

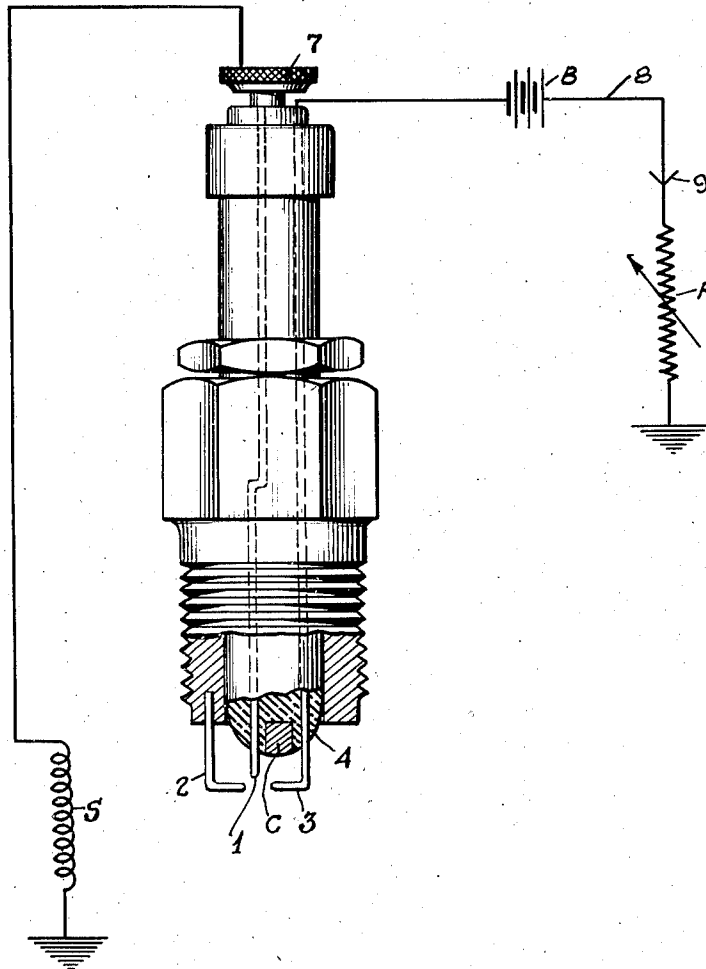
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M. BLAU

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IONIZING MEANS AND METHOD OF IONIZATION

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INVENTOR.

Marietta Blau

BY

Mock & Blum

ATTORNEYS

UNITED STATES PATENT OFFICE

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IONIZING MEANS AND METHOD OF
IONIZATION

Marietta Blau, New York, N. Y., assignor to International Rare Metals Refinery, Inc., New York, N. Y., a corporation of New York

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My invention relates to a new and improved method and to new and improved means for decreasing the breakdown or firing potential which is required to produce an electric discharge or an ionization current.

The invention applies particularly to reducing the breakdown or firing potential which is required in order to pass a spark through the gap between the electrodes of a spark plug. However, the invention is not limited to this purpose.

According to my invention, I locate a cell which produces ionizing material close to the spark gap which is provided between the two firing electrodes of said spark gap. I also provide a third or auxiliary electrode which is biased to a selected negative potential. This third electrode is insulated from the firing electrodes and it is located close to the spark gap. Some of the material emanated from the cell is collected and concentrated upon this third or auxiliary electrode. In this manner, I can collect upon the negatively charged third electrode, one or more certain ionizing decay products of radium, such as radium A, radium B and radium C, and other members of the series, depending upon the length of time during which the emanations are collected. I can use any radio-active material, which produces ionizing material. The collected ionizing material can include other radium products up to and including radium D. Some of the important active products which I desire to collect are radium A and radium C, which have the most intense alpha ray emission, with consequent intense ionizing action. The ionizing material, which can consist of a single ionizing ingredient or a plurality thereof, is collected sufficiently close to the air in said gap, to ionize the air in said gap. By thus using said collected active deposit, as radium C, the spark plug will fire, even if its points are fouled.

I thus provide a very active ionizing source which is useful whenever it is desired to lower the discharge potential through any ionizable atmosphere, irrespective of the pressure of said ionizable atmosphere.

Other objects of my invention will be stated in the annexed description and drawing, which illustrates a preferred embodiment thereof.

The drawing diagrammatically illustrates the application of my invention to a spark plug.

The spark plug is of conventional construction and it comprises the usual firing electrodes 1 and 2. The electrode 1 can be connected to the metal cap 7, which is connected to one end of a secondary coil S, the other end of said coil S being

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grounded. The auxiliary firing electrode 2 is also grounded. By inducing alternating current at suitable high voltage in the coil S, the spark is produced between the firing electrodes 1 and 2, in the usual manner. These firing electrodes 1 and 2 are made of any suitable metal or alloy. Other well-known details of the spark plug and of the ignition system are not illustrated, since the same are well-known per se. The firing electrode 1 extends through and it is fixed to the insulating core 4 of the spark plug to the metal cap 7, and the firing electrode 2 is connected in the usual manner to a metal shell which is fixed to said core 4.

