

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HESAI TECHNOLOGY CO., LTD.
Petitioner

v.

OUSTER, INC.
Patent Owner

U.S. Patent No. 11,287,515
Inter Partes Review No. 2023-01422

REPLY DECLARATION OF DR. MICHAEL LEBBY, PH.D.

I, Michael Lebby, declare as follows:

I. INTRODUCTION

1. I previously submitted a Declaration (EX1003) in support of Hesai's Petition for *Inter Partes* Review of U.S. Patent No. 11,287,515 ("the '515 patent"). My background and qualifications are set forth in that Declaration, as is my understanding of the relevant law and the details concerning my compensation, which I incorporate by reference herein.

2. In my first Declaration, I provided my opinions regarding whether claims 1-2, 4-9, 11-14, 16-17, and 19-25 of the '515 Patent ("challenged claims") are invalid as obvious to a person having ordinary skill in the art ("POSITA") at the time of the alleged invention. In this Declaration, I have been asked to respond to certain arguments made by Patent Owner and its expert, Dr. Janet, concerning my opinion that the challenged claims are invalid as obvious.

3. I note that through his declaration Dr. Janet presents opinions regarding "complications" that would arise if a POSITA attempted to physically combine references together without modification. I understand from counsel that whether a reference can be bodily incorporated into another is basically irrelevant. Nevertheless, I have been asked to respond to Dr. Janet's opinions. As I demonstrate in this declaration, the "complications" Dr. Janet raises are normal consideration a POSITA would address during the design process using their engineering judgment

and commonly available tools at their disposal.¹

II. RESPONSES

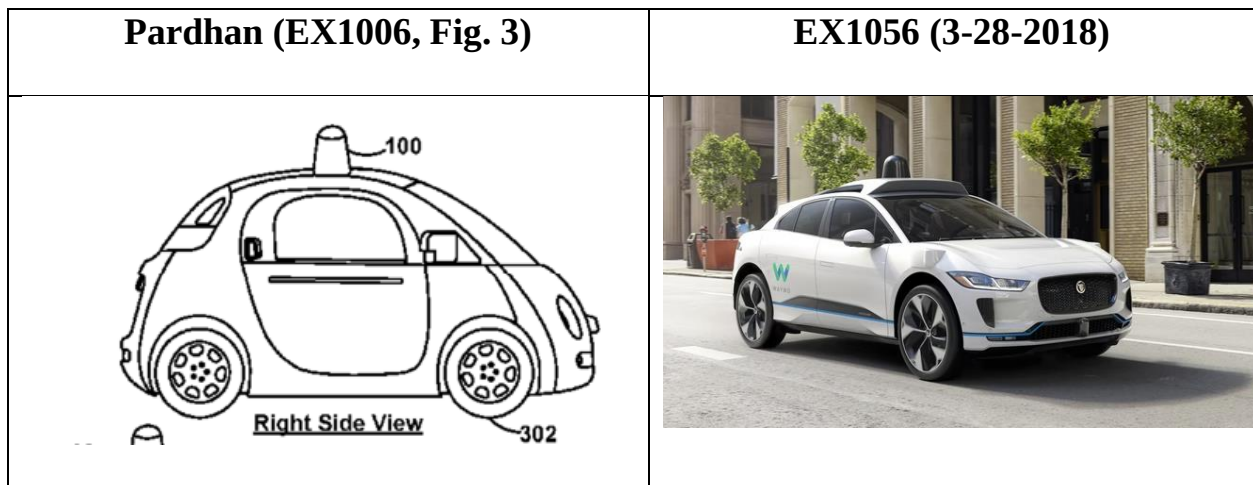
A. **Dr. Janet has not shown that Pardhan teaches away from Johnson and would result in a device with a “larger volume”**

4. I showed in my opening declaration that a POSITA would be motivated to utilize Johnson’s teaching of an integrated motor built onto rotor and stator circuit platforms because it provides a more compact design and efficient use of space when compared to using an unintegrated motor. EX1003, ¶84. Dr. Janet does not challenge my opinion that a POSITA would be motivated to combine Pacala and Johnson for this reason, but argues that “Pardhan teaches away from a compact design like the one taught in Johnson” because “placing Johnson’s PCB within Pardhan’s large volume... directly negates the compact design Petitioner supplies as the reason for utilizing Johnson’s design with Pacala in the first place.” ¶¶108-109. I disagree. Pardhan does not teach away from Johnson.

5. Indeed, Pardhan and Johnson are both Waymo patents and a POSITA

¹ This declaration does not attempt to respond to every statement in Dr. Janet’s declaration. The lack of a response should not be taken to mean I agree with Dr. Janet on a particular point. Rather, certain of the opinions Dr. Janet provides are not material, unsupported by evidence and/or do not relate to technical issues that require a response. By way of example, Dr. Janet provides a conclusory assertion that limitation 1[g] requires “multiple magnetic cores (*i.e.*, one for each of the multiple coils.”). EX2004, ¶143. I do not agree, but also do not believe technical analysis is necessary to rebut Dr. Janet’s conclusory assertion. The claim language is clear that Dr. Janet is simply importing a limitation into the claim.

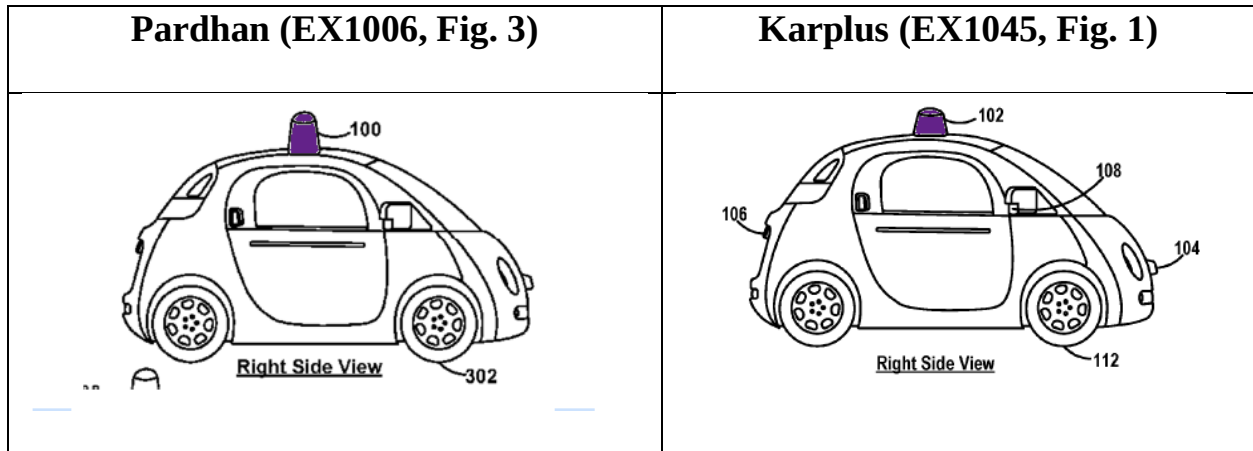
would understand that there inventions may be applied to LiDAR devices of various sizes. For instance, Dr. Janet refers to “Figure 3” of Pardhan as “illustrating the size of Pardhan’s LiDAR device 100.” EX.2004, ¶112. Figure 3 illustrates a LiDAR device mounted on the roof of a self-driving vehicle, such as a self-driving vehicle from Waymo²:



6. Dr. Janet’s assertion that a POSITA would not use Johnson with a LiDAR of this size is contrary to the evidence. For instance, Karplus (EX1045), another Waymo patent, discloses in Figure 1 a LiDAR (102) that is the same (or substantially the same) size as the LiDAR device in Figure 3 of Pardhan, as shown below. Karplus also discloses that the rotor-stator structure disclosed in Johnson may be incorporated into that LiDAR. *Compare* EX1045 (Karplus), Figs. 4B-4D

² Dr. Janet claims that Pardhan’s “relatively large size” makes it an “inefficient LiDAR.” EX2004, ¶112, n.3. Dr. Janet provides no support for his conclusory assertion, which is inconsistent with the fact that LiDAR devices of this size are used successfully by Waymo to power its self-driving vehicles.

with EX1005 (Johnson), Figs. 3B-3D; EX1003, ¶84.



