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(71) Applicant: **WELLMAN AUTOMOTIVE PRODUCTS LTD**
Cornwall Road Smethwick
Warley West Midlands B66 2LB (GB)

(72) Inventor: **O'Brien, Patrick Christopher**
3 Hensdale Off Cranbrook Drive Pinkneys Green
Maidenhead Berks, SL6 6SL (GB)

(74) Representative: **Spruce, George Philip et al**
Lewis W. Goold & Co. Whitehall Chambers 23 Colmore Row
Birmingham B3 BL2 (GB)

(54) **Glow plug.**

(57) Glow plug for engine starting is of the sheathed element self-limiting type and has a sheath (20) enclosing the heating and resistance coils (26,28) which has a reduced diameter or other discontinuity (32) in its wall in an intermediate zone at or adjacent to the interconnection (30) between the coils in order to delay or resist conductive dispersion of heat from the tip portion (22) of the sheath containing the heating element to the remainder thereof.

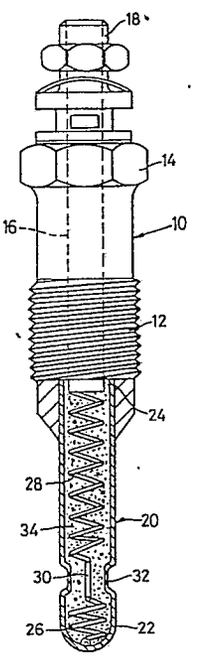

Fig. 1

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Description

GLOW PLUG

This invention relates to electrically operated glow plugs used as an aid to speedy start-up of internal combustion engines, in particular diesel and other compression ignition engines as used in vehicles.

More specifically the invention relates to glow plugs of the kind including a housing adapted to mount the plug in the wall of a cylinder or other combustion chamber of the engine in use, a tubular sheath carried by the housing to project into the combustion chamber in use, the distal extremity or tip of the sheath containing a totally enclosed heating element whereby the tip of the sheath speedily attains a high temperature when electric current is applied thereto by way of an electrode carried in the housing, and a resistance element also totally enclosed in the sheath electrically interconnecting the heating element with the electrode and formed of a material having a high positive temperature coefficient of resistance. This kind of glow plug is hereinafter referred to as "a sheathed element self-limiting glow plug".

The object of the present invention is to provide a glow plug of said kind which is economical to manufacture, reliable and durable in use, and which will attain its working temperature very much more quickly than most if not all known plugs of the kind for rapid starting of an engine from cold.

According to the invention there is provided a sheathed element self-limiting glow plug characterised in that there is a discontinuity in the wall of the sheath in an intermediate zone at or adjacent to the interconnection between the coils whereby conductive dispersion of heat from the tip portion of the sheath containing the heating element to the remainder thereof is substantially delayed or resisted.

The discontinuity is conveniently a substantial reduction in cross sectional area of the sheath in that zone as by a substantial reduction in diameter and/or a substantial reduction in wall thickness in that zone.

The discontinuity may also be provided by a gap or gaps in the sheath wall in that zone. Said gap or gaps may be occupied by one or more spacers or distance pieces which may be formed from a material having low heat conductivity and which may be bonded to the adjoining sheath wall portions to provide mechanical strength.

As the sheath normally serves as the grounded or earth return of the electrical circuit from the distal end of the heating element, if the sheath wall is completely broken by the discontinuity, as when a continuous spacer or distance piece is used which is not electrically conductive an electrical connection bridging the discontinuity e.g. a wire connection, will be provided.

Examples of the invention will now be described with reference to the accompanying drawings wherein:-

Figure 1 is a diagrammatic side elevation of a glow plug with its sheath portion shown in section;

Figure 2 is a like view of the distal end portion only of the sheath of a further example; and

Figure 3 is a like view of the latter portion of a yet further example.

Referring firstly to Figure 1, the plug comprises a tubular metal housing 10 of conventional shape including an externally screwthreaded portion 12 which will be received in a threaded bore through the wall of an engine combustion chamber in use, its outer end being provided with a hexagon head 14 for engagement by a spanner. An insulated electrode 16 having a connecting terminal 18 at its outer end is sealed into and extends through housing 10 in known manner.

A hollow cylindrical metal sheath 20 projects from the inner end of housing 10. The distal extremity or tip portion 22 remote from the body is totally closed and the proximal end part 24 of the sheath is fitted within a bore of the inner end of housing 10 and is closed in sealing engagement with electrode 16 in known manner.

A wound wire heating coil 26 is located within tip 22, its distal end being electrically connected, e.g. by welding, to the tip, sheath 20 and housing 10 constituting the earth return side of the electrical circuit.

