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IGNITION APPARATUS

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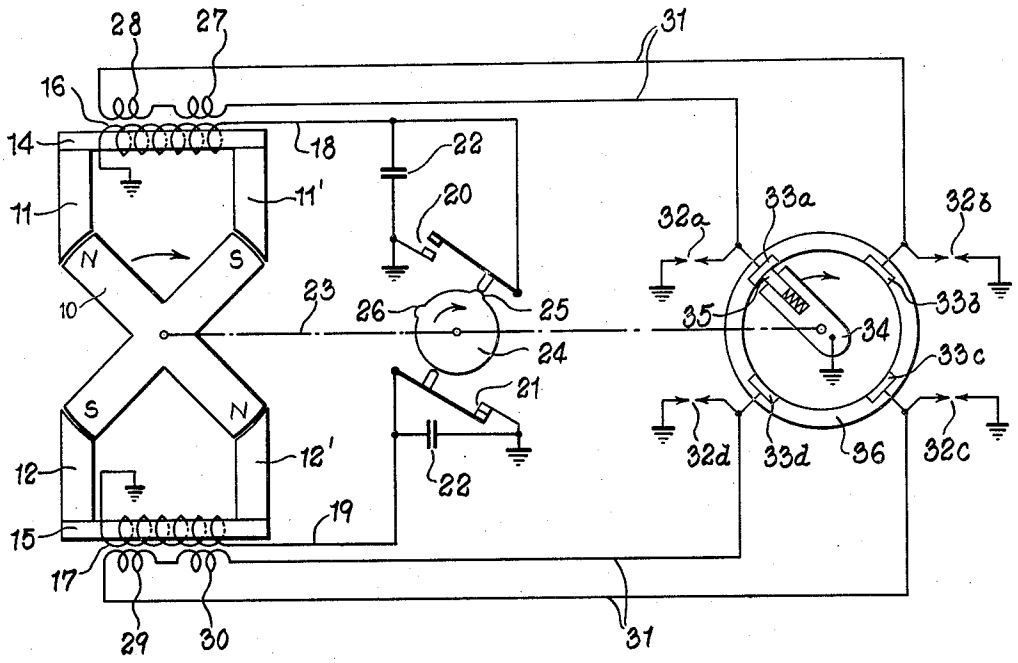

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IGNITION APPARATUS

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This invention relates to electrical apparatus and more particularly to ignition systems adapted for multi-cylinder internal combustion engines and the like.

One of the objects of the present invention is to provide novel apparatus for creating electrical energy and distributing the same to a plurality of spark gaps, such as to the spark plugs of a multi-cylinder internal combustion engine.

Another object of the invention is to provide a novel ignition apparatus for a multi-cylinder engine of either the two-stroke or four-stroke cycle type.

A further object is to provide a novelly constructed magneto and distributor combination which may be driven at engine crankshaft speed for generating electrical energy and controlling the distribution thereof to a plurality of spark plugs in timed relation.

Still another object is to provide a novel ignition system for a multi-cylinder engine wherein the sparks generated at a plurality of sparking plugs are all of the same polarity.

A still further object is to provide novel ignition apparatus which attains desired results with a minimum of electrical energy and a minimum of erosion caused by sparking.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and is not intended as a definition of the limits of the invention.

In the single figure of the accompanying drawing, one embodiment of the invention is diagrammatically illustrated in the form of an ignition system or the like for an internal combustion engine.

The illustrated embodiment of the invention represents a so-called crankshaft or flywheel type magneto-distributor unit, i. e., a unit in which the rotating parts are driven at engine crankshaft speed. Said unit is adapted to supply and distribute ignition energy to the spark plugs of a four-cylinder engine of either the two-stroke cycle or four-stroke cycle type. In such an engine of the two-stroke cycle type, a useful spark is created at each cylinder at a pre-determined point in the engine cycle during each revolution of the crankshaft. In a four-stroke cycle engine, alternate sparks at each plug occur at the end of the exhaust stroke and, hence, are neither useful nor detrimental. In the form shown, the magneto generator comprises a four-pole magnetic rotor **10** adapted to cooperate in a known manner with two pairs of stator pole shoes **11**, **11'** and **12**, **12'** which are magnetically connected by coil cores **14** and **15**, respectively, to form with rotor **10** two diametrically disposed paths for magnetic flux.

