

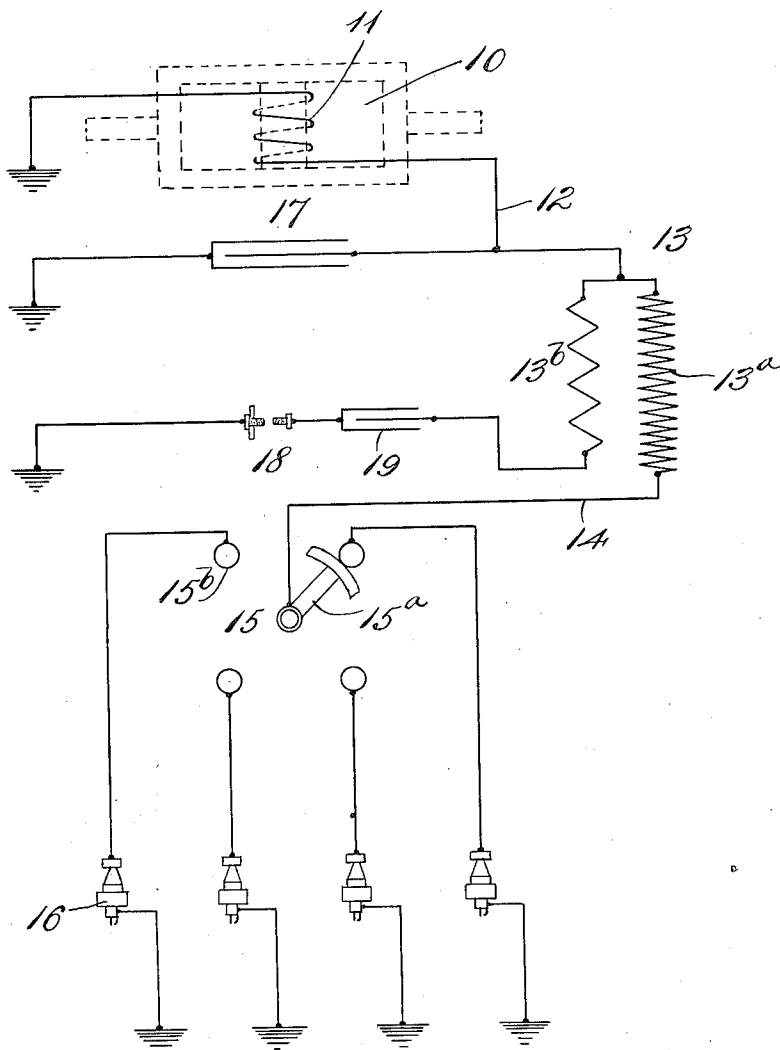
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IGNITION SYSTEM

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UNITED STATES PATENT OFFICE.

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IGNITION SYSTEM.

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To all whom it may concern:

Be it known that I, Dow B. HUGHES, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Ignition Systems, of which the following is a full, clear, and exact description.

This invention relates to ignition systems adapted particularly for internal combustion engines, and has for one of its objects to provide an ignition system wherein the time of ignition in the cycle of engine operation is automatically varied in accordance with variations in engine speed, and the invention aims to accomplish this electrically and without the necessity of mechanically operating means which vary the normal relationship of any of the parts.

It is a further object to provide an ignition system for internal combustion engines in which the source of electrical energy is an engine operated dynamo electric machine which machine is characterized by the fact that it impresses a varying voltage upon the ignition system as the engine speed varies, which varying voltage cooperates with the various elements present in the ignition system to automatically control the time of ignition in the cycle of engine operation. More specifically the invention aims to do away with the necessity of a manual control for the ignition timing device commonly employed in ignition systems.

The above and other objects are accomplished by invention, which may be briefly summarized as consisting in certain novel combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

In carrying out my invention, I take advantage of the fact that the voltage generated in the magneto is dependent upon or varies with the speed of the engine and consequently upon the speed at which the magneto is operated, and time the igniting arc with the rise in generated voltage up to a certain predetermined value. When this voltage is reached, an arc is produced by the electrical action of a certain instrumentality, which at the desired instant preferably causes a sudden inductive action in an induction coil or transformer which results in an arc at the spark plug. This takes place, as before stated, when the voltage

reaches a predetermined value, and without mechanically opening or closing the circuit of the magneto, and results in an automatic spark advance proportionate to any increase in the speed of the engine without changing the relationship between the magneto and its driving shaft, inasmuch as the particular position which the armature occupies relative to the field magnets when the predetermined voltage is reached, is dependent upon the speed of the engine. In other words, at one speed of the engine, the firing will take place with the armature in a certain position with reference to the field magnets, and at another time, the firing may take place with the armature either in advance of that position, or rearwardly of that position, depending upon whether the speed of the engine is increased or decreased.

In the preferred embodiment of my invention, I connect to the magneto, a condenser so that the potential of the condenser will vary with the generated voltage, and will rise in proportion as the generated voltage rises, and I provide a discharge circuit for this condenser, including a primary of a transformer and a spark gap, the capacity of the condenser and spark gap being such that when the voltage rises to the predetermined value, the condenser will discharge through the primary of the coil and cross the spark gap so as to produce a high frequency current in the discharge circuit. This induces in the secondary of the transformer, a high voltage high frequency current, which jumps the gap at the spark plug, or of a certain one of the series of spark plugs, depending upon the position of the distributor arm, in case the system is used in connection with a multiple cylinder engine. Preferably, the magneto armature is also connected to the secondary and to the spark plug or to the distributor so that when the high frequency spark is produced in the plug, this spark will be immediately followed up by a spark produced by lower voltage higher amperage from the magneto, producing a very hot spark which results in total ignition.