7. Moreover, Pardhan’s Figure 7B illustrates a motor integrated onto the rotor and stator platforms. In other words, like Johnson, Pardhan also teaches a design where the motor is built onto the rotor and stator platforms to provide a more compact and efficient use of space. Thus, Dr. Janet’s opinion that Johnson and Pardhan are incompatible and that Pardhan teaches away from Johnson is inaccurate. A POSITA would thermally model the environment and design a heat sink appropriately for the combined system.

B. Dr. Janet’s opinion that Pardhan’s thermal rotary link is unnecessary is wrong and contradicted by the evidence

8. My opening declaration also demonstrated that a POSITA would be motivated to apply the teachings of Pardhan to the Pacala-Johnson combination because it would, among other things, improve heat transfer and thereby operating life of the LiDAR. EX1003, ¶252. In response, Dr. Janet claims that Pardhan’s thermal rotary link is “only necessary for Pardhan’s LiDAR device” because “it is

presumed to be powered at an excessively high level.” EX2004, ¶111. According to Dr. Janet, Pacala utilizes a “multi-channel TDC (time-to-digital converter)” such that “no excess heat would be generated by Pacala’s design.” EX2004, ¶114. I disagree. Heat-spreading was a known issue for LiDAR devices and applies to devices that operated at various power levels, not just Pardhan’s LiDAR.

9. While the power level that a LiDAR device is operated at can contribute to the need for heat dissipation, operating below a threshold power does not eliminate the need for heat dissipation. Other sources of heat exist. For instance, the circuit boards of a LiDAR device and their electrical components generate heat that can lead to overheating. In fact, Pardhan states that electrical and optical components in a LiDAR devices may be densely packaged, thereby generating heat that needs to be dissipated. EX1006, 4:63-67. This teaching regarding overheating relates to the packaging of the components, not the power levels of the device.

10. Ouster’s website supports my opinion. Ouster explains on its website that heat can be generated by the optical turret “containing the lasers and receivers,” and the “computing, communication, and power” components. EX1057, 4. Ouster also states that its LiDAR sensor, which Dr. Janet claims are a commercial embodiment of the ’515 patent (EX2004, ¶¶255), comes with “two standard heat sinks,” including a “finned” heat sink. *Id.*, 5. Ouster also explains that users may “create your own custom heatsinks for your specific integration, given that it

adequately dissipates the heat from the sensor.” *Id.*

11. Dr. Janet’s opinion that that Pacala does not generate excess heat is also unsupported. Dr. Janet relies upon Pacala using a multi-channel TDC, but this does not dispense with the need for heat dissipation. For instance, the inventor of Pacala has filed other patents that use multi-channel TDC with heat sinks. See EX1052, 44:46-45:3 (“heat sink 1710 can draw heat way from emitter array 1702 during operation to prevent overheating.... Heat sink 1710 can be any suitable heat sink that can dissipate heat in the ambient environment, such as a metal structure with fins.”), 40:21-24, Figs. 12 (TDC array), 17 (finned heat sink); EX1053, ¶116 (“support structure 605 can be a highly thermally conductive material so that heat generated by the activation of emitters 602 can be quickly dissipated to avoid overheating and damage”), Fig. 12 (“TDC Array 1106”). The assignee of the Pacala patent, Quanenergy, also used heat sinks with its LiDAR. EX1054, 22 (“The rectangular base plate provides a platform for the sensor and dissipates heat produced by the sensor’s electronics and motor. It must remain attached unless exchanged for an equivalent heat sink.”), 63 (“Mount the sensor to its detachable base plate (400 g aluminum) or to a heat sink of similar or greater thermal mass to prevent overheating, then reconnect to power.”).

12. Dr. Janet’s opinions are contradicted by the evidence, including evidence from Ouster’s website, the inventor of Pacala, and the assignee of Pacala.

C. Dr. Janet's raises concerns that would not dissuade a POSITA from combining the teachings of Pardhan and Pacala

13. Dr. Janet opines regarding the alleged "complexity" of physically combining Pardhan's thermal rotary link into Pacala's LiDAR. EX2004, ¶¶117-123. In my opinion Dr. Janet raises concerns that a POSITA would have found insignificant and would have overcome as part of the design process.

14. Dr. Janet states that combining Pardhan would "increas[e] the total mass of the [Pacala] system by 50%" and thus increase "the moment of inertia." EX2004, ¶117. He opines that this "extra mass" would have "increased stresses on the system due to centrifugal forces and would also make gyroscopic effects from movement of the vehicle (and other external perturbations) more pronounced, further increasing the strain on the system." *Id.*

15. Dr. Janet's opinions are not supported by evidence. Dr. Janet relies upon the embodiment of Figure 3 as disclosing the weight and size of Pardhan's LiDAR device. But, as I showed above, the LiDAR device illustrated in the embodiment of Figure 3 of Pardhan has a size and mass that is roughly the same as that of Waymo's commercial LiDAR. These Waymo LiDAR devices drive around various cities (*e.g.* Los Angeles and San Francisco) without catastrophic failures, thereby demonstrating that a POSITA would have been more than capable of addressing motor and stability issues for a device of this size.

16. Dr. Janet is also raising alarms about issues that a POSITA would find to be insignificant. For instance, gyroscopic forces are directly proportional to rotational speed. Here, Dr. Janet states that the system spins at “10 Hz” (EX2004, ¶117), which is a speed of 10 revolutions per second. In terms of the common units of revolutions per minute (RPM), this speed corresponds to $10 \times 60 = 600$ RPM. Compared to many common applications, this is slow. A POSITA would know, for example, that many fans found in household items such as window fans, forced hot air furnaces, heat pumps, and air conditioners turn at higher speeds. It is also slow compared to common hard disk drives that typically spin at speeds between 5,400 RPM and 7,200 RPM. One would expect that gyroscopic forces in these household items would be noticeable by the user and perhaps excite objectionable oscillatory vibrations, but this is generally not the case because the magnitude of these forces is insignificant and can be addressed as part of the design process.

17. The smattering of other issues Dr. Janet identifies in paragraphs 118 through 122 are also within the expertise of a POSITA and would be overcome as part of the standard design process. For instance, Dr. Janet asserts that “Pardhan’s fins limit the placement of the rotor magnets and stator coils to a small radius which reduces torque capacity.” EX2004, ¶118. This conclusory assertion is confusing in view of Dr. Janet’s assertion elsewhere that Pardhan provides a cavity with a “large volume.” EX2004, ¶109. In any event, Dr. Janet does not provide any reason why

a POSITA would not have used their engineering judgment to design the finned heat sink so that its cavity could accommodate a motor of appropriate size for the application. As I showed above, LiDAR devices of various shapes and sizes utilize motors and heat sinks with adequate torque for their applications.

D. Dr. Janet's suggestion that a POSITA would not look to Johnson and Pardhan when implementing a spinning LiDAR, such as that disclosed in Pacala, is inaccurate

18. Dr. Janet opines that a POSITA “would not look to a reference such as Pardhan” because “[i]f Pardhan’s rotor plate 720 were implemented on Pacala’s LiDAR, the result would be that it would extend far outside the LiDAR housing, which would indicate to a POSITA that Pardhan does not teach the details of Pacala’s rotating structure nor is would it be an improvement to it.” EX2004, ¶124. Dr. Janet is mistaken. A POSITA would not exclude Pardhan from consideration simply because its purported size differs from that of Pacala. Johnson, Pardhan and Pacala are analogous art that all relate to LiDAR. A POSITA would have known that structures within these devices can be physically scaled depending on the needs of the application at hand. Examples of such scaling were ubiquitous by the time of the alleged invention of the ’515 patent. To cite two simple examples, not all automotive tires are the same size and not all hard disk drives have the same size internal mechanisms. Despite differences in size, similarities with regard to materials, construction, features, and appearance are recognized by a POSITA.

