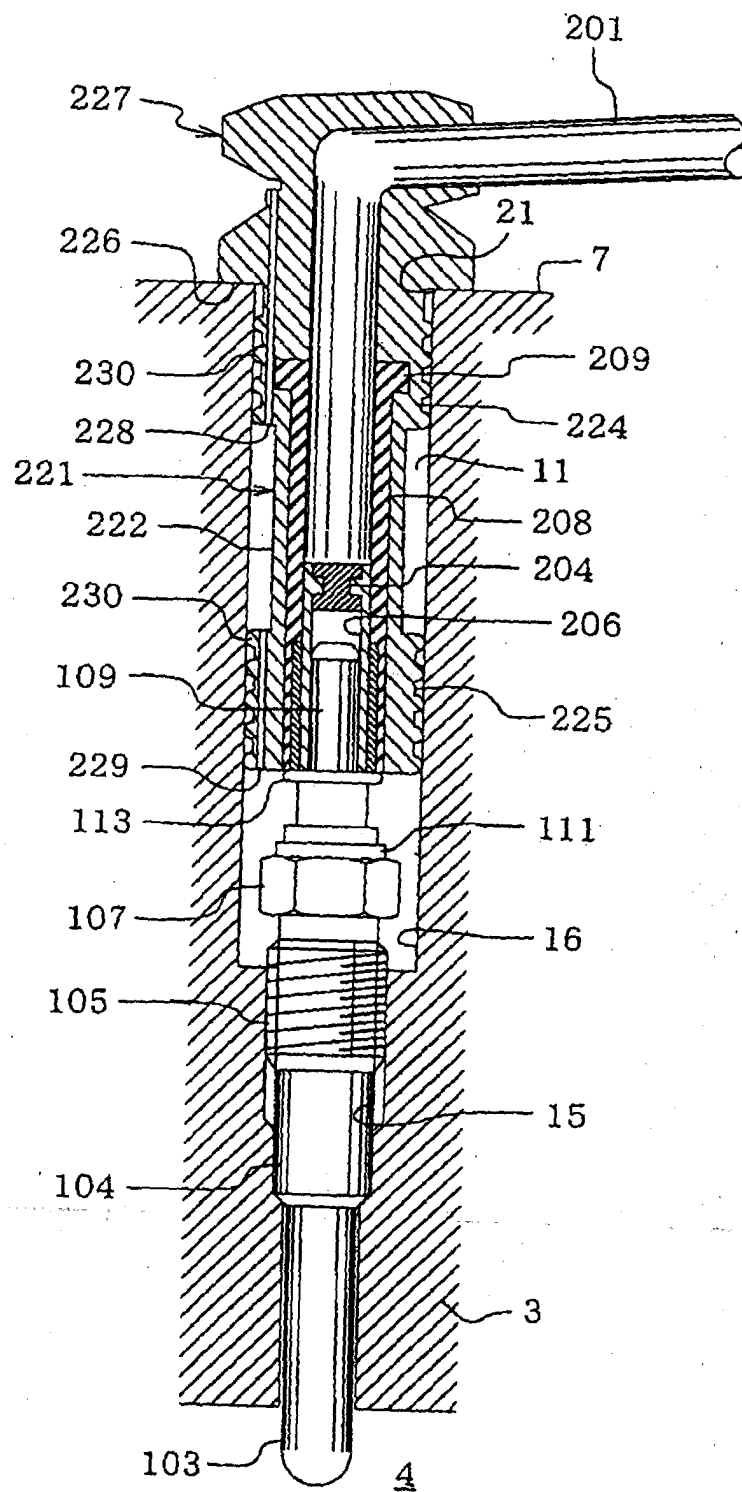


FIG.4

