UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte THORSTEN MAYER, CHRISTIAN WALZ, and JOHANNES SCHALLER

Appeal 2008-3469
Application 10/534,125
Technology Center 3700

Decided: December 29, 2008

Before: JENNIFER D. BAHR, LINDA E. HORNER, and MICHAEL W. O'NEILL, *Administrative Patent Judges*.

BAHR, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Thorsten Mayer et al. (Appellants) appeal under 35 U.S.C. § 134 from the Examiner's decision rejecting claims 11-28 and 30. The Examiner has indicated that claim 29, the only other pending claim, is allowable. We have

jurisdiction over this appeal under 35 U.S.C. § 6 (2002). Appellants' representative presented oral argument in this appeal on December 11, 2008.

The Invention

Appellants' claimed invention is directed to a method and apparatus for posttreatment of exhaust gas of an internal combustion engine to reduce nitric oxide emissions. Claim 11, reproduced below, is illustrative of the claimed invention.

> 11. A method for posttreatment of the exhaust gas of an internal combustion engine, in which nitric oxides contained in the exhaust gas are selectively catalytically reduced, the method comprising,
>
> delivering a first auxiliary agent from a supply thereof to the exhaust gas,
>
> subjecting a portion of the first auxiliary agent at least intermittently to a chemical conversion into a second auxiliary agent,
>
> storing the second auxiliary agent in an intermediate reservoir (4), and
>
> at least intermittently, delivering the second auxiliary agent to the exhaust gas parallel to or in alternation with the first auxiliary agent.

The Rejections

The Examiner relies upon the following as evidence of unpatentability:

Krutzsch	US 5,921,076	Jul. 13, 1999
Kinugasa	US 6,109,024	Aug. 29, 2000
Akama	US 2002/0038542 A1	Apr. 4, 2002

Appellants seek review of the Examiner's rejections under 35 U.S.C. § 103(a) of claims 11-20 and 30 as being unpatentable over Krutzsch and Akama; claims 21-26 as being unpatentable over Krutzsch, Akama, and design choice; and claims 27 and 28 as being unpatentable over Krutzsch, Akama, design choice, and Kinugasa.

SUMMARY OF DECISION

We AFFIRM-IN-PART.

ISSUES

Appellants argue that Akama is designed especially for low temperature engine exhaust which never reaches the normal operating temperatures addressed by Krutzsch and thus is not combinable with Krutzsch. Appeal Br. 12-13.

Appellants also argue that Krutzsch teaches generating or storing hydrogen (H_2), not generating and storing hydrogen, as called for in claim 11. Appeal Br. 10. Thus, according to Appellants, Krutzsch does not teach the step of subjecting a portion of a first auxiliary agent at least intermittently to a chemical conversion into a second auxiliary agent, as called for in claim 11, or a means for doing so, as called for in claim 30, and the step of storing the second auxiliary agent in an intermediate reservoir, as called for in claim 11, or an intermediate reservoir for doing so, as called for in claim 30. Appeal Br. 10-11.

Appellants additionally point out that Krutzsch teaches generating hydrogen using water, the cracking of gas, or the reforming of methanol. Thus, according to Appellants, Krutzsch actually teaches away from using a

first auxiliary agent to generate a second auxiliary agent, as called for in claims 11 and 30. Appeal Br. 11-12.

Additionally, Appellants argue that Krutzsch does not teach producing hydrogen only during a normal operating mode of the engine, as called for in claim 13. Appeal Br. 14.

Appellants also argue that there is no evidence of record that substituting urea and ammonia for the hydrocarbons and hydrogen in the process of Krutzsch would result in at least the reduction of nitrogen oxide (NOx) content on a catalyst as a function of operating temperatures obtained by the use of hydrocarbons and hydrogen taught by Krutzsch. Appeal Br. 16.