19. Dr. Janet also opines that a POSITA would not look to Pardhan because another patent discloses a design that may be used with Pacala. EX2004, ¶¶125-126. I disagree. My opening declaration showed that Pacala discloses the overall structure of a spinning LiDAR device (*e.g.*, a bulk receiving and transmitting optic within an enclosure with a base, a top cover, and an optically transparent window), but not the details of the rotational structures such that a POSITA would look to other references for those details. EX1003, ¶249. Dr. Janet does not challenge the fact that Johnson and Pardhan disclose rotational structure for a LiDAR device and the existence of other designs does not negate obviousness in my opinion. By way of analogy, a disclosure of painting a car blue does not negate the obviousness of painting it black.

E. Dr. Janet raises unnecessary alarms regarding substituting Johnson into the cavity of Pardhan

20. As I demonstrated in my opening Declaration, Pardhan and Johnson describe similar rotor-stator structures. Both are Waymo patents covering rotary joints and are designed to be applied to the same (or substantially the same) LiDAR device. *See supra* ¶6. The two references are a natural fit for one another. Dr. Janet nevertheless opines that a POSITA would not “replace Pardhan’s rotor magnets, transformer coils, and motor winding with Johnson’s PCB rotor and PCB stator.” EX2004, ¶127-136.

21. Dr. Janet claims that utilizing Johnson's motor with Pardhan is not simple substitution because Pardhan discloses a radial flux motor and Johnson discloses an axial flux motor. EX2004, ¶¶128-129. But a POSITA would recognize the functional equivalence of Pardhan's radial flux motor and Johnson's axial flux motor. They are both spindle motors that produce the torque needed for their applications. A POSITA would recognize that radial and axial flux configurations, including those constructed on a printed circuit boards, were well known and could be designed to deliver the torque needed for a given application.

22. Dr. Janet also identifies magnetic field issues (*e.g.*, eddy currents) that would only be a concern if one blindly attempted to physically jam Johnson's rotor-stator structure into Pardhan's thermal rotary link, without using any engineering judgment. EX2004, ¶130. But a POSITA would understand that electric motors produce torque by the attraction and repulsion of North and South magnetic poles, *i.e.*, like poles repel, opposite poles attract. This fact has been known for more than a century. Based on the fundamental laws, eddy currents are induced in electrically conductive materials whenever the magnetic fields passing through them are changing. By Ohm's law, first known in the early 1800s, eddy currents produce heat because the electrically conductive material resists their flow. In other words, eddy currents and their impact on designs would be understood by a POSITA. A POSITA would have designed a motor to address eddy currents, if necessary. This includes

designing the motor structures so that magnetic fields are shielded from surrounding areas to minimize negative consequences.

23. Dr. Janet goes on to state that a POSITA would have needed to determine “mechanical, electric, and electromagnetic power losses (e.g., due to eddy currents), performing a thermal analysis (e.g., with a computational fluid dynamics (CFD) analysis), conducting a new torsional analysis, and so on” and would have needed to consider “fluid dynamics, gyroscopic forces, etc.” EX2004, ¶¶131-134. These considerations are part of the normal design process and a POSITA would have used their engineering knowledge and software tools (e.g., MATLAB, CAD, ANSYS, etc.) to design a suitable LiDAR device that accounts for them. They would not dissuade a POSITA from combining the teachings of Pardhan and Johnson.

24. In paragraph 135, Dr. Janet asserts potential issues that may arise with printed circuit board motor construction. These potential issues are well known by a POSITA, but they do not preclude the utility of PCB motors. Such motors have been successfully used in a variety of applications long before the '515 patent. For example, Dr. Janet's statement that “ground loops, unintentional capacitance, and inductive problems, which can severely impact the motor's performance and reliability” (EX2004, ¶135) are issues that must be addressed in the design of essentially all electric circuits and apparatuses. A POSITA would have accounted for these and the other items Dr. Janet references in this paragraph and would have

known how to mitigate them so they do not negatively affect design goals.

25. I further note that all of the “complications” that Dr. Janet raises assume that a POSITA would implement Pardhan’s thermal rotary link in full, including its heat sink. However, a POSTIA would use their engineering judgment to identify those aspects and structures in prior art that are desired. For example, a POSITA can adjust the number, size, position, and material of fins when designing the combined system based on the level of heat generated by the LiDAR. Moreover, I understand that Dr. Janet has acknowledged that Pardhan’s bearing housing is a “support component,” and Dr. Janet does not challenge my opinion that a POSITA would have been motivated to use the bearing housing of Pardhan when assembling the rotor-stator structure of Johnson. Indeed, assembling a rotor-stator structure with a bearing housing and shaft was commonplace at the time of the ’515 patent.

F. Dr. Janet wrongly opines that Johnson does not disclose a stator assembly “coupled to” the stator circuit board

26. In my opening declaration, I showed that Johnson discloses an embodiment (Figures 3C-3D) where the stator assembly comprises conductive structures (leads and electrical contacts) that are interconnected to form a plurality of coil windings (lead-to-lead). EX1003, ¶¶178-180. Dr. Janet opines that this stator assembly is not “coupled to” the circuit board. EX2004, ¶¶137-141. I disagree.

27. A POSITA would understand the term “coupled to” to refer to

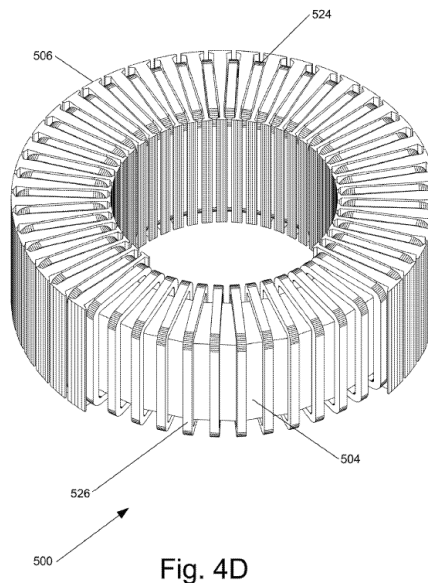
encompasses connecting, joining, associating or otherwise uniting the stator assembly and circuit board. EX1049 (“couple” means “joining two things together; bond; link”). Johnson teaches that the conductive structure “can be disposed along a mounting surface (*e.g.*, top or bottom layer) of a circuit board” (EX1005, 3:57-64), such that these structures are joined or united (*i.e.*, coupled) with the stator circuit board.

28. Dr. Janet opines that the term “coupled to” requires that the “stator assembly” and the “stator circuit board” be “separate components.” EX2004, ¶137. But, as I just explained, Johnson meets this construction because it discloses that the conductive structures that form the stator assembly are separate components from the mounting surface of the stator circuit board on which they are disposed. To the extent Dr. Janet is suggesting that “separate components” must be separately manufactured elements, I disagree. Indeed, the ’515 patent teaches coupling the stator assembly and stator circuit board may be “built onto” or “integrated on” the circuit boards. *See, e.g.*, EX1001, 4:28-31 (“Having such rotor and stator elements built onto the circuit boards themselves provides various advantages over products that use bulkier motors...”), 4:19-22 (“...stator and rotor elements integrated on upper and lower circuit boards, thereby making the light ranging system compact.”). Thus, a POSITA would understand that the stator assembly and stator circuit board may be manufactured together, with the stator assembly built onto the circuit board.

