

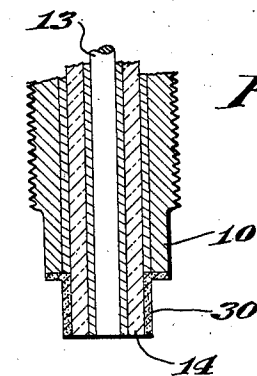
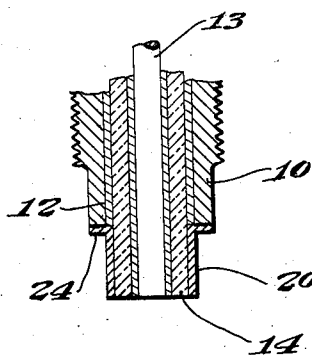
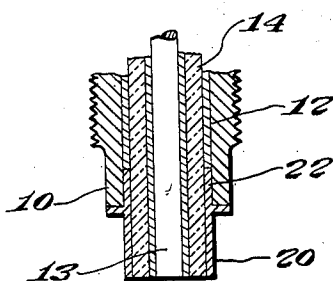
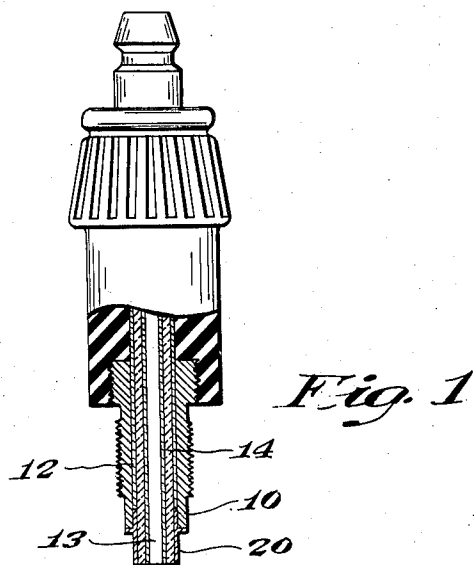
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SPARK PLUG

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SPARK PLUG

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9 Claims. (Cl. 123-169)

This invention relates to a spark plug.

One object of the invention is to improve the construction of a spark plug and more particularly of a spark plug of the general type forming the subject matter of my United States Letters Patent No. 2,069,951, to increase the operating efficiency of the plug under varying conditions of service.

A further and more specific object of the invention is to improve the construction of the firing end of a spark plug of the character described not only with respect to its operating efficiency under varying conditions of service but also to increase its durability and particularly to provide a spark plug having its firing end constructed to resist, for long periods of time, corrosion and wear, resulting from the effects of continual sparking during the use of the spark plug.

A still further object of the invention is to provide a novel and improved spark plug and particularly a spark plug of the character referred to, whose construction is such as to facilitate the manufacture of the complete plug to the end that liability of cracking of the insulating member of the plug may be reduced to a minimum, while at the same time producing a construction of spark plug which is highly efficient in operation, particularly under difficult service conditions such as are encountered in an oily engine.

With these objects in view and such others as may hereinafter appear, the invention consists in the spark plug and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawing, Fig. 1 is an elevation, partly in section of the preferred form of spark plug embodying the invention; Fig. 2 is an enlarged sectional detail of the firing end of the spark plug shown in Fig. 1; Fig. 3 is a similar view illustrating a modification of the spark plug shown in Fig. 1, and Fig. 4 is a similar view illustrating still another modification of the spark plug shown in Fig. 1.

The different features of the present spark plug are preferably but not necessarily embodied in a spark plug of the general type forming the subject matter of my United States Letters Patent No. 2,069,951, issued February 9, 1937 and as herein shown, the spark plug comprises an outer metallic sleeve 10 having a longitudinal bore 12 therethrough and a centrally disposed inner electrode 13 comprising a metallic rod or wire. The inner electrode may and preferably will com-

prise a corrosion resisting element such as is now commonly used in spark plug manufacture and which may, for example, comprise a nickel-manganese alloy. The outer and inner electrodes 10, 13 are preferably insulated by an insulating member 14 of tubular form and preferably of thin refractory material and the tubular member 14 together with the inner electrode 13 is arranged to project beyond the end of the metallic sleeve 10. The remaining elements of the spark plug may and preferably will comprise those set forth in my Patent No. 2,069,951, above referred to, to which reference may be made.

