

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BELIMO AUTOMATION AG and BELIMO AIRCONTROLS (USA),
INC.,
Petitioner,

v.

BELPARTS GROUP, N.V.,
Patent Owner.

IPR2022-00692
Patent 9,823,666 B2

Before HUBERT C. LORIN, HYUN J. JUNG, and
JAMES A. TARTAL, *Administrative Patent Judges*.

LORIN, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background

Belimo Automation AG and Belimo Aircontrols (USA), Inc. (collectively, “Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–19 and 21–30 of U.S. Patent No. 9,823,666 B2 (Ex. 1001, “the ’666 patent”). Bellparts Group, N.V. (“Patent Owner”) filed a Preliminary Response (Paper 9, “Prelim. Resp.”).

We have jurisdiction under 35 U.S.C. § 6.

Upon consideration of the arguments and evidence presented by Petitioner, we are persuaded that Petitioner has demonstrated, under 35 U.S.C. § 314(a), a reasonable likelihood that it would prevail in showing the unpatentability of at least one challenged claim.

For the reasons stated below, we institute *inter partes* review as to challenged claims 1–19 and 21–30 of the ’666 patent.

B. Related Proceedings

Petitioner indicates, and Patent Owner agrees, that the ’666 patent was asserted in *Belparts Group, N.V., v. Belimo Automation AG and Belimo Aircontrols (USA), Inc.*, No. 3:21-cv-00334-SALM (D. Conn. 2021) (“District Court Action”). Pet. 2; Paper 5.¹

Also, Petitioner notifies us that related U.S. Patent No. 10,394,257 (“the ’257 patent”) is also being asserted by Patent Owner in the District Court Action and that Petitioner is “currently requesting *inter partes* review of the ’257 patent.” Pet. 2. We note that Petitioner has requested *inter*

¹ Patent Owner indicates that the last portion of the Case No. is -00334-VAB, rather than -00334-SALM. Paper 5.

partes review of the '257 patent² in IPR2022-00698. *See* IPR2022-00698, Paper. 2.

C. The '666 patent (Ex. 1001)

1. Disclosure

The '666 patent, titled “Flow Control System,” relates to a system for “controlling a flow of a medium passing through a pipe part of a pipe system” in which “the medium is distributed from a common source to a plurality of consumer devices.” Ex. 1001, code (54), 1:11–15.

The '666 patent explains that in buildings, a pipe system is used to distribute “a medium from a common source to a number of consumer devices spread over the building.” *Id.* at 1:16–20. According to the '666 patent, such consumer devices include heat exchange systems and pipe systems for sanitary applications having water taps and “control valves with an adjustable orifice for controlling the flow of medium to the respective consumer device.” *Id.* at 1:30–39. The '666 patent explains that the amount of the medium passing through the consumer device is determined by the position of the orifice and “the pressure at which the medium is passed through the consumer device,” which differs depending on the distance between the common source and the consumer device. *Id.* at 1:44–50. In non-residential buildings having a pipe system running through a plurality of floors, closing of a valve may lead to an undesirable increase of pressure through a medium in a heat exchanger of a particular room. *Id.* at 1:50–62.

² The '257 patent is a continuation of the '666 patent.

The '666 patent discloses that flow regulation control valves and sensors have been used to sense “a value representative of a flow through the flow chamber” and “characteristic values of the section of control valve” are then determined and stored for later manual adjustment of the flow regulation control valve for a desired flow. *Id.* at 2:15–31. But these characteristic values are valve specific and their control systems have the disadvantage in that “only a narrow range of pressure variations can be accurately compensated for.” *Id.* at 2:31–40. The '666 patent purports to resolve these problems by providing “a widely applicable, pressure independent flow control system with accurate control of the flow rate.” *Id.* at 2:55–57.

Figure 1 of the '666 patent, reproduced below, depicts a pressure independent flow control system.

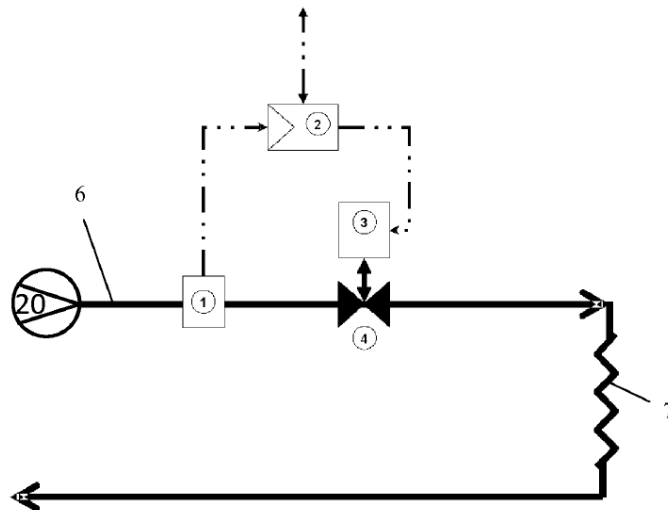


FIG. 1

Figure 1 of the '666 patent (Ex. 1001) shows “a flow control system associated with” consumer device 7. *Id.* at 6:9–11, 16–17.

Consumer device 7 depicted in Figure 1 is a heat exchange system which is provided in pipe part 6 of a pipe system, which distributes a

medium from a common source (not shown) to a plurality of consumer devices. *Id.* at 6:16–21. The flow control system comprises flow sensor 1, controller 2, and orifice adjusting systems 3, 4. *Id.* at 6:21–22. Flow sensor 1 is “for sensing an actual medium flow” through pipe part 6 and for outputting signal of the sensed flow. *Id.* at 6:23–25. Controller 2 is in communicative connection to flow sensor 1 for evaluating the signal “with a value representing a set medium flow and outputting a control signal based on this evaluation.” *Id.* at 6:25–30. Orifice adjusting systems 3, 4 are in communication with controller 2 and each comprises flow chamber 11 with adjustable orifice 12 (shown in Figures 14 and 15), “by which the flow through” pipe part 6 “can be adjusted.” *Id.* at 6:33–37.

Figure 14 of the '666 patent, reproduced below, depicts such flow chamber and adjustable orifice.

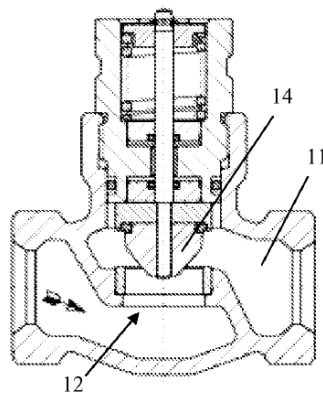


FIG. 14

Figure 14 of the '666 patent shows a cross section of a two-way valve for use in a flow control system, having flow chamber 11, movable part 14, and adjustable orifice 12. *Id.* at 6:12–15, 33–42.

Orifice adjusting systems 3, 4 have “an equal-percentage characteristic curve, so that the adjustable orifice is more sensitive at lower flow rates than at higher flow rates” via design of their movable part 14

(shown in Figures 14 and 15), which can be a two-way control valve or a three-way control valve. 7:11–24. The '666 patent discloses that

the system may comprise an additional application, wherein the flow control system is used to influence, software-wise, the characteristic curve of the three-way control valve. Such a system may for instance be used to change a linear characteristic curve of the adjustable orifice in a non-linear characteristic curve or vice versa. This software-like correction of the characteristic curve can also be used in the systems shown in FIGS. 1–2, wherein a two-way valve is used.

Id. at 7:66–8:7.

The '666 patent further discloses that “the flow sensor is arranged outside the flow chamber and has a static measurement principle based on a wave propagating in the medium.” *Id.* at 3:29–31. Such flow sensors that can be used include ultrasonic flow sensors, vortex flow sensors, and electromagnetic flow sensors. *Id.* at 3:48–62. The '666 patent discloses that in its system, “the controller makes an evaluation on the level of flow, i.e. directly compares the sensed flow (the output signal of the flow sensor) with the set flow (possibly derived from a setting).” *Id.* at 4:13–16.

2. Claims 1–19 and 21–30

Petitioner challenges claims 1–19 and 21–30. Pet. 1.

Claim 1 is the independent claim from which claims 2–19 and 21–24 depend. Claim 25 is the independent claim from which claims 26–30 depend. Claims 1 and 25 are reproduced below. Bracketing is added to assist in referring to the claim elements, following Petitioner’s Listing of Claims. *See* Pet., Claims List pp. 1–11.

1. [Preamble] A central heating/cooling system and/or sanitary system, comprising:

[1(a)] a liquid medium;

[1(a)] a common source provided for delivering the liquid medium;

[1(b)] a plurality of consumer devices connected to the common source through a pipe system via which the liquid medium is distributed, wherein the consumer devices comprise heat exchange systems, water taps, or heat exchange systems and water taps;

[1(c)] at least one flow control system associated with at least one of the plurality of consumer devices and provided for controlling a flow of the liquid medium passing through a pipe part of the pipe system and thereby controlling the flow of the liquid medium towards the associated at least one consumer device, the flow control system comprising:

[1(d)] a flow sensor for sensing an actual medium flow through the pipe part and outputting an electrical signal indicative of the sensed actual medium flow;

[1(e)] a flow controller in communicative connection with the flow sensor and outputting a control signal; and

[1(f)] an orifice adjusting system in communicative connection with the flow controller, the orifice adjusting system comprising a flow chamber with an adjustable orifice in the pipe part, the orifice adjusting system being provided for adjusting the adjustable orifice in response to the control signal of the flow controller, [1(g)] the orifice adjusting system having a characteristic curve,

[1(h)] wherein the flow sensor is arranged outside the flow chamber and has a static measurement principle based on a wave propagating in the liquid,

[1(i)] wherein the flow controller has as input a value representing a medium flow rate set point, and wherein the flow controller is provided for evaluating the electrical signal indicative of the sensed actual medium flow with the value representing the medium

flow rate set point and outputting the control signal based on said evaluation, and

[1(j)] the flow control system is arranged to provide a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations.

Ex. 1001, 10:5-47.

25. [Preamble] A central heating/cooling system and/or sanitary system, comprising:

[25(a)] a liquid medium;

[25(a)] a common source provided for delivering the liquid medium;

[25(b)] a plurality of consumer devices connected to the common source through a pipe system via which the liquid medium is distributed, wherein the consumer devices comprise heat exchange systems, water taps, or heat exchange systems and water taps;

[25(c)] a plurality of flow control systems, each being associated with a group of at least one of the plurality of consumer devices and being provided for individually controlling a flow of the liquid medium passing through a pipe part of the pipe system and the associated group of consumer devices, each flow control system comprising:

[25(d)] a flow sensor for sensing an actual medium flow through the pipe part and outputting an electrical signal indicative of the sensed actual medium flow; wherein the flow sensor is arranged outside a flow chamber and has a static measurement principle based on a wave propagating in the liquid medium;

[25(e)] a flow controller in communicative connection with the flow sensor and outputting a control signal, wherein the flow controller has an input value representing a medium flow rate set point, and wherein the flow controller is provided for evaluating the electrical signal indicative of the sensed actual medium flow with the value representing the medium flow rate

set point and outputting the control signal based on said evaluation; and

[25(f)] an orifice adjusting system in communicative connection with the flow controller, the orifice adjusting system comprising the flow chamber with an adjustable orifice in the pipe part, [25(g)] the orifice adjusting system being provided for adjusting the adjustable orifice in response to the control signal based on said evaluation and thereby controlling the flow in the pipe part until the actual medium flow equals the medium flow rate set point, [25(h)] the orifice adjusting system having a characteristic curve, and the flow control systems arranged to provide a real-time software-wise correction of the characteristic curve of the orifice in the adjusting system to compensate for pressure variations.

Id. at 12:40–13:16.

D. Asserted References

Petitioner relies on the following references:

Name	Reference	Ex. No.
Elshafei	U.S. Patent Application Publication No. 2009/0240376 A1, published Sept. 24, 2009	1011
Erdmann	German Publication No. DE 4019503 A1, published Jan. 2, 1992	1008 ³
Forshey	U.S. Patent Application Publication No. 2005/0150552 A1, published July 14, 2005	1012
Lull	U.S. Patent Application Publication No. 2004/0074311 A1, published Apr. 22, 2004	1009
McIntosh	International Publication No. WO 98/25086 A1, published June 11, 1998	1004
Shen	Chinese Publication No. CN 1837996 A, published Sept. 27, 2006	1006 ⁴
Tsuyoshi	Japanese Unexamined Patent Application Publication No. JP1993-202901 A, published Aug. 10, 1993	1005 ⁵

Petitioner also relies on the Declaration of Gregor P. Henze, Ph.D., P.E. (Ex. 1003, “Henze Declaration”) and excerpts from the prosecution file for the ’666 patent (Ex. 1002) as support for various contentions.

Patent Owner relies on the declarations of Jan Ulens, one of the three named inventors on the ’666 patent (Ex. 2001; “Ulens Declaration”); Klas

³ Ex. 1008 is a certified English translation.

⁴ Ex. 1006 is a certified English translation.

⁵ Ex. 1005 is a certified English translation.

Haglid (Ex. 2002; the “Haglid Declaration”); and, Stephanie Sarlet (Ex. 2019; the “Sarlet Declaration”) as support for various contentions.

E. Asserted Grounds

Petitioner contends that claims 1–19 and 21–30 of the ’666 patent are unpatentable under the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 2, 4–13, 17–19, 21–30	§ 103 ⁶	McIntosh, Tsuyoshi, Shen
3, 14, 15	§ 103	McIntosh, Tsuyoshi, Shen, Forshey
16	§ 103	McIntosh, Tsuyoshi, Shen, Lull
1, 2, 4–13, 17–19, 21–30	§ 103	McIntosh, Elshafei, Shen
3, 14, 15	§ 103	McIntosh, Elshafei, Shen, Forshey
16	§ 103	McIntosh, Elshafei, Shen, and Lull
1–5, 19, 21–30	§ 103	Erdmann, Forshey
6–13, 17, 18	§ 103	Erdmann, Forshey, McIntosh
14, 15	§ 103	Erdmann, Forshey, Shen
16	§ 103	Erdmann, Forshey, Lull

⁶ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §§ 102 and 103. Because the challenged claims of the ’666 patent have an effective filing date before the effective date of the applicable AIA amendments, we refer to the pre-AIA versions of 35 U.S.C. § 103 throughout this Decision.

