April 16, 1940. M. F. PETERS ET AL 2,197,006

THERMAL PROTECTION AND RADIO SHIELDING OF SPARK PLUGS

Original Filed Aug. 21, 1935

Fig. 1.

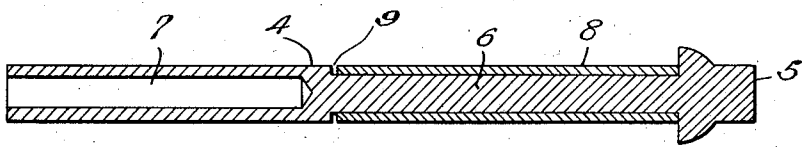


Fig. 2.

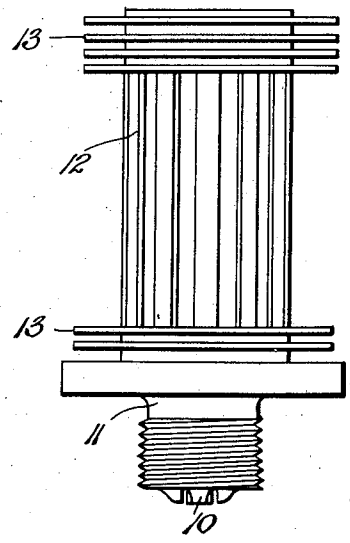
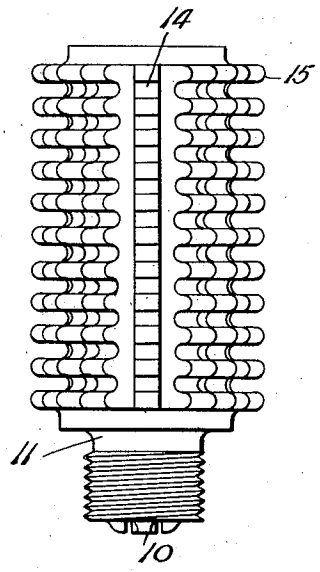


Fig. 3.



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THERMAL PROTECTION AND RADIO SHIELDING OF SPARK PLUGS

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Original application August 21, 1935, Serial No. 37,176, now Patent No. 2,186,039, dated January 9, 1940. Divided and this application September 25, 1939, Serial No. 296,410

4 Claims. (Cl. 123—169)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to radio shielded spark plugs of internal combustion engines, and more particularly to constructions to control the transfer of heat from the spark plug to the shielding harness associated with the ignition lead connected to the plug.

It is the general object of this invention to provide a shielded spark plug wherein excessive heat is conducted away from the sparking points of the plug but the transfer of heat to the associated radio shielding harness in sufficient quantities to damage insulation enclosed in the harness is prevented.

In the drawing:

Fig. 1 is a longitudinal section of a center electrode for a spark plug that is very efficient for the purposes of the present invention;

Fig. 2 is a side elevation of one form of radio shielding for controlling heat transfer; and

Fig. 3 is a side elevation of another shield for controlling heat transfer.

This application is a division of our copending application, Serial No. 37,176, filed August 21, 1935, now Patent No. 2,186,039, January 9, 1940.

An ignition system for automotive engines comprises a high tension insulated wire connecting a source of current at high potential to the insulated center electrode of a spark plug. As increasing voltage is applied to the plug, the gap breaks down and the current passes across the gap between the spark plug points and returns to the source by a path that includes the engine. If the high tension portion of the circuit is surrounded by a metal casing, the greater portion of the current, after passing through the spark gap, returns through the metal casing or shielding harness. A portion of the electro-magnetic field set up between current in the high tension part of the circuit is neutralized by the electro-magnetic field of the current flowing in the high tension portion of the circuit. The flow of the major portion of return current through the shielding harness is due to the fact that this tends to make the total or resultant magnetic field a minimum. This is known as the proximity effect. If any portion of the shield circuit does not completely surround the adjacent portion of the high tension circuit, the electro-magnetic field produced by the current flowing in the high tension ignition cable will be distorted by the current returning through the partly surrounding shield so as to tend to produce neutralization of the radiating fields.

The shielding harness surrounding the ignition cable is long in comparison with the shielding around the spark plug. If the shielding around the spark plug is removed, but means are provided for the current to return through the shield around the cable, the shielding will be effective. Furthermore, if the path provided for the return current from the spark plug shield to the cable shielding harness is placed near the shank of the spark plug, the two fields will be displaced to make the resultant field a minimum.

In view of the foregoing, one of the important aspects of the present invention consists in providing a connection between the shell of the spark plug and the cable shielding harness in which the path in this portion of the return circuit is near and parallel to but insulated from the core of the spark plug and in which the average radial angle at the core subtended by the metal of the path is greater than zero degrees and less than 360 degrees.

