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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JOHN B. GOODENOUGH, KYU-SUNG PARK, and STEEN SCHOUGAARD

Appeal 2017-005998
Application 11/447,510
Technology Center 1700

Before TERRY J. OWENS, RAE LYNN P. GUEST, and MERRELL C. CASHION, JR., *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge.*

DECISION ON APPEAL

STATEMENT OF THE CASE

The Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's rejection of claims 1, 22–24, 26–46 and 48–50. We have jurisdiction under 35 U.S.C. § 6(b).

The Invention

The Appellants claim a cathode. Claim 1 is illustrative:

> 1. A cathode consisting essentially of:
> one or more carbon coated olivine C-LiM(XO_4), wherein M is selected from Fe, Mn, Co, Ni or mixtures thereof and X is selected from Si, P, As, S or mixture thereof and wherein the lithium is inserted/extracted reversibly into/from the one or more carbon coated olivine C-LiM(XO_4);

> a cathode filler material consisting essentially of an electronically conductive polymer of repeating units of substituted or unsubstituted monomers of aniline, thiophene, pyrrole, phenyl mercaptan, furan, [(ferrocenyl)amidopropyl] pyrrole or mixtures thereof, attached to the one or more carbon coated olivine C-LiM(XO_4), wherein the electronically conductive polymer is a binder material.

The References

Goodenough	US 5,910,382	June 8, 1999
Armand	US 2004/0033360 A1	Feb. 19, 2004
Oyama	US 2005/0008934 A1	Jan. 13, 2005
Nakamura (as translated)	JP 2002-216770 A	Aug. 2, 2002

A. Naji et al., *Preparation of Membranes by Electropolymerization of Pyrrole Functionalized by Ferrocene Group*, 91 J. Polymer Sci. 3947–58 (2004).

The Rejections

The claims stand rejected under 35 U.S.C. § 103 as follows: claims 1, 22–24, 26–29 and 31 over Armand in view of Nakamura, claim 30 over Armand in view of Nakamura and Oyama, claims 32, 46 and 48–50 over Armand in view of Nakamura and Naji, and claims 33–45 over Armand in view of Nakamura and Goodenough.

OPINION

We affirm the rejections as to claims 1, 24 and 26–31 and reverse them as to claims 22, 23, 32–46 and 48–50.

Claims 1, 24 and 26–31

The Appellants argue claims 1, 24 and 26–31 as a group (App. Br. 7–11).[1] We therefore limit our discussion to one claim, i.e., claim 1. Claims 24 and 26–31 stand or fall with that claim. *See* 37 C.F.R. § 41.37(c)(1)(iv) (2012).

Armand discloses a cathode made of C—$Li_xM_{1-y}M'_y(XO_4)_n$, wherein C represents carbon cross-linked with the compound of the formula $Li_xM_{1-y}M'_y(XO_4)_n$ in which x, y and n are numbers such as $0 \leq x \leq 2$, $0 \leq y \leq 0.6$, and $1 \leq n \leq 1.5$, M is a transition metal or a mixture of transition metals from the first line of the periodic table, M' is an element with fixed valency selected among Mg^{2+}, Ca^{2+}, Al^{3+}, Zn^{2+} or a combination of these same elements and X is chosen from among S, P and Si (¶¶ 19, 35). "[T]he amount of carbon-source compound (called carbon conductor) is chosen in such a way as to coat at least a part of the surface of the particles of the compound of formula $Li_xM_{1-y}M'_y(XO_4)_n$ with carbon" (¶ 52). The cathode's binder "is advantageously a polyether, a polyester, a polymer based on methyl methacrylate units, an acrylonitrile-based polymer and/or a vinylidene fluoride or a mixture of the latter" (¶ 105). The cathode can contain carbon black "to insure electronic exchange with the current collector" (¶ 123).

