

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

REFLEX USA LLC,
Petitioner,

v.

LONGYEAR TM, INC. and GLOBALTECH CORPORATION PTY LTD.,
Patent Owner.

Case No. IPR2023-00642
Patent No. 10,830,013

**DECLARATION OF DR. JOHN P. RODGERS IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,830,013**

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I. INTRODUCTION

1. I, John P. Rodgers, have been retained as a technical consultant on behalf of Reflex USA LLC (“Reflex”), the petitioner in the present proceeding, and I am being compensated at my usual and customary hourly rate of \$350.00 per hour. I am informed that the assignees for the patent in the present proceeding are Longyear TM, Inc. and Globaltech Corporation Pty Ltd (collectively, “the Patent Owner”). I am also informed that the petition names Reflex and Imdex Limited as real parties-in-interest.

2. Other than set out above, I have no affiliation, contractual connection, or financial connection with the petitioner or any of its subsidiaries or parents, or the real party-in-interest. I similarly have no financial interest in, or affiliation with the Patent Owner. My compensation is not dependent upon the outcome of, or my testimony in, this *inter partes* review, or any litigation proceedings.

3. As reflected in the section below addressing my qualifications, I have extensive experience (including authoring patents and publications) in the design, operation, and testing of downhole tools for use in drilling applications, and associated electrical and mechanical equipment, including electronic sensors and instrumentation. My opinions are based on my years of education, research and

experience, as well as my investigation and study of relevant materials. The materials that I studied for this declaration include all exhibits of the petition.

4. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

5. My analysis of the materials produced in this investigation is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. QUALIFICATIONS

6. My background, qualifications, and experience relevant to the issues in this proceeding are summarized below. My curriculum vitae is marked as Ex. 1023.

7. I am the President and Founder of Starboard Innovations, LLC, an engineering consulting firm specializing in concept development, new technology research, design, analysis, prototyping, and testing. I founded Starboard Innovations in 2000 and have been working there since (twenty-two years to date). Starboard Innovations is headquartered in the New York metro region, with consultants

spanning the globe, with regional offices in Dallas, Boston, and Zurich, Switzerland.

8. Prior to founding Starboard Innovation, I held multiple technical roles. From November 1998 to February 2000, I was a Senior Engineer with the Mide Technology Corporation. Among other NASA and Department of Defense work there, I co-developed a novel piezoceramic actuator/sensor called “PowerAct.” Prior to that, I had roles in university research: at MIT, in both the Active Materials and Structures Laboratory, as well as the Space Engineering Research Center; and at Duke University’s Department of Mechanical Engineering.

9. For nearly twenty years, while I have worked on a wide variety of applications across many industries, the bulk of my work has come in the development of downhole tools, as explained further below. I have developed new mechanical tools and software focused on a variety of different downhole applications. Such applications include: acoustic telemetry, measurement while drilling (MWD), downhole navigation tools, dynamic perforation sensing tools, and wireline sensing tools. My involvement with many of these development projects included designing, performing engineering analyses and simulations, developing manufacturing processes, building prototypes, running qualification tests, and supporting field trials. My testing experience also includes working with a number of different optical sensing technologies.

10. I obtained Bachelor of Science degrees in Mechanical Engineering and Material Science in 1992 from the Duke University. From there, I obtained a Masters of Science degree in 1995, and a Ph.D. in 1998, from MIT, where I majored in Structures Technology and Minored in Estimation and Control.

11. Much of my work related to downhole equipment and associated components, performed through my consulting firm, has been confidential and therefore embargoed for publication purposes. However, I have authored a number of publications, and/or industry conference presentations, particularly over the past decade, related to drilling for oil and gas applications. Among these include:

- a. Rodgers, J., Glenn, T.S., Serra, M., “Prediction of Gun String Dynamic Failure Risks during Perforating” (presented at the North American Perforating Symposium, 2019 NAPS 6.3, Arlington, TX, Aug. 2019).
- b. Anderson, M., Rios, F., Rodgers, J. et al, “The Dynamic Loading Effects of Non-linear Gun Connectors During and After Detonation”, presented at the 2018 Latin American Perforating Symposium (Bogota, Columbia, Oct. 2018).
- c. Rodgers, J., Glenn, T.S., Serra, M., Craddock, G.G., “High-Fidelity Finite Element Analysis of Deepwater Gun-Parting

Failures” (presented at the North American Perforating Symposium, NAPS-46-18, July 2018).

- d. Glenn, T.S., Serra, M., Rodgers, J. et al, “Validation of a Finite Element Simulation of a Downhole Perforating Gun String through Comparison with Data from a New Datalogging Sensor Sub” (presented at ASME 2015 Verification and Validation Symposium, May 2015).
- e. Wight, J., Rodgers, J. et al, “New Shock Sensing Sub Permits Greater Understanding of the Dynamic Response of Perforating Gun Strings”, IPS-14-03 (presented at the 2014 International Perforating Symposium, May 2014).
- f. Glenn, T.S., Serra, M., Rodgers, J., Wight, J., Zhang, W., Craddock, G.G., Harive, K. “Investigating the Dynamic Three-Dimensional Loading Effects on Perforating Guns Imposed by Shaped Charges – Downhole Evaluation”. OTC 24891. (presented at Offshore Technology Conference – Asia, Malaysia, March, 2014).
- g. Craddock, G.G., Zhang, W., Wight, J., Rodgers, J., Glenn, T.S., Serra, M., and Bettenmann, T. “Investigating the Dynamic Three-Dimensional Loading Effects on Perforating Guns

Imposed by Shaped Charges” (presented at the International Petroleum Technology Conference, Doha, Qatar, 19–22 January, 2014).

12. I am or have been a member of, and/or provided services to, the following professional societies:

- a. American Society of Mechanical Engineers (ASME), where I have served as a PE License Review Instructor
- b. Society of Petroleum Engineers (SPE)
- c. Guest Lecturer at Texan Christian University, University of North Texas
- d. American Institute of Aeronautics and Astronautics (AIAA)
- e. Licensed Professional Engineer (PE) in mechanical engineering in TX, ND, CT

13. In addition to the academic experience outlined in my CV, over the past twenty years, I have been consulting for Halliburton in the development of downhole tools. I have worked on four particular projects that are particularly relevant to the subject matter of the '013 Patent:

- a. MWD Vibration Sensing. Between 2011 and 2014, I worked on the design and analysis of measurement while drilling (MWD) tools that specifically measure the vibration environment during

drilling for the purpose of tracking and predicting the reliability of the drill string. The associated sensors, including strain gauges, accelerometers, and gyros, tracked the load and motions at various points in the drill string. Data were recorded within the downhole tool, uploaded to a surface computer upon return of the string to the rig, and then used to calibrate predictive models and to aid in mechanical failure analysis for the drill string.

- b. Subsea Sensing Sub. Between 2015 and 2018, I worked on developing a subsea sensing sub for aiding in the positioning of completion strings inside deepwater wellheads in the Gulf of Mexico. The tool integrated an inertial measurement unit (IMU) to monitor the position and orientation of the system as it is moved through the blowout preventer (BOP) on the sea floor. The system was designed to provide realtime data through a wireline interface to the rig surface computer, to provide an indication to the operator to adjust rotation and depth of the string to obtain a proper latching engagement with a mating profile in the BOP. The sensors involved included accelerometers, gyros, and magnetometers, each sensing three axes of motion. An onboard computer recorded high-speed data for later recovery at

the surface while a subset of the data was telemetered via the wireline link.

- c. Autonomous downhole tool. Between 2004 and 2006, I worked on the design of an autonomous downhole tool concept that used an onboard navigation system to determine position in the wellbore. The tool would be programmed to deploy a tool such as setting a plug or firing a perforating gun at a predetermined location in the wellbore. I developed sensors and logic for tool navigation and tested the prototype in a south Texas field trial. The instrumentation included magnetic sensors to track joints of casing, pressure transducers, accelerometers, and optical motion detectors. A data fusion approach was used to combine disparate data streams in developing a position estimate. An onboard computer recorded the data and performed the calculations to trigger deployment at the proper depth.
- d. Shock Sensing Sub. Between 2009 and 2013, I developed the shock sensing sub (SSS) to measure the dynamic pressures, forces, and motions that result from detonating perforating guns in deepwater wells in the Gulf of Mexico. The SSS was positioned between loaded perforating guns containing hundreds

of shaped charges. When the charges detonated in sequence, a large fluid shock wave would propagate through the wellbore fluids and a structural shockwave propagated through the steel of the tool string. The SSS measured the high-speed dynamic pressures, loads, and accelerations and records the data on an onboard computer. When returned to the surface, the data was uploaded at high speed to a surface computer for further analysis and for the calibration of predictive software models.

14. I am a named inventor on over 30 issued U.S. Patents. A comprehensive list of my patents is contained in my attached CV, Ex. 2023.

III. SCOPE OF OPINION

15. I have been asked to provide my opinions regarding whether claims 1, 3-4, 19-22 and 24-25 of the '013 Patent would have been obvious to one of ordinary skill in the art at the time of the alleged invention over Beach-127 (Ex. 1003) in view of Wiese (Ex. 1004) (Ground I); whether claim 2 of the '013 Patent would have been obvious to one of ordinary skill in the art at the time of the alleged invention over Beach-127 in view of Wiese and Pickard (Ex. 1006); whether claims 1, 3-4, 14-15, 19-22, and 24-25 of the '013 Patent would have been obvious to one of ordinary skill in the art at the time of the alleged invention over Beach-127 in view of Wiese and Klass-839 (Ex. 1005) (Ground III); and whether claim 2 of the '013 Patent would have been

obvious to one of ordinary skill in the art at the time of the alleged invention over Beach-127 in view of Wiese, Klass-839, and Pickard.

16. This declaration, including the exhibits hereto, sets forth my opinions on these issues.

IV. MATERIALS REVIEWED AND CONSIDERED

17. In addition to the information identified in § II above and elsewhere in this Declaration, in forming my opinions, I have considered the following documents:

Exhibit	Description
1001	U.S. Patent No. 10,830,013 (the “’013 Patent”)
1002	File History for U.S. Patent No. 10,830,013 (the “’013 File History”)
1003	WO 2008/113127 (“Beach-127”)
1004	U.S. Pub. No. 2008/0001775 (“Wiese”)
1005	WO 2012/012839 (“Klass-839”)
1006	U.S. 3,305,033 (“Pickard”)
1007	U.S. 2006/0210409 (“Sumner”)
1008	WO 2013/126955 (“Hejleh”)
1009	WO 2007/109848 (“Beach-848”)
1010	U.S. Patent No. 10,465,463 (the “’463 Patent”)
1011	File History for U.S. Patent No. 10,465,463 (the “’463 File History”)
1012	U.S. Patent No. 11,466,529 (the “’529 Patent”)
1013	File History for U.S. Patent No. 11,466,529 (the “’529 File History”)
1014	Chart: Patent Office’s Evaluation of Beach-127 Against the Challenged Claims
1015	U.S. Patent Pub. No. 2013/0099935 (“Ujureh”)
1016	U.S. Patent No. 4,928,088 (“Jorion”)
1017	Central Mine Equipment Company (CMECO) Product Catalog (2013)
1018	WO 2010/091471 (“Jacobs”)

Exhibit	Description
1019	New Oxford Am. Dict. 3rd (2010) (hermetic)
1020	SPIE, Free-space optical transmission improves land-mobile communications, Henniger et al. (2007)
1021	OPTICAL COMMUNICATIONS, 2nd ed., Gagliardi et al. (1995), Ch. 1
1022	Declaration of Dr. John P. Rodgers
1023	Curriculum Vitae of Dr. John P. Rodgers

V. LEVEL OF ORDINARY SKILL IN THE ART

18. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary skill in the art (“POSITA”). I am informed that the “art” is the field of technology to which a patent is related and that a POSITA is a hypothetical person who is presumed to be aware of all pertinent art, to possess conventional wisdom in the art, is a person of ordinary creativity, and has common sense. I am informed that the purpose of using the viewpoint of a POSITA is for objectivity.

19. I am informed that the factors that may be considered in determining the level of ordinary skill in the art may include (a) the type of problems encountered in the art, (b) prior art solutions to those problems, (c) the rapidity with which innovations are made, (d) sophistication of the technology, and (e) the educational level of active workers in the field. I am also informed that in a given case, every factor may not be present, and one or more factors may predominate.

20. Taking these factors into consideration, it is my opinion that a POSITA at the time of the alleged invention would have had a bachelor's degree in petroleum, mining, mechanical, or electrical engineering (or a closely related field), and at least two years' experience in designing and developing electromechanical downhole tools, including working with sensors and other electronics.

21. At the relevant time, I would have qualified as at least a POSITA and my opinions herein are informed by my own knowledge based on my personal experiences and observing others of various skill levels (including those above and below the level of a POSITA). In particular, I was actively engaged in the field of the '013 Patent at the relevant time, as discussed above.

VI. LEGAL PRINCIPLES OF PATENTABILITY

22. Several legal standards have been explained to me that I should consider as part of my patentability analysis.

23. I am informed that Petitioner bears the burden of proving grounds of unpatentability by a preponderance of the evidence. I am informed that a "preponderance" means "more likely than not." I am informed that general and conclusory assertions, without underlying factual evidence, may not support a conclusion that something is "more likely than not."

24. I am informed that a prior art reference can render a patent claim obvious to one of ordinary skill in the art if the differences between the subject matter set forth

in the patent claim and the prior art are such that the subject matter of the claim would have been obvious at the time the claimed invention was made.

25. In analyzing obviousness, I am informed that it is important to consider the scope of the claims, the level of skill in the relevant art, the scope and content of the prior art, the differences between the prior art and the claims, and any secondary considerations.

26. I am informed that when the claimed subject matter involves combining pre-existing elements to yield no more than what one would expect from such an arrangement, the combination is obvious. I am also informed that in assessing whether a claim is obvious one must consider whether the claimed improvement is more than the predictable use of prior art elements according to their established functions. I am informed that there need not be a precise teaching in the prior art directed to the specific subject matter of a claim because one can take account of the inferences and creative steps that a person of skill in the art would employ. I am further informed that a person of ordinary skill is a person of ordinary creativity, not an automaton.

27. I am informed that obviousness cannot be based on the hindsight combination of components selectively culled from the prior art. I am informed that in an obviousness analysis, neither the motivation nor the avowed purpose of the inventors controls the inquiry. Any need or problem known in the field at the time of the invention and addressed by the patent can provide a reason for combining elements.

For example, I am informed that it is important to consider whether there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims. I am informed that known techniques can have obvious uses beyond their primary purposes, and that in many cases a person of ordinary skill can fit the teachings of multiple pieces of prior art together like pieces of a puzzle.

28. I am informed that, when there is a reason to solve a problem and there is a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. I am further informed that, if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense, which bears on whether the claim would have been obvious.

29. I am informed that secondary considerations can include, for example, evidence of commercial success of the invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, or evidence that an invention achieved surprising or unexpected results. I am further informed that such evidence must have a nexus, or causal relationship to the limitations of a claim, in order to be relevant. I am unaware of any such secondary considerations for the '013 Patent.

VII. BACKGROUND

A. Technology Background

30. The '013 Patent, in describing the “Field of The Invention,” states that the invention “relates to down hole surveying in drilling operations.” *See* Ex. 1001 ('013 Patent) at 1:19-20.

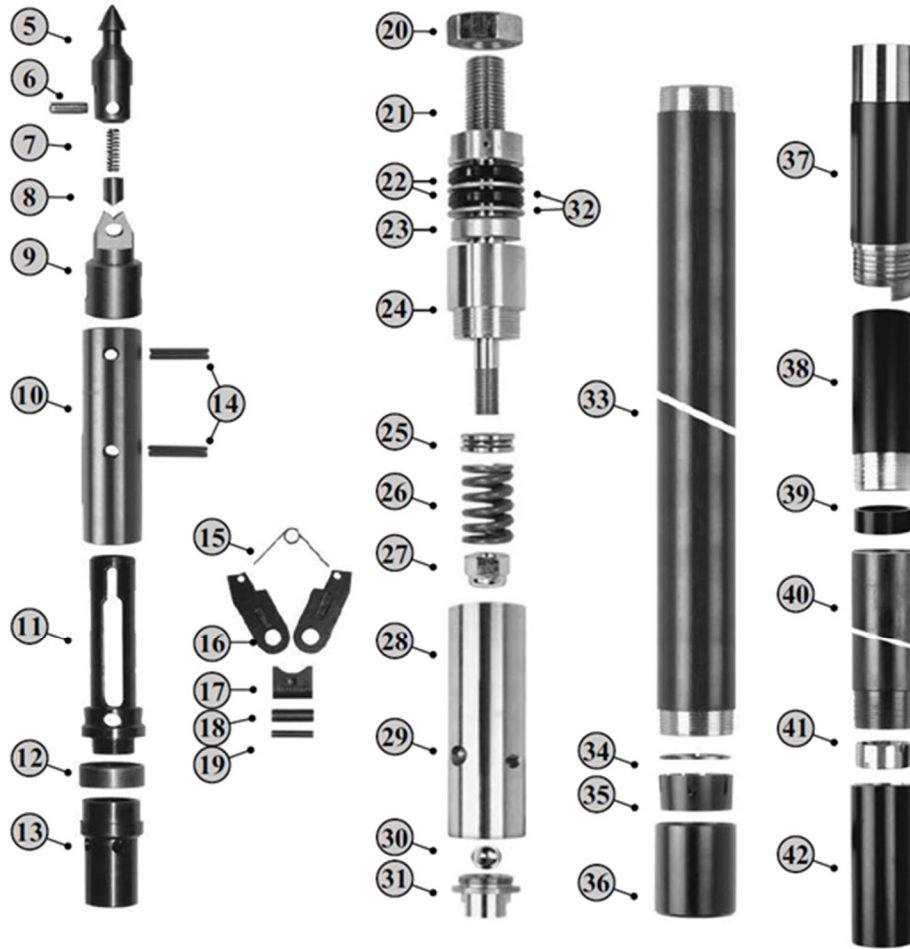
31. Downhole tools refer to equipment, typically used in the mining or exploration of hard rock or hydrocarbons, that are configured to operate within a subterranean borehole. Such equipment is subjected to elevated temperatures and hydrostatic pressures. Further, downhole tools are typically run as part of a string of tools, which, in drilling applications, is often referred to as a “drill string.” When operating as part of a drill string, downhole tools must be particularly configured to withstand a high vibration environment, as is typical for both oil and gas as well as hard rock mining-related applications.

32. As an example, in hard rock drilling, geologists are particularly interested in collecting a rock core sample (often referred to as simply “core sample,” as a shorthand) and retrieving it to the surface for additional analysis. This is demonstrated in the following content from a contemporary (2012) product catalog from a core assembly drilling manufacturer.



Ex. 1017 (CMECO Product Catalog (2013))
at 11 (showing an example of a truck-
mounted drilling rig).

33. The connection to a wireline is typically made via spearhead point 5 visible in the assembly below. Bearings 23, 24, 25 allow the spindle assembly 21 to freely rotate. Grease fitting 29 allows access to the interior of inner tube cap assembly 28 which houses the bearings and spring 26, enabling grease to be pumped into the assembly. Tubular components are threaded together; for example, the top of inner tube 33 threads into bottom of inner tube cap assembly 29.



Ex. 1017 (CMECO Product Catalog (2013)) at 194
(showing wireline core barrel assembly parts)

Ref. No.	Part No.		Description	Ref. No.	Part No.		Description
	5'	10'			5'	10'	
1	36001	36002	N W/L Core barrel assembly	24	36019	36019	Spindle bearing
2	36003	36004	Inner tube assembly	25	36020	36020	Hanger bearing
3	36005	36005	Head assembly	26	36021	36021	Compression spring
4	37076	37076	Bearing assembly	27	36022	36022	Self lock nut
5	36027	36027	Spearhead point	28	36023	36023	Inner tube cap assembly
6	36028	36028	Spiral pin (.4375" x 1")	29	36024	36024	Grease fitting
7	36029	36029	Compression spring	30	36025	36025	Steel ball
8	36030	36030	Detent plunger	31	36026	36026	Check valve body
9	36031	36031	Spearhead base	32	36017	36017	Valve adjusting washer (2 req'd.)
10	36033	36033	Latch retracting case	33	36034	36035	Inner tube
11	36011	36011	Upper latch body	34	36036	36036	Stop ring
12	36012	36012	Landing shoulder	35	36037	36037	Core lifter (Standard)
13	36013	36013	Lower latch body	35	36038	36038	Core lifter (Broached)
14	36032	36032	Spring pin (2 req'd.)	36	36039	36039	Core lifter case
15	36006	36006	Latch spring	37	36040	36040	Locking coupling (Standard)
16	36007	36007	Latch (2 req'd.)	37	36041	36041	Locking coupling (Carbide)
17	36008	36008	Latch support	38	36042	36042	Adapter coupling
18	36009	36009	Spring pin (.5" x 2")	39	36043	36043	Landing ring
19	36010	36010	Spring pin (.375" x 2")	40	36044	36045	Outer tube
20	36014	36014	Lock nut	41	36046	36046	IT stabilizer
21	36015	36015	Spindle assembly	42	36047	36047	Thread protector
22	36016	36016	Shut-off valve (2 req'd.)		36260	36260	Inner tube coupling
23	36018	36018	Ball thrust bearing				

Ex. 1017 (CMECO Product Catalog (2013)) at 195
(wireline core barrel assembly parts list)

34. For this application, sensors are required to detect the orientation of the core sample with respect to vertical (known as inclination), as well as the compass heading (known as azimuth), at the location where it is collected in the borehole. Electromechanical sensors are used to sense or measure the physical motion and provide a corresponding electrical output signal; such sensors include accelerometers

and gyros. After data is collected by sensors, it is typically stored in a memory device, such as a downhole data recorder, until the downhole tool and the obtained core sample are retrieved to the surface.

35. Upon retrieval of the core sample and drill string, the collected data is uploaded, for example, to an external receiving device (such as a remote computer) that facilitates further analysis of the sample. For operational efficiency, it is desirable to transfer this data as quickly as possible, and to do so with as little physical manipulation of the downhole tool as feasible.

36. This data transfer requires some amount of time to complete, as it is subject to both the achievable connection bandwidth as well as the volume of the collected data. Historically, a wired connection has been used for this purpose. A wired connection can facilitate a relatively quick data transfer, but it poses a number of disadvantages. First, cables can be costly and are often specialized. Second, tools that rely on a wired cable connection for data transfer require a specialized cable connector. Such a connector must be protected from the downhole environment, typically inside the pressure housing, and must be kept clean. Further, opening a connection between different subs or tools within the drill string has its associated drawbacks, including the risk of contamination, the expenditure of extra time, and the added potential risk of drill string reliability if the connections are not properly reassembled and sealed. Downhole tools return to the surface covered in wellbore

fluids and other debris encountered during operation and retrieval. In contrast, the inside of the electronics cavity must necessarily be kept clean and dry to ensure reliable operation. Further, the seals that protect the interior from wellbore fluids must also be uncontaminated and undamaged.

37. At the time of the alleged invention, persons skilled in the art would have been aware of drill string design techniques that avoid the level of disassembly and the associated drawbacks described above. For example, it was known that a downhole tool could feature a side port connection, whereby an electrical connector is mounted in the sidewall of the cylindrical tool. With this design, a side port plug would be used as a protective barrier to cover the connector, such that accessing the connector would simply require removing the side port plug. Even in this arrangement, care must be taken to keep the electrical connector clean and to ensure that the side port plug is correctly reinstalled and sealed.

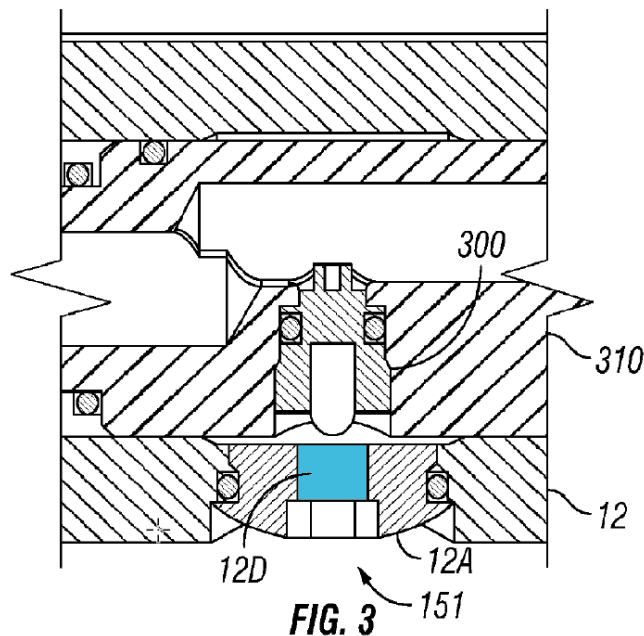
38. Other techniques known at the time of the invention involved communicating the collected information optically, through the side wall of the downhole tool. For context, optical communication refers to the communication involving the subset of the electromagnetic spectrum that includes visible light wavelengths as well as non-visible light such as infrared (IR). A POSITA at the relevant time would have appreciated that, compared to an electrical connector port, an optical interface does not require the same level of maintenance (including

40. As Jorion explains, “[o]n the interior side of the bulkhead...[l]ight emitting diode, LED, (70) is interfaced to the downhole system 14 to permit coded data generated by the downhole system (14) to be transmitted to the LED for conversion into coded light pulses that are transmitted through the quartz window (64).” *Id.*, 5:53-61. From there, the coded light pulses are “received by receiving photo transistor (72) which in turn converts the light pulses into coded electrical signals that are delivered to the surface system (10).” *Id.*, 6:25-31. A corresponding LED (68)/photo transistor (74) permits optical communication in the opposite direction, through window (65). *See id.*, 6:19-25. As a result, Jorion’s disclosed system promotes “effective two way communication...at a rapid rate and in an intrinsically safe manner.” *Id.*, 6:31-33.

41. U.S. Published Patent Application No. 2013/0099935 to Ujereh (Ex. Ex. 1015, “Ujereh”), which published April 2013, discloses another example of a downhole tool having an “optically transparent window.” Ex. 1015 (Ujereh), Abstract. Specifically, Ujereh contemplates a “wellbore measurement instrument” for hard rock mining (*i.e.*, a downhole tool) that comprises an “optical communication device 300.” As shown in Figures 3 and 4B (below), Ujereh’s optical communication device includes a “port plug 12A [that] has an optically transparent window 12D made of material such as boron glass, boron silicate glass or

certain types of plastic such that wellbore fluids are excluded from entering the port.”

Id., [0028].



42. In other words, “[t]he window is configured to resist entry of wellbore fluid into an interior of the housing” of the instrument. *See id.*, [0012]. In this regard, Ujereh’s disclosure is consistent with what a POSITA’s understanding, that a window in this context, apart from permitting optical communication, would need to serve a structural function as well—it must be strong enough to act as a pressure barrier between the wellbore and interior of the tool, and must be sealed to the pressure housing of the tool.¹

¹ As discussed in § VII.F below, this understanding warrants a construction of the “window” limitation of challenged Claim 1, to require a solid material that is transmissive to a communication signal, rather than merely an aperture or void.

43. Urejeh demonstrates an additional downhole tool feature that was known at the time of the alleged invention—use of a multi-colored LED light source to provide visual indications externally, to an instrument operator. *See id.*, [0026] (“Visual operation of the light source 302 may enable the operator to determine, for example, instrument operating status, or to observe any data or control signals stored in the instrument susceptible to operator observation and interpretation. The light source 302 may include multiple colors . . . to enable more types of information to be interpretable by the instrument operator.”).

44. Core orientation tools have taken advantage of optical transmission techniques to communicate data and to provide real-time feedback to operators about the orientation of the tool as it is being manipulated at the surface. The tools provide a visible indication regarding the relative rotation angle required for an operator to rotate the tool to the same orientation as it was at the point when the core sample was collected in the borehole.

