F. CONRAD.

IGNITION SYSTEM.

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Fig. 1.

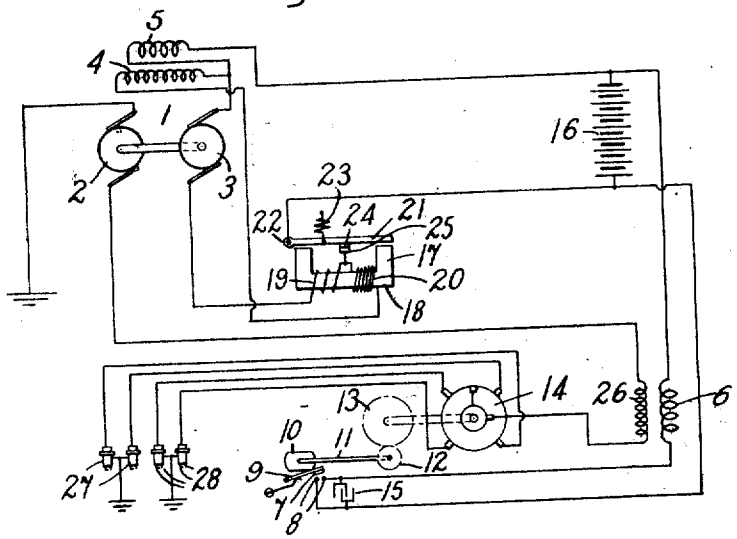
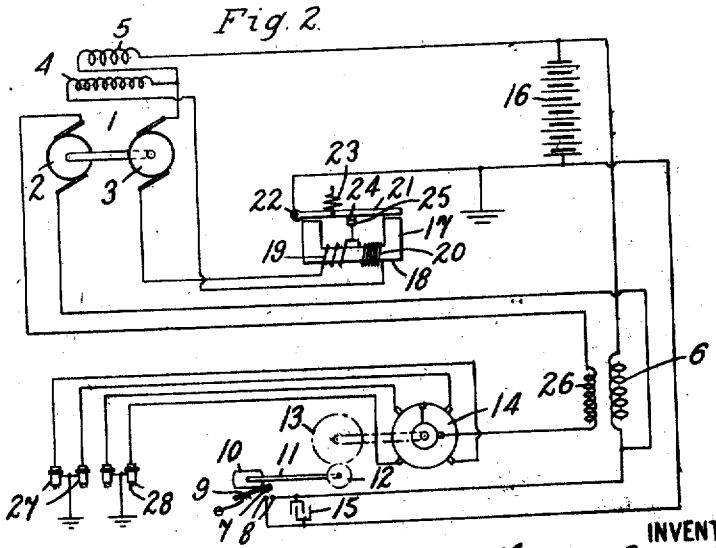


Fig. 2.



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IGNITION SYSTEM.

1,352,434. Specification of Letters Patent. Patented Sept. 14, 1920.

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To all whom it may concern:

Be it known that I, FRANK CONRAD, a citizen of the United States, and a resident of Swissvale, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Ignition Systems, of which the following is a specification.

My invention relates to ignition systems that are adapted to supply current to the spark plugs of internal combustion engines or to other ignition devices.

The object of my invention is to provide a system of the character above indicated by means of which a more reliable and effective spark may be produced than is possible with the systems heretofore provided.

In the operation of ignition systems employing spark plugs of the jump spark type, it is necessary to produce a current at high voltage to break down the resistance of the gap between the stationary terminals of the spark plugs.

Because of the high resistance of the ignition circuit, which usually comprises the secondary winding of a transformer, the amount of current which follows the initial discharge across the gap is usually so small that the spark is substantially instantaneous and of low heat value and, therefore, is not efficient for ignition purposes. It has been proposed to connect the low-voltage source of current to the secondary circuit for the purpose of securing a flow of current from the source across the gap after the resistance of the gap has been lowered by the high-tension discharge. It has been found by experiment that the flow of current from the primary source across the gap is small or negligible because the voltage of the source is too low. While the ignition systems, as at present arranged, operate with a primary voltage of 6 or 12 volts, actual experiments have demonstrated that approximately 100 volts are required to produce an appreciable increase in the time interval of the spark.

