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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/042,971	10/01/2013	Ross Dykstra Pursifull	83387215	6730

36865 7590 11/29/2019

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ART UNIT	PAPER NUMBER
3747	

NOTIFICATION DATE	DELIVERY MODE
11/29/2019	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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Ex parte CHIH-CHANG CHOU and WAN-YI LIN

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Appeal 2017-010008
Application 14/042,971
Technology Center 3700

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Before BRADLEY B. BAYAT, FREDERICK C. LANEY, and PAUL J. KORNICZKY, *Administrative Patent Judges*.

LANEY, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant[1] appeals under 35 U.S.C. § 134(a) from the Examiner's decision (mailed Sept. 8, 2016, hereinafter "Non-Final Act.") rejecting claims 1–20 under 35 U.S.C. § 103(a) as unpatentable over Pursifull (US 2009/0090331 A1, pub. Apr. 9, 2009) and Cheever (US 2014/0150751 A1, pub. June 5, 2014). We have jurisdiction under 35 U.S.C. § 6(b). Appellant's counsel appeared for an oral hearing on September 12, 2019.

We REVERSE.

[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies Ford Global Technologies, LLC as the real party in interest. Appeal Br. 3.

THE CLAIMED SUBJECT MATTER

By way of background, the Specification explains that "[m]any internal combustion engines utilize Gasoline Direct Injection (GDI) to increase the power efficiency and range over which the fuel can be delivered to [a] cylinder" of an engine. Spec. 1. The Specification notes that "GDI fuel injectors may require high pressure fuel for injection to create enhanced atomization for more efficient combustion" and that "a high-pressure fuel pump may be used to increase the pressure of fuel delivered" to these fuel injectors. *Id.* The high-pressure fuel pump may include a solenoid actuated "spill valve" (SV) to control flow of fuel into the high-pressure fuel pump, but throughout operation the actuation of the SV may generate noise/vibration/harshness (NVH). *Id.* The Specification states that the inventors "recognized potential issues" with the previous approaches to address these NVH conditions, but contends that those issues could be overcome, "at least partially," by operating a solenoid valve coupled to a direct injection fuel pump, comprising adjusting a pull-in electrical energy of the solenoid valve based on a fuel injection pump volumetric efficiency.

Claims 1, 10, and 15 are independent. Claim 1 is reproduced below and is illustrative of the claimed subject matter.

> 1. A method for operating a solenoid valve coupled to an inlet valve of a fuel injection pump, comprising:
>
> *adjusting a pull-in electrical energy of the solenoid valve*, including adjusting a pull-in applied voltage level of a duty cycle of the solenoid valve and a pull-in applied voltage duration of the duty cycle, *based on a fuel injection pump volumetric efficiency*.

Appeal Br. 28, Claims App. (emphasis added).

ANALYSIS

The Examiner's determination that independent claims 1, 10, and 15 would have been obvious in view of Pursifull and Cheever depends on a finding that Pursifull discloses adjusting a pull-in electrical energy of a solenoid valve coupled to an inlet valve of a fuel injection pump based on a fuel injection pump volumetric efficiency. *See* Non-Final Act. 2, 4, 5. Appellant argues that Pursifull does not support this finding by Examiner. Appeal Br. 10–11, 24, 26. For the following reasons, we agree.

