Robert Bosch LLC and Mercedes-Benz USA, LLC,

v.

Westport Fuel Systems Canada Inc.,

Patent Owner's Demonstratives

IPR2023-00292 (Patent 6,298,829 B1)
IPR2023-00293 (Patent 6,575,138 B1)

November 14, 2024

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

CITATIONS AND COLOR CODING EXPLANATIONS

1. Gray Outline	Cited References
2. Blue Text/Outline	Patent Owner's Papers and Expert Materials
3. Red Text/Outline	Petitioners' Papers and Expert Materials

Citation	Refers To
292 Ex. XXXX	Exhibit from IPR2023-00292
293 Ex. XXXX	Exhibit from IPR2023-00293
Ex. XXXX	All Exhibits that do not indicate 292 or 293 are identical between IPR2023-00292 and IPR2023-00293

*Objections are omitted from all deposition quotes

Roadmap

1. Brief Overview
2. Petitioners' Translation of Klügl Should be Excluded
3. Klügl's Teachings
4. Klügl Does Not Teach the Claimed Passive Hydraulic Link
5. Grounds 1 and 2 (Wirbeleit + Klügl)
    - Does Not Disclose Other Claimed Limitations
    - No Motivation to Combine for Wirbeleit + Klügl (Ground 1) or for Wirbeleit + Klügl + Newcomb (Ground 3)
6. Grounds 3 and 4 (Klügl + Hayes)
    - Does Not Disclose Other Claimed Limitations
    - No Motivation to Combine for Klügl + Hayes (Ground 2) or for Klügl + Hayes + Newcomb (Ground 4)
7. Claim 41 of the '138 Patent Would Not Have Been Obvious
8. Dependent Claims Would Not Have Been Obvious

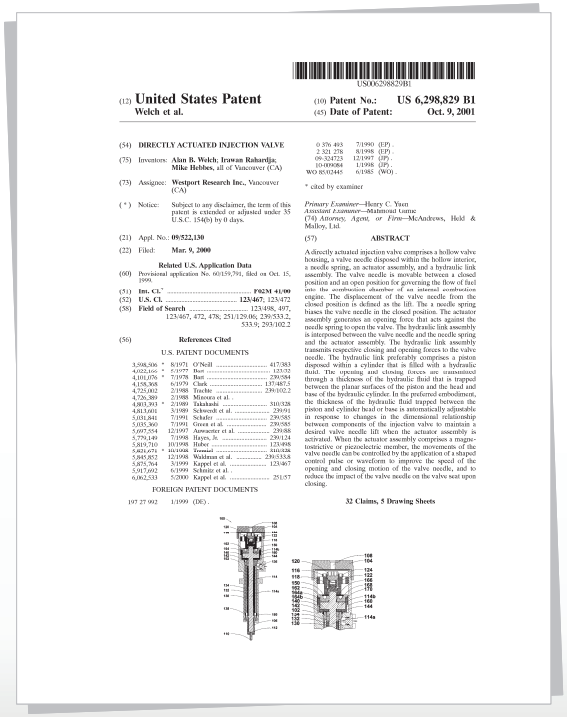
1. Brief Overview

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Westport's Challenged Patents

U.S. Patent No. 6,298,829
292 Ex. 1001



US006298829B1

(12) **United States Patent**
Welch et al.

(10) **Patent No.: US 6,298,829 B1**
(45) **Date of Patent: Oct. 9, 2001**

(54) **DIRECTLY ACTUATED INJECTION VALVE**

(75) Inventors: **Alan B. Welch**; **Irawan Rahardja**, **Mike Hebbes**, all of Vancouver (CA)

(73) Assignee: **Westport Research Inc.**, Vancouver (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/522,130**

(22) Filed: **Mar. 9, 2000**

Related U.S. Application Data

(60) Provisional application No. 60/159,791, filed on Oct. 15, 1999.

(51) **Int. Cl.**[7] **F02M 41/00**
(52) **U.S. Cl.** **123/467**; 123/472
(58) **Field of Search** 123/498, 497, 123/467, 472, 478; 251/129.06; 239/533.2, 533.9; 293/102.2

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5,917,262		6/1999	Schmid et al.	
6,062,533		5/2000	Kappel et al.	251/57

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0 376 493		7/1990	(EP) .
2 321 278		8/1998	(EP) .
09-324723		12/1997	(JP) .
10-090084		1/1998	(JP) .
WO 85/02445		6/1985	(WO) .

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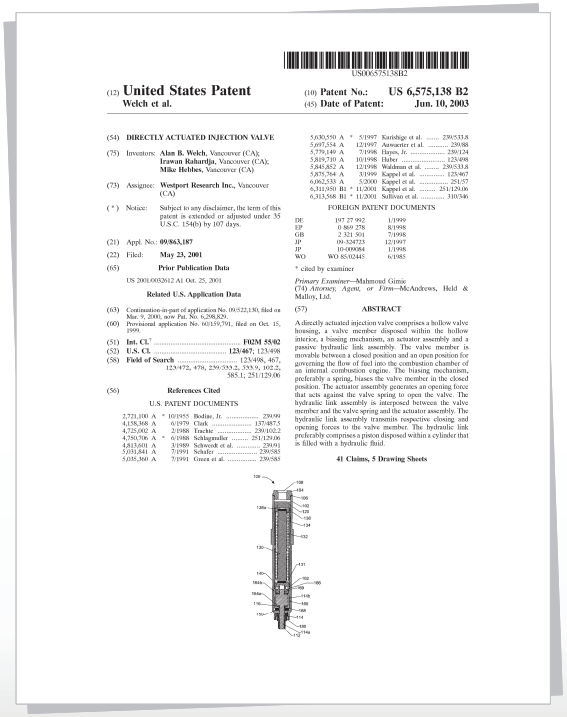
(57) **ABSTRACT**

A directly actuated injection valve comprises a hollow valve housing, a valve needle disposed within the hollow interior, a needle spring, an actuator assembly, and a hydraulic link assembly. The valve needle is movable between a closed position and an open position for governing the flow of fuel into the combustion chamber of an internal combustion engine. The displacement of the valve needle from the closed position is defined as the lift. The a needle spring biases the valve needle in the closed position. The actuator assembly generates an opening force that acts against the needle spring to open the valve. The hydraulic link assembly is interposed between the valve needle and the needle spring and the actuator assembly. The hydraulic link assembly transmits respective closing and opening forces to the valve needle. The hydraulic link preferably comprises a piston disposed within a cylinder that is filled with a hydraulic fluid. The opening and closing forces are transmitted through a thickness of the hydraulic fluid that is trapped between the planar surfaces of the piston and the head and base of the hydraulic cylinder. In the preferred embodiment, the thickness of the hydraulic fluid trapped between the piston and cylinder head or base is automatically adjustable in response to changes in the dimensional relationship between components of the injection valve to maintain a desired valve needle lift when the actuator assembly is activated. When the actuator assembly comprises a magnetostrictive or piezoelectric member, the movements of the valve needle can be controlled by the application of a shaped control pulse or waveform to improve the speed of the opening and closing motion of the valve needle, and to reduce the impact of the valve needle on the valve seat upon closing.

32 Claims, 5 Drawing Sheets

292 POR at 1, 11-12.

U.S. Patent No. 6,575,138
293 Ex. 1001



US006575138B2

(12) **United States Patent**
Welch et al.

(10) **Patent No.: US 6,575,138 B2**
(45) **Date of Patent: Jun. 10, 2003**

(54) **DIRECTLY ACTUATED INJECTION VALVE**

(75) Inventors: **Alan B. Welch**, Vancouver (CA); **Irawan Rahardja**, Vancouver (CA); **Mike Hebbes**, Vancouver (CA)

(73) Assignee: **Westport Research Inc.**, Vancouver (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 107 days.

(21) Appl. No.: **09/863,187**

(22) Filed: **May 23, 2001**

(65) **Prior Publication Data**

US 2001/0052612 A1 Oct. 25, 2001

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/522,130, filed on Mar. 9, 2000, now Pat. No. 6,298,829.
(60) Provisional application No. 60/159,791, filed on Oct. 15, 1999.

(51) **Int. Cl.**[7] **F02M 55/02**
(52) **U.S. Cl.** **123/467**; 123/498
(58) **Field of Search** 123/498, 467, 123/472, 478, 239/533.2, 533.9, 102.2, 585.1; 251/129.06

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5,697,554	A		12/1997	Auwaerter et al. 239/88
5,779,149	A		7/1998	Hayes, Jr. 239/124
5,819,710	A		10/1998	Huber 123/498
5,845,852	A		12/1998	Waldman et al. 239/533.8
5,875,764	A		3/1999	Kappel et al. 123/467
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GB	2 321 501		7/1998
JP	09-324723		12/1997
JP	10-090084		1/1998
WO	WO 85/02445		6/1985

* cited by examiner

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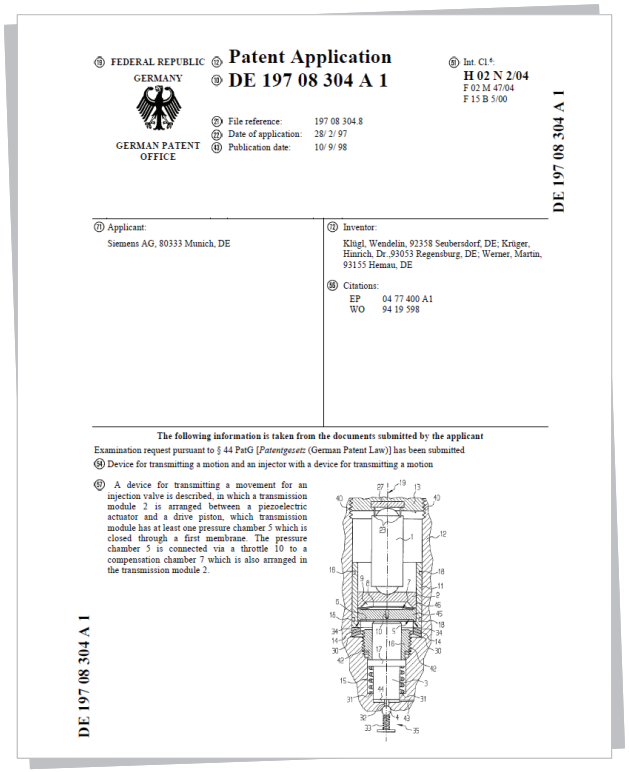
(57) **ABSTRACT**

A directly actuated injection valve comprises a hollow valve housing, a valve member disposed within the hollow interior, a biasing mechanism, an actuator assembly and a passive hydraulic link assembly. The valve member is movable between a closed position and an open position for governing the flow of fuel into the combustion chamber of an internal combustion engine. The biasing mechanism, preferably a spring, biases the valve member in the closed position. The actuator assembly generates an opening force that acts against the valve spring to open the valve. The hydraulic link assembly is interposed between the valve member and the valve spring and the actuator assembly. The hydraulic link assembly transmits respective closing and opening forces to the valve member. The hydraulic link preferably comprises a piston disposed within a cylinder that is filled with a hydraulic fluid.

41 Claims, 5 Drawing Sheets

293 POR at 1, 11-13.

All of Petitioners' Grounds in Each IPR Rely on Klügl



(19) FEDERAL REPUBLIC GERMANY
GERMAN PATENT OFFICE

(12) Patent Application
(10) DE 197 08 304 A 1

(51) Int. Cl.⁶:
H 02 N 2/04
F 02 M 47/04
F 15 B 5/00

(21) File reference: 197 08 304.8
(22) Date of application: 28/2/97
(43) Publication date: 10/9/98

DE 197 08 304 A 1

(71) Applicant:
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(72) Inventor:
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(56) Citations:
EP 04 77 400 A1
WO 94 19 598

The following information is taken from the documents submitted by the applicant

Examination request pursuant to § 44 PatG [*Patentgesetz* (German Patent Law)] has been submitted

(54) Device for transmitting a motion and an injector with a device for transmitting a motion

(57) A device for transmitting a movement for an injection valve is described, in which a transmission module 2 is arranged between a piezoelectric actuator and a drive piston, which transmission module has at least one pressure chamber 5 which is closed through a first membrane. The pressure chamber 5 is connected via a throttle 10 to a compensation chamber 7 which is also arranged in the transmission module 2.

DE 197 08 304 A 1

Ex. 1006 (Klügl, translated);
292 POR at 1, 15-16;
293 POR at 1, 16-17.

Ground	35 U.S.C. §103(a) Combinations	292 Claims Challenged	293 Claims Challenged
1	Wirbeleit, Klügl	1–3, 6, 11-12, 14-15, 18-19	1–3, 6, 13, 14, 17–21, 26, 27, 41
2	Wirbeleit, Klügl, Newcomb	20	28
3	Klügl, Hayes	1–3, 6, 11-12, 14-15, 18-19	1–3, 6, 13, 14, 17–21, 26, 27, 41
4	Klügl, Hayes, Newcomb	20	28

292 POR at 1, 4;
293 POR at 1, 4.

No Challenged Claim Would Have Been Obvious in View of the Asserted Grounds

Today's Focus:

1. Klügl does not disclose the passive hydraulic link recited in every independent claim (and their dependent claims)

   292 POR at 1, 18-47, 62-63;
   293 POR at 1, 19-48, 64-66.

   - Not Substantially Solid or a Substantially Constant Thickness During Actuation

   292 POR at 30-46, 62-63; 293 POR at 31-42, 44-47, 64-66.

2. A brief overview of other limitations missing from Petitioners' Asserted Grounds.

   292 POR at 1, 50-54, 59-62, 64-65;
   293 POR at 1, 47-48, 51-55, 66-67.

3. Petitioners failed to establish a motivation to combine references in Petitioners' Asserted Grounds

   292 POR at 55-58, 65-69;
   293 POR at 58-60, 68-72.

4. Petitioners failed to establish that Klügl discloses the limitations of Claim 41 of the '138 Patent.

   293 POR at 1, 56-57, 68.

2. Petitioners' Translation of Klügl Should Be Excluded

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Petitioners Erroneously Translated the Same Word 3 Different Ways

Fig. 1 eine Vorrichtung zur Kraftübertragung ohne Hubübersetzung,
Fig. 2 eine Vorrichtung zur Kraftübertragung mit einer Feder als Druckmittel und
Fig. 3 eine Vorrichtung zur Kraftübertragung mit Hubübersetzung.

Ex. 1005 at 1:44-49; Ex. 2026 (Holthaus Decl.) at ¶4; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

1

Fig. 1 shows a device for power transmission without stroke translation.
Fig. 2 shows a device for power transmission with a spring as a pressure medium and
Fig. 3 shows a device for power transmission with stroke translation.

Ex. 1006; Ex. 2026 (Holthaus Decl.) at ¶5; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

sten Membran **6** anliegt. Auf diese Weise wird eine Hubübersetzung zwischen der Auslenkung des Piezoaktors **1** und der Auslenkung des Antriebkolbens **3** erreicht. Zudem

Ex. 1005 at 7:11-13; Ex. 2026 (Holthaus Decl.) at ¶4; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

2

against the first membrane **6**. This way, it achieves a stroke ratio between the deflection of the piezoelectric actuator **1** and the deflection of the drive piston **3**. In addition, it is

Ex. 1006; Ex. 2026 (Holthaus Decl.) at ¶5; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

Membran **6** und der dritten Membran **26** eine Hubübersetzung zwischen der Auslenkung des Piezoaktors **1** und der Auslenkung des Antriebkolbens **3** erreicht wird.

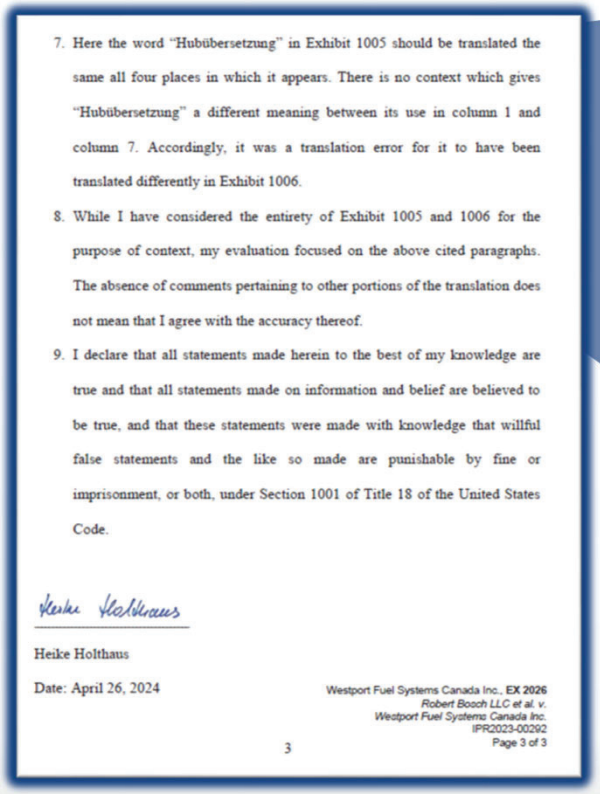
Ex. 1005 at 7:17-19; Ex. 2026 (Holthaus Decl.) at ¶4; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

3

larger than the surface of the first membrane **6**, so that over the different sized surfaces of the first membrane **6** and the third membrane **26** a stroke transmission is already achieved between the deflection of the piezoelectric actuator **1** and the deflection of the drive piston **3**.

Ex. 1006; Ex. 2026 (Holthaus Decl.) at ¶5; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

Petitioners' Translation of Klügl is Erroneous and Unreliable



7. Here 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.
8. While I have considered the entirety of Exhibit 1005 and 1006 for the purpose of context, my evaluation focused on the above cited paragraphs. The absence of comments pertaining to other portions of the translation does not mean that I agree with the accuracy thereof.
9. I declare that all statements made herein to the best of my knowledge are true and that all statements made on information and belief are believed to be true, and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Heike Holthaus

Heike Holthaus

Date: April 26, 2024

Westport Fuel Systems Canada Inc., **EX 2026**
Robert Bosch LLC et al. v. Westport Fuel Systems Canada Inc.
IPR2023-00292
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3

7. Here 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 (Holthaus Decl.) at ¶7;
292 POR at 26-27; 293 POR at 27-28;
292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6.

Petitioners' Translation of Klügl is Erroneous and Unreliable



Ex. 1026 (Holthaus Dep.) at 33:14-18, 34:1-3; 292 Sur-Reply at 6; 293 Sur-Reply at 6.

What was -- what is your base opinion in your declaration?

A My base opinion in my -- in the declaration that I -- I gave is that hububersetzung should have been translated with one single term.

Q Okay. Do you believe that Exhibit 1006 is a reliable translation of Exhibit 1005?

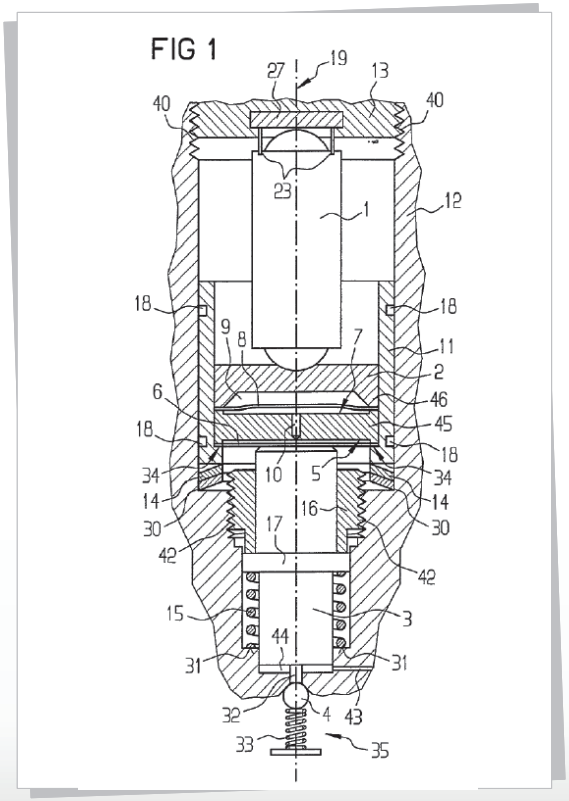
A I do not.

3. Klügl's Teachings

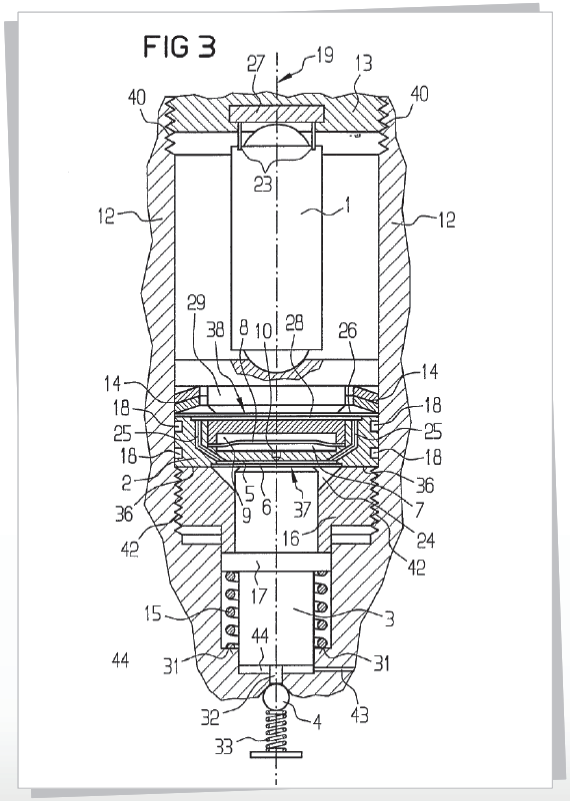
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Klügl Figure 1 and Klügl Figure 3



Ex. 1006 (Klügl), Figure 1;
292 POR at 19;
293 POR at 20.

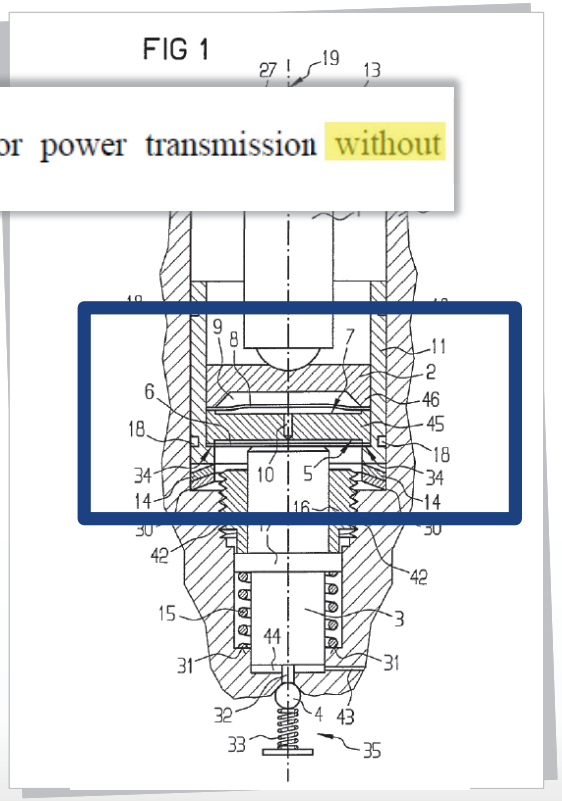


Ex. 1006 (Klügl), Figure 3;
292 POR at 19;
293 POR at 20.

"With" and "Without" Stroke Translation

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

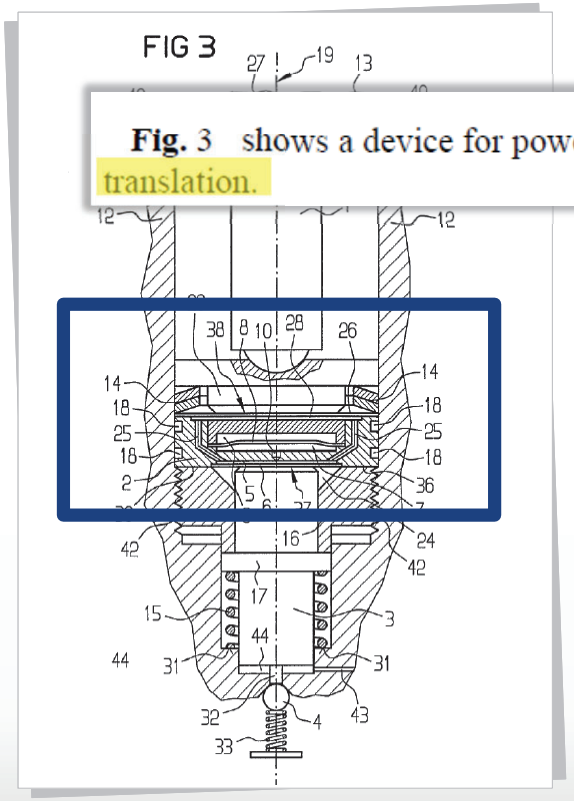
Ex. 1006 (Klügl) at 1:41-42.



Ex. 1006 (Klügl), Figure 1;
292 POR at 18-19;
293 POR at 19-20.

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

Ex. 1006 (Klügl) at 1:45-46.



Ex. 1006 (Klügl), Figure 3;
292 POR at 18-19;
293 POR at 19-20.

Klügl States the Difference Between Figs. 1 & 3 is the Type of Power Transmission



DE 197 08 304 A 1

3 4

During the production of the injection valve, the piezoelectric actuator 1, the transmission module 2 and the drive piston 3 are pre-adjusted via the upper stop 13 and the lower stop 16. The piezoelectric actuator 1, the transmission module 2 and the drive piston 3 are adjusted in such a way that the servo valve 4 is closed when the piezoelectric actuator 1 is not activated and the piezoelectric actuator 1 is in contact with the transmission module 2 with a predetermined pretension and the drive piston 3 is in contact with the first membrane 6.

The functioning of Fig. 1 is explained in more detail below: In the rest state, the piezoelectric actuator 1 is not controlled and the closing element 4 is seated on the valve seat 35. Furthermore, the piezoelectric actuator 1 and the drive piston 3 rest on opposite sides of the transmission module 2, with the drive piston 3 placed on the first membrane 6. In the rest position, the piezoelectric actuator 1 is pre-stressed against the upper stop 13 by the disk spring 14 via the guide sleeve 11 and the transmission module 2. The drive piston 3 is pressed by the spring 15 against the lower stop 16, which is adjusted in such a way that the drive piston 3 bears against the first membrane 6.