Appellants also argue that Kinugasa could not possibly suggest use of a zeolite body or salt that forms an ammonia complex as the intermediate reservoir in Krutzsch, because Krutzsch does not teach an intermediate reservoir. Appeal Br. 17.

In light of Appellants' arguments, the issues presented in this appeal are:

(1) Have Appellants demonstrated the Examiner erred in determining that the combined teachings of Krutzsch and Akama would have prompted a person of ordinary skill in the art to use diesel fuel to generate hydrogen in Krutzsch's process and apparatus?

(2) Have Appellants demonstrated the Examiner erred in determining that the combined teachings of Krutzsch and Akama would have prompted a person of ordinary skill in the art to provide an intermediate reservoir to store the generated hydrogen for delivery to the exhaust

gas as needed, such as during cold starts, and to generate hydrogen during the normal operating mode of the engine?

(3) Have Appellants demonstrated the Examiner erred in determining it would have been obvious to a person of ordinary skill in the art to replace the hydrocarbon and hydrogen reducing agents in the modified process of Krutzsch with urea and ammonia?

FACTS PERTINENT TO THE ISSUES

FF1 Krutzsch teaches a process and apparatus for reducing NOx in exhaust from diesel engines and directly injecting Otto engines for motor vehicles on a catalyst by supplying two reducing agents, namely, hydrocarbons (HC) from an HC-generator 5 and hydrogen from an H_2 generator 6, into the exhaust gas pipe 2. Krutzsch, col. 1, ll. 7-11, col. 2, ll. 44-53.

FF2 Krutzsch teaches that "[a]ny arrangement for generating or storing hydrogen can be used as the H_2 generator **6**." Krutzsch, col. 2, ll. 56-57.

a. Krutzsch teaches electrolysis of water, the generating of cracked gas, or the reforming of methanol as examples of possible techniques for generating hydrogen. Krutzsch, col. 2, ll. 57-60.

b. Krutzsch does not exclude other possibilities for generating hydrogen.

FF3 Krutzsch teaches that fuel can be entered into the exhaust gas pipe 2 in a metered manner, in which case the HC-generator 5 is a simple metering valve. Krutzsch, col. 2, ll. 61-63.

FF4 Krutzsch discusses adjusting "the generating and/or metering of the reducing agents" depending on catalyst temperature and/or engine load and other operating parameters. Krutzsch, col. 4, ll. 58-67.

FF5 Krutzsch teaches that the suitable combination of both the hydrocarbon reducing agent and the hydrogen reducing agent achieves "a synergistic effect," in which "the hydrogen has an activating effect on the course of the NOx-reduction." Krutzsch, col. 1, ll. 53-56. The "hydrogen increases the selectivity of the HC-NOx reaction and simultaneously reduces the selectivity for the production of nitrous oxide (N_2O)." Krutzsch, col. 1., ll. 56-59.

FF6 Krutzsch teaches adding hydrogen only to the exhaust gas in a first, low temperature operating range, adding hydrogen as well as hydrocarbons in a second operating range, between 50° C and 150° C, and adding only hydrocarbons in a third, higher temperature range. Krutzsch, col. 4, ll. 12-30.

FF7 Krutzsch does not explicitly teach generating hydrogen and storing the generated hydrogen in an intermediate reservoir prior to introducing the hydrogen into the exhaust gas line, but Krutzsch does not exclude the possibility of generating hydrogen and storing the generated hydrogen in an intermediate reservoir.

FF8 Krutzsch does not teach subjecting one of the two reducing agents to a chemical conversion to the other reducing agent. Krutzsch, however, does not exclude or discourage such a possibility.

FF9 Akama teaches an on-board hydrogen-containing gas producing system for supplying hydrogen-containing gas to the exhaust gas

upstream of a NOx absorbing and reducing catalyst to reduce NOx in exhaust from an internal combustion engine. Akama, ¶¶ 19 and 39.

FF10 Akama uses diesel fuel to produce the hydrogen-containing gas. Akama, ¶ 35.

