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

(11) Publication number: **0 020 200**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **80400568.4**

(22) Date of filing: **25.04.80**

(51) Int. Cl.³: **H 01 T 13/20**, H 01 T 13/46

(30) Priority: **04.06.79 US 45042**

(43) Date of publication of application: **10.12.80**
Bulletin 80/25

(84) Designated Contracting States: **FR GB**

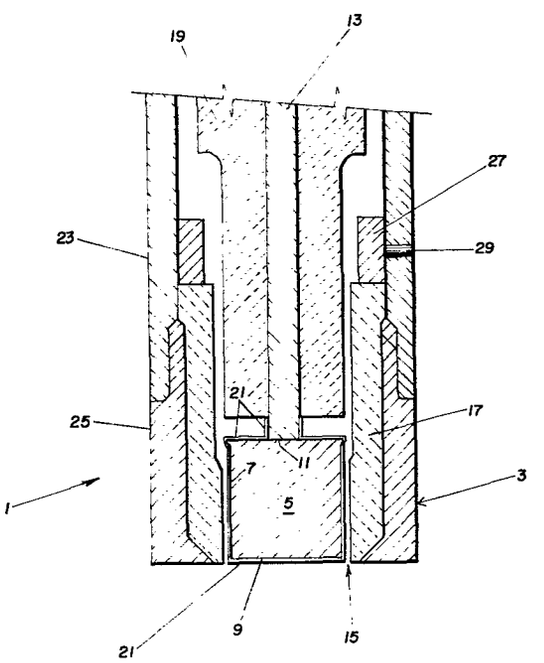
(71) Applicant: **THE BENDIX CORPORATION, Executive Offices Bendix Center, Southfield, Michigan 48037 (US)**

(72) Inventor: **Warren, Gilbert Grant, 20 Loomis Drive, Sidney New-York 13838 (US)**
Inventor: **Johnson, Colin Anthony, 20 Shareon Street, Sidney New-York 13838 (US)**

(74) Representative: **Maguet, André et al, Service Brevets Bendix 44, Rue François 1er, F-75008 Paris (FR)**

(54) Igniter plug.

(57) An igniter plug having a tungsten center electrode (5) supported by a conductive pin (13) and an annular electrode (3) with an air gap (15) between said electrodes is provided with a nickel coating (21) on the tungsten center electrode (5) and a portion of the supporting pin (13), and with a collar (27) situated within a portion of the annular electrode (3) to retain a ceramic sleeve (17) within the air gap (15).



EP 0 020 200 A1

0020200

Igniter plug

The present invention relates to an improved igniter plug that will withstand long term use at high temperatures. Generally, igniter plugs are used in engines, such as aircraft engines, to provide the spark for ignition of fuel. Such plugs comprise a central electrode that is composed of tungsten or other conductive material and an outer annular electrode spaced therefrom, to provide an air gap, with conductivity established between the center electrode and an electrical source. The annular electrode generally serves as a ground. A ceramic insulator is provided in the air gap. Upon energizing of the center electrode, a spark is produced across the gap between the center electrode and the annular electrode, which spark ignites the fuel for use in the engine.

The use of tungsten as the material from which the center electrode is formed has been preferred. However, due to the high temperature and environment to which the electrode is subjected during operation of the igniter plug, tungsten oxide is sometimes formed on the electrode surface which causes the electrode surface to expand and exercise forces on the initially spaced ceramic insulator, causing cracks in the insulator top. Such cracks shorten the effective life of the igniter plug.

The problem posed by formation of an oxide film on the surface of the tungsten tip insulator is described in U.S. Patent No. 3,890,518 wherein an oxidation resistant material, such as silicon or aluminium, is provided over the tungsten part of the inner electrode as a diffused surface layer. The application of the silicon or aluminium coating is effected by surrounding the entire electrode tip with a fine powder of the desired material and heating the assembly for four hours at a temperature of 1060°C under an argon atmosphere. In that embodiment, the electrode tip is provided with an oxidation resistant layer of diffused silicon by coating the complete tip of a thickness of about 15 microns and the layer is removed from the axial end surface of the tip that is to be connected to the main electrode or pin.

The present invention overcomes the disadvantages and limitations of the prior art arrangements by providing an igniter plug comprising a cylindrical center electrode supported by a conductive pin, an annular electrode surrounding the cylindrical center electrode and spaced therefrom by an air gap, and an insulating sleeve intermediate the electrodes, in which there is provided a nickel coating over at least the exposed surface of the cylindrical center electrode.

Such nickel coating by preventing growth of tungsten oxide on the surface of the cylindrical central electrode allows the production of a stable, long life igniter plug.

One way of carrying out the invention is described in detail below with reference to the single figure of the drawing which illustrates more particularly a cross-sectional view of the tip of the igniter plug according to the present invention.