If the piezoelectric actuator 1 is now controlled, the piezoelectric actuator 1 presses the entire transmission module 2 against the spring force of the disk spring 14 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 is exercised.

This moves the drive piston 3 against the spring force of the tension spring 15 in the direction of the closing element 4 so that the closing element 4 is lifted off the valve seat 35 by the control needle 32. As a result, a pressure chamber which applies high pressure to the injection needle of the injection valve is connected to the relief chamber 44 and the relief line 42, so that the pressure in the pressure chamber drops and the injection needle lifts off the assigned valve seat and injection begins.

If the activation of the piezoelectric actuator 1 ends, the piezoelectric actuator 1 is shortened and the transmission module 2 and the guide sleeve 11 are pushed by the disk spring 14 in the direction of the piezoelectric actuator 1. The drive piston 3 is pushed away from the closing element 4 by the spring 15, so that the closing element 4 is pushed by the valve spring 33 back onto the assigned valve seat 35. This disconnects the connection between the pressure chamber and the relief line 43 and high pressure is again applied to the valve needle, so that the valve needle is pushed onto the assigned valve seat and this ends the injection.

The adjustment of the piezoelectric actuator 1, the transmission module 2 and the drive piston 3 is carried out with a new injection valve and at a specified temperature. If, due to wear or a change in temperature, the adjustment no longer fits, the transmission module 2 achieves an automatic adjustment.

For this purpose, both the pressure chamber 5 and the compensation chamber 7 are preferably completely filled with the transmission medium and the drive piston 3 is pre-stressed against the first membrane 6 when the piezoelectric actuator 1 is in the rest position, so that the transmission medium in the pressure chamber 5 and in the compensation chamber 7 is at a specified pressure.

If 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.

The throttle 10 should preferably be dimensioned in relation to the transmission medium such that during normal activation of the drive piston 3 only so little of the transmission medium flows into the compensation chamber 7 that the activation of the drive piston is not impaired. For example, the drive piston 3 controls a servo valve of an injection valve or a nozzle needle of an injection valve. In these examples, the throttle 10 must be dimensioned in such a way that only an insignificant amount of transmission medium flows into the compensating chamber 7 during the actuation times for the servo valve or during the actuation times for the nozzle needle. The actuation times are in the range of milliseconds, preferably between 0 ms and 10 ms. Fast actuation times are around 0.1 to 1 ms.

However, 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.

Fig. 2 shows additional embodiment of the invention which corresponds essentially to the injection valve of Fig. 1, but in which a second membrane 39 is provided instead of the spring plate 8 to delimit the compensation chamber 7. The second diaphragm 39 has a plunger 21 which is tensioned against the transmission module 2, in particular, against the cover plate 46, via a compression spring 22. In this way, the deflection of the second membrane 39 from its rest position is counteracted by the spring force of the compression spring 22. The pressure of the transmission medium prevailing in the pressure chamber 5 and in the compensation chamber 7 is thus adjusted by the spring force of the compression spring 22. This also achieves an adjustment compensation through the compression spring 22 and the throttle 10 in that the pressure chamber 5 is filled with a transmission medium, which has a corresponding pressure, ensuring that the first membrane 6 is always in contact with the drive piston 3. In this way, according to Fig. 1, it achieves an automatic adjustment.

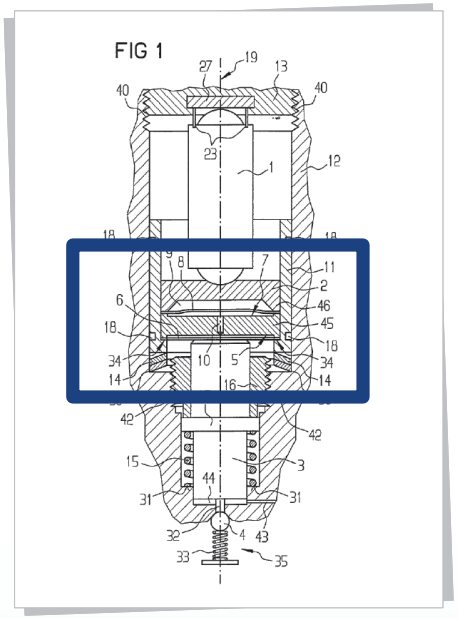
Fig. 3 also shows part of an injection valve with a piezoelectric actuator 1, which acts on a transmission module 2 and a drive piston 3 via a die 29. The injection valve shown in Fig. 3 differs from the injection valves of Fig. 2 and 1 in the type of power transmission from the piezoelectric actuator 1 to the drive piston 3. For this purpose, a die 29 is provided in the housing 12 adjacent to the piezoelectric actuator 1 and is mounted so that it is movable in the longitudinal direction of the housing 12 against a disk spring 14. The disk spring 14 pre-stresses the piezoelectric actuator 1 via the die 29 against the upper stop 13, which is connected to the housing 12 via a screw connection allowing it can be adjusted in the longitudinal direction. The disk spring 14 is supported against the transmission module 2, which rests on a lower stop 16, which is adjustable in the longitudinal direction of the housing 12.

Petitioner Ex. 1006, p. 3
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module **2** and a drive piston **3** via a die **29**. The 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**. For this

Ex. 1006 (Klügl) at 4:52-55;
292 POR at 21; 292 Ex. 2022 (Atkinson) at ¶73.
293 POR at 21; 293 Ex. 2022 (Atkinson) at ¶73.

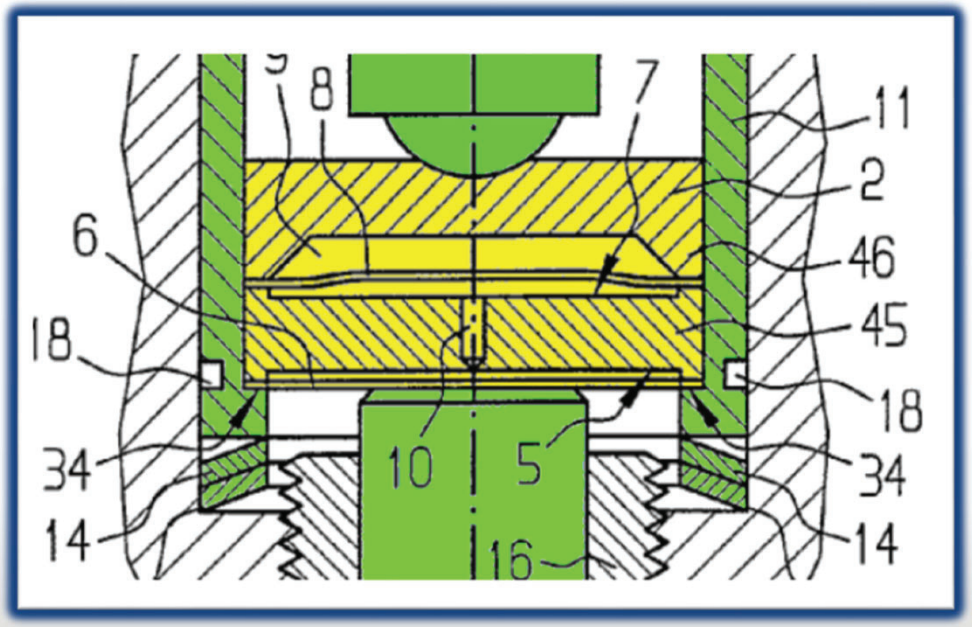
Klügl Figure 1's Transmission Module is Movable



Ex. 1006 (Klügl), Figure 1

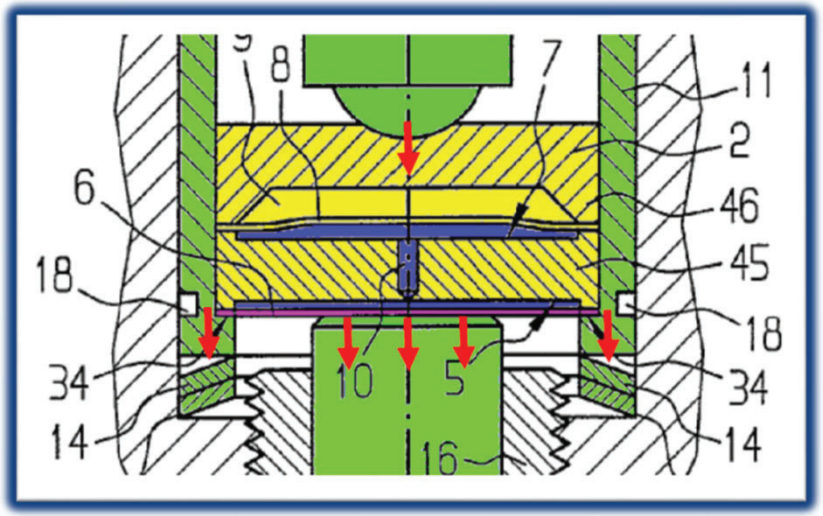
stop **30** which is introduced into the housing **12**. The transmission module **2** and the guide sleeve **11** are arranged to be movable against the disk spring **14** in the longitudinal direction of the injection valve.

Ex. 1006 (Klügl) at 2:18-21;
292 POR at 20-21;
292 Ex. 2022 (Atkinson) at ¶74;
293 POR at 21-22;
293 Ex. 2022 (Atkinson) at ¶74.



292 POR at 20-21, 292 Ex. 2022 (Atkinson) at ¶63, 74;
293 POR at 21-22, 293 Ex. 2022 (Atkinson) at ¶63, 74.

Klügl Figure 1's Transmission Module is Movable



292 POR at 23, 292 Ex. 2022 (Atkinson) at ¶¶73-74;
293 POR at 24, 293 Ex. 2022 (Atkinson) at ¶¶73-74.

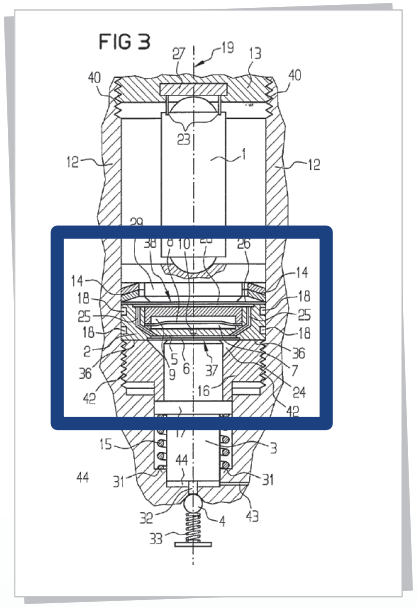
> (*Id.*, ¶¶63, 74.) In this figure, transmission module 2 will move up and down with guide sleeve 11. (*Id.*) The moveable components (except for the transmission module) are colored green. When actuated, the transmission module and guide sleeve move downward towards the piston and compress the disk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

292 POR at 20; 292 Ex. 2022 (Atkinson) at ¶74;
293 POR at 20; 293 Ex. 2022 (Atkinson) at ¶74.

> (*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.*)

292 POR at 23; 292 Ex. 2022 (Atkinson) at ¶74;
293 POR at 24; 293 Ex. 2022 (Atkinson) at ¶74.

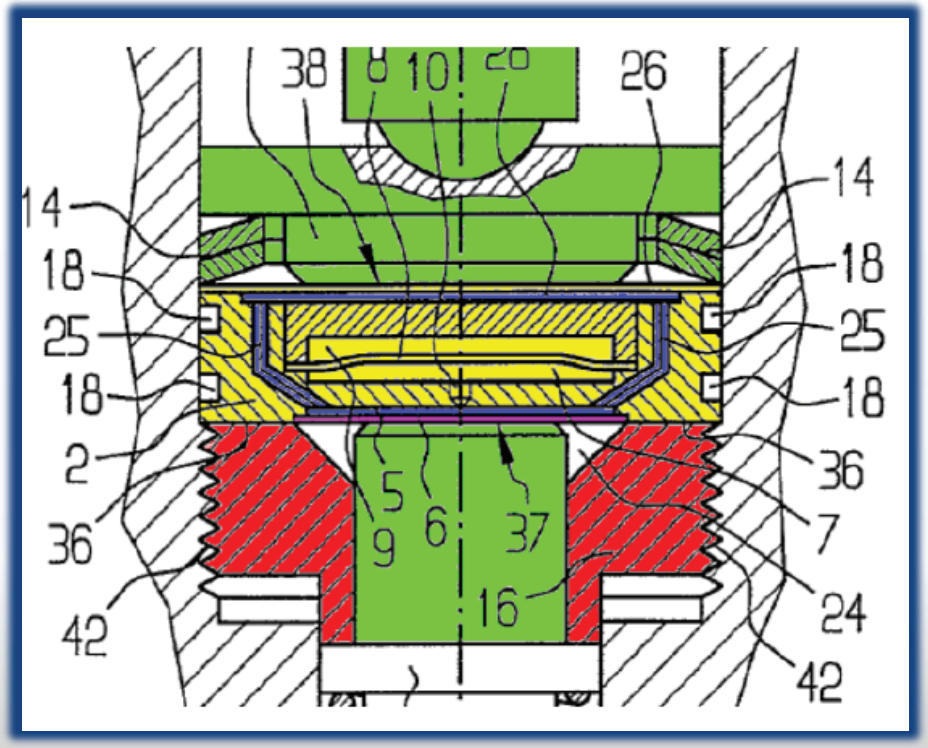
Klügl Figure 3's Transmission Module is Fixed



Ex. 1006 (Klügl), Figure 3

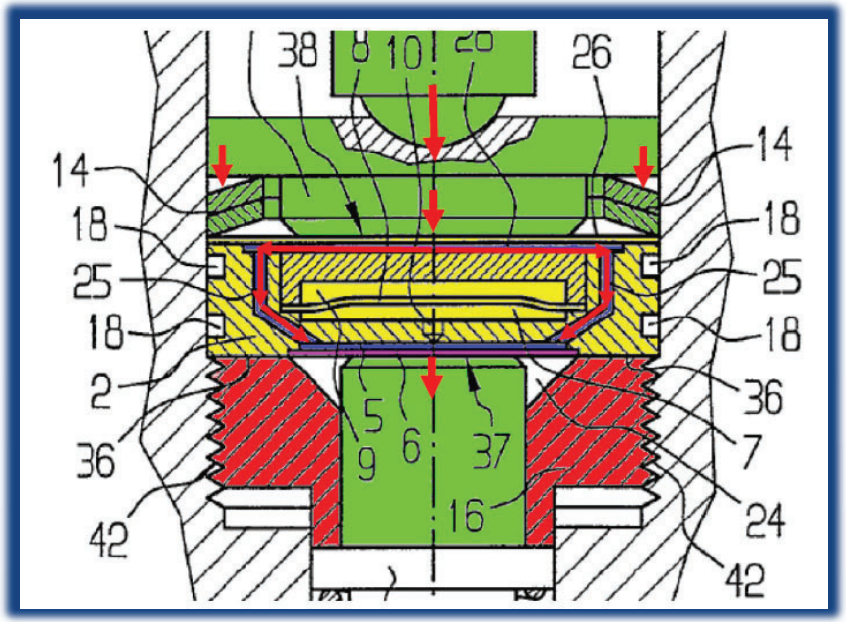
> of the transmission module 2. However, the transmission module 2 is fixed in position by the lower stop 16 preventing it from following the longitudinal movement of the die 29. As

Ex. 1006 (Klügl) at 5:55-57;
292 POR at 21 (citing Atkinson at ¶75),
292 Ex. 2022 (Atkinson) at ¶75 (citing Klügl);
293 POR at 22 (citing Atkinson at ¶74),
293 Ex. 2022 (Atkinson) at ¶74 (citing Klügl).



292 POR at 21,
292 Ex. 2022 (Atkinson) at ¶75;
293 POR at 22,
293 Ex. 2022 (Atkinson) at ¶75.

Klügl Figure 3's Transmission Module is Fixed



292 POR at 24; 292 Ex. 2022 (Atkinson) at ¶75;
293 POR at 25; 293 Ex. 2022 (Atkinson) at ¶75.

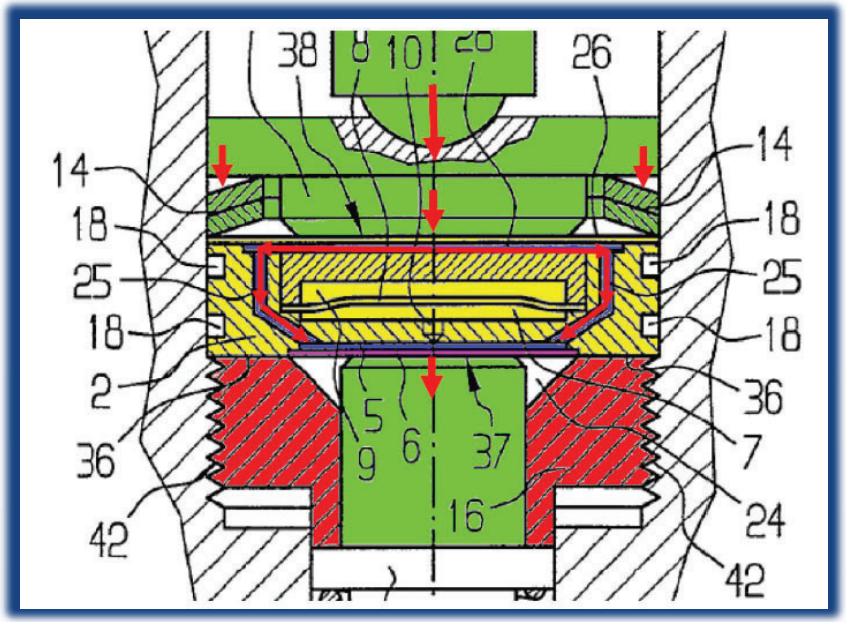
> Transmission module 2 is fixed in place by screw 42 (red) that forms lower stop 16. (*Id.*, ¶75.) Disk springs 14 are now positioned above the fixed transmission module. (*Id.*) Dr. Quinlan agrees. (Ex. 2025, 75:3-11.) Klügl explains "[t]he injection valve

292 POR at 21; 292 Ex. 2022 (Atkinson) at ¶75;
293 POR at 22; 293 Ex. 2022 (Atkinson) at ¶75.

> 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

292 POR at 21; 292 Ex. 2022 (Atkinson) at ¶75;
293 POR at 22; 293 Ex. 2022 (Atkinson) at ¶75.

Klügl Figure 3's Transmission Module is Fixed



292 POR at 24, 292 Ex. 2022 (Atkinson) at ¶75;
293 POR at 25, 293 Ex. 2022 (Atkinson) at ¶75.

(*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.*)

292 POR at 24; 292 Ex. 2022 (Atkinson) at ¶75;
293 POR at 25; 293 Ex. 2022 (Atkinson) at ¶75.

Dr. Quinlan Agreed Klügl's Figure 1 is Fixed, Figure 3 is Moveable

Q. (BY MR. PHILBIN) Sure. Referring to item number two as Klugl defines it as the transmission module, that transmission module moves during actuation in the embodiment shown in Figure 1 and does not move in the embodiment shown in Figure 3.

A. Among other parts, whether they move or not between those two figures and those two specific embodiments, yes. Component two does move in one and not the other. I think that's it.

Ex. 2025 (Quinlan Dep.) at 75:3-11;
292 POR at 21;
293 POR at 22.

4. Klügl Does *Not* Teach the Claimed Passive Hydraulic Link

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

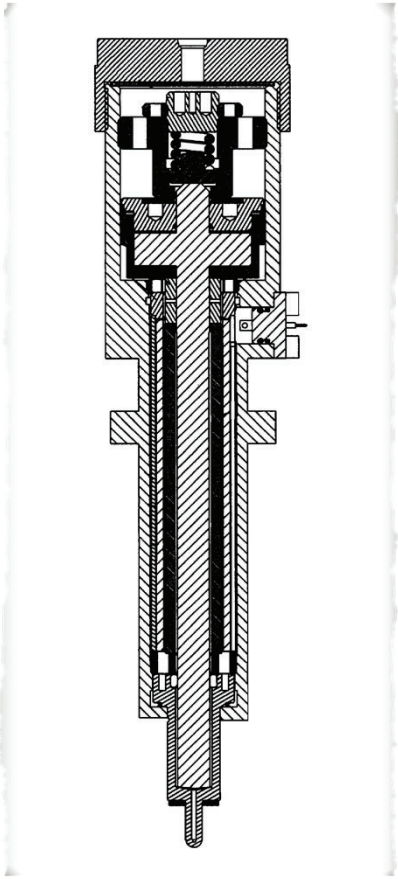
Westport Fuel Systems

Independent Claims 1 of ’829 and ’138 Patents

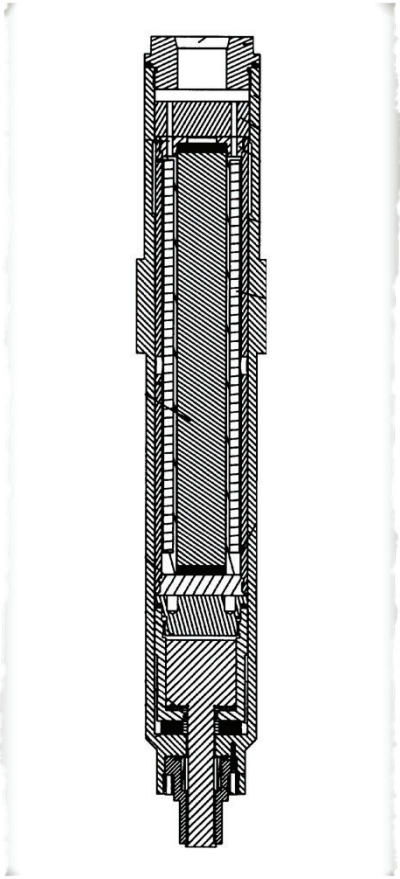
Claim 1 of the ’829 Patent	Claim 1 of the ’138 Patent
An injection valve for injecting fuel into a combustion chamber of an internal combustion engine, said injection valve comprising:	An injection valve for injecting fuel into a combustion chamber of an internal combustion engine, said injection valve comprising:
(a) a valve housing comprising: a fuel inlet port; an interior chamber fluidly connected to said fuel inlet port; a nozzle comprising a nozzle orifice providing a fluid passage from said interior chamber to said combustion chamber;	(a) a valve housing comprising: a fuel inlet port; an interior chamber fluidly connected to said fuel inlet port; and a valve seat for cooperating with a valve member to seal said interior chamber from said combustion chamber when said injection valve is closed;
(b) a valve needle disposed within said valve housing wherein said valve needle is movable between a closed position at which a sealing end of said valve needle contacts a valve seat to fluidly seal said interior chamber from said nozzle orifice, and an open position at which said sealing end of said valve needle is spaced apart from said valve seat whereby said interior chamber is fluidly connected with said nozzle orifice, wherein valve needle lift equals the distance traveled by said sealing end away from said valve seat;	(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;
(c) a needle spring associated with said valve needle, wherein said needle spring applies a closing force to said valve needle for biasing said valve needle in said closed position;	(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;
(d) an actuator assembly associated with said valve needle, wherein said actuator assembly may be activated to apply an opening force to said valve needle stronger than said closing force, for moving said valve needle to said open position; and	(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
(e) a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted, whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated and wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly.	(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.

292 Ex. 1001 (’829) Claim 1

293 Ex. 1001 (’138) Claim 1



292 Ex. 1001 (’829) Fig.1



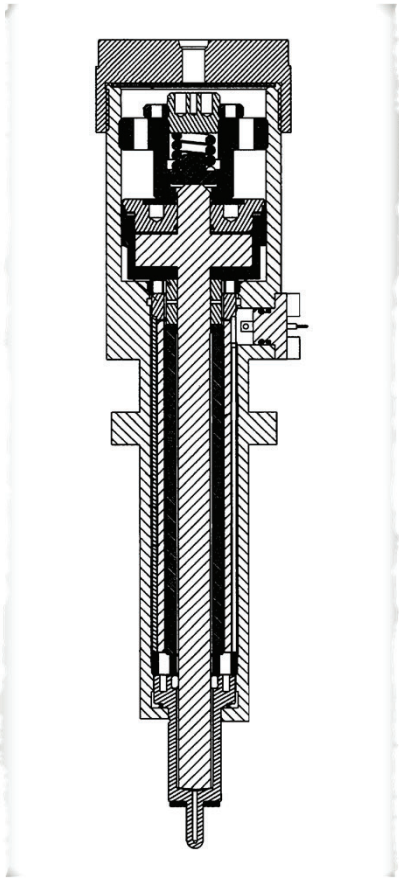
293 Ex. 1001 (’138) Fig.3

Independent Claims 1 Include a Passive Hydraulic Link

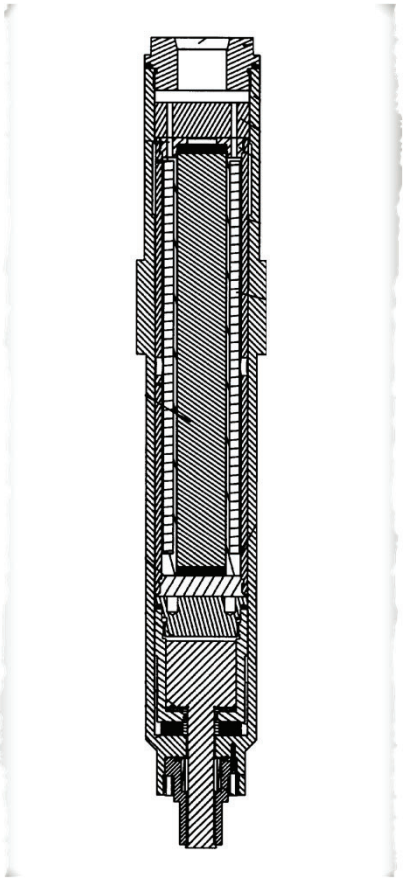
Claim 1 of the '829 Patent	Claim 1 of the '138 Patent
An injection valve for injecting fuel into a combustion chamber of an internal combustion engine, said injection valve comprising:	An injection valve for injecting fuel into a combustion chamber of an internal combustion engine, said injection valve comprising:
(a) a valve housing comprising: a fuel inlet port; an interior chamber fluidly connected to said fuel inlet port; a nozzle comprising a nozzle orifice providing a fluid passage from said interior chamber to said combustion chamber;	(a) a valve housing comprising: a fuel inlet port; an interior chamber fluidly connected to said fuel inlet port; and a valve seat for cooperating with a valve member to seal said interior chamber from said combustion chamber when said injection valve is closed;
(b) a valve needle disposed within said valve housing wherein said valve needle is movable between a closed position at which a sealing end of said valve needle contacts a valve seat to fluidly seal said interior chamber from said nozzle orifice, and an open position at which said sealing end of said valve needle is spaced apart from said valve seat whereby said interior chamber is fluidly connected with said nozzle orifice, wherein valve needle lift equals the distance traveled by said sealing end away from said valve seat;	(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;
(c) a needle spring associated with said valve needle, wherein said needle spring applies a closing force to said valve needle for biasing said valve needle in said closed position;	(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;
(d) an actuator assembly associated with said valve needle, wherein said actuator assembly may be activated to apply an opening force to said valve needle stronger than said closing force, for moving said valve needle to said open position; and	(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
(e) a hydraulic link assembly comprising a passive hydraulic link having a hydraulic fluid thickness through which said opening and closing forces are transmitted, whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated and wherein said thickness of said hydraulic link is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly.	(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.

