

L. KRIEGER.
IGNITION SYSTEM.
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1,121,025.

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Fig. 2.

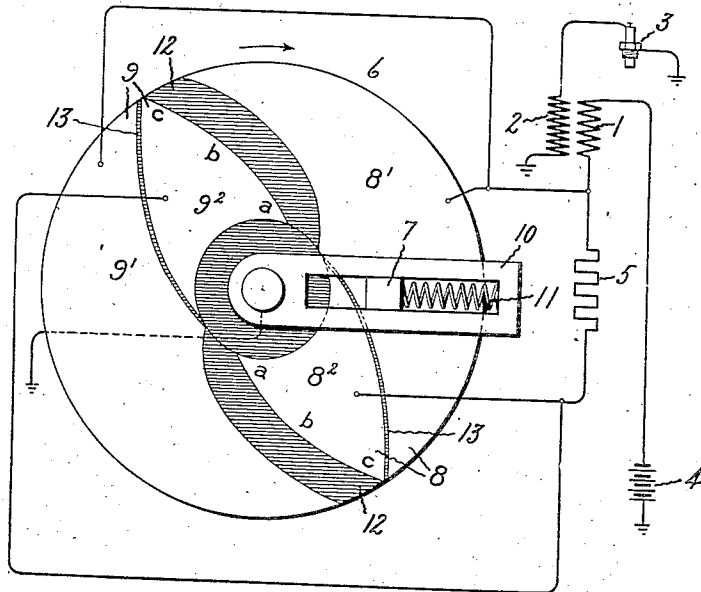
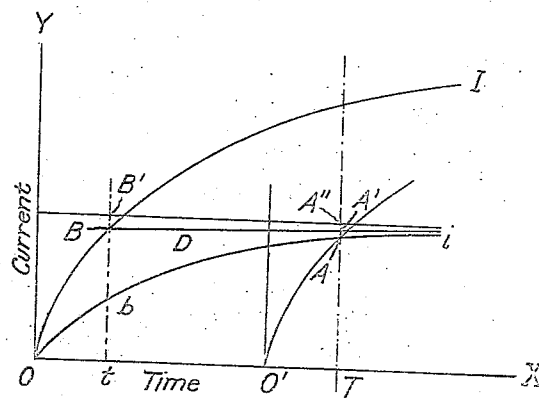


Fig. 1.



Witnesses:

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UNITED STATES PATENT OFFICE.

LOUIS KRIEGER, OF PARIS, FRANCE, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

IGNITION SYSTEM.

1,121,025.

Specification of Letters Patent.

Patented Dec. 15, 1914.

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To all whom it may concern:

Be it known that I, LOUIS KRIEGER, a citizen of the French Republic, residing at Paris, France, have invented certain new and useful Improvements in Ignition Systems, of which the following is a specification.

My invention relates to ignition systems for internal combustion engines and is particularly applicable to such systems employing induction coils, the primary of which is supplied with current from a source of substantially constant potential.

My invention has for its object a novel arrangement and construction of parts whereby the voltage applied to the primary of the induction coil is substantially constant at the time of interruption of the primary circuit at all speeds of the engine.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawing, in which—

Figure 1 is a set of characteristic curves of the establishment of current in the primary of an induction coil, and Fig. 2 is a diagrammatical view of an ignition system in accordance with my invention.

When an induction coil is employed in an ignition system for internal combustion engines and the primary of the induction coil is supplied with current from a direct current source, the impedance of the primary circuit will tend to cause the intensity of the spark to vary with the speed of the engine.

