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IGNITION SYSTEMS WITH IGNITION COILS FOR
INTERNAL COMBUSTION ENGINES
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FIG. 1

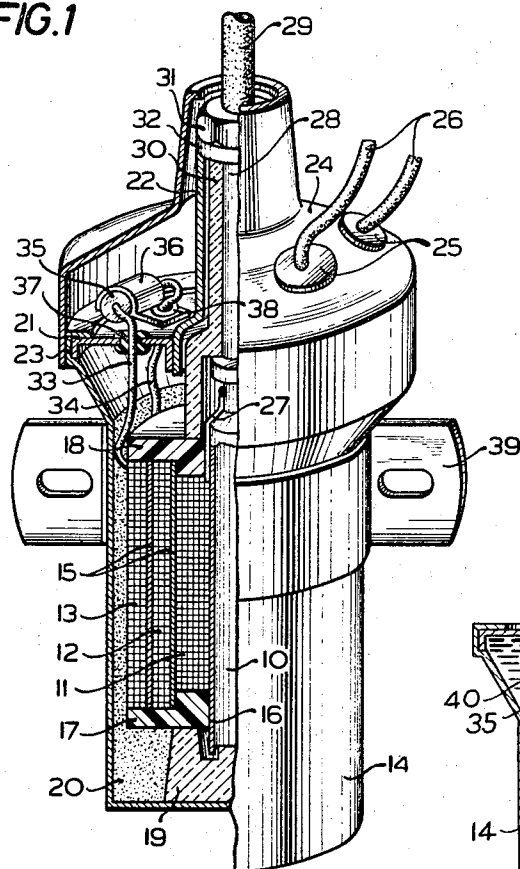


FIG. 3

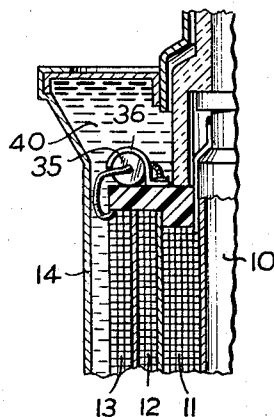
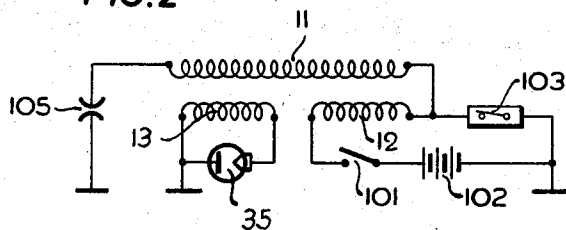


FIG. 2



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IGNITION SYSTEMS WITH IGNITION COILS FOR INTERNAL COMBUSTION ENGINES

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8 Claims. (Cl. 123—148)

ABSTRACT OF THE DISCLOSURE

In an ignition system for internal combustion engines in which a diode in series with a damping winding is arranged to short-circuit the latter when the interrupter which connects the primary winding with the source of DC current moves from its open to its closed position to thereby dampen during such movement the voltage impulse induced in the secondary winding so that production of faulty ignition sparks in the spark plug is prevented.

The present invention relates to ignition systems for internal combustion engines. More specifically, the present invention relates to battery operated ignition systems for internal combustion engines, especially gas engines of high capacity, in which an ignition coil having a primary and a secondary winding is coordinated with each spark plug of the engine.

In internal combustion engines which require for the ignition of the fuel air mixture considerable igniting energy, a separate ignition coil is coordinated with each spark plug of the engine. In multicylinder combustion engines, the primary windings of the ignition coils are connected to a common battery, whereas the secondary windings are respectively connected to the respective spark plugs. The time during each energization of the primary circuit is held as short as possible in order to reduce the load on the battery. During closing of the interrupter in the primary circuit, faulty ignition sparks may be produced on the spark plug of an ignition system of this type at a relatively short time prior to the normal ignition spark and this leads to a wrong ignition timing and to considerable difficulties as for instance damage to the carburetor and to the transmission.

It is an object of the present invention to overcome the disadvantages of ignition systems of the aforementioned kind.

It is an additional object of the present invention to provide an arrangement in which especially the voltage impulse induced in the ignition coil during closing of the primary circuit thereof is neutralized.

