April 5, 1932. O. C. ROHDE 1,852,265

SPARK PLUG

Filed Jan. 29, 1932

Fig. 1.

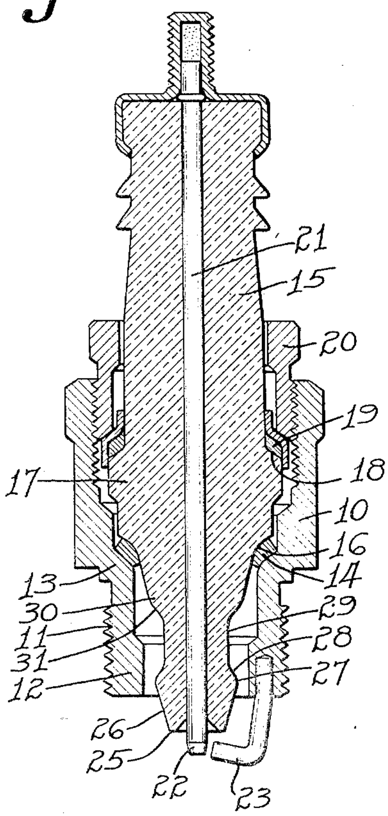
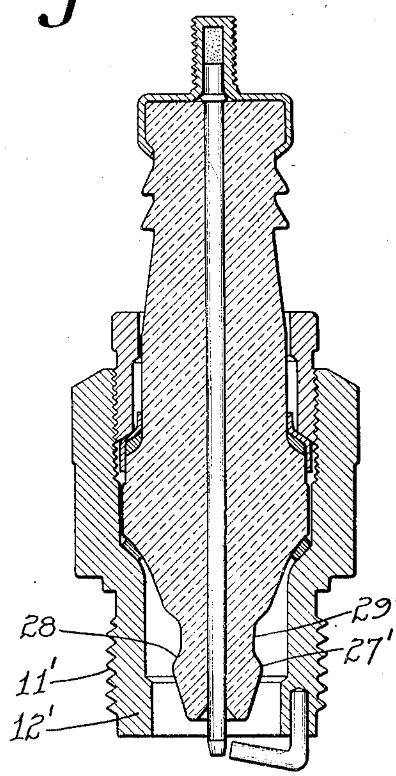


Fig. 2.



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SPARK PLUG

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This invention relates to a spark plug and more particularly to the construction of porcelain type core for a plug. The invention has for its purpose to provide a spark plug with a core which will have the various portions thereof maintained at proper working temperature under the conditions for which the plug is intended.

In high compression and high duty internal combustion motors the temperatures to which the inwardly projecting end of the spark plug core is subjected are relatively high, and there is danger of portions of the core becoming so highly heated that preignition results. In order to prevent overheating of the inner end of the core the heat must be carried off fairly rapidly. Any sharp line of division between the hotter and cooler portions of the core is apt to result in breaking or splitting of the core. For this reason a proper heat gradient between the several portions of the core must be maintained.

When portions of the core are maintained below a certain temperature, carbon is deposited thereon. As the core becomes hotter, such carbon deposits are burned off until a certain point is passed, after which carbon is again condensed upon the core in a form known as incrusted carbon. In modern practice the inner end of the core is usually heated to such an extent that there is incrusted carbon. In order to properly cool the core and prevent preignition, the portion of the core adjacent its seat in the shell is usually cool enough to have thereon a deposit of carbon. If the incrusted carbon reaches close to the deposited carbon, the insulation of the core is reduced to such an extent as to destroy the usefulness of the plug. It is, therefore, necessary to provide a material length of core which will be normally free from either incrusted or deposited carbon, as defined above.

The purpose of the present invention is to provide a core and shell properly related so as to guard against preignition and to provide an ample length of core which will be normally free from either incrusted or deposited carbon and eliminate any region where the temperature gradient between successive portions of the core is so steep as to split the core. With these and other objects in view a plug has been provided, the construction and advantages of which will appear more fully as the description proceeds.

In the accompanying drawings forming a part of this specification—

Figure 1 is a longitudinal section through a plug embodying one form of the invention and in which the inner end of the core extends beyond the surrounding shell; and

Figure 2 is a view similar to Fig. 1, but showing a plug having its shell extending beyond the inner end of the core.

