United States Patent

Beesch et al.

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[45] **Sept. 5, 1972**

[54] **GLOW PLUG**

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[73] Assignee: **Robert Bosch G.m.b.H.**, Stuttgart, Germany

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.**.....**431/208**, 123/145 A, 123/179 H

[51] **Int. Cl.**.....**F23d 11/44**

[58] **Field of Search**.....431/208, 263; 123/145 A, 123/179 H, **123/32 SJ**; 219/271

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Primary Examiner—Edward G. Favors
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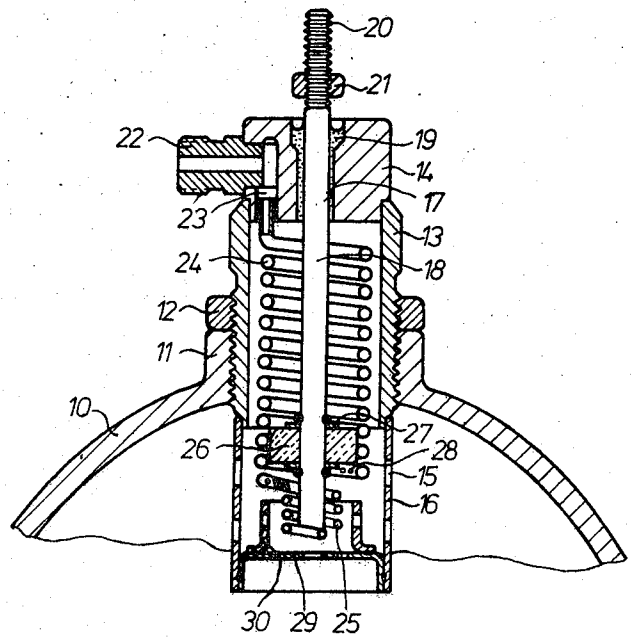
[57] **ABSTRACT**

A tubular casing is provided with two spaced ends and an electrode extends through the casing from one towards the other of these ends. A helically convoluted electrically conductive tubular member extends through the casing also and either surrounds the electrode or is located outwardly adjacent thereto. The tubular member has an inlet in the region of one end of the casing and at least one outlet in the region of the other end. A supply conduit supplies combustible fuel fluid to the inlet so that the fluid travels through the tubular member to the outlet thereof. An electrical heating wire is provided adjacent the outlet and conductively connected with the tubular member so that, when electricity is supplied to the heating wire and thus to the tubular member, the tubular member will become heated whereby the fluid will issue from the outlet as fuel vapor, to be ignited by the igniting means. The resistance wire can also be replaced by constituting the electrode as a glow pin.