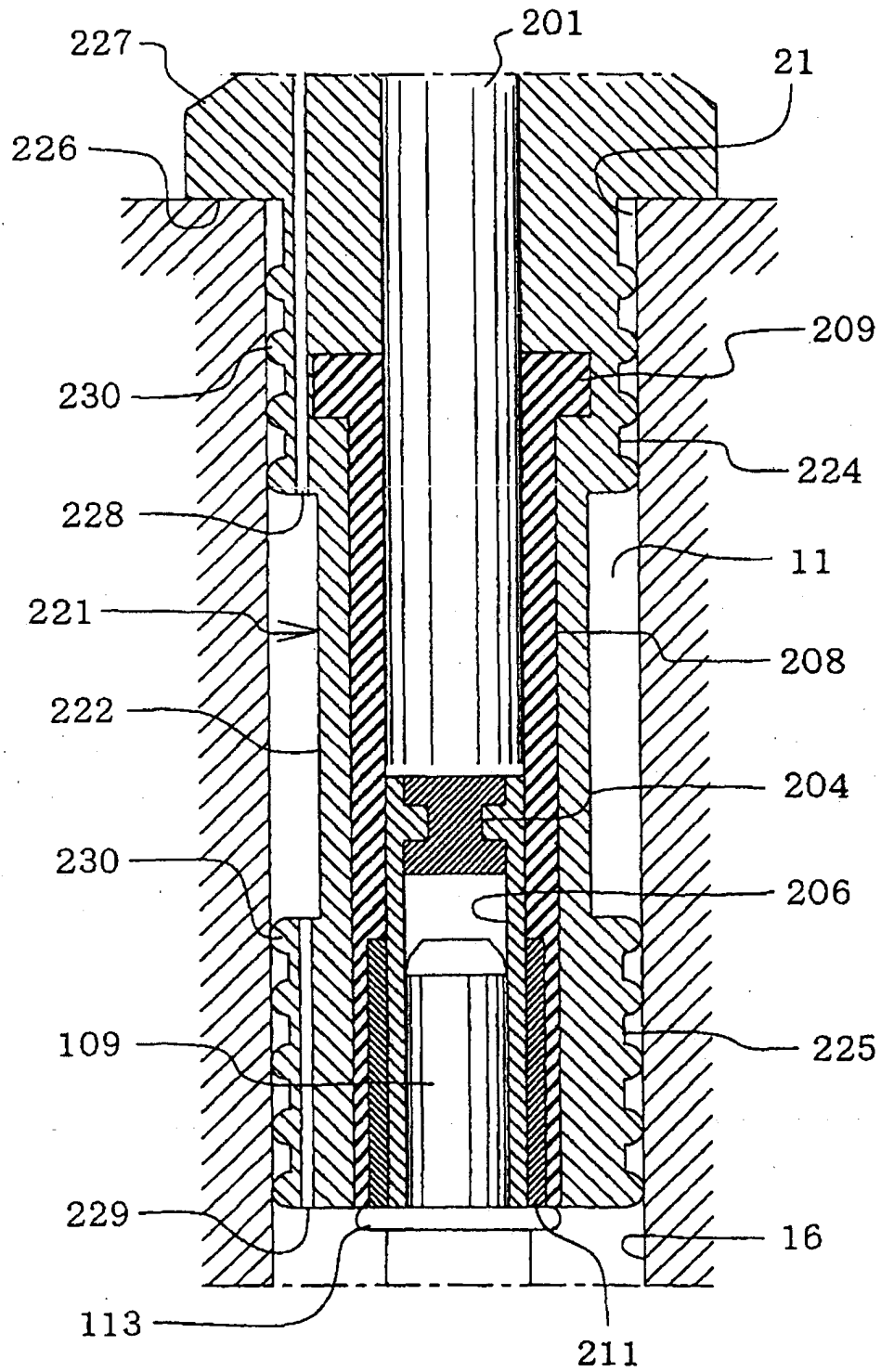


FIG.5

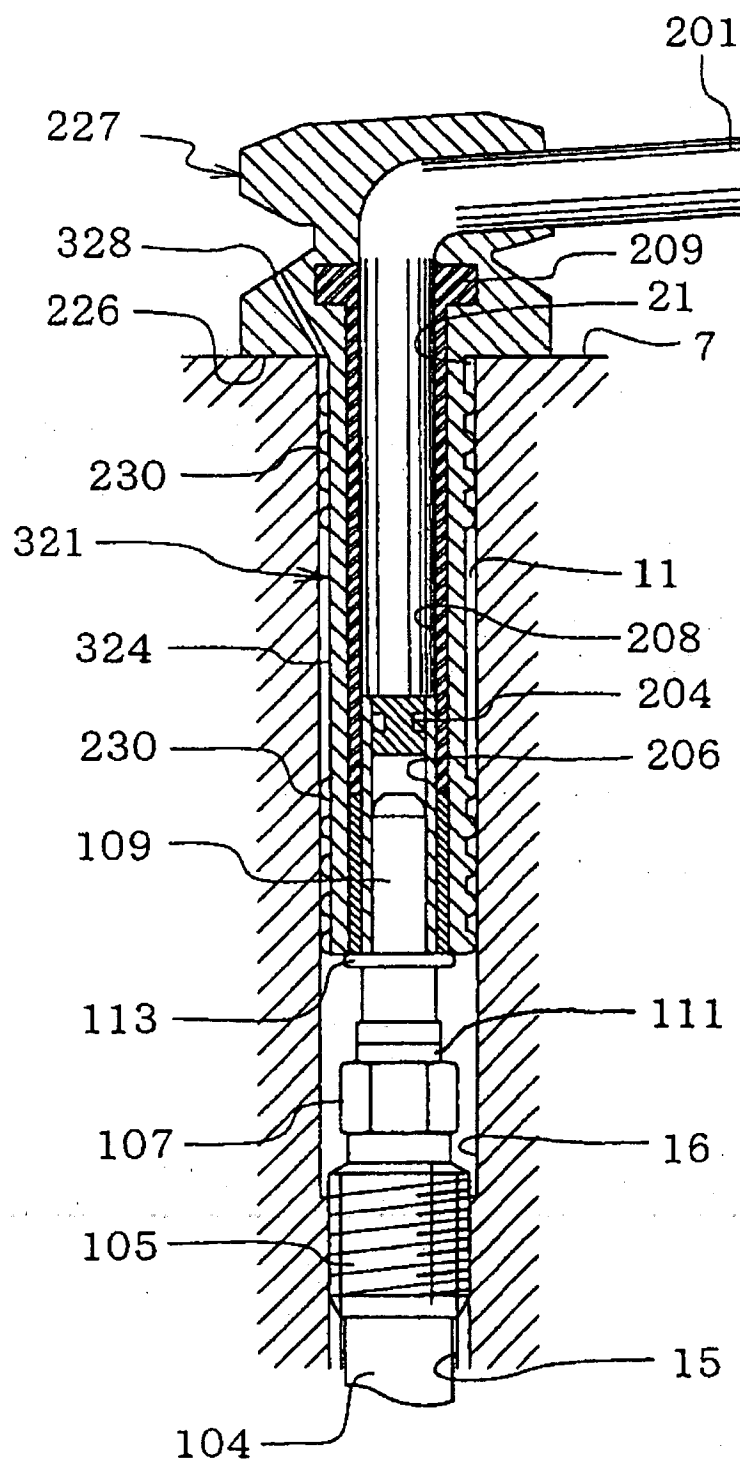