With these objects in view, the ignition system for combustion engines according to the present invention mainly comprises an ignition coil having a core of magnetizable material, a primary winding and a secondary winding, a source of DC current in circuit with the primary winding, interrupter means in said circuit between said primary winding and said source of DC current and moveable between a closed position in which current is applied to the primary winding and an open position, whereby when the interrupter means is moved from the open to the closed position a first voltage impulse will be induced in the secondary winding and when said interrupter means is moved from said closed to said open position a second voltage im-

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pulse will be induced in the secondary winding of a phase position opposite to that of said first voltage impulse, and means for damping the voltage impulse induced in the secondary winding during movement of the interrupter means from one to the other of the positions thereof so that only one of the voltage impulses will provide a spark at the spark plug of the system, said damping means comprising a damping winding cooperating with said core, said primary winding and the secondary winding and a one-way electric valve means in series with the damping winding and arranged in such a manner so as to short-circuit the latter when said interrupter means moves from said one to said other position.

The source of DC current of the system is preferably a battery and the one-way valve means above mentioned is preferably in the form of a diode, which is preferably arranged in such a manner that the damping winding will be short-circuited when the interrupter means of the primary winding moves from the open to the closed position thereof.

An advantageous arrangement of the ignition coil is obtained when the core is in the form of a rod-shaped body, for instance of iron, and when the secondary winding, the primary winding and the damping winding are wound superimposed upon each other about the rod-shaped core.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a perspective partially sectioned view of the ignition coil according to the present invention;

FIG. 2 is a wiring diagram of the ignition system according to the present invention; and

FIG. 3 is a sectioned partial view similar to FIG. 1 and showing a modified arrangement.

Referring now to the drawings, and more specifically to FIG. 1, it will be seen that the ignition coil according to the present invention mainly comprises a substantially rod-shaped core 10 of magnetizable material, for instance iron, onto which a secondary winding 11 with for instance 28,000 turns, a primary winding 12 with, for instance 160 turns and a damping winding 13 with for instance 200 turns are arranged superimposed upon each other. The core 10 and the windings thereon are located in a closed housing 14. The windings which are electrically insulated from each other by foils 15 of insulating material and from the magnet core 10 by a tube 16, which may for instance be formed from cardboard, are held at the opposite end faces thereof by discs 17 and 18 of insulating material and are together with the magnet core 10 supported on the bottom of the housing 14 by a body 19 of insulating material. The spacing between the outer surface of the outermost winding and that of the insulating body 19 and the inner surface of the housing 14 is filled with a hardenable insulating material 20, for instance a cast resin. The upper end of the housing 14 is preferably conically widened and an annular cover 21 is connected, for instance by soldering, at the outer periphery thereof to the conically widened end of the housing 14, whereas a sleeve 22 connected to the inner periphery of the cover, for instance likewise by soldering, projects upwardly from the

latter. A protective cap 24 is pushed with a tight fit onto the upper rim 23 of the housing 14. The cap is provided with two spaced insulating bushings 25 through which conductors 26 extend for connecting the primary winding 12 to a source of DC current, for instance a battery. The secondary winding 11 is connected by a wire 27 and a metal rod 28 to an ignition cable 29 which leads to a spark plug, not shown in FIG. 1. The metal rod 28 is housed in a substantially cylindrical insulator 30 which abuts with its lower end against the insulating disc 18. A nut 31 and an insulating disc 32 sandwiched between the nut and the upper end of the sleeve 30 serve to close the insulator 30 and the metal sleeve 22 at the upper end thereof.

The damping winding 13 is connected by means of the conductors 33 and 34 to a diode 35, which by means of a clamp 36 is mounted on the cover 21 in the space between the upper surface of the latter and the protective cap 24. The conductor 33 extends through an insulating bushing 37 through the metal cover 21, whereas the conductor 34 extends through a tubular metal rivet 38 which serves at the same time to secure the clamp 36 to the cover and the conductor 34 is soldered to the metal rivet 38 so as to be grounded. A metal clamp 39 serves to mount the housing 14 on a support, not shown in FIG. 1.

Since the diode 35 would be destroyed when subjected to temperatures over 100° C., it is an advantage to mount the latter in ignition coils in which the housing is filled with a hardenable insulating material on the cover of the housing, as shown in FIG. 1. If the housing 14 is filled with insulating oil 40, as shown in FIG. 3, it is advantageous to arrange the diode 35 on the upper end face of the windings so that the conductors connecting the diode to the damping winding do not have to extend through the cover. In this arrangement the conductor 34 is grounded in any convenient manner.