1–5, 19, 21–30	§ 103	Erdmann, Forshey, Tsuyoshi
6–13, 17, 18	§ 103	Erdmann, Forshey, Tsuyoshi, McIntosh
14, 15	§ 103	Erdmann, Forshey, Tsuyoshi, Shen
16	§ 103	Erdmann, Forshey, Tsuyoshi, Lull

Pet. 5–6.

II. ANALYSIS

A. *Principles of Law for Patentability*

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, “would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the

grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

C. Level of Ordinary Skill in the Art

Petitioner contends:

A person having ordinary skill in the field at the time of the purported invention of the ’666 Patent would have at least a bachelor’s degree in mechanical engineering, architectural engineering or other similar type of engineering degree, combined with at least two years of experience in the field of control systems or relevant systems design experience.

Pet. 15 (citing Ex. 1003 ¶¶ 34–36). Patent Owner does not, at this time, dispute Petitioner’s proposed definition. *See Prelim. Resp., generally.*

Petitioner’s proposed definition of a person of ordinary skill in the art appears reasonable, and we adopt that definition for our analysis in this decision.

Moreover, we see no reason why the level of ordinary skill in the art is not adequately reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

D. Claim Construction

For petitions filed on or after November 13, 2018,

[claims] of a patent . . . shall be construed using the same claim construction standard that would be used to construe the [claims] in a civil action under 35 U.S.C. § 282(b), including construing the [claims] in accordance with the ordinary and customary meaning of such claims

as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

37 C.F.R. § 42.100 (2019); *see also Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005).

Petitioner proposes construction for the following terms: (1) “orifice adjusting system;” (2) “characteristic curve;” (3) “software-wise correction of the characteristic curve of the orifice adjusting system;” (4) “real-time;” (5) “static measurement principle;” and (6) “quieting section.” *See* Pet. 10–14.

Patent Owner does not submit constructions for any claim terms. Moreover, Patent Owner states, “[i]n the underlying litigation, [] Belimo and Belparts have certain disputes as to the proper claim construction of the ’666 Patent,” but “for the purposes of this Patent Owner Statement, none of these disputes are material.” Prelim. Resp. 24.

Only those terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). To the extent the meaning of any term requires discussion, however, we provide it in our analysis of the patentability challenges.

E. Overview of the Prior Art References

1. Elshafei (Ex. 1011)

Elshafei “relates to devices for controlling the flow of a fluid through a conduit, and particularly to a system and method for controlling flow characteristics of a fluid through a valve.” Ex. 1011 ¶ 2.

Figure 2 of Elshafei, reproduced below, shows “a data plot illustrating control valve characteristics for an exemplary valve regulated by” Elshafei’s system and method for controlling flow characteristics, “shown as flow percentages plotted against stem opening percentages.” *Id.* ¶ 13.

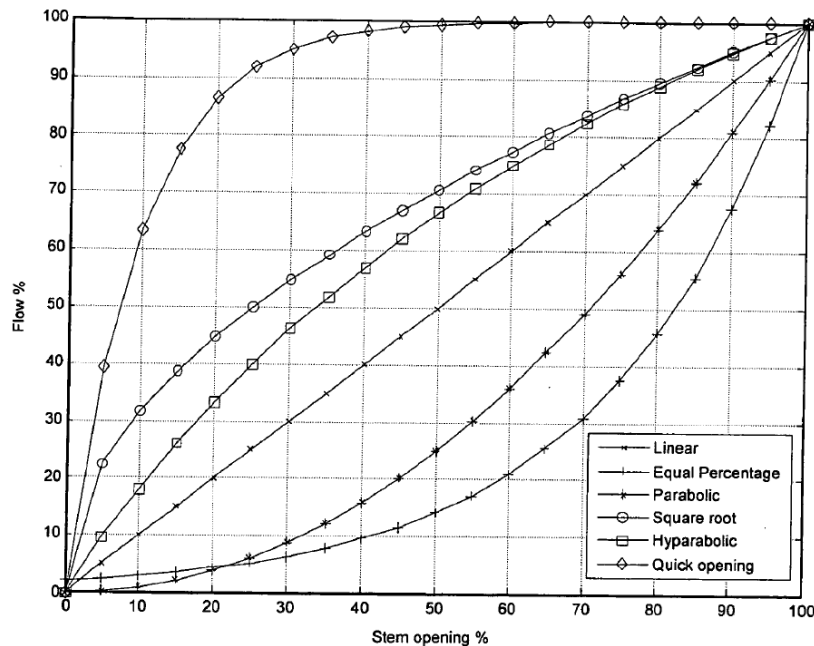


Figure 2 of Elshafei (Ex. 1011) showing a data plot with control valve characteristics that include linear and equal percentage.

Elshafei discloses that “[i]n many types of fluid systems, it is necessary to modulate or otherwise control a flow of fluid through a fluid circuit” such as in “heating, ventilation and air conditioning (HVAC) systems for buildings.” *Id.* ¶ 4. Elshafei’s method allows modifying valve flow characteristics following linear or equal percentage equations with exemplary data plots as shown in Figure 2. *Id.* ¶ 29. These “functions and their inverses are samples of possible standard functions that are stored in the firmware” of Elshafei’s system. *Id.* ¶ 30. After an operator “enters the maximum differential pressure and the operating differential pressure, as

well as the maximum and minimum flow,” a correction factor “is then calculated to convert the inherent characteristics to values that are close to the desired valve flow characteristics.” *Id.* ¶ 31. Elshafei discloses that its system “monitors the upper and lower ranges of the differential pressure and identifies these ranges” and “[t]he knowledge of these estimated values, the rated values of the valve, and the process type are used to select and automatically set the desired flow characteristics.” *Id.* ¶ 44.

2. *Erdmann (Ex. 1008)*

Erdmann, titled “Device for controlling the control valve of a central heating system,” relates to a device “having an electrically controllable actuating device for actuating [a] control valve.” Ex. 1008, code (54), 3:2–4. Erdmann discloses that its control device controls an actuating device “in such a manner that the actuating device sets the valve stroke of the valve according to a predefined flow rate” and affects the “arbitrary change to the valve stroke/flow rate characteristic curve by using the valve stroke/flow rate correction characteristic curve.” *Id.* at 5:12–18. Erdmann’s device allows a flow rate to be “determined according to the thermodynamic conditions, for example by means of a temperature regulating device of the control device” so that “the control device no longer causally predefines a valve stroke of the control valve.” *Id.* at 5:20–25. Erdmann discloses that the “associated valve stroke of the control valve according to the valve stroke/flow rate correction characteristic curve stored in the memory is then determined using this predefined flow rate of the control valve” and that the “control value corresponding to the valve stroke of the control valve is forwarded to the actuating device of the device” which “sets the valve stroke of the control valve in the desired way.” *Id.* at 5:25–33. According to

Erdmann, the “valve stroke/flow rate correction characteristic curve in the memory can be advantageously chang[e]able in order to adapt, for example on the basis of changes in the hydraulic conditions of the heating system or the thermodynamic conditions of the radiator or of the entire heating system.” *Id.* at 6:33–7:2. Erdmann further discloses that the “valve stroke/flow rate correction characteristic curve can also be controllable” by means of a further central control device of the central heating system “in order to make it possible to adapt this characteristic curve to the hydraulic conditions or the thermodynamic conditions of the entire central heating system.” *Id.* at 7:18–24.

Erdmann discloses “a central heating system having a plurality of devices” in Figure 1. *Id.* at 8:28–29. Figure 1 is reproduced below.

Fig. 1

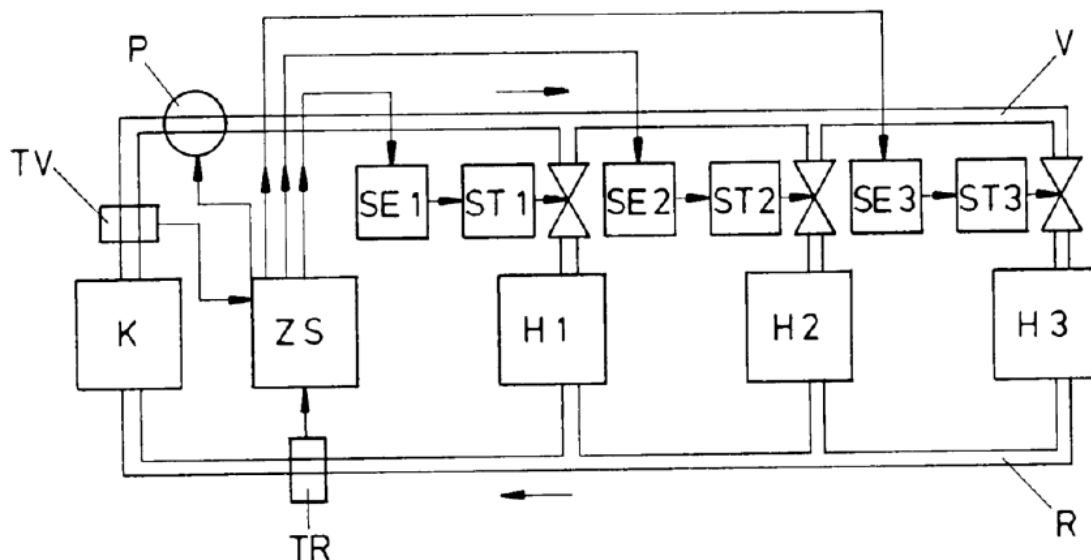


Figure 1 shows a central heating system including boiler K that supplies a heating medium such as hot water to first radiator H1, second radiator H2, and third radiator H3, via supply line V, water pump (P), and central heating control device ZS. *Id.* at 9:6–15. Also shown is a supply temperature sensor (TV) in the supply line (V), a return temperature sensor (TR) which is arranged in a return line (R) from the radiators (H1 to H3) to the boiler (K). *Id.* at 9:18–23.

In Erdmann’s central heating system, water pump P is arranged to convey the heating medium and its speed and capacity is controlled by central heating control device ZS. *Id.* at 9:10–15. Supply temperature sensor TV measures the supply temperature and return temperature sensor TR measures the return temperature to use for controlling pump P. *Id.* at 9:17–23. To this end, these measured temperatures are supplied to central heating control device ZS, so that central heating control device ZS can control first control device SE1, second control device SE2, and third control device SE3, “which are parts of devices” that can control actuating devices ST1, ST2, and ST3, “which can in turn set the valve stroke of three control valves assigned to the actuating devices.” *Id.* at 9:25–33.

3. Forshey (Ex. 1012)

Forshey “relates to a device, method, and system for controlling the flow rate of a fluid.” Ex. 1012 ¶ 3.

Figure 1, reproduced below, shows a schematic view of Forshey’s flow control device.

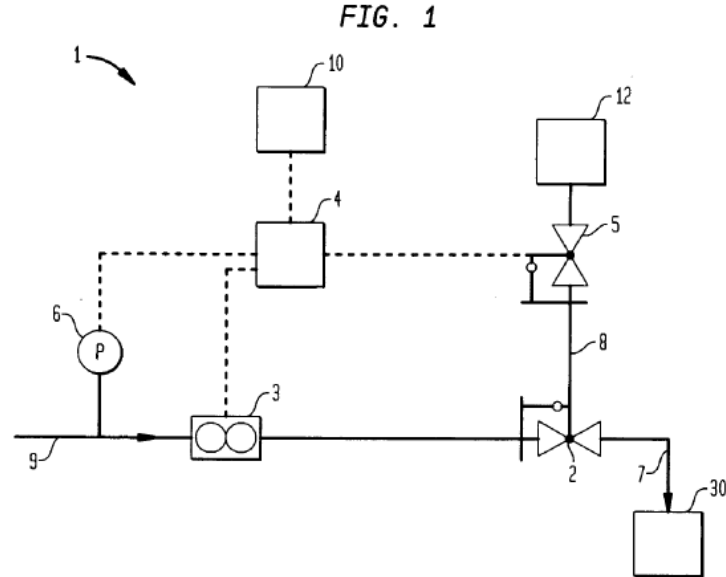


Figure 1 of Forshey (Ex. 1012) is a schematic view of flow control device 1 that includes fluid flow control valve 2, flow meter 3, and controller 4. *Id.* ¶¶ 25–26.

Forshey discloses that as shown in Figure 1, “flow meter 3 may be positioned to measure the fluid flow rate upstream of fluid flow control valve 2.” *Id.* ¶ 30. Controller 4 is used to “determine a difference between the desired flow rate and the measured flow rate and generate an adjustment signal.” *Id.* ¶ 36.

4. Lull (Ex. 1009)

Lull “relates generally to a method and system for controlling the flow rate of a fluid, and more particularly to methods and systems involving mass flow controllers.” Ex. 1009 ¶ 2.

Figure 1, reproduced below, shows a schematic block diagram of Lull’s mass flow controller. *Id.* ¶ 41.

