

IPR2023-00273
Patent 7,021,415

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZF NORTH AMERICA, INC., ZF ACTIVE SAFETY US INC.,
Petitioners,

v.

STONERIDGE CONTROL DEVICES, INC.,
Patent Owner.

Inter Partes Review No. IPR2023-00273
Patent No. 7,021,415

DECLARATION OF JEFFREY L. STEIN, Ph.D.

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I, Jeffrey L. Stein, declare:

I. QUALIFICATIONS

1. I am a Professor Emeritus of Mechanical Engineering at the University of Michigan, Ann Arbor Campus, the former Associate Director of the Automotive Research Center at the University of Michigan and a former Principal Investigator in the NSF Engineering Research Center on Reconfigurable Manufacturing Systems.
2. While I still hold the title Professor Emeritus, I have effectively retired from my duties as a full time college professor as of the end of 2022.
3. An up to date version of my CV is attached as Ex. 2006.
4. I have studied, taught, and researched automotive technology, design, and manufacturing for over 40 years.
5. I received my Ph.D. degree in Mechanical Engineering from Massachusetts Institute of Technology in 1983. I received a Masters of Science degree in Mechanical Engineering and a Bachelors of Science degree in Mechanical Engineering from Massachusetts Institute of Technology in 1976. I received a B.S. in psychology from the University of Massachusetts in 1973.
6. In my capacity as a Professor, I taught undergraduate and graduate courses in mechanical design and manufacturing, dynamics, dynamic systems, and control

engineering. In my capacity as a Professor, I did research in the area of automotive system design and control as well as manufacturing machine design and control. In several of my research projects, my students and I discovered unique ways to model, design and control automotive and manufacturing systems.

7. In addition to being the former Associate Director of the Automotive Research Center at the University of Michigan, I am also the former Principle Investigator (PI) of the project “A Multi-Scale Design and Control Framework for Dynamically Coupled Sustainable and Resilient Infrastructures, with Application to Vehicle-to-Grid Integration.” I am also the former PI of a project “Sustainable Transportation for a 3rd Century: An Interdisciplinary Approach to Addressing the Last Mile Problem for Enhanced Accessibility.” In my work at the Automotive Research Center, and on these projects, I have developed computer-based methods for facilitating the design evaluation of automotive powertrains including hybrid electric powertrains and, in particular, to improve the handling, mobility and NVH (noise, vibration and harshness) characteristics of vehicles.

8. From 1983 through 1987 and 1991 through the present, I have also worked as an Independent Consultant concentrating in the area of design and risk analysis of mechanical systems and manufacturing machines. Much of this work is particularly germane to the area of automotive engineering. Some examples include: interior

mirrors, hybrid electric vehicles, automated mechanical transmissions, four wheel drive vectoring and transfer cases for on-demand, four-wheel drive vehicles.

9. From 1988 through 1991, I was also employed as an Independent Consultant for Failure Analysis Associates in San Francisco, California, focusing on the design and risk analysis of mechanical systems and manufacturing machines.

10. I was a registered Professional Engineer in the State of Michigan, and have been a member of several professional engineering organizations including the Society of Automotive Engineers, National Society of Professional Engineers, the American Society of Mechanical Engineers, the Society of Manufacturing Engineers, and the American Society for Engineering Education.

11. In my work, I have had a number of opportunities to deal with U.S. Patents. This work has included infringement and validity analysis in the areas of mirror design, hybrid electric vehicle powertrain design, CNC machine tool design and control, automotive transfer case design and control, automotive interior lighted mirror design, automated mechanical transmissions, agricultural seed meters, automotive shipping containers, medical beds and automated chemical immunoassay machines amongst others.

12. I am a co-inventor on four patents, patent applications, or provisional patent applications, listed on page 28 of my CV.

13. I have authored with my students over 80 journal articles, including many that are related to automotive engineering. I have also contributed to over 135 refereed conference papers, including many that are related to automotive engineering.

14. My expertise is in the field of mechanical engineering as applied to automotive and manufacturing engineering. My research includes contributions to the following application areas: light and heavy duty vehicles, electric and hybrid vehicles, autonomous vehicles, and machine tool design and control. These contributions are included in the over 225 articles in journals and conference proceedings that I have authored or co-authored. Bibliographic information regarding these articles is included in my CV.

11. In my work, I have had a number of consulting opportunities related to United States Patents and intellectual property. This work has included infringement and validity analyses in the areas of automotive windshield shipping containers, value-added glass for vehicles, automotive transfer case design and control, automotive interior lighted mirror design, automotive lumbar seat actuator device design, hybrid powertrains, automated mechanical transmissions, agricultural planters, CNC machine tool control, automated chemical immunoassay analyzers, and hydraulic bicycle brake systems amongst others.

II. PRIOR TESTIMONY

15. In the past four years I have testified, either at trial or by deposition, in the following cases:

Case Name	Legal Category	Approx. Dates of Testimony	Court	Case No.
Tecnomatic S.p.A. v ATOP S.p.A. et al.	Patent Infringement	January, 2020, August, 2020, November, 2020	UNITED STATES DISTRICT COURT, EASTERN DISTRICT OF MICHIGAN, Southern Division	2:18-cv-12869-LJM-DRG
Razor USA, LLC v GDL	Patent Infringement	March, 2020 & June 2020	District Court, District Court of New Jersey	C.A. No. 2:19-cv-12939-JMV-MF
Global Shade Corp	Inter Partes Review	December, 2020, 21	United States District Court for the Central District of California	Civil Action No. 8:20-cv-00917-JVS
Arsus v Tesla	Patent Infringement	July , 2021	United States District Court Northern District Of California San Francisco Division	Case No. 3:20-CV-00313-RS

JLR v Porsche, VW, Lamborghini, & Audi	Patent Infringement	July 15, 2021 and July 30-31, 2021	ITC: Washington	Investigation No. 337-TA-1235
Caterpillar Inc. v Wirtgen American, Inc.	Inter Partes Review and Patent Infringement	8/2022, 9/2022, 5/23	ITC: Washington and US District Court, Delaware	Case No. 1:17-cv-00770-JDW-MPT and IPR
Gamevice, Inc. v Nintendo Co., LTD	Patent Infringement	Aug. 2022	US District Court for the Northern District of CA	Case No. 18-cv-01942-RS
GLOBAL SHADE CORPORATION v WITH-U E-COMMERCE (SHANGHAI) CO., LTD.,	Inter Partes Review	2/23/23	United States District Court for the Central District of California	IPR2023-00580

III. ENGAGEMENT AND COMPENSATION

16. I am making this declaration at the request of Patent Owner.
17. I am being compensated at my usual consulting rate of \$595 per hour for my work on this matter.
18. I am being reimbursed at cost for my expenses.
19. My compensation is in no way dependent upon my opinions or testimony or the outcome of this proceeding.

IV. MATERIALS CONSIDERED

20. In preparing this declaration, I have reviewed all filings and exhibits associated with IPR2023-00273.

V. APPLICABLE LEGAL STANDARDS

21. I am not an attorney. I have been informed by my attorneys of the relevant legal principles and have applied them to arrive at the opinions set forth in this declaration.

A. Claim Construction

22. I have been advised that patent claim terms are to be given their plain and ordinary meaning, i.e., the meaning that the terms would have had to the skilled artisan at the time of the invention. The relevant timeframe here is November 13, 2002 for all claims except claim 7, which has a priority date of May 5, 2003. I understand that this analysis focuses on intrinsic evidence, including how the claim term is used in the claims, specification, and prosecution history. I also understand that dictionaries or other extrinsic sources may assist in determining the plain and ordinary meaning but cannot override a meaning that is unambiguous from the intrinsic evidence.

23. I also understand that if a patent claim recites a term having a known meaning in the art, then that term should be construed according to its known, art-accepted

meaning, unless the specification attempts to redefine the art-accepted meaning of the term.

24. I also understand that different claim terms within a patent should be construed such that those terms have different meanings.

25. I also understand that common claim terms in a patent should be construed consistently between all claims in the patent.

B. Obviousness

26. I have been advised that the burden is on Petitioners to demonstrate the unpatentability of the challenged claims based on a preponderance of the evidence (i.e., that it is more likely than not).

27. I have been advised that a claimed invention is not patentable under 35 U.S.C. §103 if it is obvious.

28. I understand a patent claim is unpatentable if the claimed invention would have been obvious to a person of ordinary skill in the art at the time the claimed invention was made.

29. I have further been advised that the ultimate conclusion of whether a claim is obvious should be based upon several factual determinations including (1) the level of ordinary skill in the field; (2) the scope and content of the prior art; (3) what

differences, if any, existed between the claimed invention and the prior art; and (4) any objective indicia of non-obviousness (i.e., secondary considerations).

30. I have been advised that, in determining the level of ordinary skill in the field that someone would have had at the time the claimed invention was made, I should consider: (1) type of problems encountered in the art; (2) prior art solutions to those problems; (3) rapidity with which innovations are made; (4) sophistication of the technology; and (5) educational level of active workers in the field.

31. I have been advised that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art. In evaluating whether such a claim would have been obvious, I may consider whether there is a reason that would have prompted a person of ordinary skill to combine the elements or concepts from the prior art in the same way as in the claimed invention. I understand that for obviousness to be found, the proposed obviousness ground must be supported by an articulated reason with a rational underpinning, as opposed to a mere conclusory statement.

32. I have also been advised that the question of obviousness should not be made using the benefit of hindsight. Rather, the question of obviousness is made based on whether a person of ordinary skill at the time the claimed invention was made and not what is known today or what is learned from the teachings of the patent. I

understand it is generally improper to look to the contents of the patent-in-suit (here the '415 Patent) when formulating or evaluating whether the claimed invention would have been obvious, as doing so introduces hindsight into the analysis.

33. I have been advised that secondary considerations can serve as evidence of non-obviousness. Such secondary considerations include commercial success, long felt but unsolved needs, failure of others, unexpected results, copying, and industry praise. The secondary considerations should have a nexus to the claimed invention. I understand secondary considerations help guard against slipping into use of hindsight when making a determination of obviousness. Regarding commercial success, I understand that evidence of commercial success of another, not merely the commercial success of the patentee, may be considered.

34. I have been advised that any obviousness rationale for modifying or combining prior art must include a showing that a person of ordinary skill would have had a reasonable expectation of success.

35. I understand that there are a number of exemplary rationales that may be used to support an obviousness position, including (A) Combining prior art elements according to known methods to yield predictable results; (B) Simple substitution of one known element for another to obtain predictable results; (C) Use of known technique to improve similar devices (methods, or products) in the same way; (D)

Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (E) "Obvious to try" – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; (G) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention. However, each of these exemplary rationales must be considered in light of the facts and evidence in a particular case. For example, these rationales cannot be used as a medium for ignoring evidence in a particular case, including facts or evidence that indicate that one would not have combined the prior art.

VI. GENERAL OVERVIEW OF CASE

36. I understand that this case was brought by Petitioners to render the claims of the '415 Patent invalid.

37. Petitioners have raised various proposed grounds under which Petitioners argue that the claims would have been obvious.

38. I understand that Patent Owner submitted a preliminary response to the Petition.

39. I also understand that Patent Owner has disclaimed claims 1-4, 6, 9-13, and 20-23 of the '415 Patent. Some claims depending from the disclaimed claims are still at issue in this case. I have considered the disclaimed claims to the extent that they relate to claims that are still present in this case.

40. I understand the Board granted institution of this case on all grounds that relate to the non-disclaimed claims of the '415 Patent. Those grounds are summarized in the Decision Granting Institution (Paper 9) at page 8, and involve the prior art to Poertzgen, Boucheret, Drennen, and Weiler.

VII. TECHNOLOGY AT ISSUE

A. Generally

41. This case relates to an electronic park brake actuator (EPBA) for a vehicle.

42. Automotive disc brakes include brake calipers containing one or more pistons that can squeeze a pair of brake pads against a brake disc (or rotor) when a user applies force (creates force) on the brake pedal.

43. The '415 Patent relates to an EPBA used to actuate the brake caliper in response to an electrical signal from a parking brake switch.

44. The EPBA system 100 of the '415 Patent includes an actuator 102 configured to receive electrical power and drive a brake caliper 106 to control the parking brake function of a vehicle. Ex. 1001 at 2:60-3:35; Figure 3 (annotated below).

