Jan. 26, 1932. J. L. ARTHUR 1,842,815

IGNITION SYSTEM

Filed Dec. 31, 1930

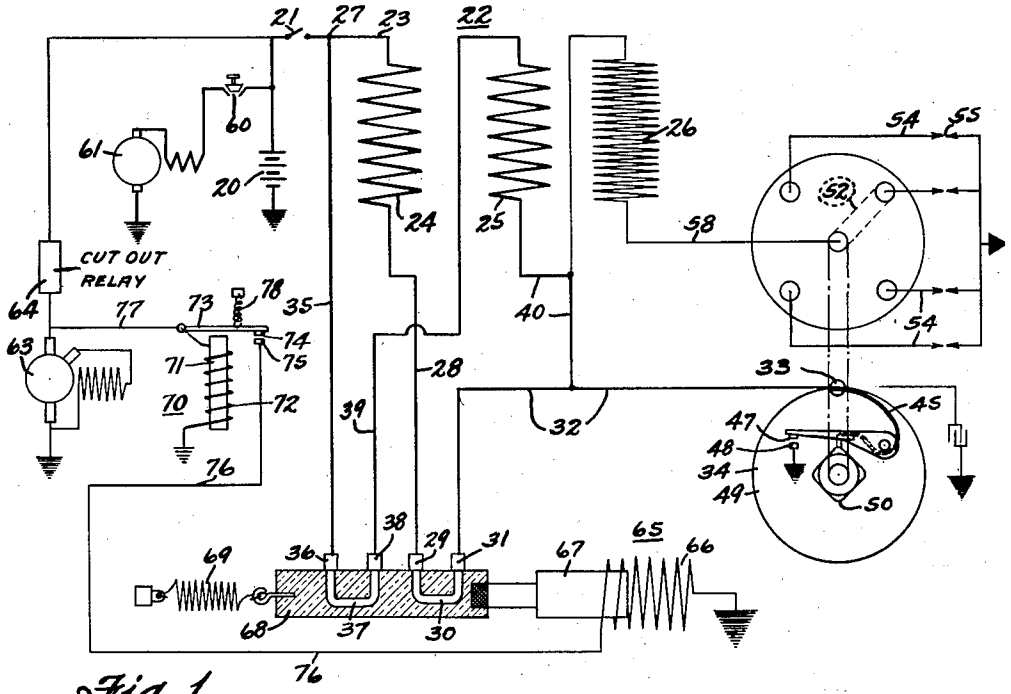


Fig. 1

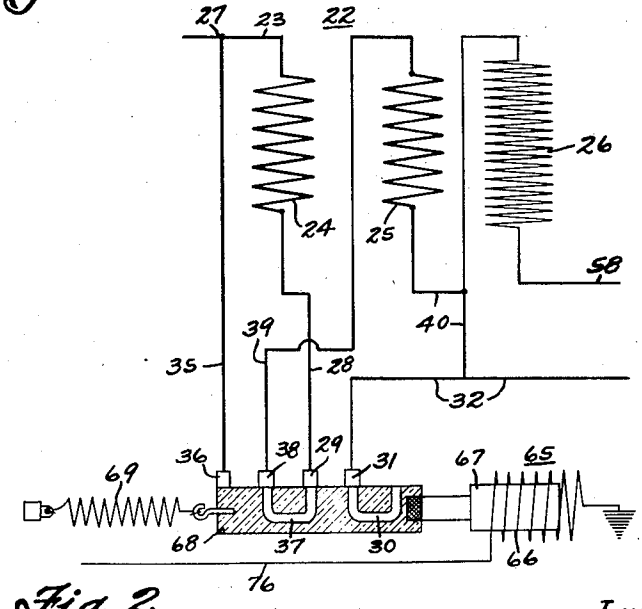


Fig. 2

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UNITED STATES PATENT OFFICE

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IGNITION SYSTEM

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This invention relates to improvements in electrical ignition apparatus of the battery type for internal combustion engines in which the storage battery supplies current to the starting motor and supplies current for ignition while cranking.

