March 23, 1926. 1,577,670

L. M. WOOLSON

IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

Filed April 15, 1924

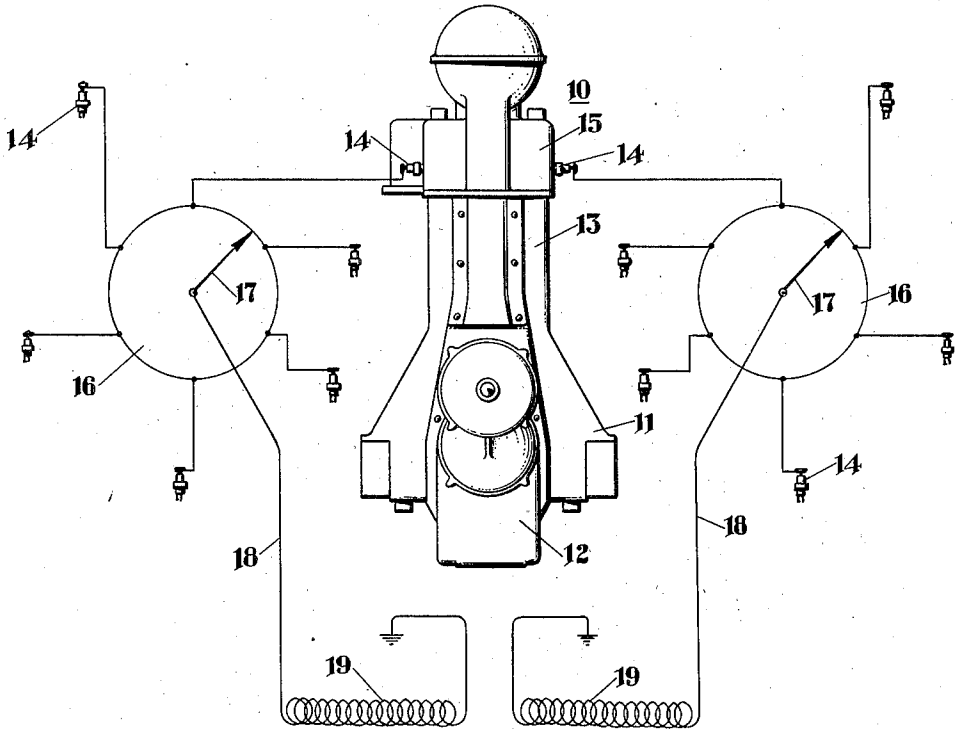


Fig. 1 A B

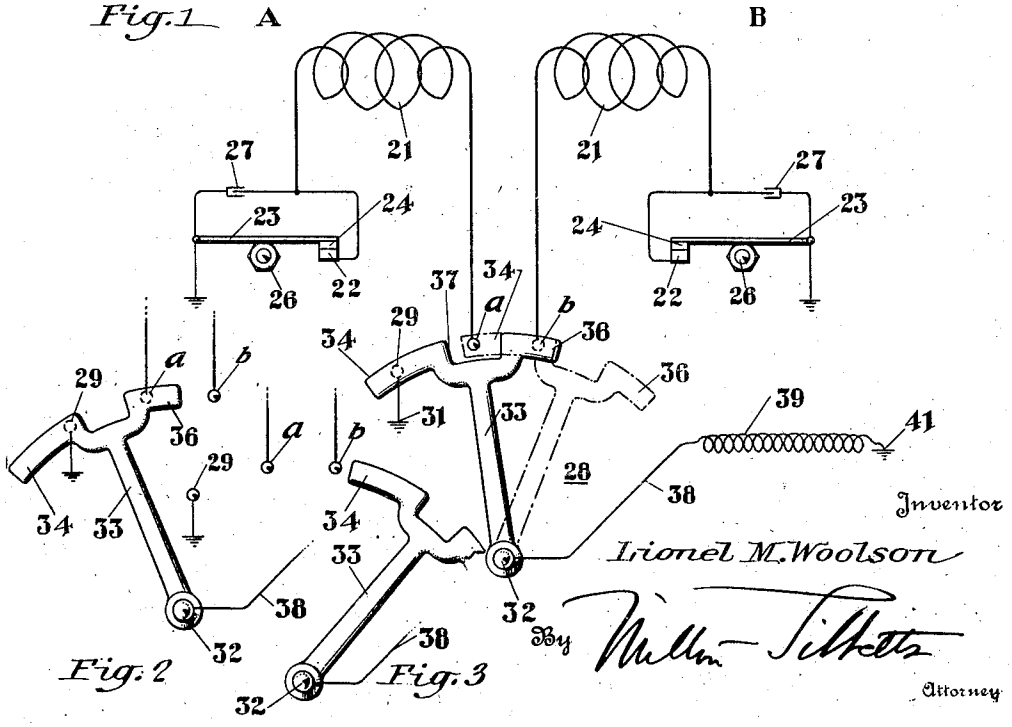


Fig. 2 Fig. 3

Inventor
Lionel M. Woolson
By Miller & Sibbetts
Attorney

Patented Mar. 23, 1926. 1,577,670

UNITED STATES PATENT OFFICE.

LIONEL M. WOOLSON, OF DETROIT, MICHIGAN, ASSIGNOR TO PACKARD MOTOR CAR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

Application filed April 15, 1924. Serial No. 706,726.

To all whom it may concern:

Be it known that I, LIONEL M. WOOLSON, a citizen of the United States, and resident of Detroit, Wayne County, State of Michigan, have invented certain new and useful Improvements in Ignition Systems for Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines and to the ignition systems of such engines, and it has especial reference to the ignition apparatus of engines such as are used in the propulsion of aircraft.

Among the chief requisites of engines of the character designated are reliability, and a high ratio of power to weight. In the furtherance of the first of these characteristics, most aircraft engines are now equipped with double ignition, by which it is understood that each of the engine cylinders is provided with two spark plugs which are supplied with electric energy from independent sources. By the use of such double systems, continuity of engine operation is insured, as in the event of a failure in one of the branches of the system the other branch would continue to supply ignition.

Certain parts of ignition apparatus of this character are of such a nature as to be practically indestructible and as these parts are relatively heavy it has been proposed to avoid the duplication thereof and thereby effect a saving in weight. Accidents seldom occur, for example, to such parts as the drive, core, pole pieces, etc. On the other hand, certain parts such as the windings, condensers, interrupters, etc., are necessarily delicate and should be duplicated. Accordingly, there has been devised a type of ignition mechanism which comprises a magneto-electric machine having a single rotor, a single drive, single magnet cores, etc., but having duplicate windings, interrupters, and condensers, the latter constituting a pair of independent electrical circuits arranged in a common magnetic circuit provided by the rotor, pole pieces and cores.

