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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte ATSUTAKA MANABE and DAGMAR KLASS

Appeal 2019-002842
Application 14/342,034
Technology Center 1700

Before LINDA M. GAUDETTE, JEFFREY B. ROBERTSON, and
N. WHITNEY WILSON, *Administrative Patent Judges*.

GAUDETTE, *Administrative Patent Judge*.

DECISION ON APPEAL¹

The Appellant² appeals under 35 U.S.C. § 134(a) from the Examiner's decision twice rejecting claims 1, 4, 5, 7–12, 19–29, 31–35, 37, and 39–43.³

We AFFIRM.

¹ This Decision includes citations to the following documents: Specification filed Feb. 28, 2014 (“Spec.”); Non-Final Office Action dated Jan. 9, 2018 (“Non-Final Act.”); Advisory Action mailed July 27, 2018 (“Advisory”); Appeal Brief filed Oct. 16, 2018 (“Appeal Br.”); Examiner’s Answer dated Dec. 21, 2018 (“Ans.”); and Reply Brief filed Feb. 21, 2019 (“Reply Br.”).

² We use the word “Appellant” to refer to “applicant” as defined in 37 C.F.R. § 1.42. The Appellant identifies the real party in interest as Merck Patent GmbH. Appeal Br. 1.

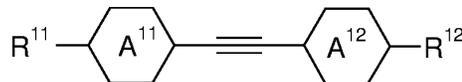
³ We have jurisdiction under 35 U.S.C. § 6(b).

CLAIMED SUBJECT MATTER

The invention relates to high frequency components, e.g., microwave components, comprising liquid-crystalline media. Spec. 1:4–6. The components may be used in high-frequency devices, such as devices for shifting the phase of microwaves, in particular for microwave phased-array antennas. *Id.* at 1:6–7. According to the Specification, at the time of the invention, known liquid-crystalline media for use in microwave components had serious disadvantages, most of which resulted in slow switching performance. *Id.* at 3:22–24. The inventors are said to have discovered liquid crystalline media having improved properties, e.g., fast switching performance with low rotational viscosity and acceptable tunability. *Id.* at 3:23–24, 3:36–4:2; *see also id.* at 4:28–33. Claim 1, the sole independent claim on appeal, is illustrative of the claimed subject matter. An image of claim 1 is reproduced below. Appeal Br. 25–28 (Claims Appendix).⁴

1. A tunable microwave phase shifter comprising a liquid-crystalline medium, said liquid-crystalline medium comprising:

one or more compounds of formula IB,

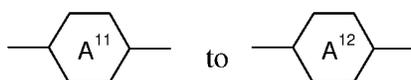


IB

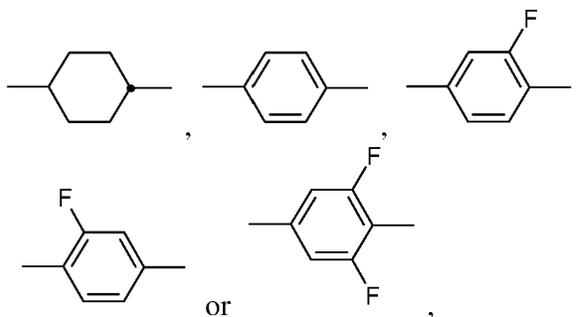
⁴ We note that the “wherein” clause following formula II includes a typographical error: “R¹¹ and R¹²” should read “R²¹ and R²².”

wherein

R^{11} and R^{12} are each independently F, Cl, CN, NCS or a straight-chain or branched alkyl group with 1 to 15 C atoms which is unsubstituted, or mono- or polysubstituted by halogen or CN, and wherein one or more non-adjacent CH_2 groups may optionally be replaced, in each occurrence independently from one another, by -O-, -S-, -NH-, -N(CH₃)-, -CO-, -COO-, -OCO-, -O-CO-O-, -S-CO-, -CO-S-, -CH=CH-, -CH=CF-, -CF=CF- or -C≡C- in such a manner that oxygen atoms are not linked directly to one another, and



denote independently of one another, in each occurrence,



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wherein the proportion of compounds of formula IB in the medium as a whole is 10 to 75 % by weight;

