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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MICHAEL D. SEEMAN

Appeal 2019-001975
Application 15/073,964
Technology Center 2800

Before MICHELLE N. ANKENBRAND, MERRELL C. CASHION, JR.,
and SHELDON M. MCGEE, *Administrative Patent Judges*.

CASHION, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF CASE

Appellant¹ appeals under 35 U.S.C. § 134(a) from the Examiner's Final Rejection of claims 1–20. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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

The invention is generally directed to a hysteretic control mechanism for power converters. Spec. ¶ 1. More specifically, the invention is directed to an apparatus comprising a hysteretic control mechanism for power converters that has a hysteretic comparator for use in a distributed power architecture (DPA). *Id.* ¶ 3. In general, DPAs allow a primary system power supply to receive an input voltage and reduce it to one or more intermediate system voltages to be bussed to a number of printed circuit board (PCB) sub-assemblies. *Id.* ¶ 4. The Specification explains that “[e]ach PCB sub-assembly typically includes a DC-DC converter that will convert the system supply voltage to one (or more) well regulated supply voltages for the sub-assembly PCB.” *Id.* The invention seeks to improve the efficiency of the power converters compared to prior art converters by using a hysteretic controller in the power converter, where the hysteretic controller has a hysteretic comparator. *Id.* ¶¶ 10–12, 50. The Specification discloses that hysteretic controllers are known in the art as suitable for regulating voltages by “inherently provid[ing] lower quiescent current and excel[ling] in extreme down conversion applications common in PoL [or points of load] converters today.” *Id.* ¶¶ 8–9. Claim 1 illustrates the subject matter on appeal and is reproduced below:

1. An apparatus, comprising:
 - a power converter including:
 - a transformer having a primary side interfacing an input voltage terminal, and a secondary side interfacing an output voltage terminal;
 - a primary side switch coupled between the input voltage terminal and the primary side of the transformer;

an inductor having a first terminal coupled to the secondary side of the transformer, and a second terminal coupled [to] the output voltage terminal;

a secondary side switch coupled between the first terminal of the inductor and a ground terminal; and

a hysteretic controller having:

a hysteretic comparator including a first input, a second input, and an output, the first input configured to receive a sensed current from the inductor, the second input configured to receive a differential voltage representing a potential difference between an output voltage at the output voltage terminal and a reference voltage;

a pulse sequencer coupled to the output of the hysteretic comparator; and

a dead-time generation circuit configured to provide a first on-time signal to the primary side switch and a second on-time signal to the secondary side switch based on a pulse signal received from the pulse sequencer.

Independent claim 14 is essentially directed to the converter used in claim 1.

Appellant (*see generally* Appeal Br.) requests review of the Examiner's rejection of claims 1–20 under 35 U.S.C. § 103(a) as unpatentable over Fahlenkamp (US 2009/0086512 A1, published April 2, 2009) and Dearborn (US 2012/0013322 A1, published January 19, 2012). Appeal Br. 7; Final Act. 3, 8.²

² For brevity, we consolidated the two rejection statements the Examiner presents in the Non-Final Action into a single rejection statement because both rely on the same evidentiary references.

OPINION

After review of the respective positions the Appellant presents in the Appeal and Reply Briefs and the Examiner presents in the Final Action and the Answer, we REVERSE for the reasons the Appellant provides. We add the following for emphasis.

Claim 1

Independent claim 1 recites a power converter comprising a hysteretic comparator including a first input configured to receive a sensed current from the inductor.³

The Examiner finds that Fahlenkamp teaches an apparatus having a power converter comprising a controller and comparator that includes a first input, but that differs from the subject matter of claim 1 in that Fahlenkamp does not disclose the controller and comparator as being a hysteretic controller and a hysteretic comparator, or a hysteretic comparator including a first input configured to receive a sensed current from the inductor. Final Act. 3–4. The Examiner turns to Dearborn for the noted missing features. *Id.* at 4. The Examiner finds that Dearborn teaches a hysteretic controller as a known means to achieve an optimum response to a disturbance in any negative feedback control system. Final Act. 4; *see* Dearborn ¶ 2, Figures 3–5. The Examiner also finds that Dearborn teaches the hysteretic controller as comprising a hysteretic comparator. Final Act. 4 (citing Dearborn Figures 3, 4); *see* Dearborn claims 5, 6. In the Answer, the Examiner asserts that

³ Independent claim 14 also recites a power converter comprising a hysteretic comparator including a first input configured to receive a sensed current from inductors. Accordingly, we limit our discussion to independent claim 1, with the understanding that our discussion applies equally to independent claim 14.