In the operation of apparatus of this kind it has been found that when one of the primary coils becomes short circuited, by reason of any accident such as the failure of a condenser, the inductive effect exerted on the other branch of the double system seriously interferes with the operation thereof, weakening the spark produced and causing it to miss and to be otherwise erratic. This result obtains because the current induced in the healthy winding by the continuous and heavy flow of current in the short circuit winding, prevents the instantaneous collapse of the lines of force in the field when the interrupter opens. Since the induction of the high tension current in the secondary winding depends on such collapse of the lines of force, the high tension ignition current becomes weak and irregular, as will be readily understood by those skilled in this art.

It has been found that the inductive effect above described may be greatly reduced, if not entirely avoided, by placing in series with the primary winding of the intake branch of the system, an inductance or resistance, preferably the former. The presence of such an inductance in the circuit does nothing to assist the ignition spark when the engine is operating on one branch only, however, and it does materially increase the arcing produced at the interrupter points.

One object of the present invention is to provide an internal combustion engine with a double ignition system of the character described in which the effect of mutual inductance on each branch of the system shall be minimized and the ignition spark provided by either branch of the system shall be much improved, especially under adverse conditions such as are caused by a short circuit of the other branch.

Another object of the invention is to provide means to reduce the inductive effect of a short circuited primary in one branch on the output of the other branch in such a manner as not to cause excessive sparking at the interrupter of either primary.