12 Claims, 7 Drawing Figures



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SHEET 1 OF 2

Fig.1

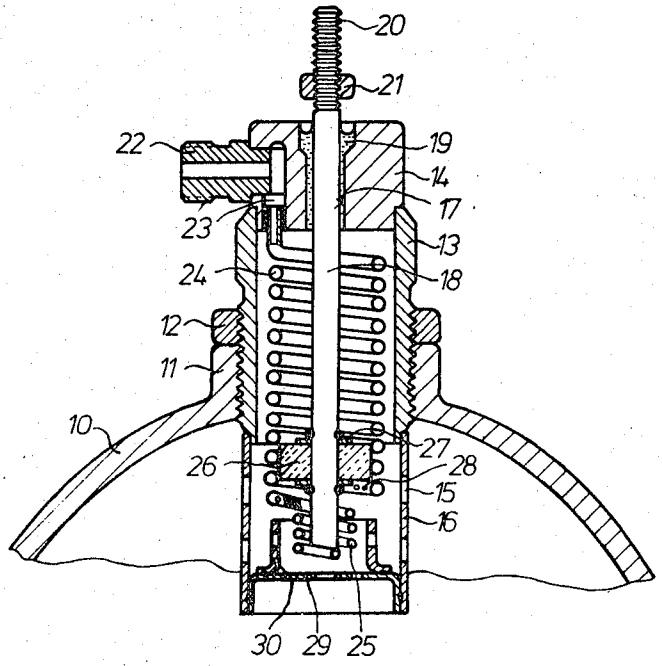

Fig.2

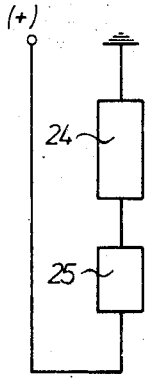

Fig.3

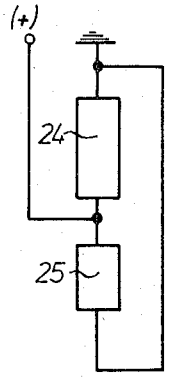

Fig.4

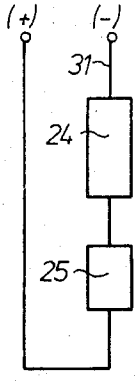

Fig.5

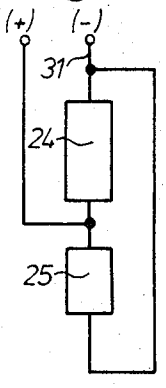

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Fig.6

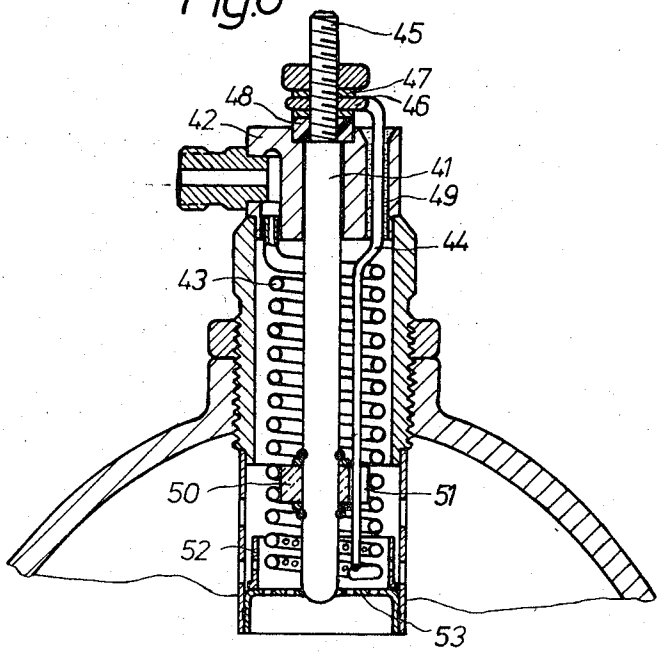
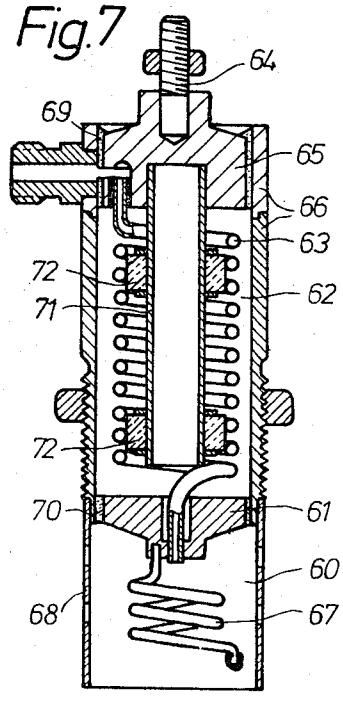


Fig.7



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GLOW PLUG

BACKGROUND OF THE INVENTION

The present invention relates generally to glow plugs, and more particularly to an improved glow plug construction.

Glow plugs basically are already known, they find use in a variety of applications. They serve for instance as a starting-aid in Diesel– and multiple fuel engines to preheat the air in the air intake manifold in such engines to a desired temperature in order to facilitate the ignition of the fuel-air mixture in the cylinders of such engines. It being understood that in such glow plugs fuel becomes vaporized due to the heating effect, becomes subsequently mixed with a part of the air in the air intake manifold and ignited, thus pre-heating the air before entering the cylinders of such engines.

It is known to supply the fuel through a helically convoluted tubular element from which it issues in the region of the combustion end of the glow plug, and to provide igniting means which extends longitudinally through the center of the helically convoluted tubular element to thereby radiate heat and heat the tubular element and the fuel passing therethrough with an end portion of the igniting means being located in the region of the outlet from which the vaporized fuel issues so as to ignite the vaporized fuel. Glow plugs so constructed have been found to have significant advantages over prior glow plugs. Thus, they will operate reliably, and independently of the position in space in which they are installed. More importantly, even, they permit the vaporization and consequently the ignition of larger quantities of fuel per unit of time than was previously known, and consequently they produce a larger flame than was previously possible and thus facilitate starting-up of the device or engine with which they are associated.