Primary windings or coils **16** and **17** are wound on said cores and have the high potential ends thereof connected by leads **18** and **19** to the insulated terminals of two circuit breakers **20** and **21**, respectively. The fixed

contacts of said circuit breakers and the other ends of said primary windings may be connected through ground or other equivalent means. The movable contacts of the circuit breakers are preferably mounted on resilient strips which are biased to normally maintain the fixed and movable contacts in engagement to thereby complete circuits through the primary windings to which the same are connected. A condenser **22** may be connected in shunt with each set of breaker contacts in the manner illustrated to reduce arcing when the contacts are separated from one another.

Magnetic rotor **10** is preferably driven by the engine crankshaft **23**, which is represented in the drawing by a dot and dash line, and mounted on the same shaft for rotation therewith is a cam **24** designed to actuate the movable contacts of both circuit breakers **20** and **21**. The cam has two lobes **25** and **26** spaced 90° apart on the circumference thereof, and the circuit breakers are diametrically disposed with respect to the axis of the cam, i. e., 180° apart so that the cam when rotating in the direction indicated by the arrow is effective to open circuit breaker **20** twice in succession and then open circuit breaker **21** twice in succession during each revolution.

Also wound on cores **14** and **15** are dual secondary windings **27**, **28** and **29**, **30**, respectively. The coils of each pair of secondary windings are connected together at adjacent ends, and each said winding has its other end connected by a high tension lead **31** to the ungrounded terminal of a spark gap **32** (*a*, *b*, *c*, or *d*), such as a spark plug in an engine cylinder. Each dual secondary winding is in effect a single coil and could be wound in the customary manner, but the dual winding facilitates production and simplifies the insulating problems.

Each high tension lead **31** is also connected to a fixed electrode **33** (*a*, *b*, *c*, or *d*), and for a purpose to more fully appear hereinafter, means are provided for successively individually connecting said electrodes directly to ground or the equivalent. As shown, said electrodes are spaced at 90° intervals on a circle, and the means for connecting the same individually and successively to ground comprises a rotating brush means which in combination with said electrodes constitutes a novel type of distributor means. The brush means comprises an arm or finger **34** secured to shaft **23** for rotation therewith and a spring-pressed carbon brush **35** carried thereby and adapted to make successive contact with the electrodes **33**. The latter may be mounted in an insulating block or distributor head **36**. The brush **35** may be connected to ground in any suitable manner and for this purpose, finger **34** may be made of metal.

It will now be seen that with rotor **10**, cam **24**, and distributor finger **34** suitably angularly adjusted with respect to each other on shaft **23**, the four spark plugs **32** will be successively energized during each revolution of the shaft. As brush **35** approaches electrode **33***a*, with circuit breaker **20** in closed position, the magnetic rotor **10** is creating the flow of magnetic flux through core **14** and creating a flow of current through primary winding **16**. At the appropriate time after the magnetic flux and primary current have attained a maximum value, as is now well understood by those skilled in the art, circuit breaker **20** is opened by cam lobe **25**, thereby interrupting the circuit through primary winding **16**. The magnetic field about the primary winding is thus caused to collapse and induce a high tension current in secondary windings **27**, **28**. At this same instant, distributor brush **35** has made contact with electrode **33***a*, thereby directly grounding one end of secondary coil **27** and shorting out the spark plug **32***a* connected therewith. The energy induced in coils **27**, **28** is thus diverted to spark plug **32***b*.

As distributor brush **35** thereafter approaches elec-

trode 33*b*, circuit breaker **20** is permitted to close again, and rotor **10** moves into position to reenergize primary winding **16**, the magnetic flux and primary current being of opposite polarity from that previously generated. When brush **35** has contacted electrode 33*b*, cam lobe **26** will reopen circuit breaker **20** and again interrupt the current through primary winding **16**. The high tension current which is thereby induced in secondary coil **27**, **28** will also be of a different polarity from that previously generated in this coil, but the opposite end thereof, i. e., the end of winding **28** is connected directly to ground through electrode 33*b* and finger **34**, thereby shorting out spark plug **32***b* so that the induced high tension energy is directed to spark plug **32***a*. Although the flow of current in secondary coils **27**, **28** is in opposite directions during successive energizations thereof, the current flow through spark plugs 32*b* and 32*a* will be in the same relative directions because the corresponding terminals of these spark plugs are connected to opposite ends of the secondary coil.