45. Drilling exploration and recovery boreholes is an expensive and time-consuming process; some holes may take many days to complete, and require the continuous presence and operation of a crew of personnel and expensive machinery.

46. The drilling environment is extremely robust, in the sense that the machinery used must be capable of withstanding a high degree of physical abuse. The abuse includes high vibration resulting from the bit interaction with the rock, the

likelihood of parts being dropped from the drilling platform to the ground, and general wear and tear of the drilling process. The drilling environment includes a great deal of liquid contamination in the form of drilling fluid or mud, and liquids in underground media such as oil and water. In most cases these liquids contain a great deal of suspended solids or grit, thereby creating a very abrasive fluid in which the tools must work.

47. For all of these reasons, the designer of a downhole tool is strongly motivated to make the instrument as robust to physical damage and fluid ingress as possible, to avoid unnecessary operations that involve the breaking of seals and the accessing of internal components, and to facilitate the timely operation of the drill rig as much as possible.

B. Overview of the '013 Patent

48. The '013 Patent is titled “Core Barrel Head Assembly with an Integrated Sample Orientation Tool and System for Using Same.” Ex. 1001 ('013 Patent) at Title. In its “Field of the Invention” section, the '013 Patent states that its invention “relates to down hole surveying in drilling operations.” *Id.* at 1:19-20. The patent provides a brief overview of conventional downhole core drilling systems, and conveys a desire to “minimize[] the need to add additional drill string elements,” thereby “allow[ing] for increased efficiency and speed of drilling.” *Id.* at 2:28-34.

49. The claims of '013 Patent are directed to a core barrel head assembly that includes an “electronic instrument” that is configured to obtain orientation data; the instrument is enclosed within a “selectively sealed interior cavity,” which features a “window” that permits “optical communication” (for example, to an external device or operator). *Id.*, claim 1.

50. Claim 1, which is the only independent claim of the '013 Patent, is shown below:

1. A core barrel head assembly having an exterior surface and comprising:
 - a first interior cavity;
 - a selectively sealed interior cavity spaced distally from the first interior cavity and having a closed proximal end;
 - a threaded proximal end portion for coupling to a wire line retrieval portion of a head assembly;
 - a base portion, wherein the first interior cavity extends distally from the threaded proximal end portion to the base portion;
 - a window that extends from the exterior surface into optical communication with the sealed interior cavity proximate the closed proximal end of the sealed interior cavity;
 - at least one electronic instrument that is configured to obtain orientation data,

a transmitter configured to transmit core orientation data,
wherein the sealed interior cavity is sized and shaped to enclose
the at least one electronic instrument.

51. As reflected in the following annotation, Figure 5 of the '013 Patent illustrates a core barrel head assembly that corresponds to claim 1:



30

an “electronic instrument 40” (labeled purple) and an “orientation indicator module 80” (labeled pink). *Id.* at 6:64-7:18. Specifically, the ’013 Patent explains that:

In one aspect, as shown, a plurality of windows 74 can be defined in the elongate tube body that extend from the exterior surface 61 of the elongate tube body into the second interior chamber 70 proximate the closed proximal end 72 of the second interior chamber. In a further aspect, an orientation indicator module 80 can be provided that comprises a plurality of light emitters 8[8].² The orientation indicator module 80 can be sized and shaped to sealingly close the second interior chamber from any intrusion of pressurized fluid into the second interior chamber 70 via the defined plurality of windows 74.

Id. at 7:12-23.

53. The specification further explains that, “[i]n one exemplary aspect, light from the plurality of light emitters 88 (e.g. LEDs, and the like)” —labeled yellow above— “passes through or can be observed through the plurality of windows 74” labeled blue above. *Id.* at 7:42-44. As I explain further below, this configuration was known, or at least would have been obvious to a POSITA, at the time of the alleged invention of the ’013 Patent.

² During prosecution of the ’529 Patent (which is a continuation of the ’013 Patent that shares the same specification as the ’013 Patent), the applicant corrected the specification to clarify that, consistent with Figure 5 and the rest of the specification, the “light emitters” correspond to element 88, rather than element 82. *See* Ex. 1013 (’529 File History) at 59, 67, 76 (April 27, 2022 Amendments and Remarks).

C. Priority Date of the '013 Patent

54. As indicated on the cover page, the '013 Patent is a continuation of U.S. Patent No. 10,465,463, which in turn is a continuation of U.S. Patent No. 10,047,581, which claims priority to Provisional Application No. 61/982,052 filed on April 21, 2014. *See* Ex. 1001 ('013 Patent). Accordingly, I have been asked to assume that the earliest possible priority date for the '013 Patent is April 21, 2014. I have therefore analyzed the prior art of one of ordinary skill for this patent as of that date or somewhat before that date.

D. The Challenged Claims

55. The challenged claims include independent claim 1, and dependent claims 2-4, 14-15, 19-22, and 24-25.

E. Prosecution History

56. I have reviewed the prosecution history of the '013 Patent (Ex. 1002, "the '013 File History"). I have also reviewed the two patents that I understand are within the same family as the '013 Patent: U.S. Patent No. 10,465,463 (Ex. 1010, "the '463 Patent") and U.S. Patent No. 11,466,529 (Ex. 1012, "the '529 Patent"). I have also reviewed the respective prosecution histories for each of these two patents, Ex. 1011 ("the '463 File History") and Ex. 1013 ("the '529 File History"), because they are particularly relevant to my analysis, as I explain further below.

57. The patent application that resulted in the '013 Patent, U.S. Patent Application No. 16/588,026, was filed on September 30, 2019. Ex. 1002 ('013 File

History) at 2. I have seen that, during prosecution, the Examiner issued an Office action rejecting the pending claims on the basis of nonstatutory double patenting, as being patentably indistinct from the claims of the '463 Patent. *See id.* at 72-73 (March 19, 2020 Office Action at 2-3). The Patent Owner responded to the Office action by filing a terminal disclaimer, which overcame the double patenting rejection. *Id.* at 38 (June 18, 2020 Response at 6). The Examiner issued the Notice of Allowability on July 9, 2020. *Id.* at 13.

1. Relevant Prosecution History of Patents within the Same Family as the '013 Patent

I have further seen that, during the prosecution of both the '463 Patent and the '529 Patent, the Examiner issued Office actions rejecting the pending claims of those respective applications over Published International Patent Application No. WO 2008/113127 to Beach et al. (hereinafter "Beach-127"). *See* Ex. 1011 ('463 File History) at 54-57 (3-14-2019 Office Action at 3-6); *see also* Ex. 1013 ('529 File History) at 191-93, 10-27-2021 Office Action at 3-5). This is notable because the pending claims at issue during those prosecutions, share the same limitations recited in Claims 1-3 and 19-22 of the '013 Patent. As a result, taken collectively, those Office actions reflect the Patent Office's assessment that Beach-127 discloses all claim limitations of Claim 1, as well as dependent claims 2-3 and 19-22, of the '013 Patent. I have further seen that, when the Patent Owner had an opportunity to respond to the Patent Office regarding the disclosures of Beach-127, the Patent

Owner did not dispute that Beach-127 discloses the relevant limitations identified by the Examiner. Instead, the Patent Owner succeeded in overcoming the Examiner's rejections, and eventually secured allowance of the claims of the '463 and '529 Patents, by amending the pending claims to require additional limitations not at issue in the '013 Patent claims here. *See* Ex. 1011 ('463 File History) at 36 (6-12-2019 Office Action Response at 8) (conceding the Examiner's argument); Ex. 1013 ('529 File History) at 77 (6-12-2019 Office Action Response at 8) (again conceding the Examiner's argument). The Patent Owner's responses therefore indicate that it accepted the Examiner's assessments that Beach-127 discloses all limitations of Claim 1, as well as dependent claims 2-3 and 19-22, of the '013 Patent. Exhibit 1014, attached to my declaration is includes a series of charts demonstrating the positions taken by both the Patent Office and the Patent Owner, during prosecution of the '463 and '529 Patents, regarding the disclosures of Beach-127, as they apply to Claims 1-3 and 19-22 of the '013 Patent.

58. In connection with this matter, I have independently reviewed Beach-127 in relation to Claims 1-3 and 19-22 of the '013 Patent. As I demonstrate further below, the Patent Examiner's analysis regarding Beach-127, and the Patent Owner's acceptance of that analysis, is consistent with my own technical analysis of these claims and Beach-127.

59. In addition, during prosecution of the '529 Patent, the Patent Owner amended the specification and the drawings. Since the '529 Patent is in the same family as the '013 Patent and shares an otherwise identical specification with the '013 Patent, I have reviewed these amendments, and I consider them to be instructive in my review of the '013 Patent because they appear to correct inaccuracies in the '013 Patent specification.

60. As relevant to my analysis for this matter, the Patent Owner's amendments to the written specification, provided in the '529 File History—see Ex. 1013 ('529 File History) at 59-62 (April 27, 2022 Office Action Response)—indicate that:

- Element 32 is the “*distal* end,” and element 34 is the “*proximal* end,” of core barrel head assembly 30.
- Element 132 is the “*distal* end,” and element 134 is the “*proximal* end,” of core barrel head assembly 130.
- Element 162 is the “*distal* end,” and element 164 is the “*proximal* end,” of elongate tube body 160.
- Light emitters are element 88 (rather than 82).
- The orientation indicator module is element 80 (rather than 82).

61. Accordingly, I have interpreted the '013 Patent specification according to these amendments, in performing my analysis for this matter.

F. Claim Construction

62. I have been asked to offer my opinion regarding the understanding of a person skilled in the art regarding certain claim terms in the '013 Patent. I am informed that claim terms are generally given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. I am further informed that, under the concept of “claim differentiation,” it is presumed that when different words are used across the various claims of a patent, they are intended to have different claim scope or meaning.

1. “window” (claim 1)

63. Claim 1 specifies “a window that extends from the exterior surface into optical communication with the sealed interior cavity . . .” Ex. 1001 ('013 Patent), cl.

1. I have been asked to offer my opinion about the understanding of a POSITA regarding the term “window.” A POSITA would understand that, in the context of the '013 Patent, the term “window” should be construed to require a solid material that is transmissive to a communication signal.

64. This construction is consistent with the '013 Patent specification. For example, the specification consistently uses the term “port” to specifically refer to an open void or aperture on the exterior of the core barrel head assembly, that may permit fluid passage into an interior cavity. *See, e.g.*, Ex. 1001 ('013 Patent), 6:54-57 (“Proximate the base portion of the second interior cavity, a port 66 is defined that

extends from the exterior surface of the elongate tube body into fluid communication with the first interior cavity.”); *see also id.*, 8:53-56, 9:64-10:3, 10:34-38 (providing similar descriptions for “port 106, “port 167,” and “port 186,” respectively.). On the other hand, the specification uses the term “window”—rather than the term “port”—to refer to structures that allow data transfer via line-of-sight transmission from within an interior cavity to a remote device. *See, e.g., id.*, 14:47-58.

65. This construction is also consistent with the prosecution histories of the related patents. I have seen that, during prosecution of the ’463 Patent (which I understand is the parent to, and therefore shares the same specification as, the ’013 Patent, the Patent Owner amended this portion of the specification to specify that such data transmitting is through a “window,” replacing the word “aperture.” Ex. 1011 (’463 File History) at 30 (June 12, 2019 Office Action Response at 2).

66. Further, this construction is consistent with the language of other claims in the ’013 Patent. Specifically, dependent claim 2 specifies “a *port* . . . extending from the exterior surface into fluid communication with the first interior cavity,” which further suggests that the term “*window*” recited in claim 1 refers to something structurally different.

67. Nevertheless, I note that even if my proposed construction of “window” were not applied—in other words, even if “window” were interpreted as encompassing a void or aperture rather than a solid material, my unpatentability

conclusions would remain the same, because as I describe further below, the prior art teaches the “window” limitation under either interpretation of the term “window.”

2. “selectively sealed” (claim 1)

68. Claim 1 specifies “a selectively sealed interior cavity . . .” Ex. 1001 (’013 Patent), cl. 1. I have been asked to offer my opinion about the understanding of a POSITA regarding the term “selectively sealed.” A POSITA would understand that, in the context of the ’013 Patent, the term “selectively sealed” refers to the capability of being both sealed and unsealed, as a product design feature. Under this construction, “a selectively sealed interior cavity” would not cover, for example, an interior cavity that is designed to be permanently sealed. Otherwise, if “selectively sealed” were interpreted broadly enough to include permanently-sealed designs, it would effectively render meaningless the Patent Owner’s choice to include the word “selectively.”

69. In addition, I have seen that the claims of the ’529 Patent (which I understand is a continuation of the ’013 Patent) merely specify “a sealed interior cavity.” *see* Ex. 1012 (’529 Patent), cl. 1. This further demonstrates that “a *selectively* sealed interior cavity” is narrower in scope.

70. Once again, however, I note that even if my proposed construction of “selectively sealed” were not applied—in other words, even if “selectively sealed” were interpreted as encompassing even permanently-sealed designs, my conclusions

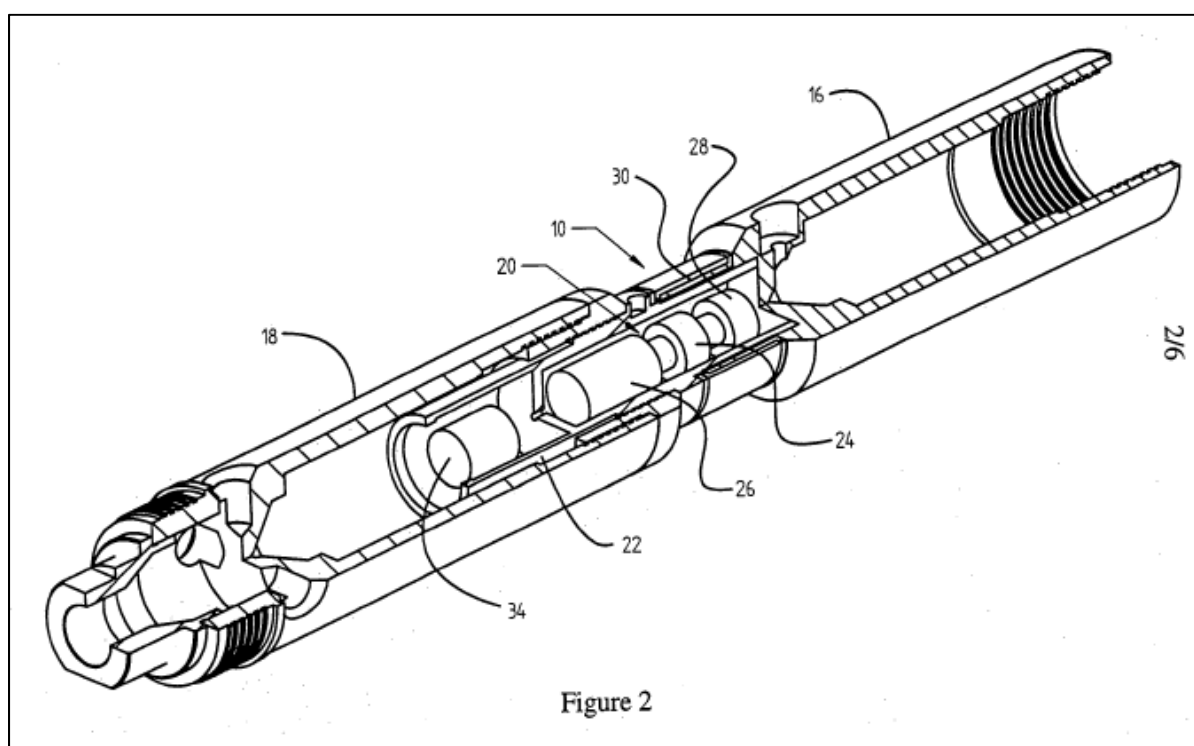
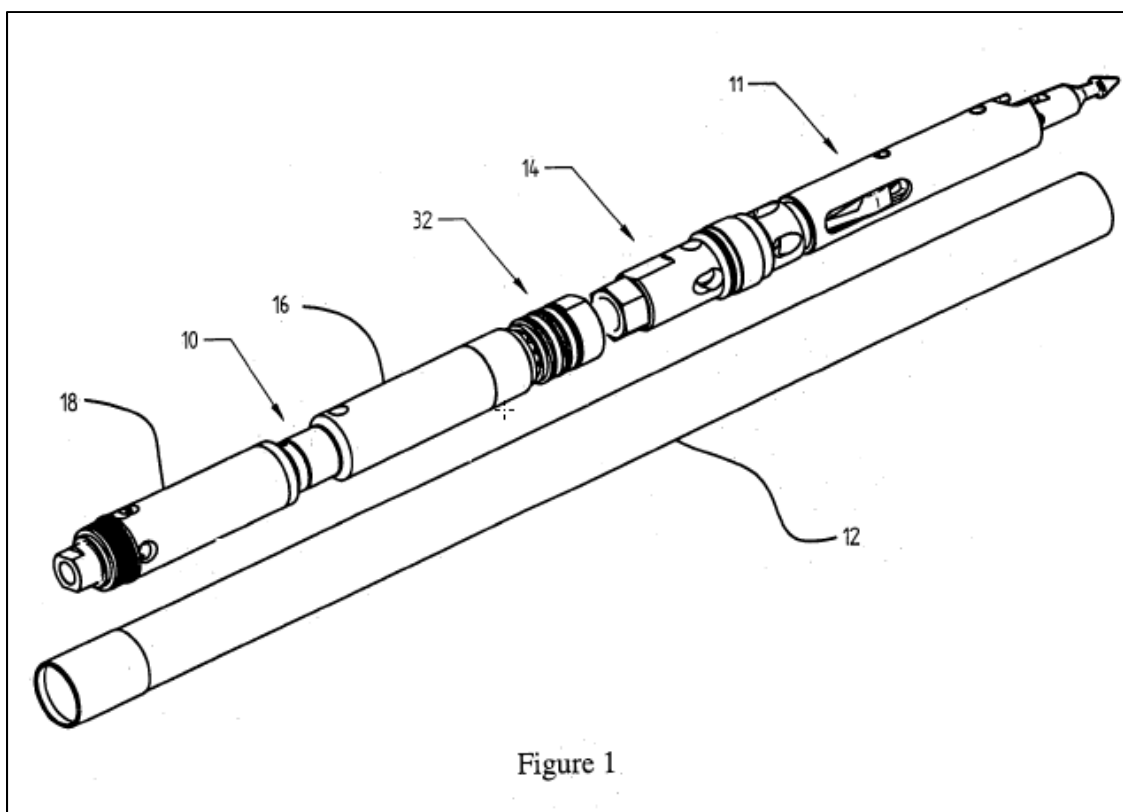
would remain the same, because as I describe further below, the prior art teaches “a selectively sealed interior cavity” limitation under either interpretation of the term “selectively sealed.”

VIII. OVERVIEW OF THE PRIOR ART REFERENCES

A. Beach-127 (Ex. 1003)

71. Beach-127, which is entitled “A Core Orientation Tool,” was published on September 25, 2008. I am informed that Beach-127 qualifies as prior art to the ’013 Patent.

72. Beach-127 discloses an embodiment of a core orientation tool, illustrated in Figure 2; as shown in Figure 1, this core orientation tool is coupled to an overall core barrel assembly. *See* Ex. 1003 (Beach-127), Figures 1-2. I have reproduced below Figures 1 and 2 of Beach-127, respectively:

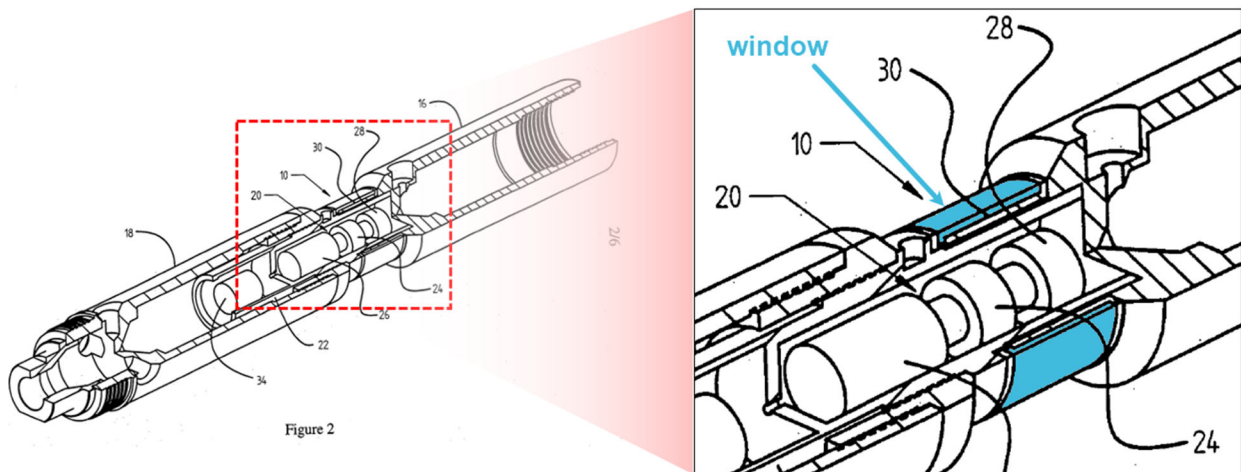


73. As shown in Figure 2, Beach-127's "core orientation tool 10" includes "an electronic core orientation device or system 20 housed within a body 22 that is coupled to and between the core tube cap 18 and the adaptor 16." *Id.*, 11:9-33. In turn, the opposite end of adaptor 16 is coupled to the "backend assembly 14." *Id.*, 11:18-22. Further, "[t]he system 20 comprises multiple sensors and transducers for sensing various events and orientation data of the tool 10 and core drill." *Id.*, 12:7-9. Specifically, Beach-127 explains that:

The electronic core orientation device 20 is configured to log one or more first indications of orientation of the tool (i.e., core orientation) upon receiving of a trigger signal. To this end, the tool 10 includes a trigger system 24 that provides the trigger signal upon detecting one or more downhole events associated with the operation of the core drill.

74. *Id.*, 11:33-12:2. Beach-127 discloses that "[t]he orientation system 20 may further comprise a transceiver 28 coupled to an antenna 30 to communicate with a hand-held computer or other like device." *Id.*, 12:24-27. Later in its disclosure, Beach-127 further discloses "a remote unit such as a hand-held computer that communicates between the tool 10 and the core position indicator," and explains that "the transceiver 28 in the tool 10 communicates via wireless communication with the hand-held computer." *Id.*, 17:29-36.

75. A POSITA would have understood Beach-127's disclosures of "an electronic core orientation device or system 20" that "is housed *within a body 22*," but that can still communicate wirelessly with a remote device by way of a transceiver, as indicating that the body 22 contains a window that is transmissive to the communication signal. *See* Ex. 1003 (Beach-127), 11:9-33 ("The tool 10 comprises an electronic core orientation device or system 20 housed within a body 22 that is coupled between the core tube cap 18 and the adaptor 16"), 17:29-36 (explaining that "the transceiver 28 in the tool 10 communicates via wireless communication with the hand-held computer," which is a type of "remote unit"). Consistent with these written disclosures, Figure 2 actually shows a window (which I have annotated below in blue). Specifically, the window is positioned directly above "antenna 30" and extends to the exterior surface of the core barrel head assembly:



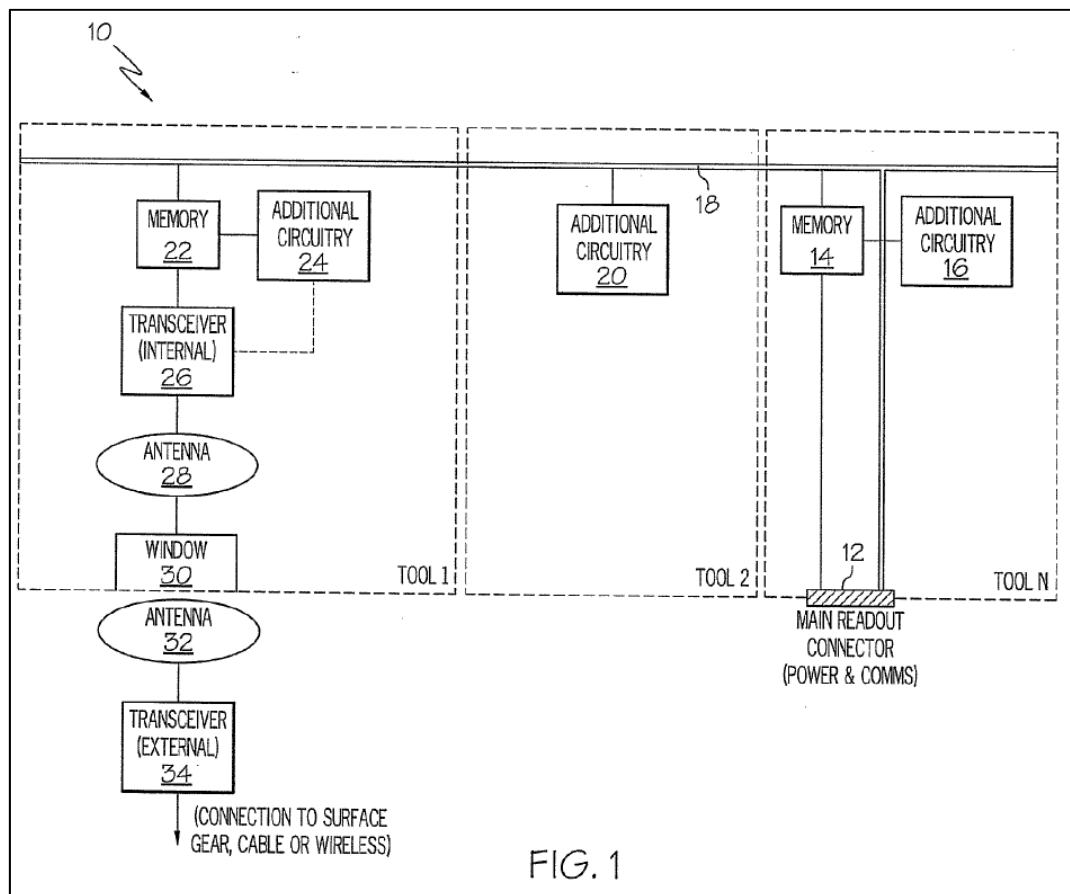
76. Ex. 1003 (Beach-127), Fig. 2 (annotated to indicate window for external communication).

B. Wiese (Ex. 1004)

77. U.S. Published Patent Application No. 2008/0001775 to Wiese (hereinafter “Wiese”) which is entitled “Apparatus and Method for Memory Dump and/or Communication for MWD/LWD Tools,” was published on January 3, 2008. I am informed that Wiese qualifies as prior art to the ’013 Patent.

78. Wiese describes known issues with transmitting data recorded by downhole drilling tools. Wiese refers to such tools as “measurement while drilling” and “logging while drilling,” or “MWD” and “LWD,” respectively. Ex. 1004 (Wiese), [0002]. As Wiese explains, the known issues for such tools include the time required to access and download data, as well as potential contamination and damage to tools that must be opened or disassembled to access the data. *See, e.g., id.*, [0003] (“One drawback associated with the use of MWD and LWD tools is the limited bandwidth for providing accumulated data to surface computers in need thereof. In some cases, where the tool is tripped to surface, the tool itself must be opened at one or more locations which is time consuming and potentially damaging to the tool in view of the fluids in which the tool is bathed during residence in the well.”), [0010] (“[I]t is not desirable to open a plurality of ports into the tool because of potential contamination and in addition simply the time it takes to clean the area of the tool surrounding the access opening and physically remove a cover.”).

