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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* SHANE ELWART,  
SURNILLA GOPICHANDRA, and  
JOSEPH R. THEIS

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Appeal 2010-006081  
Application 10/767,339  
Technology Center 1700

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Before ADRIENE LEPIANE HANLON, PETER F. KRATZ, and  
LINDA M. GAUDETTE, *Administrative Patent Judges*.

GAUDETTE, *Administrative Patent Judge*.

DECISION ON APPEAL<sup>1</sup>

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<sup>1</sup> An oral hearing was conducted on April 13, 2011, before the above-identified panel of judges.

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision<sup>2</sup> finally rejecting claims 1-40, the only claims pending in the Application.<sup>3</sup> We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

At the time of the invention, it was known in the art that “[l]ean-burning engines, or engines that run on an air/fuel mixture with a stoichiometrically greater amount of air than fuel can offer improved fuel economy relative to engines configured to run on stoichiometric air/fuel mixtures.” (Spec.<sup>4</sup> 1:5-7.) It was also known that lean-burning engines can be disadvantageous in that burning a lean air/fuel mixture may decrease the reduction of nitrogen oxides (collectively referred to as “NO<sub>x</sub>”). To reduce NO<sub>x</sub> emissions in lean-burning engines, it was known in the art to use a NO<sub>x</sub> trap, which typically includes an alkali or alkaline metal, such as barium or calcium to adsorb the NO<sub>x</sub> when the engine is running. (Spec. 1:16-17.) A known drawback of NO<sub>x</sub> traps is that they are susceptible to poisoning from sulfur in fuels, i.e., “[s]ulfur, typically in the form of sulfate (SO<sub>4</sub><sup>2-</sup>) may adsorb to the trap in the form of a material such as barium or calcium sulfate. The sulfur compounds may block NO<sub>x</sub> from adsorbing to the trap surfaces, and thus may increase NO<sub>x</sub> emissions.” (Spec. 1:22-2:2.) Methods used to desulfate NO<sub>x</sub> traps “typically involve heating a NO<sub>x</sub> trap in the presence of a reductant, such as hydrogen gas[, which] . . . may be produced by temporarily providing a rich air/fuel mixture to [the] engine.” (Spec.

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<sup>2</sup> Final Office Action mailed Dec. 15, 2005 (“Final”).

<sup>3</sup> Appeal Brief filed Oct. 22, 2008 (“App. Br.”).

<sup>4</sup> Specification filed Jan. 28, 2004.

6:23-7:2.) However, such methods can cause the production of hydrogen sulfide. (Spec. 2:3-5.)

The present invention is directed to a method which utilizes a hydrogen sulfide converter downstream of a catalytic converter “to catalyze the transformation of hydrogen sulfide to a less-noxious and less-toxic gas-phase sulfur compound (or compounds), thus lowering hydrogen sulfide in the emissions stream.” (Spec. 7:5-8.) The method is based on the inventors’ “recogni[tion] that variations in air-fuel ratio that may occur at certain stages of reactions can cause the production of hydrogen sulfide in different ways depending on exhaust temperature.” (Spec. 2:5-7; *see also*, Spec. 2:18-20.) Claim 1 is representative of the invention and is reproduced below from the Claims Appendix to the Appeal Brief:

1. A method of removing hydrogen sulfide from an emissions stream, comprising:

directing the emissions stream into a hydrogen sulfide converter having a metal oxide catalyst;

adsorbing the hydrogen sulfide in the emissions stream to the metal oxide catalyst in the hydrogen sulfide converter;

reacting the hydrogen sulfide with at least one of an oxidant and a reductant in the hydrogen sulfide converter to chemically transform the hydrogen sulfide; and

adjusting an air-fuel ratio of the emissions stream based on exhaust temperature of an emission control device, where said adjustment varies a duration of at least one of lean and rich operation to perform said adsorbing and reacting even as exhaust temperature varies.

Appellants request review of the following grounds of rejection (App. Br. 11):

1. claims 1-3, 5-7, 10, 12, 16-18, 21, 24-27, 29, 31-33, and 36-40 under 35 U.S.C. 103(a) as unpatentable over Bartley (US 6,482,377 B2, issued Nov. 19, 2002) (Ans.<sup>5</sup> 4-5); and

2. claims 4, 8, 9, 11, 13-15, 19, 20, 22, 23, 28, 30, 34, and 35 under 35 U.S.C. 103(a) as unpatentable over Bartley as applied to claims 1, 16, 21, and 31, above, and further in view of Li (US 6,419,890 B1, issued Jul. 16, 2002) (Ans. 5-6).

The Examiner found that Bartley discloses the method claimed in independent claims 1, 16, 21, and 31, with the exception of a step of adjusting an air-fuel ratio based on exhaust temperature. (Final 2; *see also*, Ans. 4.) The Examiner determined

[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the air-fuel ratio to either rich or lean in the method of Bartley because Bartley discloses operation of the method for both lean and rich stoichiometries (see column 5, lines 44-46 and 56-58), which would obviously, to one of ordinary skill, suggest adjustment of the ratio to perform the method at the disclosed rich and lean stages.

