

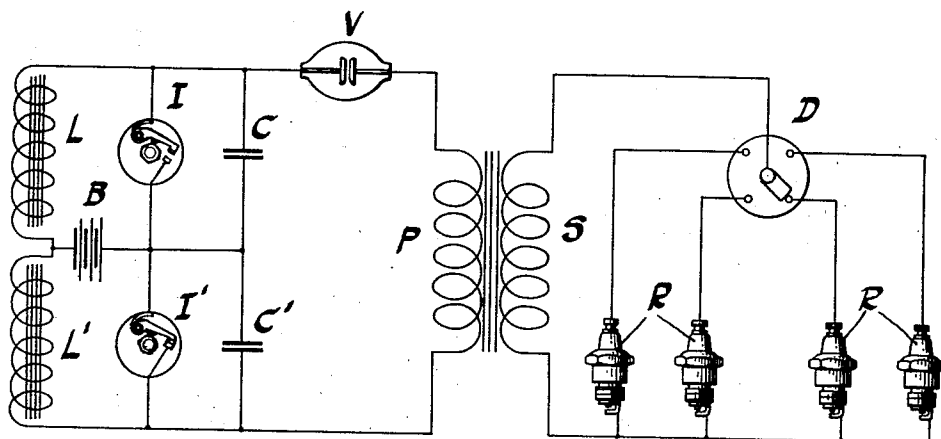
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IGNITION SYSTEM

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IGNITION SYSTEM

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This invention has to do with ignition systems of the type disclosed in the prior application of Ora S. Duffendack, Ralph A. Wolfe and Donald W. Randolph, Serial No. 668,754, filed May 1, 1933.

In that application there is disclosed an ignition system including a battery, or other source of electrical energy, arranged in series with an inductance and an interrupter. To this circuit a condenser is connected, preferably in parallel with the interrupter, so as to receive a surge of energy when the circuit is broken at the interrupter. This energy is supplied chiefly by the magnetic field of the inductance. The parts so far described may be considered an impulse producing circuit. When the condenser attains a predetermined voltage it discharges through an electrical valve arranged in a circuit coupled to the spark plug circuit preferably by means of a step-up transformer. The valve is preferably in the form of a two electrode gaseous discharge tube such as is described and claimed in the prior application of Duffendack and Wolfe, Serial No. 716,972, filed March 23, 1934. The valve is characterized by the fact that when the voltage applied to it attains a predetermined value the gap between electrodes suddenly breaks down and becomes conducting and offers practically no resistance to the passage of current. The discharge current through the tube is consequently of high value. Sudden passage of this heavy surge of current through the primary of the transformer results in the production of sparks at the spark plug. A conventional distributor preferably in the secondary circuit, determines the plug at which discharge takes place.

According to the present invention the above described system is so modified as to increase the number of sparks obtained per unit of time as well as the amount of energy in each spark, especially when operating at higher speeds. This is accomplished by employing two or more impulse producing circuits instead of one, the inductances preferably being supplied with current from the same battery as before, and each inductance being provided with its own circuit breaker and condenser. The breakers are adjusted so that one is closed just before the other one breaks its circuit. Assuming that two sets of coils, circuit breakers and condensers are used it is clear that each breaker is open but half the number of times that it would be open if there were but one set supplying the same number of sparks per second. As a consequence more time is allowed for the current to build up in the in-

ductance coils and consequently more energy is available at the spark especially at high speeds.

In the drawing, the figure indicates diagrammatically the improved circuit.

Here B indicates the battery connected to supply energy to inductances L and L'. In series with inductance L is circuit breaker I and in series with inductance L' is circuit breaker I'. A common lead connects the breakers to the other side of the battery. Circuit breaker I is bridged by condenser C and circuit breaker I' is bridged by condenser C'. In a circuit shunting the two sets of breakers and condensers is the primary P of a transformer and in series with the primary is the electrical valve V. The secondary S of the transformer supplies current through distributor D to the spark plugs R. The transformer preferably is provided with an iron core as shown.

The circuit breakers preferably take the form of contacts separated from time to time by the action of cams on a rotating shaft preferably driven at engine speed.

With the circuit shown each cam controls spark discharge at two of the plugs. The cams should be so arranged that one breaker is closed just before the other one breaks its circuit. This may be conveniently done by arranging both cams on the same drive shaft and simply displacing one angularly with respect to the other.