FF11 Akama emphasizes that the hydrogen-containing gas produced contains "much hydrogen" (H_2), which is useful as the NOx reducing agent. Akama, ¶ 36.

FF12 The hydrogen-containing gas produced by Akama's system is efficient in reducing or removing NOx in exhaust gas "**even** in a low exhaust gas temperature condition" in which the exhaust gas temperature immediately upstream of the catalyst is not higher than 250° C. Akama, ¶¶ 26 and 41 (emphasis ours). Akama does not specifically teach or suggest that the hydrogen-containing gas produced by Akama's system will not reduce or remove NOx in higher temperature exhaust gases.

FF13 Akama teaches providing a hydrogen-containing gas storing means for storing the hydrogen-containing gas produced by the hydrogen-containing gas producing system for supply to the exhaust gas purifying catalyst at a suitable timing. Akama, ¶¶ 34 and 45.

FF14 Akama teaches using heat of exhaust gas discharged from the internal combustion engine to control the reaction for generating the hydrogen-containing gas. Akama, ¶ 33. This suggests that hydrogen is generated during a normal operating mode of the engine, rather than in a cold-starting mode.

FF15 Appellants explicitly recognize the Examiner's finding that "urea is a known reducing agent for removing NOx from a gasoline engine

exhaust gas." Appeal Br. 15. Appellants do not dispute this finding in either their Appeal Brief or their Reply Brief.

FF16 Ammonia (NH_3) was a well known reducing agent for reducing NOx in engine exhaust at the time of Appellants' invention. Kinugasa, col. 2, ll. 53-57, col. 10, ll. 48-52.

FF17 As hinted at by Appellants on page 16 of their Appeal Brief, the Examiner has pointed to no evidence in this record that the use of urea and ammonia as replacements for the hydrocarbon and hydrogen reducing agents in the process and apparatus of Krutzsch would achieve the same type of synergistic result in NOx-reduction alluded to by Krutzsch (FF5).

FF18 Kinugasa teaches a zeolite substrate for use in adsorbing and storing ammonia (NH_3) for release into exhaust gas for reducing NOx in the exhaust gas. Kinugasa, col. 10, ll. 53-64.

FF19 Kinugasa gives no indication that such a zeolite body would be suitable as a reservoir for hydrogen.

PRINCIPLES OF LAW

> Section 103 forbids issuance of a patent when "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."

KSR Int'l Co. v. Teleflex Inc., 127 S. Ct. 1727, 1734 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art, (2) any differences

between the claimed subject matter and the prior art, (3) the level of ordinary skill in the art, and (4) where in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). *See also KSR*, 127 S. Ct. at 1734 ("While the sequence of these questions might be reordered in any particular case, the [*Graham*] factors continue to define the inquiry that controls.")

While there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness, "the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 127 S. Ct. at 1741.

"[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result." *Id*. at 1740.

"A person of ordinary skill is also a person of ordinary creativity, not an automaton." *Id*. at 1742.

"A reference may be said to teach away when a person of ordinary skill, upon reading the reference, . . . would be led in a direction divergent from the path that was taken by the applicant." *In re Haruna*, 249 F.3d 1327, 1335 (Fed. Cir. 2001) (quoting *Tec Air, Inc. v. Denso Mfg. Mich. Inc.*, 192 F.3d 1353, 1360 (Fed.Cir.1999)). Simply that there are differences between two references is insufficient to establish that such references "teach away" from any combination thereof. *See In re Beattie*, 974 F.2d 1309, 1312-13 (Fed. Cir. 1992).

ANALYSIS

Claims 11, 12, 18, and 30

Appellants present no arguments for the patentability of dependent claims 12 and 18 apart from independent claim 11, from which these claims depend. Therefore, in accordance with 37 C.F.R. § 41.37(c)(1)(vii), claims 12 and 18 stand or fall with representative claim 11. Our disposition of the rejection of both claim 11 and claim 30 turns on our resolution of issues (1) and (2). Accordingly, we address these claims together.

