

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ROBERT BOSCH LLC, and
MERCEDES-BENZ USA, LLC,
Petitioner,

v.

WESTPORT FUEL SYSTEMS CANADA INC.,
Patent Owner

Inter Partes Review No. IPR2023-00292
Patent No. 6,298,829

PATENT OWNER'S PRELIMINARY RESPONSE

TABLE OF CONTENTS

TABLE OF AUTHORITIES	iii
PATENT OWNER’S EXHIBIT LIST	iv
I. Introduction.....	1
II. Factors Around Parallel and Related Litigation Support a Discretionary Denial Under Section 314.....	3
III. OVERVIEW OF WESTPORT AND ITS INVESTMENT IN R&D	7
IV. Nature of the Problem and Overview of Inventors’ Solution	8
V. Petitioners’ Validity Challenge	13
VI. The Board Should Exercise its Discretion Under 35 U.S.C. § 325(d) and Deny Institution	13
A. Bosch’s Petition Presents the Same and Substantially the Same Art Previously Presented	14
VII. Level of Ordinary Skill.....	18
VIII. Claim Construction.....	18
IX. The Board Should Deny Institution Because the Petition Does Not Establish a Likelihood of Success For Any Ground Asserted For the Sole Independent Claim 1.....	19
A. Grounds 1 & 2: Neither Klügl nor Wirbeleit Disclose the Claimed Passive Hydraulic Link Claimed in Limitation 1(e)	19
1. Petitioners’ mapping fails sufficiently establish that each requirement of the passive hydraulic link limitation is met.....	20
(i) a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted	22
(ii) whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated	28
(iii) wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly.....	32
2. A POSITA would not have combined Wirbeleit and Klügl to solve the problems addressed by the ’829 Patent.....	34

B.	Grounds 3 & 4 –Klügl As Modified by Hayes Fails to Render Obvious Independent Claim 1 Obvious	37
X.	The Proposed Modification of Hayes with Klügl Renders Hayes Inoperable for Its Intended Purpose.....	38
1.	Petitioners’ mapping fails sufficiently establish that each requirement of the passive hydraulic link element is met	41
(i)	a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted	42
(ii)	whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated and.....	44
(iii)	wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly.....	44
(iv)	A POSITA would not have combined Klügl with Hayes to solve the problems addressed by the ’829 Patent	46
2.	Conclusion	47
	CERTIFICATE OF SERVICE	48
	CERTIFICATE OF WORD COUNT.....	49

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH,</i> IPR 2019-01469	13, 16
<i>Cook Grp., Inc. v. Boston Sci. Scimed, Inc.,</i> 809 Fed. Appx. 900 (Fed. Cir. 2020)	37
<i>In re Gordon,</i> 733 F.2d 900 (Fed. Cir. 1984)	37
<i>Harmonic Inc. v. Avid Tech., Inc.,</i> 815 F.3d 1356 (Fed. Cir. 2016)	25, 28
<i>Phillips v. AWH Corp.,</i> 415 F.3d 1303, Fed. Cir. 2005	18
<i>Rhine v. Casio, Inc.,</i> 183 F.3d 1342 (Fed. Cir. 1999)	18
Statutes	
35 U.S.C. §102	13
35 U.S.C. §103	12
35 U.S.C. §312	42
35 U.S.C. § 312(a)(3)	25, 28
35 U.S.C. § 314	3
35 U.S.C. § 314(a)	3, 6
35 U.S.C. § 325(D)	3, 13

PATENT OWNER'S EXHIBIT LIST

Exhibit	Description
2001	Report of Dr. J. Matt Quinlan (December 2, 2022)
2002	Deposition Transcript of Dr. J. Matt Quinlan (January 12, 2023)
2003	CV of Dr. Christopher Atkinson
2004	Declaration of Dr. Christopher Atkinson
2005	DE 199 42 816 A1 (“Klenk”)
2006	DE 199 42 816 A1 - Translation
2007	DE 198 56 617 A1 (“Klugl2”)
2008	DE 198 56 617 A1 - Translation
2009	DE 199 46 732 B4 (“Schmultzer”)
2010	DE 199 46 732 B4 – Translation
2011	DE 199 62 177 A1 (“Gottlieb”)
2012	DE 199 62 177 A1 – Translation
2013	U.S. Patent No. 6,513,487
2014	Bosch Motion to Stay Pending IPR
2015	Order Denying Bosch Motion to Stay Pending IPR
2016	GB 2 321 278 A
2017	U.S. Patent No. 4,803,393
2018	U.S. Patent No. 5,031,841
2019	U.S. Patent No. 5,875,764
2020	U.S. Patent No. 6,062,533

Exhibit	Description
2021	Bosch Declaratory Judgment Complaint

I. INTRODUCTION

Robert Bosch LLC (“Bosch”) and its purported customer Mercedes-Benz USA, LLC (“Mercedes”) (collectively “Petitioners”) filed this Petition against Westport Fuel Systems Canada Inc.’s (“Westport”) U.S. Patent No. 6,298,829 (“the ’829 Patent”). Petitioners seek to institute this proceeding (and three other *inter partes* review proceedings filed¹) in parallel with a declaratory judgment suit of non-infringement Bosch filed against Westport’s expired ’829 Patent.

By filing its declaratory judgment action and seeking institution of multiple IPR proceedings, Bosch brazenly seeks multiple bites at the invalidity apple. Bosch has overtly embraced this position, telling the Court in its Motion to Stay Pending IPR, “Bosch expects to raise affirmative defenses of invalidity” and “[a]bsent a stay, the Court could have to address the same invalidity arguments at issue before the PTAB.” (Ex. 2014, 1, 7) (emphases added). Bosch intends to subject the Court, the Board, and Westport to duplicative invalidity proceedings simply because it can. While these circumstances may not fit squarely within the usual *Finitiv* analysis, the Board has discretion to deny duplicative proceedings.

¹ Petitioners also filed IPR 2023-00293. Mercedes filed IPR 2023-00351 and IPR 2023-00352.

The Petitioners propose four grounds of unpatentability, asserting that various combinations of four references render the claims of the '829 Patent obvious. Petitioners' references, however, attempt to solve different problems in different ways than those addressed by the '829 patent, and Petitioners fail to show how or why a person of skill would have altered their teachings without reliance on impermissible hindsight. While Bosch apparently believed that it had trapped Westport in a catch-22 between Grounds 1 and 2 and Grounds 3 and 4 (Pet. 16-17), all grounds include Klügl as part of the obviousness combination, and Klügl is substantially similar to other references cited on the face of the '829 patent that were considered by the Office during prosecution. For purposes of this preliminary response, many of Westport's arguments will focus on a particular innovative feature of the claimed inventions that is referred to as the "passive hydraulic link" limitation. Westport has distinguished Klügl—and Petitioners' other references—without need for the Board to undertake claim construction and based simply on the "passive hydraulic link" limitation found in independent Claim 1, from which all remaining challenged claims depend.

The Petition invites contamination of claim construction with non-infringement arguments (despite not actually seeking the Board to make constructions) and inaccurately implies that Westport has not taken consistent positions between infringement and invalidity (Pet. 16-17, 56.) As is shown through

this preliminary response, Westport does not demand any tortured claim constructions. Moreover, Petitioners' expert (Dr. Quinlan) opined and testified that certain narrow claim constructions were needed when before the district court. Yet in these proceedings—when the burden would be on Petitioners to show that the prior art meets those narrow limitation—Dr. Quinlan has withheld his prior opinions.

Petitioners' four references are the same (or substantially the same) as prior art that was presented to the Office during prosecution, and Petitioners have not identified any material error in the original prosecution, making a discretionary denial under Section 325(d) appropriate. Westport also contends that circumstances around the parallel litigation should be taken into consideration when evaluating whether to exercise a discretionary denial under Section 314(a).

More importantly, because none of Petitioners' proposed combinations disclose key elements of the challenged claims, Petitioners cannot establish a reasonable likelihood that any challenged claim is invalid. The Board should thus deny institution because Petitioners have not shown a reasonable likelihood that they would prevail with respect to any challenged claim of the '829 patent.

II. FACTORS AROUND PARALLEL AND RELATED LITIGATION SUPPORT A DISCRETIONARY DENIAL UNDER SECTION 314

In December 2021, Westport filed suit against five auto-manufacturers in connection with their sales of certain vehicles that use infringing fuel injectors (mostly diesel trucks). These cases were brought in the Eastern District of Texas and

were identified as “Related Matters” in the Petition. (Pet. 5.) In addition, in April of 2022, Robert Bosch LLC (“Bosch”)—a U.S. subsidiary of Robert Bosch GmbH (“GmbH”)—filed a declaratory judgment action against Westport. (Ex. 2021.)

