G. A. JACOBS.

SPARK COIL.

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1,296,963. Patented Mar. 11, 1919.

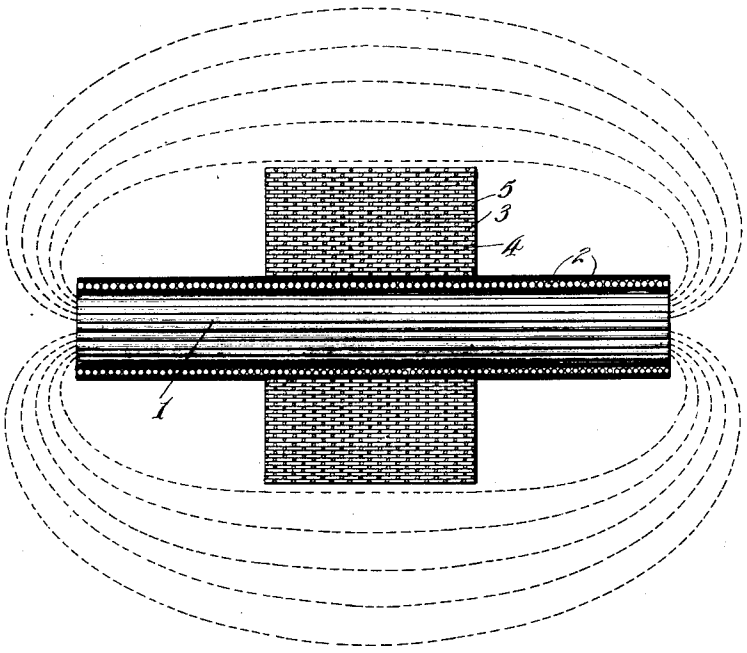


Fig. 1.

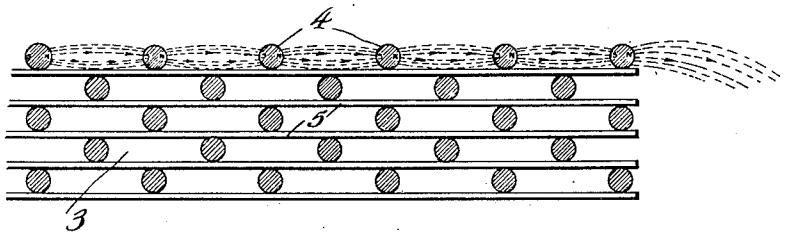


Fig. 2.

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UNITED STATES PATENT OFFICE.

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SPARK-COIL.

1,296,963. Specification of Letters Patent. Patented Mar. 11, 1919.

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To all whom it may concern:

Be it known that I, GEORGE A. JACOBS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Spark-Coils, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to spark coils and particularly to coils of the type wherein a spark is produced between two or more separated points for the purpose of igniting a combustible mixture such as that contained within the cylinders of an internal combustion engine. In the manufacture of coils for the above purpose, it has heretofore been the common practice to employ a soft iron-wire core surrounded by a magnetic coil of relatively large-diameter copper wire having a comparatively few turns, the said coil being in turn surrounded by a secondary winding of very fine copper wire having a large number of turns or convolutions, depending upon the air for the return magnetic circuit.

Inasmuch as the air is a very poor magnetic conductor, an electric current of very considerable magnetizing force is necessary in order to magnetize the core and to overcome the atmospheric resistance to the flow of magnetism. To overcome the difficulty of the high magnetic resistance of the air, it has been proposed to employ soft iron wires at a suitable distance from the secondary winding, thereby partially closing the external magnetic air circuit with iron so as to make a more nearly complete return circuit through such magnetic material. It has been found, however, that coils constructed on this principle are slower to charge than the usual coils, hereinbefore described, because of the fact that the inductance or time element of the primary winding is increased in the same ratio that the magnetic resistance of the magnetic circuit is decreased, due to the lag of the iron in the magnetic circuit—that is to say, the time required to magnetize and demagnetize such iron.

I have discovered that, by using for my secondary winding fine insulated iron wire, the turns whereof are spaced a considerable distance apart—preferably materially greater that the diameter of the wire—in place of fine insulated copper wire, I am enabled to employ iron in the magnetic circuit, which iron requires an extremely small time for charging and discharging its magnetism so that it does not materially increase the lag of the coil and that, at the same time, I am able to secure a better magnetic circuit, a larger output from a coil of the same dimensions and weight as those heretofore employed and without materially increasing the time element or lag of the coil; and that I am able to produce such coils at a large saving of expense as compared with coils as heretofore constructed.

