Convention Application for a Patent

We, ROBERT BOSCH G.m.b.H., a Company organised under the laws of the Federal Republic of Germany,

of Robert-Bosch-Platz 1, Gerlingen-Schillerhoehe, near Stuttgart, Federal Republic of Germany,

hereby apply for the grant of a Patent for an invention entitled "AN IGNITION DEVICE FOR INTERNAL COMBUSTION ENGINES"

which is described in the accompanying complete specification.

This application is a Convention application and is based on the application numbered P 26 51 658.5 for a patent or similar protection made in Federal Republic of Germany on 12th November, 1976.

Our address for service is: CALLINAN & ASSOCIATES Patent Attorneys, of 48-50 Bridge Road, Richmond, State of Victoria, Australia.

Dated this 10th day of November, 1977.

ROBERT BOSCH G.m.b.H.
By its Patent Attorneys: CALLINAN AND ASSOCIATES.

To The Commissioner of Patents.
Declaration in Support of
(a) A Convention Application
(b) An Application
for a Patent or Patent of Addition

In support of the Application/Convention Application made by
(c) Robert Bosch GmbH

for a patent/patent of addition for an invention entitled:
(d) An ignition device for internal combustion engines

(We) Friedrich Schweikhardt and Rudolf Landstädter
(1) Postfach 50, 7000 Stuttgart 1, Germany (West)
do solemnly and sincerely declare as follows:

1. (a) I am/we are the applicant(s) for the patent/patent of addition
   or
   (b) I am/we are authorised by Robert Bosch GmbH

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

2. (i) The basic application(s) as defined by Section 141 of the Act was/were made
   in Germany (West) on the 12th day of November 1976
   by Robert Bosch GmbH

3. (i) I am/we are the actual inventor(s) of the invention
   or
   (b) I am/we are the actual inventor(s) of the invention referred to in the basic application.

   1. Karl Friedrich Wittlinger, of 19, Kästlesgraben, and
   2. Jörg Isabel, of 2, Pelargusstraße

   of
   1. 7144 Schwieberdingen, Germany (West)
   2. 7000 Stuttgart 1, Germany (West)

   if I am/we are, the said Company is entitled to make the application as are follows:

   the said company is the assignee of the said invention from the
   said actual inventors and made the application in Germany (West) on
   the date claimed.

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

   West

   Declared at Stuttgart, Germany this 2nd day of November 1977

   SIGN

   HERE

To: The Commissioner of Patents.
A device for generating magnetic flux and periodically producing at least two successive pulses for an ignition system of an internal combustion engine by varying the magnetic flux, and wherein the depth of one of said pulses is less than that of the following pulses, characterised in that the pulse depth is determined by the minimum magnetic resistance arising during the pulse time.
We hereby certify that this and the following
paragraphs are a true and
correct copy of the original specification.

CALLAN AND ASSOCIATES

Patent Attorneys for Applicant

PATENTS ACT 1952–1973

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Class:
Int. Cl:

Application Number:
Lodged:

Complete Specification—Lodged:
Accepted:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: ROBERT BOSCH G.m.b.H.

Address of Applicant: Robert Bosch Platz 1, Gerlingen–Schillerhoche, near Stuttgart, Federal Republic of Germany.

Actual Inventor: Karl Friedrich Wittinger and Jorg Issler respectively.

Address for Service: Care of Callinan and Associates, 48-50 Bridge Road, RICHMOND, 3121, Victoria, Australia.

Complete Specification for the invention entitled: "AN IGNITION DEVICE FOR INTERNAL COMBUSTION ENGINES"

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

*Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 180 mm in width,
on tough white paper of good quality and it is to be inserted inside this form.

F. D. Atkinson, Government Printer, Canberra
The present invention relates to ignition devices for internal combustion engines.

Ignition is initiated at low speeds by the second pulse and at increasing speed by the first pulse. The result is ignition timing adjustment to a later time in the lower speed range. The pulses are triggered by varying the magnetic flux by means of a generator. The pulse depth is determined by the minimum magnetic resistance arising during the pulse time.

In order to allow an internal combustion engine to operate in the optimum range of capacity, circuits are known which cause the firing point to be advanced at high speeds. It is also known practice to improve combustion of the ignition mixture by means of multiple ignition pulses in the firing point. In order to achieve this, however, expensive circuits are required. In German Offenlegungsschrift 22 11 575, an ignition layout is described wherein a magnetic generator having an ignition armature acting simultaneously as an ignition coil produces two pulses of differing depths. The disadvantage of the device is that it cannot be used in ignition pulse generators used at present in motor vehicles without extensive conversion work. Moreover, special complex, and therefore expensive circuits must be used.
The present invention provides a device for generating magnetic flux and periodically producing at least two successive pulses for an ignition system of an internal combustion engine by varying the magnetic flux, and wherein the depth of said pulse is less than that of the following pulses characterised in that the pulse depth is determined by the minimum magnetic resistance arising during the pulse time.

The arrangement according to the invention and having the characterising features of the main claim has by comparison the advantage that by exchanging the mechanical ignition distributor an electronic pulse generator is easily installable which simultaneously sets the firing point back at low speeds. Conversion and a simultaneous improvement of the working characteristics is therefore possible inexpensively even in existing engines.