The plug disclosed in Fig. 1 comprises a shell 10 of common type having an inner screw threaded end 11 adapted to be screwed into the combustion chamber of an internal combustion motor. The shell is provided with a slightly restricted end portion 12 and has a shoulder 13 supporting a gasket 14 on which there rests a core 15. The core is provided with a downwardly facing seating surface 16 upon its shoulder 17, which seating surface is adapted to rest upon gasket 14. The shoulder has an upwardly facing seating surface 18 against which a gasket 19 is pressed by a sleeve 20 screwed into the upper portion of shell 10. An electrode 21 passes through the core and extends at its inner end 22 into sparking relation with an electrode 23 attached to the inner end of the shell.

The construction as thus far described is common, and is merely indicated for the purpose of showing the setting of the improvement constituting the present invention.

The lower end of the core as shown in Fig. 1 extends at 25 beyond the inner end of the shell, and from its lower end flares outwardly in a substantially conical shape, as indicated at 26, until it reaches a bulge 27, which is within the restricted portion 12 of the lower end of the shell. Immediately above the bulge 27 there is an inwardly tapering portion 28 which is shorter than portion 26 and has a somewhat steeper gradient. Above portion 28 there is a substantially cylindrical portion 29 extending for a material distance. Preferably this cylindrical portion is longer than portion 28 but not of greater length than portion 26. Above portion 29 the core flares outwardly at 30 upward to the seat 16. In the form shown there is a slightly steeper gradient 31 immediately above the cylindrical portion than there is just below the seat.

The construction shown in Fig. 2 is similar to that shown in Fig. 1 and like reference numerals are applied to like parts, with a prime added for Fig. 2. The chief distinction between the two figures is that in Fig. 2 portion 11′ is extended downward beyond the inner end of the core, or the core is shortened so that it does not extend as far as the shell. Under these circumstances it is preferable to have shoulder 27′ above restricted portion 12′ instead of within such restricted portion, as is preferable when the tip of the core extends below the shell. In the construction shown in Fig. 2 cylindrical portion 29′ is shortened, but it is still longer than tapered portion 28.

Attention is called to the fact that the diameter of the electrode 21 is substantially uniform and that there is no enlargement of this electrode where it extends below the core. Any enlargement of the extending inner end of the electrode, particularly if such enlargement is in direct contact with the core, is highly objectionable because the electrode is normally of higher heat conductivity than the core and as a consequence such enlargement of the inner end of the electrode results in transmission of excessive heat to the portion of the core in contact therewith.

The outward flaring portion 26 provides increasing space above the tip for the carrying off of heat and in this way reduces the extreme temperature of the end of the tip and thereby decreases the danger of preignition. It has been found preferable to maintain this flare along substantially conical lines in order to obtain the desirable heat gradient.

Bulge 27 between flare portions 26 and 28 is somewhat rounded in order to prevent any sharp edge, since a sharp projecting edge, particularly near the inner end of the core, is likely to become overheated and cause preignition.

The inwardly tapered portion 28 and the substantially cylindrical portion 29 provide a fairly long surface which is normally hot enough to burn off deposited carbon and not hot enough to be covered with incrusted carbon, and, therefore, maintains an effective insulating surface. This reduced cylindrical portion decreases the cross sectional area of the core through which heat may be carried off from the tip to the seating shoulder and thereby prevents the cooling of this portion of the core to such an extent that carbon is deposited thereon. The changes in direction of the surface of the core are all gradual so as to prevent either an external angle, which is likely to become overheated and cause preignition, or a reentrance angle sufficiently sharp to make a distinct line where the temperature gradient is so steep as to cause splitting of the core.

As previously indicated, it has been found preferable, where the core is extended below the shell, to locate the bulge 27 within restricted portion 26 of the core. Less satisfactory results are obtained from having this bulge either below or above the restriction under such circumstances; but where the inner end of the tip does not extend beyond the shell, it is found preferable to have the bulge above the restricted portion of the shell, as indicated in Fig. 2.

