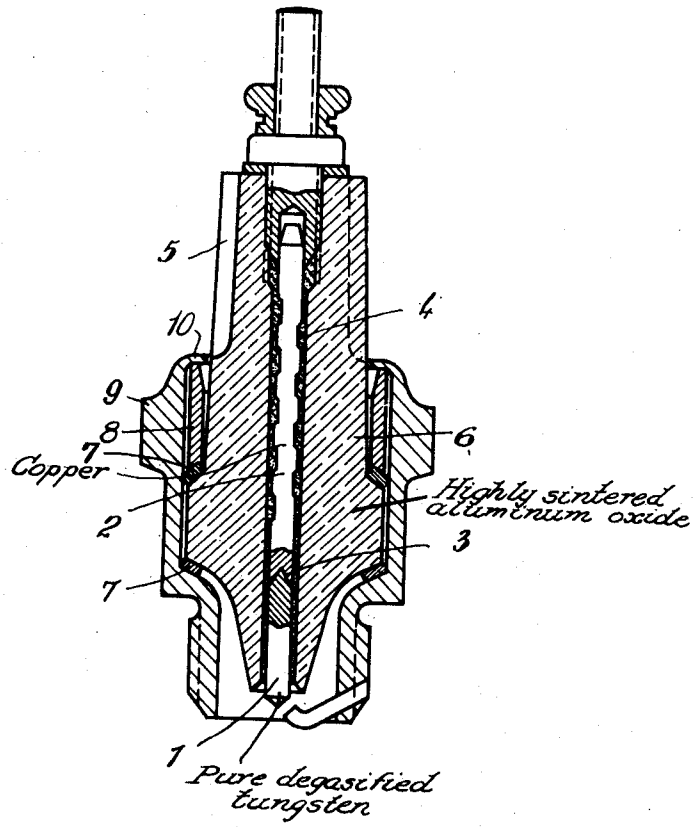
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SPARK PLUG FOR INTERNAL COMBUSTION ENGINES

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SPARK PLUG FOR INTERNAL COMBUSTION ENGINES

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Our invention relates to improvements in spark plugs for internal combustion engines, and more particularly to a spark plug with a composite central electrode.

It has hitherto been customary to use nickel as the most suitable electrode material for spark plugs. In internal combustion engines, in which high temperatures prevail, it has been found that nickel is, however, not sufficiently resistant to the intense heat developed therein, since it has a relatively poor thermal conductivity. This results in an overheating of the nickel electrodes. Beads formed by the fusion of the electrodes cluster around the sparking points thereof so that not only is the sparking impaired and the distance between the electrodes varied, but the dissipation of heat is still further affected by the formation of such beads which, moreover, retain the heat, thus overheating the sparking points to such an extent as to cause an untimely ignition of the combustion gases.

Besides, the nickel electrodes in operation experience at high temperatures a permanent increase in diameter. It is, therefore, necessary to carry out the diameter of the nickel electrodes smaller than would otherwise be required, also particularly on account of the great expansion of the nickel due to heat, in order to prevent the insulator from bursting. Allowance must also be made for a thicker cement layer in sealing the electrodes in the insulator in order that the compound may yield to the pressure caused by the expansion of the electrodes. In this case, however, the effectiveness of the sealing is frequently impaired.

In order to carry off the heat from the electrodes of the spark plugs, it has already been proposed to manufacture the electrodes of different materials by employing for the sparking points a thin platinum or iridium wire sealed into the insulator. The end of this platinum or iridium wire placed in the interior of the insulator contacts with a copper rod to the terminal of which the supply lead is connected. In an arrangement in which a copper rod contacts only with a considerably thinner platinum wire, an effective dissipation of heat cannot be attained.

Moreover, it is well known in the art to provide a nickel sleeve with a core of copper. In this case the nickel sleeve serves as a sparking means, while the copper core carries off the heat from the sleeve through the insulator to the outside atmosphere. In order to attain in such an arrangement a sufficient dissipation of heat, it is necessary to amply dimension the cross-section of the copper core. As this core is, besides, surrounded by the nickel sleeve which should not be too thin in order to be sufficiently heat resisting, the complete electrode assumes relatively large proportions so that this will give rise to difficulties as to the sealing in the insulator. Further, from the use of nickel as material for the sparking points of electrodes, the above-mentioned drawbacks arise which render such an arrangement unsuitable in connection with internal combustion engines in which high temperatures prevail.

It is also known in the art to employ tungsten as material for the electrodes of spark plugs by sealing, for instance, into the insulator an extremely thin tungsten filament or by riveting a bit of tungsten to a holding means. In the first case, a reliable and tight joint of the insulator may only be attained with the thin tungsten filament, if the insulator be fired at a sufficiently high temperature. In the other case, the riveting of a bit of tungsten to a holding means encounters difficulties owing to the difficult plasticity of tungsten; besides, the lower end of the less resistant holding means facing the combustion chamber is preferably exposed to the hot combustion gases, so that it is easily overheated. This will cause an untimely burning off of said lower end, so that the bit of tungsten riveted to the holding means drops into the cylinder of the engine and may give rise to serious causes of trouble.