Notably:

- GmbH did not join its subsidiary in the Bosch declaratory judgment action (*see* Ex. 2021) to claim responsibility for the importation of foreign manufactured Bosch-branded fuel injectors that entered the U.S. through still unidentified global supply chains between the auto- manufacturers, third party entities, and assorted GmbH subsidiaries.
- Bosch filed only declaratory judgment as to non-infringement, circumventing the restriction upon bringing these *inter partes* review petitions. Nonetheless, Bosch has stated in court filings “if Westport asserts counterclaims of infringement, Bosch expects to raise affirmative defenses of invalidity.” (Ex. 2014 at 1.) Westport has now filed its compulsory infringement counterclaims.
- Despite Bosch’s concern for over the alleged customer suits pending in Texas, Bosch filed its declaratory judgment action in the Eastern District of Virginia. The resulting fight to transfer the action to Texas to join the customer cases create not insignificant delays.

The Mercedes, Nissan, and FCA cases have been dismissed without prejudice for venue reasons. The Ford and GM cases have been stayed as “customer suits”

pending resolution of Bosch's declaratory judgment action. Bosch's declaratory judgment action was finally transferred to the Eastern District of Texas in January, and a scheduling conference was held in March 2023. Trial has been set for September 2024.

While Petitioners assert "all of the co-pending district court litigations involving the '829 patent are in very early stages" (Pet. 9), Westport disagrees. Substantial litigation had proceeded against GM and Ford, prior to the stay of those cases for Bosch: technology tutorials were submitted, *Markman* briefs were exchanged, the report of GM and Ford's claim construction expert had been served², GM's expert was deposed, and the parties were within six months of their scheduled trial date. In contrast, Bosch's declaratory judgment case is at an earlier stage due transfer-related delays. Bosch's case shutdown the GM and Ford cases. Despite derailing those cases, almost as soon as Bosch's case was transferred to Texas and ready to proceed, Bosch filed a motion to stay its own case, which was denied. (Ex. 2015.) Bosch has attempted to stall adjudication of Westport's patent litigation at every turn.

² Notably, GM and Ford used Dr. Quinlan as their expert in parallel litigation. Dr. Quinlan at the same time served as Petitioners' expert for this *inter partes* review.

Westport requested to seek an expedited *Markman* hearing date before the district court to streamline litigation, but Bosch refused. Given Bosch's infringement-focused arguments in its Petition, Westport is perplexed by Bosch's refusal to seek efficient adjudication of its non-infringement case. That said, IPR proceedings are not the proper forum for Bosch to raise whatever infringement concerns it may have; those disputes are the province of the District Court.

As another factor, Westport's patents expired in 2020. While Westport recognizes that the Board has held that it may institute IPR proceedings against expired patents and has expressed concerns over past damages,³ Westport contends that review of such long-expired patents would not be an efficient use of the Board's resources. Under these circumstances institution of an *inter partes* review would not "provide an effective and efficient alternative to district court litigation."

Westport submits that Bosch's obstant refusal to requests that the Board take into account these circumstances—together with the absence of compelling merits in the Petition and Bosch's intent to secure multiple shots at invalidating Westport's

³ *Apple, Inc. v. Gesture Tech. Partners, LLC*, IPR2021-00922, Paper 10 at 17–18 (PTAB Nov. 29, 2021); *Apple, Inc. v. Gesture Tech. Partners, LLC*, IPR2021-00921, Paper 24 at 36–38 (PTAB Dec. 5, 2022).

patents—into consideration as part of its determination as to whether to exercise its discretion not to institute under §§ 314(a) and 325(d) (discussed below).

III. OVERVIEW OF WESTPORT AND ITS INVESTMENT IN R&D

Westport is a global company, headquartered in Canada. Building on technology originally developed at University of British Columbia and counting many of the original research team members among its first employees, Westport was formed in 1995 to develop and commercialize alternative fuel technology with an emphasis on gaseous fuels. Its founding goal was to maintain the efficiency and performance of conventional combustion engines while dramatically reducing emissions through use of alternative fuels.

Over the years, Westport's fuel injector technology has won numerous awards and been recognized in scientific greenhouse gas studies. Vehicles using Westport's prototype fuel injector received awards and industry recognition. Since its founding, Westport has invested over \$863 million towards research, development and commercialization of its proprietary technologies, building a portfolio of over 1400 patents. Westport's research and development efforts have made it a leading supplier of advanced fuel delivery components and systems for a wide range of low-carbon fuels. Westport currently sells products in seventy countries, exceeding \$200 million in revenue per year since at least 2017.

IV. NATURE OF THE PROBLEM AND OVERVIEW OF INVENTORS' SOLUTION

At the time of the invention, Westport was involved in a project with a major auto-manufacturer where Westport was tasked with developing technology directed toward the development of a gaseous fuel system. Finding that then-available fuel injectors could not meet the demands of gaseous fuel systems, the inventors created a novel fuel injector for direct injection combustion engines operating at high fuel pressures that would satisfy rigorous performance standards.

Directly injecting fuel at high pressure into the combustion chamber of an internal combustion engine at specific times during the combustion cycle was known to provide advantages in both engine performance and reducing emissions. However, injecting fuel at high pressure created difficulties in providing fuel injection valves that were durable, could operate rapidly, and provide a highly reliable seal to prevent leaking of fuel into the combustion chamber.

To meet these performance standards, a fuel injection valve was needed that was capable of injecting a precise amount of fuel at high pressure into a combustion chamber of an engine at a very rapid rate. The needed fuel injection valve also had to remain securely closed when not actuated, including as the valve thermally expanded and contracted during fluctuations in temperature typically found in an internal combustion engine.

Conventional fuel injection valves did not adequately meet these requirements. Many conventional fuel injection valve designs were plagued by reliability issues caused by wear that reduced the valve's ability to reliably seal. Other valve designs employed complicated hydraulic pressure based systems that, while effective, could not operate at the high speeds needed for direct injection applications. Fast-acting piezoelectric and magnetostrictive actuators were known but there were challenges associated with designing fuel injection valves incorporating these types of actuators due to the temperature ranges at which internal combustion engines operate and the impact loads applied to the actuators during rapid operation.

The ever increasing performance demands created a need for precisely machined components having strict tolerances. The tolerances required for high pressure fuel injector components discussed in the patents are in the micron range. (Ex. 1001, 11:11-15) (the '829 patent describes clearance gaps "on the order of 50 to 250 microns".) The movement of the actuators at issue (e.g., piezoelectric and magnetostrictive actuators) is exceedingly small, exceedingly fast, and powerful. At the time of the invention, the fuel injector industry was struggling with how to implement the then-relatively new actuator technologies, deliver precise control of the valves actuation, with only microns of tolerance between components and intricate systems that had to operate reliably under increasingly high pressures, not

to mention large temperature fluctuations that would create significant dimensional changes between components. And if the components leaked fuel or failed, the potential consequences were serious.

Alan B. Welch, Irawan Rahardja, and Mike Hebbes (collectively, the “Inventors”) developed a new fuel injection valve to address these needs and described the features of that valve in a provisional application filed on October 15, 1999. The non-provisional application was filed on March 9, 2000; it was duly examined and issued as the ’829 Patent, entitled “Directly Actuated Injection Valve,” on October 9, 2001. The ’829 Patent expired on March 9, 2020.

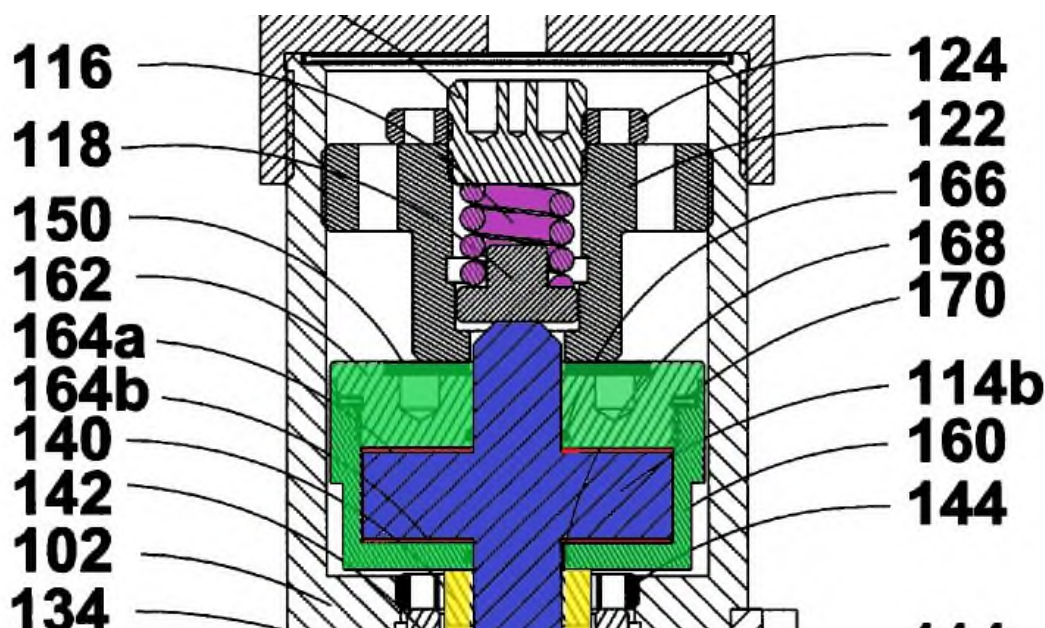
In general, the ’829 Patent is directed to a high pressure fuel injection valve that includes a passive hydraulic link that “provide[s] a load path for the opposing actuating forces that originate from at least one spring member and the actuator assembly.” (Ex. 1001, 7:10-42.) The passive hydraulic link also allows for the correction for differential thermal expansion, wear, and dimensional variability and tolerance. (*Id.*, 7:43-51.) Specifically:

the hydraulic link assembly accounts for variations in component dimensions arising from the permitted tolerances in the manufacturing processes and the injection valve assembly methods. Therefore, the hydraulic link assembly reduces manufacturing costs by allowing the injection valve components to be manufactured to less exacting tolerances. In addition, during operation, the hydraulic link assembly auto-adjusts itself between injection events to account for changes in the dimensional relationship between injection valve components that

may be caused, for example, by component wear or differential thermal expansion or contraction.