Nakamura discloses a secondary battery cathode comprising 1) $LiM_xFe_{1-x}PO_4$, where $0 \leq x \leq 0.5$ and M can be Mn, Co, Ni or mixtures

[1] The Appellants address claim 30 under a separate heading but merely assert that Oyama does not cure deficiencies in Armand and Nakamura as to the limitations in claim 1 from which claim 30 indirectly depends (App. Br. 12–13).

thereof, and 2) a conductive polymer which can be polyaniline, polythiophene or polypyrrole (Abstract; ¶¶ 14, 24). Nakamura chose Fe and P because LiFe has sufficiently strong associative strength with PO_4 that the compound is stable at elevated temperatures (¶ 10). The conductive polymer serves as a conductive regulation material which has good electron conductivity and contributes to the cell-chemistry reaction in the normal battery actuation temperature range but deteriorates to an insulating state at elevated temperatures, thereby preventing thermal runaway of the cathode (¶¶ 8, 26). "Some or all of the binding material and electrically-conductive material which are contained in a positive electrode or an anode can be replaced by using proper conductive regulation material" (¶ 25).

The Appellants rely upon the Declaration under 37 C.F.R. § 1.132 by John B. Goodenough (App. Br. 9), wherein Goodenough states:

> 9. Nakamura describes cathodes that include a conductive polymer (referred to as an electroconductivity-adjusting material) in combination with $LiFePO_4$ to provide a thermal switch that turns off the chemical reaction between the cell electrodes to prevent thermal runaway from cell overheating by causes other than an internal short-circuit by dendrites. As shown in Table 1, all of Nakamura's example cathodes include a positive electrode active material, a carbon filler, an electroconductivity-adjusting material, and optionally a binder. One knowledgeable in this field, reading Nakamura, would not have interpreted general statements in Nakamura to suggest that cathodes with higher capacity could be prepared by using only a positive-electrode active material and an electroconductivity-adjusting material.

Nakamura is not limited to its examples. *See In re Fracalossi*, 681 F.2d 792, 794 n.1 (CCPA 1982); *In re Mills*, 470 F.2d 649, 651 (CCPA 1972). Instead, all disclosures therein must be evaluated for what they would

have fairly suggested to one of ordinary skill in the art. *See In re Boe*, 355 F.2d 961, 965 (CCPA 1966). Nakamura discloses that "[s]ome or all of the binding material and electrically-conductive material which are contained in a positive electrode or an anode can be replaced by using proper conductive regulation material" (¶ 25). It appears that this disclosure would have led one of ordinary skill in the art, through no more than ordinary creativity, to replace Armand's binder and electrically-conductive filler with Nakamura's conductive polymer. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (in making an obviousness determination one "can take account of the inferences and creative steps that a person of ordinary skill in the art would employ"). Goodenough's Declaration provides no evidence or technical reasoning to the contrary.

The Appellants assert that "even if, *arguendo*, *Nakamura* were to suggest that cathodes could be prepared using only a positive electrode active material and an electroconductivity-adjusting material (which it does not), the combination of *Armand* and *Nakamura* suggested by the Office would have led one to prepare cathodes that include a carbon fill, not cathodes in which the carbon matrix in [sic] has been replaced by a conductive polymer" (App. Br. 10).

Armand's carbon black insures electronic exchange with the current collector (¶ 123). That appears to be the function of Nakamura's conductive polymer in the normal battery actuation range (¶ 8). Thus, Nakamura's disclosure that "[s]ome or all of the binding material and electrically-conductive material which are contained in a positive electrode or an anode can be replaced by using proper conductive regulation material" (¶ 25) would have led one of ordinary skill in the art, through no more than

ordinary creativity, to replace Armand's binder and carbon black with Nakamura's conductive polymer. *See KSR*, 550 U.S. at 418.

The Appellants rely (Reply Br. 3) upon the statement in Goodenough's Declaration that "[w]e have unexpectedly discovered that the carbon matrix in traditional cathodes can be replaced by a conductive polymer having a redox energy that overlaps that of the cathode particles" (¶ 6).

That statement is unpersuasive due to lacking a supporting side-by-side comparison, commensurate in scope with the claims, of the claimed invention with the closest prior art and an explanation of why the results would have been unexpected by one of ordinary skill in the art. *See In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991); *In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984); *In re Grasselli*, 713 F.2d 731, 743 (Fed. Cir. 1983); *In re Clemens*, 622 F.2d 1029, 1035 (CCPA 1980); *In re Freeman*, 474 F.2d 1318, 1324 (CCPA 1973); *In re Klosak*, 455 F.2d 1077, 1080 (CCPA 1972).

