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Longstaff-Tyrrell

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[54] **SPARK IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.²** **F02P 3/04**

[58] **Field of Search** ..... 123/148 E, 146.5 A, 148 D; 200/31 A, 31 V, 31 DP, 25, 27 A, 29, 22

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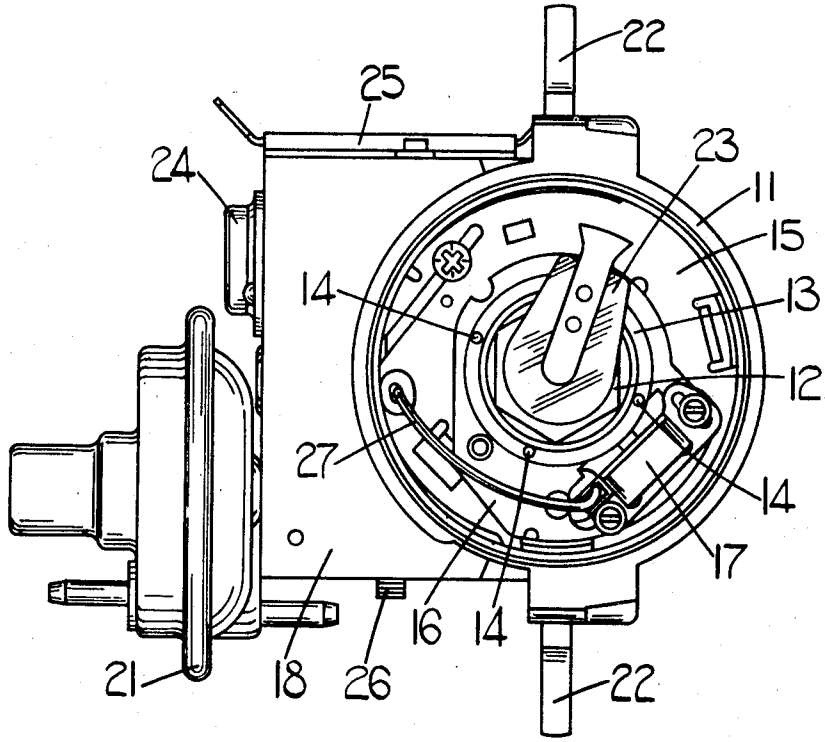
[57] **ABSTRACT**

Spark ignition apparatus for an internal combustion engine including a hollow casing rotatably supporting a shaft driven by the engine in use. A sensor is positioned within the casing, and is mounted for angular movement about the rotational axis of the shaft. The sensor is sensitive to the angular position of a member which rotates with the shaft. A housing is carried by the casing and receives the components of an electronic circuit which is operated in response to the output from the sensor. The electronic circuit in response to the output from the sensor breaks and restores an electric circuit through the primary winding of the ignition coil of the ignition system of the vehicle. Supported by the housing is a vacuum actuator the moving rod of which is coupled to the sensor. Thus the actuator which in use communicates with the inlet manifold of the internal combustion engine adjusts the position of the sensor relative to the casing of the apparatus in accordance with the pressure conditions in the engine inlet manifold.