A wound wire resistance coil 28 within sheath 20 has one end electrically connected to electrode 16, e.g. by welding. In this example coil 28 is substantially longer than coil 26 and extends from the part of sheath 20 within housing 10 along the exposed portion of the sheath towards coil 26, it is electrically connected in series with coil 26 by a short axial connecting rod or wire 30 to which the adjacent ends of the coils are welded.

In this example sheath 20 is swaged or otherwise formed to provide a reduced diameter neck 32 at an intermediate zone along the length of the sheath in the region of the connecting rod or wire 30, i.e. between the tip portion 22 of the sheath occupied by heating coil 26 and the major proximal part of the sheath occupied by the resistance coil 28.

Preferably the wall thickness of the sheath is also substantially reduced by the swaging process at said reduced diameter.

The discontinuity so formed in the sheath provides a heat stop between the coils due to the much reduced cross sectional area of the metal sheath at said intermediate zone, delaying conductive dispersion of heat from the tip portion 22 back along the sheath to its proximal portion.

Heating coil 26 may be made of "Kanthal" alloy and the resistance coil 28 may be made of nickel or nickel alloy.

Sheath 20 is filled with electrically insulating material 34 which also helps to keep the coils centered in place, for example magnesium oxide or other inert heat resistant material, in known manner. Sheath 20 is typically formed from a stainless steel.

Experiments have shown that the provision of the

heat stop discontinuity in the sheath gives an unexpectedly great reduction in the heat-up time. Tip portion 22 may attain full heat in as little as 2 seconds or less enabling extremely fast start-up of the engine from cold. This is little more than the time needed for effective cranking of the engine on start-up. Thus a diesel or other compression ignition engine e.g. in a passenger car may be started as easily and quickly as a petrol engine with electric ignition.

This does not affect the self-limiting operation of the resistance coil which protects the heating coil in known manner should the current be left on for excessive periods. Thus the plug described is at least as durable and reliable as those of conventional design; indeed the fast operation may enhance durability in that the plug will normally have to operate for only very brief periods at or near full heat.

Figure 2 shows an alternative arrangement in which the discontinuity is a complete break or gap 232 extending right around the sheath wall in the zone of the connection 30 between the coils. For electrical continuity the two parts of the sheath are connected by a short bridging wire 240. In this arrangement it is contemplated that the insulating material 34 filling the sheath might be fused or bonded to form a body within the sheath which will assist in securing the two parts safely together. For added rigidity and, at the same time to provide said electrical continuity, said gap might not be continuous, but in two or more parts separated by narrow integral bridging pieces across the gap.

Figure 3 shows a further alternative in which the tip portion 22 of the sheath is connected to the remaining portion by a washer or spacer 332 formed of a material having low heat conductivity e.g. a glass or ceramic material sintered or otherwise bonded to the remaining parts of the sheath. If said material is not electrically conducting the discontinuity so formed will again need to be bridged by a wire or the like (not shown) to complete the grounded or earth return.

In Figures 2 and 3 the adjacent ends of coils 26 and 28 are connected directly to each other at 30, e.g. by welding. This may reduce the overall length of the sheath having in mind that the length of projection into the combustion chamber is limited in some designs of engine.

Claims

1. A sheathed element self-limiting glow plug as hereinbefore defined characterised in that there is a discontinuity (32) in the wall of the sheath (20) in an intermediate zone at or adjacent to the electrical interconnection (30) of the elements (26, 28) whereby conductive dispersion of heat from the tip portion (22) of the sheath containing the heating element to the remainder thereof is substantially delayed or resisted.

2. A plug as in claim 1 characterised in that said discontinuity (32) is a substantial reduction in cross sectional area of the sheath in said zone.

3. A plug as in claim 2 characterised in that said reduction comprises a substantial reduction in diameter of the sheath.

4. A plug as in claim 2 or 3 characterised in that said reduction comprises a substantial reduction in wall thickness of the sheath.

5. A plug as in any preceding claim wherein said discontinuity is provided by or comprises a gap or gaps (232) in the sheath wall in said zone.

6. A plug as in claim 5 characterised in that said gap or gaps is or are occupied by one or more spacers or distance pieces (332) formed from a material having low heat conductivity.

7. A plug as in claim 6 characterised in that said one or more spacers or distance pieces is or are bonded to the adjoining sheath wall portions to provide mechanical strength.

8. A plug as in any preceding claim characterised by an electrical connection (240) bridging the discontinuity for operatively forming part of the electrical circuit connected from the distal end of the heating element.

9. A plug as in any preceding claim including insulating material (34) filling the sheath characterised in that said material is fused or bonded to form a body within the sheath securing the tip portion (22) of the sheath to the remainder thereof.

