BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

| A | | B | | C | X |
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File Number: T 0178/91 - 3.5.1

Application No.: 84 304 266.4

Publication No.: 0 130 762

Title of invention: Angular position detector

Classification: F02P 7/06

# D E C I S I O N
of 25 November 1992

Applicant: Lucas Industries Plc

Opponent: Siemens Aktiengesellschaft

Headword:

**EPC** Art. 56

Keyword: "Inventive step (yes)"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

**Case Number : T 0178/91 - 3.5.1**

# D E C I S I O N
## of the Technical Board of Appeal 3.5.1
## of 25 November 1992

**Appellant :** (Opponent)
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**Representative :**

**Respondent :** (Proprietor of the patent)
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**Decision under appeal :**
**Decision of the Opposition Division of the European Patent Office dated 9 January 1991 rejecting the opposition filed against European patent No. 0 130 762 pursuant to Article 102(2) EPC.**

**Composition of the Board :**

**Chairman :** P.K.J. van den Berg
**Members :** C. Biggio
W.M. Schar

**Summary of Facts and Submissions**

I. European patent EP-B1-0 130 762 was granted on 14 December 1988, on the basis of European patent application No. 84 304 266.4, filed on 25 June 1984 and claiming priority from patent application No. 8 318 008, filed on 2 July 1983 in the United Kingdom.

II. Claim 1, as granted, reads (omitting the reference signs):

"An internal combustion engine control system which incorporates an angular position detector comprising a toothed wheel having a missing tooth, a sensor device producing a pulse train as the teeth of the toothed wheel pass it, said sensor device being arranged so that when the missing tooth is passing the sensor device, the crankshaft of the engine is at a position such that one of the cylinders of the engine is substantially in a top dead centre condition, and a discriminating circuit connected to said sensor device and producing a datum signal in response to recognition of the passage past the sensor device of the missing tooth, by measuring the time intervals between the pulses of said pulse train, characterised in that said discriminating circuit recognises said missing tooth by detecting when an interpulse interval is significantly shorter than the preceding interval."

III. An opposition was filed on 11 April 1989, on the ground that the subject-matter of the patent did not involve an inventive step (Article 100(a) EPC).

In the course of the proceedings the Opponent (Appellant) referred in particular to the following prior art documents:

D1 = GB-A-2 065 310,
D2 = DE-A-2 357 061, and
D3 = EP-A-0 058 562.

IV. By its decision of 9 January 1991 the Opposition Division rejected the opposition.

V. On 25 February 1991, the Appellant (Opponent) lodged an appeal against this decision and paid the appeal fee the same day.

A statement of grounds for appeal was also filed the same day. The Appellant requested that the appealed decision be set aside and the patent be revoked in its entirety. Subsidiarily, he requested to be heard at oral proceedings.

In a letter filed 12 September 1991, the Appellant referred to a not previously cited, further document, namely D4 = US-A-4 321 580.

VI. In a communication pursuant to Article 11(2) of the Rules of procedure of the Boards of Appeal, dated 20 July 1992, the Board

- summoned the Parties to Oral Proceedings to be held on 25 November 1992, and
- made some observation as to the technical problem underlying the invention and in how far it could be said to have been solved by the features contained in Claim 1. Document D4 appeared relevant for this issue and, since moreover no objection against the late filing thereof had been raised by the Respondent, said document was admitted into the procedure, pursuant to Article 114(1) EPC.

VII. In reply to the Board's communication the Respondent (Patentee) filed on 23 October 1992 a number of graphs illustrating the working of the invention.

These graphs, which were based on a single set of experimental data, showed computed values of the ratios between adjacent tooth periods for different positions of the missing tooth relative to the location corresponding to the Top Dead Centre (TDC).

A comparison with D1 was also made, and it was concluded that the invention overcame the disadvantages of prior art without adding any structural complications to the device known from said citation.

VIII. Oral proceedings were held on 25 November 1992.

The Appellant filed a diagram showing the measured time variations of the crankshaft speed of a (firing) four-cylinder motor working at 1000 revolutions per minute and compared this diagram with another diagram derived from the information furnished by the Respondent.

The Respondent filed additional graphs showing the measurement data on which the previous curves were based.

IX. The Appellant's submissions can be summarised as follows.

The invention aimed at detecting the position of a missing tooth on a cog wheel fixed on the crankshaft of an internal combustion engine. The detection was based on the comparison of the period of one tooth interval with the preceding interval; the missing tooth was taken to have passed the detector when the following tooth period was found to be substantially shorter than the previous one (corresponding to the missing tooth).

This detecting principle was nothing but an equivalent inversion or "mirror image" of the method known from D1, according to which the missing tooth was detected when a comparatively **long** period followed a shorter one, and could not be inventive.

In fact, since D3 disclosed that a comparatively short period should be detected, albeit for a wheel with an additional tooth instead of a missing one, and since D4 disclosed to place the detector such that the missing tooth corresponded to TDC, a combination of D3 and D4 led the skilled man to the subject-matter of Claim 1.