The Examiner cites paragraphs 4, 16, 17, 19, 24, and 25 of Pursifull as disclosing adjusting a pull-in electrical energy of the solenoid valve, including adjusting a pull-in applied voltage duration of the duty cycle, based on a fuel injection pump volumetric efficiency. Non-Final Act. 2, 4, 5. The Examiner, however, does not identify anything specific within these paragraphs that supports these findings. Subsequently, in response to arguments made by Appellant before the Non-Final Action, the Examiner explains that paragraph 24 of Pursifull "discloses how the desired rail pressure would create a high pressure pump command to move a specified amount of fuel into the fuel rail" and paragraph 19 "discloses controlling the 'flow control valve' which is item 142, a solenoid, 'to control the amount of fuel delivered during the pump stroke.'" *Id.* at 7. The Examiner states paragraph 19 is not dealing only with the volume of fueled delivered, but "if one has a certain volume of fuel to deliver to the fuel rail one must know the volumetric efficiency of the pump to accurately control the flow control valve to deliver said volume." *Id.* The Examiner asserts, "[t]he volumetric efficiency of a pump will inform a person how many units of fuel can be moved by the pump." *Id.* The Examiner explains further,

> [p]aragraph 25 discloses determining a volumetric efficiency error and paragraph 19 discloses controlling volume pumped by controlling the solenoid valve, it would have been obvious to one having ordinary skill in the art at the time the invention was made to consider an already contemplated error in the high pressure fuel injection pump when controlling the solenoid valve to control a volume of fuel actually pumped to the fuel rail.

Id.

In the Answer, the Examiner notes that "[t]here is always inefficiencies in pumps which is a measurement called volumetric efficiency." Ans. 3. The Examiner asserts that, in paragraph 25, Pursifull "discloses how the command signal operating the pump (shown in fig. 1B as controlling the solenoid valve) is used to 'identify the efficiency of the higher pressure pump'" and that, in paragraph 30, Pursifull discloses an efficiency setpoint for the high pressure fuel pump, which can be varied by the control system. *Id.* The Examiner concludes, "[t]he only control that the control system has to directly command the high pressure pump is through the solenoid valve and so this variation of the volumetric efficiency is done through the voltage provided to the solenoid valve." *Id.* at 4.

We agree with the Examiner that Pursifull discloses a solenoid valve coupled to an inlet valve of a fuel injection pump, which has a controller that enables an efficiency setpoint to be either fixed or varied, and that Pursifull discloses calculating and using volumetric efficiency, but the Examiner has not shown that Pursifull discloses using volumetric efficiency to control the selection of the efficiency setpoint for the pump. First, Pursifull teaches that the efficiency setpoint can be either set "to provide desired pump efficiency or effectiveness" or "the efficiency setpoint can be varied *responsive to pump temperature, pump speed, fuel temperature, or other ambient*

conditions." Pursifull ¶ 30. In other words, Pursifull suggests fixing the efficiency setpoint value or varying that values based on factors other than volumetric efficiency calculated. Second, although Pursifull also teaches controlling the high pressure pump, which has the solenoid valve, based on fuel *pressure* error to maintain a prescribed fuel rail pressure (*id.* ¶24), Pursifull teaches using volumetric efficiency to control a different pump in the system—namely, the lower pressure pump, which does not include a solenoid valve (*id.* ¶25). *See id.* Fig. 2. Specifically, Pursifull states that the volumetric efficiency "can be used by controller **214** to identify and issue a pump command *for the lower pressure fuel pump* **130**." *Id.* ¶ 25, Fig. 2 (emphasis added). None of the other paragraphs of Pursifull cited by the Examiner suggest using volumetric efficiency to actually control the high pressure pump. On this record, the Examiner simply has not made a showing sufficient to establish Pursifull discloses adjusting a pull-in electrical energy of a solenoid valve coupled to an inlet valve of a fuel injection pump based on a fuel injection pump volumetric efficiency.

As a result, a preponderance of the evidence fails to support the Examiner's obviousness determination of independent claims 1, 10, and 15, as well as those claims depending therefrom. Therefore, we do not sustain the Examiner's rejection of claims 1–20 as being unpatentable in view of Pursifull and Cheever.

CONCLUSION

The rejection of claims 1–20 under 35 U.S.C. § 103(a) is reversed.

DECISION SUMMARY

Claims Rejected	Basis	Affirmed	Reversed
1–20	§ 103 Pursifull, Cheever		1–20

REVERSED