According to my present invention, I propose to produce a high-tension discharge by means of the usual low-tension battery or magneto and a transformer or an induction coil. A second source of current having a relatively high voltage, is connected to the secondary circuit and a flow of current from this source follows the high-tension discharge across the spark plug terminals, thus insuring continuance of the spark for an increased length of time and the production of a hot, fat spark.

In the accompanying drawings, Figure 1 is a diagrammatic view of an ignition system arranged in accordance with my invention. Fig. 2 is a view, similar to Fig. 1, of a modification.

Referring to Fig. 1, a continuous-current dynamo-electric machine 1 is illustrated diagrammatically as the details of its construction form no part of my present invention. The dynamo-electric machine 1 is provided with electrically independent armature windings as indicated at 2 and 3 which are adapted to generate a relatively high and a relatively low voltage, respectively. The field magnet of the generator, which is common to the armature windings, embodies a shunt field winding 4 and a series field winding 5 which are in circuit with the armature 3 and are wound to oppose each other. The low-voltage winding 3 supplies current to the primary winding 6 of a transformer or induction coil which is in circuit with an interrupter 7 comprising stationary terminals 8 and a movable member 9. The movable member 9 is actuated by a cam 10 having an operating shaft 11 that is connected by gear wheels 12 and 13 to a distributer 14. A condenser 15 is connected in shunt to the terminals 7 and 8 to avoid excessive sparking when the interrupter is operated. A storage battery 16 is also connected to the primary winding 6 in parallel with the generator armature 3 and supplies current to the primary winding 6 under conditions later described.

The circuit of the generator armature 3 is controlled by an automatic cut-out 17 having a core member 18 surrounded by two coils 19 and 20 that are connected in series and in shunt, respectively, with the armature 3. The cut-out is provided with an armature 21 having a pivotal support at 22 and normally held upward by a spring 23. A contact member 24 is mounted upon and connected to the armature 21 and coacts with a stationary contact member 25 to which the coils 19 and 20 are connected in common.

The secondary circuit of the system comprises the high-voltage armature winding 2, the secondary winding 26 of the induction coil, the distributer 14, which may be of the

usual construction, and spark plugs 27 having stationary terminals 28.

The operation of the system will now be described. It may be assumed that the gas engine, to which the various rotatable members are operatively connected, has been started and that its speed is increasing. The circuit of the armature 3 is broken by the cut-out 17, and current is supplied to the primary winding 6 from the battery 16. The interrupter 7 breaks the primary circuit and a high voltage is thereby induced in the secondary winding 26 to discharge across the terminals of that spark plug which is connected in circuit by the timer or distributer 14. The high resistance of the spark plug gap is broken down by the high-tension discharge and current from the generator armature 2 follows the discharge. The result is to increase the duration of the spark, which is of high heat value compared with the spark of the high tension discharge alone. The duration of the spark and the heat value of the same are important factors in the efficient operation of internal combustion engines, and the advantages of my invention will, therefore, be appreciated by those skilled in the art.

When the speed of the generator has reached a predetermined value, the coils 19 and 20 are sufficiently energized to draw the armature 21 downwardly to connect the contact members 24 and 25 and complete the circuit of the armature winding 3. The generator will then supply current to the primary winding 6 and to the battery 16 for recharging the same. If the generator voltage falls below that of the battery, current tends to flow in the reverse direction through the series coil 19. The coils now oppose each other, and the armature is released to break the generator circuit and thereby prevent the discharge of the battery 16 through the armature 3.

A modification of the system above described is shown in Fig. 2, in which like numerals are used to designate corresponding parts. One terminal of the battery 16 is grounded, in this form of my invention, and that terminal of the armature 2 which is grounded in the system shown in Fig. 1, is connected to the primary circuit between the interrupter 7 and the primary winding 6.

The operation of the system shown in Fig. 2 differs from that in Fig. 1 only in that, when the high-tension discharge occurs, the voltage of the current which follows will be the sum of the voltage of the battery 16 or the armature 3 and the armature 2. The secondary circuit extends from the ungrounded side of the battery 16 through the primary winding 6, the armature winding 2, secondary winding 26, distributer 14 and the terminals 28 of the spark plugs 27 to ground and back to the battery. When the generator armature 3 is connected in circuit, the voltage of the current flowing in the secondary circuit is the sum of the voltages of the armatures 2 and 3 which are then in series.