According to the invention the central electrode is designed in such a manner that the sparking point thereof consists of pure tungsten which is besides preferably degasified. A tungsten metal as employed in the manufacture of incandescent lamps is particularly suitable for this purpose. The tungsten is combined with a copper rod, consisting of copper fused under vacuum, by fusing the copper rod with tungsten in a well-known manner under vacuum. An extremely tight as well as a mechanically reliable joint is thus attained between tungsten and copper so that the heat may be readily transferred from the tungsten to the copper and then given off to outside atmosphere.

The pure tungsten is also resistant to the high temperatures prevailing in internal combustion engines and it is not subjected to changes as is the case with nickel. The cementing may, consequently, be effected irrespective of a continuous increase in diameter. It is, therefore, possible to obtain with the smallest amount of cement a perfectly reliable and tight joint of the electrode in the insulator. Besides, the tungsten is highly resistant to heat so that this material proves ad-

vantageous in many respects when using it as electrode material for spark plugs. The difficulties in effecting a tight joint with the copper rod are overcome by fusing under vacuum tungsten with copper fused under vacuum. Furthermore, if insulators of highly sintered aluminum oxide, for instance, sintered at 1750° C., are used, the heat of such insulators is readily carried off owing to the high heat conductivity so that both sensitive parts, central electrode and insulator, of the novel spark plug are sufficiently heat-resisting to withstand in operation the maximum stresses due to heat. In this case the high thermal conductivity of the insulator is taken advantage of in order to carry off the heat from the central electrode.

Moreover, it has proved particularly favorable that the expansion of the tungsten is similar to that of the highly sintered aluminum oxide. Also for this reason it is, consequently, impossible for additional stresses of the insulator to occur owing to the expansion of the tungsten inserted in the insulator. Tungsten has further a much higher thermal conductivity than nickel. The electrode remains, consequently, cooler.

In the accompanying drawing is illustrated a longitudinal sectional view of a spark plug embodying our invention.

The central electrode consists of the portion 1 made of tungsten projecting for the greatest part into the insulator and of the upper portion 2 of copper associated therewith. A particularly tight joint of both parts will be obtained during the fusing process, if the tungsten rod is provided with a tapered end 3 around which the copper is placed. An effective adhesion of the copper rod in the insulator body 6 is attained by providing in the upper portion 2 recesses 4, which are preferably disposed in staggered relation as shown. This results in a more reliable joint than would be the case if the surface of the electrode were merely roughened, as the cement (shown stippled) penetrates into the recesses thus securing the electrode to the insulator. Besides, the insulator may be provided with radiating fins 5 extending over the upper portion thereof. The insulator body 6 is seated in the metallic shell 9 between the conventional packing rings 7, and is held in place by means of a ferrule 8 and the inwardly upset upper rim 10 of the metallic shell 9.

We claim as our invention:

1. A spark plug for internal combustion engines comprising a holder, sparking points, a longitudinally apertured insulator of highly sintered aluminum oxide, a composite central electrode rod of high thermal conductivity tightly disposed in said insulator, the lower part of said electrode rod consisting of pure de-gasified tungsten and the upper part thereof of copper fused under vacuum, said lower part being fused with said upper part under vacuum.

2. A spark plug for internal combustion engines comprising a holder, sparking points, a longitudinally apertured insulator of highly sintered aluminum oxide for insulating one of said points from the other, a composite central electrode rod of high thermal conductivity tightly disposed in said insulator, the lower part of said electrode rod consisting of pure de-gasified tungsten and having at the upper end thereof a taper in adhesive contact with the upper part consisting of copper fused under vacuum, said lower part being fused with said upper part under vacuum.

3. A spark plug for internal combustion engines comprising a holder, sparking points, a longitudinally apertured insulator of highly sintered aluminum oxide for insulating one of said points from the other, a composite central electrode rod of high thermal conductivity tightly disposed in said insulator, the lower part of said electrode rod consisting of pure de-gasified tungsten and having at the upper end thereof a taper in adhesive contact with the upper part consisting of copper fused under vacuum, said taper being completely surrounded by copper, said lower part being fused with said upper part under vacuum.

4. A spark plug for internal combustion engines comprising a holder, sparking points, a longitudinally apertured insulator of highly sintered aluminum oxide for insulating one of said points from the other, a composite central electrode rod of high thermal conductivity disposed in said insulator, the upper part of said electrode rod consisting of copper fused under vacuum and being provided with recesses in oppositely staggered relation, and the lower part of said electrode consisting of pure de-gasified tungsten, said lower part being fused with the upper part under vacuum, and cement in the annular space between said electrode and said insulator and heat radiating fins integral with the upper portion of said insulator.

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