J. A. & B. A. JEFFERY.

ELECTRIC SPARKING DEVICE.

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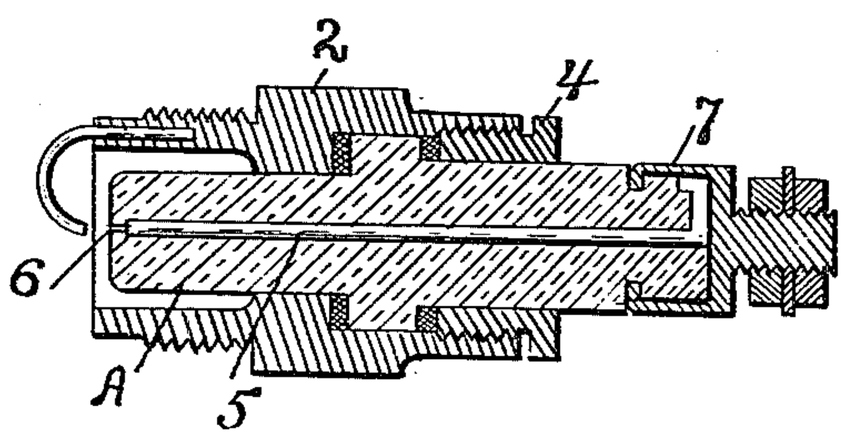
963,711.

Patented July 5, 1910



WITNESSES.

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ELECTRIC SPARKING DEVICE.

963,711. Specification of Letters Patent. Patented July 5, 1910.

Original application filed August 15, 1906, Serial No. 330,620. Divided and this application filed February 4, 1908. Serial No. 414,277.

To all whom it may concern:

Be it known that we, JOSEPH A. JEFFERY and BENJAMIN A. JEFFERY, of Newark, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Electric Sparking Devices, of which the following is a specification.

This invention relates to improvements in electric sparking devices, and particularly to electric ignition for internal combustion engines, the same being a division from our pending application for patent filed August 15th, 1906, Serial Number 330,620.

The terminals of an ignition device, (or spark plug as it is known to the trade,) working within the cylinder of an internal combustion engine are subject to fouling, or short circuiting deposits of the products of combustion, adjacent to or between such terminals. These by-products consisting primarily of carbon, or various combinations therewith, produce media of electric conductivity, which will hereinafter be referred to as short circuiting media, as its elements, or constitutents are not germane to the invention.

The object of the invention is to provide a means whereby accumulations of this short circuiting media around the electrodes is prevented, or if so deposited, to remove the same by disintegration or otherwise, by the normal discharge of the current through the plug.

Broadly the invention consists of a sparking device, the exposed area of either one or all of the terminals of which is or are restricted to a degree, where the proximity or surface contact therewith of a short circuiting medium of lesser conductivity will be insufficient to carry the current without heating such medium to the point of disintegration. The ordinary sparking current will freely travel through these short circuiting media taken as a mass; but if the mass be acted upon in small divisions or quantities, the current will heat the same to the point of disintegration or disruption of the conductive path. This result we accomplish in the present instance by restricting the dimensions of the spark gap. This is attained by terminating the terminal below the surface of the insulating block; providing only a small capillary opening between such terminal and the opposing terminal which is set near such opening clear of the insulating block surface. It is obvious that the quantity of short circuiting media that can accumulate within such orifice would be too attenuated to carry the current without disruption as before described; and with the same characteristic results. In the meantime, no matter how foul the conditions, the sparking device has not failed in a single instance to perform its functions because every normal closing of the circuit has resulted in a spark either between the normal terminals, or between one of them and the surrounding short circuiting media. Such spark is always sufficient to ignite the charge within the cylinder. Experiment has proven that no matter how weak the current may be (so long as it is sufficient to cause a discharge at the terminals), it will accomplish the desired results, the requisite time being in ratio to the strength of the current.

In the accompanying drawing, the figure is a longitudinal cross section of a sparking device constructed in accordance with this invention.

In detail the construction consists of the insulating plug A, which is preferably of porcelain or other vitreous material, with a diametrical enlargement engaging an annular shoulder in the shell 2. The insulating plug is securely held by the bushing 4, screwed into the shell behind the enlargement on the insulator. The conductor 5 extends longitudinally through the insulator, and the outer extremity thereof is exposed at the internal end of a recess 6 formed in the exposed end face of said insulator. A terminal cap 7 is beaded over the other end of the insulator and contacts with the adjacent end of the conductor 5.