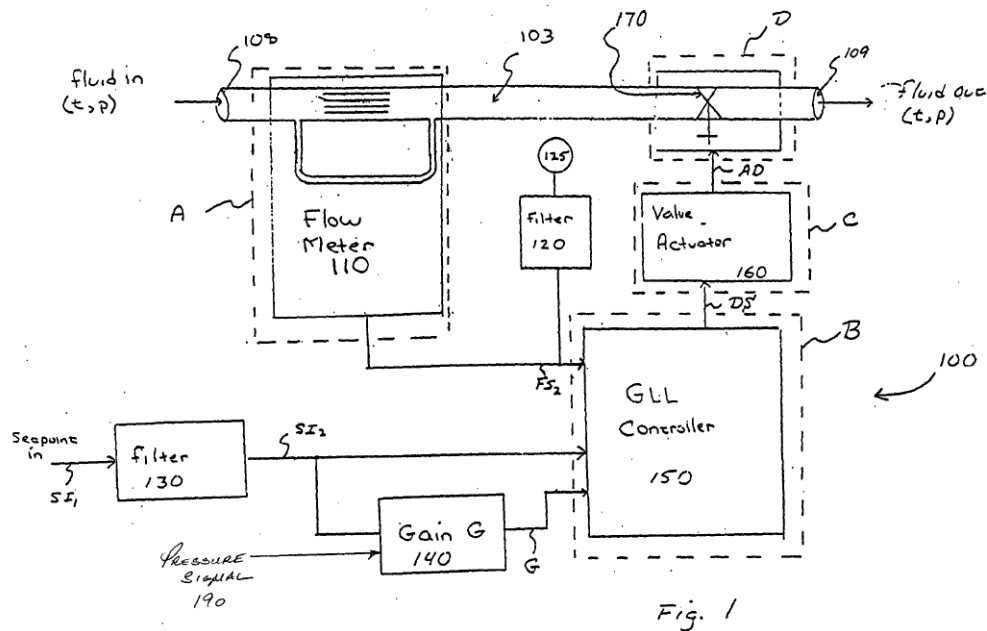


Figure 1 of Lull (Ex. 1009) is a schematic block diagram of a mass flow controller 100 that includes flow meter 110, GLL (Gain/Lead/Lag) controller 150, valve actuator 160, and valve 170. *Id.* ¶ 106.

Lull discloses that as shown in Figure 1, flow meter 110 “senses the flow rate of a fluid in the flow path, or portion of the flow path, and provides a flow signal FS2 indicative of the sensed flow rate.” *Id.* ¶ 107. Flow signal FS2 then is “provided to a first input of GLL controller 150.” *Id.* GLL controller 150 “includes a second input to receive” set point signal SI2. *Id.* ¶ 108. Based in part on flow signal FS2 and set point signal SI2, GLL controller 150 provides drive signal DS to valve actuator 160 that controls valve 170. *Id.* Lull discloses that sensor signal FS1 (shown in Figure 2) “may be converted to a digital signal with the use of an analog to digital (A/D) converter so that all further signal processing” of mass flow controller 100 “may be performed by a digital computer or digital signal processor (DSP).” *Id.* ¶ 136.

5. *McIntosh (Ex. 1004)*

McIntosh, titled “Modulating Fluid Control Device,” relates to “a modulating fluid control device for fluid based heating and cooling systems, and more particularly relates to a smart control valve for such systems.” Ex. 1004, code (54), 1:7–9. McIntosh provides “a more efficient and effective” approach to temperature and energy management in buildings by incorporating “modulating feedback directly” in one pressure independent control valve/balancing valve/BTU meter. *Id.* at 2:16–26.

McIntosh discloses “a four port three-way control valve” that incorporates “two temperature sensors, a flow detector, a room thermostat, a programmable integrated controller (PIC), ports to and from the heat exchanger or load, and ports from and to the fluid supply and return” in Figure 1. *Id.* at 5:5–9. Figure 1 is reproduced below.

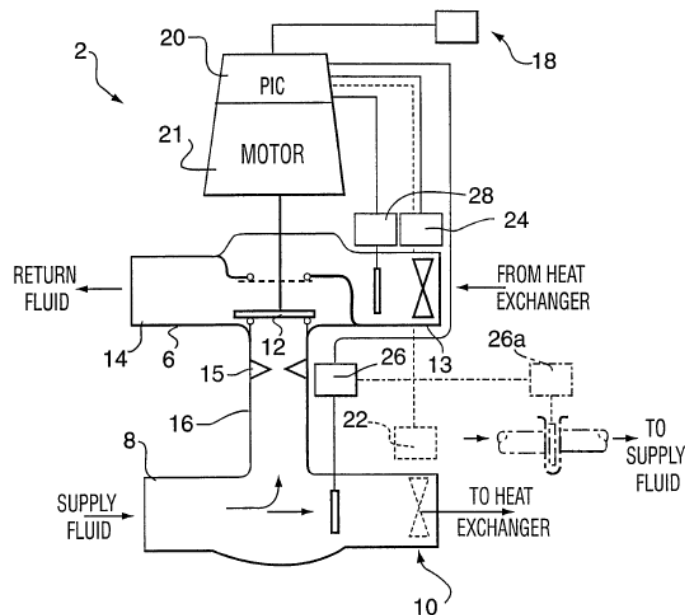


FIG.1

Figure 1 shows fluid control device 2 including a three-way four port valve having body 6 which forms fluid entry port 8 to controlling valve plug 12, and exit port 10 to a heat exchanger. *Id.* at 5:28–6:2.

In McIntosh's fluid control device 2, fluid returning from the heat exchanger enters port 13 and returns via port 14 to the heating and cooling unit. *Id.* at 6:2–4. Programmable integrated controller (PIC) 20 "is associated with valve plug 12" to control valve motor 21 "to position valve plug 12 and thereby regulate the flow of fluid to the heat exchanger." *Id.* at 6:20–23. McIntosh discloses that "PIC 20 is electronically associated with motor 21, and programmed, to control the rate of flow of fluid as detected by either detector 22 or 24" (shown in Figure 2) "to appropriately position valve plug 12 as commanded by thermostat 18" (shown in Figure 2) "or maximum programmed flow as per water system balancing requirement or BTU if required." *Id.* at 7:3–8.

McIntosh discloses that "[t]he thermostat is adapted to provide signals to the valve controller (e.g. PIC)" and "[t]he flow detection means and the valve controller are arranged to maintain a required rate of flow of fluid through the system as measured by the flow detection means." *Id.* at 3:11–15. In reference to Figure 1, McIntosh discloses that "by providing a feedback signal to PIC 20 taken from flow detector 22," valve plug 12 is driven "to an actual delivered flow rate" and thus, "the rate of flow will be maintained regardless of changes in system differential pressures." *Id.* at 7:27–8:3. According to McIntosh, its valves "can be programmed to or limited to a maximum BTU or CFM flow rate, limiting or optimizing the maximum flow." *Id.* at 9:11–13.

6. *Shen (Ex. 1006)*

Shen is titled “A control method and a valve for dynamic balancing electric regulating valves having energy metering function.” Ex. 1006, code (54). Shen discloses that there are well-known principles and methods for central air conditioning cold and heat metering. *Id.* at 5. According to Shen, the cold and heat meter “is mainly composed of a flowrate sensor, a pairing temperature sensor, and an integrator (controller)” and that “[d]epending on different forms of the flowrate sensor, such energy meters are also categorized into mechanical impeller type, ultrasonic type, and electromagnetic type.” *Id.* Shen discloses “a dynamic balancing electric regulating valve having energy metering function” that includes a “backwater temperature sensor” and a “water supply temperature sensor” and a method for controlling “typical pressure-independent electronic dynamic balancing electric valves.” *Id.* at 9, 12.

7. *Tsuyoshi (Ex. 1005)*

Tsuyoshi “relates to a valve positioner that has been improved so that the input/output characteristic can be optimized according to the usage conditions by combining various control valves and positioners.” Ex. 1005, ¶ 1.

Tsuyoshi’s Figure 1 is reproduced below.

[FIG. 1]

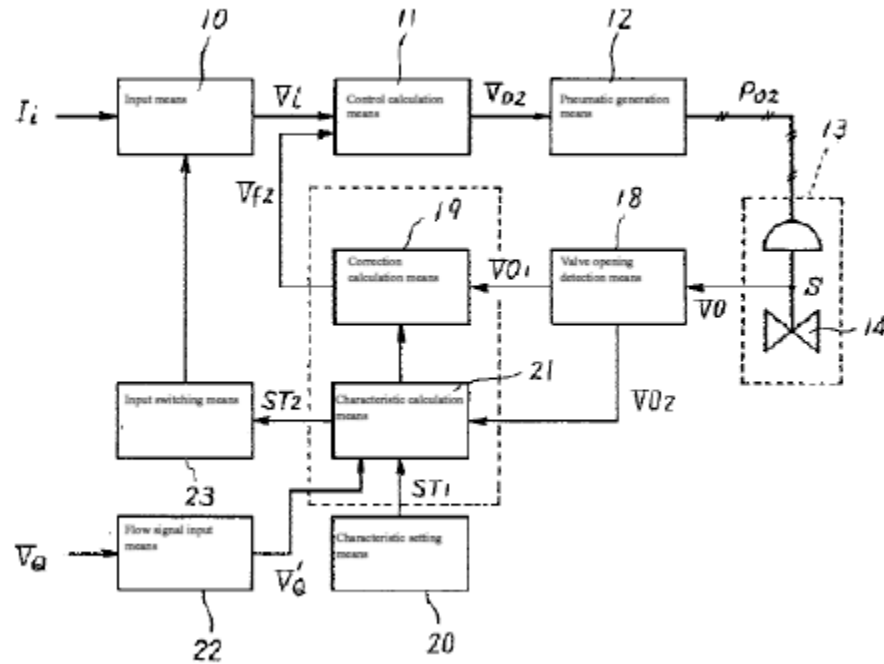


Figure 1 shows a block diagram of functions of a valve positioner that includes control valve 13 which “displaces its stem S” to control valve opening VO of valve 14. *Id.* ¶¶ 18, 20.

In Tsuyoshi’s valve positioner, “[t]he flow rate signal V_Q from a flow meter or the like connected to” control valve 13 is input to flow rate signal input means 22, “which is converted into, for example, a digital signal V_Q and output to” characteristic calculation means 21. *Id.* ¶ 23. Tsuyoshi further discloses:

The characteristic calculation means 21 calculates the flow rate vs. valve opening characteristic Y from the valve opening signal VO_2 corresponding to the switched voltage signal viewing and the flow rate signal. The correction curve Z is calculated from the flow rate vs. valve opening characteristic Y and the valve characteristic X, and this is set in the correction calculation means 19.

Id. ¶ 25. Tsuyoshi discloses that after that, control valve 13 valve opening “is controlled by the current signal I_i using the correction curve Z set in the correction calculation means 19.” *Id.* ¶ 26.

F. Grounds I–III

1. Ground I

Petitioner challenges claims 1, 2, 4–13, 17–19, and 21–30 as unpatentable under 35 U.S.C. § 103(a) over the combination of McIntosh, Tsuyoshi, and Shen. Pet. 16–62.

Basically, Petitioner contends that McIntosh (Ex. 1004) discloses all of the “central heating/cooling system and/or sanitary system” that is claimed but for the following two limitations in each of claims 1 and 25:

- a flow sensor having “a static measurement principle based on a wave propagating in the liquid” (Ex. 1001, 10:35–36, (“1(h)”); 12:59–61 (“25(d)”); and,
- a flow control system “arranged to provide a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations” (*id.*, 10:44–46 (“1(j)”); 13:13–16 (“25(h)”),

for which Shen and Tsuyoshi, respectively, are relied upon. Regarding Shen, *see* Pet. 37 (1(h)) and 61 (25(d)), and regarding Tsuyoshi, *see id.* at 39–44 (1(j)) and 59–62 (claim 25(h)).

Patent Owner disagrees, arguing *inter alia* that Shen is a teaching away and Tsuyoshi “does not disclose or suggest correcting a characteristic curve of a valve to compensate for pressure variations.” Prelim. Resp. 21, 28.

For the reasons explained herein, after having evaluated the parties’ positions based on the record presented at this stage of the proceeding,

Petitioner sufficiently shows that one of ordinary skill would have been motivated to combine the teachings of McIntosh, Tsuyoshi, and Shen in the manner recited in the claims, at the time of the filing of the '666 patent, thereby reaching the “central heating/cooling system and/or sanitary system” as claimed.

We now more specifically evaluate the sufficiency of Petitioner’s showing as to each claim element (i.e., preamble, 1(a)–1(j)) of claim 1 in light of Patent Owner’s arguments.

a. Claim 1

We observe that Patent Owner has not responded to Petitioner’s challenge as to the preamble and limitations 1(a)–1(h), and 1(i) with any particularity at this stage of the proceeding. As to these limitations, we have reviewed the evidence Petitioner has presented, briefly discussed below with respect to each limitation, and based on that evidence we determine that at this stage Petitioner sufficiently shows on this record that McIntosh discloses the preamble and limitations 1(a)–1(h) (sensor outside the flow chamber), and 1(i) as claimed.

We discuss Patent Owner’s response to Petitioner’s challenge with respect to limitations 1(h) (static measurement) and 1(j).

Preamble

The preamble calls for “A central heating/cooling system and/or sanitary system.” Ex. 1001, 10:5–6.

Petitioner contends that McIntosh meets this limitation by disclosing “a modulating fluid control device for a fluid-based heating and cooling system for a measured environment.” Pet. 23. (citing Ex. 1004 at Abstract;

Ex. 1003 ¶¶ 73–74). The Henze Declaration additionally explains that “McIntosh describes control systems for HVAC systems.” Ex. 1003 ¶ 73.

1(a): liquid/common source

The claim limitation is “a liquid medium, a common source provided for delivering the liquid medium.” Ex. 1001, 10:7–9.

Petitioner contends that McIntosh discloses said limitation in that “[t]he ‘common supply water’ described in McIntosh is provided by a common source that delivers the fluid to the control valve, as shown above in Figure 1.” Pet. 24 (citing Ex. 1004, 3:4–8; 4:5; Ex. 1003 ¶¶ 75–78). To illustrate, Petitioner provides an annotated version of Figure 1 of McIntosh emphasizing the area around the words “SUPPLY FLUID” and “RETURN FLUID” to indicate a common source of water entering and exiting fluid control device 2. *Id.*; Ex. 1004, Fig. 1, 5:28.

1(b): consumer devices

Limitation 1(b) requires there be “a plurality of consumer devices connected to the common source through a pipe system via which the liquid medium is distributed, wherein the consumer devices comprise heat exchange systems, water taps, or heat exchange systems and water taps.” Ex. 1001, 10–14.