It is particularly advantageous to construct the rotor of the ignition device so as to be interchangeable in already existing ignition systems having inductive ignition pulse generators by exchanging the rotor already installed.

The present invention is further described hereinafter, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of a preferred embodiment; and

Fig. 2 is a diagram explaining the course of the voltages of the embodiment of Fig. 1.
Tests have shown that it is advantageous to set the firing point of an engine late during starting and possibly during idling. Setting late means that the ignition pulse occurs later. Fig. 1 shows in a diagrammatic representation the basic construction of a pulse generator coupled to an internal combustion engine and such as is used for an engine which requires four pulses per revolution. A rotating rotor 10 which is driven by the engine has four cams 11,12 which lie opposite one another in pairs. The pairs of cams do not divide the rotor periphery symmetrically. One pair of cams is relative to a symmetrical division, offset by the angle W against the direction of rotation. The pairs of cams are moreover of differing lengths. The cams 11 are shorter than the cams 12. A stator 12 comprises four symmetrically disposed, coil-wound teeth made from soft magnetic material 13 and having magnets 15 whose polarity towards centre are all equal. The coils are interconnected in such a manner that the induced voltages are added. The sum of these voltages may be removed at an output 14. In Fig. 1 it is not shown that the ends of the magnets remote from centre are connected in a magnetically conductive manner to the centre of the rotor.

The mode of operation of the ignition system of Fig. 1 is described in greater detail with reference to the voltage diagram of Fig. 2. If a pair of cams lies opposite
the teeth 13, a voltage pulse is induced in the corresponding coils as a result of the strong change in the magnetic resistance which is basically determined by the air gap between magnet and rotor. The induced voltage is higher, the greater the change in the magnetic resistance. Since the cams 11 are shorter than the cams 12, the air gap between the tooth 13 and the cams is greater with the cams 11 than the air gap between the cams 12 and the teeth when they lie opposite one another. The voltage course a therefore shows at first a low pulse such as arises when the cams 11 and the teeth 13 are opposed. This case is shown in Fig. 1. If the rotor then rotates through the angle \( W \), the teeth 13 lie opposite the cams 12. Since in this case the distance between the cams 12 and the teeth 13 is less, the magnetic resistance is also less, i.e., the induced voltage is greater. The voltage course a shows the voltage then arising at the output 14. If the rotor rotates through 360°, in the embodiment four pulse trains according to Fig. 2 a are produced. After the output 14 there is preferably connected a threshold value switch (not shown) which switches over at a voltage \( U_1 \) outlined by dashed lines. A signal b is then produced at the output of the threshold value switch If the previously low speed of the rotor is then increased, the voltage induced in the coils also increases. This case
is shown as voltage course c. If the cams 11 are opposite the teeth 13, the first lower voltage pulse is triggered. If, after further rotation through the angle W, the cams 12 are opposite the teeth 13, another higher voltage pulse is produced. Because of the higher first voltage, the threshold value switch (voltage d) already switches at the first voltage pulse. The second pulse is unimportant since the threshold value switch is already in its switched state. When the speed increases, therefore, on attaining a specific reference speed the switch is made from a late to an earlier firing point. The speed at which the change-over occurs may be determined by simple structural measures. One possibility is to vary the level of the switching voltage by means of the threshold value switch. Another possibility is provided in that, by varying the cam length, the air gap is varied and it is thereby possible to determine the depth of the first pulse relative to the second.

In a further form of the invention it is advantageous to achieve the differing pulse depth by means of a stepped cam, the air gap between the rotor- and the stator cam being greater in the preceding cam part than in the subsequent part. By means of several small adjustments towards a late firing point are possible at various speeds according to the number of steps. The stator comprises at least one, for example inductive receiver. In certain cases it is advantageous to mount the cams on the stator and the receiver on the rotor.
The claims defining the invention are as follows:

1. A device for generating magnetic flux and periodically producing at least two successive pulses for an ignition system of an internal combustion engine by varying the magnetic flux, and wherein the depth of one of said pulses is less than that of the following pulses, characterised in that the pulse depth is determined by the minimum magnetic resistance arising during the pulse time.

2. A device as claimed in claim 1, wherein there are provided a rotor having at least two cams and a stator having at least one tooth for generating said pulse wherein the rotor and the stator are magnetically interconnected and there is disposed on the rotor or stator a coil in which pulses are induced.

3. A device as claimed in claim 1, wherein there are provided a rotor having at least one stepped cam, which has at least two steps, and a stator having at least one tooth for generating said pulses the rotor and the stator being magnetically interconnected and a coil being disposed on the rotor or stator in which pulses are induced.

4. A device as claimed in claim 2, wherein the magnetic resistance is mainly determined by the distance between the cams of the rotor and those of the stator and that in the direction of rotation one cam of the rotor is shorter than the following cam.
5. A device as claimed in claim 4, wherein the rotor has an even number of cams lying opposite one another in pairs, of which one half of the cams is uniformly distributed over the periphery of the rotor and the other half is disposed asymmetrically relative to the other cams over the periphery of the rotor, and a number of stator cams corresponding to the number of rotor cams is provided, all of these being mounted equally spaced on the stator.

6. A device as claimed in any of the previous claims wherein a threshold value switch is connected after the generator.

7. A device constructed substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 10th day of November 1977.

Robert Bosch G.m.b.H.
By its Patent Attorneys:
CALLINAN AND ASSOCIATES