292 Ex. 1001 ('829) Claim 1

293 Ex. 1001 ('138) Claim 1



292 Ex. 1001 ('829) Fig.1



293 Ex. 1001 ('138) Fig.3

Claimed Passive Hydraulic Link

(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 [i] said hydraulic fluid acts substantially as a solid with said [ii] thickness being substantially constant while said actuator assembly is activated and wherein said [iii] thickness of said hydraulic link is adjustable while said actuator is not activated [iv] in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly.	(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 [i] said hydraulic fluid acts substantially as a solid with said [ii] thickness being substantially constant while said actuator assembly is actuated and wherein said [iii] thickness of said hydraulic link is adjustable while said actuator assembly is not actuated [iv] 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.
292 Ex. 1001 ('829) Claim 1; 292 POR at 11-12, 46-50.	293 Ex. 1001 ('138) Claim 1; 293 POR at 12, 47-51.

Klügl's Transmission Medium is Not "Substantially Solid" or a "Substantially Constant" Thickness During Actuation

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Klügl's Transmission Medium is Not "Substantially Solid" or a "Substantially Constant" Thickness During Actuation

- Klügl's "Transmission Medium" Flows During Actuation
- Klügl Figure 1 Uses a Flexible Membrane
- Klügl Figure 1's Flexible Membrane Flexes During Actuation
- Movement of Figure 1's Actuator is Only Partially Transmitted

Klügl's Transmission Medium is Not "Substantially Solid" or a "Substantially Constant" Thickness During Actuation

- Klügl's "Transmission Medium" Flows During Actuation
- Klügl Figure 1 Uses a Flexible Membrane
- Klügl Figure 1's Flexible Membrane Flexes During Actuation
- Movement of Figure 1's Actuator is Only Partially Transmitted

Petitioners' Arguments Hinge on the Incorrect Premise that Klügl's Fluid Does Not Flow During Actuation

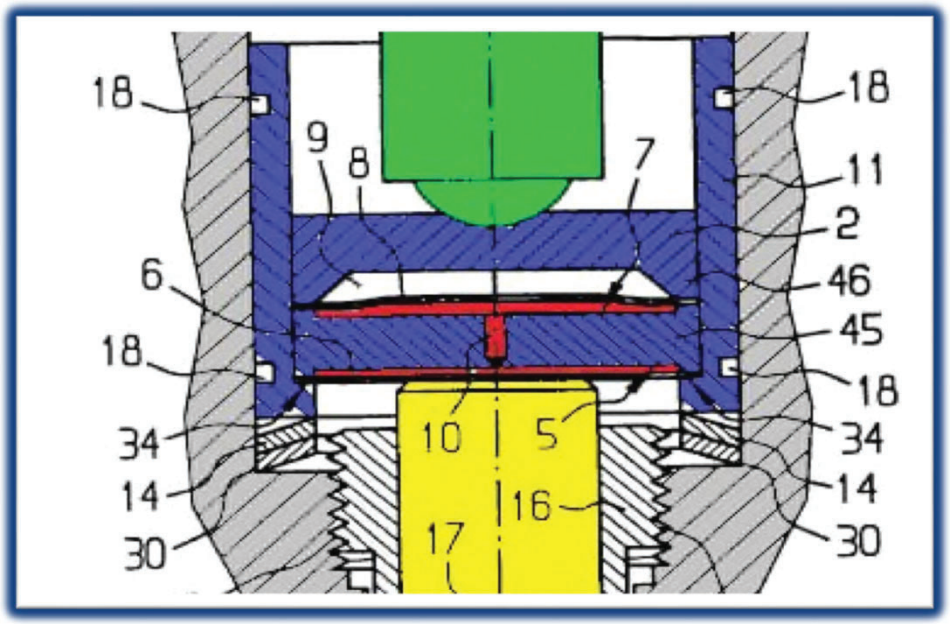
purposes of opening a valve. Further, Klügl explains that fluid does not flow into or out of chamber 5 during actuation. Thus, this chamber and the fluid it contains—like Werbeliet's own hydraulic transmission element 22—is a ***"passive hydraulic link."*** Per Klügl, the fluid also has a low compressibility. And, in the embodiment

293 Petition at 36;
292 Petition at 38-39.

233. Further, Klügl explains that fluid does not flow into or out of chamber 5 during actuation. Thus, in my opinion this chamber and the fluid it contains, just like Wirbeleit's hydraulic transmission element 22, is the claimed ***"passive hydraulic link"*** that acts as a ***"solid."***

292 Ex. 1003 (Quinlan Decl.) at ¶233;
292 Ex. 1003 (Quinlan Decl.) at ¶221.

In Fig. 1, Klügl's Transmission Medium Flows During Actuation

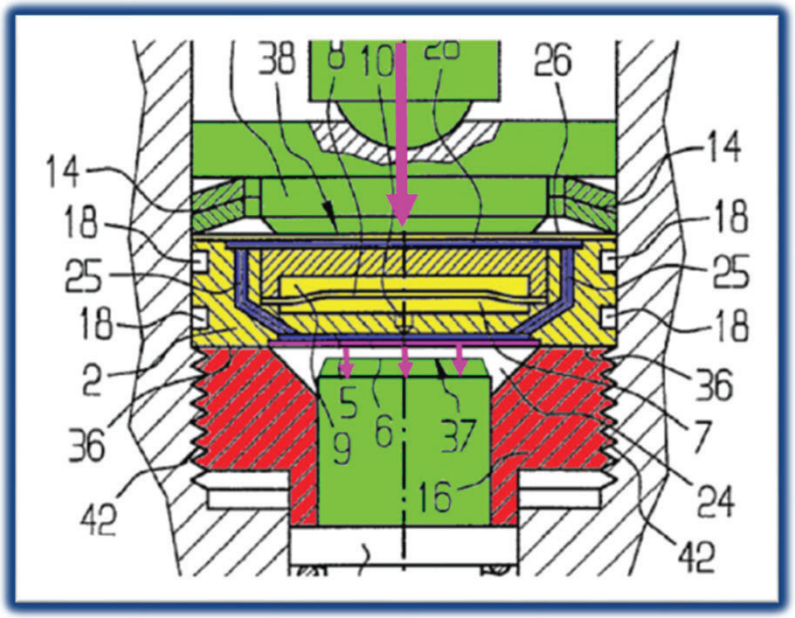


292 Ex. 2022 (Atkinson) at ¶ 63, (cited by 292 POR at 20);
293 Ex. 2022 (Atkinson) at ¶ 63 (cited by 293 POR at 21).

The throttle **10** should preferably be dimensioned in relation to the transmission medium such that during normal activation of the drive piston **3** only so little of the transmission medium flows into the compensation chamber **7** that the activation of the drive piston is not impaired. For example, the drive piston **3** controls a servo valve of an injection valve or a nozzle needle of an injection valve. In these examples, the throttle **10** must be dimensioned in such a way that only an insignificant amount of transmission medium flows into the compensating chamber **7** during the actuation times for the servo valve or during the actuation times for the nozzle needle. The actuation times are in the

Ex. 1006 (Klügl) at 4:11-22;
292 Ex. 2022 (Atkinson) at ¶¶ 72, 81 (cited by 292 POR at 35-37);
293 Ex. 2022 (Atkinson) at ¶¶ 72, 81 (cited by 293 POR at 36-38).

In Fig. 3, Klügl's Transmission Medium Flows During Actuation

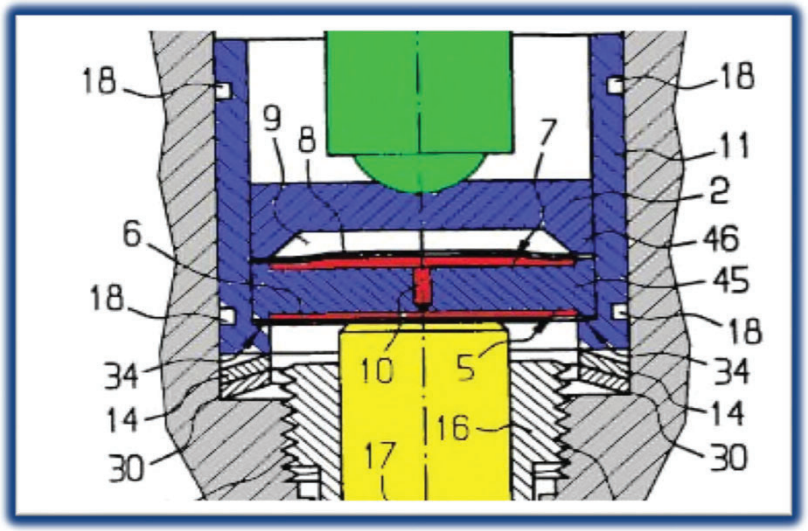


292 POR at 37-38; 292 Ex. 2022 (Atkinson) at ¶¶ 75, 82;
293 POR at 38-39; 293 Ex. 2022 (Atkinson) at ¶¶ 75, 82.

If the piezoelectric actuator **1** is now controlled by the control means **27** via the control lines **23**, the piezoelectric actuator **1** lengthens, so that as a result the die **29** is deflected against the spring force of the disk spring **14** in the direction of the transmission module **2**. However, the transmission module **2** is fixed in position by the lower stop **16** preventing it from following the longitudinal movement of the die **29**. As a result, the third membrane **26** is pushed downwards by the die **29** with the circular plunger surface **38** causing the 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 against the spring force of the spring **15** in the direction of the closing element **4**. As a result of this, the closing element **4** is lifted off the valve seat **35** by the actuating needle **32** against the force of the valve spring **33**.

Ex. 1006 (Klügl) at 5:55-67;
292 POR at 37-38; 292 Ex. 2022 (Atkinson) at ¶¶ 75, 82;
293 POR at 38-39; 293 Ex. 2022 (Atkinson) at ¶¶ 75, 82.

In Fig. 1, Klügl's Throttle is Designed to Limit Flow Through It During Actuation

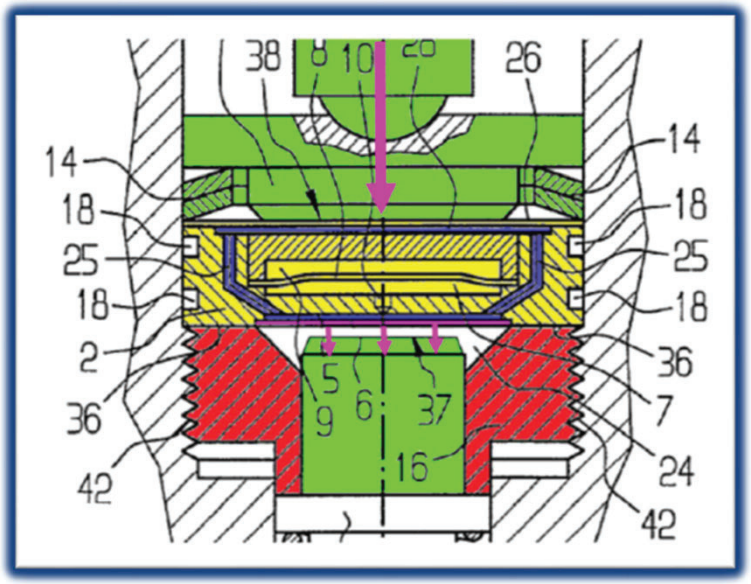


292 Ex. 2022 (Atkinson) at ¶¶ 63, 81; 292 POR at 35-36);
293 Ex. 2022 (Atkinson) at ¶¶ 63, 81; 293 POR at 36-37).

The throttle **10** should preferably be dimensioned in relation to the transmission medium such that during normal activation of the drive piston **3** only so little of the transmission medium flows into the compensation chamber **7** that the activation of the drive piston is not impaired. For example, the drive piston **3** controls a servo valve of an injection valve or a nozzle needle of an injection valve. In these examples, the throttle **10** must be dimensioned in such a way that only an insignificant amount of transmission medium flows into the compensating chamber **7** during the actuation times for the servo valve or during the actuation times for the nozzle needle. The actuation times are in the

Ex. 1006 (Klügl) at 4:11-22;
292 Ex. 2022 (Atkinson) at ¶¶ 63, 81; 292 POR at 35-36);
293 Ex. 2022 (Atkinson) at ¶¶ 63, 81; 293 POR at 36-37).

In Fig. 3, Klügl's Throttle is Designed to Limit Flow Through It During Actuation



292 POR at 37-38; 292 Ex. 2022 (Atkinson) at ¶82;
293 POR at 38-39; 293 Ex. 2022 (Atkinson) at ¶82.

compensation chamber 7. At least the throttle 10 and the transmission medium are matched to one another in such a way that only a small amount of transmission medium flows into the compensation chamber 7 for the times in which the piezoelectric actuator 1 is actuated to actuate the closing element 4, so that the actuation of the closing element is not affected.

Ex. 1006 (Klügl) at 6:6-12;
292 POR at 37-38; 292 Ex. 2022 (Atkinson) at ¶82;
293 POR at 38-39; 293 Ex. 2022 (Atkinson) at ¶82.

Dr. Quinlan's Inconsistent Testimony is Entitled to No Weight

In support of the Petition, Dr. Quinlan claims Klügl explains that fluid does not flow during actuation:

> 233. Further, Klügl explains that fluid does not flow into or out of chamber 5 during actuation. Thus, in my opinion this chamber and the fluid it contains, just like Wirbeleit's hydraulic transmission element 22, is the claimed ***"passive hydraulic link"*** that acts as a ***"solid."***

292 Ex. 1003 (Quinlan Decl.) at ¶233;
293 Ex. 1003 (Quinlan Decl.) at ¶221;
292 Ex. 2022 (Atkinson) at ¶¶81-82, cited by 292 POR at 35;
293 Ex. 2022 (Atkinson) at ¶¶81-82, cited by 293 POR at 36;
292 POR at 72-73; 293 POR at 75-76 (inconsistent opinions).

Later, in response, Dr. Quinlan claims Klügl makes no mention of fluid flow:

> 17. When 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.

292 Ex. 1040 (Quinlan Reply Decl.) at ¶17;
293 Ex. 1040 (Quinlan Reply Decl.) at ¶17;
292 Sur-Reply at 2-3, 13;
293 Sur-Reply at 2-3, 13;
292 POR at 72-73; 293 POR at 75-76 (inconsistent opinions).

Klügl's Transmission Medium is Not "Substantially Solid" or a "Substantially Constant" Thickness During Actuation

- Klügl's "Transmission Medium" Flows During Actuation
- Klügl Figure 1 Uses a Flexible Membrane
- Klügl Figure 1's Flexible Membrane Flexes During Actuation
- Movement of Figure 1's Actuator is Only Partially Transmitted

Klügl Teaches a Flexible Membrane

67. The translated version of Klügl submitted as Exhibit 1006 expressly teaches that membrane 6 is flexible. *E.g.*, Ex. 1006, 7:45–46; 7:65–9:30. Even if it did not, a POSITA would know membranes are flexible and pliable elements that will deform when subjected to the significant forces exerted within an injector at the typical actuation rates of the fuel injection process. Even a small deflection or deformation of the pliable, flexible membrane will be critical as the lift commonly generated in these applications is very small, usually less than 100 microns (about the thickness of a piece of paper). A POSITA also would understand that a membrane will not have different properties during actuation and while at rest (e.g., the membrane will be pliable and flexible in both circumstances).

292 Ex. 2022 (Atkinson) at ¶67; 292 POR at 33, 41;
293 Ex. 2022 (Atkinson) at ¶67; 293 POR at 34, 42.

Klügl Expressly Teaches Membrane 6 in Figure 1 is Flexible

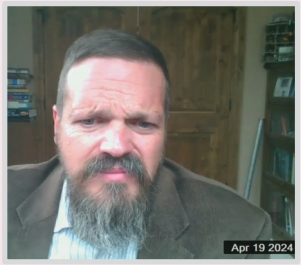
An advantageous adjustment of an injection valve according to Fig. **1** or **3** is achieved in that the upper stop **13** is adjusted in the direction of the drive piston **3** and consequently increasing the pressure of the piezoelectric actuator **1** via the transmission module **2** on the drive piston **3**. At the same time, the piezoelectric actuator **1** is controlled alternately by the control means **27**, so that the piezoelectric actuator **1** is alternately lengthened and shortened. At the same time, the opening characteristic of the servo valve **35**, **4** is measured and the screwing in of the upper stop **13** is stopped when the control characteristic is optimal. The adjustment primarily offers advantages with flexible membranes **6**, **8**, **26**, which have a progressive characteristic curve of the spring force in relation to the spring deflection.

Ex. 1006 (Klügl) at 7:34-47;
292 Ex. 2022 (Atkinson) at ¶67, cited by 292 POR at 33;
293 Ex. 2022 (Atkinson) at ¶67, cited by 293 POR at 34.

Flexible Membrane 6's Properties Will Not Change Between Actuation And Rest

> the thickness of a piece of paper). A POSITA also would understand that a membrane will not have different properties during actuation and while at rest (e.g., the membrane will be pliable and flexible in both circumstances).

292 Ex. 2022 (Atkinson) at ¶67; 292 POR at 36-37;
293 Ex. 2022 (Atkinson) at ¶67; 293 POR at 37-38.



Q. I'm not asking about a flexed state. I'm asking, is membrane 6 sometimes flexible and sometimes inflexible in Figure 3 of Klugl?

Q. Is that your complete answer to my question?

A. Well, I don't know how something has a state of being flexible at one time and not being flexible at another time. It could be in a flexed state or not at two different times.

Ex. 2025 (Quinlan Dep.) at 118:1–13;
292 Sur-Reply at 17;
293 Sur-Reply at 17.

Klügl's Claims <u>All Require</u> "Flexible" Membrane 6 (*if* Element 6 *is Recited*)

Claims

1. Device for transmitting a movement comprising a pressure chamber (**5**) which is at least partially filled with a transmission medium and which is at least partially delimited by a first flexible element (6), with a

6. Injection valve with an actuator (**1**) and a control element (**3**), which are operatively connected to one another by a transmission module (**2**), with the following features:
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);

the control element (**3**) is assigned to the first flexible element (6) on the lower side of the transmission module (**2**);

3. Device according to claim **2**, characterized in that the area with which the first flexible element (6) delimits the first pressure chamber (**5**) is different from the area with

7. Injection valve with an actuator (**1**) and a control element (**3**), which are operatively connected to one another by a transmission module (**2**), with the following features:
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);

the control element (**3**) is assigned to the first flexible element (6);

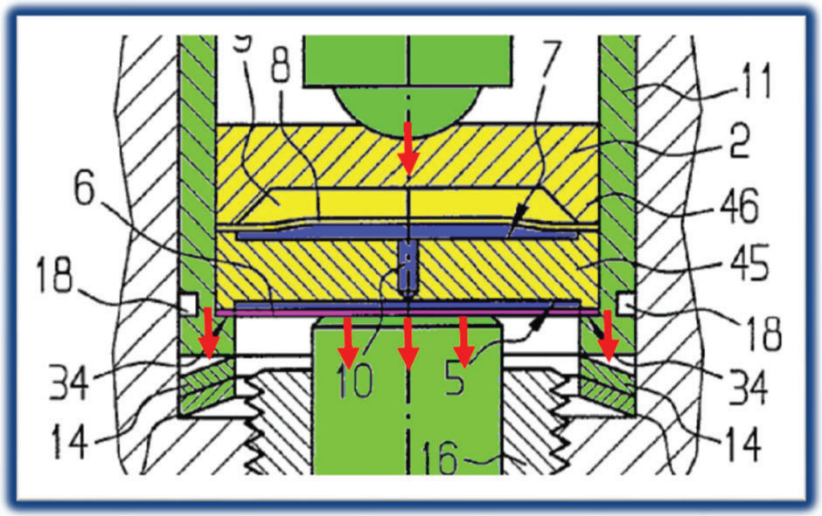
to the control element (**3**) via the first flexible element (6), the transmission medium and the second flexible element (**26**).

Ex. 1006 (Klügl) at Claims;
292 Ex. 2022 (Atkinson) at ¶¶59-61 (discussing Klügl's claims);
293 Ex. 2022 (Atkinson) at ¶¶ 59-61 (same).

Klügl's Claim 6 Covers the Figure 1 Embodiment

60. A POSITA would understand that claim 6 covers the devices depicted in Figs. 1 and 2, at least because the claim requires a "movably arranged" "transmission module (2)" and movement of the actuator (1) that "is at least partially transmitted to the control element (3) via a movement of the transmission module (2)." Ex. 1006, 8:61–68. Accordingly, a POSITA would not understand claim 6 to cover Fig. 3.

292 Ex. 2022 (Atkinson) at ¶60; 292 POR at 30-31;
293 Ex. 2022 (Atkinson) at ¶60; 293 POR at 31-32.

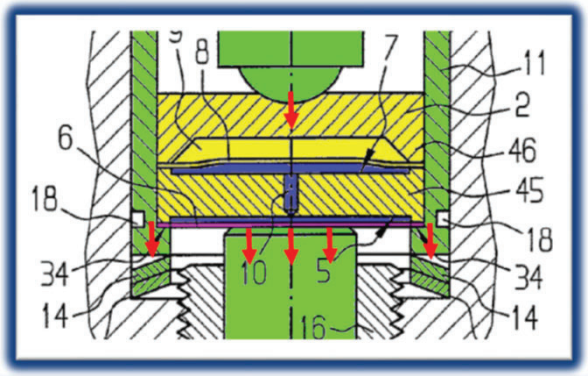


292 POR at 30-31; 292 Ex. 2022 (Atkinson) at ¶¶60, 74;
293 POR at 31-32; 293 Ex. 2022 (Atkinson) at ¶¶ 60, 74.

Klügl's Claim 6 Covers the Figure 1 Embodiment

6. Injection valve with an actuator (1) and a control element (3), which are operatively connected to one another by a transmission module (2), with the following features:
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);
the transmission module (2) has a compensation chamber (7) which is connected to the pressure chamber (5) via a connection (10);
the connection (10) and the transmission medium are designed in such a way that short-term pressure differences between the pressure in the pressure chamber (5) and the pressure in the compensation chamber (7) are hardly compensated and long-lasting pressure differences are almost completely compensated;
the actuator (1) is assigned to an upper side of the transmission module (2);
the control element (3) is assigned to the first flexible element (6) on the lower side of the transmission module (2);
the transmission module (2) is movably arranged in the housing (12) of the injection valve, so that when the actuator (1) moves in the direction of the transmission module (2), the transmission module (2) in the housing (12) in the direction of the control element (3) is moved and 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 (Klügl) at Claim 6;
292 POR at 30-31, citing 292 Ex. 2022 (Atkinson) at ¶60;
293 POR at 31-32, citing 293 Ex. 2022 (Atkinson) at ¶60.



292 POR at 23; 292 Ex. 2022 (Atkinson) at ¶¶73-74;
293 POR at 24; 293 Ex. 2022 (Atkinson) at ¶¶73-74.

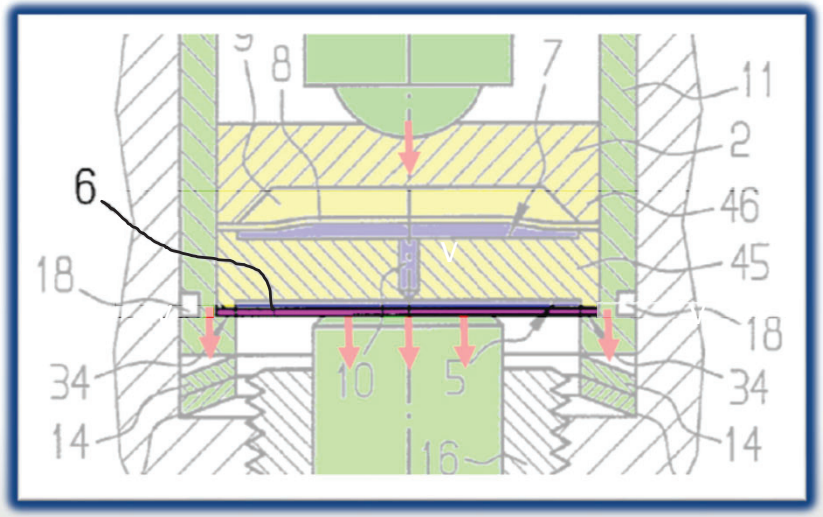
the transmission module (2) is movably arranged in the housing (12) of the injection valve, so that when the actuator (1) moves in the direction of the transmission module (2), the transmission module (2) in the housing (12) in the direction of the control element (3) is moved and the movement of the actuator (1) is at least partially transmitted to the control element (3) via a movement of the transmission module (2).

Klügl Claim 6 Requires a Flexible Membrane

6. Injection valve with an actuator (1) and a control element (3), which are operatively connected to one another by a transmission module (2), with the following features:
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);
the transmission module (2) has a compensation chamber (7) which is connected to the pressure chamber (5) via a connection (10);
the connection (10) and the transmission medium are designed in such a way that short-term pressure differences between the pressure in the pressure chamber (5) and the pressure in the compensation chamber (7) are hardly compensated and long-lasting pressure differences are almost completely compensated;
the actuator (1) is assigned to an upper side of the transmission module (2);
the control element (3) is assigned to the first flexible element (6) on the lower side of the transmission module (2);
the transmission module (2) is movably arranged in the housing (12) of the injection valve, so that when the actuator (1) moves in the direction of the transmission module (2), the transmission module (2) in the housing (12) in the direction of the control element (3) is moved and 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 (Klügl) at Claim 6;
292 POR at 30-31, citing 292 Ex. 2022 (Atkinson) at ¶60;
293 POR at 31-32, citing 293 Ex. 2022 (Atkinson) at ¶60.