(Id., 12:15-26.) The claimed inventions of the '829 Patent resolve the technical problems related to rapid, high pressure fuel injection by providing, among other features, a passive hydraulic link having a hydraulic fluid through which “opening and closing forces are transmitted,” and wherein the “hydraulic fluid acts substantially as a solid” while the actuator assembly is actuated and is “adjustable” while the actuator is not activated. (*Id.*, 17:32-43.)

Annotated Fig. 2 of the '829 Patent is shown below with the valve needle 114 shaded in blue, the connected cylinder 160 and cap 162 shaded in green, the actuator 130 shaded in yellow, and the needle spring 116 shaded in purple. Hydraulic fluid 164a/b (shaded in red) fills the cylinder 160 and forms a thin layer of fluid in between the valve needle and the cylinder.



“The opening force generated by the actuator assembly is transmitted to valve needle 114 through a hydraulic link assembly.” (*Id.*, 16:62-64.) “Furthermore, the hydraulic fluid preferably has a sufficiently high viscosity and bulk modulus so that it acts as an incompressible solid when activation of the actuator assembly causes a valve opening force to be quickly transmitted through the hydraulic fluid between the bottom of cylinder 160 and hydraulic piston 114b.” (*Id.*, 11:21-26.)

“An opening force, originating from expanding magnetostrictive member 130 is transmitted through inner pole 140, the base of cylinder 160, hydraulic fluid 164 b (see FIG. 2), which is held between the base of cylinder 160 and a planar surface of hydraulic piston 114b, and finally, through piston 114b, which in the illustrated embodiment is integral with valve needle 114. The opening force is greater than the closing force, which results in compression of needle spring 116.” (*Id.*, 12:46-54.)

“When injection valve 100 is at rest in the closed position, the closing force that biases valve needle 114 against valve seat 112 originates from needle spring 116.” *Id.* at 12:28-30. “When injection valve 100 is closed and at rest, the closing force is transmitted through the hydraulic fluid held between cylinder cap 162 and hydraulic piston 114b.” (*Id.*, 11:41-43.)

“When injection valve 100 is closed, the hydraulic link assembly automatically self-adjusts so that the position of hydraulic cylinder 160 relative to hydraulic piston 114b is corrected to account for the effects of temperature, wear,

and any small movements of valve needle 114 relative to hydraulic cylinder 160 that may have occurred while valve needle 114 was in the open position. Auto-adjustments are accomplished by the migration of hydraulic fluid 164 from one side of hydraulic piston 114b to the other . . .” (*Id.*, 13:56-65.)

V. PETITIONERS’ VALIDITY CHALLENGE

Petitioner challenges independent claim 1 and dependent claims 2-3, 6, 11-12, 14-15, and 18-20 on the following grounds, all based on 35 U.S.C. §103:

Ground	References	Claims
1	Wirbeleit and Klügl	1-3, 6, 11-12, 14-15 and 18-19
2	Wirbeleit, Klügl and Newcomb	20
3	Klügl and Hayes	1-3, 6, 11-12, 14-15 and 18-19
4	Klügl, Hayes and Newcomb	20

Although Mercedes filed invalidity contentions in the parallel district court litigation that included thirteen (13) separate contentions of invalidity based solely on 35 U.S.C. §102, none of those contentions find their way into this petition. The grounds raised in this petition also are not found in the fourteen contentions that were included in its invalidity contentions.

VI. THE BOARD SHOULD EXERCISE ITS DISCRETION UNDER 35 U.S.C. § 325(D) AND DENY INSTITUTION

The Board has established a two-part framework for determining whether to exercise discretion under Section 325(d). *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR 2019-01469, Paper 6 at 8 (PTAB Feb. 13,

2020). First, whether the petition presents to the Office the same or substantially the same art previously presented to the Office, or whether the petition presents to the Office the same or substantially the same arguments previously presented to the Office. Second, if either condition of the first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.

A. Bosch’s Petition Presents the Same and Substantially the Same Art Previously Presented

The proposed obviousness grounds do not differ significantly from the arguments and prior art previously considered by the Patent Office during prosecution. Specifically, Petitioners contend that both Wirbeleit and Klügl demonstrate the missing “passive hydraulic link.” As will be discussed at length in the sections that follow, this is simply incorrect. Further, these references are substantially the same as art considered by the Patent Office during prosecution.

1. Wirbeleit

Wirbeleit discloses a figure showing a box that bears the label “hydraulic transmission element,” and explains “magentostrictive actuator 21 . . . operates the orifice control needle 5 by way of a hydraulic transmission element 22 which is not shown in detail.” (Ex. 1004, 2:61-64.) It does not disclose or teach any detail about this element or its operation from which a POSITA could conclude that it is

“passive.” In fact, the claim language describes it as “a hydraulic force transmission structure” as opposed to an actuation or spring (mechanical) force transmission structure. (Ex. 1004, 4:16-18) (emphasis added). Moreover, other Wirbeleit (and Daimler-Benz patents) were before the Office during prosecution. For example, cited on the face of the patent is GB 2 321 278. (Ex. 2016) This reference not only lists Wirbeleit as one of the named inventors, but also cites the same Wirbeleit patent on which Bosch relies in its petition, *i.e.*, U.S. Patent No. 5,479,902. (Ex. 1004.) Exhibit 2016 includes far more detail about its components and operation than the Wirbeleit reference on which Petitioners rely.

2. Klügl

Klügl (a Siemens-owned patent) is similarly substantially similar or cumulative to the teachings of cited art. Klügl teaches a flexible membrane (or diaphragm) element. Other references before the Patent Office during prosecution taught diaphragm/membrane-type devices (*e.g.*, Takahasi 4,803,393 (Ex. 2017)). Also the Patent Office had other later Siemens-owned patents before it during prosecution that taught away from the use of diaphragm and membranes (*e.g.*, Kappel 5,875,764 (Ex. 2019); Kappel 6,062,533 (Ex. 2020)). For example, Kappel explains:

Numerous problems, such as, for example, an involved mechanical balancing, a risk of breaking the diaphragm and well as a low efficiency

of the diaphragm-type hydraulics arise given a combination of the piezo actuator with a diaphragm-type hydraulics for valve control in the injection system. Also unsatisfactory are, for example, the influence of pressure waves, a problematical temperature compensation as well as a merely satisfactory switching behavior.

(Ex. 2019, 1:43-51; *see also* Ex. 2020, 1:48-52) (“Given a combination of the piezo actuator with a membrane hydraulics for valve control in the injection system, various problems occur such as, for example, a complicated mechanical balancing, a risk of rupture of the membranes as well as a low efficiency of the membrane hydraulics.”).

3. Hayes and Newcomb

Of the remaining grounds, the first is based on a reference that Bosch admits appears on the face of the patent (i.e., the Hayes reference, Ex. 1024). (Pet. 22) This reference is also discussed in the background of the '829 Patent's specification. Bosch suggests that the Examiner did not specifically discuss Hayes (Pet. 22), but Bosch does not acknowledge that Hayes is discussed in the '829 Patent's specification, which the Examiner would have reviewed. Regardless, the precedential decision in *Advanced Bionics* is instructive: “Previously presented art includes art made of record by the Examiner, and art provided to the Office by an applicant, such as on an Information Disclosure Statement (IDS), in the prosecution history of the challenged patent.” *Advanced Bionics*, Paper 6 at 7–8 (emphasis added). Thus Hayes qualifies as prior art previously presented to the Office because

it was submitted, even if the Examiner did not substantively discussed it during prosecution.

The last remaining reference is a reference that discloses basic elements providing nothing different from the prior art references relied on by the Patent Office during prosecution (i.e., the Newcomb reference). Specifically, with respect to Newcomb, Bosch merely argues that it teaches: (a) “a control valve ... such as a fuel injection valve for controlling flow of a medium” and (b) “employ[ing] materials with matching coefficients of thermal expansion that ‘enable[] the effects of thermal expansion to be reduced.’” (Pet. 22.)

