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**D E C I S I O N**  
of 23 April 1997

**Case Number:** T 0914/95 - 3.3.1

**Application Number:** 86906042.6

**Publication Number:** 0235280

**IPC:** C10L 1/18

**Language of the proceedings:** EN

**Title of invention:**  
Nonleaded Fuel Composition

**Patentee:**  
ORR, William C.

**Opponent:**  
Ethyl Corporation

**Headword:**  
Unleaded fuel composition/ORR

**Relevant legal provisions:**  
EPC Art. 54(1) & (2), 56

**Keyword:**  
"Novelty (yes)"  
"Inventive step (yes) - non-obvious solution of the problem  
underlying the patent in suit"

**Decisions cited:**  
T 0039/82

**Catchword:**  
-



Case Number: T 0914/95 - 3.3.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.1  
of 23 April 1997

**Appellant:** ORR, William C.  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 7 September 1995  
European patent No. 0 235 280 pursuant to  
Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** A. J. Nuss  
**Members:** J. M. Jonk  
S. C. Perryman

## Summary of Facts and Submissions

- I. The Appellant (proprietor of the patent) lodged an appeal against the decision of the Opposition Division by which European patent No. 0 235 280 was revoked in response to an opposition, based on Article 100(a) EPC, which had been filed against the patent as a whole. Claim 1 of the patent in suit read as follows:

"A fuel composition for controlling hydrocarbon emissions from a spark ignition internal combustion engine comprising a mixture of:

. a nonleaded gasoline base comprised of hydrocarbons representing from about 70 to 99 volume percent of the fuel composition;

a cyclopentadienyl manganese tricarbonyl antiknock compound having a manganese concentration from about 0.000264 to about 0.264 grams of manganese per liter of the fuel composition; and

at least one solvent selected from the group consisting of C<sub>1</sub> to C<sub>6</sub> aliphatic alcohols in a concentration from about 1.0 to about 30.0 volume percent of the fuel composition."

- II. The opposition was supported by several documents including:

(3) US-A-4 191 536, and

(14) Oil and Gas Journal, 81 (37), 1983, pages 170 to 178.

- III. The decision was based on two sets of amended claims filed during the oral proceedings before the Opposition Division as main and auxiliary requests. The Opposition Division held that the subject-matter of the claims of the main request did not meet the requirements of

Article 84 EPC, and that the subject-matter of Claims 8 and 12 of the auxiliary request was not novel in view of document (3). Moreover, they held that the subject-matter of independent Claims 1 and 5 of the auxiliary request did not involve an inventive step in view of document (14) and of the fact that a reduction of the sulphur content (i.e. to a level not greater than 0.02 wt.%) of the gasoline base in order to reduce undesirable emissions was considered as obvious.

- IV. Oral proceedings were held on 23 April 1997.
- V. During these oral proceedings the Appellant replaced a set of claims as filed together with his Statement of Grounds of Appeal with new Claims 1 to 5 in order to meet objections under Article 123(2) EPC raised by the Respondent and by the Board. The only independent claim, i.e. Claim 1, read as follows:

"A fuel composition for controlling hydrocarbon emissions from a spark ignition internal combustion engine comprising a mixture of:

a nonleaded gasoline base having a sulfur content not greater than 0.02 weight percent comprised of hydrocarbons representing from about 70 to 99 volume percent of the fuel composition;

a cyclopentadienyl manganese tricarbonyl antiknock compound having a manganese concentration from about 0.000264 to about 0.264 grams of manganese per liter of the fuel composition;

at least one solvent selected from the group consisting of C<sub>1</sub> to C<sub>6</sub> aliphatic alcohols in a concentration from about 1.0 to about 30.0 volume percent of the fuel composition;

and, in addition to the aromatic content of the nonleaded gasoline base, aromatic hydrocarbons, including streams, fractions and mixtures thereof, in whole or in part boiling above gasoline range;

and, optionally, at least one co-solvent selected from the group consisting of C<sub>7</sub>-C<sub>12</sub> aliphatic alcohols, C<sub>3</sub>-C<sub>12</sub> ketones and C<sub>2</sub>-C<sub>12</sub> straight chain or branched chain ethers."