We are not persuaded by Appellants' argument that the teachings of Akama are not combinable with Krutzsch because Akama is designed especially for low temperature engine exhaust which never reaches the normal operating temperatures addressed by Krutzsch. First, Krutzsch teaches adding hydrogen as a reducing agent at temperatures lower than 150° C (FF6), which falls within the low temperature range, below 250° C, addressed by Akama (FF12). Moreover, Akama does not specifically teach or suggest that the hydrogen-containing gas produced by Akama's system will not reduce or remove NOx in higher temperature exhaust gases. (FF12.)

Krutzsch does not teach subjecting one of the two reducing agents to a chemical conversion to the other reducing agent, as called for in claims 11 and 30. Krutzsch, however, does not exclude or discourage such a possibility. (FF8.) Krutzsch teaches that "[a]ny arrangement for generating or storing hydrogen can be used as the H_2 generator **6**." (FF2.) While Krutzsch teaches electrolysis of water, the generating of cracked gas, or the reforming of methanol as examples of possible techniques for generating hydrogen (FF2a), Krutzsch does not exclude other possibilities for

generating hydrogen (FF2b). Consequently, Krutzsch does not teach away from using a first reducing agent to generate a second reducing agent.

Akama discloses an on-board system for generating a gas containing "much hydrogen" (H_2) from diesel fuel for use as a reducing agent in reducing NOx in exhaust from internal combustion engines. (FF9-FF11.) Additionally, as mentioned above, Akama teaches that the hydrogen produced is efficient in reducing NOx in the temperature range in which Krutzsch adds hydrogen to the exhaust gas. Moreover, Krutzsch already teaches using diesel fuel as a first reducing agent. (FF1 and FF3.) Accordingly, a person of ordinary skill in the art would have immediately appreciated the suitability of Akama's hydrogen producing system for use in Krutzsch's system and apparatus as the H_2 generator 6. Such a modification involves nothing more than the predictable use of prior art elements according to their established functions. Therefore, Appellants fail to convince us that the Examiner erred in determining that it would have been obvious to use diesel fuel not only as the hydrocarbon, the first reducing agent, but also as a starting material for conversion into a second reducing agent, namely, hydrogen, as called for in claims 11 and 30.

Krutzsch does not explicitly teach generating hydrogen and storing the generated hydrogen in an intermediate reservoir prior to introducing the hydrogen into the exhaust gas line, but Krutzsch does not exclude the possibility of generating hydrogen and storing the generated hydrogen in an intermediate reservoir. (FF7.) Krutzsch also discusses adjusting "the generating and/or metering of the reducing agents" depending on catalyst temperature and/or engine load and other operating parameters. (FF4.) Akama teaches providing an intermediate reservoir for storing the hydrogen-

containing gas produced by the hydrogen-containing gas producing system for supply to the exhaust gas purifying catalyst at a suitable timing. (FF13.) Krutzsch's teaching to adjust the generating and/or metering of reducing agents depending on catalyst temperature, engine load, and other parameters combined with Akama's teaching to provide a hydrogen-containing gas storing means for storing the produced hydrogen-containing gas for supply to the catalyst as needed would have prompted a person of ordinary skill in the art to include an intermediate reservoir in Krutzsch's modified apparatus and process to store generated hydrogen for supply to the exhaust gas pipe when needed.

For the above reasons, Appellants' arguments fail to convince us the Examiner erred in rejecting claims 11 and 30 as being unpatentable over Krutzsch and Akama. We sustain the rejection as to claims 11 and 30 and claims 12 and 18, which stand or fall with claim 11.

Claims 13-17, 19, and 20

Appellants argue in favor of claims 13-17, 19, and 20[1] together as a group. Appeal Br. 14-15. Thus, in accordance with 37 C.F.R. § 41.37(c)(1)(vii), we select claim 13 as the representative claim to decide the appeal of the rejection of the claims in this group, with claims 14-17, 19, and 20 standing or falling with claim 13.

