The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte ARUN KUMAR JAURA and CHAN-WOO PARK

Appeal No. 2006-2161
Application No. 10/248,326[1]

ON BRIEF

Before GRON, HANLON, and DELMENDO, Administrative Patent Judges.

GRON, Administrative Patent Judge.

Decision On Appeal

This is an appeal under 35 U.S.C. § 134 from the examiner's final rejection of Claims 1-20 of Application No. 10/248,326, filed January 9, 2003. Claims 1-20 are all the claims pending in the application. Appellant has not argued Claims 1-20 separately. Thus, the rejections of Claims 1-20 stand or fall together. In re Kaslow, 707 F.2d 1366, 1376, 217 USPQ 1089, 1096 (Fed. Cir. 1983).

1. Introduction

The invention claimed is directed to a method and system for enhancing the performance of multi-cell batteries used to power electric vehicles by improving heat transfer

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[1] Filed January 9, 2003

from the battery cells. Representative Claim 1 is reproduced below:

> 1. A battery system for an automotive vehicle, comprising:
>
> a battery case;
>
> a plurality of battery cells housed within said case;
>
> a plurality of heat transfer passages extending about said battery cells;
>
> a supply of heat transfer working fluid;
>
> at least one working fluid driver for circulating said heat transfer working fluid from said supply and through said heat transfer coolant passages; and
>
> a controller for operating said at least one working fluid driver so as to periodically reverse the direction of the flow of heat transfer working fluid through said heat transfer passages.

The examiner relies upon teachings of the following prior art references in support of the final rejection:

Lake et al. (Lake), U.S. Patent 6,138,466, issued Oct. 31, 2000; and

Kothmann et al. (Kothmann), U.S. Patent 4,582,765, issued Apr. 15, 1986.

Claims 1-20 stand finally rejected as unpatentable under 35 U.S.C. § 103 for obviousness in view of the combined teachings of Lake and Kothmann. We reverse.

2. <u>Discussion</u>

Claims 1-20 stand rejected under 35 U.S.C. § 103 because subject matter thereof would have been obvious to a person having ordinary skill in the pertinent art in view of

the combined teachings of Lake and Kothmann. Answer at 4, first ¶. When rejecting claims under 35 U.S.C. § 103, the examiner bears the initial burden to establish a prima facie case of obviousness. In re Rijckaert, 9 F.3d 1531, 1532, 28 U.S.P.Q.2d 1955, 1956 (Fed. Cir. 1993). If and when the examiner establishes a prima facie case of obviousness, the burden shifts to appellant to present evidence to the contrary. Id.

Claim 1 is directed to battery systems for use in electric powered automotive vehicles. Each battery system minimally includes a battery case, a plurality of battery cells housed within said case, a plurality of heat transfer passages extending about said battery cells, a supply of heat transfer working fluid, a working fluid driver for circulating said heat transfer working fluid from said supply and through said heat transfer coolant passages, and a controller for operating said working fluid driver so as to periodically reverse the direction of the flow of heat transfer working fluid through said heat transfer passages.

"[I]n proceedings before the PTO, claims in an application are to be given their broadest reasonable interpretation consistent with the specification." In re Sneed, 710 F.2d 1544, 1548, 218 USPQ 385, 388 (Fed. Cir. 1983). Here, the supporting specification teaches that the purpose of periodically reversing the direction of the flow

of heat transfer working fluid through the heat transfer passages about the battery cells is to create an even temperature distribution across all battery cells. Specification at 2, ¶ 6. The specification explains that a significant temperature differential exists across the battery cells when unidirectionally flowing coolant passes through the passages about the battery cells. Specification at 2, ¶ 5. The specification cautions that an "uneven temperature profile can cause non-homogeneous battery electric chemical reaction rates across the cell stack and result in accumulative degradation of battery cells." Specification at 1-2, ¶ 4.

Lake describes "a battery cooling system for efficiently reusing the heat generated by an electric vehicle battery assembly." Lake, col. 1, l. 8-12. Lake's battery cooling system comprises:

- a battery pack;
- a coolant;
- a reservoir;
- a pump;
- a controller of a heating, ventilating, and air-conditioning (HVAC) system for an automobile; and
- a heat exchanger.

Lake, col. 23, l. 34-47.