During rotation of rotor **10** through the next 180°, the coils **17**, **29** and **30**, circuit breaker **21** in conjunction with cam **24**, and electrodes **33***c* and **33***d* in conjunction with distributor finger **34**, **35** will function to energize and fire spark plugs **32***d* and **32***c* in that order, the operation being comparable to that previously described for the other half of the circuit during the first 180° of the engine cycle. It will be noted that circuit breaker **21** remains closed during the portion of the complete cycle in which spark plugs **32***b*, **32***a* are fired. With breaker **21** closed, primary winding **17** is shorted out and insufficient energy is induced in secondary winding **29**, **30** to fire either spark plug **32***c* or **32***d*. Circuit breaker **20** remains closed during the other half of each cycle with a corresponding effect on the other half of the circuit.

There is thus provided simplified apparatus for generating and distributing electrical energy, the same embodying means which functions in accordance with a principle that is novel in the realm of ignition distribution. The novel means for effecting energy distribution to a plurality of spark plugs or the like from a common source is so constructed and combined with the energy source that sparking in the distributor is avoided, and the energy is most efficiently transmitted to the spark plug. Additionally, the novel system hereby comprehended improves the efficiency of the spark plugs and prolongs the useful life thereof.

Although only a single embodiment of the invention is illustrated in the drawing and described in detail in the foregoing specification, it is to be expressly understood that the invention is not limited thereto. For example, the basic principles of the invention are applicable to systems embodying other known sources of electrical energy, such as a battery, vibrator or the like, and the invention is not limited in its uses to engine ignition systems. Various other changes may also be made, particularly in the design and arrangement of the parts illustrated, without departing from the spirit and scope of the invention, as the same will now be understood by those skilled in the art.

What is claimed is:

1. Apparatus of the class described comprising a source of electrical energy, a spark gap continuously connected between each terminal of said source and ground, and means for selectively connecting one or the other of said terminals directly to ground.

2. Apparatus as defined in claim 1 wherein said source of electrical energy includes a coil winding, the ends of which constitute said terminals, and means for intermittently energizing said winding.

3. Apparatus as defined in claim 2 wherein said energizing means comprises a magneto generator whereby successive energizations of said coil winding are of opposite polarity.

4. Apparatus as defined in claim 3 wherein said magneto generator includes a primary winding inductively coupled with said coil winding and said primary winding is in circuit with a normally closed circuit breaker.

5. Apparatus as defined in claim 4 comprising means for intermittently opening said circuit breaker, and means for actuating said magneto generator, said selective connecting means and said circuit breaker opening means in timed relation.

6. Apparatus of the class described comprising a source of electrical energy, at least two spark gaps, each having one terminal thereof connected to ground, means continuously connecting the other terminal of each spark gap to said source, said other terminals of the spark gaps being connected to opposite terminals of said source, a distributor having spaced electrodes connected to said connecting means, and rotatable means connected to ground and adapted to engage each of said electrodes once during each revolution whereby said spark plugs are alternately effectively shunted out of circuit with said source.

7. Apparatus of the class described comprising a source of electrical energy including a magnetic flux distributing rotor, a stator operatively associated with the rotor and a primary winding on the stator, a normally closed circuit breaker in circuit with said primary winding, means operable in unison with said rotor for intermittently momentarily opening said circuit breaker, a secondary winding inductively coupled with said primary winding, a spark gap continuously connected between each end of said secondary winding and ground, and means including a distributor rotor operable in unison with said flux distributing rotor for alternately momentarily connecting opposite ends of said secondary winding to ground.

8. Apparatus as defined in claim 7 wherein said rotors and said circuit breaker opening means are mounted for rotation as a unit.

9. A plurality of apparatuses as defined in claim 7 having a common flux distributing rotor, a common distributor rotor and a common circuit breaker opening means.

10. Apparatus as defined in claim 7 comprising a duplicate set of the non-rotating parts, the corresponding parts of the two sets of said non-rotating parts being diametrically disposed with respect to said rotors and circuit breaker opening means.

11. Apparatus as defined in claim 7 wherein said circuit breaker opening means comprises a rotary cam having two lobes spaced approximately 90° apart.

12. Apparatus as defined in claim 7 wherein the magnetic flux distributing rotor is a four-pole magnetic rotor.

13. Apparatus as defined in claim 7 wherein said distributor rotor provides the momentary connection to ground for opposite ends of said secondary winding.

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