In sum, discretionary denial is proper because Petitioners’ art (or substantially similar art) has already been considered and overcome during prosecution. These references are identical, substantially the same as, and/or cumulative of, references that were considered during prosecution. Despite the significant overlap and absence of any meaningful difference between the art of record and Petitioners’ cited references, Petitioners have made no attempt to show that the Examiner “erred in evaluating the art or arguments” previously presented to the Office as is required pursuant to *Advanced Bionics*, Paper 6 at 8. Petitioners essentially want a do-over of prosecution, hoping that the outcome will be different this time, and continuing their pattern of wasteful delay tactics.

VII. LEVEL OF ORDINARY SKILL

For purposes of this preliminary response, Patent Owner submits that a POSITA in the timeframe of the invention would have had a degree in mechanical engineering or a similar discipline along with two (2) years of professional experience working with fuel injectors or fuel injection systems for internal combustion engines. (Ex. 2004, ¶14)

VIII. CLAIM CONSTRUCTION

In *inter partes* reviews, the Board construes claim terms based on their ordinary and customary meaning in accordance with *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). Claims should be construed to sustain their validity, if possible. *Rhine v. Casio, Inc.*, 183 F.3d 1342, 1345 (Fed. Cir. 1999). The specification is the “best source for understanding a technical term,” to be supplemented, “as needed, by the prosecution history.” *Phillips*, at 1315.

While Petitioners do not request construction of any term, they imply that certain references render the claims obvious “when properly interpreted,” and other references render the claims obvious when using the “Patent Owner’s erroneous understanding.” (Pet. 16-17.)

Petitioners’ expert (Dr. Quinlan) submitted an expert report in parallel district court proceedings opining on the construction of three different terms that he considered necessary to understand the scope of the claims in the ’829 Patent. (Ex.

2001 pp. 22-31, 37-39.) Dr. Quinlan then considered it necessary to propose narrow constructions of the terms “passive hydraulic link,” “valve needle,” and “fluid passage from said interior chamber to said combustion chamber.” (*Id.*)

Seven days later, Dr. Quinlan executed the declaration submitted in support of this Petition, in which he now opines that “the ’829 patent’s claims do not require further construction and can be afforded their plain and ordinary meaning.” (Ex. 1003, ¶ 89.) In January 2023, Dr. Quinlan was deposed in the parallel district court proceedings. During his deposition he testified in support of the narrow constructions for three terms from the ’829 Patent. (Ex. 2002, 10:3.)

For the purposes of this preliminary response, Patent Owner does not seek construction of any term. Patent Owner explicitly reserves the right to construe claim limitations should the Board institute review.

IX. THE BOARD SHOULD DENY INSTITUTION BECAUSE THE PETITION DOES NOT ESTABLISH A LIKELIHOOD OF SUCCESS FOR ANY GROUND ASSERTED FOR THE SOLE INDEPENDENT CLAIM 1.

A. Grounds 1 & 2: Neither Klügl nor Wirbeleit Disclose the Claimed Passive Hydraulic Link Claimed in Limitation 1(e)

Claim 1 is the only independent claim challenged under Ground 1 (Klügl and Wirbeleit) and Ground 2 (Klügl, Wirbeleit, and Newcomb). The remaining challenged claims each depend from and include the limitations of Claim 1. Ground 2 adds Newcomb to address only dependent Claim 20’s limitation. Petitioners do not rely on Newcomb in connection with any limitation of Claim 1. Therefore, if the

Petition does not demonstrate a reasonable likelihood that Petitioners will prevail in demonstrating that claim 1 is obvious, the Board need not consider Petitioners' arguments with respect to any of the dependent claims. Westport's preliminary response will focus on two points:

(1) because neither Klügl nor Wirbeleit disclose the passive hydraulic link limitation 1(e), this combination does not render claim 1 obvious, and therefore, does not render any of the remaining challenged claims (each of which depend from Claim 1) obvious, and

(2) a POSITA would not have been motivated to make the proposed combination of Klügl and Wirbeleit.

1. Petitioners' mapping fails sufficiently establish that each requirement of the passive hydraulic link limitation is met

The passive hydraulic link limitation (limitation 1(e) in the Petition) includes at least three separate requirements, each of which must be met by the combination proposed by Petitioners. In the Petition, limitation 1(e) is addressed as a single limitation with each of Klügl and Wirbeleit mapped to the various requirements. (Pet. 34-40.) The Petition makes liberal use of ellipsis and partial quotes of the claim limitations, and in doing so, attempts to gloss over the fact that Klügl and Wirbeleit—even when combined—are missing important aspects of this key limitation. To illustrate this point, limitation 1(e) is reproduced below in its entirety with the portions of the limitation that Petitioners map to Klügl and Wirbeleit

emphasized in bold and italicized font while the remainder of the limitation is unbolded:

1(e) a *hydraulic link assembly* comprising a *passive hydraulic link* having a hydraulic fluid thickness *through which* said *opening and closing forces are transmitted*, whereby said hydraulic fluid acts substantially as a solid with said *thickness* being *substantially constant* while said actuator assembly is activated and wherein said *thickness* of said hydraulic link *is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components* of said injection valve to maintain a *desired valve needle lift upon activation* of said actuator assembly

The petition only addresses 41 of the 87 words in limitation 1(e) and paraphrases other portions of the limitation out of the claim.

Westport's more fulsome analysis of each requirement within limitation 1(e) demonstrates that not only did Petitioners not expressly address each requirement, but that the proposed combination of Klügl and Wirbeleit does not teach each and every requirement found in this claim limitation. Claim element 1(e) can be divided into at least three requirements:

Separate Requirements of Limitation 1(e)	
(i)	a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted
(ii)	whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated and
(iii)	wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship

	between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly
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- (i) **a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted**

For the first requirement within Limitation 1(e), Petitioners identify both Wirbeleit's hydraulic transmission element 22 and Klügl's transmission module 2. Wirbeleit's sparse four-page specification is focused on the implementation of an electronic control unit and sensor to effect the duration of the fuel injection independent of fuel pressure. (Ex. 1004, 3:12-16.) Not only is Wirbeleit not focused on the transmission element 22, Wirbeleit provides no description of what hydraulic transmission element 22 is or how it operates. Wirbeleit's entire teachings regarding its hydraulic transmission element 22 are found in two sentences (reproduced in full below) and the sole figure, which shows the hydraulic transmission element as an empty rectangle. (Ex. 1004 2:1-4, 60-64, and Figure.)

“Opening of the slot-injection orifices can be controlled by energizing a piezo actuator which acts on the injector needle by way of a hydraulic transmission element against a compression spring with a voltage-dependent force.” (*Id.* 2:1-4)

“At the rear end of the orifice control needle 5 opposite its tip 11 there is a magnetostrictive actuator 21 which is addressed by the control unit 20 and which operates the orifice control needle 5 by way of **a hydraulic transmission element 22 which is not shown in detail.**” (*Id.* at 2:60-64)

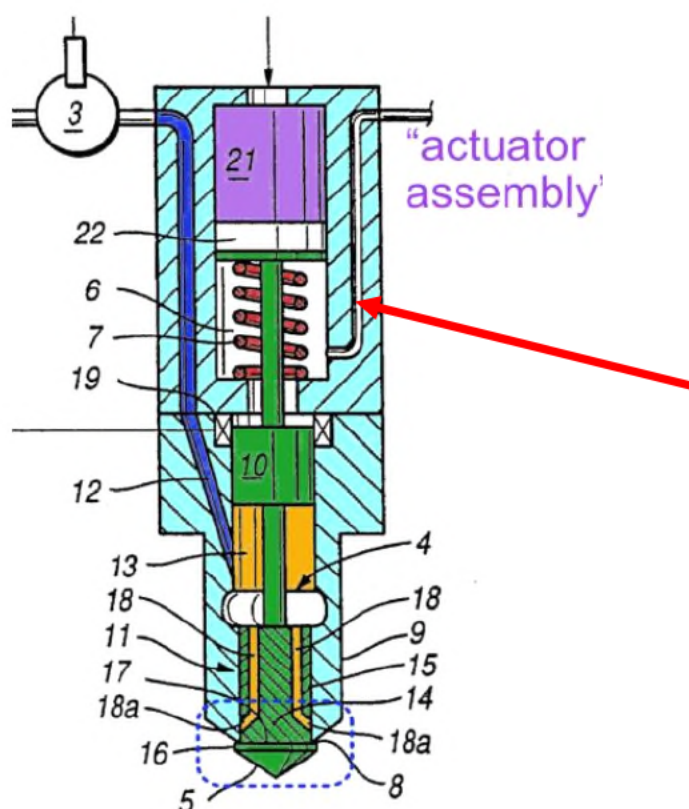
Thus Petitioners’ “primary reference” for Grounds 1 and 2 (Pet. 17) provides almost no disclosure for this key limitation, leaving Petitioners and their experts to speculate. A reasonable POSITA, however, would not understand Wirbeleit to disclose what Petitioners attempt to read into it. (Ex. 2004, ¶¶44-47.) For example, based only upon Wirbeleit’s sole figure, Petitioners request the Board to conclude “Wirbeleit’s ‘hydraulic transmission element’ is sealed within its housing and is not connected to a separate fluid supply” (Pet. 34) and that it would be considered “passive.” (Pet. 35.) Nothing in Wirbeleit’s figure or the bare disclosure would lead a POSITA to reach such a conclusion. (Ex. 2004, ¶¶44-47.) Rather based on the brevity of the disclosure and the single figure, a POSITA would understand Wirbeleit to be a placeholder for well-known components. It is unreasonable to conclude that Wirbeleit disclosed a completely novel component—for which Petitioners have found no other support in the prior art to date—in this manner.

