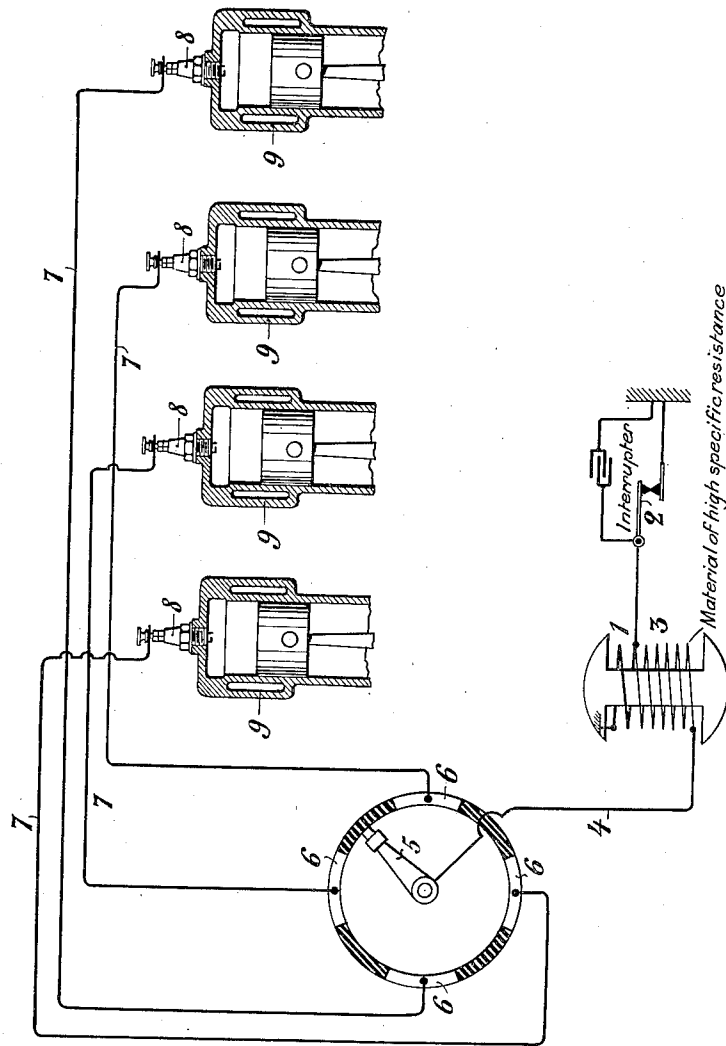


A. KAZENMAIER.
 MEANS FOR PRODUCING IGNITION SPARKS.
 APPLICATION FILED JAN. 17, 1913.

1,064,915.

Patented June 17, 1913.



WITNESSES

Vincent Savasese
C. B. Schneider

INVENTOR

August Kazenmaier
 By *Terence Davis & Goldbrun*
 ATTYS.

UNITED STATES PATENT OFFICE.

AUGUST KAZENMAIER, OF STUTTGART, GERMANY, ASSIGNOR TO THE FIRM OF
ROBERT BOSCH, OF STUTTGART, GERMANY.

MEANS FOR PRODUCING IGNITION-SPARKS.

1,064,915.

Specification of Letters Patent.

Patented June 17, 1913.

Application filed January 17, 1913. Serial No. 742,659.

To all whom it may concern:

Be it known that I, AUGUST KAZENMAIER, a subject of the Emperor of Germany, residing at and whose post-office address is Ludwig-Pfau strasse 20, Stuttgart, Germany, have invented certain new and useful Improvements in Means for Producing Ignition-Sparks; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to an improvement in the generation of ignition sparks at the spark plug in the cylinder of an internal combustion engine by means of a high tension electric ignition system, which improvement consists in reducing the duration of the ignition sparks for the purpose of limiting each interval throughout which a spark occurs to substantially the interval required for the ignition of the combustible mixture; and more particularly involves the novel idea of fixing the electrical characteristic of the sparking circuit in such manner as to allow the initial formation of the spark without material interference, but thereafter to bring about its rapid suppression each time, whereby a spark of "snappy" character, powerful at initiation but rapidly suppressed, is effected at each sparking period to which the apparatus is adjusted and irrespective of the speed of the engine within practical limits.

The sparking circuit of the usual high tension electric ignition system comprises a conductor portion and an insulation portion; the conductor portion including an inducing winding in which the sparking voltages are generated and electrical connections (including a distributor when there are multiple cylinders) between the inducing winding and the electrodes of the spark gap; the insulation portion being the spark gap between the electrodes of the spark plug. When no spark or arc stream is passing across the gap between the electrodes, the resistance at the gap is extremely high and may be considered to be practically infinite, as compared with the electrical resistance of the remainder of the sparking circuit. That is to say, the conductive resistance of the conductor portion of the circuit and the insulation resistance of the gap are of different order of magnitude. When an arc

