

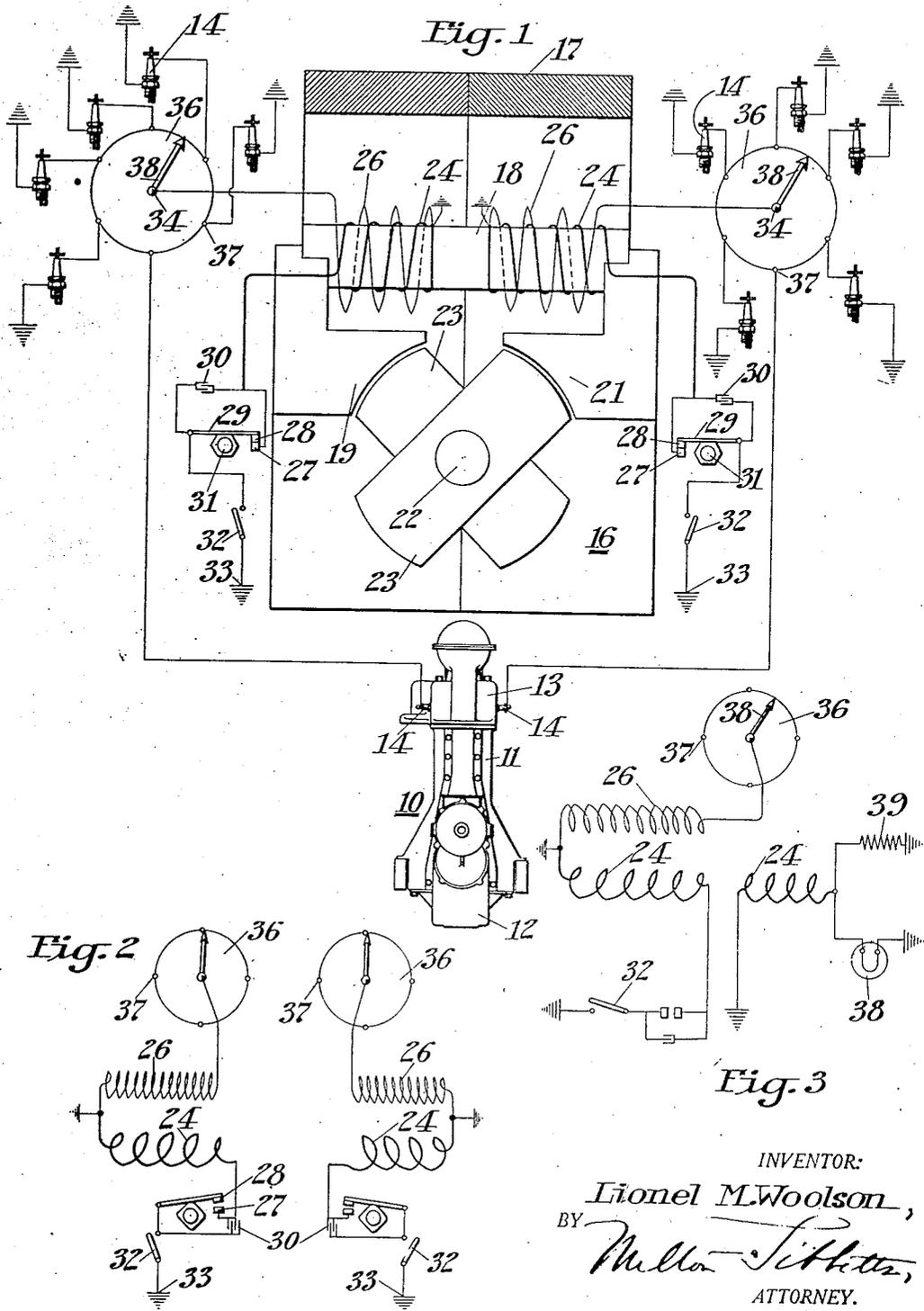
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IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES

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IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

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This invention relates to ignition apparatus for internal combustion engines, particularly of the type employed in the propulsion of aircraft, and it contemplates the provision of a double ignition system which shall be sturdy and reliable, and in which a material saving of weight shall be effected.

One object of the invention is to provide a single magneto-electric machine which shall supply ignition current from electrically distinct sources to each branch of a double ignition system.