Referring now to the drawing, there is illustrated an improved igniter plug constructed according to the present invention.

The igniter plug 1, the tip of which is illustrated, comprises an outer or annular electrode or conductive shell 3, preferably of stainless steel and tungsten alloy, and an inner or center electrode 5 of tungsten. The center electrode 5 is of general cylindrical configuration, with a circular wall 7, exposed end 9 and support end 11. The center electrode is supported by a pin or rod 13, which is of an electrically conductive material such as a nickel ferrous alloy, and is attached to the pin by welding or other attachment means.

The annular electrode 3 and center electrode 5 are spaced from each other by an air gap 15. Provided within the air gap 15, intermediate the electrodes 3 and 5, is an insulating sleeve 17. The conductive pin 13 also has thereabout a pin insulating member 19. The insulating sleeve 17 and member 19 are preferably of a ceramic insulating material, such as alumina based ceramic insulators known in the art.

The above desbribed general description of the igniter plug is of conventional design and has certain deficiencies that are corrected by the present invention.

The present invention provides a coating of nickel completely about the exposed surface of the tungsten electrode. This coating, illustrated as coating 21 in the drawing, provides exceptional stability and long life for the center electrode 5. As illustrated, the nickel coating, in addition to covering the complete surface area of circular wall 7, exposed end 9 and support end 11 of the tungsten electrode 5, also covers a portion of the supporting pin 13 adjacent the center electrode to provide complete encasement of the electrode even at welding points. The thickness of the nickel coating that is deposited on the electrode, such as by electroplating, should be between about 25 to 75 microns. Preferably, the thickness of the coating is on the order of 50 microns.

The nickel coating in the present invention, at a thickness of 25 to 75 microns is applied to the electrode tip and part of the conductive pin by electroplating. Diffusion of the nickel into the tip and the pin is achieved by heating the assembly to a temperature of about 1093°C under influence of a vacuum, using a maximum pressure of about 1×10^{-4} torr.

Preferably, the conductive shell 3 is comprised of a main shell 23, which is stainless steel, and a shell tip portion 25 which is composed of tungsten alloy, with the two portions attached by brazing. In order to retain the ceramic insulating sleeve 17 within the electrode tip assembly, while still permitting thermal expansion of the same, a collar 27 is provided about the inner circumference of the main shell 23, which collar is affixed to the shell by plug welds 29. With the provision of the collar 27, the main insulator or pin insulating member 19 telescopes freely into the tip insulator 17 but does not firmly abut the latter. Thus, the shell will not be in a longitudinal stress condition during thermal differential contraction when the igniter cools down from high operating temperatures.

As an example of the benefits of the present

invention, wherein the tungsten center electrode has a nickel coating of 50 micron thickness over the exposed surface and a portion of the pin supporting the same, such plugs were compared with plugs without such a coating.

A plug according to the present invention was subjected to voltage testing, both dry and wet, using an exciter, followed by ten minutes of sparking with fuel dripped on the tip. This was followed by a further voltage test. Subsequently, the igniter was placed in a test fixture for a heat cycle at 650°C at the tip lasting five hours, followed by inspection for cracks in the ceramic tip insulator sleeve. This sequence of voltage test, sparking test and temperature test was repeated until fifty hours of the temperature exposure was accomplished. The plug of the present invention completed the full ten cycles of five hours each at 650°C and showed no cracks in the tip insulator.

A plug without the nickel coating lasted only three cycles of five hours each at 650°C, according to the above test and, after the end of the third cycle, the tip insulator showed two radial cracks and testing was stopped.

The present invention thus provides an igniter plug having a tungsten tip that can withstand high temperature operation without cracking of the tip insulator so as to provide stability and many hours of operation of the igniter plug.

Claims:

1. Igniter plug comprising a cylindrical center electrode (5) supported by a conductive pin (13), an annular electrode (3) surrounding the cylindrical center electrode (5) and spaced therefrom by an air gap (15), and an insulating sleeve (17) intermediate the electrodes (3,5), characterized in that there is provided a nickel coating (21) over at least the exposed surface of the cylindrical center electrode (5).

