AUSTRALIA
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS—1963
COMMONWEALTH OF AUSTRALIA

THE PATENTS ACT 1952-1969

CONVENTION APPLICATION FOR A PATENT

E/We, KENLOWE ACCESSORIES AND COMPANY LIMITED,

of Burchetts Green, Maidenhead, BERKSHIRE SL6 6QU, ENGLAND,

hereby apply for the grant of a Patent for an invention entitled: "AN IGNITION SYSTEM"

which is described in the accompanying complete specification.

This application is a Convention application and is based on the application(s) numbered: 26683/75

for a patent or similar protection made in Great Britain on 24th June, 1975.

Your address for service is care of GRIFFITH, HASSEL & FRAZER, Patent Attorneys, of 323 Castlereagh Street, Sydney 2000, in the State of New South Wales, Commonwealth of Australia.

DATED this 24th day of June, 1976.

KENLOWE ACCESSORIES AND COMPANY LIMITED
By its Patent Attorney:

TO:
THE COMMISSIONER OF PATENTS
COMMONWEALTH OF AUSTRALIA.
DECLARATION FOR CONVENTION PATENT APPLICATION

(Note: (1) To be signed by the applicant(s), if individual(s). If applicant is a Company, to be signed by a person on its behalf. (2) This is a comprehensive form, and parts inappropriate to a particular application should be cancelled.)

COMMONWEALTH OF AUSTRALIA

Patents Act 1953-1990

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention application No. (a) .................................................... made by (b) KENLOWE ACCESSORIES AND COMPANY LIMITED .................................................................

for a patent/patent of addition for an invention entitled (c) "An ignition system"

1. We (d) John Malcolm Coxhead and Kenneth Stanley-Lowe ...............................................................................

for the patent/patent of addition to make this declaration on its/their behalf.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) by the following applicant(s) namely:-

in (f) Great Britain on (g) 24th June 1975 by (h) KENLOWE ACCESSORIES AND COMPANY LIMITED

in (f) .................................................. on (g) .................................................. by (h) ..................................................

in (f) .................................................. on (g) .................................................. by (h) ..................................................

3. ............................................................................................................................................................................

in (f) .................................................. on (g) .................................................. by (h) ..................................................

in (f) .................................................. on (g) .................................................. by (h) ..................................................

4. The basic application(s) referred to in paragraph 2 of this Declaration was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at BERKSHIRE ENGLAND this day of JUNE 1976.

(b) ..............................

To: The Commissioner of Patents, Commonwealth of Australia.
Commonwealth of Australia


Complete Specification

For Office Use

Class Int. Class 46.8

Application Number: 526876
Lodged: 24/6/76
Int. Class: F03 D 310.1 7100 9100

Complete Specification Lodged: 24/6/76
Accepted: 24/6/76
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Priority Related Art

Name of Applicant: Kenlowe Accessories and Company Limited
Address of Applicant: Burchetts Green, Maidenhead, Berkshire SL6 6QU.

Actual Inventors: Kenneth Stanley Lowe
John Malcolm Coxhead.

Address for Service:

Complete Specification for the invention entitled:

"An ignition system"

The following statement is a full description of this invention including the best method of performing it known to us:

[Signature]
4 JUN 1976
[Stamp]
This invention relates to an ignition system for use in internal combustion engines.

The conventional coil ignition system utilising the make and break principle operated by a cam on a distributor shaft and opening and closing a pair of contact points has limitations on modern high speed engines especially with six, eight and twelve cylinders, because at high engine revolutions the dwell time between the contact closing from one closing movement to the next opening movement of the contacts is of insufficient duration to ensure a total cut-off of electrical current.

The contact points even when made of relatively expensive tungsten material or even alloys including platinum or silver or similar material have a very short life before a male and female pip are formed on the contact surfaces which very soon affects the critical contact gap between the two surfaces and therefore necessitates constant inspection with a feeler gauge and frequent re-adjustment if the maximum performance and minimum fuel consumption of the vehicle is to be maintained.

