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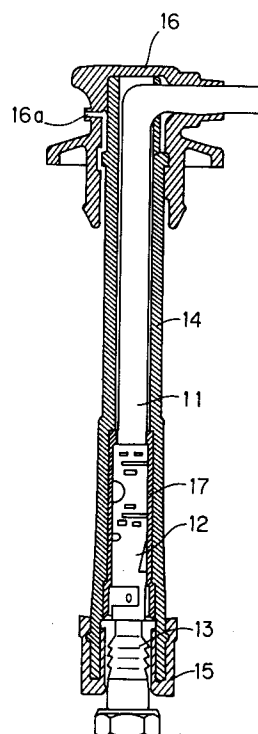
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D-85354 Freising (DE)(54) **Spark plug device.**

(57) There is disclosed a spark plug device wherein an ignition cable (11) and a spark plug body (13) connected to each other through a terminal fixture (12) are covered with a tubular plug cap (14), on which a rubber cap (15) and a rain cap (16) are mounted at its respective ends, and an insulating cover (17) is fitted in the inner peripheral surface of the plug cap (14) in a portion corresponding to the terminal fixture (12) to fill a gap external to the terminal fixture (12), whereby the spark plug device prevents corona discharge adjacent the terminal fixture and has excellent durability and reliable insulation.

FIG. 1**EP 0 619 631 A1**

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a spark plug device for a DOHC (double overhead camshaft) type gasoline engine or the like which has a ignition cable connected to a spark plug body and, more particularly, to a spark plug device capable of effectively preventing degradation of a plug cap by corona discharge.

Description of the Prior Art

An example of spark plug devices for DOHC type gasoline engines is shown in Fig. 3.

The spark plug device of Fig. 3 comprises a terminal fixture 53 shown in Fig. 4 which has a crimp-fixing portion 53a crimped and fixed to an end of an ignition cable 51 for electrical connection between the terminal fixture 53 and the ignition cable 51, and a front end portion 53b fitted to a terminal portion of a spark plug body 52 for electrical connection between the spark plug body 52 and the ignition cable 51.

The connected portion from the ignition cable 51 to the spark plug body 52 is covered with a relatively long tubular plug cap 54 made of synthetic resin. A rain cover 55 to be fitted to a plug hole of an engine is mounted on the plug cap 54 at its one end on the ignition cable side, and a rubber cap 56 is mounted on the plug cap 54 at its other end on the spark plug body side.

The above-mentioned spark plug device has a gap between the outer peripheral surface of the terminal fixture 53 and the inner peripheral surface of the plug cap 54. When the spark plug body 52 has a high discharge voltage (for example, more than 30 KV), a potential gradient at a surface of the plug cap 54 of synthetic resin is not less than 3 KV/mm, which is prone to corona discharge in the air adjacent the terminal fixture 53, resulting in the likelihood of not only lowering of insulation of the plug cap 54 with degradation thereof by corona discharge but also pin holes due to dielectric breakdown.

SUMMARY OF THE INVENTION

According to the present invention, a spark plug device comprises: an ignition cable, a spark plug body having a terminal, a terminal fixture connected to an end of the ignition cable and fitted to the terminal of the spark plug body, a tubular plug cap for covering the spark plug body through to the ignition cable, and a filler material for filling a gap formed between the outer peripheral surface of the terminal fixture and the inner peripheral surface

of the plug cap.

As above described, since the filler material is used for filling the gap between the outer peripheral surface of the terminal fixture and the inner peripheral surface of the plug cap, there is no layer of air between the terminal fixture and the plug cap to avoid corona discharge. This effectively prevents lowering of insulation of the plug cap with degradation thereof by the corona discharge and the pin holes due to dielectric breakdown.

Preferably, the filler material is rubber or an organic material containing neither aluminum nor calcium as an element.

The filler material made of rubber or the organic material other than rubber which contains neither aluminum nor calcium as an element prevents the production of the deliquescent conductive deposits such as aluminum salt or calcium salt if corona discharge is generated. The continuous conduction passageway is prevented which extends from the inner surface to outer surface of the plug cap, and no energy leaks outwardly. Thus, the non-discharge of the spark plug is avoided.