The wiring diagram shown in FIG. 2 illustrates the manner in which the above-described ignition coil is connected to the ignition system and the action of the damping winding will now be explained with reference to FIG. 2. One terminal of the primary winding 12 of the ignition coil is by means of an ignition switch 101 connected to the positive pole of a 12-volt battery 102, the negative pole of which is grounded. The other end of the primary winding is connected to an interrupter device 103 located outside the ignition coil housing and connected within the housing to one end of the secondary winding 11, whereas the other end of the latter is connected to a spark plug 105. During opening and during closing of the interrupter device 103 voltage impulses are induced in the windings which are respectively in phase opposition. The diode 35 is connected to the damping winding 13 in such a manner that the damping winding 13 is short circuited when a voltage impulse is induced therein during closing of the primary circuit. The field produced by the current flowing through the damping winding 13 will dampen the voltage impulse imparted to the secondary winding 11 so that no spark will be produced in the spark plug 105. During opening of the primary circuit by the interrupter device 103 voltage impulses will be induced in the windings of the ignition coil which are in phase opposition to the impulses induced during closing of the primary circuit. The voltage impulse induced in the secondary winding during opening of the primary circuit will not be dampened by the damping winding 13, since the diode 35, which acts as an electrical one-way valve, will now prevent flow of any current through the damping winding so that the voltage impulse induced in the secondary winding will produce a spark in the spark plug 105. The diode 35 has to be dimensioned in such a manner that it will not be destroyed by the short circuit current and the voltage peak produced in the damping winding 13. Repeat ignitions which during oscillation of the ignition voltage may normally occur are likewise prevented by the damping winding 13 which during such an occurrence is short circuited

by the diode 35. The interrupter device 103 may be controlled, in a known manner not forming part of the present invention, either mechanically or electronically.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of ignition systems differing from the types described above.

While the invention has been illustrated and described as embodied in an ignition system for internal combustion engines including an ignition coil having a damping winding, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an ignition system for internal combustion engines having a spark plug, in combination, an ignition coil having a core of magnetizable material, a primary winding, and a secondary winding and a very high transformer ratio; a source of DC current in circuit with said primary winding; interrupter means in said circuit between said primary winding and said source of DC current and being movable between a closed position in which current is supplied to said primary winding and an open position, whereby when said interrupter means is moved from said open to said closed position a first voltage impulse will be induced in said secondary winding and when said interrupter means is moved from said closed to said open position a second voltage impulse in phase opposition to said first voltage impulse will be induced in said secondary winding; conductor means connecting said secondary winding with said spark plug; and damping means for damping the voltage impulse induced in said secondary winding during movement of said interrupter means from said open to said closed position thereof so that only one of the voltage impulses will provide a spark at the spark plug, said damping means comprising a damping winding cooperating with said core, said primary winding and said secondary winding and a diode in series with said damping winding and arranged in such a manner so as to short circuit the latter when said interrupter means moves from said open to said closed position.

2. In an ignition system as set forth in claim 1, wherein said source of DC current is a battery.

3. In an ignition system as set forth in claim 2, wherein said core is rod-shaped, and wherein said windings are wound superimposed upon each other about said rod-shaped core.

4. In an ignition system as set forth in claim 3, wherein said secondary winding forms the innermost and said damping winding the outermost of said superimposed windings.

5. In an ignition system as set forth in claim 3, and including a housing in which said core and said windings are located, said diode being arranged outside said housing.

6. In an ignition system as set forth in claim 5, wherein said housing has an open end and including a cover closing said open end of said housing, said diode being mounted on said cover, and including a protective cap connected to said one end of said housing and extending over said diode.

7. In an ignition system as set forth in claim 6, and including hardenable insulating material at least partly filling the space in said housing about said windings.

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8. In an ignition system as set forth in claim 3, and including a housing having an upper and a lower closed end, said core in said windings being located in said housing spaced from said opposite ends; liquid insulating material filling the space in said housing about said core and said windings, and said diode being mounted in said housing at a portion of said windings facing said upper end of said housing.

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