Finally, the graphs provided by the Respondent made no technical sense since they indicated that in a TDC condition the crankshaft was already accelerating, which was impossible; in fact, acceleration would start shortly **after TDC**, following the explosion, as shown in the Appellant's diagram.

If the Respondent's graphs were corrected they would at most show that the invention worked neither better, nor worse than prior art control systems.

X. The Respondent's submissions can be summarised as follows.

Two features were crucial for the proper functioning of the invention, namely that an indication should be given with the motor in a TDC condition, and that the detection should be for a comparatively short tooth period.

Only the combination of both features ensured that the control system never produced false indications, as shown in the graphs filed on 23 October 1992.

This was especially important far away from the TDC, where a false indication corresponding to a very large spark advance angle might even make the engine try to run backwards, which could cause damage to it.

Prior art did not in any way suggest the claimed combination.

Moreover, the graphs provided were based on experimental data and therefore correct.

It was believed that the fact that acceleration began before TDC could be explained by the torque of the starting motor, taking the geometrical properties of the crankshaft and pistons into consideration.

XI. The Appellant requested that the patent be revoked. He further made the auxiliary request that an expert be appointed to settle the question whether it was conceivable that the acceleration phases of a cold motor begin before the TDC.

The Respondent requested that the appeal be dismissed.

**Reasons for the Decision**

1. Admissibility of the appeal

The appeal complies with Articles 106 to 108 and Rule 64 EPC and is therefore admissible.

2. Novelty

Each one of the prior art documents D1, D2, D3 and D4 taken into consideration in the present proceedings

describes an internal combustion engine control system comprising a toothed wheel on the engine crankshaft with a fixed sensor which provides a pulse train as the wheel rotates. The toothed wheel is provided with a specific datum position which determines the instant of ignition for one of the cylinders of the engine. That position is detected as the result of the comparison between the measured current time interval and a previously measured and stored time interval.

D1 is discussed in the description of the contested patent, as the prior art from which the invention starts, and was apparently intended to serve as ab basis foe the pre-characterising part of Claim 1. According to D1, one of the teeth is missing to provide the specific datum position. The sensor is used to mirror the period of the passing teeth. The current period and a previously measured "standard" period are compared and a detection pulse is output when the current period is longer than the preceding one. The missing tooth is, thus, detected as a longer period, when compared with the preceding one.

2.1. The subject-matter of Claim 1 is distinguished from this prior art in that

- the missing tooth passes the sensor when the crankshaft is at such a position that one of the cylinders of the engine is substantially in a Top Dead Centre (TDC) condition - this feature should really have been mentioned in the characterising portion of Claim 1 (Rule 29(1) EPC) since it is not explicitly known from D1. This document nowhere mentions TDC and, in the Board's view, only discloses the relationship between the specific datum position and the instant of ignition of one of the cylinders, but not between the latter and TDC. Therefore the statement in column 1,

lines 26 to 30, of the contested patent that this feature "is proposed" in D1, is erroneous - and

- a shorter period - when compared with the preceding one - is detected, instead of a longer one.

2.2. The combination of features, mentioned in preceding item 2 as being known from D1, is also known from D4. Apart from this, the first of the above-mentioned distinguishing features is known per se from D4 too, which mentions, as prior art, that a detection signal may be given in a TDC condition (column 1, lines 16 to 22), but proposes not to apply this feature in the invention it describes. The second distinguishing feature, with regard to D1, is not known from D4.

2.3. Said first distinguishing feature is also dealt with in D2, where it is stated that the Top Dead Centre (TDC) condition should advantageously be indicated by a specific signal (page 2, lines 9 to 18).

However, instead of a cog wheel having a missing tooth so arranged as to give said specific signal at the Top Dead Centre (TDC) condition, D2 discloses, for this same purpose, a cog wheel in which the element indicative of said Top Dead Centre (TDC) condition is made up by a "split tooth", i.e. with its middle portion cut away to yeld a pair of narrow teeths. The detecting principle differs from that according to Claim 1 of the contested patent and from that according to D1 and D4 in that intervals corresponding to a cog and to the space between two cogs are distinguished and compared; the said "split tooth" being recognised as a long space interval preceded by a short cog interval.

2.4. D3 discloses the second distinguishing feature (see Claim 1, last paragraph). D3, however, uses a cog wheel having a marker which consists of an additional tooth.

Thus the second distinguishing feature is only known per se from said citation.

2.5. Since the subject-matter of Claim 1, in its entirety, is not known from any single prior art document, said subject-matter shall be considered as novel, pursuant to Article 54 EPC.

3. Inventive step

According to the description of the patent at issue (column 1, lines 31 to 39), the invention should solve the problem of preventing the production of false indications, when the crankshaft would show remarkable decelerations, i.e. especially in very cold starting conditions. In such very cold starting conditions, the load on the starting motor might be such as to drastically extend the duration of the standard inter-pulse interval, thereby rendering said standard inter-pulse interval substantially as long as - and even longer than - that corresponding to the missing tooth. In such very cold starting conditions, the systems according to the prior art would produce a false datum position signal.