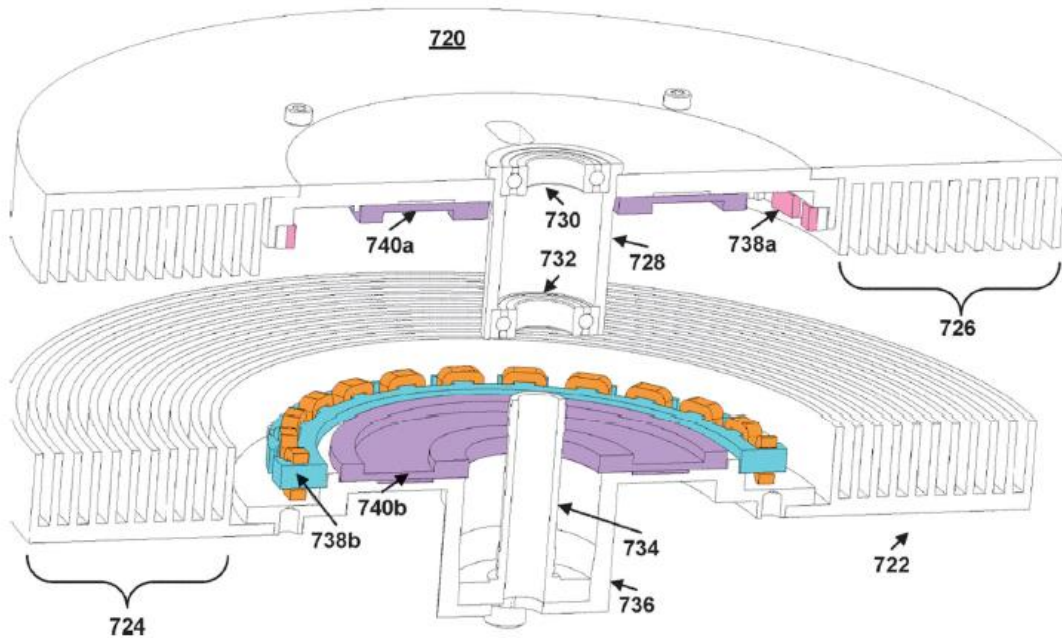
29. Dr. Janet also argues that the stator assembly must be a “mounted component” that can be “removed without destroying the printed circuit board itself.” EX2004, ¶141. I do not see any removable requirement in the claim language. A POSITA would understand that two elements can be coupled together such that their removable would be difficult or result in damage.

30. In any event, Johnson teaches an alternative embodiment where the stator assembly is comprised of coil-shaped wires that are separate from the circuit board, rather than being formed in the multi-layer PCB: “In one implementation, the coil windings may comprise a plurality of coil-shaped wires that are wound around the shared core region.... In another implementation, the coil windings can be formed in a multi-layer circuit board (*e.g.*, printed circuit board (PCB)). For example, the coil windings may comprise a first plurality of conductive structures (*e.g.*, copper traces, etc.) in a first layer of the PCB, and a second plurality of conductive structures in a second layer of the PCB.” EX1005, 3:30-45. The stator assembly in this implementation is formed from wires wound around a magnetic core, rather than interconnected conductive structures built onto a multi-layer circuit board. *Id.*, 5:7-17 (“In some examples, a coil winding can be formed from a wire or other electrical conductor that is wound around a core region to define a magnetic axis of coil 140. In other examples, a coil winding can be formed from multiple conductive structures that are connected to one another to form an electrically

conductive path in the shape of a coil, helix, spiral, etc.”); 4:56-5:7 (disclosing “first” and “second” example where stator assembly comprises one or more “wires” that “are wound around a shared core region,” and a “third example” where the coil is made of “conductive structures that are connected to one another to form one or more coil windings”; also stating that “other examples are possible.”). Implementing the stator assembly in this way was a known configuration. For example, prior art references such as the one shown below, teach that wires (526) may be wound around a ring-shaped core using “conventional winding techniques”:



EX1058, Fig. 4D (illustrating coils 526 wound around a magnetic core), 9:7-10 (“Each individual coil 526 in coil assembly 500 may be made from a conductive material, such as copper (or a similar alloy) wire and may be constructed using conventional winding techniques known in the art.”). And Pardhan also illustrates



31. Limitation 1(g) recites “...each of the plurality of stator elements including a coil wound around a magnetic core.” Dr. Janet concedes that Johnson discloses stator elements that each include a coil wound around a “ring-shaped core.” EX2004, ¶144. However, Dr. Janet claims that this does not meet the claim language because Limitation 1(g) “requires multiple magnetic cores” and not a “single, ring-shaped core shared by all coil windings.” *Id.* I disagree.

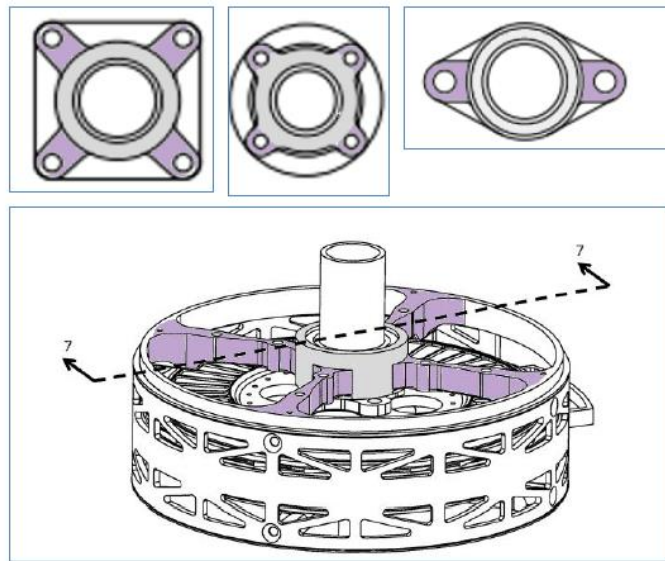
32. The claim language does not include any language that exclude a coil from being wound around a core that another coil is also wound around. Rather, the claim language recites that each coil is wound around a magnetic core (whether it be a core that is shared with other coils or one that is not. While Dr. Janet is correct that Figure 6D of the '515 patent discloses an embodiment in which each coil has its own core, the '515 patent states that this arrangement is an “example” used in “some embodiments.” EX1001, 26:15-18, 30:15-23. A POSITA would understand that this example is non-limiting. Thus, in my opinion the plurality of stator elements in Johnson satisfy this limitation because they each include a coil wound around a core.

H. Contrary to Dr. Janet’s opinions, it was obvious to utilize a support component with “a plurality of arms”

33. My opening declaration demonstrated that it was obvious to utilize a support component with “a plurality of arms” that extend away from a sleeve EX1003, ¶¶163-166.

34. I showed that the bearing housing disclosed in Pardhan does not include “a plurality of arms,” but explained that “bearing assemblies in general can come in many different mechanical and structure configurations.” EX1003, ¶¶61-62. Thus, I opined that a POSITA would have found it obvious in view of the general knowledge of a POSITA to “utiliz[e] one of various prior art bearing assembly designs that included arms which extend away from the sleeve and provide firm attachment to

the rotor platform”:



EX1003, ¶¶163-164; EX1033, 16 (top); EX1042, Fig. 6 (bottom). I also showed that a POSITA would have been motivated to use “a bearing housing with arms” to hold the shaft in “position firmly” and “minimize vibrations and movements” that may damage the motor. EX1003, ¶¶253, 62.

35. In paragraph 221, Dr. Janet asserts that the bearing housings designs shown in EX1033 “would exacerbate these stresses on the system due to the increased moment of inertia in addition to further expanding the system volume, which is once again, counter to the POSITA’s goal of choosing rotating structures for a ‘compact’ design.” EX2004, ¶221. Dr. Janet does not explain how or why utilizing a bearing design with arms would “exacerbate” stresses or increase “volume.” Moreover, his opinions appear to be based on a POSITA blindly substituting the bearing housing in EX1033 for the bearing housing in Pardhan. For

instance, Dr. Janet states that the bearing housings in EX1033 are “unnecessarily heavy” for a LiDAR application. EX2004, ¶221. This conclusion is built on the assumption that the bearing housing must be built of “cast iron and/or steel,” but that is not an intrinsic property of bearings or the housings and thus not necessary. A POSITA would have designed a bearing housing to meet any weight constraints of the system and Dr. Janet’s argument ignore the engineering judgment a POSITA would utilize when designing a LiDAR.