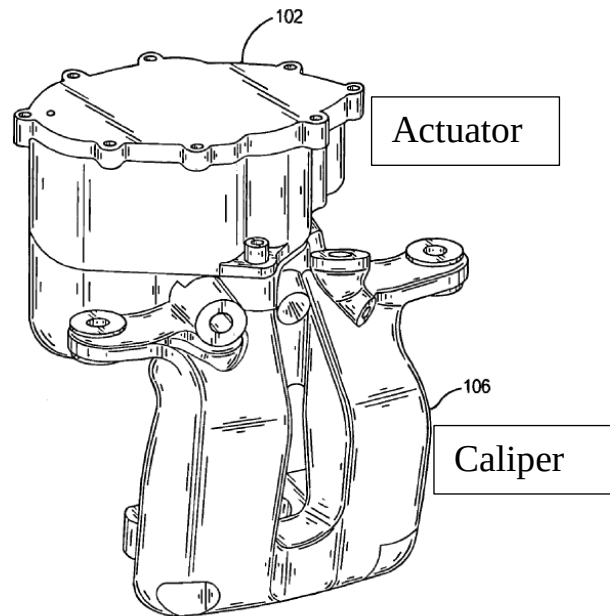


FIG. 3

45. The actuator 102 includes a motor 300 received in an actuator housing 301. Ex. 1001 at 4:7-6:11; Figures 4 and 6.

46. The shaft of the motor 300 is coupled directly to a gear train, which in the embodiment includes a drive pulley 302, a driven pulley 304, and a drive belt 303. *Id.* The drive pulley 302 is driven by the motor, and driven pulley 304 in turn drives a planetary gear set 306, which drives an output 308 that is ultimately used to operate the caliper 106 as a parking brake. *Id.*

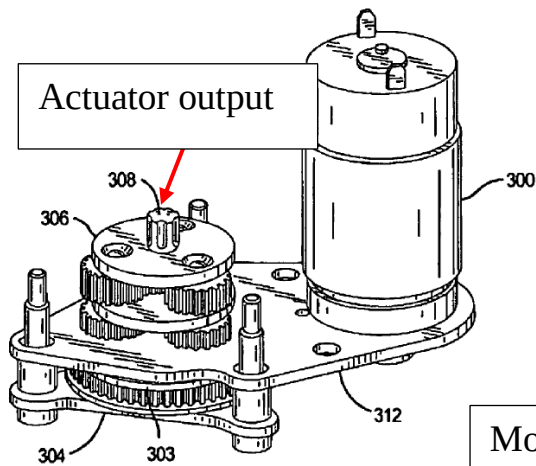


FIG. 6

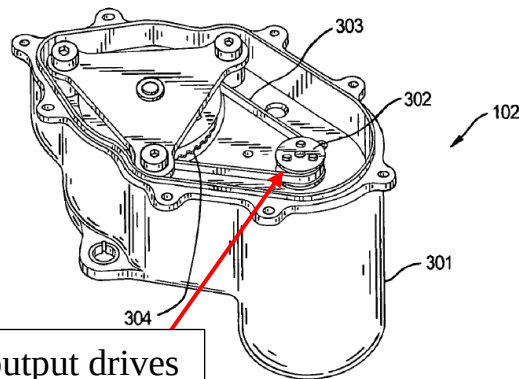


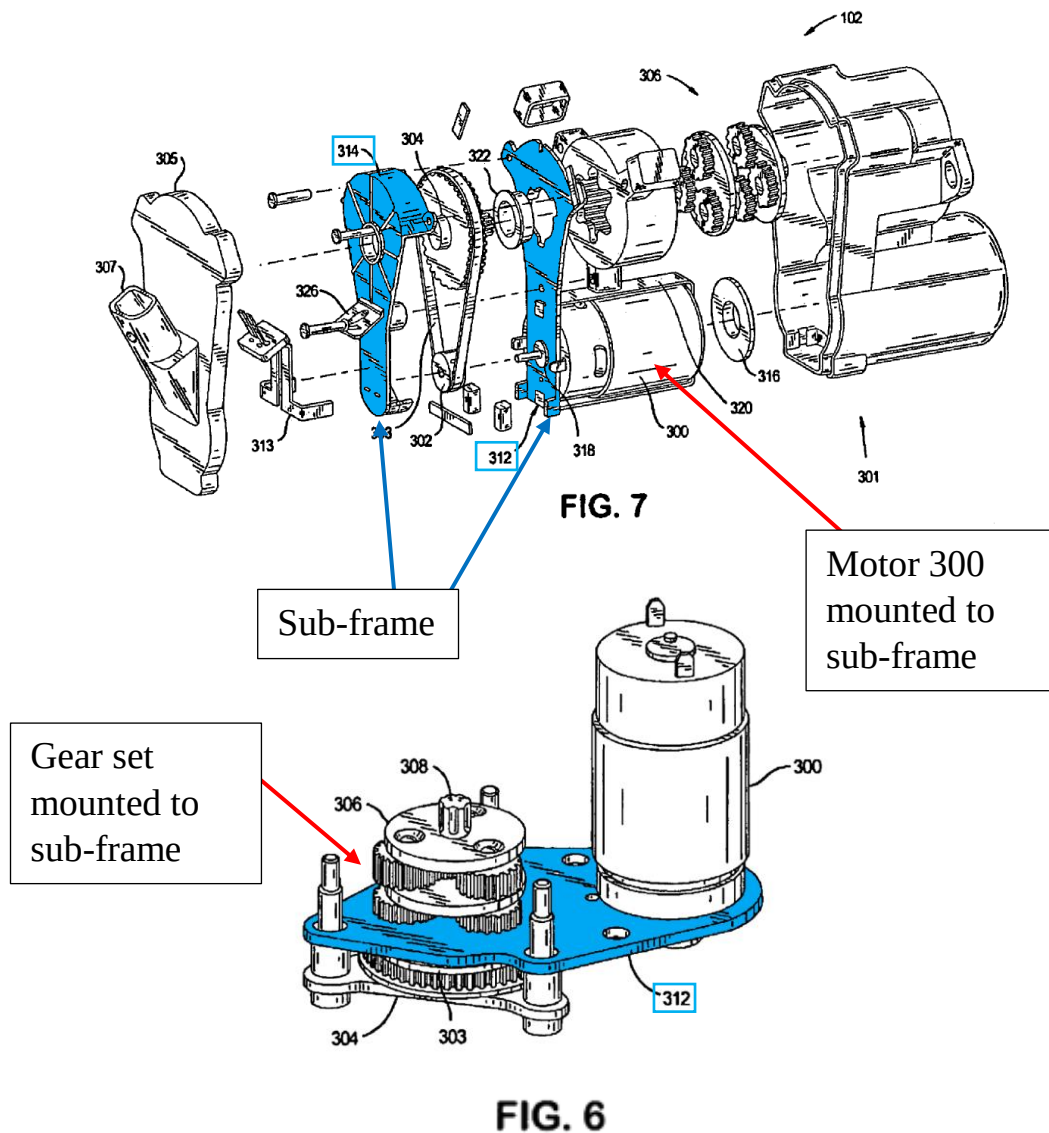
FIG. 4

Motor output drives
gears, which in turn
drive output 308

47. The motor and gear train are mounted on a sub-frame and the sub-frame is then mounted into the actuator housing. Vibration isolators are claimed at specific locations in this assembly.

B. Sub-Frame

48. The '415 Patent discloses a sub-frame, which is a frame for a sub-assembly of the EPBA. The motor 300 and drive train can be mounted to the sub-frame. An example sub-frame is shown as including a sub-frame lower portion 312 (blue) and sub-frame top portion 314 (blue). *Id.* at 4:7-64; Figures 6 and 7 (annotated below).

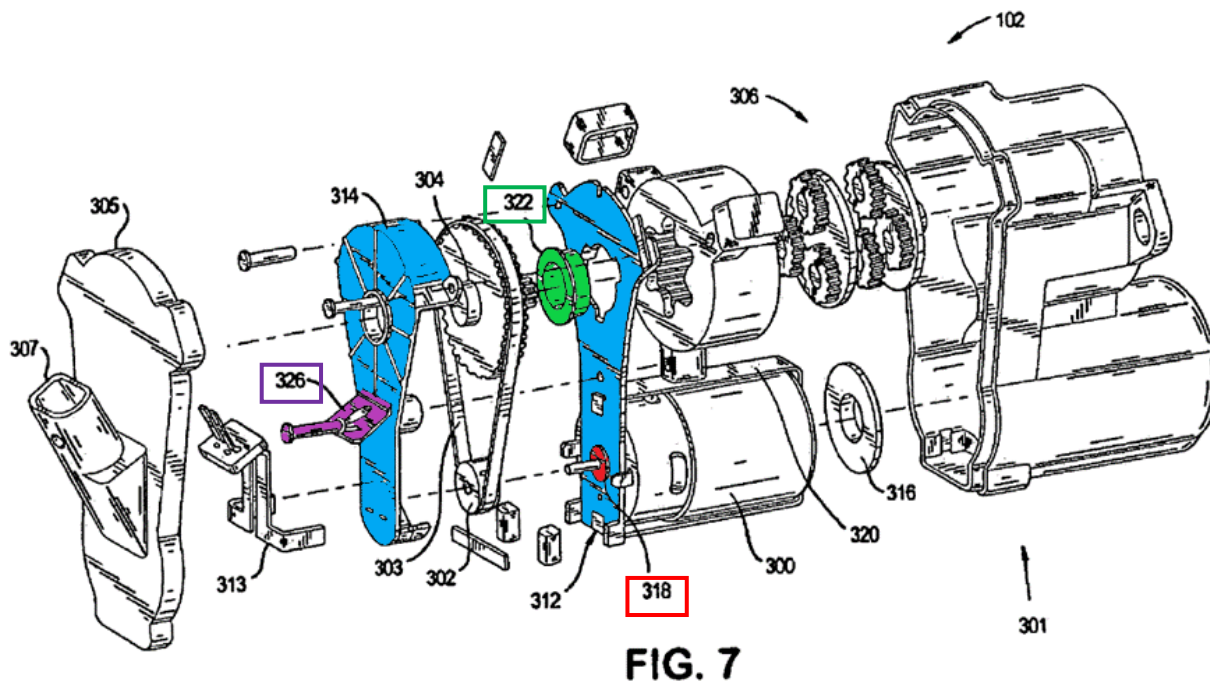


49. The '415 Patent discloses that mounting the motor 300 and gears 306 to the sub-frame 312 has a number of benefits, including increasing the ease of assembly, handling, and facilitating testing of the actuator 102. *Id.* at 4:44-54. For instance, the motor/gear assembly can be removed from the rest of the actuator as a package (or sub-assembly) without needing to decouple the motor from the gears. Conversely,

the motor and gears can be assembled to one another and to the sub-frame outside of the actuator and then installed in the actuator as a package.

C. Isolators

50. The claims at issue in this case relate to isolators between the sub-frame and another component of the actuator. Example isolators are shown in Figure 7 as isolation bushing 318 (red), isolation bushing 322 (green), and isolator 326 (purple). See Figure 7 (annotated below).



51. While some of the isolators in the '415 Patent are bushings, bushings are not necessarily isolators. An isolator is best defined by its function. If a bushing *isolates*, then it is an isolator. Here, the bushings in this case are disclosed to be isolators. See

Ex. 1001 at 6:44-47 and 6:66-7:3. However, if a bushing does not isolate vibrations, I would not consider it to be a vibration isolator simply because it is a bushing. Some bushings, such as those used for mounting or alignment of various components, permitting rotation between components, etc., are not necessarily isolators, let alone vibration isolators.

VIII. LEVEL OF ORDINARY SKILL

52. I understand that Petitioners' proposed definition of a person having ordinary skill in the art (POSA) is:

A POSA at the time of the alleged invention would have had a bachelor's degree (or equivalent) in mechanical engineering, electrical engineering, automotive engineering, or a similar discipline, and at least two years of experience with electromechanical devices such as actuators.

See Petition at page 16.

53. I object to Petitioners' inclusion of "electrical engineering" as a degree that a person of ordinary skill in the art could hold and be considered one of ordinary skill in the art because the issues in this case do not relate to electronics or electricity. This case relates to EPBAs, which do include motors, but this case does not relate to the contents or control of the motor itself.

54. Further, Petitioners believe a POSA should have at least two years of experience with electromechanical devices such as actuators. This is overly broad because there are aspects of actuator design that do not relate to any issues in the case. For example, the way in which current flows to the motor is related to actuator design but is not related to any issues in this case, which relates to noise attenuation and vibration damping for an actuator. Taking Petitioners' proposal for what it plainly states, one could have an electrical engineering degree and experience with motor controls and be deemed a POSA. However, I would not consider such an individual to be a POSA for the technology at issue.

