

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. IPR2023-00293
Patent No. 6,575,138

PATENT OWNER'S RESPONSE

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<i>Phillips v. AWH Corp.</i> , 415 F.3d 1303 (Fed. Cir. 2005) (<i>en banc</i>)	5
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37 C.F.R. §42.120	1

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 (“Klügl2”)
2008	DE 198 56 617 A1 - Translation
2009	DE 199 46 732 B4 (“Schmutzler”)
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
2022	(NEW) Declaration of Dr. Christopher Atkinson in Support of the Patent Owners' Response
2023	(NEW) Deposition Transcript of Dr. J. Matthew Quinlan (March 1, 2024)
2024	(NEW) Quinlan Dep. (March 1, 2024) Exhibit 2
2025	(NEW) Deposition Transcript of Dr. J. Matt Quinlan (April 19, 2024)
2026	(NEW) Declaration of Heike Holthaus
2027	(NEW) German-English Automotive Engineering Dictionary
2028	(NEW) Delmar's Automotive Dictionary
2029	(NEW) Lane's Complete Dictionary of Automotive Terms
2030	(NEW) Dictionary of Mechanical Engineering
2031	(NEW) Westport Annual Report 2015
2032	(NEW) Quinlan Dep. (April 19, 2024) Exhibit 13
2033	(NEW) Westport Fuel Systems Corporate Presentation March 2023
2034	(NEW) Oct. 26, 2001 News Release, WFS369772-73
2035	(NEW) Nov. 9, 2001 News Release, WFS369782
2036	(NEW) Oct. 28, 2023 News Release, WFS370088-93
2037	(NEW) Oct. 27, 2024 News Release, WFS370207-08
2038	(NEW) Updated CV of Dr. Christopher Atkinson

Exhibit	Description
2039	(NEW) Westport's Technology Tutorial, Case No. 2:23-cv-00038-JRG-RSP (E.D. Tex.)

I. INTRODUCTION

Westport Fuel Systems Canada Inc.’s submits its Patent Owner Response under 37 C.F.R. §42.120, supported by Dr. Christopher Atkinson’s expert declaration (Ex. 2022) and other cited exhibits. Petitioners assert four grounds of invalidity each based on DE19708304A1 (Ex. 1005 (German) and Ex. 1006 (Petitioners’ English translation) (collectively, “Klügl”)) in various combinations with three other references. All challenged claims of U.S. Patent No. 6,575,138 (“the ’138 Patent”) (Ex. 1001) are patentable over the asserted grounds.

The Petition concedes that each cited reference alone fails to disclose all the elements of any challenged claim. The proffered combinations fare no better. Independent claim 1 recites a passive hydraulic link requiring (i) “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 actuated” and (iii) “wherein said thickness of said hydraulic link is adjustable while said actuator is not actuated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve lift upon actuation of said actuator assembly.” (Ex. 1001, 17:42-53.) None of Petitioners’ combinations disclose the claimed passive hydraulic link, which alone compels a finding that all the challenged claims are patentable.

The Board’s original denial of institution properly determined that Klügl does not disclose the passive hydraulic link. (Paper 8, 20-22.) Petitioners’ request for rehearing asserted that Westport’s description was “directly contrary” to Klügl’s teachings that Figure 1 is “without stroke translation.” (Paper 9, 2.) Although the Board credited this argument for purposes of the rehearing decision, Petitioners’ argument does not withstand scrutiny, as explained herein.

Not only is Petitioners’ English translation of the German Klügl reference fundamentally inaccurate, but Petitioners also mischaracterize the primary difference between Klügl Figure 1 and Figure 3, which is about the *type* of power transmission, not the *amount*. Petitioners’ assertion that “without amplification” means “equal” also is unsupportable in view of Klügl’s teachings about flexible membranes. In fact, during his deposition Petitioners’ expert—Dr. Quinlan—was evasive, repeatedly taking the position he did not have a “formal opinion” about fundamental aspects of Klügl’s operation in order to avoid wrestling with the necessary consequences of those teachings. (*See, e.g.*, Ex. 2025, 34:3-12.) Petitioners’ arguments also erroneously rely on Klügl’s *flexible* membrane as being *inflexible* to allegedly disclose the claimed passive hydraulic link.

The Petition also fails to show a motivation to combine the references and proposes inoperable, complicated “frankenvalve” combinations that no POSITA would have been motivated to make, absent using impermissible hindsight as a

roadmap to arrive at the challenged claims. This failure is an independent basis to confirm the patentability of all the challenged claims.

Further, the inaccurate translation of Klügl—and Dr. Quinlan’s testimony relying thereon—should be excluded as unreliable, FRE 401, 402, 702, and 901. If excluded, Petitioners’ combinations necessarily fail and all the challenged claims should be confirmed as patentable. Westport preserved its objections on this issue (Paper 15, 4) and will file the appropriate motion at the time set in the Scheduling Order.

Petitioners rely heavily on Dr. Quinlan, who was not a POSITA at the time of invention and has admitted to relying solely on the inputs Petitioners’ counsel provided rather than conducting an independent investigation to educate himself about the state of the art at the time of the invention. *See* Section XI, *supra*. Dr. Quinlan also has taken inconsistent positions on claim construction between this proceeding and district court proceedings, further demonstrating his willingness to serve as an advocate rather than as an independent expert. In addition, Dr. Quinlan’s evasive deposition testimony on critical issues in this IPR only compounds his lack of credibility. For each of these reasons, Dr. Quinlan’s opinions should be given little (if any) weight.

In sum, all the challenged claims are patentable over Petitioners' grounds. Westport requests issuance of a final written decision confirming that each challenged claim is patentable over the asserted prior art combinations.

II. SUMMARY OF PETITIONERS' GROUNDS

Petitioners challenge independent claims 1 and 41, and dependent claims 2-3, 6, 13-14, 17-21, 26-28, on the following four grounds, all based on 35 U.S.C. §103:

Ground	References	Claims
1	Wirbeleit (Ex. 1004) and Klügl	1-3, 6, 13-14, 17-21, 26-27, and 41
2	Wirbeleit, Klügl and Newcomb (Ex. 1014)	28
3	Klügl and Hayes (Ex. 1024)	1-3, 6, 13-14, 17-21, 26-27, and 41
4	Klügl , Hayes and Newcomb	28

III. LEVEL OF ORDINARY SKILL

Petitioners state that a POSITA in the timeframe of the invention would have had a degree in mechanical engineering or a similar discipline along with two years “of professional experience working with the design and development of fuel injection systems for internal combustion engines or an equivalent level of skill, knowledge, and experience.” (Pet.23.) For purposes of this proceeding, Westport accepts Petitioners' proposed level of ordinary skill.

IV. CLAIM CONSTRUCTION

In *inter partes* reviews, the Board construes claim terms based on their ordinary and customary meaning as understood by a POSITA. 37 C.F.R. §42.100(b);

Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). The specification is the “best source for understanding a technical term,” to be supplemented, “as needed, by the prosecution history.” *Id.* at 1315.

A. Westport Does Not Request Construction of Any Term.

Westport does not seek construction of any claim term.

B. Petitioners’ Expert Applies Different And Inconsistent Constructions

Petitioners do not expressly request construction of any term here, but imply certain references render the claims obvious “when properly interpreted,” and other references disclosing different structures for the same element render the claims obvious when using the “Patent Owner’s erroneous understanding.” (Pet. 17; *see id.* 3, 17, 55-56, 63-64.) In short, Petitioners employ arguments based on alternative claim constructions without asking the Board to adopt *any* construction. Dr. Quinlan even testified that multiple “plain and ordinary” meanings of a term exist. (Ex. 2023, 69:4-70:15.)

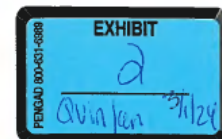
Not only are Petitioners applying different constructions for different grounds in this proceeding, Petitioners seek still other different constructions in parallel district court proceedings. Indeed, Dr. Quinlan has submitted two declarations taking express, inconsistent claim construction positions in district court proceedings. In his declarations, he opines on the construction of various terms he considered necessary to understand the scope of the claims in the ’138 Patent. (*See* Ex. 2024.)

For example, Dr. Quinlan most recently requested the district court to adopt narrow constructions of the terms “valve needle,” “lift,” “interior chamber,” and “fluid passage from said interior chamber to said combustion chamber.” (*Id.*) Dr. Quinlan’s constantly shifting claim construction positions are summarized in Exhibit 2024, reproduced below:¹

¹ Dr. Quinlan confirmed the accuracy of this summary during his deposition. *See* Ex. 2023, 50:7-13 (referring to Ex. 2024 (Second Dep. Ex. 2)).

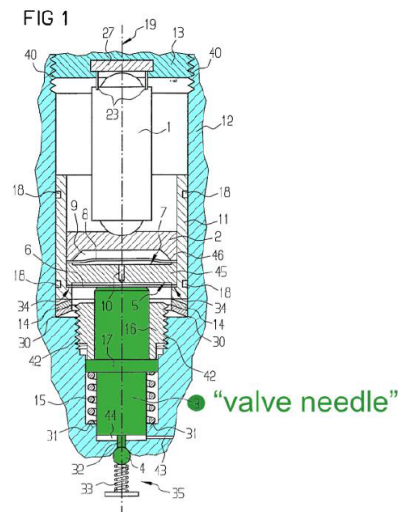
Proposed Claim Constructions from Dr. Quinlan's Declarations

Term	GM Case Declaration (dated 12/02/2022)	Bosch Case Declaration (dated 02/01/2024)	IPR2022-00292 / IPR2022-00293 Declarations (dated 12/09/2022)
"lift"	No opinion offered.	"The displacement of the valve [needle ('829 patent) / member ('138 patent)] away from its closed / seated position to its open position"	No construction of any term proposed. All terms can be "afforded their plain and ordinary meaning."
"valve needle"	"Valve consisting of a slender elongated pointed rod that directly seals interior chamber from combustion chamber"	"A slender elongated valve component that cooperates with a valve seat to seal or unseal the interior chamber from the combustion chamber"	No construction of any term proposed. All terms can be "afforded their plain and ordinary meaning."
"valve member"	"Member that directly seals interior chamber from combustion chamber"	"Valve component that cooperates with a valve seat to seal or unseal the interior chamber from the combustion chamber"	No construction of any term proposed. All terms can be "afforded their plain and ordinary meaning."
"fluid passage from said interior chamber to said combustion chamber"	"Passage for fuel to flow from the interior chamber to the combustion chamber"	"Passage for fuel to flow from the interior chamber to the combustion chamber."	No construction of any term proposed. All terms can be "afforded their plain and ordinary meaning."
"interior chamber"	No opinion offered.	"Volume from which high pressure fuel is injected into the combustion chamber when the valve is actuated"	No construction of any term proposed. All terms can be "afforded their plain and ordinary meaning."
"passive hydraulic link"	"Sealed hydraulic fluid transmitting actuating forces but not employed to generate an actuating force"	No opinion offered.	No construction of any term proposed. All terms can be "afforded their plain and ordinary meaning."



Dr. Quinlan admitted to "new wording" in his proposed constructions, but claimed his "opinion is the same in all three cases." (Ex. 2023, 53:2-8; *see id.*, 58:22-59:1;

134:6-135:13.) Yet reading the words of his proposed constructions reveals significant differences. For example, Dr. Quinlan testified “valve needle” means a “valve consisting of a slender elongated pointed rod that directly seals interior chamber from combustion chamber.” (Ex. 2024.) In the parallel IPR2023-00292 proceeding, however, Dr. Quinlan opines various elements including a ball—which is not slender, elongated, or pointed and does not directly seal the interior chamber from the combustion chamber—constitutes a “valve needle”:



(IPR2023-00292, Ex. 1003, ¶406.) Dr. Quinlan’s changing claim construction opinions are not motivated by new material he learned or any change in his understanding of the technology. (Ex. 2023, 111:10-113:6, 113:24-114:12, 125:9-23.) The opinions simply change based on the forum and whether the issue is validity or infringement. (*Id.*, 137:22-138:15.) Dr. Quinlan’s testimony should be given little weight (if any) because of his changing and inconsistent claim construction opinions.

V. 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's goal when founded in 1995 was to maintain the efficiency and performance of conventional combustion engines while dramatically reducing emissions through use of alternative fuels. Since its founding, Westport has invested over \$863 million towards research, development, and commercialization of its proprietary technologies (Ex. 2031, 15), building a portfolio of over 1400 patents and applications (Ex. 2033, 3).

Westport has developed prototype fuel injectors in projects with major automakers. For example, Ford and Isuzu vehicles using Westport's prototype fuel injectors won multiple awards and received industry praise. (*See* Ex. 2034; Ex. 2035 (reflecting award of two gold medals and a silver medal at the 2001 Michelin Challenge Bibendum competition); Ex. 2036 (reflecting award of two gold medals and a silver medal at the 2003 Michelin Challenge Bibendum competition); Ex. 2036-37.) 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.

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

At the time of the invention, in a project with a major auto-maker, 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 engine performance and emission reduction. 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 temperatures.

The fuel injector industry also was struggling with how to implement the then-relatively new actuator technologies, deliver precise control of the valves actuation,

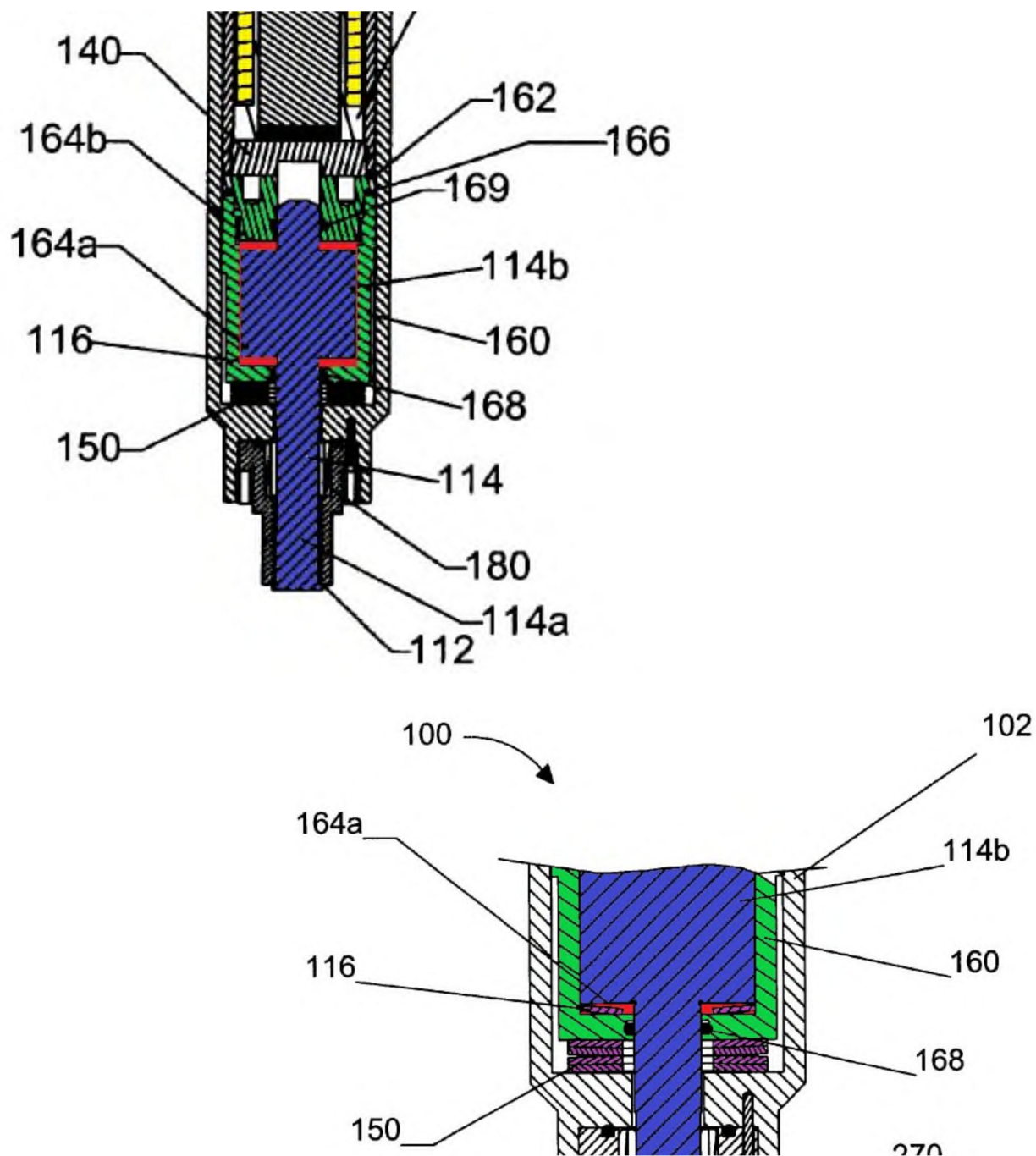
with only microns of tolerance between components and intricate systems that had to operate reliably under increasingly high pressures, not to mention large temperature fluctuations that would create significant dimensional changes between components. The ever-increasing performance demands created a need for precisely machined components having strict tolerances. The tolerances required for high pressure fuel injector components is “on the order of 50 to 250 microns.” (Ex. 1001, 12:16-17.) The movement of the actuators at issue is exceedingly small, fast, and powerful. And if the components leaked fuel or failed, the potential consequences were serious.