An object of the present invention is to provide satisfactory ignition while cranking the engine in order to facilitate the starting of the engine. This object is accomplished by providing the ignition coil with a plurality of primary windings and means for connecting the primary windings in parallel with the battery while cranking. When the engine has become self-operative the primary coils are connected in series by an automatic switch controlled by an electro-magnet responsive to generator voltage.

In the disclosed embodiment of the present invention, the ignition apparatus comprises a current source, an ignition circuit including a plurality of primary windings, a switch for normally connecting the primary windings in parallel for engine starting ignition and operable into position for connecting the windings in series, an electro-magnet for operating the switch, and a generator for energizing the electro-magnet in response to the engine becoming self-operative.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view illustrating the electrical circuit when the primary coil windings are in normal or parallel relation.

Fig. 2 is a view showing the primary coil windings in series relation during the running of the engine.

Referring to the drawings, 20 indicates a storage battery used in connection with the starting and ignition apparatus of automotive vehicles. The ungrounded terminal of the battery 20 is connected to a switch 21. An ignition coil 22 is connected to the switch 21 by a lead 23. The ignition coil comprises two primary coils 24 and 25 which are inductively related to a secondary winding 26.

The primary circuit of the present ignition system normally comprises the two primary windings in a parallel relation. The circuit comprises the battery 20, the switch 21, a terminal 27 which divides the primary circuit and one branch of the divided circuit may be traced from the terminal 27 through lead 23, coil 24, lead 28, stationary contact 29, movable contact 30, stationary contact 31, lead 32, and a terminal 33 of an ignition timer 34. The other branch may be traced from the terminal 27, lead 35, stationary contact 36, movable contact 37, stationary contact 38, lead 39, coil 25, lead 40, lead 32 and the terminal 33 of the timer 34.

The timer comprises a conducting spring 45 connected to the terminal 33 and a breaker arm 46. The breaker arm is provided with a movable contact 47 cooperating with a stationary contact 48 grounded at 49. A cam 50 is operated to intermittently and regularly move the movable contact 47 out of electrical engagement with the stationary contact 48 to break the primary circuit.

A distributor 51 has a rotor 52 rotated at the same speed with the cam 50 of the timer 34 to bring its free end into engagement with a plurality of contacts 53. Each contact of the distributor is respectively connected by a lead 54 to a spark plug 55 of the engine. The rotor 52 is electrically connected by a lead 58 to the secondary winding 26 and to ground.

To start the engine with the present invention, a switch 60 connects the battery 20 to operate a starting motor 61 to crank the engine. During the cranking of the engine, the primary windings 24 and 25, as shown in Fig. 1, will be connected in parallel with the battery 20 to provide better sparking impulses at the plugs 55 during said cranking.

When the engine has become self-operative, it is desirable to have the primary windings connected in series relation as soon as there is sufficient voltage produced by a generator 63 to operate a snap-switch or other suitable means. This means is advantageous so as not to hinder the operation of the en-

gine or injure any part of the ignition system. The present invention has accomplished this result in a satisfactory manner by providing a relay 70 operated on low voltage delivered from the generator. The relay is connected to an electro-magnet that is adapted to shift, with a quick action, the switch 68 shifting the primary windings from the parallel to the series relation while the engine is in operation.

The relay comprises a core 71, a coil 72, an armature 73 provided with a movable contact 74 and a stationary contact 75 connected to an electro-magnet 65 through a lead 76. The winding 72 of the relay 70 is connected to the generator 63 by a lead 77. After the engine is operated at low speeds, the generator supplies sufficient current to operate the relay 70 which then connects the electro-magnet to the generator by closing the contacts 74 and 75. The electro-magnet 65, and the relay 70, are responsive to lower current out-put of the generator than is the cut-out relay 64, that is also connected to the generator. The relay 70 and the electro-magnet 65 are calibrated to be responsive to low current out-put developed by the generator 63. This output is of a much lower value than is required to operate the cut-out relay 64, and in consequence thereof will shift the member 68 as soon as the engine becomes self-operative to connect the primary windings from a parallel to a series relation. When the generator reaches a predetermined or higher voltage, the cut-out relay 64 will then operate for connecting the battery 20 with the generator for charging purposes.