The opening and closing of the contact points by an insulated heel operating on a cam places a load on the distributor shaft which although marginal can affect instant acceleration and inevitably requires a form of lubrication such as a high melting point grease in order to eliminate the possibility of distributor squeak. The tolerance of machining of the necessary cam also brings about unequal firing impulses.
Much investigation into a method of overcoming the above noted problems have been going on for many years resulting in a form of ignition known as electronic ignition and methods using this principle have been adopted throughout the motor industry in a relatively few cases only because of the additional expense brought about by the solid state controls necessary and the use of amplifiers and other advanced technology which even if mass production was to be brought about would still entail additional cost to that of the conventional mechanically operated contact points.

Conventional systems have used sensors, such as optical devices, which only produce a very small firing pulse. This pulse has to be pre-amplified, and then amplified in a main amplifier before sufficient current is available to supply the ignition coil. It has been found that the two-stage amplifiers have become extremely hot due to resistance heating, and as a consequence their lifetime has been very short, often as little as one week.

According to the present invention there is provided an ignition system for use in an internal combustion engine comprising a magnetic field responsive switching element, means for applying a magnetic field periodically to the switching element at a rate dependent on the engine speed to actuate the reed switch when it is desired to fire a sparking plug, and a control circuit for producing a current pulse when the switching element is actuated.

The invention will now be described in more detail,
by way of example only, with reference to the accompanying drawings, in which:

FIGURES 1a to 1c shows examples of a trigger for an ignition system in accordance with the invention for use with a four cylinder engine;

Figures 2a to 2d show examples of a trigger for an ignition system in accordance with the invention for use with a six cylinder engine;

Figures 3a to 3d show examples of a trigger for an ignition system in accordance with the invention for use with an eight cylinder engine;

Figures 4a to 4f show examples of a trigger for an ignition system in accordance with the invention for use with a twelve cylinder engine;

Figure 5 is a sectional view through part of a distributor incorporating a second form of trigger for an ignition system in accordance with the invention; and

Figure 6 is a circuit diagram of an ignition system in accordance with the invention.

In Figure 1a, a disc 1 carries four equally spaced magnets 2 which successively pass over a reed switch 3 when the disc 1 is rotated. In use, the disc 1 is mounted on a distributor shaft (not shown) of an internal combustion engine. The reed switch 3 is so mounted below the disc 1 as to make and break its contacts at the correct time to produce a signal for a control circuit which supplies the engine coil as will later be described.
Figure 1a shows an arrangement for use with four cylinders, and it can be seen that four pulses will be produced as the four magnets 2 successively pass over the reed switch 3.

Figures 1b and 1c show alternative arrangements for achieving the same result, that is using either two magnets and two reed switches, or 4 reed switches and 1 magnet.

Figures 2a to 2d show a system for producing the six pulses which are required for a six cylinder engine.

In Figure 2a, six magnets 2 pass successively over a single reed switch 3, whereas Figures 2b to 2d describe arrangements with two reed switches and three magnets, three reed switches and two magnets, and six reed switches and one magnet respectively.

Figures 3a to 3d show arrangements for producing the eight successive pulses required with an eight cylinder engine, and similarly Figures 4a to 4e show five different configurations for producing the twelve successive pulses required for a twelve cylinder engine.

The alternative methods of using more than one reed switch allow the diameter of the rotor to be reduced which for certain sizes of distributor allows a more simple installation and can bring about better switching characteristics than would be the case with a large number of magnets which limit the minimum diameter of the rotor. From the manufacturing viewpoint, a four cylinder rotor for example could also be used in an eight cylinder engine with two reed switches. The number of
different kinds of rotor that have to be produced is therefore reduced. Similarly a six cylinder rotor could be used with a twelve cylinder engine having two reed switches.