The inventors developed a new fuel injection valve to address these needs that was first described in a provisional application filed October 15, 1999. The non-provisional application was filed March 9, 2000; it was duly examined and issued as U.S. Patent No. 6,298,829 on October 9, 2001. A non-provisional application was filed on May 23, 2001 as a continuation-in-part of the '829 Patent. That application issued as the '138 Patent, entitled “Directly Actuated Injection Valve,” on June 10, 2003. Both the '829 Patent and the '138 Patent expired on March 9, 2020. Petitioners do not dispute the challenged claims are entitled to a priority date of October 15, 1999. (Pet. 7.)

The claimed inventions 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 with said thickness being substantially constant” while the actuator assembly is actuated and is “adjustable” while the actuator is not activated. (Ex. 1001, 17:42-53.) The passive hydraulic link “provide[s] a load path for the opposing actuating forces that originate from at least one spring member and the actuator assembly.” (*Id.*, 7:34-36.) The passive hydraulic link also allows for automatic correction between injection events for differential thermal expansion, wear, and dimensional variability and tolerance. (*Id.*, 7:57-65.) The passive hydraulic link also reduces manufacturing costs. (*Id.*, 13:24-27.)

Annotated Figs. 1 and 2 of the '138 Patent are shown below with valve member 114 (blue), connected cylinder 160 and cap 162 (green), actuator 130 (yellow), and valve spring 116 and disc spring 150 (purple). (Ex. 2022, ¶¶ 36-37.) Hydraulic fluid 164a/b (red) fills cylinder 160 and forms a thin layer of fluid between the valve member and cylinder. (*Id.*)

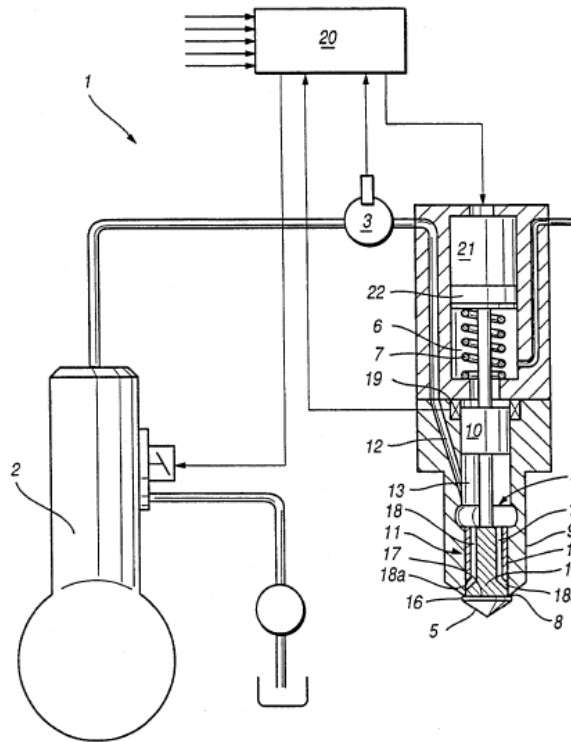


VII. BRIEF OVERVIEW OF THE SCOPE AND CONTENT OF THE ASSERTED PRIOR ART

Westport provides the following overview of the prior art references.

A. Wirbeleit

Wirbeleit is a sparse four-page reference focused on the implementation of an electronic control unit and sensor to control the duration of fuel injection independent of fuel pressure in a diesel engine having a common high pressure fuel supply conduit. (Ex. 1004, abstract, 3:12-16; Ex. 2022 ¶¶44-45,52.) Wirbeleit explains “[a]n excessively high injection pressure will, with small injection amounts, necessarily result in short injection times which however is not desirable and even problematic with today’s powerful, and especially with highly charged, direct-injection Diesel engines.” (Ex. 1004, 1:30-36.) Thus Wirbeleit’s electronic control module was intended to allow “the injection time” to be selected “independently of the level of the fuel injection pressure.” (*Id.*, 1:36-41.) Petitioners’ arguments focus on Wirbeleit’s only Figure:



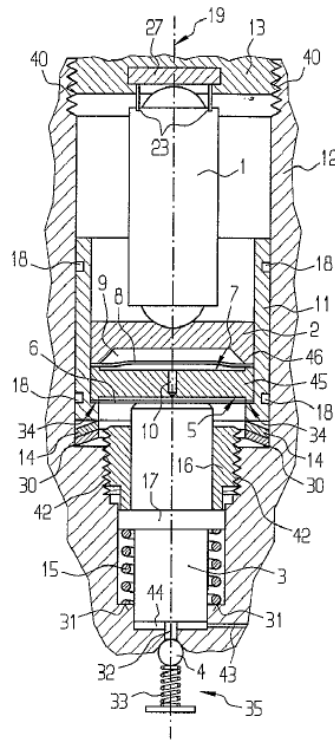
(*Id.*, Figure.) Figure shows a box labeled “hydraulic transmission element 22.” (*Id.*, 2:63-64.) Wirbeleit explains “magnetostrictive actuator 21 ... operates the orifice control needle 5 by way of a hydraulic transmission element 22 **which is not shown in detail.**”² (*Id.*, 2:61-64.) Wirbeleit’s entire teachings regarding this element are found in two sentences and the sole figure, showing the hydraulic transmission element as an empty rectangle. (*Id.*, 2:1-4, 60-64, Figure; Ex. 2022, ¶¶47-49.) On its face, Wirbeleit claims priority to a German patent application DE4325904. (Ex. 1004.) A subsequent patent (also granted to Wirbeleit and Raab as inventors) further

² All emphasis appearing in quotes in this Response has been added unless otherwise noted.

describes German patent application DE4325904 as disclosing “[a]ctuators 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” (Ex. 2013, 2:55-64.) Petitioners concede “Wirbeleit does not expressly state that its hydraulic link is structured in a way that allows it to compensate for the effects of thermal expansion and wear” (Pet. 2.)

B. Klügl

Klügl is a German-language reference disclosing an indirectly actuated valve that Petitioners had translated for this proceeding. (Exs. 1005, 1006.) Klügl describes a “control element opening a servo valve....” (Ex. 1006, 1:10.) The servo valve in turn “is used to control an injection needle, which controls the injection of an internal combustion engine.” (*Id.*, 2:55-57.) The precise arrangement of elements beyond the servo valve are not described. Petitioners rely on Klügl to provide the claimed passive hydraulic link in every proposed combination. (*See* Section VIII.) Specifically, Petitioners point to Klügl’s teachings of a flexible membrane 6 for this element. (Ex. 1006, abstract.) Petitioners’ focus on Figure 1 for their proposed combination:



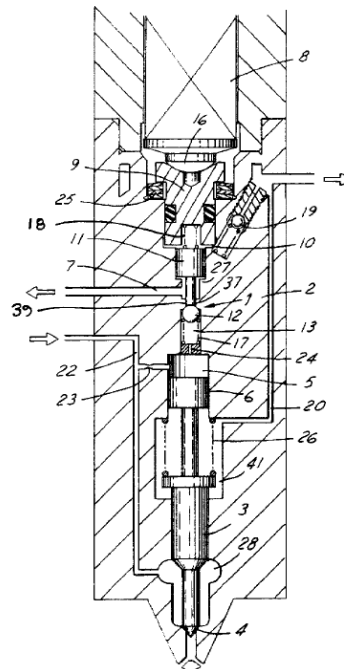
Other references before the Office during prosecution taught diaphragm/membrane-type devices (*e.g.*, Ex. 2017). The Office also had other commonly-owned patents before it during prosecution that taught away from using diaphragms and membranes. (*e.g.*, Ex. 2019; Ex. 2020). Indeed, Kappel explains some of their disadvantages:

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, 1:48-56.)

C. Hayes

As an alternative to their Wirbeleit/Klühl combination, Petitioners propose a Klühl/Hayes combination. Hayes describes a “large diameter first piston (9) in fluid communication with a smaller diameter second piston to *multiply the actuation extension* of the piezoelectric actuator.” (Ex. 1024, Abstract.) “The second piston (11) operates a poppet valve (1) to hydraulically control the injector valve.” (*Id.*) Petitioners rely on Hayes’ Figure 1:



As Petitioners admit, Hayes is cited on the face of the '138 Patent (Pet. 22.) Hayes is also discussed in the background of the '138 Patent. (Ex. 1001, 2:52-57.)

D. Newcomb

Petitioners rely on Newcomb solely to provide the missing element in Claim 28 for both the Wirbeleit/Klühl and Klühl/Hayes combinations. (Pet. 22.) Petitioners

merely argue 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’” (*Id.*)

VIII. PETITIONERS FAIL TO SHOW KLÜGL DISCLOSES A “PASSIVE HYDRAULIC LINK.”

All Petitioners’ obviousness combinations rely on Klügl alone as teaching specific limitations of the passive hydraulic link required by every challenged claim. Neither Wirbeleit nor Hayes provide additional detail to supplement or support Petitioners’ arguments with respect to those elements. Petitioners’ arguments with respect to Klügl, however, are based on an inaccurate English translation, disregard the physical reality of a flexible membrane, and are inconsistent with Klügl’s express disclosures and embodiments, as understood by a POSITA.

A. Petitioners’ Incorrectly Identify What “With” And “Without” Means In Klügl.

Petitioners incorrectly argue Klügl teaches its flexible membrane does not deform during actuation (such that its piston *must* move a distance equal to that of its actuator) based on three words that describe Klügl’s Figure 1 as “without stroke translation.” In Petitioners’ English translation of the original German document, Klügl uses the phrase “stroke translation” only twice, both in connection with the description of its figures:

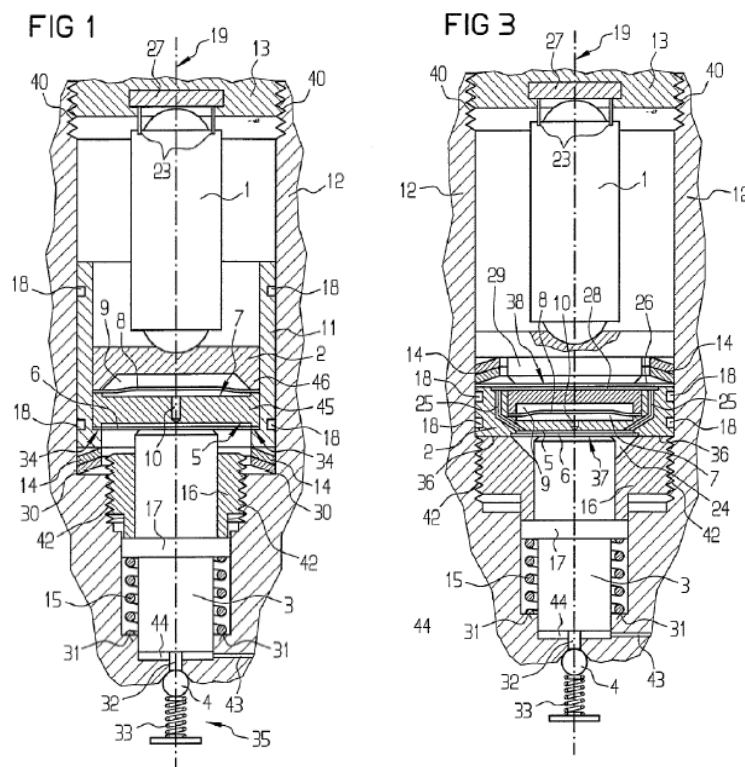
The invention is explained in more detail with reference to the figures; showing:

Fig. 1 shows a device for power transmission *without stroke translation*,

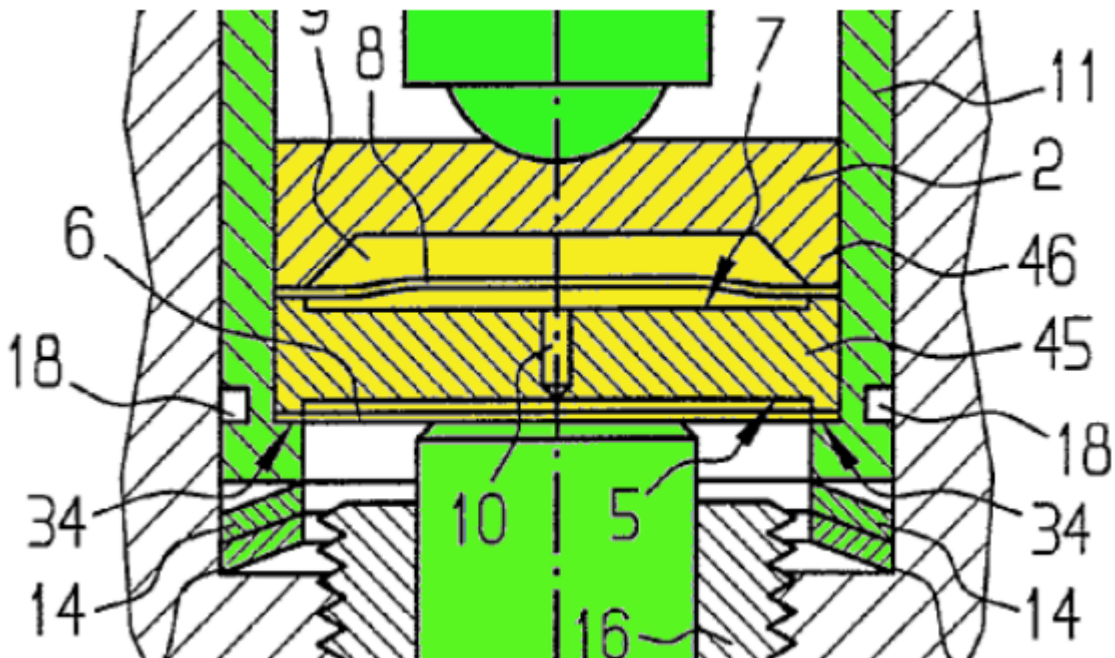
...