FIG.6

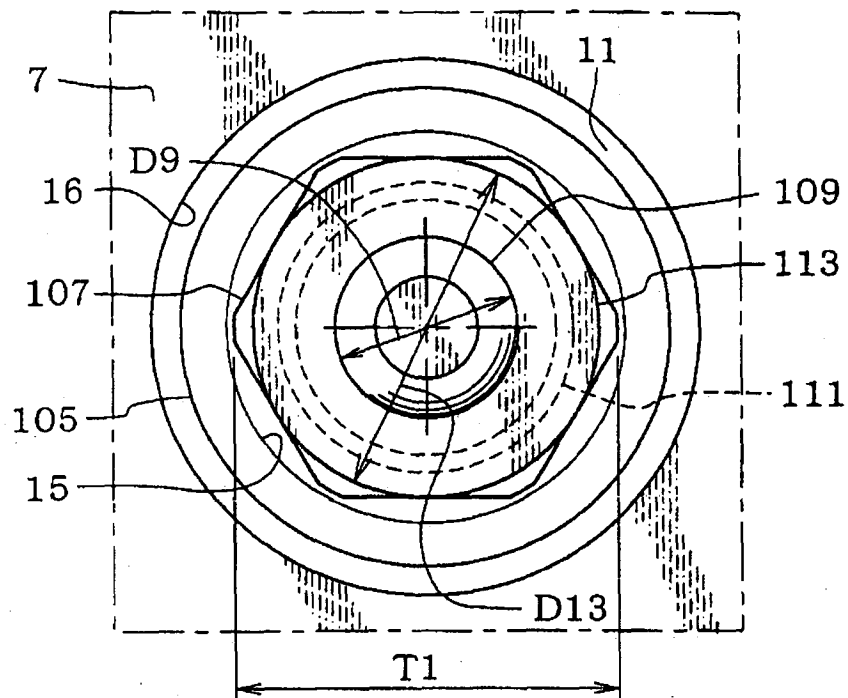


FIG.7

