

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.

IPR2023-00293
Patent 6,575,138 B2

Before NEIL T. POWELL, CARL M. DEFRANCO, and
FRANCES L. IPPOLITO, *Administrative Patent Judges*.

IPPOLITO, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

ORDER
Denying Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

Robert Bosch LLC and Mercedes-Benz USA, LLC (collectively, “Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–3, 6, 13, 14, 17–21, 26–28, and 41 of U.S. Patent No. 6,575,138 B2 (Ex. 1001, “the ’138 patent”). Westport Fuel Systems Canada Inc. (“Patent Owner”) filed a Preliminary Response to the Petition (Paper 7, “Prelim. Resp.”).

We denied the Petition on June 20, 2023. Paper 8. Petitioner filed a Request for Rehearing on July 19, 2023. Paper 9. Upon reconsideration and, applying the standard set forth in 35 U.S.C. § 314(a), we instituted an *inter partes* review as to all claims and grounds set forth in the Petition. Paper 10 (“Inst. Dec.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 19, “PO Resp.”), Petitioner filed a Reply (Paper 23, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 26, “PO Sur-reply”).

In addition, Patent Owner filed a motion to exclude (Paper 30, “PO Mot.”), to which Petitioner filed an opposition (Paper 32, “Pet. Opp.”). Patent Owner filed a reply to Petitioner’s opposition (Paper 33, “PO Reply”).

An oral hearing was held for this proceeding on November 14, 2024, and the transcript is of record. Paper 36 (“Tr.”).

We have jurisdiction pursuant to 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the Challenged Claims. Petitioner bears the burden of

proving unpatentability of the Challenged Claims. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2021).

Having reviewed the arguments and the supporting evidence, we determine that Petitioner has not shown, by a preponderance of the evidence, that claims 1–3, 6, 13, 14, 17–21, 26–28, and 41 of the '138 patent are unpatentable.

We also *deny* Patent Owner's Motion to Exclude Evidence.

II. BACKGROUND

A. *Related Matters*

The parties identify the following United States District Court actions as involving the '138 patent: *Westport Fuel Systems Canada Inc. v. Ford Motor Company*, No. 2:21-cv-00453 (E.D. Tex.); *Westport Fuel Systems Canada Inc. v. Mercedes-Benz USA, LLC*, No. 2:21-cv-00454 (E.D. Tex.) (dismissed); *Westport Fuel Systems Canada Inc. v. Nissan North America, Inc.*, No. 2:21-cv-00455 (E.D. Tex.) (dismissed); *Westport Fuel Systems Canada Inc. v. General Motors, LLC*, No. 2:21-cv-00456 (E.D. Tex.); *Westport Fuel Systems Canada Inc. v. FCA USA LLC d/b/a FCA Group US LLC*, No. 2:21-cv-00457 (E.D. Tex.) (dismissed); and *Robert Bosch, LLC v.*

Westport Fuel Systems Canada Inc., No. 1:22-cv-00370 (E.D. Va.). Pet. 4–5; Paper 5, 2.¹

In addition to the instant Petition, Petitioner filed a second petition challenging the '138 patent in IPR2023-00351. Petitioner also filed petitions challenging related U.S. Patent No. 6,298,829 B1 in IPR2023-00292 and IPR2023-00352. We instituted *inter partes* review in this proceeding and in IPR2023-00292.

B. Real Parties in Interest

Petitioner identifies itself, Robert Bosch GmbH, Mercedes-Benz Intellectual Property GmbH & Co. KG, Mercedes-Benz AG, Ford Motor Company, and General Motors LLC as the real parties in interest. Pet. 4. Patent Owner identifies only itself as the real party in interest. Paper 5, 2.

C. The '138 Patent

The '138 patent, titled “Directly Actuated Injection Valve,” relates “to high pressure fuel injection valves or injectors for internal combustion engines.” Ex. 1001, code (54), 1:16–18. The '138 patent discloses “an injection valve that is directly controllable by a position actuating material (such as, for example, a piezoelectric or magnetostrictive material) and which includes a passive hydraulic link.” *Id.* at 1:18–21.

Figure 1 of the '138 patent, reproduced below, is a cross-section view of a directly actuated fuel injection valve according to a preferred embodiment. Ex. 1001, 8:36–38, 8:61–63.

¹ Patent Owner’s Mandatory Notices (Paper 5) do not include page numbers. We consider the title page as page 1 and proceed from there in numerical order.

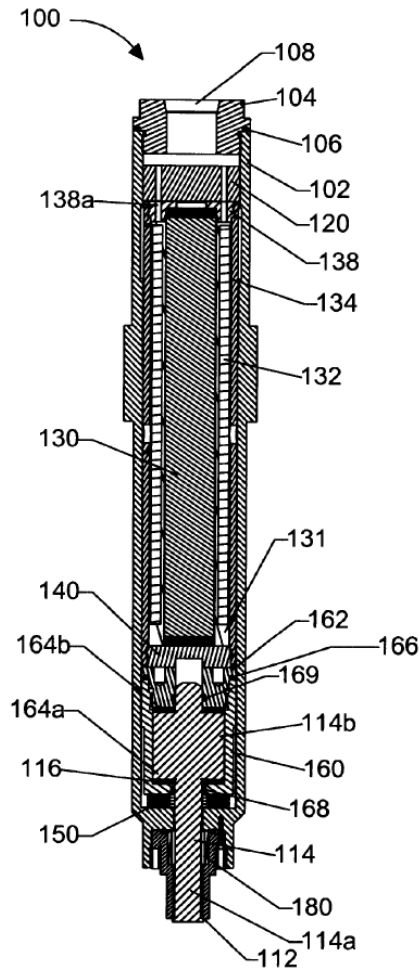


FIG. 1

Figure 1 of the '138 patent depicts injection valve 100 including elongated valve housing 102 and valve cap 104, which includes inlet port 108 through which fuel enters. *Id.* at 9:4–6, 9:8–9. Valve member 114 extends through an opening in the tip of valve housing 102 and cooperates with valve seat 112 to provide a fluid tight seal. *Id.* at 9:23–27, 9:59–61. Valve member 114 includes valve stem 114a and valve piston 114b. *Id.* at 9:64–10:1, 10:7–9. A spring assembly comprising at least one valve spring 116 biases valve member 114 in a closed position. *Id.* at 10:13–16. To open the valve, an

actuator assembly provides an opening force that overcomes the closing force provided by the spring assembly. *Id.* at 9:32–34. In the embodiment shown in Figure 1, the actuator assembly is a magnetostrictive actuator comprising solid magnetostrictive member 130, bobbin 131, electric coil 132, and flux tube 134 disposed between magnetostrictive member 130 and valve housing 102. *Id.* at 10:41–46. Actuating the actuator assembly causes magnetostrictive member 130 to grow in length and push sliding pole 140 towards valve member 114 to provide an opening force to open injection valve 100. *Id.* at 10:59–62.

Figure 2 of the '138 patent, reproduced below, is an enlarged cross-sectional view of a lower portion of a fuel injection valve in an open position and having the fuel inlet port in an alternate location from that shown in Figure 1. Ex. 1001, 8:40–43.

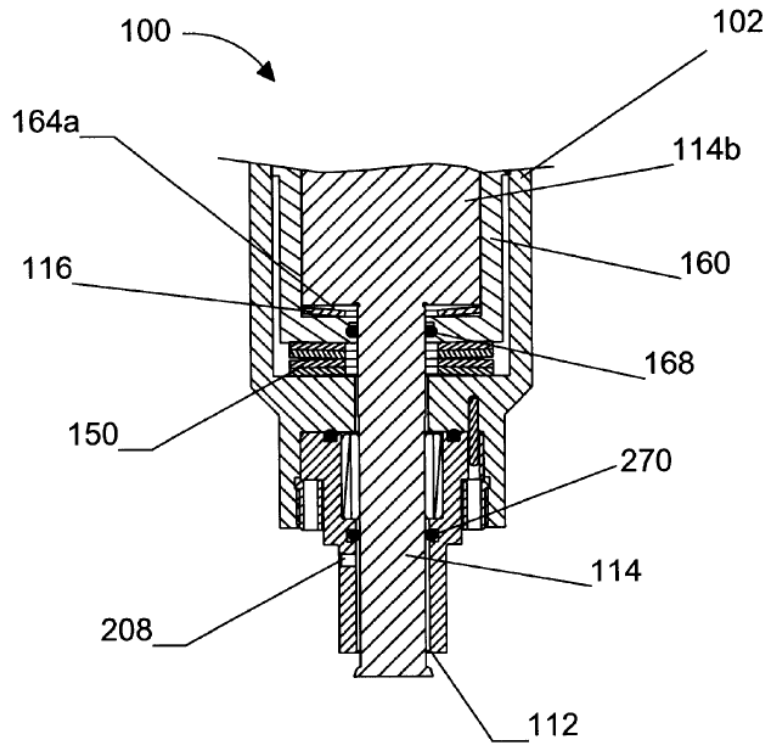


FIG. 2

Figure 2 of the '138 patent depicts valve member 114 extending through an opening in the tip of valve housing 102 to an open position in which the sealing surface of valve member 114 is not in contact valve seat 112. *Id.* at 9:59–64. The opening force that extends the valve member 114 is transmitted through a hydraulic link assembly, which comprises hydraulic cylinder 160, cylinder cap 162, seals 166, 168, 169, and viscous hydraulic fluid 164b. *Id.* at 11:65–12:3, 12:7–11, 14:16–22. Hydraulic cylinder 160 is in a close-fitting relationship around piston 114b. *Id.* at 11:67–12:3. Viscous hydraulic fluid 164b is disposed in a space between cylinder cap 162 and a planar surface of piston 114b. *Id.* at 14:16–22.

The '138 patent explains that “the hydraulic fluid preferably has a sufficiently high viscosity and bulk modulus so that it acts as an incompressible solid when actuation of the actuator assembly causes a valve opening force to be quickly transmitted through the hydraulic fluid between the bottom of cylinder 160 and hydraulic piston 114*b*.” Ex. 1001, 12:26–31. According to the '138 patent,

because valve actuation occurs suddenly (on the order of 200 μ s), hydraulic fluid 164*b* does not have time to flow through the narrow clearance gap between piston 114*b* and hydraulic cylinder 160. Instead, hydraulic fluid 164*b* acts as a solid and transfers the movement of magnetostrictive member 130 to valve member 114 via piston 114*b*, causing valve member 114 to lift away from valve seat 112.

Id. at 14:26–33.