While numerous specifically different wiring arrangements may be employed, and while as far as certain features of my invention are concerned, I do not desire to be limited to any particular arrangement, except so far as I am limited by the terms of

the appended claims, the single figure of the drawing shows conventionally an ignition system which embodies my invention, and by which the desired results are obtained effectively.

Referring now to the drawing, 10 represents the magneto, which will be driven by the engine at a speed proportionate to the speed of the engine, and the armature of the magneto will always maintain certain relationship with respect to the engine, or to the engine driven shaft which operates the magneto. The armature is provided with a winding 11, one terminal of which is shown as grounded, while the other terminal is connected by a conductor 12 to a transformer or induction coil 13, the secondary 13^a of which is connected by a conductor 14 to the movable member 15^a of a distributor 15, having in this instance four stationary contacts 15^b, connected to spark plugs 16. The system is in this case adapted for a four-cylinder engine, but it will be understood that my invention may be employed in a system for any number of cylinders, and in case it is employed for a single cylinder engine, the conductor 14, leading from the secondary 13^a, will be connected, of course, directly to the spark plug. With this arrangement, it will be seen that there is a conducting circuit from the magneto to one of the spark plugs.

At 17 is shown a condenser, one end of which is shown as grounded, while the other end is shown as connected to the conductor 12. With this arrangement, the condenser bridges the armature winding, or is connected to both terminals thereof, and consequently the condenser voltage will vary in accordance with the variation of the voltage of the magneto winding. This condenser has a discharge circuit which includes the primary 13^b of the transformer or induction coil 13, and a spark gap device 18, one terminal of which is grounded. This spark gap device 18 may be adjusted to suit requirements, especially when it is desired to vary the time of condenser discharge, or to vary the point in the generated voltage wave at which the condenser voltage will break down the gap 18, so that the condenser may be disruptively discharged across the same.

The transformer is preferably of the so-called high frequency or disruptive discharge type, although it is believed to be immaterial whether or not the transformer has an iron core.

It will be seen that when the voltage reaches a predetermined value, which may be, say—200 volts, and with the proper gap at the spark gap device, the condenser will disruptively discharge through the primary and across the gap, inducing a high voltage high frequency current in the secondary 13^a, which creates a spark at one of the spark

plugs, and this will be immediately followed by a hotter spark produced by current from the magneto which passes to the spark plug over the circuit previously referred to.

Preferably, the condenser discharge takes place at a point on the generated voltage wave below the peak of the wave, so that the voltage of the magneto will be such as to cause the passage of current from the magneto to the plug when the resistance of the plug is decreased by the high frequency spark, although the maximum voltage of the magneto will not be sufficient for this purpose, were it not for the fact that the resistance of the gap is decreased by the high frequency spark. If it is desired, I may employ an auxiliary condenser 19, in the discharge circuit of the condenser 17, for the purpose of preventing the magneto current from passing across the spark gap 18, or through that part of the discharge circuit including the spark gap 18, rather than along the path including the spark plug 16. I do not regard this auxiliary condenser 19 as essential, however.

No particular construction of magneto is required for my purpose, it being only necessary that the characteristics of the magneto be such that the generated voltage wave is formed, while the magneto is sweeping through a suitable arc, and not when the armature reaches a certain fixed or definite position, relative to the field magnets. In other words, the generated voltage wave will have a certain inclination, depending upon the speed of the engine, and when the speed increases, the voltage curve will become steeper and higher, and consequently at high engine speed the predetermined voltage at which firing takes place, will be reached in advance of the time that this voltage is reached for a slower speed, and of course, in advance as regards the position of the armature with respect to the field magnets. The total advance from the slowest speed of the engine to the highest speed will take place gradually and may well be as great as 30°, but of course, the total advance at high speed over low speed will depend upon the engine.

It will be seen therefore that with my improved system, I do away with the necessity of a circuit breaker, and thus greatly simplify ignition systems; that I obtain an automatic spark advance without mechanical means for varying the normal relationship of the parts; and that I accomplish these objects in a system in which a hot spark is produced at the spark plug.

Having thus described my invention, what I claim is:

1. In an ignition system for internal combustion engines, an engine driven generator, a transformer, a spark plug connected to the secondary of the transformer, and means for

5 timing ignition and for advancing ignition in accordance with increase in engine speed, comprising a condenser connected to the generator so as to be charged and thence discharged when the voltage reaches a predetermined value, said condenser having a discharge circuit including the primary of the transformer.

10 2. In an ignition system for internal combustion engines, an engine driven generator, a transformer, a spark plug connected to the secondary of the transformer, and means for timing ignition and for causing an automatic spark advance with increase in engine speed comprising a condenser connected to the generator so as to be charged thereby and adapted to disruptively discharge when the voltage of the generator reaches a predetermined value, said condenser having a discharge circuit including the primary of the transformer and a spark gap device.

20 3. In an ignition system for internal combustion engines, a source of electrical power comprising a dynamo electric machine

driven in fixed speed relationship with the engine, an electrical power storing means in circuit with said dynamo electric machine, a transformer adapted to receive electrical energy from said dynamo electric machine and said power storing means for producing an ignition spark, means associated with the primary of said transformer for controlling the functioning of the transformer, said means being dependent in its time of operation upon the electrical output of the dynamo electric machine for determining the time of ignition in the cycle of engine operation and a distributor for selectively connecting the secondary of said transformer to the spark plugs of the engine.

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

DOW B. HUGHES.

Witnesses:

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A. J. HUDSON.