Nov. 4, 1941. H. J. FANGER 2,261,436

SPARK PLUG AND METHOD OF MAKING THE SAME

Filed May 24, 1940

Fig. 1.

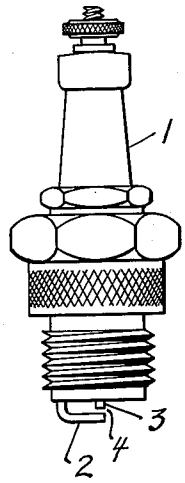


Fig. 2.

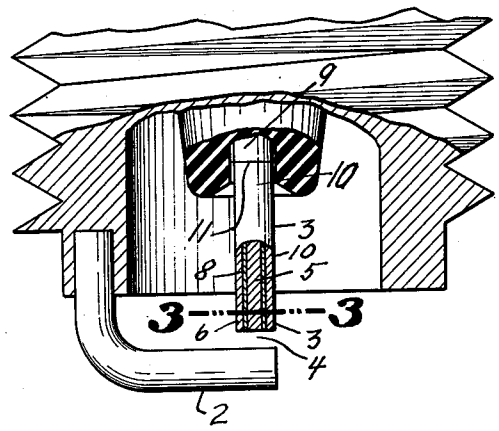


Fig. 3.

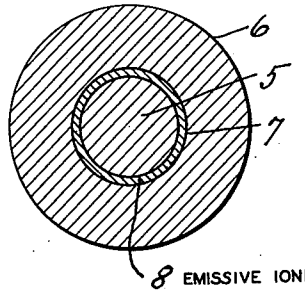


Fig. 4.

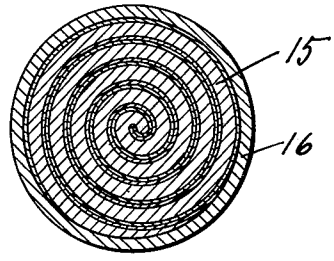
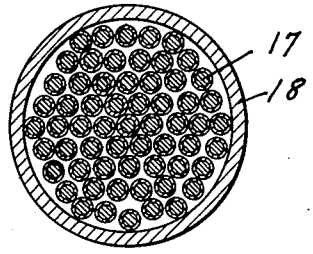


Fig. 5.



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SPARK PLUG AND METHOD OF MAKING THE SAME

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12 Claims. (Cl. 123—169)

The present invention relates to improvements in spark plugs and a method of making the same, and its principal object is to provide a spark plug for an internal combustion engine that will produce a hotter spark, reduce the voltage required to jump a given gap and thus permit the flow of a greater amperage across it, thereby insuring a more thorough combustion of the gas, and, as a result, an increase in power and flexibility in the internal combustion engine.

More particularly it is proposed to provide certain improvements in one or both of the electrodes of the spark plug whereby a stratum of emissive material is incorporated in the tip of the electrode for ionizing the gap between the electrodes.

It is further proposed to arrange the emissive material in one or more layers extending lengthwise into the body of the electrode to a considerable depth so that when the extreme exposed portion of such material wears away, a pocket or groove is left which still exposes the material.

It is further proposed to join the emissive material to the other material of the electrode by mechanical means, as by pressure, whereby the materials are forced into intimate contact without impairing the emissive properties of the emissive material.

A further object of my invention is to provide an electrode for a spark plug or the like in which the portion of the electrode exposed to the heat of the combustion chamber, hereinafter described as the tip of the electrode, is made particularly with a view of resisting heat and corrosion, whereas the portion thereof mounted remote from the combustion chamber is made of material having particularly heat-conducting properties.

Another important object of the present invention, in its preferred form, is to make the tip of the electrode itself of different metals, an outer layer being selected with a view of resisting heat and corrosion, and the inner portion with a view of conducting heat away from the combustion chamber, and also with a view, in one preferred form at least, of yielding to wear somewhat more rapidly than the outer material, whereby a cupped effect is produced which facilitates the spark discharge.

And finally I propose in the present invention to provide a number of different methods by which the said material may be incorporated in the electrode in the desired manner.

Further objects and advantages of my invention will appear as the specification proceeds and the novel features thereof will be fully set forth in the claims hereto appended.

The preferred forms of my invention are illustrated in the accompanying drawing, forming part of this application, in which:

Figure 1 shows a side elevation of a spark plug having my improvements incorporated therein;

Figure 2, an enlarged sectional view of the lower part of the spark plug;

Figure 3, a horizontal section through the electrode, on an enlarged scale, taken along line 3—3 of Figure 2;

Figure 4, a horizontal section through a modified form of electrode; and

Figure 5, a similar section through a further modified form of my invention.

While I have shown only the preferred forms of my invention, I wish to have it understood that various changes or modifications may be made within the scope of the claims hereto attached, without departing from the spirit of the invention. More particularly, it should be understood that, while I have described my invention principally in connection with a spark plug electrode, certain principles thereof may be readily applied to electrodes generally.

Figure 1 illustrates a conventional type of spark plug 1 having the two electrodes 2 and 3 arranged to form a spark gap 4 between the same. The present invention resides principally in the particular construction shown in connection with the electrode 3. The same construction, however, could be applied to the other electrode 2, or to both electrodes, if desired.

The electrode 3 is shown in Figures 2 and 3 as comprising a core 5, which is preferably made of nickel or copper, a tubular member 6 surrounding the core so as to leave an annular spacing, as at 7, and an annular layer 8 interposed between the core and the tubular member.