79. Wiese notes that “[f]aster and more reliable methods for downloading information accumulated downhole . . . are always well received by the art.” *Id.*, [0004]. Wiese then discloses a solution through the use of “a window at the housing, the window being transmissive to the signal of at least one transceiver of a tool . . . such that the signal is receivable outside of the housing through the window.” *Id.*, [0005]. Figure 1 of Wiese, reproduced below, is a schematic illustrating the “window 30” of “tool 1,” as the mechanism for allowing data to transfer from the internal transceiver 26 and antenna 28 within the tool, to external antenna 32 and transceiver 34 outside of the tool 1 (*see id.*, Fig. 1, [0015]-[0016]):



80. Wiese further explains that “[w]hile lines are utilized to signify operable communication between schematic blocks of the figure, it is to be understood that each of the lines indicating connection on FIG. 1 may be wired or wireless connections utilizing electric signal, ***optical signal***, hydraulic signal, acoustic signal, etc. as appropriate in the specific application.” *Id.*, [0014] (emphasis added). Wiese also explains that the “window is pressure sealed to the housing, and transmissive to the selected signal type.” *Id.*, [0015].

81. Wiese further conveys the broad applicability of its Figure 1 schematic, by explaining (*id.*):

The term antenna is broadly used herein to include not only electromagnetic signal propagation but also to mean a device capable of transmitting and receiving the signal contemplated. For example[, w]here infrared (IR) is the signal type, a light emitting diode (LED) would be the “antenna” to transmit the IR signal. Further, while the antenna is illustrated as a separate component from that of the transceiver, it is to be understood that the antenna may form a part of the transceiver in some embodiments.

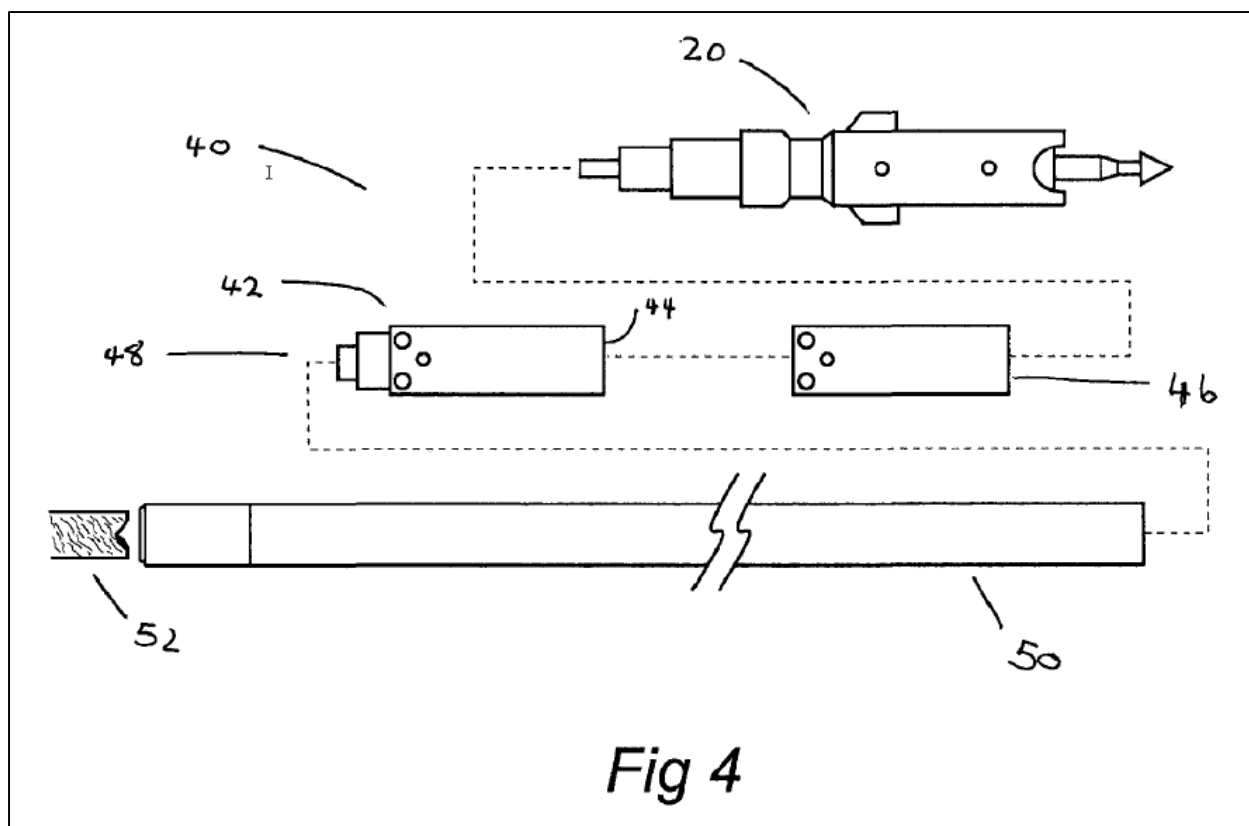
82. Thus, Wiese teaches and suggests that adopting its proposed configuration, which features an optically-transmissive window, addressed the shortcomings found in conventional downhole assemblies that required being opened at the ground surface—and were thus time-consuming and expose the electronics to

potential damage and/or contamination. *Id.*, [0003], [0010]. Instead, Wiese teaches and suggests that its configuration provided a “[f]aster and more reliable method[] for downloading information accumulated downhole...” *Id.*, [0004]; *see also id.* at [0017] (explaining that the proposed design “provides for a faster data dump to the surface computer(s)”).

C. Klass-839 (Ex. 1005)

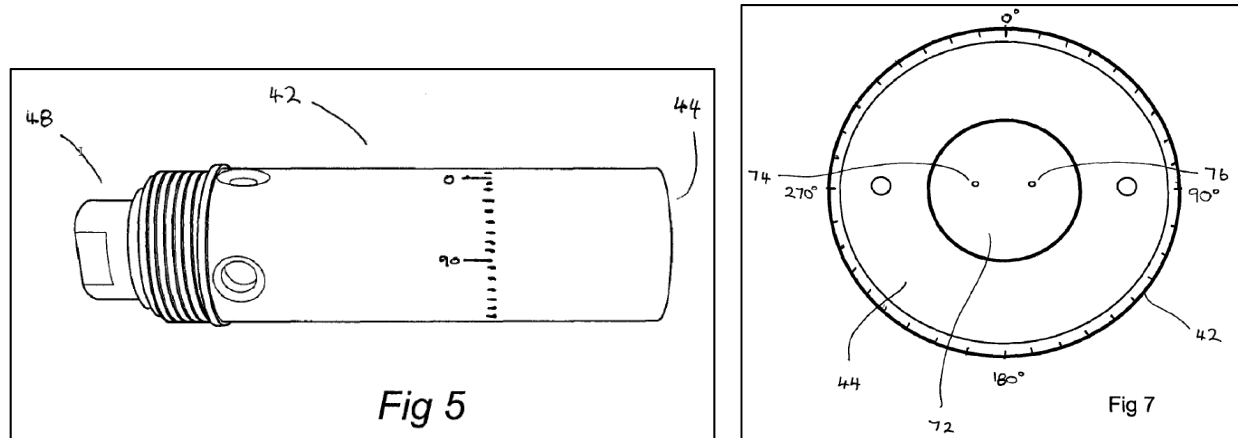
83. Published International Patent Application No. WO 2012/012839 to Klass et al. (hereinafter “Klass-839”), is entitled “Core Sample Orientation System, Device, and Method,” and was published on February 2, 2012. I understand that Klass-839 qualifies as prior art to the ’013 Patent.

84. Like the Beach-127 reference discussed above, Klass-839 discloses a downhole “core sample orientation system” assembly that is “configured to provide an indication of the orientation of a core sample relative to a body of material from which the core has been recovered.” Ex. 1005 (Klass-839), Abstract. Klass-839’s disclosed assembly includes a “hermetically sealed core sample orientation data gathering device” which, in turn, “includes a communication means arranged to communicate obtained core sample data” to a remote device. *Id.*, 3. Fig. 4, which I have reproduced below, shows the overall assembly of Klass-839, labeled 40, which includes the core sample data gathering device, labeled 42, that attaches to a greaser unit, labeled 46 (*id.*, Fig. 4):



85. Klass-839 explains that its assembly permits external communication in multiple ways. First, Klass-839 specifies that the “[c]ommunication between the orientation data gathering device and the remote orientation data electronic communication device is by wireless communication, such as infra red communication.” *Id.*, 5. In connection with this communication, Klass-839 explains that “[t]he core sample data gathering device 42 includes a transmitter which can use line of sight data transfer through [a] window, such as by infra red data transfer . . .” *Id.*, 10.

86. Second, Klass-839 further discloses that “[t]he orientation data gathering device may have one or more visual indicators to show an operator one or more required directions of rotation of a recovered core sample assembly for determining orientation of the core sample,” and that “once a required orientation has been established, the remote device “may interrogate the orientation data gathering device.” *Id.*, 4. Klass-839 discloses such an embodiment with respect to Figures 5 and 7, which I have reproduced below (*id.*, Figs. 5, 7).



87. In reference to Figures 5 and 7, Klass-839 goes on to explain:

The end 44 for connecting to the greaser unit 46 includes a window (not shown in figure 5 - see figure 7). One or more LED lights [74 and 76] are provided sealed within the device 42 behind the window. A coloured light indication is given to indicate which way (clockwise or anti-clockwise) the device 42 must be rotated to obtain a desired orientation of the core sample still within the inner tube assembly that is connected to the core sample orientation data gathering device 42. For

example, a red light may be given to indicate to rotate the device (and thus the core sample) anticlockwise or to the left, and a green light may be given to indicate to rotate the device clockwise or to the right. A combined red and green indication, or a white light indication, or other indication can be given, such as flashing lights, to indicate that the core sample is correctly orientated and ready for marking.

88. *Id.* at 9-10. As to Figure 7, Klass-839 further explains:

As shown in figure 7, the indicator window end 44 of the core sample orientation data gathering device 42 includes a window 72. The indicator lights can be seen through this window at least when illuminated. In this embodiment, two lights, red and green LEDs are shown. The left hand 74 (red) LED illuminates to indicate to a user to rotate the device 42 anti-clockwise. The right hand 76 (green) LED illuminates to indicate to a user to rotate the device 42 anti-clockwise. When correct core sample orientation is achieved, both LEDs might illuminate, such as steady or flashing red and green, or another illuminated indication might be given, such as a white light (steady or flashing).”referring to LEDs 74 (red) and 76 (green), as shown in Figure 7.

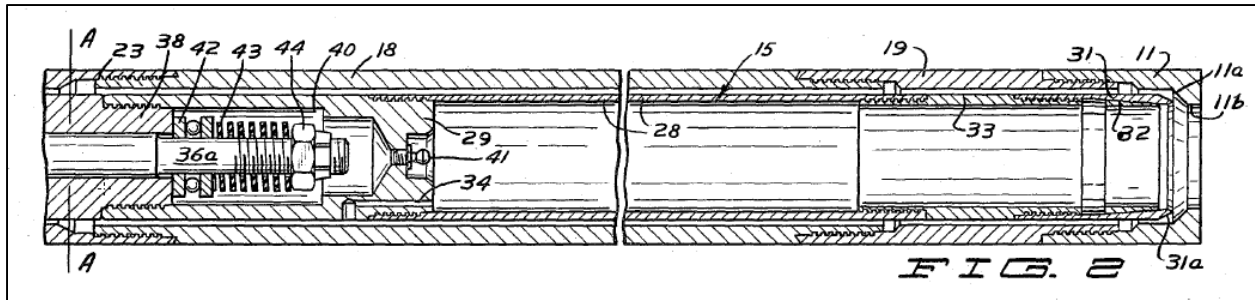
89. *Id.* at 11. Klass-839 explains that this technique of providing visual indications regarding the orientation of the sample externally from the assembly “provide[s] the advantage of a fully operating downhole tool/device without having to disconnect or disassemble any part of the tool/device from the inner tube and/or

from the backend assembly,” while still being able “to determine core sample orientation and/or to gather data recorded by the device/tool.” *Id.*, 14. As a result, this “means that there is less risk of equipment failure and drilling downtime, as well as reduced equipment handling time through not having to separate the sections in order to otherwise obtain core sample orientation.” *Id.* Accordingly, Klass-839 teaches that, by using its disclosed assembly configuration, “reliability and efficiency of core sample collection and orientating is improved.” *Id.*

D. Pickard (Ex. 1006)

90. U.S. Patent. No. 3,305,033 to Pickard et al. (Ex. 1006, hereinafter “Pickard”), which is entitled “Core Barrel,” issued on February 21, 1967. I understand that Pickard qualifies as prior art to the ’013 Patent.

91. Similar to Beach-127 and Klass-839, Pickard is directed to a core barrel assembly for exploratory mining and drilling applications. Ex. 1006 (Pickard), 1:10-70. Pickard’s proposed core barrel design features a threadable “grease fitting 41” mounted into a port that feeds into an elongated bore 40 (at the end of cap 29), to allow selective passage of grease into the bore. This design is reflected in Figure 2, reproduced below (*id.*, Fig. 2).



IX. SPECIFIC GROUNDS OF CHALLENGE

92. In my opinion, the subject matter of Claims 1-4, 14-15, 19-22, and 24-25 of the '013 Patent is disclosed and taught in the prior art, as explained below.

A. Ground I: Obviousness of Claims 1, 3-4, 19-22, and 24-25 Over Beach-127 in View of Wiese

1. Claim 1

a) **Limitation 1[pre]: “A core barrel head assembly having an exterior surface and comprising:”**

93. Beach-127 discloses “a core barrel head assembly having an exterior surface.” Specifically, Beach-127 discloses a “core orientation tool” that is coupled to “an inner barrel assembly and core tube.” Ex. 1003 (Beach-127), 9:27-29. In Figure 1, “[t]he core orientation tool is shown in association with an inner barrel assembly 11 which comprises a core tube 12 for receiving a core being cut by a core drill, and a backend assembly 14 that is attached to the core tube 12 for lowering and retrieving the core tube 12 from the core drill. *Id.*, 11:9-16, Fig. 1. Further, the “tool 10 is coupled at one end to a conventional core tube cap 18” and coupled at the

opposite end to an “an adaptor 16.” *Id.*, 11:16-22. In turn, the adaptor is coupled to “backend assembly 14.” *Id.* As seen in Figure 1, which I have annotated below, the assembly spanning from the core tube cap 18 to the inner assembly 14, is “core barrel head assembly,” where the term ‘head’ connotes the fact that this is the upper portion of the larger assembly that would include the core sample (*see e.g.*, Ex. 1017 (2013 CMECO Catalog) at 180-219).

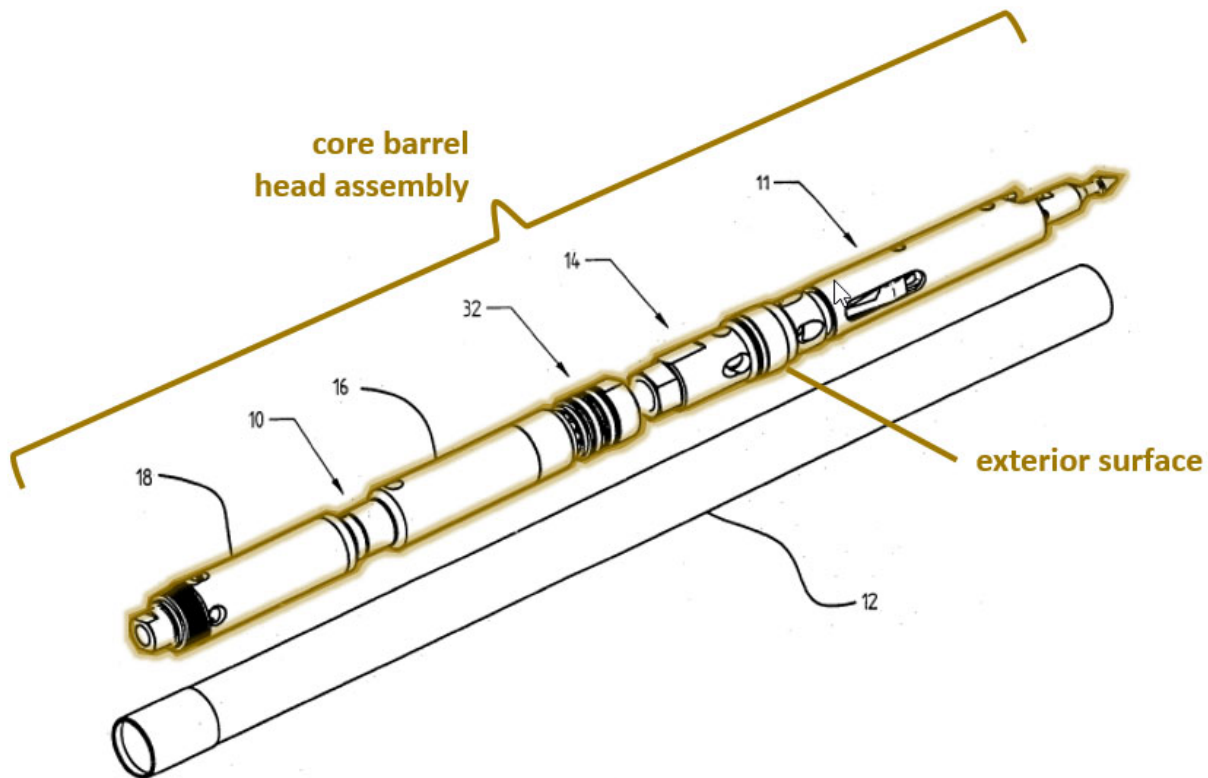


Figure 1

94. I have further annotated in Figure 1 the “exterior surface” of the core barrel head assembly. In Figure 2, which I have annotated below, a cutaway portion

of the above core barrel head assembly is shown in further detail. *Id.*, Fig. 2 (annotated).

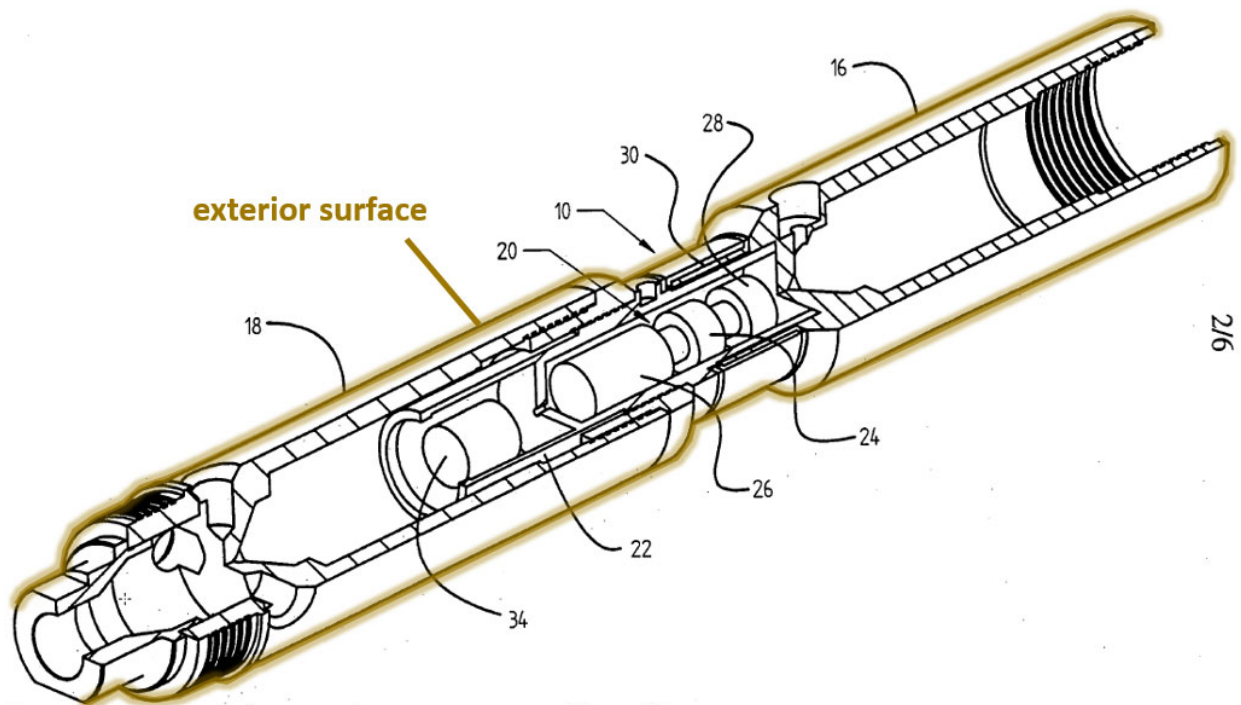


Figure 2

95. The cutaway portion in Figure 2 spans from the core tube cap 18 (on the left) to the adaptor 16 (on the right). As seen, the core orientation tool 10 “comprises an electronic core orientation device or system 20 housed within a body 22 that is coupled to and between the core tube cap and the adaptor 16.” *Id.* at 11:30-33. Accordingly, Beach-127 discloses the preamble of Claim 1.

96. Further, I have seen that during prosecution of related patents—specifically, the ’463 and ’529 Patents—the Patent Office repeatedly found that Beach-127 “discloses a core barrel head assembly having an exterior surface.” Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4); Ex. 1011

(’463 File History) at 54-55 (March 14, 2019 Office Action at 3-4). I have further seen that, when confronted with such arguments, the Patent Owner did not dispute that Beach-127 discloses this limitation. Ex. 1013 (’529 File History) at 77 (April 27, 2022 Response at 12); Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8) ; *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 1 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

b) Limitation 1[a]: “a first interior cavity;”

97. Beach-127 discloses “a first interior cavity.” Specifically, as I discussed above for Limitation 1[pre], and as reflected in Figures 1 and 2, Beach-127’s core barrel head assembly includes an adaptor 16. Beach-127 explains that “the adaptor 16 [is] used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14.” Ex. 1003 (Beach-127), 11:20-22, Figs 1-2. More particularly, the adaptor couples to backend assembly 14 by way of a bearing 32. *See id.*, 15:5-9.

98. As reflected in my below annotation of the Figure 2 (showing the cutaway view of Beach-127’s assembly), the adaptor 16 defines an interior cavity (colored green):

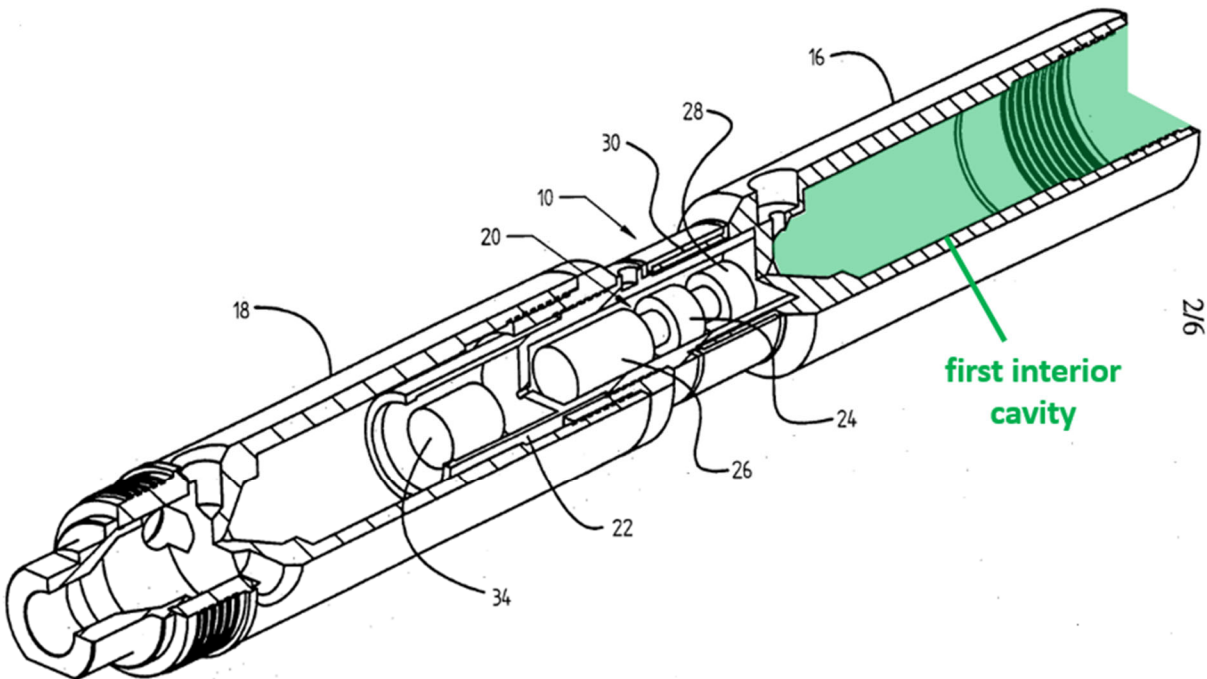


Figure 2

99. *Id.*, Fig. 2 (annotated). Accordingly, Beach-127 discloses this claim limitation.

100. Further, I have seen that during prosecution of related patents—specifically, the '463 and '529 Patents—the Patent Office repeatedly found that Beach-127 discloses “a first interior cavity (**16**).” *See* Ex. 1011 ('463 File History) at 54-55 (March 14, 2019 Office Action at 3-4) (emphasis in original); Ex. 1013 ('529 File History) at 192 (October 27, 2021 Office Action at 4) (emphasis in original). I have further seen that, when confronted with such arguments, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 ('463 File History) at 36 (June 12, 2019 Response at 8); Ex. 1013 ('529 File History) at 77 (April 27, 2022 Response at 12); *see also* Ex. 1014 (Relevant Prosecution History Regarding

Beach-127), 1 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

c) Limitation 1[b]: “a selectively sealed interior cavity spaced distally from the first interior cavity and having a closed proximal end;”

101. Beach-127 discloses “a selectively sealed interior cavity spaced distally from the first interior cavity and having a closed proximal end.” Specifically, as I discussed above for Limitations 1[pre] and 1[a], and as shown in Figures 1 and 2, the core barrel head assembly of Beach-127 includes a core tube cap 18, which is coupled to the core orientation tool 10 at one end. *See* Ex. 1003 (Beach-127), 11:18-22, Figs. 1-2.