D. The Challenged Claims

Petitioner challenges claims 1–3, 6, 13, 14, 17–21, 26–28, and 41 of the '138 patent. Pet. 1. Of the challenged claims, claims 1 and 41 are independent. Claim 1 is illustrative and reproduced below:

1. [1-p] An injection valve for injecting fuel into a combustion chamber of an internal combustion engine, said injection valve comprising:

[1(a)] (a) a valve housing comprising:

[1(a)-1] a fuel inlet port;

[1(a)-2] an interior chamber fluidly connected to said fuel inlet port; and

[1(a)-3] a valve seat for cooperating with a valve member to seal said interior chamber from said combustion chamber when said injection valve is closed;

[1(b)] (b) said valve member having one end disposed within said valve housing and an opposite end extendable from said valve seat toward said combustion chamber, wherein said

valve member comprises a sealing surface that fluidly seals against said valve seat when said injection valve is closed and that is liftable away from said valve seat when said injection valve is open;

[1(c)] (c) a biasing mechanism associated with said valve member, said biasing mechanism applying a closing force to said valve member when said valve member is in said closed position;

[1(d)] (d) an actuator assembly associated with said valve member, wherein said actuator assembly may be actuated to apply an opening force to said valve member stronger than said closing force, for moving said valve member to said open position; and

[1(e)] (e) a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted, whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated and wherein said thickness of said hydraulic link is adjustable while said actuator assembly 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, 17:17–53 (bracketed designations added by Petitioner (*see* Pet. 24–31)).

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §²	Reference(s)/Basis
1–3, 6, 13, 14, 17–21, 26, 27, 41	103(a)	Wirbeleit, ³ Klügl ⁴
28	103(a)	Wirbeleit, Klügl, Newcomb ⁵
1–3, 6, 13, 14, 17–21, 26, 27, 41	103(a)	Klügl, Hayes ⁶
28	103(a)	Klügl, Hayes, Newcomb

Pet. 8. In addition to the references listed above, Petitioner relies on the Declarations of J. Matt Quinlan, Ph.D. Ex. 1003; Ex. 1040. Patent Owner relies on the Declaration of Christopher Atkinson, Ph.D. Ex. 2022.

III. ANALYSIS

A. Level of Ordinary Skill in the Art

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the

² The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. We apply the pre-AIA version of § 103 here because the application which became the ’138 patent was filed before the effective date of the AIA. *See* Ex. 1001, code (22).

³ US 5,479,902, issued Jan. 2, 1996 (Ex. 1004, “Wirbeleit”).

⁴ Certified translation of DE 19708304 A1, published Feb. 28, 1997 (Ex. 1006, “Klügl”) and original German language version (Ex. 1005).

⁵ US 4,284,263, issued Aug. 18, 1981 (Ex. 1014, “Newcomb”).

⁶ US 5,779,149, issued July 14, 1998 (Ex. 1024, “Hayes”).

technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner contends:

A POSITA in the technology field of the '138 patent would have had a degree in mechanical engineering or a similar discipline, along with 2 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. (*See* Ex. 1003, ¶¶ 37–39, 41.) This POSITA would be aware of and generally knowledgeable about how fuel injector valves are structured and operate, and how they are used to deliver fuel to an engine's combustion chambers. (*Id.*, ¶ 40.)

Pet. 23.

Patent Owner does not dispute Petitioner's proposed definition. *See* PO Resp. 4.

For purposes of this Decision, we adopt the definition of the level of ordinary skill in the art proposed by Petitioner as reasonable and consistent with the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

B. Claim Construction

In an *inter partes* review proceeding, the Board interprets claim language using the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b), as described in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b).

Petitioner contends “that the terms of the ’138 patent’s claims do not require further construction and can be afforded their plain and ordinary meaning.” Pet. 15 (citing Ex. 1003 ¶¶ 82–85).

Patent Owner asserts that, “Westport does not seek construction of any claim term.” PO Resp. 5.

Based on the complete record, we do not perceive the need to construe any claim limitation. Claims must be construed “only to the extent necessary to resolve the controversy.” *AstraZeneca AB v. Mylan Pharms. Inc.*, 19 F.4th 1325, 1345 (Fed. Cir. 2021) (quoting *Vivid Techs., Inc. v. American Science & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); see also *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“Because we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy,’ we need not construe the claim preambles here where the construction is not ‘material to the [obviousness] dispute.’” (citations omitted, alteration in original))).

C. Dr. Quinlan’s Testimony

Patent Owner contends that the testimony of Petitioner’s declarant, Dr. Quinlan, should be given little weight because of “his changing and inconsistent claim construction opinions.” PO Resp. 8. Specifically, Patent Owner contends that Petitioner and Dr. Quinlan have provided alternative claim construction positions between this proceeding and in related district court matters. *Id.* at 5–8.

We do not agree that alternative claim construction positions requires us to categorically discount or ignore Petitioner’s arguments or Dr.

Quinlan’s testimony in this proceeding. Here, Petitioner has provided a claim construction position. *See* Pet. 15. Patent Owner has also provided its claim construction position. PO Resp. 4–5. Moreover, based on our review of the complete record, we do not perceive the need to construe any claim limitation for the purposes of this Decision. Further, Dr. Quinlan’s testimony has been reviewed and afforded weight accordingly, as discussed in this Decision.

D. Overview of the Prior Art

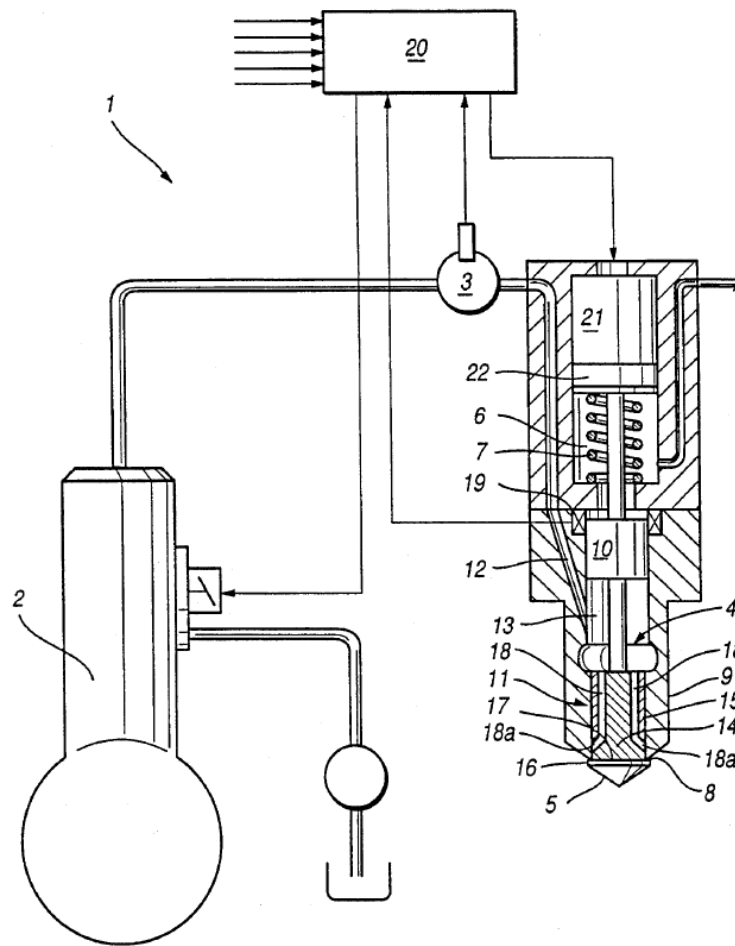
1. Summary of Wirbeleit (Ex. 1004)

Wirbeleit is titled “Fuel Injection System for a Diesel Engine.” Ex. 1004, code (54). Wirbeleit “relates to a fuel injection system for a Diesel engine which includes a high pressure fuel pump supplying fuel under pressure to a common-rail fuel supply conduit which is in communication with valve-controlled injectors for the injection of fuel under the control of an electronic control unit.” *Id.* at 1:7–12. In particular, Wirbeleit describes

fuel injectors having fuel injection control needles engaged by springs so as to be normally seated on a valve seat and a control needle actuator for lifting the control needle off the valve seat under the control of an electronic control unit, the needle includes a cylindrical needle body movable within a cylinder and has slot-shaped orifices formed in its outer surface which are fully covered when the control needle is seated but which are exposed to a degree controllable by the needle actuator for adjustment of the orifice sizes depending on engine operating parameters.

Id. at 1:45–58.

Wirbeleit’s sole figure (unnumbered) is reproduced below.



The figure of Wirbeleit depicts a fuel injection system including a fuel injector shown in a cross-sectional view. Ex. 1004, 2:21–22. The injector includes injector orifice control needle 5 forced onto valve seat 8 of injector body 9 via return spring 7 in spring chamber 6, but injector orifice control needle 5 is outwardly-movable to open slot orifice 4. *Id.* at 2:31–35. Orifice control needle 5 includes pressure compensation piston 10 that, along with needle tip 11, delimits pressure chamber 13, which is in communication with common supply conduit 3 via fuel admission passage 12. *Id.* at 2:35–39. Magnetostrictive actuator 21, under control of control unit 20, operates

orifice control needle 5 via hydraulic transmission element 22 at the end of the control needle opposite tip 11. *Id.* at 2:60–64.

1. *Summary of Klügl (Exs. 1005 and 1006)*

Klügl is titled “Device for transmitting a motion and an injector with a device for transmitting a motion.” Ex. 1006, code (54). Klügl discloses

A power transmission device . . . used, for example, in automotive engineering to transmit the movement of a piezoelectric actuator in an injection valve to a control element, the control element opening a servo valve, for example, which in turn controls the opening and closing of an injection valve.

Id. at 1:7–12.⁷

Figure 1 of Klügl is reproduced below.

⁷ In citations to Klügl, we (like the parties) refer to the native pagination (i.e., column and line numbers).