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);



292 POR at 23, 30-31; 292 Ex. 2022 (Atkinson) at ¶¶60, 73-74;
293 POR at 24, 31-32; 293 Ex. 2022 (Atkinson) at ¶¶60, 73-74.

Klügl's Membrane 6 Must Be Flexible to Maintain Contact with Piston 3 in Fig. 1

87. The translated version of Klügl submitted as Exhibit 1006 relies on the flexibility of the membranes to maintain the drive piston 3 in contact with the first membrane 6. Ex. 1006, 3:50–4:10, 4:25–31. In the absence of the flexibility of the membrane 6, the drive piston 3 would not be able to take up or accommodate any variation in dimensionality induced by thermal effects or wear. The required "flexibility" of membrane 6 so that "automatic adjustment" can occur after actuation reinforces that the membrane will behave in a flexible manner ***during*** actuation. And in both circumstances, the fluid layer of the transmission medium in the pressure chamber 5 will ***not*** be of substantially uniform thickness across the radial dimension of membrane 6 when membrane 6 is subject to flexure.

292 Ex. 2022 (Atkinson) at ¶87; 292 POR at 33-34;
293 Ex. 2022 (Atkinson) at ¶87; 293 POR at 34.

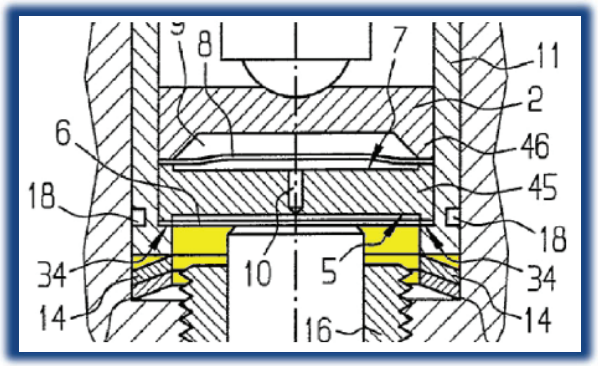
If the piezoelectric actuator **1** shortens in the rest position without being actuated due to thermal influences or signs of aging in relation to the housing **12**, the spring plate **8** pushes the transmission medium from the compensation chamber **7** via the throttle **10** into the pressure chamber **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**.

Ex. 1006 (Klügl) at 3:63-4:3;
292 Ex. 2022 (Atkinson) at ¶87; 292 POR at 33-34;
293 Ex. 2022 (Atkinson) at ¶87; 293 POR at 34.

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.

Ex. 1006 (Klügl) at 4:4-10;
292 Ex. 2022 (Atkinson) at ¶87; 292 POR at 33-34;
293 Ex. 2022 (Atkinson) at ¶87; 293 POR at 34.

Dr. Quinlan Agrees Klügl's Membrane 6 Must Maintain Contact with Piston 3 in Fig. 1



Ex. 2025 (Quinlan Dep.) at Dep. Exhibit 13 (annotated version of Ex. 6 (Klügl) at Figure 1); Ex. 2032 (reproduced stamped Dep. Exhibit 13); 292 POR at 34 (citing Quinlan Dep.); 293 POR at 35 (same).

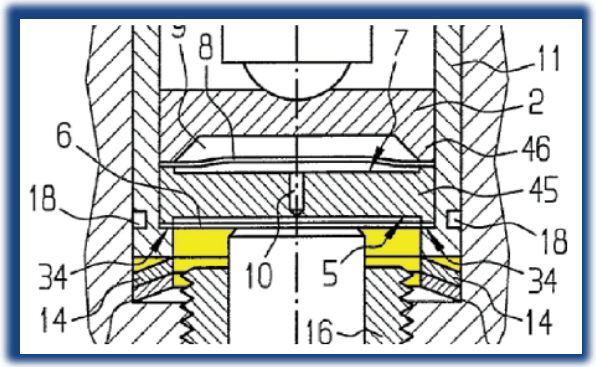


Ex. 2025 (Quinlan Dep.) at 139:10-17; 292 POR at 32-33; 293 POR at 33-34 292 Sur-Reply at 17; 293 Sur-Reply at 17.

Q. The membrane 6 in Figure 1 of Klugl designed to flex inwardly and outwardly over time, correct?

A. Whether it's inward or outward, I can't -- I can't tell you. It's -- the idea is that when you go through the design process, that you ensure that, say, a membrane 6 stays in contact with member 3, the piston-like component.

Klügl is Designed to Allow Membrane 6 to Flex into Open Space Around Piston 3



Ex. 2025 (Quinlan Dep.) at Dep. Exhibit 13 (annotated version of Ex. 6 (Klügl) at Figure 1);
Ex. 2032 (reproduced stamped Dep. Exhibit 13);
292 POR at 34 (citing Quinlan Dep.);
293 POR at 35 (same).



Ex. 2025 (Quinlan Dep.) at 127:4 - 128:21;
292 POR at 34-35;
293 POR at 35-36;
292 Sur-Reply at 13;
293 Sur-Reply at 13.

Q. What's the yellow portion of Exhibit 13?

A. I would generally consider it -- from the looks of it, it looks like it would be an open area.

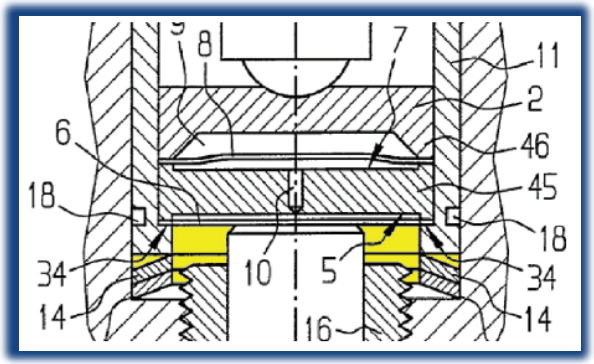
Q. (BY MR. PHILBIN) Okay. Let me give you an example. If I've got a plate that's solid on the top and a plate that's got a hole in it on the bottom and I've got a balloon in the middle and I press those two plates together, where's the balloon going to go?

A. It's going to get spread out and push through the hole in this hypothetical.

Q. Why would it get pushed through the hole?

A. The -- you're trying to balance the tension in the balloon with the pressure inside of the balloon as you push those plates together.

Klügl is Designed to Allow Membrane 6 to Flex into Open Space Around Piston 3



Ex. 2025 (Quinlan Dep.) at Dep. Exhibit 13 (annotated version of Ex. 6 (Klügl) at Figure 1);
Ex. 2032 (reproduced stamped Dep. Exhibit 13);
292 POR at 34 (citing Quinlan Dep.);
293 POR at 35 (same).



Ex. 2025 (Quinlan Dep.) at 127:4 - 128:21;
292 POR at 34-35;
293 POR at 35-36;
292 Sur-Reply at 13;
293 Sur-Reply at 13.

A. So -- but 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.

Q. (BY MR. PHILBIN) My question is: The flexible membrane 6 can flex into the yellow area of Exhibit 13, correct?

A. 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.

Dr. Quinlan Agrees Figure 1's Membrane Must be Flexible for Adjustments



Ex. 2025 (Quinlan Dep.) at 66:3-13;
292 POR at 32;
293 POR at 33;
292 Sur-Reply at 17;
293 Sur-Reply at 17.

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?

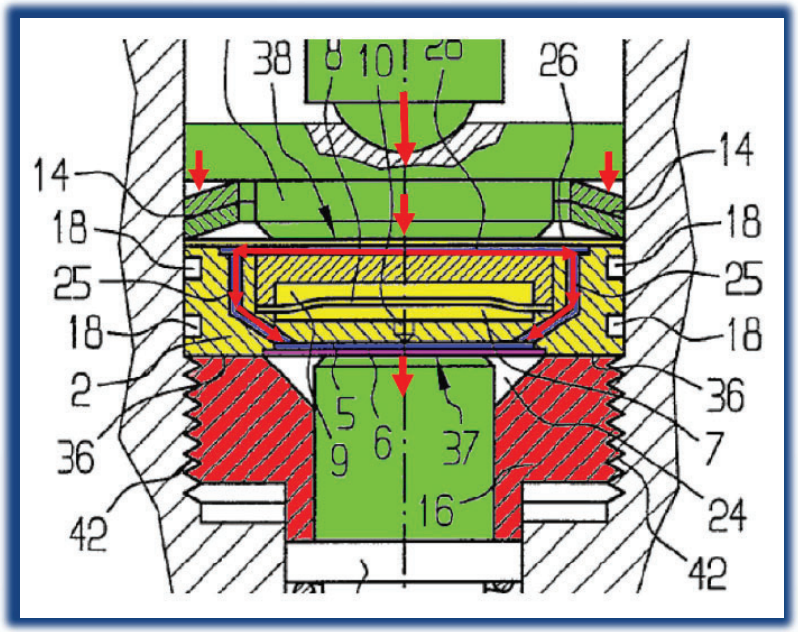
A. So, figure -- in Figure No. 1, the flexibility of 6 would be dependent on how the design was used, right? I mean, there -- there's two different functions here. One is during actuation and one is in the hydraulic link's ability to make up for things like wear and thermal expansion.

Petitioners Ignore that Membrane 6 Must be Flexible to Adjust, Arguing the Only Function is to (Inflexibly) Hold the Fluid in Place During Actuation

> No further discussion of membrane 6 was required because—in the context of Figure 1—the membrane performs no function besides holding the fluid in place. As explained, "Fig. 1 shows a device for power transmission ***without stroke***

Paper 9 at 13;
292 Sur-Reply at 16;
293 Sur-Reply at 16.

Klügl Teaches Figure 3's Membrane 6 is Flexible During Actuation



292 Ex. 2022 (Atkinson) at ¶¶75, 82; 292 POR at 37-38;
293 Ex. 2022 (Atkinson) at ¶¶75, 82; 293 POR at 37-38.

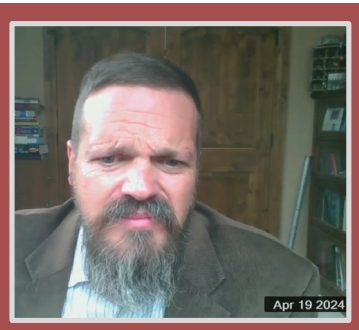
following the longitudinal movement of the die 29. As a result, the third membrane 26 is pushed downwards by the die 29 with the circular plunger surface 38 causing the transmission medium located in the second pressure chamber 28 to be pushed into the pressure chamber 5 via the lines 25. This deflects first membrane 6 in the direction of the drive piston 3 and the drive piston 3 is thus moved against the spring force of the spring 15 in the direction of the closing element 4." Ex. 1006, 5:52–65.

292 Ex. 2022 (Atkinson) at ¶¶75, 82; 292 POR at 37-38;
293 Ex. 2022 (Atkinson) at ¶¶75, 82; 293 POR at 37-38.

of the transmission module **2**. However, the transmission module **2** is fixed in position by the lower stop **16** preventing it from following the longitudinal movement of the die **29**. As a result, the third membrane **26** is pushed downwards by the die **29** with the circular plunger surface **38** causing the 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 against the spring force of the spring **15** in the direction of the closing element **4**. As a result of this, the closing element **4** is lifted

Ex. 1006 (Klügl) at 5:55-65.

Dr. Quinlan Testified Klügl Teaches Membrane 6 is Flexible During Actuation for Figure 3



Ex. 2025 (Quinlan Dep.)

Q. So you would agree that a membrane is either capable of being flexible or not capable of being flexible, correct?

A. It would be relative to the forces applied to it and the material that it's made out of, so within this embodiment in Figure 3 shown, the operation requires it to be flexible.

Ex. 2025 (Quinlan Dep.) at 118:14-21; *id.* at 62:21-24 (same);
292 POR at 38;
293 POR at 39.

Q. I'm not asking about a flexed state. I'm asking, is membrane 6 sometimes flexible and sometimes inflexible in Figure 3 of Klugl?

A. So, in Figure 3 of Klugl, the membrane 6 relies on its flexibility to perform its job, right? To actuate piston number 3. So does it have the property of being flexible? It must have some property of being flexible for this case, for Figure 3.

Ex. 2025 (Quinlan Dep.) at 118:1-8; *id.* at 62:21-24 (same);
292 POR at 38;
293 POR at 39.

Dr. Quinlan Had No "Complete Opinion" about Flexibility of Membrane 6



Ex. 2025 (Quinlan Dep.) at 66:14-18;
292 POR at 2, 31-32;
293 POR at 2, 32-33;
292 Sur-Reply at 17;
293 Sur-Reply at 17.

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.

Dr. Quinlan Testified no "Formal Opinions" about Membrane 6's Flexibility



Ex. 2025 (Quinlan Dep.) at 47:14-20;
292 POR at 2, 31-32;
293 POR at 2, 32-33;
292 Sur-Reply at 17;
293 Sur-Reply at 17.

Q. What's your understanding what flexible means in the context of the Klugl reference?

A. Again, I haven't been asked to offer a formal opinion of what flexible means in light of this, but if you want to talk about a specific -- excuse me -- part of the document, I'd be happy to.

Q. What is a flexible membrane?

A. Again, I haven't offered a formal opinion what a flexible membrane is.

Ex. 2025 (Quinlan Dep.) at 47:24-48:1;
292 POR at 2, 31-32;
293 POR at 2, 32-33;
292 Sur-Reply at 17;
293 Sur-Reply at 17.

Dr. Quinlan Was Unable to Identify ANY Exemplary Membranes



Ex. 2025 (Quinlan Dep.);
292 POR at 2, 31-32, 50;
293 POR at 2, 32-33, 51;
292 Sur-Reply at 17;
293 Sur-Reply at 17.

Q. (BY MR. PHILBIN) What is a membrane?
A. Usually, it's a thin sheet of material but I haven't formed a formal opinion on it.

Ex. 2025 (Quinlan Dep.) at 47:21-23.

Q. (BY MR. PHILBIN) Are you aware of any commercial fuel injectors that use a flexible membrane?
A. Not that I'm aware of.
Q. In October of 1999, were you aware of any commercial fuel injectors that used a flexible membrane?
A. Not that I'm aware of.

Ex. 2025 (Quinlan Dep.) at 49:14-19.

Q. (BY MR. PHILBIN) In October of 1999, what material were membranes made from in fuel injectors?

A. I -- I could imagine that you use -- could use many different materials for -- for that.
Q. (BY MR. PHILBIN) Can you name three?
A. I cannot. If you want to talk about specifics....

Ex. 2025 (Quinlan Dep.) at 48:14-21.

Q. As membrane 6 flexes over time, would you expect it to lose rigidity?

A. Seeing as how I haven't done the design process to go through and decide what 6 is made out of and what its material is, I don't know.

Ex. 2025 (Quinlan Dep.) at 140:20-25.

In Reply, Dr. Quinlan Proposes a Hypothetical Membrane Material

49. Dr. Atkinson posits that Klügl's membrane 6 "will not have different properties during actuation and while at rest (e.g., the membrane will be pliable and flexible in both circumstances)." Ex. 2022, ¶ 67.

50. While I agree that the membrane 6 has the same structure and physical properties at all times, this does not mean that it ***behaves*** the same during both actuation and periods of rest.

Ex. 1040 (Quinlan Reply Decl.) at ¶¶ 49-50;
292 Sur-Reply at 12-13, 17-18;
293 Sur-Reply at 12-13, 17-18.

52. It is these long-lasting differences—which are present only during much longer rest periods and not very short actuation periods—that cause the same membrane to behave differently during actuation and rest.

Ex. 1040 (Quinlan Reply Decl.) at ¶52;
292 Sur-Reply at 12-13, 17-18;
293 Sur-Reply at 12-13, 17-18.

In Reply, Dr. Quinlan Now Contends a POSITA Would Have Modified Klügl's Flexible Membrane 6 to be "Less Flexible"

"No Formal Opinion"



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 (Quinlan Dep.) 66:14-18;
292 Sur-Reply at 14-17;
293 Sur-Reply at 14-17.

July 2024

April 2024

33. In my opinion, 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. Likewise, a POSITA would have, in my opinion, been more than capable of reducing the possibility of membrane failure by designing the membrane appropriately (*e.g.*,

292 Ex. 1040 (Quinlan Reply Decl.) at ¶33;
293 Ex. 1040 (Quinlan Reply Decl.) at ¶33;
292 Sur-Reply at 12-13;
293 Sur-Reply at 12-13.

Klügl's Transmission Medium is Not "Substantially Solid" or a "Substantially Constant" Thickness During Actuation

- Klügl's "Transmission Medium" Flows During Actuation
- Klügl Figure 1 Uses a Flexible Membrane
- Klügl Figure 1's Flexible Membrane Flexes During Actuation
- Movement of Figure 1's Actuator is Only Partially Transmitted

Petitioners' Argument that Klügl Membrane 6 Will Not Deform is Wrong

is ***directly contrary*** to what Klügl itself teaches. The Board concluded that membrane 6 in Klügl's first embodiment would deform during injector actuation resulting in a substantial change in hydraulic fluid thickness. This—as Patent Owner

Paper 9 at 2.

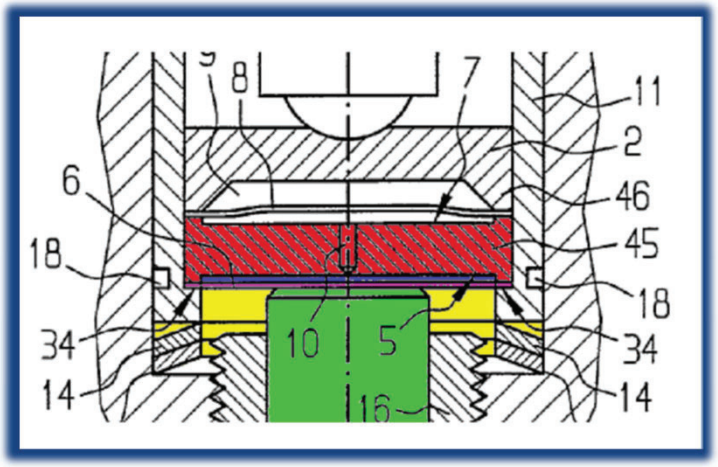
Neither Patent Owner nor the Board cite any teaching in Klügl to suggest membrane 6 deforms in this manner or that the thickness of the fluid filling pressure chamber 5 in Klügl's first embodiment would change during actuation. Moreover,

Paper 9 at 7.

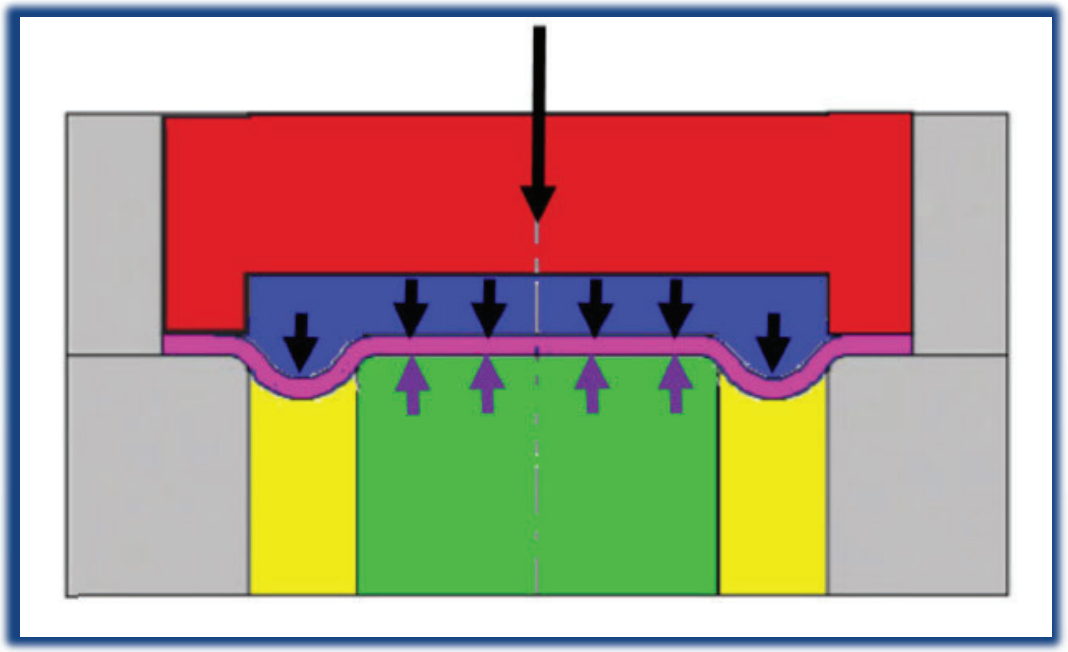
translation, or stroke." *See* Response at 32. Thus, respectfully, the Board misapprehended the teaching of Klügl. Per Klügl, actuator 1 and drive piston 3 move the same amount such that membrane 6 cannot substantially deform and the thickness of the hydraulic fluid between the transmission module and the piston must remain substantially constant. The figures below, based on Patent Owner's

Paper 9 at 11.

Flexible Membrane 6 Flexes and Deforms During Actuation



292 POR at 35-36; 292 Ex. 2022 (Atkinson) at ¶78;
293 POR at 36-37; 293 Ex. 2022 (Atkinson) at ¶78.

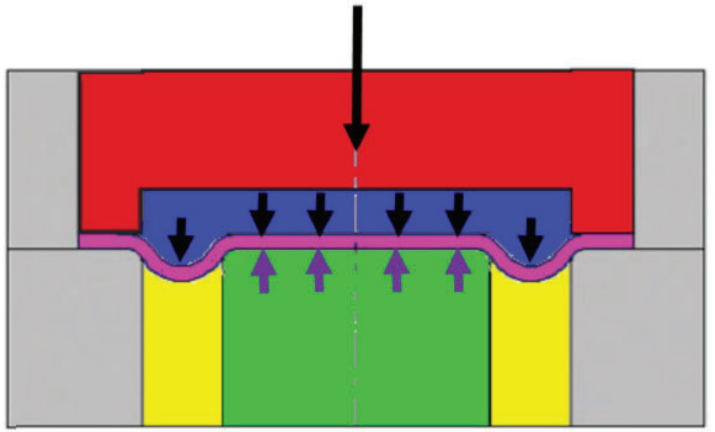


292 POR at 35-36; 292 Ex. 2022 (Atkinson) at ¶78;
293 POR at 36-37; 293 Ex. 2022 (Atkinson) at ¶78.

Flexible Membrane 6 Flexes and Deforms During Actuation

flexible membrane 6 (pink) that is in contact with drive piston 3. Due 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 where unconstrained in the annular area (i.e., void space depicted in yellow) 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.

292 Ex. 2022 (Atkinson) at ¶79; 292 POR at 35-36;
293 Ex. 2022 (Atkinson) at ¶79; 293 POR at 36-37.

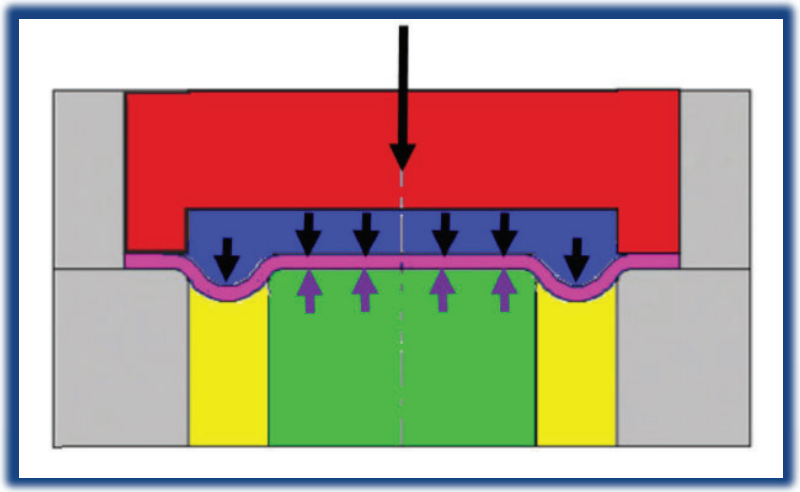


292 Ex. 2022 (Atkinson) at ¶78;
293 Ex. 2022 (Atkinson) at ¶78.

Flexible Membrane 6 Flexes and Deforms During Actuation

80. A POSITA would understand that fluids move from higher pressure to lower pressure. During actuation, there will be higher pressure in transmission fluid near the contact area between flexible membrane 6 and drive piston 3 and lower pressure at the annular area of flexible membrane 6 where there are no upward forces being applied. As a result, the transmission fluid will flow outward and cause a thinning of the transmission fluid layer in pressure chamber 5 above drive piston 3 and a bulging of transmission fluid in the annular area of pressure chamber 5. In 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 desirable feature of its intended purpose and behavior.

292 Ex. 2022 (Atkinson) at ¶80; 292 POR at 35-37;
293 Ex. 2022 (Atkinson) at ¶80; 293 POR at 36-38.



292 Ex. 2022 (Atkinson) at ¶78, 292 POR at 35-37;
293 Ex. 2022 (Atkinson) at ¶78, 293 POR at 36-38.

Dr. Quinlan's Shifting Opinions Should Be Given No Weight

"No Formal Opinion"



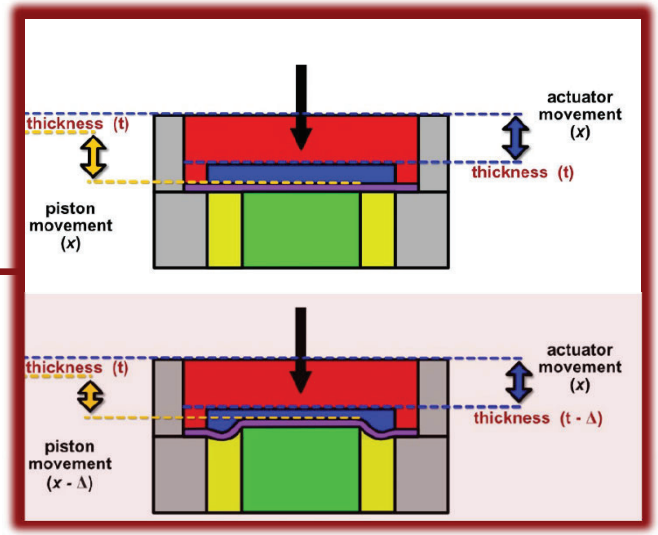
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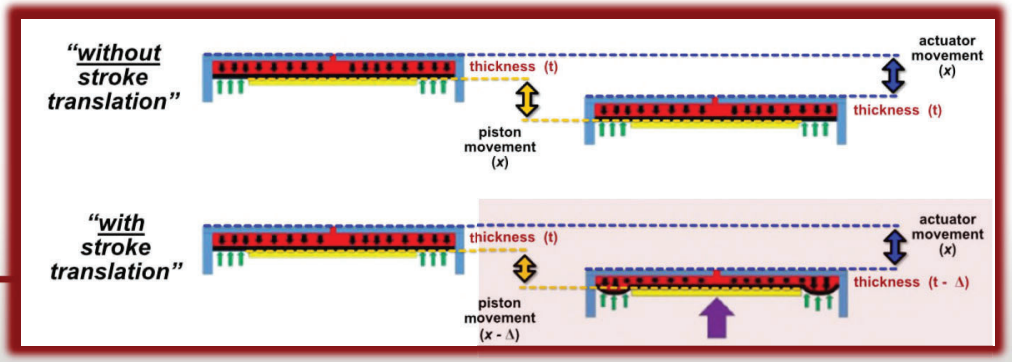
July 2023

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 (Quinlan Dep.) 66:14-18;
292 Sur-Reply at 14-17;
293 Sur-Reply at 14-17.



