Aug. 11, 1925. 1,549,732

S. J. BOUGHTON

IGNITION SYSTEM

Filed July 3, 1919

Fig. I.

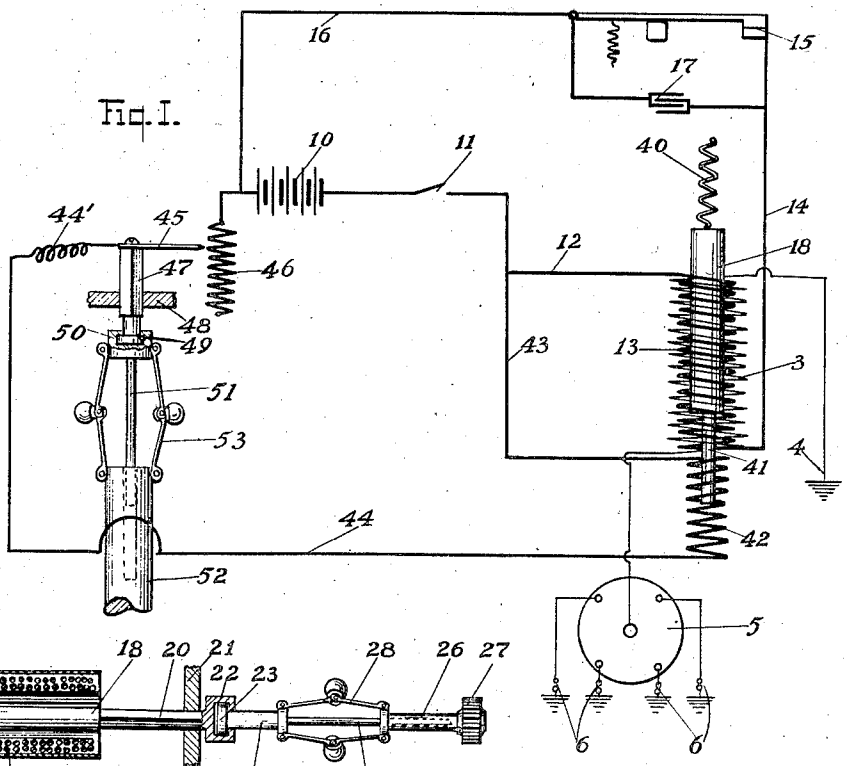


Fig. II.

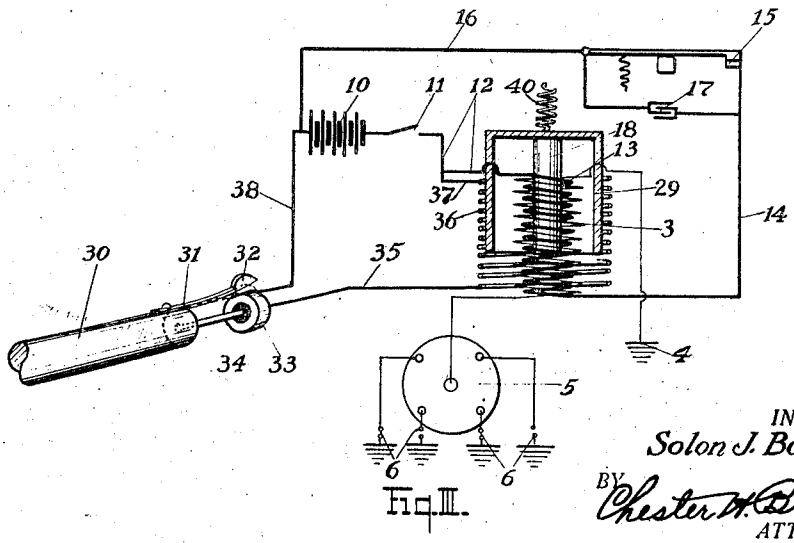


Fig. III.

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IGNITION SYSTEM.

Application filed July 3, 1919. Serial No. 308,549.

To all whom it may concern:

Be it known that I, SOLON J. BOUGHTON, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Ignition Systems, of which I declare the following to be a full, clear, and exact description.

This invention relates to improvements in ignition systems for internal combustion engines, and relates particularly to means for obtaining a satisfactory spark at both low and high engine speeds.

