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A. C. HASTINGS, JR

2,122,571

SPARK PLUG

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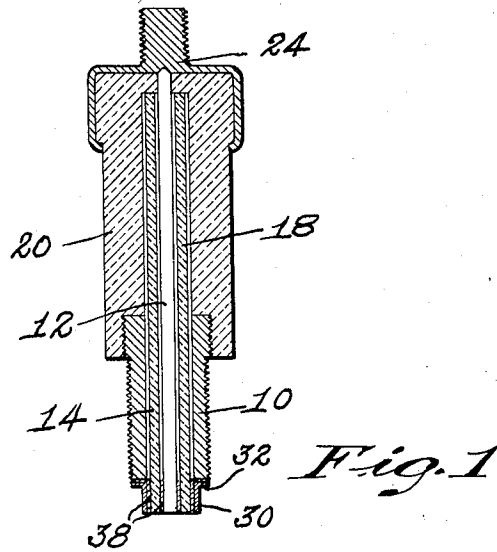


Fig. 1

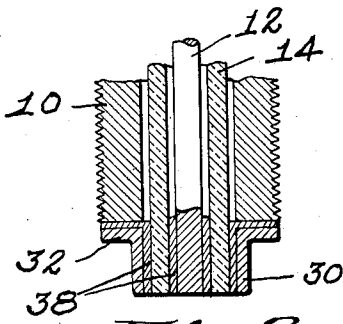


Fig. 2

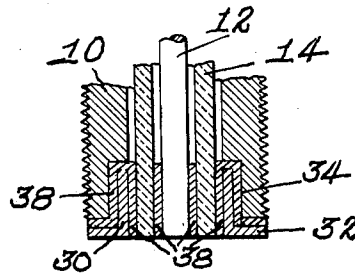


Fig. 3

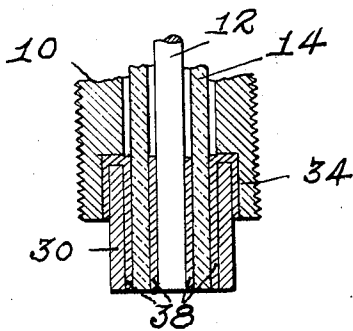


Fig. 4

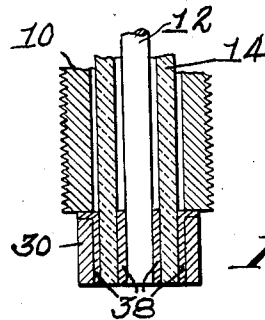


Fig. 5

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SPARK PLUG

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Application January 19, 1937, Serial No. 121,296

9 Claims. (Cl. 123—169)

This invention relates to a spark plug.

One object of the invention is to provide a novel and improved construction of spark plug which may be economically manufactured, easily cleaned, and which is adapted to operate efficiently for long periods of time.

Another object of the invention is to provide a novel and improved spark plug of the type embodying an outer electrode, an inner electrode and an insulating member between the electrodes and in which provision is made for sealing the firing end of the spark plug against gas leakage in a novel and efficient manner.

With these general 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 illustrating different embodiments of the invention, Fig. 1 is a vertical sectional view of the preferred form of spark plug; Fig. 2 is an enlarged detail of the lower portion or firing end of the spark plug shown in Fig. 1; and Figs. 3, 4, and 5 are views similar to Fig. 2 of modified forms of spark plugs embodying the invention.

In general, one feature of the invention contemplates a novel construction of spark plug of the type embodying an outer metallic electrode, an inner electrode and a tubular insulating member disposed between the electrodes and in which provision is made for sealing the spaces between the insulating member and the outer and inner electrodes in a novel and efficient manner adapted to reduce to a minimum gas leakage between these parts when the spark plug is used. Another feature of the invention contemplates a construction of spark plug of the type embodying an outer electrode, an inner electrode extended therethrough and a tubular insulating member disposed between said electrodes and in which the outer and inner electrodes are composed, for at least the hot or firing end of the plug, of metal having substantially the same expansion characteristics as the insulating member to the end that the parts during manufacture may be made to a close fit thus facilitating the sealing of the spaces between the electrodes and the insulating member. Another feature of the invention contemplates a novel and highly efficient construction of spark plug embodying an outer metallic electrode, an inner metallic electrode and a thin tube of refractory material disposed between the

electrodes and in which provision is made for sealing the firing end of the plug by fusing the insulating member to the inner and outer electrodes.