Another object is to provide a magneto adapted to supply a double ignition system, in which the unnecessary duplication of parts is avoided.

Other objects and structural details of the invention will appear from the following description taken in connection with the drawing, which forms a part of this specification, and in which:

Fig. 1 is a schematic representation of a magneto constructed in accordance with the invention, shown as adapted to supply the ignition system of a six cylinder internal combustion engine;

Fig. 2 is a diagram showing the electrical circuits of a device similar to that shown in Fig. 1, but applicable to a four cylinder engine; and

Fig. 3 is a diagram similar to Fig. 2, showing a different form of the invention.

The principal requirement for the ignition system of an airplane engine is reliability, in the furtherance of which many aircraft engines are equipped with double ignition. By a double ignition system is meant a system having duplicate sets of ignition apparatus, each complete in itself, and each in itself sufficient to fire the engine. In this way the reliability of the apparatus is greatly increased, for if one of the sets should fail, the other would continue to supply the ignition for the engine.

This feature has been obtained, however, at the expense of increased weight caused by the duplication of parts. Many of the elements of a magneto are sufficiently sturdy to be practically indestructible, and failures rarely occur in the rotor, cam, magnets, or drive of one of these machines. On the other hand, the windings, contact breakers, condensers, etc., are of necessity delicate, and should be duplicated.

With these considerations in mind, this invention provides a magneto adapted to supply the double ignition system of an internal combustion engine, in which the duplication of certain parts is avoided, without detracting from the reliability of the apparatus.

Referring to the drawing, in Fig. 1 is illustrated an internal combustion engine 10, having a cylinder portion 11 mounted on a crank case portion 12, and having a head portion 13 provided with spark plugs 14, which are adapted to ignite the fuel in the engine cylinder in the well known manner. It is to be understood that the engine, in the embodiment of the invention illustrated, is provided with a double ignition system, and as shown in Fig. 1, each cylinder has two of the spark plugs 14, so that each of the two plugs in any given cylinder is connected to a separate source of electrical energy, in a manner well understood in the art to which the invention relates.

At 16 is represented a magneto of the well known inductor type, having a pair of permanent magnets 17, between the poles of which is arranged a field structure including a laminated core 18 provided with pole extensions 19 and 21. Between and below the poles 19 and 21 is mounted a rotor 22 having four wings or extensions 23, which are arranged 90 degrees apart, the opposite wings being of the same polarity. The rotor carries the extensions 23 past the poles 19 and 21 in rapid succession causing a rapid reversal of flow of magnetic flux through the core 18 in a well known manner.

The laminated core 18 is provided with a plurality of primary windings 24 and secondary windings 26, arranged in sets, which sets constitute separate electrical circuits, and it will be evident that the magnetic circuit formed by the core 18, the pole pieces 19 and 21, and the rotor 22, is common to all of these electrical circuits. Each of the primary windings 24 is provided with a suitable circuit breaker mechanism which consists of a pair of contacts 27 and 28, the contact 28 being mounted on the end of a pivot arm 29, oscillated by a suitable cam 31 in timed relation to the engine. The contacts 27 and 28 are preferably shunted by a condenser 30 to decrease arcing in the well known manner. The arm 29 is connected in

series with a switch 32 to a ground connection 33, as will be readily seen. In practice the switches 32 are incorporated in a single structure, of well known type, having "off" and "on" positions for each branch of the system, and for both branches together.

The other end of the primary winding 24 is connected at a common ground to the secondary winding 26, which is mounted on the core 18 in inductive relation to the primary winding 24. The other end of the secondary winding 26 is connected to the central contact 34 of the distributor 36, having a number of contacts 37 arranged for co-action with a rotatable arm 38, driven in timed relation to the engine in any convenient manner as is well understood. The contacts 37 are connected to the engine spark plugs 14 in the order in which the engine cylinders are arranged to fire. Each one of the contacts 37 of each of the distributors 36 is connected to one spark plug 14 in each of the engine cylinders, in the well known manner, so that two sparks are simultaneously supplied from independent sources of electrical energy, in each of the cylinders in turn.

In the diagram given in Fig. 2 the distributors 36 are each provided with four contacts 37, whereby they are adapted for use in connection with a four cylinder engine, as is well known.

