BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 714/89 - 3.2.4

Application No.: 83 902 304.1

Publication No.: WO 84/00402

Title of invention: Ignition system for an Otto-type four-stroke engine

Classification: F02P 3/06

D E C I S I O N
of 13 October 1992

Applicant: Saab-Scania Aktiebolag

Headword:

EPC Article 56

Keyword: Inventive step (yes)

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 714/89 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 13 October 1992

Appellant : Saab-Scania Aktiebolag
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Decision under appeal : Decision of Examining Division 2.2.06.103 of the European Patent Office dispatched on 23 June 1989 refusing European patent application No. 83 902 304.1 pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : C.A.J. Andries
Members : M.G. Hatherly
J.P.B. Seitz

Summary of Facts and Submissions

I. European patent application No. 83 902 304.1, filed on 20 June 1983 (international publication No. WO 84/00402) was refused by a decision whose grounds were dispatched on 23 June 1989.

II. The reason given for the refusal was that the subject-matter of all claims then on file did not involve an inventive step.

The prior art documents cited in the examination proceedings include the following:

D1 : GB-A-1 170 151
D3 : GB-A-1 371 042
D4 : GB-A-1 498 942
D5 : DE-A-1 148 814.

III. The Appellant filed an appeal by telex on 21 August 1989, confirmation was received 23 August 1989. The fee was paid on 23 August 1989. The Statement of Grounds was received on 24 October 1989.

Oral proceedings, requested auxiliarily by the Appellant, were arranged but the Appellant stated by letter of 1 October 1992 that he would not participate therein. After subsequent telephone conversations between the Representative Mr S. Lagman and the Rapporteur, Mr Lagman filed on 12 October 1992 by facsimile a letter with new application documents. The oral proceedings were duly held on 13 October 1992 without the Appellant in accordance with Rule 71(2) EPC.

IV. Claim 1 now reads as follows:

"An ignition system for a multi-cylinder Otto-type four-stroke engine equipped with at least one spark plug per cylinder, the ignition system comprising ignition transformers (31-34) connectible to the spark plugs without cables, there being one ignition transformer for each spark plug, the ignition system also including an electronic control unit which sends signals to semi conductor switch elements (36-39) in response to the operating conditions of the engine for triggering sparks at the spark plugs in a predetermined order, each switch element being connected to the primary winding of an ignition transformer characterised in that all the ignition system components which belong to at least two adjacent spark plugs and which are intended for operation at voltages over 12 volts, including the switch elements and the ignition transformers (31-34), are included in a common, handleable unit, a so-called ignition cassette (70), which is adapted for securing to adjacent engine parts other than the spark plugs, each ignition transformer being connectible to a spark plug central electrode via a resilient member (74) that exerts pressure on the spark plug, there being provided means (76) engaging the spark plug insulator for sealing the connection between a respective ignition transformer and a spark plug."

V. The Appellant requests that the decision under appeal be set aside and that patent be granted on the basis of the following documents:

Claims:

- Claims 1, 2 and 3 (first part) appearing on the page of the claims filed with the facsimile letter of 12 October 1992; and

- Claims 3 (last part) and 4 to 7 appearing on page 2 of the claims filed with the letter of 30 August 1991.

Description:

- pages 1, 1a, 2, 3, 5, 6 and 10 filed with the letter of 30 August 1991;

- page 2a filed with the facsimile letter of 12 October 1992;

- pages 4 and 7 to 9 as originally filed;

- with amendments to pages 1, 1a and 8 as set out in the facsimile letter of 12 October 1992.

Drawings:

- Figure 1 filed with the letter of 30 August 1991; and

- Figures 2 and 3 as originally filed.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments

2.1 Basis for the present claims in the original application:

2.1.1 All the features of the originally filed Claim 1 are still present in Claim 1. Each ignition device 61, 62 specified in the original Claim 1 apparently includes merely one ignition transformer 31 - 34 (see page 6, lines 27 to 33 of the original description) so it is acceptable to amend

the imprecise term ignition device to ignition transformer. The original description of the connection as being substantially without cables was unclear, the word "substantially" has therefore justifiably been deleted.