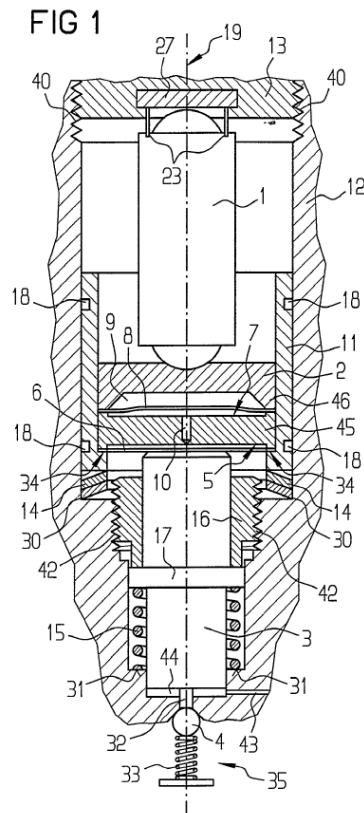


Figure 1 of Klügl depicts an injection valve including housing 12 and piezoelectric actuator 1, which is arranged between upper stop 13 and transmission module 2. Ex. 1006, 1:47–51. Transmission module 2 is essentially cylindrical and includes pressure chamber 5, which is at least partially filled with hydraulic fluid and is delimited by first membrane 6. *Id.* at 1:60–62; 1:68–2:2. Connecting bore 10, which has a throttling effect, connects pressure chamber 5 to compensation chamber 7. *Id.* at 1:62–66. Drive piston 3 is biased against lower stop 16 and merges into control needle 32, which extends through relief chamber 34 to valve seat 35. *Id.* at 2:35–36, 2:50–52. Ball (or closing element) 4 presses against valve seat 35 by valve spring 33. *Id.* at 2:54–55. Actuating piezoelectric actuator 1 presses

transmission module 2 against the spring force of the disk spring 14 and exerts pressure on drive piston 3 via first membrane 6, which exercises the hydraulic fluid in pressure chamber 5. *Id.* at 3:23–29. The hydraulic fluid moves drive piston 3 against the force of tension spring 15, and control needle 32 lifts ball 4 off valve seat 35. *Id.* at 3:30–33.

2. *Summary of Newcomb (Ex. 1014)*

Newcomb is titled “Temperature-Compensated Control Valve.” Ex. 1014, code (54). Newcomb “relates to a control valve such as a servovalve or fuel injection valve for controlling flow of a medium.” *Id.* at 1:5–7. Newcomb describes that the object of the invention is to provide a control valve with a construction that reduces the effects of thermal expansion. *Id.* at 1:45–49; *see also id.* at 1:31–38 (describing that piezoelectric valves have a small stroke and that it is essential to minimize thermal expansion of valve parts so that valve flow varies only slightly with ambient temperature changes). Newcomb discloses a control valve in which “part of the actuating member consists of a spacer or distance piece of a different non-piezoelectric material having such a coefficient of thermal expansion that with temperature variations the linear expansion of the actuating element and distance piece together is equal to that of the housing.” *Id.* at 1:51–56. Newcomb explains that using a valve body material with a similar thermal expansion coefficient to the piezoelectric actuator “minimize[s] variations of valve opening with temperature.” *Id.* at 2:10–11.

3. *Summary of Hayes (Ex. 1024)*

Hayes is titled “Piezoelectric Controlled Common Rail Injector with Hydraulic Amplification of Piezoelectric Stroke.” Ex. 1024, code (54).

Hayes relates to piezoelectric actuators for controlling a common rail injector. *Id.* at 1:8–10. Hayes discloses “a piezo actuated fuel injector comprising a[] hydraulic amplifier to increase the stroke of the piezo stack and a 2/2 poppet valve with the return spring on the top side of the valve.” *Id.* at 1:54–57.

Figure 1 of Hayes is reproduced below.

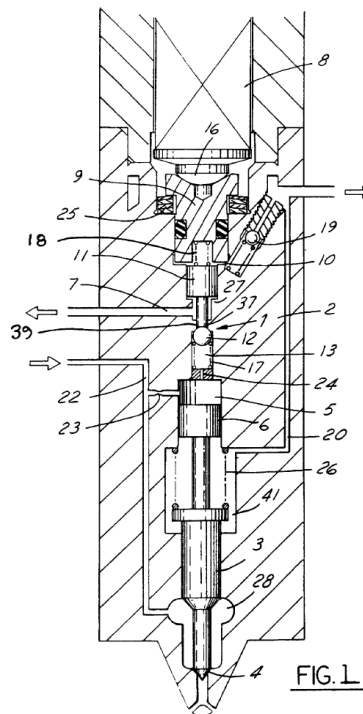


Figure 1 depicts an injector including body 2, piezoelectric actuator 8, a hydraulic stroke amplifier with pistons 9 and 11, hydraulic chamber 10 filled with low-pressure fuel, control valve 1, control chamber 5, and power piston 6 mechanically connected to injection valve needle 3. Ex. 1024, 2:6–15, 2:50–51. Feeding line 22 feeds high-pressure fuel to injection pressure chamber 28 and is connected to control chamber 5 via flow restrictor 23. *Id.* at 2:45–49. In operation, energizing piezoelectric actuator 8 opens sealing

component 12 of control valve 1, which lowers the pressure in control chamber 5 against power piston 6, which causes valve needle 3 to lift away from seat 4 and open a passage for high pressure fuel to be injected into a combustion chamber. *Id.* at 3:25–63.

E. Asserted Obviousness Based on Wirbeleit and Klügl

Petitioner asserts that claims 1–3, 6, 13, 14, 17–21, 26, 27, and 41 would have been obvious under 35 U.S.C. § 103(a) based on Wirbeleit and Klügl. Pet. 24–52. Patent Owner opposes. PO Resp. 19–61.

1. Independent Claim 1

Below, we analyze Petitioner’s contentions as applied to the required elements of claim 1. Pet. 24–37.

a. [1-p] An injection valve for injecting fuel into a combustion chamber of an internal combustion engine

To the extent that the preamble is limiting, Petitioner argues that Wirbeleit teaches fuel injectors for “direct-injection Diesel engines.” Pet. 24 (citing Ex. 1004, 1:7–12, 1:30–37). Petitioner asserts that direct injection means injecting fuel directly into the combustion chamber. *Id.* at 24–25 (citing Ex. 1007, 2:7–10; Ex. 1008, 1:16–24; Ex. 1003 ¶¶ 141–148).

Patent Owner does not specifically address element [1-p]. *See generally* PO Resp.

Based on the complete record, we find that Petitioner has explained sufficiently with reference to Wirbeleit, how Wirbeleit discloses element [1-p]. For example, Wirbeleit teaches fuel injectors for “direct-injection Diesel engines.” Pet. 24 (citing Ex. 1004, 1:7–12, 1:30–37).

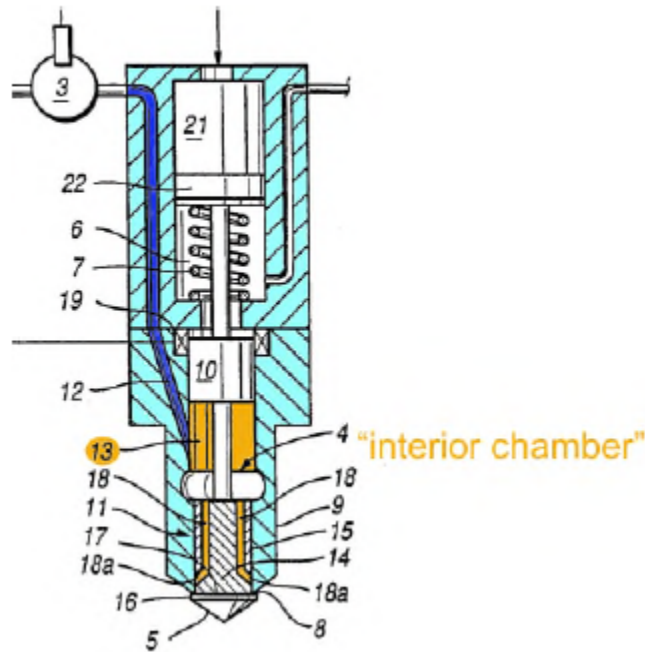
- b. [1(a)] valve housing, [1(a)-1] fuel inlet port, [1(a)-2] interior chamber fluidly connected to said fuel inlet port, and [1(a)-3] valve seat*

Claim 1 further recites that the injection valve includes:

[1(a)] (a) a valve housing comprising:
[1(a)-1] a fuel inlet port;
[1(a)-2] an interior chamber fluidly connected to said fuel inlet port; and
[1(a)-3] a valve seat for cooperating with a valve member to seal said interior chamber from said combustion chamber when said injection valve is closed[.]

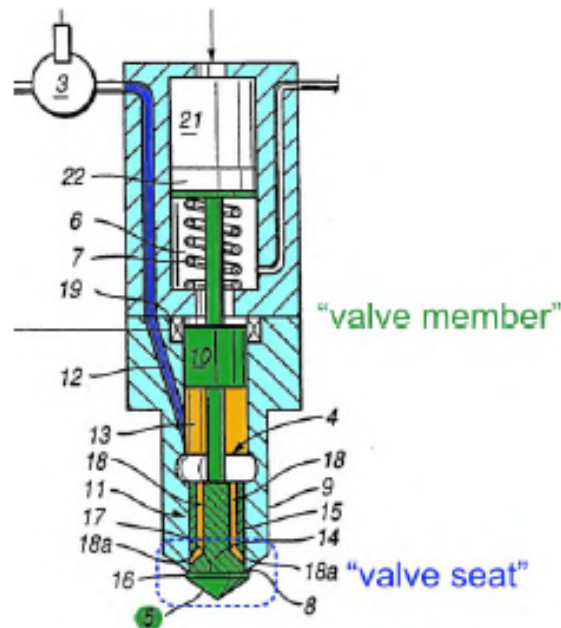
Ex. 1001, 17:18–26.

For these limitations, Petitioner contends that Wirbeleit's injector body 9 is a valve housing that includes a fuel admission passage 12 (e.g., fuel inlet port) that is in communication with supply conduit 3. Pet. 25–26. Petitioner provides an annotated version of Wirbeleit's figure, shown below:



Petitioner’s annotated version of Wirbeleit’s figure marks the “valve housing” 9 in teal and the “interior chamber” in orange. *See id.* at 25–27. Petitioner argues that the valve housing (body 9) includes a fuel inlet port (fuel admission passage 12, marked in blue) that is “in ‘communication with the common supply conduit 3’ to allow fuel to enter the injector.” *Id.* at 25 (citing Ex. 1004, 2:35–40). Petitioner further contends that Wirbeleit’s pressure chamber 13 is in communication with fuel admission passage 12, grooves 18, and orifices 18a. *Id.* at 26. Petitioner contends that these structures together teach an “interior chamber” (marked in orange) that is fluidly connected to the fuel inlet port (i.e., fuel admission passage 12).