The Appellant argued that the subject-matter of the present claims was novel, since none of the cited documents disclosed the selection of the gasoline base having a sulphur content not greater than 0.02 weight percent and the presence of aromatic hydrocarbons in whole or in part boiling above gasoline range in addition to the aromatic content of the nonleaded gasoline

Moreover, he argued that the subject-matter of present Claim 1 involved an inventive step, since the gasoline compositions as claimed showed un improved hydrocarbon emission performance compared to the compositions of the closest state of the art, namely document (3). In this respect, he relied on documents

(15) Affidavit by Mr. Frank W. Cox filed on 11 April 1990, and

(16) Affidavit by Mr. William F. Marshall, subscribed by him on 19 April 1993, filed on 2 June 1993.

Furthermore, he submitted that the achievement of said improvement was surprising, since the use of the additional high boiling aromatic compounds was considered detrimental to exhaust emissions.

Concerning document (14), he argued that this document only disclosed the influence of the addition of antiknock agents, in particular tetraethyllead (TEL) and methylcyclopentadienyl manganese tricarbonyl (MMT),

on the octane number of alcohol-gasoline blends. He concluded, therefore, that this document did not give any pointer to the solution of the hydrocarbon emission problem as claimed in the patent in suit.

VI. The Respondent argued that the claimed subject-matter lacked novelty and inventive step in view of documents (3) and (14), since said documents disclosed gasoline compositions comprising an unleaded gasoline base, aromatics, MMT and lower alcohols, whereby an unleaded gasoline base comprising a low sulphur content and high boiling aromatics as claimed in present Claim 1 of the patent in suit were not excluded. Regarding inventive step, he considered document (14) as the closest state of the art. Moreover, he argued that the combination of high boiling aromatics, MMT and lower alcohols did not involve an inventive step, since it was common general knowledge that by using a gasoline fuel having better octane-blending and antiknock characteristics a better and regular combustion of the fuel and, therefore, less exhaust hydrocarbon emission could be achieved.

VII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the set of claims submitted at the oral proceedings on 23 April 1997.

The Respondent requested that the appeal be dismissed.

VIII. At the conclusion of the oral proceedings the Board's decision was pronounced.

**Reasons for the Decision**

1. The appeal is admissible.
  
2. The amendments to Claim 1 as granted are based on the following passages:
  - (a) concerning the sulphur content: page 15, lines 56 and 57, of the patent in suit, as well as page 43, lines 2 to 5, of the original patent application;
  
  - (b) concerning the additional high-boiling aromatics: Claim 3; page 7, lines 36 to 40 (the temperature corresponding to 450°F is actually 232°C instead of 230°C); page 15, lines 35 to 39 (the temperature corresponding to 440°F is actually 227°C instead of 230°C); page 4, lines 50 to 58; page 9, lines 1 to 5; page 10, lines 16 to 19, lines 34 to 36, and lines 42 and 43, of the patent in suit; as well as Claims 1 and 5; page 17, lines 22 to 29; page 41, line 34 to page 35, line 5; page 10, lines 15 to 32; page 21, lines 15 to 22; page 25, lines 12 to 19; and page 26, lines 14 to 18 and 30 to 32; of the patent application as originally filed; and
  
  - (c) concerning the optional co-solvents: Claim 2; page 5, lines 34 to 43; page 12, lines 29 to 34 and 51 to 55; and page 13, lines 11 to 16, of the patent in suit; as well as Claims 1, 29 and 30; page 12, lines 19 to 36; page 32, lines 7 to 18; page 33, lines 17 to 23; and page 34, lines 15 to 24, of the originally filed application.

The Board observes with respect to the temperature of 230°C mentioned under point (b) above in relation to the basis in the patent in suit for the additional

high-boiling aromatics, that said temperature is actually a rounded value for the originally described temperatures of 450°F and 440°F so that a correction to 232°C and 227°C is in this case acceptable.

Furthermore, present Claim 2 is based on Claim 5 of the patent in suit; as well as Claim 30 of the original application.