At starting, and at low engine speeds, an ignition coil having a magnetic path of considerable permeability is desirable in order that there may be a large inductance, the time interval between each make and break in the primary circuit, being sufficient to permit the current to approach more or less closely the maximum value possible. At high engine speeds the time interval referred to is much smaller, and consequently it is desirable to reduce the permeability of the magnetic path of the coil in order to reduce the lag in the current and give it an opportunity to build up.

When a single storage battery is employed to furnish current for ignition and also for an electric motor for starting the engine, the latter draws a very heavy current from the battery at starting, reducing the voltage of the battery and consequently the current available for ignition. Under such circumstances it is particularly desirable that the magnetic path of the ignition coil possess considerable permeability during starting so as to compensate in part for the lessened current.

I am aware that it has been proposed to increase the permeability of the magnetic circuit automatically when the starting motor of an internal combustion engine is actuated, and also to increase the permeability of such a magnetic circuit by manual means at other times when desired, but such means do not automatically affect the spark at low engine speeds, except during starting.

It is the object of my invention to provide an automatic means for progressively decreasing the permeability of the magnetic circuit as the speed of the engine increases, whereby a spark of substantially maximum intensity is provided for all engine speeds without the necessity of attention upon the part of the operator.

Another object of the invention is the provision of means by which the regulation may be accomplished electro-magnetically, which permits of the location of the coil in the most convenient place upon an automobile, for instance, and also permits of a more accurate adjustment of the core for different engine speeds.

Other objects, and objects relating to details of construction and economies of manufacture, will appear as I proceed with the description of that embodiment of the invention, which, for the purposes of the present application I have illustrated in the accompanying drawing, in which;

Figure I is a diagram illustrating apparatus and electrical connections embodying one form of the invention.

Fig. II is a diagrammatic illustration of apparatus employed in a second modification of the invention.

Fig. III is a diagram illustrating apparatus and electrical connections embodying another form of the invention.

Similar reference characters refer to like parts throughout the views.

In the drawing, 10 indicates a storage battery which is connected through switch 11 and wire conductor 12 with the primary winding 13 of an ignition coil, the opposite end of the winding being connected by wire 14 through current interrupter 15 and wire 16 to the other side of the battery. A condenser 17 is bridged around the interrupter to reduce sparking. The secondary winding 3 of the coil is connected at one end directly to ground at 4 and at the other end to ground through current distributor 5 and spark plugs 6, the number of the latter depending, of course, upon the number of cylinders in the engine.

The core 18 of the ignition coil has a limited movement into and out of the coil, which in Fig. II, I have illustrated diagrammatically at 19. In this figure the means for accomplishing the adjustment of the core is purely mechanical, 20 is a squared rod secured to the end of the core and guided in a squared opening through plate 21. The rod carries a bearing 22 in which rotates a collar 23 fixed to the end of a sleeve 24 rotatable upon a stationary shaft 25. A similar sleeve 26 fixed against longitudinal movement and

carrying a pinion 27 is also rotatably mounted upon the shaft and is joined to sleeve 24 by centrifugal governor 28, the arms of which are resilient and tend to hold the governor weights in their innermost position. The pinion 27 is intended to be driven by gearing (not shown), operated by the engine in connection with which the invention is employed.

The parts are shown in substantially the position they occupy when the engine is at rest. When the engine is started, and rotates with increasingly greater speed, the pinion 27 is driven at corresponding speed and thus motion is transmitted through sleeve 26 to the centrifugal governor 28. The ends of the latter tend to draw together as the speed increases, and this causes the sleeve 24 to approach sleeve 26, thus retracting the core 18 to a greater or lesser extent. This modification of the invention is entirely automatic and accomplishes a gradual adjustment of the core as the speed of the engine varies.

In Figs. I and III the movement of the core 18 is produced electro-magnetically rather than mechanically. The modification of Fig. III will first be described. In this figure there is illustrated a magnetic shell 29, which is attached to core 18 and moves with it. There is thus produced a nearly closed metallic circuit for the lines of force of the coil. I desire it to be understood however, that my invention is not limited in this respect, and that the amount of metal in the magnetic circuit as well as the shape of that circuit may be varied to suit particular requirements, and also that any part or all of said metallic circuit may be connected to the adjusting means. Furthermore, the word "core" as used hereinafter in the claims is intended to signify any part or all of the metallic circuit, including a shell, if desired.

