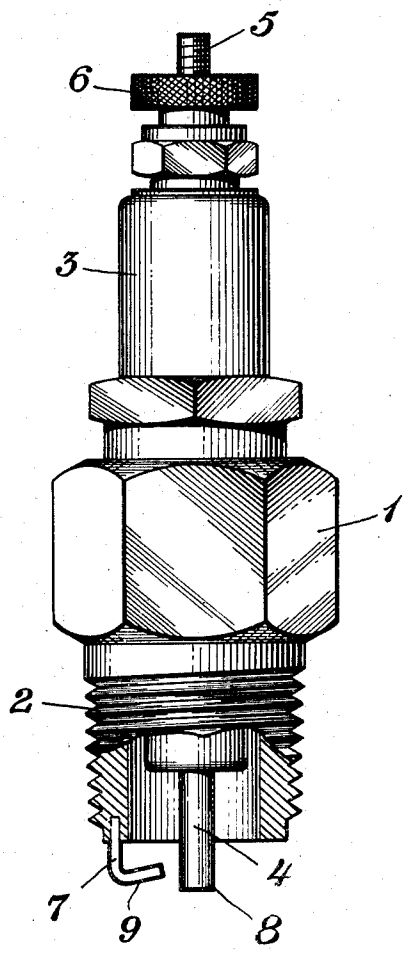
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SPARK PLUG

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SPARK PLUG

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This invention relates to improvements in spark plugs.

As is known, the conditions to which a spark plug is subjected during use impose difficultably obtainable criteria for the several elements, particularly for the central spindle or electrode. This element, in addition to possessing good thermal conductivity and requisite tensile strength, should be of such a character as to resist the errosive action of electrical discharge, accentuated as it is in this case by the high temperature conditions obtaining in the cylinder head. The metal of the electrode furthermore should present minimal tendency to scaling and pitting. These properties are not present to any considerable degree in the typical steel spindle and sparking points generally employed.

We have found that the operative characteristics of spark plugs may be markedly improved by providing at least the exposed surface of the spark points and spindles with a surface of a refractory metal of high atomic density. More particularly we have found that new improved spark plugs and analogous sparking apparatus may be produced by electrodepositing a surface of a tungsten alloy on the metallic parts subjected to the deleterious effects of electrical discharge and/or the high temperature combustion gases.

An object of the present invention therefore is to produce a novel type of spark plug.

Another object is to improve the efficiency of electrodes which operate under high temperature conditions.

Yet another object is to prolong the effective life of electrodes subjected to the errosive effects of electrical discharge at elevated temperatures.

Still another object is to produce an electrode which is highly resistant to deterioration due to electrical influences under high temperatures.

With these and other equally important and related objects in view, the invention comprehends the concept of surfacing such electrodes with an alloy having as one component a heavy refractory metal of the 6th group, such as tungsten or molybdenum. In the preferred method the electrode is electroplated with an alloy of tungsten and a second metal, such as nickel, although it will be understood that other binary tungsten alloys, such as tungsten cobalt, tungsten tantalum and so forth, or ternary alloys, such as tungsten nickel tantalum, may be utilized. Similarly, as will appear more fully hereinafter, in lieu of or in combination with tungsten, molybdenum may be used.

In order to more readily describe the invention a spark plug produced according to the improved method is illustrated in the single figure of the accompanying drawing. Such spark plug may, for example, comprise the usual metallic body 1, prepared in the usual manner with a squared portion for the reception of a suitable tool and formed at its lower end with the threaded section 2. Mounted within the body, in the usual manner, is the insulating material, such as the porcelain tube 3. As is known, this tube is hollow and is adapted to receive the central electrode 4. The electrode is threaded at its upper portion and is adapted to receive the knurled nut 6. The lower portion of the central spindle projects below the end of the body 1 in the usual manner and adjacent this is placed one or more sparking points 7.

In accordance with the present invention the central spindle 4 is provided with a surface 8 which consists of a suitable electrodeposited tungsten alloy. If desired, and as shown in the drawing, the sparking point or points 7 may be similarly covered and protected with an alloy surface 9.

In carrying out the invention the steel wire from which the central spindle is to be made is suitably cleaned as by brushing, subjection to an acid pickle or an electrolytic cleaning bath. Thereafter the lower portion, or if desired the entire length of the wire, may be immersed in a suitable electrolytic bath from which a tungsten alloy is depositable. The composition of such bath and the plating operation may be as described in copending applications Serial Numbers 744,566 and 14,372. Under the operative conditions as defined in the copending applications referred to, a dense, adherent, chemically resistant electrodeposited plate of a tungsten alloy, such as tungsten nickel, is formed on the spindle.