Other objects of the invention will appear from the following description taken in connection with the drawings, which form a part of this specification, and in which:

Fig. 1 is a schematic representation of an ignition system constructed in accordance with this invention applied to an internal combustion engine, showing the ignition control switch in one of its positions in full lines, and in another position in dotted lines, and

Figs. 2 and 3 are portions of the system illustrated in Fig. 1, showing the switch respectively in other positions.

Referring to the drawing, at 10 is illus-

trated an internal combustion engine, suitably supported upon motor arms 11 which are preferably integral with the engine crankcase 12. This crankcase is usually a casting and on it are mounted the engine cylinders 13. The engine 10 is provided with the usual head 15 communicating with the cylinders 13, in which are located suitable spark plugs 14, there being two of the spark plugs 14 for each cylinder of the engine.

One of the spark plugs 14 in each of the cylinders is connected to one of the two electrically distinct branches A and B of the ignition system, each of which branches has a distributer 16, provided with a rotary arm 17 which is driven in timed relation to the engine in any appropriate manner (not shown). Each of the arms 17 is connected by a suitable conductor 18 to one terminal of a high tension or secondary winding 19, which forms a part of the corresponding branch of the system. The other terminal of each of the windings 19 is grounded in the well known manner.

Corresponding to each of the secondary windings 19 is a low tension or primary winding 21, which windings are located in a common magnetic field with the windings 19 in the manner described. One terminal of each of the windings 21 is connected to a stationary contact point 22 of an interrupter or circuit breaker having a pivoted arm 23, which carries a movable contact point 24, and is operated by a cam 26 into and out of contact with the point 22 to make and break the circuit through the primary winding 21. The cam 26 is driven in timed relation to the engine, as is well understood. The pivoted arm 23 is connected to ground in the usual manner, and a condenser 27 is preferably connected across the contacts 22 and 24 to reduce the sparking at the surfaces thereof.

The other terminals of the windings 21 terminate respectively in contacts *a* and *b*, which are adapted to cooperate with suitable switch mechanism 28 by which the operation of the ignition apparatus is controlled, and through which the primary circuits of the branches A and B are completed.

Arranged adjacent the contacts *a* and *b* in spaced relation thereto, is a contact 29 which is connected by a suitable conductor with a direct ground as at 31. This contact 29 is arranged in spaced relation to the contacts *a* and *b*, and is adapted for connection to either one but not to both, so that the primary circuit of either branch A or B may be completed directly. Any suitable mechanism may be employed to effect this result. In the embodiment shown, the contacts *a*, *b* and 29 are arranged on the arc of a circle, at the center 32 of which is pivotally mounted an arm 33 of the switch 28. The outer end of the arm 33 is provided with contact members or blades 34 and 36, arcuate in form and spaced by a notch 37. These members 34 and 36 are thus disposed on the arc of the circle of the contacts *a*, *b* and 29. In the position shown in full lines in Fig. 1, the contacts *b* and 29 are connected, and circuit is completed through the branch B to the ground 31. In Fig. 2, the contact *a* is similarly connected to contact 29, the circuit of branch A being completed and that of branch B broken. The end of the arm 33, pivoted at 32, is connected by a suitable conductor 38 with a resistance 39, preferably of an inductive nature as shown, and the end of this inductance 39 is connected to ground as at 41.

By moving the switch arm 33 into the position shown in dotted lines in Fig. 1, it is seen that the contacts *a* and *b* are connected together and through the arm 33 and the inductance 39 to ground at 41. In this position the branches A and B are arranged in parallel, and in series with the inductance 39, and this is the normal operating position. In this manner two sparks are provided in each of the cylinders from electrically independent sources. Should any accident occur to short circuit one of the primary windings 21, such as a failure of its condenser 27, the inductance 39 is in series with the other winding 21, to minimize the inductive effect of the short circuited winding and to prevent the failure of the ignition. When it is desired to run on either of the branches A or B alone, the inductance 39 is removed from the circuit, which is completed through the direct ground 31, so that arcing at the contact points 22 and 24 is not unduly promoted.