Petitioner contends that McIntosh discloses multiple heat exchangers, thereby disclosing a plurality of consumer devices and satisfying the limitation. Pet. 24–25. According to Petitioner, McIntosh’s “valve control devices can be used in systems with multiple heat exchangers.” *Id.* at 25 (citing Ex. 1004, 11:9–13). To illustrate, Petitioner provides an annotated version of Figure 1 emphasizing the words “FROM HEAT EXCHANGER” and indicating that it is a “*Consumer device*.” *Id.* The Henze Declaration

further explains that “[a]s shown in Figure 1, the heat exchanger is connected to the common source that delivers supply fluid to the valve system by means of a pipe system for distributing the fluid.” Ex. 1003 ¶ 81; Pet. 25.

1(c): flow control system

Limitation 1(c) calls for “at least one flow control system associated with at least one of the plurality of consumer devices and provided for controlling a flow of the liquid medium passing through a pipe part of the pipe system and thereby controlling the flow of the liquid medium towards the associated at least one consumer device.” Ex. 1001, 10:15–20.

Claim 1 further calls for the “flow control system” (Ex. 1001, 10:20–21) to comprise a flow sensor (1(d)), a flow controller (1(d)), and an orifice adjusting system (1(f)). Discussion of these limitations will follow.

Petitioner contends limitation 1(c) is met by McIntosh’s disclosure of fluid control devices that “regulate the flow of fluid to the heat exchanger.” Pet. 26–27 (citing Ex. 1004, Abstract, 13:3–19, 6:18–23; Ex. 1003 ¶¶ 82–84.). Specifically, Petitioner points to the programmable integrated controller 20, the control valve motor 21, and the valve plug 12 depicted in Figure 1 as the means by which McIntosh regulates the flow. *Id.* The Henze Declaration additionally explains that “A POSITA would have also understood that McIntosh’s flow control system was provided for controlling the flow rate of the liquid medium toward the heat exchanger by way of a control valve.” Ex. 1003 ¶ 84.

1(d): flow sensor

Limitation 1(d) is “a flow sensor for sensing an actual medium flow through the pipe part and outputting an electrical signal indicative of the sensed actual medium flow.” Ex. 1001, 10:22–24.

Petitioner contends that McIntosh discloses such a flow sensor by disclosing “a ‘flowmeter’ that measures the flow of the heat transfer fluid and acts as feedback to regulate the flow by adjusting the valve opening.” Pet. 27 (citing Ex. 1004, 4:5–11, Figs. 1, 2). Petitioner provides an annotated version of Figure 1 which points to elements 22 and 24 as “*Flow detector[s]*.” *Id.* at 28. According to Petitioner, “[a]s shown in Figure 1 [], the flow detectors 22 and 24 measure the actual medium flow through a pipe part of the system.” *Id.* at 27 (citing Ex. 1004, 6:26–29; Ex. 1003 ¶¶ 85–86). The flow detectors accomplish said measurement via “‘an electronic feedback signal representative of that flow rate’ to a controller.” *Id.*

1(e): flow controller

Limitation 1(e) calls for the “flow controller [to be] in communicative connection with the flow sensor and outputting a control signal.” Ex. 1001, 10:25–26.

In that regard, Petitioner contends that McIntosh controller 20 depicted in Figure 1 is such a “flow controller.” According to Petitioner, “McIntosh describes a programmable integrated controller that ‘is adapted to control valve motor 21 to position valve plug 12.’” Pet. 28 (quoting Ex. 1004, 6:20–23). Petitioner further explains that “[t]he controller receives ‘signals from the sensor(s) and flow detection means.’” *Id.* (quoting Ex. 1004, 4:1–4). “The controller outputs electronic control signals

to the motor [21] to adjust the valve position [of valve plug 12] and regulate the flow rate.” *Id.* at 28–29 (citing Ex. 1003 ¶¶ 87–88). The Henze Declaration additionally explains that “A POSITA would have understood this signal transfer between the controller and flow sensor to be a communicative connection that allows the controller to receive signals and information from the sensors.” Ex. 1003 ¶ 88. The Henze Declaration further explains that

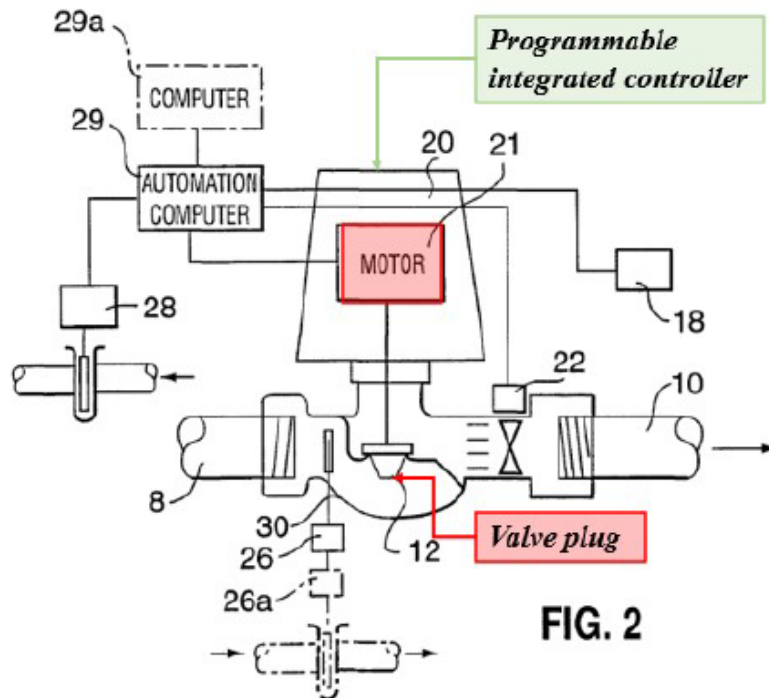
A POSITA would have known that electronic association with the motor 21 involves the controller sending a control signal to the actuator or motor to control the valve. In this way, McIntosh’s controller outputs electronic control signals to the motor to adjust the valve position and regulate the flow rate.

Id.

1(f): orifice adjusting system

Limitation 1(f) calls for “an orifice adjusting system in communicative connection with the flow controller, the orifice adjusting system comprising a flow chamber with an adjustable orifice in the pipe part, the orifice adjusting system being provided for adjusting the adjustable orifice in response to the control signal of the flow controller.” Ex. 1001, 10:27–32.

Petitioner contends that McIntosh’s valve 30 shown in Figure 2 is such an “orifice adjusting system.” Pet. 29 (citing Ex. 1003 ¶¶ 89–92). Reproduced below is Petitioner’s annotated version of Figure 2 showing valve 30. *Id.* at 31.



Petitioner's annotated version of Figure 2 showing valve 30, controller 20, valve motor 21, and valve plug 12. Pet. 31

As far as the orifice adjusting system comprises “a flow chamber with an adjustable orifice in the pipe part” (1(f)) is concerned, Petitioner states that “McIntosh’s valve 30 includes a flow chamber, as shown in Figures 1 and 2 [].” *Id.* at 29 (citing Ex. 1004, 8:11–15).

As far as the orifice adjusting system is “provided for adjusting the adjustable orifice in response to the control signal of the flow controller” (1(f)) is concerned, Petitioner states that “[t]he valve 30 is an adjustable valve and it has an actuator motor 21 that moves the valve plug 12 within the flow chamber to adjust the valve opening to regulate the flow.” *Id.* Also, it “describes a controller 20 adapted to control the valve motor 21 for adjusting the position of the valve plug 12 within a flow chamber.” *Id.* (citing Ex.—

1004, 6:23–26, Figure 2). “The controller 20 is arranged to communicate with and control the motor 21.” *Id.* (citing Ex. 1004, 7:16–20).

1(g): characteristic curve

Limitation 1(g) requires that “the orifice adjusting system hav[e] a characteristic curve.”

Petitioner concedes that “McIntosh does not specifically describe a characteristic curve of its orifice adjusting system.” Pet. 31; *see also* Prelim. Resp. 27 (“Petitioner concedes ‘McIntosh does not [even] specifically describe a characteristic curve of its orifice adjusting system.’ (Petition at 31).”)

However, Petitioner contends that “every orifice adjusting system has a physical characteristic curve.” Pet. 31 (citing Ex. 1003 ¶¶ 93–94). The Henze Declaration explains that

The physical characteristic curve is based on the physical configuration of the valve and is the inherent relationship between flow rate and valve position at a constant differential pressure across the valve.

Ex. 1003 ¶ 94.

Thus, Petitioner’s view is that McIntosh’s valve 30, which Petitioner contends is an “orifice adjusting system” as claimed (*see* discussion in section II.F.1.a.1(f)), necessarily has a “characteristic curve” to the extent claimed.

Patent Owner has not directly responded to Petitioner’s contention that “every orifice adjusting system has a physical characteristic curve.” Pet. 31. However, in a different context, Patent Owner does state that “as Petitioner itself notes . . . , all valves have characteristic curves.” Prelim. Resp. 43.

In support of its contention, Petitioner cites Tsuyoshi which, according to Petitioner, specifically describes a characteristic curve for an orifice adjusting system similar to that of McIntosh. Pet. 32–33 (citing Ex. 1005, Abstract, ¶¶ 2–14, 20–26, 22–27; Ex. 1003 ¶¶ 96–98). *See also id.* at 39 (“Tsuyoshi describes a similar flow control system [to that of McIntosh] that controls the valve opening position of a control valve 13 based on measurements from a flow meter.”) (citing Ex. 1005 ¶¶ 21–27).

1(h): sensor outside the flow chamber/static measurement

Limitation 1(h) requires the flow sensor to be “arranged outside the flow chamber and ha[ve] a static measurement principle based on a wave propagating in the liquid.”

sensor outside the flow chamber

Petitioner contends that “McIntosh’s flow sensors are positioned away from the valve plug 12, and outside the flow chamber.” Pet. 34 (citing *inter alia* Ex. 1003 ¶¶ 101–102). Petitioner provides an annotated version of Figure 2 indicating that element 22 is a “Flow meter” and which shows element 22 outside McIntosh valve 30 that Petitioner (Pet. 29) has contended is an “orifice adjusting system” as claimed. Pet. 36; *see also* section II.F.a.1(f).

Petitioner contends that Tsuyoshi also “suggests placement of the flow sensor outside the flow chamber.” *Id.* (citing Ex. 1005 ¶ 23, Fig. 1). The Henze Declaration explains that

It would be beneficial to place the flow sensor outside of the flow chamber in order to account for turbulence of the flow caused by the valve. Allowing turbulence effects to diminish after the flow chamber through a straight pipe length, can help to provide a

more accurate flow measurement. Moreover, furnishing a flow sensor outside the flow chamber allows for service, upgrade, and replacement of the flow sensor independent of the rest of the flow control system. Thus, a POSITA would, therefore, have been motivated to place the flow sensor outside the flow chamber, and would have had an expectation of success using that configuration.

Ex. 1003 ¶ 104.

static measurement

Petitioner concedes that “McIntosh does not disclose the type of flowmeter or whether it has a static measurement principle.” Pet. 37.

However, Petitioner contends that sensors for HVAC system that operate under a static measurement principle are known. In support, Petitioner relies on Shen’s disclosure of ultrasonic type flow meters. *Id.* (citing Ex. 1006, 5:34–36). “Such ultrasonic flow sensors have a static measurement principle based on a wave propagating in a liquid and do not have moving parts.” *Id.* (citing Ex. 1006, 5:34–36; Ex. 1003 ¶¶ 105–106). The Henze Declaration explains that a “”POSITA would have [] understood that using an ultrasonic sensor helps avoid any fouling of the sensing elements and provides high measurement accuracy.” Ex. 1003 ¶ 105.

Patent Owner presents two arguments.

Patent Owner first argues that Shen “does not disclose a pressure independent flow sensor, as used in the Challenged Claims.” Prelim. Resp. 20. According to Patent Owner, “the sensor disclosed in Shen is pressure *dependent*, since it is based on the pressure differential between “pressure difference sensor 10” over “orifice plate 5.” *Id.*

Patent Owner does not provide sufficient explanation. We observe that the claim does not recite “a pressure independent flow sensor.” Without

knowing how the claim limits the flow sensor to “a pressure independent flow sensor”, it is difficult to know whether a difference between Shen and what is claimed in fact exists based on Shen not disclosing a “pressure independent flow sensor.”

Not having that clarification, at present this argument does not undermine Petitioner’s contention.

Patent Owner next argues that Shen teaches away from using an ultrasonic sensor “due to factors such as price and technology.” *Id.* (quoting Ex. 1006, 5). However, as Petitioner contends, Shen expressly discloses that one can use ultrasonic type sensors. *See* Ex. 1006, 5 (“Depending on different forms of the flowrate sensor, such energy meters are also categorized into mechanical impeller type, ultrasonic type, and electromagnetic type.”). While “factors such as price and technology” (*id.*) may cause one to consider using another type of flow sensor, that alone is insufficient as a “teaching away” from using ultrasonic type sensors. *Cf. In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994) (“A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use.”).

Thus, this argument, too, does not undermine Petitioner’s contention.

We have reviewed the evidence Petitioner has presented in light of Patent Owner’s arguments and based on that evidence Petitioner sufficiently shows at this stage that, while McIntosh does not disclose a flow sensor “having a static measurement principle based on a wave propagating in the liquid,” such flow sensors for HVAC systems were known (Shen) and a person of ordinary skill in the art would have understood that using such a

sensor helps avoid any fouling of the sensing elements and provides high measurement accuracy.

*1(i): evaluating flow/outputting control signal
evaluating flow*

Limitation 1(i) requires “the flow controller [to have] as input a value representing a medium flow rate set point.”

Petitioner contends that McIntosh discloses said limitation because it describes a medium flow rate set point where the valve is responsive to input from a thermostat to restrict or permit the flow of fluid, and the “flow detection means and the valve controller are arranged to maintain a required rate of flow of fluid through the system as measured by the flow detection means.”

Pet. 37–38 (quoting Ex. 1004, 3:1–15); Ex. 1004, Fig. 1.

outputting control signal

Limitation 1(i) further requires that “the flow controller is provided for evaluating the electrical signal indicative of the sensed actual medium flow with the value representing the medium flow rate set point and outputting the control signal based on said evaluation.”

