July 20, 1954 R. SCHECHTER 2,684,060

SPARK PLUG

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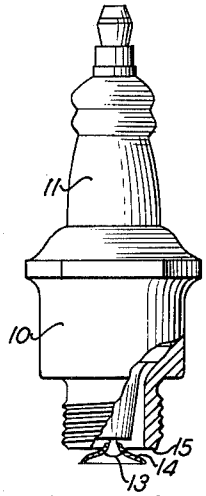


Fig. 1

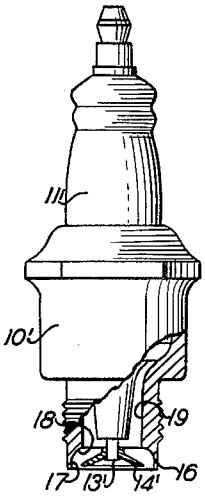


Fig. 3

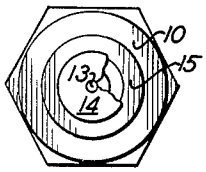


Fig. 2

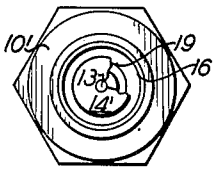


Fig. 4

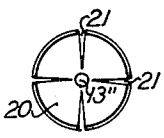


Fig. 5

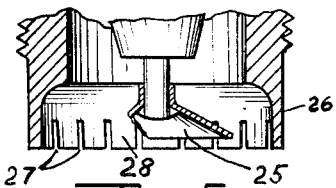


Fig. 6

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SPARK PLUG

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1 Claim. (Cl. 123—169)

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This invention relates to spark plugs adapted particularly for use in internal combustion engines.

One of the objects of the present invention is to provide a spark plug which is especially suited for use with engines having relatively high compression ratios.

Another object of the invention is the provision of a spark plug which is suitable for use in a variety of heat ranges, and in which the interior of the spark plug and its insulator are protected from the effects of excessive heat in the engine cylinder, and from the impingement of excessive oil and gasoline droplets or products of combustion.

Another object of the invention is to provide a spark plug suitable for use in engines of relatively high compression ratios which will not cause undue harmful preignition.

Still another object of the invention is the provision of a spark plug which may be substituted for the usual type of spark plug in an engine of relatively high compression ratio without causing substantial variation in the compression ratio due to the size and shape of the substituted plug.

Still another object of the invention is to provide a spark plug electrode element which may be combined with the conventional type of spark plug with a minimum of effort and with simple tools.

A further object of the invention is the provision of a spark plug having a disc-shaped central electrode provided with means whereby the peripheral gap between electrodes may be altered.

A still further object of the invention is to provide a spark plug capable of inducing a more complete mixing of the combustible vapors at the spark plug by increasing turbulence.

Another object of the invention is the provision of a spark plug provided with an electrode having an extensive surface which prolongs the life of the device and which is practically self-cleaning.

Yet another object of the invention is the provision of a spark plug which is simple, efficient, and readily manufactured.

Other objects will be apparent to those skilled in the art after studying the following specification together with the accompanying drawing illustrating various embodiments of the invention, and in which; Fig. 1 is a view in elevation of one form of spark plug, with a portion cut away to show the arrangement of the electrodes; Fig. 2 is a view looking upward at the bottom

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of the device shown in Fig. 1; Fig. 3 is a view in elevation of a modified form of spark plug, with a portion cut away as in Fig. 1; Fig. 4 is a view looking upward at the bottom of Fig. 3; Fig. 5 is a view looking upward at the bottom of a modified form of center electrode; Fig. 6 is an enlarged cross-sectional elevation of another form of device with a portion of the center electrode cut away.

One of the preferred embodiments of the invention comprises an open ended ground electrode shell 10, within which there is disposed in the usual way an insulating element 11 which provides support for a centrally disposed electrode 12. The center electrode includes a rod-shaped element 13 which is embedded in, and projects from the end of the insulator 11. The lower end of element 13 is provided with a disc-shaped element 14. The disc 14 is preferably attached at its center to the element 13, as by welding, while its peripheral edge is disposed contiguous to, but spaced from the open end of shell 10. Furthermore, in order to properly shield the interior of the spark plug the disc 14 should be of slightly greater diameter than the opening in the end of the shell and is preferably of conical configuration.

The advantages of this simple construction include the fact that a conventional spark plug may be quickly and easily converted to the present design, and presently available machinery may be used in making the article. In the case where it is desirable to convert the conventional type of spark plug, it is a simple matter to remove, or cut off the usual projecting electrode wire which is attached to the ground electrode shell, and to smooth down the end surface 15 of the shell. As previously mentioned the conically shaped portion 14 may be welded to the projecting end of the rod 13, or attached in any manner suitable for the use to which the spark plug will be put. The conically-shaped disc 14 will usually be stamped from any metal suitable for the temperature to which it will be exposed when in use. As a result of the stamping operation the periphery of the disc will tend to acquire a fairly sharp edge which will assist in the production of a strong spark across the air gap when electricity is applied. Furthermore, the life of this type of electrode is practically unlimited inasmuch as the spark will not necessarily take place each time at the same place; consequently very little of the metal will be burned away and the airgap will remain practically constant during the life of the device.