Fig. 3 shows a device for power transmission *with stroke translation*.

(Ex. 1006, 1:39-46.) Stroke translation is not defined and is not a commonly used term of art that a POSITA would have understood to have a special meaning at the time of the invention. (Ex. 2022, ¶77.) Its meaning must be determined from a comparison of Klügl's figures and the related description of the figures in its specification. (*Id.*, ¶76.) Klügl's Figures 1 and 3 are shown below:

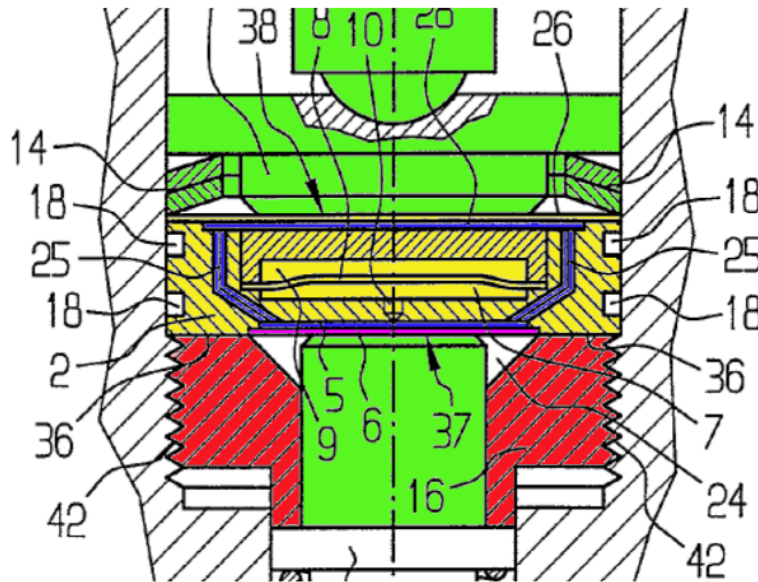


A comparison of the two figures demonstrates numerous differences in the arrangement of transmission module 2 within the embodiments, while the other surrounding elements remain relatively unchanged. (*Id.*, ¶¶72-73.) Specifically, Figure 1 depicts a **moveable** transmission module 2 (yellow) in the annotated figure below:



(*Id.*, ¶¶63, 74.) In this figure, transmission module 2 will move up and down with guide sleeve 11. (*Id.*) The moveable components (except for the transmission module) are colored green. When actuated, the transmission module and guide sleeve move downward towards the piston and compress the disk springs 14. (*Id.*)

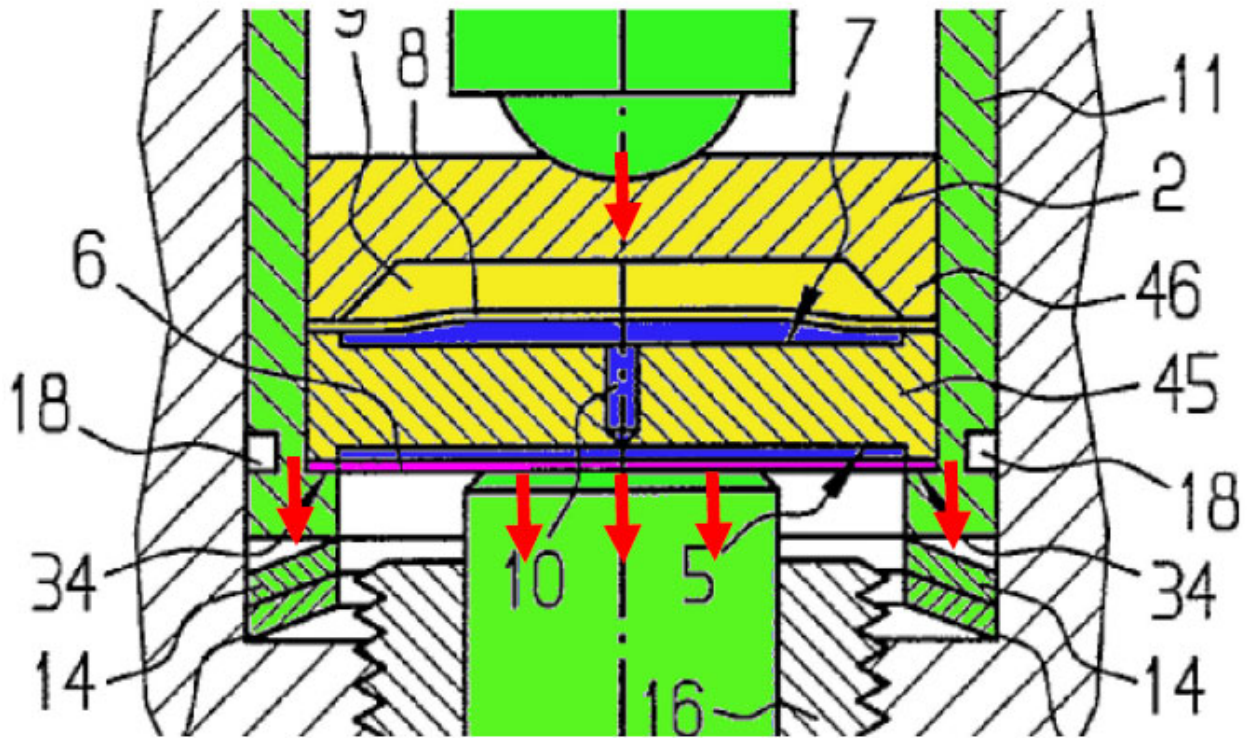
In contrast, annotated Figure 3 shows a ***fixed*** transmission module 2 (yellow):



Transmission module 2 is fixed in place by screw 42 (red) that forms lower stop 16. (*Id.*, ¶75.) Disk springs 14 are now positioned above the fixed transmission module. (*Id.*) Dr. Quinlan agrees. (Ex. 2025, 75:3-11.) Klügl explains “[t]he injection valve shown in Fig. 3 ***differs from*** the injection valves of Fig. 2 and 1 in ***the type of power transmission*** from the piezoelectric actuator 1 to the drive piston 3.” (Ex. 1006, 4:52-55.) Specifically, for Figure 3, Klügl explains “transmission module 2 is fixed in position by the lower stop 16 preventing it from following the longitudinal movement[.]” (*Id.*, 5:55-57.) In contrast, for Figure 1, Klügl describes “transmission module 2 and the guide sleeve 11 are arranged to be movable against the disk spring 14 in the longitudinal direction of the injection valve.” (*Id.*, 2:18-21.) Klügl describes the “advantage” of this difference between Figure 3 and Figure 1 as being “that when

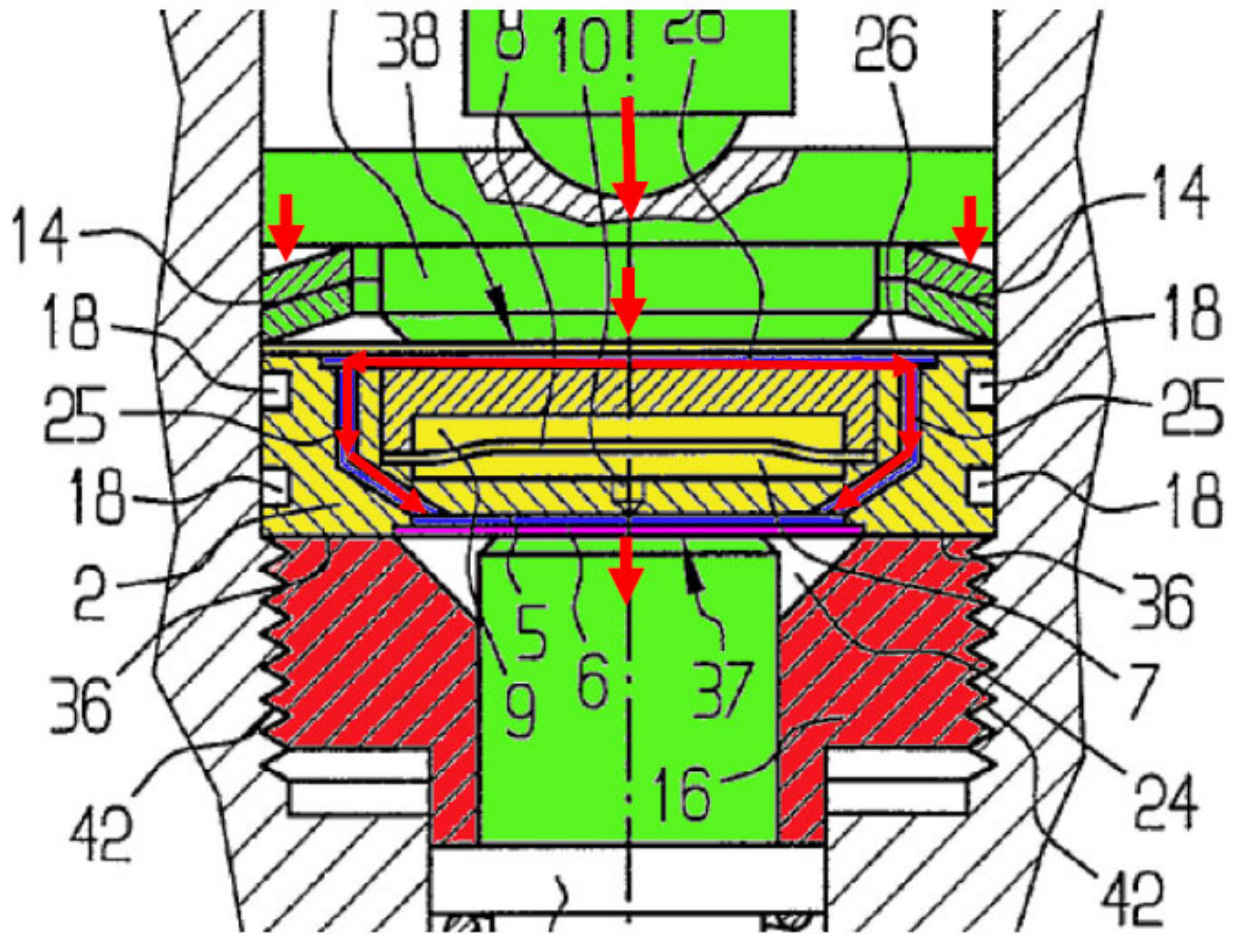
the deflection of the piezoelectric actuator 1 is transmitted to the drive piston 3, the transmission module is not moved This allows [the actuator] to only move small masses, making a rapid transfer of movement possible[.]” (*Id.*, 7:24-31.) “With stroke translation” and “without stroke translation” is thus intended to capture this difference in the type of power transmission between the figures concisely.

As Dr. Atkinson explains, this distinction between “with” and “without” “would be the consequence of differences in the physical components and principles of operation between the two figures.” (Ex. 2022, ¶71.) The principal differences are in the transmission module, which “allow for different principles of power transmission between Figs. 1 and 3.” (*Id.*, ¶73.) The principle of power transmission in Fig. 1 is all in the longitudinal direction as shown in the below demonstrative (red arrows):



(*Id.*, ¶74.) “[T]here is no redirection or translation of the force exerted by piezoelectric actuator 1 as it is conveyed through the movement of the *movable* transmission module 2 into drive piston 3.” (*Id.*)

In contrast, the principle of power transmission in Fig. 3 requires the redirection or translation of the actuation force as shown in the below demonstrative (red arrows):



(*Id.*, ¶75.) As can be seen, the force starts in the longitudinal direction, but because of the fixed nature of the transmission module has to be redirected or translated “laterally outward toward lines 25, then moves down the vertical portion of lines 25 and diagonally inward and downward through the bottom portions of lines 25 to pressure chamber 5.” (*Id.*) It is only after this translation that the force is redirected back into the longitudinal direction by the deformation of flexible membrane 6. (*Id.*) In short, the “with” and “without” distinction is not based on the amount the drive

piston moves in relation to the actuator during actuation, but on this difference in the type of power transmission. (*Id.*, ¶¶73, 76.)

B. Petitioners’ English Translation Inaccurately Translates a Key Paragraph in Klügl.

Petitioners and Dr. Quinlan rely heavily on the language found at Column 7, lines 9-20 of their English translation of Klügl to support their “stroke translation” argument. (Ex. 1003, ¶¶221-28.) However, this paragraph does not use the phrase “stroke translation.” Instead, it uses “stroke ratio” and “stroke transmission.” Dr. Quinlan’s opinions rely heavily on the phrase “stroke ratio,” asserting:

221. Showing this, Klügl itself explains that in opposition to its Figure 3, the injector of Figure 1 does not “achieve[] a ***stroke ratio*** between deflection of the piezoelectric actuator 1 and the deflection of the drive piston 3.” (*Id.*, 7:12-13.)

222. Klügl contrasts this [Figure 1] with the embodiment show[n] in Figure 3, which does provide a change in “***stroke translation***” by applying a “***stroke ratio***” such that the movement of the piston exceeds that of the actuator. (*Id.*, 1:41-46; 7:12-13.) This occurs because the dimensions of chamber 5 change during actuation in that particular figure’s embodiment. (*See id.*, Fig. 3.)

(*Id.*, ¶¶221-22.) Relying on “stroke ratio,” Dr. Quinlan concludes:

[Klügl’s Figure 1] allows for transmission of force ***without*** application of a ***non-unity stroke ratio*** (i.e., the needle still moves by the same distance the actuator expands)....

(*Id.*, ¶304.) Thus Dr. Quinlan opines that Klügl teaches ***only*** “unity” (i.e., 1:1—no more, no less) stroke ratios in Figure 1. The Board gave Dr. Quinlan’s testimony on this issue significant weight in granting Petitioners’ rehearing request. (Paper 10, 7-

8.) Westport did not have an opportunity to provide the Board with its response at that time. Given that opportunity now, Petitioners’ translation of Klügl—and Dr. Quinlan’s corresponding conclusions—are misleading and inaccurate.

First, Dr. Quinlan’s testimony in Paragraph 221 cited above is misleading when he states Klügl describes Figure 1 as *not* “achiev[ing] a stroke ratio.” The cited portion of Klügl only discusses Figure 3. In fact, Klügl never uses the words “stroke ratio” in connection with Figure 1. Moreover, as explained in detail *supra*, Klügl’s express disclosure related to Figure 1 does not support a conclusion that the “piston moves by a distance *equal to* the amount of actuator expansion,” as Dr. Quinlan opined. (Ex. 1003, ¶214; Ex. 2022, ¶¶77-78.)

Second, Petitioners—both companies with strong German roots—submitted an incorrect English translation of the original German document. When properly translated, Klügl does not even include the words “stroke ratio” that serve as the foundation for Dr. Quinlan’s opinions about a “non-unity stroke ratio.” (Ex. 2026, ¶¶3-7.) Rather Klügl uses the *same* German source word “Hubübersetzung” four times: twice in column 1 and twice in column 7. (Ex. 1005, 1:44-45, 1:48-19, 7:11-12, 7:17-18; Ex. 2026, ¶4.) In Petitioners’ English translation (Ex. 1006), that *one* German source word was translated *three* different ways: “stroke translation” the first two times, “stroke ratio” the third time, and “stroke transmission” the fourth time. (Ex. 2026, ¶5.) Westport’s translator explains that doing so was error,

“Hubübersetzung” should have been translated consistently throughout the document because no context in Klügl suggests a different later interpretation is warranted. (*Id.*, ¶¶6-7.)