Petitioner contends that McIntosh also discloses this limitation because it “explains that the flow meter 22 transmits an electronic signal to computer 29 representing the flow rate of water through the pipe.” Pet. 38 (Ex. 1004, 8:4–26). “Responsive to the measured flow rate and the set point, the controller ‘drives valve plug 12 to an actual delivered flow rate.’” *Id.* (quoting Ex. 1004, 7:27–30).

1(j): software-wise correction

Limitation 1(j) requires “the flow control system [to be] arranged to provide a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations.”

There is no dispute that “McIntosh does not specifically describe a characteristic curve of its orifice adjusting system.” Pet. 31. *See* section II.F.1.a.1(g). Thus it follows that McIntosh also does not disclose, more specifically, “a real-time software-wise correction” of a characteristic curve. *See* Prelim. Resp. 27 (“McIntosh [] does not disclose a real-time software-wise correction of a characteristic curve”) (citing Ex. 2002 ¶¶ 79–84).

correction

Petitioner contends a software-wise correction of a characteristic curve is known and in support thereof cites Tsuyoshi. Pet. 32–33; Ex. 1005.

According to Petitioner, Tsuyoshi discloses such a software correction by describing certain “calculations as being ‘executed by software operations.’” Pet. 39 (citing Ex. 1005 ¶ 27). Petitioner explains that Tsuyoshi discloses a system that includes a calculation means 21 which sets a valve characteristic curve X and which calculates a correction curve Z based on, *inter alia*, said valve characteristic curve X. *Id.* (citing Ex. 1005 ¶¶ 22–26). “Tsuyoshi then uses correction curve Z to control the valve opening, providing more accuracy to the fluid control system.” *Id.*

As additional support for its contention, Petitioner reproduces Figure 2 of Tsuyoshi and explains that it

illustrates a software process that includes: (a) selecting the valve characteristic X, (b) starting the calculation of the correction curve, (c) receiving and storing input signals, (d) calculating characteristic curve Y based on the input signals, (e)

calculating the deviation between the characteristic curves X and Y, and (f) calculating correction curve Z for eliminating the deviation.

Pet. 40 (citing Ex. 1005 ¶¶ 29–36), 41 (reproducing Fig. 2).

Patent Owner first argues that Tsuyoshi “does not disclose or suggest correcting a characteristic curve for pressure variations.” Prelim. Resp. 28. *See also id.* at 20 (“[Tsuyoshi’s [c]alibration is ... not changed or adjusted again during the process of controlling the flow with the valve.”)

The difficulty with this argument is that we do not read Petitioner as contending that Tsuyoshi discloses compensating for pressure variations.

Rather, Petitioner discusses incorporating Tsuyoshi’s software-wise correction of a characteristic curve in McIntosh’s orifice adjusting system “to optimally react to flow set point variations and pressure variations in the system.” Pet. 42. As the Henze Declaration explains, “Tsuyoshi provides calculations as part of an algorithm that could have been used within the flow control loop of McIntosh to precisely adjust the valve position and provide the desired flow rate.” Ex. 1003 ¶ 112; Pet. 39. The Henze Declaration further explains that Tsuyoshi’s algorithm “could be seamlessly used by the flow control system of McIntosh” and “could be integrated without changing the flow control hardware and architecture of McIntosh.” Ex. 1003 ¶ 116; Pet. 42.

The flow control system of McIntosh can integrate Tsuyoshi’s correction of the characteristic curve during the ongoing operation of the valve to optimally react to flow set point variations and pressure variations in the system. Using a characteristic curve that is corrected in view of the conditions makes possible accurate and stable flow control.

Id.

For these reasons, Patent Owner’s first argument does not undermine Petitioner’s contention.

Patent Owner next argues that “Tsuyoshi discloses a calibration process used to initialize a flow control system upon first use.” Prelim. Resp. 28. *See also id.* at 20–21 (citing Ex. 1005 ¶¶ 28–36, Fig. 2; Ex. 2002 ¶¶ 101–109). To support its argument, Patent Owner cites Figure 2 of Tsuyoshi and associated disclosure (Ex. 1005 ¶¶ 28–36). *Id.* at 21.

We observe that the cited Tsuyoshi disclosures makes no mention of “calibration” or “initializ[ion]” and Patent Owner does not sufficiently explain what those terms are meant to refer to relative the process Tsuyoshi discloses. Patent Owner is suggesting that Tsuyoshi discloses a different correction process than what is claimed because it is a “calibration process.” But it is unclear at present what that difference is. In the same vein, Patent Owner does not adequately explain why Tsuyoshi’s “calibration process,” which appears to be a description of a procedure for correcting a valve characteristic, undermines Petitioner’s contention; that is, Tsuyoshi discloses correcting a characteristic curve. *See* Pet. 39–40 and section II.F.1.1(g).

We have reviewed the Haglid Declaration that Patent Owner provides in support of its argument. *See* Prelim. Resp. 28 (citing Ex. 2002 ¶¶ 101–109). But paragraph 108, which discusses Tsuyoshi’s “calibration process,” simply repeats the statements made in the Preliminary Response without providing additional explanation to overcome the inadequacies just discussed.

Finally, to the extent Patent Owner means to argue that Tsuyoshi is limited to “a calibration process used to initialize a flow control system *upon first use*” (Prelim. Resp. 28, emphasis added), Patent Owner does not

adequately explain why that would distinguish Tsuyoshi from what is claimed, especially given the breadth of the claim. That being said, Tsuyoshi does not foreclose repeating the process after “first use,” notwithstanding it does state that its correction process “only needs to be executed at least once” and “there is no need to change it thereafter.” Ex. 1005 ¶ 37; Prelim. Resp. 21.

For the foregoing reasons, Patent Owner’s second argument also does not undermine Petitioner’s contention.

Patent Owner’s third argument is that Tsuyoshi is not analogous prior art. Prelim. Resp. 19.

There are

[t]wo separate tests defin[ing] the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

In re Bigio, 381 F.3d 1320, 1325 (Fed. Cir. 2004).

Regarding the first test, Patent Owner argues that “Tsuyoshi is clearly not in the same field of endeavor as the ’666 Patent. Rather than being in the HVAC field, it relates to an industrial hydraulics application where the fluid involved are incompressible fluids.” Prelim. Resp. 30 (citing Ex. 2002 ¶¶ 103–109).

There are a number of difficulties with this argument.

First, Patent Owner’s position that HVAC systems and industrial applications represent different fields of endeavor is not buttressed with sufficient evidence.

Also, we have been unable to find any mention of “industrial hydraulics application[s]” in Tsuyoshi.

Finally, while Tsuyoshi may not mention “incompressible fluids,” water, for example, is an incompressible fluid. Since the “liquid” of the claimed system covers water, the use of “incompressible fluids” would not signify a different field of endeavor.

Regarding the second test, Patent Owner states only that “Tsuyoshi is [] not reasonably pertinent to solving the problems that are the focus on the Challenged Claims in the HVAC field.” Prelim. Resp. 30. The Haglid Declaration does not elaborate. It simply repeats the statements made in the Preliminary Response. *See* Ex. 2002 ¶¶ 103–109; Prelim. Resp. 30. This is insufficient to establish that Tsuyoshi is not reasonably pertinent to the particular problem with which the inventor was involved.

Accordingly, Patent Owner has not at present sufficiently shown that Tsuyoshi is not analogous prior art. Accordingly, Patent Owner’s third argument also does not undermine Petitioner’s contention.

We have reviewed all of Patent Owner’s arguments. At this stage of the proceeding, Patent Owner insufficiently undermines Petitioner’s position that Tsuyoshi discloses a software-wise correction of a characteristic curve for an orifice adjusting system.

real-time

Turning now to the claim limitation “*real-time* software-wise correction,” Petitioner contends, *inter alia*, that “[a] POSITA would have understood that this limitation refers to ‘real-time’ generally because the ’666 Patent does not narrow or even mention this term elsewhere.” Pet. 42 (citing Ex. 1003 ¶ 117). The Henze Declaration explains that

A POSITA would have understood that this refers generally to the correction being performed while the system is in *normal operation*. This is the general understanding of this term in the context of the claims and the specification, . . .

Ex. 1003 ¶ 117 (emphasis added). With respect to McIntosh’s normal operation, the Henze Declaration explains that “[t]he flow control system of McIntosh executes during runtime of the flow control process.” *Id.*

According to the Henze Declaration, when modified in view of Tsuyoshi, McIntosh’s system “would execute the curve correction during operation of the flow control system as part of its control loop calculations.” *Id.* “[T]he characteristic curve would be corrected while the valve is in normal use, as opposed to an offline correction to the characteristic curve.” *Id.*

Patent Owner argues that “McIntosh [] does not disclose a real-time software-wise correction of a characteristic curve.” Prelim. Resp. 27 (citing Ex. 2002 ¶¶ 79–84).

But that is not in dispute. See preceding discussion under “*correction*.”

Patent Owner also argues that the Henze Declaration does not support a contention that Tsuyoshi disclose “both real-time correction and reaction to pressure variations.” *Id.* at 28 (referring to Ex. 1003 ¶¶ 111–118).

However, Petitioner’s position is not that Tsuyoshi, or McIntosh, individually disclose “both real-time correction and reaction to pressure variations.” Rather, as previously discussed, we understand Petitioner’s position to be that when McIntosh is modified in view of Tsuyoshi, McIntosh’s system “would execute the curve correction during operation of the flow control system as part of its control loop calculations.” Ex. 1003 ¶ 117; Pet. 42.

For these reasons, Patent Owner’s argument does not undermine Petitioner’s contention.

We have reviewed the evidence on this record in light of Patent Owner’s arguments and find that at this stage it sufficiently supports Petitioner’s position that Tsuyoshi discloses “a real-time software-wise correction of the characteristic curve” as claimed.

b. Motivation to Combine McIntosh, Shen, Tsuyoshi

In order to demonstrate obviousness, a petitioner must demonstrate that a skilled artisan would have had a reason to combine the teachings of the prior art in the manner claimed in the patent and would have had a reasonable expectation of success in doing so. *KSR*, 550 U.S. at 406. “To facilitate review, this analysis should be made explicit.” *See In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (“[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’).” *Id.* at 418.

As more specifically evaluated above in section II.F.1.a., Petitioner contends that McIntosh (Ex. 1004) discloses all that is claimed but for a “flow sensor” having “a static measurement principle based on a wave propagating in the liquid” and a “flow control system” “arranged to provide a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations,” for which Shen and Tsuyoshi, respectively, are relied upon. *See* discussions in sections II.F.1.a.1(h), and II.F.1.a.1(g) and II.F.1.a.1(j), respectively.

Regarding the “flow sensor” having “a static measurement principle based on a wave propagating in the liquid,” Petitioner contends, *inter alia*, that “[a] POSITA would have been motivated to use an ultrasonic flow sensor [as disclosed in Shen] [in McIntosh] to avoid the risk of the moving parts failing, to avoid the need for maintenance, to avoid fouling, and to reduce the pressure drop and energy waste caused by other flowmeters.” Pet. 37 (citing Ex. 1003 ¶ 105–106). “Thus, McIntosh, Tsuyoshi and Shen disclose these limitations, and it would have been obvious to use an ultrasonic sensor outside the flow chamber.” *Id.*

We addressed Patent Owner’s arguments in section II.F.1.a.1(h). We found that they did not undermine Petitioner’s position. We stated there that, based on the evidence Petitioner has presented, Petitioner sufficiently shows on this record that, while McIntosh does not disclose a flow sensor “having a static measurement principle based on a wave propagating in the liquid,” such flow sensors for HVAC systems were known (Shen).

Furthermore, according to the Henze Declaration, a person of ordinary skill in the art would

have been motivated to select a flow sensor having a static measurement principle [i.e., Shen] , which avoids moving parts and their associated risk of failure and need for maintenance as well as reduces the pressure drop and energy waste caused by the flowmeter [and a] POSITA would have also understood that using an ultrasonic sensor helps avoid any fouling of the sensing elements and provides high measurement accuracy.

Ex. 1003 ¶ 105; Pet. 37

Given this, Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of McIntosh and Shen and thereby reach a “flow

sensor” having “a static measurement principle based on a wave propagating in the liquid” as claimed.

Regarding a “flow control system” “arranged to provide a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations,” Petitioner contends that adding “software-wise correction of the characteristic curve” (Shen) “would have been obvious to include in McIntosh’s system.” Pet. 21. “[I]t would have been obvious to include this portion of Tsuyoshi’s system in the McIntosh system.” Pet. 34 (citing Ex. 1003 ¶¶ 93–100).

We addressed Patent Owner’s arguments in section II.F.1.a.1(j). We found that they did not undermine Petitioner’s position. We stated there that, based on the evidence Petitioner has presented, Petitioner sufficiently shows on this record that Tsuyoshi discloses “a real-time software-wise correction of the characteristic curve” as claimed.

Furthermore, the Henze Declaration explains that

a POSITA would have been motivated to modify McIntosh to utilize the flow control characteristic curve correction of Tsuyoshi to precisely adjust the valve position and provide the desired flow rate. Controlling the flow rate based on a characteristic curve that is initially provided as a reference curve and thereafter either periodically or continuously corrected based on measurements taken in real-time by the flow control system offers the advantage of more accurate flow rate set point tracking with less overshoot and less variation of the actual flow rate around the flow rate set point.

Ex. 1003 ¶ 116; Pet. 42.

Given this, Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of McIntosh and Tsuyoshi and thereby reach of a

“flow control system” “arranged to provide a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations” as claimed.

c. Secondary Considerations

Notwithstanding what the teachings of the prior art would have suggested to one skilled in the art, objective evidence of nonobviousness (so called “secondary considerations”) may lead to a conclusion that the challenged claims would not have been obvious. *In re Piasecki*, 745 F.2d 1468, 1471–72 (Fed. Cir. 1984). Objective evidence of nonobviousness “may often be the most probative and cogent evidence in the record” and “may often establish that an invention appearing to have been obvious in light of the prior art was not.” *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (citing *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)).