Referring now to the drawing, the spark plug illustrated in Fig. 1 embodies an outer metallic electrode shown as comprising a metallic sleeve 10 having a longitudinal bore therethrough and a centrally disposed inner electrode comprising a metallic rod or wire. The insulating member 14 is preferably of tubular form and of substantially uniform wall thickness to the end that it may be produced economically in accordance with existing methods of manufacture. The tubular insulating member 14 is preferably, but not necessarily, arranged to terminate at the firing end of the plug in substantially the plane of the ends of the outer and inner electrodes 10, 12 so that during the operation of the spark plug, sparks are caused to traverse across the ends of the insulating member 14. The end portion 18 of the insulating member 14 is, as herein shown, arranged to project above the outer electrode 10 and is protected by a second insulating member 20 preferably comprising a molded insulating composition such as a phenolic-formaldehyde resinous composition or other suitable insulating material. The inner electrode may be electrically connected to a suitable terminal member 24 in any desired manner as illustrated in Fig. 1.

In accordance with one feature of the invention, it is preferred to construct at least the firing end portion of the outer and the inner electrodes of a metal or metallic alloy selected from any of the known metals or alloys having substantially the expansion characteristics as the insulating member 14. As typical of one such alloy I may refer to and have experienced satisfactory results utilizing, an iron-nickel-cobalt alloy obtainable upon the market under the trade name "Kovar". This particular alloy possesses substantially the expansion characteristics of glass, and it is preferred therefore, in accordance with this feature of the invention, to utilize glass as the tubular insulating member 14 and preferably of a wall thickness substantially equal to the usual spark gap employed in between the electrodes of the usual spark plug now on the market. For economical reasons, and as illustrated in Fig. 1, the outer electrode may be composed of a composite structure formed by welding or brazing a small "Kovar" or equivalent sleeve or eyelet 30 to the lower end of the outer electrode 10. The sleeve or eyelet 30 is preferably provided with a flanged portion 32 of a size substantially coexten-

sive with the end of the outer electrode 10 and the flanged portion may be conveniently welded to the sleeve as illustrated in Figs. 1 and 2. As a modification of this structure, the outer electrode may be provided with a countersunk portion 34, as shown in Fig. 3, and the "Kovar" or equivalent eyelet 30 disposed in the countersunk portion with the body of the eyelet, as well as the flange, welded to the outer electrode. In Figs. 4 and 5 I have illustrated other forms of the firing end of the plug in which the metallic sleeve may be countersunk as shown in Fig. 4 and the sleeve or eyelet formed without a flange the body and end of the eyelet 30 welded to the outer electrode. In Fig. 5 the end of the eyelet 30 is welded directly to the end of the outer electrode without the use of a flange.

In order to effectively seal the spark plug against gas leakage during the use of the plug, I prefer to construct the insulating member 14 of a fusible material, preferably a tube of a sealing glass obtainable upon the market and to subject the firing end of the plug to heat and pressure such as to effect fusion of the end portion of the insulating tube 14 to thereby cause it to adhere to the inner and outer electrodes to hermetically seal the spaces therebetween. In the drawing such fused sealing portions are illustrated at 38 and when "Kovar" or another equivalent metallic alloy is utilized as the firing end portion of the outer and inner electrodes, as above described, expansion troubles are eliminated and the fused seal thus produced is of a permanent and highly efficient nature.

In some instances I may find it of advantage to reinforce the fused sealing portions 38 by additional cement of any usual composition at present employed for this purpose, disposed between the upper portions of the insulator 14 and the outer and inner electrodes, and in some instances where it is preferred not to utilize the fusible seal, I prefer to provide a cementitious seal between the insulator member 14 and the inner and outer electrodes.