102. Further, as reflected in the cutaway view of Figure 2 (which I have annotated again below), the core tube cap 18 and body 22 collectively form a “sealed interior cavity” (colored red):

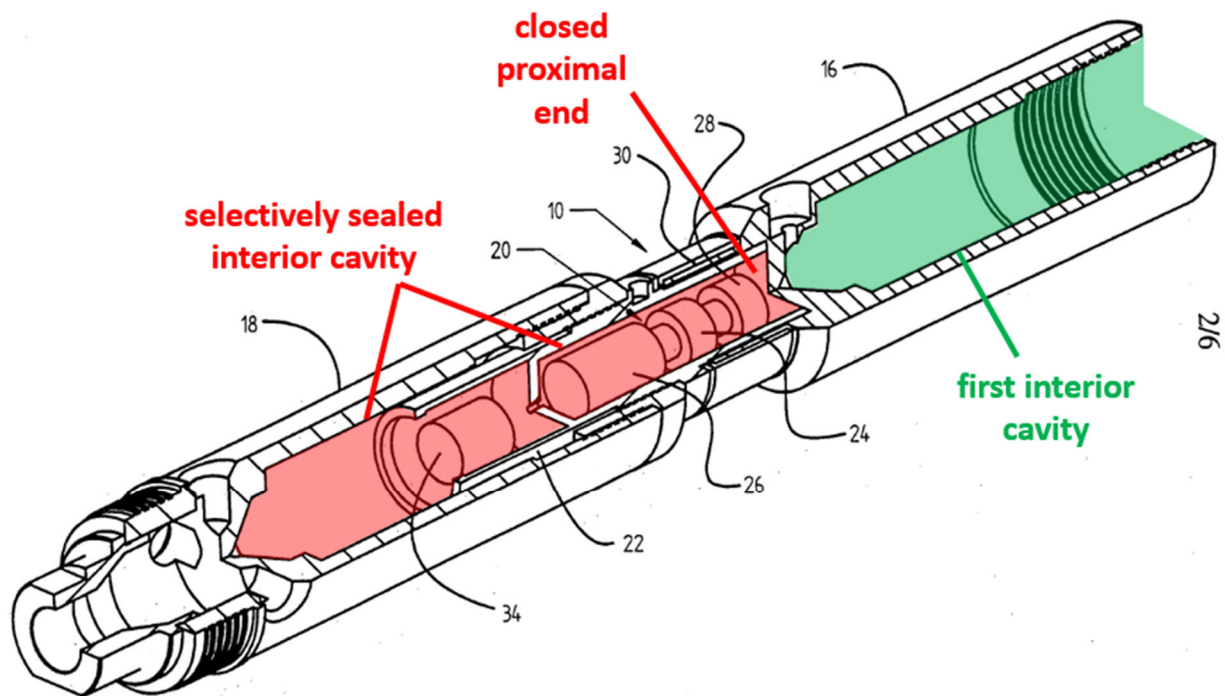


Figure 2

103. *Id.*, Fig. 2 (annotated). Figure 2 indicates the metes and bounds of this “sealed interior cavity”: specifically, it spans from the closed, interior end of the core tube cap 18 on the left hand side, extends past the open, opposite end of cap 18 and into the tool 10, and terminates at the right-hand side at a closed end where the tool 10 is coupled to the adaptor 16—*i.e.*, at the “opposite end” of the tool relative to where the core tube cap is coupled. *See id.*, 9:27-33, Fig. 2. Further, using the “inner barrel assembly” (also referred to as the “head assembly”) as the point of reference

within Beach-127's assembly, this end is "proximal end."³ *See id.*, Fig. 1. As such, sealed interior cavity has a "closed proximal end." Further, as disclosed in Figure 2, since this proximal end of tool 10 is "coupled" to the adaptor 16, *id.*, 11:18-22, the selectively sealed interior cavity is also "spaced distally from the first interior cavity" (colored green in the above annotation).

104. Further, the "sealed interior cavity" (colored red in the above annotation) is formed in part by core tube "cap" which, as shown in Figure 2, is threadably coupled to the other side of the tool 10. A POSITA would have understood that, in the context of downhole tools, such a "cap" has the capability of being sealed or unsealed. For example, Published International Patent Application No. WO 2007/109848 to Beach et al. (Ex. 1009, hereinafter "Beach-848"), which I see is incorporated by reference in Beach-127 for its disclosure of core orientation systems (*see* Ex. 1003 (Beach-127) at 1:21-31), describes a "cap 74" as being

³ For context, I have seen that the '013 Patent specification uses the terms "proximal" and "distal" inconsistently. As discussed in § VII.E above, during prosecution of the '529 Patent (which I understand is the child patent to the '013 Patent), the Patent Owner amended the specification "to ensure that the terms 'proximal' and 'distal' are used consistently. . . (in the manner reflected in the original drawings and claims)." Ex. 1013 ('529 File History) at 76, 59-62 (April 27, 2022 Response). I have considered these amendments in rendering my analysis. Based on those amendments, I see that the specification consistently uses the term "proximal end" with the head assembly as the point of reference, such that the "distal end" is nearer to the drill bit end of the drill string. *See, e.g.*, Ex. 1012 ('529 Patent), 6:46-48 ("The core barrel head assembly 30 has a distal end 32 that is operatively oriented toward the drill bit end of the drill string and an opposed proximal end 34); Figs. 1, 5.

“demountably connectable” to other components. *See* Ex. 1009 (Beach-848) at Abstract. This is consistent with how “caps” are described in other prior art references in the relevant field. *See* Published International Patent Appl. No. WO 2010/091471 to Jacobs et al. (Ex. 1018, hereinafter, “Jacobs”) at 10:14-19 (describing upper cap part 22 as being “selectively separable” from lower body part 21, but that, when secured together, the components have a “fluid-tight sealing engagement”). Accordingly, a POSITA would have appreciated that, in Beach-127’s assembly, the red-colored cavity in my Figure 2 annotation above is indeed a “*selectively* sealed interior cavity,” even if the proper (narrower) interpretation of that term were applied. *See* §§VII.F.2, *supra*.⁴ Accordingly, Beach-127 discloses this claim limitation.

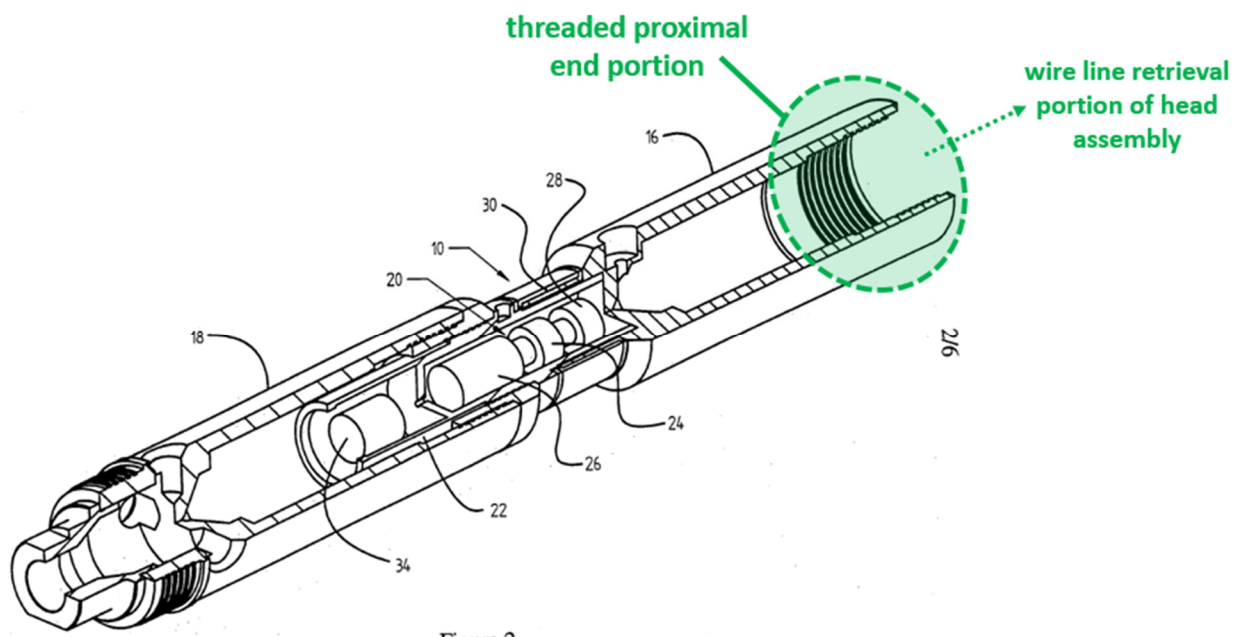
105. Further, I have seen that during prosecution of a related patent—specifically, the ’463 Patent—the Patent Office found that Beach-127 discloses “a selectively interior cavity (**18**) spaced distally from the first interior cavity.” *See* Ex. 1011 (’463 File History) at 54-55 (March 14, 2019 Office Action at 3-4) (emphasis in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 (’463

⁴ On the other hand, if “selectively sealed interior cavity” were construed broadly—in other words, so as to not require the added capability of being unsealed—Beach-127 would still meet this limitation for all of the reasons I have shown and described above.

File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 1-2 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

d) Limitation 1[c]: “a threaded proximal end portion for coupling to a wire line retrieval portion of a head assembly;”

106. Beach-127 discloses “a threaded proximal end portion for coupling to a wire line retrieval portion of a head assembly.” Specifically, Beach-127 discloses that “the adaptor 16 [is] used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14.” Ex. 1003 (Beach-127), 11:18-22. To achieve that coupling function, the adaptor has a “threaded end portion,” as I have indicated in the following annotation of Figure 2:



107. *Id.*, Fig. 2 (annotated). I have seen that Beach-127 incorporates by reference Beach-848, Ex. 1009, for its corresponding disclosure of a core orientation system. Ex. 1003 (Beach-127), 1:21-31. Consistent with Figure 2 of Beach-127, Beach-848 explains at length how “helical threads” are used as “coupling mechanisms” in core barrel head assemblies. *See, e.g.*, Ex. 1009 (Beach-848), 6:31-33 (“A first coupling mechanism in the form of a helical thread 52 is formed in the outer circumferential surface 50 near the first end 30.”); 8:5-24 (“In order to couple the cap 74 to end 30 of the body 28 the thread sections 94 pass through respective channels 100 (see Figure 6) formed in the outer circumferential surface 50 at the end 30 of the body 28.”); 10:36-11:4 (“The cap 74 is engaged with the body 28 by engaging the thread sections 94 with the partial thread 52 at the first end 30 of the body 28. Due to the helical nature of the thread 52, when the cap 74 is screwed onto the first end 30 of the body 28 the seat 92 can be brought into tight and sealing contact with the face 32.”).

108. In addition, as I discussed for Limitation 1[b] above, the threaded end portion of Figure 2 is “proximal” according to the convention used in the intrinsic record of the ’013 Patent (in other words, “proximal” with respect to the head assembly). *See* n.3 above; Ex. 1012 (’529 Patent), 6:46-48. Accordingly, this threaded end portion is a “threaded *proximal* end portion.”

109. Lastly, the threaded proximal end portion of the adaptor 16 is “for coupling to wireline retrieval portion of a head assembly,” as that term would be understood from the ’013 Patent specification as well as the understanding of a POSITA. *See* Ex. 1001 (’013 Patent), 5:63-67 (“In one aspect, the core barrel head assembly 30 is integrated into the drill string 10 to form a portion of the drill string, such as shown in FIG. 1, where the 65 core barrel head assembly is operably coupled to a conventional head assembly 20.”); 6:45-48, (“As shown in FIGS. 1 and 5-6, the core barrel head assembly 30 has an elongate tube body 60 that is conventionally joined to a *conventional wire line retrieval portion* of a head assembly 10.”) (emphasis added); Figs. 1, 5-6. More particularly, in Beach-127, the “wireline retrieval portion of a head assembly”—which is the same “head assembly” I identified for Limitation 1[pre]—includes the “backend assembly 14” along with its “bearing 32,” as well as the “inner barrel assembly 11,” as I have indicated (colored brown) in the following annotation of Figure 1:

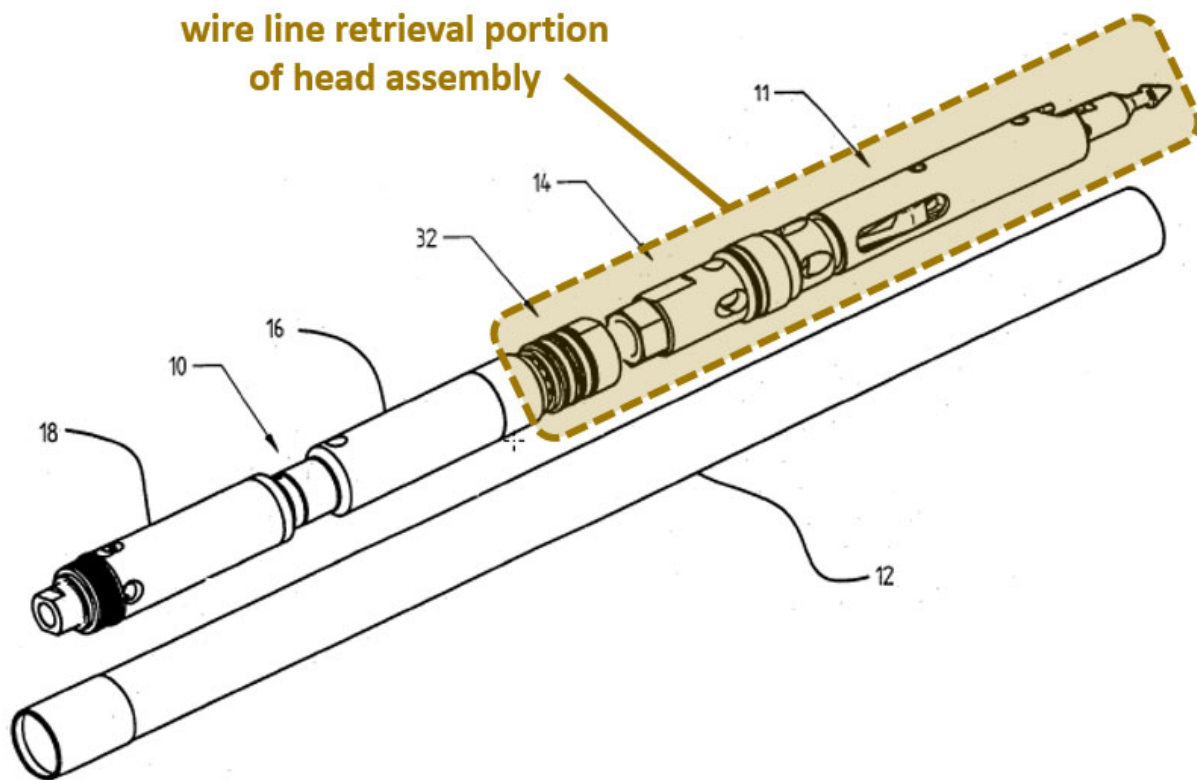


Figure 1

110. Ex. 1003 (Beach-127), Fig. 1 (annotated). Beach-127’s written disclosure further supports this understanding. *See id.*, 11:11-22 (“The tool 10 is coupled at one end to the conventional core tube cap 18 of the backend assembly 14 with the adaptor 16 being used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14.”), 15:5-9 (referring to the “backend assembly 14” and the “bearing 32 of the backend assembly.”). Accordingly, Beach-127 discloses this claim limitation.

111. Further, I have seen that during prosecution of related patents—specifically, the ’463 and ’529 Patents—the Patent Office repeatedly found that Beach-127 discloses “a threaded proximal end for coupling to a wireline retrieval

portion of a head assembly.” *See* Ex. 1011 (’463 File History) at 54-55 (March 14, 2019 Office Action at 3-4); Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4). I have further seen that, when confronted with such arguments, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); Ex. 1013 (’529 File History) at 77 (April 27, 2022 Response at 12); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 2 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

e) Limitation 1[d]: “a base portion, wherein the first interior cavity extends distally from the threaded proximal end portion to the base portion;”

112. Beach-127 discloses “a base portion, wherein the first interior cavity extends distally from the threaded proximal end portion to the base portion.” Specifically, in the Beach-127 assembly, the adaptor 16 includes a “base portion,” as I have indicated in the following annotation of Figure 2:

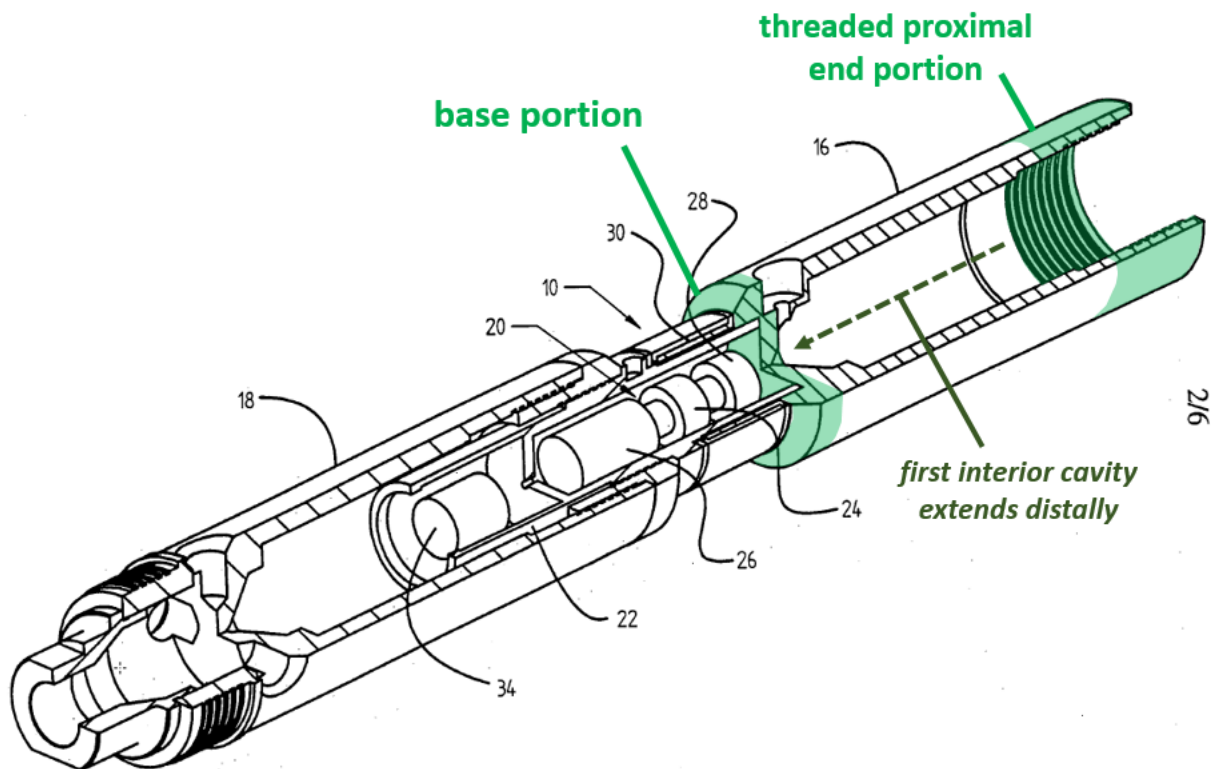


Figure 2

113. *Id.*, Fig. 2 (annotated). As shown in Figure 2, the “base portion” is situated at the opposite end of the adaptor 16 relative to the “threaded proximal end portion” that I discussed above for Limitation 1[c]. *See* § IX.A.1(d), *supra*. Further, this opposite end of the adaptor 16 is its “distal” end, according to the convention of the intrinsic record of the ’013 Patent (in other words, “distal” with respect to the head assembly). *See* n.3 above; Ex. 1012 (’529 Patent), 6:46-48. Accordingly, the “first interior cavity”—which, as I discussed for above for Limitation 1[a], is defined by the adaptor 16 (*see* § IX.A.1(b), *supra*), “extends distally from the threaded proximal end portion to the base portion,” as required. Accordingly, Beach-127 discloses this claim limitation.

114. Further, I have seen that during prosecution of a related patent—specifically, the '463 Patent—the Patent Office found that Beach-127 discloses that “the first interior cavity extends distally from the threaded proximal end to a base portion (**illustrated in Fig. 2[]**).” *See* Ex. 1011 ('463 File History) at 54-55 (March 14, 2019 Office Action at 3-4) (emphasis in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 ('463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127) at 2 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

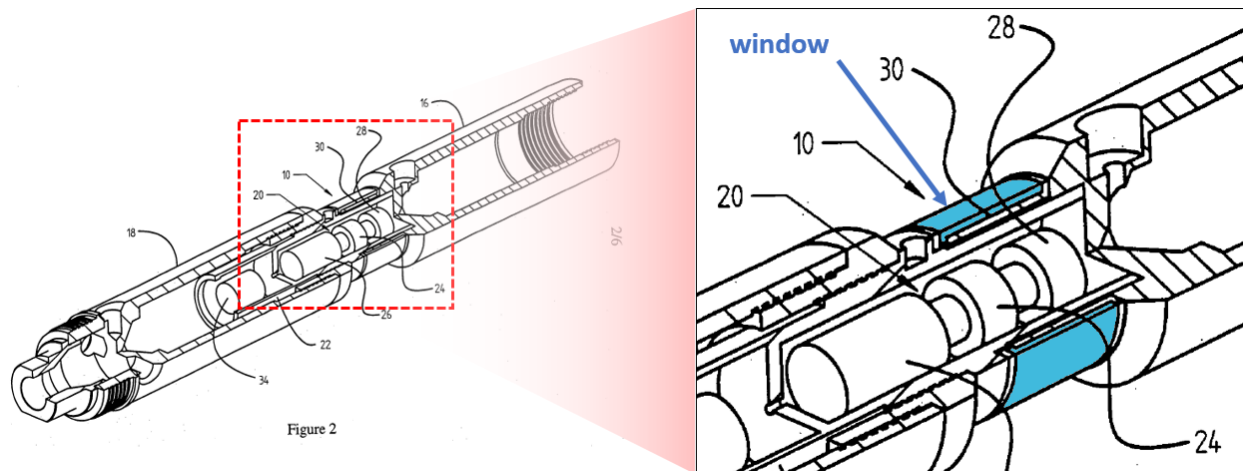
f) Limitation 1[e]: “a window that extends from the exterior surface into optical communication with the sealed interior cavity proximate the closed proximal end of the sealed interior cavity;”

115. Beach-127 discloses “a window that extends from the exterior surface into optical communication with the sealed interior cavity proximate the closed proximal end of the sealed interior cavity,” or else a POSITA would have been motivated to implement this feature based on Beach-127 alone or in view of Wiese.

116. First, as I discussed for Limitation 1[b] above, Beach-127’s sealed interior cavity is defined, in part, by “a body 22.” *See* §IX.A.1(c), *supra*. Specifically, Beach-127 discloses that “[t]he tool 10 comprises an electronic core

orientation device or system 20 *housed within a body 22* that is coupled to and between the core tube cap 18 and the adaptor 16.” Ex. 1003 (Beach-127) at 11:30-33. In addition, Beach-127 states that “[t]he orientation system 20 may further comprise a transceiver 28 coupled to an antenna 30 to communicate with a hand-held computer or other like device.” *Id.*, 12:24-28; *see also id.*, 17:29-31 (describing the “hand-held computer” as one example of “a remote unit”). Further, Beach-127 explains that “the transceiver 28 in the tool 10 communicates via wireless communication with the hand-held computer.” *Id.*, 17:33-36.

117. In view of these collective teachings of Beach-127, coupled with the cutaway view depiction of the assembly seen in Figure 2, a POSITA would have appreciated that the Figure 2 assembly includes a “window.” Further, this window is next to, or “proximate” to, “the closed proximal end of the sealed interior cavity” that I identified above for Limitation 1[b]. *See* §IX.A.1(c). In the following annotation of Figure 2, I have indicated (in blue color) this “window,” which is consistent with this claim limitation:



118. Ex. 1003 (Beach-127), Fig. 2 (annotated). As shown in Figure 2, Beach-127’s “window” is depicted as “extending from the exterior surface” of the core barrel head assembly that I identified for Limitation 1[pre] above—specifically, from the outer surface of the body 22 of Beach-127. For this reason, a POSITA would have additionally recognized that, as shown in Figure 2, Beach-127 discloses a “window” even under the proper (narrower) construction that requires a solid material that is transmissive to a communication signal, as I described earlier. *See* § VI.F.1, *supra*.

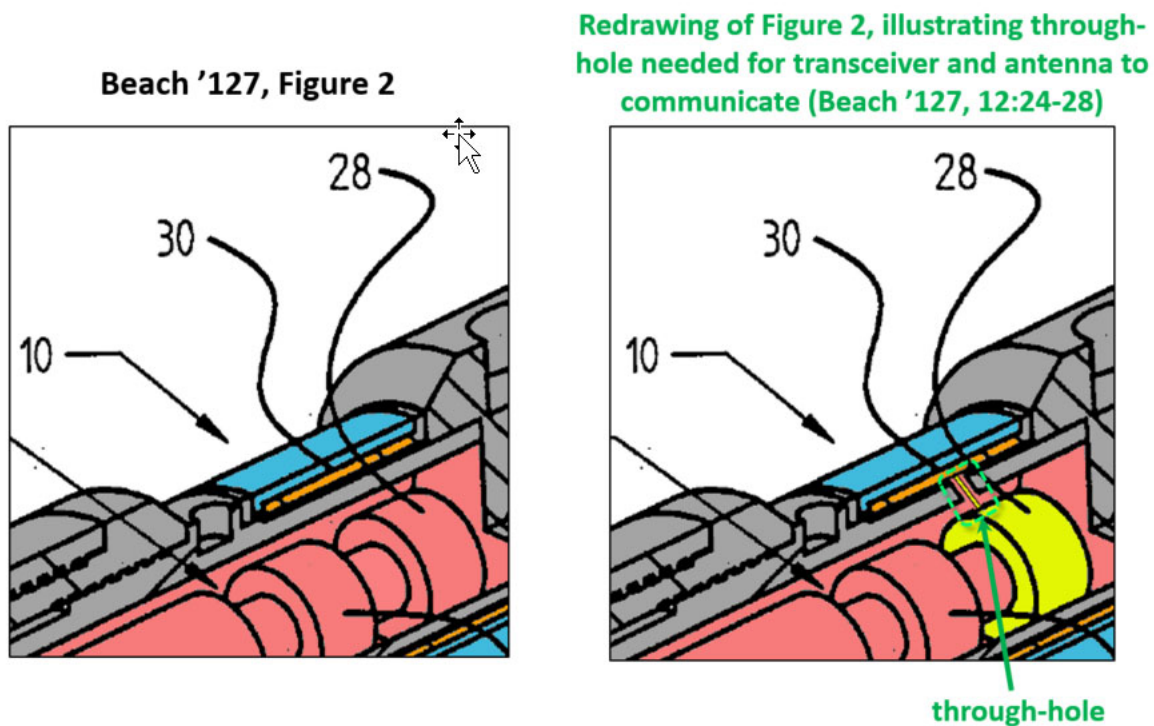
119. In addition, the Beach-127’s window is positioned such that it overlies the “antenna 30” of electronic system or device 20. Importantly, Beach-127 teaches that the antenna 30 is communicatively coupled to the transceiver 28, which resides within the sealed interior cavity that I identified earlier. *See* Ex. 1003 (Beach-127), 12:24-28 (“The orientation system 20 may further comprise a transceiver 28 *coupled to* an antenna 30 *to communicate* with a hand-held computer or other like device.”)

(emphases added). In light of these disclosures, a POSITA would have appreciated that the window of serves an important purpose in the Beach-127 core barrel head assembly: it facilitates the transmission of data gathered by the electronic system 20 (*i.e.*, from within the assembly), to the remote unit such as hand-held computer (*i.e.*, to communicate externally, outside of the assembly).

120. A POSITA would have further recognized that Beach-127's teaching that the transceiver 28 is "coupled to an antenna 30 *to communicate* with a hand-held computer or other like device" (*id.*, 12:24-28) implies that a through-hole must be present in the body 22 in the region under the antenna 30, in order to permit access for some reliable communication between the transceiver and antenna. With such a through-hole, a POSITA would have understood that the communication link could take the form of a wire (such as copper), a fiber optic cable, or various forms of wireless communication (such as RF or optical signals).