(Final 2-3; *see also*, Ans. 4.)

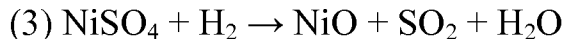
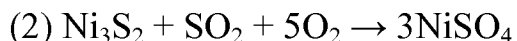
The issue we consider is whether the Examiner failed to establish a *prima facie* case of obviousness because the Examiner did not identify a teaching or suggestion of making adjustments to air-fuel ratio based on temperature. (App. Br. 18; *see generally, id.* 15-18.)

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<sup>5</sup> Examiner's Answer mailed Sept. 25, 2009.

The Examiner does not dispute that Bartley fails to expressly teach adjusting A/F ratio based on exhaust temperature. (*See generally*, Ans. 6-10.) However, the Examiner contends “[i]t would have been within the knowledge of an ordinary artisan that temperature involving exhaust emissions would vary to some extent.” (Ans. 10.) The Examiner further maintains the claims do not require a “particular amount or direction of change based on temperature” (Ans. 10) and that any adjustment of A/F ratio in Bartley’s method would necessarily vary the duration of a lean or rich operation (*see* Ans. 6-9 (“[S]o long as the ratio of the lean or rich operation is changed, the duration thereof is also changed.”)).

The Specification identifies the following exemplary three-step reaction scheme for transforming hydrogen sulfide (H<sub>2</sub>S) to a less-noxious and less-toxic gas-phase sulfur compound, such as sulfur dioxide (SO<sub>2</sub>) using a metal oxide catalyst such as nickel oxide:



(Spec. 7:14-19). The Specification also identifies an exemplary two-step reaction scheme in which the nickel sulfide produced in reaction (1) can be converted directly to sulfur dioxide and nickel oxide via the following equation:  $2\text{Ni}_3\text{S}_2 + 7\text{O}_2 \rightarrow 6\text{NiO} + 4\text{SO}_2$  (Spec. 15:18-21).

According to the Specification, reaction temperature may be set and controlled by varying the A/F ratio of the engine lean and rich in order to reduce or increase the heat generated by the reactions. (Spec. 9:9-12; 10:9-10.) The Specification describes the following “example routine . . . for

controlling engine air-fuel ratio to remove sulfur while reducing generation of hydrogen sulfide” (Spec. 16:15-16):

If the system requests sulfur removal, exhaust gas temperature is raised, “such as by retarding ignition timing, operating some cylinders lean and others rich, alternating the A/F ratio of the engine lean and rich to generate an exotherm on the catalysts, or via electrically heating the catalyst.” (Spec. 16:17-23.) Once temperature of the NO<sub>x</sub> trap ( $T_{\text{trap}}$ ) is greater than a desulphation temperature ( $T_{\text{desulphate}}$ ), an air-fuel ratio modulation scheme is selected based on exhaust temperature, for example, temperature  $T_{\text{trap}}$ . (Spec. 17:1-4.) “[T]he exhaust air-fuel ratio is [then] adjusted to regenerate[] stored sulfur and reduce H<sub>2</sub>S emissions based on the determined temperature (e.g.,  $T_{\text{trap}}$ ) and the selected modulation scheme.” (Spec. 17:7-9.)

Where the Examiner establishes a reasonable assertion of inherency and thereby evinces that a claimed process appears to be identical to a process disclosed by the prior art and/or that the products claimed by the applicant and disclosed in the prior art appear to be the same, the burden is properly shifted to the applicant to show that they are not. *See In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990); *In re Best*, 562 F.2d 1252, 1254-56 (CCPA 1977).

Appellants have persuasively argued the Examiner’s findings are insufficient to establish that Bartley inherently discloses or suggests a step of adjusting A/F ratio based on temperature in the manner required by the appealed claims. (See App. Br. 12-19.) From a review of the Specification, it is apparent the methods recited in the independent claims require a step of measuring temperature, since the step of adjusting lean and rich operations is

based on such measurement. The mere fact that exhaust temperature might vary in Bartley's method does not establish Bartley inherently performs a temperature-based adjustment of lean and rich operations. (*See* App. Br. 16.)<sup>6</sup>

In sum, Appellants have persuaded us that the Examiner failed to establish a *prima facie* case of obviousness as to appealed claims 1-40. Therefore, we do not sustain the rejections under 35 U.S.C. § 103(a).

REVERSED

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<sup>6</sup> We add that Appellants have also persuasively argued the Examiner's findings are insufficient to support a determination that adjustment of A/F ratio in Bartley's method would necessarily result in a variation of the duration of a lean or rich operation. (Rep. Br.<sup>6</sup> 6 (explaining, for example, that a lean operation may be adjusted such that it is more or less lean without varying the duration of the lean operation itself).)