55. I have reviewed Dr. Lequesne's Declaration, his CV, and his deposition testimony. I commend Dr. Lequesne for his career accolades and his accomplishments. I have no reason to doubt Dr. Lequesne's expertise in his particular field. However, Dr. Lequesne's expertise is not directly relevant to the questions presented in this case.

56. Dr. Lequesne's background is primarily focused on motor control. Dr. Lequesne stated during his deposition that his background focused primarily on controlling motors to avoid the creation of noise in the first instance, rather than mitigating the transfer of noise between mechanical components, which is a significant difference.

57. I believe a more precise definition of a POSA at the time of the invention would be someone that would have had a bachelor's degree (or equivalent) in mechanical engineering, automotive engineering, or a similar discipline, and at least two years of experience with vibration isolation, vibration damping, or noise attenuation in the context of mechanical or electromechanical systems.

58. At the time of the invention, I had a mechanical engineering degree and I had a substantial amount of advanced technical and higher level education, as well as automotive, manufacturing and other relevant experiences. I had at least two years of experience with vibration isolation, vibration damping, or noise attenuation in the context of mechanical or electromechanical systems. I met the requirements of a person of ordinary skill in the art, and continue to meet the requirements of a person of ordinary skill in the art, under either my definition in the preceding paragraph or under Petitioners' definition.

IX. CLAIM CONSTRUCTION

A. Sub-frame

59. In the context of the '415 Patent, a sub-frame (312) is a frame for a sub-assembly. The sub-frame (312) is distinct from an actuator housing (301), which is an outer casing of the actuator (102). The actuator 102, in turn, is essentially everything shown in Figure 3 of the '415 Patent, minus the brake caliper 106.

60. When reviewing the claims in light of the specification, it is clear to me that the term sub-frame refers to a frame, which can include one or two plates, that permits one to mount the motor 300 and gear train, and any intervening isolators, thereto. This sub-assembly can be built and tested “outside of the actuator housing 301,” which provides for “greater access” to the motor and drive train and “handling is improved.” Ex. 1001 at 4:44-54. Further, “once the components have been mounted to the sub-frame 312... performance of the actuator 102 may be tested prior to final assembly” so that “detected problems may be resolved at an earlier stage in the assembly process.” *Id.* The sub-frame and actuator housing are also disclosed as cooperating to define a motor cavity. Ex. 1001 at 6:36-54. It is clear to me that the specification contemplates benefits of the sub-frame as well as the distinct nature of the sub-frame and the actuator housing.

61. Also, when reviewing the claims of the '415 Patent themselves, the claims use the term “sub-frame” distinct from an “actuator housing.” Claims 13, 16, 17, and 20, of the '415 Patent each recite both a “sub-frame” and an “actuator housing.” Claim 16, 17, and 25 even recite an isolation bushing between the actuator housing and the sub-frame.

62. Given the disclosed benefits of a sub-frame, which are attributable to its distinctness from the actuator housing, coupled with the consistent usage of the

different terms “sub-frame” and “actuator housing” in the claims, I do not consider a “sub-frame” to be an “actuator housing” and vice versa.

63. With respect to claims 16, 17, and 25 in particular, where an isolation bushing is between the actuator housing and the sub-frame, one would not be able to provide an isolation bushing between a sub-frame and an actuator housing if the components were not separate structures.

B. Actuator housing

64. Again, an actuator housing is an outer casing of the actuator 102. Further, the actuator housing is attachable to a brake caliper. As used in the '415 Patent, I do not read the term “actuator housing” (301) as being so broad that it can read on a brake caliper (106). In other words, they are distinct structures.

65. The '415 Patent uses the terms “actuator housing” and “caliper” to refer to different structures. The term “actuator housing” is used to refer to the housing 301, which is the outer casing of the actuator 102—and is not an outer casing of the brake caliper 106. Ex. 1001 at 4:7-21. The actuator 102 is disclosed to be a structure that is attachable to the caliper 106. See *Id.* at 3:1-9; Figures 1, 3, and 4 (annotated below).

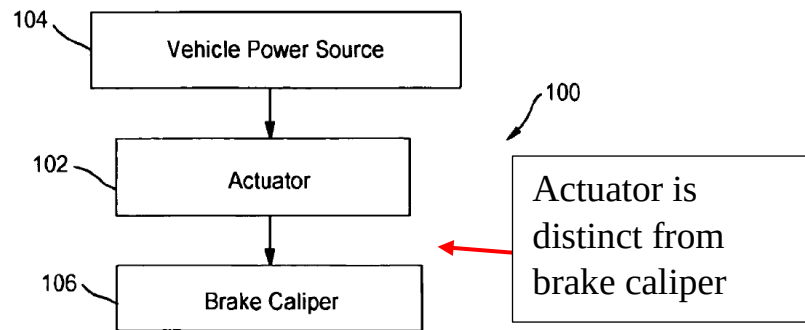


FIG. 1

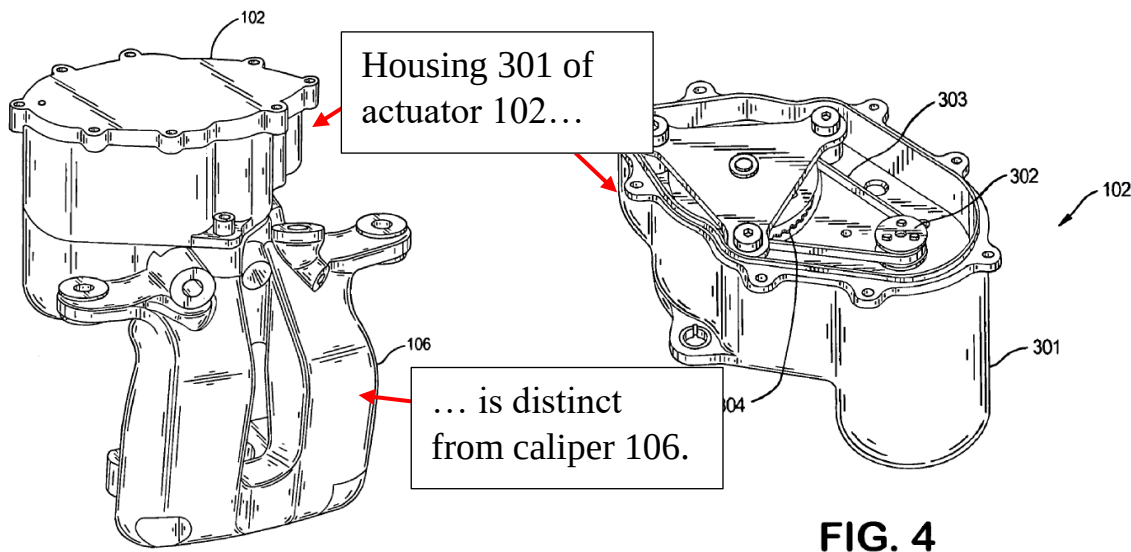


FIG. 4

66. Providing the actuator housing as a separate structure from the brake caliper provides advantages, including that the actuator assembly can be tested independently of the brake caliper and before it is mounted to the brake caliper.

67. In the '415 Patent, the term “actuator housing” is never used to refer to a brake caliper or a portion of a brake caliper. Further, some claims in the '415 Patent recite

both an “actuator housing” and a “brake caliper.” Different claim terms are presumed to have different meanings and, coupled with the remainder of the disclosure of the ’415 Patent, I do not think it is reasonable to read an “actuator housing” on a brake caliper.

X. PRIOR ART REFERENCES RELIED ON IN GROUNDS 1-5

68. In Grounds 1-5, Petitioners rely primarily on prior art references to Poertzgen (Ex. 1007), Boucheret (Ex. 1010), Drennen (Ex. 1011), and Weiler (Ex. 1012). I have reviewed these references. Of these four references, three of them (Poertzgen, Drennen, and Weiler) disclose EPBAs with hard-mounted components. Specifically, the components of the EPBAs of Poertzgen, Drennen, and Weiler are hard-mounted because their components are required to be mounted in a precise relationship to one another in order to function properly. In these disclosures, precision mounting and tight tolerances were deemed to be paramount, and one would not have introduced isolators into these systems as it could lead to misalignments or relative movement between parts, in turn leading to vibration propagation, noise, and general usability concerns.

69. Boucheret, on the other hand, is not an EPBA. Boucheret relates to a motor for a fan. This is the type of system where the actuator is only a motor with an attached fan. There is no intricate, complex arrangement of components constituting

a gear train mechanism. Boucheret only requires loose tolerances between its components, and therefore Boucheret can accommodate motions introduced by the isolators. Isolators can be introduced into systems like Boucheret to smoothen the operation of the device without the same level of concern for introducing motion or misalignment as in Poertzgen, Weiler, or Drennen. Boucheret would be of no use and no interest to a POSA facing the problems addressed by the '415 Patent. I will discuss these and other features of the prior art below.

A. Isolators, Generally

70. In general, isolators are devices that isolate. Specifically, isolators mitigate the transmission of some energy between two components.

71. Example isolators are those that isolate for heat, vibration, or electricity, as examples. The isolators at issue in this case are vibration isolators. A vibration isolator, or simply an isolator (or, alternatively a vibration damper) is an isolator that mitigates the transmission of vibrations between adjacent components. In general, mitigating the transmission of vibrations within a system leads to a reduction in noise of that system.

72. When evaluating a design as a candidate for potential noise reduction, one would first consider whether the actuator in question is the type that could or should include vibration isolators, or whether one should pursue another technique for

reducing noise. For instance, instead of isolators, one could replace a metal chain with a rubber belt, or one could attempt to insulate a housing of an actuator, such as by covering the housing with a particular noise-insulating material.

73. Some mechanical systems include multiple mechanical components mounted in close relationships with tight tolerances, meaning these systems are designed such that there is a relatively small amount of variation permitted between the specified (or designed) dimensions of the components, and where they are mounted, in relation to the actual dimensions and mounting locations of the components. These systems may be referred to as “hard mounted” systems. In such systems, precision is paramount. Notably, the Boucheret reference on which Petitioners rely is not a hard mounted system.

74. Vibrations in hard-mounted systems can be created and transmitted to other components of the system if the tight tolerances are not maintained. Misalignment of one or more parts of the system can compromise the system’s performance (including static and dynamic accuracy) and reliability. More specifically, with respect to the system’s dynamic accuracy, isolators introduce compliance (i.e., softness) into a system which can manifest itself as lag, or delay, making it more difficult to transfer forces from the motor, to the gears, etc. This is one of the reasons why positioning systems that desire rapid responses, like Poertzgen (discussed

below), include hard-mounted components without any isolators. In hard mounted systems, adding vibration dampers may change the dynamics of the system or introduce misalignments and can actually lead to the creation of noise. *See Ex. 1001 at 3:14-18.*

75. On the other hand, some different types of systems may be less concerned with precision, such as systems where a motor output is not coupled to a series of other mechanisms. These systems can be designed and manufactured with relatively larger tolerances, meaning the system can accept components that have dimensions that deviate by a relatively large amount from a designed nominal dimension or a designated mounting location. Such systems are less likely to create vibrations and transmit them throughout the system. In such systems, vibration dampers can be used to minimize noise and improve the overall smoothness of the operation, with little to no concern over deleterious behaviors being introduced by the addition of an isolator.

76. Assuming one has decided that a particular system was amenable to introduction of a vibration isolator, one must carefully design that isolator, because, again, it is possible for isolators to lead to a system that creates more noise and reduced performance. When designing a vibration isolator for a particular system, one must consider factors such as the resonant frequency of the system (both with

and without the isolator), the shape, placement and material properties of the isolator, the amplitude and frequency of forces that the isolator will be subjected to, and the targeted reduction in amplitude and frequency of the vibrations. It is important to carefully design and test the system with the vibration isolators to ensure that the targeted vibration reduction is achieved and that the performance of the system matches the desired specifications.