It will be appreciated that depending upon the particular electrical characteristics desired to be imparted to the electrode, the composition of the bath and hence the resulting electrodeposited plate 8 may be varied. Thus, if desired, the spindle may first be plated with nickel either in dull or bright form and thereafter a surface of a tungsten alloy may be electrodeposited on the nickel. Similarly the respective percentages of the components of the alloys may be varied over wide ranges depending upon such factors as the initial ionic concentration of the platable components in the bath, the acidity of the bath, temperature and current density. Operating un-

der the disclosures referred to heretofore electrodeposited plates of say tungsten and nickel may be produced ranging from five percent tungsten to seventy percent tungsten. In ordinary operations an alloy is produced containing approximately thirty-five percent tungsten and the remainder is nickel. Operating with a bath containing ions of tungsten and nickel, various percentages of these components in the plates may likewise be obtained.

As indicated hereinbefore the surface 8 may be formed on the lower portion of the spindle or on the entire length. Similarly this surface may comprise a tungsten nickel alloy with varying percentages of the two components or may comprise other binary alloys, such as tungsten cobalt. Where a surface characterized by a high degree of resistance to thermal influences is desired, the electrodeposited surface 8 may comprise a tungsten tantalum alloy or a ternary alloy of tungsten, nickel and tantalum. Such surface, for example, may be produced according to the method described in the copending application Serial No. 28,187.

The sparking point 7 may be similarly treated. As is known, such points may be separately formed and inserted in a tapped aperture or hole formed in the metal body 1. The sparking point 7 may be plated with tungsten nickel, tungsten cobalt, or other binary tungsten or molybdenum alloys and, if desired, the electrodeposited plate on the sparking point 7 may be of an alloy of different characteristics from that plated on the central spindle 4.

It will likewise be understood that if it is desired to secure the advantages of the invention with spark plugs which have already been formed or made up, this may readily be done by immersing the entire spark plug to the desired depth in the bath and then simultaneously or sequentially plating the electrode 4 and the sparking point 7, together with whatever portion of the threads 2 that is immersed.

It will be appreciated that the spark plug produced in accordance with the present invention presents numerous advantages. In a preferred modification, as for example where the sparking elements are electroplated with a tungsten nickel alloy, the sparking surface is comprised of an alloy which, besides presenting advantageous electrical characteristics, is most resistant to chemical action. The electrodeposited alloys of tungsten and analogous metals referred to herein are characterized by a smooth and resistant surface and hence considerably reduce the tendency to accumulation of amorphous carbon on the surface. A major advantage of the improved spark plug resides in the resistance of the sparking surface to disintegration due to the effect of the electrical discharge accentuated or accelerated under the high temperature conditions obtaining in the cylinder head.

It will thus be seen that the electrodes comprising the spark plug present many advantages. The ferruginous base of the electrodes provide adequate heat conduction and satisfactory tensile properties. The improved electrodeposited surface insures improved electrical characteristics and increased longevity due to the fact that such surface is substantially non-scaling at elevated temperatures and is eminently resistant to erosion under the conditions of electrical discharge at the elevated temperatures obtaining during use.

While the preferred modification of the invention has been described, it is to be understood that this has been given didactically to illustrate the principles involved. It will be appreciated that these principles may be invoked in other circumstances where analogous conditions obtain and a comparable product is desired; this is to say that the invention is considered to comprehend not only specific units such as spark plugs, but other articles or units functioning similarly under equivalent conditions.

We claim:

1. A spark plug for internal combustion motors having sparking elements, said elements having a surface comprising an electrodeposited tungsten alloy, said alloy having a tungsten content of from five to seventy percent.

2. A spark plug spindle comprising a metallic base and a surface comprising an electrodeposited alloy of tungsten, said alloy containing from twenty-five percent to fifty percent tungsten.

3. A spark plug spindle comprising a metallic base and a surface comprising an electrodeposited alloy of tungsten and nickel.

4. A spark plug spindle comprising a metallic base and a surface comprising an electrodeposited alloy of tungsten and cobalt.

5. A spark plug spindle comprising a ferruginous base metal and a surface comprising an electrodeposited alloy of tungsten and tantalum.

6. A spark plug spindle comprising a ferruginous base metal and a sparking point which is surfaced with an electrodeposited alloy of tungsten, the alloy containing approximately between thirty and forty percent of tungsten.

7. A spark plug spindle comprising a ferruginous base metal and a sparking point which is surfaced with an electrodeposited alloy of tungsten and nickel.

8. A spark plug spindle comprising a ferruginous base metal and a sparking point which is surfaced with an electrodeposited alloy of tungsten and cobalt.

9. A spark plug spindle comprising a ferruginous base metal and a sparking point which is surfaced with an electrodeposited alloy of tungsten and tantalum.

10. A spark plug for internal combustion engines comprising a central electrode and an adjacent cooperating spark point, each of which are surfaced with an electrodeposited tungsten nickel alloy.

11. A spark plug for internal combustion engines comprising a central electrode and an adjacent cooperating spark point, the electrode being surfaced with an electrodeposited tungsten nickel alloy, the sparking point being surfaced with an electrodeposited tungsten alloy of different characteristics.

12. A spark plug electrode comprising a metallic base, which base is surfaced with an electrodeposited alloy of tungsten, tantalum and nickel.

13. A spark plug electrode comprising a metallic base, which base is surfaced with an electrodeposited alloy of tungsten, tantalum and cobalt.

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