36. In paragraph 221, Dr. Janet also asserts that the bearing housing designs in EX1033 “discloses a flange and not arms” and that EX1042 discloses arms that are not cantilevered. Dr. Janet, however, does not provide any support for his assertion that the plain meaning of “arms” does not encompass these structures. In fact, Dr. Janet identifies similar structures when arguing that Petitioner’s devices copy the ’515 patent. See EX2004, ¶251 (identifying similar structures for limitations 1(e), 14(e)). Moreover, Dr. Janet wrongly states that I do not provide for my opinion that “a ‘bearing housing with arms’ will minimize vibrations.” But I previously explained how arms minimize vibrations by restraining the movement of the shaft and sleeve. EX1003, ¶253. Taking EX1042 as an example, the arms that project outwards from the sleeve press-up against the edges, such that they restrain the sleeve’s ability to move and dissipate vibrations. Dr. Janet does not explain why this would not minimize vibrations and does not dispute that a POSITA would be

motivated to minimize vibrations to avoid motor damage. EX1003, ¶253.

37. I additionally showed in my opening declaration that a “plurality of arms” was obvious in further view of Zhang. EX1003, ¶165. Dr. Janet opines that “implementing the heat dissipation structure of Zhang onto Pardhan’s rotor plate would add more stress and vibration to the system” because “every window edge in Zhang will draw in and/or expel air.” EX2004, ¶¶151-152. Again Dr. Janet focuses on a concern that a POSITA would find insignificant. Rotors and motors are designed with mechanical vibrational specifications. The amount of air flow from a spinning rotor can be modeled, simulated and adequately designed. The rotor will not be subject to 100 mph air flow as it is protected when implemented on a vehicle. Any increased air flow will be minimal and not at the level where vibration and stress will cause catastrophic failure. A POSITA would be mechanically aware of these factors, and given that they are not extreme, they can be modeled to address stress, stability, vibration and to maintain operating life. Any parts that need weight balancing can be accomplished with standard mechanical modeling design tools today. A POSITA would also know how to balance weights and minimize stress with rotating discs and rotating parts similar to any rotating part that can be found in systems today and at the time of the ’515 patent. In short, Dr. Janet exaggerates the significance of these issues, and, in my opinion, they would not dissuade a POSITA from combining the teachings of these references.

38. Dr. Janet also asserts that a POSITA would not combine Pardhan and Zhang because Zhang's heat dissipation structures release heat "upwards," and Pardhan's heat sink pulls heat "down." EX2004, ¶¶154-158. As an initial matter, Dr. Janet incorrectly illustrates the direction of heat out of the dissipation structures:

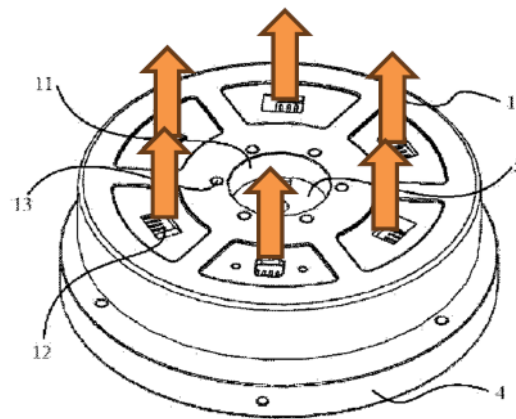


Fig. 1

EX2004, ¶153. Specifically, Dr. Janet illustrates heat being dissipated upwards towards the LiDAR that would be mounted on the rotor plate, but in reality heat will escape outwards from the dissipation structures (not straight upwards). More fundamentally, Pardhan and Zhang's heat dissipation techniques are not incompatible as Dr. Janet suggest. A POSITA would understand that Zhang's heat dissipation structures use heat convection to dissipate heat inside the motor, while Pardhan's heat sink uses heat convection to conduct heat from the rotor and stator platform to a cooling plate. A POSITA would understand that heat conduction and heat convection can be used together to increase heat dissipation. Indeed, Zhang's heat dissipation structure simply provide another path for heat from the LiDAR

device (above the rotor) to escape as it moves downwards from the LiDAR device. In fact, I explained in my deposition (and Dr. Janet does not dispute) that in Zhang's existing device some heat escapes out of the heat dissipation structures, while other heat is pulled downwards towards Zhang's metallic base (shown in Figure 2 of Zhang) due to the thermal impedance of the metallic base. See EX2005, 79-80. A POSITA would be motivated to combine the teachings of Zhang and Pardhan which disclose similar structures and subject matter. In fact, Dr. Janet emphasizes the importance of reducing weight throughout his declaration. A POSITA would understand that compared to a solid or fully enclosed rotor plate, a rotor plate with arms that are realized by featuring spaces or gaps between arms such as in Zhang can reduce the volume of the material used thus reduce the weight.

39. In paragraph 159, Dr. Janet argues that there is no reasonable expectation of success in the combination because a POSITA would need to determine "the mechanical, electric, and electromagnetic power losses (e.g., due to eddy currents), performing a thermal analysis (e.g., with a computational fluid dynamics (CFD) analysis), conducting a new torsional analysis, and so on." As I showed above, these considerations would not dissuade a POSITA from combining the teachings of Pardhan and Zhang. Dr. Janet has merely identified considerations that are standard in the design process and a POSITA would utilize known tools to design a suitable LiDAR device that accounts for them.

I. Implementing a third and fourth circuit board was a straightforward design choice

40. I understand that the Institution Decision “preliminarily ‘agree[d] with Patent Owner’s argument that the recitation of four circuit boards ... is not disclosed by Johnson,” but left open the question of whether this limitation was obvious. In my opinion, it is obvious for the reasons I discussed in my opening declaration. EX1003, ¶¶218-223 (Ground 1) and ¶¶265-269 (Ground 2).

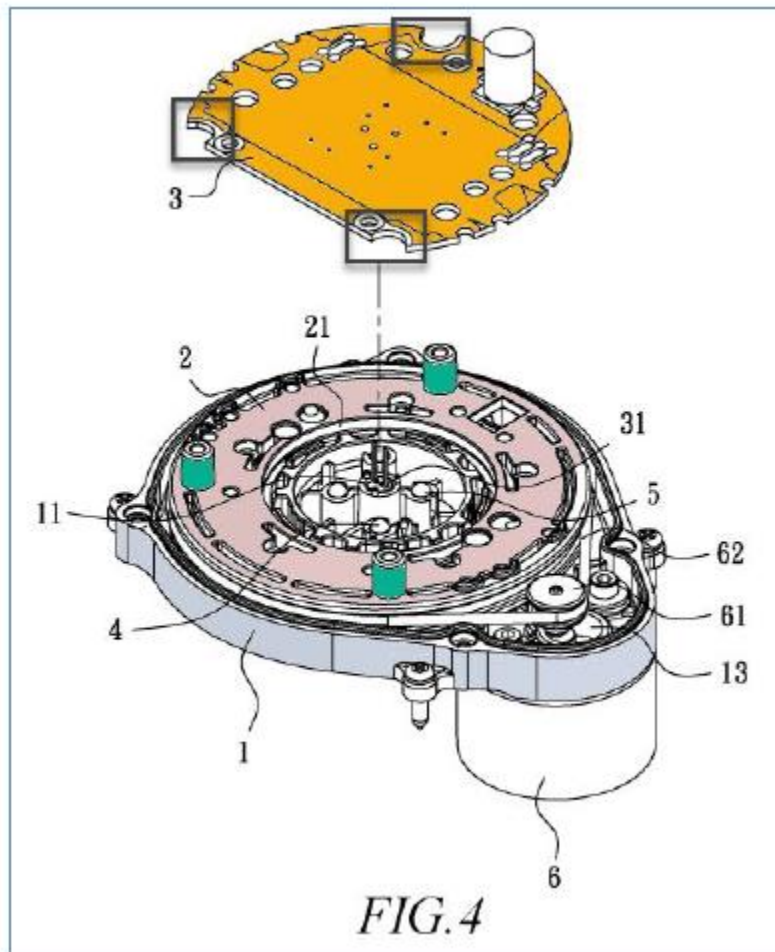
41. While Dr. Janet opines that Johnson’s multi-layer circuit boards are a single circuit board and that it would not have been obvious to utilize single layer circuit boards with a LiDAR device (EX2004, ¶¶162-175), he does not challenge my opinion that a POSITA would have been motivated to utilize third and fourth circuit boards to provide additional space for mounting electronics in view of the knowledge of a POSITA. In particular, the number of circuit boards and their orientation was a straightforward design choice and a POSITA would have been motivated to utilize third and fourth circuit boards to provide more space for electronic components. EX1003, ¶223. My opinion is supported by evidence, such as the Nubling prior art reference (EX1043), which discloses a LiDAR device with rotor (red) and stator circuit boards (blue) and reflects the knowledge of a POSITA that the number of circuit board was a straightforward design choice. Indeed, Nubling teaches that LiDAR devices can include “more circuit boards” to provide