control circuit 208 is a hysteretic controller because it comprises hysteretic comparators 430 and 432 inside 310 and hysteretic comparator 434 inside 312. Ans. 5 (citing Dearborn Figures 3, 4); *see* Dearborn claims 5, 6. The Examiner further finds that Dearborn teaches providing a first input to hysteretic comparator 434 that is configured to receive a sensed current from an inductor as claimed. Final Act 4 (citing Dearborn Figures 3–5). The Examiner determines that having a hysteretic controller and hysteretic comparator, as claimed, is a mere arrangement of old elements with each performing their known function, the combination yielding no more than one would expect from such an arrangement. Final Act. 4. The Examiner concludes that it would have been obvious to one having ordinary skill in the art to replace Fahlenkamp’s controller and comparator with Dearborn’s hysteretic controller and hysteretic comparator to enhance the power efficiency of the power converter via better control of the power converter by optimizing the response to disturbances in the power converter. *Id.*

Appellant argues that the combination of Dearborn’s pulse width modulation (PWM) comparator 434,⁴ summer 440, and current sense signal 328 does not amount to the claimed hysteretic comparator because Dearborn’s PWM comparator 434 is not a part of the hysteretic controller 310. Appeal Br. 6 (citing Dearborn ¶ 28). Instead, Appellant contends that Dearborn’s PWM comparator 434 is a part of the PWM error generator 334,

⁴ Contrary to Appellant’s argument (Appeal Br. 6), Dearborn does disclose that the comparator of the PWM error generator can be a hysteretic comparator (Dearborn claim 6). Therefore, we interpret this argument as Appellant explaining that hysteretic comparator 434 associated with the PWM generator/controller does not amount to the recited hysteretic comparator.

which operates separately from the hysteretic controller 310. Appeal Br. 6. Appellant further argues that Dearborn's comparator 434 is not configured to receive a sensed current from the inductor because the current sense signal 328, as shown in Figure 5, is generated by sensing a current from an unregulated supply voltage 540, which is interposed from an inductor 542 by a series pass switch 544. *Id.* (citing Dearborn ¶ 30). Thus, Appellant asserts that Dearborn does not specify that current sense signal 328 is generated by sensing any current from an inductor and that current sense signal 328 is not representative of a current conducted by inductor 542. *Id.* Appellant also argues neither of hysteretic comparators 430 and 432 is configured to receive current sense signal 328, and hysteretic controller 310 does not include any other hysteretic comparator besides hysteretic comparators 430 and 432. *Id.*

We agree with Appellant that there is reversible error in the Examiner's determination of obviousness.

The Examiner bears the initial burden of presenting a prima facie case of obviousness. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). “[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006), *quoted with approval in KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007).

The Examiner's assertion that Dearborn's component 208 is a hysteretic controller (Ans. 5) is unsupported by evidence and adequate explanation. First, Dearborn specifically recites the use of two distinct control means, a hysteretic control in combination with a fixed frequency,

pulse-width modulated (PWM) control, to improve the response to disturbances in buck or buck derived SMPS system topologies. Dearborn ¶ 3. This disclosure of two types of controllers is consistent with Appellant's Specification disclosure that there exists two types of controllers, the PWM type and the hysteretic type. Spec. ¶¶ 8–9. Second, Dearborn describes that it is control circuit 208 that is optimized to respond to a disturbance in power system 102. Dearborn ¶ 26. Third, Dearborn describes component 208 as a control circuit that is distinct from the hysteretic control circuit. *Id.* ¶¶ 4, 27. Although component 208 is a control circuit that responds to a disturbance in a power system, the Examiner directs us to no portion of Dearborn that describes control circuit 208 as a hysteretic controller. Nor does the Examiner explain adequately why one skilled in the art would have inferred that control circuit 208 is a hysteretic controller, particularly when Dearborn discloses two different types of controllers associated with control circuit 208.

With respect to hysteretic comparator 434, which forms part of the PWM error generator (control), the Examiner contends that the first input of this comparator is configured to receive a sensed current from an inductor. Final Act. 4. In support of this contention, the Examiner points to Dearborn's Figure 5 showing a circuit with inductor 542. Ans. 4–5. However, we agree with Appellant that Dearborn's Figure 5 shows that current sense signal 328 is generated by sensing a current from unregulated supply voltage 540. Appeal Br. 6. The Examiner has not addressed this argument adequately. *See* Ans. 5. Dearborn does disclose that power converters employ a restricted set of components that include inductors, capacitors, transformers, switches and resistors that are connected based on

the desired power translation. Dearborn ¶ 23. However, the Examiner points to no portion of Dearborn that teaches or suggests a first input configured to receive a sensed current from an inductor where this first input is included in a hysteretic comparator, much less an hysteretic comparator that is part of a hysteretic controller. Nor does the Examiner explain why one skilled in the art would have found the combination of this input with a hysteretic controller and hysteretic comparator suitable for Fahlenkamp's apparatus and controller.

The Examiner has not provided an adequate technical explanation with the requisite rational underpinning of why or how one skilled in the art would have arrived at the claimed hysteretic controller and hysteretic comparator including a first input configured to receive a sensed current from the inductor. Thus, the Examiner has not made a prima facie case of obviousness.

Accordingly, we reverse the Examiner's prior art rejections of claims 1–20 under 35 U.S.C. § 103(a) for the reasons the Appellant presents and those provided above.

CONCLUSION

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1-20	103(a)	Fahlenkamp, Dearborn		1-20

REVERSED