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Delphi Technologies IP Limited
3000 University Drive
Delphi Technologies Legal Staff - M/C 483-300-450
Auburn Hills, MI 48326

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joshua.m.haines@delphi.com
us.patent@delphi.com

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte FRANK LORENZ, MARCO LOENARZ, and PETER WEYAND

Appeal 2019-006075
Application 15/036,434
Technology Center 2800

Before JEFFREY B. ROBERTSON, CHRISTOPHER C. KENNEDY, and JANE E. INGLESE, *Administrative Patent Judges*.

INGLESE, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant[1] requests our review under 35 U.S.C. § 134(a) of the Examiner's decision to finally reject claims 11–21.[2] We have jurisdiction over this appeal under 35 U.S.C. § 6(b).

We REVERSE.

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[1] We use the word "Appellant" to refer to the "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies Delphi Automotive Systems Luxembourg SA as the real party in interest. Appeal Brief filed April 3, 2019 ("Appeal Br.") at 3.
[2] Final Office Action entered November 2, 2018 ("Final Act.") at 1.

CLAIMED SUBJECT MATTER

Appellant claims a method of controlling an ignition system. Appeal Br. 4–7. Independent claims 11 and 21 illustrate the subject matter on appeal, and read as follows:

> 11. A method of controlling an ignition system, said ignition system including
>
> a spark plug control unit adapted to control at least two coil stages so as to successively energise and deenergise said at least two coil stages to provide a current to a spark plug,
>
> including two stages comprising a first transformer including a first primary winding inductively coupled to a first secondary winding; a second transformer including a second primary winding inductively coupled to a second secondary winding;
>
> said spark plug control unit enabled to simultaneously energize and deenergize said first primary winding and said second primary winding by simultaneously switching on and off two corresponding switches to sequentially energize and deenergize said first primary winding and said second primary winding by sequentially switching on and off both of said two corresponding switches to maintain a continuous ignition fire, and
>
> includes a step-down converter stage located between said spark plug control unit and said at least two coil stages, said step-down converter including a switch and a diode,
>
> said spark plug control unit being enabled to switch off said switch,
>
> wherein the method provides control to limit a secondary current peak at the end of a Coupled Multi-Charge period, *comprising the steps of, at the end of the Coupled Multi-Charge period:*
>
> *i) switching off said switch which allows said primary current to fall to zero; and*
>
> *ii) toggling said two corresponding switches after switching off said switch in step i) and while said switch remains off.*

21. A method of controlling an ignition system, said ignition system including

a spark plug control unit adapted to control at least two coil stages so as to successively energise and deenergise said at least two coil stages to provide a current to a spark plug,

including two stages comprising a first transformer including a first primary winding inductively coupled to a first secondary winding; a second transformer including a second primary winding inductively coupled to a second secondary winding;

said spark plug control unit enabled to simultaneously energize and deenergize said first primary winding and said second primary winding by simultaneously switching on and off two corresponding switches to sequentially energize and deenergize said first primary winding and said second primary winding by sequentially switching on and off both of said two corresponding switches to maintain a continuous ignition fire, and

includes a step-down converter stage located between said spark plug control unit and said at least two coil stages, said step-down converter including a switch and a diode,

said spark plug control unit being enabled to switch off said switch,

wherein the method provides control to limit a secondary current peak at the end of a Coupled Multi-Charge period, *comprising the steps of, at the end of the Coupled Multi-Charge period:*

i) allowing said Coupled Multi-Charge period to expire;

ii) switching off said switch after step i) which allows said primary current to fall to zero; and

iii) toggling said two corresponding switches after switching off said switch in step ii) and while said switch remains off.

Appeal Br. 20, 22–23 (Claims Appendix) (emphasis and spacing added).

REJECTION

The Examiner maintains the rejection of claims 11–21 under 35 U.S.C. § 103(a) as unpatentable over Lorenz et al. (EP 2 325 476 A1, published May 25, 2011) in the Examiner's Answer entered June 13, 2019 ("Ans.").