The electro-magnet 65 comprises a coil 66 and an armature 67. The armature 67 is secured to the switch member 68 of suitable insulating material. The member 68 insulatingly supports the movable contacts 30 and 37.

When the electro-magnet is connected into the circuit through the relay 70, the coil 66 is energized and attracts the armature 67 which moves the member 68 from the position shown in Fig. 1 to that of Fig. 2. The armature 67 and member 68 are moved against the tension of a spring 69. While the engine is running the primary coils 24 and 25 are connected in series relation with the battery, as illustrated in Fig. 2, for the reason that the magnetic influence of the coil 66 on the armature 67 is sufficient to overpower the effect of the spring 69, and thereby shifts the switch member 68 from the position illustrated in Fig. 1 to that of Fig. 2. The movable contact 37 of the member 68 then connects the windings 24 and 25 in series.

Should the engine idle down to a speed that the generator will not produce sufficient energy to magnetize the coil 72, the contacts 74 and 75 will open allowing the coil 66 to deenergize, whereupon the spring 69 will cause the switch 68 to connect the primary windings in parallel relation, and produce a better spark at the plugs to keep the engine from stalling. When the engine reaches a speed sufficient for causing the generator to operate the relay 70 the above cycle of movement will be repeated through which the primary windings 24 and 25 will be connected in series. Should the engine stop or become nonoperative, the relay 70 would be deenergized causing the contacts 74 and 75 to be separated by the spring 78 and the electro-magnet would be then deenergized causing the switch member 68 to be returned to its normal position by the spring 69 that connects the primary windings in parallel relation and holds them in readiness to insure better sparking when the engine is to be started.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An ignition apparatus for internal combustion engines, comprising in combination; a current source; an ignition circuit including a plurality of primary windings; a switch for normally connecting the windings in parallel; and means responsive to engine becoming self-operative to operate the switch to connect the primary windings in series.

2. An ignition apparatus for internal combustion engines, comprising in combination; a current source; an ignition circuit including a plurality of primary windings; a switch for normally connecting the windings in parallel; electro-magnetic means; and means responsive to engine becoming self-operative for energizing the electro-magnet to operate the switch to connect the primary windings in series.

3. An ignition apparatus for internal combustion engines, comprising in combination; a current source; an ignition circuit including a plurality of primary windings, a switch for normally connecting the primary windings in parallel, a generator driven by the engine; and an electro-magnet connected with the generator to operate the switch to connect the primary windings in series.

4. An ignition apparatus for internal combustion engines, comprising in combination; a battery; an ignition circuit including a plurality of primary windings; a generator; a switch for controlling parallel and series connections of the primary windings; and an electro-magnet for operating the switch and having a coil connected with the generator.

5. An ignition apparatus for internal combustion engines, comprising in combination; a battery; an ignition circuit including a plurality of primary windings; a switch for

normally connecting the primary windings in parallel for engine starting ignition and operable into position for connecting the windings in series; an electro-magnet for operating the switch; and means for energizing the electro-magnet in response to the engine becoming self operative.

6. An ignition apparatus for internal combustion engines comprising in combination; a current source; an ignition circuit including a plurality of primary windings; a switch for normally connecting the windings in parallel; a relay; electro-magnetic means; and means responsive to engine becoming self-operative for energizing the relay and the electro-magnet to operate the switch for connecting the windings in series.

7. An ignition apparatus for internal combustion engines comprising in combination; a current source; an ignition circuit including a plurality of primary windings; a switch for normally connecting the primary windings in parallel; a generator driven by the engine; a relay connected with the generator and an electro-magnet connected with the relay, said relay being responsive to low current development of the generator for operating the switch to connect the primary windings in series.

In testimony whereof I hereto affix my signature.

JAMES L. ARTHUR.