stream is flowing across the gap between the electrodes, the resistance at the spark gap is immensely reduced, the arc stream being a conductor and having a resistance of the same order of magnitude as the conductor portion of the circuit. At such times the total resistance of the ordinary sparking circuit is very small. On the other hand, the electrical inductance of the inducing winding is usually considerable, so that the ratio of inductance to resistance in the circuit when the arc stream is flowing, is a large quantity, and, as is well known, the lag of the current behind the electromotive force is dependent upon that ratio. Hence, the ignition current has a considerable time lag behind the sparking voltage after the spark has been initiated, causing thereby the persistence of the arc stream throughout a considerable part of the electrical cycle. However, the initial part of the interval of sparking is usually sufficient to satisfactorily ignite the combustible gas in the engine cylinder, so that the prolongation of the interval beyond this point is unnecessary and in fact is undesirable in practical operation for several reasons. The sparking electrodes are consumed and burned to an unnecessary degree as a result of this action, and furthermore the function of the inducing winding is interfered with, especially at the higher speeds of the engine. As a result of the lag of the current relatively to the sparking voltage, and therefore relatively to the position of the rotating armature in a magneto generator, for instance, the magnetic field is distorted and weakened to such an extent, especially at the higher speeds, that the ignition voltage generated at the succeeding period of ignition may not be high enough to jump across the spark gap, whereupon no spark would be produced. Often at lower engine speeds also, even though the electric inductive is of smaller value as a result of the lower frequency, the normal operation is sometimes interfered with owing to the retardation or reduction of volume of the spark generated. For instance, in a four cycle engine it may happen that although the first sparking voltage effects satisfactory ignition, the second sparking voltage does not generate a satisfactory spark; whereas the third sparking voltage then produces a spark, while the fourth sparking voltage is unsatisfactory for the purpose; and so on due to the lag of

the current, which occurs after the initiation of one spark reacting on the inducing winding to materially interfere with the generation of the succeeding sparking voltage.

5 I have discovered that by reducing the duration of the ignition sparks, that is, by decreasing their time extent, these disadvantages may be eliminated. I have further
10 discovered that the duration of the ignition sparks may be limited to the extent necessary for overcoming the above stated objections, by increasing the electrical resistance of the conductor part of the sparking
15 circuit by an amount of the same order of magnitude as the usual resistance of such conductor part, that is, by increasing the conductive resistance of the conductor portion of the circuit, thereby substantially reducing the absolute value of the ratio of
20 inductance to resistance. Said additional conductive resistance will be negligible as compared with the insulation resistance of the arc gap when the arc stream is not flowing, so that the increase of the resistance
25 will not have any appreciable effect upon the conditions at the initiation of the spark, and will not operate to diminish the effectiveness of the spark during that first short period which is alone of importance in effecting ignition.

The accompanying drawing illustrates diagrammatically an arrangement suitable for carrying out my idea.

30 The primary winding 1 of a magneto generator is connected to a mechanical interrupter 2, which is driven from the engine to periodically interrupt the primary circuit of the magneto at the proper moment of its cycle, and thereby induce a sparking
40 voltage in the secondary winding 3. This secondary winding is grounded on one side, as indicated, and is connected on the other side by a conductor 4 to the rotatable brush 5 of the distributor, for conducting the ignition currents by way of the distributor contacts 6 and the electrical connections 7 to the proper spark plugs 8 in the engine cylinders 9. In the spark plugs these electrodes
45 which are not connected to the distributor are grounded in the usual way so as to complete the secondary circuit.

The resistance added for the purpose of accomplishing the objects of my invention may be distributed throughout the conductor part of the sparking circuit; that is,
55 throughout the secondary winding 3, the connection 4, the distributor 5—6 and the connection 7 to the spark plugs, or it may be concentrated and located in any portion of the circuit. I prefer, however, to add the required resistance by making the secondary winding 3 of a metal of high specific resistance, such as "new silver" (nickel-
60 elin), the remaining parts of the sparking circuit being of copper, as is usual. In this

way, the ratio of the resistance to the inductance in the secondary circuit is increased to the desired value by increasing the resistance without introducing any more inductance in the circuit than is required
70 in the inducing winding 3. My invention is, therefore, characterized by the fact that the resistance of the secondary circuit is increased to such value that when an arc stream is present in the spark gap the resistance of the circuit is high compared with the inductance thereof, whereby the arc stream is rapidly suppressed and interrupted without adversely affecting the initial
75 period of the spark. The rapidity with which the arc stream is suppressed is intended to be such that by the time the magneto armature reaches the position for generating the succeeding sparking voltage, the current in the secondary winding following
80 after the initiation of the preceding spark has been reduced to zero or to such a small value as not to materially interfere with the generation of the succeeding sparking voltage, whereby the succeeding sparking voltage will then be of sufficient value to
85 produce a satisfactory ignition spark at the spark plug at the desired period of ignition.

In order to assist those skilled in the art in carrying out my invention, I mention, by way of specific example, that it has been
90 successfully embodied in a sparking system in which the secondary winding of "new silver" had a resistance of 15000 ohms, as compared with the resistance 3000 ohms
95 which a like winding of copper would have, the number of turns of the secondary winding and the other elements of the sparking circuit being as usual, so that the sparking circuit was of the normal inductance but the
100 added resistance was 12000 ohms.

What I claim is:—

1. Means for shortening the spark duration in high-tension electric ignition systems for internal combustion engines having a sparking circuit including a spark gap and an inducing winding for generating voltages sufficient to establish arc streams across said gap, said means comprising an added conductive resistance in the sparking
110 circuit sufficient to substantially reduce the absolute value of the ratio of inductance to resistance in said circuit and thereby quickly suppress the current flowing in the circuit to avoid the adverse influence of said current
115 on the generation of the next succeeding sparking voltage, substantially as described.

2. A high tension electric ignition system for internal combustion engines having a sparking circuit including a spark gap
120 and an inducing winding of wire having high specific resistance for generating voltages sufficient to establish arc streams across said gap, the resistance of said winding being sufficient to substantially reduce the ab-
125 130

solute value of the ratio of inductance to resistance in said circuit and thereby quickly suppress the current flowing in the circuit to avoid the adverse influence of said current on the generation of the next succeeding sparking voltage, substantially as described.

In testimony whereof I affix my signature,
in presence of two witnesses.

AUGUST KAZENMAIER.

Witnesses:

PAUL WOLFART,
HERMANN SCHNEIDER.