In the drawings forming part hereof, there is illustrated a coil constructed in accordance with my invention wherein Figure 1 represents a central longitudinal diagrammatic sectional view through such coil and Fig. 2 an enlarged longitudinal diagrammatic sectional view through part of the secondary coil.

In the aforesaid drawings, 1 represents the core which, as previously stated, may be made of soft iron wire. Surrounding this core is the primary winding 2 comprising a coil or helix of relatively large-diameter copper wire, the said wire forming a comparatively few turns or convolutions about the core. It will be observed that the winding 2 extends substantially to the ends of the core.

Surrounding the primary winding is a secondary winding or coil 3 comprising a large number of turns of fine insulated iron-wire. This secondary coil is considerably shorter than the primary coil as shown herein, whereby the core and the primary winding project a considerable distance beyond the ends of such secondary winding. This arrangement is extremely desirable as facilitating the return circuit of the magnetic lines of force from the core to and through the secondary winding.

Reference has been made hereinbefore to the employment for the secondary winding of fine insulated iron-wire, so wound that the space between the adjacent turns or convolutions thereof shall be relatively great—preferably materially greater than the diameter of such wire. The purpose of employing such fine wire and of winding it in the manner described will be apparent from the diagrammatic view in Fig. 2, wherein the wire is indicated at 4 and the insulating sheets between concentric layers thereof are indicated at 5. Because of the

spacing apart of the convolutions of each layer of the secondary coil, the wire will be magnetized in a direction transverse to its axis and substantially parallel with the axis of the coil, with the production of consequent poles in the adjacent convolutions and without any danger of magnetic short-circuiting within such coil. If, for instance, an iron shell in one piece were substituted for the various layers of the secondary coil and this shell were disposed axially about the core, the shell would tend to generate a counter-electromotive force with all turns of wire wound externally thereto because of the fact that it provides a complete unbroken magnetic circuit; so that, while the magnetic circuit would be enhanced by the use of such continuous shell, a deleterious counter-electromotive force would be produced and the lag of the secondary coil would be increased. By employing for my return magnetic circuit a coil composed of the turns of fine iron-wire arranged as described, the lines of force, instead of being continuous, will be broken up by magnetic induction into a large number of small magnetic polarities. Furthermore, for equal axial lengths of iron in the magnetic circuit, as between the shell arrangement on the one hand and my secondary coil arrangement on the other hand, the latter construction and arrangement provides a portion of the magnetic circuit which will magnetize and demagnetize far more rapidly than will be the case with such continuous iron circuit.

I have also found that, because of the enormous external resistance of the air gap which is under compression and which the spark has to jump, the extra amount of ohmic resistance incidental to the use of iron wire for the secondary winding in place of the copper wire employed heretofore in such winding is negligible and that, on the other hand, I obtain the positive advantages of having a better magnetic circuit and of producing the coils at a less expense, because of the use of the iron-wire.

Having thus described my invention, what I claim is:—

1. A spark coil having an iron core and also having a secondary coil of iron wire surrounding said core and disconnected therefrom, the turns of the secondary winding being insulated electrically and disconnected magnetically from each other.

2. A spark coil having its secondary shorter than its primary and having its lateral ends each located at a point removed from the corresponding end of the primary, the secondary coil being constructed of iron wire whose layers are insulated electrically from each other and turns are separated from adjacent turns in the same layer by distances at least as great as the diameters of the secondary wire, said secondary being electrically independent of the core.

3. A spark coil having the outer portion of its secondary winding composed of turns of iron wire the diameter whereof is less than the distance between adjacent turns thereof, the turns of said secondary winding being insulated electrically from each other and from the core.

4. A spark coil having its secondary composed of turns of iron wire of small diameter, the distance between adjacent turns being at least as great as the diameter of such wire.

5. A spark coil having its secondary shorter than its primary and having its ends located each at a point removed from the corresponding end of the primary and constructed of iron wire of small diameter, the turns thereof being insulated electrically and disconnected magnetically, said coil having a core insulated electrically from both primary and secondary coils.

In testimony whereof, I hereunto affix my signature.

GEORGE A. JACOBS.