292 Ex. 1040 (Quinlan Decl.) at 27;
293 Ex. 1040 (Quinlan Decl.) at 27;
292 Sur-Reply at 14-17;
293 Sur-Reply at 14-17.



292 Paper 9 at 11-12 (asserting that Klügl does not bulge and calling Westport's flexibility argument an "erroneous interpretation");
293 Paper 9 at 11-12 (same);
292 Sur-Reply at 14-17;
293 Sur-Reply at 14-17.

Dr. Quinlan Opined Membrane 6 "Holds Fluid in Place"

220. In 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." (*id.*, 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. (*See id.*)

292 Ex. 1003 (Quinlan) at ¶220;
293 Ex. 1003 (Quinlan) at ¶208;
292 Sur-Reply at 13;
293 Sur-Reply at 13.

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). It is incompressible (so it will not change volume upon application of pressure). As a result, during the actuation, the distance between the actuator and piston remains constant (so as to ensure that there is a unity stroke ratio).

292 Ex. 1003 (Quinlan) at ¶224;
293 Ex. 1003 (Quinlan) at ¶212;
292 Sur-Reply at 13;
293 Sur-Reply at 13.

An Incompressible Fluid Must Be Sufficiently Constrained Under Actuation Forces



Ex. 2025 (Quinlan Dep.) at 125:5-9;
292 POR at 33;
293 POR at 34.

Q. Will an incompressible fluid change volume under pressure against a flexible membrane?

A. 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 Testified No "Formal Opinions" on Deformation



Ex. 2025 (Quinlan Dep.) at 49:4-8;
292 POR at 2, 28, 31;
293 POR at 2, 29, 32;
292 Sur- Reply at 15-16;
293 Sur-Reply at 15-16.

Q. (BY MR. PHILBIN) Would you agree that a material that is flexible can deform?

A. Again, I haven't offered formal opinions on what flexible means and whether it can deform or not.

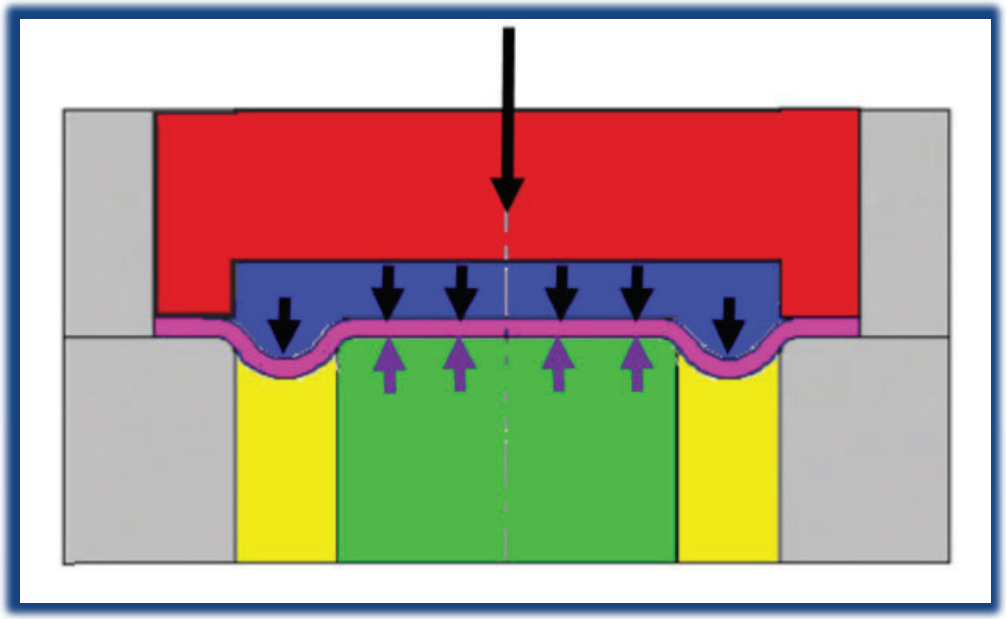
Klügl's Transmission Medium is Not "Substantially Solid" or a "Substantially Constant" Thickness During Actuation

- Klügl's "Transmission Medium" Flows During Actuation
- Klügl Figure 1 Uses a Flexible Membrane
- Klügl Figure 1's Flexible Membrane Flexes During Actuation
- Movement of Figure 1's Actuator is Only Partially Transmitted

Actuation Movement is "Partially Transmitted" Because of Deformation of the Flexible Membrane

amplification." *See* Ex. 1003, ¶ 220. To the contrary, the translated version of Klügl submitted as Exhibit 1006 teaches that in Fig. 1 when the actuator is controlled the amount of its movement must only be "***at least partially transmitted***" to the drive piston 3 via the movement of the transmission module 2. Ex. 1006, 8:61–68 (emphasis added).

78. This partial transmission of movement is consistent with how the device depicted in Fig. 1 would work. In operation, the actuator 1 of Fig. 1 extends longitudinally and pushes the transmission module 2 downward (along with guide sleeve 11). The downward movement of transmission module 2 applies downward force on drive piston 3 across the interface between drive piston 3 and flexible membrane 6 in order to cause drive piston 3 to move longitudinally down. A POSITA would understand that the innate flexibility of flexible membrane 6 means that a specific movement of the actuator 1 would be "partially transmitted" to the drive piston 3, and never "always fully transmitted."



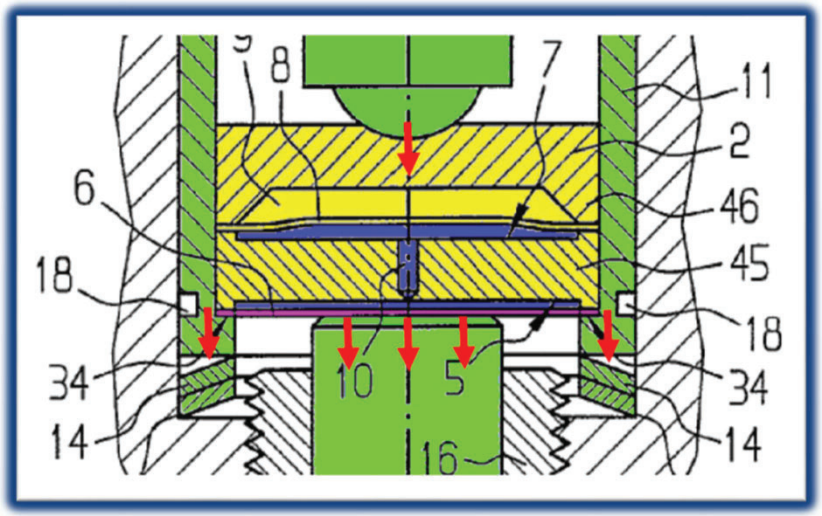
Ex. 2022 (Atkinson) at ¶78; POR at 35-36.

Ex. 2022 (Atkinson) at ¶¶ 77-78; POR at 41.

Klügl's Claim 6 Covers the Movable Embodiment of Figure 1

60. A POSITA would understand that claim 6 covers the devices depicted in Figs. 1 and 2, at least because the claim requires a "movably arranged" "transmission module (2)" and movement of the actuator (1) that "is at least partially transmitted to the control element (3) via a movement of the transmission module (2)." Ex. 1006, 8:61–68. Accordingly, a POSITA would not understand claim 6 to cover Fig. 3.

292 Ex. 2022 (Atkinson) at ¶60; 292 POR at 30-31;
293 Ex. 2022 (Atkinson) at ¶60; 293 POR at 31-32.



292 POR at 30-31; 292 Ex. 2022 (Atkinson) at ¶¶60, 74;
293 POR at 31-32; 293 Ex. 2022 (Atkinson) at ¶¶ 60, 74.

Klügl Claim 6 Requires Only That Movement is "Partially Transmitted"

6. Injection valve with an actuator (1) and a control element (3), which are operatively connected to one another by a transmission module (2), with the following features:
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);
the transmission module (2) has a compensation chamber (7) which is connected to the pressure chamber (5) via a connection (10);
the connection (10) and the transmission medium are designed in such a way that short-term pressure differences between the pressure in the pressure chamber (5) and the pressure in the compensation chamber (7) are hardly compensated and long-lasting pressure differences are almost completely compensated;
the actuator (1) is assigned to an upper side of the transmission module (2);
the control element (3) is assigned to the first flexible element (6) on the lower side of the transmission module (2);
the transmission module (2) is movably arranged in the housing (12) of the injection valve, so that when the actuator (1) moves in the direction of the transmission module (2), the transmission module (2) in the housing (12) in the direction of the control element (3) is moved and the movement of the actuator (1) is at least partially transmitted to the control element (3) via a movement of the transmission module (2).

the transmission module (2) is movably arranged in the housing (12) of the injection valve, so that when the actuator (1) moves in the direction of the transmission module (2), the transmission module (2) in the housing (12) in the direction of the control element (3) is moved and 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 (Klügl) at Claim 6;
292 POR at 30-31, citing 292 Ex. 2022 (Atkinson) at ¶60;
293 POR at 31-32, citing 293 Ex. 2022 (Atkinson) at ¶60.

Petitioners Told the Board in Their Rehearing Request that if Westport is Correct, then Thickness is Not "Substantially Constant"

At Rehearing Stage:

> Moreover, if the embodiment did operate this way, "stroke translation" would occur and a "stroke ratio" would be applied because drive piston 3 would move less than actuator 1 as a result of a reduction in the thickness of the fluid in pressure chamber 5. Klügl itself teaches, however, that the embodiment of Figure

Paper 9 at 7.

Westport is Correct, But Now Petitioners Contend the Change in Thickness is "Insubstantial" and Unquantified

> Ex. 1001, claim 1 (emphasis added). Insubstantial, meaningless changes in link thickness do not matter. Patent Owner does not attempt to quantify how much membrane flexing purportedly occurs when Klügl's injector is actuated. And it

292 Reply at 10; *id.* at 6;
293 Reply at 10; *id.* at 6;
292 Sur-Reply at 14-15;
293 Sur-Reply at 14-15.

"[In]Substantial Change in the Thickness" is Not the Claim Language

membrane flexing purportedly occurs when Klügl's injector is actuated. And it offers no explanation of why any such flexing would result in a "substantial" (as opposed to insubstantial) change in the "thickness" of Klügl's hydraulic link.

292 Reply at 10; *id.* at 6 (substantially flex);
293 Reply at 10; *id.* at 6 (same).

transmitted, whereby said hydraulic fluid acts substantially as a solid with said thickness being substantially constant while said actuator assembly is activated and wherein said thickness of said hydraulic link is adjust-

292 Ex. 1001 ('829 Patent) at Claim 1;
293 Ex. 1001 ('138 Patent) at Claim 1.

The Thickness is Not Substantially Constant

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

292 POR at 46, 63; 292 Ex. 2022 (Atkinson) at ¶¶ 78-82, 88;
293 POR at 47, 65; 292 Ex. 2022 (Atkinson) at ¶¶ 78-82, 88;
292 Sur-Reply at 14-18;
293 Sur-Reply at 14-18.

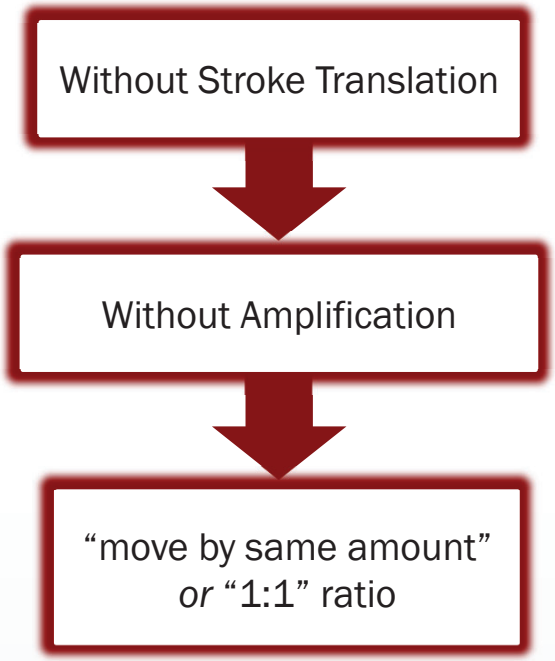
67. The translated version of Klügl submitted as Exhibit 1006 expressly teaches that membrane 6 is flexible. *E.g.*, Ex. 1006, 7:45–46; 7:65–9:30. Even if it did not, a POSITA would know membranes are flexible and pliable elements that will deform when subjected to the significant forces exerted within an injector at the typical actuation rates of the fuel injection process. Even a small deflection or deformation of the pliable, flexible membrane will be critical as the lift commonly generated in these applications is very small, usually less than 100 microns (about the thickness of a piece of paper). A POSITA also would understand that a membrane will not have different properties during actuation and while at rest (e.g., the membrane will be pliable and flexible in both circumstances).

292 POR at 33-36; 292 Ex. 2022 (Atkinson) at ¶67;
293 POR at 34-37; 292 Ex. 2022 (Atkinson) at ¶67;
292 Sur-Reply at 12;
293 Sur-Reply at 12.

Petitioners' Stroke Amplification Argument Fails

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Even if "Stroke Ratio" Refers to "Amplification," It Does Not Mean 1:1 Ratio



In short, what started as "'without stroke translation' means 'without amplification'" has evolved into a requirement that the components in Figure 1 "mov[e] by the same amount." (Reply, 7.) This is an unsupportable interpretation and should not be countenanced. Klügl simply does not teach that the actuator and piston in Figure 1 would move by "the same amount." To the contrary, because Petitioners fail to contest that Claim 6 of Klügl is directed to Figure 1, and Claim 6 expressly requires only the ***partial transmission*** of the movement of the actuator, Petitioners concede Figure 1 cannot be limited to movement by the same amount. (Ex. 1006, Claim 6; Ex. 2022, ¶¶60, 77; POR, 30-31.) That alone should be the end

292 Sur-Reply at 10;
293 Sur-Reply at 10;
292 POR at 27-31;
293 POR at 28-32.

Petitioners Argue "Without Stroke Translation" Means "Without Stroke Amplification"

220. In 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.

292 Ex. 1003 (Quinlan Decl.) at ¶ 220;
293 Ex. 1003 (Quinlan Decl.) at ¶ 208.

234. As I have noted, Klügl states that the fluid in chamber 5 has a low compressibility. And, as I have also explained, in the embodiment of Figure 1, no stroke amplification or change in translation distance occurs and chamber 5 does not change dimension during actuation. As a result, its ***"thickness"*** is ***"substantially constant"***

292 Ex. 1003 (Quinlan Decl.) at ¶ 234;
293 Ex. 1003 (Quinlan Decl.) at ¶ 222.

in the embodiment of Figure 1 (unlike the embodiment of Figure 3), no stroke amplification occurs and chamber 5 does not change dimension during actuation.

292 Petition at 38, *see also id.* 36-37;
293 Petition at 36, *see also id.* 34-35;
Paper 9 at 6-7;
292 Reply at 6;
293 Reply at 6.

Petitioners Argue "Without Amplification" Requires 1:1 movement.

220. In 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.

292 Ex. 1003 (Quinlan Decl.) at ¶ 220;
293 Ex. 1003 (Quinlan Decl.) at ¶ 208.

it will not change volume upon application of pressure). As a result, during the actuation, the distance between the actuator and piston remains constant (so as to ensure that there is a unity stroke ratio).

292 Ex. 1003 (Quinlan Decl.) at ¶ 224;
293 Ex. 1003 (Quinlan Decl.) at ¶ 212.

the pressure chamber 5…." (Ex. 1006, 3:23-29.) 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. (*See id.*, Fig. 1; 3:23-

292 Petition at 37;
293 Petition at 34.

1:41-42. This means the piston and actuator move by the ***same amount***. *Id.* at Fig. 1, 1:41-42, 3:32-29; Ex. 1003, ¶¶ 220-22. Klügl contrasts this with another

Paper 9 at 1, 6-7.

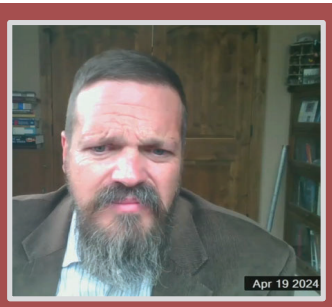
Despite his Decl, Dr. Quinlan Testified No Opinion on "Stroke Amplification"

"passive hydraulic link." Per Klügl, the fluid also has a low compressibility. And, in the embodiment of Figure 1 (unlike the embodiment of Figure 3), no stroke amplification occurs and chamber 5 does not change dimension during actuation. As a result, the hydraulic link simply transmits force rather than generating it and its *"thickness"* is *"substantially constant."* (*See* Ex. 1003, ¶¶ 230-234.) Finally, fluid

292 Petition at 39;
293 Petition at 36.

234. As I have noted, Klügl states that the fluid in chamber 5 has a low compressibility. And, as I have also explained, in the embodiment of Figure 1, no stroke amplification or change in translation distance occurs and chamber 5 does not change dimension during actuation. As a result, its *"thickness"* is *"substantially constant"*

292 Ex. 1003 (Quinlan Decl.) at ¶ 234;
293 Ex. 1003 (Quinlan Decl.) at ¶ 222.



Ex. 2025 (Quinlan Dep.) at 39:16-23,
292 POR at 2, 28, 30;
293 POR at 2, 29, 31.

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.

Dr. Quinlan Had No "Formal Opinion" on Amplification



Ex. 2025 (Quinlan Dep.) 292 POR at 2, 28, 30; 293 POR at 2, 29, 31.

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

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 (Quinlan Dep.) at 37:4-10.

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.

Ex. 2025 (Quinlan Dep.) at 34:3-8.

Q. (BY MR. PHILBIN) Do you have an opinion as to whether without stroke translation means without amplification?

A. Again, I haven't done any formal definitions based on stroke amplification, so I would have to -- you know, have time to take a deep dive and form an opinion on that.

Ex. 2025 (Quinlan Dep.) at 40:12-18.

Q. (BY MR. PHILBIN) Does without amplification mean exactly equal to?

A. Again, I haven't formed an opinion exactly of what amplification means in terms of this, and so I don't think I would be able to offer an opinion on that.

Ex. 2025 (Quinlan Dep.) at 40:23–41:2.

Petitioners Do NOT use "Stroke Translation" and "Stroke Ratio" as Synonyms

says, the interpretation of Klügl's Figure 1 embodiment proffered by Patent Owner and adopted by the Board results in a hydraulic link "*with stroke translation*" that applies a "*stroke ratio*" to the piston movement. This is in clear contradiction to

Paper 9 at 2.

Moreover, if the embodiment did operate this way, "stroke translation" would occur and a "stroke ratio" would be applied because drive piston 3 would move

Paper 9 at 7.

220. Thus, the intermediate fluid layer through which force is transmitted must maintain substantially the same thickness during actuation (otherwise, the stroke would be subject to translation and a stroke ratio would be applied). *Id.*; Petition at

Paper 9 at 7.

claimed subject matter. Because Klügl's first embodiment is "without stroke translation," no stroke ratio is applied, and the piston moves by the same amount as the actuator. This in turn means that the thickness of Klügl's hydraulic fluid 5

Paper 9 at 10.

that the injector shown in Figure 1 operates "with stroke translation" and applies a "stroke ratio" (*i.e.*, the piston moves by a different amount than the actuator).

Paper 9 at 14.

the thickness of hydraulic fluid 5 changes during operation resulting in less movement of piston 3, stroke translation, and the application of a stroke ratio. Per

Paper 9 at 15.

way that has the ***opposite*** effect of what Klügl teaches (*i.e.*, an embodiment "without stroke translation" instead has "stroke translation" and applies a "stroke ratio" during actuation). Because the Board's decision is contrary to and

Paper 9 at 15.

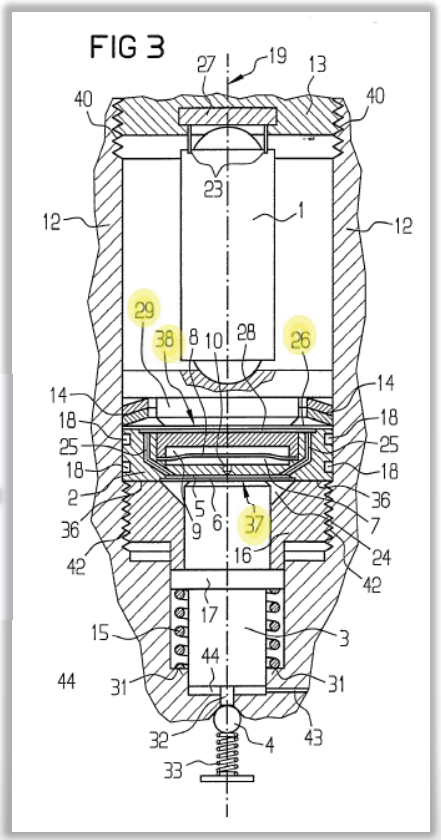
Dr. Quinlan Misquotes Klügl's Description of Figure 3; Klügl Does Not Use "Stroke Ratio" when Discussing Figure 1

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 defection of the piezoelectric actuator 1 and the deflection of the drive piston 3." (*Id.*, 7:12-13.)

292 Ex. 1003 (Quinlan) at ¶221;
293 Ex. 1003 (Quinlan) at ¶209;
292 POR at 25-27; 293 POR at 26-28..

The die surface **38** with which the die **29** bears against the third membrane **26** is advantageously larger than the piston surface **37** with which the drive piston **3** bears against the first membrane **6**. This way, it achieves a stroke ratio between the deflection of the piezoelectric actuator **1** and the deflection of the drive piston **3**. In addition, it is

Ex. 1006 (Klügl) at 7:9-14, Figure 3.



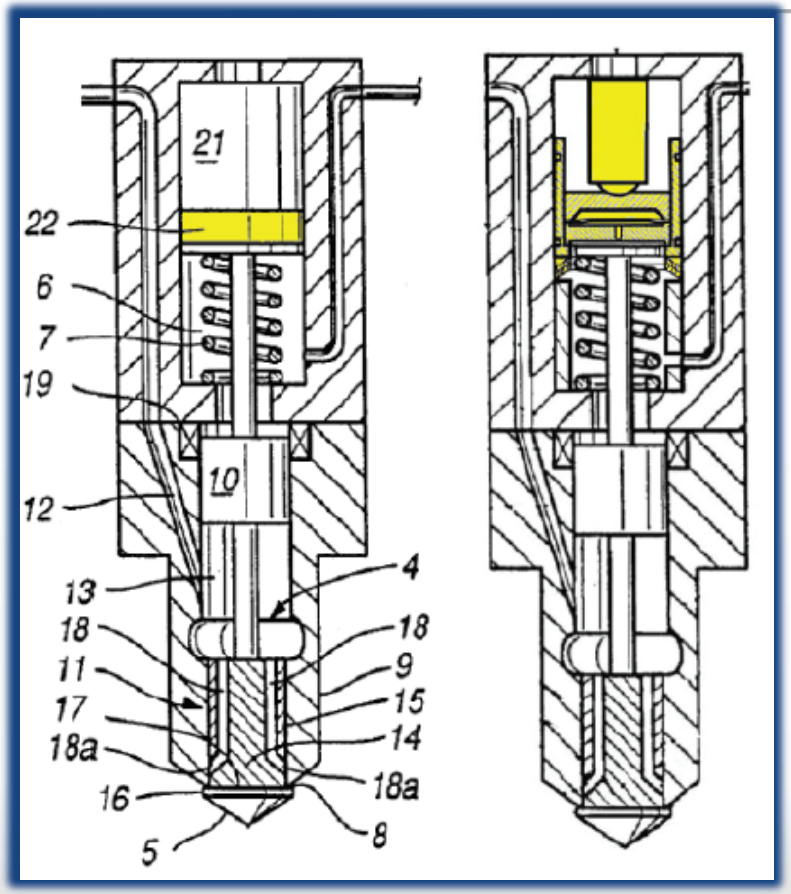
Even if Klügl uses "stroke ratio" in connection with Figure 3, it does NOT follow that Figure 1 "does not achieve a stroke ratio."

5. Grounds 1 and 2 (Wirbeleit + Klügl)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Petitioners' Combination of Wirbeleit + Klügl Fails to Teach Other Limitations



292 Ex. 2022 (Atkinson) at ¶110; 292 POR at 43-44;
293 Ex. 2022 (Atkinson) at ¶110; 293 POR at 44-45.

1. Petitioners do not explain "how closing forces are transmitted through a hydraulic fluid thickness after Petitioners substitute Wirbeleit's magnetostrictive actuator for Klügl's piezoelectric actuator," as shown in the combined figure. POR at 44.
2. Wirbeleit includes no details that supplement Klügl's disclosure as to a passive hydraulic link. POR at 44.
3. Wirbeleit does not describe that Element 22 is "sealed within its housing," that it is "not connected to a separate fluid supply," or that it provides a direct "simple force pathway," as Petitioners argue. POR at 45.
4. Klügl does not disclose adjustments "in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift." POR at 47-48. Wirbeleit does not cure this deficiency. It describes a system where needle lift is adjusted by electronic means, not mechanical means. POR at 48.

