April 21, 1931. T. L. LEE 1,801,608

ELECTRIC IGNITION APPARATUS

Filed March 19, 1929

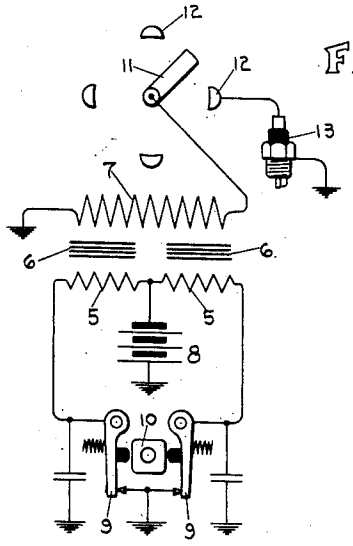


Fig. 1

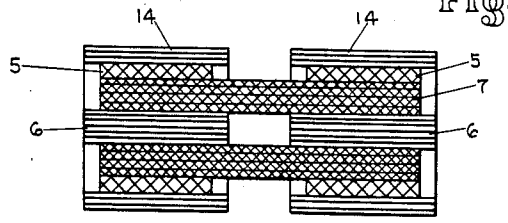


Fig. 2

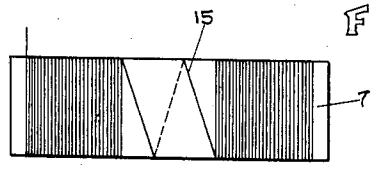


Fig. 3

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Patented Apr. 21, 1931

1,801,608

UNITED STATES PATENT OFFICE

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ELECTRIC IGNITION APPARATUS

Application filed March 19, 1929. Serial No. 348,241.

This invention relates to ignition apparatus of the jump-spark type, and the object of the invention is to produce a system which shall be capable of the high-speed operation required by modern automobile engines, without the necessity of overloading and burning the contacts of the primary circuit breaker.

High-speed operation, in apparatus of the kind in question, necessitates the use, in the primary winding of the ignition coil, of a relatively heavy current, to compensate for the short space of time during which the circuit can be closed. This requirement makes low contact resistance desirable, but the heavy current has a tendency to cause oxidation of the contacts of the circuit controller with the result of increasing the contact resistance and of destroying the contacts rapidly.

To reduce these undesirable effects it has been the practice, to some extent, to provide the circuit controller with two pairs of contacts, which are operated simultaneously, by the same cam, and are connected in parallel so as to divide the current between them. This arrangement tends to reduce the total contact resistance. It is not effective to prevent oxidation of the contacts, however, because it is impossible to adjust the mechanism for absolutely simultaneous operation, and the interruption of the current is always performed chiefly by the pair of contacts which opens later.

In the apparatus of the present invention the equal division of the primary current, between two pairs of contacts, is insured by providing two distinct primary windings in the ignition coil or transformer, each of these windings being connected with its respective pair of contacts. The secondary winding is in inductive relation with the two primary windings, so that they act cumulatively upon it, the effect being substantially the same as if all the primary current passed through a single winding, except that the present arrangement absolutely insures that each pair of contacts shall have the duty of interrupting only one half of the total primary current.

In an arrangement such as just described, it is desirable to avoid magnetic coupling between the two parallel primary circuits. It is inevitable that one circuit will be opened slightly before the other, and if the two primary windings are arranged upon the same magnetic core, the result will be a transfer of energy from one circuit to the other, which transfer will cause dissipation of energy and also enhance the tendency to arcing at the contacts. In accordance with the present invention, accordingly, each primary winding is provided with an independent iron core, and the two cores are separated as far as convenience in construction will permit, to minimize magnetic influence of one core upon the other.

In theory it might seem that the distinct primary windings and cores might also be provided with distinct secondary windings, so that there would be, in fact, two entirely separate coils or transformers, with their secondary windings connected in parallel or in series. Actually, this arrangement is not satisfactory. If the secondary windings be connected in parallel, the non-simultaneous operation of the primary contacts results in a difference in the potential of the two secondary windings, so that there is an interchange of energy between the two coils, first in one sense and then in the opposite sense, whereby the energy is largely dissipated, so that the arrangement is inefficient. If the secondaries be connected in series, on the other hand, serious difficulties in insulation arise, owing to the fact that portions of the windings which are at high potential will inevitably be in close proximity to the primary winding and the core, one or both of which are at low potential or grounded. In accordance with the present invention, accordingly, the primary windings and the cores are combined with a secondary wound as a single helical coil in inductive relation with both magnetic cores.

In the accompanying drawings Fig. 1 is a diagram of an ignition system embodying the present invention. Fig. 2 is a diagrammatic longitudinal sectional view of the ig-

nition coil, and Fig. 3 is a detail view of the secondary winding of the coil.

Fig. 1 shows the ignition apparatus as comprising a coil or transformer having two primary windings 5, 5 associated with their respective cores 6, 6. A single secondary winding 7 is associated with both cores. A battery 8 furnishes the electrical energy, and the current through the primary windings is controlled by two contact-arms 9, 9, which are operated, as nearly simultaneously as possible, by a single cam 10 in the usual manner. The high-tension current from the secondary winding 7 is controlled by the usual distributor, comprising a rotor 11 and electrodes 12, the electrodes being connected with the spark-plugs 13 (of which only one is shown) in the respective cylinders of the engine.

The ignition coil used in the system of Fig. 1 is shown, in Fig. 2, as being arranged with the primary windings outside the secondary winding. The cores 6 are separated by a sufficient air-gap to prevent any substantial amount of magnetic coupling, and the magnetic circuit of each primary is preferably improved by the addition of iron 14 outside the windings.

Since the secondary winding 7 is wound as a single helical coil, it is obvious that those turns lying in the air-space between the two magnetic circuits are practically dead, i. e. useless for the induction of electromotive force, and that they add undesirable resistance to the secondary circuit. The number and effect of these intermediate turns may be minimized by changing the pitch of the middle part of each layer of the winding, so that this part consists of only a few turns, as shown at 15 in Fig. 3.

The invention claimed is:

An ignition coil for a divided primary ignition system, comprising in combination, a secondary coil having its layers so wound that an intermediate portion of each layer consists of turns of wire spaced apart a greater distance than other portions of the layer, separated magnetic cores each within the coil portion consisting of the closely spaced turns, separate primary coils each surrounding a secondary coil portion consisting of the closely spaced turns, and separate magnetic tubular bodies each surrounding a primary coil.

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