Preferably, the filler material includes an insulator for integrally covering the inner peripheral surface of the plug cap.

Preferably, the spark plug device further comprises a rubber cap fitted to the plug cap at its one end on the spark plug body side, the filler material being formed of the same material as and integrally with the rubber cap.

If the filler material is the insulative material, the insulation thickness of the plug cap substantially increases by the presence of the insulative material, whereby the pin holes due to the dielectric breakdown are not liable to be produced. When the insulative material is rubber, abrasion of the head of the spark plug body and inner surface of the plug cap due to vibration is alleviated.

The filler material may be either insulative or conductive only for the purpose of preventing corona discharge.

An object of the present invention is to provide a spark plug device which prevents corona discharge adjacent a terminal fixture and has excellent durability and reliable insulation.

These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of a preferred embodiment according to the present invention;
Fig. 2 is a sectional view of another preferred embodiment according to the present invention;

Fig. 3 is a sectional view of the prior art; and
Fig. 4 is a perspective view of a terminal fixture
of the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, a preferred embodiment will be described hereinafter according to the present invention. As shown in Fig. 1, a terminal fixture 12 is crimped and fixed to an end of an ignition cable 11 for electrical connection between the ignition cable 11 and the terminal fixture 12. A front end of the terminal fixture 12 is fitted to a terminal portion of a spark plug body 13 for electrical connection between the ignition cable 11 and the spark plug body 13.

The ignition cable 11 and spark plug body 13 electrically connected to each other through the terminal fixture 12 are covered with a plug cap 14 of elongated, tubular configuration like the prior art made of synthetic resin such as PBT (polybutylene terephthalate) and UP (unsaturated polyester resin). A rubber cap 15 is fitted in and on the plug cap 14 at its one end or lower end. A rain cover 16 made of rubber or the like is fitted over the plug cap 14 at its other end or upper end, and an air bent hole 16a is formed exteriorly of the rain cover 16.

A cylindrical insulating cover 17 made of a fluid material having elasticity if hardened such as silicone rubber is fitted in the inner periphery of the plug cap 14 in a portion corresponding to the terminal fixture 12 to fill the gap external to the terminal fixture 12.

Thus, almost no layer of air external to the terminal fixture 12 prevents corona discharge adjacent the terminal fixture 12 if the discharge voltage of the spark plug 13 is high. This also prevents lowering of insulation of the plug cap 14 made of synthetic resin with degradation thereof by corona discharge and pin holes due to dielectric breakdown.

When corona discharge is generated by the presence of a slight layer of air between the insulating cover 17 and the terminal fixture 12, the insulating cover 17 made of silicone rubber, if containing a metallic element such as aluminum or calcium, produces no conductive deposits such as aluminum salt or calcium salt, thereby preventing outward energy leaks and non-discharge of the spark plug body 13.

If the insulating cover 17 is made of an organic material other than rubber and containing aluminum or calcium, ozone gas (O_3) generated by the corona discharge chemically reacts with nitrogen gas (N_2) in the air to produce nitrate ions (NO_3^-), which in turn react with aluminum or calcium in the in-

insulating cover 17 to produce deliquescent $Al(NO_3)_3$ or $Ca(NO_3)_2$. A continuous conduction passageway is thus formed which extends from the inner surface to outer surface of the insulating cover 17, resulting in electrical energy leaks.

For this reason, the material of the insulating cover 17, if an organic material other than rubber, preferably contains neither aluminum nor calcium.

In this preferred embodiment, as above described, the separate insulating cover 17 is fitted in the plug cap 14. However, the inner peripheral surface of the plug cap 14 may be integrally coated with the same insulator. Otherwise, the gap between the terminal fixture 12 and the plug cap 14 may be filled with an insulative material.

Although the insulating cover 17 and the rubber cap 15 are separate members in this preferred embodiment, the insulating cover 17 and the rubber cap 15 may be integrally formed of the same material, provided that the material is suited for the insulating cover 17.