While I have shown my invention in its preferred form, it is understood that such changes may be made as fall within the limits of the appended claims. For example, the dynamo-electric machine 1 is indicated as being provided with armatures which supply direct current, but it is obvious that the same effects may be produced by means of alternating current armatures if the battery be omitted.

I claim as my invention:

1. In an ignition system, the combination with a source of current at a relatively high voltage, of a circuit connected to said source and having a gap normally impassable to said current, of means for causing said current to flow across said gap, said means comprising a source of current at a relatively low voltage and an induction coil having its secondary winding in said circuit.

2. In an ignition system, the combination with a source of current at a relatively high voltage, of a circuit connected to said source and having a gap normally impassable to said current, and means for causing a discharge of current at high voltage across said gap to cause the passage of current from said source, said means comprising a source of current at a relatively low voltage and an induction coil having a secondary winding in circuit with said high voltage source.

3. In an ignition circuit, the combination with a source of current, a primary circuit connected to the source, a secondary circuit that is inductively related to the primary circuit and includes a second source of current having a voltage higher than that of the source of primary current, and a spark plug having a permanently open gap.

4. In an ignition system, the combination with a source of current at a relatively low voltage, of a primary circuit connected to the source, a source of current at a relatively high voltage, a secondary circuit that is inductively related to the primary circuit and is connected to the second source of current, and a spark plug connected to said secondary circuit.

5. In an ignition system, the combination with a spark plug having a permanently open gap, and a plurality of sources of current, of means including one of said sources for causing a discharge of current at a high voltage across said gap and for causing a flow of current having a voltage which is the sum of the voltages of said sources to follow said discharge across said gap.

6. In an ignition system, the combination with a spark plug having a permanently open gap, and sources of current having relatively high and low voltages, of means

including the low voltage source, for causing a discharge of current at a high voltage across said gap and for causing a flow of current from said sources in series to follow said discharge across said gap.

7. In an ignition system, the combination with sources of current having relatively high and low voltages, and a spark gap that is normally impassable to the current from said sources, of means, including the low-voltage source, for causing a discharge of current at a high voltage across said gap and for causing a flow of current at a voltage which is the sum of the voltages of the said sources to follow said discharge across said gap.

8. In an ignition system, the combination with sources of continuous current having relatively high and low voltages, and a spark gap that is normally impassable to the current from said sources, of means including the low-voltage source, for causing an inductive discharge of current at a high voltage across said gap and for causing a flow of continuous current from said sources in series to follow said discharge across said gap.

9. In an ignition system, the combination with a source of current at a relatively high voltage, of a circuit connected to said source and having a gap normally impassable to said current, of means for causing said current to flow across said gap in a single direction, said means comprising a source of current at a relatively low voltage and an induction coil having its secondary winding in said circuit.

10. In an ignition system, the combination with a source of current at a relatively high voltage, of a circuit connected to said source and having a gap normally impassable to said current, and means for causing a discharge of current at high voltage across said gap to cause the passage of current from said source in a single direction, said means comprising a source of current at a relatively low voltage and an induction coil having a secondary winding in circuit with said high voltage source.

11. In an electrical system for motor vehicles, the combination with two sources of current, of a battery connected to the first source of current and adapted to be charged thereby, an induction coil having its primary winding connected to said battery and to said first source, the second source of current being of relatively higher voltage than the source that charges the battery, a circuit including the second source of current and also the secondary winding of said induction coil and having a gap normally impassable to the current from said second source, and an interrupter in the primary circuit of said induction coil for causing a discharge of current across said gap, whereby said gap will be rendered passable to current from the second source.

12. In an electrical system for motor vehicles, the combination with a dynamo-electric machine comprising two windings for generating currents of different voltages, of a battery connected to the winding generating the lower voltage and adapted to be charged with current therefrom, an induction coil having its primary winding connected to said battery and to said low-voltage winding, a circuit including the winding that generates the higher voltage and also including the secondary winding of said induction coil and having a gap normally impassable to the current from said high-voltage winding, and means for interrupting the primary circuit of said induction coil to cause a discharge of current across said gap, whereby said gap will be rendered passable to current from the high-voltage winding.

In testimony whereof I have hereunto subscribed my name this 31st day of May, 1913.

FRANK CONRAD.

Witnesses:
B. B. HINES,
C. E. WILSON.