In Figs. 3 and 4 there is shown a modified form

of the invention, which includes an open ended ground shell electrode 10', insulating element 11'. and centrally disposed electrode 14' supported by the rod-shaped element 13'. This modified form of construction is similar to the previously described device, with the addition of a cylindrically disposed skirt portion 16 annularly disposed at the end of the shell 10'. The skirt portion is relatively thin-walled by comparison with the thickness of the shell portion, and is provided with a substantially cylindrical inner surface 17 which merges upwardly and inwardly near the opening in the shell, into a curved annular surface 18 which resembles a portion of a toroid. the uppermost portion of this toroidal surface being disposed tangent to a plane disposed perpendicularly with respect to the axis of the spark plug. This inner construction may be modified to suit individual requirements.

As in the first-described form, the conically-shaped electrode 14' is disposed with its peripheral edge spaced from the opening in the shell 10' and is of slightly greater diameter than that opening. Preferably, in the second-mentioned modified form, the disc 14' is disposed within the skirt portion 16, this arrangement offering a more effective barrier to the entrance of undesirable combustion products into the interior of the spark plug.

In both forms of the device, the disc-shaped electrode performs a twofold function in that it covers the opening in the end of the ground electrode, offering obstructive resistance to the products of combustion which might otherwise foul the interior of the spark plug, and it serves to dissipate heat which would normally be absorbed by the insulator. In the second-mentioned form, the skirt portion also assists in the performance of both these functions. The importance of heat-dissipation cannot be overemphasized, especially where high-compression engines are concerned. Spark plugs for these engines are required to be produced for use in varying heat ranges, which necessitates the maintenance of large stocks of spark plugs by suppliers, whereas with the present invention, a single item may be used for several different heat ranges.

Another advantage of the present invention is the fact that an external spark is provided, rather than one that takes place in close proximity to the insulator and the interior of the spark plug.

Because of the shape of the disc-electrode and the configuration of the adjacent surface of the shell electrode, the raw vapors and the products of combustion in the engine cylinder are directed away from the insulator and the interior in a direction generally across the open end of the shell, instead of down into the shell. In the first-mentioned modification the surface 15 is flat and disposed in a plane perpendicular to the axis of the insulator and shell. In the second-mentioned modification, the surface 18 merges with the interior cylindrical wall 19 at the opening at the end of the shell 10' in a surface which is tangent to a plane perpendicular to the axis of the insulator and shell. For convenience, it can be said that both surfaces 15 and 18 merge with the interior wall of the shell electrode tangent to a plane perpendicular to the axis of the insulator and shell, and that thereby the gases in this area will be directed across the opening rather than into it.

Furthermore, the turbulence created by the gases passing through the air gap between the center electrode and the shell electrode assists in the mixing of the gasoline with the air, and will also drive off incombustible products, either solid or liquid, which might otherwise adhere to the surface of the electrodes. The spark will also jump the gap in the restricted zone around the periphery of the disc electrode because there will be a lower pressure at this point than in the rest of the cylinder during the compression stroke.

In the spark plugs just described, the discs 14 and 14' consist of relatively inflexible, but thin-walled, elements which are permanently positioned to provide a fixed air gap. This has the advantage that the gap may be set at the factory with precision instruments and, because relatively little burning of the metal takes place at any one point, this gap will remain constant during the life of the spark plug. But where it is desirable to provide an air gap which may be adjusted within wide limits, it is preferred to use the type of disc electrode shown in Fig. 5. In this modification the conically shaped element 20 is provided with one or more radially extending slits 21 along its periphery. The central portion of the disc 20 is secured as before to the projecting end of rod or wire, such as 13'', so as to position the disc in conjunction with a ground shell electrode, such as 14, or 14' in the manner previously described.

In making the slits 21, the metal may be merely severed, or sheared, as by a cutting tool, or narrow radially extending portions of the metal may be removed, as by a die. In either case, the presence of the slits enables the disc to be conically distorted so as to alter the effective diameter of the disc. Such distortion will also be effective to alter the lateral positioning of the periphery of the disc with respect to the centrally supported section. In the case of the modification shown in Figs. 1 and 2, this lateral displacement of the periphery will alter its distance from the surface 15 of the ground electrode. In the case of the modification shown in Figs. 3 and 4, the alteration of the diameter of the periphery of electrode 20 would alter the gap between it and the surface 17 of the skirt 16. In either case the effect of conical distortion of electrode 20 is to alter the air gap between the two electrodes.

A modified form of skirt construction is shown in Fig. 6, which may be used in combination with a center electrode 25, similar in shape to either of the previously described electrodes. In this modification the cylindrically disposed skirt 26 may be provided with a number of longitudinally disposed slots 27, extending into the lower margin of the skirt. This type of skirt is particularly adapted for use with a fixed center electrode, inasmuch as the air gap between the electrodes may be adjusted by bending the arcuate portions 28, defined by the slots 27.

Having thus described several preferred forms of the invention, it will be understood that they are illustrative only, and not intended to limit the scope of the invention other than as claimed.

I claim:

In a spark plug having an open ended ground electrode shell, a longitudinally extending insulator disposed within the shell and provided with a second electrode projecting beyond the end of the insulator, said shell being provided with a substantially smooth cylindrical inner surface terminating at the open end of the shell, a relatively thin-walled cylindrical skirt portion projecting beyond the open end of the shell and of greater diameter than the diameter of the inner

surface of said shell, said second electrode being provided with a conically shaped portion having the circumferential edge disposed within said skirt portion spaced from said opening, said second electrode being also provided with radially disposed slits to permit adjustment of the spark gap, and an annularly extending surface resembling a portion of a toroid extending between the opening in said shell and the inner surface of the skirt portion, said skirt portion being provided with longitudinally extending slits to permit further adjustment of the spark gap.

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