2.1.2 The features added to the original Claim 1 to arrive at the present Claim 1 are as follows:

- the control unit is electronic - see original page 4, lines 16 and 17;

- semiconductor switch elements - see original page 5, lines 6 and 7;

- each switch element is connected to the primary winding of an ignition transformer - see original page 5, lines 1 and 2;

- all the ignition system components which belong to at least two adjacent spark plugs and which are intended for operation at voltages over 12 volts are included in the ignition cassette - see original Claims 2 and 4; original description page 6, lines 15 to 33; and original Figures 1 and 2;

- the ignition cassette is adapted for securing to adjacent engine parts other than the spark plugs - see original page 7, lines 1 to 6;

- each ignition transformer is connectable to a spark plug central electrode via a resilient member that exerts pressure on the spark plug - see Figure 2; original page 7, lines 26 to 35; and original Claim 7; and

- means engaging the spark plug insulator for sealing the connection between ignition transformer and spark plug - see original page 7, line 35 - page 8, line 2.

2.1.3 The dependent claims are based as follows on the original application:

- Claim 2 is based on original Claim 3;

- Claim 3 is based on original Claim 5;

- Claim 4 is based on original Claim 7 and original page 6, lines 33 to 36;

- Claim 5 is based on original page 7, lines 1 to 6;

- Claim 6 is based on Figure 2 and original page 7, lines 29 to 35; and

- Claim 7 is based on original page 6, lines 35 to 37.

2.1.4 The present claims therefore do not contravene Article 123(2) EPC.

2.2 The description has been adapted to the present claims and to acknowledge the prior art. The drawings are as originally published except for Figure 1 which has been redrawn to place the spark plugs outside the high voltage block which is indeed the case. Thus no objection arises under Article 123(2) EPC.

3. Novelty

After examination of the cited documents, the Board is satisfied that none of them discloses an ignition system having all the features set out in Claim 1, in particular none of them discloses a plurality of semiconductor switch

elements and ignition transformers included in a common handleable unit.

The subject-matter as set forth in Claim 1 is to be considered novel within the meaning of Article 54 EPC.

4. Closest state of the art, problem and solution

4.1 The starting point for the invention is an ignition system having a separate ignition transformer for each spark plug, such a system being known from document D3. Since the ignition system known from this document D3 comprises for each spark plug 1 - 4 a semiconductor switch element 14 - 17 connected to the primary winding 5a - 8a of an ignition transformer 5 - 8 connectable to the spark plug without cables, the ignition voltage is advantageously high (see page 1, lines 27, 49 and 50) and has a advantageously short rise time (see page 2, lines 56 to 58) when compared to the most commonly used ignition system in which the output voltage from a single ignition coil is applied by distributor contacts to the spark plugs.

4.2 The skilled person designing an ignition system strives for efficient functioning with low power loss but must also ensure that the ignition system functions properly and reliably during a long life. High ignition voltages and short rise times increase the liability of an ignition system to flashover between ignition transformer output and adjacent grounded engine parts, creeping of currents along spark plug insulator and emanation of electrical and magnetic fields from flashover and from ignition voltage inducement in the ignition transformer.

4.3 To summarise therefore, starting from the ignition system disclosed by document D3, the problem to be solved by the

invention is to provide a more safe, efficient and compact ignition system which is easy to use.

4.4 The Board is satisfied that the problem can be solved by the ignition system set out in Claim 1, and in particular by the features in its characterising portion.

The common handleable unit or ignition cassette which houses all the ignition system components which belong to at least two adjacent spark plugs and which are intended for operation at voltages over 12 volts is easier and safer to handle e.g. during servicing than separate units for each spark plug.

Furthermore, since the ignition cassette is secured to the engine it is not necessary to mechanically support the cassette using the plugs and it becomes possible to electrically connect each ignition transformer to its corresponding spark plug central electrode in a more reliable manner via a resilient member that exerts pressure on the spark plug.