Petitioners further speculate that “Wirbeleit—the primary reference at issue in Grounds 1 and 2—teaches a ***directly actuated valve***.” (Pet. 17.) On its face, Wirbeleit claims priority to a German patent application DE 4325904. (See Ex. 1004.) A subsequent patent (also naming Wirbeleit and Raab as inventors) provides further support that Petitioners may be reading too much into Wirbeleit’s bare disclosure. The subsequent patent suggests the transmission element embodiment may not be a directly actuated valve:

Finally, German Patent No. 432590 4C2 describes a fuel injection System in which a high-pressure pump delivers the fuel into a supply line common to all injector nozzles. **Actuators** which are driven by an electronic control unit and which work in accordance with a piezoelectric or magnetostrictive principle, act **directly or** via a **transmission element**, on a valve needle of the injector valve that opens to the outside, the orifice cross-sections having an elongated and rectangular shape in the opening direction.

(Ex. 2013, 2:55-64 (emphasis added); *id.* 4:41-45.)

Wirbeleit also does not disclose that the transmission element 22 contains fluid, much less that it has “**a hydraulic fluid thickness through which said opening and closing forces are transmitted.**” Both Petitioners and their expert entirely ignore the fluid line shown on the right of Wirbeleit’s figure, as indicated by the red arrow Westport added to Petitioners’ expert’s annotated figure (Ex. 1003 ¶192):



It is more plausible that the hydraulic transmission element relates (in some undisclosed way) to the fluid line shown. Wirbeleit’s intentional omission of any details of the internal design and operation of its hydraulic transmission element cannot be relied on to teach all possible configurations. Wirbeleit should only be relied on for what it actually discloses. Because Wirbeleit only teaches that the actuator moves the valve “by way of” a hydraulic transmission element, the Petitioners’ reliance on Wirbeleit to teach any additional limitations is unsupported.

Petitioners also have inexplicably divided limitations between Klügl and Wirbeleit. For example, Petitioners rely on only Wirbeleit to teach “**opening and**

closing forces are transmitted.” (Pet. 34.) Then Petitioners point to Klügl as teaching **“a thickness.”** (Pet. 39.) The Petition provides no explanation of how Klügl and Wirbeleit are combined to teach **“a hydraulic fluid thickness through which said opening and closing forces are transmitted.”** In fact, the only references to “hydraulic fluid thickness” found in the Petition are citations of the claim language. (Pet. 34.) Other references to “thickness” occur in relation to other requirements of limitation 1(e). (*Id.* 39.)

Petitioners must demonstrate with particularity where each limitation of each challenged claim is found in the prior art. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring IPR petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). Because Petitioners have not shown that Klügl in combination with Wirbeleit teach **“a hydraulic fluid thickness through which said opening and closing forces are transmitted,”** Petitioner has failed to meet their burden and the Board should deny institution.

Contrary to the assertions in the Petition that closing forces are transmitted through the “hydraulic transmission element,” Wirbeleit actually teaches that “[a]t the end of the injection period energization of the actuator 21 is interrupted so that the orifice control needle is returned by the spring 7 to a rest position in which the needle tip 11 is seated on the valve seat 8.” (Ex. 1004, 3:7-11) A POSITA would

have understood that Wirbeleit's actuators longitudinally contract when de-energized and provide whatever force is needed to return the hydraulic transmission to its initial position. Ex. 2004 at ¶¶41. Thus, Wirbeleit does not provide any teachings that its hydraulic transmission element is used to transfer closing forces.

Nothing in Klügl supplies this missing element for Wirbeleit because, as opposed to teaching “**a hydraulic fluid thickness through which said opening and closing forces are transmitted,**” Klügl teaches a system where closing forces are specifically not transferred through the identified hydraulic fluid thickness. (*Id.* ¶¶51-52) Rather, Klügl explains that when “activation of the piezoelectric actuator 1 ends, the piezoelectric actuator 1 is shortened and the transmission module 2 and the guide sleeve 11 are pushed by the disk spring 14 in the direction of the piezoelectric actuator 1.” (Ex. 1006 3:39-42) Klügl further explains, when at rest, hydraulic fluid from the compensation chamber 7 moves via the throttle 10 into the pressure chamber 5 “so that the first membrane 6 is moved in the direction of the drive piston 3.” (*Id.* 3:63 - 4:3)

Klügl does not teach closing forces being transferred through the membrane 6 and chamber 5, and Klügl's system would be unnecessary if the closing force was so transferred. (Ex. 2004 ¶¶51-52.) In order to transfer the closing forces from spring 15 or spring 33 through the hydraulic fluid in the chamber 5, the drive piston 3 would have to maintain contact with the membrane as both move upward. (*Id.*) If the drive

piston 3 maintained contact with the first membrane 6 during closing, the adjustment of the membrane to re-establish the contact after closing (e.g. the purpose of Klügl) would never be necessary. (*Id.*)

Further, a POSITA, appreciating the complex balancing of forces and pressures in a fuel injector, would have understood that a closing force from drive piston 3 acting on membrane 6 would tend to push fluid out of pressure chamber 5 and destroy the functionality of the transmission module 2 in Klügl. (*Id.*) Therefore, a POSITA would have understood that Klügl would be designed so that any closing force generated by spring 15 or spring 33 would be isolated from the membrane 6 as described in Klügl. (*Id.*)

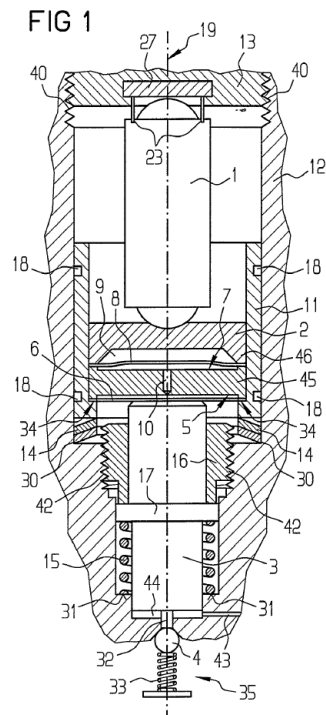
Because the Petition fails to identify how the combination of references teach **“a hydraulic fluid thickness through which said opening and closing forces are transmitted,”** and there is no reasonable way to infer that the combination of references teach this limitation, the Petition fails to show any likelihood—much less a reasonable likelihood—that any challenged claim would be found unpatentable under Grounds 1 or 2.

- (ii) **whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated**

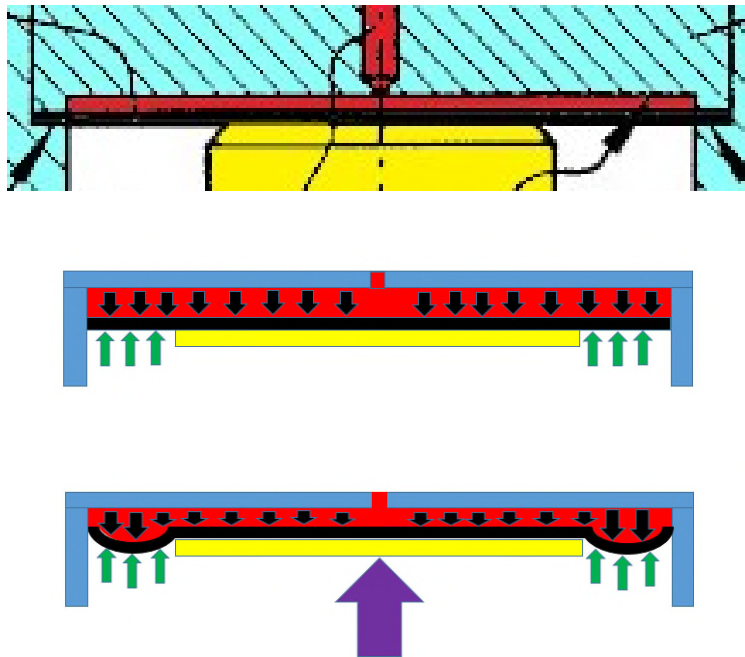
With respect to the second requirement of limitation 1(e), Petitioners argue Klügl’s **“‘thickness’ is ‘substantially constant.’”** (Pet. 39.) Petitioners do not even

attempt to argue that either Klügl or Wirbeleit teaches a “hydraulic fluid [that] acts substantially as a solid.” In fact, Petitioners only mention of the word “solid” is in the recitation of the claim limitation. As with the first requirement of limitation 1(e) above, it is Petitioners’ burden to show where each limitation of each challenged claim would have been found in the prior art. *Harmonic Inc.* at 1363. Because they fail to do so, Petitioners do not comply with the requirements of 35 U.S.C. § 312(a)(3) to identify with particularity the grounds on which the challenge is based and the evidence supporting the grounds.