While the invention has been shown and described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is therefore understood that numerous modifications and variations can be devised without departing from the scope of the invention.

Claims

1. A spark plug device comprising:
 - an ignition cable,
 - a spark plug body having a terminal,
 - a terminal fixture connected to an end of said ignition cable and fitted to the terminal of said spark plug body,
 - a tubular plug cap for covering said spark plug body through to said ignition cable, and
 - a filler material for filling a gap formed between the outer peripheral surface of said terminal fixture and the inner peripheral surface of said plug cap.
2. The spark plug device of claim 1, wherein said filler material is rubber.
3. The spark plug device of claim 1, wherein said filler material is an organic material containing neither aluminum nor calcium as an element.
4. The spark plug device of claim 1, wherein said filler material includes an insulating cover fitted in said plug cap.
5. The spark plug device of claim 1, wherein said filler material includes an insulator for integrally covering the inner peripheral surface

of said plug cap.

6. The spark plug device of claim 1, further comprising

a rubber cap fitted to said plug cap at its one end on the spark plug body side,
said filler material being formed of the same material as and integrally with said rubber cap.

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FIG. 1

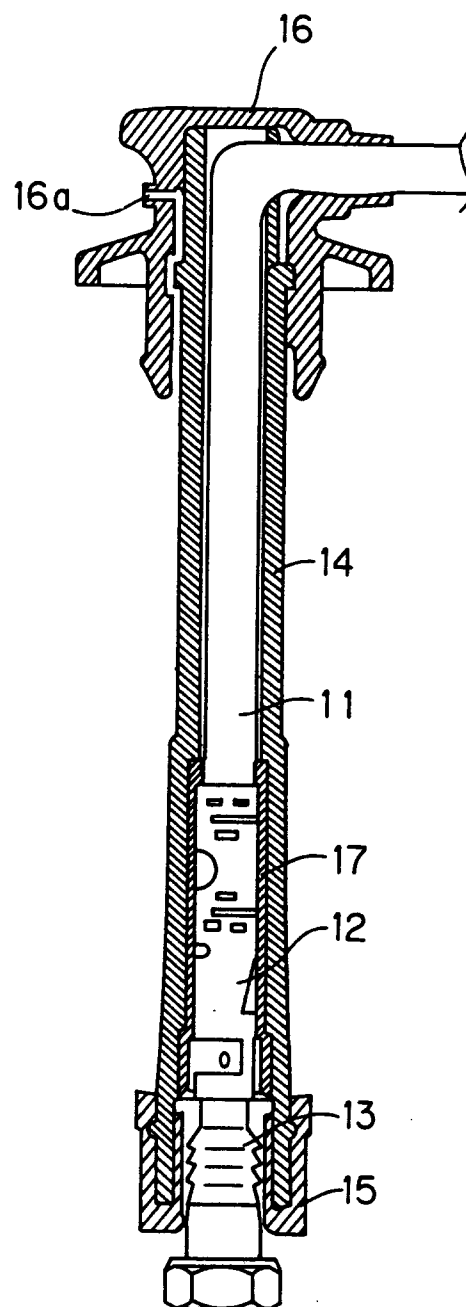


FIG. 2

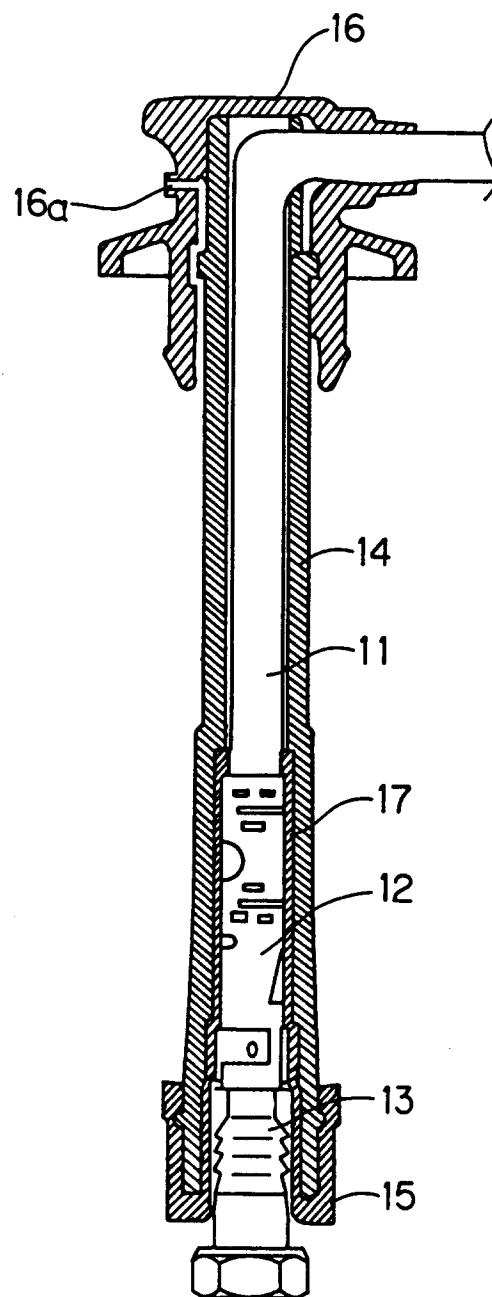


FIG. 3 (PRIOR ART)

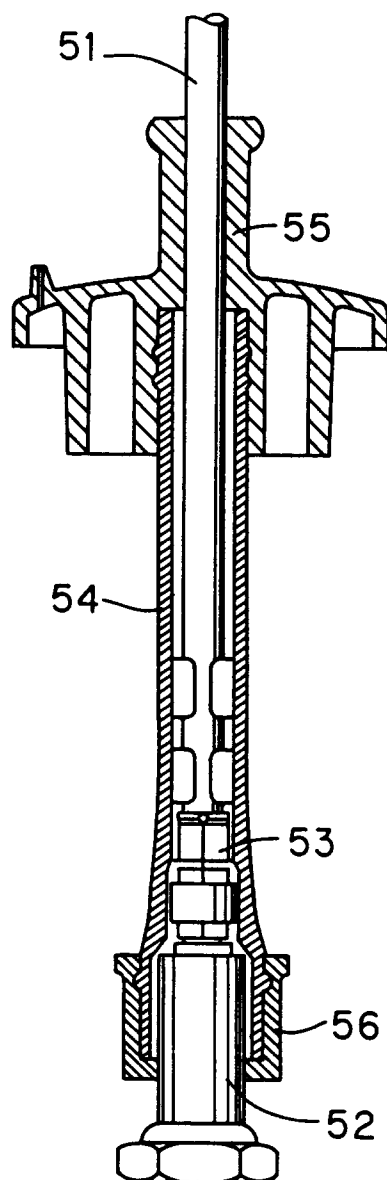
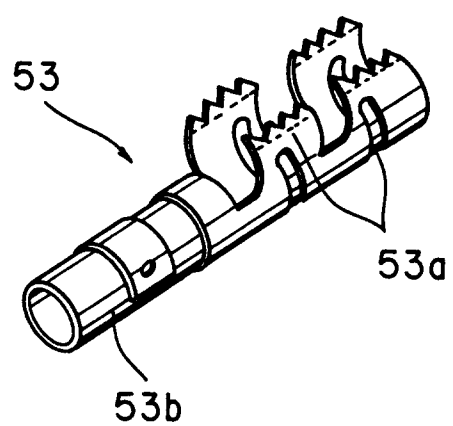


FIG. 4 (PRIOR ART)





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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 5175

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	US-A-2 458 121 (WALDRON) * column 3, line 43 - column 4, line 5; figure *	1,2	H01T13/06
X	EP-A-0 383 661 (SOC. D'APPLICATION DES FERRITES-MUSORB) * column 5, line 33 - line 54; figure 1 *	1,4	
X	US-A-3 914 003 (LOY) * column 2, line 9 - line 64; figures 1-3 *	1,4,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			H01T H01R
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 July 1994	Examiner Bijn, E
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document			