In the operation of the circuit, assuming that circuit breaker I' is closed and circuit breaker I is open, energy is discharged from inductance L charging the condenser C. When the charge on the condenser C reaches a sufficiently high value, valve V breaks down permitting a heavy surge of current to flow through the primary P. This flow of current produces a surge in the secondary S which discharges at the spark gap of the plug to which the distributor is then directing current. The discharge is really a series of discharges at such high frequency that there is insufficient time for appreciable leakage of current through parallel paths which may be provided by coatings on the insulator of the plug. Hence misfiring due to fouling of plugs does not occur.

Circuit breaker I now closes and circuit breaker I' opens and as a consequence electrical energy passes from the inductance L' to the condenser C', and thereafter, upon break down of the electrical valve V, through the primary P. This produces discharge at the next plug to which the distributor directs current.

With this arrangement since the two sets of impulse producing circuits consisting of induc-

tance, interrupter and condenser act alternately, there is twice as much time between sparks during which each inductance may receive energy from the battery compared with the time available in case but one inductance supplied all the plugs. As a consequence more energy is stored in the field of the inductance and is available for discharge at the spark especially at the higher speeds where the lag of current flow into the coils appreciably reduces the amount of stored energy.

It will be apparent that another advantage of the described circuit consists in the fact that by having the two parallel impulse producing circuits discharge into the common circuit containing the valve V, the polarity of the energy applied to the valve reverse upon going from one impulse producing circuit to the other. As a consequence the current flow through the valve is first in one direction, and then in the other so that there is no opportunity for metal to pile up on one electrode, tending to bridge the gap. When this occurs the tube, of course, fails to function. This difficulty is avoided entirely by the reversal of polarity which is inherent in the present circuit.

It is of course apparent that this invention is capable of a great deal of modification in practice. Thus three or more impulse producing circuits may be used instead of two. The circuit including the valve V may be tuned for resonance if this is found advantageous and the same may be done in the case of the secondary and other sub-circuits although the many variables present may make tuning difficult or inadvisable. Instead of a battery I may use a generator as the source of current and in such event the inductances L and L' may be composed of windings of the generator armature. Other modifications will occur to those skilled in the art.

I claim:

1. In an impulse operated electrical system, the combination of a plurality of impulse producing circuits arranged in parallel, a circuit including an electrical valve into which said first named circuits discharge upon breaking down of the valve, and means for timing said impulse producing circuits to cause them to alternately energize the discharge circuit.

2. In an impulse operated electrical system, the combination of a plurality of impulse producing circuits arranged in parallel, a circuit including an electrical valve into which said first named circuits discharge upon breaking down of the valve, and means for timing said impulse producing circuits to cause them to alternately energize the discharge circuit, and a work circuit coupled to said discharge circuit.

3. In an impulse operated electrical system, the combination of a plurality of impulse producing circuits arranged in parallel, a circuit including an electrical valve into which said first named circuits discharge upon breaking down of the valve, and means for timing said impulse producing circuits to cause them to alternately energize the discharge circuit, and a work circuit coupled to said discharge circuit including a plurality of ignition devices, and means for distributing the flow of current to said devices.

4. In an ignition system the combination of a source of electrical energy and a plurality of circuits connected to said source in parallel, each circuit comprising an inductance and a circuit breaker in series with said source and a condenser in parallel with said circuit breaker, a discharge circuit arranged to receive energy from each of

said condensers, said discharge circuit including an electric valve.

5. In an ignition system the combination of a source of electrical energy and a plurality of circuits connected to said source in parallel, each circuit comprising an inductance and a circuit breaker in series with said source and a condenser in parallel with said circuit breaker, a discharge circuit arranged to receive energy from each of said condensers, said discharge circuit including an electric valve, and means for timing said circuit breakers to cause them to alternately energize the discharge circuit.

6. In an ignition system the combination of a source of electrical energy and a plurality of circuits connected to said source in parallel, each circuit comprising an inductance and a circuit breaker in series with said source and a condenser in parallel with said circuit breaker, a discharge circuit arranged to receive energy from each of said condensers, said discharge circuit including an electric valve, a circuit including an igniting device coupled to said discharge circuit.

7. In an ignition system the combination of a source of electrical energy and a plurality of circuits connected to said source in parallel, each circuit comprising an inductance and a circuit breaker in series with said source and a condenser in parallel with said circuit breaker, a discharge circuit arranged to receive energy from each of said condensers, said discharge circuit including an electric valve, means for timing said circuit breakers to cause them to alternately energize the discharge circuit, and a circuit including an ignition device inductively coupled to said discharge circuit.