With respect to limitation [1(a)-3], Petitioner provides another annotated version of Wirbeleit’s figure, reproduced below:



Petitioner's annotated version of Wirbeleit's figure marks the "valve member" in green and adds the phrase "valve seat" to designate a section in the figure that Petitioner purports teaches a "valve seat" within a dashed blue circle. Pet. 28. Referring to the annotated figure, Petitioner contends that Wirbeleit's injector orifice control needle 5 includes piston-like needle tip 11 with collar 16. *Id.* at 27 (citing Ex. 1004, 2:35–37). Petitioner asserts that rear side 17 of collar 16 forms a valve seating surface. *Id.* (citing Ex. 1004, 2:43–45). Petitioner explains that this structure is "forced onto the valve seat 8 on the injector body 9" to close the injector. *Id.* at 27 (citing Ex. 1004, Abstract, 1:48–52, 2:31–35).

Patent Owner does not specifically address elements [1(a)], [1(a)-1], [1(a)-2], and [1(a)-3]. *See generally* PO Resp.

Based on the complete record, we find that Petitioner has explained sufficiently with reference to Wirbeleit, how Wirbeleit discloses these claim limitations. *See* Pet. 25–28.

c. [1(b)] said valve member . . . comprises a sealing surface that fluidly seals against said valve seat when said injection valve is closed and that is liftable away from said valve seat when said injection valve is open

Claim 1, element [1(b)], further recites:

(b) said valve member having one end disposed within said valve housing and an opposite end extendable from said valve seat toward said combustion chamber, wherein said valve member comprises a sealing surface that fluidly seals against said valve seat when said injection valve is closed and that is liftable away from said valve seat when said injection valve is open[.]

Ex. 1001, 17:27–33.

For these limitations, Petitioner contends that Wirbeleit teaches needle 5 moves outward to open orifices for fuel injection. Pet. 28. Petitioner adds that needle 5 “can be ‘forced onto the valve seat 8 on the injector body 9’ to stop injection.” *Id.* (citing Ex. 1004, Abstract, 1:52–58, 2:31–35, 3:5–11). Petitioner adds that needle 5 can be extended from the valve seat toward the combustion chamber and can also fluidly seal against the valve seat to close the injector. *Id.*

Patent Owner does not specifically address element [1(b)]. *See generally* PO Resp.

Based on the complete record, we find that Petitioner has explained sufficiently with reference to Wirbeleit, how Wirbeleit discloses these limitations. *See* Pet. 28.

- d. [1(c)] a biasing mechanism associated with said valve member, said biasing mechanism applying a closing force to said valve member when said valve member is in said closed position*

Claim 1 further recites:

(c) a biasing mechanism associated with said valve member, said biasing mechanism applying a closing force to said valve member when said valve member is in said closed position[.]

Ex. 1001, 17:33–36.

For these limitations, Petitioner asserts that Wirbeleit’s injector includes a “return spring 7.” Pet. 29 (citing Ex. 1004, 2:35–36). According to Petitioner, the spring forces needle 5 onto valve seat 8 on injector body 9 to close the injector. *Id.* (citing Ex. 1004, Abstract, 2:31–36, 3:7–11).

Patent Owner does not specifically address element [1(c)]. *See generally* PO Resp.

Based on the complete record, we find that Petitioner has explained sufficiently with reference to Wirbeleit, how Wirbeleit discloses these limitations. Pet. 29.

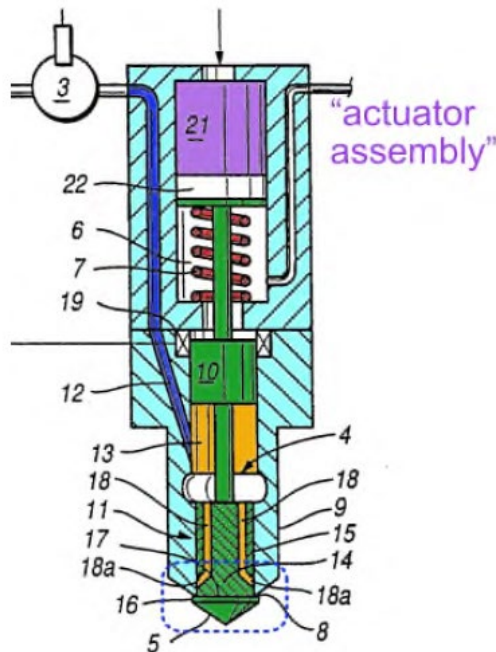
- e. [1(d)] an actuator assembly associated with said valve member, wherein said actuator assembly may be actuated to apply an opening force to said valve member stronger than said closing force, for moving said valve member to said open position*

Claim 1 further recites:

(d) an actuator assembly associated with said valve member, wherein said actuator assembly may be actuated to apply an opening force to said valve member stronger than said closing force, for moving said valve member to said open position[.]

Ex. 1001, 17:37–41.

For these limitations, Petitioner provides another annotated version of Wirbeleit's figure, reproduced below:



Petitioner's annotated version of Wirbeleit's figure marks, among other things, the "actuator assembly" in purple, valve member in green, interior chamber in yellow, and a biasing mechanism in red. Pet. 30–31. Referring to the annotated figure, Petitioner contends Wirbeleit's actuator assembly includes a magnetostrictive actuator 21 (or "piezo actuator") located at the rear end of the orifice control needle 5 opposite its tip 11. *Id.* at 30 (citing Ex. 1004, 2:60–65). Petitioner relies on Wirbeleit's teaching that "[o]pening of the slot-injection orifices can be controlled by energizing" the "actuator which acts on the injector needle ... against a compression spring with a

voltage-dependent force.” *Id.* (citing Ex. 1004, Abstract, 2:1–4, 1:50–52) (alteration in original).

Patent Owner does not specifically address element [1(b)]. *See generally* PO Resp.

Based on the complete record, we find that Petitioner has explained sufficiently with reference to Wirbeleit, how Wirbeleit discloses these elements. Pet. 30–31.

f. [1(e)] a hydraulic link assembly

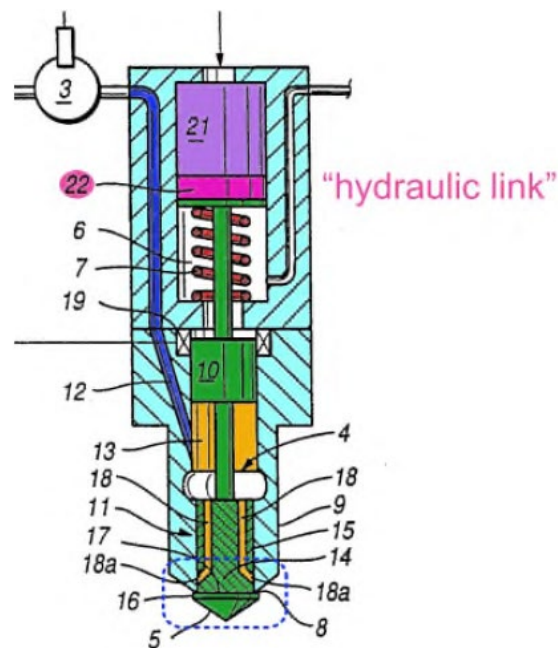
Claim 1 further recites:

[1(e)] (e) a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted, whereby said *hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated* and wherein said thickness of said hydraulic link is adjustable while said actuator assembly 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 (emphasis added).

i. Petitioner’s Contentions

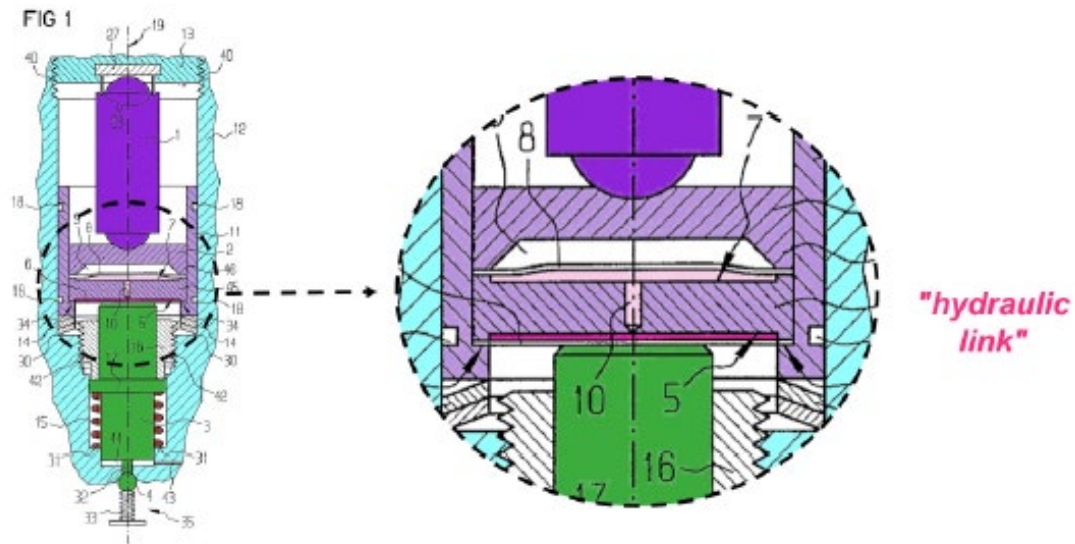
For these limitations, Petitioner asserts that Wirbeleit’s hydraulic transmission element 22 is sealed within its housing and is not connected to a separate fluid supply. Pet. 32 (citing Ex. 1004, Fig.). Petitioner provides an annotated version of Wirbeleit’s figure, shown below, in which the hydraulic transmission element 22 is marked in pink.



Petitioner's annotated figure provided on page 32 of the Petition marks Wirbeleit's hydraulic transmission element 22 in pink. Pet. 32.

Because Wirbeleit does not teach the specifics of element 22 in detail, Petitioner relies on Klügl for the remaining limitations recited in claim 1. *Id.* at 32; *see* Ex. 1004, 2:63–64. Petitioner contends that Klügl's transmission module 2 is located between the actuator and drive piston 3. Pet. 33 (citing Ex. 1006, 1:48–51, 2:23–41, Fig.). Petitioner asserts that transmission module 2 includes pressure chamber 5, compensating chamber 7, and throttle/connecting bore 10. *Id.* (citing Ex. 1006, 1:60–2:4, Fig. 1). Petitioner further argues that pressure chamber 5 and compensating chamber 7 are filled with incompressible hydraulic fluid. *Id.* (citing Ex. 1006, 1:60–2:4).