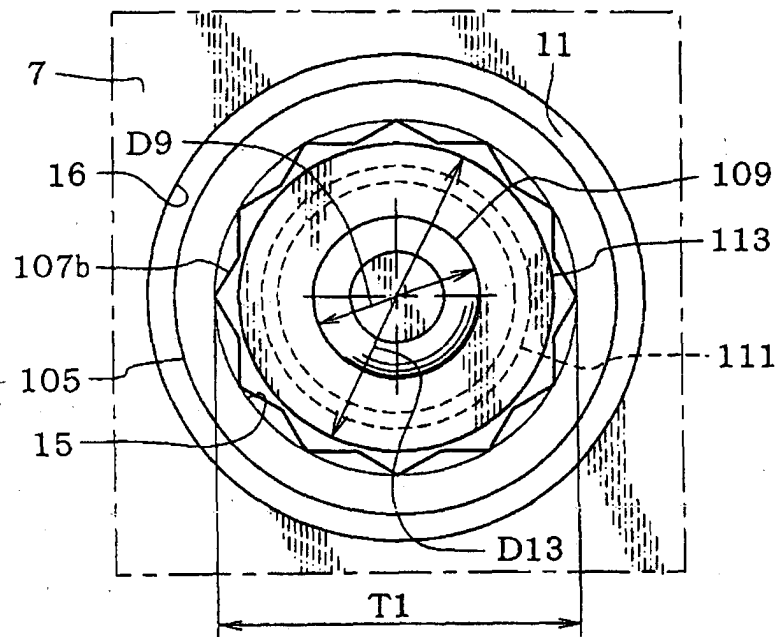


FIG.8

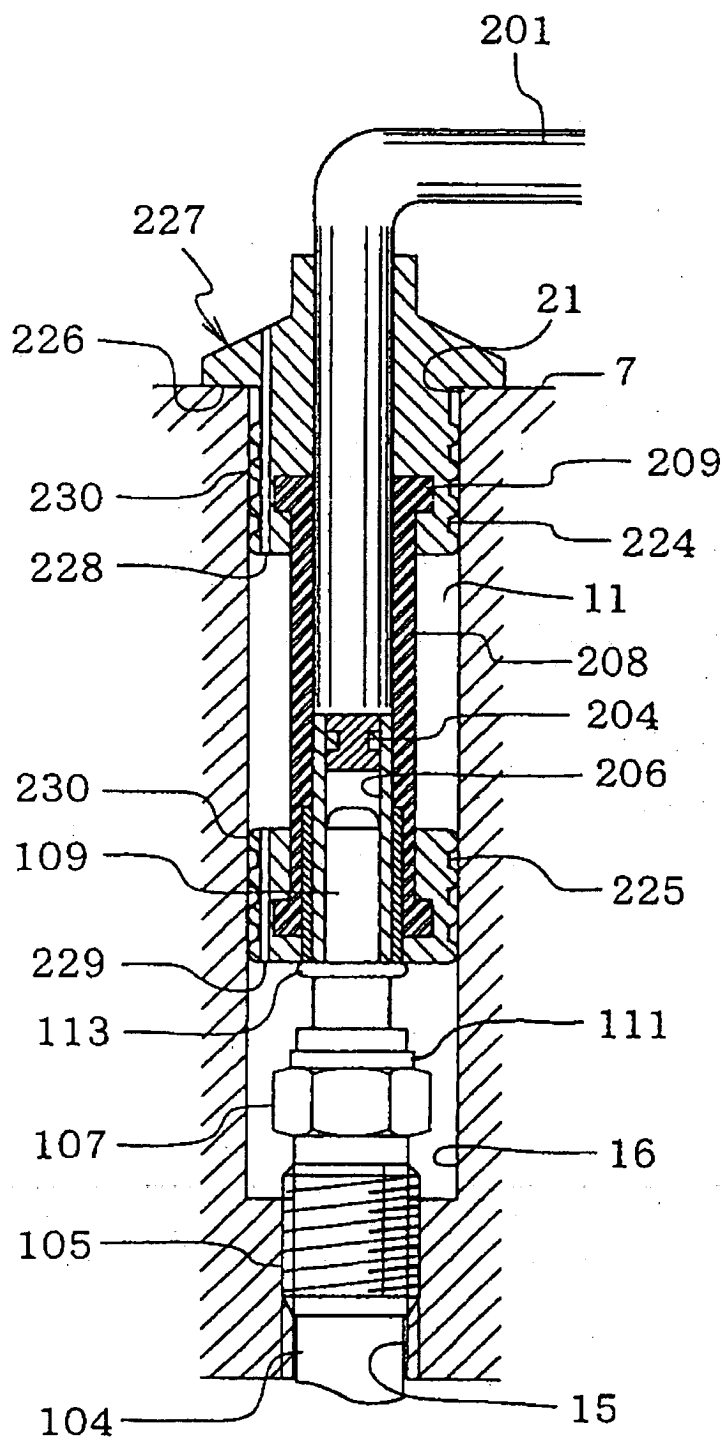