Klügl also does not teach a hydraulic fluid that acts substantially as a solid with [a] thickness being substantially constant while [the] actuator assembly is activated. Klügl does not include the words “solid” or “thickness” and teaches a system that transmits movement using a chamber of fluid maintained at a constant pressure behind a flexible membrane so that the membrane can deform to adjust for dimensional changes. Ex. 2004 at ¶¶50.



Klügl teaches that throttle 10 is dimensioned to minimize the flow of hydraulic fluid from pressure chamber 5 into compensation chamber 7 during actuation. Ex. 1006 at 4:11-24. Limiting flow out of pressure chamber 5 will limit the decrease in volume of fluid contained within in pressure chamber 5 but the flexibility of membrane 6 will not maintain the constant thickness of the pressure chamber. (Ex. 2004, ¶¶48-50.) As illustrated below, the membrane 6 (black) will tend to deform inward where it contacts the drive piston 3 (yellow) and bulge outward into the annular area between the drive piston and the sleeve 11 (blue) when a force (purple arrow) is applied. (*Id.*)



Even at the rapid actuation speeds consistent with fuel injectors, a POSITA would have understood that flexible membranes used in fuel injectors will flex during actuation. *Id.* For example, Petitioner Mercedes filed a patent application in 1999 that relied on this exact behavior. (Ex. 2005.) Because the membrane 6 will flex during actuation, the fluid behind the membrane will tend to flow away from the area of the membrane in contact with the drive piston and the layer of fluid will not maintain a constant thickness. (Ex. 2004 ¶¶48-50.)

Because Klügl does not teach a hydraulic fluid that acts “**substantially as a solid with said thickness being substantially constant while said actuator assembly is activated,**” Petitioners failed to show that claim 1 is obvious over the combination of Wirbeleit and Klügl.

- (iii) **wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly**

For the third requirement of the limitation 1(e), as discussed above, the inherent flexibility of the membrane 6 during actuation will not maintain a substantially constant thickness of hydraulic fluid in the pressure chamber of the transmission module during actuation. (*Id.* ¶¶48-50; *see also* Section VI.A.1.(ii) *supra.*) Because the thickness of hydraulic fluid in pressure chamber 5 is reduced during actuation, the downward movement of drive piston 3 will be less than the longitudinal expansion of the actuator 1. (Ex. 2004 ¶¶48-49.) This loss of actuator linear translation, or stroke, means that the actual lift created in ball 4 by actuator 1 will not be consistent. (*Id.*) Although the loss of linear translation may be small, because the lift in high pressure injectors is very small (about 65 microns) any loss of translation is significant. (*Id.*; *see also* Ex.1001 8:66-67.)

This is completely consistent with the disclosure of Klügl, which as cited in the Petition, teaches that the system of Klügl is intended to maintain contact between the membrane 6 and the drive piston 5. (Pet. 39, *see also* Ex. 1006 3:4-10, 4:9-10 and 4:44-48.) Klügl teaches that this contact is critical so that, during operation, the pressure created by the actuator is transferred to the drive piston and the closing element to lift off of the valve seat. (Ex. 1006 3:23-38.)

Consequently, Klügl does not teach a system that will reliably generate a desired lift. A POSITA would have understood that Klügl's use of a flexible membrane and its overall arrangement of components show that even if Klügl successfully transfers force, it does not transmit a predictable and repeatable linear translation from the actuator to the drive piston to create lift in the ball. (Ex. 2004 ¶¶48-49.)

Showing a further misunderstanding of the cited art, Petitioners argue that “a POSITA would have understood that when applied to Wirbeleit, Klügl's transmission module should be structured as to maintain the intended needle lift or position range.” (Pet. 39.) The entire objective of Wirbeleit is to provide a system where injection of fuel is controlled by an electronic control unit. (Ex. 1004, 1:7-12.) Wirbeleit achieves this by providing a system that constantly senses the position of the orifice needle and adjusts the position (e.g. lift) of the orifice needle via the actuator. (*Id.* 2:1-2, 3:1-7.) Wirbeleit is able to adjust for any dimensional changes due to thermal effects or wear because it senses the position of the needle and adjusts actuation to achieve a desired lift. (Ex. 2004 ¶61.) It is not clear why a POSITA would be motivated to add the complicated structure of Klügl to Wirbeleit “to maintain a desired needle lift” when Wirbeleit already senses and adjusts lift as needed. The deflection of the membrane in Klügl, as described above, would make the system of Wirbeleit work even harder to ensure a desired lift. *Id.*

Because Klügl does not teach a hydraulic link that **“is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly”** the Petition has failed to show that claim 1 is obvious over the combination of Wirbeleit and Klügl.

2. A POSITA would not have combined Wirbeleit and Klügl to solve the problems addressed by the '829 Patent

Petitioners contend that a POSITA would have considered the transmission module of Klügl “particularly suitable for use with Wirbeleit.” (Pet. 47.) Petitioners further argue that a POSITA also would have had a reasonable expectation of success in combining Wirbeleit and Klügl. (Pet. 52.)

Petitioners rely entirely on the declaration of Dr. Quinlan to support their conclusions. (Pet. 47-53; Ex. 1003, ¶¶ 291-337.) Dr. Quinlan, however, was not a POSITA at the time the invention of the '829 Patent was made. (Ex. 1003, ¶110.) In addition, Dr. Quinlan has no personal knowledge on which to form his opinions about what a POSITA would have found obvious in 1999. It is effectively impossible for someone who has no such personal knowledge from the perspective of a POSITA at the relevant time to opine about what a POSITA would have found obvious then, without using impermissible use of hindsight from current experiences and without using the '829 Patent as a roadmap.

The Board, however, does not have to rely solely on the conclusions of Dr. Quinlan, or even Westport's expert. Klügl was filed in 1997 by Siemens AG naming Wendelin Klügl as the first named inventor. (Ex. 1006, pg. 1.) By late 1998, Mr. Klügl himself recognized that the design disclosed in Klügl was problematic. He found that it has "a complicated structure" and that even a "slight leak in the system leads to . . . a failure of the transmission module and thus of the injection valve" and proposed an improved structure. (Ex. 2007 and Ex. 2008 (Klügl2), 1:57-66.)

By late 1999, other inventors at Siemens were also aware that Klügl's system was especially unsuitable for use with high precision, high pressure fuel injectors. Klügl's system was susceptible to leaks, and even when operating properly, it "significantly impairs the quality of the combustion process." (Ex. 2009/2010 (Schmoltzer) ¶[0005].) Klügl's system also was known as of 1999 to (i) be a complicated structure, (ii) have difficulty compensating across a high range of thermal fluctuation (-40°C to +150°C), and (iii) cause reliability problems at high actuation forces/pressures. (Ex. 2011/2012 (Gottlieb), 2:12-26.) The problematic temperature ranges cited in Gottlieb are very close to the temperature ranges discussed in the '829 Patent. (Ex. 1001, 12:4-6 (indicating temperature of -40°C to +125°C).)

These assessments of the technology were all filed around the time the '829 Patent invention was conceived and reduced to practice. This evidence directly contradicts Petitioners' conclusions that Klügl would have:

- been "particularly suitable for use with Wirbeleit" (Pet. 47);
- "substantially improve[d] Wirbeliet's valve" (Pet. 49);
- provide[d] a simplified "process of manufacturing" (Pet. 49);
- reduce[d] "the possibility of hydraulic fluid leaks" (Pet. 50); and
- support[ed] Wirbeleit's objectives of improving engine performance (Pet. 50-51).

Petitioners' assertion that a POSITA would have had a reasonable expectation of success in combining Klügl and Wirbeleit directly contradicts the actual, contemporaneous evidence from Klügl², Schmoltzer, and Gottlieb, which shows recognized and serious technological deficiencies in Klügl's system.

Therefore, even if a POSITA could have combined Klügl and Wirbeleit as proposed in the Petition, a POSITA at the time of the invention of the '829 Patent would not have been motivated to make such a combination knowing that Klügl's system would not produce the desired results.