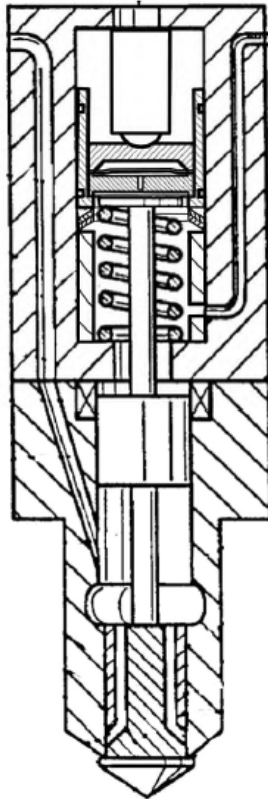
Below is an annotated version of Klügl's Figure 1 provided on page 34 of the Petition.



Petitioner's annotated Figure 1 from page 34 of the Petition marks the actuator assembly in dark and light purple. Pet. 34. In Petitioner's annotated figure, pressure chamber 5 is shown in dark pink while throttle 10 and compensation chamber 7 are shown in light pink. *Id.*

Petitioner argues that in "Figure 1, the dimensions of chamber 5—including its thickness—remain constant so that the movement of the actuator results in the same amount of movement of the piston." Pet. 34. (citing Ex. 1006, 3:23–29, Fig. 1; Ex. 1003 ¶¶ 207–215). According to Petitioner, "no stroke amplification occurs and chamber 5 does not change dimension. As a result, the hydraulic link simply transmits force rather than generating it and its 'thickness' is 'substantially constant.'" *Id.* at 36 (citing Ex. 1003 ¶¶ 218–222) (emphasis omitted).

Petitioner argues that in a different embodiment shown in Figure 3 of Wirbeleit, “the dimensions of chamber 5 change during actuation resulting in movement amplification from the actuator to the piston” because that embodiment operates “with stroke translation.” Pet. 34–35 (citing Ex. 1006, 1:41–46, 7:12–14; Ex. 1003 ¶¶ 208–215). For the asserted combination, Petitioner provides an example drawing that shows how the structures in Klügl apply to Wirbeleit. *Id.* at 37. The example drawing is reproduced below:

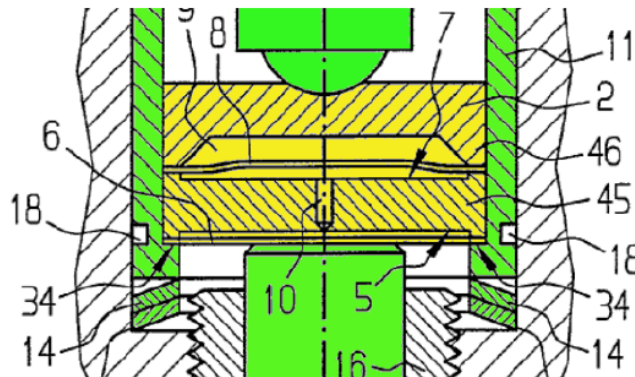


Id. Petitioner’s drawing purportedly shows “Wirbeleit’s hydraulic transmission element 22 replaced with Klügl’s transmission module.” *Id.* at 36–37 (citing Ex. 1003 ¶ 226).

ii. Patent Owner’s Contentions

Initially, Patent Owner contends that Petitioner’s translation of Klügl is incorrect. *See* PO Resp. 19, 26. Nonetheless, Patent Owner also addresses Klügl’s teachings as presented in Petitioner’s translation (Exhibit 1006), which we do as well for our discussion here.

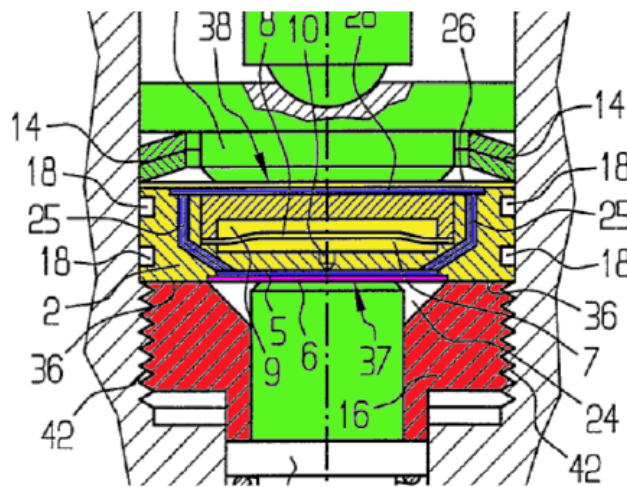
Turning to Klügl’s Figure 1 and Figure 3, and the related description of the figures, Patent Owner observes that there are several structural differences between Klügl’s two embodiments. PO Resp. 21 (“A comparison of the two figures demonstrates numerous differences in the arrangement of transmission module 2 within the embodiments, while the other surrounding elements remain relatively unchanged.”) (citing Ex. 2022 ¶¶ 72–73). For the embodiment shown in Klügl’s Figure 1, Patent Owner provides an annotated, enlarged version of the drawing, reproduced below:



Patent Owner’s annotated figure marks transmission module 2 in yellow, actuator 1 in green, guide sleeve 11 in green, spring 14 in green, and drive

piston 3 in green. *See id.* According to Patent Owner, “transmission module 2 will move up and down with guide sleeve 11. . . [and] [w]hen actuated, the transmission module and guide sleeve move downward towards the piston and compress the disk springs 14.” *Id.* (citing Ex. 2022 ¶¶ 63, 74).

With regard to the embodiment shown in Klügl’s Figure 3, Patent Owner provides an annotated version of that drawing, reproduced below:



Patent Owner’s annotated version of Figure 3 shows transmission module 2 in yellow, screw 42 in red, piston 3 in green, actuator 1 in green, and spring 14 in green. PO Resp. 22. According to Patent Owner, annotated Figure 3 shows transmission module 2 is fixed in place by screw 42. *Id.* (citing Ex. 1006, 4:52–55, 5:55–57; Ex. 2025, 75:3–11).

Patent Owner contends that 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.” PO Resp. 22 (citing Ex. 1006, 4:52–55) (emphasis omitted). Patent Owner argues that “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.* (citing Ex. 1006, 2:18–21). Patent Owner explains that 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.* at 22–23 (citing Ex. 1006, 7:24–31) (alterations in original).

Patent Owner contends that while Klügl uses the phrase “stroke translation” for Figures 1 and 3, “stroke translation” is not defined in Klügl. PO Resp. 20 (citing Ex. 1006, 1:39–46). Patent Owner adds that stroke translation 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.” *Id.* (citing Ex. 2022 ¶ 77).

Moreover, Patent Owner asserts that Dr. Quinlan could not explain the difference between “stroke translation,” “stroke ratio,” and “stroke amplification” during his cross-examination deposition even though Dr. Quinlan uses these terms in his declaration. PO Resp. 28 (citing Ex. 2025, 29:13–23, 40:5–41:2; Ex. 1003 ¶ 222). Patent Owner contends that Dr. Quinlan testified he didn’t “form[] a formal opinion on what the transmission module is in Figure 3 of Klügl.” *Id.* at 29 (citing Ex. 2025, 70:11–15) (alteration in original). Patent Owner further argues that “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.* (citing Ex. 2025, 34:3–12).

With regard to Klügl’s membrane 6, Patent Owner contends that “Dr. Quinlan was evasive when asked what ‘flexible’ and ‘membrane’ meant in the context of Klügl.” PO Resp. 32. Patent Owner asserts that

Dr. Quinlan had not formed a “formal opinion” about . . . [t]he 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)[.]

Id. Patent Owner contends that Dr. Quinlan could not or would not directly answer whether membrane 6 is flexible when actuated in Figure 1. *Id.* at 33 (citing Ex. 2025, 62:25–66:18 (“A. I -- I haven’t formed a complete opinion on how 6 specifically is flexible or is not flexible.”))).

According to Patent Owner, Klügl teaches that membrane 6 is flexible and deforms outwardly and inwardly during operation. PO Resp. 34. Because of this, Patent Owner contends that “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.” *Id.* at 40 (emphasis omitted).

iii. Discussion

Based on the complete record, we agree with Patent Owner. We start with Klügl’s Figure 1, reproduced below.

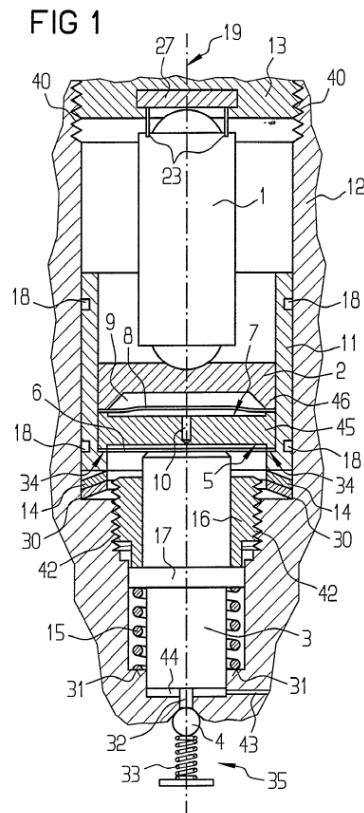


Figure 1 of Klügl depicts an injection valve including housing 12 and piezoelectric actuator 1, which is arranged between upper stop 13 and transmission module 2. Ex. 1006, 1:47–51. We observe that transmission module 2 includes pressure chamber 5 that is at least partially filled with hydraulic fluid and is “delimited” by first membrane 6. *Id.* at 1:60–62, 1:68–2:2. Throttle or connecting bore 10 connects pressure chamber 5 to compensation chamber 7. *Id.* at 1:62–66. The connecting bore or throttle allows transmission fluid to flow between pressure chamber 5 and compensation chamber 7. *Id.* at 3:56–4:10.

We further note that Klügl expressly teaches first membrane 6 is “flexible.” Ex. 1006, 7:45–47 (“[F]lexible membranes 6, 8, 26 . . . have a

progressive characteristic curve of the spring force in relation to the spring deflection.”). Indeed, consistent with this flexibility, Klügl explains that membrane 6 “moves” to maintain contact with drive piston 3. Specifically, Klügl teaches:

[i]f the piezoelectric actuator 1 shortens in the *rest position* without being actuated due to thermal influences or signs of aging in relation to the housing 12, *the spring plate 8 pushes the transmission medium from the compensation chamber 7 via the throttle 10 into the pressure chamber 5, so that the first membrane 6 is moved in the direction of the drive piston 3* and, as a result, the drive piston 3 bears against the first membrane 6 despite the shortening of the piezoelectric actuator 1.