Klügl and Wirbeleit Combined Do Not Disclose the Claimed Passive Hydraulic Link

(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 [i] said hydraulic fluid acts substantially as a solid with said [ii] thickness being substantially constant while said actuator assembly is activated and wherein said [iii] thickness of said hydraulic link is adjustable while said actuator is not activated [iv] in response to changes in the dimensional relationship between components of said injection valve to maintain a desired valve needle lift upon activation of said actuator assembly.	(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 [i] said hydraulic fluid acts substantially as a solid with said [ii] thickness being substantially constant while said actuator assembly is actuated and wherein said [iii] thickness of said hydraulic link is adjustable while said actuator assembly is not actuated [iv] 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.
292 Ex. 1001 ('829) Claim 1; 292 POR at 11-12, 46-50.	293 Ex. 1001 ('138) Claim 1; 293 POR at 12, 47-51.

Klügl and Wirbeleit Combined Do Not Disclose the Claimed Passive Hydraulic Link

> Next, Patent Owner argues that "disadvantages with flexible membranes" would purportedly weigh against combination. Response, 57. **The decisive fact is that Klügl fills a gap in Wirbeleit's disclosure.** And it does so in a way that is not

292 Reply at 21;
293 Reply at 21.

Klügl does not teach "to maintain a desired <u>valve needle lift</u> …"

> 40. As Klügl explains, module 2 is meant to account for changes in the dimensions of the ***actuator*** (*e.g.*, different materials with differing thermal expansion), not the piston 3 or needle 32 (*e.g.*, similar materials with similar thermal expansion).

292 Ex. 1040 (Quinlan Reply Decl.) at 40;
293 Ex. 1040 (Quinlan Reply Decl.) at 40;
292 Sur-Reply at 19-20;
293 Sur-Reply at 19-20.

Wirbeleit does <u>not</u> teach adjusting a "**thickness**," and <u>not</u> in response to **dimensional changes** ("aging" or "thermal")

> Further, while Wirbeleit does allow for control of valve lift, it does not itself "solve" problems like component misalignment resulting from aging and thermal effects: Klügl's transmission module 2 does solve that. *Id.*, 47-52.

292 Reply at 20;
293 Reply at 20;
292 Sur-Reply at 19-20;
293 Sur-Reply at 19-20.

Klügl and Wirbeleit Combined Do Not Disclose the Claimed Passive Hydraulic Link

235. Finally, Klügl explains that fluid can flow between chambers 5 and 7 through the throttle 10 during times of rest to account for thermal expansion or wear so as to ensure that the various components (such as the piston 3 and transmission module 2) remain in contact. Thus, in my opinion, its ***"thickness … is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components."***

292 Ex. 1003 (Quinlan Decl.) at 235;
293 Ex. 1003 (Quinlan Decl.) at 223.



184. Further, as noted above, the "lift position" of Wirbeleit's needle can both be controlled by an "electronic control unit" and measured using a "needle lift sensor." (*Id.*, 2:4-10.)

236. Further, Wirbeleit's system is meant to facilitate control of the amount of "needle lift." (Ex. 1004, 2:1-12)

292 Ex. 1003 (Quinlan Decl.) at 236;
293 Ex. 1003 (Quinlan Decl.) at 224.



wherein said **thickness of said hydraulic link is adjustable** while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve **to maintain a desired valve needle lift** . . .

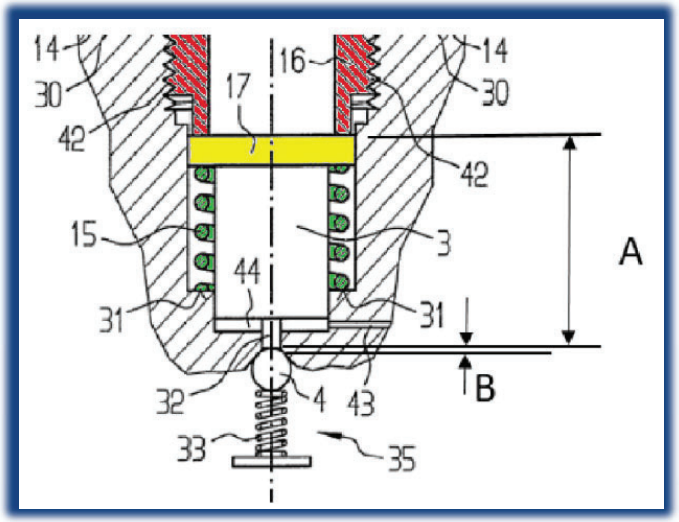
292 Ex. 1001 ('829 Patent) at Claim 1;
293 Ex. 1001 ('138 Patent) at Claim 1;
292 POR at 47-49;
293 POR at 48-50.

Klügl Cannot Adjust "A," and Thus, Cannot Adjust to Maintain "Desired Valve Needle Lift"

components within the valve. As discussed, annotated Fig. 1 below has a check ring 17 (yellow) that will be pressed upward by spring 15 (green) against lower stop 16 (red). Ex. 1006, 2:35–49. As the translated version of Klügl submitted as Exhibit

16. This way, the lower stop 16 specifies the rest position of drive piston 3." Ex. 1006, 2:44–49 (emphasis added). In other words, as shown in the annotated Fig. 1 below, when at rest, the distance A from the lower stop 16 to the end of the valve needle 32 is fixed and any "automatic adjustment" provided by the flexible membrane of Klügl's transmission module will not adjust distance A, which is the critical distance in Klügl's design for insuring desired valve needle lift.

292 Ex. 2022 (Atkinson) at ¶68;
293 Ex. 2022 (Atkinson) at ¶68;
292 POR at 47-49;
293 POR at 48-50.



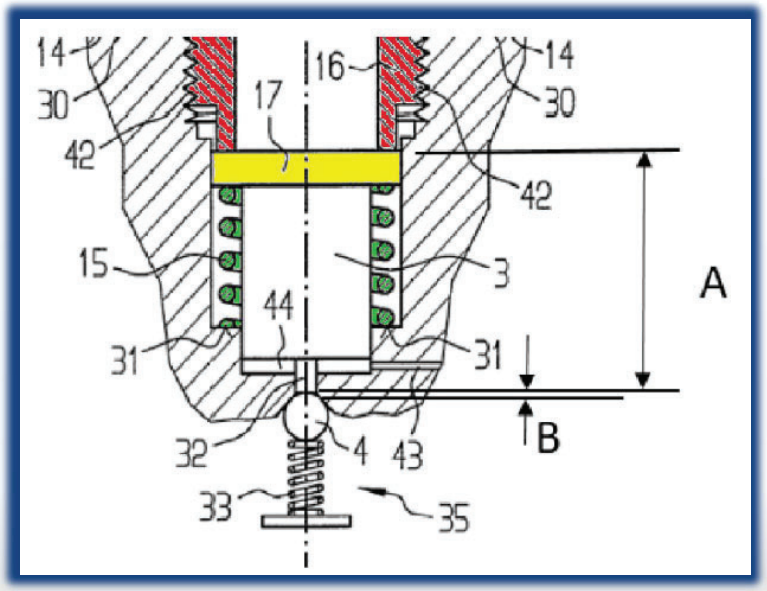
292 Ex. 2022 (Atkinson) at ¶68;
293 Ex. 2022 (Atkinson) at ¶68.

Klügl Cannot Adjust "A," and Thus, Cannot Adjust to Maintain "Desired Valve Needle Lift"

69. Ball 4 is illustrated as being in direct contact with the valve needle 32 but, because the upward movement of the ball is limited by its contact with the housing, thermal expansion or wear can create a gap B between the end of the valve needle 32 and ball 4. If gap B exists, then the ultimate lift of ball 4 away from the housing will be decreased and Klügl's design will not be able to maintain a desired needle lift. Consequently, its ability to regulate the flow of high-pressure fuel would be severely compromised.

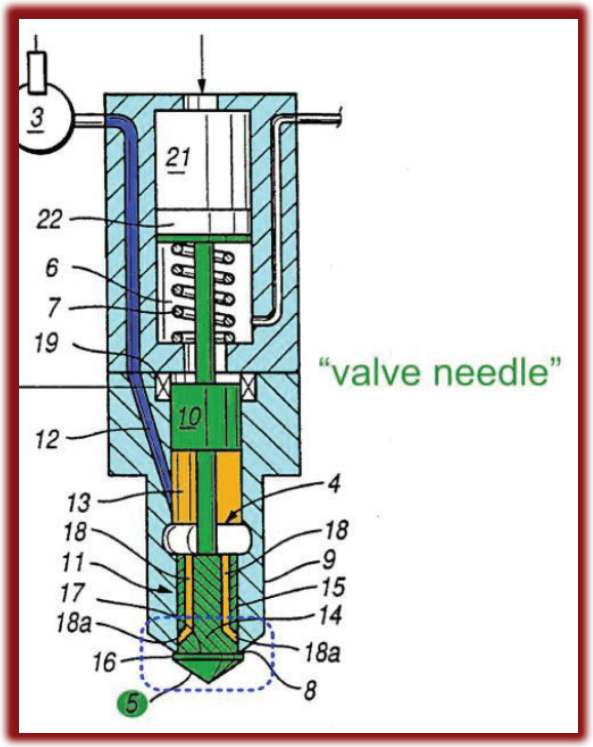
70. Just as thermal expansion or wear may create a gap B, those same effects may operate in the other direction and cause the distance A to extend farther toward the contact between ball 4 and housing 12. This downward movement could cause ball 4 to move away from its seat, which would cause leakage between ball 4 and housing 12. Consequently, its ability to regulate the flow of high-pressure fuel would be severely compromised.

292 Ex. 2022 (Atkinson) at ¶¶ 69-70;
293 Ex. 2022 (Atkinson) at ¶¶ 69-70;
292 POR at 47-49;
293 POR at 48-50.

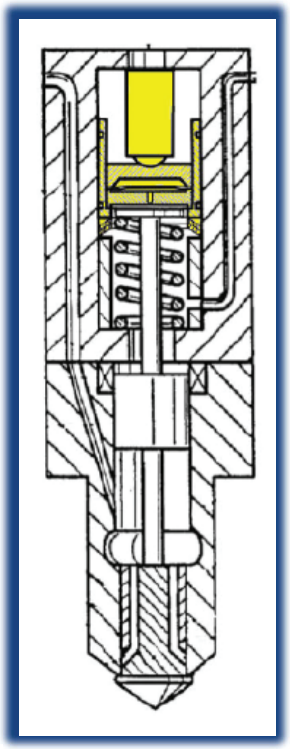


292 Ex. 2022 (Atkinson) at ¶68;
293 Ex. 2022 (Atkinson) at ¶68.

Combination of Wirbeleit and Klügl Does Not Teach the Claimed Element



292 Ex. 1003 (Quinlan) at ¶178;
293 Ex. 1003 (Quinlan) at ¶165;

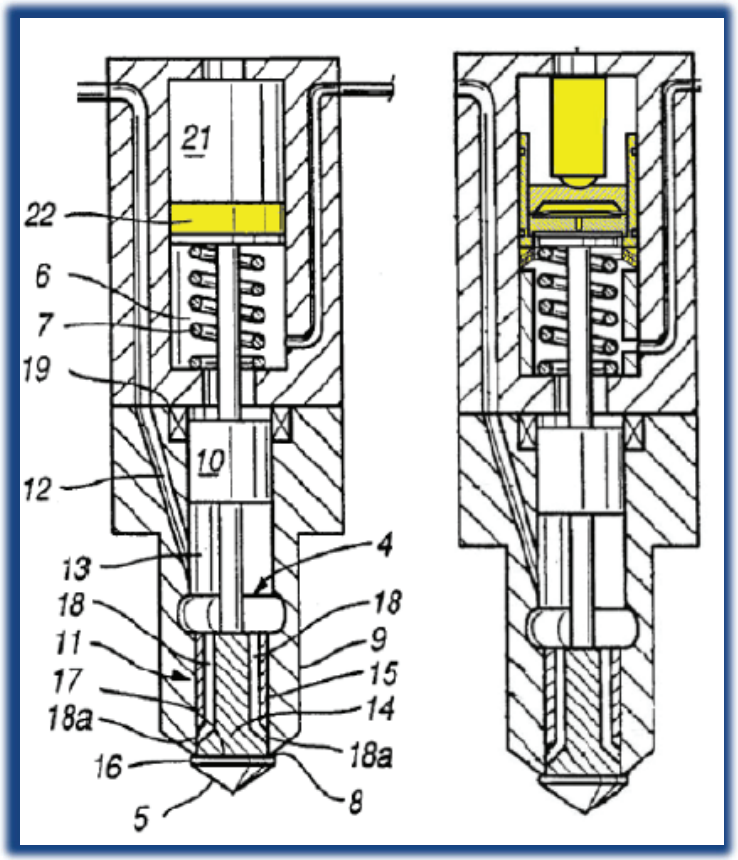


292 Ex. 2022 (Atkinson) at ¶109;
293 Ex. 2022 (Atkinson) at ¶109;
292 POR at 43-44;
293 POR at 44-45.

237. Because Klügl's transmission module 2 is designed to keep the injector's components in contact, a POSITA would have understood that when applied to Wirbeleit, Klügl's transmission module 2 would maintain the intended needle lift or position range despite wear and thermal expansion. Thus, my opinion, the references teach the maintenance of the claimed ***"desired valve needle lift upon activation."***

292 Ex. 1003 (Quinlan) at 237;
292 Ex. 1003 (Quinlan) at 225;
292 Sur-Reply at 19-20;
293 Sur-Reply at 19-20.

Combination of Wirbeleit and Klügl Does Not Teach the Claimed Element



292 Ex. 2022 (Atkinson) at ¶109; 293 Ex. 2022 (Atkinson) at ¶109;
292 POR at 43-44; 293 POR at 44-45.

> Further, while Wirbeleit does allow for control of valve lift, it does not itself "solve" problems like component misalignment resulting from aging and thermal effects: Klügl's transmission module 2 does solve that. *Id.*, 47-52.

292 Reply at 20;
293 Reply at 20;
292 Sur-Reply at 19-20;
293 Sur-Reply at 19-20.

Dr. Quinlan Relies on Low Stop 16 of Klügl for Motivation to Combine

324. For example, Klügl's injector includes an "upper stop 13" and a "lower stop 16" that are both attached via "screw" connections and can be used to set the compression of the piezoelectric actuator, disk spring 14 and spring 15. (Ex. 1006, 1:57-60; 2:35-39.)

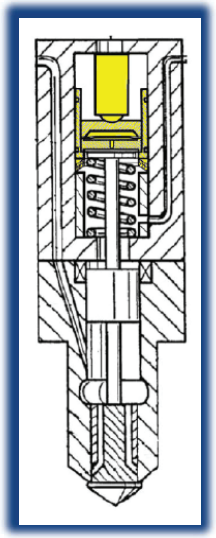
325. Klügl explains that this allows "the piezoelectric actuator 1," the "transmission module 2," and "the drive piston 3" to be "pre-adjusted" "[d]uring … production of the injection valve." (*Id.*, 3:1-10.)

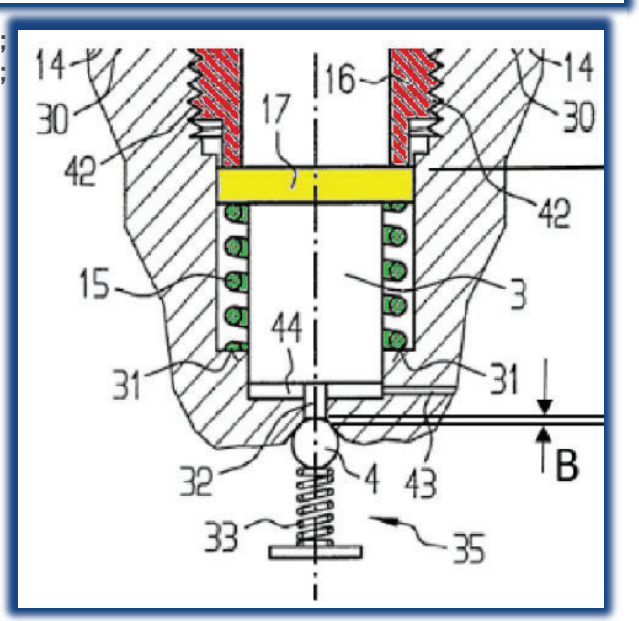
326. In my opinion, this would have further motivated application of Klügl to Wirbeleit. Using similar adjustment mechanisms (which are again allowed by Klügl's injector design, including its use of transmission module 2) would allow Wirbeleit's injector be adjusted at the time of manufacture to account for slight variations of component size, or to refine the load on the injector's components. A POSITA would have understood that this would have had the potential to improve (or at the very least refine) the operation of the injector.

292 Ex. 1003 (Quinlan Decl.) at ¶¶ 324-327;
293 Ex. 1003 (Quinlan Decl.) at ¶¶ 336-338

components within the valve. As discussed, annotated Fig. 1 below has a check ring 17 (yellow) that will be pressed upward by spring 15 (green) against lower stop 16 (red). Ex. 1006, 2:35–49. As the translated version of Klügl submitted as Exhibit

292 Ex. 2022 (Atkinson) at ¶¶ 68, 109;
293 Ex. 2022 (Atkinson) at ¶¶ 68, 109;
292 POR at 47-49;
293 POR at 48-50.





In Reply, Dr. Quinlan Revises His Opinion

235. Finally, Klügl explains that fluid can flow between chambers 5 and 7 through the throttle 10 during times of rest to account for thermal expansion or wear so as to ensure that the various components (such as the piston 3 and transmission module 2) remain in contact. Thus, in my opinion, its ***"thickness … is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components."***

292 Ex. 1003 (Quinlan Decl.) at 235;
293 Ex. 1003 (Quinlan Decl.) at 223.

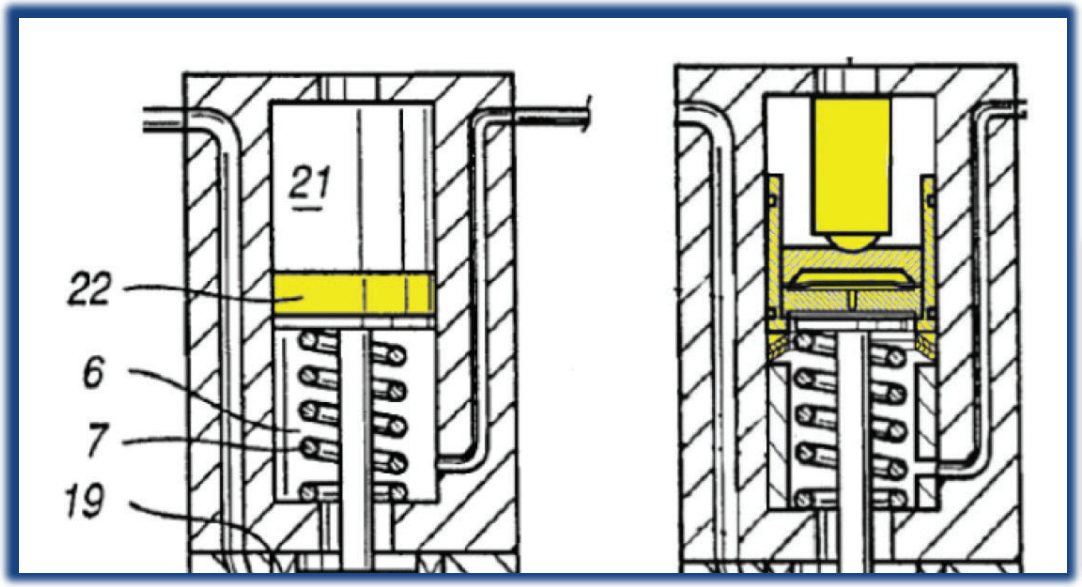
40. As Klügl explains, module 2 is meant to account for changes in the dimensions of the ***actuator*** (*e.g.*, different materials with differing thermal expansion), not the piston 3 or needle 32 (*e.g.*, similar materials with similar thermal expansion).

292 Ex. 1040 (Quinlan Reply Decl.) at 40; 293 Ex. 1040 (Quinlan Reply Decl.) at 40;
292 Sur-Reply at 19-20; 293 Sur-Reply at 19-20.

47. So, per Klügl, transmission module 2 is meant to account for thermal effects and aging that cause the actuator to either increase or decrease in size. This in turn would cause the piston to be pushed either too little or too much during actuation. The rest of Klügl—in particular the movement of fluid within transmission module 2 during times of rest—operates to avoid this and ensure that a consistent amount of lift is provided even if components change size.

292 Ex. 1040 (Quinlan Reply Decl.) at 47; 293 Ex. 1040 (Quinlan Reply Decl.) at 47;
292 Sur-Reply at 19-20; 293 Sur-Reply at 19-20.

In Reply, Dr. Quinlan Removes Lower Stop from The Combination



292 Ex. 2022 (Atkinson) at ¶109;
293 Ex. 2022 (Atkinson) at ¶109;
292 POR at 43-44; 293 POR at 44-45;
292 Sur-Reply at 20; 293 Sur-Reply at 20.

and 4 in my prior declaration. In Grounds 1 and 2, I explained that a POSITA would have used Klügl's transmission module 2 when implementing Wirbeleit's hydraulic transmission element 22. The rest of Wirbeleit's injector would remain the same. Thus, the combined injector would not include the same type of "lower stop 15" and "valve needle 32" as Klügl. It follows that the supposed "flaw in the design"

292 Ex. 1040 (Quinlan Reply Decl.) at ¶38;
293 Ex. 1040 (Quinlan Reply Decl.) at ¶38;
292 Sur-Reply at 19-20;
293 Sur-Reply at 19-20.

A POSITA Would Not be Motivated to Combine Wirbeleit and Klügl

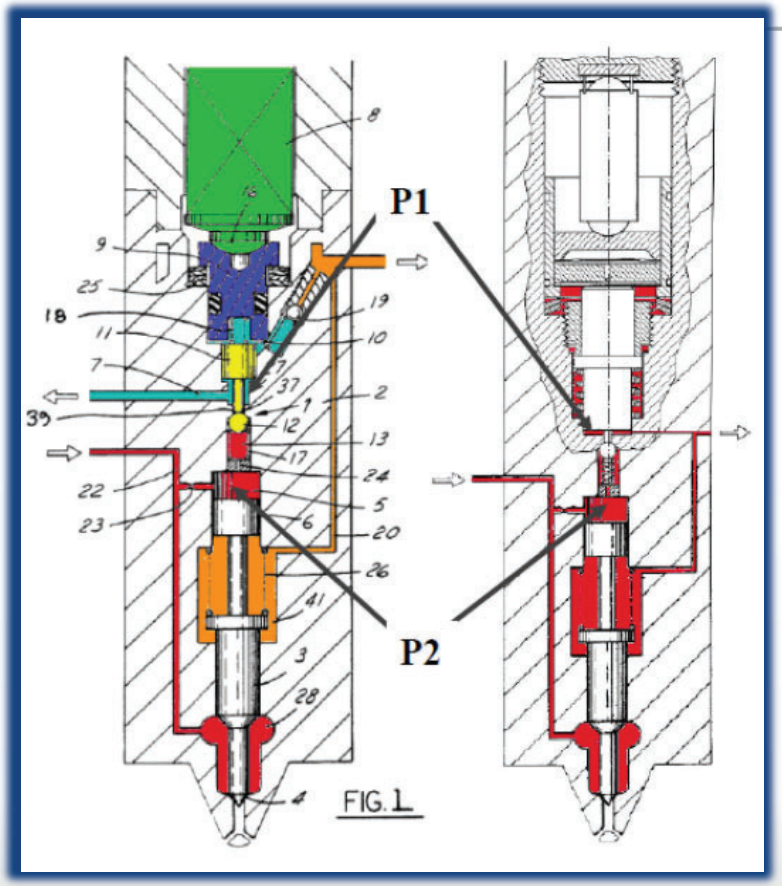
- Wirbeleit provides electronic control of its injector needle lift (it's alleged passive hydraulic link plays no role in the valve lift adjustability); Klügl provides a flexible membrane to adjust for changes in the dimensions of the actuator. 292 POR at 55; 293 POR at 58.
- The proposed combination introduces fluid into structures that were sealed in Klügl. 292 POR at 56; 293 POR at 59.
- The proposed combination is likely inoperable, and modification is not routine, as Dr. Quinlan could not himself devise an operable example. 292 POR at 56; 292 Ex. 2022 (Atkinson) at ¶115; 293 POR at 59.
- A POSITA would not introduce flexible membranes, with their disadvantages into Wirbeleit's electronically controlled injector. 292 POR at 57; 293 POR at 60.

6. Grounds 3 and 4 (Klügl + Hayes)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Petitioners' Combination of Klügl + Hayes Fails to Teach Other Limitations



292 Ex. 2022 (Atkinson) at ¶¶133-34; 292 POR at 66-68;
293 Ex. 2022 (Atkinson) at ¶¶ 133-34; 293 POR at 66-68.

1. Petitioners contend that Klügl discloses a "fuel inlet port," "interior chamber," "nozzle," and "nozzle orifice," but the cited portions of Klügl do not establish that any of these elements are arranged as required by the claims. 292 POR at 59; 293 POR at 62.
2. Petitioners' identified "valve needle" in Klügl does not constitute a valve needle or a valve needle having the claimed arrangement. 292 POR at 60; 293 POR at 63.
3. Petitioners' combination of Klügl and Hayes would have been inoperable because no pressure differential exists. 292 POR at 67-68; 293 POR at 70-71.

Petitioners' Combination of Klügl and Hayes Does Not Teach the Claimed Adjustability to Maintain Desired Valve Needle Lift

235. Finally, Klügl explains that fluid can flow between chambers 5 and 7 through the throttle 10 during times of rest to account for thermal expansion or wear so as to ensure that the various components (such as the piston 3 and transmission module 2) remain in contact. Thus, in my opinion, its ***"thickness … is adjustable while said actuator is not activated in response to changes in the dimensional relationship between components."***

292 Ex. 1003 (Quinlan Decl.) at 235;
293 Ex. 1003 (Quinlan Decl.) at 223.

+

???

Valve Needle Lift Adjustability

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wherein said **thickness of said hydraulic link is adjustable** while said actuator is not activated in response to changes in the dimensional relationship between components of said injection valve **to maintain a desired valve needle lift** . . .