The means engaging the spark plug insulator for sealing the area of the connection between spark plug and ignition transformer against dust and dirt provides a barrier to prevent high voltage flashovers and creeping currents along the spark plug insulator which could otherwise occur due to the high and short rise time ignition voltage.

4.5 The easy to use ignition cassette, as claimed, can only allow a more effective and a more reliable transfer of a higher voltage with a shorter rise time if it is guaranteed by other features that a good electrical contact be made with the spark plugs and moreover that the contact areas (transformer - spark plug) are isolated from the motor environment. These last two requirements arise

from the fact that the ignition cassette is secured to the engine so the Board sees the technical problem as defined above (in section 4.3) as a single problem towards whose solution all the features of the characterising portion of Claim 1 contribute rather than as a plurality of technically independent partial problems.

5. Inventive step

5.1 It is part of the normal work of the skilled person to improve existing devices and so it could be expected that he would wish to put into practice and improve the ignition system disclosed by document D3, naturally considering safety, efficiency, compactness and ease of use.

5.2 To do this, he can be expected to consider the ignition system disclosed in document D4 which includes a terminal manifold 16 which can be easily replaced (see page 2, lines 8 to 14) and which comprises an aluminium alloy housing 17 containing an electrical insulating cast resin block 18 including four projecting skirt portions 19 having recesses 20 to complement the upper profiles of spark plugs 11 - 14, see page 1, lines 45 to 50 and Figure 1. An external distributor operates reed switches 25 - 28 in the block 18 in turn to connect the secondary winding of a single ignition transformer C to the spark plugs.

The terminal manifold is connected only via a plug 30 to a 12 volt supply and to a computer controlled system, thus all the ignition system components which operate at voltages above 12 volts are contained in the terminal manifold. Hence he would realise that document D4 teaches him how to house all high voltage components in a single easy-to-handle unit.

5.3 The question next arises of whether the skilled person would be led to use the teaching obtained from document D4 when modifying the ignition system according to document D3 and, if so, at which system he would arrive.

5.4 The Board is of the opinion that the skilled person would at least consider putting all the components operating above 12 volts, which are present in the ignition system according to document D3, in a terminal manifold like that known from document D4. Since the individual ignition transformers of the system of document D3 are already mounted on the spark plugs (see page 1, lines 25 to 32 and page 2, lines 127 to 129) and since the single coil C of the system of document D4 is incorporated in the terminal manifold, in his modification he would house the individual transformers in such a terminal manifold.

Although it was the trend in electronic systems in general to use electronic switches rather than mechanical switches, a person skilled in the art would have been reluctant at the priority date of the present application to locate the semiconductor switch elements 14 to 17 disclosed by document D3 within the single terminal manifold as was disclosed for the reed switches in document D4. Indeed, not only is it stated in page 1, line 87 to page 2, line 3 of document D3 that the semiconductor switches may be associated with the distributor which implies to the Board that the switches are located away from the spark plugs but also it must be borne in mind that transistors are sensitive to thermal overloads. In fact, at the priority date of the present invention the skilled person tended to encapsulate electronic switches in metal containers having cooling ribs and moreover to mount the containers on a conducting surface in a cool place. The prior art available to the

Board does not convince it that another approach, namely locating electronic switches near to the combustion chambers, was already known or obvious to a person skilled in the art at the priority date of the present application. While it may well have been technically feasible to mount the semiconductor switches near the spark plugs, which would only have been possible at greater expense, the fact remains that the prior art available to the Board did not suggest such an approach.

Furthermore it should be remembered that other technical possibilities were at hand, e.g. changing the type of switch or locating the switches away from the terminal manifold, so that a person skilled in the art was not guided automatically to the claimed subject-matter.

The Board thus considers that at the priority date - contrary to the disclosure of document D4 where the (reed) switches are mounted in the terminal manifold - the skilled person would not have chosen to mount semiconductor switches in the terminal manifold known from document D4.

5.5 With respect to the further features claimed in Claim 1, i.e. the securing of the terminal manifold (ignition cassette), the electrical connection of ignition transformer to spark plug central electrode, and the sealing means of that connection area, the following is observed.