In accordance with the present invention, the firing end of the present spark plug is formed by mounting a separate tip member 20 upon the end of the metallic sleeve 10 to form in effect an extension thereof, and the tip member is preferably of tubular shape and arranged to surround the projecting portion of the insulating member 14 to form the firing end of the plug. In the preferred embodiment of the invention the tip member 20 preferably comprises a corrosion resisting alloy such as a nickel-manganese alloy or it may be formed of other high nickel alloys including a nickel chromium alloy or of any suitable corrosion resisting alloy now upon the market. In the preferred form of the invention the tip member 20 of the outer electrode is formed of thin walls and of a size such as to very closely fit the projecting end portion of the insulating member 14 to reduce to a minimum the liability of oil accumulation between the insulating member 14 and the tip member 20 of the spark plug. The tip member 20 may be secured to the end portion of the metallic sleeve 10 in various ways, as, for example, by being welded in the manner illustrated in Fig. 3, or the tip member may be provided with a flange and a portion 22 of a size such as to form a driving fit into the end of the bore 12 of the sleeve 10.

It is preferred that the tip member 20 and the projecting portions of the insulating member 14 and the inner electrode 13 may be related to one another so that the ends thereof lie in substantially one plane to form the firing end of the plug so that during operation the sparking occurs across the end of the insulation from one electrode to the other.

In order to increase the operating efficiency for spark plugs of the general type illustrated in my patent above referred to, it has been found that the reduced dimension or thickness of the walls of the present tip contributes markedly to increasing the heat range within which the present

plug may be used and operated efficiently. It is my theory that the thin tip conducts an amount of heat away from the relatively large body of the insulator 14 at such a rate as to enable the end of the insulator 14 to remain in a most efficient heated condition so as to enable the plug to operate under a relatively wide range of heat conditions in different engines while at the same time sufficient heat is conducted away so as to prevent the firing end portion of the plug from getting hot enough to cause detonation. Another explanation appears to be that the present construction of the firing end of the plug is such that the plug does not become excessively hot in the explosion part of the cycle of operation of the engine but neither does it become excessively cool from the exhaust part of the cycle of operation of the engine, and as a result minimum fouling of the firing end of the plug has been found to occur even though the plug is used in hot and cool running engines and under oily conditions.

In order to resist the corrosive action due to the continual sparking, I prefer to construct the tip of the plug of corrosion resisting alloys such as 95% nickel, 5% manganese, or nickel chromium alloys and in fact many suitable corrosion resisting alloys may be obtained upon the market. The thinness of the wall section of the present tip makes it desirable that the tip be made of such a corrosion resisting alloy in order that the plug may be operated for long periods of time.

In producing the present structure of plug I have experienced very satisfactory results using a center electrode of 0.045 of an inch diameter, a porcelain insulating tube of from 0.025 to 0.026 of an inch wall thickness and with the metal tip 20 of the wall thickness of about 0.010 of an inch and of an inside diameter of 0.103 of an inch. The metal tip is preferably arranged to fit around the projecting end of the insulating tube 14 with minimum clearance and in practice a clearance of 0.001 of an inch has been found to provide a satisfactory joint.

The present construction of spark plug may be utilized to facilitate the manufacture of the plug and the assembling of the insulating member with relation to the metal sleeve. It has been found desirable to construct a metal sleeve with a bore 12 of a size such as to provide substantial clearance between the walls of the bore and the insulating tube 14 such, for example, as a clearance of 0.005 of an inch so that the tube may be readily inserted into the bore with minimum liability of bending strains being placed upon the tube and hence minimum liability of cracking of the tube during the assembling of the component parts of the plug. By constructing the tip 20 so as to closely fit the end portion of the insulating tube 14 it has been found that this advantage may be secured while reducing oil accumulation to a minimum under varying conditions of use. The inner electrode 13 may be cemented within the insulator 14 and the portion of the latter above the tip 20 cemented to the outer electrode 10.

In the modified form of spark plug shown in Fig. 3 the tip 20 may be provided merely with the flange 24 and the latter welded to the end of the outer electrode 10. In the modification illustrated in Fig. 4 the thin tip member 20 constituting the firing end of the outer electrode may be formed by depositing a thin film or layer 30 of metal and preferably of corrosion resisting metal such as chromium or nickel directly upon the projecting end of the insulating tube 14. In prac-

tice I may deposit this film 30 by spraying or plating the same in accordance with the known spraying and plating methods and the thin film 30 will be deposited to a sufficient thickness to comprise an extension of the sleeve 10 and to thereby produce a thin tubular metallic tip electrically connected with the sleeve 10 and firmly secured to the surface of the projecting portion of the insulator 14, all as is clearly illustrated in Fig. 4.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In a spark plug, an outer metallic threaded sleeve, an inner electrode, and a body of insulating material between the outer and inner electrodes, said inner electrode and insulating member projecting beyond the end of the threaded sleeve, and a short preformed thin-walled metallic tubular member welded to the end of the sleeve and surrounding the projecting ends of the insulating member and inner electrode.