121. A POSITA would have understood the through-hole for communication to be present even though it is not explicitly shown in Figure 2. Furthermore, Figure 2 is intended to show only a "cutaway view" of the Beach-127 assembly (see *id.* at 9:31-33 ("Figure 2 is a cutaway view . . ."))—that is, it is intended to show the assembly from one specific viewpoint, at which a 90-degree segment of the volume of the assembly has been cut away. Accordingly, a POSITA would have understood that another cutaway view of the same assembly—for example, from the opposite

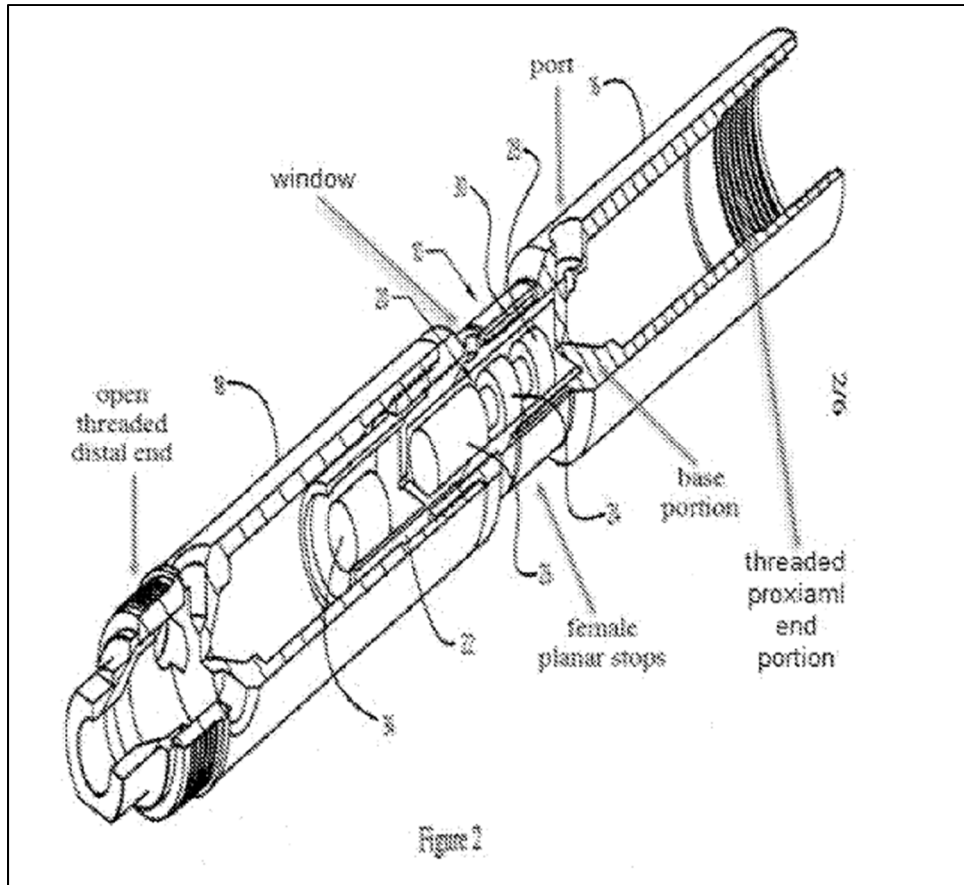
viewpoint as the one shown in Figure 2—could show the through-hole necessary to facilitate the communication between the transceiver and antenna, consistent with the teachings of Beach-127. For the purpose of illustration, however, I have redrawn Beach-127 Figure 2 with a minor modification, to indicate how the through-hole (which is necessarily present in Beach-127’s assembly) would appear if it were positioned at the cutaway view of Figure 2:



122. For simplicity, my redrawing of Figure 2 (above, right) shows the communication link between the transceiver and antenna as a simple wire, but as I discussed above, a POSITA would have appreciated the communication link could take various forms. In any event, the “sealed interior cavity” identified for Limitation 1[b] above, §IX.A.1.(c), actually extends to and incorporates both components.

Further, because the antenna is positioned directly below the window, a POSITA would have understood that the “window” in Beach-127 Figure 2 extends from the exterior surface of the assembly *into communication with the sealed interior cavity*.

123. Further, I have seen that during prosecution of a related patent—specifically, the ’529 Patent—the Patent Office found that Beach-127 discloses “a window (**illustrated in Fig. 2[]**) that extends from the exterior surface into optical communication with the sealed interior cavity.” *See* Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4) (emphasis in original). Further, Examiner’s Figure 2 annotation located the “window” as being proximate the “closed proximal end” of the “sealed interior cavity,” which is “adjacent [the] base portion.”



Examiner's Annotation of Beach-127,
Ex. 1013 ('529 File History) at 192 (October 27, 2021 Office Action at 4)

124. I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses the “window” limitation. *See* Ex. 1013 ('529 File History) at 77 (April 27, 2022 Response at 12); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 2-3 (summarizing the same). The Patent Office's assessment that Beach-127 meets this limitation, and the Patent Owner's concession, is consistent with my own analysis of Beach-127.

- (1) Obviousness Based on Beach-127, particularly in view of Wiese

125. To the extent that Beach-127 were interpreted as not necessarily disclosing “a window that extends from the exterior surface into “optical” communication with the sealed interior cavity,” including that feature would have nevertheless been within the skill of a POSITA at the time of the alleged invention of the ’013 Patent, as I explain below.

126. As a preliminary matter, a POSITA would have appreciated that optical communication techniques—for example, infrared (IR) or visible light—were, at the time of the ’013 Patent priority date, common and straightforward methods for transferring data from downhole equipment to surface equipment. Optical wireless communication uses optical wavelengths over a wide spectral range from a few hundred nanometers to a few micrometers. Optical communication by narrow light beams have a number of advantages over other EM signals. For example, they are easily directable, more energy-efficient as compared to radio waves, have lower levels of latency (in other words, the delay between a command issuance to initiate data transfer and the actual initiation of the data transfer), and provide significantly larger capacity. *See* Ex. 1020 (SPIE, Free-space optical transmission improves land-mobile communications, Henniger et al. (2007)) at 1; Ex. 1021 (OPTICAL COMMUNICATIONS, 2nd ed., Gagliardi et al. (1995), Ch. 1) at 1. A POSITA would have appreciated that these known advantages would have yielded benefits when applied to downhole systems.

127. Accordingly, even if Beach-127 does not necessarily disclose this feature, it would have nevertheless been within the skill of a POSITA at the time of the alleged invention to implement the assembly shown in Figure 2 of Beach-127 such that its “window . . . extends from the exterior surface into *optical* communication with the sealed interior cavity.”

128. For example, the prior art Wiese reference describes a configuration that transfers data by way of optical communication from a downhole assembly to an external device, through “a window at the housing” of the downhole assembly; as a result, “the signal is receivable outside of the housing through the window.” Ex. 1004 (Wiese), [0005], [0015] (discussing using “infrared (IR) [as] the signal type”). Wiese discloses, in Figure 1, a “schematic tool 10”—specifically, an MWD or LWD assembly—that includes a series of *N* “tools.” *Id.*, Fig. 1. As reflected in the following annotation of Figure 1, Wiese shows and describes the “tool 1” as featuring an internal transceiver 26 (colored yellow) communicably coupled to an internal antenna 28 (colored orange), and a window 30 (colored blue):

130. Wiese further explains that “each of the lines indicating connection in Fig. 1 may be wired or wireless connections utilizing,” among other signal types, an “optical signal,” [0014], and that “[t]he term antenna is broadly used . . . to mean a device capable of transmitting and receiving the signal contemplated. For example[, w]here infrared (IR) is the signal type, a light emitting diode (LED) would be the ‘antenna’ to transmit the IR signal.” *Id.*, [0015]. Wiese further explains that the “window is *pressure sealed* and transmissive to the selected signal type” such that, for infrared signals “for example, the window 30 may be glass or other material transmissive to IR light.” *Id.* Based on this disclosure, a POSITA would have recognized that Wiese—like Beach-127—discloses a “window” even under the proper (narrower) construction that requires a solid material that is transmissive to a communication signal, as I described earlier. *See* § VI.F.1, *supra*.

131. Wiese also explains that the structural composition of its antenna and transceiver within “tool 1” are not limited to the schematic shown for in Figure 1—specifically, that “while the antenna is illustrated as a separate component from that of the transceiver, it is to be understood that the antenna may form part of the transceiver in some embodiments.” *Id.*

132. Wiese explains the advantages of this configuration: by incorporating a transmissive “window” in the housing, its proposed design tool alleviates the drawbacks of conventional downhole assemblies that required being opened upon

retrieval at the ground surface—and were thus time-consuming, and were vulnerable to damage and/or contamination. *Id.*, [0003] (“One drawback associated with the use of [conventional] MWD and LWD tools is the limited bandwidth for providing accumulated data to surface computers in need thereof. In some cases, where the tool is tripped to surface, the tool itself must be opened at one or more locations which is time consuming and potentially damaging to the tool in view of the fluids in which the tool is bathed during residence in the well.”); [0010] (“[I]t is not desirable to open a plurality of ports into the tool because of potential contamination and in addition simply the time it takes to clean the area of the tool surrounding the access opening and physically remove a cover.”). As a result, Wiese’s configuration provided a “[f]aster and more reliable method[] for downloading information accumulated downhole...” *Id.*, [0004]; *see also id.*, [0017] (“This [design] provides for a faster data dump to the surface computer(s) . . . and is less prone to corruption than any device in the prior art.”); [0018] (discussing objective of “very rapid communication of information, reduc[tion of] downtime,” and “a most efficient process.”).

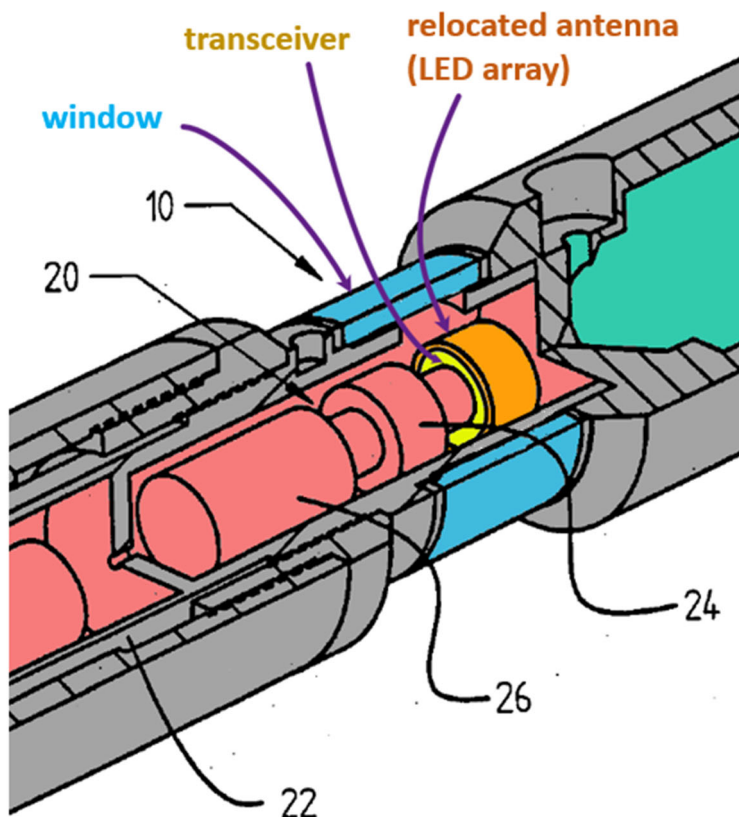
133. Wiese therefore provides a teaching, suggestion, or motivation for a POSITA to implement “a window that extends from the exterior surface” of a downhole assembly “into optical communication with the sealed interior cavity” of such an assembly. As such, a POSITA would have been motivated to implement Beach-127’s Figure 2 configuration with “a window that extends into optical

communication with the sealed interior cavity” as taught above in Wiese, in order to provide a reliable, efficient way to transfer the orientation data obtained from Beach-127’s electronic device or system 20, to the “remote unit” or other external device.⁵ More particularly, a POSITA would have been motivated to implement Beach-127’s assembly using the same basic configuration as shown in Figure 2, but to do so with the “antenna 30” taking the form of an LED array (such as an infrared LED array), as taught in Wiese. In implementing Wiese’s teachings into the Beach-127 assembly, the LED array (*i.e.*, “antenna”) would be communicatively coupled to the transceiver 28, and both components would reside within the sealed interior cavity, thereby optimizing speed and reliability of the data transfer, per Wiese’s teachings. Ex. 1004

⁵ I note that Wiese states that MWD and LWD tools are “ubiquitously used in the hydrocarbon exploration and production (E&P) industry.” Ex. 1004 (Wiese), [0002]. However, it does not restrict its proposed tool to particular downhole drilling applications. As I discussed above in the technical background section, at the time of the alleged invention of the ’013 Patent (*i.e.*, prior to April 2014), a POSITA would have recognized that features of downhole equipment for use in the oil and gas applications, may just as well apply to downhole equipment for use in core mineral exploration. Further, I see nothing in the disclosure of Wiese to suggest that its disclosed configuration and associated benefits would not be applicable to the specific application of exploratory mining and drilling for core minerals. As such, a POSITA would have looked to Wiese, and consider its teachings and suggestions, in considering ways to improve equipment for use in core mineral exploration equipment. Relatedly, I have seen that the Patent Owner itself has acknowledged the common ground between these two industries with respect to the subject matter of the Challenged Claims. *See* WO 2013/126955 to Hejleh, Ex. 1008 (hereinafter, “Hejleh”), [0003] (“As part of mining/oil & gas exploration activities, as well as extracting rock samples for construction/ civil engineering, there is a need to obtain underground ‘core’ samples for analysis by geologists.”)

(Wiese) at [0004], [0010]. Beach-127's window would thus "extend[]" into optical communication with the sealed interior cavity," as required by this limitation. While I understand that bodily incorporation of systems disclosed in multiple prior art references are not required in an obviousness analysis, I have provided below two examples demonstrating how a POSITA would have been motivated to apply Wiese's teachings to Beach-127's Figure 2 assembly, and how doing so would satisfy this limitation.

134. **Beach/Wiese Example 1:** First, this implementation could use the same configuration shown in Figure 2 of Beach-127—which, as indicated above, already explicitly shows "a window that extends from the exterior surface"—but with the "antenna 30" taking the form of an LED array such as infrared array, and the array being communicatively coupled to the transceiver 28 within the sealed interior cavity in order to optimize speed and reliability of the data transfer, as collectively taught in Wiese (hereinafter, "Beach/Wiese Example 1"). This example would render Beach's 127 window "in optical communication with the sealed interior cavity:"



Beach/Wiese Modification 2:

Beach-127 Figure 2, modified to relocate antenna 30 such that it forms part of the transceiver 28, and implemented using an LED array as the antenna, as collectively taught in Wiese

* * * *

136. As reflected above, either of the two examples shown above would render the “window . . . in optical communication with the sealed interior cavity,” as required.

137. Further, it would have been straightforward for a POSITA to implement Beach-127’s Figure 2 embodiment according to Wiese’s teachings. As I explained above with respect to the technical background, in the context of downhole

equipment, design configurations having LED arrays, as well as optically transmissive windows for external communication, were well within the level of ordinary skill in the art. For example, the Jorion reference, Ex. 1016, demonstrates that this configuration was known since at least May 1990. *See* Ex. 1016 (Jorion) at 5:53-61; 6:19-33, Fig. 3. Further, the Ujereh reference, Ex. 1015, which was published in 2013, likewise demonstrates that this was a known configuration. *See* Ex. 1015 (Ujereh) at Abstract, [0012], [0028], Figs. 3 and 4B.

138. Furthermore, Wiese explicitly discloses a schematic configuration for a downhole tool that includes a transceiver, an antenna, and a pressure-sealed “window at the housing” of the tool (*see* Ex. 1004, [0005], [0015]); these three core components are likewise featured in “tool 10” of the Beach-127 Figure 2 downhole assembly (*see* Ex. 1003, 12:24-27, 17:29-36, Fig. 2). A POSITA would thus have recognized that Wiese’s teaching of implementing the downhole assembly’s “antenna” as an LED array could be readily applied to the assembly of Beach-127. This is reflected in the Beach/Wiese Example 1 which I have shown above. Alternatively, a POSITA would have further recognized that Wiese’s additional teaching that the antenna (LED array) could “form part of the transceiver” as a choice that could aid in the design simplicity for Beach-127’s electronic device, and thus could likewise be readily applied to the Beach-127 assembly, as demonstrated in the Beach/Wiese Example 2.

139. The implementation of Beach-127's assembly according to Wiese's teachings would have constituted nothing more than the application of known techniques (specifically, using an LED array as an "antenna" for downhole equipment—whether separate from, or integrated with, the downhole transceiver—as collectively taught in Wiese) to a known device ready for improvement (specifically, the downhole of assembly of Beach-127 Figure 2, which already shows a generic "antenna 30" and a window that is transmissive to external communication) to obtain predictable results (*e.g.*, providing external communication from Beach-127's downhole assembly to the remote unit using an optical signal, which increases efficiency and reliability, and uses a simple design configuration). Moreover, the choice of an optical signal, as opposed to other segments of the electromagnetic spectrum—in addition to being particularly advantageous for the reasons I described above—also would have been obvious to try as one of a limited number of solutions for transmitting signals from the downhole assembly wirelessly. Further, POSITA would have had a reasonable expectation of success in implementing this form of communication to the Beach-127 assembly, for all of the reasons I have explained above.

g) Limitation 1[f]: "at least one electronic instrument that is configured to obtain orientation data;"

140. Beach-127 discloses "at least one electronic instrument that is configured to obtain orientation data." Specifically, Beach-127 explains that the core

orientation tool 10 “comprises an electronic core orientation device or system 20 housed within a body 22 that is coupled to and between the core tube cap and the adaptor 16.” Ex. 1003 (Beach-127), 11:30-33. The electronic device or system 20 is an electronic “instrument.” I have indicated this feature (in purple color) in the following annotation of Figure 2:

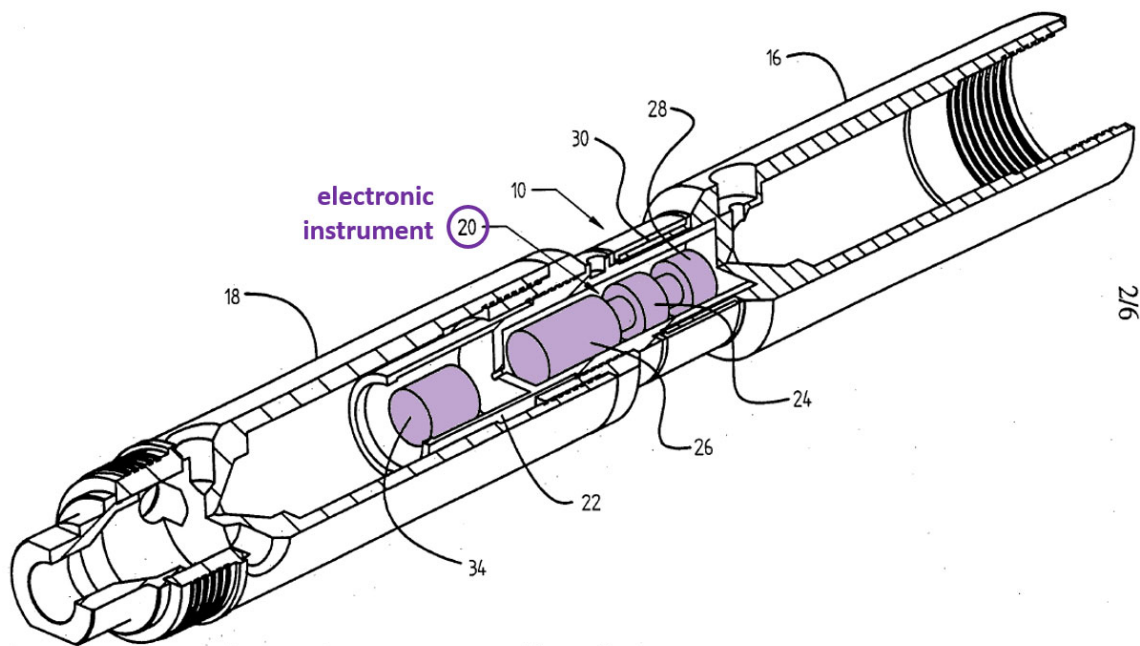


Figure 2

141. *Id.* at Fig. 2 (annotated). Beach-127 explains that “[t]he electronic core orientation device 20 is configured to log one or more first indications of orientation of the tool (in other words, core orientation data) upon receiving a trigger signal.” Ex. *Id.* at 11:33-36; *see also id.*, 2:26-3:2, 3:14-16, 6:28-30, 7:33-35, 8:15-17. Moreover, Beach-127 specifies that “[t]he first indications of orientation may comprise one or a combination of borehole dip, borehole azimuth, core orientation,

core dip and core azimuth.” *Id.* at 7. Accordingly, in the Beach-127 Figure 2 assembly, the electronic instrument is “configured to obtain orientation data,” as required.

142. Further, I have seen that during prosecution of related patents—specifically, the ’463 and ’529 Patents—the Patent Office repeatedly found that Beach-127 discloses “at least one electronic instrument **(20)** that is configured to obtain orientation data **(pg. 11, lines 33-36).**” *See* Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4) (emphasis in original); *see also* Ex. 1011 (’463 File History) at 55 (March 14, 2019 Office Action at 4). I have further seen that, when confronted with such arguments, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1013 (’529 File History) at 77 (April 27, 2022 Response at 12); Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 3 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

h) Limitation 1[g]: “wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensor in a core orientation data recording tool;”

143. Beach-127 discloses that “the at least one electronic instrument comprises at least one digital and/or electromechanical sensor in a core orientation

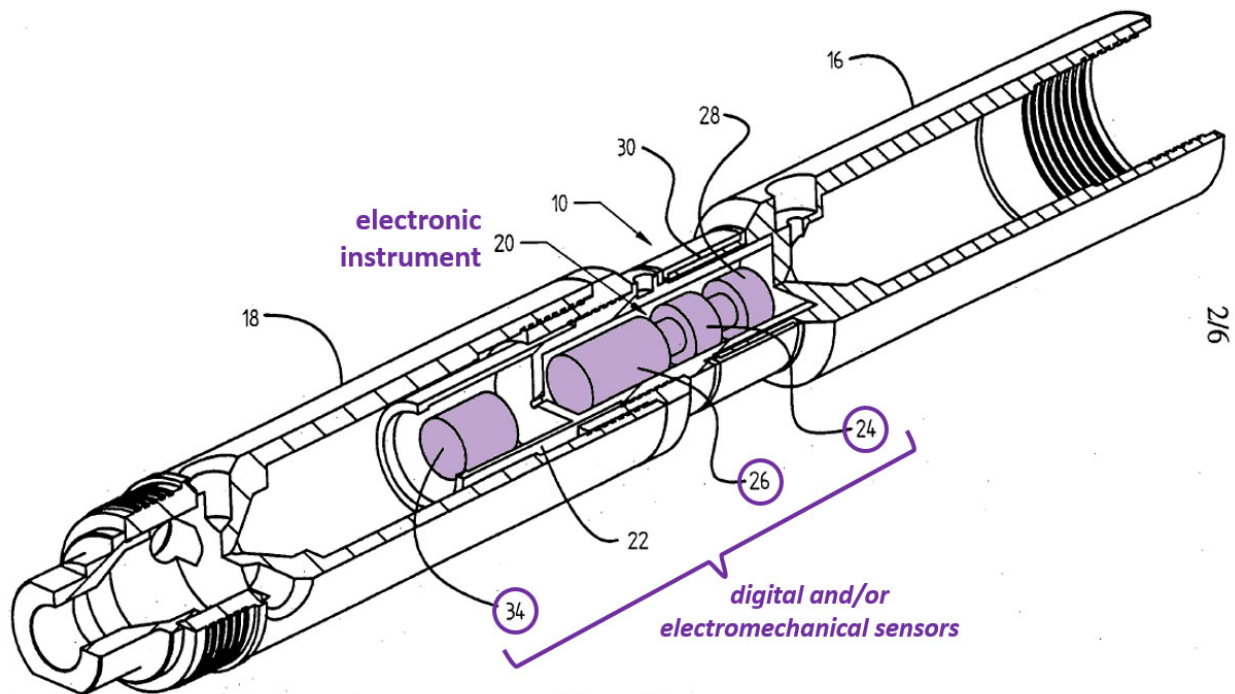
data recording tool.” More specifically, Beach-127 teaches that its “‘electronic orientation device’ is intended to denote an electronic device or system that utilises electronic sensors and transducers such as but not limited to accelerometers, inclinometers, gyroscopes and magnetometers.” Ex. 1003 (Beach-127) at 10:19-23.

As Beach-127 goes on to explain:

The system 20 comprises multiple sensors and transducers for sensing various events and orientation data of the tool 10 and core drill. The sensors may comprise for example accelerometers, gyroscopes, physical switches, magnetometers, vibration sensors, inclinometers, inductive RPM sensors, flow sensors and pressure sensors. Some of the sensors and transducers send information to the trigger system that analyses the information to determine when to provide the trigger signal. Other sensors and transducers, notionally forming an orientation module 26, may be either in an idle state or continually providing data indicative of core and/or bore hole orientation, however these sensors and transducers are not activated and/or the orientation data is not logged until the trigger system 24 provides the trigger signal. It will be appreciated by those skilled in the art that some of the sensors and transducers that are used by the trigger system may also provide orientation data.

144. *Id.*, 12:7-24. Beach-127 further explains that “sensors may be provided in the module 26 or trigger system 24 to sense the speed, direction, or change in

speed or direction of rotation of the core drill.” *Id.*, 14:35-15:1. A POSITA would appreciate that such sensors used in this application are “electromechanical sensors,” and may optionally be “digital” rather than analog; in other words, the sensors in Beach-127 are “digital and/or electromechanical sensors,” as required. Beach-127’s written disclosure indicates that such sensors include, or are incorporated within, the orientation module 26, trigger system 24, and gyroscope 34. I have indicated these (again in purple color) in the following annotation of Figure 2:



145. Ex. 1003 (Beach-127) at Fig. 2 (annotated). Furthermore, as discussed for Limitation 1[f] above, § IX.A.1(g), Beach-127 discloses that the electronic instrument 20 is “configured to log” orientation data. *See id.*, 11:33-36. Beach-127 also indicates that the logging of orientation data may be performed by the sensors,

see, e.g., id., 16:13-14 (“the tool 10 may comprise a gyroscope or similar device for logging azimuth and dip”), and that the electronic instrument 20 comprises “a memory device for storing logged data.” *Id.*, 14:23-25. These disclosures regarding “logging” and “storing” data demonstrate that, in Beach-127’s assembly, electronic instrument 20 “comprises at least one digital and/or electromechanical sensor in a *core orientation data recording tool*,” as required. Thus, Beach-127 discloses this claim limitation.

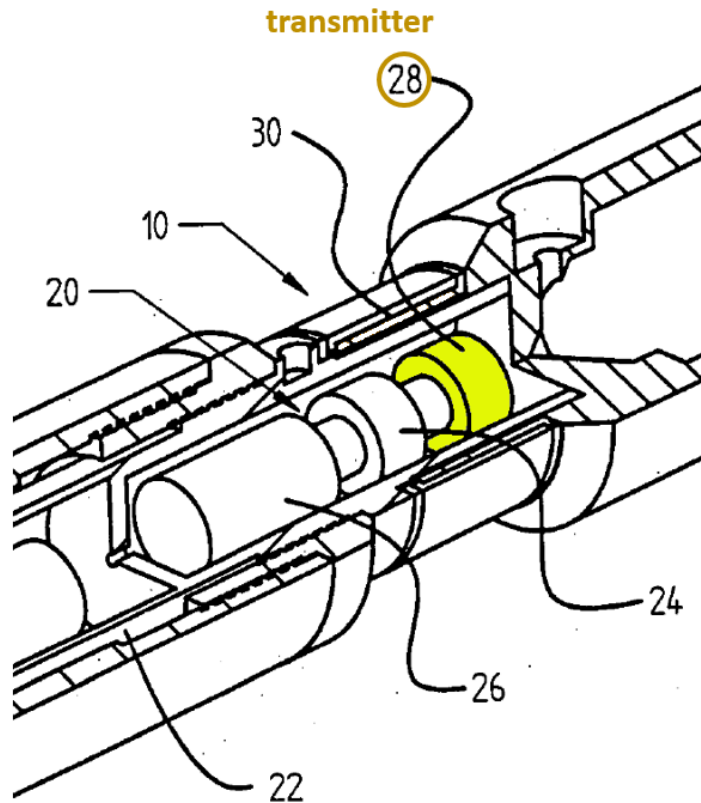
146. Further, I have seen that during prosecution of related patents—specifically, the ’463 and ’529 Patents—the Patent Office repeatedly found that Beach-127 discloses that “the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensor in a core orientation data recording tool **(pg. 12, lines 7-21).**” *See* Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4) (emphasis in original); *see also* Ex. 1011 (’463 File History) at 55 (March 14, 2019 Office Action at 4). I have further seen that, when confronted with such arguments, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1013 (’529 File History) at 77 (April 27, 2022 Response at 12); Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 3-4 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent

Owner's concession, is consistent with my own analysis that Beach-127 meets this limitation.

i) Limitation 1[h]: “a transmitter configured to transmit core orientation data;”

147. Beach-127 discloses “a transmitter configured to transmit core orientation data.” More specifically, as discussed above for Limitation 1[e], the assembly of Beach-127 Figure 2 includes “a transceiver 28 coupled to an antenna 30 to communicate with a hand-held computer or other like device.” Ex. 1003 (Beach-127) at 12:24-27. Beach-127 further explains that “the transceiver 28 in the tool 10 communicates via wireless communication with the hand-held computer,” and indicates that the hand-held computer is one example of “a remote unit.” *Id.* at 17:29-36. Furthermore, Beach-127 makes clear that the data sent to the remote device is core orientation data. *Id.*, 17:14-15 (“the tool 10 is used as a stand alone tool to obtain orientation data), 33-37 (explaining that “the tool 10 logs orientation data of a reference point on the core tube 12,” and that it “communicates via wireless communication with the hand-held computer”). Accordingly, in Figure 2 of Beach-127, the transceiver, alone or together with the antenna (which would have been obviously implemented as an LED array, per Wiese's teaching) is the required

“transmitter configured to transmit core orientation data.”⁶ I have indicated the “transmitter” (in yellow color) in the following annotation of Figure 2:



148. *Id.* at Fig. 2 (annotated). Accordingly, Beach-127 discloses this limitation.