B. EPBAs and Isolators

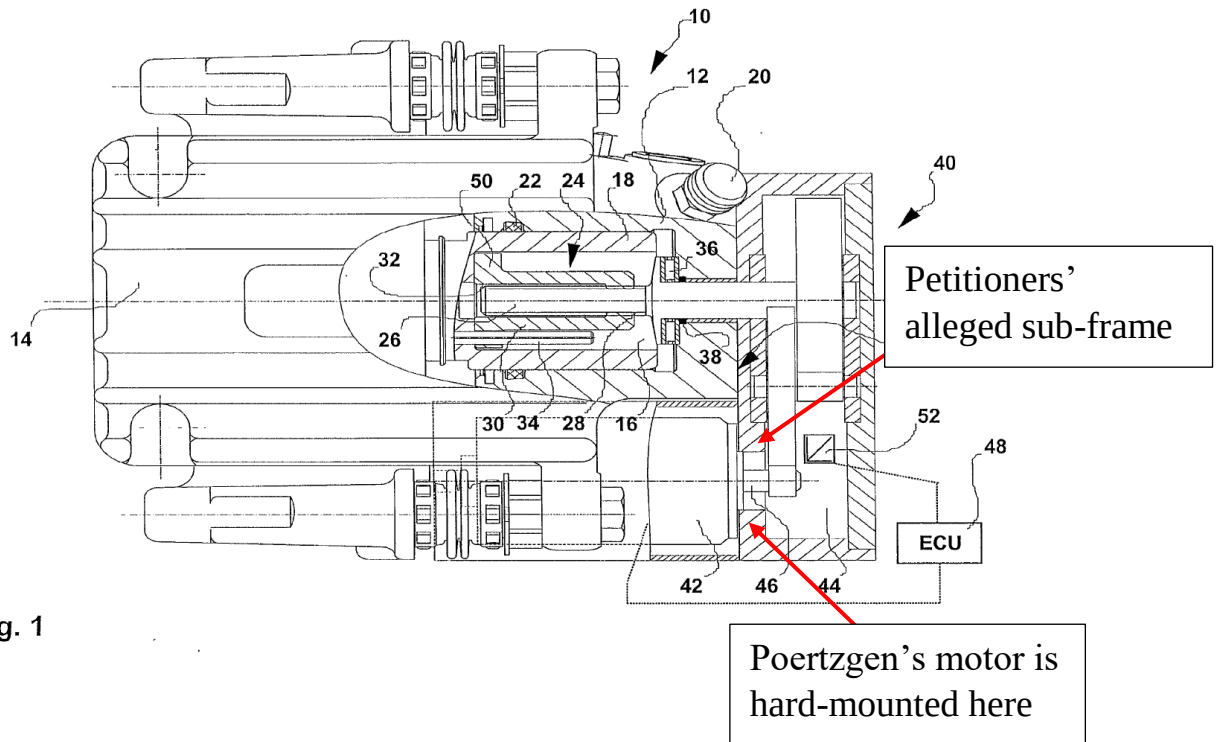
77. The EPBAs that I have reviewed from the time of invention included motors that were hard-mounted to another mechanism, such as a gear train, which in turn is coupled to at least one additional mechanism. Such a series of mechanisms needs to be mounted in a precise relationship, which strictly adheres to a tight set of tolerances, to function properly. This is because EPBAs from the time of invention are precision positioning systems. Introducing an isolator into such a system would tend to introduce relative movement between the components, because isolators are typically made of relatively soft materials. This introduced motion could cause parts to interact out of tolerances and could lead to the creation of vibrations, which in turn leads to noise generation. So, the introduction of an isolator into a hard-mounted system could cause the very noise generation problem that the isolators were designed to mitigate.

C. Poertzgen

78. Poertzgen (Exs. 1007, 1008) discloses a hydraulic service brake which is usable as a parking brake when selectively driven by motor 42, shown below in annotated Figure 1. Poertzgen is a precision actuator. Specifically, it is a precision positioning system. It does not disclose any isolators in its system, let alone any isolators mounted relative to its motor 42, gear train, or anything that Petitioners have deemed a sub-frame. Reviewing Poertzgen's disclosure as a whole, it makes sense to me that Poertzgen would not include any vibration isolators. The problem that Poertzgen is addressing is to modify a hydraulically actuated service brake to have it also serve as a parking brake that is electrically actuated and that is more compact and lightweight than a brake disclosed in a previously published version (EP 0 729 871 A1). As an initial matter, adding isolators to Poertzgen would make it heavier and less compact. There are more reasons why one would not add isolators to Poertzgen, outlined below.

79. Poertzgen's motor 42 is mounted to a plate on the immediate right-hand side of its motor (see below), which is what Petitioners purport to be Poertzgen's sub-frame. The output of Poertzgen's motor is disclosed as having an output shaft 46 which is coupled to another series of devices, namely a reduction gear 44 which, in

turn, is coupled to spindle 26, which is configured to move a nut 30, which is configured to move the brake piston 18.



80. Poertzgen is the type of precision actuator that would not benefit from the addition of vibration isolators. Because Poertzgen's motor output 46 must be mechanically coupled to the reduction gear 44, which itself is coupled to a series of movable mechanical components, Poertzgen is the type of actuator that favors hard-mounting of its components in close, tight relationships to one another. Introducing vibration isolators into Poertzgen would permit unwanted movement between components potentially creating out of tolerance interactions of Poertzgen's system leading to performance issues, among other potential problems.

81. When Poertzgen squeezes and retracts its brake piston 18 relative to its brake rotor, Poertzgen needs to do so with accuracy. Poertzgen describes a desire to maintain a constant distance of about 0.5 mm between its brake piston 18 and nut 30. Poertzgen at 3:17-34. Introducing isolators into Poertzgen would lead to potential movements and misalignments between component parts, which in turn may lead to vibrations, and ultimately undermines Poertzgen's desire to maintain a constant distance between its brake piston 18 and nut 30.

82. Introducing isolators into Poertzgen would also introduce compliance, or softness, into Poertzgen's system which would in turn create a lag, or delay, in the time it takes Poertzgen to achieve a maximum clamping force, for example. This goes against Poertzgen's desire for achieving maximum clamping force in a short time period, on the order of 1 second.

83. Poertzgen describes the use of its disclosure as a replacement for a traditional, manually-operated hand brake. In manually-operated hand brakes, a user pulling on a lever gets some feedback from the system, and in other words has a sense of feel, regarding the amount of force that is being applied to the brake rotor. Most users learn how hard to pull the hand brake lever in order to properly apply the parking brake. Because Poertzgen does not relate to a manually-operated brake, it attempts

to monitor travel of its actuator and the corresponding clamping force applied to the brake rotor using feedback from sensors, such as current and speed measurements.

84. In describing the method of Figures 2A-2C, Poertzgen again reiterates that it seeks to maintain a distance “X of 0.5 mm” between its brake piston 18 and nut 30 when in the non-actuated condition. According to Poertzgen, the distance X achieves a desired clamping force in as short a duration as possible, while allowing the brake piston 18 to return after actuation without prematurely contacting the nut 30. Poertzgen 9:3-10.

85. Figures 2A-2C plot motor output shaft 46 speed, motor current consumption, and clamping force relative to time, respectively. Poertzgen 9:13-16. Poertzgen can monitor each of these values during its locking and unlocking functions. However, during unlocking, Poertzgen relies solely on motor rotation to deduce the position of its nut 30. Specifically, at time t0 to t1, the motor is operated at a relatively high speed and nearly constant low current because no clamping force has yet been applied. Poertzgen at 9:17-22. At time t1, the nut 30 comes into contact with the brake piston 18, and current consumption and clamping force increase while motor speed decreases up until time t2. From times t2 to t3, the maximum clamping force is reached and the motor is switched off. To release the parking brake, at time t3, the motor runs in the opposite direction, resulting in a generally reduced current and

clamping force until time t4, at which point clamping force returns to zero and the motor runs at a nominal current. Poertzgen seeks to return the nut to the distance X between times t4 and t5. Poertzgen does this, not by relying on clamping force or current measurements, but “simply by appropriately selecting the time interval between points of time t4 and t5.” Poertzgen at 9:11-10:20. However, Poertzgen can only conclude that a set time interval will result in movement of its nut by X distance “[b]ecause of the known reduction ratio between the output shaft 46 of the electric motor 42 and the spindle 26.” *Id.* And Poertzgen only has a “known reduction ratio” because it is a precision actuator which exhibits tight tolerances. Any misalignment in component parts or undue vibrations in Poertzgen’s system could make it such that operating Poertzgen’s motor for a set time will not result in movement of its nut by X distance.

86. In another embodiment, Poertzgen monitors movement of the nut 30 by measuring revolutions of the motor or its reduction gear. Poertzgen at 4:1-16. However, Poertzgen can only relate movement of the nut 30 to revolutions of its gears or motor if the motor and gear, and all components in between, are mounted precisely. Introducing isolators into this system, and therefore introducing potential movements, misalignments, etc., would undermine Poertzgen’s ability to use revolutions of the motor or gear to deduce movement of the nut 30.

87. Poertzgen does generally contemplate a sensor that directly measures movements of its nut (*see* 2:29-31). Introducing isolators into Poertzgen's system could introduce misalignments and relative movement (i.e., vibrations) such that the distance X cannot be reliably achieved regardless of how it is measured.

88. While vibration isolators can reduce noise, when used correctly and in a system that can accommodate them, Poertzgen's disclosure is not focused on noise reduction but nonetheless suggests one design option for those seeking to reduce noise—specifically, Poertzgen mentions that its reduction gear could include a belt drive. *See* Ex. 1007 at 3:1-8. This, again, makes sense to me. Poertzgen is the type of actuator that would not have sought to reduce noise by the introduction of vibration isolators between the very components (e.g., the motor, reduction gear) where it requires precision mounting. Thus, while Poertzgen does briefly mention noise decoupling, this does not mean that one would have introduced isolators into Poertzgen.

D. Boucheret

1. Boucheret's fan motor does not have the same precision mounting concerns of Poertzgen, Drennen, or Weiler

89. Unlike Poertzgen, Boucheret (Ex. 1010) does not disclose an EPBA. Further, unlike Poertzgen, Boucheret is not a precision positioning system. Rather, Boucheret teaches a system for spinning a fan. Boucheret's motor is not positioning anything.

Unlike the nut and brake piston of Poertzgen, the exact location of Boucheret's fan in space is not important.

90. More specifically, Boucheret relates to a motor for a fan in an HVAC unit, for example, see Ex. 1010 at 1:7; 3:6. Boucheret's motor is not used in a precision actuator, such as that of Poertzgen. Fans are configured to simply rotate with the motor. The output of Boucheret's motor is not coupled to a series of additional mechanisms, such as a gear train, which is in turn coupled to a spindle, which is in turn coupled to a brake piston, as in Poertzgen. If there is some misalignment relative to the mounting of Boucheret's motor, it is of minimal to no concern in a system like that of Boucheret. Boucheret is the type of system that can accommodate relatively lax tolerances, and thus Boucheret can benefit from the introduction of vibration isolators without concern of the deleterious effects they can create in hard mounted systems such as Poertzgen.

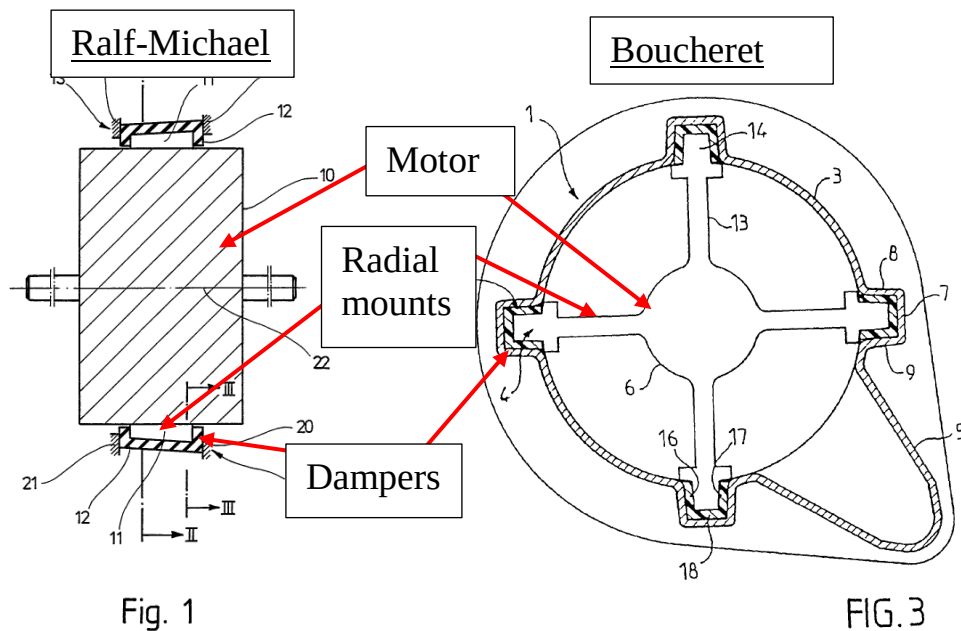
91. Boucheret relates to a specific type of motor with "radial fastening lugs" integrated into the motor casing. Ex. 1010 at 1:10-18. Boucheret characterizes its disclosure as an improvement over another radially-mounted motor from FR 2 693 779 to Ralf-Michael (Ex. 2002, 2003). *Id.* The annotated Figures below, from Boucheret and Ralf-Michael, show that these two references apply to motors with several radially-projecting lugs arranged around an outer circumference of the

motor. Nothing in these disclosures suggests to me that the motors of Boucheret or Ralf-Michael are the type of motors that would require precision mounting due to concerns that the motor output would not properly engage with another mechanism, for example. These motors simply spin fans—they are not trying to accurately position them.