The third or auxiliary electrode 3 is made of any suitable metal or alloy, such as nickel. It need not be made of radio-active material. This auxiliary electrode 3 also extends through and it is fixed to said insulating core 4. One end of this auxiliary electrode 3 is connected to the negative terminal of a source of biasing potential, which is represented by the battery B. The positive terminal of the battery B is grounded through wire 8 and through a variable resistor R. The circuit between the positive terminal of battery B and the ground may include a variable inductor as well as a variable resistor.

The invention is not limited to any specific example which is stated herein. However, in order to provide certain practical working information, it is noted that the negative biasing potential which is impressed upon the auxiliary terminal 3 can be between 50 volts—100 volts, in the case of an ordinary spark plug. The electrode 3 is not grounded, save through the battery B.

A radium cell C is supported in close proximity to the firing electrodes 1 and 2, and also in close proximity to the auxiliary electrode 3. As an example, the distance between the cell C and the tip of the auxiliary electrode 3, can be from 1 mm. to 2 mm.

In this embodiment, the cell C is shown as being embedded in and fixed to the insulating core 4 of the spark plug. The radium cell C can be of any type. As an example, the cell C may be of the porcelain type, and it may have a filling of Hahn mixture. This Hahn mixture is a well known mixture of radium or radium salt, with iron oxide. Since this mixture is well known per se, further description thereof is not required, especially as the invention is not limited to any particular type of radiation cell. Such cell is permeable to the radon which is produced in said cell, if it contains radium or a radium compound.

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In the case of a spark plug, the distance of the tip of the auxiliary electrode 3 from the spark gap may be 1-5 mm. All these details can be varied, depending upon the type of discharge apparatus, the pressure of the gaseous atmosphere through which the discharge is to be sent, etc.

Due to the negative potential bias which is impressed upon the auxiliary electrode 3, the important alpha-ray-emitting products from the cell C will be collected on and concentrated on the exposed part of the electrode 3, adjacent the spark gap which is located between the tips of electrodes 1 and 2. The diameter of the auxiliary electrode 3 may be from 2-4 mm. The important decay products from the cell C will be collected upon the entire adjacent and exposed part of the auxiliary electrode 3. That is, if radium is used in cell C, gaseous radon is emitted from the cell C, and this radon disintegrates to produce the well known decay products radium A, B and C, and such decay products are collected upon the exposed part of the auxiliary electrode 3. The radium A and C which are thus collected, emit alpha rays. Optionally, the tip of the auxiliary electrode 3 may be very close to the cell C, so that there will be a maximum concentration of the decay products upon the tip of the auxiliary electrode 3.

I thus produce a novel and powerful source of ionization in very close proximity to the spark gap which is located between the tips of the firing electrodes 1 and 2. Without the auxiliary electrode 3, there is no such collection and concentration of the decay products, so that the desired effect is not produced to any substantial extent.

By using a sufficiently intense or powerful cell C, I can reduce the ordinary required firing potential between the firing electrodes 1 and 2 by as much as 20%.

When the internal combustion engine is idle, there will be a steady accumulation of the decay product or products upon the auxiliary electrode 3. Hence, when the engine is started, the auxiliary electrode 3 will have its maximum effect, just at the time when it is required to produce quick and easy starting.

The invention is also useful in securing proper firing of fouled spark plugs. If dust or carbon collects upon the auxiliary electrode 3, this does not interfere with the proper working thereof.

As an example, the cell C may contain 20-50 micrograms of radium, or a mass of a radium salt which comprises 20-50 micrograms of radium.

The electrode 2 is connected in the usual manner to the metal shell of the spark plug, and said metal shell is grounded in the usual manner.

When the spark-producing current is an alternating current, the central electrode 1, which passes through the insulating core 4, is alternately plus and minus relative to the grounded main electrode 2, and the grounded auxiliary electrode 3.

Hence, when electrode 1 is positive during a respective firing period, a branch spark may be produced between electrodes 1 and 3, and a branch current will be sent through wire 8, in the direction of arrow 9. In such case, the potential difference between electrodes 1 and 3 is in series with the potential of battery B, and they are cumulative.

When electrode 1 is negative relative to grounded electrodes 2 and 3 during the next firing period, the potential difference between electrodes 1 and 3 is opposed to the potential of battery B. Depending upon the relation between the difference

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of potential between electrodes 1 and 3, and the potential of battery B, there may be a pulse of current in wire 8, in a direction reverse to the direction of arrow 9.