3.1. In D4 it is said that in the case of cold-starting, large variations of instantaneous speed, of the order of 1 to 10 over a half turn, throw off "all presently used systems" (column 1, lines 36 to 44). Said citation states, moreover, that strong **deceleration** during the starting phase may give rise to interference pulses,

especially before the Top Dead Center point (column 6, lines 26 to 32).

This problem corresponds to the one addressed in the patent at issue.

It is noted that the problem of speed variations is also briefly referred to in D3 (page 8, lines 14 to 25), where, however, it is said not to cause disturbances.

This statement is not regarded by the Board as susceptible of leading the skilled person to neglect the problem: since D3 describes a cog wheel having only five teeth, the marker being defined by two teeth arranged close together, it is only natural that speed variations would be of little relevance on such arrangement.

Thus no inventive step may be considered as involved in the recognition of the technical problem.

3.2. In an internal combustion engine control system according to Claim 1 of the patent at issue, the production of false indications during deceleration, is prevented by detecting a shorter inter-pulse period after a longer one.

3.3. According to D4, which is the single prior art document relating to a control system employing a missing tooth and addressing the same technical problem as the patent at issue, it is ensured that the datum position is detected with a high degree of probability by providing a marker consisting of a sufficient number of consecutive missing teeth (two in the preferred embodiment), although these missing teeth are detected as a longer period, when compared with the preceding one.

Said citation further proposes to place the marker at a position not corresponding to the TDC (figure 2). Once the missing teeth have been located, spurious detection signals are filtered out by a blocking circuit (column 6, lines 26 to 32).

3.4. Consequently, in the Board's opinion, D4 points away from the invention, because it teaches that the missing teeth should not be placed in a position corresponding to TDC.

In said citation, moreover, the production of false detection pulses is, strictly speaking, not avoided, as in the patent at issue; they may well be generated, but are subsequently eliminated by an ad hoc blocking circuit (column 6, lines 26 to 32).

Thus D4 does not suggest the claimed solution.

3.5. The Appellant has argued that the claimed invention would be obvious in view of D3 combined with D4.

The Board cannot share this view.

It is true that D3 proposes to detect a short pulse following a longer one, as in the contested patent, however, this is done with a cog wheel having an additional tooth. This kind of marker results in a comparatively shorter inter-pulse interval, whereas a missing tooth generates a comparatively longer inter-pulse interval. Thus, both in D3 and the prior art systems employing missing teeth, the marker is immediately recognised by comparison with the preceding, normal period, whereas, according to the invention, it is the normal tooth interval immediately following the marker, which is detected.

The combination of the teachings from D3 and D4 is, therefore, not regarded as nearer to the invention than the teaching from D4 alone.

3.6. The Appellant has further submitted that the invention would be nothing but an equivalent inversion of the system known from D1.

The Board assumes that the implication is that the invention can be seen as an obvious solution to the problem of creating a mere alternative to the system known from D1.

However, the patent specifies a particular problem to be solved and an advantage which can be achieved over prior art systems (the insensitivity to decelerations). Since this problem is indeed solved by the invention, this must be taken into account when judging the inventive step.

3.7. The Appellant's objection would only be relevant if the problem given in the patent would turn out not to be the objective one.

The present invention is said to prevent false indications during deceleration of the crankshaft of an internal combustion engine. The skilled man knows from D4 (and from D3) that not just decelerations might cause disturbances, but any kind of **speed variations** (see point 3.1 above) - consequently also accelerations.

Therefore, supposing that the present invention had no other effect than avoiding the deceleration problem by creating an **equivalent** acceleration problem, it could be argued that the given problem is not a true technical problem in the sense of Rule 27(1c) EPC since the overall

detrimental effect due to speed **variations** remains unchanged.

The objective problem would then indeed be reduced to providing an alternative to the system known from D1, and the assessment of inventive step would have the starting-point indicated by the Appellant.

3.8. However, in the Board's view, it cannot be maintained that the deceleration and acceleration problems are fully equivalent.

As shown in figure 2 of D4, the deceleration part and the acceleration part of the crankshaft speed curve are more or less symmetrically arranged around TDC, so that a false indication, in the deceleration phase, might trigger an **earlier** ignition, whereas a false indication, in the acceleration phase, might trigger a **later** ignition.

This is not quite the same thing.

3.9. The Appellant has contended that the invention does not provide for any advantage over the prior art systems.

However, since the EPC does not require that an invention shall provide for an advantage over the prior art, the Board sees no reason for speculating about the respective positive and negative effects on an engine in the two cases.

It suffices to establish that, between the invention and the prior art systems, there is a difference in technical effect which a skilled man might want to achieve.

As already stated, the way of obtaining this difference in technical effect appears non-obvious.

3.10. The Board notes that the above observations do apply, irrespective of whether the crankshaft acceleration phase begins some 20° to 30° before TDC, as the Respondent holds, or shortly after TDC, as the Appellant contends.

The Appellant's auxiliary request for hearing an expert is consequently not allowed.

3.11. The patent at issue thus claims an invention which involves an inventive step pursuant to Article 56 EPC.

**Order**

**For these reasons, it is decided that:**

The appeal is dismissed.

The Registrar: The Chairman:

M. Kiehl P.K.J. van den Berg