

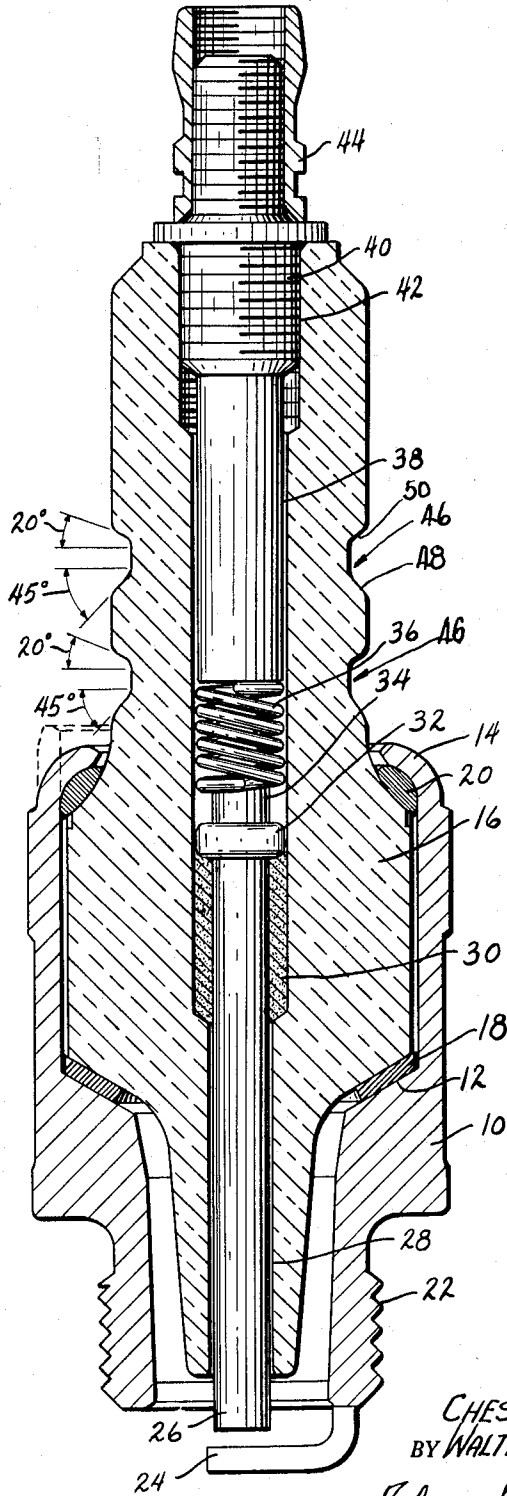
Nov. 8, 1955

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2,723,364

SPARK PLUG

Filed Jan. 26, 1951



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2,723,364

SPARK PLUG

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Application January 26, 1951, Serial No. 207,992

3 Claims. (Cl. 315—58)

This invention relates to spark plugs, more particularly to resistor spark plugs. In spark plugs incorporating a carbonaceous resistor, the effect of corona has been found very destructive to the resistor, particularly if the resistor is mounted adjacent the lip of the shell, at which point the corona is concentrated. After a period of use with the resistor mounted in the zone of the shell lip in an insulator having a smooth outer contour, it has been found that the resistor is eroded away by the destructive effect of the corona which appears to disrupt the resistor either by a chemical action of highly oxidizing atmosphere or other corrosive agents, or by some mechanical or electrical effect which is not clearly understood.

This invention contemplates the provision of a spark plug which substantially eliminates these difficulties and reduces the corrosive effect on the resistor to a very substantial degree. This is accomplished by a novel form of the insulator exterior which reduces the effect of the corona emanating from the lip of the shell by increasing the length of the creepage path, accomplished by annular corrugations in the outer surface of the insulator adjacent the shell lip. Furthermore, the resistor itself, being made of a chemically combined carbonaceous or carbide material, is moved from the area of high electrical stress which is to be found adjacent the shell lip, so that the ionization of the air in this area and the formation of oxidizing material by the corona in the interior of the insulator is not immediately effective to attack the resistor.

It is, therefore, a principal object of this invention to provide a spark plug incorporating a carbonaceous resistor wherein the resistor is positioned in a corona free locus within the bore of the insulator to obviate chemical attack thereon during use.

It is a further object of this invention to provide a spark plug which is provided with an insulator having external surface corrugations, annular in form, to lengthen the creepage path of corona and to concentrate the corona adjacent the lip of the shell, whereby the flashover voltage of the spark plug is materially increased.

Other objects and advantages of this invention relating to the arrangement, operation and function of the related elements of the structure, to various details of construction, to combinations of parts and to economies of manufacture, will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawing forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Referring to the drawing:

The figure is a cross-sectional elevation of a spark plug to which the invention has been applied.

The spark plug shown in the drawing is provided with a metallic shell 10 having an internal annular seat 12 and an inturned upper lip 14, between which is seated an insulator body 16. A pair of gaskets 18 and 20 are provided at the insulator shoulders to form a seal between

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the shell and the insulator, the seal being made by the thermoplastic collapse of a central portion of the shell by the application of heat and pressure as is well known in the art. A threaded portion 22 is provided at the lower end of the shell to fit the spark plug into the threaded aperture of the cylinder of an automotive engine. A ground electrode 24 is provided on the lower terminus of the shell to cooperate with the firing end of a center electrode 26, which is positioned in the central bore 28 of the insulator 16 and sealed therein by a compacted body 30.