However, if the distance between the piezoelectric actuator 1 and the drive piston 3 is reduced, *the first membrane 6 is pushed in by the drive piston 3 so that the transmission medium is pressed through the throttle 10 into the compensation chamber 7 against the spring force of the spring plate 8*. As a result, the drive piston 3 is always in contact with the first membrane 6 in this case as well.

Id. at 3:63–4:10 (emphases added).

Consistent with this disclosure, Patent Owner’s expert, Dr. Atkinson, explains that “[i]n all embodiments shown, Klügl only ever specifies and describes membrane 6 as a “flexible” membrane or element acknowledging that this flexibility is a necessary and desired feature of its intended purpose and behavior.” Ex. 2022 ¶ 80. Dr. Atkinson further opines that in operation, drive piston 3 exerts an opposite, upward force on flexible membrane 6. *Id.*

¶ 79. Dr. Atkinson testifies that

[d]ue to the inherent flexibility and pliability of flexible membrane 6, the membrane will tend to deform longitudinally upward where it contacts the drive piston and bulge outward . . .

between the edge of the drive piston 3 and the wall of transmission module 2 and guide sleeve 11 in order to accommodate the volume of the transmission fluid contained therein and the pressure differences created within the transmission fluid.

Id.

In this way, we observe that Klügl better supports Patent Owner's position that the shape and thickness of chamber 5 may change during operation because member 6 may deflect during operation. Klügl expressly teaches membrane 6 is "flexible," and *moves* or can be *pushed in* by contact with the drive piston or by way of fluid flow into or out of pressure chamber 5. Ex. 1006, 3:63–4:10, 7:45–46, 8:46.

In its Reply, Petitioner contends "the mere fact that Klügl sometimes labels its 'membrane 6' as 'flexible' does not end the analysis." Pet. Reply 6. Petitioner asserts "in the injector of Figure 1, membrane 6 does not *substantially flex* during actuation" and "[i]nsubstantial, meaningless changes in link thickness do not matter." *Id.* at 6, 10. Petitioner further argues that Patent Owner does not quantify how much the membrane flexes when Klügl's injector is actuated. *Id.* at 10. Petitioner adds that Dr. Quinlan testified at his deposition that "a POSITA would readily be able to design Klügl's injector such that any flexing of membrane 6 is immaterial during actuation." *Id.* (citing Ex. 2025, 63:21–64:10).

We do not agree with Petitioner on these points. Petitioner characterizes Klügl's changes in thickness as "insubstantial" or "meaningless" without citation to the record or explanation. Pet. Reply 10. Petitioner also argues that Patent Owner has not shown substantial flexing

by Klügl's membrane 6. Yet, Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Here, it is Petitioner who must adequately address the structural components of transmission module 2 in Klügl's Figure 1, because Petitioner has asserted that transmission module 2 teaches or suggests the "hydraulic link assembly" recited in limitation [1-e] of independent claim 1.

Based on the complete record, Patent Owner has shown more than the "mere fact" that Klügl labels the membrane as "flexible." As discussed, Patent Owner explains Klügl teaches membrane 6 is flexible and that membrane 6 deflects and moves in response to fluid pressure in chamber 5 and contact with piston 3. PO Resp. 34 (citing Ex. 1006, 3:63–4:10). Additionally, Dr. Atkinson's testimony is consistent with Klügl's disclosure. Dr. Atkinson, explains that "[i]n all embodiments shown, Klügl only ever specifies and describes membrane 6 as a "flexible" membrane or element acknowledging that this flexibility is a necessary and desired feature of its intended purpose and behavior." Ex. 2022 ¶ 80. With this underlying disclosure in mind, Dr. Atkinson further reasons that a flexible membrane will tend to deform longitudinally upward where it contacts the drive piston and bulge outward based on the structure disclosed in Figure 1. *See id.* ¶¶ 63, 66–67, 77–81, 87.

In contrast, Dr. Quinlan's testimony in many instances, including this one, is substantively incomplete and fraught with contradictions that undermine the weight of his testimony. For example, at his cross-

examination deposition, he testified that he had seen and worked with membranes, but could not provide his opinion on the meaning of “flexible” or “membrane” as disclosed in Klügl. *See* Ex. 2025, 47:14–48:1.

Dr. Quinlan was then directed to column 8 in Klügl, where Klügl teaches among other things that “the transmission module (2) has a pressure chamber (5), which is filled with a transmission medium and is delimited by a first *flexible* membrane (6).” *See id.* at 65:5–15; Ex. 1006, 8:44–46 (emphasis added). Provided below is the exchange between Patent Owner’s counsel and Dr. Quinlan regarding this express disclosure:

Q. You would agree with me that multiple times in the Klugl reference, item number 6 is defined as a flexible membrane or flexible element, correct? . . .

Q. (BY MR. PHILBIN) Specifically, if you look at column seven, line 69, column eight, line 46, column seven, line 45 --

A. Let’s take the first one of those. Which line would you like me to look at?

Q. Sir, it’s throughout column seven, eight, and nine --

A. Okay. Well, you just gave me a specific reference. Can you give me the first one, please?

Q. Yeah. Sure. Column eight, line 46. First flexible membrane 6. Do you see that?

A. Okay. I see where --

Q. So my question -- my question, sir: In your opinion, is item 6 in Figure 1 of Klugl flexible or not? . . .

A. The device that Klugl teaches in Figure 1 is intended to have the same stroke, length from the bottom of the actuator as the same distance that component number three would change -- would move axially. Does that mean that it’s flexible or not? And

when it's not operating, whether that's considered flexible or not? Then we have to talk about a specific time and when we're looking at this thing, it's –

Q. (BY MR. PHILBIN) So -- so it's your opinion that Figure 3 of Klugl discloses a flexible item number 6 and you can't determine whether item number 6 in Figure 1 is flexible or not. Is that correct? . . .

A. So, figure -- in Figure No. 1, the flexibility of 6 would be dependent on how the design was used, right? I mean, there – there's two different functions here. One is during actuation and one is in the hydraulic link's ability to make up for things like wear and thermal expansion.

Q. (BY MR. PHILBIN) Is that your complete opinion on flexibility of item number 6 in Figures 1 and 3? . . .

A. *I -- I haven't formed a complete opinion on how 6 specifically is flexible or is not flexible.*

Ex. 2025, 65:1–66:18 (emphases added). Notably, Dr. Quinlan did not, or could not, provide his *complete* opinion as to whether membrane 6 is flexible at his deposition. In fact, Dr. Quinlan later conceded at his deposition that he had not “*done the design process to go through and decide what [membrane] 6 is made out of and what its material is[.]*” *Id.* at 66:17–18, 140:23–25 (emphases added).

Consistent with his cross-examination testimony, Dr. Quinlan's testimony in his first declaration (Exhibit 1003) is also incomplete on this issue. There, Dr. Quinlan testifies that “the hydraulic fluid in chamber 5 will not flow, will maintain substantially the same thickness, and will act substantially as a solid during actuation. The fluid is unable to leave chamber 5 during actuation (it cannot flow through throttle 10 and *is held in*

place by a membrane 6).” Ex. 1003 ¶ 212 (emphasis added). Similarly, Dr. Quinlan testifies that

[a]s the fluid in chamber 5 is held in place by a *membrane 6* and moves through a cylindrical space of constant width and unchanging shape, the thickness of the fluid in chamber 5 will remain constant throughout actuation.

Id. ¶ 208. Nonetheless, in his first declaration, Dr. Quinlan did not address how the flexible nature of member 6 applies or affects the shape and thickness of fluid in chamber 5. Ex. 2025, 66:17–18, 140:23–25.

His Reply Declaration (Exhibit 1040) does not fare much better. There, Dr. Quinlan testifies Klügl teaches that “fluid flows, pressure increases occur, membranes deflect, and a stroke ratio is applied to piston movement” for the injector of Figure 3. Ex. 1040 ¶ 16. Dr. Quinlan maintains that

[w]hen describing the operation of the injector shown in Figure 1, however, there is no mention in Klügl of fluid flow, pressure increases, membrane deflection, or application of a stroke ratio. *A POSITA would understand that these omissions are purposeful: no fluid flow, pressure increases, membrane deflection, or stroke ratio application occurs in connection with Figure 1’s injector.*

Id. ¶¶ 17–18 (emphases added). Dr. Quinlan’s testimony, however, is contradicted by Klügl’s express disclosure. Klügl teaches that membrane 6, in the injector shown in Figure 1, is flexible and can structurally deflect, and in fact does so at least in the rest position. Ex. 1006, 3:63–4:10. Further, Klügl also teaches that there is fluid flow and pressure increases during actuation. That may be “little” such that the activation of the piston is not impaired, but Klügl nevertheless teaches that fluid flow can and does occur

between compensation chamber 7 and chamber 5 via throttle 10. *See id.* at 4:11–36. Klügl further contemplates that

if there are long-lasting pressure differences between the pressure chamber 5 and the compensation chamber 7 lasting from one second to minutes, *the transmission medium is exchanged between the compensation chamber 7 and the pressure chamber 5 via the throttle 10.* This is especially the case in terms of thermal expansion differences and gradual wear.

Id. at 4:25–31 (emphases added).

Dr. Quinlan further admits that “[a] POSITA would have understood that whether membrane 6 *meaningfully* flexes during injector actuation will depend on a variety of factors.” Ex. 1040 ¶ 31 (emphasis added). Although Dr. Quinlan does not explain what meaningful flexing entails, he does opine that the “various factors” include “the inherent flexibility of the material the membrane is made from, the membrane’s thickness, how the edges of the membrane are supported, the fluid pressure in the chamber 5, and the size of the membrane/piston interface.” *Id.* ¶ 32. Dr. Quinlan does not address any of these various factors in detail for membrane 6, shown in Figure 1 of Klügl. *See generally id.* Instead, Dr. Quinlan asserts that

a POSITA would have understood that *flexing during actuation can be avoided simply by choosing the correct (less flexible) membrane material and dimensioning it appropriately.* This would entail, for instance, simply making the membrane thicker and increasing the membrane/piston interface.