149. Further, I have seen that during prosecution of related patents—specifically, the '463 and '529 Patents—the Patent Office repeatedly found that Beach-127 discloses that “a transmitter (28, 30) configured to transmit core

⁶ Alternatively, a POSITA could also consider that in Beach-127, transceiver 28 and antenna 30, collectively, form “a transmitter configured to transmit core orientation data.” Accordingly, either of the two exemplary illustrations based on Beach-127 in view of Wiese, as described for Limitation 1[e] above, § IX.A.1(f)(1), would have the required “transmitter.”

orientation data (pg. 12, lines 25-28).” *See* Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4) (emphasis in original); *see also* Ex. 1011 (’463 File History) at 55 (March 14, 2019 Office Action at 4). I have further seen that, when confronted with such arguments, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1013 (’529 File History) at 77 (April 27, 2022 Response at 12); Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 4 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 meets this limitation.

j) Limitation 1[i]: “wherein the sealed interior cavity is sized and shaped to enclose the at least one electronic instrument.”

150. Beach-127 discloses the added feature that “the sealed interior cavity is sized and shaped to enclose the at least one electronic instrument.” More specifically, as I discussed for Limitation 1[b] above, in the assembly of Beach-127 Figure 2, the core tube cap 18 and body 22 collectively form a “sealed interior cavity.” *See* § IX.A.1(c). In addition, as I further discussed for Limitation 1[f] above, the “electronic core orientation device or system 20,” which resides within the “sealed interior cavity,” satisfies the claimed “electronic instrument.” *See* § IX.A.1(g). As I have indicated in the following annotation of Figure 2, “sealed

interior cavity” of the Beach-127 assembly is therefore “sized and shaped to enclose the[] electronic instrument,” as required:⁷

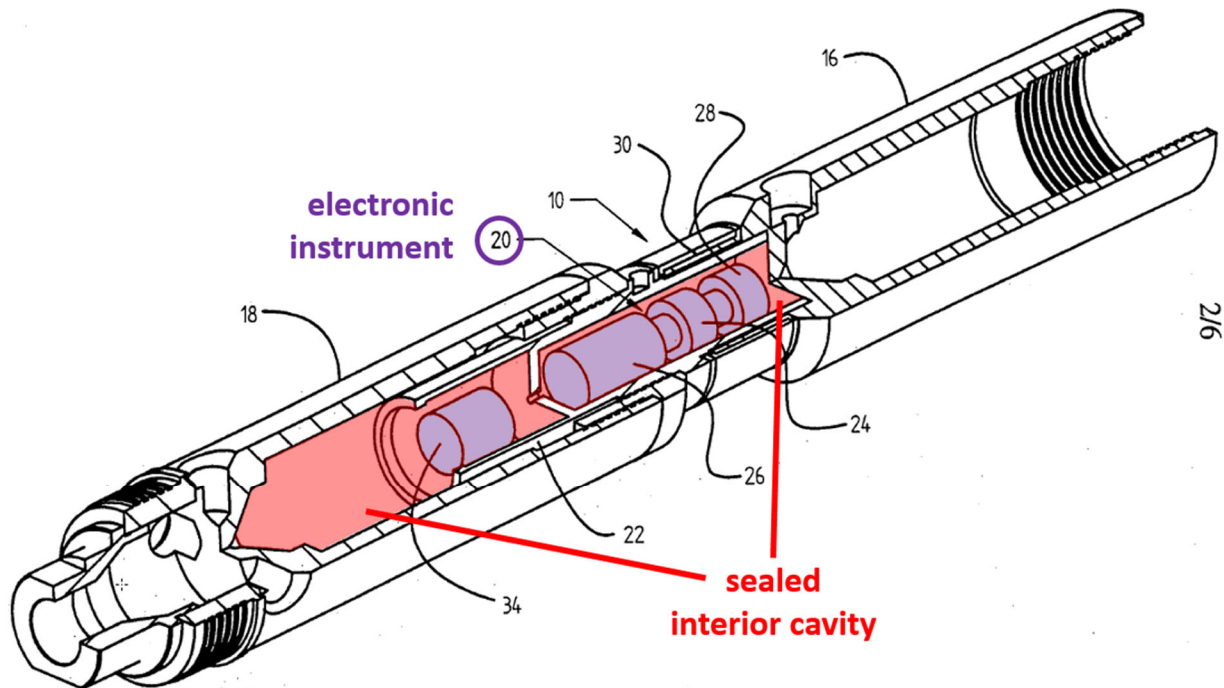


Figure 2

151. Ex. 1003 (Beach-127) at Fig. 2 (annotated). Accordingly, Beach-127 discloses this limitation.

152. Further, I have seen that during prosecution of a related patent—specifically, the '529 Patent—the Patent Office found that Beach-127 discloses that “the sealed interior cavity is sized and shaped to enclose the at least one electronic

⁷ As discussed for Limitation 1[e], a POSITA would have understood that, in the Beach-127 Figure 2 assembly, the “sealed interior cavity” encompasses antenna 30 (which could have been obviously implemented as an LED array, per Wiese’s teachings) of electronic instrument device 20.

instrument (**Fig. 2**).” *See* Ex. 1013 (’529 File History) at 192 (October 27, 2021 Office Action at 4) (emphasis in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1013 (’529 File History) at 77 (April 27, 2022 Response at 12); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 4 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis of Beach-127.

2. Claim 3: “The core barrel head assembly of claim 1, wherein the sealed interior cavity is sized and shaped to hermetically enclose the transmitter.”

153. Beach-127 discloses the added feature that “the sealed interior cavity is sized and shaped to hermetically enclose the transmitter.” More specifically, as I have explained above for Limitation 1[i] and as shown in Figure 2, the Beach-127 core barrel head assembly includes a “sealed interior cavity that is sized and shaped to enclose the electronic instrument”—in other words, it is sized and shaped to enclose the “electronic core orientation device or system 20.” *See* §IX.A.1(j), *supra*. In turn, as I have explained above for Limitation 1[h], the device or system 20 includes a transceiver 28, which is a “transmitter configured to transmit core orientation data.” *See* § IX.A.1(i), *supra*. Accordingly, Beach-127 discloses that the

“sealed interior cavity” is sized and shaped to “enclose the transmitter,” as reflected below. I have indicated this in the following annotation of Figure 2:⁸

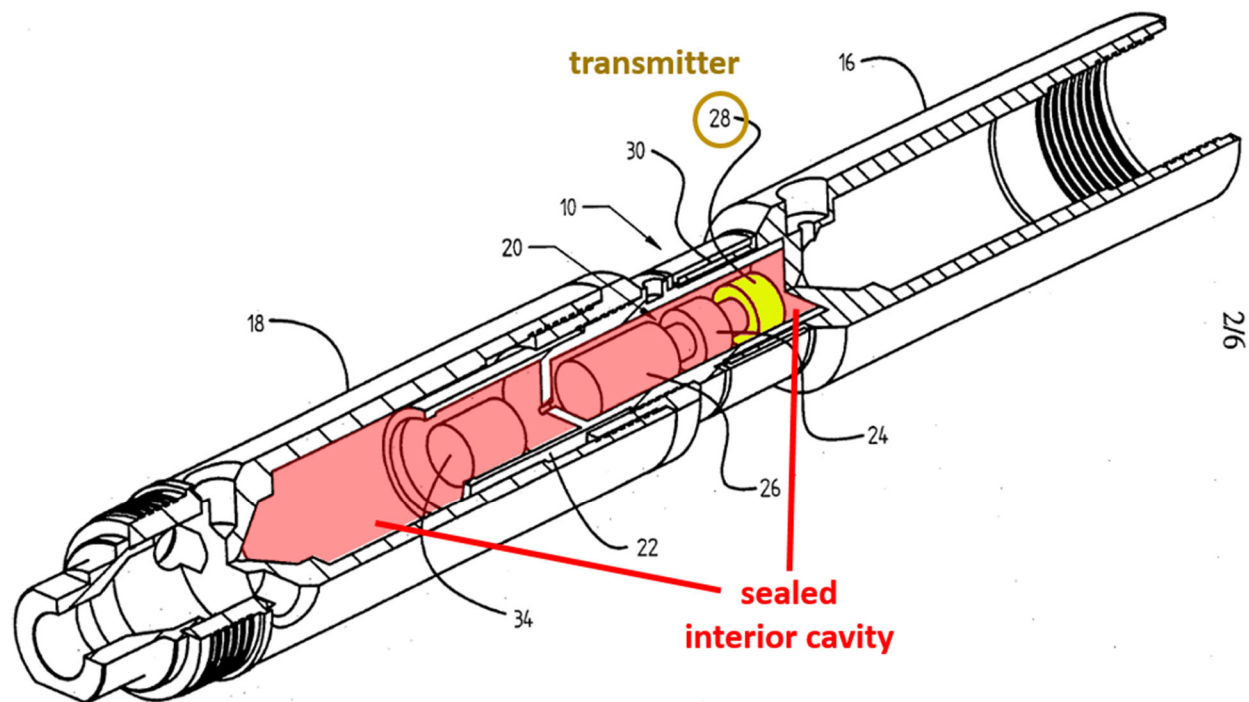


Figure 2

154. Ex. 1003 (Beach-127), Fig. 2 (annotated). Further, as reflected in the above annotation, the “interior cavity” shown above becomes “sealed” when the core tube cap 18 is threaded into engagement with the body 22 of the electronic orientation device or system 20. A POSITA would have appreciated that, in the

⁸ As I have discussed above for Limitation 1[e], while not shown in Figure 2, a POSITA would have understood that a through-hole is present in the body 22 of the Beach-127 assembly in order to facilitate communication between the transceiver 28 and the antenna 30, and that the “sealed interior cavity” therefore encompasses the antenna 30. See § IX.A.1(f), *supra*. As I have discussed above for Limitation 1[e], the antenna 30 of Beach-127 would have obviously been implemented as an LED array, according to Wiese’s teachings. *Id.*

context of downhole tools, this threaded engagement between the cap 18 and the body 22 results in a “*hermetic seal*” according to the ordinary meaning of that term at the time of the alleged invention; in other words, the threaded engagement between results in seal that is complete and air tight. *See* Ex. 1019 (New Oxford Am. Dict. 3rd (2010)) (defining the word “hermetic” meaning “complete and airtight,” in reference to a “seal or closure”). This understanding is further corroborated by the prior art Beach-848 reference, which is incorporated by reference in Beach-127 for its disclosure of core orientation systems. *See* Ex. 1003 (Beach-127) at 1:21-31. Specifically, Beach-848 explains that “the helical nature of the thread” used to engage a “cap 74” with a “body 28” results in a “tight and sealing contact.” Ex. 1009 (Beach-848) at 10:36-11:4 (“ The cap 74 is engaged with the body 28 by engaging the thread sections 94 with the partial thread 52 at the first end 30 of the body 28. Due to the helical nature of the thread 52, when the cap 74 is screwed onto the first end 30 of the body 28 the seat 92 can be brought into tight and sealing contact with the face 32.”). Indeed, a contemporary product catalog from the Central Mine Equipment Company (CMECO), a manufacturer of core drilling equipment, further demonstrates that at the time of the alleged invention of the ’013 Patent, it was “standard practice” in core barrel head assemblies to achieve a hermetic seal using threaded coupling. *See* Ex. 1017 (2013 CMECO Catalog) at 248 (“All flush thread screens and casings are . . . hermetically sealed at both ends as a standard practice.”).

155. Accordingly, a POSITA would have appreciated that, in Figure 2 of Beach-127, “the sealed interior cavity is sized and shaped to *hermetically* enclose the transmitter,” as required.

156. Further, I have seen that during prosecution of a related patent—specifically, the ’463 Patent—the Patent Office found that Beach-127 discloses the added feature that the “sealed interior cavity **(18)** is sized and shaped to hermetically enclose the communication means **(28)** to receive and/or transmit orientation data **(Fig. 2).**” *See* Ex. 1011 (’463 File History) at 56 (March 14, 2019 Office Action at 5) (emphases in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 6 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Claim 3.

3. Claim 4: “The core barrel head assembly of claim 1, further comprising an orientation indicator module comprising a light emitter.”

157. The Beach-127 assembly, when implemented per Wiese’s teachings, would satisfy the added feature of “an orientation indicator module comprising a light emitter.” More specifically, as I have explained above for Limitation 1[e], a

POSITA at the time of the alleged invention would have been motivated to implement the Figure 2 Beach-127 assembly, particularly in view of Wiese's teaching, such that the "antenna 30" would take the form of an LED array such as an infrared array. *See* Ex. 1004 (Wiese), [0015] ("[t]he term antenna is broadly used herein . . . to mean a device capable of transmitting and receiving the signal type contemplated. For example[, w]here infrared (IR) is the signal type, a light emitting diode (LED) would be the 'antenna' to transmit the IR signal."); § IX.A.1(f)(1), *supra*.

158. Thus, when Wiese's teachings are applied to Beach-127 pursuant to my analysis for Limitation 1[e]—as illustrated by either of the two examples that I presented earlier—a "light emitter" (*i.e.*, an LED) would be present in the resulting "Beach-127/Wiese" assembly. Further, I note that the term "orientation indicator module" is not a standard term of art in the relevant field, and, based on my review of the specification, I do not see that the '013 Patent ascribes any specific definition for the term. Nonetheless, a POSITA would appreciate that, in the "Beach-127/Wiese" assembly, any one or more components associated with the "electronic core orientation device or system 20" could have been considered to form an "orientation indicator module," according to the plain language meaning of that term. In other words, in the Beach-127/Wiese assembly, "orientation indicator module" could comprise the LED array as a whole (in the sense that it provides visual

indications of orientation data through the window), along with the transceiver 28 communicatively coupled to the LED array, and it could further comprise the “trigger system 24” which “issues the trigger signal” to activate sensors or transducers to log orientation data “upon sensing particular events or sequences of events that are expected to occur”). *See* Ex. 1003 (Beach-172) at 12:7-36 (explaining that “sensors and transducers,” including those that provide “orientation data,” “are not activated and/or the orientation data is not logged until the trigger system 24 provides the trigger signal.”)

159. Accordingly, the Beach-127 assembly, as implemented according to the teachings of Wiese, would have included “an orientation indicator module comprising a light emitter,” and therefore would have satisfied the added feature of Claim 4.

4. Claim 19: “The core barrel head assembly of claim 1, wherein the exterior surface defines a plurality of female planar stops.”

160. Beach-127 discloses the added feature that “the exterior surface defines a plurality of female planar stops.” More specifically, as shown in Figure 2, the exterior surface of the core barrel head assembly includes several “planar stops”—in other words, flat segments (which are “planar”) along the exterior surface of the assembly, which is otherwise cylindrically-shaped or rounded. I have reproduced below (1) Figure 2 of Beach-127, where I have annotated the “exterior surface” of

the core barrel head assembly for reference, and (2) an close-up segment of Figure 2, where I have indicated two examples of “planar stops” along the exterior surface:

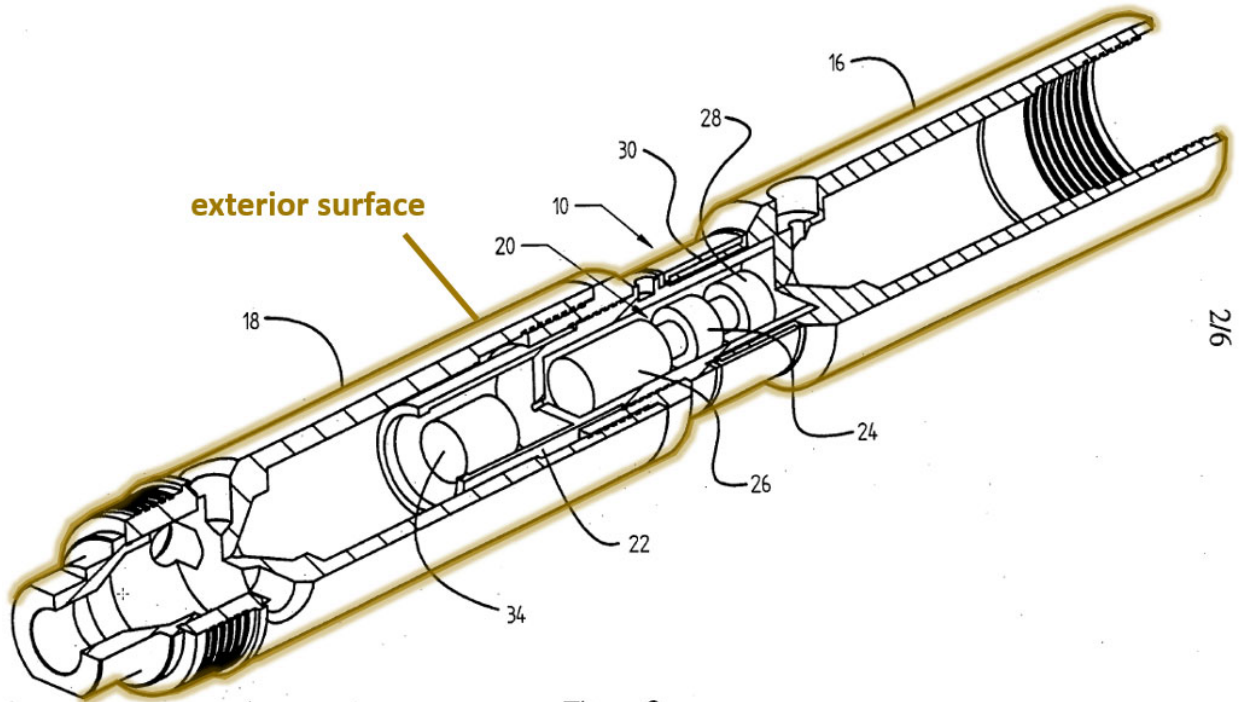
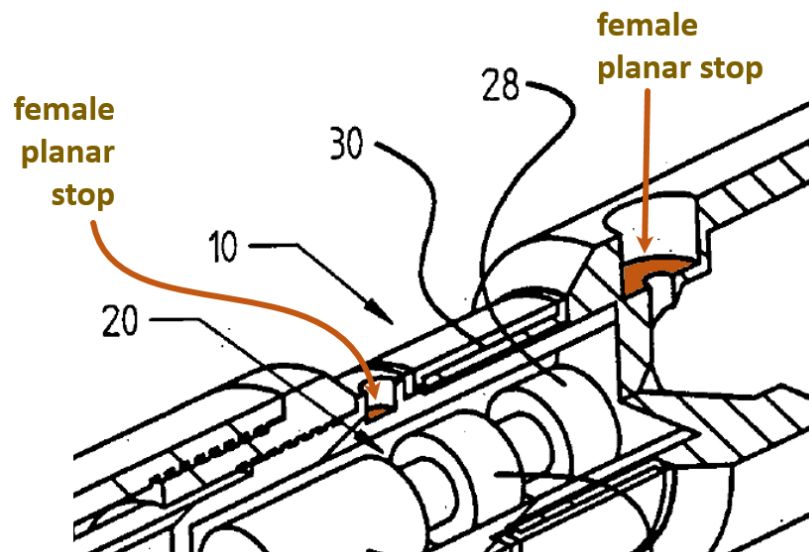


Figure 2



161. Ex. 1003 (Beach-172), Fig. 2 (annotated). I further note that the planar stops seen in Figure 2 can be structurally characterized as “female” in that the surfaces are recessed relative to the surrounding portions of the cylindrical exterior surface. Accordingly, Beach-127 discloses the added feature of Claim 19.

162. Further, I have seen that during prosecution of a related patent—specifically, the ’463 Patent—the Patent Office found that Beach-127 discloses the added feature that the “exterior surface of the elongate tube body **(18, 16)** defines a plurality of female planar stops proximate the mid-body portion **(Fig. 2 above)**.” *See* Ex. 1011 (’463 File History) at 56 (March 14, 2019 Office Action at 5) (emphases in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 7 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Claim 19.

5. **Claim 20: “The core barrel head assembly of claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least**

one electronic instrument senses no relative movement of the at least one electronic instrument.”

163. Beach-127 discloses the added feature that “the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.”

To exemplify this, Beach-127 teaches that its electronic orientation device or system 20 (which qualifies as the claimed “electronic instrument”) “comprises multiple sensors and transducers for sensing various events and orientation data of the tool 10 and core drill,” including “vibration sensors.” Ex. 1003 (Beach-172), 12:7-15 (“The system 20 comprises multiple sensors and transducers for sensing various events and orientation data of the tool 10 and core drill. The sensors may comprise for example accelerometers, gyroscopes, physical switches, magnetometers, vibration sensors, inclinometers, inductive RPM sensors, flow sensors and pressure sensors.”)

164. The electronic instrument further includes “a trigger system 24 to issue the trigger signal upon sensing particular events or sequences of events,” such that “the orientation data is not logged until the trigger system 24 provides the trigger signal.” *Id.*, 12:15-36.

165. Beach-127 further explains that, during operation of the assembly, “the trigger system 24 may be configured to issue the trigger signal when sensors in the module 26 detect,” among other key events, “a change in direction of motion from a downhole direction to an uphole direction,” *id.*, 13:4-8, or “cessation of drilling,” *id.*,

13:24. A POSITA would understand that, as a matter of basic physics, such a change in direction of the Beach-127 assembly (i.e., from downhole to uphole) would entail a moment in which there is no relative movement of the electronic instrument. Furthermore, Beach-127 itself discloses that, “on cessation of drilling the sensor,” which “may comprise an inductive RPM sensor, accelerometer or gyroscope,” “will subsequently detect a change in the speed of rotation and *more particularly a zero speed of rotation.*” *Id.* 15:1-9 (emphasis added). These collective disclosures demonstrate that the electronic instrument 20, in connection with the trigger system 24, is programmed to obtain orientation data when it “senses no relative movement,” as required. This is further demonstrated by Beach-127’s disclosure that:

As the gyroscope 34 will only need to track changes in the orientation of the tool 10 *after drilling has stopped*, the need to track changes during the descent of the tool down the hole and during drilling is avoided . . . [, which] obviates the need for the gyroscope to track changes in high vibration periods during drilling thus avoiding a significant loss of accuracy.

166. *Id.* at 17:4-12. Accordingly, Beach-127 satisfies this added feature of Claim 20. Further, the intrinsic record demonstrates the Office’s assertion, and the Patent Owner’s acquiescence, that Beach-127 discloses this limitation. *See* Ex. 1014, 8.

167. Further, I have seen that during prosecution of a related patent—specifically, the '463 Patent—the Patent Office found that Beach-127 discloses the added feature that the “the at least one electronic instrument **(34)** is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument[] **(pg. 17, lines 4-12).**” *See* Ex. 1011 ('463 File History) at 56 (March 14, 2019 Office Action at 5) (emphases in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute that Beach-127 discloses this limitation. *See* Ex. 1011 ('463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 8 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Claim 20.

6. Claim 21:

- a) Limitation 21[a]: “The core barrel head assembly of claim 20, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations,”**

168. Beach-127 discloses the added feature that “the least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations.” As I have explained above for Claim 20, Beach-

127 explains that, during operation of the assembly, “the trigger system 24 may be configured to issue the trigger signal when sensors in the module 26 detect,” among other key events, “a change in direction of motion from a downhole direction to an uphole direction,” Ex. 1003 (Beach-127), 13:4-8, or “cessation of drilling,” *id.*, 13:24. *See also id.*, 12:12-21 (explaining that “[s]ome of the sensors and transducers send information to the trigger system that analyses the information to determine when to provide the trigger signal,” and that other “sensors and transducers are not activated and/or the orientation data is not logged until the trigger system 24 provides the trigger signal.”). Furthermore, Beach-127 discloses that, “on cessation of drilling the sensor,” which “may comprise an inductive RPM sensor, accelerometer or gyroscope,” “will subsequently detect a change in the speed of rotation and *more particularly a zero speed of rotation.*” *Id.* 15:1-9 (emphasis added); *see also id.*, 17:4-12 (explaining that gyroscope 34 will only need to track changes in the orientation of the tool 10 *after drilling has stopped*”). These collective disclosures demonstrate that the electronic instrument 20, through the trigger system 24, is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations,” pursuant to the added feature of Limitation 21[a].

169. Further, I have seen that during prosecution of a related patent—specifically, the ’463 Patent—the Patent Office found that Beach-127 discloses the added feature that “the at least one electronic instrument (**34**) is programmed to

obtain orientation data when the at least one electronic instrument senses no vibrations.” *See* Ex. 1011 (’463 File History) at 57 (March 14, 2019 Office Action at 6) (emphasis in original). The Examiner further explained, referring to Beach-127 at 17:4-12 that “[t]he gyroscope 34 tracks changes in orientation of the tool after drilling has stopped meaning there is no movement or vibrations. Vibrations would occur during drilling.” *Id.* I have further seen that, when confronted with this argument, the Patent Owner did not dispute Examiner’s identification of this limitation in Beach-127. *See* Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 9 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Limitation 21[a].

b) Limitation 21[b]: “and wherein the at least one electronic instrument is programmed to not obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling.”

170. Beach-127 further discloses the additional feature that “the least one electronic instrument is programmed not to obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling.” This is reflected by the analysis and cited disclosures from Beach-127, which I have

provided above for Limitation 21[a], which likewise demonstrate the circumstances in which the electronic instrument, through the trigger system 20, is programmed *not* to obtain core orientation data. *See* § IX.A.7(a), *supra*. Accordingly, Beach-127 discloses the added feature of Limitation 21[b].

171. Further, I have seen that during prosecution of a related patent—specifically, the '463 Patent—the Patent Office found that Beach-127 discloses the added feature that “the at least one electronic instrument **(34)** is programmed to not obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling **(pg. 17, lines 4-7).**” *See* Ex. 1011 ('463 File History) at 57 (March 14, 2019 Office Action at 6) (emphasis in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute Examiner’s identification of this limitation in Beach-127. *See* Ex. 1011 ('463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 9-10 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Limitation 21[b].

7. **Claim 22: “The core barrel head assembly of claim 1, wherein the at least one electronic instrument is**

programmed to obtain orientation data based on a predetermined time interval scheme.”

172. Beach-127 discloses the added feature that “the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme.” More specifically, Beach-127 discloses that:

The logging of information by the electronic device 20 may occur at a predetermined frequency for a predetermined period of time. For example the electronic orientation device/system 20 may log orientation data every 10 seconds for a two minute period after receipt of the initial trigger signal.