However, in order to obtain a sufficiently large flame in the intake manifold of the motor for effecting preheating of the latter as an aid in starting the motor, it is necessary to supply to the ignition end of the glow plug a correspondingly large quantity of vaporized fuel. In the known constructions, where a glow pin extends through the helical tubular member carrying the fuel to be vaporized and subsequently ignited, more than a minute is necessary when the engine is cold, for the glow plug to heat the helical tubular member to the extent necessary to produce vaporization of fuel passing through it. For this period of time, the engine can obviously not be started. It is hardly necessary to point out that this is disadvantageous and that it is desirable to reduce the pre-heating time, that is the time required between initial energization of the glow plug in the air intake manifold and the initiation of combustion of vaporized fuel and air in the cylinders of a Diesel– or multiple fuel engine.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to avoid the disadvantage of the prior art and to afford the aforementioned desirable improvement.

More particularly, it is an object of the present invention to provide an improved glow plug construction which affords this improvement.

A concommitant object of the invention is to provide such a glow plug construction which is simple and reliable.

Still another object of the invention is to provide such a glow plug construction which affords significantly better utilization of the electrical energy than what is heretofore known.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides in a glow plug which, briefly stated, comprises a tubular casing having two spaced ends, and an elongated electrode extending through the casing from one towards the other of the ends. A helically convoluted electrically conductive tubular member extends intermediate these ends longitudinally of the electrode and the casing has an inlet in the region of one end and at least one outlet in the region of the other end of the casing. At least one mounting element connects the electrode and the member with the casing at least in the region of the one end. A supply supplies combustible fuel fluid to the interior of the member through the inlet so that fluid travels to the outlet. Electrical means is provided which is conductively connected with the helically convoluted tubular member so that, when the electrical means is energized, electrical current travels through the tubular member for heating the same and thereby heating the fuel fluid as it travels through the member so that it issues as a vapor from the outlet, whereupon the electrical means ignites the thus-issued vapor.

It has been found that by resorting to the present invention the pre-heating time, that is as explained above, the time which has to ellapse between initial energization of the glow plug and the initiation of combustion of issued fuel vapor in the cylinders of the engine, is reduced to approximately 20 seconds versus more than 1 minute as known from the prior art. Thus, a Diesel or other engine provided with the improved glow plug according to the invention can be started — - due to the starting aid it receives from the flame which develops upon combustion of the vaporized fuel on the glow plug, after a time-lapse subsequent to energization of the glow plug which is only approximately one-third as long as was previously required. This is important for many applications, not only as a matter of convenience in the private sector, but, conceivably, also as a matter of safety in military applications, for instance where Diesel-powered armored vehicles may be concerned.

It will be appreciated that the direct heating of the helically convoluted tubular member through which the fuel fluid passes to be heated and vaporized, eliminates otherwise unavoidable heat losses and consequently the electrical energy required is utilized substantially better than was heretofore the case.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal section through a glow plug according to one embodiment of the invention;

FIG. 2 is a circuit diagram illustrating the electrical connection of the helically convoluted tubular member and the ignition device in the embodiment of FIG. 1;

FIG. 3 is a view analogous to FIG. 2 but illustrating a further electrical connection;

FIG. 4 is a view analogous to FIG. 2 also, illustrating yet an additional electrical connection;

FIG. 5 is a view analogous to FIG. 3 illustrating still a further electrical connection;

FIG. 6 is a view similar to FIG. 1 but illustrating another embodiment of the invention; and

FIG. 7 is another axial section through still a further embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly FIGS. 1 and 2 thereof, it will be seen that in FIG. 1 we have illustrated in somewhat diagrammatical form the suction manifold **10** of a Diesel engine. The engine itself is not shown because it is not necessary for an understanding of the present invention and does not, of course, constitute a part of the present invention. The manifold **10** is provided with screw nibble **11** into which there is threaded a glow plug according to the present invention and retained against undesired separation by a nut **12**.

As FIG. **1** clearly shows, the glow plug according to this particular embodiment has a casing composed of of an upper portion **14**, a lower portion **13** which is connected with the upper portion **14** in conventional manner, for instance by hard-soldering, and a flame-protecting portion **16** configurated as an apertured sleeve having the apertures **15** therein. It is primarily the portion **16** which extends into the interior of the manifold **10** and the purpose of the sleeve **16** —— within which combustion of the vaporized fuel will occur as is to be described subsequently —— is to protect the flame from being extinguished by the air rushing through the manifold **10**.