While the particular shape of the core indicated in the figures is the best embodiment of the invention at present known for the majority of motors now in use, it will be understood that some changes may be made, particularly to suit varying conditions, within the scope of the appended claims, it being particularly borne in mind that increasing the diameter of the core above a given point tends to decrease the temperature at said point, while decreasing the cross section of the core above a given point tends to increase the temperature at said point. It will be further understood that any conducting material contacting the outer surface of the core between its seat and tip not only interrupts the insulating surface upon which dependence is placed to insulate the central electrode from the shell, but also is objectionable because of its greater heat conductivity and consequent disturbance of proper heat distribution in the core. While reference has been made to a porcelain core, it will be understood that the invention applies to other materials having similar characteristics as heat conductivity, etc.

What I claim is:

1. A spark plug core having a downwardly facing seating surface, the core between said seating surface and its lower end presenting one continuous insulating surface with only curving changes in direction and consisting of an intermediate substantially cylindrical restricted portion, a single enlargement between said portion and said lower end, and a portion enlarging from said restricted portion to said seating surface, the heat transfer being from said enlarged end portion through said restricted portion and then through said enlarged seating portion whereby a carbon free zone is provided at said restricted portion.

2. A spark plug core having a shoulder with a downwardly facing seating surface and an electrode embedded in and projecting from the lower end of the core, the cross section of the lower part of the embedded por-

tion of the electrode being as large as the cross section at any point of the projecting end of the electrode, the core presenting one continuous insulating surface with only curving changes of direction between said seating surface and its lower end, and the core having a single enlargement adjacent its lower end and a single restricted portion between said enlargement and said seating surface, whereby the heat transfer is from said enlarged end portion through said restricted portion and a carbon free zone is provided at said restricted portion.

3. A spark plug core having a downwardly facing seating surface and an electrode extending through the core and projecting from its lower end, said electrode being of substantially uniform cross section from its lower end to at least as high as said seating surface, the core between said seating surface and its lower end presenting one continuous insulating surface with only curving changes in direction and consisting of an intermediate substantially cylindrical portion, a single enlargement between said portion and said lower end, and a portion enlarging from said cylindrical portion to said seating surface, the heat transfer from said enlarged end portion through said cylindrical portion and then through said enlarged seating portion whereby a carbon free zone is provided at said cylindrical portion.

4. A spark plug core having a downwardly seating shoulder and a tip, said core flaring from its tip to a bulge, tapering from the bulge to a substantially cylindrical portion, and flaring from the upper end of said cylindrical portion to its seat, the first said flare being at least as long as said cylindrical portion and said taper being shorter than said cylindrical portion, whereby the heat transfer is from said enlarged end portion through said cylindrical portion and a carbon free zone is provided at said cylindrical portion.

5. A core in accordance with claim 4 and in which the first said flare is substantially conical.

6. A spark plug comprising a shell having a seat for a core and a restricted inner end, and a core with a shoulder having a downwardly facing surface cooperating with said seat, the core projecting inward from said seat farther than the shell and flaring outward from its tip substantially conically to a bulge within but out of contact with the restricted portion of said shell, tapering from the bulge to a substantially cylindrical portion and flaring from the upper end of the cylindrical portion to said downwardly facing surface, the distance from the bulge to the cylindrical portion being substantially less than that from the cylindrical portion to the seat.

7. A spark plug comprising a shell having a seat for a core and a restricted inner end, and a core with a shoulder having a downwardly facing surface cooperating with said seat, the core projecting inward from said seat to a tip within said restricted portion of the shell, the core flaring upward from the tip to a bulge located above the restricted portion of the shell, tapering from the bulge to a substantially cylindrical portion and flaring from the upper end of the cylindrical portion to said downwardly facing surface, the heat transfer being from said enlarged end portion through said cylindrical portion and then through said enlarged seating portion whereby a carbon free zone is provided at said cylindrical portion.

8. A spark plug comprising a core having a seating surface and projecting inward from said surface to a tip, and an electrode embedded in the core and projecting from said tip, the cross section of the lower end of the embedded portion and the projecting portion of the electrode being substantially uniform, the core flaring outward from its tip to carry off the heat from the tip and minimize preignition, having a restricted portion of substantial length above said flaring portion to retain sufficient heat to eliminate deposited carbon, flaring from the upper end of said restricted portion to said seating surface, presenting an insulating surface from seat to tip to avoid disturbance of heat distribution, and changing in contour gradually to avoid excessive heat gradients.

In testimony whereof I have hereunto signed my name to this specification.

OTTO C. ROHDE.