“sufficient space and capacity” for mounting electronics (EX1043, 6:1-8) and discloses that these additional circuit boards can be coupled to the rotor circuit board and the stator circuit board in the base (EX1043, 3:36-40).

42. Dr. Janet argues that Nubling does not show that it was obvious to orient the third and fourth circuit boards “parallel” to the stator. I disagree. For instance, Figure 3 of Nubling illustrates a third circuit board (52) coupled to the base in a parallel orientation (purple):

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further circuit board 52 can be dispensed with or, conversely, even more circuit boards can be provided.”). Indeed, a POSITA would have recognized that circuit boards can be oriented in a parallel or perpendicular configuration and would have found both options to be an obvious design choice.



board being coupled to the rotor platform, but argues that this is possible because Yan is a “low power” device whereas the proposed combination involves Pardhan and its “high power LiDAR.” EX2004, ¶¶225-226. Dr. Janet further contends that coupling the control board to the rotor “increases overall thermal resistance” and would disrupt heat flow. EX2004, ¶¶179, 226. I disagree. Pardhan contemplates that the LiDAR device may include a control board disposed within the LiDAR device. EX1006, 6:33-37 (“Electronics 104 may include one or more electronic components and/or systems each arranged to help facilitate certain respective operations of the LiDAR device 100. In practice, these electronics 104 may be disposed within the LiDAR device 100 in any feasible manner.”), 6:55-59 (“electronics 104 may also include the controller.”). Thus, the control board is not a separate heat source that increase overall thermal resistance but rather a component of the existing LiDAR device. Dr. Janet’s opinion is also in tension with his opinion that the ’515 patent discloses a fourth circuit board as a LiDAR “control board”:

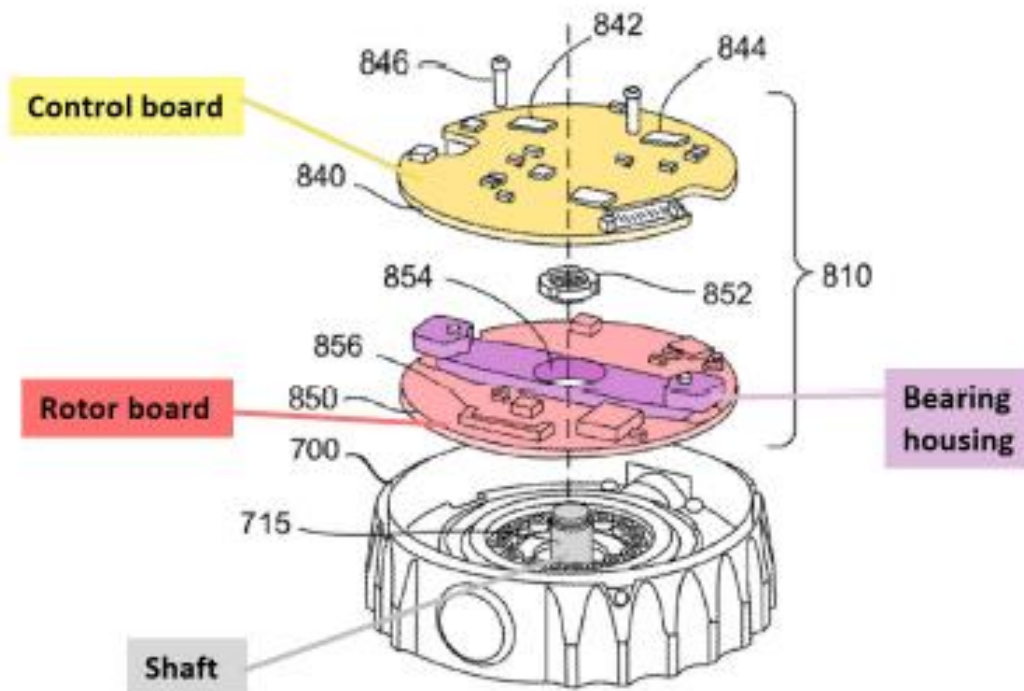


FIG. 8A

EX2004, ¶78.

44. I also showed in my opening declaration that this limitation was obvious in further view of Cai. EX1003, ¶¶265-269. In particular, Cai teaches implementing a communication channel through a hollow shaft by mounting transceivers on an additional third and fourth circuit board coupled to the rotor and stator circuit boards. *Id.* Dr. Janet states that Cai discloses “two circuit boards (113/124)” for the transceivers, but does not dispute that those two circuit board are positioned above Cai’s brushless DC motor 13 that includes the first and second circuit boards. EX2004, ¶197. Indeed, as I explained in my opening declaration, “a

POSITA would have understood that Johnson's rotor and stator circuit boards and the PCB motor that they form correspond to the brushless DC motor 13 of Cai," such that the combined system would utilize the claimed four circuit boards. EX1003, ¶¶266, 269. Thus, there does not appear to be any dispute that the combined system would utilize four circuit boards in a parallel orientation.

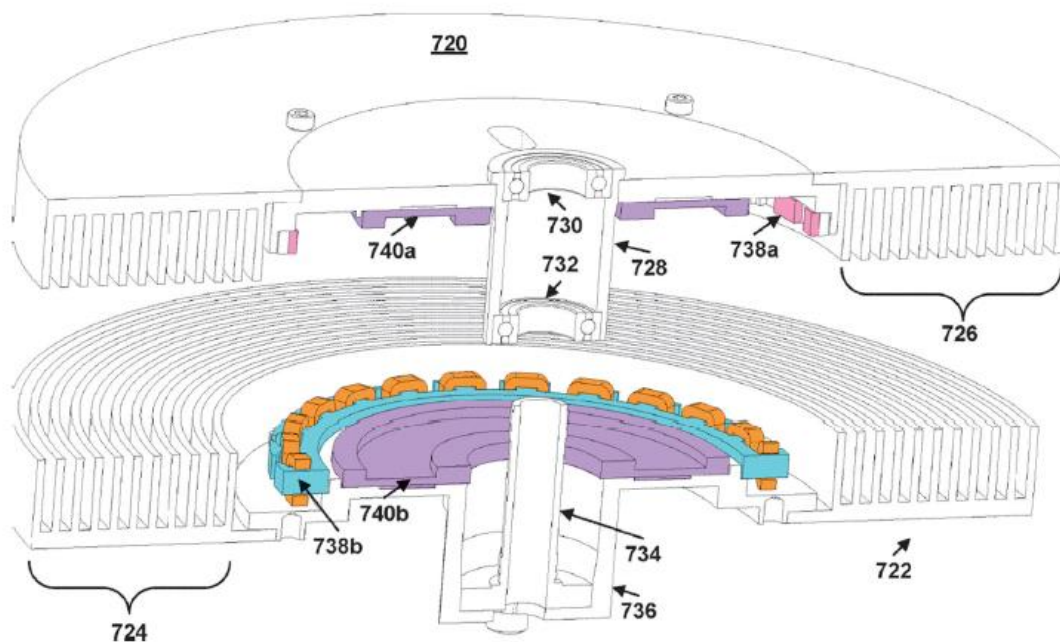
45. However, Dr. Janet opines that the combination with Cai provides a "redundant feature" because Johnson discloses an embodiment where the transceivers are mounted on the "circuit boards within Johnson's motor." EX2004, ¶197. I disagree. The propose combination does not duplicate the transceivers, but rather moves them on third and fourth circuit boards. I identified multiple reasons why a POSITA would be motivated to make this modification in my opening declaration. EX1003, ¶¶277-278. For instance, Cai provides an express teaching that this configuration permits a communication channel through a hollow shaft and prevents interference. *Id.*, ¶277. None of these reasons are challenged by Dr. Janet.