In general, it is preferred to utilize a thin walled glass tube as the insulator 14, thus enabling the spark plug to possess the advantages in this respect of the spark plug forming the subject matter of my copending application, Serial No. 59,351, but it is not desired to limit the invention in this respect as other known insulating members may, for some purposes, be found advantageous, particularly vitreous refractory materials such as porcelain, and the firing ends of such spark plugs, may, if desired, be sealed in any desired manner, as for example by utilizing any known or preferred fusible materials to form the fused sealing portions 38 between the insulator and the outer and inner electrodes.

While it is preferred to hermetically seal the firing end of the plug, as above described, nevertheless other forms of seal may be used with advantages, particularly in spark plugs of the character described and embodying "Kovar" or equivalent electrodes or parts thereof.

By the use of the term "thin" as employed in my claims, I intend to define a thickness of glass sufficiently small that the thickness of the insulating materials now commercially employed between the inner and outer electrodes in the manufacture of spark plugs for the same operating conditions at least is several times as great.

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. A spark plug having an outer metallic member having an elongated bore therethrough, an inner electrode extending through the bore, a thin tube of heat resisting glass between the inner electrode and said outer metallic member, a metallic tube having substantially the coefficient of expansion of the glass secured to and forming a part of said outer metallic member, the lower portion of said glass being fused to said metallic tube and to the inner electrode.

2. A spark plug having an elongated metallic outer member provided with a tubular metal member welded upon one end thereof, an inner electrode having one end extending within said tubular metal member, and an insulating member comprising a tubular member of heat resisting glass having its end portion disposed between the tubular metal member and said inner electrode and fused to each to seal the firing end of the plug.

3. A spark plug having an elongated metallic outer member provided with a tubular metal member welded upon one end thereof, an inner electrode having one end extending within said tubular metal member, and an insulating member comprising a tubular member of heat resisting glass having its end portion disposed between the tubular metal member and said inner electrode and fused to each to seal the firing end of the plug, said tubular metal member having substantially the coefficient of expansion of the glass insulating member.

4. A spark plug having an elongated metallic outer member provided with a thin tubular metal member welded upon one end thereof, an inner electrode having one end extending within said thin tubular metal member, and an insulating member comprising a thin tubular member of heat resisting glass having its end portion disposed between the thin tubular metal member and said inner electrode and fused to each to seal the firing end of the plug, said thin tubular metal member and said inner electrode having substantially the coefficient of expansion of the glass insulating member.

5. A spark plug having an outer metallic electrode, an inner metallic electrode extended therethrough, a fusible insulating member between the inner and outer electrodes, a metallic tube forming part of the outer electrode and having the same expansion characteristics as said fusible insulating material and being provided with a flange secured to the end portion of the outer member, said fusible insulating material being fused to said metallic tube and to the end portion of the inner electrode whereby to hermetically seal the plug.

6. A spark plug having an outer metallic electrode, an inner metallic electrode extended therethrough, a fusible insulating member between the inner and outer electrodes, a metallic tube forming part of the outer electrode and having the same expansion characteristics as said fusible insulating material and provided with a flange, said flange being secured to the end portion of the outer member, said fusible insulating material being fused to said metallic tube and to the end portion of the inner electrode whereby to hermetically seal the plug.

7. A spark plug having an outer metallic electrode, an inner metallic electrode extended there-

through, a fusible insulating member between the inner and outer electrodes, a metallic tube having the same expansion characteristics as said fusible insulating material, said tube extending upwardly
5 into the outer member and provided with a flange, said flange being secured to the end portion of the outer member, said fusible insulating material being fused to said metallic tube and to the end portion of the inner electrode whereby to
10 hermetically seal the plug.

8. A spark plug having an outer metallic electrode, an inner metallic electrode extended there-through, a fusible insulating member between the metallic electrodes, a metal tube of the same ex-

pansion characteristics as the fusible insulating material secured to the end portion of the outer metallic electrode, said insulating material being fused to said metallic tube and inner electrode.

9. A spark plug having an elongated metallic
5 outer member having an elongated bore there-through, an inner electrode extending through the bore and an insulating member comprising a tubular member of heat resisting glass disposed between the inner and outer electrodes and fused
10 to both electrodes at the firing end only to seal the firing end of the plug.

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