one or more compounds of formula IC-1



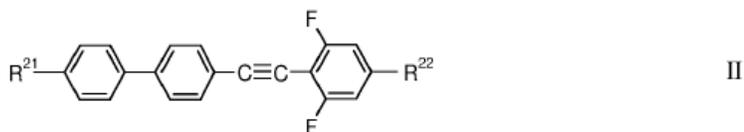
wherein

R^{11} and R^{12} are, respectively, C_nH_{2n+1} and C_mH_{2m+1} , C_nH_{2n+1} and $O-C_mH_{2m+1}$, $CH_2=CH-(CH_2)_z$ and C_mH_{2m+1} , $CH_2=CH-(CH_2)_z$ and $O-C_mH_{2m+1}$, C_nH_{2n+1} and $(CH_2)_z-CH=CH_2$, $(C_nH_{n+1})-CH=CH-(CH_2)_z$ and $O-C_mH_{2m+1}$, or C_nH_{2n+1} and $(CH_2)_z-CH=CH-(C_mH_{2m+1})$,

n and m independently of one another, denote an integer in the range from 1 to 7, and

z denotes 0, 1, 2, 3 or 4;

one or more compounds of formula II

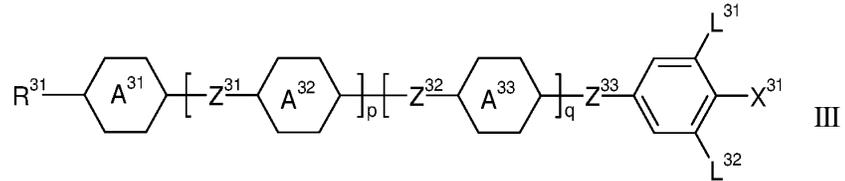


wherein

R^{11} and R^{12} are each independently F, Cl, CN, NCS or a straight-chain or branched alkyl group with 1 to 15 C atoms which is unsubstituted, or mono- or polysubstituted by halogen or CN, and wherein one or more non-adjacent CH_2 groups may optionally be replaced, in each occurrence independently from one another, by -O-, -S-, -NH-, -N(CH₃)-, -CO-, -COO-, -OCO-, -O-CO-O-, -S-CO-, -CO-S-, -CH=CH-, -CH=CF-, -

CF=CF- or -C≡C- in such a manner that oxygen atoms are not linked directly to one another; and

one or more compounds of formula III

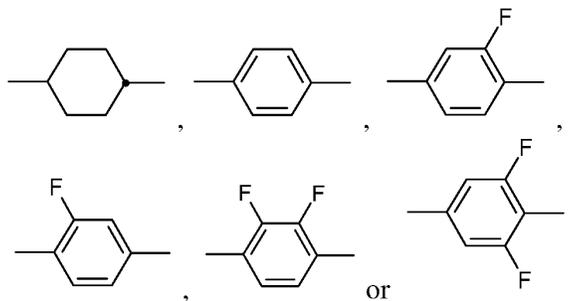


wherein

R^{31} is F, Cl, CN, NCS or a straight-chain or branched alkyl group with 1 to 15 C atoms which is unsubstituted, or mono- or polysubstituted by halogen or CN, and wherein it being also possible for one or more non-adjacent CH_2 groups may optionally be replaced, in each occurrence independently from one another, by -O-, -S-, -NH-, -N(CH₃)-, -CO-, -COO-, -OCO-, -O-CO-O-, -S-CO-, -CO-S-, -CH=CH-, -CH=CF-, -CF=CF- or -C≡C- in such a manner that oxygen atoms are not linked directly to one another,



each independently of one another, and in case A^{32} and/or A^{33} is/are present twice, also these independently of one another, are



L^{31} and L^{32} are each independently of one another H or F,

X^{31} is halogen, halogenated alkyl or a halogenated alkoxy with 1 to 3 C-atoms, or halogenated alkenyl or halogenated alkenyloxy with 2 or 3 C-atoms, or CN or NCS,

Z^{31} to Z^{32} are each independently of one another, and in case Z^{31} and/or Z^{32} is/are present twice, also these independently of one another denote $-\text{CH}_2\text{CH}_2-$, $-\text{CF}_2\text{CF}_2-$, $-\text{COO}-$, *trans*- $-\text{CH}=\text{CH}-$, *trans*- $-\text{CF}=\text{CF}-$, $-\text{CH}_2\text{O}-$, $-\text{CF}_2\text{O}-$ or a single bond,

Z^{33} is $-\text{CF}_2\text{O}-$, and

p and q are each independently of one another 1, 2 or 3,

wherein said phase shifter is tunable by the application of a magnetic and/or electric field.

Above is an image of claim 1, which recites a “tunable microwave phase shifter comprising a liquid-crystalline medium” that includes compounds of formulas IB, IC-1, II, and III.