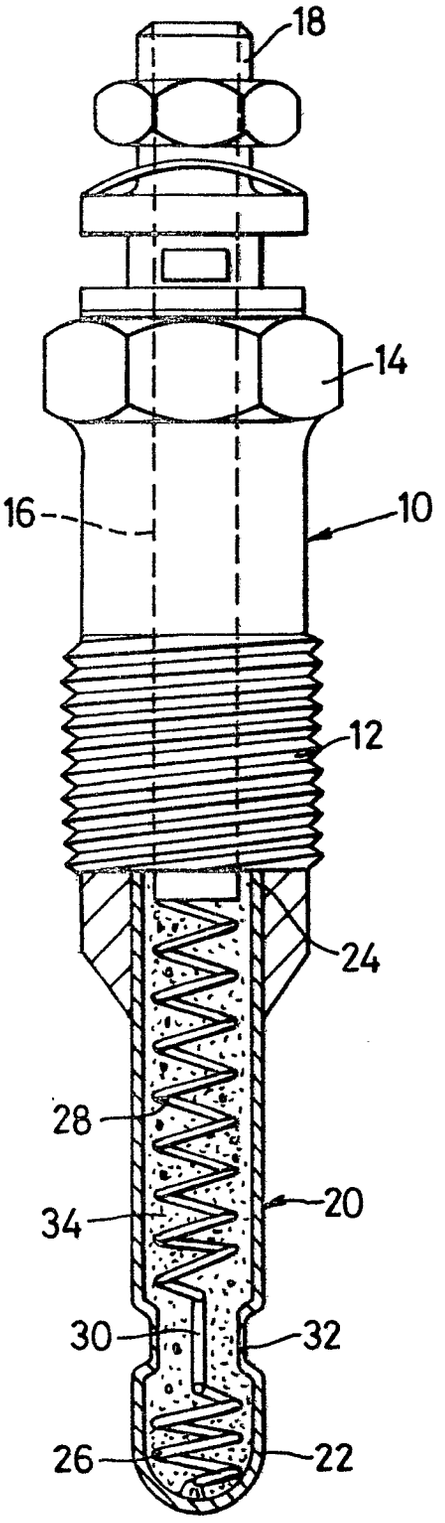

Fig. 1

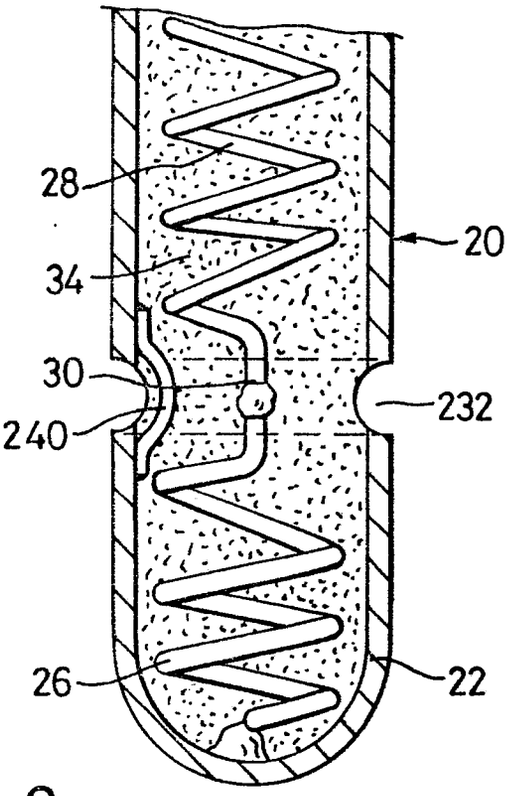

Fig. 2

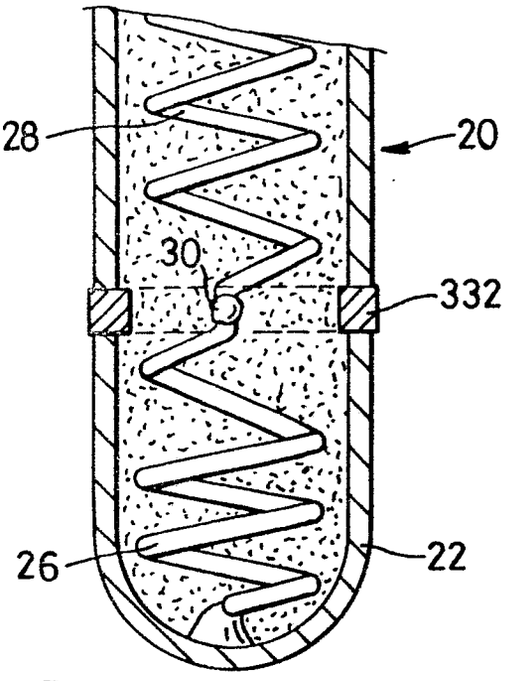

Fig. 3