Owing to the hypothetical nature of the science of electricity, it is deemed inadvisable to attempt a detailed technical or scientific analysis of the effect produced by the discharge of the electric spark by the present modified form of sparking device. However, the following facts, proven by experiment and under the most trying circumstances, have produced visible effects, and positive results that are best explained by parallel dynamic phenomena. For instance, photo-

graphs taken across the muzzle of heavy ordnance at the moment of discharge show the combustible gases expanding laterally into the altmosphere, disclosing in profile a fragmentary hemisphere, flattened at the poles as it issues from the muzzle. If the muzzle adjacent the bore is coated with an adherent dust, powder, or soot, the lateral effect of the expanding gases dislodges such adherents by attrition, friction or otherwise removes it by mechanical force and heat. A parallel effect results at the discharge point of the terminals. The adjacent dust or soot is removed in identically the same manner and apparently by the same force or forces. The electrical discharge presents the same visible fragmentary spherical zone of action flattened at both poles where it approaches the terminals, but only because the insulator surface is flat, and the terminal flush with the surface; as is the case with the gun muzzle. When the insulator tapers back from the terminal, or the terminal projects beyond the surface, these results are not present; at least not effectively so. The sudden expansion of the gases, in the instance of the ordnance; and the sudden expansion of the lines of electrical discharge, and their sudden convergence in reëntering the circuit at the other pole causes this spherical zone; the flattened poles of which come into frictional contact with the insulator surface with sufficient velocity and force to dislodge the befouling particles by chemical, mechanical and electric force. So important is the phenomenon of the truncated sphere that this device will discharge a spark with both terminals submerged in water, this sudden lateral expansion of the lines of electrical discharge being sufficient to drive the water away from the terminals by decomposing it, and forming a truncated globule of gas under water. This serves to prove the working combination between the reduced flush terminal, with the flat surface of the insulator. The surface of the insulator adjacent and over the terminal has been piled up with emery, powdered glass, soapstone, and other insulating material which has been invariably scattered by the electrical discharge between the terminals, as above described.

The contents of a gas engine cylinder after firing are substantially carbon dioxid, carbon monoxid, moisture, soot, or unconsumed carbon, oil, carbonized oil, minute particles, etc. Any or all, or any combination thereof will cause an accumulation of short circuiting media between the terminals of the device. The presence of these conditions sooner or later render inoperative any sparker with large exposed terminal area. This is true whether the short circuiting media are in contact with the terminal, or whether it is adjacent said terminal. If in contact the efficiency of the ignition device is greatly impaired, and it is well known that an accumulation of short circuiting media adjacent the terminals, while it will not necessarily prevent the spark from passing between said terminals, will cause such a leakage as will eventually dissipate the force and heat of the spark and render the igniting device useless. These disadvantages are all overcome in our invention, which is not only constructed to destroy any short circuiting media that might have collected on the terminals, but it also serves to prevent the accumulation of such short circuiting media in proximity to said terminals.

If a small body of good electrical conductivity is brought into contact with a body of poor electrical conductivity and a volume of electricity that approximates the carrying capacity of the first, is passed through them, the body of poor electrical conductivity will become heated at the point of contact between the two bodies, due to the resistance that the poor conductor offers to the passage of the current.

The conditions mentioned are those which we have actually met in practice. As to whether the results are purely electrolytic, chemical, or mechanical, due to atmospheric disturbances we cannot state positively. As to the reduced terminal area, and flat insulator surfaces being responsible for the improved and valuable result there can be no question.

We claim as our invention:—

1. An electric sparking device comprising an insulating block provided with a recess in one end, and a conductor embedded in said insulating block and terminating at the inner end of said recess, the diameter of said recess being so restricted that accumulations of short circuiting media therein would be insufficient in quantity to carry the current without disintegration of such media.

2. A spark plug comprising an electrode having a sparking point, an insulating casing therefor completely inclosing said electrode and provided with a spark duct of less diameter than said sparking point and leading outwardly therefrom, and a second electrode arranged exteriorly of the casing and arranged in line with the duct.

In testimony whereof, we have signed this specification in the presence of two subscribing witnesses.

JOSEPH ARTHUR JEFFERY.
BENJAMIN ALFRED JEFFERY.

Witnesses:
JOSEPH S. SUTPHEN,
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