4 Claims, 2 Drawing Figures



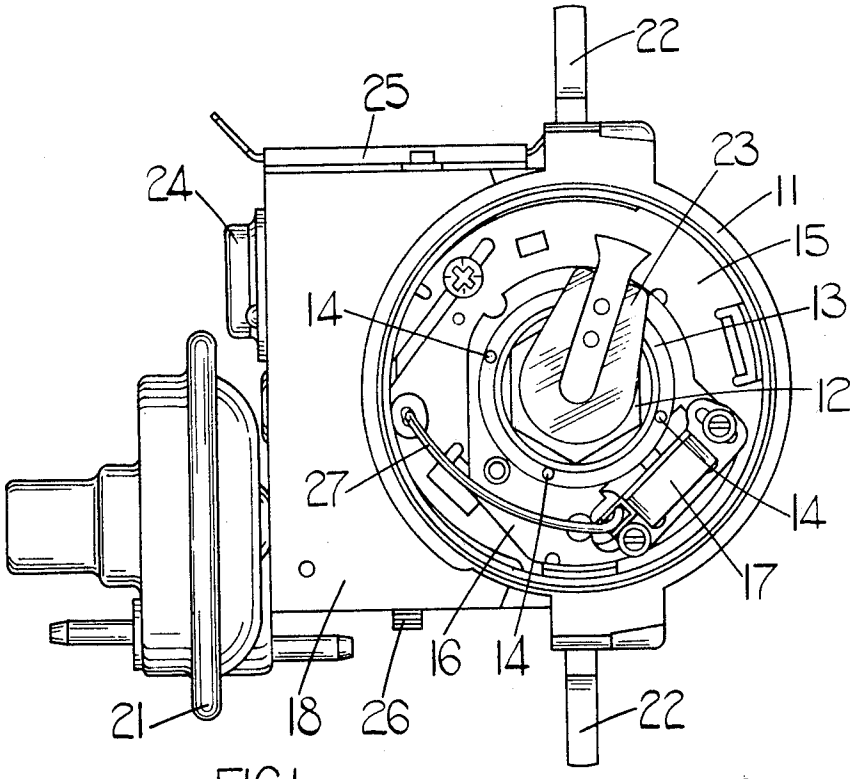

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FIG.1.

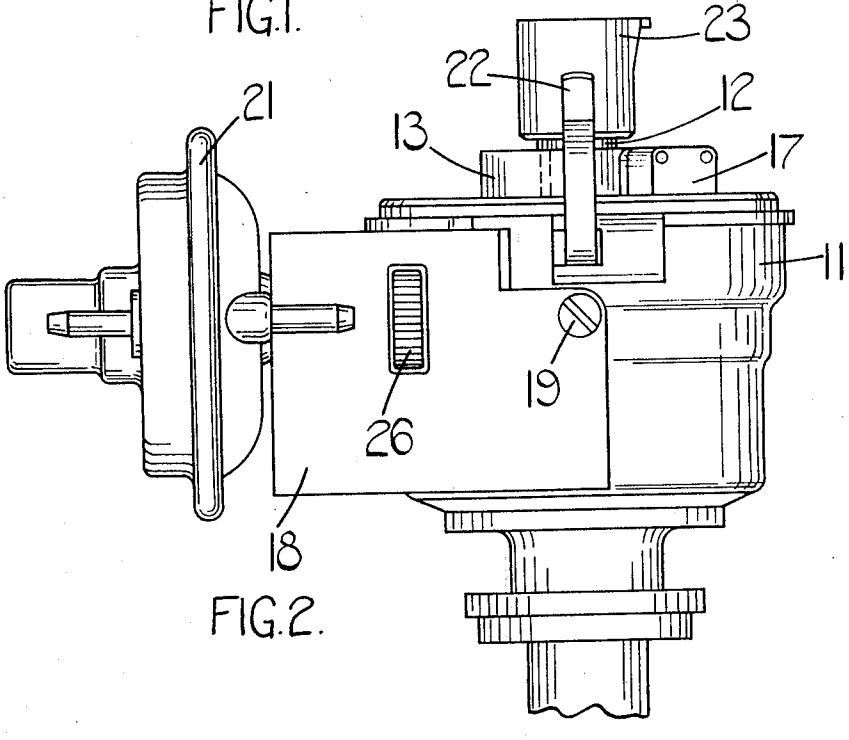
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FIG.2.

SPARK IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES

This invention relates to spark ignition apparatus for internal combustion engines.

Apparatus according to the invention includes a hollow casing, a shaft rotatable in the casing and driven by the engine in use, a sensor adjustably mounted within the casing for angular movement about the rotational axis of the shaft and sensitive to the angular position of a member rotating with said shaft, a housing carried by said casing and receiving components of an electronic circuit operable in use in response to the output from said sensor to break and restore an electric circuit through the primary winding of an ignition coil, and a vacuum actuator supported by said housing and coupled to said sensor, the actuator in use communicating with the inlet manifold of the internal combustion engine and adjusting the position of said sensor relative to the casing in accordance with the pressure conditions in the inlet manifold.