FACTUAL FINDINGS AND ANALYSIS

Upon consideration of the evidence relied upon in this appeal and each of Appellant's contentions, we reverse the Examiner's rejection of claims 11–21 under 35 U.S.C. § 103(a), for reasons set forth in the Appeal and Reply Briefs, and below.

Independent claims 11 and 21 both recite a method of controlling an ignition system to provide a current to a spark plug, where the ignition system includes, in part, at least two coil stages comprising a first transformer including a first primary winding and a second transformer including a second primary winding, a corresponding switch for each of the first and second primary windings, and a step-down converter including a switch. Claims 11 and 21 require the recited method to comprise, at the end of a Coupled Multi-Charge period, switching off the step-down converter switch to allow a primary current to fall to zero, and toggling the two switches for the primary windings ("the two corresponding switches") after switching off the step-down converter switch while the step-down converter switch remains off.

The Examiner finds that Lorenz discloses, and illustrates in Figure 1, an ignition system that includes a first transformer including a first primary winding, a second transformer including a second primary winding, a corresponding switch for each of the first and second primary windings, and a step-down converter including a switch. Final Act. 6 (citing Lorenz Abst.; Fig. 1). The Examiner finds that Figure 1 of Lorenz does not disclose the method steps recited in claims 11 and 21 of at the end of the Coupled Multi-Charge period, "i) switching off said switch which allows said primary current to fall to zero; and ii) toggling said two corresponding switches after switching off said switch in step i) and while said switch remains off." Final Act. 7 (emphasis omitted).

The Examiner finds, however, that other portions of Lorenz, including Figures 2 to 5, disclose such steps. Final Act. 7–8 (citing Lorenz Abst.; ¶¶ 22, 23, 27, 28, 30, 34; Figs. 2–5). The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the ignition system illustrated in Figure 1 of Lorenz to include the relied-upon steps from Lorenz's Figures 2 to 5, to produce a continuous ignition spark over a wide area of burn voltage, and detect "burn voltage at spark plug by measuring the gradient of secondary current as disclosed by Lorenz." Final Act. 8–9 (citing Lorenz ¶ 5).

On the record before us, however, for reasons expressed by Appellant (Appeal Br. 11–14, 18; Reply Br. 2–3) and discussed below, the Examiner does not provide a sufficient factual basis to establish that Lorenz discloses or would have suggested a method for controlling an ignition system that involves switching off a step-down converter switch to allow a primary current to fall to zero, and toggling two switches for primary windings ("the two corresponding switches") after switching off the step-down converter switch while the step-down converter switch remains off, as required by claims 11 and 21.

Lorenz discloses a multi-charge ignition system that produces a continuous ignition spark over a wide area of burn voltage, delivers an adjustable energy to a spark plug, and allows a burning time of the ignition fire to be chosen freely. Lorenz ¶ 5.

Lorenz discloses that the multi-charge ignition system comprises ignition coils including primary windings L1, L3 wound on common core K1 to form a first transformer, and secondary windings L2, L4 wound on second common core K2 to form a second transformer. Lorenz ¶ 17; Fig. 1. Lorenz discloses that one end of each primary winding L1, L3 is connected to a corresponding switch Q1, Q2, and the other end of each primary winding L1, L3 is connected to battery 15. Lorenz ¶¶ 18, 19; Fig. 1. Lorenz discloses that battery 15 is coupled through ignition switch or transistor M1 to primary windings L1, L3. Lorenz ¶ 21; Fig. 1. Lorenz discloses that control circuit 13 "is enabled to switch off switch M1 by means of a signal FET," and Lorenz discloses that control circuit 13 also controls the state of switches Q1, Q2. Lorenz ¶¶ 20, 21.