FIG.9

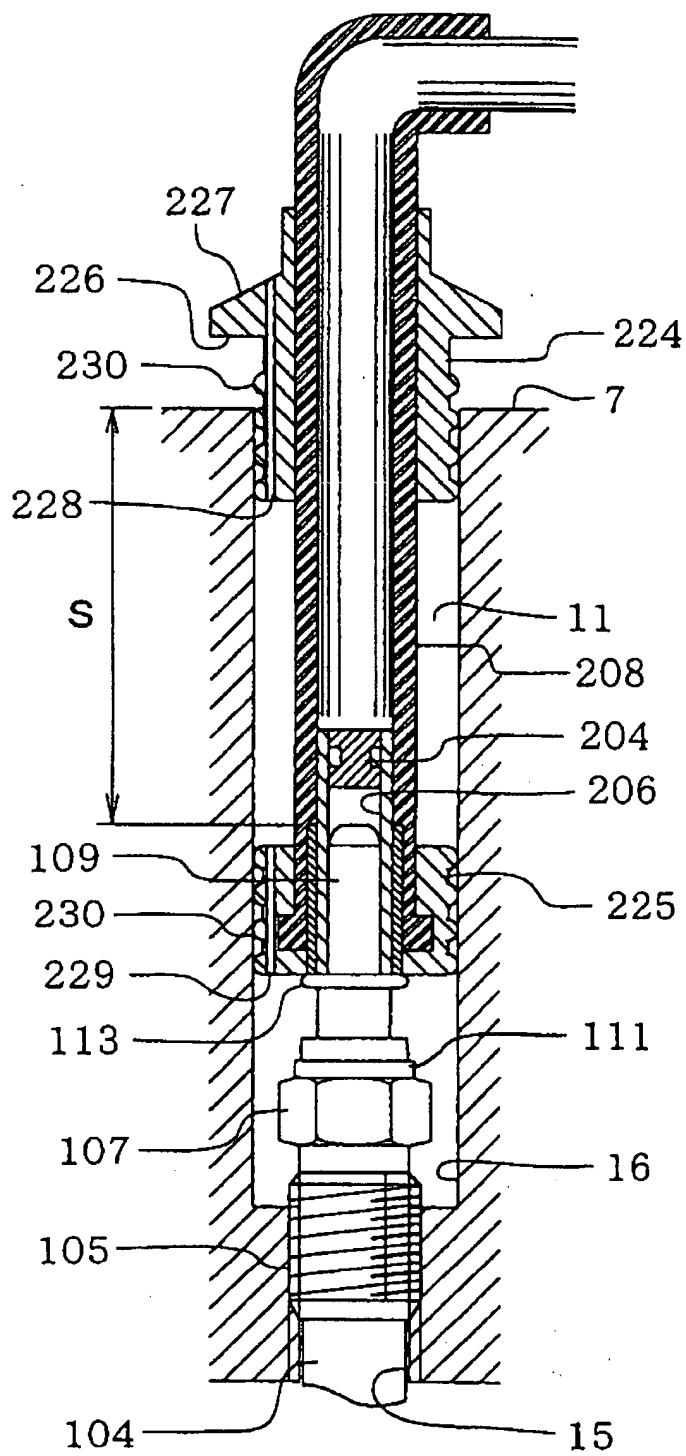


FIG.10