In the case of a single reed switch 3, it may be encapsulated in a plastics material, or mounted on a base plate, and mounted where the contact breaker points would be in a conventional system. Conveniently, the same locating screw may be used so that conventional points can be very simply replaced by the reed switch.

The above arrangements may of course be reversed, that is the magnet or magnets could be stationary and the or each switch could be mounted for rotation.

In Figure 5 a rotor arm 4 is mounted on a distributor drive shaft 5. The rotor arm 4 carries an apertured ferrous disc 6 part of whose periphery extends between a fixed reed switch 3 and a fixed magnet 7. The magnet 7 and the reed switch 3 are mounted in the tines of a plastics fork arrangement which is screwed to a baseplate 8 of the distributor.

In operation, the ferrous disc 6 acts as a magnetic screen so that as the apertures in the disc 6 pass over the magnet 7, the magnetic field passes through the apertures to make and break the contacts of the reed switch 3. The apertures are arranged in the periphery of the disc 8 in the same configuration as would be the case if the series of magnets were arranged around the disc 1 described in Figures 1 to 4. The apertures would normally be in the form of radially extending slots.
With this arrangement, it is normally only necessary to provide one fixed reed switch and one fixed magnet incorporated in the tines of the fork arrangement which may be mounted in the position normally occupied by the contact breaker points. The use of a single reed switch and single magnet leads to a reduction in the cost of manufacture in relation to systems using a greater number of either component. The only component, in this arrangement, that is dependent on the number of cylinders is the ferrous metal disc and, as this is normally a simple pressed metal disc, it is cheap to manufacture with different discs having different numbers of slots. A standard reed switch and magnet unit can then be sold for all engines, and the appropriate disc sold with the standard unit for the engine on which the system is to be fitted.

The ignition system shown in Figure 6 includes the reed switch 3 having contacts 9, 10 which are made and broken by the action of the magnet 2. The contact 9 is connected to the positive line, and the contact 10 is connected through a resistor to the base of a driver transistor 13, the emitter of which is connected to the base of a main power transistor 14 whose emitter is connected to the negative line 15. The collector of the transistor 13 is connected to the collector of transistor 14 and to the positive line through a coil 16. The collector of the transistor 14 is connected through a coil 17 to provide the high voltage signal to the sparking plugs.
As the contacts of the reed switch 3 are closed, the driver transistor 13 is turned on and this, in turn, switches on the transistor 14 which produces a voltage pulse at the output of the transistor 14. With the arrangement described, a substantially square-wave output is produced and the low rise time produces a high voltage at the output of the coil.

The very simple circuit completely eliminates the need for pre-amplifier with high thermal dissipation requirements and therefore a relatively high rate of failure in the very elevated under-bonnet ambient temperatures now being brought about by the modern vehicles with very congested under-bonnet layouts. The elimination of the pre-amplifier also cuts out the component with the largest cost of manufacture and therefore allows the complete assembly to be made available to vehicle and engine manufacturers at the very minimum cost. The pre-amplifier is also the largest component and again its elimination very much reduces the size of the entire assembly which can be important in today's modern vehicles with so little space under the bonnet.

The speed of actuation of the reed switch can be many times greater than the most expensive and advanced contact set of points available anywhere in the world and therefore the safety factor at maximum engine revolutions even with a multi-cylinder engine would always be far in excess of that obtainable with the best engineered contact set so giving all the advantages of a true electronic
ignition system without the use of suspect components such as amplifiers and light triggering devices which have been proved to be unreliable in the automotive application where very high under-bonnet ambient temperatures coupled with unskilled or semi-skilled maintenance services can very much reduce the life of such components.

If required a static timing light may be incorporated in the control unit. This light, which may be in the form of a light emitting diode, is illuminated when the reed switch is closed enabling the timing to be set accurately without a stroboscope.

The circuit may further include a zener diode to protect the power transistor from any voltage induced in the primary winding of the coil.