Lorenz describes operation of the multi-charge ignition system as involving six steps. Lorenz ¶¶ 22–30; Fig. 3. Lorenz discloses that the first step involves switching switches M1, Q1, and Q2 on, which rapidly increases a primary current and results in energy being stored in the transformers; the second step involves switching off switches Q1 and Q2 when a high secondary voltage is induced, creating an ignition spark; the third step involves switching Q1 on and Q2 off (or vice versa) so that primary windings L1, L3 store energy while secondary windings L2, L4 deliver energy to the spark plug (or vice versa); and the fourth step involves control circuit 13 switching transistor M1 off if the primary current increases over a pre-determined limit. Lorenz ¶¶ 22–28; Fig. 3. Lorenz discloses that "[p]referably, transistor M1 will be permanently switched on and off to hold the energy in the transformer on a constant level." Lorenz ¶ 22. Lorenz further explains that during the fourth step, "control signal FET is switched off for a short time," thus switching off transistor M1 for a short time. Lorenz ¶ 28; *see also* ¶ 21("[c]ontrol unit 13 is enabled to switch off switch M1 by means of a signal FET."). And Figure 3 of Lorenz shows that control signal FET, which switches M1 off, is switched off for 50 microseconds if the primary current exceeds a predetermined limit.

Lorenz discloses that the fifth step involves switching Q1 off and Q2 on (or vice versa), and the sixth step involves integrating steps 3 to 5 "by sequentially switching on and off switches Q1 and Q2." Lorenz ¶¶ 22, 23, 30. Lorenz explains that "[b]ecause of the alternating charging and discharging of the two transformers the ignition system delivers a continuous ignition fire." Lorenz ¶ 23.

Lorenz thus discloses switching Q1 on and Q2 off (step 3), switching control signal FET off, which switches M1 off, for 50 microseconds or "for a short time," if the primary current exceeds a predetermined limit (step 4), switching Q1 off and Q2 on (step 5), and repeating these three steps (step 6) in order to deliver a continuous ignition fire to the spark plug.

Appellant argues that Lorenz discloses switching M1 off temporarily to limit the primary current when it exceeds a pre-determined value, switching M1 back on again, and toggling Q1 and Q2 to hold the energy in the transformers constant, in order to produce a continuous ignition spark. Appeal Br. 11–13, 18. Appellant argues that Lorenz does not teach or suggest toggling Q1 and Q2 while switch M1 remains off as required by claims 11 and 21. *Id.*

The Examiner responds to Appellant's arguments in the Answer by asserting that Figure 3 of Lorenz discloses that during steps 4 to 6 of Lorenz's method, the FET transistor "remains off." Ans. 6, 11–12, 18, 28.

As discussed above, however, Lorenz discloses switching control signal FET off, which switches M1 off, for 50 microseconds, or "for a short time," and Lorenz discloses that "[p]referably, transistor M1 will be permanently switched on and off to hold the energy in the transformer on a constant level." Lorenz ¶¶ 22, 28; Fig. 3. Lorenz's illustration in Figure 3 of switching FET off for 50 microseconds implicitly indicates that after 50 microseconds, FET is switched back on, thereby switching M1 back on. Contrary to the Examiner's assertion, Figure 3 of Lorenz, therefore, does not show that FET, and switch M1, remain off during steps 4 to 6 of Lorenz's method.

On the record before us, the Examiner does not identify any disclosure in Lorenz that teaches or would have suggested switching M1 off (the step-down converter switch) to allow a primary current to fall to zero, and toggling Q1 and Q2 (the two switches for the primary windings ("the two corresponding switches")) after switching M1 off (the step-down converter switch) *while M1 (the step-down converter switch) remains off*, as required by claims 11 and 21.

Nor does the Examiner provide an explanation grounded in sound technical reasoning for why one of ordinary skill in the art would have modified Lorenz's method to involve such steps, in view of Lorenz's disclosure that the purpose of Lorenz's multi-charge ignition system is to produce a continuous ignition spark, and disclosure that M1 preferably is permanently switched on and off to hold the energy in the transformer on a constant level. As Appellant argues, one of ordinary skill in the art reasonably would have understood that M1 would need to be switched back on after switching it off to provide a source of energy to the transformer to hold the energy in the transformer on a constant level, allowing the transformer to produce a continuous ignition spark, and if M1 were to remain off, a source of energy would not exist for continuously producing an ignition spark. Reply Br. 2–3.

We, accordingly, do not sustain the Examiner's rejection of claims 11–21 under 35 U.S.C. § 103(a).

CONCLUSION

Claims	35 U.S.C. §	Reference(s)/ Basis	Affirmed	Reversed
11–21	103(a)	Lorenz		11–21

REVERSED