173. Ex. 1003 (Beach-127), 26:13-18; *see also id.*, 19:35-20:6 (further describing “cyclically provid[ing] trigger signals for a prescribe[d] period of time”). In addition, Beach-127 explains that “[t]he trigger system 24 may trigger the sensors in the module 26 to record one, or a combination of readings of orientation at a point/points in time,” including “(c) prior to the trigger by selecting a pre recorded reading where multiple readings are taken at predetermined intervals.” *Id.*, 19:25-33. Beach-127 further discloses that triggers are programmed based on a predetermined time interval scheme, explaining that “[t]he time triggers may comprise one or a combination of: (a) a single trigger at a specified delay time relative to a time the device was initialized by an operator or triggered by a physical event; [or] (b) multiple continuous triggers at preset intervals commencing at a specified delay time

relative to the time the device was initialized by an operator or triggered by a physical event and from which one or more data sets are selected.” *Id.*, 19:15-23.

Accordingly, Beach-127 discloses the added limitation of Claim 22.

174. Further, I have seen that during prosecution of a related patent—specifically, the ’463 Patent—the Patent Office found that Beach-127 discloses the added feature that “the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme. **(pg. 19, lines 11-23).**” *See* Ex. 1011 (’463 File History) at 57 (March 14, 2019 Office Action at 6) (emphasis in original). The Examiner further explained, referring to Beach-127 at 17:4-12 that “[t]he gyroscope 34 tracks changes in orientation of the tool after drilling has stopped meaning there is no movement or vibrations. Vibrations would occur during drilling.” *Id.* I have further seen that, when confronted with this argument, the Patent Owner did not dispute Examiner’s identification of this limitation in Beach-127. *See* Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 11 (summarizing the same). The Patent Office’s assessment that Beach-127 meets this limitation, and the Patent Owner’s concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Claim 22.

8. Claim 24:

- a) Limitation 24[a]: “The core barrel head assembly of claim 1, wherein the at least one electronic instrument**

is programmed to: record orientation data relating to an orientation of the at least [one] electronic instrument in a borehole; and,”

175. Beach-127 discloses the added feature that “the at least one electronic instrument is programmed to record orientation data relating to an orientation of the at least [one] electronic instrument in a borehole.” This is exemplified by Beach-127’s disclosure that “the tool 10 [is] able to log”—in other words, to *record*—“*in situ* orientation data relating to the core and the borehole from which the core is extracted at a time shortly before or at core breakage;” this is accomplished with the aid of “a trigger system 24 to issue the trigger signal upon sensing particular events or sequences of events that are expected to occur when a core is broken from the ground.” Ex. 1003 (Beach-172), 12:30-36; *see also id.*, 2:16-19 (describing “core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool”), and 6:20-22 (describing “logging *in situ* orientation data of a core sample extracted from the ground by a core drill”). Accordingly, Beach-127 discloses the added feature of Limitation 24[a].

b) Limitation 24[b]: “receive an interrogation command from an external communication device.”

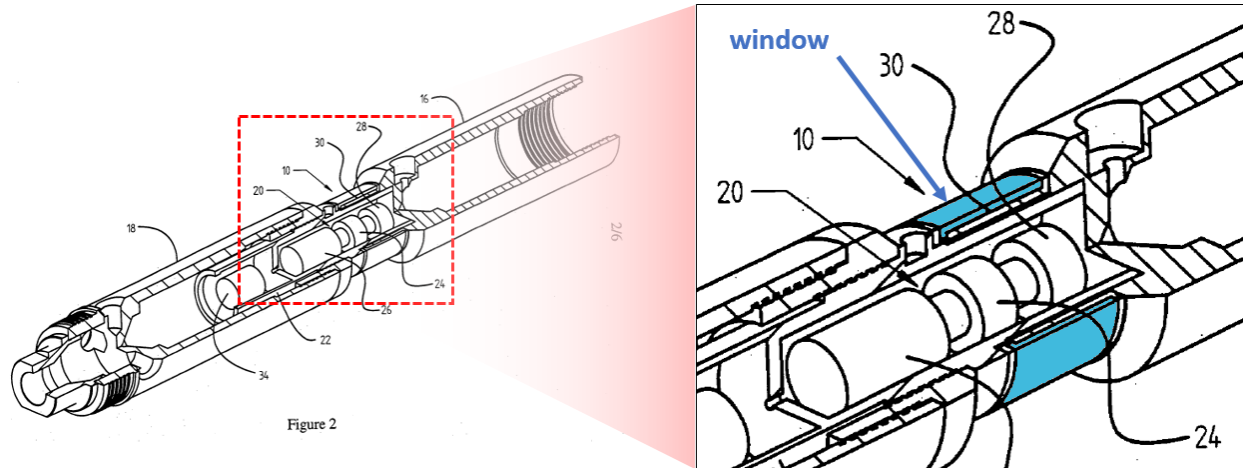
176. Based on the collective teachings of Beach-127, a POSITA would have been motivated to implement the added feature that “the at least one electronic instrument is programmed to . . . receive an interrogation command from an external communication device.” More specifically, Beach-127 discloses “transferring data

from the electronic device 20 to the device 120 by an intervening hand held telemetry device (hand held computer) that interrogates the device 20 to obtain for example the tool face orientation data at the time the trigger signal is provided by a triggering system 26,” which will provide a bearing that “can be physically marked on the scale 138.” *See* Ex. 1003 (Beach-172), 21:31-22:14.

177. In view of this teaching, a POSITA would have understood that, with respect to the Figure 2 embodiment, the remote (i.e., external) hand held computer could have been programmed to transmit an interrogation command to electronic device or system 20 of the downhole assembly, and that the device or system 20 could have likewise been programmed to receive such a command. At the time of the alleged invention, it was commonplace to use such an interrogation command as a signal to initiate a connection between two wireless electronic devices, and Beach-127’s own disclosure demonstrates that this technique was known as being applicable to downhole assemblies in particular. Accordingly, based on Beach-127’s own disclosure, a POSITA would have appreciated that programming the remote unit and electronic instrument associated with Beach-127’s Figure 2 embodiment to, respectively, transmit and receive an interrogation command, would have been a routine and straightforward way to establish a communication link between those components, and would have facilitated the subsequent transmission of data from the downhole tool to the hand held computer.

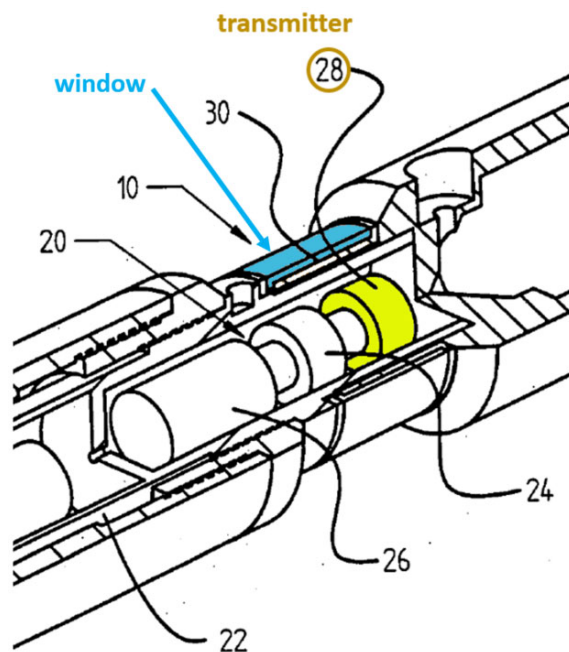
9. Claim 25: “The core barrel head assembly of claim 1, wherein the transmitter is configured to transmit core orientation data to a remote device through the window.”

178. Beach-127 discloses the added feature that “the transmitter is configured to transmit core orientation data to a remote device through a window.” More specifically, as I have explained above for Limitation 1[e], the Figure 2 assembly of Beach-127 features a “window,” as I have indicated (in blue color) below:



179. Ex. 1003 (Beach-172), Fig. 2 (annotated); *see* § IX.A.1.(f), *supra*. In connection with Figure 2, Beach-127 explains that “[t]he orientation system 20 may further comprise a transceiver 28 coupled to an antenna 30 to communicate with a hand-held computer or other like device.” Ex. 1003 (Beach-172), 12:24-28; *see also id.*, 17:29-31 (characterizing the “hand-held computer” as one example of “a remote unit”). In addition, Beach-127 explains that “the transceiver 28 in the tool 10

communicates via wireless communication with the hand-held computer.” *Id.*, 17:33-36. As I have explained above for Limitation 1[h], a POSITA would have recognized that the transceiver 28 (alone or combined with antenna 30) is a transmitter. § IX.A.1.(i), *supra*. In particular, a POSITA would have recognized that the transmitter (*i.e.*, transceiver, alone or combined with the antenna) is configured to transmit core orientation data to the remote device (for example, to the hand-held computer) through the window of Figure 2. For context, I have indicated the Beach-127 transmitter and window in the following annotation of Figure 2:



180. Ex. 1003 (Beach-172), Fig. 2 (annotated). Accordingly, Beach-127 discloses the added feature of Claim 25.

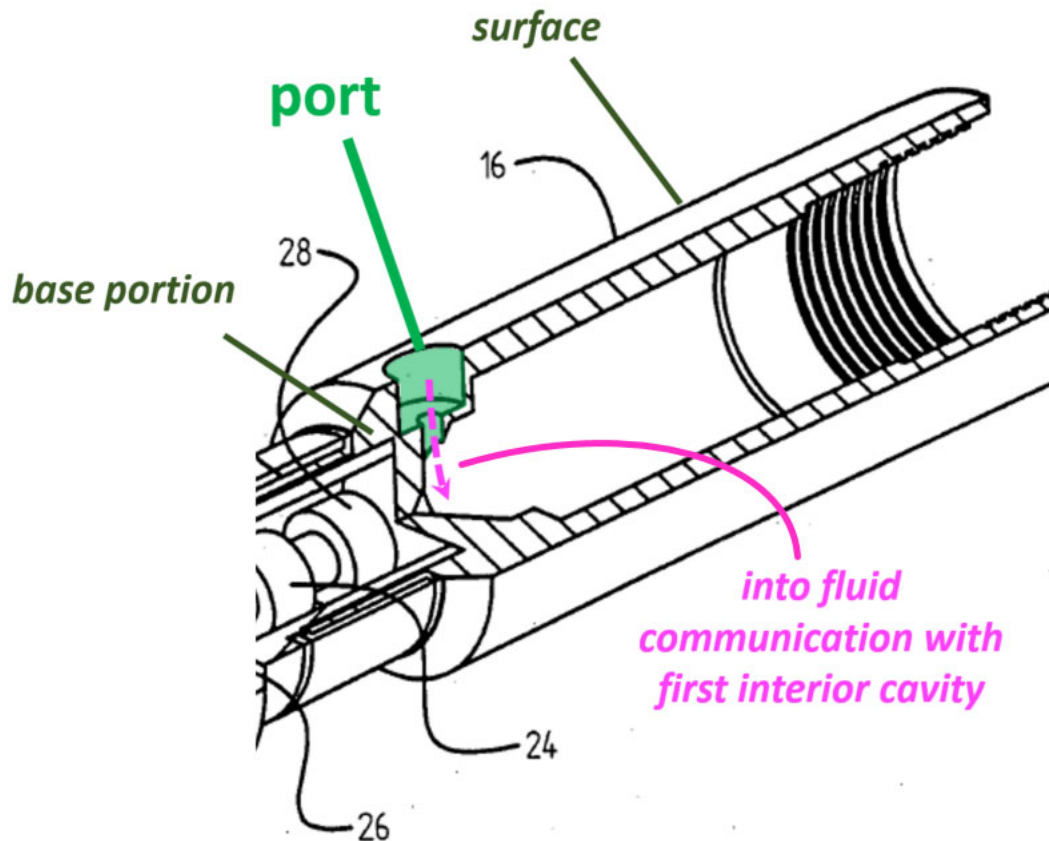
B. Ground II: Obviousness of Claim 2 Based on Beach-127 in view of Wiese and Pickard

1. Claim 2

181. As I discuss further below, a POSITA would have understood that the combination of Beach-127 in view of Wiese and Pickard discloses the limitations of claim 2.

a) Limitation 2[a]: “The core barrel head assembly of claim 1, further comprising: a port positioned proximate the base portion and extending from the exterior surface into fluid communication with the first interior cavity; and”

182. Beach-127 discloses the added feature of “a port positioned proximate the base portion and extending from the exterior surface into fluid communication with the first interior cavity.” More specifically, in the Beach-127 assembly, the “adaptor 16,” which is “used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14,” features a “port . . . extending from the exterior surface” of the assembly. I have indicated the port (in green color) in the following annotation of Figure 2:



183. Ex. 1003 (Beach-172), 11:16-22 (“The core tube 12 is of conventional construction while the backend assembly 14 is modified by the inclusion of an adaptor 16. The tool 10 is coupled at one end to the conventional core tube cap 18 of the backend assembly 14 with the adaptor 16 being used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14.”), Fig. 2 (annotated). I note that this same “port” in adaptor 16 is also shown in Figure 1 of Beach-127. *See id.*, Fig. 1.

184. Furthermore, as seen in Figure 2, which is a cutaway view of the assembly, the port I have identified includes a complete void, or through-hole, that extends into the “first interior cavity” defined by the adaptor 16, which I identified

above for Limitation 1[b] (*see* § IX.A.1.(c), *supra*). As I explain in further detail below for Limitation 2[b], a POSITA would have understood that lubricant (which is a “fluid”) is intended to pass through this port, between the exterior of the assembly and the first interior cavity. Based on this fluid passage design, the Beach-127 port is “extending from the exterior surface into fluid communication with the first interior cavity,” as required. Lastly, as I have further indicated above, the “port” is situated near, the “base portion” of adaptor 16, as I have defined for Limitation 1[d] above. *See* § IX.A.1(e), *supra*. Stated differently, the Beach-127 “port” is “positioned proximate to the base portion,” as further required. Thus, Beach-127 discloses the added feature of Limitation 2[a].

185. Further, I have seen that during prosecution of a related patent—specifically, the ’463 Patent—the Patent Office found that Beach-127 discloses the added feature of “a port (**illustrated in Fig. 2 above**) positioned proximate the base portion and extending from the exterior surface . . . into fluid communication with the first interior cavity.” *See* Ex. 1011 (’463 File History) at 55 (March 14, 2019 Office Action at 4) (emphasis in original). I have further seen that, when confronted with this argument, the Patent Owner did not dispute Examiner’s identification of this limitation in Beach-127. *See* Ex. 1011 (’463 File History) at 36 (June 12, 2019 Response at 8); *see also* Ex. 1014 (Relevant Prosecution History Regarding Beach-127), 5 (summarizing the same). The Patent Office’s assessment that Beach-127

meets this limitation, and the Patent Owner's concession, is consistent with my own analysis that Beach-127 satisfies the added feature of Limitation 2[a].

b) Limitation 2[b]: “a grease fitting mounted in the port to allow for selective passage of grease or other lubricant to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.”

186. A POSITA would have been motivated to implement the added feature of “a grease fitting mounted in the port to allow for selective passage of grease or other lubricant to and from the exterior surface of the barrel head assembly into communication with the first interior cavity,” based on Beach-127 alone or in view of Pickard.

187. First, as I have discussed above for Limitation 2[a], Beach-127 discloses “a port . . . extending from the exterior surface into fluid communication with the first interior cavity.” *See* § IX.B.1(a), *supra*. While it is not explicitly shown in Figure 2, it would have been obvious to a POSITA at the time of the alleged '013 Patent invention to further include a “grease fitting mounted in the port to allow for selective passage of grease or other lubricant to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.”

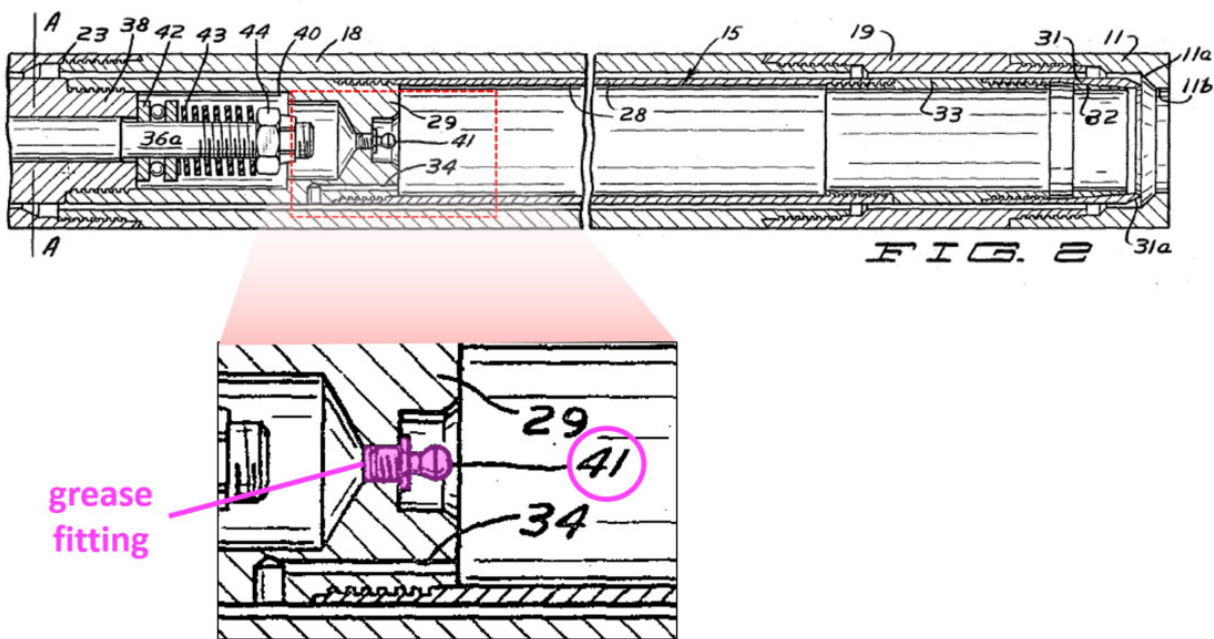
188. At the time of the alleged invention, a grease fitting was recognized as standard industrial component used in various mechanical systems involving lubricants. This is demonstrated, for example, by U.S. Patent Publication No.

FIG. 1

117

this application, the grease fitting permits selective passage of such lubrication to one or more internal spaces within the downhole assembly.

190. U.S. Patent No. 3,305,033 to Pickard et al. (Ex. 1006, hereinafter, “Pickard”), demonstrates this. Pickard, which issued 1967, is directed to a core barrel assembly suited for hard rock mining. *See* Ex. 1006 (Pickard), 1:10-70. Pickard’s core barrel design features a “grease fitting 41.” I have indicated the grease fitting (in pink color) in the following annotations of Figure 2:



191. *Id.*, Fig. 2 (annotated). As explained by Pickard, the “grease fitting 41 is threaded into the opposite end of the bore 40,” which is positioned at the end of the “cap 29.” *Id.*, 4:34-35; *see also id.*, 4:7-45 (describing the context in which grease 41 is used in the assembly). Thus, in Pickard’s assembly configuration, the grease

fitting 41 is mounted into a port that feeds into the bore (which is to the left of the fitting, as shown in Figure 2); a POSITA would have understood that, being positioned this way, the grease fitting enables the selective passage of grease into the cavity housing the spring and bearing, since those components require lubrication.

192. Further, Pickard's disclosure of the structure and operation of the grease fitting is corroborated by the contemporary product brochure from CMECO, a manufacturer of core drilling equipment. *See generally* Ex. 1017 (2013 CMECO Catalog) at 180-219 (showing the grease fittings mounted at ports extending from the exterior surface of core barrel assemblies). These references demonstrate that use of grease or other lubricant into cavities within a core barrel head assembly was recognized as a standard maintenance procedure for assemblies.

193. Referring back to Beach-127, the adaptor 16 is shown and described as being used to mechanically couple two key moving parts of the core barrel head assembly: the tool 10, and the remainder of the backend assembly 14, as seen below:

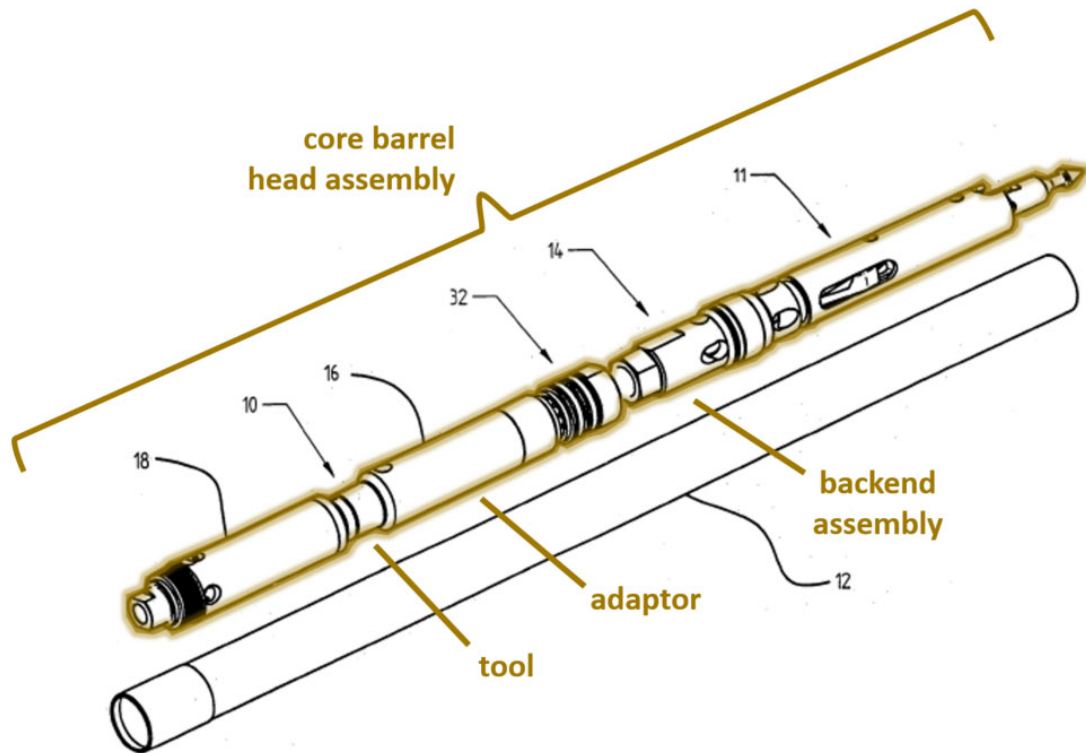


Figure 1

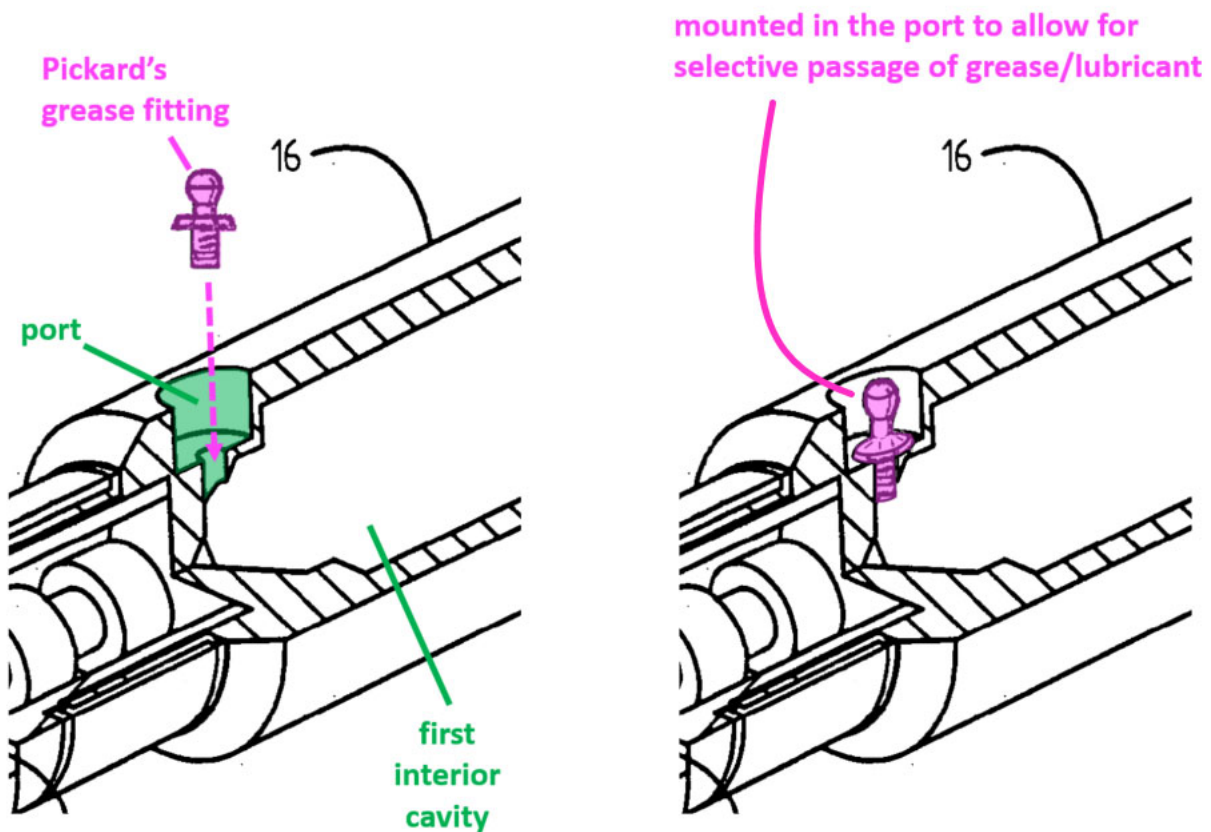
194. Ex. 1003 (Beach-127), 11, 16-22 (“The core tube 12 is of conventional construction while the backend assembly 14 is modified by the inclusion of an adaptor 16. The tool 10 is coupled at one end to the conventional core tube cap 18 of the backend assembly 14 with the adaptor 16 being used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14.”), Fig. 1 (annotated).

195. As I discussed above for Limitation 2[a], since adaptor 16 likewise features a port that extends into fluid communication with the first interior cavity defined by the adaptor, *see* § IX.B.1(a), *supra*, a POSITA would have understood that the port serves as an access point for delivering lubrication to the spring and bearing 32 of the Beach ’127 assembly, in order to minimize the undesirable friction

between or within these components of the assembly. Consistent with this understanding, a POSITA would have further appreciated that the port design shown in Figure 2 of Beach-127 already reflects a design that would mate with a grease fitting. This grease fitting would have facilitated the pressurized injection of lubricant into the first interior cavity defined by adaptor 16, and, as a result, provided the necessary lubricant to the bearing 32 adjacent the adaptor 16.

196. Therefore, to the extent that it is not already implicitly included in Beach-127, a POSITA would have been motivated to implement Beach-127's Figure 2 assembly configuration with "a grease fitting mounted in the port" as taught above in Pickard, in order to facilitate proper injection of lubrication in the system; this would have been achieved since the grease fitting would permit "selective passage of grease or other lubricant to and from the exterior surface" of the core barrel head assembly, and "into communication the first interior cavity" defined by the adaptor 16.