REFERENCES

The Examiner relies on the following prior art as evidence of unpatentability:

Name	Reference	Date
Gray et al.	US 5,156,763	Oct. 20, 1992
Takeshita et al.	US 6,315,922 B1	Nov. 13, 2001
Suermann	US 6,753,045 B2	June 22, 2004
Lussem et al.	US 2005/0067605 A1	Mar. 31, 2005
Tanaka	US 2010/0127211 A1	May 27, 2010
Lietzau et al.	US 8,197,709 B2	June 12, 2012

REJECTIONS⁵

1. Claims 1, 4, 5, 7–12, 19–29, 31–35, and 39–43 are rejected under 35 U.S.C. § 103(a) as unpatentable over Lussem in view of Suermann, Takeshita, and Gray.

2. Claim 37 is rejected under 35 U.S.C. § 103(a) as unpatentable over Lussem in view of Suermann, Takeshita, Gray, and Tanaka.

OPINION

The Examiner found that Lussem discloses “switchable (tunable) components for high-frequency technology, in particular microwave technology, which use liquid-crystalline dielectrics [abstract] such as phase shifters, varactors, radio wave antenna arrays and others [0057].” Non-Final Act. 7. The Examiner found that Lussem discloses mixtures of “liquid crystal compounds [that] are essentially selected from . . . known compounds or are obtained analogously to known compounds.” *Id.* (citing Lussem ¶ 67). The Examiner found that Lussem includes PTP (p. 7), CC-n-V1 and CC-n-V (p. 9), and UTPP (p. 15) in the list of compounds identified as suitable for use in the mixture. Non-Final Act. 8. The Examiner found that PTP, CC-n-V1 or CC-n-V, and UTPP are equivalent to the Appellant’s claim 1 formulas IB, IC-1, and II. *Id.* at 9–11. Lussem discloses that the mixture contains a compound having “particularly preferably zero or one[] bridging group[,] . . . preferably . . . —CF₂O—.” Lussem ¶ 70. The Examiner found that Lussem identifies PUQU (p. 8), which includes

⁵ The Examiner has withdrawn the rejections of claim 32 under 35 U.S.C. § 112, first paragraph, claims 36 and 38 under 35 U.S.C. § 112, fourth paragraph, and claim 38 under 35 U.S.C. § 103(a) over Lussem in view of Suermann, Takeshita, Gray and Lietzau. Advisory Act., Continuation Sheet

bridging group —CF₂O—, as suitable for use in the mixture. Non-Final Act. 11–12. The Examiner found that PUQU is equivalent to the Appellant’s claim 1 formula III compound. *Id.* at 12.

The Examiner acknowledged that Lussem “does not teach a specific example comprising [the] App[ell]ant’s claimed compounds.” *Id.* at 9. As further discussed below, however, the Examiner found that Suermann and Takeshita teach why one of ordinary skill in the art would have selected from Lussem’s list of suitable liquid crystal compounds the same compounds used in the Appellant’s claim 1 liquid-crystalline medium (i.e., compounds of claim 1 formulas IB, IC-1, II, and III). *See Ans.* 24.

The Examiner found that Suermann discloses a liquid crystal mixture comprising at least three compounds having formulas I, II, and III. Non-Final Act. 9 (citing Suermann 4:3–45). The Examiner found that Suermann’s formula II is equivalent to Lussem’s UTPP compound. *Id.* at 11 (citing Suermann 4:25). The Examiner determined that the ordinary artisan would have included Lussem’s UTPP compound—equivalent to the Appellant’s claim 1 formula II—in Lussem’s liquid crystal mixture based on Suermann’s teaching that this compound has low values for the rotational viscosity. *Id.* at 11 (citing Suermann 12:63–67).

Suermann discloses that in addition to the formula I, II, and III compounds, the mixture preferably comprises one or more liquid-crystalline tolan compounds (Suermann 16:13–15) and one or more alkenyl compounds (*id.* at 5:18–20). The Examiner found that Suermann identifies as preferred a tolan compound (formula Ta) that is equivalent to Lussem’s PTP compound. Non-Final Act. 9; *see* Suermann 16:18–25. The Examiner determined that the ordinary artisan would have included Lussem’s PTP compound—

equivalent to the Appellant's claim 1 formula IB—in Lussem's liquid crystal mixture based on Suermann's teaching that “[o]wing to the high birefringence of the tolan compounds, lower layer thicknesses can be used, which significantly shortens the response times” (Suermann 16:15–18).