J. Positioning the transformer coils on the outside perimeter of the rotor and stator elements was obvious

46. My opening declaration acknowledged that Figure 3B of Johnson illustrates transformer coils on the inside of the rotor and stator elements of the motor, but showed that moving them to the outside of the rotor and stator elements was an obvious modification. EX1003, ¶¶244-247 (Ground 1) and ¶¶272-275

(Ground 2).

47. For instance, I showed that moving the transformer coils to the outside of the rotor and stator elements was obvious in view of Johnson and the knowledge of a POSITA, particularly given Johnson's disclosure that "other implementations are possible" when discussing its power interface. EX1003, ¶247. Dr. Janet responds that Pardhan "teaches away" from a configuration where the transformer coils are on the outside of the rotor and stator elements because it discloses a "smaller rotary transformer." EX2004, ¶¶182-183. I note that Dr. Janet's opinion appears to be in tension with his earlier opinion that Pardhan discloses a "voluminous" design. EX2004, ¶¶107-109. Moreover, Dr. Janet fails to show that positioning the transformer coils outside of the rotor and stator elements would result in an overall larger device. A POSITA would understand that the components of the device can be designed to maintain the same or roughly the same sizing. This is particularly true given that Figure 3B of Pardhan (reproduced below) shows that moving the rotary transformer (purple) to the outside of the magnets and windings (738a/738b) would not meaningfully change the size of the cavity.



48. In my opinion, even accepting Dr. Janet's assertion as true for the sake of the argument (*i.e.*, that configuring the transformer coils on the outside of the rotor and stator elements would result in some size increase), this would at most mean that there are simultaneous advantages and disadvantages in making the proposed combination. That does not negate the motivation to combine because the increase in size is at best minimal and Dr. Janet does not dispute that it would result in increased power and transfer distance. Thus, a POSITA would have been motivated to use larger transformer coils to achieve higher power transmission and distance.

49. In my opening declaration I also showed that a POSITA would be motivate to utilize larger transformer coils because the center region of the device may not have sufficient space in certain embodiments. EX1003, ¶247. Dr. Janet

does not dispute the substance of my opinion, and instead states that he interprets my statement “as an acknowledgement that larger transformer coils are not desirable in Johnson’s design, Pardhan’s design, Zhang’s design, nor the combination of Ground 1.” EX2004, ¶187. Such an interpretation is certainly unfounded and contrary to my declaration. It also reflects a fundamental error throughout Dr. Janet’s declaration. The existence of references that illustrate transformer coils on the inside perimeter of the rotor stator elements does not mean that it was not obvious to configure the transformer coils on the outside perimeter. Indeed, Dr. Janet does not dispute that my declaration cited references, such as Cai (*infra* ¶¶51-52), that disclose the transformer coils configured outside the rotor and stator elements, and errs by ignoring the engineering judgment a POSITA would exercise when designing LiDAR. Nor does he dispute that both configurations were known in the art and that a POSITA would have understood that larger transformer coils would have provided increased power transfer and not fit within the center region of the LiDAR. Thus, the placement of the transformer coils was a straightforward design choice, with coils being placed on the outside to achieve higher power transfer.

50. Dr. Janet also asserts that “there is no space outside of the rotor magnets” due to Pardhan’s fins. EX2004, ¶189. Again Dr. Janet fails to appreciate that a POSITA would exercise engineering judgment when designing a LiDAR device. In this case, a POSITA would recognize that the size of the cavity can be

designed to accommodate the transformer coils positioned on the outside of the rotor magnets or that the rotor magnets can be slightly repositioned. Indeed, Figure 3B of Johnson illustrates that moving the transformer coils to the outside of the rotor magnets would not meaningfully change the size of the device. *See supra* ¶47.

51. My opening declaration also showed that it was obvious to move the transformer coils to the outside perimeter of the rotor and stator elements in view of Cai. EX1003, ¶¶272-275. Dr. Janet does not dispute that Cai discloses a configuration in which the transformer coils are positioned on the outside of the rotor and stator elements. *See* EX2004, ¶¶198-203. However, Dr. Janet argues that there is “no room” to “move the transformer coils” because of “where Pardhan’s fins are located.” EX2004, ¶201. This is the same argument Dr. Janet raises earlier in his declaration and which I addressed above. *See supra* ¶50. A POSITA would recognize that the size of the cavity can be designed to accommodate the transformer coils positioned on the outside of the rotor magnets or that the rotor magnets can be slightly repositioned to maintain the same size. Indeed, as I explained above, Figure 3B of Johnson illustrates that moving the transformer coils to the outside of the rotor magnets would not meaningfully change the size of the device. In fact, the position of a coil will not necessarily result in an expanded rotor or platform size because a POSITA can realize a larger coil without expanding the platform size, for example by making small tweaks to the positioning of the rotor-stator elements or the fins of

the heat sink. Dr. Janet ignores the engineering judgement a POSITA would have relied upon to meet any spacing requirements.

52. In paragraph 202, Dr. Janet also argues that Cai does not disclose that the transformer coils are disposed on the surface of the stator and rotor circuit boards. However, Dr. Janet's argument misunderstands the proposed combination. In my opening declaration I showed that Johnson discloses transformer coils disposed on the surface of the stator and rotor circuit boards. Dr. Janet does not dispute this fact. I relied upon Cai only with regards to moving the transformer coils to the outside perimeter of the rotor and stator elements, which Dr. Janet concedes Cai discloses. Thus, Dr. Janet's focus on whether Cai discloses transformer coils disposed on the surface of the stator and rotor circuit boards is misplaced.

K. Droz is not a stationary device and renders obvious the plurality of pixels limitation

53. As I explained in my opening declaration, Pacala states that an optoelectronics component 70 includes detector circuitry that can be "integrated into the pixels of a detector array (*e.g.*, Single-Photon Avalanche Diode [SPAD] array)." EX1003, ¶312 (citing EX1004, [0012]-[0014]). I further opined that to the extent Pacala does not expressly disclose that each pixel in the plurality of pixels can comprise a *plurality* of SPADs, that is disclosed by Droz. EX1003, ¶313.

54. Dr. Janet opines that a POSITA would not combine Droz with Pacala,

Johnson, Pardhan, and Zhang because Droz “teaches *stationary* (non-rotary) LIDA,” whereas the other references relate to spinning LiDAR. EX2004, ¶204. I disagree. Dr. Janet does not cite to any disclosure in Droz that limits its teachings to “stationary” LiDAR. A POSITA would understand that optical structures, such as the waveguide in Droz, are designed to minimize optical crosstalk, which exists with respect to both stationary and rotating LiDAR. Indeed, Droz is a Waymo patent, and at the time Waymo was working on spinning LiDAR designs. I also note that the inventor of Droz, Pierre-Yves Droz, is also a named inventor on the Pardhan reference, which Dr. Janet acknowledges relates to spinning LiDAR. *Compare* EX1006 with EX1011.