It will be observed that the switch 32 is in series with the contacts 27 and 28 in the primary circuit 24 so that with this switch open, the circuit 24 is open, and the magneto is rendered inoperative. In this way, only a single wire from each of the breakers 29 to the switch 32 is needed, the primary circuit being completed to ground through this switch.

In the operation of the device, if one of the sets of coils is open-circuited, either intentionally or accidentally, there is a marked increase in the output of the other coil set caused by the decrease in choking effect exerted by the coil which is open-circuited. Thus in case of accident to one of the branches of the system it is only necessary to open the circuit of this branch at the switch 32, to intensify the action of the remaining branch, thus promoting the reliability of the device.

If one of the coil sets is short-circuited, its choking effect is increased and consequently the output of the other coil is decreased somewhat, but not sufficiently to interfere with the operation of the engine.

In Fig. 3 is shown another form of the invention, adapted for single ignition, in which the terminals 37 of the single distributor 36 are each connected to one spark plug in each of the engine cylinders. In this apparatus the magneto 16 is provided with a primary winding 24, but has only one of the

secondary windings 26, which is connected to the distributor arm 38 in the usual manner. The other primary winding 24 may be used to supply low tension current to independent electrical circuits, a lamp 38 and a resistance 39 being illustrated by way of example.

It will be evident that by this invention is provided a structure in which the magnets, pole pieces and rotor of the single machine are common to the two independent sets of coils and their associated parts. By this construction, a single magnetic circuit is made common to a plurality of electrical circuits, so that duplication of the relatively heavy parts associated with the magnetic circuit, is avoided. At the same time, the electrical circuits are totally separate and distinct, so that trouble originating in either one will not affect the operation of the other to any extent. In this way the reliability of the apparatus is enhanced.

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 internal combustion engine, of a magneto having a single magnetic circuit and a plurality of electrical circuits arranged in inductively associated sets, one of said electrical circuits including the ignition system of the engine.

2. The combination with an internal combustion engine, of a magneto having a plurality of electrical circuits each including windings in transformer relation, of a single magnetic circuit common to all the windings, and means connecting at least one of the windings to the ignition system of the engine.

3. The combination with an internal combustion engine, of a magneto having a plurality of electrical circuits each including a primary and secondary winding, a single magnetic circuit for all of the windings, and means connecting the secondary windings to the ignition system of the engine.

4. The combination with an internal combustion engine having spark plugs, of a magneto having a plurality of electrical circuits each including inductively associated windings, a single magnetic circuit for all of the windings, and means adapted to distribute current from at least one of the windings to the spark plugs.

5. The combination with an internal combustion engine having an ignition system, of a magneto having electrical circuits including a plurality of primary windings, a magnetic circuit common to all of the electrical circuits, and means associated with at least one of the electrical circuits to supply current to said ignition system.

6. The combination with an internal com-

bustion engine, of a magneto having a plurality of electrical circuits including primary and secondary windings, a magnetic circuit common to said electrical circuits, separate means adapted to break the circuit in each of the primary windings in timed relation to the engine, and a switch in series with each of said breaker means adapted to complete the circuit through the last named winding.

7. The combination with an internal combustion engine having an ignition system, of a magneto having a plurality of electrical circuits each including inductively associated sets of windings, and a single magnetic circuit common to all of the windings, separate means adapted to break the circuits in some of the windings of each set in timed relation to the engine, a switch in series with each of said breaker means, and means adapted to distribute current from other of said windings to the ignition system of the engine.

8. A magneto having a plurality of primary and secondary windings forming electrically independent circuits, ground connections for the primary windings, and switch means in series with the primary windings

and the ground connections adapted to complete or open the circuit therethrough.

9. In combination in a magneto, a plurality of sets of windings associated in inductive relation, circuit breaking means in series with one of the windings of each set, a condenser arranged to shunt each of said circuit breaking means and a single magnetic circuit common to all of said windings.

10. The combination in ignition apparatus for internal combustion engines having a plurality of spark plugs in each cylinder thereof, of a magneto having pairs of windings inductively associated in sets in transformer relation, a separate circuit breaker for one of the windings of each set operable in timed relation to the engine, a separate condenser arranged to shunt each circuit breaker, a separate distributing means associated with the other windings of each set adapted to distribute current from said windings to one of the spark plugs of each cylinder, and single means to produce a magnetic field common to all said windings.

In testimony whereof I affix my signature.

LIONEL M. WOOLSON.