The subject-matter of present Claim 3 is based on Claim 15, and the description, page 7, lines 9 and 10, of the patent in suit; as well as Claims 19 and 20, and the description, page 16, lines 11 to 14, of the patent application as originally filed.

Present Claim 4 is based on Claim 17, and the description, page 7, lines 54 to 57 and page 8, lines 17 to 21, of the patent as granted; as well as Claims 1 and 48 of the original patent application.

The subject-matter of present Claim 5 is based on Claim 21 of the patent in suit; as well as page 39, lines 26 to 31, of the originally filed application.

Furthermore, the scope of Claim 1 as granted is restricted by incorporating the required sulphur content and the additional high-boiling aromatics.

Thus, all amendments made to the claims as granted comply with the requirements of Article 123(2) and (3) EPC.

3. After examination of the cited prior art documents, the Board has reached the conclusion that the now claimed subject-matter of present Claim 1 is novel.



In this context, the Respondent submitted that the teaching of document (3) and that of document (14) would not exclude the use of nonleaded gasoline bases according to present Claim 1 of the patent in suit.

However, according to the established jurisprudence of the boards of appeal, in assessing novelty the question is not whether or not the scope of a disclosure includes particular features, but whether a disclosure as a whole directly and unambiguously makes available to a skilled person as a technical teaching the subject-matter for which protection was sought.

According to document (3) a suitable gasoline base comprises a mixture of hydrocarbons having a boiling range of from about 80°F (26.7°C) to about 430°F (221.1°C) (see column 2, lines 33 to 35). Moreover, it discloses that such a mixture of hydrocarbons can contain individual constituents boiling above or below these figures (see column 2, lines 35 to 37). Furthermore, a preferred hydrocarbon mixture contains from 10 to about 60 vol.% aromatic hydrocarbons, from 40 to 80 vol.% saturated hydrocarbons and from 0 to about 30 vol.% olefinic hydrocarbons, as well as sulphur in an amount of no more than about 0.22 wt.% (see column 2, lines 37 to 68; and column 4, lines 5 to 8). Therefore, in the Board's judgment, document (3) does not clearly and unambiguously teach to apply as a gasoline base a composition as now claimed in the patent in suit, i.e. a composition having a sulphur content not greater than 0.02 weight percent and containing, in addition to the aromatic content of the base, aromatic hydrocarbons in whole or in part boiling above gasoline range.

Regarding document (14) the Board comes to the same conclusion, since this document only indicates that a suitable gasoline base contains 23.5 to 25.5 vol.%, or 38 vol.% aromatics (see page 172, the first two paragraphs under "Blending number").

4. This leaves the issue of whether the subject-matter of the present claims involves an inventive step.
- 4.1 Article 56 EPC sets forth that an invention involves an inventive step if, having regard to the state of the art (in the sense of Article 54(2) EPC), it is not obvious to a person skilled in the art.

For deciding whether or not a claimed invention meets this criterion, the Boards of Appeal consistently apply the "problem-solution-approach", which consists essentially in (a) identifying the "closest prior art", (b) assessing the technical results (or effects) achieved by the claimed invention when compared with the "closest state of the art" established, (c) defining the technical problem to be solved as the object of the invention to achieve these results, and (d) examining whether or not a skilled person, having regard to the state of the art in the sense of Article 54(2) EPC, would have suggested the claimed technical features for obtaining the results achieved by the claimed invention.

- 4.2 According to the established jurisprudence of the Boards of appeal the "**closest prior art**" for assessing inventive step is normally a prior art document disclosing subject-matter conceived **for the same purpose** as the claimed invention and having the most relevant technical features in common.