55. Dr. Janet opines that Droz does not disclose that each pixel includes a plurality of SPADs because Droz states that the system “may include ‘various types of light detectors’ and offers SPADs as one example.” EX2004, ¶208. It is unclear why Dr. Janet believes that this disclosure is insufficient. As I showed in my opening declaration, Droz discloses a plurality of light detector arrays 310, 316, and 318 that each correspond to a pixel. EX1003, ¶313. And Droz explains that each light detector array includes a “a plurality of light detectors,” such as a plurality of “SPADs.” *Id.* These disclosures are unchallenged and teach this limitation.

56. Dr. Janet further opines that there is no motivation to combine Droz because it allegedly uses “bulky structures.” EX2004, ¶209. Dr. Janet does not

identify any disclosure in Droz that requires a particular size, weight, or material, and I see no such requirement in the claims. Moreover, Dr. Janet's assertions that the combination would have impacted weight and gyroscopic forces (EX2004, ¶¶211-212) yet again points to standard considerations a POSITA would have accounted for in the design process, as I discussed above.

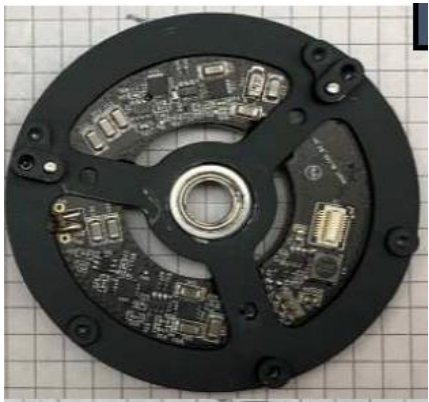
L. There are no secondary considerations

57. Dr. Janet also opines that there are secondary considerations that support a finding of non-obviousness. EX2004, ¶¶246-27. I disagree.

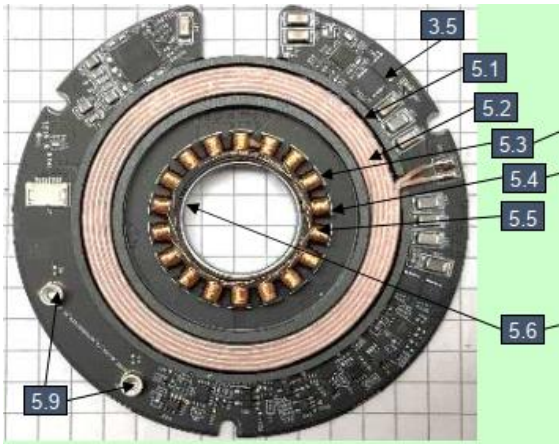
58. Dr. Janet asserts that "Petitioner's copying" supports a finding of non-obviousness. EX2004, ¶247. However, Dr. Janet does not present any evidence that Petitioner was aware of the '515 patent. Instead, Dr. Janet appears to conclude there was copying based on high-level similarities between Ouster's alleged commercial embodiment of the '515 patent and Petitioner's device. Indeed, both designs use stators, both have an enclosure, both have a stator driver circuit, *etc.* In my opinion, these similarities do not show copying and instead reflect the fact that the '515 patent combines known structures in a predictable manner.

59. While I identifying every difference in the two designs is beyond the scope of this declaration, one need only review the two devices to show that they are not the same. Compare EX2024 (teardown of Ouster OS1-64) with EX2015 (Hesai Schematic). For example, the alleged "support component" in Petitioner's product

is different, with Petitioner’s component being more similar to prior art designs:

Ouster OS1-64 (EX2024)	Hesai’s Pandar QT (EX2025)
	

60. Similarly, the stator assembly and stator circuit boards of the two products and the direction of the magnetic field they generate is also different:

Ouster OS1-64 (EX2024)	Hesai’s Pandar QT (EX2025)
	

61. Dr. Janet also alleges that there was “industry praise for the claimed invention of the ’515 patent.” EX2004, ¶¶263-269. I understand from counsel that evidence of commercial success, or other secondary considerations, is only

significant if there is a nexus between the claimed invention and the commercial success. In my opinion, Dr. Ouster has not established any nexus. For instance, Dr. Janet claims that the '515 patent “opened the door to new uses for drones,” but this assertion is conclusory and he does not cite any evidence as support.

62. Similarly, none of the other publications Dr. Janet relies upon establish the required nexus. For instance, EX2018 vaguely references “patented digital lidar technology” without any mention of the '515 patent. Dr. Janet also focuses on its discussion of a “simple two-chip architecture” that is not claimed in the '515 patent. Similarly, EX2019 and EX2024 describe advantages of using LiDAR over “using a camera,” and Dr. Janet provides no explanation of how these discussions have a nexus to the '515 patent. Because Dr. Janet has not established any nexus, he has not shown there are any secondary considerations that would support a finding of non-obviousness.

M. Definition of a POSITA

63. Dr. Janet states that my definition of a POSITA “would be acceptable if it included the caveat that “at a minimum, at least one year of work experience was with LiDAR designs, including LiDAR designs implemented on a rotor-stator structure specifically.” EX2004, ¶66. It is unclear what Dr. Janet means by “at least one year of work experience with LiDAR designs.” A POSITA may obtain experience with LiDAR principles and design without having worked at a company

that designs or sells LiDAR. For example, I have more than a year of experience working with LiDAR designs that does not directly come from working for a LiDAR company. Indeed, I have been qualified as an expert in prior district court matters specifically involving LiDAR devices and designs, including those at issue here. For instance, I provided expert opinions and testimony for Uber Technologies Inc., Ottomotto LLC., Otto Trucking LLC. in their trade secret and patent litigation lawsuit against Waymo LLC (Google) in 2017 and 2018 (17-CV-00939 (N.D. Ca filed: Mar 10th, 2017)). In that litigation, I inspected, analyzed, and generated simulation and modeling of LiDAR performance. I also inspected and analyzed Waymo LLC's self-driving vehicles that utilized LiDAR, as well as Uber Technologies based LiDAR systems. The IPR proceedings here involve multiple prior art references from Waymo that are related to the Waymo designs I opined on. As another example, I have organized workshops, reports, and updates for members of OIDA trade association on optical free space for automotive applications that included LiDAR based technology. I have also spoken at conferences on the subject of LiDAR and participated in panel sessions of technical experts. One example is at the 5th PIC International conference (Nov 2021), (www.picinternational.net), where I was invited to be session chairman and an invited speaker for the panel entitled, "PICs for LiDAR" where the focus was on next generation miniaturization of LiDAR technologies and systems by incorporating for example photonic integrated

circuits (PICs).

64. Moreover, my definition of a POSITA already includes a requirement of “two to three years of work experience with electro-optical and electro-mechanical devices or systems,” which would provide a POSITA with an understanding of the fundamental principles of LiDAR and rotor-stator structures. For instance, I have spent decades working on component technologies that go into LiDAR systems, as I explained in my opening declaration. Indeed, my experience with brushless motors began in the 1980s when I was employed by the Ministry of Defence, UK. At that time, I worked to maintain, repair and design different types of brushless motors, and was involved in actually creating motors as well as wrapping copper coils by hand in a variety of configurations, and a variety of different gauge wires. I have supervised work in brushless motors while working at Motorola (1989-1998), and when working in corporate research in the 1990s. At that time, a number of motor designs were analyzed and researched for applications that involved miniaturization. While at Motorola I conducted research into LiDAR techniques, and especially laser scanning, as well as light detection using photodetectors for received reflected optical signals that involved time of flight measurements. At Intel (1998-2000), I reviewed business and technology plans for optical free space laser/detector based systems, and similarly for the EU Commission over the past decade. The work at the EU Commission over the past decade (2013-

present) involved the review and technical assessment, monitoring and leadership with LiDAR based systems that included various motor and optical free space techniques.

III. CONCLUSION

65. I understand that this Declaration will be filed as evidence in a contested case before the PTAB. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place in the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

66. I declare that all statements made in this Declaration of my own knowledge are true to the best of my knowledge and that all statements made on information and belief are believed to be true. These statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: September 26, 2024

By: _____



Michael Lebby, Ph.D.