In Fig. III, 30 represents a shaft driven by the engine. 31 is a spring metal arm carrying a small weight 32. 33 is a fixed annular contact over the periphery of which the free end of the spring 31 runs at the lower speeds of the engine. An electric conductor 34 passes through insulation within the annular contact 33, and at its end bears against the center of the shaft 30. From the conductor 34 a wire 35 leads to one end of a coil 36 surrounding the shell 29, the other end of coil being connected through wires 37 and 12 and switch 11 to battery 10. A wire 38 electrically joins annular contact 33 with the other side of the battery.

While the engine is being started and while it is running at comparatively low speed, spring arm 31 runs upon the contact 33 and maintains electric connection therewith. As a consequence, current travels from battery 10 through wire 38, contact 33, spring arm 31, shaft 30, conductor 34, wire 35, coil 36, wires 37 and 12, and switch 11 back to the battery. Thus the coil 36 is energized and draws the core 18 and shell 29 down to increase the permeability of the magnetic field in opposition to spring 40, which tends to hold the core and shell withdrawn partially as shown in the drawing. As soon however, as the engine speed exceeds a predetermined limit, centrifugal force acting upon the weight 32 bends the spring arm 31 outwardly as shown in full lines, breaking the circuit through coil 36 and thus permitting the spring 40 to retract the core and shell. When the engine speed again decreases, spring arm 31 again makes electric connection with contact 33, and the core and shell are again drawn down to increase the permeability of the coil. Thus the modification illustrated in Fig. III is automatic, but provides for two adjustments only of the core and shell.

In Fig. I the core 18 carries at its lower end an auxiliary core 41, which slides within a solenoid 42. The latter is connected at one end through wire 43 and switch 11 to battery 10, and at the other end through wire 44, having a flexible portion 44′, with a movable contact finger 45 and thence through more or less of a resistance coil 46 and back to the battery. The finger 45 is supported upon the end of a square rod 47 guided through a square opening in plate 48, and carrying at its lower extremity a collar 49 forming a bearing for a rotatable socket member 50, mounted upon the upper end of a guiding post 51, which is slidable in an axial bore in the end of a shaft 52 driven by the engine. The spring arms of a centrifugal governor 53 join the socket member 50 with the end of the shaft 52 and by this means the socket member 50 is drawn downwardly as the speed of the engine increases.

As the engine gets up speed, the contact finger 45 moves gradually downward cutting in more and more of the resistance coil 46 and thereby lessening the current through solenoid 42 and enabling spring 40 to retract core 18 proportionately. In this manner there is provided an automatic regulation with as many different adjustments as there are turns in resistance coil 46. Obviously, also, the coil 46 may be designed so as to include greater resistance per unit length in certain portions of the coil than in other portions thereof, and thus, if desired, a certain length of movement of the contact finger 45 may be caused to produce quite different degrees of movement of the core at low engine speeds and at high engine speeds respectively.

I am aware that the particular embodiment of my invention above described, and illustrated in the accompanying drawing, is

susceptible of considerable variation without departing from the spirit thereof, and therefore I desire to claim my invention broadly, as well as specifically as indicated by the appended claims.

I claim as my invention:

1. An ignition system for internal combustion engines, comprising an ignition coil, and electro-magnetic means controlled by the speed of the engine, for varying the reluctance of the magnetic circuit of said coil.

2. An ignition system for internal combustion engines, comprising an ignition coil having a movable core, and electro-magnetic means acting in proportion to the speed of the engine for retracting the core to a greater or lesser extent.

3. An ignition system for internal combustion engines, comprising an ignition coil having a movable core, electro-magnetic means for retracting said core, and centrifugal means driven from the engine for decreasing the strength of said electro-magnetic means as the speed of the engine increases.

4. In an ignition system for internal combustion engines comprising an ignition coil having a movable core, an electro-magnetic means controlled by the speed of the engine and the position of said core for varying the reluctance of the magnetic circuit of said coil.

5. An ignition system for internal combustion engines comprising an ignition coil having a movable core, an electro-magnetic means for moving said core; and means including a variable resistance controlled by the speed of the engine for varying the strength of the electro-magnetic means.

6. An ignition system for internal combustion engines comprising an ignition coil having a movable core, an electro-magnetic means for moving said core; and means including a resistance variably in accordance with the engine speed for decreasing the strength of the electro-magnetic means as the speed of the engine increases.

In testimony whereof, I affix my signature.

SOLON J. BOUGHTON.