2. In a spark plug, an outer electrode provided with a bore, an inner electrode within said bore, a thin-walled elongated tubular insulating member disposed within and substantially filling the space between said outer and inner electrodes, the inner electrode and insulating member projecting beyond the end of the outer electrode, and a thin-walled tubular metal member mounted upon the end of the outer electrode and closely fitting around said insulating member and being of a length commensurate with the projecting portions of the inner electrode and insulating member.

3. In a spark plug, an outer metallic sleeve provided with a bore of substantially uniform dimension throughout its length, an inner electrode within said bore and projecting beyond one end thereof, a thin walled elongated tubular insulating member of substantially uniform dimension throughout its length disposed within said bore between the metallic sleeve and the inner electrode, said insulating member being of a size sufficiently smaller than the bore to provide a clearance between the insulating member and the bore, a body of cement filling said clearance and a separate thin metal tip member mounted on the end of the sleeve and surrounding the projecting portion of the insulating member so closely as to provide substantially no clearance whereby to control the operating temperature of said projecting portion of the insulating member.

4. In a spark plug, an outer metallic sleeve provided with a bore of substantially uniform dimension through its length, an inner electrode within said bore and projecting beyond one end thereof, a thin walled elongated tubular insulating member of substantially uniform dimension throughout its length disposed within said bore between the metallic sleeve and the inner electrode, said insulating member being of a size sufficiently smaller than the bore to provide a clearance between the insulating member and the bore, a body of cement filling said clearance and a separate thin metal tip member welded to the end of the sleeve and surrounding the projecting portion of the insulating member so closely as to provide substantially no clearance whereby to control the operating temperature of said projecting portion of the insulating member.

5 5. In a spark plug, an outer metallic sleeve provided with a bore of substantially uniform dimension throughout its length, an inner electrode within said bore, a thin walled elongated tubular insulating member of substantially uniform dimension throughout its length disposed within and substantially filling the space between said outer metallic sleeve and said inner electrode, the inner electrode and insulating member projecting beyond the end of said sleeve and a thin walled tubular metal member secured upon the end of the metallic sleeve to form a part thereof, the thinness of said tip controlling the operation temperature of the projecting portion of said insulating member.

10 6. In a spark plug, an outer metallic sleeve provided with a bore of substantially uniform dimension throughout its length, an inner electrode within said bore, a thin walled elongated tubular insulating member of substantially uniform dimension throughout its length disposed within and substantially filling the space between said outer metallic sleeve and said inner electrode, the inner electrode and insulating member projecting beyond the end of said sleeve and a thin walled tubular metal tip member mounted upon the end of said sleeve and closely fitting around the projecting portion of said insulating member whereby to control the temperature of said projecting portion of said insulating member during use of the plug.

15 7. In a spark plug, an outer electrode comprising a sleeve having a bore, an inner electrode within said bore, a thin walled elongated tubular insulating member disposed within and substantially filling the space between said outer and said inner electrodes, said inner electrode and insulating member projecting beyond the end of

said sleeve and a tubular metal tip member mounted upon the end of said sleeve and closely fitting around the projecting portion of said insulating member whereby to control the temperature of said projecting portion of said insulating member during use of the plug.

5 8. In a spark plug, an outer electrode comprising a sleeve having a bore, an inner electrode within said bore, a thin walled elongated tubular insulating member disposed within and substantially filling the space between said outer and said inner electrodes, said inner electrode and insulating member projecting beyond the end of said sleeve, and a tubular metal tip member of corrosion resisting alloy welded upon the end of said sleeve and closely fitting around the projecting portion of said insulating member whereby to control the operating temperature of said projecting portion of the insulating member during the use of the plug.

10 9. In a spark plug, an outer metallic sleeve provided with a bore of substantially uniform dimension throughout its length, an inner electrode within said bore and projecting beyond one end thereof, a thin walled elongated tubular insulating member of substantially uniform dimension throughout its length disposed within said bore between the metallic sleeve and the inner electrode, said insulating member being of a size sufficiently smaller than the bore to provide a clearance between the insulating member and the bore, a body of cement filling said clearance and a separate thin metal tip member welded upon the end of the sleeve and surrounding the projecting portion of the insulating member, said tip member being substantially the length of said projecting portion of the insulating member.

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