Lake's coolant flows from a heat exchanger through a battery pack where it absorbs heat generated during the energy storage and discharge cycles of the battery cells. Lake, col. 23, l. 34-40. The coolant then collects in a reservoir connected to the inlet of a pump. Lake, col. 23, l. 40-41. The coolant is pumped from the reservoir through the controller of the HVAC system of the automobile, where it collects additional heat generated by the controller. Lake, col. 23, l. 41-45. Finally, the coolant returns to the heat exchanger where it transfers its accumulated heat to the HVAC circuit used to manage the temperature of the passenger compartment of the automobile. Lake, col. 24, l. 4-6. The coolant flow cycle is continually repeated. Lake, col. 24, l. 12-14. Heat from the battery pack is transferred to the HVAC circuit to supplement heat energy absorbed from other sources. Thus, the efficiency of the vehicle's heating system is improved. Lake, col. 24, l. 54-67.

The examiner finds that Lake's battery cooling system comprises:

- a battery case;
- a plurality of battery cells housed within said case, i.e., the battery pack;

- a plurality of heat transfer passages extending about said battery cells ("coolant . . . flows through battery pack" – Lake, col. 24, l. 10-11);[2]
- a supply of heat transfer working fluid; and
- at least one working fluid driver for circulating said heat transfer working fluid from said supply through said heat transfer coolant passages, i.e., a pump.

See Answer at 4. The examiner also finds that Lake does not disclose a controller for operating a working fluid driver to periodically reverse the direction of the flow of heat transfer fluid through the heat transfer passages of its battery pack. Answer at 4. To remedy the deficiency of Lake's disclosure, the examiner combines the teaching of Kothmann. Answer at 4.

Kothmann discloses an apparatus for "cooling of fuel cell stacks . . . through directional control of the cooling medium." Kothmann, col. 1, l. 11-13. To this effect, Kothmann discloses a fuel cell cooling circuit comprising:

- a fuel cell stack with cooling modules placed between approximately every third to eighth cell;
- a coolant;

[2] While Appellant disputes Lake's disclosure of this element (Appeal Brief at 4, ¶ 2), we need not address the issue to decide this appeal. We presume the examiner's findings with regard to claim elements described by Lake are accurate.

- a heat exchanger;
- a pump or blower;
- a diverter valve; and
- a controller for the diverter valve.

Kothmann, col. 3, l. 64, through col. 4, l. 5; and col. 4, l. 29-43.

The cooling modules Kothmann places at selected positions in its fuel cell stack contain a plurality of cooling channels through which coolant flows. Kothmann, col. 4, l. 16-28. Heat that is generated from exothermic electrochemical reactions of the fuel cells transfers to the coolant. Kothmann, col. 3, l. 64-66. Even cooling of the fuel cell stack is necessary to "maintain component integrity," since many components of the fuel cell, such as bipolar plates or the electrolyte matrix, tend to degrade at higher temperatures. Kothmann, col. 1, l. 22-31. After exiting the cooling modules of the fuel cell stack, the coolant flows through a heat exchanger where heat is transferred from the coolant. See Kothmann, col. 4, l. 36-38.

Kothmann's coolant is forced through the fuel cell cooling circuit by a pump or blower. Kothmann, col. 4, l. 38-39. A diverter valve moves between two positions as directed by a controller. Kothmann, col. 4, l. 41-43. A diverter valve modulator allows for selective periodic

reversal of the coolant flow path through the fuel cell stack, thus preventing any portion of the fuel cells "from always being exposed to, and cooled by, a coolant which is either hotter or colder than the average coolant temperature." Kothmann, col. 5, l. 4-9. Uniformity of temperature within the fuel cell stack is said to be maintained by periodically reversing the coolant flow direction. Kothmann, col. 5, l. 9-12.

The test for obviousness is "whether the teachings of the prior art, taken as a whole, would have made obvious the claimed invention." In re Gorman, 933 F.2d 982, 986, 18 U.S.P.Q.2d 1885, 1888 (Fed. Cir. 1991). Obviousness, based on a combination of references, regularly requires the prior art to provide "a reason, suggestion, or motivation to lead an inventor to combine those references." Pro-Mold and Tool Co. v. Great Lakes Plastics Inc., 75 F.3d 1568, 1573, 37 U.S.P.Q.2d 1626, 1629 (Fed. Cir. 1996). "[E]vidence of a suggestion, teaching, or motivation to combine may flow from the prior art references themselves, the knowledge of one of ordinary skill in the art, or . . . from the nature of the problem to be solved." In re Dembiczak, 175 F.3d 994, 999, 50 U.S.P.Q.2d 1614, 1617 (Fed. Cir. 1999).