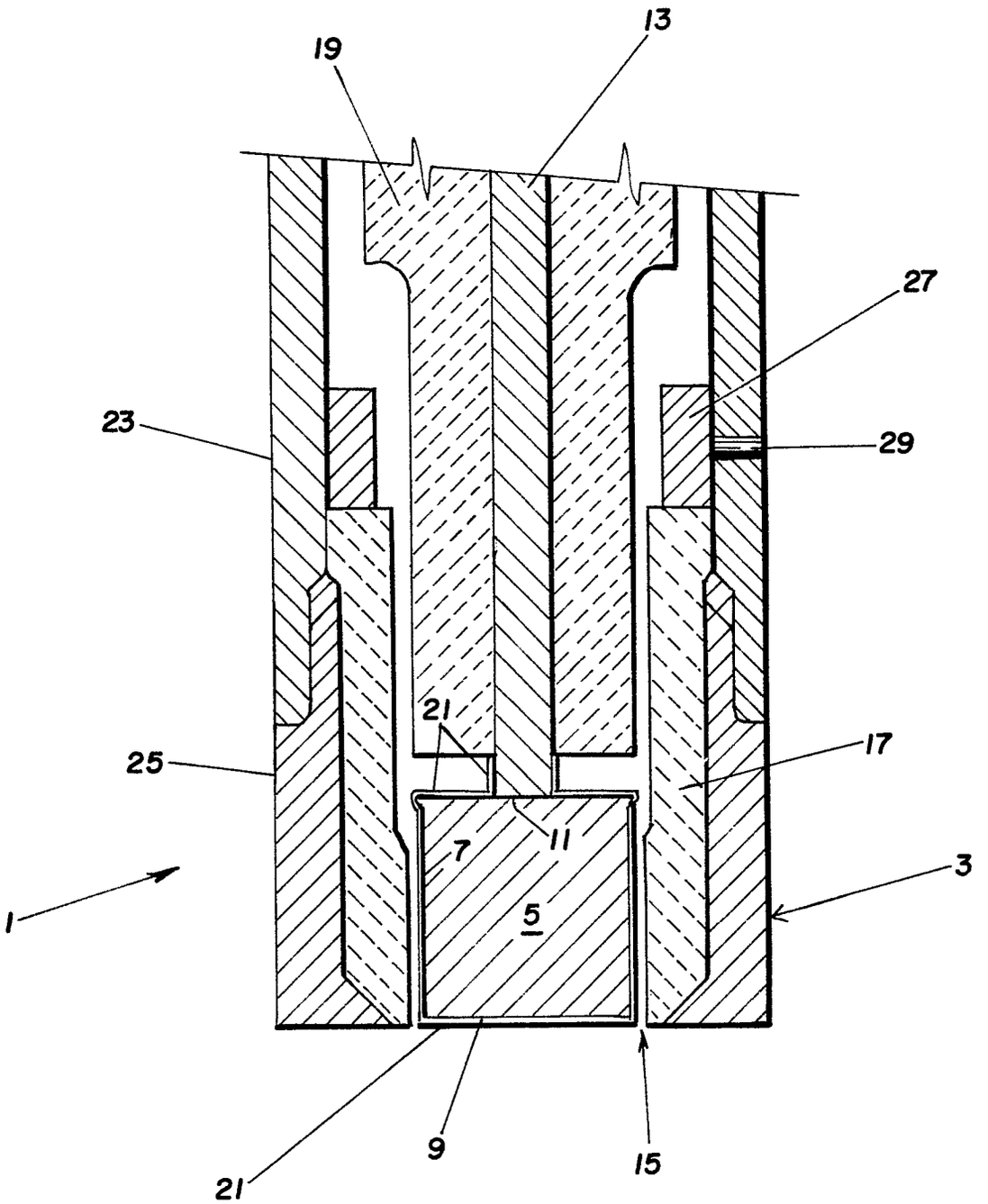
2. Igniter plug as claimed in claim 1, characterized in that the nickel coating (21) also covers a portion of the supporting pin (13) adjacent the cylindrical center electrode (5).

3. Igniter plug as claimed in claim 1 or 2, characterized in that there is provided a ceramic insulator (19) about the conductive pin (13), spaced from the cylindrical center electrode (5).

4. Igniter plug as claimed in claim 1, characterized in that the annular electrode (3) is formed of a plurality of sections (23,25), with the section (25) proximate the cylindrical center electrode (5) comprised of a tungsten alloy and the remaining section (23) of stainless steel.

5. Igniter plug as claimed in claim 4, characterized in that the insulating sleeve (17) is retained within the igniter plug tip by means of a collar (27) situated within the remaining stainless steel section (23) of the annular electrode (3) and affixed to said electrode (3).

6. Igniter plug as claimed in claim 1, characterized in that the nickel coating (21) is between 25 to 75 microns in thickness.


19
13
27
23
29
21
25
17
7
11
3
1
5
21
9
15

European Patent Office

EUROPEAN SEARCH REPORT

0020200

Application number

EP 80 40 0566

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 119 073 (TURNBULL) * page 2, line 44 to page 3, line 12; figure 1 *	1-4
	US - A - 3 356 882 (HALL AUER) * column 2, lines 53-69; figure 7 *	1
	US - A - 3 017 532 (TALMEY) * column 3, lines 13-20; figure 1B *	1

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

H 01 T 13/20
H 01 T 13/46

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

H 01 T 13/20
H 01 T 13/46

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	08.09.1980	BIJN

EPO Form 1503.1 06.78