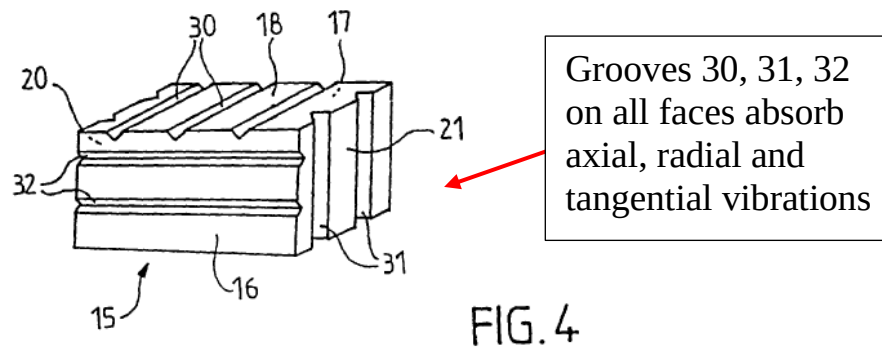
92. Boucheret, for example, states that a benefit of its disclosure is that it accommodates elements that exceed the designed “tolerances.” *See* Ex. 1010 at 1:65-2:3; 2:26-34. According to Boucheret, a problem that preceded its patent was that motors would either be assembled in a manner that over-compressed a vibration isolator such that it did not perform a damping function, or that the motor would not fit into its housing at all. Ex. 1010 at 1:30-38. So, Boucheret does not teach one to mount a motor in close proximity to its surrounding components, and instead teaches that accommodating components that exceed the designed tolerances and avoiding over-compression of its vibration isolators is a primary design concern.

93. Both Boucheret and Ralf-Michael disclose motors mounted to a housing via the lugs. In the left-hand image below, Ralf-Michael’s motor 10 has radial ribs 11 for mounting to a housing 20, 21. Damping elements 12 are provided between the ribs 11 and Ralf-Michael’s housing 20. In the right-hand image, below, Boucheret likewise discloses a motor 6 with radial lugs 13, which are again used to mount the

motor 6 to a housing 1 via damping elements 15. Neither Ralf-Michael nor Boucheret has a sub-frame. The motors of Ralf-Michael and Boucheret are soft-mounted motors, unlike Poertzgen.



94. According to Boucheret, the dampers of Ralf-Michael cannot adequately absorb axial vibrations. Ex. 1010 at 1:18-29. Boucheret seeks to improve on this aspect of Ralf-Michael by providing its damping elements 15 with grooves on all outer faces, which, according to Boucheret, makes it possible “to absorb the axial, radial and tangential vibrations and their combinations.” *Id.* at 1:65-2:3. Example grooves 30, 31, and 32 are visible in Boucheret’s annotated Figure 4, below.



95. To the extent Boucheret's damping elements can be considered isolators, they are arranged only between the lugs and the surrounding housing, e.g., around the radial circumference of the motor. Boucheret does not include isolators at the axial ends of motor 6 (the flat ends of the cylinder). See Boucheret's Figure 2, annotated below.

2. Additional differences between Poertzgen and Boucheret

96. Another significant difference between Boucheret and Poertzgen, for example, is that the motor of Boucheret is designed to run for extended periods at one or more set speeds, depending on the requirements of the HVAC system. EPBAs like Poertzgen, for example, are designed to run for a mere matter of seconds. For example, Poertzgen states that its actuator can achieve a maximum clamping force "within a short period of time, i.e., within the range of approximately 1 second." Ex. 1007 at 3:24. During this extremely short time, Poertzgen's motor runs at variable speeds and consumes variable amounts of current. See Ex. 1007 at 4:30-5:34. On the

other hand, HVAC systems are typically run for time periods significantly longer than a matter of seconds, sometimes exceeding hours at a time, while holding a set motor/fan speed and consuming relatively constant levels of current.

97. EPBAs like Poertzgen are essentially short burst actuators, whereas fan motors like Boucheret are continuously operating actuators. Continuously operating actuators will achieve a steady-state operation, where the motor settles into a stable speed and produces vibrations at a consistent frequency. These vibrations will have a continuous and predictable pattern. On the other hand, short burst actuators like EPBAs will exhibit transient behavior, including short-lived events that occur when a system is subjected to a sudden change, like rapidly changing motor speeds. The frequency of vibrations during these short bursts will likely vary depending on the speed changes and the motor's characteristics. As such, vibration frequencies between the two categories of systems will exhibit different amplitudes, with continuously operating actuators exhibiting sustained, stable amplitudes and at a limited number of predictable frequencies, while in contrast short burst actuators exhibit a more complex vibration signature with many frequencies of varying amplitudes.

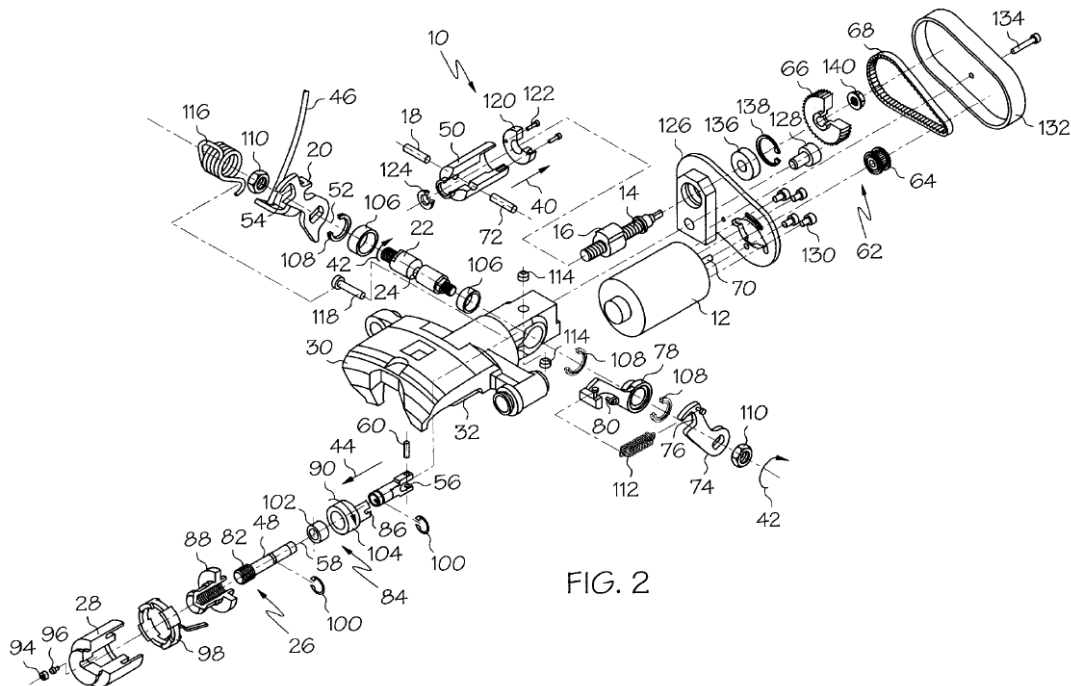
98. Further, while Poertzgen seeks to provide a fast response time, there is no such concern in Boucheret. If there is some lag or delay in the time it takes Boucheret's

fan to get up to speed it will not have a significant effect on the overall function of the HVAC system.

99. For at least these reasons, a POSA would understand that the vibration damping techniques from Boucheret would not apply to Poertzgen, for example. A POSA would not have used a vibration isolator designed for use in a system like Boucheret's in an EPBA, like that of Poertzgen.

E. Drennen

100. Drennen discloses a combination EPBA and manual park brake actuator. The dual inputs for the park brake actuator are provided to address the possibility of loss of electric power to the EPBA. *See* Ex. 1011 at 3:27-4:19. Specifically, Drennen includes a motor 12 which can operate the brake caliper 10 as a parking or service brake, and a cable 46 which can manually operate the brake caliper 10 as a parking/emergency brake. *Id.* Figure 2 of Drennen is copied below:



101. The motor 12 of Drennen is, like Poertzgen's, part of a precision-mounted position actuator. The motor 12 includes a motor shaft 70, which is coupled to a pulley 64, which is in turn coupled to a second pulley 66 via a belt 68. The second pulley 66 is secured to a ball screw 14, which eventually moves a precision cam that actuates the brake caliper 10. For essentially the same reasons as Poertzgen, I do not consider Drennen the type of actuator that one would introduce an isolator into, because it would introduce variability between an otherwise tight-tolerance arrangement.

102. While a mounting block 126 is shown in Drennen, neither the motor 12 nor the gear train (pulleys 64, 66) are mounted to the block 126 via an isolator. Drennen does reference a bushing 136, but there is no evidence that the bushing 136 is configured as an isolator, let alone a vibration isolator. Further, the bushing 136 is used to mount the ball screw 14 to the block 126. Ex. 1011 at 7:29-32. The bushing 136 is likely used to align the screw and allow for reducing rotational friction as opposed to isolate for any vibration.

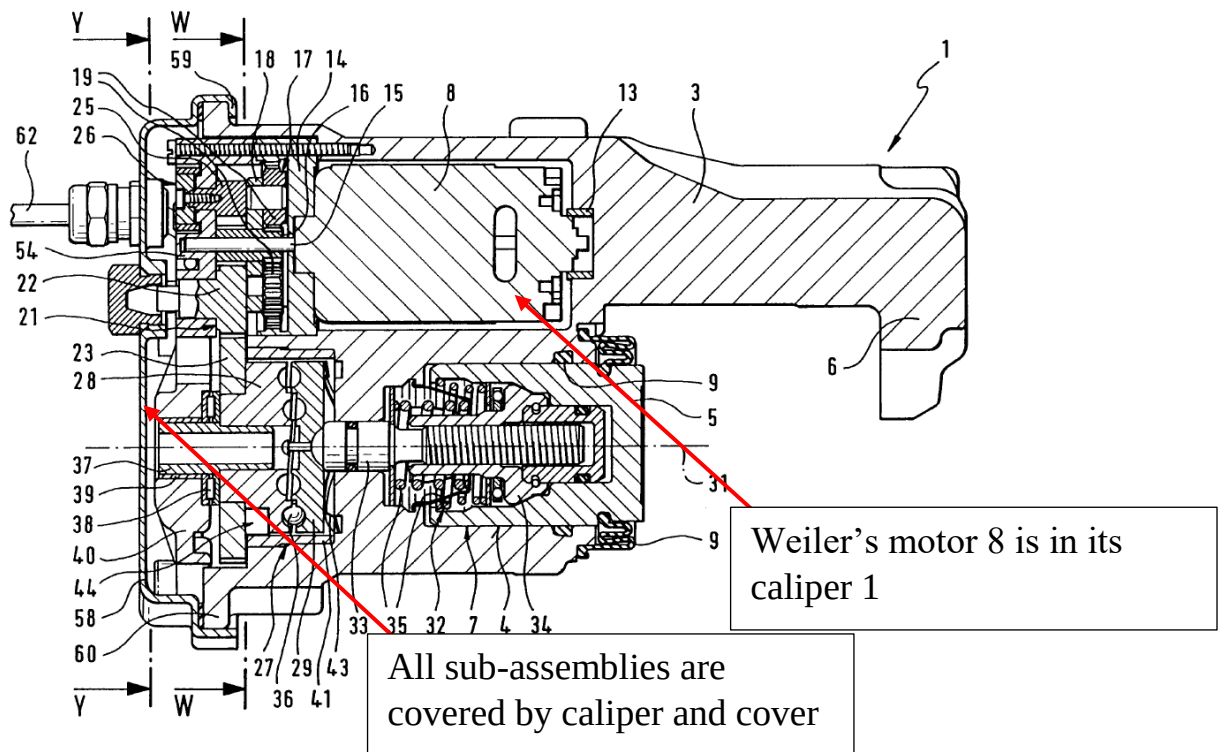
103. The mounting block 126 of Weiler is not disclosed as having any functionality that would be deemed similar to the sub-frame of the '415 Patent. For instance, Drennen does not explain that its motor or gear train are mounted to the mounting block 126 before final assembly.