The interposed layer 8 consists of emissive material adapted to cause ionization of the gap between the two electrodes whereby the properties of the spark are much improved. The emissive material itself is well-known in the art and may comprise a large variety of different mixtures, such as, for instance, any one of a group including barium oxide, strontium oxide, cerium dioxide, and thorium oxide, mixed with carbon and a suitable binder, such as molasses.

It will be noted that the emissive material is exposed to the gap and forms an annular ring facing the same. In use the ring will wear away to a certain depth so as to form an annular groove which still exposes the emissive material. As the latter wears away, the adjacent edges of the core and of the tubular member will also wear to a certain extent so as to round into the groove.

If the core is made of copper, the entire thickness will wear away to a certain depth, thereby producing a cupped effect which is favorable to and facilitates the spark discharge. If the core is made of nickel, this would be true to a less extent, but a natural rounding off at the edges would still occur, leaving a scalloped cross-sec-

tion, with the emissive material exposed in the bottom of the groove.

The entire electrode may be made of the same construction throughout the length thereof, but it is also possible to use a main upper section 9 of electrode of different construction and a tip section 10 made in accordance with my invention, the tip section being capable of being welded to the main body section, as at 11.

If the electrode is made in two pieces, I preferably use copper for the upper portion of the electrode which is protected by the body of the plug, because copper is a good conductor of heat and tends to carry heat away from the combustion chamber. The lower part or tip section of the electrode should be made in accordance with my invention, as above described, preferably with a heat and corrosion resisting outer layer, such as nickel, and a core made either of copper to encourage heat conduction or of nickel or similar material to resist corrosion, whichever property seems most desirable under given conditions.

It is also possible, of course, to use a tip of conventional construction, without emissive material, but heat and corrosive resistant, and to attach the same to a body made of material selected principally for its heat conducting properties, such as copper.

Since the electrode of a spark plug is of a rather small diameter, usually not more than one-tenth of an inch, the construction of my electrode offers certain difficulties, which I have successfully overcome in a number of different ways.

In disclosing these methods, I do not wish to be understood as confining myself to the particular methods of making the electrode, but desire protection on the electrode itself, regardless of the methods by which it is made.

To produce the electrode shown in Figure 3, I first make the same of much larger dimensions. I might, for instance, use a core of about three-sixteenths of an inch in diameter, apply a pasty coat of the emissive material to the surface, making the layer about one sixty-fourth of an inch thick, baking the layer and then introducing the core with the layer into a tubular member which may be about three-sixteenths of an inch thick. This would make the total diameter somewhat over one-half of an inch.

This assembly, thus constructed, is then attenuated by a swaging process to the thinness desired, which is about one-tenth of an inch in diameter. It is then cut into proper lengths to form complete electrodes, or mere tips for electrodes.

Another method, for producing a suitable electrode of the type shown in Figure 4, may be described as follows:

A thin plate 15 of copper or nickel may be coated with a film of emissive material and may then be rolled spirally into the form illustrated in Figure 4. It is then approximately tubular and may be pushed into a retaining tube 16, which is preferably made of nickel. After completion, it may be attenuated in the manner previously described.

A third method of construction is illustrated in Figure 5, according to which a number of wire strands 17 are coated with the emissive material, and are bundled into approximately cylinderical form and pushed into the retaining tube 18. Any voids which may exist between the strands will be squeezed out in the attenuating process.

In the forms shown in Figures 4 and 5, the selection of materials is subject to the same considerations as in the form shown in Figure 3. The outer material should be particularly resistent to heat and corrosion, while the material used on the inside may be either the same or may be selected more with a view of encouraging heat conduction.

I claim:

1. A spark plug having an electrode containing a body of emissive material facing the gap of the plug.

2. A spark plug having an electrode containing a body of emissive material mechanically confined therein so as to face the gap of the plug.

3. A spark plug having an electrode containing a body of emissive material mechanically held therein so as to face the gap of the plug, the body of emissive material extending into the electrode to a substantial depth.

4. A spark plug having an electrode containing a body of emissive material mechanically held therein so as to face the gap of the plug, the body of emissive material extending into the electrode to a substantial depth and being of substantially uniform cross-section.

5. A spark plug having an electrode comprising a rod of heat-conducting material having a tip secured thereto, the tip having emissive material embedded therein so as to be exposed at the free end of the tip, and the emissive material extending uniformly throughout the length of the tip.

6. The method of making an emissive electrode which comprises coating a rod with emissive material and surrounding the coated rod with a retaining wall.

7. The method of making an emissive electrode which comprises coating a rod with emissive material, surrounding the coated rod with a retaining wall and attenuating the resulting assembly to a desired thinness.

8. The method of making an emissive electrode which comprises coating a sheet of material with emissive material, spirally rolling the sheet into tubular form and surrounding it with a retaining wall.

9. The method of making an emissive electrode which comprises coating a plurality of rods with emissive material, bundling the rods to form a tubular assembly and surrounding the assembly with a retaining wall.

10. An electrode for a spark plug or the like having a free end comprising an outer retaining wall of heat and corrosive resisting material, a core facing the gap of the spark plug and being of less resisting material, and a body of emissive material confined with the core within the retaining wall and extending into the electrode to a considerable depth, whereby upon use portions of the core and the emissive material wear away to form a cup in the bottom of which the core and the emissive material are exposed.

11. An electrode for a spark plug or the like having a tip comprising an outer wall of heat and corrosion resistant material and a core of material having a high degree of heat conductivity and having a body of emissive material mechanically held within the outer wall so as to face the gap of the spark plug.

12. An electrode for a spark plug or the like having a tip with a body of emissive material mechanically held therein so as to face the gap of the spark plug.

HERMAN J. FANGER.