Conveniently said vacuum actuator is adjustably mounted on said housing so that a rest position of said sensor can be adjusted.

Desirably said sensor is part of a transformer and includes a pair of windings and said member includes a plurality of similar angularly spaced parts each part, when adjacent the sensor, altering the magnetic coupling between said windings and so altering the output of the sensor.

Preferably at least some of said components received by said housing are in heat exchange relationship with housing.

Desirably the casing is closed by an insulating cap carrying a plurality of terminals for connections to respective sparking plugs of the internal combustion engine and said shaft carries a distributor arm which rotates with said shaft and in use distributes electrical sparking pulses to said terminals in turn.

In the accompanying drawings,

FIG. **1** is a plan view of part of spark ignition apparatus in accordance with one example of the invention, and

FIG. **2** is a side elevational view of the apparatus shown in FIG. **1.**

Referring to the drawings, the apparatus includes a hollow cylindrical metal casing **11** within which is rotatably mounted a driven shaft **12.** The shaft **12** is driven in use by the internal combustion engine with which the apparatus is associated and the shaft **12** carries a moulded synthetic resin cylinder **13** which rotates with the shaft, and which includes, adjacent its periphery four parallel axially extending equi-angularly spaced ferrite rods **14.** Within the casing **11** is an annular metal base plate **15** which is fixed to the casing, and through which the shaft **12** extends with clearance. Rotatably mounted on the base plate **15** for movement about the axis of the shaft **12** is a timing plate **16** and carried by the timing plate **16** is a sensor **17.** The sensor is mounted for movement towards and away from the axis of the shaft **12,** so that the sensor can be set in the optimum position in relation to the periphery of the cylinder **13.** Once set, it is not intended that the position of the sensor **17** should be adjusted, other than for the purpose of maintenance.

Secured to the exterior of the casing **11** is a generally rectangular metal housing **18.** The housing **18** is secured to the casing **11** by screws one of which is shown at **19,** the screws **19** extending through the wall of the casing **11,** and co-operating with the base plate **15** to retain the base plate **15** in position within the casing **11.** Slidably mounted on the housing **18** is a vacuum unit **21** which in use is coupled by way of a flexible conduit to the inlet manifold of the internal combustion engine. The vacuum unit **21** includes a diaphragm which is moved, in use, in response to pressure changes in the inlet manifold of the engine, and coupled to the diaphragm is a push rod which extends through the housing **18** and an aperture in the casing **11,** and which is connected to the timing plate **16.** Thus the timing plate, and therefore the sensor **17** are moved relative to the casing **11** about the axis of the shaft **13** in accordance with variation in the pressure in the inlet manifold of the engine.

One end of the casing **11** is closed in use by a moulded synthetic resin cap which is secured to the remainder of the casing **11** by means of hinged clips **22.** The insulating cap carries four equi-angularly spaced terminals for connection to the four sparking plugs of the internal combustion engine, and the cap additionally carries a centre terminal electrically connected to a spring loaded contact within the cap which bears upon one end of a conductor carried on an insulating distributor arm **23** rotating with the shaft **12.** During rotation of the shaft **12** the conductor of the distributor arm **23** passes close to each of said four terminals on the cap in turn. The centre terminal of the cap is electrically connected to the high tension terminal of a conventional ignition coil, and so receives sparking pulses, the sparking pulses being distributed by the distributor arm **23** to the spark plug terminals of the cap in turn, as the shaft **12** rotates.

The sensor **17** comprises an E-shaped ferrite core two of the three parallel limbs of which terminate at their free ends adjacent the cylindrical surface of the cylinder **13.** Each of the three limbs of the core is encircled by a respective winding, and so when one of the ferrite rods **14** is adjacent said two limbs of the core, then the magnetic coupling between the respective two windings is substantially increased. The three windings constitute part of an oscillator which in turn constitutes part of an electronic control circuit controlling current flow in the primary winding of the ignition coil of the spark ignition system of the internal combustion engine. In addition to the oscillator, the electronic circuit includes an amplifier, and components of the oscillator and amplifier are carried by the hollow housing **18.** Some of the components, for example a power transistor **24** and a power resistor **25** are secured to the exterior of the housing **18,** and are in heat exchange relationship with the housing **18** so that these components can dissipate heat both by radiation to the atmosphere, conduction to the atmosphere, and conduction to the housing **18,** and through the housing **18** to the casing **11.** Desirably, the housing **18** and casing **11** between them carry all of the components of the electronic control circuit, and additionally carry terminals whereby the necessary electrical connections to a battery, and the ignition coil can be made. Thus in such an arrangement the apparatus described above can be substituted for the ignition distributor of a conventional spark ignition system.