Despite it being the centerpiece of his passive hydraulic link opinion, when asked during deposition, Dr. Quinlan could not explain the difference between “stroke translation,” “stroke ratio,” and “stroke transmission.” (Ex. 2025, 29:13-23; *see id.*, 40:5-41:2.) Yet he uses the phrases differently in his declaration. For example, Dr. Quinlan states in his declaration that “Figure 3, which does provide *a change in ‘stroke translation’* by *applying a ‘stroke ratio’* such that the movement of the piston exceeds that of the actuator.” (Ex. 1003, ¶222.) Dr. Quinlan attributed different meanings to these phrases when he wrote his declaration, but could not explain his understanding of the differences when asked at his deposition. (Ex. 2025, 29:13-23.) At the very least, Dr. Quinlan’s testimony should be given little weight in view of his inability to explain his opinions when asked and his reliance on Petitioners’ inaccurate Klügl translation.

C. Petitioners Incorrectly Contend “*With Stroke Translation*” Means “*With Amplification*”

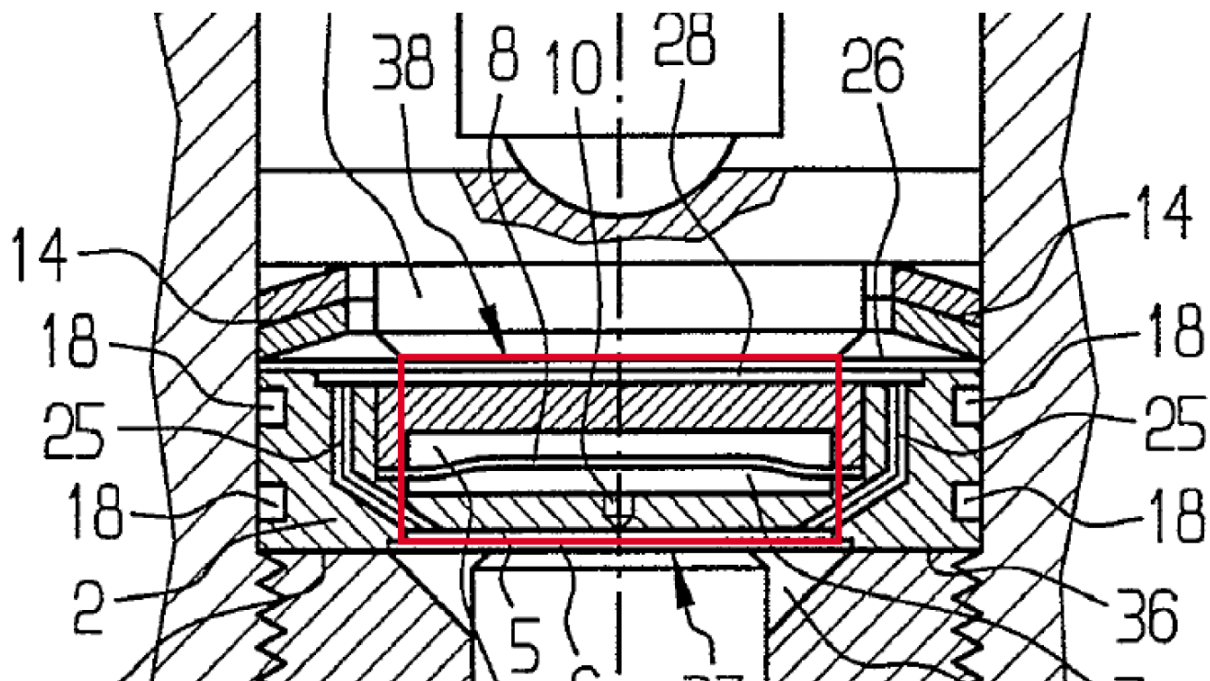
Petitioners use their inaccurately translated “stroke ratio” language in an attempt to avoid the necessary consequences of using a flexible membrane 6 to contain an incompressible transmission fluid during actuation: deformation of the membrane. (*See supra* Section VIII.) Petitioners and Dr. Quinlan repeatedly use

“stroke translation” interchangeably with “amplification.” (Paper 9, 6-11.) They interpret Figure 3 “with stroke translation” as providing amplification of the movement of the piston relative to the actuator, and Figure 1 “without stroke translation” as not providing such amplification. (*Id.*, 8.) Petitioners’ argument about “amplification” ignores Klügl’s own identification of the “with” and “without” difference between Figures 1 and 3, explained in Section VIII.A.

Contrary to Dr. Quinlan’s declaration, Klügl is not distinguishing Figure 1 from Figure 3 based on any difference in the relative movement of the piston to the actuator, whether called “amplification” or “stroke ratio.” (Ex. 2022, ¶¶76-78.) In fact, Klügl never uses the words “amplify” or “amplification.” Dr. Quinlan’s analysis is superficial at best, he testified that he didn’t “form[] a formal opinion on what the transmission module is in Figure 3 of Klügl.” (Ex. 2025, 70:11-15.) And despite repeatedly using the word “amplification” and “amplify” in his Declaration, Dr. Quinlan testified “I haven’t taken the time to do a formal analysis on what amplification means,” whether generally to a POSITA or within the context of Klügl. (*Id.*, 34:3-12.)

With respect to amplification, Westport does not disagree with the general principle Dr. Quinlan describes in his figure, although Westport disagrees with Dr. Quinlan’s math, which is incorrect because he calculates displacement based on a 2D area not a 3D volume. (Ex. 1003, ¶225; Ex. 2022, ¶¶84-85.) Westport disagrees,

however, that Klügl teaches or discloses amplification. (Ex. 2022, ¶¶83-85.) In fact, Klügl Figure 3—which is the figure Dr. Quinlan contends is with amplification—shows that surface area 37 of the die 29 is identical to the surface area of the top of the pressure chamber 5, as shown by the red rectangle in annotated Figure 3 below. (*Id.*, ¶84.)



While Klügl states the surface area 38 is larger than the surface area 37 of the piston 3 (Ex. 1006, 7:9-12), this difference in surface area would not necessarily produce amplification. (Ex. 2022, ¶¶84, 86-87.) While the incorrectly translated Klügl describes that “it achieves a stroke ratio between the deflection of the piezoelectric actuator 1 and the deflection of the drive piston 3” (Ex. 1006, 7:12-14), when read as stroke translation, Klügl’s purported purpose for using a larger die is to ensure

that sufficient fluid moves from the second pressure chamber 28 through the lines 25 to the chamber 5 to translate or redirect the stroke from actuator 1 to drive piston 3 (regardless of any ratio).

D. “Without Amplification” Does Not Mean “Equal.”

Ultimately, whether Klügl teaches amplification is irrelevant to whether it discloses the claimed passive hydraulic link. Even if Petitioners’ interpretation of “stroke translation” to mean “amplification” is accepted, the conclusion that Petitioners and Dr. Quinlan assert does not follow. “Without amplification of movement” is not the same as “equal movement,” *i.e.*, a 1:1 correspondence between the movement of the actuator and the movement of the piston. (Paper 9, 8.) Rather, the plain and ordinary meaning of “without amplification” is “without making greater or larger,” as opposed to “equal.” (*See* Ex. 1024, 1:31-35.) And in the context of Klügl Fig. 1 specifically, a POSITA would ***not*** understand “without amplification” to mean “equal” because the disclosed flexible membrane must flex, for the reasons explained in Section VIII.E. Rather, the movement of Klügl’s piston 3 must be something less than 1:1. (Ex. 2022, ¶¶77-82, 86-87.) Klügl’s claim directed to Fig. 1 expressly support this, reciting “the movement of the actuator (1) is at least ***partially transmitted*** to the control element (3) via a movement of the transmission module (2).” (Ex. 1006, 8:66-68.) Because this claim recites a moveable transmission module 2, we know that the claim is referring to the

embodiment in Figure 1 rather than the embodiment in Figure 3. (Ex. 2022, ¶60.) Thus, even if the Board agrees with Petitioners that “without stroke translation” means “without amplification,” “without amplification” does *not* imply or suggest that the flexible membrane 6 works “without deformation.” Petitioners’ ultimate conclusion about “substantially constant thickness” follows *only if* the flexible membrane works without deformation. A POSITA would not arrive at the conclusion Petitioners’ assert, as explained further in Section VIII.E.

E. Klügl’s Membrane 6 Must Flex.

Petitioners and Dr. Quinlan wrongly conclude Klügl teaches a “substantially constant thickness” based on implausible and unsupported interpretations of Klügl, including that Klügl’s flexible membrane does not flex. (*See* Pet. 34-36; Paper 9.)

Despite this issue being central to Dr. Quinlan’s opinions the Board relied on in granting institution, during his deposition, Dr. Quinlan was evasive when asked what “flexible” and “membrane” meant in the context of Klügl. Indeed, Dr. Quinlan had not formed a “formal opinion” about any of these critical issues:

- The meaning of “flexible,” (Ex. 2025, 47:24-48:1), “membrane,” (*id.*, 47:21-23), or “flexible membrane,” (*id.*, 130:3-4 (“I haven’t determined what that flexible membrane means in terms of its definition[.]”)); *see id.*, 123:2-6);

- The material that would form membrane 6 in Klügl Figure 1, (*id.*, 48:14-21);
- Whether “diaphragm” has the same meaning as “membrane” in the automotive art, (*id.*, 48:2-13; *see id.* 137:21-138:18);
- Whether a flexible material will deform or deflect. (*id.*, 49:4-13); and
- Whether membrane 6 flexes in Figure 1. (*id.*, 62:25-66:18).

He even repeatedly referred to whether membrane 6 flexes as an issue of “semantics.” (*Id.*, 49:23-24 (referring to “semantics on what a membrane is”), 61:22-65:5 (“[W]hat we call it and what a person of ordinary skill in the art maybe understands it to be, is probably semantics.”).) Ultimately, Dr. Quinlan could not—or would not—directly answer whether membrane 6 is flexible when actuated in Figure 1. (*Id.*, 62:25-66:18 (“A. I -- I haven’t formed a complete opinion on how 6 specifically is flexible or is not flexible.”).)

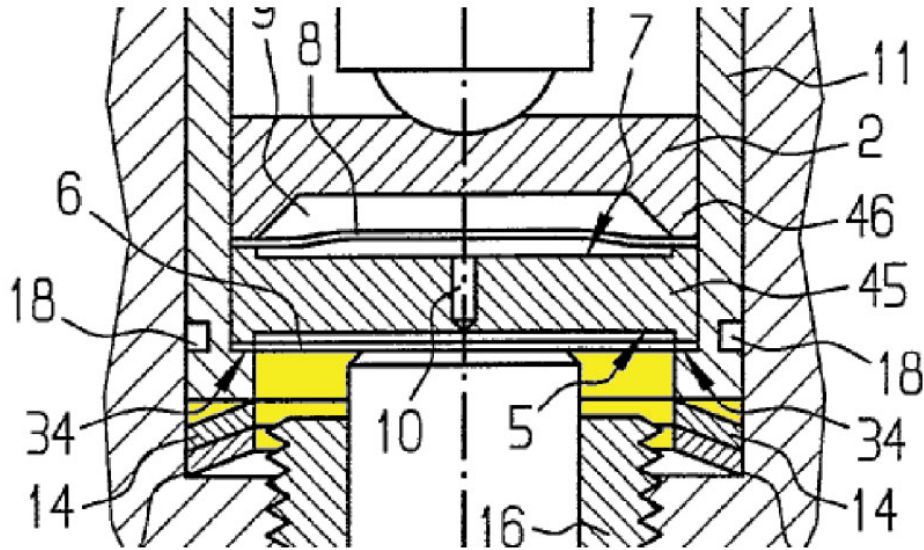
From his non-responses, it is apparent that Dr. Quinlan understood the consequences of his testimony. **If** he agreed membrane 6 is flexible when actuated, Petitioners’ entire argument about “substantially constant thickness” necessarily fails. And so, he simply would not answer. It is incredible that Petitioners’ technical expert who opined that Figure 1 must have a “non-unity stroke ratio” (*i.e.*, a 1:1 stroke ratio) has not formed an opinion on these issues **because** his conclusion necessarily rests on the assumption that membrane 6 serves as a rigid barrier against

the transmission medium in pressure chamber 5 during actuation. Dr. Quinlan understands that without a rigid barrier, transmission medium would **not** act “substantially as a solid” during actuation. (*Id.*, 125:5-9 (“An incompressible fluid would not change its volume due to reactions of forces -- force applied to it **if** it’s, you know, **constrained**.”)) Dr. Quinlan’s testimony should be given little (if any) weight.

As Dr. Atkinson explains, a POSITA would understand that Klügl’s membrane 6 must be flexible. (Ex. 2022, ¶¶63, 66-67, 77-81, 87.) The only stated purpose of flexible membrane in Figure 1 is to maintain contact with the piston. (Ex. 1006, 4:9-10.) To accomplish this stated purpose, membrane 6 **must** be flexible. (Ex. 2022, ¶¶66-67.) The flexibility of membrane 6 allows it to deform sufficiently to maintain the contact with the piston if the actuator shortens “due to thermal influences or signs of aging[.]” (Ex. 1006, 3:63-4:10.) Klügl explains that membrane 6 deforms when unactuated: it can be deformed outwardly such that it is “moved in the direction of the drive piston.” (*Id.*) Membrane 6 also can be deformed inwardly such that it is “pushed in.” (*Id.*) If membrane 6 did not deform outwardly or inwardly, it would not be capable of maintaining contact with piston 3 when the actuator 1 shortens over time. (Ex. 2022, ¶¶66-67.)

Figure 1’s embodiment shows open space around the top portion of piston 3 to accommodate deformation of flexible membrane 6 due to the flow of the

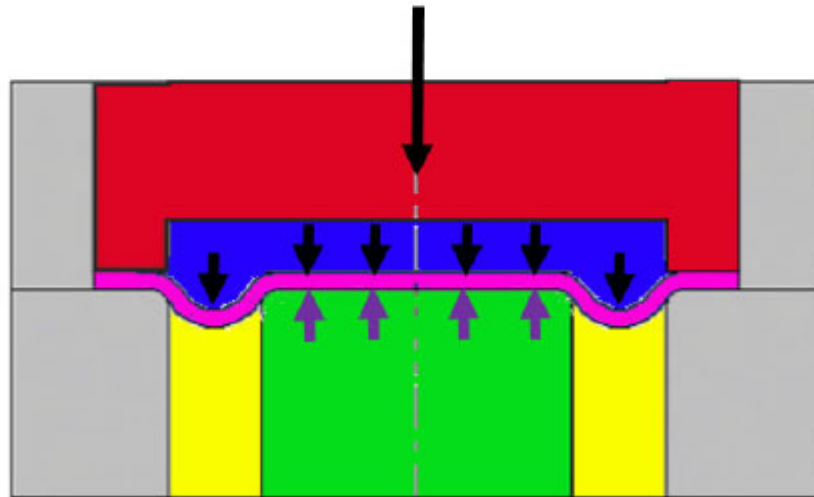
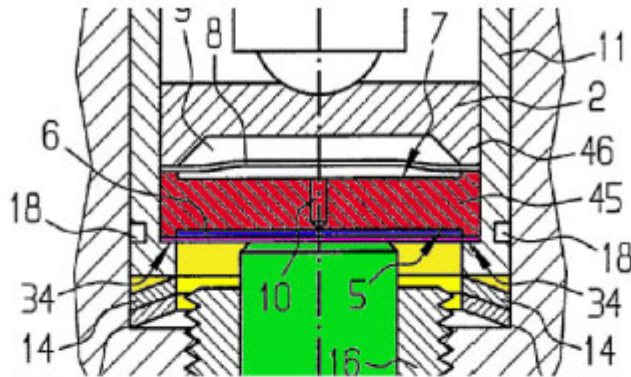
transmission medium in chamber 5. (Ex. 2022, ¶¶72, 78-79.) The annotated figure below—Exhibit 13 from Dr. Quinlan’s latest deposition—highlights the open space as yellow gaps on either side of piston 3. (Ex. 2032.)