The upper end of the electrode 26 is provided with an upset head 32 which is positioned above the sealing body 30 which holds and seals the electrode permanently in the bore of the insulator. Above the head 32 a short stud 34 is provided with which cooperates a compression spring 36 to form an anchor therefor, so that the spring is enabled to resiliently urge in an upward direction a carbonaceous resistor 38 of a value of 10,000 ohms or more by contacting its lower end as shown. The upper end of the resistor 38 contacts the lower face of a terminal stud 40 which is provided with a threaded section 42 to screw into a threaded portion located at the upper end of the bore of the insulator 16. Cement is preferably used to affix the terminal stud 40 permanently in position in the insulator. Nut 44 is attached by threaded sections to the stud as is well known in the art.

In this way, the sectional electrode of the spark plug is permanently positioned in the bore of the insulator 16, so that when the plug is used in connection with the ignition system of an internal combustion engine, the electric current for ignition is led by a cable to the terminal stud 40, then passes through the resistor 38, then through the spring 36 and finally to the firing electrode 26 to fire the spark gap formed with the ground electrode 24.

It will be noted that the stud 34 of the lower electrode 26 is positioned adjacent the upper terminus of the shell or the annular inturned lip 14 as clearly shown in the drawing, with the spring 36 positioned thereabove extending substantially above to contact the lower end of the resistor 38. When high tension potential is applied to this sectional electrode, as when used with the ignition system of an automobile, the lip 14 is at ground or zero potential, so that maximum electrical or dielectrical stress is concentrated in the insulator 16 at this point by the potential difference between the lip and the center electrode. When the potential difference is sufficiently great, a corona is formed both at the lip on the outside of the electrode and also in the bore of the insulator adjacent the lip as, for example, on the spring 36. The corona tends to creep upwardly both on the outside and the inside of the insulator and tends to ionize the air in its locality. The corona creepage continues until the gap breaks down or if the gap has sufficient resistance to breakdown, the corona creepage will continue up the insulator until the insulator flashover occurs. The corona creates a path of ionized air adjacent or on the insulator surface which precedes the breakdown spark over the insulator interior from the terminal stud 44 to the lip 14.

To concentrate the corona adjacent the lip and to prevent its propagation up the insulator, a pair of annular spaced corrugations 46 are provided in the insulator surface formed symmetrically with the axis of the bore 28, which forms a center of rotation for their formation during the grinding of the insulator blank before firing. These corrugations are in similar spaced relation with each other, having rounded contours as the lower corrugation is with reference to the lip 14, and are preferably formed as annular cut-away portions into the main contour of the insulator body, substantially as shown.

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The leading slope 48 next adjacent to the lip is preferably given an angularity approximately 45 degrees with a horizontal plane, while the trailing slope 59 is given an angle of approximately 20 degrees with the same horizontal plane. The leading slope is, therefore, flatter than the trailing slope which is relatively steep with reference to the aforesaid plane. This steepness of the trailing slope has a strong tendency to retard the corona creepage which tends to concentrate the corona discharge adjacent the lip 14 to thereby reduce the corona on the interior of the insulator in the bore thereof, so that the electrical, mechanical, and chemical effects brought about by such corona are kept away from the resistor, which are destructive thereto and cause breakdown of the spark plug during operation. The corrugations are conformed, so that the corona from the terminal stud 44 to the lip 14 does not substantially occur until over 10 kv. is impressed on the plug, the test being whether or not such corona is visible when the spark plug is energized in total darkness. Normally, the corona becomes readily visible at the potential impressed when such is impressed upon a standard spark plug.

We claim:

1. A spark plug comprising, a metallic shell, a ceramic insulator mounted in sealed relation with said shell and extending above the shell a substantial distance for preventing flash over, annular outwardly diverging corrugations indented in said insulator in spaced relation adjacent the upper terminus of the shell to lengthen the creepage path of the spark and to concentrate corona discharge, each of said corrugations having an angle on its leading slope adjacent the shell of approximately 45 degrees and an angle of approximately 20 degrees on its trailing slope, a composite center electrode extending through a bore in the insulator in sealed relation therewith and projecting from its ends to form a firing tip and a terminal, said composite electrode including a carbonaceous resistor and a helical spring freely positioned in the bore of the insulator, said helical spring being mounted adjacent the upper terminus of the shell substantially below the corrugations in the region of high dielectrical stress urging the resistor upwardly against the terminal.

2. A spark plug comprising, a metallic shell, a ceramic insulator mounted in sealed relation with said shell and

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extending above the shell a substantial distance for preventing flash over, rounded annular corrugations with outwardly diverging leading and trailing slopes indented in said insulator in spaced relation adjacent the upper terminus of the shell to lengthen the creepage path of the spark, said leading slope adjacent the shell having an angle substantially twice that of the trailing slope to concentrate corona discharge, a composite center electrode extending through a bore in the insulator in sealed relation therewith and projecting from its ends to form a firing tip and a terminal, said composite electrode including a carbonaceous resistor and a helical spring freely positioned in the bore of the insulator, said helical spring being mounted adjacent the upper terminus of the shell in the region of high dielectrical stress substantially below the corrugations urging the resistor upwardly against the terminal.

3. A spark plug comprising, a metallic shell, a ceramic insulator mounted in sealed relation with said shell and extending above the shell a substantial distance for preventing flash over, annular outwardly diverging corrugations indented in said insulator having a substantially steeper trailing side in spaced relation adjacent the upper terminus of the shell to lengthen the creepage path to prevent visible corona up to ten kilovolts, a composite center electrode extending through a bore in the insulator in sealed relation therewith and projecting from its ends to form a firing tip and a terminal, said composite electrode including a carbonaceous resistor and a helical spring positioned freely in the bore of the insulator, said helical spring being mounted adjacent the upper terminus of the shell in the region of high dielectrical stress substantially below the corrugations urging the resistor upwardly against the terminal.

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