“In order to accord substantial weight to secondary considerations in an obviousness analysis, ‘the evidence of secondary considerations must have a “nexus” to the claims, i.e., there must be “a legally and factually sufficient connection” between the evidence and the patented invention.’” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (citing *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019)). “The patentee bears the burden of showing that a nexus exists” *WMS Gaming Inc. v. Int’l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco*

Corp. v. F. Von Langsdorff Licensing Ltd., 851 F.2d 1387, 1392 (Fed. Cir. 1988). A nexus is presumed when “the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘embodies the claimed features, and is coextensive with them.’” *Fox Factory*, 944 F.3d at 1373 (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)). “A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations,” as “the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Id.* at 1373–74 (citing *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)).

Patent Owner argues that “there are substantial and significant objective indicia that the claims are nonobvious.” Prelim. Resp. 51. Patent Owner puts forth evidence of commercial success (*id.* at 52–55), long-felt need (*id.* at 56–58), and industry recognition (*id.* at 58–62).

Patent Owner bears the burden of showing that a nexus exists. *WMS Gaming*, 184 F.3d at 1359.

On this record, Patent Owner does not sufficiently demonstrate that it is entitled to a presumption of nexus.

Patent Owner directs our attention to three products:

- dynamx™ (*see, inter alia*, Prelim. Resp. 52–54);
- Electronic Pressure Independent Valve (“EPIV”) (*see, inter alia, id.* at 54–56); and,
- Energy Valve (“EV”) (*id.*).

dynamxTM

Patent Owner contends that “[t]he invention was commercialized by Belparts as the dynamxTM flow control valve.” *Id.* at 52 (citing Ex. 2001

¶ 6). The Ulens Declaration explains:

Belparts first valve implementing the invention of the ‘666 and ‘257 Patents — the dynamxTM flow control valve - was introduced in 2010 at an HVAC exhibition in the Utrecht, Netherlands called the VSK Exhibition in February of 2010. (See <https://vwww.vsk.nl>).

Ex. 2001 ¶ 6.

Patent Owner provides further discussion about the dynamxTM flow control valve but in insufficient detail for us to ascertain whether Patent Owner has sufficiently demonstrated that it is entitled to a presumption of nexus.

For example, Patent Owner states that

Belparts has promoted the dynamxTM flow control valve by highlighting the innovative features claimed in the ‘666 Patent, including its being “first electronic flow-control valve offering pressure independent variable flow control” and “self balancing.”

Prelim. Resp. 53 (citing Ex. 2001 ¶¶ 11–12). But details about the dynamxTM flow control valve are not fully explained. The Ulens Declaration is likewise devoid of details. It states, *inter alia*, that:

The commercial success of Belparts' dynamxTM flow control valve is directly related to the claimed invention because the “real-time” “corrections of the characteristic curve” are exactly what makes the product highly efficient and much easier to maintain balancing of HVAC systems than the prior art.

Belparts has promoted the dynamxTM flow control valve by highlighting the innovative features claimed in the ‘666 and ‘257

Patents, including its being "first electronic flow-control valve offering pressure independent variable flow control" and "self balancing." Ex. 2007 ("Dynamx Product Introduction") at Page 3.

Ex. 2001 ¶¶ 11–12; Prelim. Resp. 53. No details about the dynamx™ flow control valve are provided. We have reviewed page 3 of Dynamx Product Introduction but it, too, discloses no details about the dynamx™ flow control valve. Ex. 2007.

EPIV and EV

Patent Owner refers to "Petitioner's ePIV and Energy Valve ("EV") products." Prelim. Resp. 54. According to Patent Owner, "Petitioner has promoted [these] products by highlighting features of the Challenged Claims since first launching the ePIV in 2010 and the EV in 2012." Prelim. Resp. 55 (providing three hyperlinks allegedly providing access to information about Belimo products, two of which are inactive). In support thereof, Patent Owner has provided several alleged Belimo annual and semiannual reports. Exs. 2024–2033; Prelim. Resp. 55–56.

We have reviewed said documents and the corresponding discussion in the Preliminary Response but do not find that either provides sufficient details about the ePIV and EV products.

The discussions on commercial success (Prelim. Resp. 54–56), long-felt need (*id.* at 56–58) and industry recognition (*id.* at 58–62) have been reviewed but the dynamx™ flow control valve and ePIV and EV products on which they are based are insufficiently described for us to ascertain whether the dynamx™ flow control valve and ePIV and EV products "embod[y] the claimed features, and is coextensive with them." *Fox Factory*, 944 F.3d at 1373 (quoting *Polaris*, 882 F.3d at 1072).

Thus, on this record, Patent Owner has not shown sufficiently that it is entitled to a presumption of nexus. On this record, Patent Owner has not sufficiently shown that the alleged commercial success, long–felt need, and industry recognition are a “direct result of the unique characteristics of the claimed invention.” *See id.* at 1373–74.

At this stage of the proceeding, and on this record, Patent Owner has not sufficiently shown at this stage a nexus between the asserted objective indicia of nonobviousness and the claimed invention of the ’666 patent.

d. Conclusion as to claim 1

After considering Petitioner’s and Patent Owner’s positions, as well as the supporting evidence, we determine that Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of McIntosh, Tsuyoshi and Shen in the manner proposed by Petitioner.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claim 1 of the ’666 patent is obvious over the combined teachings of McIntosh, Shen, and Tsuyoshi.

e. Claims 2, 4–13, 17–19, and 21–24

Petitioner argues that dependent claims 2, 4–13, 17–19, and 21–24 are obvious over McIntosh, Shen, and Tsuyoshi. Pet. 44–58.

We have reviewed the evidence Petitioner has presented and based on that evidence Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of McIntosh, Shen, and Tsuyoshi and thereby reach the subject matter claimed.

Patent Owner does not provide any specific arguments as to these claims. *See generally* Prelim. Resp. 27–30.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claims 2, 4–13, 17–19, and 21–24 of the ’666 patent are obvious over the combined teachings of McIntosh, Shen, and Tsuyoshi.

f. Claim 25

Independent claim 25 parallels claim 1 but is more limited in, for example, defining the “central heating/cooling system and/or sanitary system” as comprising a “plurality of flow control systems” instead of “at least one flow control system.” Petitioner argues that claim 25 is obvious over McIntosh, Shen, and Tsuyoshi for essentially the same reasons provided in challenging the patentability of claim 1. Pet. 59–62, *cf. id.* at 21–44.

We have reviewed the evidence Petitioner has presented and based on that evidence Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of McIntosh, Shen, and Tsuyoshi and thereby reach the subject matter claimed.

Patent Owner does not provide any specific arguments as to this claim. *See generally* Prelim. Resp. 27–30.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claim 25 of the ’666 patent is obvious over the combined teachings of McIntosh, Shen, and Tsuyoshi.

g. Claims 26–30

Petitioner argues that dependent claims 26–30 are obvious over McIntosh, Shen, and Tsuyoshi. Pet. 62.

We have reviewed the evidence Petitioner has presented and based on that evidence Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of McIntosh, Shen, and Tsuyoshi and thereby reach the subject matter claimed.

Patent Owner does not provide any specific arguments as to these claims. *See generally* Prelim. Resp. 27–30.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claims 26–30 of the ’666 patent are obvious over the combined teachings of McIntosh, Shen, and Tsuyoshi.

2. Ground II

Petitioner challenges claims 3, 14, and 15 as unpatentable under 35 U.S.C. § 103(a) over the combination of McIntosh, Tsuyoshi, Shen, and Forshey. Pet. 62–66.

Claim 3 further limits claim 1 by requiring “the sensor [to be] provided in said pipe part in a position *in front of the orifice adjusting system*.” Ex. 1001, 10:52–55. Emphasis added.

Petitioner relies on McIntosh which, according to Petitioner, discloses sensors positioned in the pipe part in front of the orifice adjusting system as the claim requires. Pet. 63 (citing Ex. 1004, 6:26–7:7, Fig. 1 (flow sensors 22, 24); Ex. 1003 ¶¶ 207–208). Petitioner also relies, alternatively, on Forshey (Ex. 1012). *Id.* at 62–64.

Claim 14 provides for a “pressure measurement device system” for measuring the medium entering the consumer device (e.g., a heat exchanger) to be positioned in the pipe part *in front of the consumer device*. Ex. 1001, 11:48–53.

Petitioner concedes that McIntosh “does not explicitly describe a pressure sensor in front of the consumer device.” Pet. 64. However, according to Petitioner, “this feature was common and would have been obvious.” *Id.* (citing Ex. 1003 ¶¶ 211–215). Relying on Forshey, which according to Petitioner discloses such a system positioned in front of a consumer device (*id.* at 65–66 (citing Ex. 1012 ¶ 34; Ex. 1003 ¶¶ 211–215)), Petitioner contends that a “POSITA would have been motivated to include [said system] in McIntosh . . . to provide pressure measurements of the liquid entering the heat exchanger and adaptively tune the performance of the system.” *Id.* at 66 (citing Ex. 1003 ¶¶ 214–215).

Claim 15 provides for a second “pressure measurement device system” for measuring a second pressure *behind the consumer device*. Ex. 1001, 11:54–59.

According to Petitioner, “Forshey explains that pressure sensors 6 may be positioned at various locations relative to the flow control valve 2.” *Id.* (citing Ex. 1012 ¶ 34).

According to Petitioner, a “POSITA would have been motivated and understood the benefits of including an additional pressure sensor in the return pipe [of McIntosh] to provide the pressure measurement of the fluid leaving the consumer device,” such as to “allow tracking of the differential pressure across the heat exchanger and help identify any problems inside the pipe.” *Id.* (citing Ex. 1003 ¶¶ 217–218).

Patent Owner argues, *inter alia*, that Forshey, “do[es] not disclose or suggest correcting a characteristic curve for pressure variations.” Prelim. Resp. 31. The characteristic curve and software-wise correction limitations are addressed in sections II.F.1.a.1(g) and 1(j) where we determined that Petitioner sufficiently shows on this record that *Tsuyoshi* (rather than Forshey) discloses “a real-time software-wise correction of the characteristic curve” as claimed.

Patent Owner also argues that “Shen teaches away from using ultrasonic and electromagnetic flowmeters.” Prelim. Resp. 31. That argument is addressed in section II.F.1.a.1(h)).

No other arguments are presented. *See id.*

Accordingly, Patent Owner insufficiently undermines Petitioner’s position in challenging claims 3, 14, and 15 as unpatentable under 35 U.S.C. § 103(a) over the combination of McIntosh, Tsuyoshi, Shen, and Forshey.

The secondary considerations argued by Patent Owner are addressed in section II.F.1c.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claims 3, 14, and 15 of the ’666 patent are obvious over the combined teachings of McIntosh, Tsuyoshi, Shen, and Forshey.

3. *Ground III*

Petitioner challenges claim 16 as unpatentable under 35 U.S.C. § 103(a) over the combination of McIntosh, Tsuyoshi, Shen, and Lull. Pet. 66–68.

Claim 16 calls for the flow sensor to be an “electronic device outputting a digital value indicative of the actual medium flow.” Ex. 1001, 11:60–63.

Petitioner contends that “McIntosh does not explicitly describe a digital signal, but such digital signals were obvious and commonly used as one of two main types of electrical signals” (*id.* at 67 (citing Ex. 1003, ¶¶ 219–222)), exemplified by Tsuyoshi (*id.*; Ex. 1005) and Lull (*id.* at 68; Ex. 1009).

Regarding Lull, Petitioner states that it “discloses a sensor signal FS 1 that is converted to a digital signal before it is processed by the controller.” *Id.* (citing Ex. 1009 ¶ 136).

According to Petitioner, a “POSITA would have been motivated to include an A/D converter in the sensor [of McIntosh] . . . because digital signals have a higher rate of information transmission, are generally cheaper, and are used in computing appliances.” *Id.* (citing Ex. 1003 ¶¶ 220–222).

Patent Owner argues that “Lull . . . does not disclose or suggest correcting a characteristic curve for pressure variations.” Prelim. Resp. 32. Correcting a characteristic curve for pressure variations is discussed in section II.F.1.a.1(j) with respect to McIntosh and Tsuyoshi which, unlike Lull, is the prior art combination Petitioner contends renders that limitation obvious.

For the foregoing reasons, at this stage of the proceeding, Patent Owner insufficiently undermines Petitioner’s position.

The secondary considerations argued by Patent Owner are addressed in section II.F.1c.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claim 16 of the '666 patent is obvious over the combined teachings of McIntosh, Tsuyoshi, Shen, and Lull.

G. Grounds IV–VI

Grounds IV–VI are the same as Grounds I–III, “except that Tsuyoshi is replaced by Elshafei for the characteristic curve limitations.” Pet. 68.

Patent Owner challenges the prior art status of Elshafei (Ex. 1011) but does not otherwise respond to Petitioner’s challenge as to these grounds with any particularity at this stage of the proceeding.

According to Patent Owner:

The inventors of the '666 Patent conceived the subject matter of the Challenged Claims before the filing date of the Elshafei reference (i.e., March 19, 2008) and diligently reduced the claimed subject matter to practice thereafter up through filing the application that led to the '666 Patent in June 26, 2008.

Prelim Resp. 32.

There are two routes to establishing antedation. To antedate Elshafei, Patent Owner must establish either (1) prior reduction to practice of the claimed invention or (2) prior conception coupled with reasonable diligence from just prior to the publication date of Elshafei until reduction to practice or constructive reduction to practice (namely, the filing of a patent application). *See ATI Techs. ULC v. Iancu*, 920 F.3d 1362, 1369 (Fed. Cir. 2019).

Patent Owner makes no claim that the invention was actually reduced to practice, so we focus on the second route to establishing antedation.