Id. ¶ 33 (emphases added). In short, Dr. Quinlan opines that a POSITA could modify the “flexible” membrane to be less flexible or to avoid flexing altogether. However, Klügl expressly teaches that membrane 6 is *flexible*, and Dr. Quinlan’s testimony in this regard contradicts the express teachings

in the reference regarding that flexibility. As such, we are not persuaded by Petitioner or Dr. Quinlan that we can disregard the expressly taught flexibility of Klügl's membrane 6 and assume that the membrane does not flex "meaningfully" or that the shape, thickness, or width of chamber 5 (e.g., hydraulic fluid in chamber 5) does not change when the membrane flexes in operation. More importantly, based on the entire record, we do not find that Petitioner has adequately explained why a POSITA would understand Klügl "hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated" when membrane 6 is taught to be flexible.

Additionally, we are not persuaded by Petitioner's asserted distinction between "without stroke translation" and "with stroke translation." In its Reply, Petitioner argues that

[w]hen Klügl's teachings are considered in their entirety, it is apparent that in the injector of Figure 1, membrane 6 does not *substantially* flex during actuation. It follows that Klügl's "hydraulic link" maintains a substantially constant thickness as the claims here require.

Pet. Reply 6 (emphasis added). Petitioner maintains that Figure 1's injector operates "without stroke translation," which Petitioner contends means that the movement of the actuator results in the same amount of movement of the piston *without amplification*. *Id.* at 6 (citing Ex. 1006, 1:41–42 (emphasis added)). Petitioner further argues that

in Figure 1, when "the piezoelectric actuator 1" is actuated it "presses the entire transmission module 2 ... in the direction of the drive piston 3, so that pressure is exerted on the drive piston 3 via the first membrane 6 and the transmission medium located

in the pressure chamber 5....” Wirbeleit, 3:23–28. This in turn “moves the drive piston 3” to open the valve. *Id.*, 3:30–32. *Klügl also explains that “transmission medium” does not “flow” during this process to avoid “impair[ing]” “activation of the drive piston.” Id.*, 4:11–15.

Id. at 6–7 (emphases added, alterations in original). Petitioner contends that “the actuator actuates, the transmission module moves, the fluid in the transmission module does not flow, and the piston is pushed by the transmission module such that it moves by the same amount as the actuator. There is no ‘stroke translation.’” *Id.* at 7.

Petitioner contrasts the operation of “without stroke translation” in Figure 1 with Klügl Figure 3’s injector that operates “*with stroke translation.*” Pet. Reply 7–8. For Figure 3, Petitioner argues that

[d]uring actuation, when “third membrane 26” is “pushed downwards by the die 29,” the “transmission medium located in the second pressure chamber 28” is “pushed into the pressure chamber 5 via the line 25” causing “brief pressure increases” in the chamber 5 that in turn cause the “first membrane 6” to “deflect[] ... in the direction of the drive piston 3” to move the piston to open the valve. *Id.*, 5:28-6:6. Then, because “die 29” and “piston 3” are different sizes—and because “membrane 6” and “third membrane 26” are also “different[ly] sized surfaces”—this embodiment “achieve[s] a stroke ratio between the deflection of the piezoelectric actuator 1 and the deflection of the drive piston 3.” *Id.*, 7:9-20.

Id. (emphases added, alterations in original). Petitioner asserts that “fluid flows, pressure increases, and a stroke ratio is applied to piston movement.” *Id.* at 8.

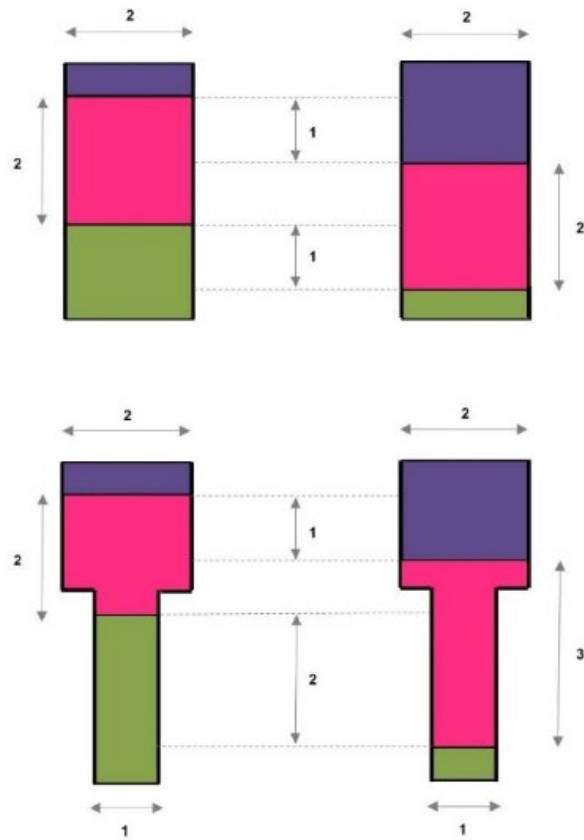
We observe, again, that Klügl teaches there may be “little” fluid flow in transmission module 2 such that the activation of the piston is not

impaired, but Klügl nevertheless teaches that fluid flow can and does occur between compensation chamber 7 and chamber 5 via throttle 10. *See* Ex. 1006, 4:11–36. While there are differences between the embodiments shown in Figures 1 and 3 of Klügl, we are not persuaded by Petitioner that the labels of “without stroke translation” versus “with stroke translation” mean that there is no fluid flow or pressure differences in the embodiment of Figure 1. *See* Pet. Reply 7–8; *see also* Ex. 1003 ¶¶ 212–216. Klügl’s disclosure expressly provides that fluid flow and pressure differences occur for the embodiment of Figure 1 during operation. *See* Ex. 1006, 4:25–31.

Dr. Quinlan’s testimony is unhelpful in this regard. In paragraphs 212–216 of Dr. Quinlan’s first declaration, his testimony relies on the same disclosure discussed above that there is no fluid flow or pressure differences in the embodiment of Figure 1 of Klügl. *See* Ex. 1003 ¶¶ 212–216. However, as discussed, Klügl teaches otherwise. Ex. 1006, 4:25–31.

Moreover, Dr. Quinlan’s testimony on this issue is undermined generally by an incomplete or contradictory analysis on substantive and technical issues. For example, in paragraph 210, Dr. Quinlan testifies that Klügl contrasts the embodiment of 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.” Ex. 1003 ¶ 210 (citing Ex. 1006, 1:41–46; 7:12–13).

Additionally, Dr. Quinlan provides a demonstrative in declaration, provided below:



Dr. Quinlan testifies that the top figures represent Klügl's injector from Figure 1, and the bottom figures represent Klügl's injector from Figure 3. *Id.* ¶ 212. In the figure above, Dr. Quinlan indicates the actuator is shown in purple, the intermediate hydraulic fluid is in pink, and the control piston (which pushes on the needle) is shown in green. *Id.* Referring to the figure above, Dr. Quinlan testifies that

when the actuator in the bottom set of figures expands, the hydraulic fluid is pushed from a cylinder of larger diameter into a cylinder of smaller diameter. While the volume of the fluid stays constant (as it is incompressible), its thickness changes (as it is now contained in a differently shaped space). This causes the needle to be moved by a distance greater than the expansion of

the actuator. Again, *this is representative of Klügl's Figure 3 and is what Klügl means when it refers to a "stroke ratio" or "stroke translation."* In the bottom figure here the actuator to control piston stroke ratio is 1:2.

Id. ¶ 215 (emphases added). In Dr. Quinlan's second declaration (Exhibit 1040), he also uses the terms "stroke ratio" and "stroke translation." For example, he opines that "Klügl—when considered in its entirety—clearly teaches that Figure 3 operates to apply a 'stroke ratio' (i.e., the piston moves by a different amount than the actuator) while Figure 1 does not apply a 'stroke ratio.'" Ex. 1040 ¶ 22.

While Dr. Quinlan uses the terms "stroke ratio" and "stroke translation" in his declarations, Dr. Quinlan could not clearly articulate whether these terms mean the same or different things during cross-examination. For example, an exchange in his cross-examination deposition is provided below:

Q. (BY MR. PHILBIN) So is it your testimony that despite relying on the Klügl reference in every one of your opinions in this case, you don't know whether there's any difference between the term stroke translation, stroke transmission, and stroke ratio as those terms are used in the Klügl reference?

A. Again, we can talk about what each word means in a specific light, but I think what that -- taking Klügl as a whole, what we see is that there are different ways of -- for example, treating that stroke ratio and whether or not that's one or no[t] one, and the specific words as they got translated from German aren't necessarily, you know, the whole thing. We're taking the whole document, the embodiments that they teach, and using that to see what a POSITA would understand.

Ex. 2025, 28:22–29:12. Later, when asked once more whether “stroke translation” and “stroke ratio” mean the same thing as used in his declaration, Dr. Quinlan stated:

A. So, again, I don’t know if they mean the same exact thing, but they’re referring to the same function and that’s why we have said -- *I have said that we’re saying that stroke translation is the same as maybe applying a stroke ratio. So, you know, can you say those things are the same? I’m not sure*, but it surely is talking about the same function whether or not the one side of the hydraulic link and the other side of the hydraulic link are traveling the same displacement.

Id. at 31:8–16 (emphases added).

In other parts of his declaration, Dr. Quinlan uses the term “amplification.” In paragraph 208, Dr. Quinlan opines that

[i]n the embodiment shown in Klügl’s Figure 1, *the movement of the actuator results in the same amount of movement of the piston without amplification*. In other words, there is no change in the “stroke translation.” ([Ex. 1006], Fig. 1; 1:41-42, 3:23-29.) As the fluid in chamber 5 is held in place by a membrane 6 and moves through a cylindrical space of constant width and unchanging shape, the thickness of the fluid in chamber 5 will remain constant throughout actuation.

Ex. 1003 ¶ 208 (emphases added). Similarly, in paragraph 220, Dr. Quinlan testifies that

[i]n Klügl, as in Wirbeleit, force from an actuator passes through the hydraulic fluid in chamber 5 to the piston 3 for purposes of opening a valve during actuation. As I have explained, in Figure 1, the fluid in the chamber 5 simply transmits the actuator force. *It does not generate force or engage in amplification*.

Id. ¶ 220 (emphases added).

Despite his declaration testimony, Dr. Quinlan could not explain the meaning of “amplification” or “without amplification” at his cross-examination:

Q. (BY MR. PHILBIN) My question was about stroke amplification. Does stroke amplification occur in Figure 1 of Klugl?

A. So, again, I haven’t done any definition of, you know, any deep dive in thinking about the specific term, stroke amplification, so I can’t offer an opinion about that, but I do understand how the -- the injector – the components shown in Figure 1 of Klugl function.