F. Weiler

104. Weiler (Exs. 1012, 1013) discloses a vehicle brake with an electric actuator configured to operate the vehicle brake as both a parking and a service brake (Weiler does mention the option of using a hydraulic actuator device in an alternate embodiment; see Weiler at 5:13-20). In general, Weiler is addressing the problem of electric actuators that do not produce enough braking force, and is further addressing its perceived problems with the solutions proposed by Poertzgen and the like—namely that they are too complicated due to their combined electric and hydraulic

actuators. Like Poertzgen and Drennen, Weiler is an EPBA and is the type of actuator that requires precision mounting of its components in a close, tight relationship. Introducing isolators into Weiler would lead to the same negative consequences as discussed above relative to Poertzgen and Drennen, namely that it would introduce potential misalignments, unwanted movements, and lag.

105. Weiler's actuator includes a motor 8 that is received directly within the caliper 1, as opposed to a separate actuator housing. Specifically, a design objective of Weiler is a "compact" design, and Weiler states that disposing and fastening its "electromechanical actuator unit, the actuator element, and the multi-stage reduction gear... within the brake caliper" facilitates the design goals of a "particularly compact design." See Weiler at 6:23-7:2. Further, because Weiler mounts all of its various sub-assemblies within the brake caliper 1 and covers them with a housing cover, "[t]he housing cover prevents contamination of the individual sub-assemblies" which Weiler alleges increases reliability of the brake. *Id.*



106. Weiler also discloses an angular position sensor 26, which is used to determine “the angular position or the rotary motion of the electric motor 8 in relation to the direction or rotation and the speed of rotation at any given time” which “provides information on the current actuating state of the brake.” Weiler at 9:1-18. While Weiler does not specify this, I read Weiler as describing the concept of using the motor revolutions to deduce the position of its brake piston based on the known relationship between the various gears and components connecting its motor to the brake piston, similar to Poertzgen. Weiler could not reliably determine the current actuating state of its brake based on motor rotation if Weiler’s motor, gears, etc., were misaligned or exhibited unwanted vibrations or movement. The precise

specifications and relationship between Weiler's motor and its various gears must be known in order to deduce the actuating state of the brake based on the motor's measured rotation. In fact, Weiler stresses that the sensor should be located as near to the motor as possible so a high resolution measurement of the motor's rotation can be made. Weiler at 9:14-18 ("...the angular position sensor 26 should be arranged as close as possible to the electric motor 8 .").

107. Further, Weiler's motor 8 is supported at one axial end by a bearing bush 13 and is supported at another axial end by a bearing plate 14 as shown in annotated Figure 2 above. Dr. Lequesne states that the bearing bush 13 serves a vibration isolation function. *See* Ex. 1002 at ¶ 276. I do not agree that the bearing bush 13 and bearing plate 14 serve an isolation function. Bearing bush 13 appears to be the type of bearing bush that would permit rotation of Weiler's motor. Bearing bush 13 otherwise appears to merely support the motor at one end, likely to increase the ease of installing the motor, whereas bearing plate 14 merely abuts the other end of the motor, likely to hold it in place, because Weiler's motor needs to be mounted such that it does not spin freely. Weiler's motor must be held in place firmly both axially and torsionally. The bearing bush 13 and bearing plate 14 are not disclosed to be isolators, and I am not convinced based on the content of Weiler that they would function as vibration isolators. Rather, again, Weiler is an EPBA that would

prioritize precision mounting over introducing vibration isolators, which would undercut the design objective of precision mounting.

108. From my review of Weiler, bearing bush 13 is a friction reducing element and not a vibration isolator. Further, regarding bearing plate 14, putting an isolator between the bearing plate and the motor housing makes no sense to me. Again, Weiler must mount its motor in a manner that prevents it from moving axially but also from twisting. Given that one end of the motor has a bearing bush 13, putting an isolator between the motor and bearing plate 14 would allow the motor to twist and negatively impact the accuracy and repeatability of Weiler's system.

109. Petitioners do point to Ex. 1018 for support, but Ex. 1018 is a patent teaching rubber isolators for continuously-running motors, not a positioning servo like those that are used in electric brakes.

110. Even accepting Dr. Lequesne's interpretation of the function of Weiler's bush bearing 13 and bearing plate 14 as structures that may reduce friction, absorb vibrations, and distribute the loads of the motor 8, it is unclear to me why Petitioners also then seek to add additional isolation features relative to Weiler's bearing plate 14. Petitioners do not explain why one would want to add more isolators to Weiler. Again, I do not believe the Weiler's bearing bush 13 and bearing plate 14 are isolators, and there would be no reason to add an isolator between bearing plate 14

and Weiler's motor because doing so would permit unwanted twisting of Weiler's motor.

111. I also do not agree that bearing plate 14 is a sub-frame. Bearing plate 14 is merely a plate that bears directly against an end of the motor 8. Weiler does not disclose its bearing plate 14 as having the same functionality as the disclosed sub-frame, such as permitting assembly of the motor and gear train relative to the bearing plate 14 before insertion into the brake caliper.

XI. NON-OBVIOUSNESS OF THE CHALLENGED CLAIMS

112. Petitioners have not addressed or contemplated the full scope of considerations relevant to vibration isolators and actuator design. The matter is not so simple such that one could place an isolator from one system (i.e., Boucheret) and place it in another, different system (i.e., Poertzgen or Weiler), and expect it to function as desired. In fact, once the full scope of Poertzgen and Weiler are considered, it is apparent that they would not benefit from the addition of vibration isolators at all (again, when I refer to "isolators" generally in this Declaration I am referring to vibration isolators).

A. Ground 1 – Poertzgen in view of Boucheret does not support obviousness of claims 5, 7, 8, or 14-19

113. In this ground, Petitioners propose modifying a reference without isolators, Poertzgen, to include an isolator in the particularly-claimed locations, as allegedly taught by Boucheret. Petition at 40-52. There is no reason provided in these references that would lead a POSA to do so, however.

1. Claim 5 is not obvious over Poertzgen and Boucheret—No Motivation

114. Claim 5 is not obvious over Poertzgen and Boucheret. Claim 5 recites, in relevant part, “a sub-frame, said motor being mounted on said sub-frame, said actuator further comprising a component isolator having a spring constant and a damping constant, said isolator coupled between said motor and said sub-frame.”

115. According to Petitioners, it would have been obvious to add an isolator between the motor of Poertzgen and the structure in Poertzgen that Petitioners have identified as a sub-frame, in view of Boucheret. Specifically, Petitioners propose placing an isolator at the right-hand (relative to Poertzgen’s Figure 1) axial end of Poertzgen’s motor.

116. I disagree with Petitioners that one would have sought to introduce an isolator in this location. A POSA would not add an isolator in this location because it could introduce relative movement and cause misalignments between Poertzgen’s motor and the structure that Petitioners allege is a sub-frame. It would also introduce lag

into Poertzgen's system. As explained above, introducing an isolator into Poertzgen's system could lead to a number of concerns, including increased vibrations and noise, ultimately raising concerns of whether the modified version of Poertzgen would be usable. Petitioners do not acknowledge that Poertzgen desires to maintain a precise relationship of about 0.5 mm between its nut and piston, and that Poertzgen deduces that precise distance based on motor speed. Introducing isolators would introduce variability into the system such that the 0.5 mm distance may not be able to be obtained reliably, and would further undermine Poertzgen's ability to deduce the relative distance based on motor speed, as discussed above. One skilled in the art would not have modified Poertzgen as Petitioners propose for at least these reasons. Petitioners' introduction of an isolator into Poertzgen also cuts against Poertzgen's desire for a fast response time, namely achieving a maximum clamping force in about 1 second, because adding isolators into Poertzgen's system would create a lag in response time.

117. Petitioners' stated motivation for adding an isolator to Poertzgen is "when NVH needs to be reduced, it is standard engineering practice, obvious to a POSA, to analyze the design for vibration/noise transmission paths and place isolators in those paths." See Petition at 41. I disagree with Petitioners because Petitioners do not acknowledge that some actuators would not benefit from placing an isolator in a

particular location. Petitioners fail to acknowledge that Poertzgen may favor hard-mounted, precisely-arranged components arranged with tight tolerances.

118. Further, when Petitioners allege that a POSA would have added isolators to an actuator “when NVH needs to be reduced,” I find Petitioners’ reasoning to be circular because Petitioners never allege that NVH needs to be reduced. Petitioners also never allege that Poertzgen would exhibit vibration or noise at the location where it seeks to add an isolator. Petitioners have not alleged that a test of Poertzgen would lead one to place an isolator between the motor and the alleged sub-frame. So, Petitioners have created a condition (i.e., “when NVH needs to be reduced”) that they have not met. That is, they have not shown why a POSA would understand that Poertzgen would produce unwanted noise at the location indicated. Instead, they have misused the ’415 Patent as a road map to where the NVH needs to be reduced. In my opinion, based on the entirety of Poertzgen’s teachings, I believe adding isolators where Petitioners seek to add them could actually create the very vibrations Petitioners claim they are trying to avoid, among other possible issues.

119. Petitioners also argue that using an isolator between an electric motor and the components to which it is mounted is nothing more than using a known technique to improve a similar device in the same way, and that a POSA would have appreciated that Boucheret’s technique for reducing NVH “would also apply to Poertzgen.”

Petition at pages 36-37. Finally, Petitioners argue that the claims are merely reciting a combination of prior art elements according to known methods. *Id.* at 37-38. However, again, Poertzgen is an actuator with mechanical components that are arranged in tight tolerances relative to one another, while the motor of Boucheret merely rotates a fan. Boucheret does not have the same concerns with a precise motor output, as in Poertzgen. This is why Boucheret can mount its motor using dampers, while Poertzgen does not. In fact, despite the fact that vibration dampers existed in the art at the time of the invention of Poertzgen, Poertzgen seeks to reduce noise without using vibration dampers, instead suggesting that its gear train could include a relatively quiet belt drive. This is strong evidence that Poertzgen desires tight tolerances between its mechanical components and chose other techniques for noise reduction. Further, fan motors, like Boucheret's, are designed to be running for extended periods at one or more set speeds. On the other hand, electronic park brake actuators are designed to operate for a matter of a few seconds, and typically operate at variable speeds. The resonant frequencies of these two systems are quite different. Fan motors like Boucheret's, which run at relatively steady speeds for extended periods, have resonant frequencies which can be easily determined and designed for. Components for electronic park brake actuators, on the other hand, may vibrate at irregular frequencies or at frequencies that are difficult to quantify given the short

duration of operation. Petitioners do not address or even acknowledge any of these discrepancies between Poertzgen and Boucheret. One would not simply have incorporated the teachings of Boucheret into Poertzgen for at least these reasons.

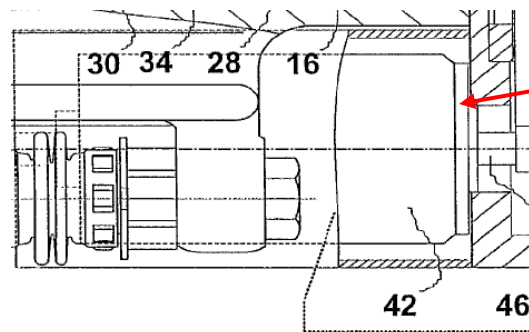
120. Boucheret's motor does not share the same concerns as Poertzgen with respect to tight tolerances. Boucheret has not been improved in the same way as the claimed invention. Boucheret does not teach one how to manage the downsides of introducing a vibration isolator into a precision positioning actuator.

121. Neither Poertzgen nor Boucheret teaches an isolator mounted between a motor and a sub-frame, and the references do not otherwise teach a known method for introducing vibration isolators into actuators that require precise outputs.

122. Petitioners also cite to a portion of a book (Ex. 1014), along with Dr. Lequesne's interpretation of this book, as evidence that one would have added the claimed isolator between Poertzgen's motor and the alleged sub-frame of Poertzgen. Ex. 1002 at ¶ 181. The cited portions do generally discuss vibration damping in the automotive context, but they do not teach one to place vibration dampers in the particularly-claimed locations, nor do these sections of Ex. 1014 discuss the drawbacks of using vibrations dampers in systems with tight tolerances between adjacent components.