197. A POSITA would have appreciated that incorporating Pickard's threadable grease fitting into Beach-127's assembly could, for example, have resulted in the following exemplary modification to the Beach-127 Figure 2 assembly:



**Exemplary modification of Figure 2 of Beach-127
to include Picard's grease fitting**

198. This exemplary modification demonstrates how, as discussed above, the Beach-127 Figure 2 port design is *already configured* to mate with a grease fitting as shown and described in Pickard. Thus, it would have been straightforward for a POSITA to implement the Figure 2 assembly of Beach-127 by mounting a grease fitting into the port, as shown and described in Pickard. As I have discussed above, for decades before the alleged invention of the '013 Patent, grease fittings had long been recognized as a standard component in mechanical systems involving lubricants. This recognition and use extended to downhole assemblies for hard rock

mining in particular, as exemplified by the Pickard reference, whose grease fitting 41 is mounted in a port and is therefore configured to permit the injection of lubricant into the bore by selectively allowing the passage of the lubricant. *See* Ex. 1006 (Pickard), 4:7-45, Fig. 2. Accordingly, a POSITA would have appreciated that the grease fitting 41 of Pickard could have been readily incorporated into the Beach-127 downhole assembly—specifically, mounted into the port which extends from the exterior surface into fluid communication with the first interior cavity—as I have demonstrated in the above exemplary modification.⁹

199. Accordingly, the Beach-127/Pickard combination would have constituted nothing more than the application of a known technique (here, using a grease fitting in a port to allow selective passage of grease or other lubricant in a downhole assembly, as disclosed in Pickard) to a known device ready for improvement (here, the downhole assembly of Beach-127 Figure 2, which already

⁹ Further, a POSITA would have understood that, in Beach-127 Figure 2 assembly, the port of adaptor 16 would have included a female threaded portion within the through-hole, in order to reliably mate with a grease fitting. Nonetheless, even assuming such female threads were not already implicitly included in Figure 2, implementing such female threads would have been a routine task that was well within the skillset of a POSITA. For example, Figure 2 *already features* female threaded portions at multiple locations within the disclosed assembly, in order to ensure coupling between mechanical components. Ex. 1003 (Beach-127) at Fig. 2. This understanding is consistent with my earlier analysis for Limitation 1[c], *see* § IX.A.1(d), *supra*, where I have shown and described how Beach-127 already discloses the female “threaded proximal end portion” at the opened end of the adaptor 16.

features a port that extends into fluid communication into a first interior cavity) in order to obtain predictable results (here, facilitating the injection of lubricant into the first interior cavity defined by the adaptor 16 in the Beach-127 assembly, and, in turn, the ability to lubricate the adjoining bearing 32 of the assembly in order to curb unwanted friction during normal operation). Furthermore, a POSITA would have had a reasonable expectation of success in implementing Figure 2 of Beach-127 with Pickard's grease fitting, for the reasons described above.

200. Moreover, a POSITA would have appreciated that the inclusion of the grease fitting as I have shown and described above, could likewise be applied to the Beach-127/Wiese combination that I have discussed for Claim 1 above. *See* Section IX.A.1.(f)(1), *supra*. Accordingly, the implementation of Beach-127 in view of the teachings of both Wiese and of Pickard (*i.e.*, the “Beach-127/Wiese/Pickard combination”) would have satisfied Limitation 2[b].

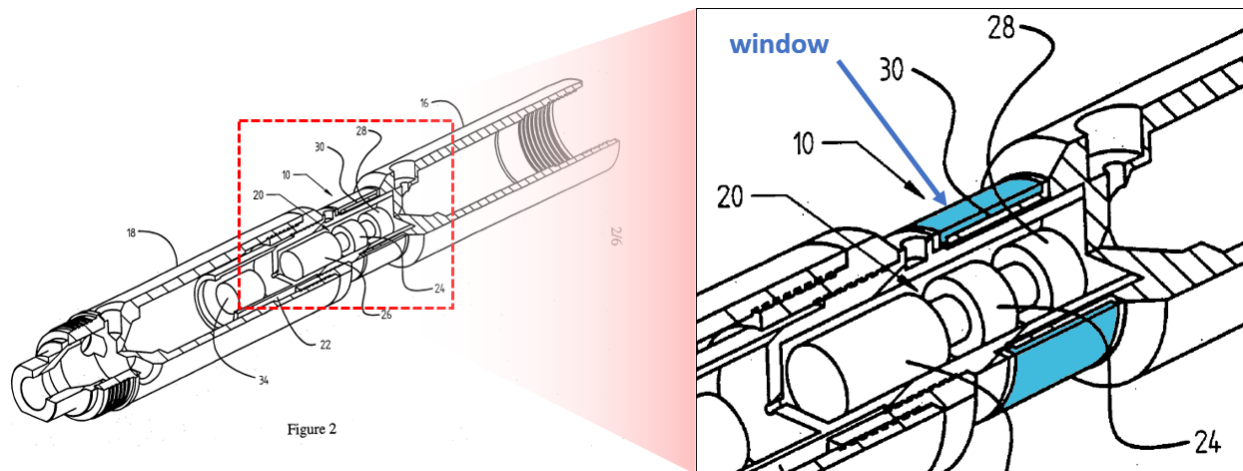
C. Ground III: Obviousness of Claims 14-15 Based on Beach-127 in view of Wiese and Klass-839

1. Claim 14

201. As I discuss further below, a POSITA would have understood that the combination of Beach-127 in view of Wiese and Klass-839 discloses the limitations of claim 14.

a) Limitation 14[a]: “The core barrel head assembly of claim 4, wherein the light emitter underlies the window,” and”

202. The Beach-127 assembly, as implemented in view of Wiese’s teachings, would satisfy the added feature that “the light emitter underlies the window.” More specifically, as I have discussed above for Limitation 1[e] and for Claim 4, a POSITA would have been motivated to implement Figure 2 of Beach-127, particularly in view of the teachings of Wiese, so that the “antenna 30” would take the form of an LED array such as an infrared array. *See* Ex. 1004 (Wiese), [0015] (“[t]he term antenna is broadly used herein . . . to mean a device capable of transmitting and receiving the signal type contemplated. For example[, w]here infrared (IR) is the signal type, a light emitting diode (LED) would be the ‘antenna’ to transmit the IR signal.”); *see* §§ IX.A.1(f)(1) and IX.A.3, *supra*. Accordingly, a “light emitter” (which an LED) would be present in the Beach-127/Wiese assembly. In addition, the Beach-127/Wiese assembly would otherwise have the same structural configuration as shown in Figure 2 of Beach-127. As reflected in the below annotation of Figure 2, in the Beach-127 assembly, the antenna 30 underlies the window:



203. Ex. 1003 (Beach-127), Fig. 2 (annotated). Accordingly, in the Beach-127/Wiese assembly, the light emitters present in the LED array would similarly underlie the window extending from the exterior surface, as required by Limitation 14[a].

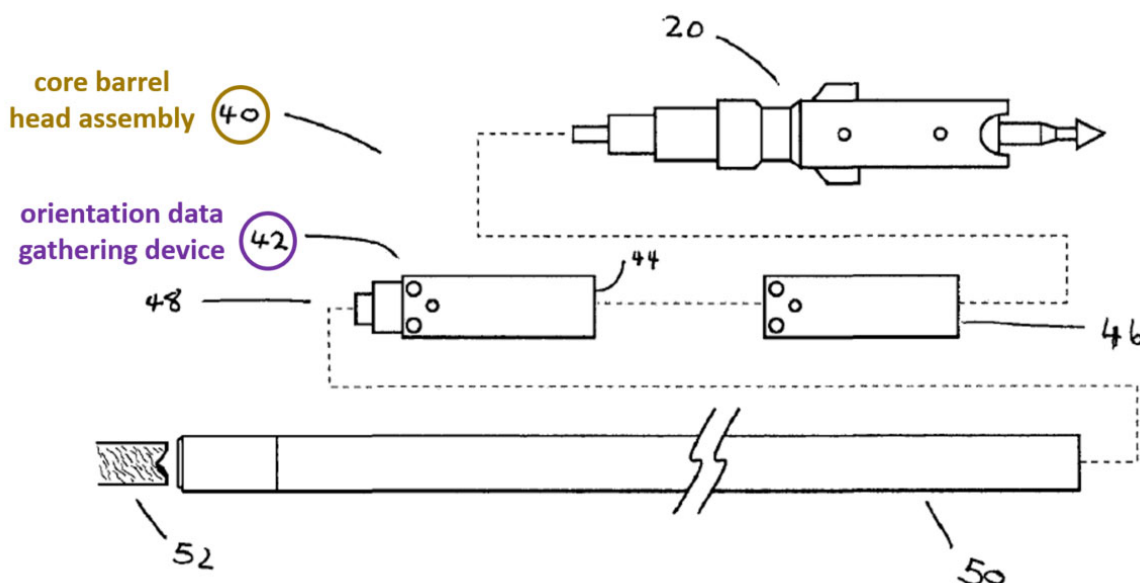
- b) Limitation 14[b]: “and wherein following retrieval of the core barrel head assembly from down a borehole, the light emitter is configured to provide a visual indication that a desired rotational orientation of the core barrel head assembly has been achieved.”**

204. A POSITA would have been motivated to implement the added feature that “following retrieval of the core barrel head assembly from down a borehole, the light emitter is configured to provide a visual indication that a desired rotational orientation of the core barrel head assembly has been achieved,” based on Beach-127 in view of Wiese and Klass-839.

205. First, as I have described above for Limitation 1[e], at the time of the alleged invention, a POSITA would have been motivated to implement the Beach-

127 assembly according to Wiese’s teaching that the “antenna” could take the form of an LED array, such as an infrared array, for *optical* communication through the Beach-127 window to an external device. *See* § IX.A.1.(f)(1), *supra*. In addition, the POSITA would have been motivated to further modify the Beach-127/Wiese assembly in view of the additional teachings of the Klass-839 reference.

206. For context, Klass-839 discloses a core barrel head assembly that incorporates *multiple forms* of optical communication to transfer orientation data externally from within the core barrel head assembly. *See generally*, Ex. 1005 (Klass-839). The assembly of Klass-839 (labeled element 40), includes a core orientation data gathering device (labeled element 42). I have indicated these components in the following annotation of Figure 4:



207. *Id.* at Fig. 4 (annotated). As explained in Klass-839, the “[c]ommunication between the orientation data gathering device and the remote

orientation data electronic communication device is by wireless communication, such as infra red communication.” *Id.* at 5; *see also id.* at 7 (“Data may be obtained from the orientation data gathering device by communication with a remote device, such as by an infra red link or other wireless communication, such as radio link, between the orientation data gathering device and an orientation data communication device.”). More specifically, Klass-839 explains that “[t]he core sample orientation data gathering device 42 includes a transmitter which can use ***line of sight data transfer through the window***, such as by infra red data transfer . . .,” *id.* at 10, where the window 72 is shown and described with respect to Figure 7.

208. Of particular relevance here, Klass-839 further explains the data gathering device may additionally feature “one or more visual indicators to show an operator one or more required directions of rotation of a recovered sample assembly.” *Id.* at 4. More specifically, Klass-839 discloses that the data gathering device (42) includes “[o]ne or more LED lights,” 74 and 76, which are “sealed within the device 42 behind the window [72].”¹⁰ *Id.* at 9-10. I have indicated the LED lights 74 and 76, along with the window 72, in the following annotations of Figures 5 and 7 of Klass-839:

¹⁰ I note that, based on this disclosure, Klass ’839—like the Beach-127 and Wiese references—discloses a “window” even if that term were narrowly (properly) construed to require a solid material that is transmissive to a communication signal. *See* § VII.F.2, *supra*.

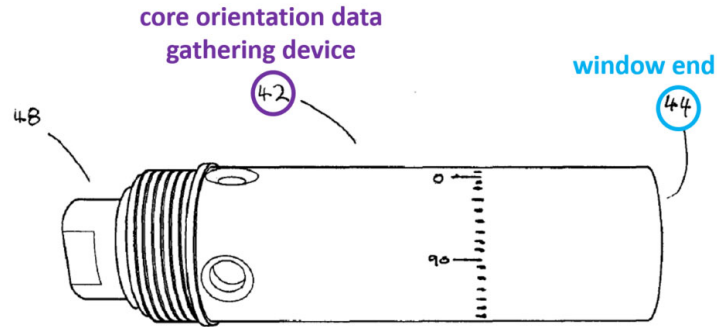


Fig 5

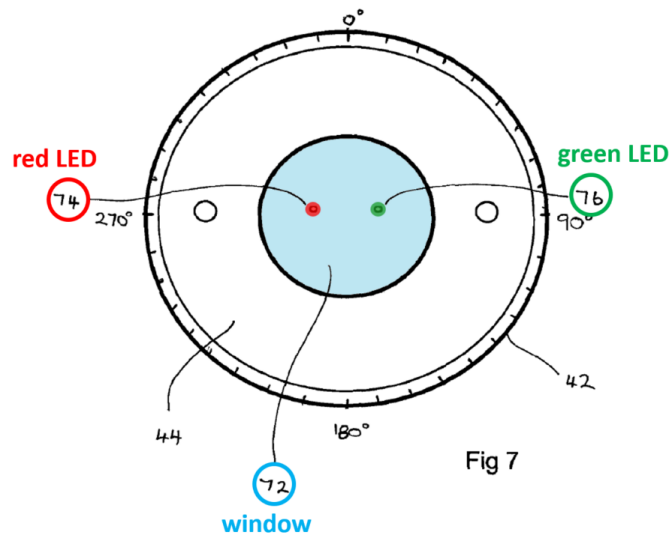


Fig 7

209. *Id.* at 9-10, Figs. 5, 7 (annotated). As explained in Klass-839, the LEDs are configured to emit different colored lights through the window in order to indicate which direction to rotate the retrieved device in order to obtain a desired core sample orientation, to the extent such rotation is needed. Specifically, Klass-839 discloses that, using its red and green LED lights (74 and 76, respectively):

A coloured light indication is given to indicate which way (clockwise or anti-clockwise) the device 42 must be rotated to obtain a desired orientation of the core sample still within the inner tube assembly . . . For example, a red light may be given

to indicate to rotate the device (and thus the core sample) anticlockwise or to the left, and a green light may be given to indicate to rotate the device clockwise or to the right. A combined red and green indication, or a white light indication, or other indication can be given, such as flashing lights, to indicate that the core sample is correctly orientated and ready for marking.

210. *Id.* at 9-10. Similarly, Klass-839 further discloses that, with respect to the disclosed core barrel head assembly:

The whole inner tube 50, core sample 52 and core sample orientation data gathering device 42 are rotated as necessary to determine a required orientation of the core sample. The indicators on the greaser end of the core sample orientation data gathering device 42 indicate to the operator which direction, clockwise or anti-clockwise, to rotate the core sample. One colour of indicator is used to indicate clockwise rotation and another colour to indicate anti-clockwise rotation is required. This is carried out until the core sample is orientated with its lower section at the lower end of the tube. The core sample is then marked for correct orientation and then used for analysis.

211. *Id.* at 10-11. These collective teachings of Klass-839 demonstrate that its LEDs are “configured to provide a visual indication”—for example, combined red and green or flashing lights—that a desired rotational orientation of core barrel head assembly has been achieved,” as required by the added limitation of Limitation 14[b].

Furthermore, Klass-839 explains that the colored light indications are provided “[a]fter core retrieval” to the surface (*see id.* at 7); in other words, the light indications are provided “following retrieval of the core barrel head assembly from down a borehole,” as further required by Limitation 14[b].

212. Similar to the teachings of Wiese I discussed earlier, Klass-839 teaches that its disclosed assembly configuration “provide[s] the advantage of a fully operating downhole tool/device without having to disconnect or disassemble any part of the tool/device from the inner tube and/or from the backend assembly,” while still being able “to determine core sample orientation and/or to gather data recorded by the device/tool.” *Id.* at 14. As a result, this “means that there is less risk of equipment failure and drilling downtime, as well as reduced equipment handling time through not having to separate the sections in order to otherwise obtain core sample orientation.” *Id.* In turn, the “reliability and efficiency of core sample collection and orientating is improved.” *Id.*

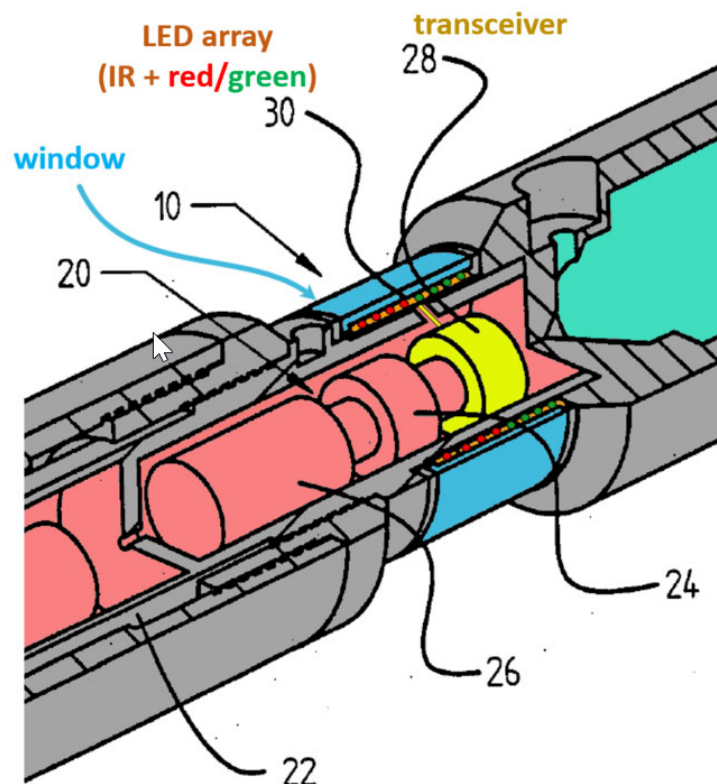
213. To summarize, Klass-839 also provides a teaching, suggestion, or motivation for equipping a downhole assembly housing with a window that is transmissive to *multiple* forms of optical communication emanating from within a sealed interior cavity of a core barrel head assembly—not only an infrared signal to a remote device, but also visual indications, as provided by multi-colored LED lights to

inform the human operator whether and how to rotate the retrieved core sample at the surface.

214. Accordingly, a POSITA would have been motivated to further modify the Beach-127/Wiese assembly (which I have discussed above for Limitation 1[e]) based on Klass-839's teaching of including colored LEDs in addition to an infrared signal, in order to provide a reliable, efficient way to transfer the orientation data obtained Beach-127's electronic device or system 20 externally—to both the remote device, as well as to the operator handling the retrieved core sample. In other words, the POSITA would have been motivated to implement Beach-127's assembly with the "antenna 30" taking the form of an LED array that emits colored lights as well as infrared light, according to the combined teachings of Wiese and Klass-839.

215. As with the Beach-127/Wiese combination, while I understand that bodily incorporation of systems disclosed in multiple prior art references are not required in an obviousness analysis, I have provided below two examples demonstrating how a POSITA would have been motivated to further apply the additional teachings of Klass-839 to the Beach-127/Wiese assembly, and how the resulting implementations would satisfy this limitation. Specifically, relative to the exemplary "Beach/Wiese" implementations which I have presented above for Ground 1, applying the additional teachings of Klass-839 would require minor structural and programming adjustments:

216. **Beach/Wiese/Klass Example 1:** this implementation is simply a further modification to the Beach/Wiese Example 1 discussed above for Ground 1, but with the an “antenna” taking the form of an LED array that not only emits infrared signals (as taught in both Wiese and in Klass-839), but that also features red and green LEDs lights, which are configured to indicate to the operator whether and how to rotate the retrieved core sample (pursuant to the additional teachings of Klass-839):¹¹

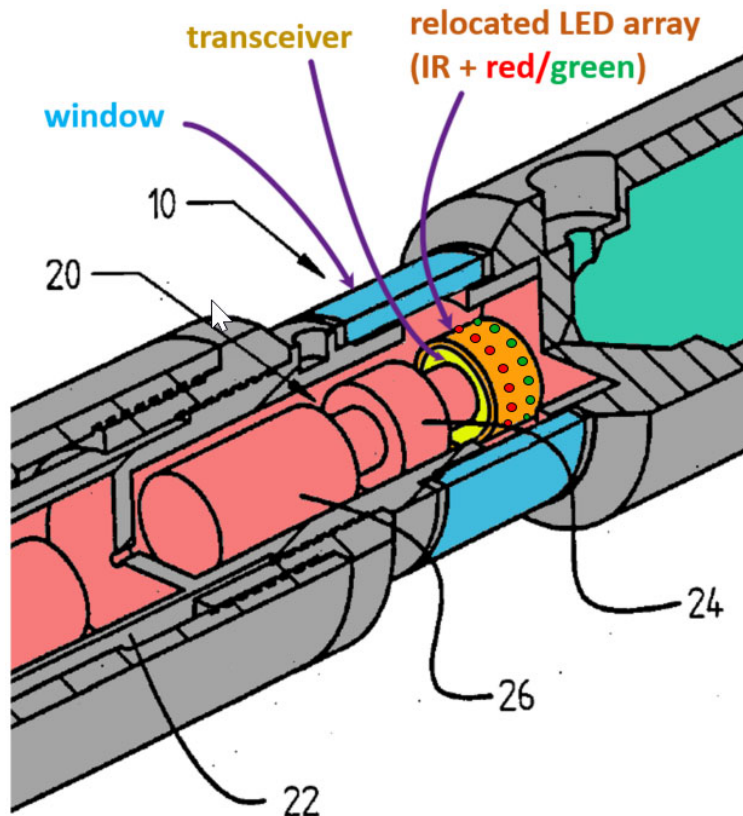


Beach/Wiese/Klass Modification 1:

Beach-127 Figure 2, indicating through-hole between antenna 30 and transceiver 28, and implemented using an LED array with multi-colored LED lights as the antenna, as taught in Wiese and Klass-839

¹¹ As I discussed further below, a POSITA would have readily appreciated that Beach-127’s existing trigger system 24 could be configured to illuminate the colored LEDs as appropriate.

217. **Beach/Wiese Example 2:** this implementation is simply a further modification to the Beach/Wiese/Klass Example 2 discussed above for Ground 1, where—for additional design simplicity, the antenna 30 has been relocated so that it “forms part of transceiver 28,” pursuant to the additional teachings of Wiese, but—like the previous example—implements the antenna as an LED array that emits both infrared signal and colored light:



Beach/Wiese/Klass Modification 2:

Beach-127 Figure 2, modified to relocate antenna 30 such that it forms part of the transceiver 28, and implementing the “antenna” as an LED array with a multi-color light scheme, per the collective teachings of Wiese and Klass-839

* * * *

218. As reflected above, either of the “Beach/Wiese/Klass” examples I have shown above would render the “window . . . in optical communication with the sealed interior cavity,” as required by Claim 1. Further, both examples feature a light emitter that would be configured to provide a visual indication that a desired rotational orientation of the core barrel head assembly has been achieved, following retrieval of the core barrel head assembly from down a borehole, as further required by Limitation 14[b].

219. Further, it would have been straightforward for a POSITA to implement Beach-127’s Figure 2 assembly according to the collective teachings of Wiese and Klass-839 as described above. More specifically, in the context of downhole equipment, design configurations having LED arrays—including those that emit infrared signals or visible light were well within the level of ordinary skill in the art. In addition, the use of optically transmissive windows for external communication were likewise well within the level of ordinary skill in the art. As I explained above with respect to the technical background, in the context of downhole equipment, design configurations having LED arrays, as well as optically transmissive windows for external communication, were well within the level of ordinary skill in the art. For example, the Jorion reference, Ex. 1016, demonstrates that this configuration was known since at least May 1990. *See* Ex. 1016 (Jorion) at 5:53-61; 6:19-33, Fig. 3. Further, the Ujereh reference, Ex. 1015, which was published in 2013, likewise

demonstrates that this was a known configuration. *See* Ex. 1015 (Ujereh) at Abstract, [0012], [0028], Figs. 3 and 4B.

220. In addition, as I discussed above for Ground 1, Wiese explicitly discloses a schematic configuration for a downhole tool that includes a transceiver, an antenna, and a pressure-sealed “window at the housing” of the tool (*see* Ex. 1004 (Wiese) at [0005], [0015])—three core components that are likewise featured in “tool 10” of the Beach-127 Figure 2 downhole assembly (*see* Ex. 1003 (Beach-127) at 12:24-27, 17:29-36, Fig. 2). In a similar vein, Klass-839 discloses a core barrel head assembly whose electronic device 42 includes a transmitter and an optically transmissive “window 72,” like the assemblies of both Beach-127 and Wiese, but further includes “LED lights” that are configured to illuminate in a manner that visually indicates to the operator whether and how the retrieved “device 42 must be rotated to obtain a desired orientation of the core sample.” *See* Ex. 1005 (Klass-839) at 9-11. In view of the shared features among these three references, a POSITA would have recognized that Wiese’s teaching of implementing the downhole assembly’s “antenna” as an LED array, and Klass-839’s additional teaching of further including multi-colored LED lights in order to provide visual indications through the window, could be readily applied to Beach-127’s assembly.

221. In connection with this combination, a POSITA would have readily appreciated that, when incorporating Klass-839’s LED lights into Beach-127, the

trigger system 24 of Beach-127 could be configured—based on orientation data gathered from the sensors and transducers within device 20—to illuminate the red and green LEDs as appropriate to visually indicate whether and how to rotate the retrieved tool in order to obtain a desired core sample orientation, pursuant to Klass-839’s teachings.

222. Further, implementing the Beach-127 assembly according to the collective teachings of Wiese and Klass-839 would have constituted nothing more than the application of known techniques (here, using: (1) an LED array as an “antenna” for downhole equipment—whether separate from, or integrated with, the downhole transceiver—as collectively taught in Wiese; and (2) colored LED lights to provide visual indications from within a core barrel assembly device through a window, as taught in Klass-839) to a known device ready for improvement (here, the downhole of assembly shown in Figure 2 of Beach-127, which already shows a generic “antenna 30” and a transmissive window) in order to obtain predictable results (here, providing external optical communication from Beach-127’s downhole assembly to the remote unit and equipment operator, and doing so efficiently and reliably, and using a simple assembly configuration). Furthermore, these modifications would have been obvious to try as one of a limited number of solutions for transmitting signals to an external device and for providing visual indications to an operator externally from the downhole assembly, and a POSITA would have had a

reasonable expectation of success in implementing these modifications to the assembly of Beach-127, for all of the reasons I have described above.

223. Accordingly, the Beach-127 assembly, as implemented according to the teachings of Wiese and Klass-839, combination would satisfy Limitation 14[b].

2. Claim 15

224. As I discuss further below, a POSITA would have understood that the combination of Beach-127 in view of Wiese and Klass-839 discloses the limitations of claim 15.

- a) **“The core barrel head assembly of claim 14, wherein the light emitter is further configured to provide a visual indication that further rotation of the core barrel head assembly is required to reach the desired rotational orientation.”**

225. For the same reasons I have explained above for Limitation 14[b], the Beach-127 assembly, as implemented in view of the collective teachings of Wiese and Klass-839, would further satisfy the added feature that “the light emitter is further configured to provide a visual indication that further rotation of the core barrel head assembly is required to reach the desired rotational orientation.” *See* §IX.C.1(b), *supra*. As discussed above, the disclosed operating scheme of Klass-839 is one in which the light emitters (i.e., the red and green LEDs 74 and 76, respectively) are configured to provide a visual indication that further rotation of the core barrel head assembly is no longer required. Specifically, Beach-127 teaches that

“a red light may be given to indicate to rotate the device (and thus the core sample) anticlockwise or to the left, and a green light may be given to indicate to rotate the device clockwise or to the right.” *See* Ex. 1005 (Klass-839) at 9. When this disclosed operation is applied to the Beach-127 assembly, in the straightforward manner I discussed for Limitation 14[b], the resulting Beach-127/Wiese/Klass-839 assembly would satisfy the added feature of Claim 15.

X. CONCLUSION

226. Based on my review and analysis of the prior art, it is my opinion that a POSITA would have been motivated to combine the teachings of the prior art as claimed in claims 1-3, 14-15, 19-22, and 24-25 of the '013 Patent.

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227. I declare under penalty of perjury that the foregoing is true and correct. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with 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.

Dated: February 27, 2023


John P. Rodgers, Ph.D.