Appellants' arguments fail to convince us the Examiner erred in the rejection of claim 13. Akama's teaching to use heat from exhaust gas from the internal combustion engine for controlling the reaction for generating the

[1] We treat Appellants' arguments for the patentability of claims 13-17 on pages 14 and 15 of the Appeal Brief as also being directed to claims 19 and 20, which depend from claims 13 and 14, respectively.

hydrogen-containing gas suggests that the chemical conversion is effected during the normal operating mode of the internal combustion engine, rather than in a cold-starting mode of the engine. (FF14.) Accordingly, we sustain the rejection of claim 13 and claims 14-17, 19, and 20 that stand or fall with claim 13 as being unpatentable over Krutzsch and Akama.

Claims 21-28

We do not sustain the rejections of claims 21-28, which are grounded in part on the Examiner's determination that it would have been obvious to substitute urea and ammonia for the diesel fuel (HC) and hydrogen-containing gas (H_2), respectively, in the modified apparatus and process of Krutzsch.[2] There does not appear to be any dispute that urea and ammonia are well known reducing agents for reducing NOx in engine exhaust gas. (FF15 and FF16). Krutzsch, however, teaches a synergistic effect from using a hydrocarbon reducing agent in combination with a hydrogen reducing agent for reducing NOx in exhaust gas. (FF5.) As hinted at by Appellants on page 16 of their Appeal Brief, the Examiner has pointed to no evidence in this record that the use of urea and ammonia as replacements for the hydrocarbon and hydrogen reducing agents in the process and apparatus of Krutzsch would achieve this same type of synergistic result in NOx-reduction. (FF17.) In the absence of such evidence, the Examiner fails to establish a rational underpinning for the reasoning for substituting urea and ammonia for the synergistic combination of hydrocarbon and hydrogen so as to arrive at the subject matter of claims 21-26. This deficiency carries over

[2] Although claims 27 and 28 do not expressly require urea and ammonia as the first and second agents, they do require use of a zeolite body or a salt that forms an ammonia complex as the intermediate reservoir.

to the rejection of claims 27 and 28, which require a zeolite body or a salt that forms an ammonia complex as the intermediate reservoir. While Kinugasa teaches a zeolite substrate for use in adsorbing and storing ammonia (NH_3) for release into exhaust gas for reducing NOx in the exhaust gas (FF18), Kinugasa gives no indication that such a zeolite body would be suitable as a reservoir for hydrogen (FF19). Accordingly, it is not apparent why a person of ordinary skill in the art would consider such a substrate as a means for storing the produced hydrogen-containing gas in the modified apparatus and process of Krutzsch.

CONCLUSIONS OF LAW

(1) Appellants have not demonstrated the Examiner erred in determining that the combined teachings of Krutzsch and Akama would have prompted a person of ordinary skill in the art to use diesel fuel to generate hydrogen in Krutzsch's process and apparatus.

(2) Appellants have not demonstrated the Examiner erred in determining that the combined teachings of Krutzsch and Akama would have prompted a person of ordinary skill in the art to provide an intermediate reservoir to store the generated hydrogen for delivery to the exhaust gas as needed, such as during cold starts, and to generate hydrogen during the normal operating mode of the engine.

(3) Appellants have demonstrated the Examiner erred in determining it would have been obvious to a person of ordinary skill in the art to replace the hydrocarbon and hydrogen reducing agents in the modified process of Krutzsch with urea and ammonia.

Accordingly, we sustain the rejection of claims 11-20 and 30, but we reverse the rejections of claims 21-28.

DECISION

The Examiner's decision is affirmed as to claims 11-20 and 30 and reversed as to claims 21-28.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv) (2007).

AFFIRMED-IN-PART

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