Non-Final Act. 10. The Examiner found that Suermann identifies as particularly preferred an alkenyl compound (formula IVe) having the same formula as Lussem's CC-n-V or CC-n-V1 compound. *Id.* at 10; *see* Suermann 6:17–18 (“Particular preference is given to compounds of the formulae IVe and IVf . . .”). The Examiner determined that the ordinary artisan would have included Lussem's CC-n-V or CC-n-V1 compound—equivalent to the Appellant's claim 1 formula IC-1—in Lussem's liquid crystal mixture based on Suermann's teaching that alkenyl compounds result in low rotational viscosity. Non-Final Act. 11 (citing Suermann 6:21–23).

The Examiner found that Takeshita discloses a liquid crystal composition comprising a compound (1-1) that is structurally similar to Lussem's PUQU compound. Non-Final Act. 12 (citing Takeshita 3:35). The Examiner determined that the ordinary artisan would have used Takeshita's compound (1-1) in Lussem's liquid crystal mixture because Takeshita discloses that the compound “provide[s] a very large dielectric constant anisotropy, a relatively small viscosity, a large optical anisotropy, and a high resistivity value.” *Id.* at 12–13.

The Examiner concludes that

one of ordinary skill in the art would easily arrive at Appellant's claimed composition from the disclosures of Lussem, Suermann, Takeshita, and Gray based on the knowledge of one of ordinary skill in the liquid crystal art to combine known equivalents through routine experimentation in

order to achieve increased addressability among other desirable properties for high-frequency technology.

Ans. 24.

The Appellant contends that the Examiner erred reversibly in finding that the ordinary artisan would have formulated Lussem’s liquid crystal mixture based on the teachings of Suermann and Takeshita, because both Suermann and Takeshita are “completely devoid of any mention of microwave components, let alone phase shifters.” Appeal Br. 10, 13. The Appellant argues that Suermann is directed to nematic liquid-crystal mixtures used in twisted nematic and supertwisted nematic liquid-crystal displays, and is concerned with “providing TN and STN displays which ‘have short response times, in particular at low temperatures, and/or good steepnesses and improved temperature dependence of the operating voltage and/or good angle dependenc[i]es of the contrast.’” *Id.* at 10 (quoting Suermann 2:14–21). The Appellant argues that Takeshita “is directed to providing nematic liquid crystal compositions that can be used in an active matrix mode in a liquid crystal display.” *Id.* 13.

The Appellant’s argument is not persuasive of error in the Examiner’s obviousness determination.

An obviousness rejection predicated on selection of one or more components from numerous possible choices may be appropriate if the prior art provides direction as to which of many possible choices is likely to be successful. *See PharmaStem Therapeutics, Inc. v. ViaCell, Inc.*, 491 F.3d 1342, 1364 (Fed. Cir. 2007). The fact that a reference “discloses a multitude of effective combinations does not render any particular formulation less obvious.” *Merck & Co., Inc. v. Biocraft Labs*, 874 F.2d 804, 807 (Fed. Cir. 1989) (*citing In re Corkill*, 771 F.2d 1496, 1500 (Fed. Cir. 1985)).

The Appellant does not dispute the Examiner’s finding that Lussem discloses microwave components comprising a mixture of liquid-crystal compounds, and identifies as useful in the mixture, compounds that are equivalent to the Appellant’s claim 1 compounds. *See generally* Appeal Br. 8–10. As acknowledged by the Appellant, Lussem discloses “that the liquid-crystal compounds are selected from ‘known compounds or are obtainable analogously to known compounds.’” Appeal Br. 9 (quoting Lussem ¶ 67). Although Suermann and Takeshita are not concerned with microwave components or phase shifters, they describe known liquid-crystal compounds. The Appellant has not explained convincingly why the ordinary artisan would not have looked to these references in determining which of Lussem’s known, liquid-crystal compounds to combine to achieve a mixture having desired properties. *See In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992) (explaining that if a reference is in a different field from that of the inventor’s endeavor, it is still analogous art if it deals with a matter which logically would have commended itself to an inventor’s attention in considering a problem).

The Appellant argues that Suermann provides no suggestion that properties desirable in TN and STN displays, such as low values of rotational viscosity, would benefit a tunable microwave phase shifter. Reply Br. 3–4. The Appellant cites Lietzau (US 8,197,709 B2, issued June 12, 2012)⁶ as evidence that the ordinary artisan would have understood that compounds having a high rotational viscosity are preferable in liquid

⁶ Lietzau is the English language equivalent of CN 102050708 A, relied on by the Examiner in a prior rejection that has been withdrawn. *See* footnote 5 *supra*.

crystalline phase shifters. Appeal Br. 12–13; Reply Br. 4. The relied-upon disclosure in Lietzau reads: “the compounds according to the invention have . . . an advantageously high rotational viscosity about the longitudinal axis of the molecule These properties make them particularly suitable for use in components for high-frequency technology, in particular in liquid-crystalline phase shifters.” Lietzau 2:50–59. The Examiner relies on Lussem paragraph 75 in support of a finding that the ordinary artisan would have selected compounds having low rotational viscosity. Ans. 20. Lussem paragraph 75 discloses that “[c]ompounds containing a vinyl end group and compounds containing a methyl end group have low rotational viscosity.”