The examiner concludes that it would have been obvious to a person of ordinary skill in the art in view of Kothmann's teaching to modify the unidirectional flow of

coolant through Lake's battery pack in the manner Kothmann describes for evenly cooling fuel cell stacks and eliminating the problems caused by uneven cooling of fuel cell stacks. Answer at 5. The examiner relies exclusively on Kothmann's teaching to reverse coolant flow through a fuel cell stack to support his determination that it would have been obvious to a person having ordinary skill in the art similarly to reverse coolant flow through Lake's battery pack system and alleviate uneven cooling of the battery cells thereof. The examiner points to no incentive or motivation to reverse the flow of coolant through Lake's battery pack than that provided by Kothmann's disclosure.

We find that the examiner's evidence as a whole is insufficient to establish the prima facie obviousness of subject matter encompassed by the claims on appeal. Therefore, we must reverse the examiner's rejection.

The fuel cell system disclosed in Kothmann differs substantially from the battery pack system described by Lake. Kothmann's fuel cells are arranged in stacks to form a composite fuel cell system. Kothmann, col. 1, l. 19-22. The cooling system described by Kothmann positions cooling modules between every third to eighth fuel cell in a stack. Each of Kothmann's cooling modules is designed and positioned to cool multiple fuel cells in a stack. See Kothmann, col. 3, l. 67, through col. 4, l. 5. The

arrangement of the fuel cells in Kothmann's fuel cell stack differs substantially from the arrangement of battery cells in Lake's battery pack. The examiner has not established that Kothmann's cooling modules would be suitable for use with Lake's battery pack system or effective to provide even cooling of Lake's battery pack. Reaction characteristics of continuously fed fuel and oxidant in a fuel cell appear to differ from those reaction characteristics conventional to electric vehicle batteries. See Kothmann, col. 3, l. 54-63. The evidence suggests the fuel cell components that must be cooled and protected from degradation at high temperatures differ substantially from those components of electric vehicle batteries that must be cooled and protected from high temperatures. See Kothmann, col. 1, l. 26-31.

Kothmann's cooling loop is designed for selective reversal of coolant flow through a fuel cell stack to ensure uniform fuel cell temperatures. Kothmann, col. 5, l. 4-12. Given the comparative differences in the design, chemical reaction characteristics, and utility of Kothmann's fuel cell system and Lake's battery pack system, we find that the examiner has not provided sufficient evidence that one of ordinary skill in the art at the time of appellant's filing would have recognized the need or the desirability of maintaining uniform temperatures across all cells of Lake's electric vehicle battery pack system. Notwithstanding the

examiner's finding that fuel cells and batteries generally are current generating systems which produce heat (Answer at 10), there is little, if any, evidence in this record that one of ordinary skill in the battery art would have been motivated to look past the differences between fuel cell stacks and battery cell packs to apply teachings beneficial to fuel cell cooling systems to electric vehicle battery packs.

Moreover, Lake's failure to recognize any problems associated with its unidirectional cooling system or any significant temperature differential across conventional battery cells reasonably suggests that Lake's battery packs so differ in design, composition and function from the fuel cell stacks cooled by Kothmann's cooling system that persons having ordinary skill in the art would have had no incentive or motivation to alter Lake's system to eliminate problems peculiar to Kothmann's fuel cell stacks. While Lake teaches that electric "vehicle batteries must be cooled," (Lake, col. 2, l. 44-45), Lake does not recognize any problems associated with the unidirectional flow cooling system that it employs.

Lake is primarily interested in "efficiently reusing the heat generated by an electric vehicle battery assembly" by transferring the heat generated from the exothermic reaction of the battery pack to the HVAC system to

redistribute that heat to the vehicle's passenger compartment. Lake, col. 1, l. 8-11, and col. 3, l. 1-17. To accomplish Lake's purpose, it is not clear from the record that persons having ordinary skill in the art would ever need or desire to periodically change the direction of coolant flow through the battery pack to improve or otherwise modify heat transfer from the battery pack to the HVAC system. The PTO's initial burden to establish a prima facie case of unpatentability under 35 U.S.C. § 103 has not been met.

For the reasons stated, we conclude that the examiner has not established the unpatentability of appellant's claimed invention under 35 U.S.C. § 103. Accordingly, we reverse the examiner's final rejections.

3. Conclusion

Having considered all the evidence of record, and for the reasons stated herein above, we reverse examiner's rejection of Claims 1-20 under 35 U.S.C. § 103.

REVERSED

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Romulo H. Delmendo Administrative Patent Judge	)

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