Dr. Quinlan agreed that the yellow gaps “would be an open area.” (Ex. 2025, 127:4-6.) But he claimed to not know whether membrane 6 would flex into that open area because he did not know “design details” about Fig. 1. (*Id.*, 128:10-21 (“I don’t know how much the flex into that yellow area is without doing the detailed design[.]”), 127:25-128:21 (“I don’t know how large in diameter piston 3 is versus the diameter inside of 11 which is the unsupported edge of the membrane, so I don’t know how big that gap is. ... I don’t know how much the flex into that yellow area is without doing the detailed design of the contact between membrane 6; what the material of membrane 6 is; what the thickness of the material 6 is; what the size of the volume

of the yellow is; the diameter of piston 11; the inside diameter on piston 13. I can't that analysis yet. [sic].") Yet Dr. Quinlan's need for "design detail" regarding flexible membrane 6 in Fig. 1 did not prevent him from opining about the alleged lack of a stroke ratio in connection with Fig. 1.

Klügl teaches that transmission medium *must* flow during actuation and when unactuated. Because of this flow, throttle 10 must be designed to prevent transmission medium from flowing upwards into chamber 7 during actuation, which makes it much smaller relative to the dimension of the yellow gaps. (Ex. 2022, ¶¶72, 78-82.) As Klügl teaches, because membrane 6 deforms when unactuated, it is flexible and also will deform when actuated. (*Id.*) As illustrated below, when actuated, membrane 6 (purple) will tend to deform inward where it contacts the drive piston 3 (green) and bulge outward where unsupported by the drive piston into the empty spaces (yellow) because the empty spaces provide less resistance to the downward force as compared to piston 3. (*Id.*, ¶¶78-79.)



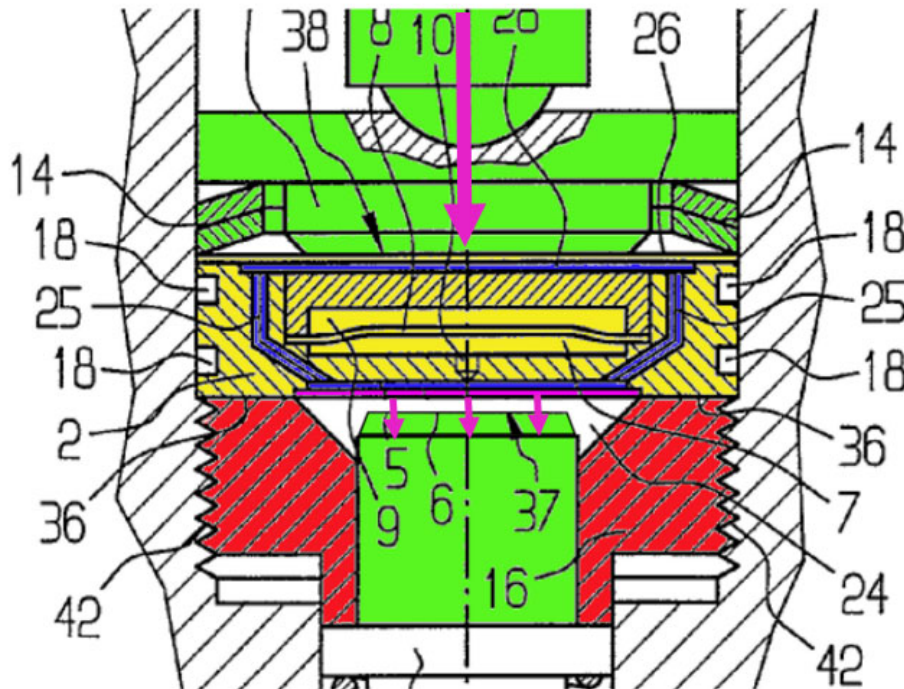
Because the transmission medium has low compressibility and is not permitted to flow upwards through throttle 10 during actuation (Ex. 1006, 2:2, 4:11-13), it will act downwards, causing membrane 6 to bulge on the sides of the piston where it is unsupported by piston 3. (Ex. 2022, ¶¶78-82.) Nothing in Klügl supports a conclusion that membrane 6 will deform inwardly and outwardly when unactuated

but will act as a rigid barrier to resist the force of the transmission medium during actuation. (*Id.*, ¶¶66-67, 78-82.)

Figure 3 further teaches that membrane 6 is flexible. Klügl uses “membrane 6,” “throttle 10,” and “transmission medium” consistently in its discussion between Figure 1 and Figure 3. (*Id.*, ¶72.) The use in Figure 3 confirms that membrane 6 must be flexible during actuation. (*Id.*, ¶¶75, 82.) Specifically, Figure 3 explains that its transmission element is fixed. (Ex. 1006, 5:55-57.) During actuation:

transmission medium located in the second pressure chamber 28 to be pushed into the pressure chamber 5 via the lines 25. ***This deflects first membrane 6 in the direction of the drive piston 3 and the drive piston 3 is thus moved***

(*Id.*, 5:59-62.) In Figure 3, the membrane 6 must deform and the transmission fluid must flow during actuation. (Ex. 2022, ¶82.) Specifically, as shown in annotated Figure 3 below, when actuated, the purple membrane 6 must flex downwards to push against the piston 3 because transmission module 2 does not move.



Even Dr. Quinlan agreed for Figure 3, that membrane 6 must flex. (Ex. 2025, 62:21-24 (“In [Fig. 3], I believe that 6 relies on some bending to perform and function.”). Yet Dr. Quinlan does not have any more information about the design parameters for the membrane in this figure than Figure 1.

Further, the German version of Klügl uses the word “membran.” Petitioners’ flawed translation (Ex. 1006) interpreted this to mean “membrane.” However, as with “stroke translation,” Petitioners’ translation is inaccurate. In the context of this art, the proper English translation of the German word “membran” is “diaphragm.” (Ex. 2027, 321) Indeed, Dr. Quinlan repeatedly referred to membrane 6 as a

“diaphragm” during his deposition. (Ex. 2025, 60:21-61:5, 103:8-18; *see id.*, 48:7-13, 137:21-138:10.)

Contemporaneous automotive dictionary definitions also reflect a POSITA would have understood Klügl’s diaphragm/membrane 6 to be flexible. Specifically, these technical dictionaries define “diaphragm” as “flexible.” (Ex. 2028, 68 (defining “diaphragm” as “[t]he flexible membrane found in a temperature- or pressure-control device that seals in an inert fluid from the atmosphere while allowing a mechanical movement”); Ex. 2029, 84 (defining “diaphragm” as “a thin sheet of flexible material, usually circular, to divide compartments and form part of the operating mechanism, *e.g.* in a fuel pump or some valves”); Ex. 2030, 107 (defining “diaphragm” as “[a] flexible disc or membrane which deflects under a change of the differential fluid pressure across it”).)

Relatedly, Petitioners assert that Klügl’s transmission medium “acts as a solid (*i.e.*, does not flow or change thickness) during actuation.” (Pet. 2,3.) But because flexible membrane 6 deforms, the incompressible transmission medium will redistribute to fill the changed shape of chamber 5, thereby **not** acting substantially as a solid during actuation, in addition to **not** maintaining substantially the same thickness. Petitioners acknowledge that **only if** flexible membrane 6 does **not** flex when actuated could Figure 1’s embodiment theoretically achieve a 1:1 movement between the actuator and piston. (Pet. 39; Paper 9.) This is confirmed through

Petitioners' express assumption that the "dimensions of chamber 5 ... remain constant so that the movement of the actuator results in the same amount of movement of the piston." (Pet. 34; Paper 9.) The only way the dimensions of chamber 5 could "remain constant" is if flexible membrane 6—which defines the bottom of chamber 5 and thus chamber 5's shape—does not flex when actuated. (Ex. 2022, ¶¶79-81.) *Petitioners' express assumption* of a constant shape—and the related implicit assumption that membrane 6 will *not* flex—is *directly contrary to Klügl's express and clear teaching* of a flexible membrane.

When membrane 6 flexes as Klügl teaches, then chamber 5 necessarily changes shape. (Ex. 2022, ¶78-79) Petitioners appear to *disagree* with the predicate (*i.e.*, that membrane 6 flexes during actuation), but *agree* with the consequent (*i.e.*, that chamber 5 would change shape.). (Paper 9, 13-14.) Similarly, *when* chamber 5 changes shape during actuation, Klügl's transmission medium will not "maintain substantially the same thickness during actuation." (*Id.*, 7.) Again, Petitioners disagree with the predicate (*i.e.*, chamber 5 changes shape during actuation) but do not disagree with the consequent (*i.e.*, Klügl's transmission medium will not "maintain substantially the same thickness" during actuation). (*Id.*) Thus the crux of the dispute for the Board to resolve is whether membrane 6 flexes during actuation.

Yet Petitioners refuse to provide a direct answer to this fundamental question because the only answer Klügl supports (*i.e.*, membrane 6 is flexible) means Petitioners' argument fails. They have no other reference to rely on as teaching this claim element, which is required by every challenged claim. Instead, Petitioners offer an ambiguous, hindsight-driven interpretation of Klügl based on their mischaracterization of the difference between Figures 1 and 3, supported by their inaccurate translation of the original German document. Petitioners' technical expert offered *no opinion* about whether flexible membrane 6 is flexible in his declaration or during his deposition. (Section VIII.E.)

In sum, a POSITA would *not* interpret Klügl to teach that its flexible membrane 6 is inflexible in view of Klügl's numerous teachings that its membrane 6 is flexible. (Ex. 2022, ¶¶53-87.) Because Klügl's membrane 6 is flexible, there will be deformation of the membrane during actuation such that the transmission medium in chamber 5 does not act "substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated." (*Id.*, ¶¶87-88.) Accordingly, the challenged claims are patentable.

F. Petitioners' Klügl Argument Is Fatal To Its Obviousness Claims.

As discussed at length, Petitioners' and Dr. Quinlan's explanation of Klügl is incorrect and Petitioners' obviousness grounds all must fail. However, even if Petitioner were correct that flexible membrane 6 is inflexible during actuation—

which they are not—all Petitioners’ obviousness grounds still fail. If membrane 6 is inflexible during actuation, then it would likewise be inflexible when unactuated. (Ex. 2022, ¶67.) If membrane 6 is inflexible when unactuated, it cannot compensate (adjust) for changes in the actuator’s length over time by deforming to maintain contact with the piston 3. (*Id.*, ¶87.)

IX. GROUNDS 1 & 2: PETITIONERS’ WIRBELEIT/KLÜGL COMBINATION DOES NOT RENDER ANY CHALLENGED CLAIM OBVIOUS.

Claims 1 and 41 are the only independent claims challenged under Ground 1 (Wirbeleit/Klügl). The remaining challenged claims each depend from and include the limitations of claim 1. Claim 28—which depends from claim 1—is the only claim challenged under Ground 2 (Wirbeleit/Klügl/Newcomb). Ground 2 adds Newcomb to address only dependent Claim 28’s additional limitation. Because Petitioners have not carried their burden to show that independent claim 1 or claim 41 is obvious, for the reasons explained herein, and therefore, none of claim 1’s dependent challenged claims are obvious either.

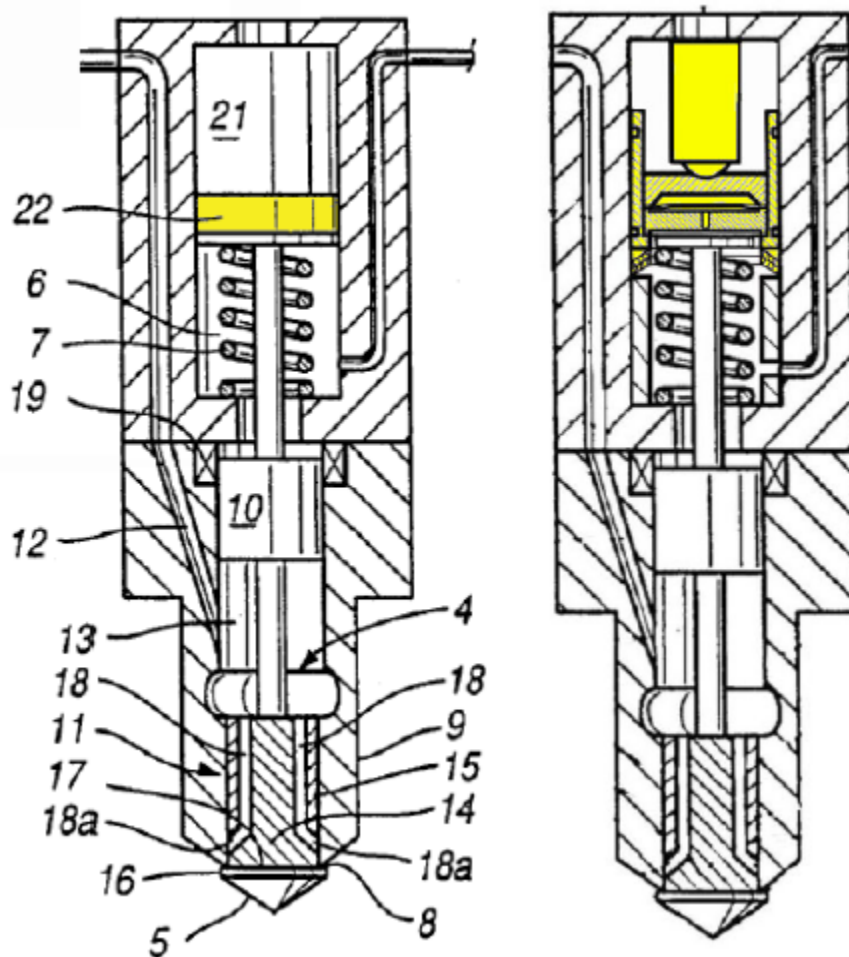
A. Neither Klügl nor Wirbeleit Disclose the Claimed Passive Hydraulic Link Claimed in Limitation 1(e)

The passive hydraulic link (limitation 1(e) in the Petition) can be broken into three separate requirements, each of which must be met by Petitioners’ proposed Wirbeleit/Klügl combination. Petitioners address limitation 1(e) as a single limitation with each of Klügl and Wirbeleit mapped to different portions of its

requirements. (Pet. 31-37.) Petitioners make liberal use of ellipsis and partial quotes of the claim limitations, and in doing so, gloss over the fatal fact that neither Klügl nor Wirbeleit—even when combined—teach the requirements of this limitation.

1. **“a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted”**

Petitioners fail to demonstrate the Wirbeleit/Klügl combination discloses the first requirement of this limitation. Rather than discussing the required “hydraulic fluid thickness,” Petitioners discuss a hydraulic link assembly as a whole. (Pet. 31.) Though Petitioners point to Wirbeleit’s hydraulic transmission element 22, they do *not* allege that element 22 constitutes “*a hydraulic fluid thickness* through which said opening and closing forces are transmitted.” Further, as shown in the annotated figure below, Dr. Quinlan proposes taking Wirbeleit’s element 22 (in yellow on the left) and replacing it with Klügl’s transmission module and related components (in yellow on the right):



(Ex. 1003, ¶226; Ex. 2022 ¶110.) However, there is no discussion of how closing forces are transmitted through a hydraulic fluid thickness after Petitioners substitute Wirbeleit’s magnetostrictive actuator for Klügl’s piezoelectric actuator. (See Ex. 1003, ¶¶230-33.) Given the dearth of disclosure regarding Wirbeleit’s element 22, a POSITA could not fill in the gaps in Wirbeleit’s disclosure to conclude that it is necessarily “active” or “passive.” Dr. Quinlan agrees “Wirbeleit ... *does not depict the specifics* of its hydraulic transmission element.” (Ex. 1003, ¶293; see *id.*, ¶292.)