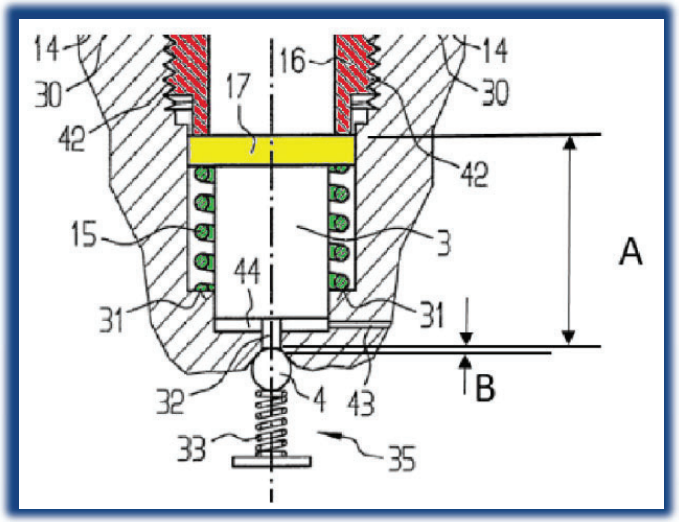
292 Ex. 1001 ('829 Patent) at Claim 1;
293 Ex. 1001 ('138 Patent) at Claim 1.

Klügl Cannot Adjust "A," and Thus, Cannot Adjust "Valve Needle Lift"

components within the valve. As discussed, annotated Fig. 1 below has a check ring 17 (yellow) that will be pressed upward by spring 15 (green) against lower stop 16 (red). Ex. 1006, 2:35–49. As the translated version of Klügl submitted as Exhibit

16. This way, the lower stop 16 specifies the rest position of drive piston 3." Ex. 1006, 2:44–49 (emphasis added). In other words, as shown in the annotated Fig. 1 below, when at rest, the distance A from the lower stop 16 to the end of the valve needle 32 is fixed and any "automatic adjustment" provided by the flexible membrane of Klügl's transmission module will not adjust distance A, which is the critical distance in Klügl's design for insuring desired valve needle lift.

292 Ex. 2022 (Atkinson) at ¶68;
293 Ex. 2022 (Atkinson) at ¶68;
292 POR at 47-49;
293 POR at 48-50.



292 Ex. 2022 (Atkinson) at ¶68;
293 Ex. 2022 (Atkinson) at ¶68.

A POSITA Would Not be Motivated to Combine Klügl and Hayes

Petitioners do not provide any meaningful motivation to combine.

2. Motivation to Combine

This ground points to Hayes as an example of what a POSITA would understand Klügl to already teach. In other words, Hayes simply provides elaboration. Klügl is not being modified or changed in view of Hayes's teachings. Regardless, a POSITA would have been motivated to look to Hayes—and would have had a reasonable expectation of success when doing so—not only because of the structural and functional similarity of Hayes and Klugl, but also because Hayes teaches that its injector is designed to be "simple," and "compensate[s] for tolerances and shifts due to temperature and wear." (Ex. 1024, 1:32-35.) Klugl's injector is designed with similar goals in mind. (*See* Ex. 1003, ¶¶ 468-469.)

292 Petition at 73; 293 Petition at 73-74;
292 POR at 65-66; 293 POR at 68-69;
292 Sur-Reply at 20-21; 293 Sur-Reply at 20-21.

7. Claim 41 of the ’138 Patent (IPR2023-00293) Would Not Have Been Obvious

DEMONSTRATIVE EXHIBIT – *NOT EVIDENCE*

Westport Fuel Systems

U.S. 6,575,138 – Claim 41

41. A method of operating a fuel injection valve for an internal combustion engine, said injection valve having a longitudinal axis, said method comprising:

(a) actuating a dimensionally responsive member comprising at least one of a magnetostrictive material and a piezoelectric material, said dimensionally responsive member expanding in length in the direction of said longitudinal axis upon actuation of said actuator;

(b) transferring movement caused by said actuated dimensionally responsive member through a passive hydraulic link to cause a corresponding movement of a valve member to open said valve by lifting said valve member away from a valve seat and compressing a biasing mechanism that biases said valve in a closed position, 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, said layer of hydraulic fluid acts as an incompressible solid so that movement caused by the actuation of said dimensionally responsive member is transmitted through said fluid layer;

(c) deactuating said dimensionally responsive member to contract the length of said dimensionally responsive member to unload said biasing mechanism and cause a corresponding movement of said valve member to close said valve;

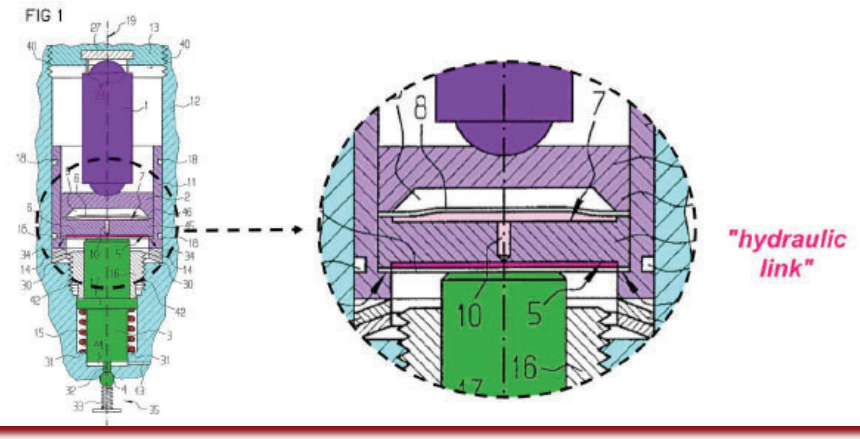
(d) providing sufficient time between consecutive valve openings to allow at least some of said hydraulic fluid within said passive hydraulic link to flow from one side of said piston to the other side of said piston.

293 Ex. 1001 ('138 Patent) at Claim 41;
293 POR at 56-57, 68.

Petitioners' Mapping of Elements Does Not Meet the Claim Requirements

302. In particular, Klügl teaches that its transmission module 2 includes a bore 10 (throttle/orifice), which allows the fluid from chamber 5 on one side of the module to flow to chamber 7 on the other side of the module during injector idle periods. (*See supra* Section IX.B.1.a.[1(e)].)

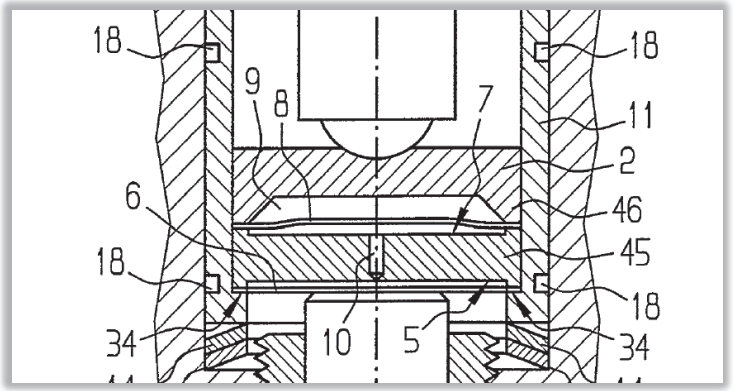
293 Ex. 1003 (Quinlan Decl.) at ¶302, cited by 293 Petition at 45-46.



293 Ex. 1003 (Quinlan Decl.) at ¶199.

discussed at length above, it is my opinion that a POSITA would not understand Klügl to teach or disclose the claimed "hydraulic link assembly" of claim 1 of the '138 Patent. Further, Klügl does not teach or disclose the flow of hydraulic fluid from one side of the piston to the other side of said piston.

293 Ex. 2022 (Atkinson) at ¶98; 293 POR at 56-57.

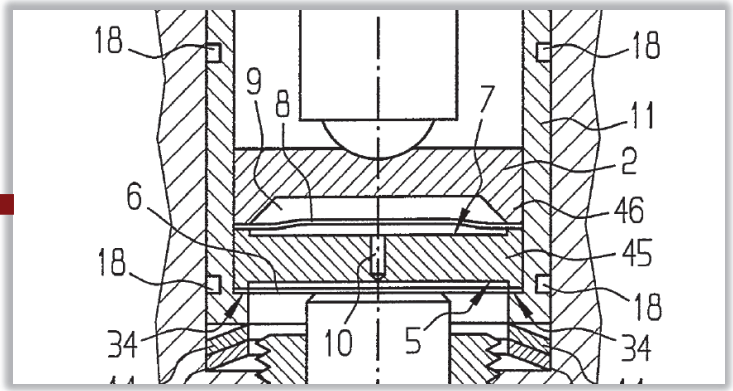


Ex. 1006 (Klügl) at Figure 1.

Petitioners' Mapping of Elements Does Not Meet the Claim Requirements

¶¶ 295-297.) Klügl also includes the claimed *"hydraulic cylinder which houses a piston"*: its transmission module 2 is surrounded by a cylindrical "guide sleeve 11" located within the hollow interior of the injector's housing 12. (*See* Ex. 1006, 2:7-16; Fig. 1; *see also* Ex. 1003, ¶¶ 298-300.)

293 Petition at 45-46.



Ex. 1006 (Klügl) at Figure 1.

discussed at length above, it is my opinion that a POSITA would not understand Klügl to teach or disclose the claimed "hydraulic link assembly" of claim 1 of the '138 Patent. Further, Klügl does not teach or disclose the flow of hydraulic fluid from one side of the piston to the other side of said piston.

293 Ex. 2022 (Atkinson) at ¶98; 293 POR at 56-57.

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

293 POR at 56-57.

When asked if Transmission Module 2 is a Piston, Dr. Quinlan Testified It is "Maybe" "Shaped Like a Piston"

41. A method of operating a fuel injection valve for an internal combustion engine, said injection valve having a longitudinal axis, said method comprising:

(a) actuating a dimensionally responsive member comprising at least one of a magnetostrictive material and a piezoelectric material, said dimensionally responsive member expanding in length in the direction of said longitudinal axis upon actuation of said actuator;

(b) transferring movement caused by said actuated dimensionally responsive member through a passive hydraulic link to cause a corresponding movement of a valve member to open said valve by lifting said valve member away from a valve seat and compressing a biasing mechanism that biases said valve in a closed position, 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, said layer of hydraulic fluid acts as an incompressible solid so that movement caused by the actuation of said dimensionally responsive member is transmitted through said fluid layer;

293 Ex. 1001 ('138 Patent) at Claim 41;
293 POR at 56-57.



Ex. 2025 (Quinlan Dep.) at 141:5-13; 293 POR at 56-57.

Q. (BY MR. PHILBIN) Is it your opinion that Klugl's transmission module 2 is a piston?

A. I don't think that I would necessarily require it to be a piston. Maybe it's shaped like a piston, but its main function is to transit loads from the actuator 1 downwards in the stack and maybe to hold membrane 8 in location. And as long as the component (noise interference) requirements, I don't particularly care what shape it is at this point.

Dr. Quinlan's Opinions Regarding Claim 41's Element is Based on an Imagined Design

(c) deactuating said dimensionally responsive member to contract the length of said dimensionally responsive member to unload said biasing mechanism and cause a corresponding movement of said valve member to close said valve;

(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.

293 Ex. 1001 ('138 Patent) at Claim 41;
293 POR at 56-57.



Ex. 2025 (Quinlan Dep.) at 142:5-15; 293 POR at 56-57.

Q. (BY MR. PHILBIN) I guess I'm not asking for your imagination. I'm asking: Does the transmission medium in Klugl form any layer between guide sleeve 11 and transmission module 2?

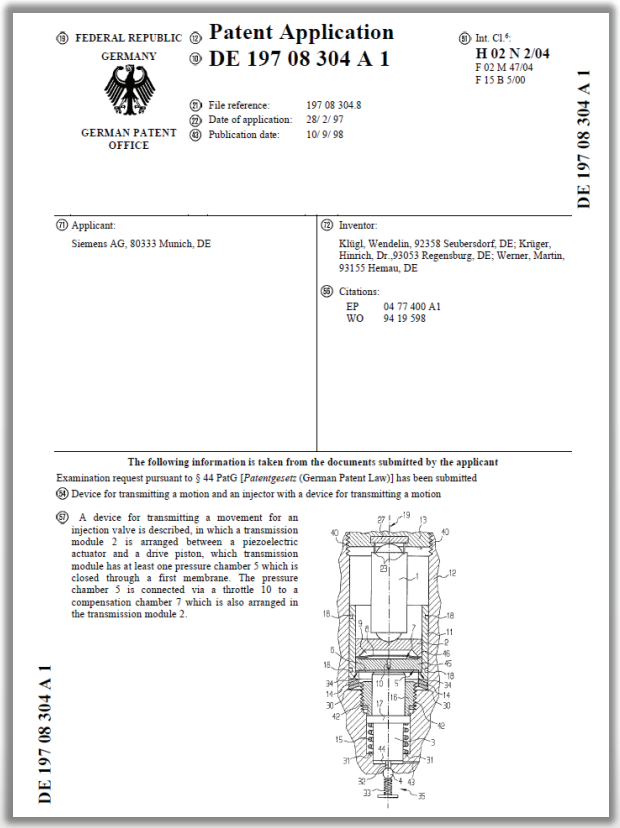
A. Well, so what Klugl teaches is a way of doing this. The details of actually doing that aren't in Klugl. That would be through -- again, through the design process. So, I can imagine a design where that is and I can imagine that there is a design where that is not.

8. Dependent Claims Would Not Have Been Obvious

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Patent Owner Separately Disputes Additional Claim Limitations



(19) FEDERAL REPUBLIC GERMANY
GERMAN PATENT OFFICE

(12) Patent Application
(19) DE 197 08 304 A 1

(51) Int. Cl.[6]:
H 02 N 2/04
F 02 M 47/04
F 15 B 5/00

(21) File reference: 197 08 304.8
(22) Date of application: 28/ 2/ 97
(43) Publication date: 10/ 9/ 98

DE 197 08 304 A 1

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(56) Citations:
EP 04 77 400 A1
WO 94 19 598

The following information is taken from the documents submitted by the applicant

Examination request pursuant to § 44 PatG [*Patentgesetz* (German Patent Law)] has been submitted

(54) Device for transmitting a motion and an injector with a device for transmitting a motion

(57) A device for transmitting a movement for an injection valve is described, in which a transmission module 2 is arranged between a piezoelectric actuator and a drive piston, which transmission module has at least one pressure chamber 5 which is closed through a first membrane. The pressure chamber 5 is connected via a throttle 10 to a compensation chamber 7 which is also arranged in the transmission module 2.

DE 197 08 304 A 1

Ex. 1006 (Klügl, translated);
292 POR at 1, 15-16;
293 POR at 1, 16-17.

35 U.S.C. §103(a) Combinations	292 Claims Challenged	293 Claims Challenged
Wirbeleit, Klügl	1, 2, 3, 6, 11, 12, 14, 15, 18, 19	1, 2, 3, 6, 13, 14, 17, 18, 19, 20, 21, 26, 27, 41
Wirbeleit, Klügl, Newcomb	20	28
Klügl, Hayes	1, 2, 3, 6, 11, 12, 14, 15, 18, 19	1, 2, 3, 6, 13, 14, 17, 18, 19, 20, 21, 26, 27, 41
Klügl, Hayes, Newcomb	20	28

292 POR at 47-54, 58, 63-65, 69.
293 POR at 48-57, 60, 66-68, 72.

Dependent Claims in the '829 Patent Would Not Be Obvious in View of Ground 1 or 2

Claim	Reason	Cite
2, 3	Klügl's Membrane 6 cannot be both inflexible (during actuation) and flexible (at rest). Thus if the Board finds that Klügl teaches an inflexible membrane 6, then Petitioners have failed to establish that such membrane would meet the adjustment limitations of these dependent claims.	292 POR, 50-51.
6, 15	Petitioners rely on Klügl's piezoelectric actuator for their combination as to Claim 1(d), but then point to Wirbeleit's magnetostrictive actuator for Claim 1(e) and dependent Claim 6. Petitioners provide no explanation of how Wirbeleit's magnetostrictive actuator satisfies Claim 1(e)'s requirements.	292 POR, 51-52.
11, 12	Petitioners rely on Wirbeleit as disclosing "desired lift between 10 and 100 percent of maximum lift" but Wirbeleit does not disclose any range.	292 POR, 53
14	Valve needle actuation times are not disclosed in Wirbeleit, and the claimed range is not disclosed in Klügl.	292 POR, 54-55

Dependent Claims in the ’829 Patent Would Not Be Obvious in View of Ground 3 or 4

Claim	Reason	Source
2, 3	Klügl's Membrane 6 cannot be both inflexible (during actuation) and flexible (at rest). Thus if the Board finds that Klügl teaches an inflexible membrane 6, then Petitioners have failed to establish that such membrane would meet the adjustment limitations of these dependent claims.	292 POR, 64.
11, 12	Petitioners rely on Klügl as disclosing “desired lift between 10 and 100 percent of maximum lift” but Klügl does not disclose any range.	292 POR, 64
14	Valve needle actuation times within the claimed range is not disclosed in Klügl.	292 POR, 65
19	Petitioners’ identified “valve housing” (Klügl's housing 12 together with “upper stop 13”) does not include elements claimed as comprising the “valve housing” in independent Claim 1.	292 POR, 65

Dependent Claims in the ’138 Patent Would Not Be Obvious in View of Ground 1 or 2

Claim	Reason	Source
2, 3	Klügl's Membrane 6 cannot be both inflexible (during actuation) and flexible (at rest). Thus if the Board finds that Klügl teaches an inflexible membrane 6, then Petitioners have failed to establish that such membrane would meet the adjustment limitations of these dependent claims.	293 POR, 51-52.
6, 13	Petitioners rely on Klügl’s piezoelectric actuator for their combination as to Claim 1(d), but then point to Wirbeleit’s magnetostrictive actuator for Claim 1(e) and dependent Claim 6. Petitioners provide no explanation of how Wirbeleit’s magnetostrictive actuator satisfies Claim 1(e)’s requirements.	293 POR, 53-54.
17	Petitioners rely on Wirbeleit as disclosing “desired lift between 10 and 100 percent of maximum lift” but Wirbeleit does not disclose any range.	293 POR, 54
19	Valve needle actuation times are not disclosed in Wirbeleit, and the claimed range is not disclosed in Klügl.	293 POR, 55-56

Dependent Claims in the ’138 Patent Would Not Be Obvious in View of Ground 3 or 4

Claim	Reason	Source
2, 3	Klügl's Membrane 6 cannot be both inflexible (during actuation) and flexible (at rest). Thus if the Board finds that Klügl teaches an inflexible membrane 6, then Petitioners have failed to establish that such membrane would meet the adjustment limitations of these dependent claims.	293 POR, 66.
17, 18	Petitioners rely on Klügl as disclosing “desired lift between 10 and 100 percent of maximum lift” but Klügl does not disclose any range.	293 POR, 66-67
19	Valve needle actuation times within the claimed range is not disclosed in Klügl.	293 POR, 67

Appendix of Challenged Claims

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

U.S. 6,298,829 – Claim 1

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

(a) a valve housing comprising:

a fuel inlet port;

an interior chamber fluidly connected to said fuel inlet port;

a nozzle comprising a nozzle orifice providing a fluid passage from said interior chamber to said combustion chamber;

(b) a valve needle disposed within said valve housing wherein said valve needle is movable between a closed position at which a sealing end of said valve needle contacts a valve seat to fluidly seal said interior chamber from said nozzle orifice, and an open position at which said sealing end of said valve needle is spaced apart from said valve seat whereby said interior chamber is fluidly connected with said nozzle orifice, wherein valve needle lift equals the distance traveled by said sealing end away from said valve seat;

(c) a needle sp ring associated with said valve needle, wherein said needle spring applies a closing force to said valve needle for biasing said valve needle in said closed position;

(d) a n actuator assembly associated with said valve needle, wherein said actuator assembly may be activated to apply an opening force to said valve needle stronger than said closing force, for moving said valve needle to said open position; and

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

292 Ex. 1001 ('829 Patent) at Claim 1

U.S. 6,298,829 – Claim 2

2. The injection valve of claim 1 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.

292 Ex. 1001 ('829 Patent) at Claim 2

U.S. 6,298,829 – Claim 3

3. The injection valve of claim **2** 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.

292 Ex. 1001 ('829 Patent) at Claim 3

U.S. 6,298,829 – Claim 6

6. The injection valve of claim **1** wherein said actuator assembly comprises a magnetostrictive member or a piezo-electric stack.

292 Ex. 1001 ('829 Patent) at Claim 6

U.S. 6,298,829 – Claim 11

11. The injection valve of claim **6** wherein when said actuator assembly is controllable to control said desired lift to between 10 and 100 percent of maximum lift.

292 Ex. 1001 ('829 Patent) at Claim 11

U.S. 6,298,829 – Claim 12

12. The injection valve of claim **11** wherein said lift is controllable by controlling the electric current directed or voltage applied to said respective magnetostrictive or piezo-electric actuator assembly.

292 Ex. 1001 ('829 Patent) at Claim 12

U.S. 6,298,829 – Claim 14

14. The injection valve of claim **6** wherein said valve needle is controllable to move between said open and closed positions in less than about 200 microseconds.

292 Ex. 1001 ('829 Patent) at Claim 14

U.S. 6,298,829 – Claim 15

15. The injection valve of claim **6** further comprising a compression spring member for applying a compressive force to said magnetostrictive or piezoelectric member.

292 Ex. 1001 ('829 Patent) at Claim 15

U.S. 6,298,829 – Claim 18

18. The injection valve of claim **1** wherein said fuel is injected into said combustion chamber at a pressure greater than about 2000 psi (about 13.8 MPa).

292 Ex. 1001 ('829 Patent) at Claim 18

U.S. 6,298,829 – Claim 19

19. The injection valve of claim 1 wherein said valve housing comprises a plurality of parts which are joined with each other to provide a fluidly sealed body.

292 Ex. 1001 ('829 Patent) at Claim 19

U.S. 6,298,829 – Claim 20

20. The injection valve of claim **1** wherein said valve housing, said valve needle, and said actuator assembly, are selected from materials with similar thermal expansion coefficients to reduce changes in the dimensional relationship between said components caused by changes in temperature.

292 Ex. 1001 ('829 Patent) at Claim 20

U.S. 6,575,138 – Claim 1

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

(a) a valve housing comprising:

a fuel inlet port;

an interior chamber fluidly connected to said fuel inlet port; and

a valve seat for cooperating with a valve member to seal said interior chamber from said combustion chamber when said injection valve is closed;

(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;

(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;

(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

(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.

293 Ex. 1001 ('138 Patent) at Claim 1

U.S. 6,575,138 – Claim 2

2. The injection valve of claim 1 wherein said thickness of said hydraulic link is auto-adjustable while said actuator assembly is not actuated in response to changes in said dimensional relationship caused by differential thermal expansion.

293 Ex. 1001 ('138 Patent) at Claim 2

U.S. 6,575,138 – Claim 3

3. The injection valve of claim **2** wherein said thickness of said hydraulic link is auto-adjustable while said actuator assembly is not actuated in response to changes in said dimensional relationship caused by wear to components of said injection valve.

293 Ex. 1001 ('138 Patent) at Claim 3

U.S. 6,575,138 – Claim 6

6. The injection valve of claim 1 wherein said actuator assembly comprises a dimensionally responsive member.

293 Ex. 1001 ('138 Patent) at Claim 6

U.S. 6,575,138 – Claim 13

13. The injection valve of claim **6** wherein said dimensionally responsive member is formed from a piezoelectric material.

293 Ex. 1001 ('138 Patent) at Claim 13

U.S. 6,575,138 – Claim 14

14. The injection valve of claim **6** further comprising a compression spring member for applying a compressive force to said dimensionally responsive member.

293 Ex. 1001 ('138 Patent) at Claim 14

U.S. 6,575,138 – Claim 17

17. The injection valve of claim **6** wherein said actuator assembly is controllable to maintain said desired lift between 10 and 100 percent of maximum lift.

293 Ex. 1001 ('138 Patent) at Claim 17

U.S. 6,575,138 – Claim 18

18. The injection valve of claim **17** wherein said lift is controllable by varying at least one of the electric current, the electric voltage and the magnetic field imposed upon said dimensionally responsive member.

293 Ex. 1001 ('138 Patent) at Claim 18

U.S. 6,575,138 – Claim 19

19. The injection valve of claim **6** wherein said valve member is controllable such that said valve member moves between said open and closed positions in less than about 200 microseconds.

293 Ex. 1001 ('138 Patent) at Claim 19

U.S. 6,575,138 – Claim 20

20. The injection valve of claim **6** further comprising a biasing mechanism for applying a compressive force to said dimensionally responsive member.

293 Ex. 1001 ('138 Patent) at Claim 20

U.S. 6,575,138 – Claim 21

21. The injection valve of claim 1 wherein said biasing mechanism comprises a spring.

293 Ex. 1001 ('138 Patent) at Claim 21

U.S. 6,575,138 – Claim 26

26. The injection valve of claim **1** wherein said fuel is injected into said combustion chamber at a pressure greater than about 2000 psi (about 13.8 Mpa).

293 Ex. 1001 ('138 Patent) at Claim 26

U.S. 6,575,138 – Claim 27

27. The injection valve of claim 1 wherein said valve housing comprises a plurality of parts which are joined with each other to provide a fluidly sealed body.

293 Ex. 1001 ('138 Patent) at Claim 27

U.S. 6,575,138 – Claim 28

28. The injection valve of claim **1** wherein said valve housing, said valve member and said actuator assembly are selected from materials having thermal expansion coefficients sufficiently compatible such that changes in the dimensional relationship between said components caused by changes in temperature are reduced.

293 Ex. 1001 ('138 Patent) at Claim 28

U.S. 6,575,138 – Claim 41

41. A method of operating a fuel injection valve for an internal combustion engine, said injection valve having a longitudinal axis, said method comprising:

(a) actuating a dimensionally responsive member comprising at least one of a magnetostrictive material and a piezoelectric material, said dimensionally responsive member expanding in length in the direction of said longitudinal axis upon actuation of said actuator;

(b) transferring movement caused by said actuated dimensionally responsive member through a passive hydraulic link to cause a corresponding movement of a valve member to open said valve by lifting said valve member away from a valve seat and compressing a biasing mechanism that biases said valve in a closed position, 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, said layer of hydraulic fluid acts as an incompressible solid so that movement caused by the actuation of said dimensionally responsive member is transmitted through said fluid layer;

(c) deactuating said dimensionally responsive member to contract the length of said dimensionally responsive member to unload said biasing mechanism and cause a corresponding movement of said valve member to close said valve;

(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.