An inventor may swear behind a reference if the inventor was the first to conceive of a patentable invention, and then connects the conception of

the invention with its reduction to practice by reasonable diligence on the inventor's part, such that conception and diligence are substantially one continuous act. *Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1577 (Fed. Cir. 1996). An inventor's testimony, standing alone, is insufficient to prove conception and diligence, as some form of corroboration is required. *Mahurkar*, 79 F.3d at 1577; *Price v. Symsek*, 988 F.2d 1187, 1194 (Fed. Cir. 1993). A rule of reason applies to determine whether the inventor's testimony has been corroborated. *Price*, 988 F.2d at 1194. During the period in which reasonable diligence must be shown, there must be continuous exercise of reasonable diligence. *In re McIntosh*, 230 F.2d 615, 619 (CCPA 1956); *see also Burns v. Curtis*, 172 F.2d 588, 591 (CCPA 1949) (referring to "reasonably continuous activity"). A party alleging diligence must provide corroboration with evidence that is specific both as to facts and dates. *Gould*, 363 F.2d at 920; *Kendall v. Searles*, 173 F.2d 986, 993 (CCPA 1949). The rule of reason does not dispense with the need for corroboration of diligence that is specific as to dates and facts. *Gould*, 363 F.2d at 920; *Kendall*, 173 F.2d at 993; *see also Coleman v. Dines*, 754 F.2d 353, 360 (Fed. Cir. 1985) ("The rule of reason . . . does not dispense with the requirement for some evidence of independent corroboration.").

According to Patent Owner,

there is ample evidence that the inventors of the '666 Patent conceived the subject matter of the Challenged Claims before the effective date of Elshafei (i.e., March 19, 2008) and diligently reduced the claimed subject matter to practice within the relevant time period from the effective date of Elshafei on March 19, 2008 until the June 26, 2008 constructive reduction to practice by the filing of the patent application.

Prelim. Resp. 35 (citing Ex. 2001 ¶¶ 19–28; Ex. 2019).

The Ulens Declaration is provided as evidence of prior conception. “Mr. Ulens states: ‘I conceived of the invention by at least May 21, 2007,’ almost 10 months prior to Elshafei.” Prelim. Resp. 36 (quoting Ex. 2001 ¶ 19).

Certain corroborating exhibits accompany the Ulens Declaration “[to] support the credibility of the Jan Ulens’ testimony that the inventors conceived the claimed invention by at least May of 2007, which is 10 months prior to the priority date of the Elshafei reference.” Prelim. Resp. 36. They are Exhibits 2012, 2013, 2015, 2016, 2017, and 2018. *See id.* at 37–40. These exhibits are discussed in the Ulens Declaration. *See* Ex. 2001 ¶¶ 20–21, 23–26.

On the question of reasonable diligence having been exercised from before Elshafei’s earliest effective date (i.e., March 19, 2008) until Patent Owner’s alleged constructive reduction to practice on June 26, 2008, Patent Owner relies on a statement in the Ulens Declaration as well as the Sarlet Declaration. Prelim. Resp. 41 (citing Ex. 2001 ¶ 28 and Ex. 2019, respectively). *See also id.* at 40:

[T]he Ulens Declaration and Sarlett [sic] Declaration both establish the requisite diligence for the three-month period from the March 19, 2008 priority date of Elshafei up to the filing of the priority patent application of the ’666 Patent on June 26, 2008.

According to Patent Owner,

Stephanie Sarlet ... was the primary European patent attorney that drafted the priority Belgian patent application to which the ’666 Patent claims priority. Her Declaration is based on her review of her work file and records from that time period.

Id. at 41 (citing Ex. 2019). Patent Owner details the activities Ms. Sarlet allegedly performed from around March 2008 until the application was filed on June 26, 2008. *Id.* at 41–43 (citing Ex. 2019 ¶¶ 5–14).

We have reviewed the evidence as to conception and diligence.

The principal difficulty with the evidence is that it is not fully explained.

For example, Exhibit 2012 is alleged to be “a two-page document from a Belparts engineering notebook [that] shows the earliest date of conception for the ’666 and ’257 Patented technology in May of 2007” and that “shows, the inventors had by that time already decided we needed a flow sensor with no moving parts and a static measurement principle.”

Prelim. Resp. 37 (citing Ex. 2001 ¶ 20 which cites Ex. 2012). The Ulens Declaration states that

In particular, on page 2 [of Ex. 2012] we list out the parts needed including a control valve, electric actuator, flow sensor and controller. A controller was needed to perform real-time correction of a characteristic curve. Further, as the concept drawing shows, we had already decided we needed a flow sensor with no moving parts and a static measurement principle.

The “list” is on a separate page from the drawing. Given no further explanation, the task of figuring out how the elements on the “list” are shown on the drawing is left to us. In that regard, we have been unable to discern where the listed elements are disclosed in the concept drawing. Because Patent Owner insufficiently explains how said drawing relates to the claimed subject matter, let alone “a flow sensor with no moving parts and a static measurement principle” as Patent Owner contends, at this stage, the concept drawing provides insufficient evidence of prior conception.

The corroborating exhibits are similarly insufficiently explained. For example, Exhibit 2015 is alleged to show “work included investigating, testing, and developing the various components of the claimed system” Prelim. Resp. 38 (citing Ex. 2001 ¶ 23 which cites Ex. 2015). The Ulens Declaration states that:

As shown in on the page 2 summary of its contents and the rest of the document [i.e., Ex. 2015], we were looking at various type of flow sensors for our commercial product that would implement the system we invented. This shows conception of a sensor with a static measurement principle.

Ex. 2001 ¶ 23. But page 2 is simply a list of 4 items with no indication “show[ing] conception of a sensor with a static measurement principle.” *Id.* The rest of the document is similarly vague. Because Patent Owner insufficiently explains how said document relates to the claimed subject matter, let alone “conception of a sensor with a static measurement principle” as Patent Owner contends, at this stage, the document is insufficient as corroborating evidence.

Applying the rule of reason to the current record, we are not persuaded that Patent Owner has provided sufficient evidence to remove Elshafei as prior art at this stage in the proceeding. Without further explanation, the evidence on this record provides an insufficient basis to evaluate whether the inventors of the ’666 patent conceived the subject matter of the challenged claims before March 19, 2008 and diligently reduced the claimed subject matter to practice thereafter up through June 26, 2008.

Patent Owner has not otherwise responded to the substance of these challenges at this stage of the proceeding. Accordingly, there are presently

no arguments undermining Petitioner’s reliance on Elshafei as an alternative to Tsuyoshi.

The secondary considerations argued by Patent Owner are addressed in section II.F.1c.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claims 1, 2, 4–13, 17–19, and 21–24 of the ’666 patent are obvious over the combined teachings of McIntosh, Elshafei, and Shen; claims 3, 14, and 15 are obvious over the combination of McIntosh, Elshafei, Shen, and Forshey; and, claim 16 is obvious over the combination of McIntosh, Elshafei, Shen, and Lull.

H. Grounds VII–X

1. Ground VII

Petitioner challenges claims 1–5, 19, and 21–30 as unpatentable under 35 U.S.C. § 103(a) over the combination of Erdmann and Forshey. Pet. 71–94.

a. Claim 1

Petitioner’s basic position is that Erdmann (Ex. 1008) discloses all that is claimed but for the following limitations for which Forshey (Ex. 1012) is relied upon:

- “a flow sensor for sensing an actual medium flow through the pipe part and outputting an electrical signal indicative of the sensed actual medium flow” (1(d)) (*see* Pet. 77);
- “arranged outside the flow chamber and has a static measurement principle based on a wave propagating in the liquid” (1(h)) (*see* Pet. 82); and,

- “the flow controller has as input a value representing a medium flow rate set point, and wherein the flow controller is provided for evaluating the electrical signal indicative of the sensed actual medium flow with the value representing the medium flow rate set point and outputting the control signal based on said evaluation” (1(i)) (*see* Pet. 83).

According to Petitioner, “Erdmann and Forshey describe similar systems with flow control valves, the features of Forshey would have been readily compatible with and easily incorporated into the system of Erdmann with a reasonable expectation of success.” Pet. 73 (citing Ex. 1003 ¶ 229).

Patent Owner has not responded to Petitioner’s challenge as to the preamble and limitations 1(a)–1(i) with any particularity at this stage of the proceeding. As to these limitations, we have reviewed the evidence Petitioner has presented, discussed briefly below, and based on that evidence Petitioner sufficiently shows on this record that Erdman discloses the preamble and limitations 1(a)–1(i) as claimed.

Patent Owner has responded to Petitioner’s challenge as to limitation 1(j). *See* Prelim. Resp. 43–49. This is discussed below.

Preamble

Petitioner contends that “Erdmann describes a ‘central heating system’ with an electrically controllable control valves,” thereby meeting what the preamble calls for. Pet. 74 (citing Ex. 1008, Abstract).

1(a): liquid/common source

To satisfy the limitation “a common source provided for delivering the liquid medium,” Petitioner points to “Erdmann’s central heating system [which] includes a boiler K which supplies radiators H1, H2 and H3 with hot

water via a supply line V using a water pump P.” Pet. 74 (citing Ex. 1008, 9:5–15, Figure 1; Ex. 1003 ¶¶ 233–236).

1(b): consumer devices

Regarding the limitation “[a plurality of] consumer devices compris[ing] heat exchange systems,” Petitioner contends that “Erdmann’s boiler K and pump P are connected through a pipe system which distributes hot water to a plurality of radiators H1, H2 and H3.” *Id.* at 75 (citing Ex. 1008, 9:5–15; Ex. 1003 ¶¶ 237–238). To illustrate this, Petitioner provides an annotated version of Figure 1 that labels the elements “H1”, “H2, and “H3” in Figure 1 as “*Consumer devices.*” *Id.*

1(c): flow control system

Petitioner provides an annotated version of Figure 1 indicating “ST1”, “ST2” and “ST3 are “*Actuating devices.*” Pet. 76. These form part of a flow control system. Petitioner explains:

Erdmann’s central heating control device ZS controls multiple control devices (SE1, SE2, SE3) that “control actuating devices (ST1 to ST3) which can in turn set the valve stroke of three control valves assigned to the actuating devices.” Ex. 1008, 9:25-33. Each of the flow control devices controls the flow of liquid through a pipe part and towards each of the radiators H1, H2 and H3. *Id.*

Id. at 75 (citing Ex. 1003 ¶¶ 239–240).

1(d): flow sensor

Petitioner concedes that that Erdmann does not expressly disclose a flow sensor. Pet. 76.

However, according to Petitioner, “a flow sensor is inherent in Erdmann’s embodiments.” *Id.* (citing Ex. 1003 ¶¶ 241–243). This is so according to Petitioner, because, *inter alia*, “Erdmann uses a flow rate to

determine the correction characteristic curve, and can determine the flow rate according to the thermodynamic conditions” (*id.*, citing Ex. 1008, 5:11–33) and “Erdmann expressly uses flow rate in its flow control process” (*id.*, citing Ex. 1003 ¶¶ 241–243).

Alternatively, “[i]t was well-known to use a flow sensor in a control valve system to provide the measured flow rate in the system.” *Id.* at 77. In that regard, Petitioner cites Forshey’s disclosure of “flow sensor 3.” *Id.* (citing Ex. 1012 ¶ 26, Fig. 1). Petitioner explains that Forshey uses sensor data from the flow sensor to “compensate[] for specific valve properties and provides better tracking between valve position and desired flow rate.” *Id.* (citing Ex. 1012 ¶ 38).

1(e): flow controller

Petitioner explains that Erdmann discloses a flow controller outputting a signal because, *inter alia*, “control devices SE have a control unit S for each of the control valves.” Pet. 78 (citing Ex. 1008, 10:1–20, Figs. 1, 2; Ex. 1003 ¶¶ 244–246). “The control unit S communicates with actuating device ST1 which controls the actuating motor M by sending signals through the input/output unit (I/O).” *Id.*

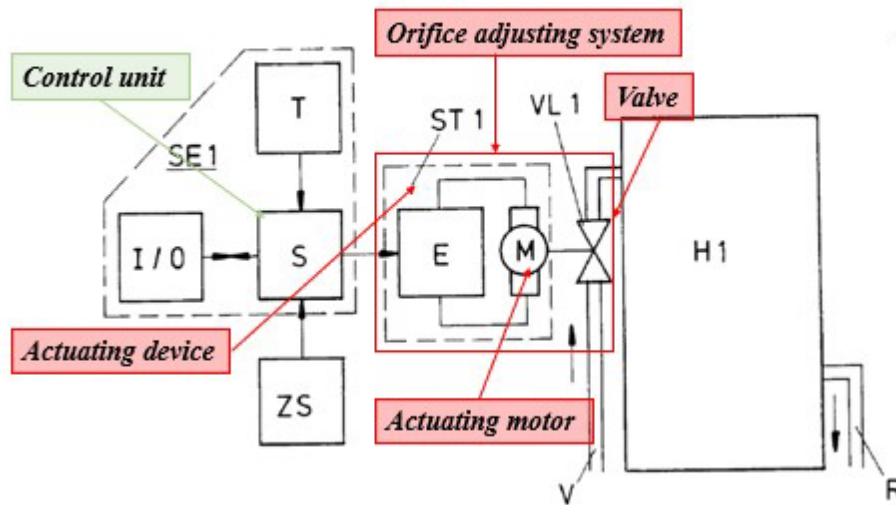
Regarding “a flow controller in communicative connection with the flow sensor,” Petitioner explains, *inter alia*, that “Erdmann’s control unit S is in communicative connection with the temperature sensor T” and when modified in view of Forshey, “Erdmann’s system would also have a flow sensor for each valve that is in communicative connection with the control unit S.” *Id.* (citing Ex. 1008, 10:1–20, Figs. 1, 2; Ex. 1003 ¶ 246).

1(f): orifice adjusting system

Petitioner contends that Erdmann's control valve VL1 shown in Figure 2 comprises such an "orifice adjusting system." Pet. 80 (citing Ex. 1003 ¶¶ 89–92).

Petitioner provides an annotated version of Figure 2 showing Erdmann's control valve VL1. Pet. 80, reproduced below.

Fig. 2



Petitioner's annotated version of Figure 2 of Erdmann showing valve VL1, control unit S, actuating device ST1, and actuating motor M. Pet. 80.