The portion **14** is provided with an axial bore **17** through which there extends, as illustrated, an elongated electrode **18** which is gas-tightly and in electrically insulated relationship mounted in the portion **14** by means of a glass seal **19**. The forward end of the electrode **18** extends to the region of the front end of the casing, that is into the space surrounded by the portion **16**. The outer rearward end of the electrode **18** is externally threaded as are indicated at **20** so that a nut **21** can be brought into mesh with it as shown to connect to the electrode **18** an electrical conductor. An inlet nipple **22**, constituting in effect a supply, is also secured in the portion **14** by hard-soldering or the like, and supplies fuel fluid into the inlet of a tubular helically convoluted member **24**. The end portion of the member **24** which is provided with this inlet is inserted and retained in —— as by hard-soldering —— a bore or passage **23** provided in the portion **14** and communicating with the passage of the nipple **22**. The member **24** preferably is composed of chrome-nickel steel and is convoluted to have a plurality of concentric turns which do not contact one another in order to avoid electrical shorting between them.

The forward (in FIG. **1** lower) end of the member **24** is provided with one —— usually several —— outlet apertures **28** for vaporized fuel. Secured at the forward end of the member **24**, closing the interior of the passage therein, is a resistance wire which here is convoluted to form a winding **25** one end portion of which extends into the interior of the member **24** and is soldered or welded in place under a protective-gas atmosphere. The helix constituted by the winding **25** also surrounds the electrode **18** with clearance just as does the member **24**, and its convolutions also do not contact one another. At one end, however, the ignition wire of the winding **25** is welded to the electrode **18**. As illustrated the diameter of the winding **25** is smaller than that of the helically convoluted member **24**.

The member **24** and the winding **25**, both of which of course are helices, are supported by a cheramic supporting element **26** which is pushed onto the electrode **18** and held in place by metallic washers **27** welded or otherwise secured to the electrode **18**.

An apertured partition wall **29** closes the open end of the portion **16** and serves with the latter, and with a flame-holding sleeve **30** welded or otherwise secured to the partition wall **29**, to protect the flame which develops from extinguishing by the air rushing through the manifold **10**.

It will be appreciated that when a Diesel engine provided with the embodiment of FIGS. **1** and **2** is started electrical current flows through the electrode **18** the ignition coil **25**, the helically convoluted tubular member **24**, the housing portion **14** and the housing portion **13** to the manifold **10** which is connected to mass. This is illustrated in FIG. **2** and it will be evident that as a result of this pass of the electrical current the member **24** is heated sufficiently for the fuel supplied to it from the nipple **22** and which passes towards the outlet openings **28**, to become heated and thus vaporized so that it issues from the outlet openings **28** as fuel vapor. The vapor then admixes with the air which passes from the manifold **10** through the apertures **15** into the interior of the portion **16** and is ignited by contact with the winding **25** which is at ignition temperature.

As FIG. **3** shows, it is not necessary for the elements **24** and **25** to be connected in series as shown in FIG. **2**. Instead, they can be connected in parallel as clearly evident from FIG. **3**.

FIG. **4** shows that if the electrical connection is that of FIG. **2**, the return conductor **31** may be insulated a measure which is known from and conventional in installations where the danger of explosion exists. FIG. **5** is similar to FIG. **4** but shows the measure of FIG. **4** applied to a connection such as that originally illustrated in FIG. **3**.

Coming now to the embodiment of FIG. **6**, it is pointed out that this differs from that of FIG. **1** in that the ignition coil **25** of the initial Figure is replaced in FIG. **1** with a known glow pin. The glow sleeve **41** of the glow pin is hard-soldered into the central passage of the portion **42** which corresponds to the portion **14** of FIG. **1**. The helically convoluted tubular member **43** corresponds to the tubular member **24** of FIG. **1** and is connected with the source of electrical energy by means of a conductor **44** which is welded or otherwise secured to the forward or lower free end of the member **43** and which is connected with the terminal portion **45** of the glow pin by being climbingly retained between two metal washers **47** which are pressed together by the illustrated nut threaded onto the portion **45**. The lower of the washers **47** is insulated from the portion **42** by an electrically insulating washer **48**. Where the conductor **44** passes through the portion **42** it is electrically insu-

lated from the latter by a glass-melt seal 49; the cheramic supporting member 50 —— which corresponds to the member 26 of FIG. 1 —— is provided with a slot or bore 51 through which the conductor 44 passes. A partition wall 53 is again provided together with a flame-holding sleeve 52, as in the embodiment of FIG. 1, and the operation and place of ignition in FIG. 6 is the same as described with reference to FIG. 1.