Internal combustion engines, as usually constructed, comprise several cylinders and a distributor in the secondary circuit of the induction coil connects the proper cylinders successively to the secondary of the induction coil. The sparks are produced by opening the primary circuit of the induction coil which is immediately closed again, and the current in the primary circuit reestablished so that the next spark can be reproduced when necessary. The current in the primary of the induction coil is not reestablished instantaneously, but in accordance with an

exponential law having for its equation the following:

$$I = \frac{E}{R} \left(1 - e^{-\frac{RT}{L}} \right),$$

in which E is the voltage of the source, R, the resistance of the primary circuit, e, the Napierian logarithmic base, T, the time from closure of circuit, and L, the self induction of the primary circuit. This curve is represented in Fig. 1 by laying off the duration of current I on the abscissa OX and the intensity thereof at the time T on the ordinate OY. Depending upon the speed of the engine, the length of time that the primary circuit is closed may vary from OT to Ot as the speed increases. If a coil is fed with the voltage e, the curve of establishment of current will be Oi. When the speed is low the primary current has a value AT at the moment of its interruption. The coil then gives good sparks and the ignition is perfect. If the speed increases considerably, say to such a value that the duration of contact is only Ot, then the corresponding current is only tb, this small value of current will give only a very feeble spark. The reason for this small value of current is that the flux in the core of the induction coil has not reached its maximum value.

One method of carrying out my invention is to take a source of voltage E capable of furnishing the curve of current establishment OI, but always preserve a duration of the establishment of the current that is constantly equal to Ot, even at low speed. In order to accomplish this, the current would be interrupted during the time OO', the circuit being closed only at O', so that O'T equals Ot. At this moment the current will be established according to the curve O'A, a curve identical with OB, and consequently there would always be a primary current equal to TA at the moment of interruption, at all engine speeds, the time OO' varying, becoming zero at high speeds. In order to accomplish this the interrupter is constructed so that the angle of rotation during which the contact lasts shall be as much greater as the speed is greater. I prefer, however, to connect the primary of the induction coil to a source of voltage with

a resistance in circuit therewith and provide an interrupter which short circuits this resistance at the beginning of the closure of the primary circuit and during a time that is constant and equal to Ot . The curve of the current at the time of closure of the primary circuit will then become OB and then the resistance being inserted into the primary circuit, the curve of current will become BDA' . The asymptote of the curve OAi has the equation I is equal to $\frac{E}{R}$ and is represented by the straight line $B'A''$. It will therefore be seen that the curve BDA' tends toward the same asymptote as the curve OAi . As A' is very near A'' , since it is comprised between A and the asymptote, it may be said that practically from t to T the primary current is the same. The spark then will always have the same intensity. On the other hand a rapid increase of the flux during the time Ot may give without any danger a spark; this spark being produced at the beginning of the closure of the circuit which follows the rupture, will be produced during the expansion of the gases and consequently would have no effect upon the engine.

In Fig. 2 of the drawing, the primary and secondary circuits of the ignition system are inductively related by an induction coil having a primary 1 and a secondary 2. 3 is a spark plug in the secondary circuit, any number of which may be employed depending upon the number of engine cylinders. 4 is a suitable source of substantially constant voltage, such as a battery or generator, connected in the primary circuit of the induction coil, as is a resistance 5 and an interrupter 6. The interrupter comprises a contact member 7 and a plurality of contact segments 8 and 9, the member 7 and the segments being relatively rotatable. Each of the segments is divided into two parts insulated from each other, the terminals of the resistance 5 being connected to the parts of each segment. The contact segments 8 and 9 are separated by strips of insulation 12, which are wider than the contact member 7. The contact member 7 is arranged to insert the resistance 5 in the primary circuit of the induction coil for smaller intervals of time as the relative speed of the contact member and the contact segments increases. I prefer to rotate the contact member 7, as by an arm 10, in which it may be displaced by centrifugal force against a spring 11. The interrupter shown gives two interruptions per revolution, each of them when it clears the strips of insulations 12. The segments 8 and 9 are divided into two parts $8'$ and $8''$ and $9'$ and $9''$ by thin strips of insulation 13 and when the member 7 engages $8'$ or $9'$, the primary of the induction coil is grounded directly,

without the resistance 5 being in circuit. When the member 7 has left $8'$ or $9'$ and is on $8''$ or $9''$, the resistance 5 is connected in the primary circuit. The strips of insulation 12 are preferably arranged so that the contact of member 7 with parts $8'$ or $9'$ of the segments takes place on arcs increasing with the speed, in order that the duration of this contact be constantly equal to the time Ot (Fig. 1) and the duration of contact with the parts $8''$ or $9''$ will constantly decrease. By giving the strips of insulation 12 a curved form, such as abc , upon which the rupture of the primary circuit is made at an angle equal to the necessary variation of lead of the ignition with the speed, the ignition is automatically advanced with the speed. By making the plate carrying the segments 8 and 9 movable, it is possible to make this lead regulable manually.