123. Further, when Ex. 1014 does discuss specific examples of designs that do include vibration isolators, they are for designs that are more akin to a continuously-operating actuator, such as that of Boucheret, which achieves stable amplitudes and at a limited number of predictable frequencies. For example, engine mounts and crankshafts achieve steady-state vibrations and excitations, and thus isolators can be readily introduced into these designs. Engine mounts and crankshafts are quite different from the short-burst, precision actuators of Poertzgen or Weiler.

124. Outside of Boucheret and the cited sections of Ex. 1014, Petitioners attempt to support their argument by referencing an alleged “spacer” in Poertzgen. In particular, Petitioners believe a spacer is present between Poertzgen’s motor and the alleged sub-frame. See Petition at 35, 38; Figure 1 of Poertzgen (portion of which is annotated below).



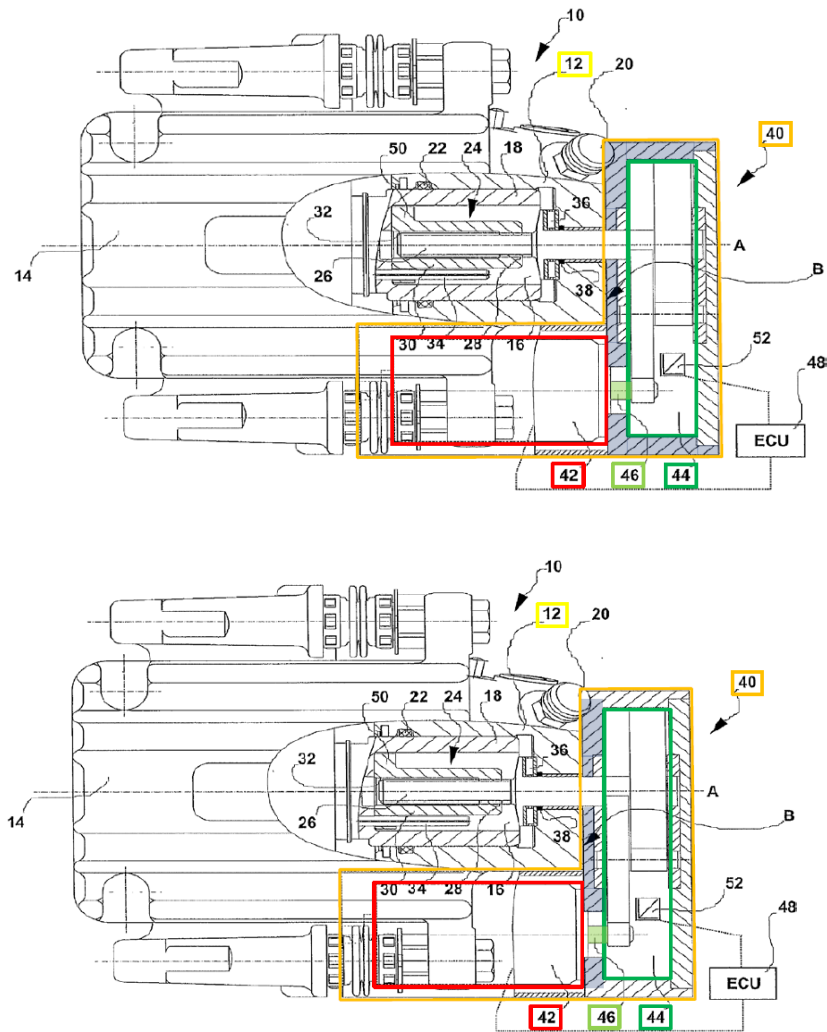
I find no support for Petitioners’ belief that this is a spacer, let alone an isolator.

125. The above rectangular-shape could be an end section or end cap of the motor as opposed to a spacer (let alone an isolator). Because it is not disclosed to be an

isolator, and because I do not believe (as I have already explained) Poertzgen is the type of actuator that would benefit from the introduction of isolators, I find no support for Petitioners' belief that the alleged spacer is an isolator.

2. Claim 5—No sub-frame

126. Poertzgen lacks a “sub-frame” that is distinct from an actuator housing. Petitioners believe the yellow region below is an “actuator housing” and that either of the below grey portions is a “sub-frame.” *See* Petition at 24, 25.



127. As I explained above, a sub-frame is a distinct structure from an actuator housing, and it is improper for Petitioner to read the “sub-frame” in the claims on the same structure that is also being relied on to teach the claimed “actuator housing.”

3. Claim 7 is not obvious over Poertzgen and Boucheret

128. Claim 7 recites “a component isolator having a spring constant and a damping constant, said isolator coupled between said at least one planetary gear set and said sub-frame.” As noted, Poertzgen does not disclose isolators at all, and Boucheret merely teaches one to provide grooved dampers radially outward of a fan motor. While Boucheret does, in a general sense, teach one to mount a motor using an arrangement of isolators, neither Poertzgen nor Boucheret teaches an isolator mounted to a planetary gear set or a sub-frame. A POSA would not have understood to mount an isolator relative to a planetary gear set in light of Boucheret’s teachings which relate to motor mounts.

129. Further, for essentially the same reasons I stated above, Poertzgen is a precision system with tight tolerances and Petitioners have not addressed whether, or how, isolators could be introduced into that system without creating undesirable motions that would violate the tolerances of the otherwise precision mounted mechanical components of Poertzgen’s system. Boucheret does not share Poertzgen’s concern with mounting components according to tight tolerances. And again, Boucheret teaches nothing related to mounting a sub-frame and a gear set relative to one another via an isolator. Claim 7 is non-obvious for at least these reasons.

4. Claim 8 is not obvious over Poertzgen and Boucheret

130. Claim 8 recites “said actuator further comprising a sub-frame isolator having a spring constant and a damping constant, said isolator coupled between said sub-frame and a remainder of said actuator.”

131. Again, Poertzgen does not disclose isolators at all, and Boucheret merely teaches one to provide grooved dampers radially-outward of a motor, surrounding lugs that project from a motor. While Boucheret does, in a general sense, teach one to mount a motor using an arrangement of isolators, neither reference teaches an isolator mounted to a sub-frame and the remainder of the actuator. Further, again, Petitioners have not addressed the negative effects of introducing isolators into the precision-mounted system of Poertzgen. Further, Poertzgen lacks a sub-frame. Claim 8 is not obvious for at least these reasons.

5. Claims 14 and 15 are not obvious over Poertzgen and Boucheret

132. Claim 14 recites an isolator disposed “between said sub-frame and said motor,” similar to claim 5, and is non-obvious for the same reasons as claim 5. Claim 15 depends from claim 14 and is non-obvious for the same reasons as claim 14.

133. Claims 14 and 15 are also not obvious because they depend from claim 13, which recites “an actuator housing, said housing defining a motor cavity.” As

explained below relative to claim 18, Poertzgen does not disclose an actuator housing that defines a motor cavity.

134. Further, claim 15 depends from claim 14 and introduces a second isolator in another location. As noted below relative to claim 19, Boucheret essentially teaches one to absorb all vibrations from a common location, as opposed to plural, distinct locations. Therefore, Boucheret would not lead one to make the combination of claim 15.

6. Claim 16 is not obvious over Poertzgen and Boucheret

135. Claim 16 recites “a component isolator having a spring constant and a damping constant disposed between said sub-frame and an actuator housing.” Claim 16 is not obvious for the same reasons set forth above with respect to claim 8. However, there are additional reasons as well. Petitioners’ argument for claim 16 is also wrong because Petitioners read the “sub-frame” on a portion of Poertzgen’s actuator housing. However, Petitioners would essentially be required to separate Poertzgen’s housing into two pieces, and then add a vibration isolator between those pieces. One would not have done so for a number of reasons, including adding to the complexity of Poertzgen’s design. I also find Petitioners’ logic to be completely based on hindsight because none of the prior art supports Petitioners’ position, and their reasons seem only guided by the disclosures of the ’415 Patent.

136. Claim 16 is not obvious for the additional reason that Petitioners have not acknowledged or addressed the fact that introducing isolators into Poertzgen's system is likely to make it perform poorly, for essentially the same reasons discussed above.

7. Claims 17 is not obvious over Poertzgen and Boucheret

137. Claim 17 recites "a component isolator having a spring constant and a damping constant disposed between said sub-frame and an actuator housing." As noted relative to claims 8 and 16, this combination of features is not obvious over Poertzgen in view of Boucheret.

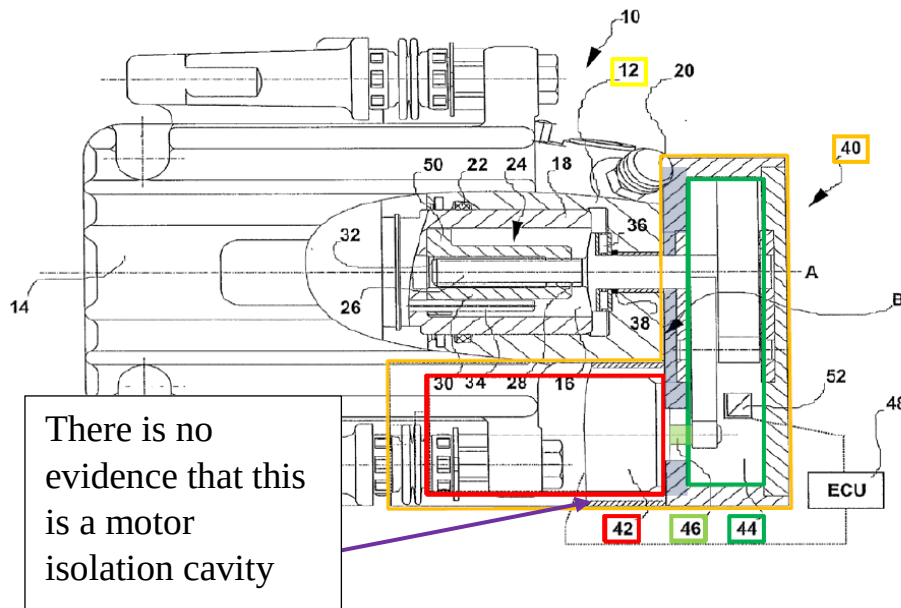
8. Claims 18 and 19 are non-obvious

138. Claims 18 and 19 are non-obvious at least because they depend from claim 17. But further, claim 19 recites a "motor isolator having a spring constant and a damping constant, said motor isolator disposed between said motor and said mounted plate." The "mounted plate" is a typographical error that refers to the "sub-frame" of claim 17.

139. In claim 19, there must be an isolator between the sub-frame and the actuator housing, and another isolator between the motor and the sub-frame. Petitioners' alleged basis for obviousness of claim 19 is effectively that, again, based on Boucheret, one could essentially place multiple isolators within the device of

Poertzgen and reach the claims. However, as noted above, Boucheret's dampers can absorb vibrations in all three directions from a radially-outer location, so there is no teaching that suggests using additional isolators in different locations. Adding additional isolators would only compound the issues I have outlined above. Not only would the isolators introduce unwanted movements, misalignments, etc., into a hard-mounted system that would not benefit from isolators at all, but the interplay between multiple added isolators could exacerbate these unwanted movements and misalignments.

140. Additionally, claim 18 recites "said actuator housing comprising a motor isolation cavity receiving at least a portion of said motor." Petitioners read the claimed actuator housing on the yellow highlighted section of Poertzgen, above. However, there is no evidence that Poertzgen's motor is actually contained within anything that could be considered a motor isolation cavity.

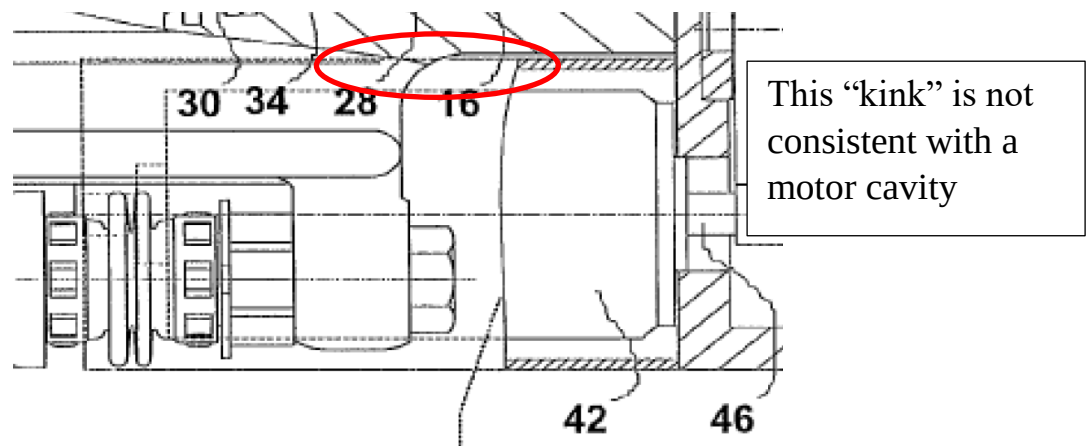


141. I am not convinced that the above area is a cavity. As an example, it could be some structure connected to the brake caliper of Poertzgen and arranged adjacent the motor. The distinct cross-hatching indicates it is not even part of Poertzgen's unit 40 and no attachment to the unit 40 is indicated. The structure in question could be a strap for mounting the motor, similar to straps 320 in the '415 Patent, for example. A strap would not form a cavity.