It is emphasized that the glow pin need not be located within the confines of the helically convoluted tubular member 43; instead, it could be located outside the helix constituted by the tubular member 43 if the space provided for the casing so permits. It must be kept in mind, however, that the end portion of the glow sleeve 41 of the glow pin must be located in the region of the vapor outlet openings of the tubular member 43 in order to be able to ignite the issuing vapor.

Coming, finally, to the embodiment of FIG. 7, it will be seen that here the interior of the casing is subdivided into two chambers by a partition wall 61. One of the chambers is the vaporizing chamber and the other, in which the ignition coil 57 is located, is identified with reference numeral 60 and is the combustion chamber.

This embodiment has the advantage that no oil residue can become deposited on the convolutions of the helically convoluted tubular member 63 which corresponds to the tubular member 24 of FIG. 1, during combustion; such oil residue could lead to electrical shorts between the adjacent convolutions of the tubular member 63 and to the consequent destruction of the same.

Current in this embodiment is supplied from a contact pin or bolt 64 which is connected in suitable manner with a supply of electrical energy, into the portion 65 in which the member 64 is conductively secured. The portion 65 is electrically insulated from the housing portion 66 by a glass-melt seal 69 and from the portion 65 current passes into the tubular member 63. The tubular member 63 has a portion which extends into an aperture provided in the conductive partition wall 61, which, as illustrated, is electrically insulated from the casing 66, 68 by a glass-melt seal 70. From the partition wall 61, in turn, current passes into a helically configurated ignition coil or winding 67 which is welded to the partition wall 61 with one end and which is welded with this other end to the housing or casing portion 68 as illustrated.

As FIG. 7 shows, the tubular member 63 is supported by a metallic tube 71 located within it and surrounded by a cheramic supporting member 72 which engages the inside of the helix constituted by the tubular member 63. The tube 71 is secured to the portion 65, as by hard-soldering or the like. One end of the tubular member 63 passes centrally through the partition wall 61, as already pointed out and as illustrated in FIG. 7, to discharge fuel vapor from the open outlet of this one end toward the ignition coil 67 for ignition thereby. To prevent condensation of the fuel vapor the area of contact between the tubular member 63 and the partition wall 61 is as small as possible —— note the enlarged portion of the bore through which the outlet end portion of the tubular member 63 extends and in which enlarged portion it has contact with the partition wall 61 ——, whereby this undesired phenomenon is prevented.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a glow plug, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. A glow plug, comprising a tubular casing having two spaced ends; an elongated electrode extending through said casing from one toward the other of said ends; a helically convoluted electrically conductive tubular member extending intermediate said ends longitudinally of said electrode and said casing, said member having an inlet in the region of said one end at least one outlet in the region of said other end; at least one mounting element connecting said electrode and said member with said casing at least in the region of said one end; a supply supplying combustible fluid to the interior of said member through said inlet for travel to said outlet; and electrical means conductively connected with said member for heating said fluid during travel through said member so that the fluid issues as a vapor from said outlet, and for igniting the issued vapor.

2. A glow plug as defined in claim 1, said means comprising a resistance wire mounted within said casing and adapted to be connected to a source of electrical energy.

3. A glow plug as defined in claim 2, wherein said resistance wire is configurated as a helix.

4. A glow plug as defined in claim 2, said member having an end portion provided with said outlet, and said resistance wire being mounted adjacent but forwardly spaced from said end portion; and a partition interposed in said casing between said resistance wire and said end portion and having at least one aperture communicating with said outlet for access of said vapor to said ignition wire.

5. A glow plug as defined in claim 1, wherein said electrode is located with clearance within the confines of said member.

6. A glow plug as defined in claim 1, wherein said electrode is located outside the confines of said member.

7. A glow plug as defined in claim 1, wherein said electrode is a glow pin.

8. A glow plug as defined in claim 7, wherein said glow pin is located within the confines of said member.

9. A glow plug as defined in claim 7, wherein said glow pin is located outside the confines of said member.

10. A glow plug as defined in claim 1, wherein said electrical means and said member are electrically connected in parallelism.

11. A glow plug as defined in claim 1, wherein said electrical means and said member are electrically connected in series.

12. A glow plug as defined in claim 1, said casing comprising a flame-protecting apertured sleeve portion provided in the region of said outlet.

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