If the potential of battery B is sufficiently high, the branch current through wire 8 may consist of a series of unidirectional pulses, in the direction of arrow 9. Said branch current may consist of successive and reversed pulses.

It is optional to have a minimum branch current in wire 8, and said branch current may be zero or substantially zero, although the invention is not limited to this feature. I can thus shield the negatively biased collector electrode 3 from the discharge current. The branch circuit of wire 8 may have considerable resistance or inductance or both, in order to minimize the branch current, to substantially zero. In addition or as an alternative, the space between the tips of electrodes 1 and 3, may exceed the space between the tips of electrodes 1 and 2, thus minimizing a branch spark between electrodes 1 and 3, or preventing the formation of such branch spark.

By preventing the formation of a branch spark and branch current the electrode 3 is subjected to a constant negative potential bias by the battery B. If there is a branch spark with the resultant branch current, the bias of auxiliary electrode 3 will vary while the engine is operating.

The ignition system may be of any type. For example, the firing current may be supplied by a magneto.

The ionizable gaseous filling of the space between the electrodes 1, 2, and 3 may be air, or any gas or mixture of gases, or a vapor, or a mixture of a vapor with a gas or gases.

The discharge device may have a pair of discharge electrodes, or any greater number of discharge electrodes.

The negative potential bias may be impressed upon auxiliary electrode 3 by any means, and the invention is not limited to a source of unidirectional and constant potential, and it is not limited to impressing a continuous or constant negative potential upon electrode 3.

I have described a preferred embodiment of my invention, but numerous changes and omissions and additions can be made without departing from its scope.

I claim:

1. A spark plug which has an insulating core and a pair of firing electrodes which are separated by a spark gap, a radium cell fixed to said core, said cell producing a gaseous decay product of radium which disintegrates to produce successive ionizing decay products which include radium A, radium B, and radium C, said cell being permeable to said gaseous decay product, a conductive collector fixed to said core, means for impressing a sufficient negative potential on said collector to collect ionizing decay products resulting from the disintegration of said gaseous decay product upon the surface of said collector, said collector being sufficiently close to said spark gap to ionize the medium therein by means of said collected ionizing decay products.

2. An ionization discharge device, said device comprising discharge electrodes which are spaced by a discharge gap and which are located in a medium which is selected from a class which is selected from gases and vapors, said medium being under sufficient pressure to provide an ionization discharge through said medium in said discharge gap when firing potential is applied to said discharge electrodes, a conductive collector held

in fixed relation relative to said discharge electrodes, a radium cell which is supported in fixed relation to said discharge electrodes and collector, said radium cell producing a gaseous decay product of radium which disintegrates to produce successive ionizing decay products which include radium A, radium B, and radium C, said cell being permeable to said gaseous decay product, means for impressing a sufficient negative potential on said collector to collect ionizing decay products resulting from the disintegration of said gaseous decay product upon the collecting surface of said collecting electrode, said collecting surface being sufficiently close to said discharge gap to ionize the medium therein by means of said collected ionizing decay products.

3. A method of producing an ionization discharge through an ionizable medium in a discharge gap between discharge electrodes, said ionizable material being selected from a class which consists of gases and vapors and being under sufficient pressure to produce an ionization discharge when firing potential is applied to said discharge electrodes, which consists in disintegrating radium to produce radon adjacent a conductive collector, subjecting said collector to a sufficient applied negative bias to collect ionizing decay products of said radon on the surface of said collector, and subjecting said medium in said discharge gap to the ionizing action of said collected ionizing decay products.

4. In combination with a spark plug which has an insulating core, and which also has a grounded firing electrode and an ungrounded firing electrode, which are separated by a spark gap, and which also has an ignition coil which has one end grounded and the other end connected to said underground firing electrode, a radium cell fixed to said core, said cell producing a gaseous decay product which disintegrates to produce successive ionizing decay products which include

radium A, radium B, and radium C, said cell being permeable to said gaseous decay product, a conductive collector fixed to said core, a source of unidirectional biasing current, the negative terminal of said source being connected to said collector, the positive terminal of said source being grounded, said source being of sufficient voltage to impress a sufficient negative potential on said collector to collect ionizing decay products resulting from the disintegration of said gaseous decay product upon the surface of said collector, said collector being sufficiently close to said spark gap to ionize the medium therein by means of said collected ionizing decay products.

5. A combination according to claim 4, in which the circuit of said source has sufficient impedance to substantially prevent any branch spark between said ungrounded electrode and said collector when a spark is produced in said spark gap by said ignition coil.

6. A combination according to claim 4, in which the space between the tip of said ungrounded electrode and the tip of said collector is sufficiently great to substantially prevent any branch spark between said ungrounded electrode and said collector when a spark is produced in said spark gap by said ignition coil.

MARIETTA BLAU.

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