142. The structure in question could be a part of Poertzgen's brake caliper that is positioned below or above the motor.

143. The drawings of Poertzgen are simply inconclusive as to whether there is a motor cavity. For example, the line outlining the left end of the purported cavity is dotted indicating it is hidden by some unknown structure. Also, the line purportedly

forming the upper edge of the cavity is not straight but instead has an unexpected “kink” in it. Specifically, as shown below, the top line as it runs from the back of the purported cavity to the front does not match-up with the edge of the cross hatched section as it seemingly does on the lower edge.



144. I do not agree with Petitioners that “[p]art of the housing for this subassembly 40... encloses the motor 42” and that “[t]his has a cavity.” See Petition at 27, 50.

B. Ground 2 – Poertzgen in view of Boucheret and Drennen does not support obviousness of claims 5, 7, 8, or 14-19

145. Ground 2 is similar to Ground 1 except Petitioners now add Drennen into the combination “[t]o the extent that Patent Owner argues Poertzgen lacks the required sub-frame.” Petition at 62. As I explained above, Drennen does not teach one to mount any components of an actuator to a sub-frame for testing, for example, prior

to final assembly, such that one would deem Drennen to truly teach a sub-frame. Further, even so, if Petitioners combined Drennen's block 126 into Poertzgen, it would still not be distinct from Poertzgen's actuator housing. Further, Ground 2 would still suffer from the other flaws mentioned above, namely that Poertzgen (whether modified by Drennen or not) would still be the type of actuator that prioritizes precision mounting and would not otherwise benefit from the addition of the claimed isolators. Drennen, for example, is also a precision actuator and would not benefit from isolators. Despite the fact that Drennen teaches a bushing, I have already explained that bushings are not necessarily isolators. As such, in my opinion Ground 2 suffers from essentially the same flaws as Ground 1.

C. Ground 3 – Poertzgen in view of Boucheret and Weiler does not support obviousness of claims 5, 7, 8, or 14-19

146. Ground 3 is similar to Grounds 1 and 2 except Petitioners now add Weiler instead of Drennen “[t]o the extent that Patent Owner argues Poertzgen lacks the required sub-frame.” Petition at 70.

147. Even if Petitioners' modification were made, the alleged sub-frame from Weiler would still be part of the alleged “actuator housing,” which is not consistent with the meaning of the term “sub-frame.” Further, like Drennen, Weiler does not truly disclose a sub-frame, as I noted above, and Weiler lacks any teachings that

correspond to those of the disclosed sub-frame. Therefore, the result of the combination of Poertzgen and Weiler would still not result in the claimed “sub-frame.” Further still, Weiler is a precision actuator that would not benefit from the addition of isolators. So, even when modified by Weiler, Poertzgen would still be a precision actuator that would not benefit from isolators. While Weiler does disclose a bearing bush and a bearing plate, I have already explained that those structures are not disclosed to be isolators and, reviewing Weiler as a whole, I would not expect them to perform an isolation function because of the negative effect it would have on Weiler’s system. In general, if a Boucheret-type of vibration damper were somehow reshaped to hold Weiler’s motor casing, the isolator would allow the motor to twist and the positioning zero reference, the anchor of the motor, would be lost. This is particularly true if the position of the piston is deduced from measurements made at the motor which is the case in Weiler. In summary, this collection of prior art would not teach one to add isolators to Poertzgen. Ground 3 thus suffers from the same basic flaws as Grounds 1 and 2.

D. Ground 4 – Weiler does not support obviousness of claims 24 or 25

148. The grounds of rejection that use Weiler as a base reference (i.e., Grounds 4 and 5) are improper for a number of reasons.

1. Bearing bush 13 is not an “isolator,” and lack of motivation

149. As with Poertzgen, Weiler's electronic park brake includes a plurality of components coupled to one another requiring relatively tight tolerances. Introducing isolators into Weiler's system could cause unwanted misalignments and movements of various components that exceed the designed tolerances, in turn leading to unwanted system behaviors and usability concerns. Further, introducing isolators into Weiler's system would introduce softness into Weiler's otherwise hard-mounted system, which could cause a lag, or delay, in actuation time. Further, while I do not believe Weiler discloses any isolators, Petitioners do believe bearing bush 13 is an isolator. That said, taking Petitioners' statement at face value, Petitioners do not explain why Weiler needs more isolators if it already includes isolators.

150. Petitioners state that "having an isolator bushing between the motor and the sub-frame is equally as obvious as having one between the motor and the housing." Petition at 80. Petitioner continues, positing that "[a] POSA would have understood that the bushing 13 between the motor and the housing in Weiler helped isolate the motor, and that having another bushing between the motor and sub-frame would further isolate the motor." *Id.* Petitioners then argue that duplicating and moving the bearing bush 13 of Weiler would have been obvious. Again, it is unlikely that Weiler would have used vibration dampers, let alone multiple vibration dampers, relative to

its motor given the close mechanical relationships shown in the Weiler design, and the tight tolerances required to make that mechanism function properly.

151. Petitioners seek to essentially duplicate bearing bush 13, which as noted above is not actually a vibration isolator, and mount it relative to the bearing plate 14. However, again, adding vibration isolators to Weiler could lead to misalignments or relative movement in Weiler's system. As noted above, adding a friction reducing element like a bearing bush 13 between Weiler's motor and its bearing plate 14 could potentially permit axial and/or rotational movement of Weiler's motor, which is undesired in Weiler. Doing so would also render it more difficult for Weiler's sensor 26 to accurately deduce the operational state of the actuator based on motor speed. Petitioners have not acknowledged these issues let alone proposed a solution for them.

152. For at least these reasons, one skilled in the art would not have modified Weiler in the manner proposed by Petitioners.

2. The “actuator housing” does not read on Weiler’s caliper

153. Dependent claim 24 depends from claims 20 and 23, and recites “providing a first motor isolation bushing between said portion of said actuator housing and said motor; and providing a second motor isolation bushing between said sub-frame and

said motor.” Claim 25 recites “providing at least one isolation bushing between said portion of said actuator housing and said sub-frame.”

154. Petitioners read the claimed “actuator housing” on the area within a yellow box (Petition at 74), which is a portion of Weiler’s brake caliper 1. As I noted above, one would not have read an “actuator housing” on a brake caliper. Weiler even states that the alleged actuator housing is merely a “housing-like recess” of its brake caliper. A housing-like recess is not a separate housing. It is just a recess, or depression, in Weiler’s brake caliper. Further, Weiler deems separate actuator housings, like those of Poertzgen, to have a “complex overall structural design.” Ex. 1012 at 1:26-2:10. So, Weiler acknowledges that “actuator housings” exist as being separate from a brake caliper, but instead chooses to mount its electric park brake components in a housing-like section of an actual brake caliper, seemingly because Weiler believes they are too complex.

3. Petitioners have not addressed redundancy

155. With respect to claim 24, Petitioners argue that since Weiler includes a bearing bush 13 at the opposite end of its motor 8, it would be obvious to provide one at the opposite end of its motor 8, between the motor 8 and the bearing plate 14 as a matter of duplicating a known element. Petition at 80-81. But Petitioners have already taken the position that bearing bush 13 and bearing plate 14 are known to

accomplish at least some, if not all, of the functions of the isolator Petitioners seek to add to Weiler. While I do not agree that the bearing bush 13 and bearing plate 14 are disclosed as isolators, I am equally confused by Petitioners logic—if those structures do perform an isolating function, then why are Petitioners seeking to add additional isolators to Weiler. If, for example, those structures did perform some vibration isolating (which I disagree with), I fail to see a need to provide Weiler with additional vibration damping. Petitioners do not even attempt to explain how additional isolators would interact with the bearing bush 13 and bearing plate 14 of Weiler. Petitioners have not addressed the redundancy introduced by the purported introduction of additional vibration dampers.

E. Ground 5 – Weiler in view of Boucheret does not support obviousness of claims 24 or 25

156. Petitioners introduce Ground 5 to address the possibility that “Patent Owner argues Weiler fails to teach the required isolation bushings.” Petition at 83. My arguments above apply to this ground as well. First, again, Weiler is not the type of actuator that would benefit from the addition of isolators. The addition of Boucheret does not help Petitioners because Boucheret is not a precision actuator like that of Weiler. Boucheret can accommodate components that deviate from designed tolerances, unlike Weiler.

157. I also maintain that Weiler lacks an “actuator housing” regardless of the teachings of Boucheret.

158. I maintain, regardless of the teachings of Boucheret, that Petitioners have not resolved why they are seeking to add additional isolators to Weiler with their position that Weiler’s bearing bush 13 and bearing plate 14 already accomplish some vibration isolation functionality.

159. Further, with respect claim 24, which recites multiple distinct isolators in different locations, Boucheret teaches one to absorb all vibrations acting on a motor (i.e., axial, tangential, and radial vibrations) with dampers mounted at a common location, not multiple distinct locations, as recited in claim 24. If anything, Boucheret teaches one to absorb vibrations from a common location as opposed to the claimed distinct locations.

XII. SECONDARY CONSIDERATIONS

160. I understand that so-called “secondary considerations” are relevant to an obviousness inquiry. I understand that secondary considerations are also referred to as objective evidence of non-obviousness. Such secondary considerations include copying, licensing, commercial success, and praise in the industry, among others. I also understand that secondary considerations must be tied to the novel aspects of

the claimed invention. In other words, there must be a nexus between the secondary consideration and the claims.

161. In addition to the above-discussed reasons why the claims would not have been obvious, the claims of the '415 Patent would not have been obvious because I understand there is evidence that the novel aspects of the claimed combination were copied by others, drove sales and commercial success, and received praise in the industry.

A. COPYING

162. I understand that copying by others is a relevant secondary consideration.

163. I understand that an affiliate of Patent Owners presented a prototype design to an affiliate of Petitioners. The prototype design that was presented included a sub-frame and at least one vibration isolator. I understand the presentation compared test results of this prototype to Petitioners' then-existing design, which lacked a sub-frame and vibration isolators, and Patent Owner's prototype exhibited reduced noise. I understand that, subsequently, Petitioners introduced a design including a sub-frame and vibration isolators, which comes within the scope of the '415 Patent. In this regard, I have reviewed the claim charts of Ex. 2016, which I understand includes photographs of two products sold by Petitioners (or their affiliate), and I agree that the claim charts establish that there is a component in each of the

photographed products that corresponds to each one of the claim elements. Further, I have inspected one of the photographed products and my inspection supports my overall agreement with the positions taken in the claim charts.

B. PRAISE BY INDUSTRY

164. I understand that industry praise is a relevant secondary consideration.

165. I have reviewed Ex. 2010 and read this document as praising the Petitioners' EPBA, and I understand at least some of the EPBAs being praised are the same EPBAs shown in Ex. 2016. Therefore, this document constitutes praise for the invention of the '415 Patent.

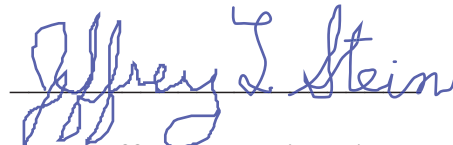
C. COMMERCIAL SUCCESS

166. I understand that commercial success is a relevant secondary consideration. I understand that Petitioners have stated that they have sold over 200 million EPBAs. I understand that at least some of these EPBAs are covered by the '415 Patent, as shown in Ex. 2016. I understand the EPBAs in Ex. 2016 are co-extensive in scope with the '415 Patent, meaning the EPBAs of Ex. 2016 do not include any critical unclaimed features that materially impact the product's functionality. I am unaware of any unclaimed features that would have driven sales.

XIII. CONCLUSION

167. I understand and have been warned that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. § 1001). I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of title 18 of the United States Code.

168. I declare under penalty of perjury that the foregoing is true and correct.



By: Jeffrey L. Stein, Ph.D.

Dated: August 24, 2023