This disqualifies document (14) as the "closest state of the art", since - as submitted by the Appellant and indicated in the patent in suit (cf. page 5, lines 11 to 39) - the claimed invention relates to gasoline compositions showing improved hydrocarbon emissions, whereas document (14) concerns a totally unrelated issue, namely, that of the octane-blending characteristics of eight alcohols, namely methanol, ethanol, isopropanol, n-propanol, tert-butanol, n-butanol, n-hexanol and n-octanol, and the effectiveness of commercial anti-knocks, in particular tetraethyllead (TEL) and methylcyclopentadienyl manganese tricarbonyl (MMT), in gasoline compositions containing each of said alcohols other than n-hexanol and n-octanol (see page 170 to page 172, left column, first whole paragraph; and page 172, under "Experimental design").

- 4.3 In these circumstances, the Board considers that the compositions described in document (3) represent the closest state of the art.

This document relates - like the claimed subject-matter of the patent in suit - to unleaded gasoline compositions for spark ignited internal combustion engines comprising a mixture of hydrocarbons boiling within the gasoline range and a cyclopentadienyl manganese tricarbonyl antiknock compound (see Claim 1). Moreover, it discloses that undesirable increase in exhaust emissions and engine deposits caused by the cyclopentadienyl manganese tricarbonyl antiknock compound can be reduced by adding an amount of a saturated cyclic ether, in particular tetrahydrofuran (see Claim 1; column 1, lines 45 to 50; column 4, lines 9 and 10; and column 7, lines 30 to 46). According to the examples a **reduction** of the **increase** due to MMT of the exhaust hydrocarbon emission up to 32% was obtained (see Table II).

4.4 Regarding this closest prior art the Appellant argued essentially that the modestly reduced **increase** due to MMT of hydrocarbon emissions was still not adequate for truly controlling hazardous hydrocarbon emissions, and that by using the compositions according to the claimed invention surprisingly the hydrocarbon emissions associated with cyclomatic manganese carbonyl antiknock compounds are reduced so that satisfying exhaust hydrocarbon emission characteristics are achieved. In this respect, he relied on documents (15) and (16).

4.5 Therefore, in the light of this closest state of the art, the underlying problem can be seen in the provision of nonleaded fuel compositions containing a cyclopentadienyl manganese tricarbonyl antiknock compound and yet having satisfying hydrocarbon emission characteristics (see also page 5, lines 11 to 39; page 11, lines 6, 7 and 13 to 18; and page 12, lines 13 to 15, of the patent in suit).

According to present Claim 1 this technical problem is essentially solved by fuel compositions containing at least one solvent selected from the group consisting of C<sub>1</sub> to C<sub>6</sub> aliphatic alcohols in a concentration from about 1.0 to about 30.0 volume percent of the fuel composition and, in addition to the aromatic content of the nonleaded gasoline base, aromatic hydrocarbons in whole or in part boiling above gasoline range.

4.6 Having regard to the description of the patent in suit, as well as the test-results provided in documents (15) and (16), the Board considers it plausible that the technical problem as defined above has been solved. In this context the Board observes that according to the description of the patent in suit the combined inclusion of the additional high-boiling aromatics, the manganese antiknock compound and the lower alcohols as

now claimed provides an unexpected synergism concerning the control of the exhaust emissions (see in particular page 5, lines 30 to 39; page 10, lines 34 to 36; page 10, lines 49 to 54; and page 12, lines 9 to 16). Actually, the Respondent did not contest that the compositions according to the claimed invention show satisfying exhaust hydrocarbon emission characteristics, but rather argued that the improvements in this respect would have been expected by a skilled person.

- 4.7 The question now is whether the cited prior art would have suggested to a person skilled in the art solving the above-indicated technical problem in the proposed way.
- 4.8 Document (3) - as indicated above under point 4.3 - relates to gasoline compositions for spark ignited internal combustion engines comprising a mixture of hydrocarbons boiling within the gasoline range and a cyclopentadienyl manganese tricarbonyl antiknock compound, which compositions are characterised in that they contain an amount of a saturated cyclic ether, in particular tetrahydrofuran, in order to reduce exhaust emission and engine deposits. Moreover, it discloses that the gasoline compositions may contain numerous additional components such as methanol, ethanol, isopropanol and tert-butanol (see column 4, lines 9 to 31). However, document (3) does not suggest any relationship between the optional addition of said lower alcohols and the reduction of the exhaust hydrocarbon emissions. Moreover, as set out above under point 3, fourth paragraph, document (3) does not suggest the application of a gasoline base containing, in addition to the aromatic content of the base, aromatic hydrocarbons in whole or in part boiling above gasoline range. Nor is the skilled person given any reason for leaving out the saturated cyclic ether

suggested by document (3) as an essential feature. Therefore, in the Board's judgment, document (3) does not give any pointer to the skilled person that the technical problem underlying the patent in suit could be solved by providing a fuel composition as now claimed.