In the system described so far, the high tension is distributed to the sparking plugs by means of a rotor arm in a conventional distributor cap. The distributor cap may be eliminated by using one ignition coil for each sparking plug and a number of reed switches arranged to energise each coil in turn.

The ignition system may be sold as an accessory kit to replace an existing conventional contact breaker mechanism. Having installed the reed switch and the rotor arm, the user sets the engine to the recommended timing marks. The distributor base-plate is then adjusted until the light emitting diode just comes on. At this
point the base-plate is secured in position and the engine timing is then set.

The described ignition system has the advantage that the rapid rise time of the output pulse of the control unit leads to a high voltage spark which leads to an improvement in economy and performance. This is a consequence of the more efficient combustion and the reduction in the loss coming from the continual wear, contact bounce, and incorrect timing often present with conventional points. Mis-firing and scatter, due to interaction of conventional points with the advance mechanisms is reduced and substantially optimum timing can be maintained.

The absence of points means there is a lighter loading on the distributor bearings, and the manufacturing tolerances in general can be relaxed. A capacitor is not required with the system described.

Also the small area of the contacts of the reed switch means they can be coated with expensive metal to improve still further the performance of the switch.

The control unit could ultimately be mounted in the distributor cap which could be made as a sealed unit.

In an alternative arrangement, the reed switch may be replaced by a magneto-resistor in any of the above-described embodiments. A magneto-resistor is a circuit element whose resistance changes sharply when a magnetic field is applied to it. The magneto-resistor is normally connected to a pulse shaping circuit which determines at which point the control circuit is actuated.
CLAIMS
The claims defining the invention are as follows:

1. An ignition system for use in an internal combustion engine comprising a magnetic field responsive switching element, means for applying a magnetic field periodically to the switching element at a rate dependent on the engine speed to actuate the switching element when it is desired to fire a sparking plug, and a control circuit for producing a current pulse when the switching element is actuated.

2. An ignition system as claimed in Claim 1 wherein the control circuit is arranged to produce a substantially rectangular current pulse.

3. A system as claimed in Claim 1 or 2 wherein the switching element is fixed, and a plurality of magnets equal to the number of cylinders are mounted on the rotor at the correct spacing to actuate the switching element at the correct time.

4. A system as claimed in Claim 1 or 2 including a combination of a plurality of fixed switching elements and moving magnets arranged to provide the correct number of pulses per revolution for the number of cylinders of the engine.

5. A system as claimed in Claim 1 or 2 having a fixed magnet and a fixed switching element between which passes a rotatable magnetic screen having apertures arranged in its periphery so as to allow the magnet to act on the switching element and actuate it at the correct time.

6. A system as claimed in any one of Claims 1 to 5 wherein the control circuit comprises a power transistor which is switched into conduction by the switching element.
7. A system as claimed in Claim 6 wherein the base of the power transistor is connected to the switching element through a driver transistor.

8. A system as claimed in Claim 7 wherein the emitter of the driver transistor is connected to the base of the power transistor.

9. A system as claimed in any one of Claims 1 to 8 wherein the control circuit includes means for indicating the state of the switching element.

10. A system as claimed in Claim 9 wherein the means for indicating the state of the switching elements are provided by a light emitting diode.

11. A system as claimed in any one of Claims 1 to 6 wherein the control circuit includes a zener diode to protect the power transistor from any voltage induced in the primary winding of the coil.

12. A system as claimed in any one of Claims 1 to 10 wherein the switching element is a reed switch.

13. A system as claimed in any one of Claims 1 to 10 wherein the switching element is provided by a magnetoresistor.

14. An ignition system for an internal combustion engine substantially as herein described with reference to the accompanying drawings.

15. An engine including an ignition system as claimed in any one of Claims 1 to 14.
DATED this 24th day of June, 1976.

KENLOWE ACCESSORIES AND COMPANY LIMITED
By its Patent Attorney:

of GRIFFITH, HASSEL & FRAZER
Fellows, Institute of Patent
Attorneys of Australia.
DRAWINGS