Regarding the limitation, "the orifice adjusting system comprising a flow chamber," Petitioner states

A POSITA would have known that control valve VL1 includes a flow chamber and an adjustable orifice through which the flow through the valve is adjusted by the stroke of the valve. [Ex. 1003 ¶¶ 247–249]. A POSITA would have understood that such HVAC control valves all have a flow chamber and an adjustable orifice. *Id.*

Pet. 80. “Erdmann’s control valve VL1 is an adjustable valve with a flow chamber, and the actuating device ST1 is an actuator that adjusts the valve opening to regulate the flow.” *Id.* at 80–81 (citing Ex. 1003 ¶¶ 247–249).

1(g): characteristic curve

Petitioner contends that Figure 3 of Erdmann illustrates “the actual ‘characteristic curve of the control valve,’ the correction characteristic curve in the memory, and the ‘resulting’ characteristic curve.” Pet. 81 (citing Ex. 1008, 8:31–9:3, Ex. 1003 ¶¶ 250–251).

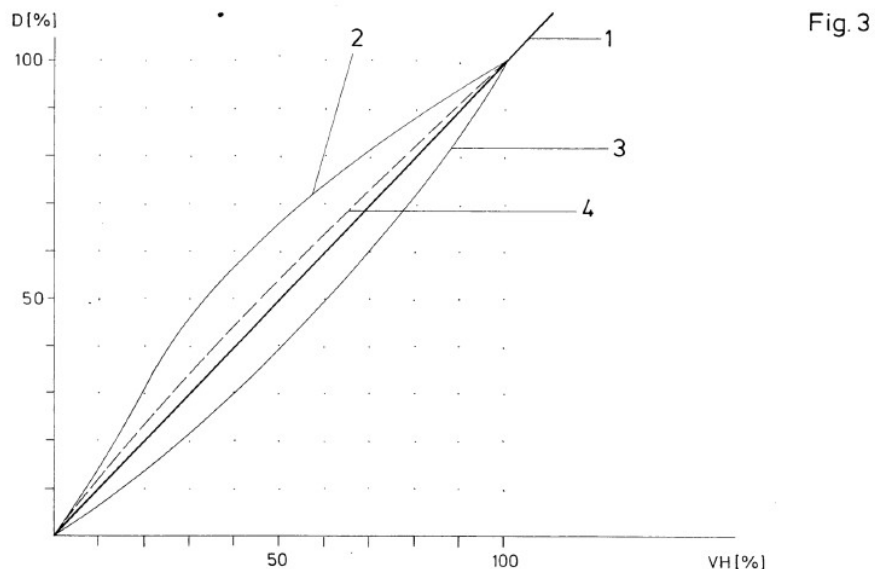


Figure 3 of Erdmann showing “a schematic illustration of a first set of characteristic curves consisting of the valve stroke/flow rate characteristic curve of the control valve.” Ex. 1008, 8:32–34; Pet. 81–82.

Petitioner also notes that Erdmann’s “characteristic curve of the orifice adjusting system [] is software-based.” Pet. 81 (citing Ex. 1003 ¶¶ 250–251).

1(h): sensor outside the flow chamber/static measurement

Petitioner contends that “Forshey describes an ultrasonic flow sensor 3 with a static measurement principle based on a wave propagating in the liquid.” Pet. 82 (citing Ex. 1012 ¶ 29; Ex. 1003 ¶¶ 252–253). According to Petitioner, Forshey’s flow sensor “is positioned far from the control valve 2 and outside the flow chamber.” *Id.*, further citing Figure 1 of Forshey.

1(i): evaluating flow/outputting control signal

Petitioner contends that this limitation is met by Forshey controller 4 which “determines a difference between the desired flow rate and the measured flow rate, which is used to generate an adjustment signal for controlling the valve.” Pet. 83 (citing Ex. 1012 ¶ 36). “The controller 4 calculates the ‘error’ by comparing the desired flow rate set point with the measured flow rate to determine and send the output signal.” *Id.* (citing Ex. 1012 ¶¶ 36–39; Ex. 1003 ¶¶ 254–256).

1(j): software-wise correction

According to Petitioner, “Erdmann’s control system corrects the characteristic curve to compensate for pressure variations.” Pet. 84 (citing Ex. 1003 ¶¶ 257–260). Petitioner explains that “Erdmann’s flow control system corrects the characteristic curve stored in the memory in order to adjust the flow rate to account for changes in the hydraulic/thermodynamic conditions of the heating system.” *Id.* (citing Ex. 1008, 6:33–7:35). “[T]he characteristic curve is changeable to maintain the desired flow rate even if there are changes in pressure due to more valves being open or closed.” *Id.* (citing Ex. 1008, 7:24–32). Petitioner further contends that “Erdmann’s system provides a real-time software-wise correction of the characteristic

curve of the orifice adjusting system to compensate for pressure variations.” Pet. 85 (citing Ex. 1003 ¶ 259). In support, Petitioner explains that “Erdmann’s correction to the curve occurs during operation of the control system and is stored in memory as part of a software operation.” *Id.* (citing Ex. 1008, 6:33–8:8, 11:2–13:15, 16:3–17:16).

Patent Owner argues that Erdmann “does not disclose or suggest correcting a characteristic curve to compensate for pressure variations.” Prelim. Resp. 43.

Regarding Erdmann, Patent Owner appears to agree that “all valves have characteristic curves [but] Erdmann does not disclose or suggest the solution of the Challenged Claims.” Prelim. Resp. 43. Specifically, Patent Owner argues that Erdmann’s correction of the characteristic curve is “not real-time but require[s] manual user input.” *Id.* at 44 (citing Ex. 1008, 7:3–8).

However, this does not undermine Petitioner’s position because Petitioner is relying on other disclosures in Erdmann. *See* Pet. 85 (citing, *inter alia*, Ex. 1008, 6:33–8:8, 11:2–13:15, 16:3–17:16), discussed above.

Patent Owner makes a similar argument about Forshey. Prelim. Resp. 48–49.

The difficulty with this argument is that Petitioner is relying on Erdmann, not Forshey, as meeting limitation 1(j). *See* Pet. 84, discussed above.

Next, Patent Owner discusses various passages in Erdmann.

Patent Owner contends that the disclosure at page 4, lines 1 to 23 of Erdmann “merely states a known and long unsolved program in the art” and

provides an “object of the present invention.” Prelim. Resp. 45; Ex. 1008, 4:1–23.

However, we do not see how such a statement undermines Petitioner’s position.

Patent Owner argues that the disclosure at page 5, lines 12 to 33 of Erdmann provides “no method for determining flow [] nor is there a method disclosed for determining the starting ‘thermodynamic conditions’ or the ending ‘thermodynamic conditions.’” Prelim. Resp. 45 (citing Ex. 2002 ¶ 91); Ex. 1008, 5:12–33.

However, Patent Owner does not explain the relevance of determining the starting “thermodynamic conditions” or the ending “thermodynamic conditions” given that the claim does not call for determining conditions. Rather, the claim seeks “to compensate for pressure variations” by providing a characteristic curve correction.

Patent Owner argues that the disclosure at page 6, lines 19 to 32 of Erdmann “references an attempt to measure valve stroke using revolutions of an actuating motor.” Prelim. Resp. 45–46 (citing Ex. 1002 ¶¶ 93–94); Ex. 1008, 6:19–32.

However, this does not undermine Petitioner’s position because Petitioner relies, *inter alia*, on Exhibit 1008, column 6 line 33 to column 7 line 35 of Erdmann to show the correction as claimed. *See* Pet. 84, discussed above.

Finally, Patent Owner draws our attention to “Page 7, line 18 to 35” of Erdmann which, according to Patent Owner, does not disclose “measuring in real-time the flow through each valve that may be adjusted.” Prelim. Resp.

47 (citing, *inter alia*, Ex. 2002 ¶¶ 98–99). According to Patent Owner, this is what “the Challenged Claims do.” *Id.*

However, Patent Owner does not explain the relevance of measuring flow in real–time given the claim does not call for measuring flow in real–time. Rather, the claim associates “in real–time” with providing a characteristic curve correction.

We have reviewed the parties’ positions and the evidence presented at this stage of the proceeding. Based on the evidence on this record, Petitioner sufficiently shows on this record that Erdmann discloses “a real-time software-wise correction of the characteristic curve” as claimed.

b. Motivation to Combine Erdmann and Forshey

As more specifically evaluated above in section II.H.1.a., Petitioner contends that Erdmann (Ex. 1008) discloses all that is claimed but for limitations 1(d), 1(h), and 1(i), for which Forshey is relied upon. *See* discussions in sections II.H.1.a.1(d), II.H.1.a.1(h), and II.H.1.a.1(i), respectively.

Petitioner further contends, *inter alia*, that “a POSITA would have been motivated to use a flow sensor like Forshey’s in Erdmann.” Pet. 77 (citing Ex. 1003 ¶ 243). “Such an addition would have been a mere combination of a familiar element according to a known methods to yield predictable results. *KSR*, 550 U.S. at 416.” *Id.*

We have reviewed the evidence and based on the evidence on this record, Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of Erdmann and Forshey and thereby incorporate a

“flow sensor” providing the features of limitations 1(d), 1(h), and 1(i) as claimed.

After considering Petitioner’s and Patent Owner’s positions, as well as the supporting evidence, we determine that Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of Erdmann and Forshey in the manner proposed by Petitioner.

c. Secondary Considerations

The secondary considerations argued by Patent Owner are addressed in section II.F.1c.

d. Conclusion as to claim 1

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claim 1 of the ’666 patent is obvious over the combined teachings of Erdmann and Forshey.

e. Claims 2–5, 19, and 21–30

Petitioner argues that claims 2–5, 19, and 21–30 are obvious over Erdmann and Forshey. Pet. 86–94.

We have reviewed the evidence Petitioner has presented and based on that evidence Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of Erdman and Forshey and thereby reach the subject matter claimed.

Patent Owner has not responded to Petitioner’s challenge as to these claims with any particularity at this stage of the proceeding.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claims 2–5, 19, and 21–30 of the '666 patent are obvious over the combined teachings of Erdmann and Forshey.

2. *Grounds VIII–X*

Petitioner challenges claims 6–13, 17, and 18 as unpatentable under 35 U.S.C. § 103(a) over the combination of Erdmann, Forshey, and McIntosh (Ground VIII) (Pet. 95–101); claims 14 and 15 as unpatentable under 35 U.S.C. § 103(a) over the combination of Erdmann, Forshey, and Shen (Pet. 101) (Ground IX); and, claim 16 as unpatentable under 35 U.S.C. § 103(a) over the combination of Erdmann, Forshey, and Lull (Pet. 102) (Ground X).

We have reviewed the evidence Petitioner has presented and based on that evidence Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art would have had sufficient reason to combine the teachings of the cited references and thereby reach the subject matter claimed.

Patent Owner responded to Petitioner's challenge as to these claims by arguing that each of McIntosh, Shen, and Lull "like all the other prior art relied upon by Petitioner, does not disclose correcting a characteristic curve for pressure variations." Prelim. Resp. 48–50, respectively.

However, such an argument does not undermine Petitioner's contention which is that "*Erdmann's* system provides a real-time software-wise correction of the characteristic curve of the orifice adjusting system to compensate for pressure variations." Pet. 85 (citing Ex. 1003 ¶ 259), emphasis added.

Patent Owner’s other arguments about Shen (e.g., “teaching away”) are addressed in section II.F.1.1(h). Prelim. Resp. 50–51. For the reasons discussed in that section, the arguments do not undermine Petitioner’s contentions.

The secondary considerations argued by Patent Owner are addressed in section II.F.1c.

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that claims 6–13, 17, and 18 of the ’666 patent are obvious over the combined teachings of Erdmann, Forshey, and McIntosh; claims 14 and 15 of the ’666 patent are obvious over the combined teachings of Erdman, Forshey, and Shen; and, claim 16 of the ’666 patent is obvious over the combined teachings of Erdman, Forshey, and Lull.

I. Grounds XI–XIV

Grounds XI–XIV are the same as Grounds VIII–X, “except Tsuyoshi is added to provide additional evidence for the software-wise correction of the characteristic curve.” Pet. 102. *See also* Pet. 84 (“Even if Erdmann somehow fails to disclose this limitation, it would have been obvious to provide a real-time software-wise correction of the characteristic curve, as disclosed by Tsuyoshi (Grounds 11-14)”).

Patent Owner argues the sufficiency of Tsuyoshi for the same reasons as we discussed in section F.1.a.1(j). Prelim. Resp. 50–51. As there, we do not find the argument undermines Petitioner’s position.

We have reviewed the evidence Petitioner has presented with respect to these grounds and based on that evidence Petitioner appears to have sufficiently shown at this stage that a person of ordinary skill in the art

would have had sufficient reason to combine the teachings of the cited references and thereby reach the subject matter claimed.

At this stage, the secondary considerations argued by Patent Owner are insufficient to lead to a conclusion that the challenged claims would not have been obvious. *See* section II.F.1.c..

On this record, Petitioner has demonstrated a reasonable likelihood of prevailing in demonstrating that the challenged claims of the '666 patent would have been obvious over the combined teachings of Erdman, Tsuyoshi and Forshey (claims 1–5, 19, and 21–30); Erdmann, Tsuyoshi, Forshey, and McIntosh (claims 6–13, 17, and 18); Erdmann, Tsuyoshi, Forshey, and Shen (for Claims 14 and 15); and, Erdmann, Tsuyoshi, Forshey, and Lull (claim 16).

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has demonstrated a reasonable likelihood that it would prevail in showing the unpatentability of at least one of claims 1–19 and 21–30 of the '666 patent. Accordingly, we grant the Petition and institute an *inter partes* review of the '666 patent.

Because a decision to institute is “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition,” *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 & n.2 (Fed. Cir. 2018) (citing *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018) and corresponding USPTO Guidance, <https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial> (Apr. 26, 2018)), and because we have determined that at least one ground set forth in the Petition satisfies the threshold for institution, trial

is instituted on the proposed grounds based on the various combination of cited art.

IV. ORDER

It is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), *inter partes* review of claims 1–19 and 21–30 of the '666 patent is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4(b), *inter partes* review of claims 1–19 and 21–30 of the '666 patent shall commence on the entry date of this Order, and notice is hereby given of the institution of *inter partes* review.

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