Based only upon Wirbeleit's sole figure, Petitioners request the Board to conclude "Wirbeleit's 'hydraulic transmission element' is *sealed* within its housing," that it is "*not connected* to a separate fluid supply," and that it discloses a direct "simple force pathway." (Pet. 32.) It is unreasonable to conclude Wirbeleit disclosed a novel component by not saying anything. It is more likely that the lack of detail reflects the simple fact that the component was not a critical part of the invention claimed in Wirbeleit. (Ex. 2022 ¶49.) Regardless, Wirbeleit's intentional omission of any details of the internal design and operation of its hydraulic transmission element cannot teach all possible configurations. *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"))). Wirbeleit should only be relied on for what it actually discloses, which is *nothing* with respect to the structure of a hydraulic transmission element. Because Petitioners fail to identify how the Wirbeleit/Klühl combination teaches this first requirement of Claim 1(e), Petitioners fail to show any challenged claim would be obvious under either Ground 1 or 2.

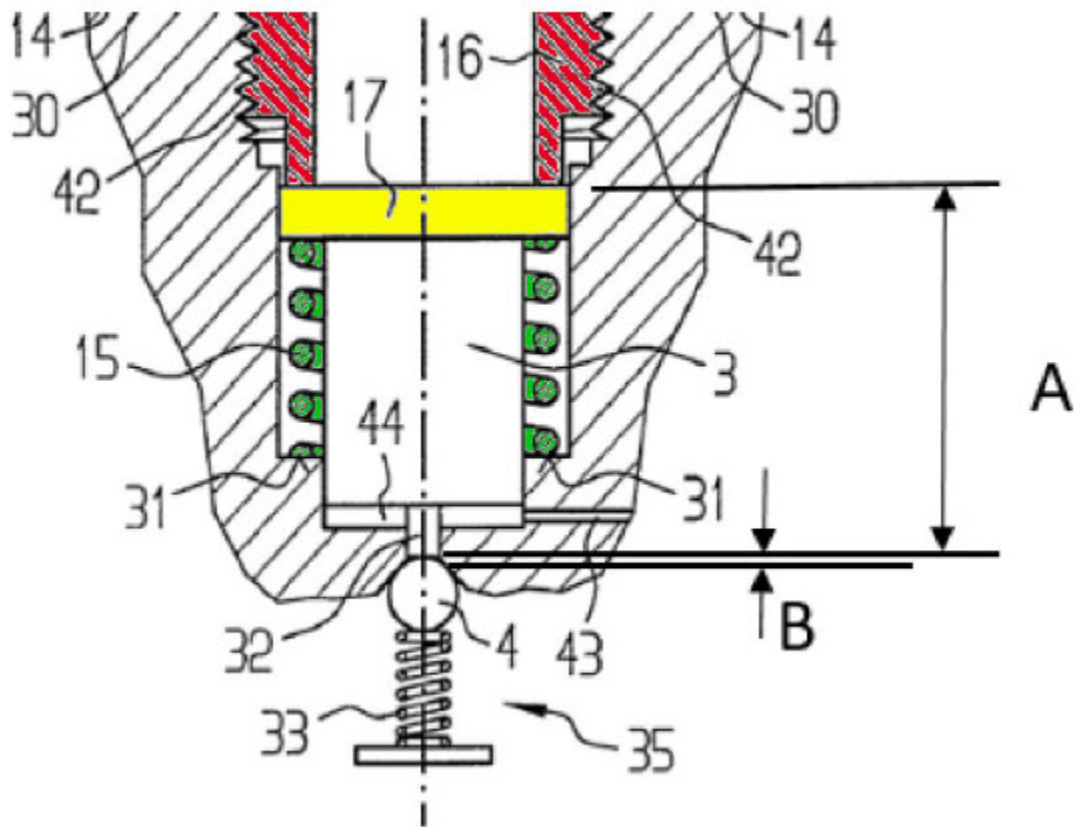
2. “whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated”

With respect to the second requirement of limitation 1(e), Petitioners rely on Klügl’s disclosure (Pet. 39), as Wirbeleit does not teach any hydraulic fluid and Petitioners do not contend that it does. However, Klügl’s transmission medium does not act substantially as a solid for the reasons explained in detail in Section VIII.

Klügl also does not teach a hydraulic fluid that has “a thickness being substantially constant” while the actuator assembly is actuated. (Ex. 2022 ¶¶88.) For all of the reasons discussed in Section VIII, Klügl teaches a flexible membrane. Because Klügl’s membrane 6 is flexible, the incompressible transmission medium contained by membrane 6 will cause it to deform during actuation, causing the space in pressure chamber 5 to change. (*Id.*, ¶¶81-82.) Klügl’s transmission medium will redistribute within pressure chamber 5 by flowing from the higher pressure nearest the contact surface between membrane 6 and piston 3 toward the lower pressure unsupported annular areas of membrane 6. (*Id.*, ¶¶78-80.) Because Klügl does not teach the second requirement of Claim 1(e), Petitioners fail to show any challenged claim would be obvious under either Ground 1 or 2.

3. **“wherein said thickness of said hydraulic link is adjustable while said actuator is not actuated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve lift upon actuation of said actuator assembly”**

For the third requirement of Claim 1(e), Petitioners point to Klügl’s teaching related to transmission module 2. (Pet.36.) Klügl describes that transmission module 2 is designed to address changes “[i]f the piezoelectric actuator 1 shortens in the rest position without being actuated due to thermal influences or signs of aging” to ensure “drive piston 3 is always in contact with the first membrane 6[.]” (Ex. 1006, 3:63-4:10.) Klügl, however, does not describe adjusting for other changes in the dimensional relationship between components to maintain a desired valve lift. (Ex. 2022, ¶¶68-70.) As illustrated in the annotated figure below and explained in Klügl, spring 15 (green) will always push drive piston 3 upward until check ring 17 (yellow) abuts lower stop 16 (the bottom of the portion shown in red). (*Id.*; Ex. 1006, 2:39-49.)



In other words, the distance A from the lower stop 16 to the end of the control needle 32 is fixed, as Klügl explains: “lower stop 16 specifies the rest position of the drive piston 3.” (Ex. 1006, 2:48-49.) In other words, piston 3 cannot lengthen or shorten distance A. (Ex. 2022, ¶68-70.) An adjustment of flexible membrane 6 also would not alter distance A. (*Id.*) In addition, ball 4 is illustrated as being in direct contact with the control needle 32 but, since the upward movement of the ball is limited by its contact with its valve seat, thermal expansion or wear could create a gap B between the end of the control needle and the ball. (*Id.*) If gap B exists, then the lift of the ball away from its valve seat will be less than the movement of the piston 3.

(*Id.*) Just as thermal expansion or wear may create a gap B, those effects may also operate in the other direction, causing the distance A to extend farther toward the ball 4 and housing 12 when the actuator is closed. (*Id.*) This could cause leakage between ball 4 and housing 12. (*Id.*) While Klügl's transmission module 2 is intended to maintain contact between the actuator 1 and the piston 3, it does not provide any solution to remedy a potential gap B in either direction. (*Id.*) Thus Klügl's transmission module 2 will not maintain a desired lift of ball 4, and does not teach this requirement of Claim 1(e). (*Id.*) To address this missing teaching, Petitioners suggest 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. 36.) Wirbeleit's objective, however, is to provide a system where needle lift is controlled by an electronic control unit, *not* by its transmission element 22. (Ex. 1004, 1:7-12; Ex. 2022, ¶¶51-52, 106.) Wirbeleit achieves this through a sensor that senses the position of the orifice needle via the pressure compensation piston 10 and adjusts the lift of the orifice needle via a change in the voltage of the actuator. (Ex. 1004, 2:1-2, 3:1-7; Ex. 2022, ¶¶51-52, 106.) A POSITA would not be motivated to add Klügl's transmission module 2 to Wirbeleit "to maintain a desired needle lift" when Wirbeleit already senses and adjusts lift as needed. (Ex. 2022, ¶¶106.)

Moreover, Klügl’s “adjustment” is only available to correct “long-lasting pressure differences between the pressure chamber 5 and the compensation chamber 7 lasting from one second to minutes[.]” (Ex. 1006, 4:25-27.) Given that Klügl references actuation times “in the range of milliseconds,” Klügl’s adjustments are only made over 1000s of cycles.

Further, Petitioners’ argument compels finding all the challenged claims are patentable. If, as Petitioners argue, Klügl teaches a rigid membrane not a flexible membrane, then Klügl could not satisfy the “auto-adjustment” limitation because a rigid membrane would not provide the requisite adjustability during periods of non-actuation. (Ex. 2022, ¶67.) Dr. Quinlan was not aware of the type of membrane material that Klügl teaches at all, much less whether that material would behave as a rigid membrane during actuation and as a flexible membrane when not actuated. (Ex. 2025, 140:20-25 (“Seeing as how I haven’t done the design process to go through and decide what [membrane] 6 is made out of and what its material is, I don’t know.”).) Either way, Petitioners have not and cannot shown that Klügl discloses the claimed passive hydraulic link. Thus, Petitioners fail to show any challenged claim would be obvious under either Ground 1 or 2.

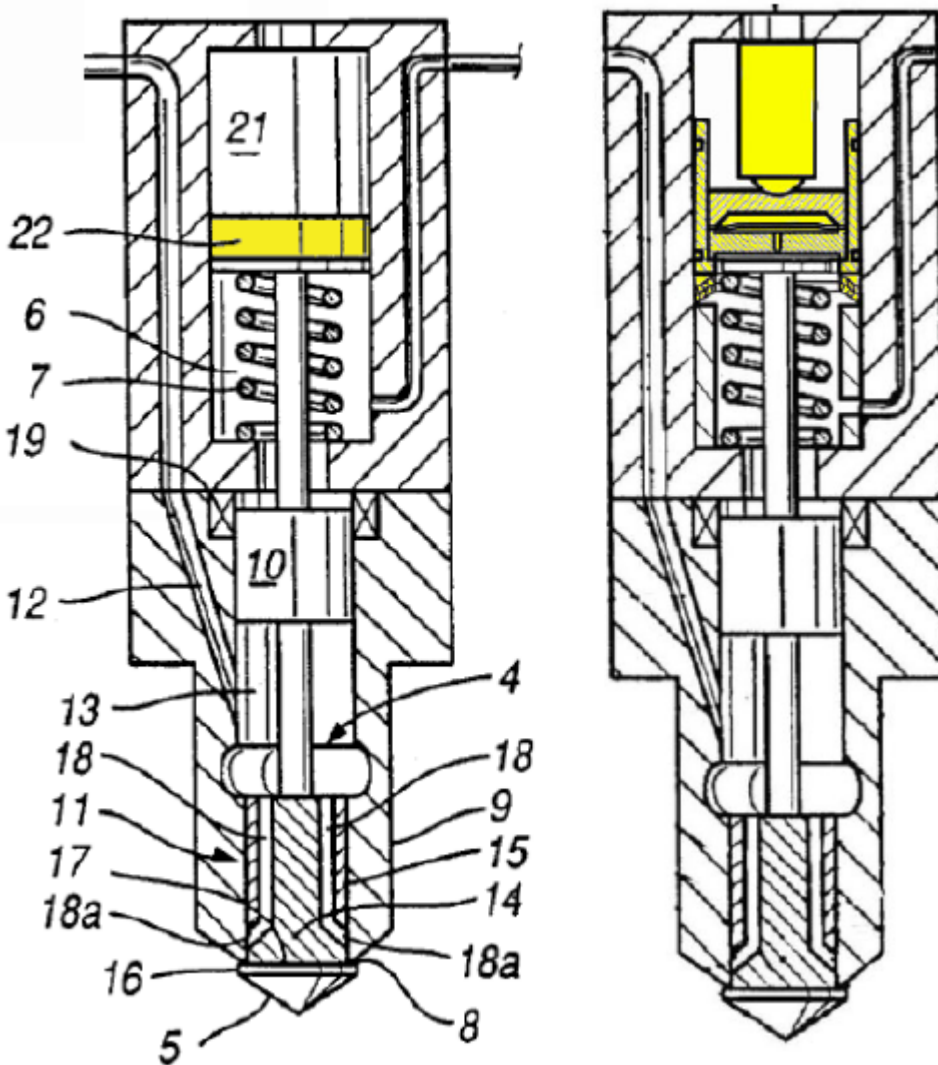
B. Claims 2 and 3

Petitioners rely on Klügl as disclosing the additional elements of claims 2 and 3. (Pet.40-41.) First, as discussed in Section IX, Klügl does not sufficiently

adjust its valve needle lift for the dimensional changes. Second, as explained herein, if the Board agrees with Petitioners that Klügl teaches a rigid membrane—as opposed to a flexible membrane— then Klügl does not disclose Claim 2’s limitation “wherein said thickness of said hydraulic link is auto-adjustable while said actuator assembly is not activated in response to changes in said dimensional relationship caused by differential thermal expansion” or claim 3’s limitation “wherein said thickness of said hydraulic link is auto-adjustable while said actuator assembly is not activated in response to changes in said dimensional relationship caused by wear to components of said injection valve.” A rigid membrane would not allow such adjustments during periods of non-actuation. (Ex. 2022, ¶87.) Thus, if the Board agrees with Petitioners that flexible membrane 6 is rigid (not flexible), Petitioners fail to show that claims 2 and 3 are obvious over the Wirbeleit/Klügl combination for these additional reasons.

C. Claims 6 and 13

Petitioners contend *Wirbeleit* teaches claim 6’s requirement: “wherein said actuator assembly comprises a dimensionally responsive member.” (Pet. 41-42.) Petitioners do not rely on Klügl for this element in this combination. However, for the Wirbeleit/Klügl “frankenvalve,” Dr. Quinlan replaces Wirbeleit’s actuator 21 (on the left) with Klügl’s actuator (on the right):



(Ex. 2022, ¶110.) Thus Dr. Quinlan’s proposed combination does not rely on Wirbeleit’s actuator to disclose this element. Yet in his discussion of Claim 1(d) and dependent Claim 6’s “actuator assembly,” Dr. Quinlan points to Wirbeleit’s actuator. (Ex. 1003, ¶¶189, 250.) Given the nature of Wirbeleit’s invention, Wirbeleit teaches that “[i]t is particularly advantageous to use a magnetostrictive actuator for the controlled opening of the injector orifice in place of a piezo actuator

since it requires substantially lower electrical voltages than are necessary for operating a piezo actuator.” (Ex. 1004, 2:13-17.) Because Dr. Quinlan relies on Klügl’s piezoelectric actuator for purposes of showing his proposed Wirbeleit/Klügl combination in claim 1, he cannot rely on Wirbeleit’s actuator for purposes of satisfying the requirements of claim 6 (as well as for other claims that depend from claim 6). Similarly, for claim 13, which recites “wherein said dimensionally responsive member is formed from a piezoelectric material,” Petitioners again rely on Wirbeleit’s actuator assembly, and thus suffer the same failure. Thus, for this additional reason Petitioners fail to show that claims 6 and 13—and their dependent claims—are obvious over the Wirbeleit/Klügl combination.