Although, as argued by the Appellant, Lussem does not explicitly describe low rotational viscosity as “beneficial or advantageous” (Reply Br. 7), Lussem also does not indicate that such property is undesirable. To the contrary, Lussem paragraph 75 follows a description of preferred compounds for use in Lussem’s liquid crystal mixture. *See* Lussem ¶¶ 68–74. Moreover, as found by the Examiner, Lussem discloses that compounds CC-n-V and CC-n-V1, both of which contain vinyl end groups, may be included in Lussem’s liquid-crystal mixture used in microwave components. Ans. 20 (citing Lussem, p. 9). Given this disclosure, we are not persuaded by the Appellant’s argument that the ordinary artisan would have understood Lietzau’s preference for compounds having high rotational viscosity as discouraging the use of compounds having low rotational viscosity in all tunable microwave phase shifters.

The Appellant argues that like Suermann, Takeshita fails to disclose that the properties of its compounds would benefit a tunable microwave phase shifter. Reply Br. 8. The Appellant also argues that the Examiner erred

in finding that the ordinary artisan would have included Takeshita's formula (1-1) compound in Lussem's mixture because it has a large dielectric anisotropy and a large optical anisotropy. *See* Appeal Br. 15–16. The Appellant argues that, to the contrary, Takeshita discloses several exemplary mixtures containing Takeshita's formula (1-1) compound, each of which exhibited a significantly lower optical anisotropy and dielectric anisotropy than exhibited by Lussem's exemplary mixtures M1-M3. *Id.*

The Appellant's argument is not persuasive.

The Examiner's rejection is not based on Lussem's mixtures M1-M3. Rather, the rejection is based on a mixture suggested by the combined teachings of Lussem and Suermann. The Appellant has not shown reversible error in the Examiner's finding that the ordinary artisan would have included Takeshita's formula (1-1) compound in a mixture suggested by the combined teachings of Lussem and Suermann based on Takeshita's disclosure that “[t]he component A in the liquid crystal composition . . . has the effects to maintain the viscosity relatively small, increase the optical anisotropy,” etc., and that these effects are attributable to the formula (1-1) compound which “has a[] very large dielectric constant anisotropy . . . and . . . a relatively small viscosity, a large optical anisotropy and a high resistivity value” (Takeshita 14:61–15:11).

The Examiner relies on Gray for limitations found only in dependent claims 5 and 7. *See* Non-Final Act. 15; Appeal Br. 17. The Appellant argues that because Gray “is devoid of any mention of . . . microwave components or phase shifters,” the ordinary artisan would not have had “any reasonable expectation that the inclusion of compounds of Gray et al.'s formula 1.5 in

mixtures M1-M3 of Lussem et al. would not adversely impact the material quality of the Lussem et al. mixtures.” Appeal Br. 18.

These arguments are not persuasive for the reasons discussed above in connection with Suermann and Takeshita, i.e., the rejection is not based on Lussem’s mixtures M1-M3, and the Appellant has not explained convincingly why the ordinary artisan would not have looked to Gray in determining which of Lussem’s known, liquid-crystal compounds to combine to achieve a desired result. *See Non-Final Act. 15; Ans. 23.*

As to the separate rejection of claim 37, the Examiner has fully addressed the Appellant’s arguments, and we agree with the Examiner that they are not persuasive of reversible error for the reasons stated in the Answer. *See Appeal Br. 20–21; Ans. 24–26.*

Any additional arguments made by the Appellant but not discussed explicitly in this decision are unpersuasive of reversible error in the Examiner’s conclusion of obviousness for the reasons stated in the Answer. *See Ans. 19–24.*

DECISION SUMMARY

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 4, 5, 7–12, 19–29, 31–35, 39–43	103(a)	Lussem, Suermann, Takeshita, Gray	1, 4, 5, 7–12, 19–29, 31–35, 39–43	
37	103(a)	Lussem, Suermann, Takeshita, Gray, Tanaka	37	
Overall Outcome			1, 4, 5, 7–12, 19–29, 31–35, 37, 39–43	

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

AFFIRMED