Fig. 3, illustrates the position of the switch 28 in which all ignition current to the engine is cut off. This is effected by moving the arm 33 into a position so that the portion 34 does not touch either of the contacts *a* or *b*. By placing the switch 28 in this position the engine 10 may be readily stopped.

It will be understood that various forms of the invention other than those described above may be used without departing from the spirit or scope of the invention.

What is claimed is:

1. The combination with an ignition system including a pair of windings, of switch means adapted to control the flow of current through said windings and adapted for connection thereto either singly or together in parallel, and an inductance coil in series with the switch.

2. The combination with an ignition system for internal combustion engines including a pair of windings, of switch means

adapted to complete the circuit through either of said windings or through both said windings in parallel, and an inductance coil in series with the switch.

3. The combination with an ignition system for internal combustion engines including a pair of windings, of switch means adapted to complete the circuit through either of the windings in two of its positions, and to complete the circuit of the windings in parallel through an inductance coil in another position.

4. The combination with an ignition system for internal combustion engines including a pair of windings, a current interrupter in each winding circuit adapted to connect one end thereof to ground, a direct ground connection, an inductive ground connection, and switch means adapted to connect the other end of either winding to the direct ground connection and to connect the said ends in parallel to the inductive ground connection.

5. The combination in an ignition system for internal combustion engines having a pair of primary circuits including interrupters, of means to complete either circuit or both circuits comprising terminals for the circuits, a direct ground, a switch arm, and an inductance coil in series with said arm and the ground, whereby either circuit terminal may be connected to the direct ground, and both terminals may be connected in parallel through said coil to ground.

6. The combination with an internal combustion engine, of a dual ignition system including electrically distinct circuits, means to directly complete either of the circuits, and means to diminish the mutually inductive effect of the circuits including an inductive resistance associated with the first named means and adapted to complete both said circuits.

7. The combination with an internal combustion engine having a dual ignition system including windings arranged in a common magnetic field, of means connecting the windings in parallel to operate together, and means including an inductive resistance in series with the first named means to diminish the effect on either winding of a short circuit in the other winding.

8. The combination with an internal combustion engine having a dual ignition system including windings arranged in a common magnetic field and each having an interrupter, of switch means adapted to complete the circuit in either winding independently of the other and to complete the circuit in both windings in parallel, and means including an inductive resistance in series with the switch means when the windings are connected in parallel.

9. The combination with an internal combustion engine having a dual ignition system including windings arranged in a common magnetic field and each having an interrupter, of switch means adapted to complete the circuit in either winding independently of the other and to complete the circuit in both windings in parallel, and means to prevent reduction in intensity of the current in one of said windings upon short circuit of the other winding, said means including a resistance in series with the switch means when the windings are in parallel.

10. The combination with an internal combustion engine, of a dual ignition system having electrically distinct primary and secondary windings arranged in a common magnetic field and adapted for operation either independently or in unison, control means for the system including a switch adapted to complete the circuit through either primary winding independently of the other, and to connect the primary windings in parallel for operation in unison, and a resistance associated with the switch means connected in series with the primary windings when said windings are in parallel.

11. The combination with an ignition system including a pair of windings arranged in a common magnetic field, of means including an inductive resistance to limit the flow of current induced in either winding upon a short circuit of the other winding.

12. The combination with an ignition system including a pair of windings arranged in a common magnetic field, of means to connect the windings for operation either singly or together, and an inductance in series with the other means when said windings are connected for operation together.

13. The combination with an ignition system including a pair of windings arranged in a common magnetic field, of a direct ground, means adapted to complete the circuit of either winding to said ground, and an inductive resistance adapted for connection in series with both said windings.

14. The combination with an ignition system having a pair of windings, of means including a resistance adapted to minimize the mutual inductive effect between said windings.

15. The combination with an ignition system having a pair of windings, of means including a resistance adapted to limit the formation of continuous currents in either of said windings.

In testimony whereof I affix my signature.

LIONEL M. WOOLSON.