As stated above the vacuum unit **21** is slidably mounted on the housing **18.** In order to permit the rest

position of the sensor **17** relative to the casing **11** to be set, the vacuum unit **21** is provided with a screw-threaded shank which extends into the housing **18,** and mounted for rotation, but not axial movement within the housing **18** is a thumb wheel **26** in screw-threaded engagement with the shank of the vacuum unit **21.** The vacuum unit **21** is held against rotation, and so rotation of the thumb wheel **26** moves the vacuum unit **21** and the sensor **17** relative to the casing **11.** It will be appreciated, that if desired the screw-threaded shank of the unit **21** and the thumb wheel **26** can be dispensed with, the vacuum unit **21** being fixed in position relative to the housing **18.**

The sensor **17** is connected to the remaining components of the oscillator by means of a flexible lead **27,** and the arrangement of the electronic control circuit is such that the substantial increase in the magnetic coupling between said pair of windings of the sensor **17** when any one of the four ferrite rods **14** is adjacent the respective poles of the core of the sensor **17** causes the oscillator to operate, the output signal of the oscillator being amplified, and being used to switch off a transistor which is associated with the primary winding of the ignition coil, so breaking the electrical circuit through the primary winding of the ignition coil, and causing a sparking pulse to be generated in the secondary winding of the coil. When the ferrite rod moves out of the proximity of the sensor **17** the oscillator ceases, and the transistor is switched on so re-establishing the electrical circuit through the primary winding in readiness for subsequent operation by the next, adjacent ferrite rod **14.** It will be appreciated that since it is the arrival of a ferrite rod adjacent the sensor which causes a sparking pulse to be produced, then movement of the sensor relative to the casing **11** about the axis of the shaft **12** will alter the ignition timing of the internal combustion engine.

I claim:

1. In an internal combustion engine having a plurality of spark plugs, an ignition coil, an inlet manifold, and means for distributing electrical impulses to said plugs in a predefined order, a spark ignition apparatus which comprises:

a rotatable shaft driven by said engine;

a hollow casing within which said shaft is rotatably mounted;

timing means rotatably mounted with respect to said shaft within said casing;

a sensor mounted to said timing means so as to be rotatably adjustable with respect to said shaft along with said timing means;

means coupled to and rotating with said shaft, said sensor being responsive to the angular position of said coupled means for generating output signals;

means connected adjacent to said casing for separately housing semiconductor electronic circuit component means for responding to said output signals from said sensor for opening and closing an electrical circuit through the primary winding of said ignition coil;

said semiconductor electronic circuit component means being mounted on said housing means which further serve to dissipate heat generated by said component means during use; and

a vacuum actuator supported by said housing means and coupled to said sensor, said actuator in communication with the inlet manifold of said engine for adjusting the angular position of said sensor relative to said casing according to the pressure conditions in the inlet manifold of said engine.

2. Apparatus as claimed in claim **1** wherein the vacuum actuator is adjustably mounted on said housing means so that a rest position of said sensor can be adjusted.

3. Apparatus as claimed in claim **1** wherein said sensor is part of a transformer and includes a pair of windings and said coupled means includes a plurality of similar angularly spaced parts each part, when adjacent the sensor, altering the magnetic coupling between said windings and so altering the output of the sensor.

4. Apparatus as claimed in claim **1** wherein the casing is closed by an insulating cap carrying a plurality of terminals for connections to respective sparking plugs of the internal combustion engine and said shaft carries a distributor arm which rotates with said shaft and in use distributes electrical sparking pulses to said terminals in turn.

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