293 Ex. 1001 ('138 Patent) at Claim 41

Patent Owner's Motion to Exclude

Paper 30 (Motion)

Paper 33 (Reply)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Westport Fuel Systems

Overview

- Petitioners' Fatally Flawed Exhibit 1006 Should Be Excluded
- Exhibit 1025 is Excludable as Hearsay
- Exhibits 1029, 1031, 1033, 1035 and 1037 Are Untranslated And Therefore Excludable as Irrelevant

Overview

- Petitioners' Fatally Flawed Exhibit 1006 Should Be Excluded
- Exhibit 1025 is Excludable as Hearsay
- Exhibits 1029, 1031, 1033, 1035 and 1037 Are Untranslated And Therefore Excludable as Irrelevant

Petitioners Erroneously Translated the Same Word 3 Different Ways

Fig. 1 eine Vorrichtung zur Kraftübertragung ohne Hubübersetzung,
Fig. 2 eine Vorrichtung zur Kraftübertragung mit einer Feder als Druckmittel und
Fig. 3 eine Vorrichtung zur Kraftübertragung mit Hubübersetzung.

Ex. 1005 at 1:44-49; Ex. 2026 (Holthaus Decl.) at ¶4; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6; Paper 30 (Mot.) at 3-4; Paper 33 (Reply) at 1.

1

Fig. 1 shows a device for power transmission without stroke translation.
Fig. 2 shows a device for power transmission with a spring as a pressure medium and
Fig. 3 shows a device for power transmission with stroke translation.

Ex. 1006; Ex. 2026 (Holthaus Decl.) at ¶5; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6; Paper 30 (Mot.) at 3-4; Paper 33 (Reply) at 1.

sten Membran **6** anliegt. Auf diese Weise wird eine Hubübersetzung zwischen der Auslenkung des Piezoaktors **1** und der Auslenkung des Antriebkolbens **3** erreicht. Zudem

Ex. 1005 at 7:11-13; Ex. 2026 (Holthaus Decl.) at ¶4; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6; Paper 30 (Mot.) at 3-4; Paper 33 (Reply) at 1.

2

against the first membrane **6**. This way, it achieves a stroke ratio between the deflection of the piezoelectric actuator **1** and the deflection of the drive piston **3**. In addition, it is

Ex. 1006; Ex. 2026 (Holthaus Decl.) at ¶5; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6; Paper 30 (Mot.) at 3-4; Paper 33 (Reply) at 1.

Membran **6** und der dritten Membran **26** eine Hubübersetzung zwischen der Auslenkung des Piezoaktors **1** und der Auslenkung des Antriebkolbens **3** erreicht wird.

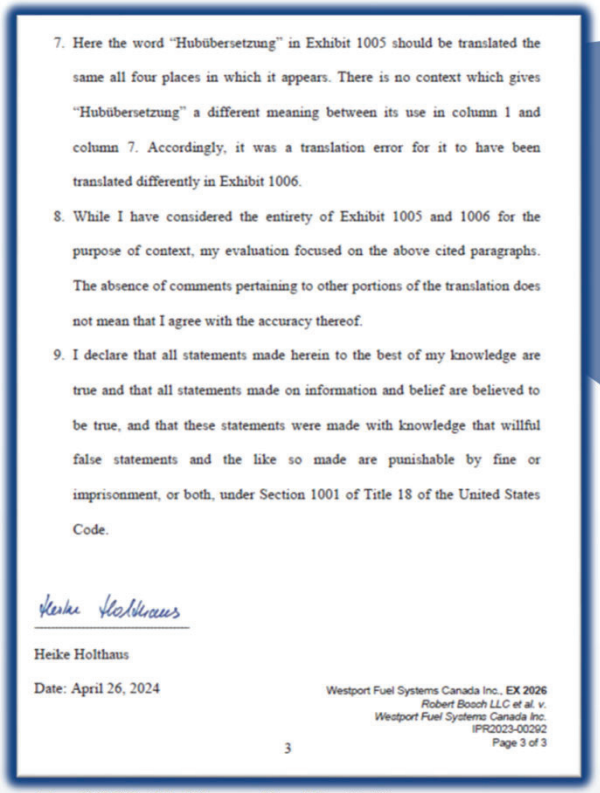
Ex. 1005 at 7:17-19; Ex. 2026 (Holthaus Decl.) at ¶4; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6 ; Paper 30 (Mot.) at 3-4; Paper 33 (Reply) at 1.

3

larger than the surface of the first membrane **6**, so that over the different sized surfaces of the first membrane **6** and the third membrane **26** a stroke transmission is already achieved between the deflection of the piezoelectric actuator **1** and the deflection of the drive piston **3**.

Ex. 1006; Ex. 2026 (Holthaus Decl.) at ¶5; 292 POR at 26-27; 293 POR at 27-28; 292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6; Paper 30 (Mot.) at 3-4; Paper 33 (Reply) at 1.

Petitioners' Translation of Klügl is Erroneous and Unreliable



7. Here 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.
8. While I have considered the entirety of Exhibit 1005 and 1006 for the purpose of context, my evaluation focused on the above cited paragraphs. The absence of comments pertaining to other portions of the translation does not mean that I agree with the accuracy thereof.
9. I declare that all statements made herein to the best of my knowledge are true and that all statements made on information and belief are believed to be true, and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Heike Holthaus

Heike Holthaus

Date: April 26, 2024

Westport Fuel Systems Canada Inc., EX 2026
Robert Bosch LLC et al. v. Westport Fuel Systems Canada Inc.
IPR2023-00292
Page 3 of 3

3

7. Here 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 (Holthaus Decl.) at ¶7;
292 POR at 26-27; 293 POR at 27-28;
292 Sur-Reply at 3-6; 293 Sur-Reply at 3-6;
Paper 30 (Motion to Exclude) at 2-7.
Paper 33 (Reply) at 1-2.

Petitioners' Translation of Klügl is Erroneous and Unreliable



Ex. 1026 (Holthaus Dep.) at 33:14-18, 34:1-3; Paper 30 (Motion) at 2, 6.

What was -- what is your base opinion in your declaration?

A My base opinion in my -- in the declaration that I -- I gave is that hububersetzung should have been translated with one single term.

Q Okay. Do you believe that Exhibit 1006 is a reliable translation of Exhibit 1005?

A I do not.

The Meanings are Different AND Using Just One Would Render Opinions "Nonsensical"



Ex. 2025 (Quinlan Dep.)

Q. (BY MR. PHILBIN) My question, sir, is: In the context of Klugl, is it your opinion, stroke translation and stroke transmission mean the same thing?

A. Again, I think that the key is here, that stroke translation has to do with -- from looking at the embodiments in Figure 1 and Figure 3, we see that it's clear that we're talking about the stroke ratio. And by stroke transmission, I think we can potentially mean two different things.

Ex. 2025 at 24:13-22;
Paper 30 (Motion) at 4-6.

Q. (BY MR. PHILBIN) Yes or no? Can we put stroke ratio to mean stroke translation in your paragraph 222 to mean the same thing?

A. So, whether the specific words could be interchanged, I would have to look at everywhere in the declaration since that's what you asked about and see whether we could switch them everywhere --

Q. (BY MR. PHILBIN) No. I just asked about paragraph 222, sir.

A. Okay. So we're talking about just paragraph 222.

Q. Yes, sir.

(Simultaneously speaking)

A. -- nonsensical to replace one with the other, but that doesn't mean that they don't mean that they are obviously related phrases.

Ex. 2025 (Quinlan Dep.) at 32:9-24;
Paper 30 (Motion) at 4-6.

“Stroke Translation” and “Stroke Ratio” Not Necessarily the Same.



Ex. 2025 (Quinlan Dep.) at 16-21;
Paper 30 (Motion) at 4.

Q. (BY MR. PHILBIN) Okay. So, categorically, you you can't say that stroke translation and stroke ratio mean the same thing, correct?

A. I -- I think it depends on the context. We'd have to talk about specific context.

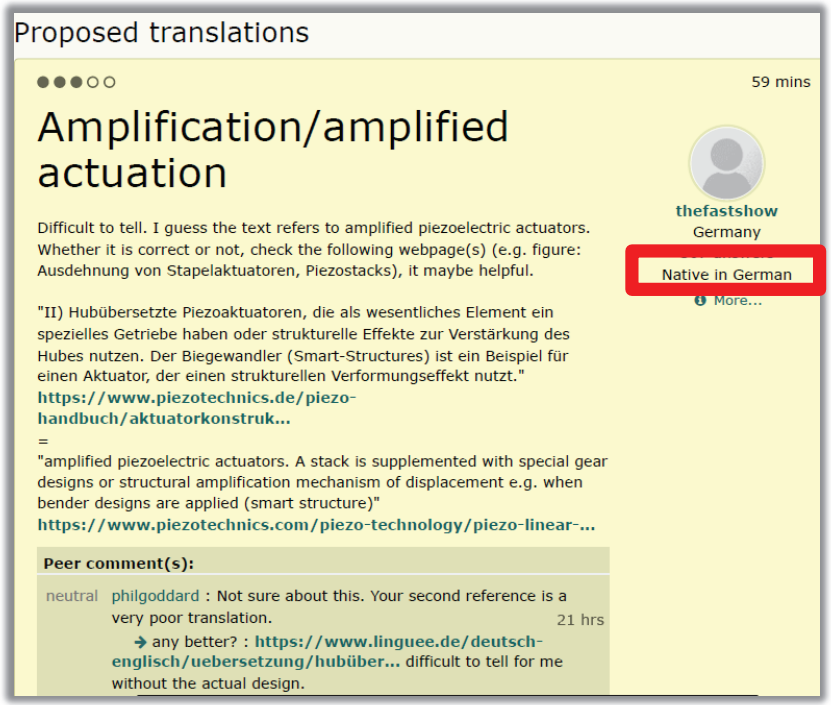
Ex. 2026 (Holthaus Decl.) at ¶7;
Paper 30 (Motion) at 6.

7. Here 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.

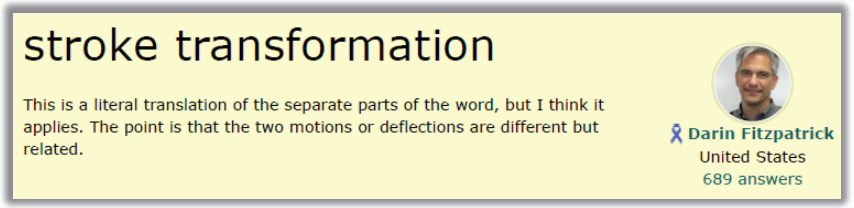
Overview

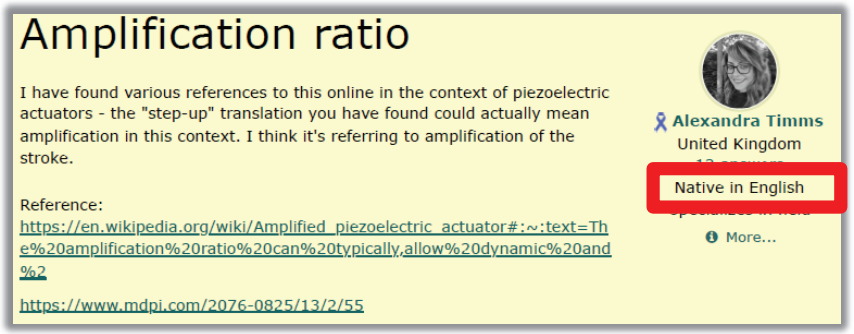
- Petitioners' Fatally Flawed Exhibit 1006 Should Be Excluded
- Exhibit 1025 is Excludable as Hearsay
- Exhibits 1029, 1031, 1033, 1035 and 1037 Are Untranslated And Therefore Excludable as Irrelevant

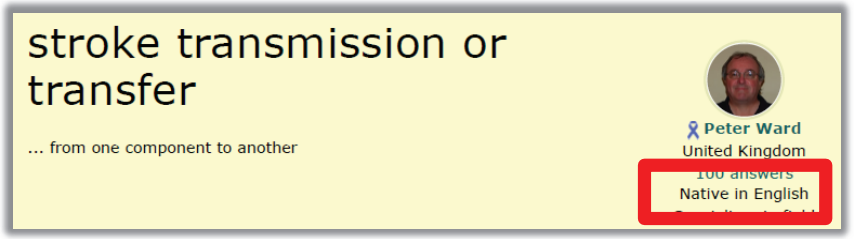
Responses of Other Translators in Exhibit 1025 Are Hearsay



Paper 30 (Motion to Exclude) at 8;
Paper 33 (Reply) at 2-3.







Holthaus' Posting (Exhibit 1025) is Hearsay



Hubübersetzung

German to English | Tech/Engineering | Automotive / Cars & Trucks | Fuel injector

Auf diese Weise wird eine ***Hubübersetzung*** zwischen der Auslenkung des Piezoaktors 1 und der Auslenkung des Antriebkolbens 3 erreicht. Zudem ist es vorteilhaft, wenn die Flache der dritten Membran 26 größer ist, als die Fläche der ersten Membran 6, so daß schon über die unterschiedlich großen Flächen der ersten Membran 6 und der dritten Membran 26 eine ***Hubübersetzung*** zwischen der Auslenkung des Piezoaktors 1 und der Auslenkung des Antriebkolbens 3 erreicht wird.

This from a patent on a fuel injector.
I found:
stroke translation
https://patents.google.com/patent/WO2006108741A1/en (looks machine translated)
stroke step-up
https://worldwide.espacenet.com/patent/search/family/0079290.
..

and was also offered stroke ratio

What does "Übertragung" mean here?
I was unable to find any other source for "stroke step-up"

Heike Holthaus
United States
318 questions
More...

Out of Court Statement Offered for the Truth of the Assertion.

No Applicable Exceptions:

- Does Not Impeach Credibility, Not Inconsistent with Testimony.
- Was not "Adopted" by Westport.
- Not A Party Admission, as Westport did not authorize her to make posting and Ms. Holthaus is not a Westport agent or employee

Paper 30 (Motion to Exclude) at 8-9;
Paper 33 (Reply) at 2-3.

Overview

- Petitioners' Fatally Flawed Exhibit 1006 Should Be Excluded
- Exhibit 1025 is Excludable as Hearsay
- German Exhibits 1029, 1031, 1033, 1035 and 1037 Are Untranslated And Therefore Excludable as Irrelevant

German Exhibits 1029, 1031, 1033, 1035 and 1037 Are Untranslated And Irrelevant


(19) Deutsches Patent- und Markenamt

(10) DE 10 2010 040 612 A1 2012.03.15

(12) Offenlegungsschrift

(21) Aktenzeichen: 10 2010 040 612.0
(22) Anmeldetag: 13.09.2010
(43) Offenlegungstag: 15.03.2012

(51) Int Cl.: F02M 51/06 (2006.01)

(71) Anmelder: Siemens Aktiengesellschaft, 80333, München, DE

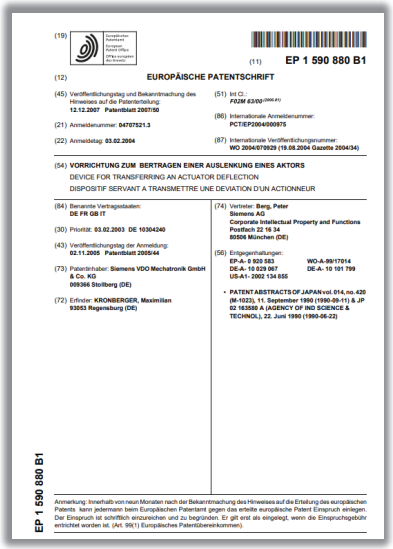
(72) Erfinder: Bachmaier, Georg, 80469, München, DE; Ebelsberger, Gerti, 81737, München, DE; Fischer, Bernhard, 84513, Töging, DE; Höge, Michael, 85622, Feldkirchen, DE; Magori, Erhard, 85622, Feldkirchen, DE

Prüfungsantrag gemäß § 44 PatG ist gestellt.

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: Hydraulischer Temperaturkompensator und hydraulischer Hubübertrager

(57) Zusammenfassung: Der hydraulische Temperaturkompensator (5) weist mindestens eine längsausdehnbare Hydraulikkammer (10, 11) und eine gasgefüllte Kammer (12), die von der Hydraulikkammer (10, 11) zumindest teilweise umgeben ist, auf, wobei die Hydraulikkammer (10, 11) in eine erste Teilkammer (10) und eine zweite Teilkammer (11) unterteilt ist, welche mittels mindestens einer Drosselstelle (26) miteinander hydraulisch verbunden sind und wobei die zweite Teilkammer (11) an die gasgefüllte Kammer (12) grenzt. Der Hubübertrager (1) weist mindestens den hydraulischen Temperaturkompensator, einen auf den Temperaturkompensator (5) wirkenden Hubaktor (2) und eine weitere Hydraulikkammer (18a), welche mit der ersten Teilkammer (10) der Hydraulikkammer (10, 11) des Temperaturkompensators (5) fluidisch verbunden ist, auf, wobei die weitere Hydraulikkammer (18a) fluidisch mit einem verschieblich gelagerten Stellelement (20) in Verbindung steht.


(19) Europäisches Patentamt European Patent Office Office européen des brevets

(11) EP 1 590 880 B1

(12) EUROPÄISCHE PATENTSCHRIFT

(45) Veröffentlichungstag und Bekanntmachung des Hinweises auf die Patenterteilung: 12.12.2007 Patentblatt 2007/50

(51) Int Cl.: F02M 63/00 (2006.01)

(21) Anmeldenummer: 04707521.3

(86) Internationale Anmeldenummer: PCT/EP2004/000975

(22) Anmeldetag: 03.02.2004

(87) Internationale Veröffentlichungsnummer: WO 2004/070929 (19.08.2004 Gazette 2004/34)

(54) VORRICHTUNG ZUM BERTRAGEN EINER AUSLENKUNG EINES AKTORS
DEVICE FOR TRANSFERRING AN ACTUATOR DEFLECTION
DISPOSITIF SERVANT A TRANSMETTRE UNE DEVIATION D'UN ACTIONNEUR

(84) Benannte Vertragstaaten: DE FR GB IT

(30) Priorität: 03.02.2003 DE 10304240

(43) Veröffentlichungstag der Anmeldung: 02.11.2005 Patentblatt 2005/44

(73) Patentinhaber: Siemens VDO Mechatronik GmbH & Co. KG 009366 Steilberg (DE)

(72) Erfinder: KRONBERGER, Maximilian 93053 Regensburg (DE)

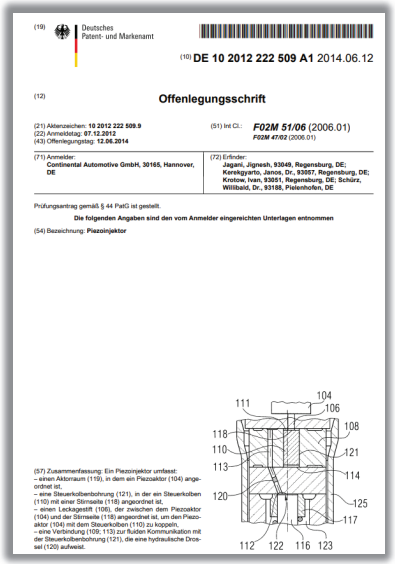
(74) Vertreter: Berg, Peter Siemens AG Corporate Intellectual Property and Functions Postfach 22 16 34 80506 München (DE)

(56) Entgegenhaltungen:
EP-A- 0 920 583
DE-A- 10 029 067
US-A1- 2002 134 855
WO-A-99/17014
DE-A- 10 101 799

- PATENT ABSTRACTS OF JAPAN vol. 014, no. 420 (M-1023), 11. September 1990 (1990-09-11) & JP 02 163588 A (AGENCY OF IND SCIENCE & TECHNOL), 22. Juni 1990 (1990-06-22)

EP 1 590 880 B1

Anmerkung: Innerhalb von neun Monaten nach der Bekanntmachung des Hinweises auf die Erteilung des europäischen Patents kann jedermann beim Europäischen Patentamt gegen das erteilte europäische Patent Einspruch einlegen. Der Einspruch ist schriftlich einzureichen und zu begründen. Er gilt erst als eingelegt, wenn die Einspruchsgebühr entrichtet worden ist. (Art. 99(1) Europäisches Patentübereinkommen).


(19) Deutsches Patent- und Markenamt

(10) DE 10 2012 222 509 A1 2014.06.12

(12) Offenlegungsschrift

(21) Aktenzeichen: 10 2012 222 509.9
(22) Anmeldetag: 07.12.2012
(43) Offenlegungstag: 12.06.2014

(51) Int Cl.: F02M 51/06 (2006.01)
F02M 47/02 (2006.01)

(71) Anmelder: Continental Automotive GmbH, 30165, Hannover, DE

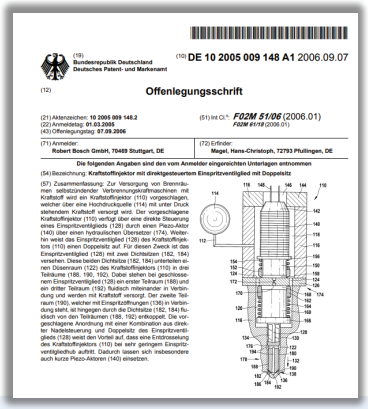
(72) Erfinder: Jagani, Jignesh, 93049, Regensburg, DE; Kerekgyarto, Janos, Dr., 93057, Regensburg, DE; Krotow, Ivan, 93051, Regensburg, DE; Schürz, Willibald, Dr., 93188, Pielenhofen, DE

Prüfungsantrag gemäß § 44 PatG ist gestellt.

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: Piezoinjektor

(57) Zusammenfassung: Ein Piezoinjektor umfasst:
– einen Aktorraum (119), in dem ein Piezoaktor (104) angeordnet ist,
– eine Steuerkolbenbohrung (121), in der ein Steuerkolben (110) mit einer Stirnseite (118) angeordnet ist,
– einen Leckagestift (108), der zwischen dem Piezoaktor (104) und der Stirnseite (118) angeordnet ist, um den Piezoaktor (104) mit dem Steuerkolben (110) zu koppeln,
– eine Verbindung (109; 113) zur fluiden Kommunikation mit der Steuerkolbenbohrung (121), die eine hydraulische Drossel (120) aufweist.


(19) Bundesrepublik Deutschland Deutsches Patent- und Markenamt

(10) DE 10 2005 009 148 A1 2006.09.07

(12) Offenlegungsschrift

(21) Aktenzeichen: 10 2005 009 148.2
(22) Anmeldetag: 01.03.2005
(43) Offenlegungstag: 07.09.2006

(51) Int Cl.[8]: F02M 51/06 (2006.01)
F02M 61/10 (2006.01)

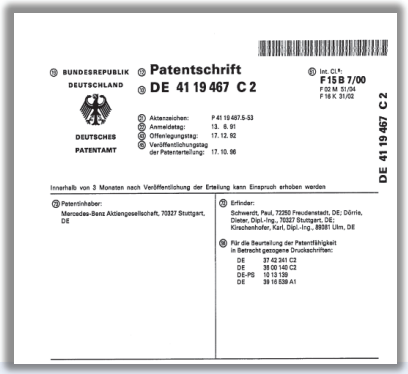
(71) Anmelder: Robert Bosch GmbH, 70469 Stuttgart, DE

(72) Erfinder: Magel, Hans-Christoph, 72793 Pfullingen, DE

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: Kraftstoffinjektor mit direktgesteuertem Einspritzventilglied mit Doppelsitz

(57) Zusammenfassung: Zur Versorgung von Brennräumen selbstzündender Verbrennungskraftmaschinen mit Kraftstoff wird ein Kraftstoffinjektor (110) vorgeschlagen, welcher über eine Hochdruckquelle (114) mit unter Druck stehendem Kraftstoff versorgt wird. Der vorgeschlagene Kraftstoffinjektor (110) verfügt über eine direkte Steuerung eines Einspritzventilglieds (126) durch einen Piezo-Aktor (140) über einen hydraulischen Übersteuer (174). Weiterhin weist das Einspritzventilglied (126) des Kraftstoffinjektors (110) einen Doppelsitz auf. Für diesen Zweck ist das Einspritzventilglied (126) mit zwei Dichtsitzen (182, 184) versehen. Diese beiden Dichtsitze (182, 184) unterteilen einen Düsenraum (122) des Kraftstoffinjektors (110) in drei Teilräume (186, 190, 192). Dabei stehen bei geschlossenem Einspritzventilglied (126) ein erster Teilraum (186) und ein dritter Teilraum (192) fluidisch miteinander in Verbindung und werden mit Kraftstoff versorgt. Der zweite Teilraum (190), welcher mit Einspritzöffnungen (138) in Verbindung steht, ist hingegen durch die Dichtsitze (182, 184) fluidisch von den Teilräumen (186, 192) entkoppelt. Die vorgeschlagene Anordnung mit einer Kombination aus direkter Nadelsteuerung und Doppelsitz des Einspritzventilglieds (126) weist den Vorteil auf, dass eine Entdrosselung des Kraftstoffinjektors (110) bei sehr geringem Einspritzventilgliedhub auftritt. Dadurch lassen sich insbesondere auch kurze Piezo-Aktoren (140) einsetzen.


(19) BUNDESREPUBLIK DEUTSCHLAND

(12) Patentschrift DE 41 19 467 C2

(51) Int Cl.[6]: F15B 7/00
F02 M 51/06
F16 K 31/02

(21) Aktenzeichen: P 41 19 467.5-53
(22) Anmeldetag: 13. 6. 91
(43) Offenlegungstag: 17. 12. 92
(47) Veröffentlichungstag der Patenterteilung: 17. 10. 96

DEUTSCHES PATENTAMT

Innerhalb von 3 Monaten nach Veröffentlichung der Erteilung kann Einspruch erhoben werden

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(56) Für die Beurteilung der Patentfähigkeit in Betracht gezogene Druckschriften:
DE 37 42 041 C2
DE 35 05 140 C2
DE-PS 10 13 139
DE 39 10 539 A1

DE 41 19 467 C2

- 37 C.F.R. §42.63 requires translation.

"(b) Translation required. When a party relies on a document or is required to produce a document in a language other than English, a translation of the document into English and an affidavit attesting to the accuracy of the translation must be filed with the document."

- Petitioners are relying on what they say these documents state.
- Requirement for a translation should not be waived.
- Cannot confirm the accuracy of counsel's "translation".

Paper 30 (Motion to Exclude) at 9-10;
Paper 33 (Reply) at 4-5.