For at least the reasons described above, Petitioners have not shown any likelihood—much less a reasonable likelihood—that independent claim 1 would have been obvious in view of the combination of Klügl and Wirbeleit. Because all

remaining claims challenged under Ground 1 depend from claim 1, the Petition has failed to show any challenged claim would have been obvious in view of their proposed combination of Klügl and Wirbeleit.

Petitioners' Ground 2 proposes the addition of Newcomb to the combination of Klügl and Wirbeleit would render the added limitation of dependent claim 20 obvious. Petitioners do not contend that Newcomb provides any disclosures missing from the combination of Klügl and Wirbeleit as to claim limitation 1(e). For purposes of this preliminary response, Westport contends that Petitioners' Ground 2 does not demonstrate a reasonable likelihood that the additional challenged claim 20 would have been obvious for the same reasons set forth with respect to Ground 1 and for the additional lack of motivation to combine Newcomb with Klügl and Wirbeleit, apart from using Claim 20 as a roadmap to select references disclosing the additional limitation. Petitioners' only proffered motivation is that the three references relate to fuel injectors generally. (Pet. 55.)

B. Grounds 3 & 4 –Klügl As Modified by Hayes Fails to Render Obvious Independent Claim 1 Obvious

Claim 1 is the only independent claim challenged under Ground 3 (Klügl and Hayes) and Ground 4 (Klügl, Hayes, and Newcomb). The remaining challenged claims each depend from and include the limitations of Claim 1. Ground 4 adds Newcomb to address only dependent Claim 20's limitation. Petitioners do not rely on Newcomb in connection with any limitation of Claim 1. Therefore, if the Petition

does not demonstrate a reasonable likelihood that Petitioners would prevail in showing claim 1 is obvious, the Board need not consider Petitioners' arguments with respect to any of the dependent claims. Westport's preliminary response will focus on three points:

(1) the combination of Klügl and Hayes would not have rendered Claim 1 obvious because it would render Hayes inoperative;

(2) because neither Klügl nor Hayes disclose the passive hydraulic link limitation 1(e), this combination does not render claim 1 obvious, and therefore, does not render any of the remaining challenged claims (each of which depend from Claim 1) obvious; and

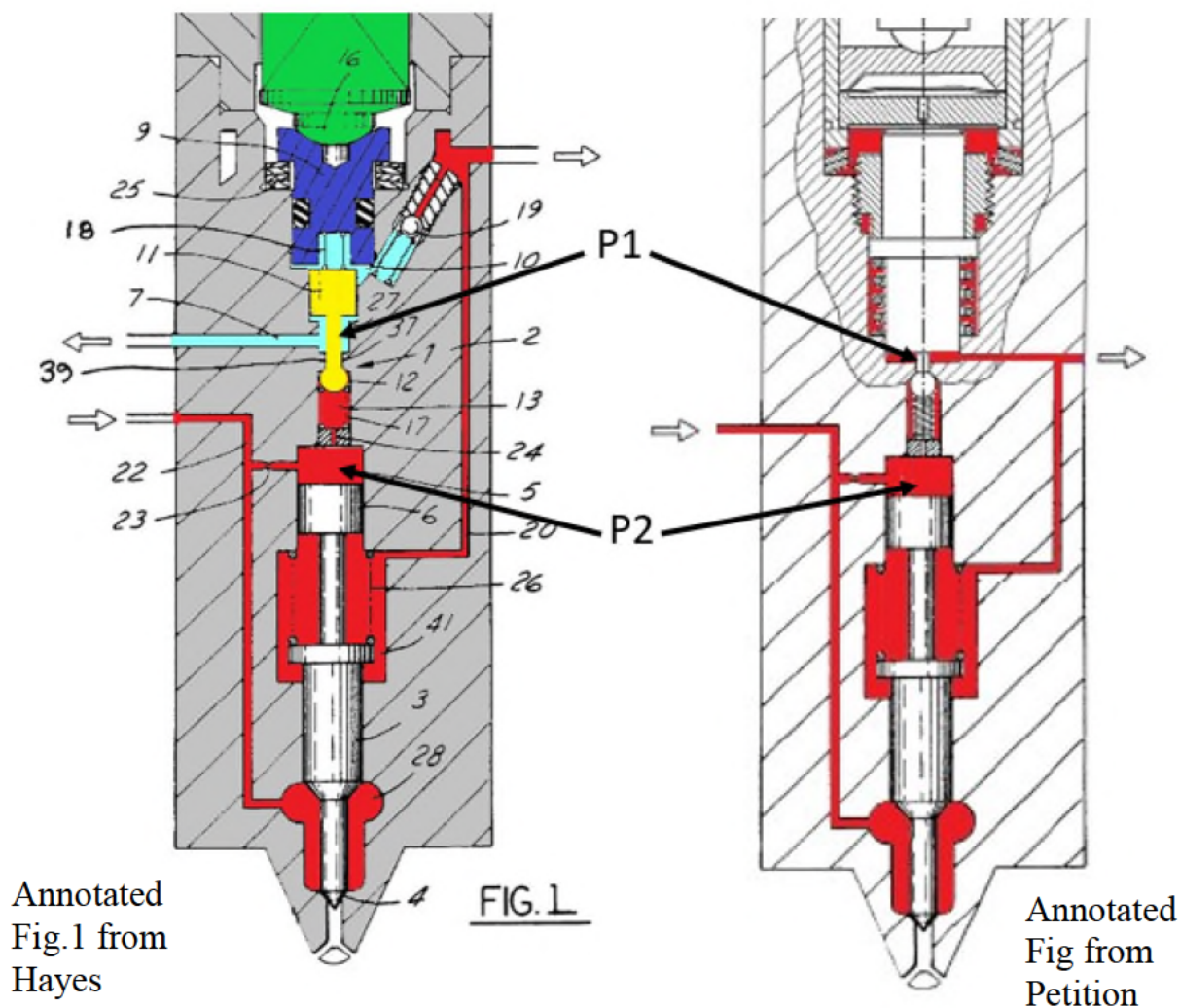
(3) a POSITA would not have been motivated to make the proposed combination of Klügl and Wirbeleit.

**X. THE PROPOSED MODIFICATION OF HAYES WITH KLÜGL
RENDERS HAYES INOPERABLE FOR ITS INTENDED
PURPOSE**

Proposed modifications that render the prior art inoperable for its intended purpose fail to support a conclusion of obviousness. *Cook Grp., Inc. v. Boston Sci. Scimed, Inc.*, 809 Fed. Appx. 900, 1000-1001 (Fed. Cir. 2020) (“[W]here the motivation to combine rests on a modification alleged to improve the primary reference, ... the Board may consider whether the modification renders the reference inoperable for its intended function”); *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir.

1984) (no obviousness where a device “would be rendered inoperable for its intended purpose”).

Here, Grounds 3 and 4 rely on Klügl as modified by Hayes to teach the limitations of the challenged claims. (Pet. 8, 56-72.) Throughout these Grounds, Petitioners present annotated figures from Hayes to show certain claim elements, followed by an illustration of Klügl mashed together with Hayes. (*See, e.g., id.* 60.) Petitioners explain “Hayes teaches an indirectly actuated fuel injector.” (Pet. 22.) Opening Hayes’ “control valve lowers the pressure in a ‘chamber 5’ which causes a separate ‘valve needle 3’ to lift and open a passage into combustion chamber.” (Pet. 22.) In the annotated version of Hayes Fig 1. below, spaces that are in fluid connection with high pressure feeding line 22 are shaded in red and spaces in fluid connection with low pressure drain line 7 are shaded in light blue. (Ex. 2004, ¶54.) For the fuel injector to be operable, there must be a pressure differential between the point labeled as P1 and the point labeled as P2, such that the pressure at P2 must be higher than the pressure at P1. (*Id.*, ¶65.)



The illustrations above compares an annotated Hayes Fig. 1 (on the left) with an annotated version of Petitioners' mash-up of Hayes + Klügl (on the right) (*see* Pet., 60). The spaces in fluid connection with the high pressure feeding line are shaded in red. (Ex. 2004, ¶66.) In Hayes, there exists a pressure differential as shown by the blue and the red. In contrast, Petitioners' combination of Hayes + Klügl, everything is red showing that no pressure differential exists; fuel at points P1 and

P2 are at the same pressure. (*Id.*) Because there is no differential pressure across the control valve, opening the control valve will not create any movement. (*Id.*) Petitioners' proposed modification of Hayes with Klügl simply would not work. (*Id.*)

Petitioners' proposed modification of Hayes with Klügl is illogical and renders the system of Hayes inoperable for its intended purpose. Thus, the rationale for the modifications provided in the Petition does not support a finding of obviousness. A POSITA would not be motivated to modify the prior art in a way that would render it inoperable. Consequently, Petitioners have failed to show that a suggestion or motivation exists for its proposed modifications. The Petition does not show any likelihood that any claim would be found unpatentable.