D. Claim 17

Petitioners contend that Wirbeleit teaches claim 17’s requirement: “wherein when said actuator assembly is controllable to maintain said desired lift to between 10 and 100 percent of maximum lift.” However, Petitioners admit that Wirbeleit merely discloses a “valve needle that allows for a controllable amount of lift.” (Pet. 41.) Because Wirbeleit does not disclose any specific range, it cannot teach the claimed range, and Petitioners have failed to carry their burden. Further, as Dr. Atkinson explains, a POSITA would not understand the combination to disclose this range because “a POSITA would not contemplate a very low lift around a fuel injector needle due to the non-linear flow effects that naturally occur around a needle

at low lifts.” (Ex. 2022, ¶97.) Thus Petitioners fail to show that claim 17 is obvious over the Wirbeleit/Klügl combination for this additional reason.

E. Claim 19

Petitioners argue Wirbeleit and Klügl teach claim 19’s requirement: “wherein said valve member is controllable such that said valve member moves between said open and closed positions in less than about 200 microseconds.” First, Petitioners do not identify any range disclosed in Wirbeleit, which merely states “injection time is adjustable.” (Pet.42.) This does not disclose *any* range, much less *the claimed range*. Second, Petitioners contend that Klügl discloses this element in its discussion of “actuation times” of an injection valve. (Pet.42.) Petitioners also do not identify any range in Klügl *corresponding* to the claimed range. (Pet.70.) The cited portion of Klügl refers to actuation times in the “range of *milliseconds*, preferably 0 ms to 10 ms” for the servo valve or for the nozzle needle. Even if Klügl’s “actuation times” are relevant to the actuation times for Wirbeleit’s injection needle, Klügl still does not teach the claimed range, as 0-10 milliseconds corresponds to 0-10,000 microseconds. Klügl’s recited range is so broad as compared to the claimed range that it does not render it obvious. While Klügl states that fast actuation times are around 0.1-1 milliseconds (i.e., 100-1000 microseconds) (Ex. 1006, 4:24), there is no disclosure that Klügl’s valves operate at “fast actuation times.” Rather, this merely provides a metric against which to measure Klügl’s “preferred” actuation

times of 0-10 milliseconds. Further, in view of the Klügl's disclosure that adjustment across compensation chamber 7 occurs "from one second to minutes" (Ex. 1006, 4:25-30), a POSITA would not understand Klügl to teach the use of "fast actuation" times for its embodiment. Thus Petitioners fail to show that claim 19 is obvious in view of their Wirbeleit/Klügl combination (in addition to the reasons identified for the claims from which claim 19 depends).

F. Claim 41

Petitioners contend that their Wirbeleit/Klügl combination teach all of the limitations of independent claim 41. (Pet.45.) Claim 41 recites:

A method ... comprising:

...

- (b) transferring movement caused by said actuated dimensionally responsive member through a passive hydraulic link . . . , said ***passive hydraulic link comprising a hydraulic cylinder which houses a piston and is filled with a hydraulic fluid***, wherein said hydraulic fluid ***forms a layer between said piston and a cylinder head*** and because of the short duration that said valve is open, said hydraulic fluid does not have time to flow from one side of said piston to the other side and while said injection valve is open

...

- (d) providing sufficient time between consecutive valve openings to allow at least some of said hydraulic fluid within said passive hydraulic link ***to flow from one side of said piston to the other side of said piston***.

(Ex. 1001, claim 41.) Petitioners do not even attempt to walk through where each limitation of this claim would be found in this combination. (Pet.45-46.) Petitioners argue that Klügl's guide sleeve 11 constitute "a hydraulic cylinder" and transmission

module 2 constitutes “a piston” such that Klügl teaches “a hydraulic cylinder which houses a piston.” (Pet. 45-46.) Klügl’s guide sleeve is not a “hydraulic cylinder,” nor is Klügl’s transmission module a piston housed within a hydraulic cylinder. Guide sleeve 11—which Petitioners allege constitutes the claimed “hydraulic cylinder”—does not have a “cylinder head.” Guide sleeve 11 also does not contain or interface with any hydraulic fluid. (Ex. 2022 ¶98.) Rather the identified hydraulic fluid is contained entirely within the transmission module, which Petitioners describe as being within a “fluidly sealed” interior space created between housing 12 and upper stop 13. (Pet. 44, 72.) Moreover, Petitioners do not identify any “hydraulic fluid which forms a layer between said piston [transmission module 2] and a cylinder head [unidentified element of guide sleeve 11].” Finally, even if a POSITA would consider transmission module 2 to be a “piston”—which they would not—Klügl does not teach “at least some of said hydraulic fluid within said passive hydraulic link to flow from *one side* of said piston [transmission module 2] *to the other side* of said piston.” Rather, Klügl teaches containing its transmission medium within chambers 5 and 7, which are contained by the flexible membrane. (*Supra* Section VIII.) Klügl’s transmission medium moves within transmission module 2 but *not* from “one side” of the transmission module 2 to the other side, as claimed. Thus Petitioners fail to show that claim 41 is obvious in view of their Wirbeleit/Klügl combination. (Ex. 2022 ¶98.)

G. A POSITA would not have combined Wirbeleit and Klügl to solve the problems addressed by the '138 Patent

Contrary to Petitioners' arguments (Pet. 47, 52), there are numerous reasons why a POSITA would *not* combine Wirbeleit with Klügl. (Ex. 2022, ¶¶99-119.) In view of Wirbeleit and Klügl's disclosures, Petitioners' true rational for seeking to combine these references as proposed appears to be impermissible hindsight. (*Id.*, ¶100.) First, both Wirbeleit and Klügl address compensation for wear and thermal changes in different ways. (*Id.*, ¶100, 106-07, 116.) On one hand, Wirbeleit describes electrically controlling the voltage to the actuator to adjust valve needle lift for performance changes. (*Id.*) On the other hand, Klügl proposes a flexible membrane that would bulge to ensure contact between the actuator and piston. (*Id.*) A POSITA would not be motivated to combine Klügl with Wirbeleit to correct a problem that Wirbeleit purportedly solved. (*Id.*, ¶¶100-02, 106-07, 116.) A POSITA also would not consider Wirbeleit and Klügl to be "structurally and functionally similar" such that their combination would have been "particularly suitable," even in view of disclosure of elements that are common to almost every fuel injector. (*Id.*, ¶¶105, 116-17.) To the contrary, there are a multitude of differences that would teach away from such a combination. (*Id.*, ¶¶102, 103, 106-08, 116, 117.) For example, Wirbeleit teaches an outwardly opening fuel injector, such that the actuation forces must push the injection needle off its seat outwardly into the combustion chamber. (*Id.*; Ex. 1004, Figure 1 Ex. 2022, ¶103.) In contrast, Klügl teaches an inwardly

opening fuel injector, wherein the actuator must pull the injection needle inwardly off its seat. (Ex. 1006, 3:33-38; Ex. 2022, ¶103.) A POSITA would not have combined a hydraulic transmission element for an inwardly opening fuel injector with a hydraulic transmission element for an outwardly opening fuel injector. (Ex. 2022, ¶103.)

Dr. Quinlan's proposed Wirbeleit/Klühl frankenvalve also adds needless complexity to Wirbeleit's simple, electronically-controlled injection valve. (*Id.*, ¶¶104-08, 110.). Dr. Quinlan did not simply add the mechanism depicted in Klühl Fig. 1 to Wirbeleit Fig. 1. (*Id.* ¶¶105, 111.) Rather he added other elements and modified the piston/membrane interface. (*Id.* ¶¶110-11, 118.) The proposed combination would neither be simple to manufacture (*id.* ¶¶113-14.), or compact as even a visual inspection reveals that Klühl's structures would take up much more space within the injector housing (*id.* ¶¶109-10). Finally, the frankenvalve would not function as desired. (*Id.* ¶¶111, 112, 119.) And rather than eliminate delays, Klühl teaches that its adjustment occurs over "long lasting" pressure differences. (*Id.* ¶112.) If the combination constituted "routine" design choices, Dr. Quinlan may have been able to design an operable frankenvalve, but a POSITA would not consider this routine. (*Id.* ¶¶115-16.) This arrangement is also problematic because the proposed combination introduces fluid into structures that were sealed in Klühl.

(*Id.* ¶¶110-11.) It would likely experience “hydro-lock” due to the absence of any drain to remove hydraulic fluid that leaks past the top of piston 3. (*Id.* ¶119.)

Dr. Quinlan is aware of disadvantages associated with flexible membranes, including the risk of rupture and loss of efficiency. (Ex. 2025, 130:17-23, 131:2-7.) In fact, rupture is a serious consideration among other disadvantages associated with flexible membranes given the high pressure, rapid actuation environment of fuel injectors. (Ex. 2022 ¶89; Ex. 2019, 1:43-51; Ex. 2020, 1:48-53 (“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.”).) Consequently, even if a POSITA *could* have combined Klügl and Wirbeleit as proposed, a POSITA would not have been motivated to make such a combination knowing that Klügl’s system would not produce the desired results. (Ex. 2022, ¶¶99-119.) For at least the reasons described above, Petitioners have not shown that any challenged claim would have been obvious in view of the combination of Klügl and Wirbeleit.

H. Ground 2: Claim 28

Petitioners’ Ground 2 proposes the addition of Newcomb to Wirbeleit/Klügl. Petitioners do not contend that Newcomb provides any disclosures missing from the Wirbeleit/Klügl combination for claim 1, from which claim 28 depends. Claim 28 is

not obvious for the same reasons set forth with respect to Claim 1 in Ground 1 (*see supra* Section IX.A,I) and for the additional lack of motivation to combine further Newcomb with the Wirbeleit/Klühl combination. Petitioners improperly use claim 28 as a roadmap to combine their cherry-picked references. Petitioners' only proffered motivation to combine is that the three references relate to fuel injectors generally. (Pet. 55.) A mere recitation of common generic elements in the prior art does not provide a sufficient motivation to combine; there must exist some reason for combining those elements. *Virtek Vision Int'l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882 (Fed. Cir. 2024). Thus Petitioners fail to show that dependent claim 28 is obvious in view of their Wirbeleit/Klühl combination.

X. GROUNDS 3 & 4: PETITIONERS' PROPOSED KLÜGL/HAYES COMBINATION DOES NOT RENDER ANY CHALLENGED CLAIM OBVIOUS

As the Petition concedes, Petitioners' Grounds 3 and 4 reflect an alternative construction of the claims. (Pet.55-56.) The consequence of Petitioners' alternative argument is that either Grounds 1 and 2 apply the plain and ordinary meaning of claim terms or Ground 3 and 4 do. It cannot be both. Regardless, even under this alternative construction, Petitioners' proposed Klühl/Hayes combination does not teach each and every limitation of the challenged claims. Claims 1 and 41 are the only independent claims challenged under Ground 3 (Klühl/Hayes). The remaining challenged claims depend from and include the limitations of Claim 1. Only

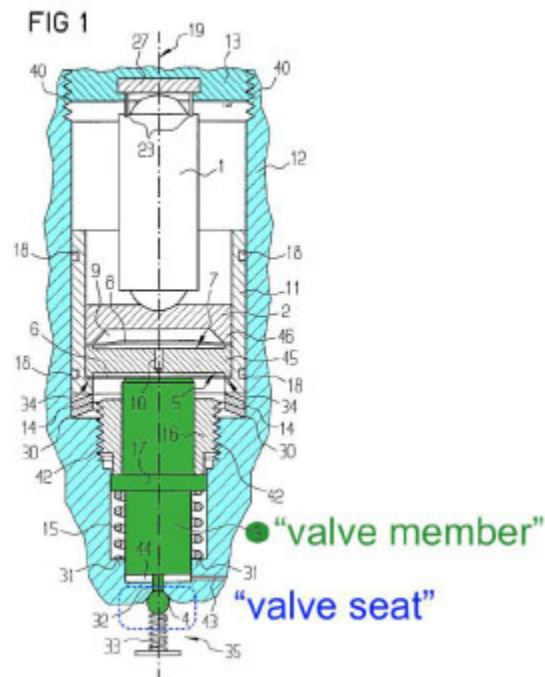
dependent claim 28 is challenged under Ground 4 (Klügl/Hayes/Newcomb). Petitioners have not carried their burden in showing that either Claim 1 or 41 is obvious, for the reasons explained herein. Because claim 1 is not obvious, none of its dependent challenged claims are obvious either.

A. Petitioners Fail to Establish that Klügl Discloses a “Fuel Inlet Port,” “Interior Chamber” Claimed in Limitation 1(a).

For the Klügl/Hayes combination, Petitioners contend that Klügl discloses the “fuel inlet port” set forth in limitation 1(a). (Pet.57-58.) To the contrary, Klügl’s valve housing 12, on which Petitioners rely does not depict a “fuel inlet port.” (Ex. 2022, ¶¶123-125.) In addition, because Klügl does not depict a “fuel inlet port,” it also does not depict “an interior chamber fluidly connected to said fuel inlet port.” There is no inherent requirement that these structures be arranged as claimed. Given that these elements are not shown, there is no support in Klügl that these elements would necessarily be arranged as required by the challenged claims. Accordingly, Petitioners fail to show that claim 1 is obvious in view of their Klügl/Hayes combination, which renders all dependent claims non-obvious under Ground 3 as well.

B. Petitioners Have Failed to Establish that Klügl Discloses a “Valve Member” Claimed in Limitation 1(b).

For the Klügl/Hayes combination, Petitioners contend that Klügl discloses the “valve member” set forth in limitation 1(b) based on a combination of a drive piston, control needle, and ball, which is shown in green in the Figure below. (Pet.62-63.)



(Ex. 1003, 93.) A POSITA would not consider the identified elements taken together to constitute the claimed valve member. In addition, as explained *supra* Section X.A, no specific arrangement of a “fuel inlet port,” or “interior chamber,” is shown in Klügl. (Ex. 2022, ¶¶125-127.) Because no specific arrangement of these elements is shown in Klügl (or would necessarily be required by Klügl), Petitioners have no support on which to base their contention that what they point to as the “valve needle” would be arranged as claimed, *i.e.*, “extendable from said valve seat toward said combustion chamber,” “lifts away from said valve seat” to open the injector, and cooperates with the valve seat “to seal said interior chamber from said combustion chamber.” (Pet.93.) Instead, Petitioners merely speculate about such a

structure using impermissible hindsight and the challenged claim element as a roadmap. *Metalcraft of Mayville, Inc. v. The Toro Co.*, 848 F.3d 1358, 1367 (Fed. Cir. 2017) (“[W]e cannot allow hindsight bias to be the thread that stitches together prior art patches into something that is the claimed invention.”). Accordingly, Petitioners fail to show that claim 1 is obvious in view of their Klügl/Hayes combination, which renders all challenged dependent claims in Ground 3 or 4 non-obvious in view of this combination as well.

C. Neither Klügl nor Hayes Disclose the Claimed Passive Hydraulic Link Claimed in Limitation 1(e)

In contrast to Ground 1—where Petitioners relied on both Klügl and Wirbeleit together as teaching limitation 1(e)—for Ground 3, Petitioners now contend Klügl alone discloses limitation 1(e). (Pet.68-69.) Despite removing Wirbeleit from the combination for Grounds 3 and 4, Petitioners do not substitute any disclosures from Hayes in place of those from Wirbeleit.

1. a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted

Petitioners cite to their discussion of this limitation for Ground 1 as supporting their statement that “the closing force of the spring 15 is transmitted back through this same chamber 5 during valve closing.” (Pet.34.) However, the Ground 1 discussion relies on Wirbeleit and provides no support for Petitioners here. Because Petitioners fails to identify how the Klügl/Hayes combination teach this first

requirement of limitation 1(e), Petitioners fail to show claim 1 or its dependent claims would be obvious under Ground 3 or 4.

2. whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated and

Petitioners cite to their discussion of the second requirement of claim 1(e) as it relates to their Wirbeleit/Klügl combination as the entire support for their argument that Klügl teaches this requirement for their Klügl/Hayes combination. (Pet.68.) For the same reasons explained for Wirbeleit/Klügl, Petitioners likewise fail to identify how the Klügl/Hayes combination teaches the second requirement of limitation 1(e) and thus fail to show claim 1 or its dependent claims would be obvious under Ground 3 or 4.

- 3. wherein said thickness of said hydraulic link is adjustable while said actuator is not actuated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve lift upon actuation of said actuator assembly**

Petitioners cite to their discussion of the third requirement of limitation 1(e) for the Wirbeleit/Klügl combination as the entire support for their argument that Klügl teaches this requirement for their Klügl/Hayes combination. (Pet., 66-67.) For the for the same reasons explained for Wirbeleit/Klügl, Petitioners likewise fail to identify how the Klügl/Hayes combination teaches the third requirement of limitation 1(e) and thus fail to show claim 1 or its dependent claims would be obvious under Ground 3 or 4.

D. Claims 2 and 3

Petitioners contend that Klügl/Hayes teach the additional elements of claims 2 and 3 for the same reasons as Wirbeleit/Klügl. For the reasons explained *supra* Section IX.B, Petitioners fail to show that claims 2 and 3 (and their dependent claims) are obvious over the Klügl/Hayes combination for this additional reason.

E. Claims 17 and 18

In contrast to Ground 1, Petitioners now contend that Klügl (not Wirbeleit alone) teaches the additional element of claim 17. (Pet.70.) Petitioners admit that Klügl does not teach that the actuator assembly is “controllable to maintain said desired lift” or that the desired lift can be “maintained” within the claimed range of 10 to 100 percent of maximum lift. (Pet.69-70.) Further, as Dr. Atkinson explains, a

POSITA would not understand the combination to disclose this range because “a POSITA would not contemplate a very low lift around a fuel injector needle due to the non-linear flow effects that naturally occur around a needle at low lifts.” (Ex. 2022, ¶129.) Klügl’s recitation of a piezoelectric actuator alone does not disclose the claimed controllability or correct the deficiencies associated with Klügl’s teachings to maintain desired lift, discussed *supra*. Relatedly, Petitioners contend that Klügl discloses the additional requirement of claim 18 (i.e., “varying . . . the electric voltage . . . upon said dimensionally responsive member”)—which depends from claim 17—citing the same passage of Klügl. (Pet. 71.) Just as Klügl does not teach an adjustable lift between 10 to 100 percent, Petitioners do not cite to any teaching in Klügl to vary the electric voltage for this purpose. Thus Klügl does not disclose these claim elements, and Petitioners have failed to carry their burden. Thus Petitioners fail to show that claims 17 and 18 are obvious in view of the Klügl/Hayes combination for these additional reasons.

F. Claim 19

Petitioners now contend that Klügl teaches claim 19’s for the same reasons as previously discussed. (Pet. 71.) For the reasons explained *supra* Section X.E, Petitioners Fail to show that claim 19 is obvious over the Klügl/Hayes combination for this additional reason.

G. Claim 41

Petitioners contend that the Hayes/Klügl combination teaches all of the limitations of independent claim 41. (Pet.71.) As discussed in this Response for the Wirbeleit/Klügl combination, Petitioners do not even attempt to walk through where each limitation of this claim would be found in Klügl. (Pet.71-72.) Petitioners do not contend that Hayes adds any relevant additional disclosures. Thus Petitioners also fail to show that claim 41 is obvious over the Hayes/Klügl combination.

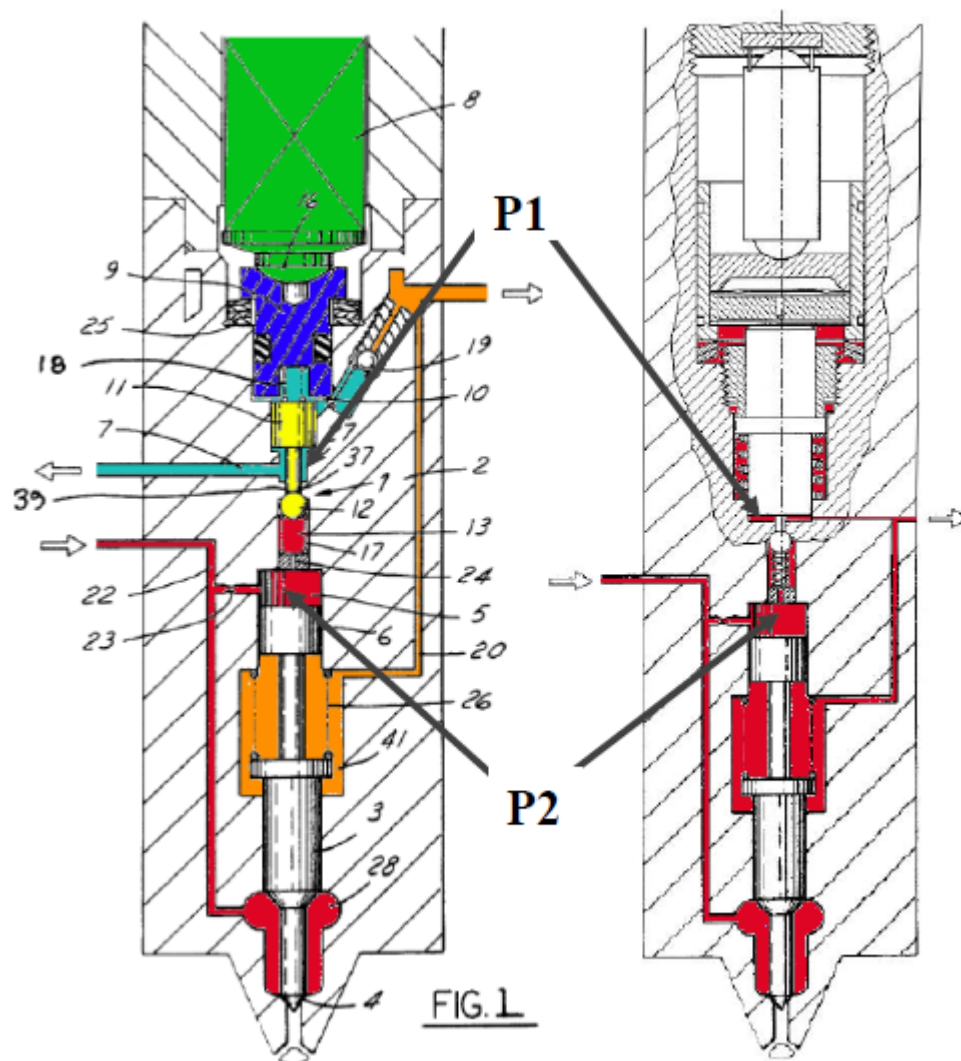
H. A POSITA would not have combined Klügl with Hayes to solve the problems addressed by the '138 Patent

There is extensive evidence that a POSITA considered the design of Klügl technologically deficient and inappropriate for high pressure fuel injectors. (See, e.g., Ex. 2022, ¶¶89, 108, 132.) This is true whether Klügl is combined with Wirbeleit or Hayes. Therefore, even if a POSITA *could* have devised an operable embodiment of Petitioners' Klügl/Hayes frankenvalve, 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. (*Id.*)

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.” (*Id.*)



The illustrations above compare an annotated Hayes Fig. 1 (left) with an annotated version of Petitioners' Klügl/Hayes frankenvalve combination (right) (*see* Pet.60). (Ex. 2022, ¶133.) The spaces in fluid connection with the high-pressure feeding line are shaded in red. (*Id.*) In Hayes, there exists a pressure differential as shown by the blue (P1) and the red (P2). (*Id.* ¶134.) In contrast, in Petitioners' Klügl/Hayes combination, everything is red showing that no pressure differential exists; fluid 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 Klügl/Hayes frankenvalve simply would not work. (*Id.*) A POSITA would not be motivated to modify the prior art in a way that would render it inoperable. (*Id.* ¶131.)

Petitioners' proposed Klügl/Hayes frankenvalve also renders the system of Hayes inoperable for its intended purpose. Specifically, Hayes describes “[t]he present invention uses a simple hydraulic amplifier to increase the stroke of the piezoelectric actuator and compensate for tolerances and shifts due to temperature and wear” (Ex. 1024, 1:32-34), which Hayes identifies as “hydraulic stroke amplifier comprising two pistons, 9 and 11,” (*id.* 2:9-10). Petitioners, however, suggest a POSITA would remove Hayes' invention concept entirely and replacing it with the Klügl's transmission module 2, as reflected in Dr. Quinlan's figure showing his proposed Klügl/Hayes combination. (Pet.34-35) Further Petitioners contend (wrongly) that transmission module 2 is “without amplification” (Pet.59) such that their proposed modification would remove the concept of amplification entirely from the Hayes embodiment. A POSITA would not be motivated to modify the prior art in a way that would completely disregard its teachings. Consequently, Petitioners have failed to show any suggestion or motivation for their proposed modifications.

(Ex. 2022, ¶131.) Thus, no claim challenged based on the Klügl/Hayes combination is obvious.

I. Ground 4: Claim 28

Petitioners' Ground 4 proposes the addition of Newcomb to the Klügl/Hayes combination would render the added limitation of dependent claim 28 obvious. Petitioners do not contend that Newcomb provides any disclosures missing from the Klügl/Hayes combination for claim 1, from which claim 28 depends. Claim 28 is not obvious for the same reasons set forth with respect to Claim 1 in Ground 3 (*see supra* Section X.A.I) and for the additional lack of motivation to combine Newcomb with the Klügl/Hayes combination. Petitioners improperly use claim 28 as a roadmap to combine their cherry-picked references. Petitioners' only proffered motivation is that the three references relate to fuel injectors generally. (Pet. 55.) A mere recitation of common generic elements is not sufficient motivation to combine. *Virtek Vision Int'l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882 (Fed. Cir. 2024). Thus Petitioners also fail to show that claim 28 is obvious over the Klügl/Hayes/Newcomb combination.

XI. PETITIONERS HAVE NOT ESTABLISHED THAT THEIR TECHNICAL EXPERT IS QUALIFIED TO OFFER OPINIONS FROM THE PERSPECTIVE OF A POSITA IN 1999.

The level of ordinary skill in the art is “a prism or lens” through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). All grounds in the Petition are obviousness grounds.

Determining whether an invention would have been obvious under 35 U.S.C. §103 requires resolving the level of ordinary skill in the pertinent art at the time of the effective filing date of the claimed invention. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). For the '138 Patent, that date is October 1999. (*See supra* at 6.) Petitioners submit the testimony of their technical expert, Dr. Quinlan, to provide the perspective of a POSITA. Ex. 1003. Yet he freely admits that he was not a POSITA as of October 1999 because he “didn’t have a degree” and “didn’t have much work experience.” Ex. 2024 (Ex. 2023, 55:20-56:2.) He was not working on fuel injectors, as of 1999. (Ex. 2025, 122:3-7.) Thus, under Petitioners’ own definition, Dr. Quinlan did not possess the qualifications of a POSITA at the time of invention. Neither his declaration nor his CV describes any professional experience or qualifications prior to his undergraduate degree in 2001 that would cure this deficiency. (Ex. 1003, ¶¶5-16 and Attachment A.) And Petitioners do not contend that Dr. Quinlan constituted a POSITA in October 1999.

Dr. Quinlan also did not independently educate himself about the state of the art, the prior art, or knowledge of a POSITA as of October 1999. He did not speak to anyone who would have qualified as a POSITA in 1999. (Ex. 2023, 35:23-36:4.) He also did not know basic industry knowledge from 1999, such as the percentage of light duty diesels trucks that used diesel fuel injectors in 1999, whether such trucks used direct or indirect injection in 1999, and the top fuel injector manufacturers in

1999. (Ex. 2023, 72:18-74:2, 74:14-75:20). Instead, Dr. Quinlan testified that counsel supplied him with the prior art references. (Ex. 2023, 31:4-17.) He then used the patents, their prosecution history, and the supplied prior art references to arrive at his opinions. (Ex. 2023, 31:19-35:7.) This is the hallmark of prohibited hindsight. *See, e.g., ActiveVideo Networks, Inc. v. Verizon Commc'ns, Inc.*, 694 F.3d 1312, 1327 (Fed. Cir. 2012) (“[T]he expert’s testimony on obviousness was essentially a conclusory statement that a person of ordinary skill in the art would have known, based on the ‘modular’ nature of the claimed components, how to combine any of a number of references to achieve the claimed inventions. This is not sufficient and is fraught with hindsight bias.”).

Dr. Quinlan also did not educate himself about key developments and advances that occurred in the industry around October 1999. (Ex. 2023, 72:18-73:3.) Although he admitted that there were “big changes” in the industry that occurred roughly around 1999, Dr. Quinlan could not get within five years of those big changes. (*Id.*, 73:9-11.) He acknowledged the implementation of “Tier 1 emissions” regulations and changes for light duty diesel vehicles “from older-style injectors to more, like common rail-style injectors.” (Ex. 2023, 72:18-73:3.) But he likewise did nothing to educate himself about how these changes in the industry would have impacted the knowledge and perspective of a POSITA at the time. (*Id.*; *see also id.*, 85:9-86:7.)

Because Dr. Quinlan lacks direct personal experience as a POSITA in 1999 and failed to educate himself, Dr. Quinlan's testimony about the state of the art, the knowledge of a POSITA, and what a POSITA would have found to be obvious, at the time of the invention, should be given little or no weight. He has no basis for his statements beyond express disclosures in the cherry-picked references counsel provided to him. To the extent that the express disclosures are not present, Dr. Quinlan is not qualified to offer opinions to fill in such gaps for the reasons explained.

In contrast to Dr. Quinlan, Westport's technical expert, Dr. Atkinson, satisfied Petitioner's definition of a POSITA well before the priority date of the '138 Patent. (Ex. 2038.) Dr. Atkinson obtained his Doctor of Science in Mechanical Engineering from Massachusetts Institute of Technology in 1991. (*Id.*) By 1999, Dr. Atkinson had worked as an assistant professor for over nine years. (*Id.*) He is a fellow in the Society of Automotive Engineers, currently serves as a Deputy Director of Advanced Research for the U.S. Department of Transportation, concurrently serves as a professor at Ohio State University, and is the founder of Atkinson LLC, a company he started to develop model-predictive control and calibration for engines and industrial processes over 24 years ago. (*Id.*) Dr. Atkinson's testimony about a POSITA should be given more weight than Dr. Quinlan's hindsight-driven testimony that was controlled and directed by Petitioners' limited supply of

documents to him. Dr. Quinlan's inconsistent opinions based upon the forum, uninformed opinions, and evasiveness on plainly relevant technical issues also warrant giving all of his opinions little or no weight. Simply stated, Dr. Quinlan is not a credible, independent expert on the relevant technology at issue here.

XII. CONCLUSION

For at least the reasons set forth herein, Petitioners cannot meet their burden to prove that any challenged claim is unpatentable over any of the obviousness combinations asserted in Petitioners' Grounds 1-4. None of the challenged claims is unpatentable. To the extent that Westport has not addressed a specific claim element in this response, it is not a concession that the element is disclosed in the prior art, but a reflection of the word count limitations imposed.

Dated: May 3, 2024

Respectfully submitted,

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.6(e), the undersigned certifies that on May 3, 2024, a complete and entire copy of Patent Owner's Response was served on the Petitioner by email to the following email addresses:

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Patent Owner Response, exclusive of the parts exempted by 37 C.F.R. §42.24, contains 13,919 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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