4.9 Document (14) concerns - as indicate above under point 4.2, second paragraph - a study investigating the octane-blending characteristics of eight specified alcohols, namely methanol, ethanol, isopropanol, n-propanol, tert-butanol, n-butanol, n-hexanol and n-octanol, and the effectiveness of commercial antiknock compounds in gasoline compositions containing said alcohols except n-hexanol and n-octanol. It discloses, in particular, experiments for determining the antiknock response using nonleaded gasoline compositions comprising a commercial gasoline base containing 23.5 to 25.5 vol.%, or 38 vol.% aromatics, one of said alcohols other than n-hexyl and n-octyl alcohol which are excluded because of their low octane-blending values in a concentration of 0.0, 5.0 or 10.0 vol.%, and TEL in an amount of 0.0, 0.5 or 1.0 g Pb/gal or MMT in an amount of 1/32 (0.0313) g and 1/16 (0.0625) g Mn/gal (see page 172, middle column, second paragraph, to right column, first paragraph); page 172, under "Experimental design"; and page 172, right column, first paragraph under "Antiknocks and alcohol blends"). Said experiments show:

(a) that the octane effectiveness of the antiknock agents TEL and MMT in alcohol-gasoline blends is essentially independent of alcohol concentration in the range studied (0.0 to 10.0 vol.%) (see page 178, the paragraph bridging the middle and the right column), and

(b) that the test results are also essentially independent of aromatics concentrations (24 and 38 vol.%) in the gasoline base (see page 178, middle column, last but one line, to right column, line 8).

Therefore, the disclosure of document (14) does not have any relationship with the problem underlying the patent in suit as defined above, so that the Board cannot see any reason why the skilled person should ever consider this document as a possible source of useful hints in solving said technical problem (cf. T 39/82, OJ EPO 1982, 419, point 7.3 of the Reasons). Moreover, it is clear that the teaching of document (14) does not give any pointer to the solution of the above defined technical problem, since it is silent about the nature of the aromatics in the gasoline base used and, therefore, does not provide any incentive to use a gasoline base containing additional high-boiling aromatics as now claimed.

4.10 In this context, the Board observes that Respondent's contention that a skilled person would have expected on the bases of his common general knowledge that by combining MMT with lower alcohols and additional aromatics boiling above the gasoline range a better and regular combustion of the fuel and, therefore, a reduction of exhaust hydrocarbon emissions could be achieved fails, since the Respondent did not provide any evidence in support of this point of view, and because - as submitted by the Appellant and not disputed by the Respondent - it was commonly known that aromatic hydrocarbons having boiling points above the gasoline boiling range tend to increase exhaust emissions (see the patent in suit, page 4, lines 50 to 52; page 9, lines 45 to 52; and page 12, lines 7 to 13; Appellant's submissions filed on 9 January 1996; and Respondent's letter filed on 7 May 1996, page 4, third

paragraph). Thus, if the question had been considered by the skilled person then the common general knowledge rather would lead to the expectation that the claimed mixture would make emissions worse and not better.

4.11 In conclusion, the Board finds that the fuel compositions according to Claim 1 involve an inventive step in the sense of Article 56 EPC.


Since Claims 2 to 5 relate to particular embodiments of the compositions claimed in Claim 1 they are also allowable.

## Order


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

1. The decision under appeal is set aside.
2. The matter is referred to the first instance with the order to maintain the patent on the basis of the set of claims submitted at the oral proceedings on 23 April 1997, and a description to be adapted.

The Registrar:

  
E. Gorgmaier

The Chairman:

  
A. Nuss