The relative effectiveness of the described method of suppressing radio interference depends in the general case upon the ratio of the total angle subtended by the conducting strip (or strips) at the axis of the center electrode to the total angle subtended by the openings. The relative effectiveness of the interference suppression depends further on the distribution of the conducting strips around the center electrode. For any given arrangement of the strips there is little change in the effectiveness of shielding as long as the ratio of the angle subtended by the strips to the angle subtended by the openings is equal to or greater than one. Cooling of the plug and cable increases as the openings are increased, so, from this point of view, it is desirable to have the openings as large as possible. An optimum value, from both points of view, would be to have the openings approximately equal to the strips. The effectiveness of the suppression of noise increases, for any given total angle subtended by the strips, as the number of strips increases. The greatest changes are from one to two and two to three. As the number of strips is increased beyond three the change in shielding effectiveness is much more gradual and beyond six is almost negligible. Since the cost of plug manufacture is likely to increase as the number of strips is increased, it does not seem worth while to increase the number of strips to much beyond six.

In certain special arrangements of ignition systems the gains in shielding effectiveness by distributing the conducting strips around the center electrode and decreasing the size of the opening as compared to strips may be quite negligible. This is true in systems where the bonds between

the engine and the cable shield are critically adjusted or where a large mass of metal (cowling, etc.), effectively screens the antenna of a radio set from the plugs. In such cases a two strip shield with openings 2 or 3 times the width of the strips provides adequate shielding.

It is important that the sparking points of a spark plug be permitted to attain a sufficient temperature during operation to prevent the accumulation of oil and other materials that would foul the plug and prevent the formation of a hot spark. It is also important that the sparking points be not permitted to become sufficiently hot to cause preignition. The center electrode shown in section in Fig. 1 is devised with these conditions in mind. The center electrode, designated generally by the reference character 4, has adjacent the sparking terminal 5 a reduced portion 6 and substantially the remainder of the electrode beyond the reduced portion 6 is bored out as indicated at 7. Around reduced portion 6 is a sleeve or sheath 8 of metal having high heat conductivity, such as copper. The length of sleeve 8 is a trifle less than that of the portion 6 when the parts are cold, as indicated by the small gap at 9 to permit sleeve 8 to expand freely when heated.

It is thus apparent that heat will be rapidly conducted away from sparking terminal 5 but that, upon reaching the diminished cross sectional area of metal around bore 7, the flow of heat will be very much retarded and radiation thereof will take place. The metal around the bore 7 may be of low heat conductive properties, such as stainless steel.

The center electrode 4 may be mounted in a spark plug having firing points 10, as shown in Fig. 2, carried by the shell 11 that is screwed into the engine body. This plug is provided with a shielding having spaced longitudinal bars 12 for radio shielding purposes, in accordance with the conditions of shielding above set forth. The spaces between the bars are of substantially the same transverse width as the width of the bars themselves. The bars 12 may be, in the portions thereof nearest the engine, of material having good heat conductive properties and the remainder of each bar be made of material having poor heat conductive properties, or vice versa, depending upon the type of service in which the spark plug is employed. Radiation of the heat is facilitated by the provision of a plurality of transversely extending annular fins 13 that expose large radiating areas to air passing thereover.

Fig. 3 depicts another form of our invention wherein the radio shielding is constituted by longitudinally extending bars 14 spaced from each other by each other, but each bar has formed in it corrugations 15 extending transversely of the bar, whereby the distance traveled by heat flowing along a bar 14 is very materially increased and the radiating surface is likewise greatly augmented.

The invention described herein may be manufactured and/or used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

We claim:

1. A center electrode for spark plugs having an axial bore therein extending inwardly from the outer end thereof for substantially half the length of the electrode and a portion of diminished cross section inwardly of said bore, and a sheath of metal having high thermal conductivity disposed around said diminished portion, the normal length of said sheath when unheated being somewhat less than the length of said portion to permit free longitudinal expansion of said sheath when heated.

2. A center electrode for spark plugs whereof substantially the outer half has a lower thermal conductivity than the remainder thereof and a portion of undiminished cross section extending inwardly therefrom, and a sheath of metal of high thermal conductivity disposed around the said diminished portion, the length of said sheath being somewhat less than the length of said portion to permit free longitudinal expansion of said sheath when heated.

3. A radio shielding device for spark plugs, comprising a plurality of spaced apart longitudinally extending bars and circumferentially extending fins in heat radiating relation with said bars adjacent at least one end of said bars.

4. A radio shielding device for spark plugs, comprising a plurality of longitudinally extending spaced apart bars disposable around a spark plug in electrically conducting relation with the shell of said plug, said bars being transversely corrugated, and a portion connecting together the outer ends of all of said bars.

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