For the above reasons we are not persuaded of reversible error in the rejection of claims 1, 24 and 26–31.

Claims 22, 23 and 33–45

Claim 22, which depends from claim 1, requires that X is Si, As or S, and claim 23, which depends from claim 1, requires that M is Mn, Co or Ni. Claims 33–45, which depend from claim 1, require that M is not Fe and/or that X is not P.

Goodenough discloses "an ordered olivine compound having the general formula $LiMPO_4$, where M is at least one first row transition-metal cation" (col. 2, ll. 12–15).

The Examiner finds that "[t]he phosphate-compound containing positive electrode active material having an olivine structure containing at least Li and Fe disclosed in Nakamura is just one example of a positive electrode active material that would function in the Nakamura positive electrode" (Ans. 13, 19), and "[b]ased upon the teachings of Armand, one of ordinary skill in the art would have recognized that C-LiM(SO_4), C-LiM(PO_4) and C-LiM(SiO_4) are functional equivalents" (Ans. 13–14, 19) and "C-LiFe(XO_4). C-LiMn(XO_4), C-LiCo XO_4), C-LiNi(XO_4) are also functional equivalents" (Ans. 14, 19).

Nakamura chose Fe and P because LiFe has sufficiently strong associative strength with PO_4 that the compound is stable at elevated temperatures at which the conductive polymer deteriorates to an insulating state (¶ 10). The Examiner does not establish that Armand's compounds in which M is Mn, Co or Ni instead of Fe, or X is Si, As or S instead of P, have sufficient elevated temperature stability that one of ordinary skill in the art would have had an apparent reason to use Nakamura's conductive polymer with those compounds. *See KSR*, 550 U.S. at 418 (establishing a prima facie case of obviousness requires an apparent reason to modify the prior art as proposed by the Examiner).

Accordingly, we reverse the rejections as to claims 22, 23 and 33–45.

Claims 32, 46 and 48–50

Independent claims 32 and 46 require a cathode filler material consisting essentially of an electrically conductive [(ferrocenyl)amidopropyl]pyrrole/pyrrole copolymer.[2]

[2] Claims 48–50 depend from claim 46.

Naji discloses [(ferrocenyl)amidopropyl]pyrrole/pyrrole copolymer electrocontrollable membranes for ionic transport (pp. 3953–56).

The Examiner concludes that "the invention as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made because the disclosure of Naji et al indicates that a copolymer of [(ferrocenyl)amidopropyl]pyrrole (FAPP) and pyrrole (Py), with a ratio of FAPP/Py that is 50:50 is a suitable material for use as conducting polymer. The selection of a known material based on its suitability for its intended use has generally been held to be *prima facie* obvious (MPEP §2144.07)" (Ans. 7)

Naji's intended use of the [(ferrocenyl)amidopropyl]pyrrole/pyrrole copolymer is ionic transport (p. 3956). The Examiner does not establish that conducting polymers are substitutable for each other generally or that the applied references would have provided one of ordinary skill in the art with an apparent reason to use Naji's [(ferrocenyl)amidopropyl]pyrrole/pyrrole copolymer in Armand's secondary battery's cathode. *See KSR*, 550 U.S. at 418.

Hence, we reverse the rejection of claims 32, 46 and 48–50.

DECISION/ORDER

The rejection of claims 1, 22–24, 26–29 and 31 under 35 U.S.C. § 103 over Armand in view of Nakamura is affirmed as to claims 1, 24, 26–29 and 31 and reversed as to claims 22 and 23. The rejection of claim 30 under 35 U.S.C. § 103 over Armand in view of Nakamura and Oyama is affirmed. The rejections of claims 32, 46 and 48–50 under 35 U.S.C. § 103 over Armand in view of Nakamura and Naji and claims 33–45 under

35 U.S.C. § 103 over Armand in view of Nakamura and Goodenough are reversed.

It is ordered that the Examiner's decision is affirmed-in-part.

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

AFFIRMED-IN-PART