8. In an impulse operated ignition system, the combination of a plurality of impulse producing circuits arranged in parallel, a circuit into which said first-named circuits discharge including means adapted to normally prevent passage of current therethrough but adapted to break down and permit passage of a surge of current upon application of predetermined voltage, and means for timing said impulse producing circuits to cause them to alternately energize the discharge circuit.

9. In an impulse operated ignition system, the combination of a plurality of impulse producing circuits arranged in parallel, a circuit into which said first-named circuits discharge including means adapted to normally prevent passage of current therethrough but adapted to break down and permit passage of a surge of current upon application of predetermined voltage, means for timing said impulse producing circuits to cause them to alternately energize the discharge circuit, a work circuit coupled to said discharge circuit including a plurality of ignition devices, and means for distributing the flow of current to said devices.

10. In an ignition system the combination of a source of electrical energy and a plurality of circuits connected to said source in parallel, each circuit including an inductance and a circuit breaker in series with said source and a condenser in parallel with said circuit breaker, a discharge circuit arranged to receive energy from each of said condensers, said discharge circuit including means adapted to normally prevent passage of current therethrough but adapted to break down and permit passage of a surge of current upon application of the necessary voltage.

11. The combination of a source of direct current, impulse producing circuits arranged in par-

allel and including said source, a circuit into which said circuits discharge including a device adapted to normally prevent passage of current therethrough but adapted to break down and permit passage of a surge of current upon receiving from either of said impulse producing circuits an impulse of sufficient voltage, and means for timing said impulse producing circuits to cause them to alternately energize the discharge circuit.

12. The combination as defined in claim 11 and a work circuit coupled to said discharge circuit.

13. The combination as defined in claim 11 and a work circuit including an ignition device inductively coupled to said discharge circuit.

14. The combination of a source of direct current, impulse producing circuits arranged in parallel and including said source, means for timing said impulse producing circuits to cause them to alternately produce electrical impulses, means for temporarily storing the energy of said impulses, and a discharge circuit for said last named means comprising a device adapted to normally prevent passage of current therethrough but to break down and permit passage of a surge of current upon application of predetermined voltage.

15. In the combination as defined in claim 14, a work circuit coupled to said discharge circuit.

16. In the combination as defined in claim 14, a work circuit including an ignition device inductively coupled to said discharge circuit.

17. The combination of a plurality of impulse producing circuits arranged in parallel, each comprising an inductance and an interrupter together with a source of direct current common to said circuits, means for alternately operating said interrupters so as to produce electrical impulses alternately in said circuits, and a circuit into which said first named circuits discharge including means adapted to break down and permit passage of a surge of current upon application of predetermined voltage.

18. In the combination as defined in claim 17, a circuit including an igniting device coupled to said last named circuit.

19. In the combination as defined in claim 17, a circuit including an igniting device coupled to said last named circuit by means of a step-up

transformer having its primary in said discharge circuit and its secondary in series with said igniting device.

20. The combination of a plurality of impulse producing circuits arranged in parallel, each comprising an inductance and an interrupter with a source of direct current common to said circuits, means for alternately operating said interrupters so as to produce electrical impulses alternately in said circuits, means connected to said circuits adapted to temporarily store the energy of said impulses, and a circuit into which said last named means discharges including a device adapted to break down and permit passage of a surge of current upon application of sufficient voltage.

21. In the combination as defined in claim 20, a work circuit coupled to said last named circuit.

22. In the combination as defined in claim 20, a work circuit including an igniting device coupled to said last named circuit.

23. In the combination as defined in claim 20, a step-up transformer having its primary in said last named circuit, and an igniting device in series with the secondary.

24. The combination of a plurality of impulse producing circuits arranged in parallel, means for timing said impulse producing circuits to cause them to alternately produce current impulses, means connected to said circuits for temporarily storing the energy of said impulses, and means in circuit with said energy storing means adapted to normally prevent passage of current therethrough but to break down and permit passage of current upon application of a predetermined voltage.

25. The combination of a plurality of impulse producing circuits arranged in parallel, means for timing said impulse producing circuits to cause them to alternately produce current impulses, means connected to said circuits for temporarily storing the energy of said impulses, means in circuit with said energy storing means adapted to normally prevent passage of current therethrough but to break down and permit passage of current upon application of a predetermined voltage, and a circuit including an igniting device inductively coupled to said last named circuit.

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