I desire it to be understood that my invention is not limited to the particular arrangement of interrupter shown and described and that the contact segments may be developed on a surface of a cylinder instead of on a plane surface as shown, and I aim in the appended claims to cover such modifications as well as any others that do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In an ignition system, primary and secondary circuits, an induction coil inductively relating said circuits, a source of substantially constant voltage in said primary circuit, and an interrupter in the primary circuit comprising a contact member and contact segments, said member and segments being relatively rotatable, said contact member being capable of being moved under the action of centrifugal force to maintain the voltage applied to that part of the induction coil in the primary circuit substantially constant at the time of interruption at all speeds.
2. In an ignition system, primary and secondary circuits, an induction coil inductively relating said circuits, a source of substantially constant voltage in said primary circuit, and an interrupter in the primary circuit comprising a contact member and contact segments, said member and segments being relatively rotatable, said contact member being capable of being moved under the action of centrifugal force to maintain the voltage applied to that part of the induction coil in the primary circuit substantially constant at the time of interruption at all speeds, said segments being curved at such an angle that the interruption of said primary circuit varies with the speed and thereby automatically advances the ignition with increase of speed.

3. In an ignition system, primary and secondary circuits, an induction coil inductively relating said circuits, a source of substantially constant voltage in said primary circuit, a resistance, and an interrupter in said primary circuit comprising a rotatable contact member and a plurality of contact segments, each of said segments being divided into two parts insulated from each other, said resistance being connected to said parts of the segments, said contact member being arranged to insert said resistance in said primary circuit for smaller intervals of time as the speed of said contact member increases.

4. In an ignition system, primary and secondary circuits, an induction coil inductively relating said circuits, a source of substantially constant voltage in said primary circuit, a resistance, and an interrupter in said primary circuit comprising a rotatable contact member and a plurality of contact segments, each of said segments being divided into two parts insulated from each other, said resistance being connected to said parts of the segments, said contact member being arranged to insert said resistance in said primary circuit for smaller intervals of time as the speed of said contact member increases, said segments being curved at such an angle that the interruption of the primary circuit varies with the speed and thereby automatically advances the ignition with increase of speed.

5. In an ignition system, primary and secondary circuits, an induction coil inductively relating said circuits, a source of substantially constant voltage in said primary circuit, a resistance, and an interrupter in

said primary circuit comprising a contact member and contact segments, said contact member and contact segments being relatively rotatable, each of said segments being divided into two parts insulated from each other, said resistance being connected to said parts of the segments, said contact member being arranged to insert said resistance in the primary circuit for smaller intervals of time as the relative speed of said contact member and contact segments increases.

6. In an ignition system, primary and secondary circuits, an induction coil inductively relating said circuits, a source of substantially constant voltage in said primary circuit, a resistance, and an interrupter in said primary circuit comprising a contact member and contact segments, said contact member and contact segments being relatively rotatable, each of said segments being divided into two parts insulated from each other, said resistance being connected to said parts of the segments, said contact member being arranged to insert said resistance in said primary circuit for smaller intervals of time as the relative speed of said contact member and contact segments increases, said segments being curved at such an angle that the interruption of said primary circuit varies with the speed and thereby automatically advances the ignition with increase of speed.

In witness whereof, I have hereunto set my hand this sixteenth day of March, 1914.

LOUIS KRIEGER.

Witnesses:

ELY E. PALMER,

WERNER HILDEBRAND.