1. Petitioners' mapping fails sufficiently establish that each requirement of the passive hydraulic link element is met

For Grounds 3 and 4, Petitioners now take the position that Klügl by itself discloses the full passive hydraulic link limitation 1(e). (Pet. 68-69.) Petitioners refer back to back to Section VII.C.1.a.[1(e)] of the Petition for their prior discussion of Klügl's teachings related to this limitation in connection with Grounds 1 and 2. (*Id.*) Notably, Petitioners do not argue that Hayes discloses any part of the passive hydraulic link limitation 1(e). (*Id.*) Petitioners' discussion of this limitation in connection with Grounds 1 and 2 relied upon Wirbeleit as disclosing portions of the requirements but Petitioners do not incorporate Wirbeleit as part of Grounds 3 and 4.

- (i) **a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted**

The Petition cites to Section VII.C.1.a.[1(e)] as supporting the statement that “the closing force of the spring 15 is transmitted back through this same chamber 5 during valve closing.” *Id.* While Petitioners had relied on Wirbeleit as showing an element “through which . . . opening and closing forces are transmitted” (Pet. 34), Petitioners contend that “**closing force** of the spring 15 is transmitted back through **this same chamber 5** during valve closing.” (Pet. 68 (emphasis added).)

Klügl teaches that “[t]he drive piston 3 is pushed away from the closing element 4 by the spring 15, so that the closing element 4 is pushed by the valve spring 33 back onto the assigned valve seat 35.” (Ex. 1006, 3:39-45.) There does not appear to be any disagreement that the closing force of valve spring 33 is not transmitted through the Klügl’s chamber 5 (i.e., the element that Petitioners contend corresponds to the claimed passive hydraulic link). Thus the only arguable “closing force” Petitioners identify is the force from spring 15 that works to push piston 3 away from closing element 4 to allow spring 33 to push closing element 4 closed. (*Id.*, 3:39-45.) It does not follow, however, that the closing force of spring 15 would be transferred to piston 3, then through first membrane 6, to be “transmitted through” the hydraulic fluid of Klügl’s chamber 5. Rather, Klügl describes that when in the rest position, hydraulic fluid moves in the opposite direction; namely, from the

compensation chamber 7 via the throttle 10 to the pressure chamber 5 “so that the first membrane 6 is moved in the direction of the drive piston 3.” (*Id.*, 3:63-4:3 (emphasis added).)

Accordingly, Klügl cannot be said to teach or disclose transmitting closing forces through the membrane 6 and chamber 5. Logically, a POSITA would have known that to transfer the closing forces through the hydraulic fluid in the chamber 5, the drive piston 3 would have to remain in contact with first membrane 6 as the closing forces were applied from to drive piston 3. (Ex. 2004, ¶¶51-52.) If so, closing and the adjustment of the membrane as described by Klügl would not be necessary. (*Id.*) In fact, the closing force from drive piston 3 acting on membrane 6 would tend to push fluid out of pressure chamber 5 and render Klügl’s transmission module 2 superfluous. (*Id.*)

A POSITA also would have understood that Klügl is designed so that closing forces generated by spring 15 (and spring 33) are isolated from membrane 6. (*Id.*) Because the Petition fails to identify how the combination of references teach “**a hydraulic fluid thickness through which said opening and closing forces are transmitted,**” and there is no reasonable way to infer that the combination of references teach this limitation, the Petition not only fails to meet the requirements of 35 U.S.C §312 but has also failed show any likelihood that any claim would be found unpatentable under grounds 3 or 4.

- (ii) **whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated and**

The Petition cites to Section VII.C.1.a.[1(e)] as supporting the statement that “the closing force of the spring 15 is transmitted back through this same chamber 5 during valve closing.” (Pet. at 68.) As explained above, due to the inherent flexibility of membrane 6 of Klügl, the fluid behind the membrane will tend to flow away from the area of the membrane in contact with the drive piston and the layer of fluid will not maintain a constant thickness. (Ex. 2004, ¶¶51-52, *see also* Section VI.A.1.(ii) *supra*).

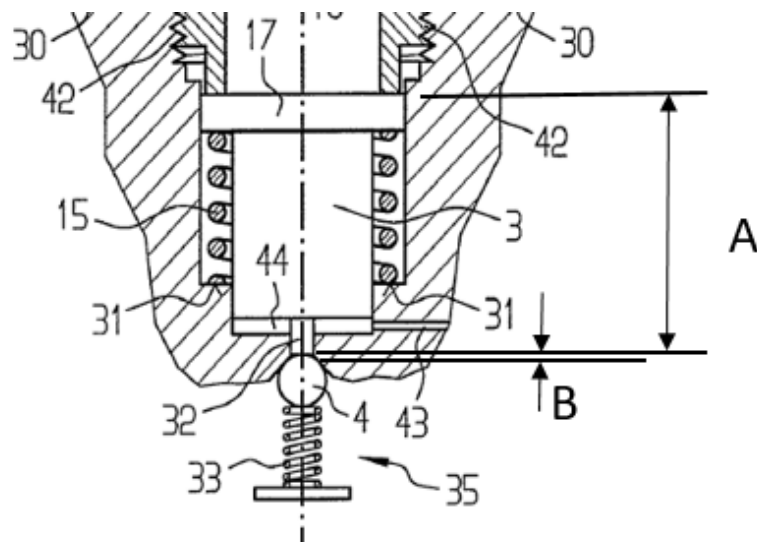
Because Klügl does not teach a hydraulic fluid that acts “**substantially as a solid with said thickness being substantially constant while said actuator assembly is activated**,” the Petition has failed to show that claim 1 is obvious over the combination of Hayes and Klügl.

- (iii) **wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly**

As discussed above, Klügl does not teach a system that can reliably generate a desired lift and a POSITA would have understood that Klügl’s use of a flexible membrane and its overall arrangement of components show that even if Klügl successfully transfers force as intended, it does not transmit a predictable and

repeatable linear translation from the actuator to the drive piston to create lift in the ball. Ex. 2004 at ¶¶48-50, *see also* Section VI.A.1.(iii) *supra*.

This deficiency is further amplified in the proposed combination of Klügl as an entire unit into the system of Hayes. As illustrated in the annotated figure below and explained in Klügl, spring 15 will always push drive piston 3 upward until check ring 17 contacts lower stop 16. Ex. 1006 at 2:39-49. Thus, the distance A from the lower stop 16 to the end of the valve needle 32 is fixed. Ex. 2004 at ¶67.



Any adjustment provided by the flexible membrane of Klügl's transmission module will not adjust distance A. *Id.* Ball 44 is illustrated as being in direct contact with the valve needle 32 but, since the upward movement of the ball is limited by its contact with housing 12, thermal expansion or wear can create a gap B between the

end of the valve needle 32 and the ball 4. *Id.* at ¶68. If gap B exists, then the ultimate lift of ball 4 away from the housing will be less than the linear translation of the actuator. *Id.* In such a condition, the hydraulic transmission of Klügl will not be able to maintain a desired lift. *Id.*

The system of Klügl is also problematic because just as thermal expansion or wear may create a gap B, those same effects may operate in the other direction and cause the distance A to extend farther toward the contact between ball 4 and housing 12 when the actuator is closed. *Id.* at ¶69. This would cause sealing pressure to decrease and increase the likelihood of leakage between ball 4 and housing 12. *Id.*

Because Klügl does not teach a hydraulic link that **“is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly”** the Petition has failed to show that claim 1 is obvious over the combination of Hayes and Klügl.

(iv) A POSITA would not have combined Klügl with Hayes to solve the problems addressed by the '829 Patent

As discussed above in Section A.2, there is extensive evidence that a POSITA considered the design of Klügl technologically deficient and inappropriate for high pressure fuel injectors. This is true whether Klügl is being combined with Wirbeliet or Hayes. Therefore, even if a POSITA could have devised an operable embodiment of Petitioners' mash-up of Klügl + Hayes, a POSITA at the time of the invention of

the '829 Patent would not have sought to make such modifications because it was technically undesirable for the intended purpose.

For at least the reasons described above, the Petition fails to show any likelihood that claim 1 is obvious over the combination of Klügl and Hayes. Because every other claim challenged under Grounds 3 and 4 depend from claim 1, the Petition has failed to show that any challenged claim is obvious over the combination of Klügl and Hayes.

2. Conclusion

Petitioner has failed to demonstrate a reasonable likelihood of prevailing against at least one challenged claim in any of Grounds 1-4. The Board should decline to institute *inter partes* review.

Dated: March 23, 2023

Respectfully submitted,

By: /Derek V. Forinash/

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CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing patent owner preliminary response, together with all exhibits and other documents filed therewith, was served on the Petitioner's counsel of record by email (to which Petitioner has consented) to:

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Dated: March 23, 2023

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Patent Owner Preliminary Response, exclusive of the parts exempted by 37 C.F.R. § 42.24, contains 9,986 words, according to the word processing program used to prepare it, and therefore complies with the limitations of 37 C.F.R. § 42.24.

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