Q. Do you have an understanding of what the word amplification means in the context of Klugl? . . .

A. *Seeing as how I don’t see it in the document, I would not be able to form an opinion about it in that light.*

Q. (BY MR. PHILBIN) Do you have an opinion as to what without amplification means in the context of Klugl?

MR. HERMAN: Objection, form.

A. *Seeing as how I haven’t had time to think about what amplification means in that light, I would say that I can’t form an opinion on that.*

Ex. 2025, 39:16–40:11 (emphases added). Similarly, Dr. Quinlan reiterated in another exchange that he did not have an opinion on what “amplification” means:

Q. (BY MR. PHILBIN) What does amplification mean in the context of the Klugl reference? . . .

A. I haven’t studied that one specific word in terms of this -- in terms of that, so I can’t offer a formal opinion on what that one word means.

Q. (BY MR. PHILBIN) Okay. What does amplification mean to you?

A. Again, I haven't taken the time to do a formal analysis on what amplification means.

Id. at 34:3–12.

It is clear from Dr. Quinlan's deposition testimony that he did not do a "formal analysis" on what amplification means and had no "formal" opinion on what "without amplification" means in the context of Klügl. This contradicts his testimony in his declaration that "[i]n the embodiment shown in Klügl's Figure 1, *the movement of the actuator results in the same amount of movement of the piston without amplification.*" Ex. 1003 ¶ 208 (emphasis added). As a whole, these admissions in cross-examination contradict and undercut his testimony presented in his declarations, and generally entitle his testimony to little or no weight on this issue.

It bears mentioning that limitation [1-e] requires that the recited hydraulic link assembly have a hydraulic fluid thickness that acts "*substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated.*" Ex. 1001, 17:42–47 (emphasis added). Neither limitation [1-e] nor claim 1 as whole recites "stroke translation," "stroke ratio," or "amplification." *Id.* As such, the express language of claim 1 does not equate or relate the hydraulic fluid's thickness to a particular type of stroke, stroke translation, stroke amplification, or stroke ratio. Thus, even if we agreed with Dr. Quinlan and Petitioner that the embodiments of Klügl employ specific types of stroke translation, that alone is not dispositive. As discussed above, Dr. Quinlan and Petitioner also

fail to persuasively account for the entire structure of Klügl’s transmission module 2, e.g., membrane 6, and how that structure functions with a flexible membrane. *See, e.g.*, Ex. 2025, 66:17–18 (Dr. Quinlan testifying that he has not “formed a complete opinion on how [membrane] 6 specifically is flexible or is not flexible.”).

For this challenge, Petitioner must show that the asserted combination of Wirbeleit and Klügl teaches or suggests each and every limitation of the claim, including a hydraulic fluid thickness that acts “*substantially as a solid with said thickness being substantially constant while said actuator assembly is actuated.*” For reasons discussed, Petitioner has not done so.

g. Conclusion

Based on the complete record, Petitioner has not demonstrated by a preponderance of the evidence that the proposed combination of Wirbeleit and Klügl renders claim 1 of the ’138 patent unpatentable.

2. Independent Claim 41 and Dependent Claims 2, 3, 6, 13, 14, 17–21, 26, and 27

Petitioner’s obviousness contentions for independent claim 41 rely on the same deficient analysis discussed with respect to claim 1. Pet. 45–46. Thus, we determine that Petitioner has not demonstrated by a preponderance of the evidence that the proposed combination of Wirbeleit and Klügl renders claim 41 of the ’138 patent unpatentable.

Petitioner’s analysis for dependent claims 2, 3, 6, 13, 14, 17–21, 26, and 27 also rely on the same deficient analysis. Pet. 37–52. Thus, we determine that Petitioner has not demonstrated by a preponderance of the

evidence that the proposed combination of Wirbeleit and Klügl renders claims 2, 3, 6, 13, 14, 17–21, 26, and 27 unpatentable.

F. Asserted Obviousness Based on Wirbeleit, Klügl, and Newcomb

Petitioner asserts that claim 28 would have been obvious under 35 U.S.C. § 103(a) based on Wirbeleit, Klügl, and Newcomb. Pet. 52–55.

Claim 28 depends from claim 1. Petitioner’s contentions regarding claim 28 rely on the same deficient analysis. Pet. 52–55. Thus, we determine that Petitioner has not demonstrated by a preponderance of the evidence that the proposed combination of Wirbeleit, Klügl, and Newcomb renders claim 28 of the ’138 patent unpatentable.

G. Asserted Obviousness Based on Klügl and Hayes

Petitioner asserts that claims 1–3, 6, 13, 14, 17–21, 26, 27, and 41 would have been obvious under 35 U.S.C. § 103(a) based on Klügl and Hayes. Pet. 55–74. Patent Owner opposes.

Petitioner’s analysis for these claims rely on the same deficient analysis regarding Klügl. Pet. 55–74. Thus, we determine that Petitioner has not demonstrated by a preponderance of the evidence that the purposed combination of Klügl and Hayes renders claims 1–3, 6, 13, 14, 17–21, 26, 27, and 41 unpatentable.

H. Asserted Obviousness Based on Klügl, Hayes, and Newcomb

Petitioner asserts that claim 28 would have been obvious under 35 U.S.C. § 103(a) based on Klügl, Hayes, and Newcomb. Pet. 74.

Petitioner’s contentions regarding claim 28 rely on the same deficient analysis discussed above. Pet. 74. We determine that Petitioner has not

demonstrated by a preponderance of the evidence that the purported combination of Klügl, Hayes, and Newcomb renders claim 28 unpatentable.

IV. PATENT OWNER’S MOTION TO EXCLUDE

Patent Owner filed a motion to exclude Exhibits 1006, 1025, 1029, 1031, 1033, 1035, and 1037, along with any testimony or argument relying on any of these exhibits. PO Mot. 1.

The party moving to exclude evidence bears the burden of proving that it is entitled to the relief requested—namely, that the material sought to be excluded is inadmissible under the Federal Rules of Evidence (“FRE”). *See* 37 C.F.R. §§ 42.20(c), 42.62(a).

A. Exhibit 1006

Exhibit 1006 is an English translation of Klügl, which is a German reference (Exhibit 1005). With the Petition, Petitioner filed Exhibit 1006 with a certified translation of the German language version of Klügl and an accompanying translator’s declaration. Pet. Opp. 4; Ex. 1006.

Patent Owner contends that Exhibit 1006 is “Petitioner’s fatally flawed” and “unreliable” English translation. PO Mot. 2. Patent Owner contends further that the term “Hubübersetzung” is mis-translated in Petitioner’s version. *Id.* Patent Owner relies on the testimony of its declarant, Ms. Heike Holthaus, who testifies that

the word “Hubübersetzung” in Exhibit 1005 should be translated the same all four places in which it appears. There is no context which gives “Hubübersetzung” a different meaning between its use in column 1 and column 7. Accordingly, it was a translation error for it to have been translated differently in Exhibit 1006.

Ex. 2026 ¶ 7. Patent Owner argues that Petitioner’s attempts “to serve the Board ‘word soup’ should be rejected and their fatally flawed translation excluded as unreliable.” PO Mot. 6.

We note that Patent Owner has not provided an alternative translation of Klügl, nor has Patent Owner deposed Petitioner’s translator regarding the *certified* English translation provided by Petitioner in Exhibit 1006. At best, we have nothing more than a difference of opinion between two translators as to the more accurate way to translate certain terms in Klügl. We do not agree with Patent Owner that there is enough evidence in the record to show that the *certified* translation is unreliable with no probative value. *See* PO Mot. 6. As discussed in detail above, the parties have both reviewed and provided arguments based on the only fully certified translation of Klügl, Exhibit 1006, available in this record. And, based on the same translation, we have provided our detailed analysis for this Decision, including our review of Klügl’s entire disclosure, the experts’ understanding and opinions based on that entire disclosure, and the parties’ arguments premised on the same.

The Board acts as both the gatekeeper and the weigher of evidence and is well positioned to determine and assign the appropriate weight to evidence, including by giving it little-to-no weight. *Cf. Donnelly Garment Co. v. NLRB*, 123 F.2d 215, 224 (8th Cir. 1941) (“One who is capable of ruling accurately upon the admissibility of evidence is equally capable of sifting it accurately after it has been received.”). Rather than excluding evidence that is allegedly confusing, misleading, unsupported, and/or irrelevant, we instead give it little or no probative weight, as appropriate. To

the extent that there is any confusion or disagreement between the parties as to Klügl's disclosure, we have addressed those issues as needed and where needed for the purposes of this Decision.

Patent Owner's motion to exclude Exhibit 1006 is denied.

B. Exhibits 1025, 1029, 1031, 1033, 1035 and 1037

Exhibit 1025 is a copy of a discussion from a message board discussing interpretations of the German word "Übertragung." Ex. 1025. Patent Owner contends that Exhibits 1029, 1031, 1033, 1035 and 1037 are German references for which Petitioner has not submitted any required translation. PO Mot. 9–11.

We note that these exhibits were submitted by Petitioner to contest Patent Owner's position that Petitioner's proffered translation of Klügl was inaccurate or subject to exclusion. *See, e.g.*, Ex. 1026, 17:4–30:15. We have not, however, excluded Exhibit 1006. Moreover, we have considered Petitioner's translation of Klügl as discussed in detail above.

Regarding these exhibits, we deny Patent Owner's motion to exclude as moot, as we do not rely on these exhibits in our Decision.

V. CONCLUSION

Having reviewed the arguments and the supporting evidence, we determine that Petitioner has not shown, by a preponderance of the evidence, that claims 1–3, 6, 13, 14, 17–21, 26–28, and 41 of the '138 patent are unpatentable.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–3, 6, 13, 14, 17–21, 26, 27, 41	103(a)	Wirbeleit, Klügl		1–3, 6, 13, 14, 17–21, 26, 27, 41
28	103(a)	Wirbeleit, Klügl, Newcomb		28
1–3, 6, 13, 14, 17–21, 26, 27, 41	103(a)	Klügl, Hayes		1–3, 6, 13, 14, 17–21, 26, 27, 41
28	103(a)	Klügl, Hayes, Newcomb		28
Overall Outcome				1–3, 6, 13, 14, 17–21, 26–28, 41

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–3, 6, 13, 14, 17–21, 26–28, 41 of the '138 patent have not been shown to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is denied; and

FURTHER ORDERED that because this Decision is final, a party to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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