5.5.1 The connectors 21 - 24 of the terminal manifold disclosed by document D4 snap onto the spark plug connectors and the recesses 20 in the terminal manifold complement the upper profiles of the spark plugs (see page 1, lines 49 to 51). In the absence of further disclosure in document D4 as to how precisely the spark plugs fit in the recesses it can

only be said with certainty that the terminal manifold is located in a vertical direction by its connectors 21 -24.

Thus the feature in the present Claim 1 of securing the ignition cassette to adjacent engine parts other than the spark plugs is not known from document D4; neither is it known from document D3. These documents therefore can give the skilled person no hint to secure the ignition cassette in the claimed manner. Moreover it is common to mount spark plug caps on spark plugs merely by their electrical connectors. Adding an extra attachment would mean that removal of the assembly from the spark plugs will then take longer. However the skilled person would not have found it difficult to provide an extra attachment (e.g. see Figure 1 of document D5 which shows a housing 1 for an ignition coil 2, 3 attached by supports 15 to a cylinder head 8).

5.5.2 It is clear for a person skilled in the art that the electrical connection of each ignition transformer to the respective spark plug central electrode must be a good connection. It is common practice that a spark plug connecting cap grips the spark plug central electrode and so exerts pressure thereon via a resilient member e.g. a spring or a slit lip; moreover the original description of the present application refers on page 7, lines 26 to 29 to "a conventional connection means 73". Both the Appellant and the Board see the clip 37 on Figure 4 of document D1 as falling within the scope of this claimed feature (see the Appellant's letter of 30 August 1991, page 7, paragraph 1).

5.5.3 The application as originally filed states that rubber boots 76 seal against the spark plug insulator (see page 7, line 35 to page 8, line 2). The Appellant argues that, because of the present system's higher voltage and

shorter rise time, sealing against the spark plug insulator is necessary to prevent high voltage flashovers and creeping currents along the spark plug insulators (also see the original description, page 1, lines 27 to 32).

Document D3 gives no information whatsoever on the sealing aspect. The recesses 20 of the cast resin block 18 according to document D4 complement the upper profiles of the spark plugs but there is no disclosure of how precisely the spark plugs fit in the recesses i.e. whether the connection is effectively sealed. Figure 4 of document D1 shows a metallic tubular extension 38a adapted to be releasably secured over the top end of a spark plug 22 and extending down over the base of the plug to effect a good ground (see page 3, lines 116 to 122). A ring member is shown inside the tubular extension 38a but whether this merely centres the tubular extension on the spark plug and/or whether it seals off the space around the spark plug electrode connector is not disclosed.

However, despite the lack of information in the prior art documents available to it, the Board considers that, in view of conventional rubber boot seals for spark plugs, such seals per se as set out in Claim 1 are known by a person skilled in the art.

5.5.4 Although these further features are known or obvious as such to the person skilled in the art, the Board considers that these features have a functional interrelationship and constitute a true combination making it possible that high ignition voltages and short rise times can be employed without decreasing the ignition system's reliability. Accordingly the skilled person had to make a particular selection for each feature from the numerous possibilities in the prior art in order to arrive at the

whole system. The particular combination of features could thus in this specific case only be arrived at as a result of ex post facto analysis, there being no hints in the available prior art to lead the man skilled in the art to make the specific choices necessary to arrive at the combination in expectation of some improvement or advantage.

5.6 The Board has also considered the further documents available to it and found them non-prejudicial to the present Claim 1, either alone or in combination with the documents cited above.

5.7 The particular combination of features set out in Claim 1 thus involves an inventive step within the meaning of Article 56 EPC.

6. The subject-matter of Claim 1 is thus patentable within the meaning of Article 52 EPC. A patent may therefore be granted, based on this allowable independent claim and dependent Claims 2 to 7, which concern preferred embodiments of the ignition system according to Claim 1, and the amended description and drawings.

Order

For these reasons, it is decided that:

1. The impugned decision is set aside.

2. The case is remitted to the first instance with the order to grant a European patent with the documents defined in above point V.

The Registrar: The Chairman:

N. Maslin C. Andries